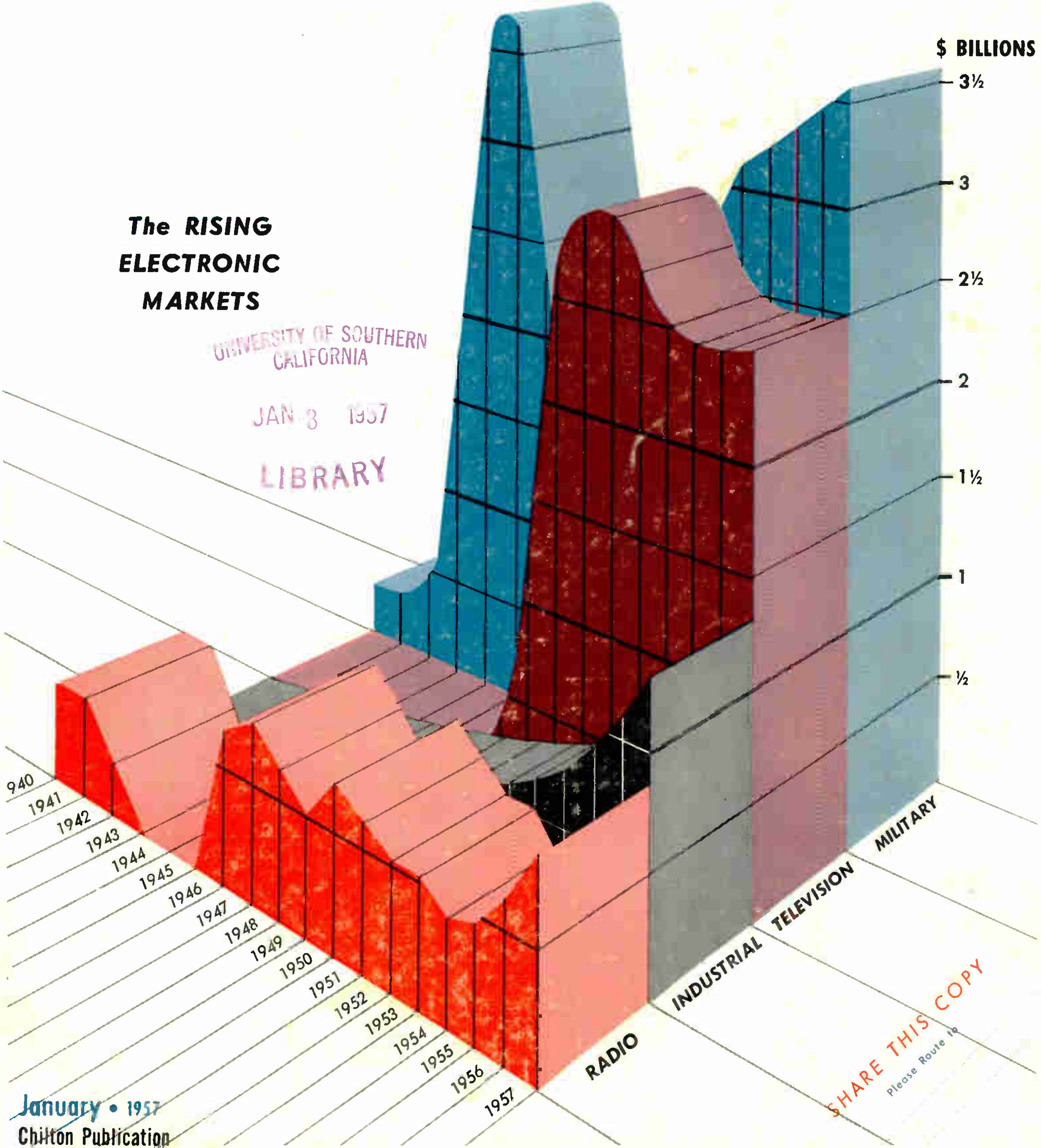
ELECTRONIC INDUSTRIES

& TELE-TECH

The RISING ELECTRONIC MARKETS



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January • 1957
Chilton Publication

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Specify RMC DISCAPS for the finest in ceramic capacitors

RMC has steadily increased its leadership in the ceramic capacitor industry as a direct result of a continuing research program. Our modern research laboratory has contributed many innovations in the field and is always at work improving the characteristics of standard DISCAPS. Write on your company letterhead for information on DISCAPS for standard or special applications.

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CERAMIC
CAPACITORS

RMC

RADIO MATERIALS CORPORATION
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
Two RMC Plants Devoted Exclusively to Ceramic Capacitors
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

ELECTRONIC INDUSTRIES

& TELE-TECH

Vol. 16, No. 1 **January, 1957**

FRONT COVER: This isometric projection shows graphically the growth of the electronic industry over the years since 1940. Further details will be found in our annual statistics round-up on pages 52, 53 and 54.

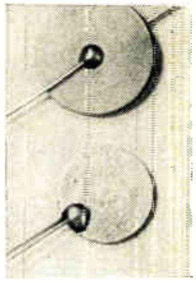
MONTHLY NEWS ROUND-UP

NEW ELECTRONIC EQUIPMENT

DEPARTMENTS

BPA NBP

Thermometer for Missiles 55

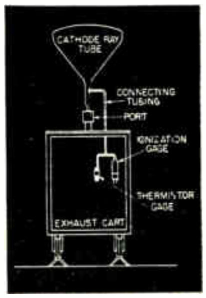


Temperatures down to the boiling point of liquid oxygen — 183°C. — are measured with these new thermistor sensing elements.

Operating Room Intercom 56

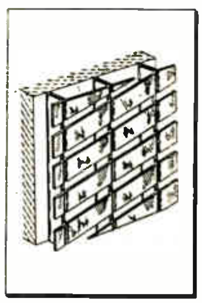
Details on how a new system designed to coordinate delicate surgery overcomes the problems of explosive atmosphere and sterility, and stray radiation.

Measuring Tube Exhaust 60



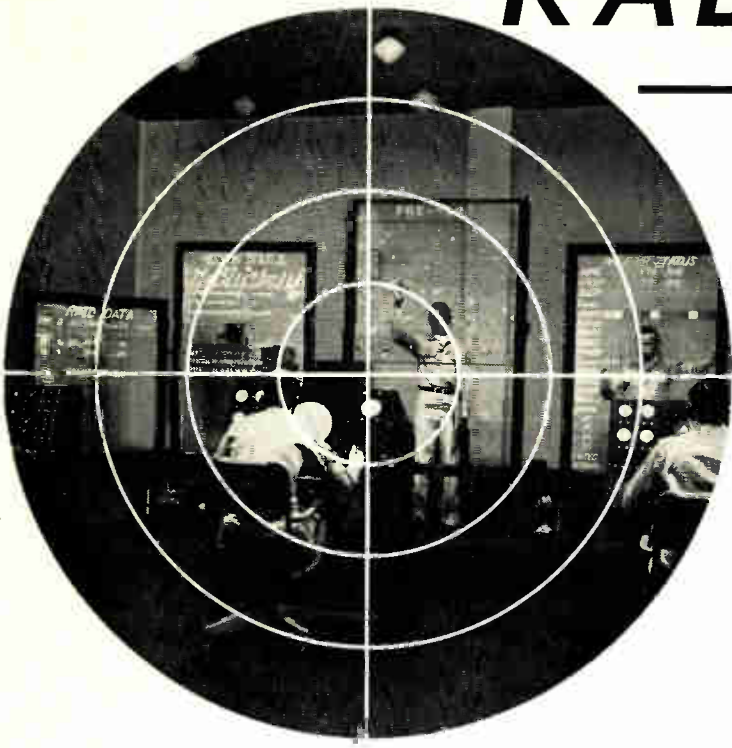
A tiny thermistor gauge makes it possible for the first time to read the degree of tube exhaust at any point in the exhausting process.

Color CRT—4 In. Deep! 76



This British development has a right-angle gun and a "beam reversing" system that folds the beam 180°. Need for vertical oscillator eliminated.

RADARSCOPE



AIR INTERCEPT HEADQUARTERS

Nerve center of the new AN/GPA-37 automatic ground control intercept system developed by the Heavy Military Electronic Equipment Dept., G. E. and ARDC's Rome Air Development Center (USAF), Rome, N. Y.

NEW COMPUTER COMPONENTS are appearing so rapidly that computer manufacturers are reluctant to start working with those that are available—for fear something better will come along. A most frustrating situation for the component manufacturers.

NEW SILICONE RESIN insulation will make it possible for electric motors to withstand constant copper temperature of 240°C for 60,000 hrs. Dow Corning is the developer.

LACK OF TOP SYSTEMS ENGINEERS will be the limiting factor in the speed with which guided missiles are designed, says Dr. Simon Ramo of Ramo-Wooldridge, Los Angeles.

[redacted] onics by highway
[redacted] v system recom-
[redacted] would have tiny
[redacted] ving instructions
[redacted] Only those trav-
[redacted] le to receive the
[redacted] demonstrated the
[redacted] of State Highway

NEW LOW VOLTAGE PICTURE TUBE GUN has been developed by Westinghouse which uses first-anode voltage of 110 v. and provides a 17% improvement in contrast over conventional black and white picture tube guns. First application will be in portable TV receivers where 125 v. supplies are used.

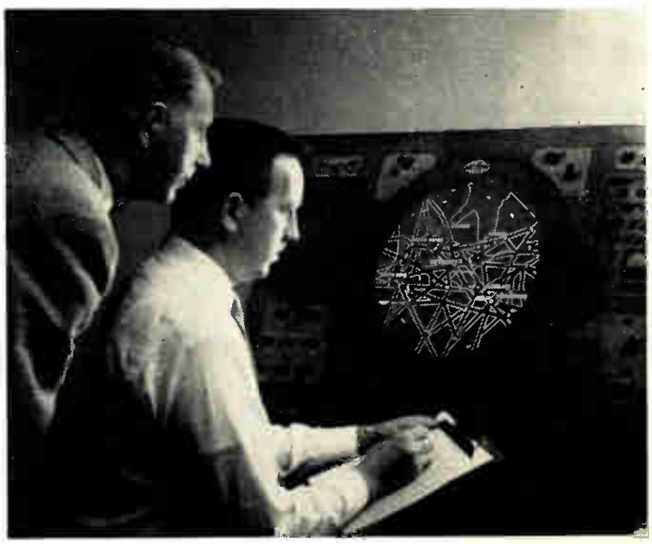
NEW MEMORY DEVICE, announced by RCA, is claimed to have much greater capacity than magnetic core devices, and to be much easier to manufacture. The new units are fashioned from printed plates of special ferromagnetic material. Capacity is indicated by RCA claim that a million bits of information can be stored in a shoebox-sized space.

XEROGRAPHIC PRINTING may be the answer to the demands of computers for printers capable of matching their speed. Xerography is a fast, dry, electrostatic printing process. Stromberg-Carlson sees possibilities of combining xerography with their Charactron shaped-beam cathode ray tube which achieves a rate of 1,200,000 characters a minute.

AUTOMATIC PRODUCTION TECHNIQUES are whittling away the price of semiconductors. Latest announcement is a cut of as much as 40% in the price of silicon power rectifiers at General Instrument's Automatic Manufacturing Div.

SCANNING THE AIRWAYS

Big news this month is that the CAA has ordered 23 long range radars from Raytheon as major step in their plans to improve U.S. air traffic control systems. Model here has a map overlay that instantly pinpoints a plane's position; new units track aircraft up to 200 mi. away.



Analyzing current developments and trends throughout the electronic industries that will shape tomorrow's research, manufacturing and operation

ENGINEERING PROCUREMENT

BETTER PAY FOR ENGINEERS is promised by the rash of surveys being conducted by top electronic firms and professional societies. Engineering firms are coming to realize that just meeting the local salary requirements is not enough; the country-wide level must be considered as well. One large Eastern firm, which employs a great many engineers, has called in an outside consulting firm to survey the situation and tell them exactly how competitive their salaries are. Chief difficulty here is that there are no standard titles for the grades of engineers; but some measure of contrast is being found by separating them into "management" and "non-management."

NOT GENERALLY REALIZED is that an equally serious side of the present shortage of skilled manpower is in the designers and draftsmen category. If these "support" jobs cannot be filled with properly trained personnel, engineering projects will be hamstrung for lack of implementation. To stimulate concerted action on this problem more than 300 representatives of industry, education and government met last month at the First Annual Design and Drafting Workshop at the Burroughs Corp. Research Center, Paoli, Pa. Among problems discussed at the meeting were the curricula of technical and high schools, industrial recruitment of draftsmen, industrial training of draftsmen and uniform evaluation of qualifications and job titles.

MANUFACTURING

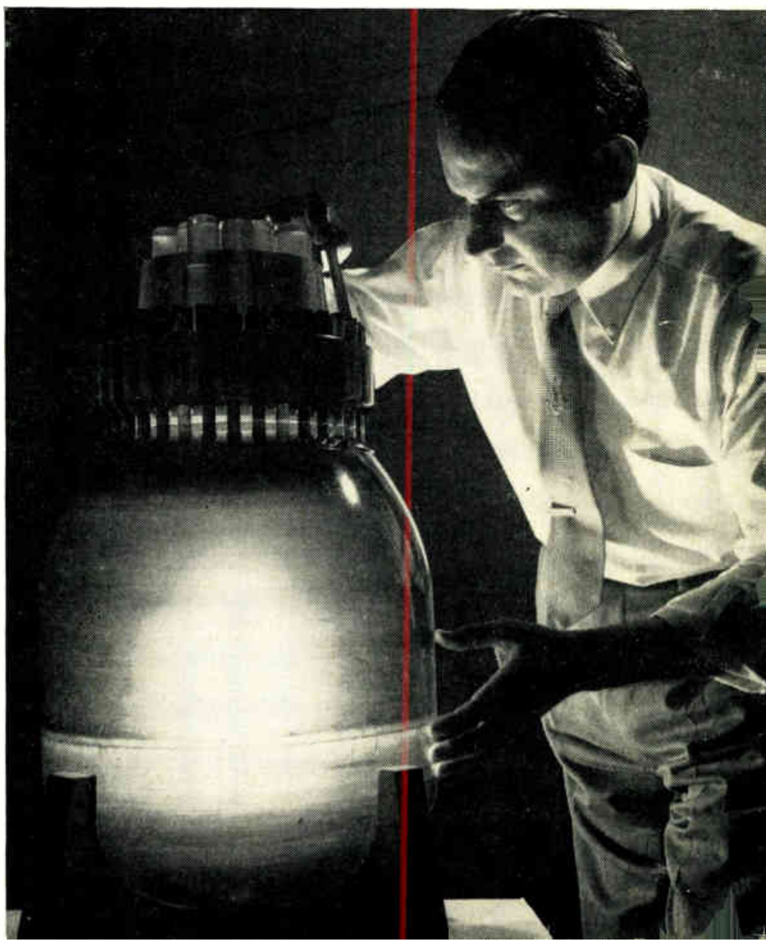
QUARTZ CRYSTAL INDUSTRY may get a helping hand from the government. Defense officials are distressed over reports that the industry would be unable to meet the demands of the military in an emergency. Industry officials are throwing the blame back on the government, pointing out that under the present system of bidding for contracts, some manufacturers actually have had to sell at less than cost. Mortality rate has been high; only 30 companies are now active in the field. Any financial assistance would go into new equipment. At the same time industry officials are asking for a new procurement policy of negotiating, rather than bidding.

MORE R&D BUSINESS FOR SMALL FIRMS. A new Air Research and Development Command (ARDC) procurement agency, the "Executive For Small Business," has been established to increase utilization of small firms in certain research and development areas. Main office of the agency will be located at ARDC headquarters in Baltimore, Md., and field development offices will be at each ARDC Center.

FIRMS PLANNING NUCLEAR ENERGY work should set up research and development programs just as soon as possible, says J. W. Blanton of National Research Metals Corp. Describing his own firm's experience, he points out that neither the AEC nor industrial companies will entrust nuclear work to a firm that does not have a high degree of competence in the field. The company now entering the field, he says, should be prepared to build the necessary background. He adds that many concerns are already in the nuclear business and those companies "which are to play an important part in future developments are those which have already entered or are soon to enter."

REACTOR TESTING

Stresses corresponding to those in the pressure vessel, or "shell," of a real nuclear reactor are "frozen" into this plastic model at Westinghouse Research Labs. Thin sections sliced from this model will be examined under polarized light for defects.



A COMPLETE LINE OF DEPENDABLE ENCAPSULATED RESISTORS

PERMASEAL®

PRECISION WIREWOUND RESISTORS FOR 85C AND 125C AMBIENTS

For applications requiring accurate resistance values at 85C and 125C operating temperatures—in units of truly small physical size—select the precise resistor you want from one of the 46 standard Permaseal designs in tab or axial lead styles.

Winding forms, resistance wire and embedding material are matched and integrated, resulting in long term stability at rated wattage over the operating temperature range. The embedding material is a special plastic that extends protection well beyond the severe humidity resistance specifications of MIL-R-93A and Proposed MIL-R-9444 (USAF).

These high-accuracy units are available in close resistance tolerances down to ± 0.1%. They are carefully and properly aged by a special Sprague process so that they maintain their accuracy within the limits set by the most stringent military specifications.

SPRAGUE

FOR COMPLETE DATA WRITE FOR COPY OF SPRAGUE ENGINEERING BULLETIN NO. 122A

SPRAGUE ELECTRIC COMPANY • 233 MARSHALL ST. • NORTH ADAMS, MASS.

As We Go To Press . . .

FLIGHT MEMORIZER

This new IBM RAMAC will handle reservations on 300 daily flights for United Air Lines.

Component Industry Ready for Emergency

Representatives of the resistor, capacitor, and electronic relay industries attending advisory committee meetings have expressed their confidence in the industry's ability to cope with emergency conditions. Cautioning against complacency in the matter, they pointed out that there is an increasing demand for more reliable components.

Increased requirements to withstand higher temperatures, shock, vibration, and other environmental conditions, might reduce substantially the industry's ability to produce in quantities necessary.

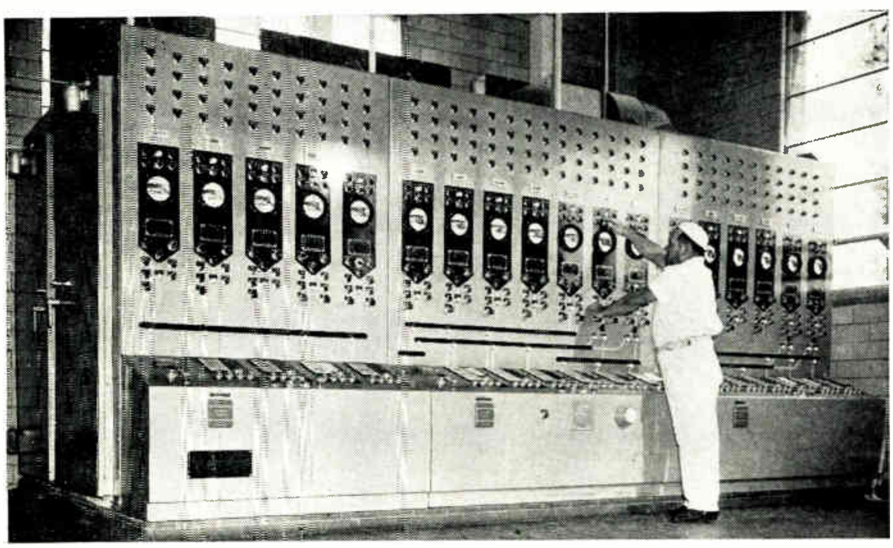
Network to Telecast Educational TV

The National Broadcasting Co. has announced plans to furnish specialized educational programs to all of the nation's non-commercial educational stations. These programs will be produced in network studios and furnished live to the educational stations over network lines. They will be telecast during an afternoon time period which does not conflict with the regular schedule. They will also be kinescoped for repeat broadcast or subsequent classroom use.

The programs will consist of three half-hour presentations each week, with instruction in mathematics, the humanities, and government. The project will extend through 26 weeks in 1957, beginning next March for a 13-week period, and resuming next October for another 13 weeks. Each of the three program series will be conducted by experts in the field. An NBC producer will be assigned to oversee each of the series.

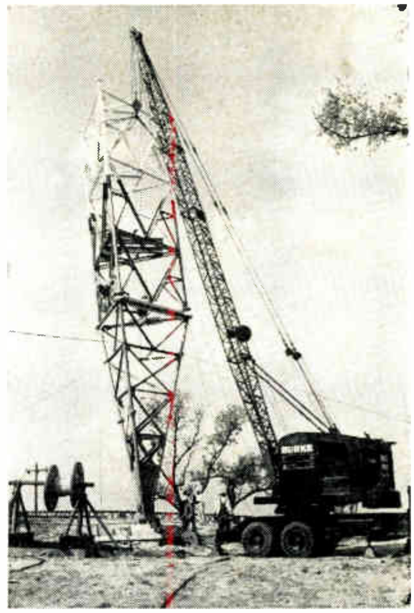
This service will be provided by NBC at no charge to the educational stations. Commitments have been made for more than $300,000 for programs, production facilities and personnel.

COMPUTER MIXES DOUGH FOR BAKERY



Master control console on the mixing floor of Nabisco's new Phila. bakery takes push-button orders for sugar, flour and other ingredients, and regulates their delivery to any of 16 mixing machines, to make a wide variety of crackers and cookies. Console distributes about 62 tons of ingredients during a normal eight-hour day.

NEW TALL TOWER



Under construction for WSM-TV, Nashville, Tenn., this 1,379-ft. tower will be the third highest in the world. Blaw-Knox, the designer, says new high-strength steel has reduced total weight by one-third.

CAA Purchases 23 Long-Range Radars

The biggest single purchase of electronic equipment in CAA's history has heralded the sweeping improvement plan of the nation's air traffic control system.

The cost will approximate $9 million. Raytheon Mfg. Co., Waltham, Mass., will design and build the equipment.

The giant, 40-ft. antenna can apply circular polarization to the outgoing beam which, by filtering rain return, will enable the radar to detect and track aircraft in bad weather.

Spherical raindrops reflect the "twisting" microwaves with a reverse twist. Irregular surfaces of planes reflect the beam with its original twist. This is the underlying principle for the filter.

Dual controls—in effect, two systems in one — reduce the chances of breakdown of the radar coverage of 125,000 sq. mi.

More News On Page 13

for electronic and avionic devices

STEMCO® THERMOSTATS

give you more of what you want most

FEATURES such as snap or positive-action . . . various terminal arrangements or mounting provisions . . . different temperature ranges—there's a *standard* type Stemco thermostat for your *special* needs. That means you cut down on lead time, research and development costs, tooling and production inventory. Specify Stemco and you get *better thermostats, faster and for less* than you can make them or buy them elsewhere.

SIZE and weight are particularly important in avionic and electronic applications. And here Stemco thermostats score, too. Their compactness and lightness give a better product without sacrificing performance.

ECONOMY of mass production of many standard Stemco types with literally hundreds of terminal arrangements and mounting provisions means your product costs less to make.

AVAILABILITY of most types is good. Design is flexible for your special applications, tooling is in existence for short-term delivery. If heat control is your problem, Stemco thermostats can provide the answer.

AA-4092

**Refer to Guide 400 EO for U.L. and C.S.A. approved ratings*

STEVENS *manufacturing company, in*
Lexington and Mansfield, Ohio

TYPE A*
Semi-enclosed

Insulated, electrically in-ependent bimetal disc ives fast response and ick, snap-action control. peration from –10° to 0°F or higher on special der. Various mountings nd terminals. Average ting 6½ amps at 115 ts AC, 4 amps at 230 lts AC and 28 volts DC. in 3000.

TYPE A*
Hermetically sealed

Electrically identical to semi-enclosed Type A. Temperatures from –10° to 300°F. Various enclosures and mountings, including brackets, available. For appliance, electronic, apparatus applications. Bulletin 3000.

TYPE C
Hermetically sealed

Electrically identical to semi-enclosed Type C but sealed in crystal can. Also supplied as double thermostat "alarm" type. Turret terminals or wire leads. Request Bulletin 5000.

TYPE C
Semi-enclosed

Small, positive-acting. Electrically independent bimetal strip for operation from –10° to 300°F. Rated at approximately 3 amps, depending on application. Terminals and mountings to customer specifications. See Bulletin 5000.

TYPE M*
Semi-enclosed

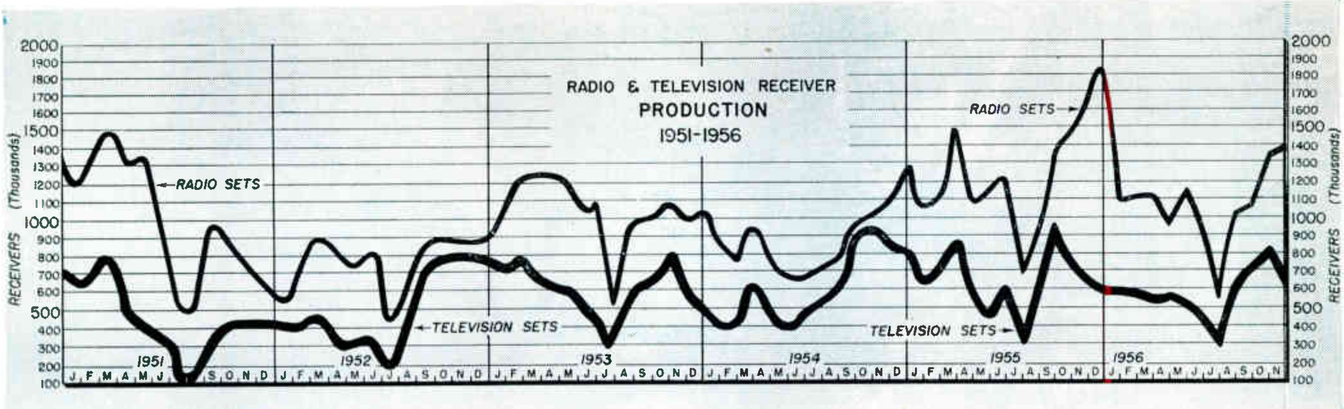
Electrically independent bimetal disc type for appliance and electronic applications from –10° to 350°F. Rating: 8 amps at 115 volts AC, 4 amps at 230 volts AC and 28 volts DC. Virtually any type terminal. Bulletin 6000.

TYPE M*
Hermetically se

Electrically same as enclosed Type M. furnished with pin der-type terminal leads and various ing brackets. Wr Bulletin 6000.

STEMCO® THERMOSTATS

TOTALS



INDUSTRY PREDICTIONS FOR 1957

Computers

Computers constitute approximately a $150 million industry, not including the military.

There is a current backlog of about $600 million in orders for computer equipment.

Expect to see computer sales increase to $250-$300 million in the next two years.

75% of the computer market is expected to be for data processing equipment.

Industrial Automation

Machine tool controls, process controls and other industrial instruments constitute annual factory sales of $110 million today.

Approximately $3 million spent annually for closed circuit TV. This is expected to increase to $20 million annually by 1960.

11% of an atomic reactor instalation cost is estimated for control equipment.

Communication Equipment

Communication equipment during 1956 reached about $200 million total volume.

$85 million each was spent for mobile radio and broadcast equipment.

The annual dollar volume of communication equipment should be $265 million by 1960.

—Dr. W. L. Barrow, V.P., Sperry Rand Corp.

Electronic Industry

Electronics is now a $11.5 billion business. Expected to be $22 billion in a decade.

The investment in the industry is now more than $9 billion dollars. The investment is expected to be $15.5 billion by 1966.

Sales

'Factory door' sales of TV estimated at $966 million for 1956. Expected to be $1.445 billion in 1966.

The U. S. Government is spending approximately $2.9 billion annually for electronic equipment.

Sales of tubes and other parts and components for the repair of electronic equipment will total about $844 million in 1956.

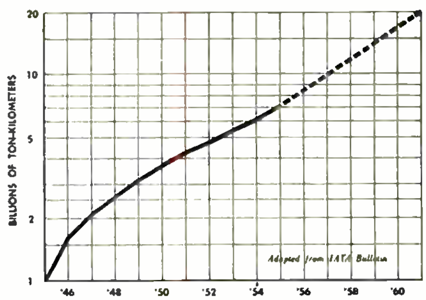
—Mr. F. W. Mansfield of Sylvania.

Atomic Reactors For Research and Experimentation

United States	25
Britain	6
Russia	4
France	4
All Others	7
Total	46

—From *"Nuclear Reactor Data," Raytheon Manufacturing Co., Waltham, Mass.*

WORLD AIR TRAFFIC



—From *an article by Gilbert Perier, chairman of Sabena Belgian World Airlines, in the "Bulletin" of the International Air Transport Association.*

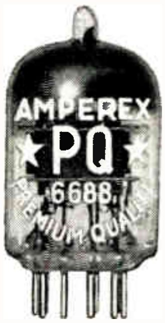
GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government procurement agencies in July, 1956.

Amplifiers	1,254,332
Amplifiers, Servo	457,603
Analyzers	215,027
Antennas	126,337
Antenna Towers	320,079
Batteries, Dry	1,775,415
Batteries, Storage	594,591
Cable Assemblies	122,883
Capacitors, Variable	54,879
Coils	30,116
Computers & Accessories	346,100
Computers, Airborne	1,156,322
Connectors	109,985
Converters	36,344
Duplexers	55,990
Facsimile Equipment	332,482
Filters	26,691
Generators, Signal	180,144
Headsets	269,214
Indicators	395,705
Inverters	43,148
Kits, Electronic Training	28,851
Kits, Modification	26,879
Kits, Radar Modification	699,453
Kits, Radio	42,529
Meters	28,012
Meters, Volt	37,811
Microphones	68,222
Multimeters	32,770
Navigational Systems	9,870,000
Oscillographs	239,769
Oscilloscopes	120,095
Panels, Radio Distribution	64,400
Radar Equipment	1,396,953
Radio Beacon Sets	53,734
Radio Receivers	71,712
Radio Receiver-Transmitters	38,709
Radio Transmitters	1,121,203
Recorders & Accessories	46,807
Relays, Solenoid	63,430
Resolvers	313,670
Sonar Equipment	63,788
Spare Parts	145,796
Switchboard Equipment	479,156
Switches	29,286
Syncros	73,595
Telemeter Equipment	205,625
Teletype Equipment	155,218
Testers	138,910
Test Sets	205,220
Test Sets, Insulation	506,505
Test Sets, Radar	102,221
Transformers	58,954
Tubes, Electron	3,088,970
Wire & Cable	3,044,590

PQ* *engineered for* SIMPLER I.F. & VIDEO

with fewer stages and lower noise...



ACTUAL SIZE

the

Amperex® E180F/6688

Ruggedized

BROADBAND AMPLIFIER PENTODE

With a figure of merit of 1.57 as a broadband amplifier, the AMPEREX E180F/6688 permits the design of simpler, better and more economical IF and video circuits, having 30 to 40 percent fewer stages and improved signal-to-noise ratio, at no sacrifice of either gain or bandwidth. Combining all these superior electrical characteristics with completely ruggedized construction and extremely long life, the E180F/6688 is ideal for use in unattended communications equipment and instrumentation circuits. It is designed and manufactured in accordance with the special techniques developed for the production of the famous AMPEREX line of 10,000-hour tubes.

***An Amperex 'Premium Quality' Tube**

Comparison of the AMPEREX E180F/6688 with other tubes used in the same applications.

	E180F/6688	TYPE A	TYPE B	TYPE C
Type of Tube	Pentode [1]	Pentode [1]	Tetrode	Pentode [1]
$\frac{G_m}{C_{in} + C_{out}}$ (Figure of Merit as Broadband Amplifier)	1.57	1.25	1.36	0.73
Maximum Power Output at 10% Distortion	0.95 W	....	0.53 W	....
Maximum Power Output at 2½% Distortion	0.52 W	....	0.075 W	....
Transconductance Phase Angle at 50 Mc	9° [2]	12°	12.5°	....
Input conductance at 100 Mc	500 µmhos [3]	....	665 µmhos	....
Grid resistance at Maximum Ratings	0.5 Megohm [4]	0.1 Megohm	0.1 Megohm	0.1 Megohm
Pins	gold-plated [3]	not gold-plated	not gold-plated	not gold-plated

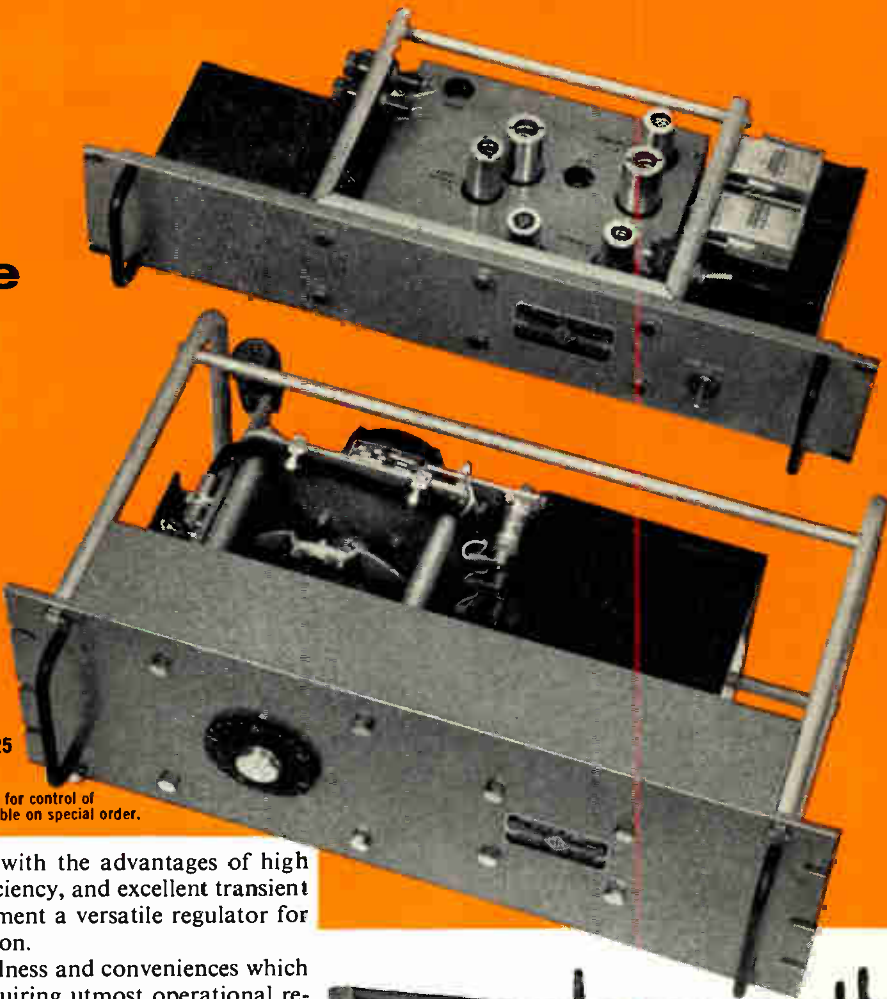
1 inherently more linear
2 small angle, achieved by use of special twin cathode lead, ideal for broadband amplifier applications
3 for better high-frequency performance
4 higher permissible grid resistance, due to gold-plated grid, makes possible greater overall gain

For the input stages of your I.F. amplifiers, write for information on the AMPEREX E88CC/6922 twin triode—another PQ* tube especially designed for this application.

Detailed data sheets and applications engineering assistance available from:

Special Purpose Tube Division
Amperex ELECTRONIC CORP.
230 Duffy Avenue, Hicksville, L. I., N. Y.

New
Militarized
Line-Voltage Regulator



6 KVA Power Capacity

Holds Output Constant within ±0.25%

Fast 10v-per-sec Response

Type 1570-ALS15
Automatic Line-Voltage Regulator
for 115v, 50-60 cycle service . . . **$625**
(Price for qantities on request)

230v models and units for control of 400-cycle power available on special order.

High power handling capacity coupled with the advantages of high accuracy, no waveform distortion, high efficiency, and excellent transient response make this servo-controlled equipment a versatile regulator for laboratory, industrial, or military application.

This new unit features mechanical ruggedness and conveniences which recommend it to many industrial users requiring utmost operational reliability. For example: it can operate at higher ambient temperatures (55°C) without derating; all tubes and components are military types meeting stringent performance standards; the complete hermetic sealing of transformers, capacitors and other components provides maximum protection in corrosive atmospheres.

In addition to meeting military environmental requirements, the unit is designed with particular emphasis on flexibility and accessibility. The electronic circuitry for sampling the output voltage and controlling the servo motor is in a separate package; this "control" section can be used with various combinations of Variacs and "buck-or-boost" transformers in a second package to make possible regulators with various power ratings. This feature also simplifies servicing, since only one type control circuit, interchangeable in all units, is involved. When service of the electronic circuitry is required, only one unit need be removed; the larger unit with all its power wiring can stay in service and will supply uninterrupted power under manual control.

Advanced mechanical design makes this a convenient unit to install and maintain. A complete circuit diagram is silk-screened on the inside of the bottom cover plate; when removed, this plate exposes *all* wiring. Every tube may be replaced directly, and removal of a single dust cover exposes all other components. Component values and circuit designations are etched on the mounting board for rapid, convenient identification. These are but a few of the special features built into this design.

As is often the case, care and consideration given important details make the first-class instrument. Where maximum electrical and mechanical reliability is needed, this Regulator will do the job.

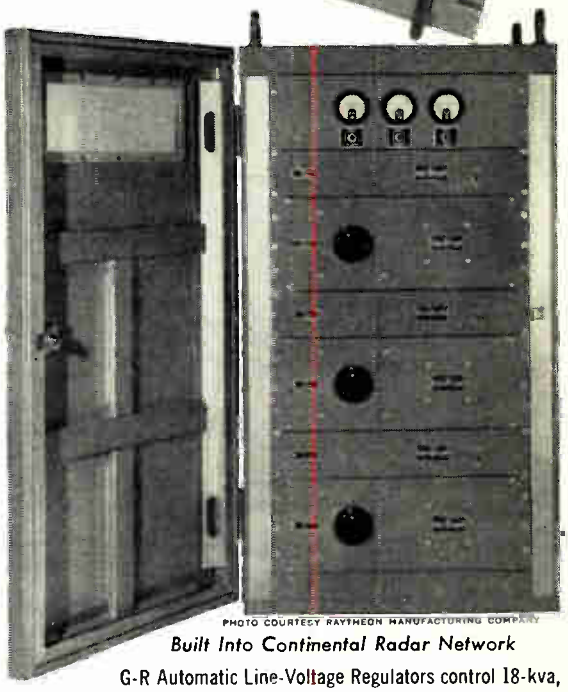


PHOTO COURTESY RAYTHEON MANUFACTURING COMPANY

Built Into Continental Radar Network

G-R Automatic Line-Voltage Regulators control 18-kva, 3-phase power for reliable 24-hour a day operation

WRITE FOR COMPLETE INFORMATION

GENERAL RADIO Company

75 Massachusetts Avenue, Cambridge 39, Mass., U.S.A.

Engineering Opportunities: A few openings in Development and Sales Engineering groups are available for qualified engineers. For further information, please fill out and mail this coupon. 613

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INTERESTED IN: Development Engineering ☐ Sales Engineering ☐

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For *reliability* under *extreme* conditions . . . design with TI's military silicon transistors . . . built to give you high gain in small signal applications at temperatures up to 150°C. Made to the stringent requirements of MIL-T-19112A (SHIPS) and MIL-T-19502 (SHIPS), these welded case, grown junction devices furnish the tremendous savings in weight, space and power you expect from transistorization . . . *plus* close parameter control that permits you to design your circuits with confidence.

All 19 Texas Instruments silicon transistor types have proved themselves in military use. First and largest producer of silicon transistors, TI is the country's major supplier of high temperature transistors to industry for use in military and commercial equipment.

degradation rate tests for TI's USN-2N117 and USN-2N118 silicon transistors

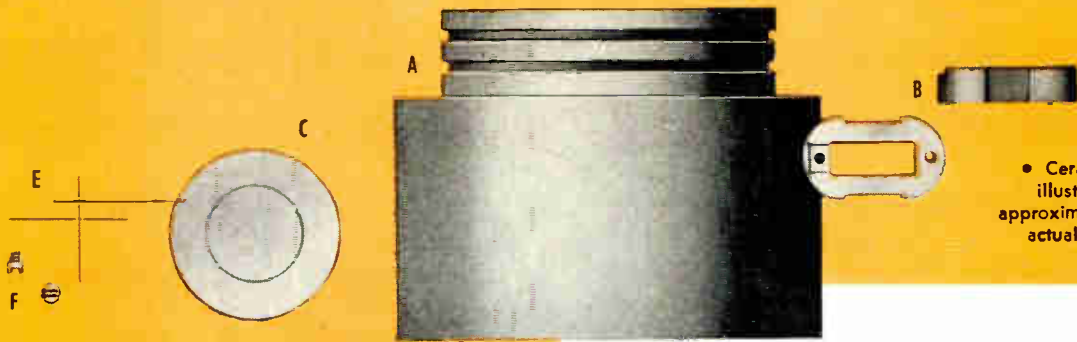
test	condition	duration	end point at 25°C
lead fatigue	three 90-degree arcs	——	no broken leads
vibration	100 to 1000 cps at 10 G	3 cycles, each x, y, and z plane	I_{CO} = 2μA maximum at 5V
vibration fatigue	60 cps at 10 G	32 hours, each x, y, and z plane	h_{ob} = 2μmhos maximum
shock	40 G, 11 milliseconds	3 shocks, each x, y, and z plane	h_{fb} = —0.88 minimum for 2N117
temperature cycle	—55°C to +150°C	10 cycles	h_{fb} = —0.94 minimum for 2N118
moisture resistance	MIL-STD-202	240 hours	
life, intermittent operation	P_c = 150 mW, V_c = 30V	1000 hours, accumulated operating time	
life, storage	150° C, ambient	1000 hours	
salt spray	MIL-STD-202	50 hours	no mechanical defects interfering with operation

LOOK TO TI FOR: SILICON HF, MEDIUM POWER, POWER, AND SMALL SIGNAL TRANSISTORS
SILICON DIODES AND RECTIFIERS • GERMANIUM VHF, POWER, RADIO, AND GENERAL PURPOSE TRANSISTORS

pioneer producer of silicon transistors

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

 For product information, use inquiry card on page 123.



• Ceramics illustrated approximately actual size.

ALSIMAG®

PRECISION CERAMICS

produced to precision tolerances

New equipment and techniques are constantly added to improve precision. Few people—few engineers—are aware of the close tolerances which are now possible. There are 3 main reasons for this progress:

COMPOSITIONS. Widest range in the industry. Some AlSiMag materials are hard as sapphire — more wear resistant than tool steel — and are non-magnetic and chemically inert. New Alumina "super ceramics" perform unbelievable feats of strength, thermal and mechanical shock resistance plus excellent electrical characteristics at ultra high frequencies and temperatures. Improved characteristics promote ruggedization, permit miniaturization.

CONTROLS. In preparation of raw materials, designing and building dies, calculating shrinkages . . . at every manufacturing step — forming, firing, inspecting. Over 55 years of experience — where precision in ceramics was pioneered!

FINISHING. Equipment plus skill. Every machine for precision finalizing. Thoroughly trained personnel who consider difficult specifications a personal challenge.

Tell us about your component problems. AlSiMag Precision Ceramics may do a better job for you. Send us a blueprint or sketch with an outline of the operating procedure for complete details.

Do you know.....

that ceramics can be supplied, in quantity: To tolerances generally associated with precision metal work.

A. Pistons and cylinders with maximum clearance of as little as .0015″.

B. With faces parallel within .0005″.

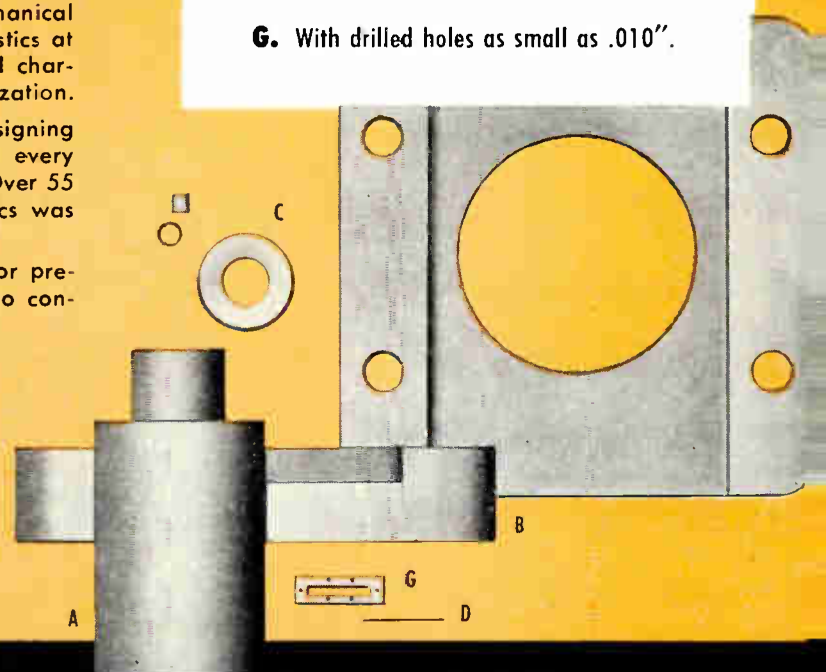
C. In flatnesses within light bands.

D. In thicknesses from .007″ up.

E. In tubular form as small as .015″ OD, .008″ ID.

F. Threaded screws as small as 2-56 thread.

G. With drilled holes as small as .010″.



A Subsidiary of Minnesota Mining and Manufacturing Company

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENN.
55TH YEAR OF CERAMIC LEADERSHIP

For service, contact Minnesota Mining & Manufacturing Co. Offices in these cities (see your local telephone directory): Atlanta, Ga. • Boston: Newton Center, Mass. • Buffalo, N. Y. • Chicago, Ill. • Cincinnati, O. • Cleveland, O. • Dallas, Texas • Detroit, Mich. • High Point, N. C. • Los Angeles, Calif. • New York: Ridgefield, N. J. • Philadelphia, Pa. • Pittsburgh, Pa. • St. Louis, Mo. • St. Paul, Minn. • So. San Francisco, Calif. • Seattle, Wash. Canada: Minnesota Mining & Manufacturing of Canada, Ltd., P. O. Box 757, London, Ont. All other export: Minnesota Mining & Manufacturing Co.,

As We Go To Press (cont.)

IRE Announces New Officers for 1957

Dr. John T. Henderson, principal Research Officer of the National Research Council, Canada, has been accorded one of the highest engineering honors with his election as president of the IRE for 1957. He succeeds Arthur V. Loughren, color TV consultant.

J. T. Henderson

Y. Niwa

Yasujiro Niwa, president of Tokyo Electrical Engineering College, Japan, will succeed Herre Rinia, director of research, Philips Research Labs, Eindhoven, Holland, as IRE vice president.

Ask Lower TV Tax

RETMA asks removal of excise tax on all-channel TV receivers and color TV, and reduction of the present 10 per cent tax on radio and TV sets to 5 per cent. Speaking before the Forand Subcommittee on Excise Taxes, House Ways and Means Committee, RETMA representative Sigurd Tranmal cited the historic Congressional policy of not taxing new products until they become established.

NEW MERGER

Wm. Dubilier, Octave Blake and Tobe Deutschmann celebrate the completion of negotiations whereby Cornell-Dubilier acquired majority control of the Tobe Deutschmann Corp.

ELECTRONIC SHORTS

▶ **Further step in business automation is announced by Stromberg Time Corp., a General Time Corp. subsidiary. Stromberg Time plans to market data transmitting equipment developed by the Hillyer Instrument Co. All rights, patents, and equipment for the system have been acquired by Stromberg Time. Essentially, the new system will accept job cards at centers within the manufacturing area, code the time and cost information on the cards, and transmit the information to computing centers.**

▶ Standard upward pilot escape system is the goal of a USAF program coordinated by Convair Division of General Dynamics Corp. Thirteen major aircraft companies are cooperating in the ejection seat development program, aimed at a standard ejection seat for supersonic jet fighters.

▶ **First private nuclear reactor in Canada will be designed and built by AMF Atomics (Canada) Ltd., a subsidiary of American Machine & Foundry Co.**

▶ Light-weight 110-degree TV tubes are being manufactured by Sylvania. The new tubes are 20 per cent lighter than 90-degree tubes using conventional face plates.

▶ **Ionospheric turbulence can scatter radio waves. NBS Boulder Laboratories at Boulder, Colorado is conducting experiments to learn more about the ionosphere. One technique is to beam two or more simultaneous signals into the ionosphere to a highly ionized point caused by passage of a meteor through an ionospheric eddy.**

▶ Time and money are saved by new test rack techniques developed at USAF Wright Air Development Center, Dayton, Ohio. Electronic equipment to be flight tested is mounted on 30 x 30 inch racks in the shops. The standard racks can then be changed between flights with a minimum of lost time.

▶ The new 21-inch TV-Phono just introduced by Admiral features a hi-fi audio system including 20-watt amplifier, phono preamplifier, four-position record compensator, and a three-speaker woofer-midrange-tweeter combination. Essentially flat response from 30 to 30,000 cps is claimed.

▶ Ballistic-launching ship, Compass Island, commissioned by the Navy in early December will contain "the most fantastic array of navigation instruments ever assembled in a ship." Primary mission is to speed evaluation of new inertial aids for precise mid-ocean navigation and to expedite launching of the Fleet Ballistic Missile.

▶ **Karl Jansky, an American engineer, first detected radio signals from outer space in 1932. Since this initial discovery, other nations have studied the subject more avidly than the United States. Several nations have built large radio telescopes, giving their radio astronomers access to better equipment than we have in the U. S. Now, National Science Foundation has contracted with Associated Universities, Inc., for construction of a 140 ft. precision radio telescope at Green Bank, Pocahontas County, W. Va.**

▶ Burroughs' ElectroData Division has over 50 orders for the new Datafile electronic filing equipment. Unique feature of the equipment is substitution of fifty 250-ft. tapes for continuous reels.

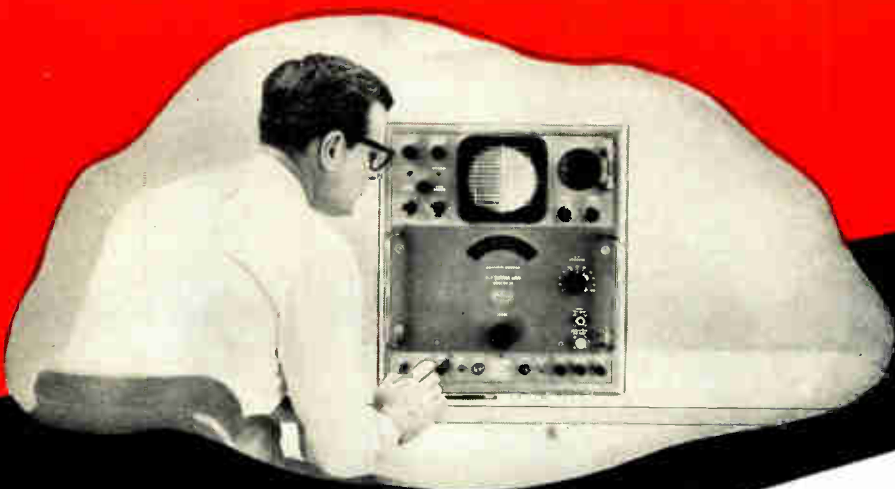
▶ **Price pressures on TV manufacturers and distributors are caused by lack of technical developments to obsolete old sets, according to H. Leslie Hoffman, president of Hoffman Electronics Corp., Los Angeles. He pointed out that radio business is having one of its best years due to the impetus of transistors.**

▶ **Possibilities for simplification of complex electronic equipment are demonstrated by the new Motorola model 17T27 TV set. Combination of plated circuit chassis and Centralab Packaged Electronic Circuits brought 20 per cent reduction in chassis area, elimination of 80 parts and 90 per cent of conventional wiring.**

Direct Reading Spectrum Analyzer

for
- Visual frequency calibration — high resolution
- Leakage and interference measurements
- Standing wave measurements
- Pulse modulation analysis
- Sensitive receiver

The BASIC SCOPE for VISUAL MICROWAVE



SPECIFICATIONS

Model No.	Equipment
Model Du........	Spectrum Display and Power Unit
Model STU-1...	RF Tuning Unit 10-1,000 mc.
Model STU-2A.	RF Tuning Unit 910-4, 560 mc.
Model STU-3A.	RF Tuning Unit 4,370-22,000 mc.
Model STU-4...	RF Tuning Unit 21,000-33,000 mc.
Model STU-5...	RF Tuning Unit 33,000-44,000 mc.

Frequency Range: 10 mc to 44,000 mc.
Frequency Accuracy: ±1%
Resolution: 25 kc.
Frequency Dispersion: Electronically controlled, continually adjustable from 400 kc to 25 mc per one screen diameter (horizontal expansion to 20 kc per inch)

Input Impedance: 50 ohms—nominal
Overall Gain: 120 db
Input Power: 400 Watts
Sensitivity: (minimum discernible signal)
STU-1: 10-400 mcs—89 dbm
400-1,000 mcs—84 dbm
STU-2A: 910-2,200 mcs—87 dbm
1,980-4,560 mcs—77 dbm
STU-3A: 4,370-10,920 mcs—75 dbm
8,900-22,000 mcs—60 dbm
STU-4: 21,000-33,000 mcs—55 dbm
STU-5: 33,000-44.000 mcs—45 dbm
Attenuation:
RF internal 100 db continuously variable (STU-1, STU-2A, STU-3A)
IF 60 db continuously variable

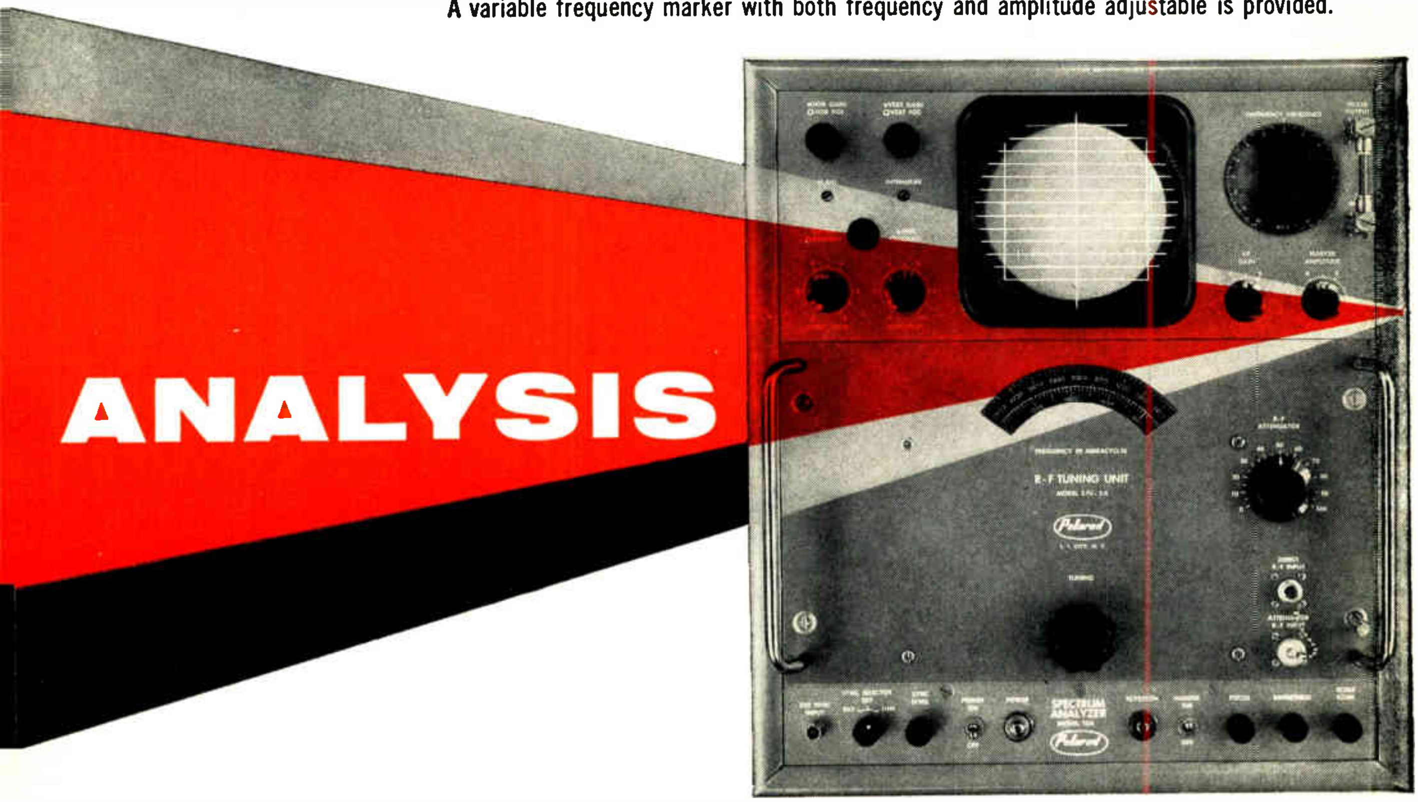
Frequency differences as small as 40 kc measurable by means of variable frequency marker with adjustable amplitude. Portable and completely self-contained.

Broadband 10-44,000 mc

Now, the Polarad Model TSA Spectrum Analyzer provides the same visual advantages for microwave testing as the standard oscilloscope accomplishes for low frequency signals. This is a "must" instrument for microwave work! It displays with high sensitivity on a bright easily defined CRT, pulse modulation components, frequency differences, attenuation and band width characteristics, leakage detection, radiation and interference signals, and VSWR information.

This is visual instrumentation—it provides immediate and complete information because of the high resolution obtainable.

Frequencies are read directly on the linear dial with 1% accuracy as the set is tuned. Maximum reliability and long life are assured through use of non-contacting oscillator plungers. A variable frequency marker with both frequency and amplitude adjustable is provided.



Write today—directly to Polarad, or your nearest Polarad representative—to find out how the Model TSA Spectrum Analyzer can speed your research and solve your microwave measurement and testing problems.

Write for your copy of the Polarad "Handbook of Spectrum Analyzer Techniques". 50c per copy. Includes discussion of Spectrum Analyzer operation, applications and formulae for·analysis techniques.

AVAILABLE ON EQUIPMENT LEASE PLAN

FIELD MAINTENANCE SERVICE AVAILABLE THROUGHOUT THE COUNTRY

For private demonstration without obligation ask for the

to stop at your plant

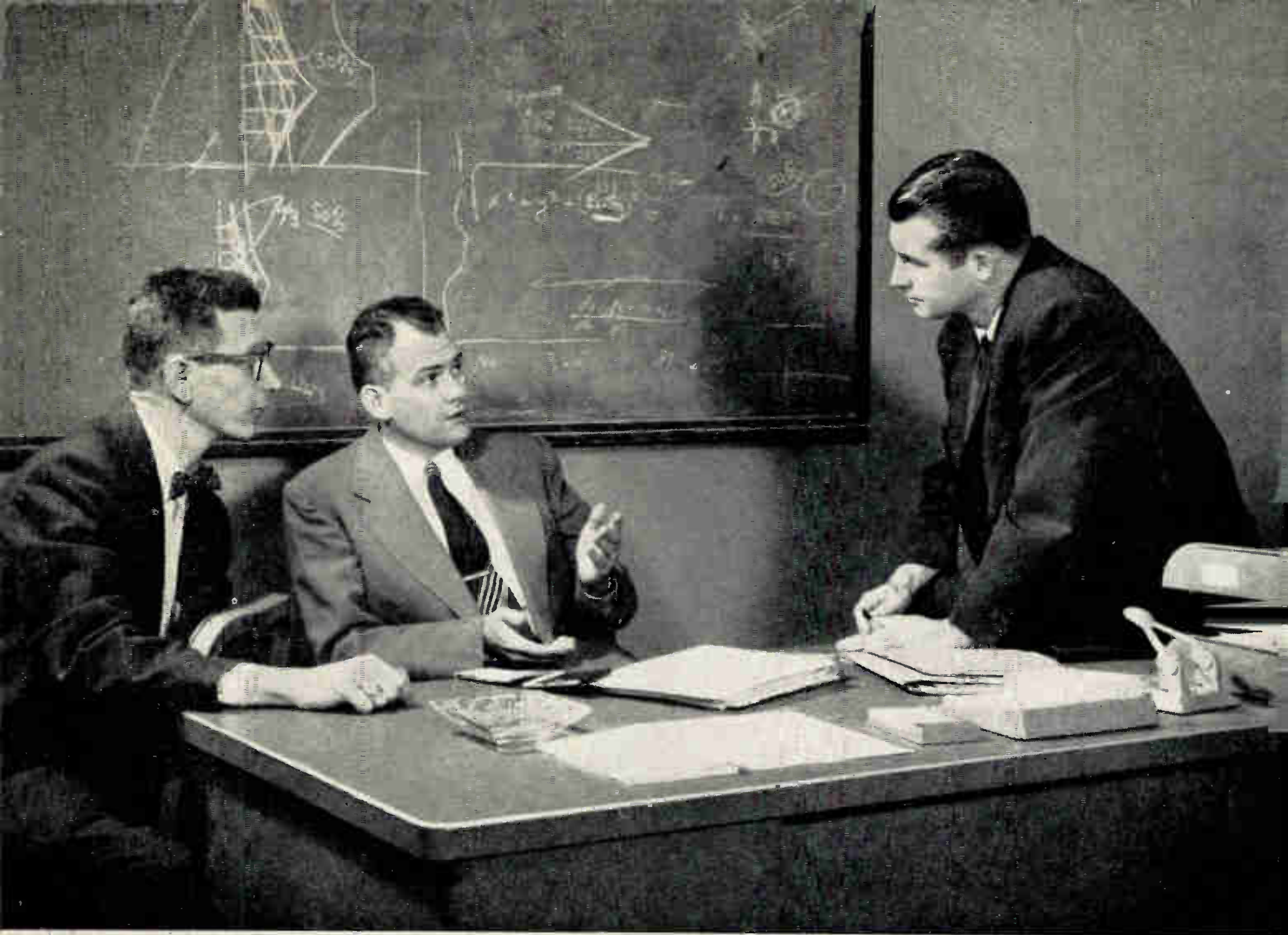
POLARAD PROVEN RELIABILITY

ELECTRONICS CORPORATION

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

REPRESENTATIVES: Albuquerque, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cleveland, Dayton, Denver, Fort Worth, Kansas City, Los Angeles, New York, Philadelphia, Portland, St. Louis, San Francisco, Schenectady, Syracuse, Washington, D. C., Winston-Salem, Canada; Arnprior, Ontario. Resident Representatives in Principal Foreign Cities

For product information, use inquiry card on page 123.



L. K. Edwards (center), head of the Advanced Design and Systems Analysis Department, discusses atmosphere effects on missile guidance with L. Lowell (right), Advanced Design Staff Engineer, and W. F. Wright, head of the Analysis, Plans and Reports Section.

MISSILE SYSTEMS ANALYSIS — *a field of varied assignments*

Engineers and scientists seeking a wide range of assignments will be interested in Lockheed Missile Systems Division's concept of systems analysis. For at Lockheed, systems analysis responsibilities involve virtually every phase of missile preliminary design and development. Essentially, engineers and scientists in this department formulate overall analytical treatment; perform original analyses when problems defy conventional handling; coordinate analytical activities among different departments.

Present openings are in areas related to inertial guidance, functional systems, power plants, control systems and overall weapon configuration. Openings are at Sunnyvale and Van Nuys Engineering Centers.

Inquiries are invited from engineers and scientists whose ability and aptitude demand a wide range of assignments.

Lockheed

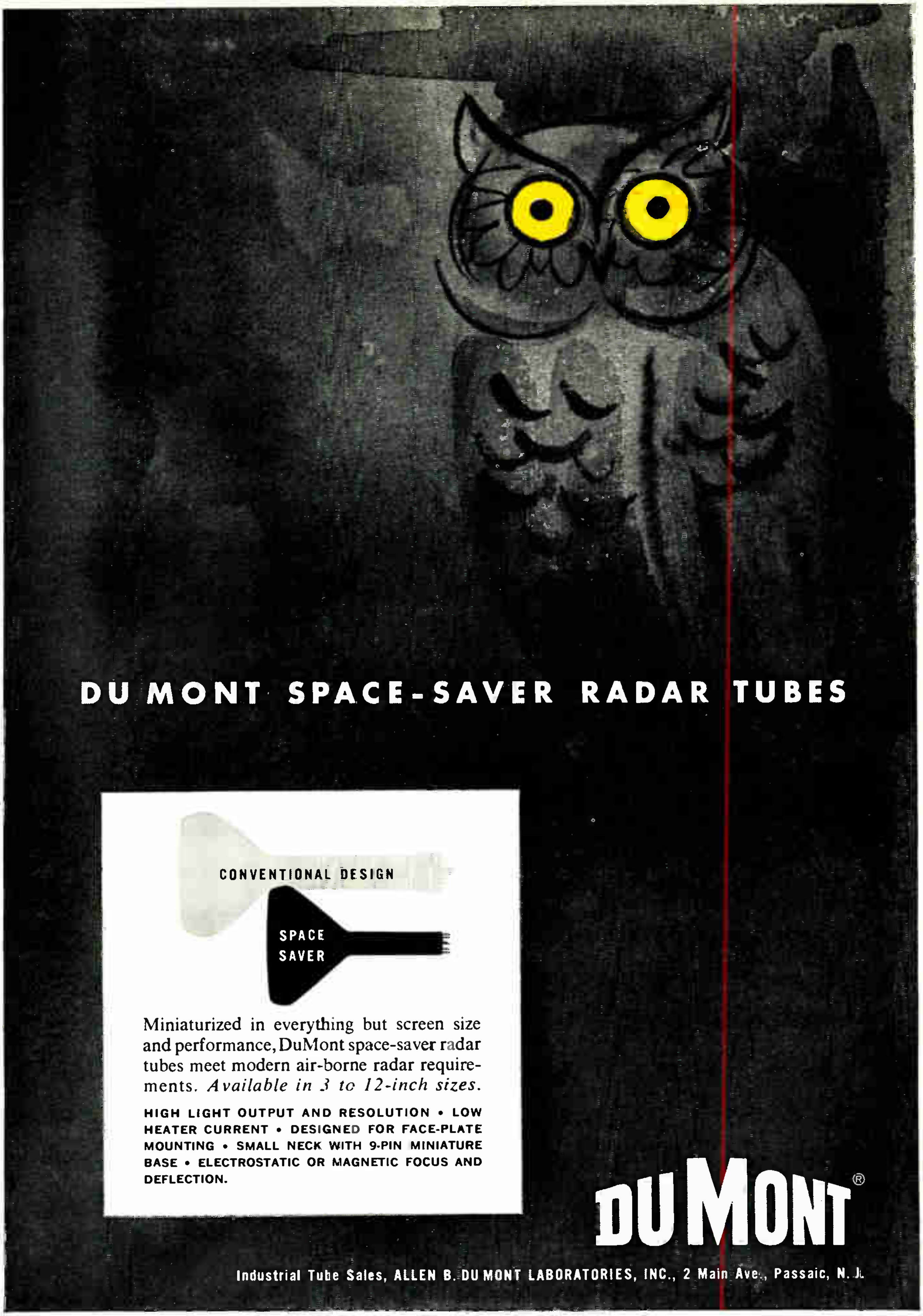
MISSILE SYSTEMS DIVISION

research and engineering staff

LOCKHEED AIRCRAFT CORPORATION

VAN NUYS · PALO ALTO · SUNNYVALE

CALIFORNIA



 For product information, use inquiry card on page 123.

ALL VIDEO TRANSMISSION TEST

STANDARDS in a suitcase

The Original Full Rack and the Portable Unit Produce the same Precise Test Signals.

TELECHROME INCORPORATED

Model 1003-B

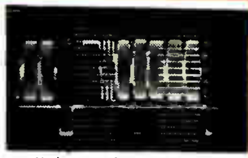
Video Transmission Test Signal Generator

★ Completely self contained ★ Portable
★ Multi-frequency burst ★ Stairstep ★ Modulated stairstep
★ White window ★ Composite sync ★ Regulated power supply.

Now, Telechrome Video Transmission Test Equipment is available as a completely portable 12¼" standard rack mounting unit.

Everyday these Test Signals generated by Telechrome equipment, are transmitted Coast to Coast by NBC, CBS, ABC, the Bell System, Canadian Bell and leading independent TV stations throughout the U.S. and Canada. Hundreds of network affiliated TV stations and telephone TV centers thus check incoming video signals.

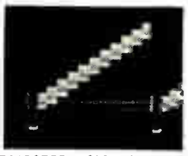
The compact, inexpensive, portable Model 1003-B is all that is required to generate signals for local and remote performance checking of your entire video, cable, or micro wave facilities.



MULTI-FREQUENCY BURST AMPLITUDE vs FREQUENCY. Check wide band coaxial cables, microwave links, individual units and complete TV systems for frequency response characteristics without point to point checking or sweep generator.

WHITE WINDOW

LOW & HIGH FREQUENCY CHARACTERISTICS. Determine ringing, smears, steps, low frequency tilt, phase shift, mismatched terminations, etc. in TV signals or systems.



STAIRSTEP SIGNAL modulated by crystal controlled 3.579 mc for differential amplitude and differential phase measurement. Checks amplitude linearity, differential amplitude linearity and differential phase of any unit or system.

Model 1003-C includes variable duty cycle stairstep (10-90% average picture level).

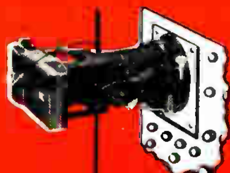
Model 608-A HI-LO CROSS FILTER for Signal analysis.

MODULATED STAIRSTEP signal thru high pass filter. Checks differential amplitude.

MODULATED STAIRSTEP signal thru low pass filter. Checks linearity.

DELIVERY 30 DAYS

Literature on the above and more than 100 additional instruments for monochrome and color TV by TELECHROME are available on request.



1521-A OSCILLOSCOPE CAMERA—Polaroid type for instantaneous 1 to 1 ratio photo recording from any 5" oscilloscope.

1004-A VIDEO TRANSMISSION TEST SIGNAL RECEIVER for precise differential phase and gain measurements. Companion for use with 1003-B.

TELECHROME INCORPORATED

The Nation's Leading Supplier of Color TV Equipment

28 Ranick Drive Amityville, N. Y.

Lincoln 1-3160

Having your ups and downs?

... if they involve WIRE WOUND RESISTORS

DALOHM has the answer!

All Dalohm components are carefully designed and skillfully made to assure you of supreme quality and dependability, plus the widest versatility of application.

Outstanding examples of the Dalohm line are the following miniature, silicone coated, wire wound resistors.

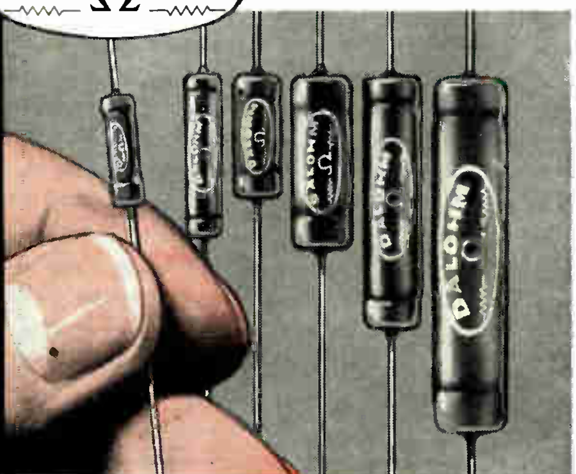
DALOHM Ω ®

Miniature but Mighty

FOR CRITICAL ELECTRONIC DESIGN WHERE SPACE IS A PROBLEM

DALOHM Ω

TYPE RS



Smallest in size, Dalohm Type RS resistors are silicone sealed, offer high di-electric strength, maximum heat dissipation, and resistance to abrasion, plus every other desirable characteristic:

- 100% impervious to moisture and salt spray
- Complete welded construction from terminal to terminal
- Temperature coefficient 0.00002/Deg. C
- Resistance ranges from 0.05 ohm to 175K ohm, depending on type
- Tolerances 0.05% to 3%, depending on type
- Five wattages—2, 3, 5, 7, and 10; six physical sizes

Write for Bulletin R-23D

TYPE RLS

Essentially the same as Type RS, but built with radial leads for printed circuit applications.

- Five wattages—2, 3, 5, 7 and 10; six physical sizes

Write for Bulletin R-30A

TYPE RSE

"RUGGEDIZED"

A modified RS Type, with tremendous shock resistance obtained by encasing them in a metal housing, yet maintaining miniature size.

- Five wattages—2, 3, 5, 7, and 10; seven physical sizes.

Write for Bulletin R-25B

JUST ASK US!

You are invited to write for the complete catalog of Dalohm precision resistors, potentiometers and collet-fitting knobs.

If none of our standard line fills your need, our able engineers and skilled craftsmen, equipped with the most modern equipment, are ready to help solve your problem in the realm of development, engineering, design and production.

Just outline your specific situation.

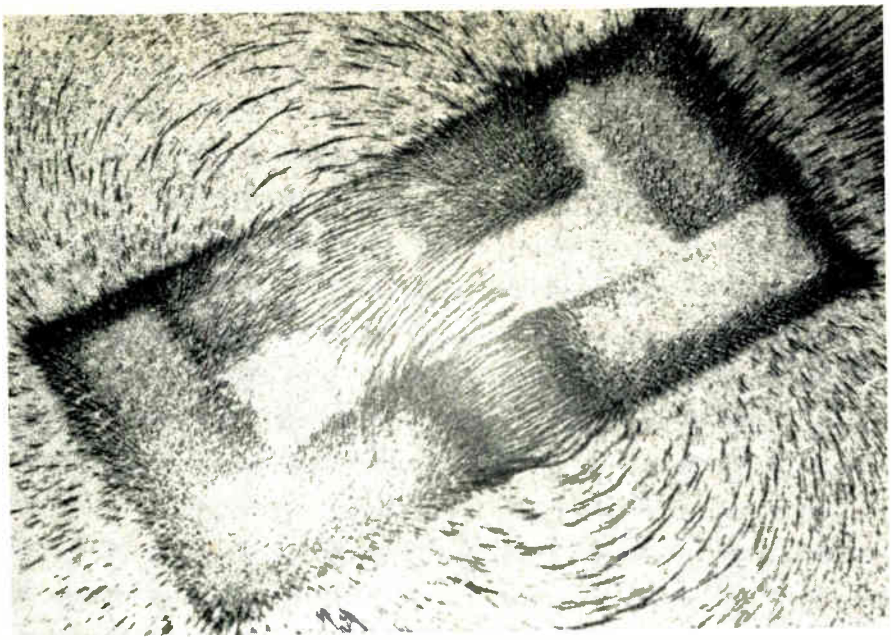
DALE PRODUCTS, Inc.

1304 28th Avenue
Columbus, Nebraska, U.S.A.

• Export Dept:
Pon-Mar Corp.,
1270 Broadway, New York 1, N.Y.

• In Canada:
Charles W. Pointon, Ltd.
6 Alcina Ave., Toronto, Ont.

For product information, use inquiry card on page 123.



Flux pattern of experimental magnetic circuits

How location of magnets affects magnetic circuits

Adapted from an article by Charles A. Maynard, vice president, Research and Engineering, The Indiana Steel Products Company

The LOCATION of permanent magnets in a magnetic circuit is a definite factor in design. To determine the extent to which this is true, involved calculations are necessary.

A comparatively simple experiment, however, which shows the nature of the changes that take place when permanent magnets are placed in different positions in a magnetic circuit, was devised by Mr. Maynard. The material on which the following questions and answers are based was taken from a report, "An Experiment in Magnet Location," published in Vol. 3, No. 5, of Applied Magnetics. *A copy of this issue is available on request to The Indiana Steel Products Co., Dept. N-1, Valparaiso, Ind.*

Question: What affect does the location of permanent magnets have on a magnetic circuit?

Answer: It has a marked influence on the flux density in the various portions of the magnetic circuit.

Question: Is there a preferred location for magnets?

Answer: Yes, it is important to place the magnets as close to the air gap as possible.

Question: What is the benefit of their location?

Answer: The leakage flux is reduced, and the useful flux in the air gap is increased.

Question: How is this an important factor in design?

Answer: It minimizes the amount of magnet material required to produce a given flux in the air gap.

Question: Does this mean lower magnet costs?

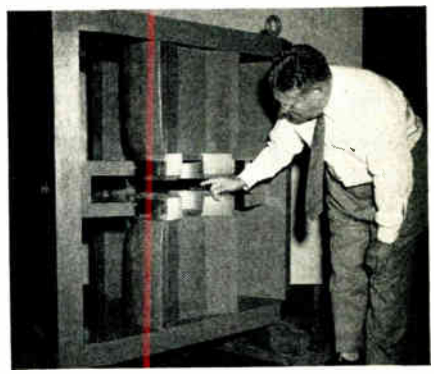
Answer: Generally, this is true. However, structural considerations may prevent the placement of permanent magnets at preferred positions.

Question: Are there available quantitative data which indicate the degree to which magnet position influences the efficiency of a circuit?

Answer: A brief experiment was conducted on the nature and magnitude of the changes that occur when magnets are placed in various positions in a simple magnetic circuit. The results are discussed in *Applied Magnetics*, Vol. 3, No. 5.

World's largest permanent magnet separates electron particles

The largest and most powerful permanent magnet ever designed is an important part of a new Mass Spectrometer to be used for high molecular weight hydrocarbon



Indiana's C. A. Maynard inspects air gap of giant Alnico V magnet assembly

analysis at the Whiting, Indiana, research and development laboratories of a large Midwestern oil company. Function of the spectrometer is to establish a strong magnetic field that separates electron particles.

The Alnico V permanent magnet used in the assembly has a maximum field strength of 6,000 gauss . . . equal to 10 tons of magnetic holding force . . . and weighs 1,300 pounds. The complete assembly, which weighs approximately 4,700 pounds, was designed and fabricated by The Indiana Steel Products Company, Valparaiso, Indiana.

 For product information, use inquiry card on page 123.

Industry News

Neil Uptegrove has been appointed Advertising Manager of the Technical Products Div., A. B. DuMont Labs, Inc.

Albert S. Hovannesian has assumed the offices of President and Treasurer of Diamond Antenna and Microwave Corp. of Wakefield, Mass.

L. Eugene Root has been appointed Vice President of Lockheed Aircraft Corp. and General Manager of its expanding new Missile Systems Division.

L. E. Root

W. E. Peek

Walter E. Peek is now General Sales Manager of Centralab, Milwaukee, a div. of Globe Union, Inc.

Dr. Donald D. King has been appointed Vice President in charge of research for Electronic Communications, Inc., a wholly-owned subsidiary of Air-Associates, Inc. He will be Director of the new research laboratory in Baltimore, Md.

Ralph Herzog has been employed by the Dowmotor Co., Santa Clara, Calif., a Division of Dalmo Victor Co., as Sales Manager.

Robert W. Pearson has been appointed Deputy General Manager for operations at American Machine and Foundry Co. Electronics Division, Boston, Mass.

George S. Kariotis appointed General Sales Manager of Microwave Associates, Inc., Boston.

E. Wayne Copeland named Asst. Sales Mgr.-Telemetering at Bendix Aviation's Pacific Div., No. Hollywood.

William A. Hauser is now Advertising Manager of Potter & Brumfield, Inc., Princeton, Ind.

Heli-Coil Corp., Danbury, Conn., has appointed **John E. Fascano** as Sales Manager.

Maxwell Ratner to the post of Sales Manager for General Transistor Corp., Richmond Hill, N. Y.

Richard W. Walker is now Vice President in charge of manufacturing at Transitron, Inc., Manchester, N. H.

(Continued on page 24)

Industry News

(*Continued from page* 18)

Raymond J. Barclay appointed Manager of Mfg. for General Electric's Industrial Computer Section, Syracuse.

Paul H. Kreager has been appointed Contracts Manager of the entire Western Div. of Kearfott Co.

Charles G. Burress has been appointed Sales Manager of the Poly-Scientific Corp., Blacksburg, Va.

J. P. Arndt, Jr., has been appointed Assistant to the Vice President and General Sales Manager of Brush Electronics Co., Division of Clevite Corp., Cleveland.

Sherman M. Fairchild, President of Fairchild Recording Equipment Co., Long Island City, has been elected Executive Vice President of the Audio Engineering Society.

Henry F. Argento has been appointed Vice President, Commercial Sales, for Raytheon Mfg. Co., Waltham, Mass.

Capt. Gould Hunter, USN (Ret) has been named Assistant to the Vice President, Manufacturing, at Eitel-McCullough, Inc., San Bruno, Calif.

Milton R. Schulte is now Executive Vice President, a newly created post, at Tung-Sol Electric, Inc., Newark, N. J.

Harry G. McKenzie has been named General Sales Manager of the Gray Research and Development Co., Inc., Manchester, Conn.

William Sendell was appointed General-Products Production Manager of the Red Bank Div. of Bendix Aviation Corp.

B. Howard Dean has been appointed Director of Marketing of AMF's Electronic Div., Boston.

Telex, Inc., St. Paul, Minn., has announced the appointment of **Dale L. Dale** as General Sales Manager of its industrial electronics div.

Richard M. Paullus has been appointed Manager of the West Coast Electronic Manufacturers Assn. (WCEMA).

George W. Henyan was honored in recognition of 40 years of service with the General Electric Corp.

Jack Rosenberg is now Manager of Automation, Electronic Control Systems, Inc., Los Angeles, a Stromberg-Carlson affiliate.

Arthur J. Costigan elected Vice President, Radiomarine Dept., RCA Communications, Inc., New York.

New Allen-Bradley developments

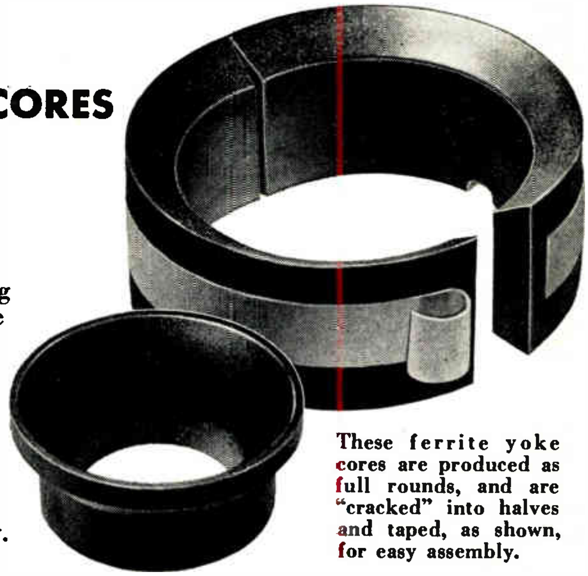
GREATER COLOR PURITY—BETTER CONVERGENCE

1. FULL ROUND YOKE CORES

FOR COLOR TV

ALSO BLACK AND WHITE

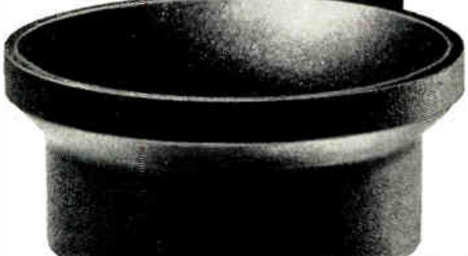
Allen-Bradley has developed a method of producing ferrite deflection yoke cores as a full 360° ring! Unlike cores made from quarter rounds, the new full round cores are perfectly concentric and have parallel inner surfaces. They require no grinding. The round rings are "cracked" into halves and taped for shipment. Assembly is quick and economical. The tape is rolled back, the core is slipped over the coils, and the tape put back in place. The core's concentricity assures better convergence and greater color purity.



These ferrite yoke cores are produced as full rounds, and are "cracked" into halves and taped, as shown, for easy assembly.

2. FLARED YOKE FERRITE CORES

FOR NEW 110° TUBE . . . SAVES WEIGHT



For the new 110° picture tube, Allen-Bradley has developed a flared yoke ferrite core whose outer surface is also shaped to reduce the amount of material required. This makes possible a weight reduction of approximately 30% over conventional cylindrical cores. The new flared yoke is produced as a solid piece but, with the Allen-Bradley method, the yoke is "cracked" into halves, yet a perfect ring is maintained. Available in Allen-Bradley Class WO-1 ferrites which are to be preferred because of their uniform magnetic characteristics.

FERRITE SAVED BY CURVED SHAPE

Allen-Bradley Co.
1342 S. Second St.
Milwaukee 4, Wis.

In Canada—
Allen-Bradley Canada Ltd., Galt, Ont.

A-B Quality

ALLEN-BRADLEY

RADIO, ELECTRONIC, AND TELEVISION COMPONENTS

QUALITY

 For product information, use inquiry card on page 123.

Tele-Tips

ENGINEERING VOCABULARY (slightly revised version). In Hoffmann Electronics' "Transmitter" we came across these intriguing daffy-nitions.

Channels: The trail left by inter-office memos.

Coordinator: The guy who has a desk between two expeditors.

Consultant (or expert): Any ordinary guy more than 50 mi. from home.

Under consideration: Never heard of it.

Under active consideration: We're looking in our files for it.

Re-orientation: Getting used to working again.

Reliable source: The guy you just met.

Informed source: The guy who told the guy you just met.

Unimpeachable source: The guy who started the rumor originally.

We are making a survey: We need more time to think of an answer.

To note and initial: Let's spread the responsibility for this.

Let's get together on this: I'm assuming you're as confused as I am.

Give us the benefit of your present thinking: We'll listen to what you have to say as long as it doesn't interfere with what we've already decided to do.

Will advise you in due course: If we figure it out, we will let you know.

With modification: Will be shipped to you in kit form—put together (if you can) yourself. Glue optional.

EVERYONE'S ELECTRONICS, run by Mr. Bigg, employs such people as Willie the Scrounger and Miss Demeanor. These two play important roles in the neorealistic novel (48 page pocket book) narrated against the stirring backdrop of the contemporary electronics scene. "Murder in the Model Shop," written about engineers for engineers, distributed by Servo Corp. of America, will leave you listening for the throaty voice of that pulchritudinous package of femininity, that lab assistant, Miss Demeanor . . .

(*Continued on page* 28)

Another product surprise from Helipot!

Fire burn and cauldron bubble! Cook our new HELIPOT® Model 50 trimming-type potentiometer to a fare-thee well. Fish it out . . . shake it . . . kick it over the goalposts. And it works as good as new.

Question:

How come this amphibious trim-type miracle?

Answer:

Fusing and housing. The resistance element "slip ring" and terminals are fused to the Steatite (high-grade, mechanically stable porcelain) frame . . . enclosed in a one-piece stainless-steel seamless-tubing housing . . . to form an indefatigable unit that laughs off heat and moisture, sneers at shock and vibration.

For a trimming-type potentiometer with nominal resistance values from 1,000 to 25,000 ohms . . . that remains stubbornly stable after being set . . . for airborne applications, where weight and space are critical, stability and resistance to vibration vital . . . there's only one answer: Model 50.

Model 50 and the encapsulated Model 51 are both fully described in data file 124.

Beckman®

Helipot *Corporation: Newport Beach, California*

a division of Beckman Instruments, Inc.

Engineering representatives in principal cities

833

 For product information, use inquiry card on page 123.

Tele-Tips

(*Continued from page* 26)

PAGING SERVICE that operates over a 40-mi. radius around New York City has a list of subscribers that includes doctors, beer-truck drivers and airline crews. Receiving unit is a 6-oz. VHF receiver. Each user is assigned his own code number which is repeated at one-minute intervals when he is being paged. He responds by calling his home, office or telephone answering service which operates the hook-up. The charges: $12 a month rent, $1.20 tax, and $25 deposit.

THAT RED-TAPE COMPLAINT may soon be literally true. Companies using electronic data processing machines are being urged by the U. S. Revenue Service to submit their quarterly reports on magnetic tape.

THE TRANSISTOR RADIO has been a natural target for shoplifters ever since its introduction. So much so that many dealers have actually been refusing to display the tiny receivers. Now Emerson Radio and Phono Corp. has come up with a solution. Their new display case contains just four cabinet fronts, securely attached—and without chassis.

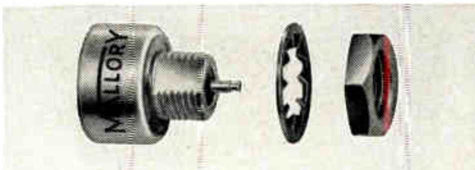
ALL THE TWO-WAY RADIO equipped cars, placed bumper-to-bumper, would form a line 1600 mi. long. This same string could provide a radio equipped automobile every 16 mi. around the entire earth.

ELECTRONIC STOCK-CASTING. Dr. Larry Rosenfeld, Melpar Inc., is working on an electronic computer technique that will predict a stock's behavior, enabling the investor to take short-term profits as they occur. Dr. Rosenfeld is testing the method on some 2,000 stocks on the American and New York Stock Exchanges.

LATEST CLOSED-CIRCUIT gimmick: A camera on the front of the locomotive and the receiver in the club car so passengers can "see where they're going."

for dependable service
under extreme conditions . . .

Mallory Tantalum Capacitors



MILITARY AND INDUSTRIAL services require component dependability under extreme conditions of temperature and shock. Mallory research and production made possible the Mallory XT line of tantalum capacitors, now thoroughly performance tested and proven for this kind of service.

Mallory XT capacitors were the *first* made to withstand vibration shock to 2000 cps., and temperatures to 175° C. (the highest standard rating). On special order Mallory XT capacitors can be furnished for continuous duty at 200° C.

Mallory tantalum capacitors were *first* to employ a true hermetic seal—metal to glass—without use of rubber or synthetic materials, and are absolutely impervious to immersion. Only Mallory makes available such a broad range of capacity and voltage ratings.

Complete information on Mallory XT capacitors can be had by asking for a copy of the paper—"Typical Expected Performance Characteristics of Extreme Temperature Range Tantalum Capacitors." Data on subminiature capacitors, including the newest tantalum type, can be had by requesting technical bulletins on Mallory types TAP, TAW and TNT.

Write, or ask the Mallory representative.

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Parts distributors in all major cities stock Mallory standard components for your convenience.

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

For product information, use inquiry card on page 123.

Books

International Dictionary of Physics and Electronics

Published 1956 by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 1021 pages. Price $20.00.

This is possibly the best book of definitions available on the market today covering the fields of Physics and Electronics. It is highly recommended for mathematicians and biologists as well as physicists and engineers.

For those without an extensive mathematical background, both explicit and discursive statements and entries are given, as well as the definitions of the more common mathematical terms encountered.

All definitions, wherever possible, which have been established or recommended by responsible groups are included. The units and systems of units, so important in physics, are treated both by definition and by a comprehensive discussion at the beginning of the book.

The vast fund of facts and figures in this unique reference is knit together by a proven system of cross-referencing. Every topic is fully explained in basic terms, and then every word important to the explanation, that is further defined elsewhere in the book, is printed in bold face type.

This dictionary, prepared by an international group of distinguished scientists and educators, has terms from 16 major subject divisions and over 300 illustrations, all designed to provide the exact and unambiguous definitions needed in everyday work.

Frequency Modulation Engineering, 2d Ed.

By C. E. Tibbs & G. G. Johnstone. Published 1956 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 447 pages. Price $8.50.

Since the publication of the first edition, there have been extensive additions to the literature dealing with many aspects of frequency modulation engineering, and the engineering practice associated with FM systems has developed considerably.

Increased information is now available on interference, aerials, limiters, and discriminators. Much of the BBC's postwar work on FM is treated and that work is also the basis for this revision.

The Signal Corps: The Emergency

Published 1956 by the U. S. Government Printing Office, Washington 25, D. C. 396 pages. Price $3.50.

This volume, one of the series "United States Army in World War II," is the first to be published in the group of three Signal Corps volumes in the subseries "The Technical Services."

The course which the Signal Corps

(*Continued on page 36*)

How much should a Tape Recorder cost?

$45,000* **The new Ampex Videotape Recorder** at $45,000 achieves flawless reproduction of TV picture and sound. The system not only promises to revolutionize network telecasting but will actually reduce material costs by 99%. In hundreds of TV stations throughout the country Ampex Videotape Recording will repay its cost in less than a year.

$1,315* **The Ampex Model 350 studio console recorder** at $1,315, costs less per hour than any other similar recorder you can buy. Year after year it continues to perform within original specifications and inevitably requires fewer adjustments and parts replacements than machines of lesser quality.

$545* **The Ampex Model 601 portable recorder** at $545 gives superb performance inside and outside of the studio. This price buys both the finest portable performance available and the most hours of service per dollar.

YOU CAN PAY LESS FOR A TAPE RECORDER BUT FOR PROFESSIONAL USE YOU CAN'T AFFORD TO BUY LESS THAN THE BEST

*Net price as of August 1, 1956 and subject to change.

SIGNATURE OF PERFECTION IN MAGNETIC TAPE RECORDERS
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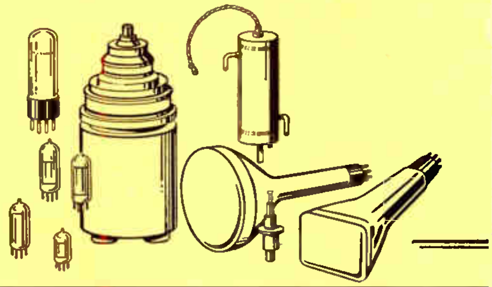
AMPEX
CORPORATION

For product information, use inquiry card on page 123.

TUBE DESIGN NEWS

GENERAL ELECTRIC



RECEIVING * POWER * CATHODE RAY

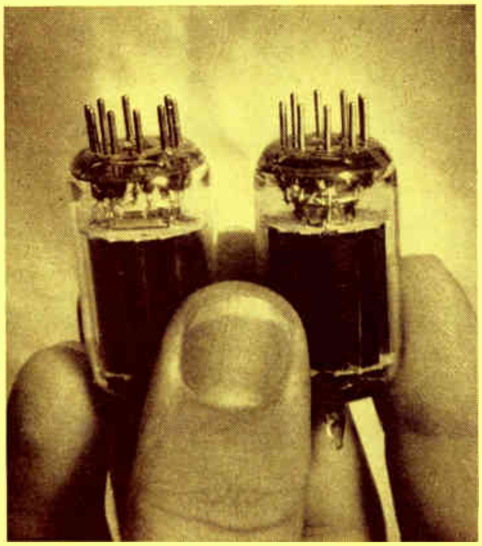
Now 54 600-ma, 31 450-ma G-E Series-String Receiving Tubes! Every Circuit Requirement Met

By the steady introduction of new series-string types for television, General Electric, originator of series-string tubes, continues to keep abreast of all circuit requirements of TV manufacturers.

Both in 600-ma and 450-ma ratings, there are G-E tubes with uniform warm-up time to fill virtually every series-string socket. The 54 600-ma types bring economy with reliability to builders of larger-model TV receivers, while the 31 G-E 450-ma tubes offer the same advantages on small second sets and portables.

In handy 8½″ by 11″ form, General Electric has prepared a complete list of G-E series-string tubes (ETD-1163-D), with all key ratings. Copies on request from any of the G-E offices on the next page.

New, Special General Electric "Sand-Blast" Process Scrubs 5-Star Tube Pins for Better Electrical Contact



ABOVE: operator holds a 5-Star high-reliability tube while streams of abrasive emulsion scour oxidation off surfaces of pins.
LEFT: pins before and after cleaning (unretouched photograph).

In order to assure efficient electrical contact of 5-Star high-reliability tube pins from the time the tubes are installed, General Electric has pioneered and developed a new, special process of "sand-blasting", or scouring the pins with a jet-propelled emulsion of abrasive material.

Twin guns that rotate 360° scrub off all oxidation residues and other impurities, so that the cleaned pins have surfaces free from non-conductive substances.

Afterwards the tube pins are rinsed in clear water, then dried by infra-red lamp. When 5-Star Tubes are plugged in, the full surface area of every pin is conductive. Electrical contact is complete.

As one of many processes that contribute to 5-Star Tube high reliability, cleaning pins with abrasive is a link in a long chain of G-E design, manufacturing, and testing steps that make possible dependable tube service in military and industrial applications.

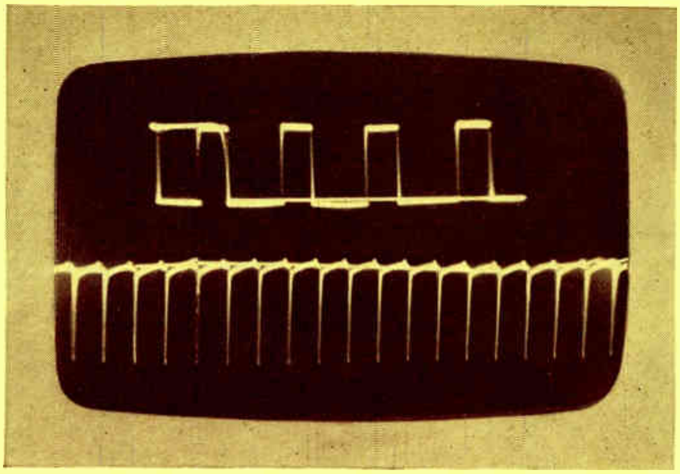
Heavy-duty design protects 5-Star Tubes

(Continued on Page 2, Column 2)

New GL-6942 900-mc Power Tetrode Has Heavy-Duty Cathode for Long Tube Life

Checking a GL-6942 for operating temperature (optimum relationship between cathode emission and cathode life). Increasing power is fed into tube filament until cathode glow matches color of the element in the optical pyrometer, calibrated for 1950K—the optimum figure. Thoriated tungsten for the cathode permits high-output service with long tube life. See further GL-6942 story on next page, describing tube and its applications.

New General Electric 2-Gun 7ALP19 and 7ALP25 Have Space-Saving Rectangular Face-Plates



Guns are separately controlled, and share a single face-plate for their independent presentations. These presentations may be alike (for precise comparison) or unlike. Tube deflection and focus are both electrostatic.

General Electric's new cathode-ray tubes for military and industrial service take up minimum space when installed. A single face-plate carries dual images, and the face-plate is rectangular, with virtually no "waste" area. Post-acceleration and gun design with extra-high sensitivity reduce deflection-voltage requirements substantially.

Two types are in production: 7ALP19, with a phosphor that eliminates the initial blue flash of P7 . . . 7ALP25, with a burn-resistant phosphor that has longer persistence than P19. The tubes can also be obtained with other phosphors if this is desired by the customer.

Face-plate is 4″ by 6″—rectangular, spherical. Tight mechanical specifications assure an angle of less than one degree between corresponding traces. Complete tube data will be supplied on request.

1 Kw GL-6942 Meets Power and Frequency Needs in U-h-f "Scatter Propagation"

The new General Electric GL-6942 power tetrode lends itself to "scatter-propagation" techniques, by which a military or commercial u-h-f signal is pushed beyond line-of-sight transmission into distant areas.

Adequate power; dependability; stamina for long periods of max-rating operation—all are power-tube requisites for this work. The GL-6942 has these qualities; and in addition, broad band-width capabilities and high efficiency.

In developing new Type GL-6942 for scatter propagation or for other uses, military and commercial, where high tube output must join with long life, General Electric has introduced design features that make possible 2,000 hours and more operation at full ratings. Extensive G-E factory tests confirm the ability of the tube to operate this length of time at top output.

For example: the GL-6942 cathode is a high-emission-with-long-life thoriated tungsten cylinder. Grid material is strong, dependable platinum-clad tungsten. Ring-seal construction and ceramic insulation are other contributions to tube strength and high-temperature resistance.

Type GL-6942 has many u-h-f applications waiting for it in communications, TV transmission, and data-link systems. Forced-air cooling simplifies installation and maintenance. Complete ratings, characteristics, and performance data on request.

NEW PRODUCT BRIEFS

Receiving Tubes:

4BA6. New G-E 450-ma series-string version of 6BA6 high-gain amplifier pentode.

4BE6. New G-E 450-ma series-string version of 6BE6 pentagrid converter heptode.

5CL8, 6CL8. New G-E triode-pentodes for v-h-f TV tuners. Tubes are identical except for (1) heater ratings, (2) 5CL8 is suited to 600-ma series-string circuits.

12BL6. New G-E remote-cutoff pentode for use as amplifier in auto-radio receivers.

Cathode-ray Tubes:

12SP7-D. New General Electric 12-inch C-R tube for radar and oscillographs. Magnetic focus; 50-degree deflection angle; long-persistence phosphor.

Ask for complete information!

General Electric 5-Star "Sand-Blast" Process

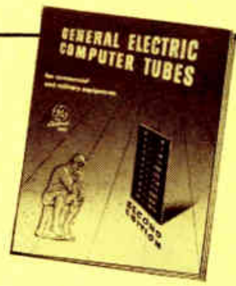
(*Continued from Page 1*)

where shock and vibration are hazards, as in military field and air service. Manufacture is carried out by special trained G-E workers, in surroundings of "Snow White" cleanliness, in order to ward off short circuits that can come from dust or dirt inside a tube. 5-Star life tests are exhaustive, duplicating actual temperature and other operating conditions that will be encountered when tubes are in use.

Airlines, the armed services, industry, all are successfully using 5-Star Tubes to increase the trustworthiness of electronic equipment, cut downtime, and reduce the effort and cost of maintenance.

NEW EDITION!

G-E Computer Tubes and Their Applications



Includes complete technical data on General Electric computer tubes—standard and 5-Star high-reliability types. Ask for Booklet ETD-1140-A.

EASTERN REGION
General Electric Company, Tube Sales
200 Main Avenue, Clifton, N. J.
Phones: (Clifton) GRegory 3-6387
(N.Y.C.) WIsconsin 7-4065, 6, 7, 8

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Chicago 41, Ill.
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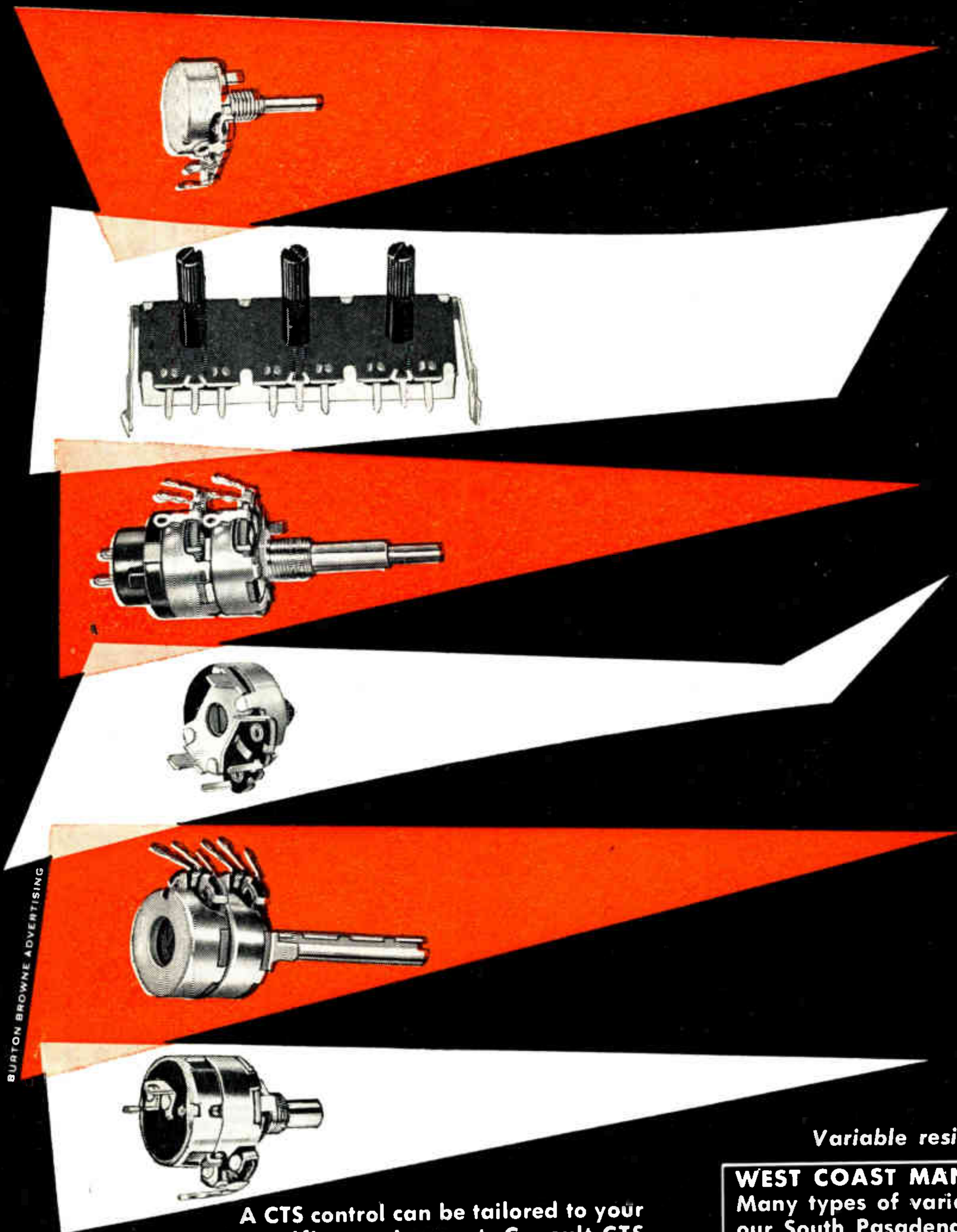
ELECTRONIC COMPONENTS DIVISION, GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.


BURTON BROWNE ADVERTISING

Books

(*Continued from page* 30)

followed between WWI and WWII, a period of planning and preparation, is traced. The reader can follow from birth, the history of Army radar, mobile radio, and the beginnings of the far-flung communications network that eventually encircled the globe.

Electrical Interference

By A. P. Hale, Grad.I.E.E. Published 1956 by Philosophical Library, Inc., 15 E. 40th St., New York 16, N. Y. 129 pages. Price $4.75.

This book has been written from a thoroughly practical point of view. It covers the causes of interference; the effect of interference; receiver antenna systems; measurement of interference levels; location of sources of interference; and basic filters.

Books Received

Rayleigh's Principle and its Applications to Engineering

By G. Temple and W. G. Bickley. Published 1956 by Dover Publications, Inc., 920 Broadway, New York 10. 165 pages, paper bound. Price $1.50.

Introduction to Printed Circuits

By Robert L. Swiggett. Published 1956 by John F. Rider, Publisher, Inc., 480 Canal St., New York 13. 112 pages, paper bound. Price $2.70.

Atomic Energy

By E. C. Roberson & A. Radcliffe. Published 1956 by The Philosophical Library, 15 E. 40th St., New York 16. 142 pages. Price $4.75.

Proceedings 1956 Electronic Components Symposium

Published 1956 by Engineering Publishers, GPO Box 1151, New York 1. 240 pages. Price $8.25 cloth bound, $5.00 paper bound.

Proceedings of the Conference on Radio Interference Reduction, Vol. I and II

Published 1956 by Armour Research Foundation, 10 W. 35th St., Chicago 16. 730 pages, paper bound. Price $6.00 per set.

Basic Electricity

By Paul B. Zbar and Sid Schildkraut. Published 1956 by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. 84 pages, price $1.75.

Basics of Phototubes & Photocells

By David Mark. Published 1956 by John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. 136 pages, paper bound. Price $2.90.

Servicing Record Changers

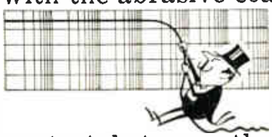
By Harry Mileaf. Published 1956 by Gernsback Publications, Inc., 154 W. 14th St., New York

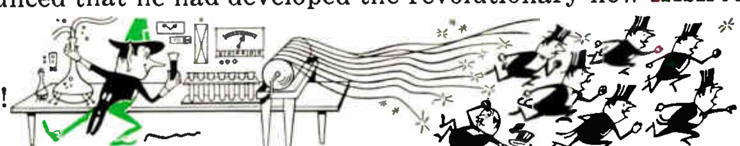
Numerical Integration of Differential Equations

By A. A. Bennett, W. E. Milne, and H. Bateman. Published 1956 by Dover Publications, Inc., 920 Broadway, New York 10. 108 pages, paper bound. Price $1.35.

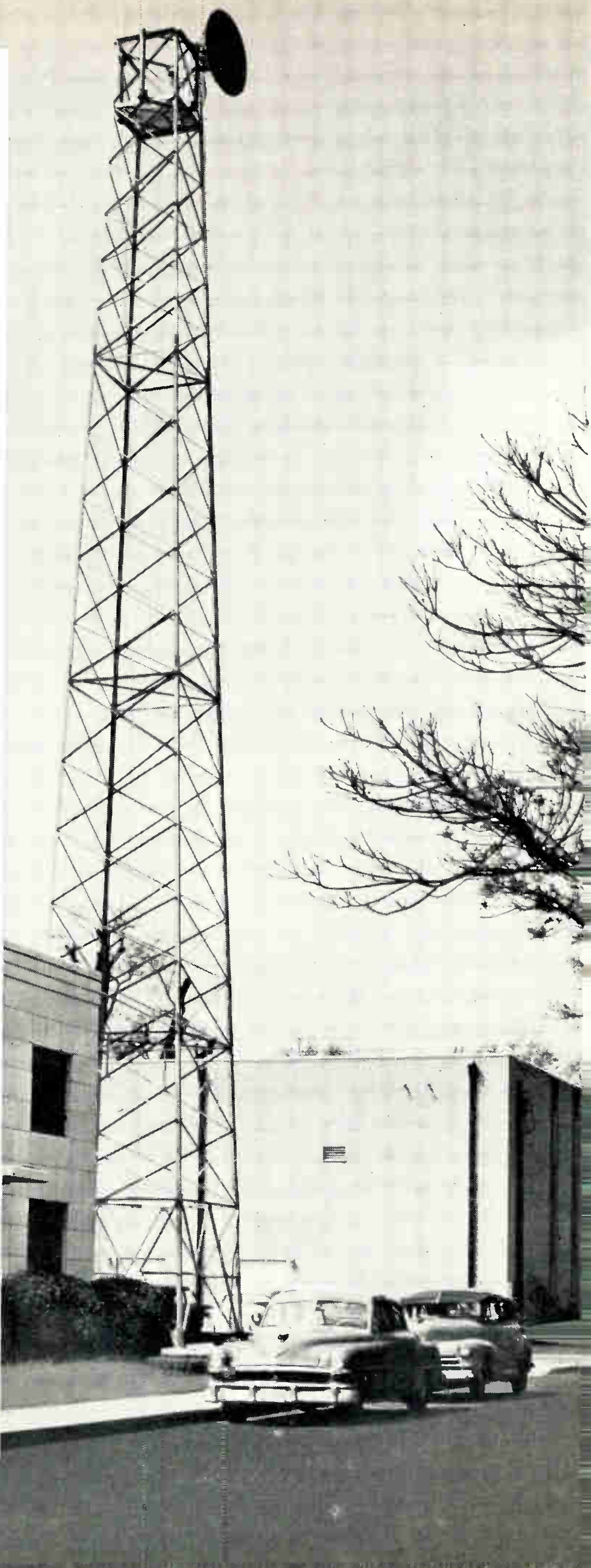
The 7 Old-Fashioned Villains of Tape Recording

...and How **irish** BRAND FERRO-SHEEN Foiled Them All

Once upon a time, 7 Old-Fashioned Villains like this  were wreaking endless woe on Decent People with Tape Recorders. The 1st Villain was Oxenscheid the Oxide Shedder.  He scraped away at the crumbly oxide coating of old-fashioned tape and gummed up tape recorders with the shedding particles. The 2nd Villain was Wearhead the Head Wearer.  He filed down the magnetic heads with the abrasive coating of old-fashioned tape. The 3rd Villain was Frickenshaw the Frequency Discriminator.  He dragged down the high-frequency response of old-fashioned tape through inadequate contact between the "grainy" coating and the head. The 4th Villain was Noysenhiss the Noise Generator. He generated tape hiss and modulation noise  as a result of the random vibrations and irregular flux variations caused by the uneven magnetic coating of old-fashioned tape. The 5th and 6th Villains were Dropofsky the Drop-Out Artist and Pringlethorpe the Print-Through Bug.  They put nodules and agglomerates into the oxide emulsion of old-fashioned coated tape, causing "drop-outs" whenever these trouble spots lost contact with the record or playback head, and inducing "print-through" on the recorded tape when the extra flux at the trouble spots cut through adjacent layers on the reel. The 7th Villain was Brattleby the Embrittler. 

He dried out the plasticizers in old-fashioned coated tape and embrittled irreplaceable recordings. Then: OCTOBER, 1954! That's when a very un-old-fashioned little man by the name of F. R. O'Sheen  announced that he had developed the revolutionary new **irish** FERRO-SHEEN process of tape manufacture and presto!  the 7 Old-Fashioned Villains were sent a-scurrying with cries of "Confound it—Foiled again!" Yes, F. R. O'Sheen had made the new magnetic oxide lamination of **irish** FERRO-SHEEN tape so smooth-surfaced and non-abrasive, so firmly anchored and homogeneously bonded to the base, so free from nodules and agglomerates, that the 7 Villains were evicted—for good! **Moral:** Don't let Old-Fashioned Villains do you out of your hi-fi rights!  Just say "No, thanks" to ordinary coated tape and ask for F. R. O'Sheen **irish** FERRO-SHEEN, that is! ORRadio Industries, Inc., Opelika, Alabama.

Inquiries Invited on
irish
BRAND
FERRO-SHEEN
INSTRUMENTATION
AND
COMPUTER TAPE




FROM "GIANT" 10-INCHERS TO "SUPER-COLOSSAL" 27'S . . . early black-and-white to the latest rainbow colors . . .
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...an internal thermal gradient of 1.2° C/watt or less!

Industry's Highest Power Transistors

Large area, thinness and intimacy of collector contact with large copper base provide the efficient thermal transfer.

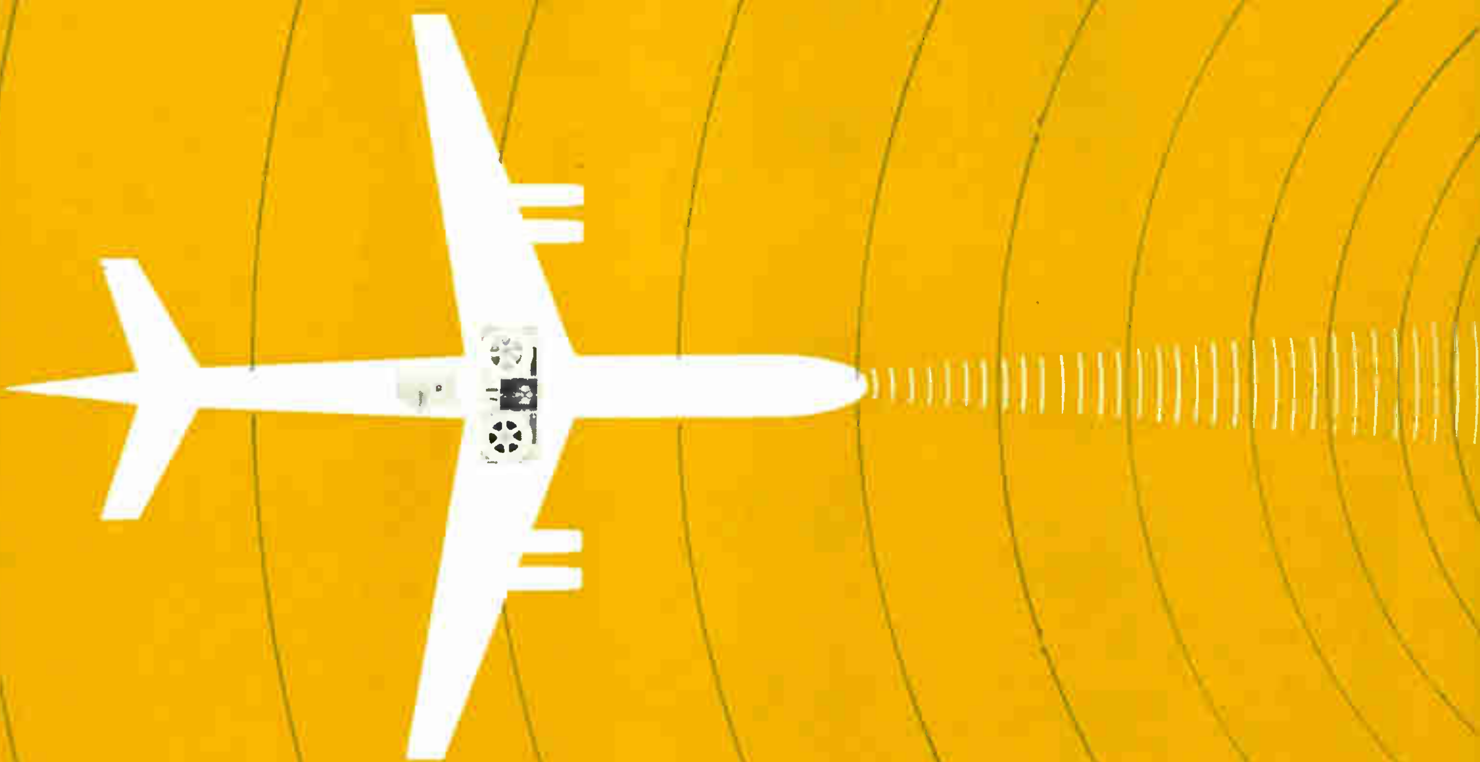
Result—an unusually cool collector junction in the Delco Radio alloy-type germanium PNP power transistor. The Delco Radio 2N173 and 2N174 transistors not only have high power handling ability but also low distortion characteristics. Thus, they are ideal for audio as well as your general power applications.

Furthermore, these transistors are normalized to retain their performance characteristics regardless of age. Write for engineering data. Delco Radio transistors are produced by the thousands every day.

TYPICAL CHARACTERISTICS

	2N173	2N174	
Properties (25°C)	12 Volts	28 Volts	
Maximum current	12	12	amps
Maximum collector voltage	60	80	volts
Saturation voltage (12 amp.)	0.7	0.7	volts
Power gain (Class A, 10 watts)	38	38	db
Alpha cutoff frequency	0.4	0.4	Mc
Power dissipation	55	55	watts
Thermal gradient from junction to mounting base	1.2°	1.2°	°C/watt
Distortion (Class A, 10 watts)	5%	5%	

DELCO RADIO DIVISION OF GENERAL MOTORS
KOKOMO, INDIANA



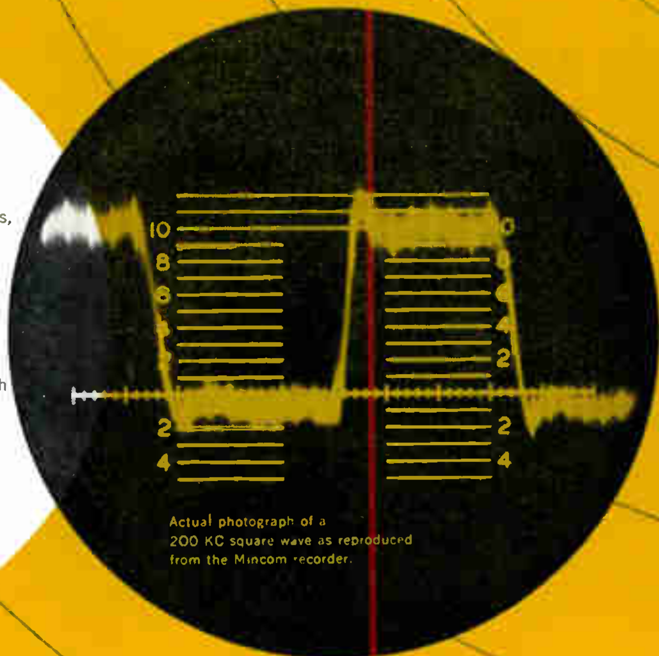
DC to 2,500,000 cycles!

mincom wide band magnetic tape recorder

That's the frequency response, DC to 2,500,000 cycles, delivered by the Mincom, now in operation in all military services, unsurpassed for radar recording, telemetering, TV recording and other ground and airborne applications.

Machines provided for airborne and ground applications meet MIL specifications. Many versions of the recorder can be employed, including 120 IPS speed providing 16 minutes playing time, with response to 1 mc; 60 IPS speed providing 32 minutes playing time with response to 500 KC. Various tracks for separate functions can provide: low frequency recording by FM methods; audio; a speed control reference frequency, and one or more distinct channels of wide-band information. Describe your specific problem. There is a Mincom Tape Recorder to meet your needs.

write for full particulars.



Actual photograph of a 200 KC square wave as reproduced from the Mincom recorder.

typical specifications:

Frequency response: DC to 2.5mc within ±2db
Phase corrected for faithful waveform reproduction
S/N ratio: 30db or better (peak signal to RMS noise)
Running time: 8 minutes
Input levels: 0.1V to 10V P-P
Output levels: 0.1V to 10V P-P
Timing accuracy throughout an 8 min reel 0.005%
7 tracks can be simultaneously recorded on ½" tape

PRODUCT OF 3M RESEARCH

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To qualify, you should have:
1.) An M.S.E.E. degree with a strong leadership in communication engineering;
2.) At least two years of recent experience in the development of pulse in modulated LF, VHF, or UHF receiving and transmitting equipment, or in antenna, propagation, or noise studies.

If you are capable of top performance in both the analytical and experimental aspects of communication development work and can teach and direct other engineers engaged in advanced development activities, you should investigate these career opportunities.

These positions appeal to a communications expert not only because they involve the application of top ability and experience to an important new communications project, but also because of the excellent opportunity to extend and broaden this experience, relating it to digital data processing systems.

Write, giving details of education and experience, to:

D. H. Hammers, Dept. 4601,
International Business Machines Corp.,
Military Products Division,
Kingston, New York

DATA PROCESSING
ELECTRIC TYPEWRITERS
TIME EQUIPMENT
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IBM® MILITARY PRODUCTS

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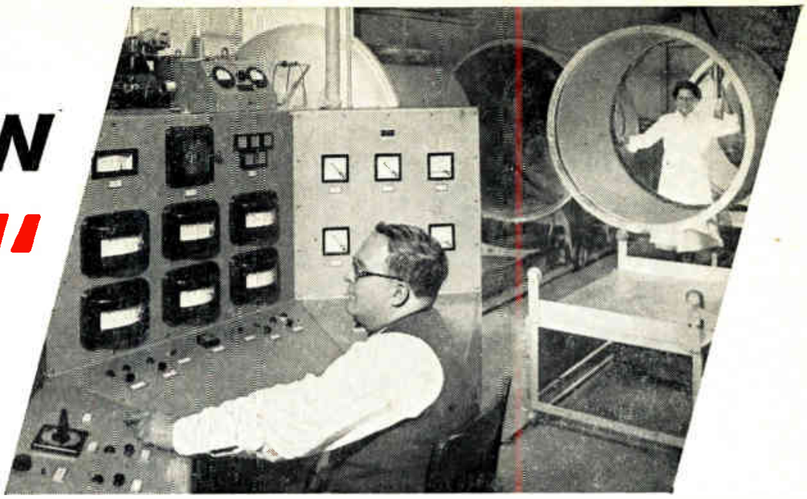
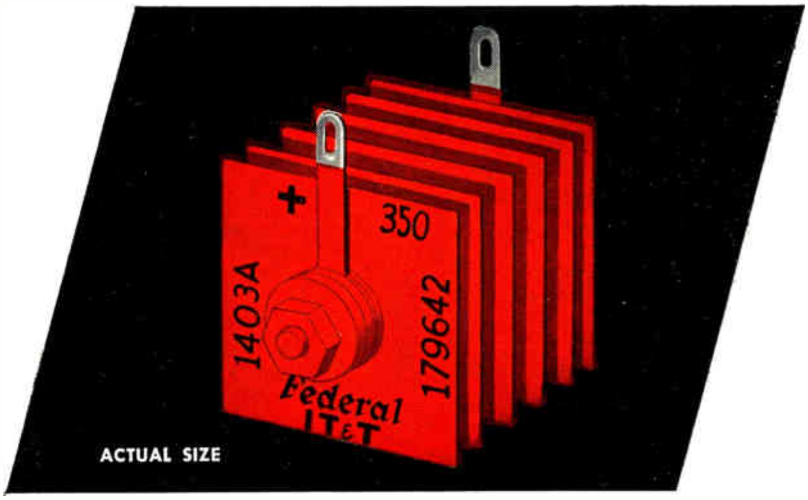
Federal's NEW "V-M-D" PROCESS



produces HI-DENSITY Selenium Rectifiers with 3 MAJOR SAVINGS...



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...more than **42%**

WEIGHT
...averaging **23%**

COST
...as much as **24%**

"V-M-D" (Vacuum Multiple Deposition) is the unique process developed by Federal for the controlled application of the selenium and counterelectrode to the aluminum base plate. "V-M-D" cells are remarkable for their lower voltage drop, longer life, greater uniformity and higher temperature and voltage ratings.

One of the many new products made possible by this exclusive process is the Federal *Hi-Density* Radio-TV Rectifier. These miniature, low cost Hi-Density Seleniums rectify *twice* as much power as equivalent-sized rectifiers of other make. They are being produced in ratings of 150 to 500 ma. and are backed by two years of laboratory testing and more than a year's success in the replacement field. They are now available in volume to the electronics industry. Other products also possible with the "V-M-D" process are:

45-Volt-Cell Rectifiers • 150°C. Hi-Temperature Rectifiers
40,000-Hour Rectifiers • Hi-Density Industrial Rectifiers

For more information about any of these new products write to Dept. F-266

FEDERAL'S NEW "V-M-D" CELLS HAVE 4 EXCEPTIONAL CHARACTERISTICS...

- **Longer life... 40,000 hours and more.**
- **Higher temperature ratings... up to 150° C. ambient.**
- **Higher voltage ratings... up to 45V RMS.**
- **Higher efficiency... 25% lower forward losses.**

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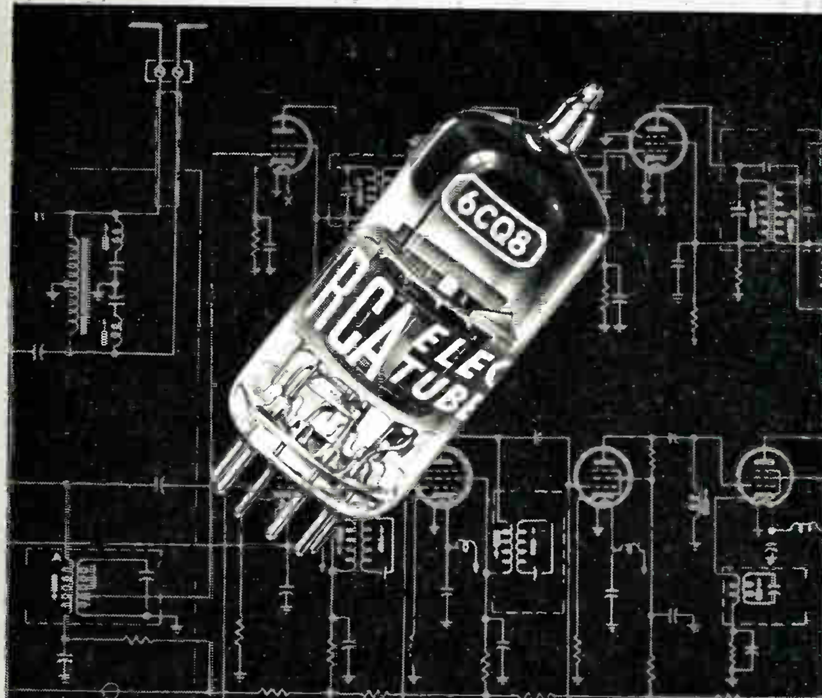
A Division of INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
COMPONENTS DIVISION • 100 KINGSLAND ROAD • CLIFTON, N. J.

In Canada: Standard Telephones and Cables Mfg. Co. (Canada) Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., New York

Federal
FEDERAL TELEPHONE & RADIO FTR
A DIVISION OF IT&T

For product information, use inquiry card on page 123.

DATA FOR



NEW MINIATURE TRIODE-TETRODE

RCA-6CQ8...enables flexibility in circuit design for VHF and combination VHF-UHF TV tuners!

Containing a medium-mu triode and a sharp-cutoff tetrode—with an internal shield to prevent electrical coupling between the two units—RCA-6CQ8 may be used in a combination of applications in color, and black-and-white TV receiver designs. It is especially useful as a combined oscillator and mixer tube in tuners of receivers utilizing an intermediate frequency of 40 Mc. The triode unit is also useful as an rf amplifier, phase splitter, sync clipper and sync separator. The tetrode unit is also useful as a sound or video-if amplifier tube.

The tetrode unit features a plate-current characteristic with a sharp knee. This enables mixer operation with good linearity at relatively low plate voltages. Low grid #1-to-plate capacitance minimizes feedback problems; low output capacitance permits the use of a high-impedance plate circuit with resultant increase in mixer gain.

Additional features of special interest to designers are: separate cathodes—adding to circuit design flexibility, and 450-milliampere heater with controlled warm-up time for series-string circuits. Write for technical data.

17 NEW TUBES FOR SERIES-STRING TV DESIGNS

RCA now offers a comprehensive line of tube types especially useful in TV receivers utilizing 450-milliampere series-heater strings. The heaters all have 11-second warm-up time to minimize voltage unbalance during starting. All types have heater-cathode voltage ratings sufficiently high to insure dependable performance in series-string circuitry.

4AU6	6AM8-A	6CQ8	8CG7
4CB6	6AQ5-A	6CZ5	8CM7
4DT6	6AT8-A	6U8-A	17AX4-GT
5BQ7-A	6CG8-A	8AW8-A	17BQ6-GTB
			17DQ6-A

Chart listing these types, their prototypes, and heater-cathode voltage ratings available on request.

DEFLECTION-AMPLIFIER TUBES FOR 110° SYSTEMS

RCA-6CZ5 for vertical deflection; RCA-6DQ6-A and -12DQ6-A for horizontal deflection...these types are beam-power tubes for service in TV receiver designs utilizing the new short picture tubes having diagonal-deflection angles of 110°. Internal structures are designed to provide for maximum distribution of heat in order to prevent "hot spots" on the plates and to allow "cooler" operation of the grids—resulting in long life. RCA-6CZ5 has a 6.3-volt, 0.45-ampere heater; RCA-6DQ6-A, a 6.3-volt, 1.2-ampere heater; and RCA-12DQ6-A, a 12.6-volt, 0.6-ampere heater. The heaters of these types have the same controlled warm-up time to minimize voltage unbalance during starting in series-string TV applications.

New AF TRANSISTOR PROVIDES HIGH POWER GAIN AT LOW DISTORTION AND WITH HIGH EFFICIENCY

RCA-2N270...an hermetically sealed, alloy-junction transistor of the germanium p-n-p type...is designed especially for use in large-signal audio-frequency circuit applications in home-entertainment radio sets, phonographs, and battery-operated communications equipment. In class A service, one RCA-2N270 can deliver a maximum-signal power output of approximately 60 milliwatts with a power gain of 35 db. In push-pull class B service, two 2N270's can deliver a maximum-signal power output of approximately 500 milliwatts with a power gain of 32 db. Low collector saturation current permits design of af amplifiers which can operate under varying ambient temperature conditions and, at the same time, provides both high efficiency and a high degree of operating stability. Current transfer ratio of 2N270 is nearly constant over the full range of the output-signal swing, even when the peak output-signal current reaches the peak collector current rating. This feature minimizes distortion at high power outputs when low supply voltages are used.

Sizes and Types for every Fuse need

you'll quickly find the right fuse for the job
–in the complete BUSS fuse line!

Standard type, dual-element (slow-blowing), renewable and one-time type fuses are all available from one source —BUSS. You'll save time and trouble by turning first to BUSS when you need fuses.

And of great importance, there are no 'kicks' or complaints from your customers about the operation of BUSS fuses—for to assure dependable protection under all service conditions, BUSS fuses are tested in a sensitive electronic device. Any fuse not correctly calibrated, properly constructed and right in all physical dimensions is automatically rejected.

Save engineering time on special problems in electrical protection. The BUSS fuse engineers are at your service to help you determine the fuse or fuse mounting best suited to your needs. If possible, they will suggest a fuse or fuse mounting already available in local wholesalers' stocks, so that your device can be easily serviced.

For more information on BUSS and FUSETRON Small Dimension fuses and fuseholders . . . Write for bulletin TT, Bussmann Mfg. Co. (Div. of McGraw Electric Co.), University at Jefferson, St. Louis 7, Mo.

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

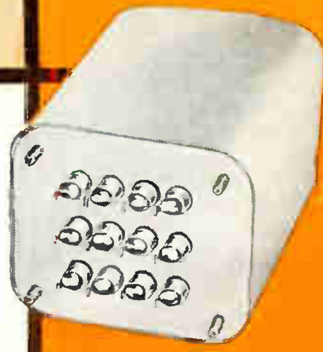
FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

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

157

NEW HERMETIC POWER COMPONENTS

HIGHEST RELIABILITY FOR MILITARY AND INDUSTRIAL USE



Listed below are just a few of the 50 new **stock items** in the United hermetic power series. These MIL-T-27A power components add to the 200 other hermetic stock items of filter, audio, and magnetic amplifier types. Through the use of proven new materials and design concepts, an unparalleled degree of life and reliability has been attained, considerably exceeding MIL-T-27A requirements. Test proved ratings are provided, not only for military applications but for **industrial, broadcast, and test equipment service (55°C. ambient).**

For complete listing of these new items, write for Catalogue #56.

MIL-T-27A RATINGS IN REGULAR TYPE — **INDUSTRIAL RATINGS IN BOLD TYPE**

TYPICAL POWER TRANSFORMERS, PRI: 115V., 50-60 cycles.

Type No	HV Sec. C.T.	Approx* DC volts	DC MA	Fil. Wdg.	**Approx* DC volts**	**MA DC**	**Fil. Wdg.**	MIL Case
H-81	500 550	L 180 C 265 L 200 C 300	65 55 60 50	6.3VCT-3A 5V-2A	**L 170 C 240 L 190 C 280**	**75 65 70 60**	**6.3VCT-3A 5V-2A**	HA
H-84	700 750	L 255 C 400 L 275 C 420	170 110 160 105	6.3V-5A 6.3V-1A 5V-3A	**L 240 C 360 L 260 C 380**	**210 150 200 140**	**6.3V-6A 6.3V-1.5A 5V-4A**	KA
H-87	730 800	L 245 C 390 L 275 C 440	320 210 300 200	6.3V-6A 6.3V-2A 5V-4A	**L 210 C 350 L 245 C 400**	**420 310 400 300**	**6.3V-6A 6.3V-2A 5V-4A**	NB
H-93	1000 1200	L 370 L 465	280 250	6.3V-8A 6.3V-4A 5V-6A	**L 340 L 455**	**340 300**	**6.3V-10A 6.3V-5A 5V-6A**	OA

*After appropriate H series choke. L ratings are choke input filter, C ratings are condenser input.

United "H" series power transformers are available in types suited to every electronic application. Proven ratings are listed for both high voltage outputs . . . condenser and choke input filter circuits . . . military and **industrial** applications.

United "H" series filter reactors are extremely flexible in design and rating. Listings show actual inductance at four different values of DC. Bold type listings are industrial application maximums.

A FEW TYPICAL LISTINGS OF FILTER REACTORS.

Type No.	Ind. Hys.	MA DC	Ind Hys	MA DC	Ind. Hys.	MA DC	Ind. Hys.	MA DC	Res. Ohms	Max. DCV* Ch. Input	Test V. RMS	MIL Case
H-71	20	40	18.5	50	15.5	60	**10**	**70**	350	500	2500	FB
H-73	11	100	9.5	125	7.5	150	**5.5**	**175**	150	700	2500	HB
H-75	11	200	10	230	8.5	250	**6.5**	**300**	90	700	2500	KB
H-77	10	300	9	350	8	390	**6.5**	**435**	60	2000	5500	MB
H-79	7	800	6.5	900	6	1000	**5.5**	**1250**	20	3000	9000	9x7x8

*Based on maximum ripple voltage across choke in choke input filter circuit, in terms of DC output voltage.

TYPICAL FILAMENT TRANSFORMERS, PRI: 105/115/210/220V., 50-60 cycles.

Type No.	Sec. Volts	Amps. (MIL)	**Amps. (Ind)**	Test Volts RMS	MIL Case
H-121	2.5	10	**12**	10000	JB
H-124	5	3	**3**	2000	FB
H-127	5	20	**30**	21000	NA
H-131	6.3CT	2	**2.5**	2500	FB
H-132	6.3CT 6.3CT	6 6	**7 7**	2500	JA
H-136	14, 12, 11CT	10	**14**	2500	LA

United "H" series filament transformers have multi-tapped primaries, good regulation, and are rated for **industrial** as well as military service.

United "H" series plate transformers incorporate dual high voltage ratings and tapped primaries to provide versatile units for a wide range of military and industrial electronic applications. Large units have terminals opposite mounting for typical transmitter use.

TYPICAL PLATE TRANSFORMERS, PRI: 105/115/210/220V., 50-60 cycles.

No. Type	Sec. V. C.T.	Approx.* DC volts	MA DC	Choke No.	**MA DC**	**Choke No.**	Case
H-110	1050 1200	380 465	275 250	H-75 H-75	**385 350**	**H-77 H-77**	MB
H-113	2500 3000	1050 1275	280 250	H-77 H-76	**340 300**	**H-77 H-76**	5¼ x 6 x 7
H-115	3500 4400	1500 1900	265 225	H-77 H-77	**350 300**	**H-77 H-77**	8¾ x 6½ x 8
H-117	5000 6000	2125 2550	900 800	H-79 H-79	**1100 1000**	**H-79 H-79**	13½ x 11 x 14½

*After filter choke. All ratings are for choke input filter.

UNITED TRANSFORMER CO.

150 Varick Street, New York 13, N. Y. • EXPORT DIVISION: 13 E. 40th St., New York 16, N. Y. CABLES: "ARLAB"

PACIFIC MFG. DIVISION: 4008 W. Jefferson Blvd., Los Angeles, Cal.

Letters
to the Editor

"Battery Protective Switch"

Editors, ELECTRONIC INDUSTRIES:

The article in the August 1956 issue, in your "Cues For Broadcasters," entitled "Battery Protective Switch," has definite merit as it is good engineering practice to protect batteries from being discharged and could be of value with remote amplifiers of other makes than the Collins 12Z.

Our station has a supply of Collins 12Z Remote Amplifiers and it is impossible to put the cover on without shutting off the "Battery" power.

According to the instruction booklet dated November 1, 1952 for the 12Z-2 and the 12Z-3 put out by Collins, the explanation for the "Battery" shut off when the cover is replaced is that the spring loaded Dzus fastener which secures the front cover also trips an interlock, thereby cutting off the Battery "A" supply.

This switch (labeled S 106) is located just beneath the Program Monitor jack. It is mechanically linked to the Dzus fastener spring. The switch is readily accessible by removing the AC power supply. It's possible that the cut off switch has shifted it's position which can be remedied.

The "A" battery is cut off by this switch but the "B" supply is not. Tracing the circuit through it will be noticed that there is a two-megohm resistor from the "B" bus to ground. As the "B" batteries are rated at 80 continuous hours while drawing 12 ma, the drain through the two megohm bleeder is in the order of 60 μ amps. With a drain of that sort the battery should be good for "Shelf Life."

Bert Greenberg
Engineering Dept.
Radio Station WNYC
New York 7, N. Y.

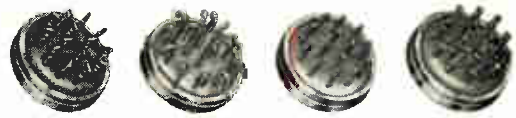
"Phase Shift Network"

Editors, ELECTRONIC INDUSTRIES:

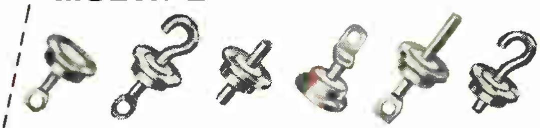
This letter is in reference to the article, "A Less-Than-Minimum Phase Shift Network," by R. F. Destebelle, C. J. Savant, and C. J. Savant, Jr., published in the September 1956 issue of ELECTRONIC INDUSTRIES & TELE-TECH.

I have read the article with interest and wish to point out that the demodulator has at least a half-cycle carrier frequency delay. This gives rise to a lagging phase shift which is linear with modulating frequency and must be taken into account if the carrier frequency is of the order of 60 cycles.

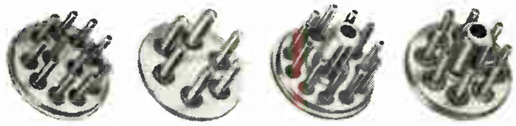
Leon Horowitz
Electronics Engineer
Ahrendt Instrument Co.
4910 Calvert Rd.,
College Park, Md.



• MULTIPLE HEADERS

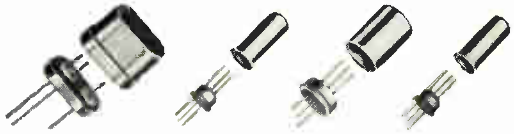


• SINGLE LEAD TERMINALS



• PLUG-IN CONNECTORS

• COMPONENT END SEALS



• TRANSISTOR CLOSURES

• CUSTOM TERMINATIONS

E-I

Specified industry-wide for DEPENDABILITY PLUS!

COMPRESSION TERMINATIONS*

Hermetically Sealed miniature, sub-miniature or standard E-I terminals are specified for performance *plus* in military and commercial service. These dependable compression seals perform successfully under the most gruelling conditions . . . offer maximum immunity to shock, vibration and wide variations of temperature and pressures. Check your sealed terminal requirements with E-I — recommendations will be made on your specific applications without obligation.

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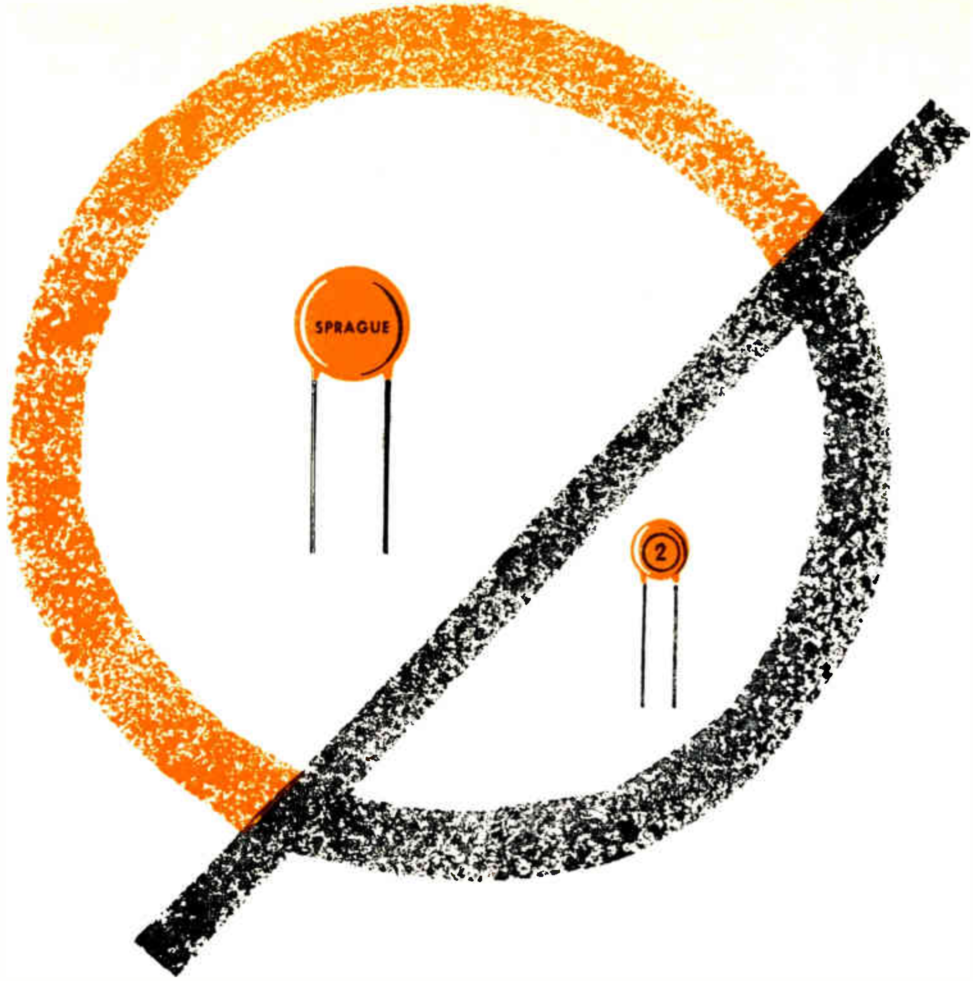

miniaturized CERA-MITE* capacitors for transistor radios

TRIED AND PROVEN in thousands of transistor radios, Sprague's miniaturized line of Cera-Mite* disc capacitors is building an enviable record of trouble-free service in the field.

Mass production of a standardized line of the five popular capacitance values in the new smaller 50 volt d-c sizes assures continued high quality.

Two widely separated plants, one at Nashua, New Hampshire, and another at Grafton, Wisconsin, assure our customers of a dependable source of supply to meet production schedules.

Complete technical data on Cera-Mite capacitors for transistor applications is given in Engineering Data Sheet 6121. Write (on your business letterhead, please) for your copy to the Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Mass.

• • •

Sprague on request will provide you with complete application engineering service for optimum results in the use of ceramic capacitors.

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 For product information, use inquiry card on page 123.

ELECTRONIC INDUSTRIES
& TELE-TECH

M. CLEMENTS, Publisher ★ O. H. CALDWELL, Editorial Consultant ★ B. F. OSBAHR, Editor

WHAT'S AHEAD FOR '57

In 1957 the Electronic Industries are expected to increase their annual dollar volume by more than 10% over this year's estimated $10.5 billion figure. The principal contributing segments are: Consumer goods manufacture (Radio, Television, Hi Fi) $5.5 billion; Military electronic equipment $3.9 billion; Industrial electronic equipment $1 billion; Commercial communication equipment $150 million. At year's end the present number of about 4500 electronic manufacturers should swell to more than 5000.

RADIO AND TELEVISION

Black and white television sales are expected to continue at approximately the same level as in 1956 with 7,000,000 sets to be produced The market will be primarily for the 2nd or 3rd set in the home. Thus the accentuation will again be toward portable designs which this year will undoubtedly be using picture tubes with 110° deflection. Further shrinking in the number of television receiver manufacturers can be expected. This in turn may lead to some price stabilization. The continuance of short profit margins on black-and-white receivers, however, may force remaining manufacturers to seek new sources of revenue. In this case, color-TV may get long-awaited sparking. By year's end completely transistorized printed circuit TV designs should be announced but production will probably not take place until 1958. Color-TV sales in 1957 are expected to be 250,000.

Radio sets sales are also expected to continue at a high level with some 13,000,000 units expected in 1957. Portable radio and automobile set sales may be up as much as 25%. Portable set sales will be mostly for completely transistorized units. Completely transistorized automobile sets can be expected before the end of the year.

SEMI-CONDUCTORS

Transistor production in 1957 will nearly double the 11.5 million units produced in 1956. 95% of the production will be in germanium, 5% in silicon. Automobile radios are expected to utilize approximately 20% of the production, home radios and electronic devices about 50%. Industrial electronic equipment will also account for 20% while military applications may still be confined to about 10%. Power transistor types will account for approximately 20% of production; high frequency transistor types 45%; transistors for high temperature applications 5%; special transistors 10%; all others 20%. New technological breakthroughs are on the horizon and these, coupled with production know-how, should rapidly reduce unit costs.

MILITARY

Military expenditures for electronic equipment are again on the upswing. Anticipated purchasing during 1957 should amount to approximately $3.9 billion. This breaks down as follows: U. S. Army (Signal Corps) $300 million. U. S. Navy (BuShips) $600 million. (BuAir) $500 million. U. S. Air Force $2 billion with heavy expenditures for guided missiles (see p. 54). Miscellaneous government expenditures $200 million.

Because of the unattractive return on R&D-only type contracts, most manufacturers will confine bidding to contracts that offer some production along with the R&D. Under the Weapons Systems concept, the airframe manufacturers become the prime contractors and well-established electronic manufacturers frequently become subcontractors. Many assignments at the subcontracting level, however, involve specialties which the larger electronic manufacturers have customarily farmed out to smaller organizations. Thus, these organizations now offer stiff competition because they too can deal directly with the prime contractor. In 1957, therefore, smaller electronic producers of specialty items can be expected to become stronger.

MANPOWER

Electronic Engineers will continue in short supply throughout the coming year. Manufacturers may encounter added difficulties under a new military ruling which requires each contractor to stipulate that he will not hire away engineers employed on any other government contract. The movement to import engineering talent from foreign countries will probably continue, but there are difficulties in obtaining security clearances for aliens. In-plant engineering training courses to upgrade technicians will probably be intensified. Some activity in Federal support of school programs can be expected. Engineers-in-industry will be taking more positive steps in their respective cities to try to guide youngsters into scientific and engineering careers.

1956-1957 Statistics of the

1957 ELECTRONIC MARKETS

Consumer Goods	$5,500,000,000
Military & Government	3,900,000,000
Industrial	1,000,000,000
Commercial Communications	150,000,000
	$10,550,000,000

RADIO AND TV SETS IN U. S.

January 1, 1957	Radio	TV
United States homes* with	53,000,000	35,200,000
Secondary sets in above homes	41,500,000	4,000,000
Sets in business places, institutions	12,000,000	3,000,000
Auto sets	37,000,000	
TOTAL	143,500,000	42,200,000
Total Radio-TV Sets in U. S.	185,700,000	

*Note: Figure on "homes" includes every dwelling unit, whether individual or family, and includes permanent residents in hotels, apartment-hotels and apartment houses.

ANNUAL BILL OF U. S. FOR RADIO-TV 1956

Sale of Time By Broadcasters	$1,936,000,000
Electricity, Batteries, etc., to operate 185,700,000 Radio & TV Receivers	784,000,000
14,400,000 Radio Sets, at Retail Value	558,000,000
7,500,000 Television Sets, at Retail Value	1,237,600,000
Phono Records, 275,000,00 at Retail Value	350,000,000
Radio-TV Servicing and Installation: (Retail Value)	
176 Million Replacement Receiving Tubes	310,000,000
3.3 Million Replacement TV Picture Tubes	130,000,000
Radio-TV Component Parts, Antennas, Accessories	695,000,000
Labor	960,000,000
TOTAL	6,960,000,000

PRODUCTION OF CIVILIAN RADIO SETS—1922 TO 1956

	Total Civilian Radio Sets Manufactured		Total Civilian Tubes* Manufactured		Automobile Sets Manufactured		Auto Sets in Use	Homes with Radio Sets	Total Radio Sets in Use in U. S.	
	Number	Retail Value	Number	Retail Value	Number	Retail Value	Number	Number	Number	
1922	100,000	$ 5,000,000	1,000,000	$ 6,000,000	....	....	....	260,000	400,000	1922
1923	550,000	30,000,000	4,500,000	12,000,000	....	....	....	1,000,000	1,100,000	1923
1924	1,500,000	100,000,000	12,000,000	36,000,000	....	....	....	2,500,000	3,000,000	1924
1925	2,000,000	165,000,000	20,000,000	48,000,000	....	....	....	3,500,000	4,000,000	1925
1926	1,750,000	200,000,000	30,000,000	58,000,000	....	....	....	5,000,000	5,700,000	1926
1927	1,350,000	168,000,000	41,200,000	67,300,000	....	....	....	6,500,000	7,000,000	1927
1928	3,281,000	400,000,000	50,200,000	110,250,000	....	....	....	7,500,000	8,500,000	1928
1929	4,428,000	600,000,000	69,000,000	172,500,000	....	....	....	9,000,000	10,500,000	1929
1930	3,827,000	300,000,000	52,000,000	119,600,000	34,000	$ 3,000,000	....	12,048,762	13,000,000	1930
1931	3,420,000	225,000,000	53,000,000	69,550,000	108,009	5,940,000	100,000	14,000,000	15,000,000	1931
1932	3,000,000	140,000,000	44,300,000	48,730,000	143,000	7,150,000	250,000	16,809,562	18,000,000	1932
1933	3,806,000	180,500,000	59,000,000	49,000,000	724,000	28,598,000	500,000	20,402,369	22,000,000	1933
1934	4,084,000	214,500,000	58,000,000	36,600,000	780,000	28,000,000	1,250,000	21,456,000	26,000,000	1934
1935	6,026,800	330,192,480	71,000,000	50,000,000	1,125,000	54,562,500	2,000,000	22,869,000	30,500,000	1935
1936	8,248,000	450,000,000	98,000,000	69,000,000	1,412,000	69,188,000	3,500,000	24,600,000	33,000,000	1936
1937	8,064,780	450,000,000	91,000,000	85,000,000	1,750,000	87,500,000	5,000,000	26,666,500	37,600,000	1937
1938	6,000,000	210,000,000	75,000,000	93,000,000	800,000	32,000,000	6,000,000	28,000,000	40,800,000	1938
1939	10,500,000	354,000,000	91,000,000	114,000,000	1,200,000	48,000,000	6,500,000	28,700,000	45,300,000	1939
1940	11,800,000	450,000,000	115,000,000	115,000,000	1,700,000	60,000,000	7,500,000	29,200,000	51,000,000	1940
1941	13,000,000	460,000,000	130,000,000	143,000,000	2,000,000	70,000,000	8,750,000	29,700,000	56,000,000	1941
1942	4,400,000	154,000,000	87,700,000	94,000,000	350,000	12,250,000	9,000,000	30,800,000	59,340,000	1942
1943	....	....	17,000,000	19,000,000	....	....	8,000,000	32,000,000	58,000,000	1943
1944	....	....	22,000,000	25,000,000	....	....	7,000,000	33,000,000	57,000,000	1944
1945	500,000	20,000,000	30,000,000	35,000,000	....	....	6,000,000	34,000,000	56,000,000	1945
1946	14,000,000	700,000,000	190,000,000	200,000,000	1,200,000	72,000,000	7,000,000	35,000,000	60,000,000	1946
1947	17,000,000	800,000,000	220,000,000	260,000,000	2,500,000	150,000,000	9,000,000	37,000,000	66,000,000	1947
1948	14,000,000	600,000,000	200,000,000	230,000,000	2,800,000	200,000,000	11,000,000	40,000,000	74,000,000	1948
1949	10,000,000	500,000,000	190,000,000	350,000,000	3,500,000	240,000,000	14,000,000	42,000,000	81,000,000	1949
1950	14,600,000	721,000,000	383,000,000	644,000,000	4,760,000	248,000,000	17,000,000	45,000,000	90,000,000	1950
1951	13,000,000	605,000,000	430,000,000	640,000,000	4,800,000	255,000,000	20,000,000	45,850,000	100,000,000	1951
1952	10,000,000	500,000,000	330,000,000	740,000,000	2,750,000	148,000,000	25,000,000	46,000,000	114,500,000	1952
1953	13,400,000	536,000,000	410,000,000	920,000,000	4,800,000	250,000,000	29,000,000	48,000,000	120,500,000	1953
1954	10,000,000	400,000,000	400,000,000	880,000,000	4,300,000	220,000,000	32,000,000	50,000,000	127,000,000	1954
1955	12,500,000	485,000,000	500,000,000	890,000,000	5,500,000	276,000,000	35,700,000	52,000,000	138,700,000	1955
1956	14,400,000†	558,000,000	600,000,000	1,170,000,000	6,000,000	310,000,000	37,500,000	53,200,000	143,500,000	1956

* Tubes used as replacements accounted for about 35% of total in 1956.
† Estimated retail sales, including carryovers.

PRODUCTION OF PRINCIPAL COMPONENTS USED IN RADIO-TV RECEIVERS

Year	Trans-formers (Iron Core)	Coils	Capacitors (Electrolytic)	Capacitors (Mica)	Capacitors (Ceramic)	Capacitors (Paper)	Resistors (Composition)	Resistors (Wire Wound)	Loud-speakers	Year
1946	49	149	22	69	284	155	477	29	14	1946
1947	70	193	27	84	349	196	608	37	17	1947
1948	46	250	28	86	357	212	654	42	17	1948
1949	39	196	25	74	310	218	670	50	13	1949
1950	65	332	44	106	417	351	1090	70	22	1950
1951	47	288	38	90	394	284	862	59	19	1951
1952	56	305	42	100	433	312	948	67	17	1952
1953	63	323	43	103	455	325	900	69	21	1953
1954	54	276	37	88	390	278	770	59	18	1954
1955	50	274	51	86	378	338	852	41	24	1955
1956	43	283	45	88	423	369	963	35	25	1956

Figures are in millions of units.

Radio-TV Electronic Industries

VITAL TELEVISION STATISTICS 1946-1956

	Total TV Sets Manufactured		Receiving Tubes Used in New TV Sets and for Replacements		Total TV Picture Tubes Manufactured		Total Receiving Sets Manufactured	TV Stations on the Air	Total TV Sets in Use in U. S.	At Close of
	Number	Retail Value	Number	Retail Value	Number	Retail Value	AM-FM-TV			
1946	10,000	$ 5,000,000	350,000	$ 588,000	20,000	$ 1,000,000	14,010,000	5	8,000	1946
1947	250,000	100,000,000	8,500,000	15,000,000	300,000	15,000,000	17,250,000	20	230,000	1947
1948	1,000,000	350,000,000	32,200,000	53,000,000	1,500,000	75,000,000	17,000,000	44	1,000,000	1948
1949	3,000,000	950,000,000	87,000,000	146,000,000	3,500,000	210,000,000	13,000,000	100	3,800,000	1949
1950	7,500,000	2,700,000,000	225,000,000	378,000,000	8,000,000	400,000,000	22,100,000	107	10,500,000	1950
1951	5,600,000	2,100,000,000	161,000,000	270,000,000	6,000,000	300,000,000	19,100,000	108	15,750,000	1951
1952	6,300,000	2,360,000,000	168,000,000	380,000,000	6,500,000	260,000,000	16,300,000	123	21,800,000	1952
1953	7,300,000	1,675,000,000	210,000,000	400,000,000	9,000,000	360,000,000	20,700,000	350	28,000,000	1953
1954	7,300,000	1,278,000,000	215,200,000	409,000,000	10,300,000	360,500,000	17,700,000	415	33,000,000	1954
1955	7,800,000	1,263,600,000	220,000,000	407,000,000	10,600,000	371,000,000	20,000,000	457	39,400,000	1955
1956	7,500,000*	1,237,500,000	200,000,000	400,000,000	11,000,000	318,000,000	21,900,000	491	42,300,000	1956

* Estimated retail sales including carryovers.

Broadcast Stations in U. S.

	AM	FM	TV
Stations on Air...	2935	488	395 VHF 96 UHF
Under Construction (CPs).....	156	67	44 VHF 114 UHF
Applications......	270	10	107 VHF 28 UHF

SERVICE

During 1956 the annual retail bill for servicing of home electronic appliances is summarized:

176,000,000 replacement receiving tubes	$ 310,000,000
3,300,000 replacement picture tubes....	$ 130,000,000
Antennas, components, parts, instruments	$ 695,000,000
Labor	$ 960,000,000
Total servicing bill.......	$2,100,000,000

Recorders
(non-commercial)

Estimated 1957 tape recorder sales in new units and retail $ volume

Year	Units	Retail $ volume
1955	325,000	$48,750,000
1956	425,000	$63,750,000
1957	475,000	$95,000,000

Phonographs

Estimated 1957 sales of phono players in new units and retail $ volume

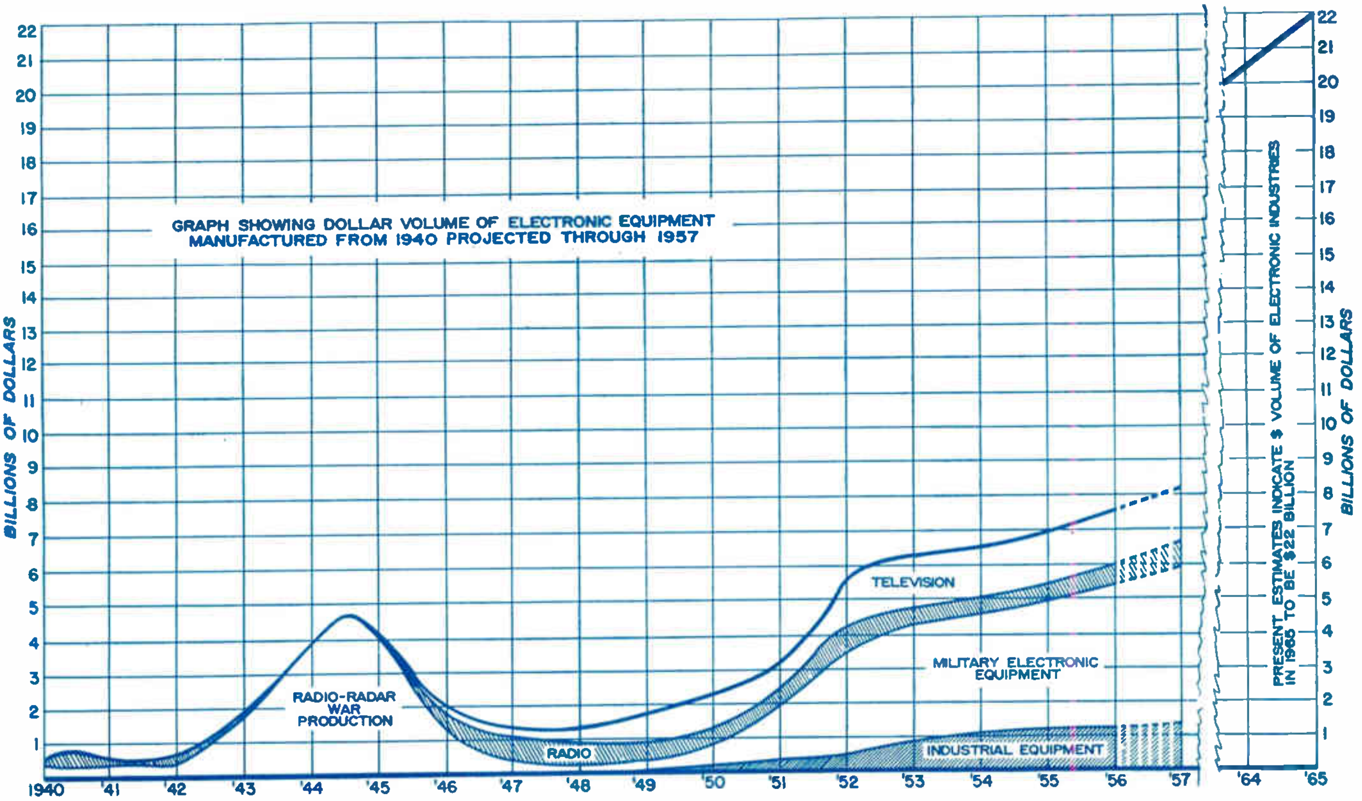
Year	Units	Retail $ volume
1955	4,000,000	$120,000,000
1956	4,150,000	$124,500,000
1957	4,250,000	$127,500,000

ENGINEERING MANPOWER 1956-57

Engineering Curriculum	No. of Bachelors Degrees Est. for 1955-56	Est. for 1956-57
Aeronautical	900	1,100
Ceramic	150	150
Chemical	2,800	3,300
Civil	5,050	6,000
Electrical	6,350	7,750
Eng'g. Physics	300	350
General Eng'g.	750	950
Industrial	1,600	2,000
Mechanical	7,500	8,900
Metallurgical	600	750
Other	2,750	3,150
TOTAL	28,750	34,400

From the Engineering Manpower Commission of Engineers Joint Council.

GRAPH BELOW illustrates principal manufacturing segments in the electronic industries. Other activities swell annual dollar volume to more than 10.5 billion dollars.



1956-1957 Industry Statistics (continued)

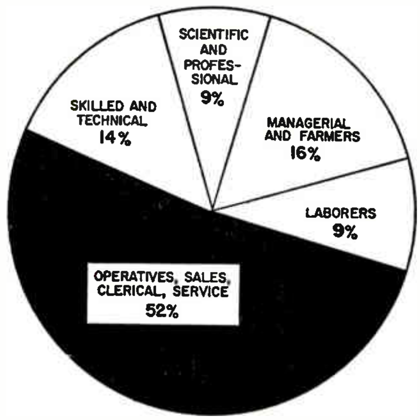
Military Expenditures for Aircraft, Missiles, Electronics (000,000)

	1955 Avail. Oblig.	1955 Exp.	1956 Avail. Oblig.	1956 Exp.	1957 Avail. Oblig.	1957 Exp.
USAF						
Aircraft	$2,480	$6,295	$5,476	$5,216	$3,826	$5,041
Missiles	219	305	700	485	1,422	799
Electronics	309	450	197	494	818	511
Navy						
Aircraft	$1,918	$1,676	$ 761	$1,561	$1,489	$1,600
Missiles	126	176	238	172	354	177
Electronics	96	159	151	82	191	104
Army						
Aircraft	....	$ 67	....	$ 103	....	$ 110
Missiles	....	150	....	260	....	300
Electronics	....	28	....	95	....	130
Total Defense Dept.						
Aircraft	$4,398	$8,038	$6,237	$6,880	$5,315	$6,751
Missiles	345	569	938	917	1,776	1,276
Electronics	414	637	347	671	1,009	745

Military Electronics ($ billions)

	Total Defense	% Govt. Electronics	Value-Mil. Electronics
1955	$33.2	7.4%	$2.5
1960	$37.0	8.8%	$3.3
1965	$40.1	9.9%	$4.0

THE NATION'S WORK FORCE



From "The Skilled Work Force of the United States."—U. S. Dept. of Labor.

Projections of Bachelor Degrees in Electrical Engineering

Year	All Eng'g Degrees	Electrical Degrees	Year	All Eng'g Degrees	Electrical Degrees
1956	28,000	6,600	1961	39,000	8,750
1957	30,000	7,600	1962	39,000	8,750
1958	37,000	8,300	1963	40,000	9,000
1959	37,000	8,300	1964	43,000	9,700
1960	38,000	8,500	1965	43,000	9,700

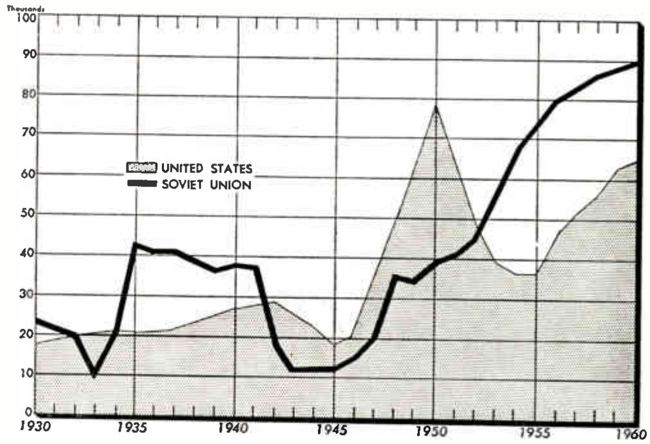
GRAPH BELOW shows graduates per year in the Physical Sciences and Engineering for the United States and the Soviet Union —*"Scientific Manpower Resources of the USSR," a speech by Dr. Herbert Scoville, Asst. Director, Central Intelligence Agency.*

EMPLOYED SCIENTISTS*

	Estimated total	Register count	Estimate of coverage (%)
Astronomers	400	356	89
Biologists	50,000	15,551	31
Chemists	86,000	26,156	30
Earth scientists	17,000	11,346	67
Meteorologists	4,000	3,133	78
Physicists	22,000	10,035	46
Psychologists	14,000	11,071	79

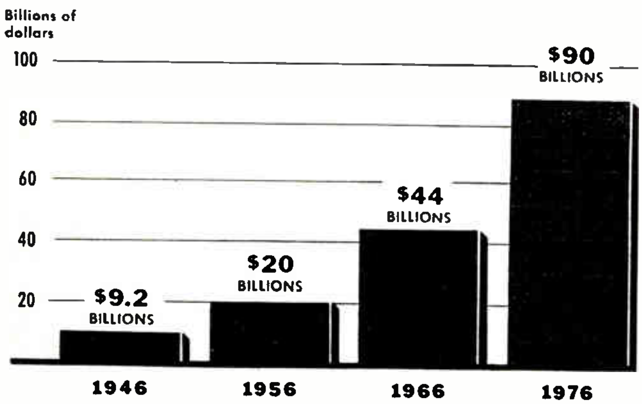
*Includes scientists on active military duty.

—National Science Foundation

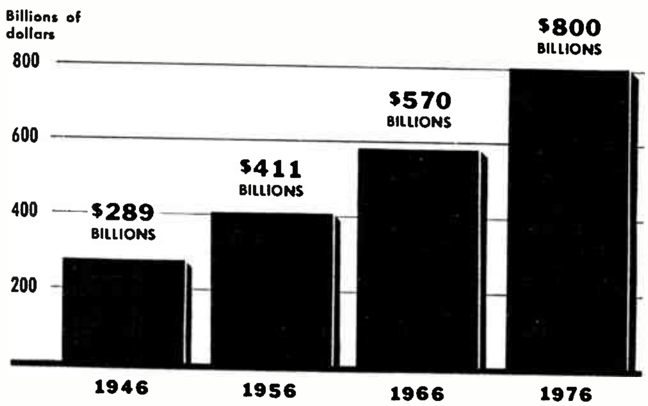


Below—United States Output of Electrical Products

Below Right—United States Gross National Product



Data: National Elec. Mfrs. Assn.
Projection: General Electric Co.



Data: U. S. Dept. of Commerce
Projection: General Electric Co.

Missile Research Points To

Low Resistance Thermistors As Ultra-Cold Thermometers

At the temperature of liquid oxygen rocket fuels new thermistors exhibit resistive characteristics as low as 300 ohm-cm and temperature coefficients as high as 35% per °C

By DR. HERBERT B. SACHSE

Very low temperatures have, until recently, had application almost exclusively in the laboratory and the separation of atmospheric gases. Even in aviation, test specifications for normal air-borne equipment call only for medium low temperatures of the order of —40 to —80°C.

Now, however, electronic engineers are confronted with the problems of designing equipment for use in the upper atmosphere and in vehicles using liquid oxygen as a fuel component. Equipment must now be designed to measure and control temperatures down to the boiling point of liquid oxygen, —183°C.

Classical Means

The classical device to measure low temperatures between ambient and —210°C is the platinum-resistance thermometer. The temperature coefficient of pure platinum at 0°C is .392%/°C. Between 0°C and —183°C the resistance of a "25 ohm" platinum resistance thermometer drops from 25 to approximately 5.80 ohm—corresponding to an average resistance change of .105 ohm/°C. In order to eliminate the influence of lead resistance, the voltage drop across the platinum thermometer must be measured. This means the complication of additional lead wires and a very sensitive instrument.

Thermocouples have the principal disadvantage that the temperature of their "warm" junction must be well defined. Furthermore, their thermoelectric power does not normally exceed 8-10 mv at —210°C; this also calls for a sensitive instrument.

For temperatures above ambient, resistors with a high negative coefficient of resistance—thermistors—have been advantageously applied to temperature control and measurement. At temperatures below ambient they seem to be still more promising because of the fact that their temperature coefficient increases rapidly with falling temperature. According to Eq. 1,

$$\alpha = \frac{-B}{T^2} \qquad (1)$$

(T = Absolute Temperature in °K. = 273.15 + °C.)

(The constant B describes the slope of resistivity vs. temperature.)

Thermistors are made from semiconducting materials which are physically and chemically stable within their usual range of application. At elevated temperatures sintered metal oxides or sulfides are used as semiconducting materials. Their thermostability implicitly involves a choice of temperature stable contacts. The temperature coefficient at room temperature lies between 2 and 8%/°C.

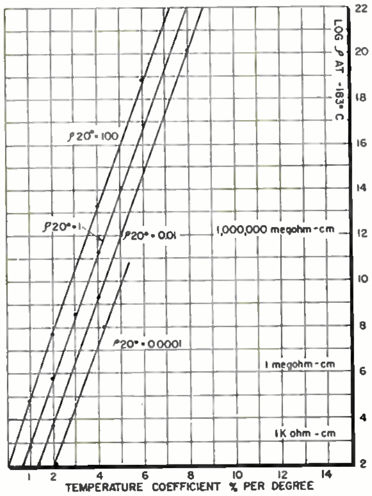
At temperatures below ambient, practically every semiconducting material can be used as a sensing element. Considerations as to thermostability of material and contact can be dismissed. However, a new viewpoint became important. The usual thermistor materials with temperature coefficients of 2-8%/°C at room temperature will have a very high resistivity at —185°C.

Resistivity

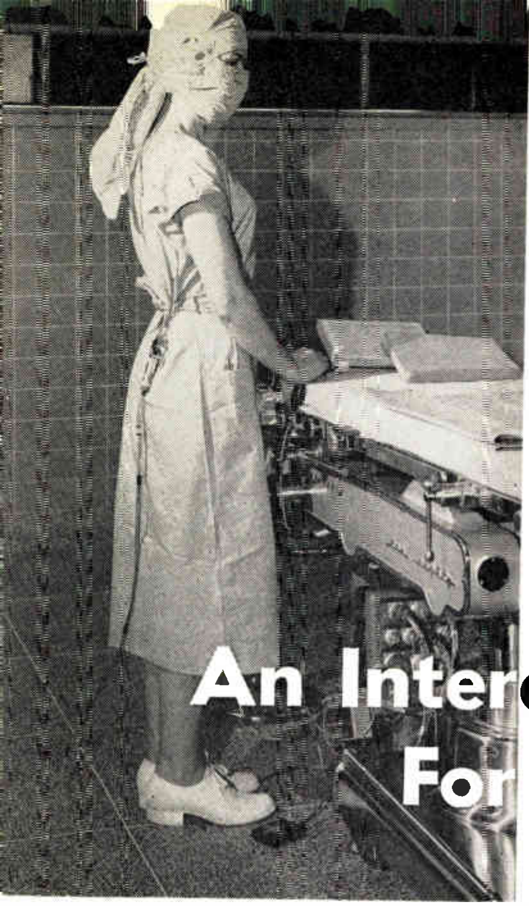
Fig. 1 shows the specific resistivity observable at —183°C for a series of materials having specific resistivities between 10^{-4} and 100 ohm-cm in dependence on the temperature.

(*Continued on page* 142)

Fig. 1: Specific resistivity at —183°C



DR. HERBERT B. SACHSE, Keystone Carbon Co., Saint Marys, Penna.



The designer of electronic equipment for the operating room must cope with a potentially explosive atmosphere, splashed cleaning solutions, and interference with other equipment operating with microvolt inputs.

By MICHAEL M. DAVIS, JR., and DR. MAITLAND BALDWIN

An Intercom System For The Operating Room

"Surgeon to electroencephalographer, surgeon to electroencephalographer, come in please—over," may not be heard in actual practice, but at least one surgical operating team has had to install an intercommunications system as complex as that used by many aircraft crews. The surgical team must be coordinated with electronic equipment and technicians too numerous to be contained in the operating room itself. Among the modern electronic tools to be coordinated may be electroencephalographs, stimulators, oscilloscopes, electrocardiographs, blood pressure recorders, heart and respiration rate recorders, infusion pumps, and artificial kidneys.

In order to bring greater efficiency to the surgical team and the many other personnel and equipment required for neurosurgical procedures, an intercommunications system has been developed and tested at the National Institutes of Mental Health and Neurological Diseases and Blindness, in Bethesda, Maryland.

The system developed around a particular need and situation, specifically the surgical treatment of epilepsy. In such treatment we must localize a focal point or epileptogenic lesion within the brain. The first method of localization is by electrical stimulation of the cerebral cortex and subcortical structures with a gentle current. The responses to this stimulation serve as guides to the localization of function within the exposed brain. Thus we may reproduce the warning or a part of the habitual attack after a careful analysis of normal functional representation in the surrounding area. The analysis of normal function gives us landmarks and tells us what we must avoid if we are to remove the lesion safely, while activation of the attack tells us where the lesion lies among the more normal representations.

Many of the responses to electrical stimulation take the form of movements, sensations or psychological changes. We can observe the movements, but the patient must tell us of the feelings and thoughts. Therefore, we operate with the patient under local anesthesia and we have come to realize that treatment is most effective and safe when the patient is alert, conscious, and cooperative.

If we are dependent upon the verbal expression of the patient for some of the response to electrical stimulation, we must have an effective means of communication with him. Also we must coordinate his responses with electrical recordings of his cortical activity. Therefore our communication system must include the adjacent area where these responses are recorded. The patient's voice must be carried to the operating team and the voices of the operating team must be clearly understood in the recording area. Conversely the verbal reports from the person who observes the recording must be clearly understood by the operating team. The members of this team must in turn communicate with each other in order to make use of the information received from the patient and the recording room.

Description

Our system provides two-way communication between various

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DR. MAITLAND BALDWIN, National Inst. of Metal Health, Bethesda 14, Md.

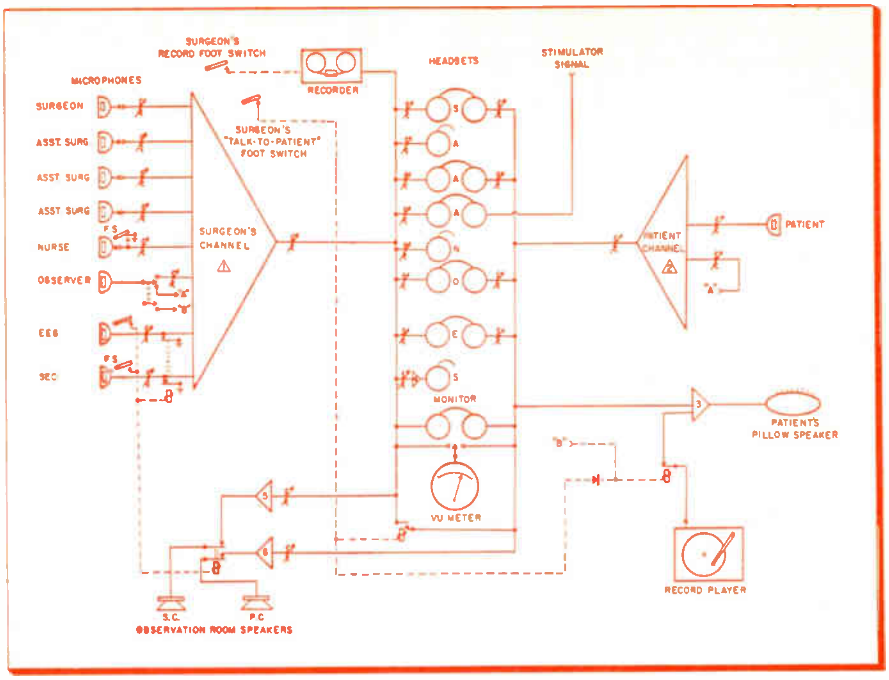


Fig. 2: Block diagram of medical intercom system

members of the operating team, and from any of them to personnel in the observation room, as well as foot-switch controlled communication from the operating team to and from the patient.

In the present installation all communication controls are located in the observation room. The original installation provided individual junction boxes, each with a volume control, located in the operating room, but it was soon apparent that this was impractical since the operating personnel could not make volume level adjustments and still maintain sterility. Current practice requires a short test routine during which each person on the system gives a test count, while an operator adjusts the microphone volume level by means of a VU meter, and following this each person's headset volume is adjusted for his particular listening comfort.

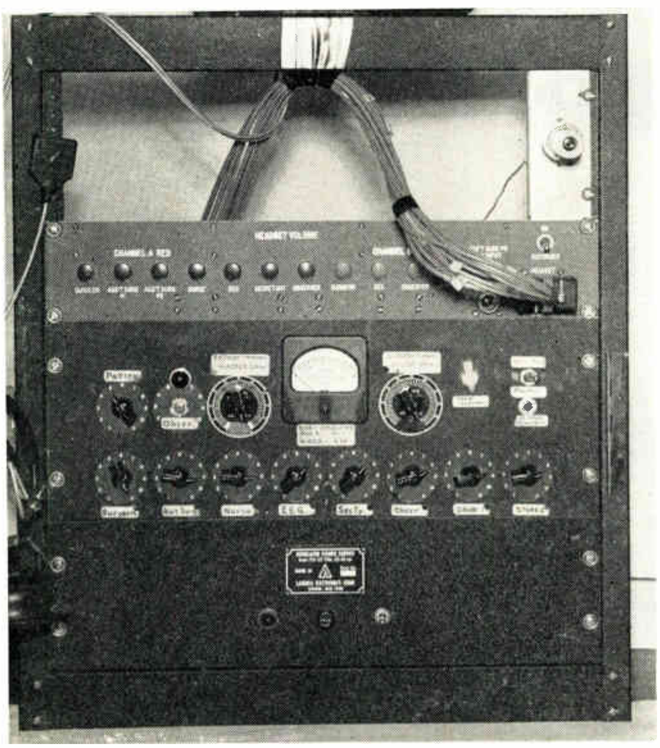


Fig. 1: The control panel of the communication system. The lower unit is the power supply; in the middle is the amplifier unit providing independent and master microphone volume level controls for the surgeon's and patient's channels. The top unit provides headset volume controls

Block Diagram

Fig. 2 is a functional block diagram of the equipment. On the left of the illustration is the surgeon's channel amplifier, indicated by the large triangle (1), with its eight microphone inputs. On the right is the patient's channel amplifier (2), with only two inputs, one from the patient, and the other from the observer, who can speak through either channel. In the center of the figure are the various headsets, some with a single earphone, others with two, depending on the team function of the individual. Below the headsets is shown the volume level indicator, used for balancing the various microphone levels.

At the top of the figure is shown a tape recorder, which is energized by one of the surgeon's foot switches when he wishes to record pertinent data. To the lower left are monitor speakers located in the observation room for visitor listening. Their booster amplifiers are indicated by triangles 5 and 6. In the lower right corner of the figure are the patient's booster amplifier (3), and the record player by which he can listen to his choice of music except when the surgeon or observer wishes to talk to him. Note also the booster amplifier (4) beside the secretary's (SEC) headset.

System Details

The headset-microphone assembly worn by members of the operating team is one of the more critical items of the system. It must be light, compact, reasonably rugged, essentially moisture proof, and of good acoustical quality; it must not slip or move on the head and yet must be comfortable to wear continuously for periods as long as six to ten hours. The microphones used are a small crystal type (Brush type BA-110-2) weighing 8 grams each, and are supported by the headset with a double loop of piano wire attached to an adapter plate on one earphone. Although the microphones are hermetically sealed, a small plastic bag is placed over the cartridge in order to prevent moisture from collecting on the microphone diaphragm and interfering with normal performance. The headsets are a good fidelity crystal type (Brush type RA-206 or -027). Large earphone cushions are used in order to attenuate external sound, and keep the earphone completely away from the pinna of the ear. The portion of the earphone cushion at the rear of the head is perforated with small holes to aid in ventilation and make possible more satisfactory communication in the event of sound system failure. Fig. 3 shows a single earphone assembly. Cabling from the headset assembly is carried to a connector pinned to the back of the clothing, as shown in Fig. 4b. Some problem was initially encountered with this disconnect in providing sufficient ruggedness as well as simplicity of manipulation. Operating room procedures require that the headset-microphone assembly with its associated connector be put on before the final sterile gown and hood. The gown entirely covers the connector so that joining the mating connector must be done blind by an assistant reaching under the gown. Subminiature connectors were tried in order to reduce weight but were found to be insufficiently rugged and too difficult to manipulate. We are presently using Cannon XL latching type audio connectors which have substantial cable clamps (See Fig. 4). They have proved entirely trouble free.

Fig. 3: Headset assembly

Switching

A number of foot switches are used with the system. The surgeon has two switches, one of which controls the recorder used for storing critical information spoken by the surgeon or patient, or for that matter anyone on the system. As can be seen from the block diagram, the other foot switch carries out two functions: it parallels the outputs of the surgeon's channel amplifier and patient's amplifier and at the same time disconnects the record player. Normally, the patient will hear nothing but music or the observer (who is often the anesthetist), although all those on the operating team with split headsets can hear the patient. By depressing his "talk-to-patient" foot switch, the surgeon can talk to the patient. The nurse also has a foot switch for disabling her microphone so she can give instructions to circulating nurses around her without disturbing other operating team communication. The observer has a foot switch or key to enable him to talk selectively on the surgeon's channel or on the patient's channeL Since his primary concern is the patient's immediate well being, it is desirable for him to communicate frequently with the patient without interfering with the surgeon's job. His switch also disconnects the record player while he is talking to the patient.

Fig. 4: Headset connector

Observation Room

Both the electroencephalographer and the secretary are located in the observation room behind a large glass window, and each has a foot switch to de-energize the system loud speakers when he wishes to speak. Because of the high noise level in the observation room due to the presence of visitors witnessing the operation, we found it necessary to install a booster amplifier (4) on the secretary's circuit to provide another 5 to 10 db of gain. We also found it necessary to install a booster amplifier for the patient's pillow speaker, which is buried in foam rubber.

Stimulator Monitor

As previously mentioned, one of the several techniques used to assist in locating focal lesions consists of stimulating the cortex

(Continued on page 120)

A feedback system controlled by a voltage proportional to the output current. Especially useful in measurement techniques.

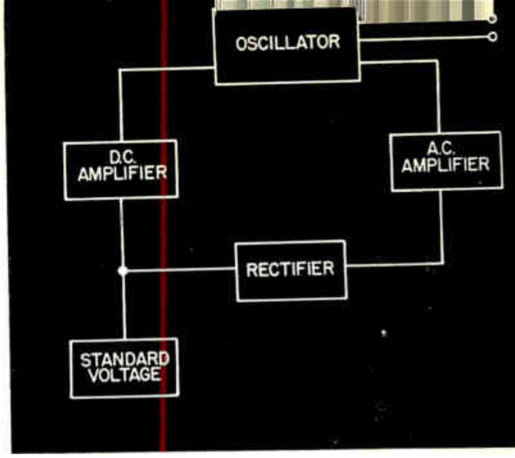


Fig. 1: Output current is compared to a constant reference potential

Design For A Constant Current Oscillator

Bernard Fabricant

Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

While many articles have been published on voltage stabilized oscillators, little attention seems to have been paid to current stabilized oscillators. Nevertheless, these oscillators would be very useful in measurement techniques. The present investigation was started in connection with a study for the construction of a constant current DC power supply. The latter could be obtained from a constant current oscillator with the use of rectifiers and series chokes.

Essentially, the constant current oscillator is a feedback control system in which the control element is a voltage proportional to the output current. The latter is obtained from the load after suitable amplification, rectification, and a comparison with a constant reference potential.

A block diagram of the unit is shown in Fig. 1. The related circuit diagram of the prototype is shown in Fig. 2.

Oscillator

The oscillator utilizes a tuned-plate tuned-grid circuit and a 6AG7 pentode with a separate suppressor grid. It operates in Class C at approximately 20KC from a 290 v. power supply. It has been found that the feedback voltage could not be returned to the control grid due to the discontinuous operation of the tube in Class C. Better performance was obtained with the suppressor grid which, however, required higher feedback loop amplification because of its low transconductance. In Fig. 3, the dynamic suppressor control characteristic is shown. It is seen that g_m is approximately 20 μmhos.

Feedback Loop

The signal proportional to the output current is obtained from a suitable resistor in series with the load. In order that the signal be of constant amplitude, the resistor across which it is taken is made variable inversely with the load current so that the product RI is a constant. In the particular realization, the feedback signal is 1 v. and is applied to a 6SJ7 resistance capacitance amplifier. This provides a gain of approximately 40. The amplifier is followed by a 6H6 rectifier and a 6SJ7 DC amplifier. The output of the 6H6 is connected directly in series opposi-

(*Continued on page* 126)

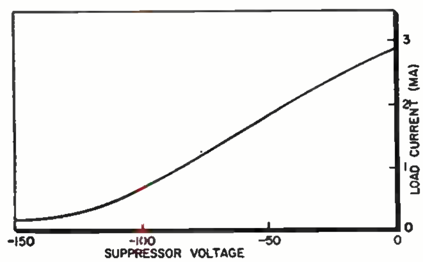
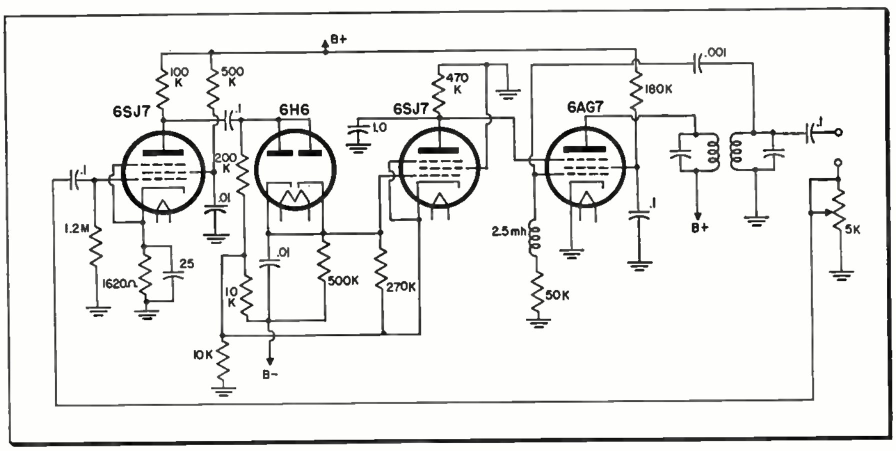


Fig. 3: Dynamic suppressor control characteristic shows low transconductance.

Fig. 2: Basic constant current osc. Load series resistor provides feedback.



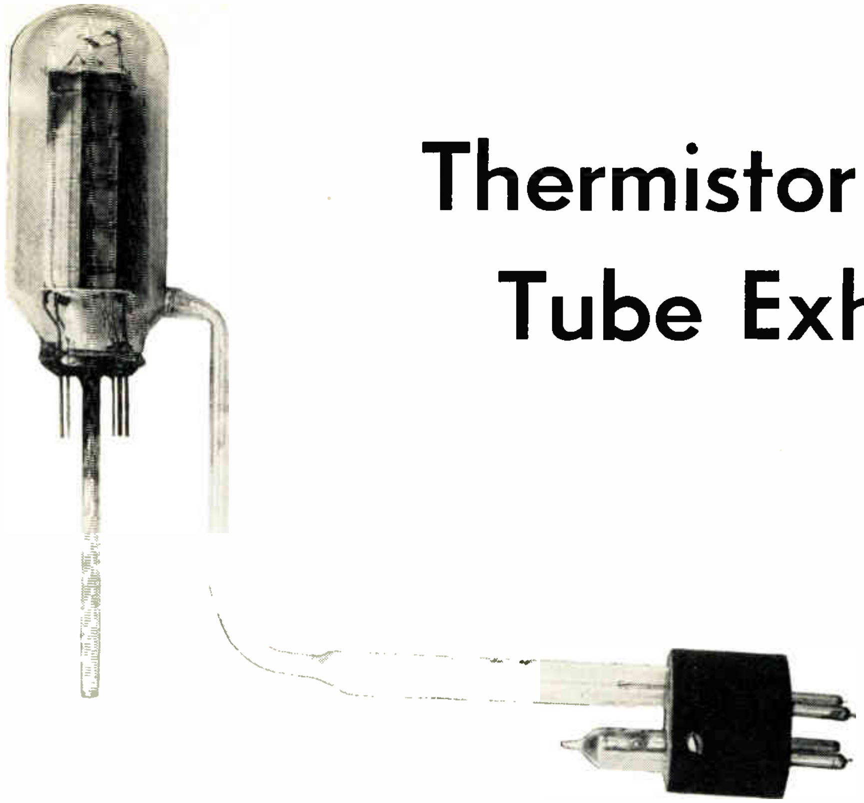


Fig. 1: Attachment of a thermistor vacuum gauge to a receiving tube (5U4GB)

Thermistor Checks Tube Exhausting

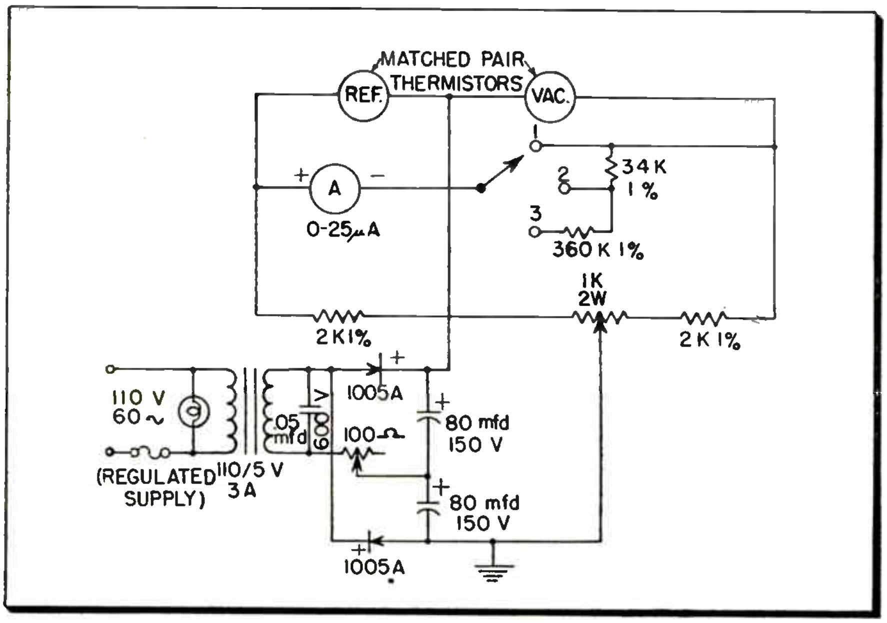
By R. L. KORNER
and G. N. RIEGER

Based on past experience, present practice for the determination of exhaust schedules is established in an experimental manner. Once a schedule which produces good tubes is established, there is considerable reluctance to change to achieve the optimum process for tube quality and output. If it were possible then to determine the pressure inside the tube at each stage of the process, exactly duplicating the manufacturing process, a valuable tool would be available for the analysis and intelligent improvement of the equipment, the process, and the product.

Fig. 1 illustrates a thermistor vacuum gauge attached to a receiving tube—5U4GB. This configuration was chosen so that the thermistor would not interfere with the tube processing and also would be located in a spot sheltered from heat or r-f fields. This type of vacuum gauge was selected for the following reasons:

1. Small size.
2. Glass-to-glass seals.
3. Temperature compensated having the reference element next to the pressure element.
4. Covers the range of exhaust pressures for receiving type tubes.
5. Measures total pressure.

Fig. 2: Simple bridge circuit used for the pressure determination.



Thermistors

Thermistors are devices made of semiconductors whose electrical resistance varies rapidly with temperature. Semiconductors usually have high negative temperature coefficients of resistance. As the temperature is increased from 0° C to 300° C, the resistance may decrease by a factor of 1000. Over the same temperature range, the resistance of a typical metal, such as platinum, will increase by a factor of 2.

The application of a thermistor as a vacuum gauge is based upon the physical principle that the dissipation constant of the thermistor depends on the thermal conductivity of the medium in which it is

R. L. KORNER and G. N. RIEGER, Advanced Equipment Development Section, Electronic Tube Div., Westinghouse Electric Corp., Elmira, N. Y.

A thermistor coupled to a glass envelope and indicating pressure as a function of the tube's internal temperature provides, for the first time, constant measurement of evacuation through all stages of the exhaust process.

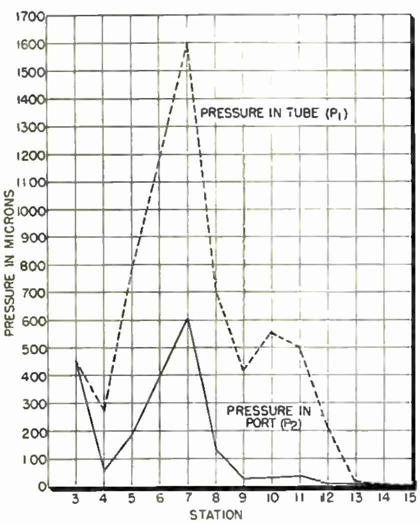
R. L. KORNER

G. N. RIEGER

immersed. To eliminate or reduce the thermistor response to changes in ambient temperature of the medium, a second thermistor of similar characteristics can be introduced into the measuring circuit.

The 2 thermistors are connected into adjacent arms of a Wheatstone bridge which is balanced when the test effect is zero and becomes unbalanced when the effective thermal conductivity of the medium is changed. The time constant for the matched thermistors used in this circuit is 1 sec. The time constant is a measure of how rapidly the thermistor will heat or cool, and is the time required for the temperature of the sensing element to fall 63% of the way toward ambient (Fig. 2).

Fig. 3: Pressure results by station.



Sealing and Exhaust

The 5U4GB tube is exhausted on a 16-head rotary sealing and exhaust machine which indexes from position to position with the following schedule at the positions indicated:

Position Number	Operation
1	Load tube on machine
2	Start exhaust
3, 4	Exhaust
5	Filament
6-12	R-F heat, filament
13, 14	R-F flash getter, filament
15	Tip-off and remove tube
16	Remove tubulation

In normal factory operation of sealing and exhaust, the tube is still warm from sealing when exhaust is started. This heat permits vapors in the first few exhaust positions to be removed rapidly.

The pressure curve (Fig. 3) shows the pressure for 1 point at each station and the connecting lines do not represent the pressure curve between them. When a chart

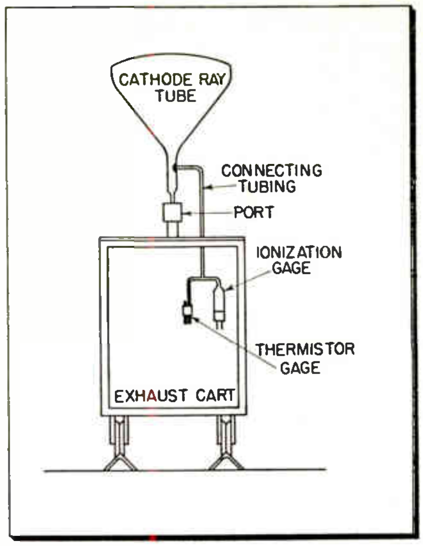


Fig. 4: Gages protected from oven heat during outgassing of CRT.

recorder is used, the resulting curve does show the actual pressure between stations.

Having obtained the pressure curves, the first check is to determine if the pressures are low enough to permit complete conversion of the barium carbonate coating of the filament. Reference to a dissociation curve for the emission material, which is a plot of pressure vs. temperature, will indicate whether the critical condition is met.

Exhaust Pump

The next thing to check is the adequacy of the pumps and the plumbing connecting to the tube. To accomplish this, it is only necessary to compare the pressure in the tube with the pressure in the port near the tubulation end. The formula for gas flowing through the tubulation for the region of molecular flow is:

$$Q = S(p_1 - p_2)$$

where, Q = gas flow (liter-microns/sec.)

p_1 = pressure in tube (microns)

p_2 = pressure in port (microns)

S = speed of the tubulation = $\dfrac{80d^3}{L - \dfrac{4d}{3}}$ (liters/sec.)

d = dia. (in.)

L = length (in.)

Molecular flow for air occurs if $p_1 + p_2$ is equal or less than $6.45/d$. If $p_1 + p_2$ is greater, the flow varies with the value of $(p_1^2 - p_2^2)$.

If p_1 and p_2 are almost equal, it

(*Continued on page* 153)

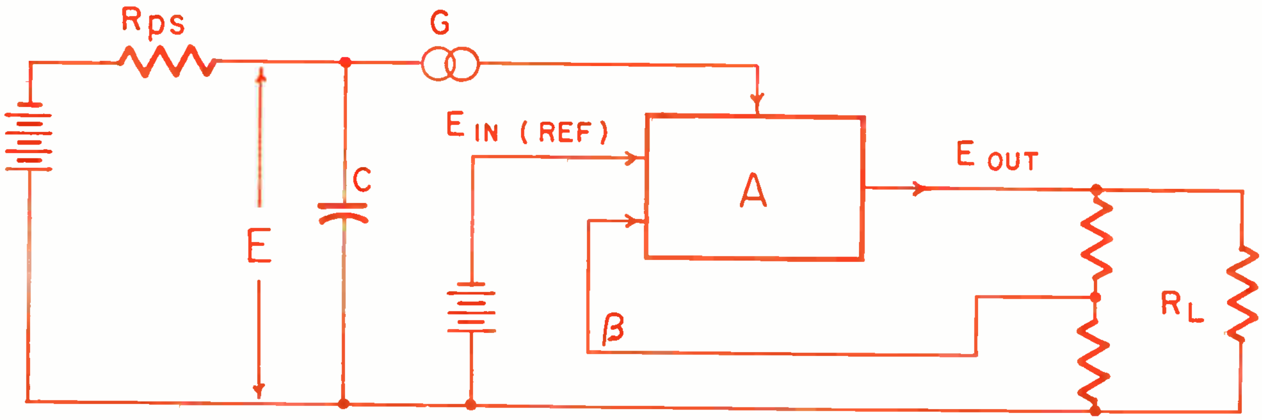


Fig. 1: Basic electronic regulator

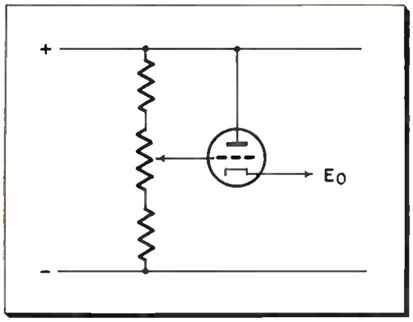


Fig. 2: Cathode-follower regulator

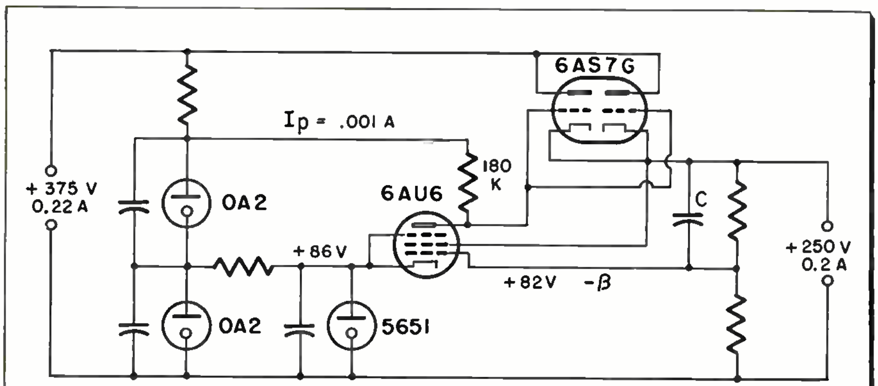
The performance of pulsed electronic equipment, such as radar and computers, is sharply dependent on the stability of their associated power supplies. This article examines the design of the basic regulator circuits with respect to ripple, output impedance and transient response

Power Supply Regulator Design

By H. R. HYDER

REGULATED Power Supplies are usually taken for granted; they exist. The advanced design engineer seldom concerns himself with them. If a regulated supply is needed, the design is usually turned over to a junior. The result is that regulated supplies are seldom as good as they could be and the performance of the equipment which they supply is thereby deteriorated.

Fig. 3: Practical 2-stage regulator



	6AU6	6AS7G (BOTH SECTIONS)
E_{c1}	−4 V	−55 V
E_B	109 V	125 V
E_{c2}	164 V	
I_p	.001 A	0.2 A

What do we want?

One difficulty is that the design engineer usually does not have a clear idea of what characteristics he really wants in a regulated supply. A great deal of thought should be given to this before a power supply is specified, since this largely determines the design of the supply. For any particular purpose, some features may have little importance and some may have a great deal. The purpose of this article is to assist the design engineer in deciding, first: what he wants, second: is what he wants

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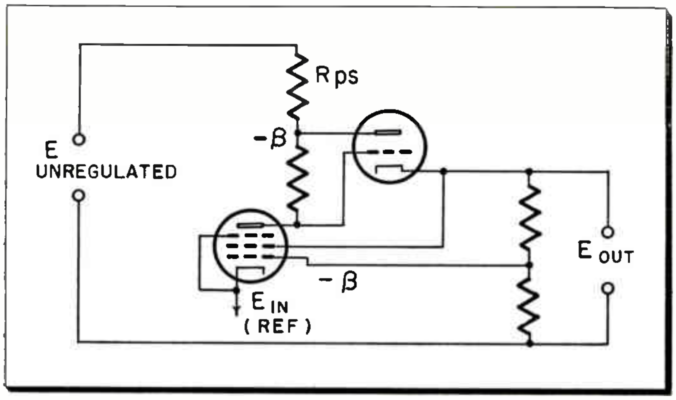


Fig. 4: 2-stage regulator with subsidiary negative feedback

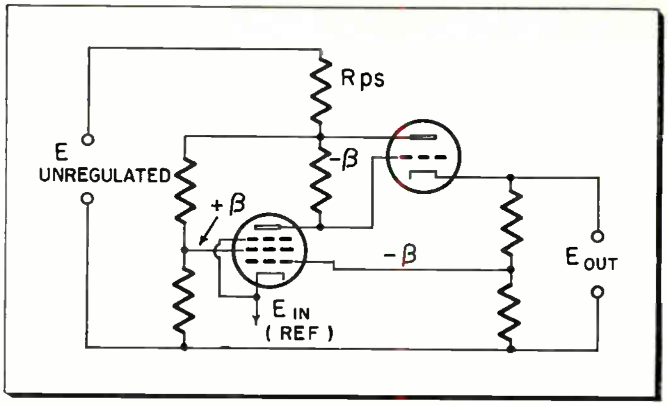


Fig. 5: Regulator with pos. feedback and subsidiary neg. feedback

attainable, and third: how it may be attained.

Since the greatest number of power supplies is used in pulsed electronic equipment, such as radar and computers, this article will restrict itself to a discussion of this type supply. The "laboratory" type supply, which must not only include some of all of the desirable characteristics of regulated supplies, but in addition must have a variable output voltage, will not be discussed; although the principles outlined here certainly apply. A "laboratory" supply is of necessity a compromise design; no regulated supply can obtain optimum characteristics over a very wide variety of output voltages. Fortunately, in specifying a regulated supply, the desired output voltage is one of the few things that is accurately known by the design engineer.

Now, regulated power supplies are thought of as having the following desirable characteristics: 1. Constancy of output voltage with regard to line voltage changes, load current changes, and time. 2. Low ac ripple voltage. 3. Good transient response. 4. Low output impedance.

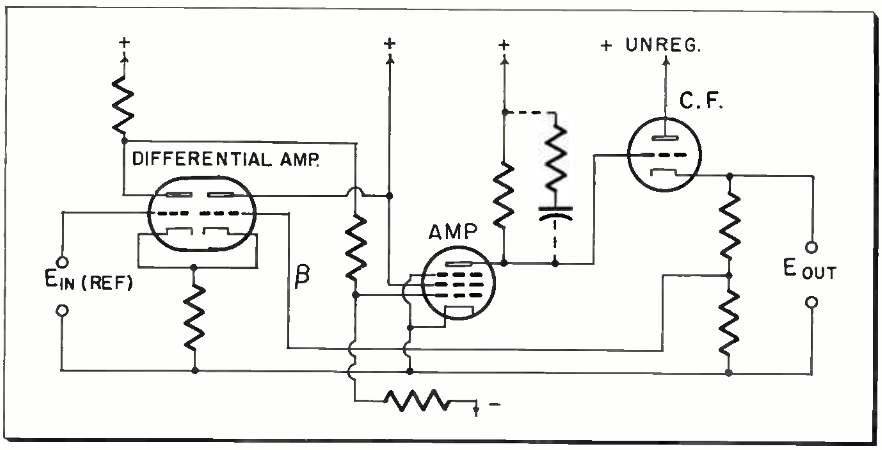
The first of these is a relative thing. What is excellent for some purposes is poor for others. In ac coupled circuits, a variation of an appreciable fraction of a volt in the B+ supply is usually inconsequential; in dc coupled circuits, a few mv. may be intolerable. A circuit which held the output voltage to 1 mv. would be sinfully wasteful if 1/10 v. were adequate. To obtain the best supply for our purposes, we must know what we really want.

The second of these, low ripple, is confused by many engineers with No. 3. Ripple is defined as an ac voltage harmonically related to the supply-line frequency which appears on the dc output.

The third characteristic, good transient response, is usually of the utmost importance in radar and other pulse equipment. A simple blocking oscillator with an average plate current of 1 ma. may have a peak plate current of several hundred ma. The power supply must be able to supply this peak demand without dropping its terminal voltage appreciably, and must recover rapidly.

The fourth requirement, low output impedance, is really a combination of the first three in varying proportion depending on the purpose of the supply.

Fig. 6: Three-stage regulator



Regulated Power Supplies

Thinking on regulated power supplies by the average engineer tends to be fairly muddy, and unnecessarily so. One reason is that the terminology applied to regulated supply circuits is all wrong. For instance, why do we call them "series regulators" or "series passing tubes"? They are cathode followers, and calling them anything else merely confuses things. A regulator is nothing but a direct-coupled power amplifier with negative feedback. Any analysis which applies to such an amplifier applies without alteration to power supply regulators.

The reference voltage, which all regulators have, is the signal input. The signal output is the dc output voltage of the regulator. The gain of the regulator is the quotient of the two. Thus, if the reference voltage is 87 v. from a type 5651 voltage-reference tube and the output voltage of the supply is 300 v., the gain of the amplifier (or regulator) is 3.45. That is the closed-loop gain; the open-loop gain is anything we like. The feedback factor, of course, is the fraction of the output voltage which is fed to the input grid of the regulator and is exactly

(*Continued on page* 147)

1957 Coming Events Calendar

ELECTRONIC INDUSTRIES & TELE-TECH

Portraying important electronic events ahead from January to June

Engineering Events — Trade Events — Avionic Events — Electronic Meetings and Shows

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

JANUARY

Annual Convention
National Appliance & Radio-TV Dealers Assn.
Conrad Hilton Hotel, Chicago

Symposium,
Solar Furnace Design & Operation
Hotel Westward Ho,
Phoenix, Arizona

Symposium on Microwave
Ferrite Devices & Application
IRE
Engineering Societies Bldg., New York

[illegible]

Plant Maintenance & Engineering
Show and Conference
Public Auditorium, Cleveland

Symposium on Reliability
& Quality Control in Electronics
IRE ASQC and RETMA
Statler Hotel, Washington, D. C.

25th Annual Meeting
Inst. of Aeronautical Sciences
Sheraton-Astor Hotel, New York

Very Low Frequency Symposium
PGAP & Nat'l Bureau of Standards
NBS Boulder Labs, Boulder, Col.

Electronics in Aviation Day
IRE Aeronautical & Navigational
Electronics Group
Sheraton-Astor Hotel, New York

13th Annual National Technical Conference
Society of Plastic Engineers, Inc.
Sheraton-Jefferson Hotel, St. Louis, Mo.

3rd Annual Midwest Welding Conference
Armour Res. Found. & American Welding Soc.
Ill. Inst. Tech., Chicago

FEBRUARY

Western Winter
Radio-TV & Appliance Market
Western Merchandise Mart,
San Francisco

Electrical Trade Conference
& Exposition
Washington, D. C.

[illegible]

Joint Military Industrial Guided Missile
Electronic Test Instrument Symposium
Redstone Arsenal, Huntsville, Ala.

Annual Mid-Winter
Aircraft Instrumentation Symposium
ISA
Garden City Hotel, New York

13th Annual National
Adequate Wiring Conference
National Adequate Wiring Bureau
Sherman Hotel, Chicago, Illinois

Symposium
On Recording of Heart Sounds
IRE & Univ. of Buffalo
Buffalo, N. Y.

1957
Western Joint Computer Conference
IRE, AIEE, ACM
Statler Hotel, Los Angeles

Operations Research Symposium
IRE Eng'g Management Group & SIAM
Univ. of Pa. Museum, Philadelphia

Operations Research Symposium on
Mathematical Models in Management
& Decision Making
Univ. of Pa., Philadelphia

Transistor & Solid State Circuits
Conference
IRE, AIEE and Univ of Pa.,
Univ. of Pa., Philadelphia

West Coast Audio Convention
Audio Engineering Society
Ambassador Hotel, Los Angeles

MARCH

[illegible]

[illegible]

25th Annual Meeting
American Society of Tool Engineers
Shamrock-Hilton Hotel
Houston, Texas

NEMA
Convention
Edgewater Beach Hotel, Chicago

National Symposium on Telemetry
IRE Telemetry &
Remote Control Group
Philadelphia, Pa.

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

APRIL

NARTB Annual Convention
National Association of Radio & TV Broadcasters
Conrad Hilton Hotel, Chicago

International Symposia on Solid State Devices
Polytechnic Inst. of Brooklyn & IRE
Circuit Theory & Electron Devices Groups
33 W. 39th St., New York City

SAMA Annual Meeting
Scientific Apparatus Makers Assn.
White Sulphur Springs, West Virginia

Annual Industrial Electronic Educational Conference
IRE Industrial Electronics Group
Ill. Inst. of Tech., Chicago

National Symposium on Telemetering
IRE
Philadelphia, Pa.

National Industrial Research Conference
Armour Research Foundation
Conrad Hilton Hotel, Chicago

Radio Pioneers
Annual Dinner-Meeting
Conrad Hilton Hotel, Chicago

U. S. World Trade Fair
Coliseum, New York City

7th Regional Technical Conference & Trade Show
IRE
San Diego, California

National Simulation Conf. on Computers
S. W. Regional Conf. & Electrical Show
IRE
Houston, Texas

Tenth Annual Conference for Protection Relay Engineers
Texas A&M College, College Station, Texas

11th Spring TV Conference
IRE
Eng'g Society Bldg., Cincinnati

81st Semi-annual Convention
Society of Motion Picture & TV Engineers
Shoreham Hotel, Washington, D C

MAY

SAMA Annual Meeting
Scientific Apparatus Makers Assn.
White Sulphur Springs, West Virginia

[illegible]

[illegible]

49th Annual Convention
National Association of Electrical Distributors
Sheraton Park & Shoreham Hotels, Wash., D. C.

81st Semi-annual Convention
Society of Motion Picture & TV Engineers
Shoreham Hotel, Washington, D. C.

Annual Meeting on Ferrite Devices
IRE Microwave Theory & Techniques Group
Western Union Auditorium, New York

Annual Meeting
National Electronic Distributors Assn.
Conrad Hilton Hotel, Chicago

Electronics Parts Distributors Show
Conrad Hilton Hotel, Chicago

Electronics Components Symposium
IRE Component Parts Group
Morrison Hotel, Chicago

National Conference on Aeronautical Electronics
IRE
Biltmore Hotel, Dayton, Ohio

Annual Convention
RETMA
Sheraton Hotel, Chicago

AFCEA Convention & Exhibits
IRE—Armed Forces Communications & Electronics Association
Washington, D. C.

Design Engineering Show
Coliseum, New York City

ICA Convention
Industrial Communication Association
Atlantic City, New Jersey

Spring Meeting
Acoustical Society of America
New York City

Abbreviations:

ACM: Assn. for Computing Machinery
AICE: American Inst. of Chemical Engrs.
AIEE: American Inst. of Electrical Engrs.
AIMMPE: American Inst. of Mining, Metallurgical & Petroleum Engineers
ASCE: American Society of Civil Engineers
ASME: American Soc. of Mechanical Engrs
ASQC: American Society for Quality Control
ASTM: American Society for Testing Materials
IAS: Inst. of Aeronautical Sciences
ICA: Industrial Communication Association
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
NARTB: National Assn. of Radio & TV Broadcasters
NEMA: National Electrical Manufacturers Association
NICB: National Industrial Conference Board
RETMA: Radio-Electronic-TV Mfrs. Assn.
SIAM: Society of Industrial and Applied Mathematics

JUNE

[illegible]

6th Annual Convention & Trade Show
National Community Television Association Inc.
Pittsburgh, Pa.

National Convention
IRE Military Electronics Group
Sheraton-Park Hotel, Washington, D. C.

Summer General Meeting
American Institute of Electrical Engineers
[illegible]

Summer Annual Meeting
Institute of Aeronautical Sciences
Los Angeles, California

Annual Meeting
National Society of Professional Engineers
Statler Hotel, Dallas, Texas

12th National Meeting
Association for Computing Machinery Inc.
Univ. of Houston, Houston, Texas

Measuring Radome Tracking Error

The radome tends to distort the returned signal, causing an error in the tracking system. Described equipment provides the designer with a quick, accurate means of measuring the degree of error.

By JOHN B. DAMONTE and ALBERT F. GAETANO

To design a radome mounting fixture such that we may conveniently explore any desired portion of a given radome at first sounds like a straightforward design procedure. However, we must be careful that whatever scanning motion we use truly reproduces that which takes place in the actual installation.

Consider, for example, an aircraft installation of a tracking antenna and a radome where the antenna executes an azimuth sweep for an elevation angle of —10°. The intersection of the radar line of sight with the radome is a curve, a parabola, that lies in a plane parallel to the axis of the radome.

Install the radome about the tracking antenna on the pattern range. Take an azimuth cut by rotating the radome with the radome tilted, relative to the fixed tracking antenna, to simulate —10° in elevation at dead ahead. The intersection of the line of sight with the radome in this case is a curve, a parabola, but lying in a plane that intersects the axis of the radome. These two cuts are not equivalent.

It can be shown that if we wish to accurately duplicate the boresight errors encountered in an actual installation, that the test radome must be mounted with its azimuth and elevation axes interchanged.

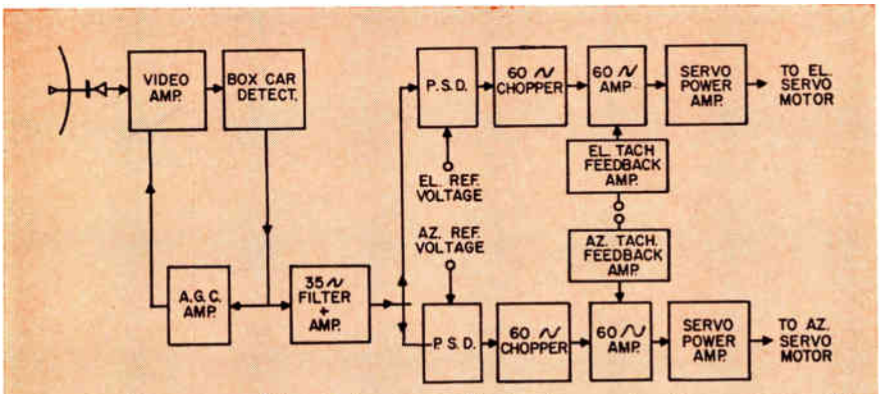


Fig. 1: Boresight servo amplifier. Tachometer feedback reduces motor time constant and improves h-f response thereby reducing wind loading effects.

JOHN B. DAMONTE, Asst. Dir. of Research, and ALBERT F. GAETANO, Project Engr., Dalmo Victor Co., Belmont, Calif.

Electrical Design

Electrically, the automatic boresight measuring equipment operates somewhat as follows: a microwave source supplies energy via a flexible coaxial cable to a parabolic antenna mounted on the null seeking mechanism. This antenna transmits a pencil beam in the direction of the radome and radar tracking antenna mounted at the other end of the 1,000 in. boresight range.

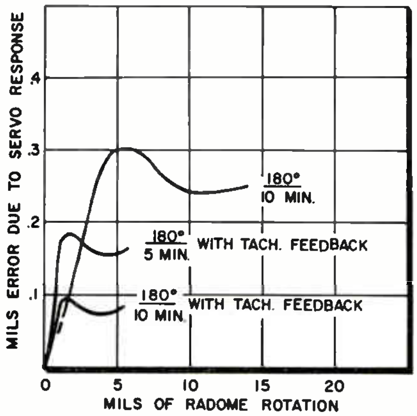
The radar tracking antenna receives this energy as modified by the radome and develops a tracking error signal proportional to the apparent location of the null seeker source of energy. These tracking error signals are resolved into azimuth and elevation components and are fed back to motors that control the null seeker. This, in turn, drives the null seeker in such a manner as to reduce the tracking error signal to zero.

As the radome is rotated through some desired cut, the effect of the radome changes and the apparent location of the null changes, thereby changing the relative position of the null seeker. The position of the null seeker is transmitted to a graphic recorder where boresight error, cross talk error and the vector sum of these two are available for analysis.

Operation

A block diagram of the boresight servo amplifier is shown in (*Continued on page* 128)

Fig. 2: Typical system response curves.



International

ELECTRONIC SOURCES

ELECTRONIC INDUSTRIES' exclusive monthly digest of the world's top electronic engineering articles

ANTENNAS, PROPAGATION

Some Aircraft Measurements of Beyond-The-Horizon Propagation Phenomena at 91.3 Mc/s, by B. J. Starkey. "Proc. BIEE." Nov. 1956. 3 pp. It is suggested that many phenomena of long-distance propagation could possibly be explained by the simple hypothesis of specular reflection from temperature-inversion layers at the tropopause.

An Experimental Design Study of Some S- and X-Band Helical Aerial Systems, by G. C. Jones. "Proc. BIEE." Nov. 1956. 8 pp. Tests show that acceptable characteristics may be obtained with helices of unorthodox form, and that encapsulation of helical aerials in foamed dielectric material to improve rigidity is practical.

Microwave Refractometer Predicts Propagation, by C. M. Crain and C. E. Williams. "El." Dec. 1956. 5 pp. Instruments are described for obtaining refractive index profiles and for measuring small scale, small amplitude, variations in refraction.

On the Measurement of the Scatter Coefficient for the Back-Scattering of Short-Wave Telegraph Signals, by B. Beckmann and K. Vogt. "Nach. Z." Oct. 1956. 8 pp. The dependence of the field strength in the transmitter and receiver areas on the transmitting antenna radiation pattern is investigated. The backward scatter coefficient is established by determining the elevation angle of the maximum backward scatter.

AUDIO

An Intercom System for the Operating Room, by M. M. Davis, Jr., and Dr. Maitland Baldwin. "El. Ind." Jan. 1957. 4 pp. Explosive atmosphere, splashed cleaning solutions, and interference with other equipment operating at microvolt inputs are considerations in the design of Medical intercommunications.

A Magnetodynamic Gramophone Pick-Up, I Construction, by N. Wittenberg. "Phil. Tech." Oct. 20, 1956. 9 pp. In contrast to the conventional dynamic pickup, the new device described here has a stationary coil and a moving magnet.

New Investigations on the "Rough Sound" of Loudspeakers, by J. B. Fischer. "Arc. El. Uber." Oct. 1956. 14 pp. It is established that the subharmonic excitation of the conical diaphragms of dynamic loudspeakers at single-tone tests is permissible to a certain extent and will not affect the reproduction quality. The mode of oscillation of the loudspeaker diaphragm is measured and a different interpretation of subharmonic excitation is presented.

Design for a Constant Current Oscillator, by B. Fabricant. "El Ind." Jan. 1957. 2 pp. Oscillator includes a feedback system controlled by a voltage proportional to the output current.

A New Approach in R-F Front End Design, by B. B. Bycer. "El. Ind." Jan. 1957. 4 pp. A tunable r-f head is described using permeability tuning.

Graphical Analysis of Cathode Followers, by H. H. Nord. "El. Ind.—Operations Section." Jan. 1957. 2 pp. A useful and powerful tool for the analysis of cathode followers is presented, with practical examples of the method.

The 6146 as a VHF Power Amplifier, by H. G. Stratman. "El. Ind.—Operations Section." Jan. 1957. 2 pp. Elimination of feedback paths and parasitics in 6146 circuits is discussed.

Power Supply Regulator Design, by H. R. Hyder. "El. Ind." Jan. 1957. 3 pp. The author examines the design of basic regulator circuits with respect to ripple, output impedance and transient response. Primary concern is supplies for pulsed electronic equipment such as radar and computers.

Attenuation and Phase Shift Changes in RC Sections from Curves, by S. K. Benjamin. "El. Des." Dec. 1, 1956. 2 pp. Curves are given which aid in finding the effect of component tolerances, temperature changes, etc., on attenuation and phase shift.

Resistance-Capacitance Tuned Amplifiers Using Negative Feedback, by D. J. O'Connor. "El. Eng." Dec. 1956. 4 pp. The transfer function of an LC tuned amplifier is compared with that obtained for a feedback amplifier using particular types of RC feedback networks. A design procedure is developed which permits the design of circuits having predicted performance.

Synthesizer Stabilized Single-Sideband Systems, by B. Fisk and C. L. Spencer. "Proc. IRE." Dec. 1956. 6 pp. A fundamental limitation to diversified application of SSB is the need for precise frequency control. The necessary degree of frequency control can be obtained over long periods of time through the use of precision frequency standards such as the 100-kc Loran Timing Oscillator in conjunction with properly designed frequency synthesizers. Considerable reduction in complexity is possible by limiting the synthesizer to the generation of output frequencies at the 1000-cycle points.

Comparison of Linear Single-Sideband Transmitters with Envelope Elimination and Restoration Single-Sideband Transmitters, by L. R. Kahn. "Proc. IRE." Dec. 1956. 7 pp. By use of a converter to eliminate the envelope of a SSB signal, the resultant r-f can be amplified by existing AM transmitters and modulation reimposed by the conventional modulator. Several significant advantages are claimed for use of such a conversion.

Circuitry For Photodiodes, by J. Grant. "El. Des." Nov. 15, 1956. 2 pp. Transistorized photodiode circuits for detection and counting, position indication, and speed control are described. Circuits shown are designed around Sylvania's 1N77A photodiode.

REGULARLY REVIEWED

AEG Prog. AEG Progress
Aero. Eng. Rev. Aeronautical Engineering Review
Ann. de Radio. Annales de Radioelectricite
Arc. El. Uber. Archiv der elektrischen Ubertragung
ASTM Bul. ASTM Bulletin
Auto. Con. Automatic Control
Auto. El. The Automatic Electric Technical Journal
Avto. i Tel. Avtomatika i Telemekhanika
AWA Tech. Rev. AWA Technical Review
BBC Mono. BBC Engineering Monographs
BC News. Broadcast News
Bell Rec. Bell Laboratories Record
Bell J. Bell System Technical Journal
Bul. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Comp. Computers and Automation
Con. Eng. Control Engineering
Elek. Elektrichestvo
El. Electronics
El. & Comm. Electronics and Communications
El. Des. Electronic Design
El. Energy. Electrical Energy
El. Eng. Electronic Engineering
El Eq. Electronic Equipment
EL. Ind. ELECTRONIC INDUSTRIES & Tele-Tech
El. Mfg. Electrical Manufacturing
El. Rund. Electronische Rundschau
Eric. Rev. Ericsson Review
Fern. Z. Fernmeldetechnische Zeitschrift
Freq. Frequenz
GE Rev. General Electric Review
Hochfreq. Hochfrequenz-technik und Elektroakustik
Inst. & Auto. Instruments
Insul. Insulation
Iz. Akad. Izvestia Akademii Nauk SSSR
J. BIRE. Journal of the British Institution of Radio Engineers
J. ITE. Journal of The Institution of Telecommunication Engineers
J. IT&T. Electrical Communication.
J. UIT. Journal of the International Telecommunication Union
Nach. Z. Nachrichtentechnische Zeitschrift
NBS Bull. NBS Technical Neews Bulletin
NBS J. Journal of Research of the NBS.
Onde. L'Onde Electrique
Phil. Tech. Philips Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers
Proc. BIEE. Proceedings of the Institution of Electrical Engineers
Proc. IRE. Proceedings of the Institute of Radio Engineers
Radiotek. Radiotekhnika
Radio Rev. La Radio Revue
RCA. RCA Review
Rev. Sci. Review of Scientific Instruments
Rev. Tech. Revue Technique
Syl. Tech. The Sylvania Technologist
Tech. Haus. Technische Hausmitteilungen
Tech. Rev. Western Union Technical Review
Telonde. Telonde
Toute R. Toute la Radio
Vak. Tech. Vakuum-Technik
Vide. Le Vide
Vestnik. Vestnik Svyazy
Wirel. Eng. Wireless Engineer
Wire. Wld. Wireless World

For more information, contact the respective publishers directly. Names and addresses of publishers may be obtained upon request by writing to "Electronic Sources" Editors. ELECTRONIC INDUSTRIES & Tele-Tech, Chestnut & 56th Sts., Philadelphia 39.

International ELECTRONIC SOURCES

Linear Power Amplifier Design, by W. B. Bruene. "Proc. IRE." Dec. 1956. 6 pp. Simple expressions for quickly estimating tube operating conditions and a more detailed presentation of the Chaffee 11-point analysis for accurate computation is made.

Distortion Reducing Means for Single-Sideband Transmitters, by W. B. Bruene. "Proc. IRE." Dec. 1956. 6 pp. Direct r-f feedback and envelope distortion canceling modulation are advanced as methods for reducing distortion.

Bandwidth Curves for Designing Amplifier Stages, by H. D. Webb. "El. Des." Nov. 15, 1956. 3 pp. Professor Webb presents curves for use in the design of amplifiers consisting of two or more cascaded L-C stages of unequal bandwidth, but tuned to the same center frequency.

The RC Generator, by H. Voelz. "El. Rund." Nov. 1956. 2 pp. The properties of the RC-coupled amplifier have been derived in a preceding installment of this article. These are now extended to include the case of sufficient positive feedback to start oscillations. The simultaneous generation of two and more frequencies is considered.

Researches into Spark Generation of Microwaves, by M. H. N. Potok. "Proc. BIEE." Nov. 1956. 7 pp. It is pointed out that one particular advantage of spark generation of microwaves is that the wide band of frequencies generated permits the use of filters to select any desired band of any width.

Modern Synthesis Network Design From Tables—IV, by L. Weinberg. "El. Des." Nov. 1, 1956. Theoretical and practical considerations in the design of filters are discussed.

Principle and Analysis of a Stabilized Phase Multiplier Type of Magnetic Frequency Convertor, by E. Friedlander. "El. Energy." Oct. 1956. 6 pp. Newly developed high gain magnetic amplifiers with quick response have revived interest in magnetic frequency multiplication. The system described here uses harmonic generation produced by passing a sinusoidal magnetizing current through a highly saturated reactor. Generation of the seventh harmonic of power line frequency is described as an example.

The Gyrator, An Electric Network Element, by B. D. H. Tellegen. "Phil. Tech." Oct. 20, 1956. 5 pp. Professor Tellegen, inventor of the gyrator, describes the reasoning by which the gyrator came to be postulated, and properties of the ideal gyrator. He approaches the problem of linear, constant, passive networks by asking what ideal network elements must be introduced in order to realize all such systems. Finding no grounds for including reciprocity (a characteristic of resistors, coils, and capacitors), he shows that, apart from the conventional elements, a new network element must be introduced. The new element has been christened the ideal gyrator.

Graphic Construction of Image Attenuation of a Ladder-Type Filter with Either One or Two Cut-off Frequencies and With or Without Loss, by J. Bimont. "Cab. & Trans." Oct. 1956. 21 pp. The graphical method proposed relies on two nomograms. The first nomogram permits to evaluate the attenuation introduced by the reactive elements for all bands, and the second nomogram takes care of the losses suffered by the transmitted as well as the attenuated bands. A numerical example is included.

A Phase-Shift Network, by H. Voelz. "El. Rund." Oct. 1956. 4 pp. Three-section phase-shift networks designed to introduce a 180° shift are studied. Design diagrams are presented. Subsequently symmetrically controlled two-section phase shifters including a tube are discussed. In each instance an RC section and a complementary section with the R and C positions reversed are considered.

A Simple Circuit for Obtaining a Voltage Proportional to the Square of an Angular Velocity, by V. V. Gorsky. "Avto. i Tel." Oct. 1956. 2 pp. Brief description of the circuit and its operation.

On the Analytic Representation of Active Four-Terminal Networks, by Johanna Piesch. "Arc. El. Uber." Oct. 1956. 9 pp. In computing the analytic representation of active four-terminal networks, amplifying elements as well as non-reciprocal elements, such as gyrators and converters are included. A four-terminal amplifying network in which the current and voltage transformations are not correlated and which permits complete decoupling between input and output independently of the gain is studied; transition to a generator by introducing feedback is outlined.

Pulse-Shaping Circuits in Industrial Transistor Engineering, by A. Haidekker. "El. Rund." Oct. 1956. 4 pp. The use of a transistor as a switch is set forth, and conditions for its use are explained. A multivibrator circuit with tubes is compared to one using transistors. Industrial counter circuits are illustrated and component values given. Applications with photosensitive transistors are included.

On Some Transformations of Four-Terminal Networks, by J. E. Colin. "Cab. & Trans." Oct. 1956. 21 pp. It is pointed out that Norton's transformation frequently results in a negative capacity. The derivation of three-stage networks using a minimum of inductances is follows. A low-pass filter is converted into a pass-band filter to illustrate the suppression of the negative capacity introduced by the transformation to economize inductances. The appendix presents a large number of transformation formulas.

Selection of the Geometric Dimensions of the Magnetic Circuit and the Selection of an Over-All Structural Design for an Electrodynamic Coupler, by I. M. Makarov. "Avto. i Tel." Oct. 1956. 13 pp. The paper examines the dependence of the moment applied to the output shaft of the electrodynamic coupler upon the geometric dimensions of the magnetic circuit. Recommendations are given concerning the structural design of the coupler, and concerning the necessity of laminating the magnetic circuit.

Staggered Low-Pass Filters with High Cut-off Frequency, by G. Mahler. "Freq." Oct. 1956. 10 pp. This continuation of a previous article deals with the input circuit connecting a line to a tube and with four terminal filter design. General considerations are followed by numerical examples. The effects of staggering are investigated.

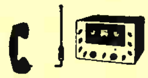
The Properties of an Adjustable Transformer, by H. K. Ruppersberg. "Arc. El. Uber." Oct. 1956. 3 pp. The mutual dependence of the reference points of the ideal transformer appearing on the input and output line of a loss-less six-terminal network is investigated when a short-circuit is moved along the second output line. The transformer ratio is variable only within certain limits. The addition of a loss-less four-terminal network permits the transformation ratio to be adjusted to any desired value.

Contribution to the Theory of Oscillators, by E. Frisch and W. Herzog. "Nach. Z." Oct. 1956. 8 pp. This third installment of a survey article is concerned with oscillators containing reactance filters. Oscillation stability and reproducibility, oscillator efficiency, temperature compensation and suppression of harmonics are studied.

Problems Posed by the General Theory of Circuits Containing a Nonlinear Magnetic Element, by S. A. Ginzburg. "Avto. i Tel." Sept. 1956. 12 pp. The paper examines the general postulates of the quasi-linear theory of nonlinear ac circuits. In particular, the paper analyzes a circuit containing nonlinear magnetic elements. The relationships between the static and dynamic parameters of such a circuit are clarified. A general method is given for plotting the characteristics of circuits containing a saturable reactor. The general conditions governing voltage stabilization and relay operation are derived. Experimental results are used to verify the theory.

Transfer Factor of Networks with Prescribed Transient Response, by V. Fetzer. "Nach. Z." Oct. 1956. 7 pp. The Laplace transform of the transfer factor is determined as the ratio of the Laplace transform of the transmitted frequency spectrum and the frequency spectrum desired at the output. Approximation by means of rational function then permits finding the network. Symmetrical band-pass filters derived from low-pass filters and narrow band-pass filters are treated.

Microwave High - Speed Continuous Phase Shifter, by W. Sichak and D. J. Levine. "J IT&T." Sept. 1956. 4 pp. A small, low loss, continuous phase shifter using circularly polarized helixes in a circular waveguide is described.



COMMUNICATIONS

"Peak-Up" That Microwave Receiver, by F. L. Hopkins. "El. Ind.—Operations Section." Jan. 1957. 2 pp. Some engineering hints to maintenance men are included in a discussion of normal and unusual steps possible in maintaining peak performance.

A Car Receiver Using Transistors, by H. Schreiber. "Toute R." Nov. 1956. 7 pp. The design of a simple car receiver using transistors is presented. A detailed circuit diagram including component values facilitates the understanding of the text.

Multiplexing For Economy, by A. S. Westneat, Jr. "Auto. Con." Nov. 1956. 4 pp. Time multiplexing systems have been highly developed for military telemetering applications. These systems and components have significance for industrial applications. The author makes pertinent suggestions in this direction.

A Method for Time-to-Pulse Conversion, by I. A. Zakhariya, V. N. Mikhailovsky. "Avto. i. Tel." Sept. 1956. 11 pp. The paper examines the properties of a new method for converting rectangular pulse voltages into directly proportional time segments which are produced between the leading edges of two pulses that are superimposed upon a high-frequency carrier. The results of the analysis indicate that it is possible to use such a system for telemetering purposes.

An Introduction to Single-Sideband Communications, by J. F. Honey and D. K. Weaver. "Proc. IRE." Dec. 1956. 9 pp.

Early History of Single-Sideband Transmission, by A. A. Oswald. "Proc. IRE." Dec. 1956. 4 pp.

SSB Receiving and Transmitting Equipment for Point-to-Point Service on HF Radio Circuits, by H. E. Goldstine, G. E. Hansell, and R. E. Shock. "Proc. IRE." Dec. 1956. 6 pp.

Conversion of Airborne HF Receiver-Transmitter from Double Sideband to Single Sideband, by H. A. Robinson. "Proc. IRE." Dec. 1956. 6 pp.

Problems of Transition to Single-Sideband Operation, by N. H. Young. "Proc. IRE." Dec. 1956. 4 pp.

Problems of Transition to Single-Sideband Techniques in Aeronautical Communications, by J. F. Honey. "Proc. IRE." Dec. 1956. 7 pp.

The Application of SSB to High-Frequency Military Tactical Vehicular Radio Sets, by R. A. Kulinyi, R. H. Levine, and H. F. Meyer. "Proc. IRE." Dec. 1956. 14 pp.

Single-Sideband Techniques Applied to Coordinated Mobile Communication Systems, by A. Brown. "Proc. IRE." Dec. 1956. 5 pp.

Single-Sideband Techniques in UHF Long-Range Communications, by W. E. Morrow, Jr., C. L. Mack, Jr., B. E. Nichols, and J. Leonhard.

A Suggestion for Spectrum Conservation, by R. T. Cox and E. W. Pappenfus. "Proc. IRE." Dec. 1956. 4 pp. Possible spectrum assignment changes are suggested which lend weight to arguments in favor of SSB operation. Aside from elimination of lower sidebands, more precise frequency control now possible suggests reduction of guard bands for further savings of spectrum space.

Power and Economics of Single Sideband, by Ernest W. Pappenfus. "Proc. IRE." Dec. 1956. 3 pp. Size, weight, floor area, and prime equipment costs are compared between SSB and AM equipment. The authors favor SSB in h-f communications systems.

Application of Single-Sideband Technique to Frequency Shift Telegraph, by C. Buff. "Proc. IRE." Dec. 1956. Tests show that frequency shifts as low as ± 30 cycles for single printer and ± 50 cycles for four-channel time-division multiplex are practicable, providing ultra-stable oscillators or afc are used.

Frequency Control Techniques for Single Sideband, by R. L. Craiglow and E. L. Martin. "Proc. IRE." Dec. 1956. 6 pp. Harmonics and subharmonics of a single stable crystal oscillator can be combined to produce a multiplicity of accurate and stable channel frequencies.

A Third Method of Generation and Detection of Single-Sideband Signals, by D. K. Weaver. "Proc. IRE." Dec. 1956. 3 pp. The method described differs from conventional filter or phasing methods in its lack of sharp cutoff filters or wide-band 90° phase-difference networks. A further unique feature is that malfunction causes the unwanted sideband to appear as an inverted modulation superimposed on the desired sideband, thus eliminating adjacent channel interference.

Automatic Telephone System and Operational Freedom, by F. Etzel. "Nach. Z." June 1956. 8 pp. The operational freedom of an automatic telephone system, i.e., its adaptability to all requirements resulting from the development of telephone traffic, is one of the most important criteria for planning and operating telephone installations. Generally valid terms of reference for the criticism of the operational freedom are compiled. The operational freedom of the most important automatic telephone systems is discussed on the basis of large experience and many publications.

Curved Passive Reflector, by E. Bedrosian. "El." Dec. 1956. 3 pp. An analysis of curved-reflector performance is made on the basis of the aperture-field method. Practical results are presented.

Single-Sideband in the Amateur Service, by G. Grammer. "Proc. IRE." Dec. 1956. 5 pp. The broad categories of equipment in current use are described, and some of the problems peculiar to a service in which several modes of radiotelephony are used simultaneously in a frequency band, without channelization, are discussed.

Comparison of SSB and FM for VHF Mobile Service, by H. Magnuski and W. Firestone. "Proc. IRE." Dec. 1956. 6 pp.

SSB Performance as a Function of Carrier Strength, by W. L. Firestone. "Proc. IRE." Dec. 1956. 10 pp.

Design of a High Power Single-Sideband VHF Communications System, by J. W. Smith. "Proc. IRE." Dec. 1956. 6 pp. Some of the factors influencing the design of a 40-kw, duplex, VHF system are presented.

Polarization Discrimination in V.H.F. Reception, by J. A. Saxton and B. N. Harden. "Proc. BIEE." Nov. 1956. 4 pp. Practical discrimination limits in the 40-200 MC band are the results of measurements described in this article.

Synchronous Communications, by J. P. Costas. "Proc. IRE." Dec. 1956. 5 pp. Advantages of the synchronous AM (double sideband) system over SSB are presented. Effective transmission and reception techniques are explained.

Traffic Transmitter, by J. Henry. "Toute R." Nov. 1956. 3 pp. This small transmitter consists of a one-stage quartz-crystal oscillator, a frequency doubler, an amplifier and a power supply. It may emit telegraphic signals or telephone signals on either 80 meter or 40 meter waves.

The Phase-Shift Method of Single-Sideband Signal Generation, by D. E. Norgaard. "Proc. IRE." Dec. 1956. 18 pp.

The Phase-Shift Method of Single-Sideband Signal Reception, by D. E. Norgaard. "Proc. IRE." Dec. 1956. 9 pp.

Reducing Distortion in Mobile Radio Systems, by W. C. Babcock and R. V. Crawford. "Bell. Rec." Nov. 1956. 5 pp. Distortion areas between co-channel transmitters and means of reducing or circumventing these effects in mobile communications are discussed.

Automatic Tuning Techniques for Single-Sideband Equipment, by V. R. DeLong. "Proc. IRE." Dec. 1956. 9 pp. The article covers such points as servo systems, gain control, sequencing of control circuits, and protection of tubes during tuning cycles.

Factors Influencing Single-Sideband Receiver Design, by L. W. Couillard. "Proc. IRE." Dec. 1956. 3 pp.

Single-Sideband Operation for International Telegraph, by E. D. Becken. "Proc. IRE." Dec. 1956. 7 pp. SSB operation with multiple subcarriers and automatic frequency control is pointed out as permitting a high order of frequency utilization efficiency.

Scatter SSB Technique Uses Power Klystron, by G. M. W. Badger. "El." Dec. 1956. 4 pp. A power klystron providing improved distortion, linearity, and efficiency characteristics is used for SSB forward scatter communication.

A Stable Radio Receiver Tuner, by W. R. Harter. "El. Mfg." Nov. 1956. 2 pp. Silver ribbon tuning elements are molded in a stable ceramoplastic to provide frequency stability approaching that of a crystal oscillator in a 20—70 MC radio receiver tuner. Design and construction techniques are discussed.

Some Aspects of Intermediate Frequency Filters in Receivers, by J. Carteron. "Cab. & Trans." Oct. 1956. 16 pp. The properties of lattice band-pass filters using piezoelectric crystals as filter elements are discussed; one-crystal and two-crystal networks are considered. Adjustment of the attenuated band as well as of the pass band is studied.

COMPONENTS

Low Resistance Thermistors as Ultra-Cold Thermometers, by Dr. H. B. Sachse. "El. Ind." Jan. 1957. 3 pp. New thermistors are described which are suitable for use in liquid oxygen temperature measurement and control.

Thermistor Monitors Tube Exhaust Process, by R. L. Korner and G. N. Rieger. "El. Ind." Jan. 1957. 3 pp. Indirect temperature measurement is obtained by use of a thermistor unit. Application discussed is tube exhaust process.

Location of Maximum Loading Errors in Potentiometers, by D. A. Landauer. "El. Des." Nov. 1, 1956. 2 pp. Linear potentiometers give nonlinear outputs when loaded. The author tells how the point of maximum error can be found and demonstrates the importance of this point. A graphical solution is offered for a common range of load ratios.

Designing Iron-Core Inductances, by J. H. Davis. "El. Des." Nov. 15, 1956. 3 pp. The special case of the inductance carrying both dc and ac current components is explored. Design data and essential design steps are given.

Sequential Flow Cooling of Electronic Equipment, by P. Meissner. "El. Mfg." Dec. 1956. 6 pp. Applications, problems, and design techniques for the sequential cooling of electronic components are discussed. Article derives from work performed at NBS in a study of shipboard electronic equipment.

Wrapped Electrical Connections Made Automatically, by S. J. Begun. F. Rosenthal, R. F. Krejci, and V. J. Galati. "El. Mfg." Dec. 1956. 8 pp. Several major producers of radio and TV equipment are now using solderless wrapped connections made by hand-held wrapping tools. An automatic machine to make wire wrap connections is described. Punched tape programming is feasible with this machine.

Terminals for Sealed Apparatus, by R. F. Squires. "Bell. Rec." Nov. 1956. 4 pp. Rubber-sealed, molded phenolic-sealed, glass-sealed, copper-glass, fluorocarbon resin-sealed, molded plastic-sealed, gasket-sealed ceramic, and solder-sealed high alumina ceramic terminals are considered.

Electromechanical Filters for 100-KC Carrier and Sideband Selection, by R. W. George. "Proc. AIRE." Sept. 1956. 6 pp. Following a general discussion of a torsional type mechanical filter and its termination by mechanical and electrical means, the author presents a detailed description of the design, fabrication, and frequency adjustment of two, one-piece multiple section filters for 100 KC.

Printed Distributed R-C Networks, by A. B. Smith and G. Cooper. "El. Mfg." Nov. 1956. 6 pp. Construction, performance, and applications of several distributed components are described. Included are: the series resistance-capacitance equivalent, the distributed low-pass filter, and the open and short circuited resistance-capacitance lines.

Flexible Printed Conductor Cables, by C. R. Heck. "El. Mfg." Nov. 1956. 2 pp. Applications and advantages of laminated printed conductor cables are discussed. Unique suggestion is use of flexible printed conductor as wiring harness.

Electromechanical Filters for Single-Sideband Applications, by D. L. Lundgren. "Proc. IRE." Dec. 1956. 6 pp. Longitudinal and torsional mode electromechanical filters are considered. Limits at present are approximately 50 to 600 KC, but production considerations point to 200—250 KC as preferable.

Silicon Carbide Varistors: Properties and Construction, by H. F. Dienel. "Bell Rec." Nov. 1956. 5 pp. Construction, characteristics, and performance of silicon carbide varistors are discussed.

Calculation of the Operating Characteristics of Two-Phase Servomotors and Tachometer-Generators, by G. M. Kasprzhak, E. I. Slepushkin. "Avto. i Tel." Sept. 1956. 17 pp. The paper provides a method for calculating the electrical and mechanical quantities which characterize the operating regime of a symmetrical two-phase asynchronous motor in the general case of an asymmetrical supply. An explanation is given of the phenomena which occur when asymmetrical micromachines are cut in.

On The Measurement of Attenuation in Ultrasonic Delay Lines, by M. Redwood and J. Lamb. "Proc. BIEE." Nov. 1956. 8 pp. A theoretical and experimental study into the effects of coupling films on the propagation of compressional waves from a transducer to a solid medium.

Environmental Tests for Embedded Electronic Units, by C. A. Harper. "El. Mfg." Dec. 1956. 4 pp. Increasing use of encapsulated electronic units and subassemblies has led to this study comparing polyester-and epoxy-embedded units. Tests include temperature, altitude, thermal shock and aging, humidity, salt spray, fungus attack, and mechanical shock and vibration.

International ELECTRONIC SOURCES

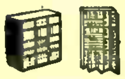
A Polarized Relay with a Ball Armature, by A. Svoboda. "Avto. i Tel." Sept. 1956. 1 p. This paper gives a brief description of a new relay device recently developed by Czech engineers.

Cathode-Follower Type Power Supplies, by B. J. Perry. "El. Eng." Dec. 1956. 4 pp. Grid controlled rectifier tubes are compared to the simple series stabilizer for use in variable voltage power supplies. Performance of a combination of these circuits is given and a practical circuit described for use in electrophoresis equipment. Low frequency instability problems are mentioned.

Rectifiers and Circuits for DC Relays, by F. W. Parrish. "El. Des." Nov. 15, 1956. 3 pp. Germanium and silicon power diodes are being added to the traditional rectifiers for relay operation. Methods of preventing chatter, circuit variations, and special rectifier applications are discussed.

The Production and Testing of Potted Circuits, by T. C. B. Talbot. "El. Eng." Dec. 1956. 5 pp. Techniques used in small production runs of a hundred or less potted circuits are described. Development steps are stressed. Development and application of special test gear for use with potted circuits are described.

Characteristics of Tantalum Electrolytic Capacitors, by A. Lunchick and E. Gikow. "El. Mfg." Dec. 1956. 6 pp. These Signal Corps engineers discuss the evaluation of tantalum electrolytic capacitors on the basis of dc leakage, dissipation factor, low-temperature characteristics, and changes due to high temperature, voltage, and humidity.



COMPUTERS

How to Filter for Perfect Pulse Patterns, by R. F. Biloon. "El. Eq." Dec. 1956. 2 pp. Commutating pulse-forming circuits introduce discontinuities; even highly polished commutators and brushes will have surface discontinuities causing bounce. The author discusses a low-pass electronic filter to eliminate distortions.

Human Bottlenecks in Data Systems, by B. Benson. "Auto. Con." Nov. 1956. 2 pp. Although presented in a humorous vein, the article contains a careful analysis of man as a component. The author examines the input, processing, and output facilities of man, and illustrates various levels of utilization of each function required in various applications of man as a component. In closing, the author presents a six-point outline for the guidance of system designers.

The Field of Magnetic Tape-Recording Heads, by H. Nottebohm. "El. Rund." Nov. 1956. 2 pp. An approximate expression for the field strength in the gap is derived. This leads to a graphical representation of the field showing lines of equal field strength and equal direction of the field. Curves indicating the field strength components in the direction of the band extension and at right angles thereto are illustrated with the distance from the gap plane as parameter.

Document Processor Reads Coded Dots, by R. L. Fortune. "El." Dec. 1956. 5 pp. A dot coding and readout system is described.

Philosophy of Automatic Computers, by L. Bouthillon. "Onde." August-Sept. 1956. 15 pp. The contribution of automatic computers in the automation of industrial processes is outlined and related philosophical, economical and social aspects are considered. Computers for solving mathematical problems as well as computers for automatic translation, imitation of animal behavior, "artificial brains" are treated.

The "Bull" Magnetic-Drum Computer, by H. Paesler. "El. Rund." Nov. 1956. 3 pp. An additional 64 track magnetic drum in combination with a 64 unit magnetostrictive storage device for 12 decimal digits each has been developed to cooperate with the "Bull" program-controlled digital computer. Details of the storage device, the program code, and the operation of the computer are outlined.

Pulse-Width Modulation Element Is Used to Investigate Pulse Control Systems on an Electronic Simulator, by M. A. Shneidman. "Avto. i Tel." Oct. 1956. 11 pp. The paper analyzes the circuit of a pulse-width modulation element. When this element is combined with existing electronic simulators it permits simulation of pulse control systems. It is shown that the most rational design of such circuits is based upon decision amplifiers.

"Gamma" Magnetic-Drum Electric Computer. "Onde." August-Sept. 1956. 8 pp. A detailed description of the "Gamma" computer developed by the Compagnie Française de Machines Bull is given. Basic operations are explained and applications mentioned.

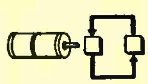
Principles of Operation and Production of a Parallel Binary Adding Machine, by M. Bataille. "Onde." August-Sept. 1956. 8 pp. Operating principles and circuit development are set forth. Information on standardized parts developed for this apparatus is included; interchangeability and reliability are stressed.

Direct Reading Pulse Counter, by C. N. Williamson. "El." Dec. 1956. 2 pp. In the operation of this device, an input pulse triggers a binary counter to generate a balanced square wave which is amplified and detected in a magnetic detector circuit. Pulse output is rectified and averaged by a d'Arsonval meter movement to give an indication of pulse frequency.

The Problem of the Approximate Solution of Differential Equations in Terms of Partial Derivatives by Means of Analog Computers, by E. S. Kozlov, N. C. Nikolaev. "Avto. i Tel." Oct. 1956. 7 pp. The paper describes the various units of the analog computer by means of detailed block diagrams. The principles of operation of the units are briefly described and analyzed.

Considerations on the Principles of Universal Numerical Computers, by F. H. Raymond. "Onde." August-Sept. 1956. 10 pp. An attempt is made to explain the operation of universal numerical calculators to non-specialists. The number equivalent in a computer is explained as well as digital methods; the automatic features in a prescribed program is outlined.

An Automatic Method of Solving Mathematical Problems Using an Electronic Arithmetic Computer, by L. Gaudfernau. "Onde." August-Sept. 1956. 10 pp. A simple numerical method to be used in connection with electronic computers is presented. No knowledge of the analytical solution is required, the method being based on numerical calculations. Examples are included. The method is adaptable to complicated mathematical problems.



CONTROLS

"Chopper" Amplifiers and Their Application in Servo-Systems, by Ia. E. Gukailo, S. M. Fedorov. "Avto. i Tel." Oct. 1956. 8 pp. The paper describes the operating principles of several variants of "chopper" amplifiers consisting of polarized relays with external excitation and with self-excitation. Typical curves are given for the function $U_{out} = f(U_{in})$; an approximate derivation of this function is given for a "chopper" amplifier with external excitation. The paper also points out the most important features of applying "chopper" amplifiers in servo-systems.

Digital Codes for Numerical Control, by W. H. T. Holden. "El. Mfg." Dec. 1956. 7 pp. A survey of existing codes and their applications is presented.

Extremity-Controller for Turbine Drilling of Oil Wells, by Iu. I. Ostrovsky, M. G. Eskin. "Avto. i Tel." Sept. 1956. 15 pp. The paper analyzes corrective circuits for the optimum automatic control of maximum turbine drill speed. Various types of extremity-control devices are described, and data is presented for their industrial performance.

The Use of D-Subdivision for Plotting Root Loci and for Analyzing the Performance Characteristics of Feedback Control Systems, by Iu. A. Gopp. "Avto. i Tel." Sept. 1956. 10 pp. D-subdivision is used to plot families of curves which consist of straight lines parallel to the imaginary axis. This makes it possible to calculate the root loci (which are defined as the curves that describe the variation of the real and imaginary components of the roots of the characteristic equation) as a function of the variable parameters. This also permits the establishment of the optimum parameter values which ensure the specified transient performance. The method is illustrated by means of a numerical example.

Evaluation of Feedback Control System Performance on the Basis of Reserve Stability with Respect to Modulus and Phase and with Respect to the Quantity M, by M. V. Meerov. "Avto. i Tel." Oct. 1956. 6 pp. The paper critically examines the method of evaluating system performance on the basis of reserve stability with respect to the modulus and phase obtained from the amplitude-phase characteristic of an open-loop system, and with respect to magnitude of the peak M of the amplitude-frequency characteristic of a closed-loop system. A comparison is made with other frequency-analysis methods of performance evaluation. The concepts which establish the limitations of this method are presented.

Determination of Optimum Controller Parameters for the Control of Objects Which Have a Lag, by S. A. Levitan. "Avto. i Tel." Sept. 1956. 4 pp. The paper presents a simple method for determining the optimum parameters of a controller. This method is based upon an analysis of the over-all time characteristic of the control system. In performing the computations on an integrator it was assumed that the controlled object was equivalent to a lag element and to a single-capacity (inertial) element. The lag element was simulated by means of an element that can be represented by fourth-order differential equation. The controller was assumed to have a proportional element and an integrating element.

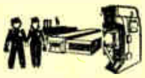
A Synchronous Filter-Oscillator for Remote-Control Frequency Units, by V. L. Inosov, A. M. Luchuk. "Avto. i Tel." Oct. 1956. 5 pp. The paper describes a narrow-bandfrequency relay (filter) which is combined with an oscillator. Its principle of operation is based upon the coincidence (synchronism) or non-coincidence between the frequencies of the signal and of the local oscillator. The phenomenon of "clamping" the local oscillator with the signal voltage is utilized. A phase-detecting circuit containing an integrator is used in order to detect synchronism.

The Synthesis of Parallel Corrective Networks for Servo-Systems by the Method of Logarithmic Frequency Responses, by S. M. Fedorov. "Avto. i Tel." Sept. 1956. 6 pp. The paper demonstrates a method for effecting the transition between logarithmic amplitude responses. Such an operation considerably simplifies the synthesis of parallel corrective networks.

Control Circuits Using Temperature-Compensated Thermistors, by W. Dietrich. "El. Rund." Nov. 1956. 4 pp. Conditions for compensating the effect of ambient temperature variations on thermistors in control circuits are studied. Suitable indirectly and directly heated thermistor arrangements are discussed and the dependence of temperature of different thermistor types is set forth.

Controlling the Drill Feed When Using Cutting Engines for Well Drilling, by D. I. Marianovsky. "Avto. i Tel." Oct. 1956. 10 pp. The paper determines the control parameters for which the controller which regulates the drill feed operates in a stable manner. The cutting engines are assumed to have either "hard" or "soft" characteristics. Two circuits are given for the feed controller; these circuits maintain a constant maximum rate of depth increase when a cutting engine with a "soft" characteristic is used.

The Effect of Over-All Feedback Upon Multi-Stage Magnetic Amplifiers, by N. P. Vasilieva, M. A. Boiarchenkov. "Avto. i Tel." Oct. 1956. 7 pp. The paper examines the effect of over-all negative feedback upon the speed of response of multi-stage magnetic amplifiers. Approximate relationships are derived which characterize the speed of response of the amplifier when electrical and magnetic feedback is used.



INDUSTRIAL ELECTRONICS

Measuring Radome Tracking Error, by J. B. Damonte and A. Getano. "El. Ind." Jan. 1957. 3 pp. Equipment is described which will provide the designer with a quick, accurate means of measuring the degree of error in a tracking system as a result of distortions introduced by the radome.

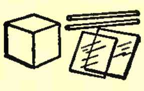
The Noise Emission of Ballasts For Fluorescent Lamps, by E. W. Van Heuven. "Phil. Tech." Oct. 20, 1956. 10 pp. Noise production in fluorescent light fixtures is centered in the ballasts. They vibrate at 120 cps to produce hum and also vibrate at high frequencies to produce rustle. Both forms of vibration result from alternating elastic and magnetostrictive deformations due to variations in current.

A Directional Radioactive Tracer Relay, by A. N. Svenson, V. P. Sigorsky. "Avto. i Tel." Sept. 1956. 8 pp. The paper examines a radioactive tracer relay which has a directional sensitivity characteristic.

Magnetic Amplifiers for High-Performing Power Servos, by G. P. deWestfelt. "El. Mfg." Nov. 1956. 7 pp. The replacement of hydraulic, thyratron, or rotating machinery controls with heavy duty magnetic amplifiers is discussed.

Levitation by Static Magnetic Fields, by A. H. Boerdijk. "Phil. Tech." Oct. 20, 1956. 3 pp. The essential factor in experiments with levitation by magnetic fields is the need for stable equilibrium. Stable equilibrium has been obtained in experiments involving a permanent magnet floating freely over a cup-shaped superconducting body. Theory predicts further limited possibilities in this direction.

Radio System Controls Railroad In Venezuela, by B. Sheffield. "El." Dec. 1956. 6 pp. Techniques and advantages of radio control instead of wire control of switches and signals on a railroad system are discussed. Extensive safety features are included in the microwave control and communications system.



MATERIALS

Copper-Inert Flexible Coil Encapsulation, by R. S. Norman, D. E. Crawford, and A. A. Kessel. "El. Mfg." Nov. 1956. 4 pp. A new butyl rubber compound has been developed which has no corrosive effects on copper wire. Authors stress suitability for low-cost, high-production rate processes. Results of the development program and evaluation tests are cited.

Potting with Epoxy Resins, by W. H. Crandell. "El. Des." Dec. 1, 1956. 3 pp. Effect of fillers and physical properties of a typical potting compound are given, with a discussion of mold design and potting procedure.

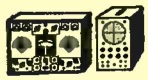
Thermenol—A New "Soft" Magnetic Alloy, by J. F. Nachman and W. J. Buebler. "El. Mfg." Nov. 1956. 7 pp. A non-strategic iron-aluminum-molybdenum structural material may result in replacement of critical nickel or cobalt magnetic alloys.

Research Progress in Dielectrics—1956, by A. E. Javitz. "El. Mfg." Nov. 1956. 10 pp. A general review of the 25th Annual Meeting of the Conference on Electrical Insulation of the National Academy of Sciences—National Research Council.

Electrical Insulation (Part 1, Dielectric Breakdown), by J. H. Mason. "El. Energy." Nov. 1956. 8 pp. Mechanisms of dielectric breakdown by internal and surface discharges, thermal instability, and chemical deterioration are discussed.

Ceramics In Electronic Design, by P. J. Lazarkis. "El. Des." Nov. 1, 1956. 4 pp. In question and answer form, the author presents a basic survey of the whole field of ceramics as applied to electronic equipment.

Encyclopedia of Electrical Insulation, by G. de Senarclens. "El. Mfg." Dec. 1956. 8 pp. This is an in-progress report containing charts showing some of the work sponsored by the International Electrotechnical Commission.



MEASURING & TESTING

Wide-Range Recording on Narrow Strip Charts, by H. B. Keller and C. G. Dols. "El. Ind." Jan. 1957. 3 pp. Main feature of this folded-scale technique is retention of maximum resolution over an extended range, contrary to conventional range expansion methods.

Insulation Resistance of Capacitors, by G. Mystic. "El. Des." Dec. 1, 1956. 4 pp. A survey of common methods for measurement of capacitor leakage resistance.

Linearity Testing Techniques for Sideband Equipment, by P. J. Icenbice, Jr., and H. E. Fellhauer. "Proc. IRE." Dec. 1956. 8 pp. Included in the discussion are descriptions, photographs, and block diagrams for audio-video and high frequency spectrum measuring instruments.

The Indirectly Heated Thermistor as a Precise A.C.-D.C. Transfer Device, by F. C. Widdis. "Proc. BIEE." Nov. 1956. 11 pp. An investigation into the possibilities of using an indirectly heated thermistor as a precise ac/dc transfer device over a wide range of frequencies is described.

A Bridge For The Measurement of Permittivity, by A. M. Thompson. "Proc. BIEE." Nov. 1956. 6 pp.

An Experimental Assessment of the Linearity of a V.H.F. Transmitter, by D. E. Hampton. "Proc. BIEE." 5 pp. An experimental procedure is described for testing the assumption that a generator behaves as a linear source.

Apparatus for the Stationary Measurement and the Oscillographic Representation of the Phase-Frequency Curve or the Group Velocity Curve, by H. Schoenfelder. "Freq." Oct. 1956, 10 pp. The apparatus described is essentially a delay distortion scanner for the rapid testing of four terminal networks and in particular of filters. Either the differential coefficient of the phase shift with respect to frequency or the phase shift as a function of frequency is measured and represented. Various circuits are presented and results illustrated.

A High Speed Oscillograph Cathode-Ray Tube for the Direct Recording of High Current Transients, by R. Feinberg. "El. Eng." Dec. 1956. 2 pp. High current transients can be displayed using a current transient oscillograph cathode-ray tube for direct signal deflection. The Y-deflector is a single-turn coil consisting of two symmetrical sections screwed together to form a compact unit placed closely around the neck of the tube.

Microwave Measuring Devices, by H. H. Klinger. "El. Eng." Dec. 1956. 4 pp. This is essentially a review of the principles and characteristics of microwave measuring equipment for radio link systems. It deals in particular with equipment for test, installation, and monitoring of link systems: measuring oscillators, frequency meters, impedance measuring devices, calibrated attenuators, wattmeter multipliers, and low-pass filters.

Transistorized Indicator Measures Jet Exhaust, by G. H. Cole. "El." Dec. 1956. 3 pp. Construction, circuits, characteristics of light, compact unit are discussed.

Measurements of the Impedance of Delay Lines, by R. Mueller. "Arc. El. Uber." Oct. 1956. 5 pp. The coupling impedance of a delay line may be measured by inserting a dielectric rod into the electric field of the line and determine either the change in the resonance frequency or the change in the propagation velocity. It is held that the conventional formulae do not apply in all instances and corrected formulae as well as limiting conditions are set forth. A comparison between theoretical and experimental results is included.

An Automatic Noise Figure Indicator, by F. L. H. M. Stumpers and N. van Hurck. "Phil. Tech." Oct. 20, 1956. 4 pp. A direct-reading noise factor meter is described which indicates the effect of amplifier alterations on noise factor.

Electronic Video-Test Image Generator with Continuously Variable Image, by W. Dillenburger and J. Wolf. "El Rund." Nov. 1956. 4 pp. The image generator produces a horizontal or vertical strip or both, i.e., a cross; the strip is either black on a white background or vice versa. Width and length of the strip and its position on the screen may be continuously varied. Circuit diagrams are included.

DC Amplifiers for Measuring Instruments Using Transistors, by H. Beneking, K. H. Kupferschmidt, and H. Wold. "El. Rund." Oct. 1956. 2 pp. A complete circuit diagram of a two-stage dc amplifier including component values is presented. Its current amplification factor is 100, its input resistance 1500 ohms. Bridges provide temperature compensation provided the collectors' characteristics are practically identical and both collectors are kept at the same temperature; negative feedback further stabilizes operations.

A TV Signal Generator for Laboratories, by E. E. Huecking. "El. Rund." Oct. 1956. 5 pp. The TV signal generator generates alternatively test spots and net pattern for the development of TV deflection systems and circuits. Design details including a circuit diagram with component values as well as performance data are included.

RADAR, NAVIGATION

A 'True Motion' Radar System, "El. Eng." Dec. 1956. 1 p. Speed and direction of one's own ship is entered into the radar display device, thus controlling the position of the electrical center representing the observing ship. The resulting display shows the observing ship progressing across the display. Periodic resetting shifts the observing ship back onto the display.

International ELECTRONIC SOURCES

Applying the Doppler Effect to Direction Finder Design, by J. A. Fantoni and R. C. Benoit, Jr. "El. Ind." Jan. 1957. 4 pp. A Doppler principle direction finder using an antenna rotation simulation system is described. A circular array of fixed antennas is scanned with a rotating switch.

Radio Astronomy and the Jodrell Bank Telescope (The Forty-Seventh Kelvin Lecture), by A. C. B. Lovell. "Proc. BIEE." Nov. 1956. 11 pp. A general description of some of the scientific characteristics of the 250 ft-aperture steerable radio telescope being built at the Jodrell Bank Experimental Station of the University of Manchester is given. Proposed uses and benefits of the telescope are outlined.

An Investigation of Atmospheric Radio Noise at Very Low Frequencies, by F. Horner and J. Harwood. "Proc. BIEE." Dec. 1956. 9 pp. Investigating technique and type of information obtained at very low frequencies are discussed.

Storage Tube Projects Radar PPI Display, by N. W. Gates. "El." Dec. 1956. 4 pp. Function and use of the Iatron storage tube for projecting displays onto a plotting surface are described. A feature of the Iatron is the use of a low intensity writing beam to scan a charge-storing layer which in turn controls intensity of flood electrons passing through to the phosphor screen.

Producing 3D Visual Patterns. "El. Des." Nov. 15, 1956. 1 p. A patented concept is described in which a three dimensional matrix of closely spaced electrodes is placed within an atmosphere suitable for glow discharge. Proper connection of a potential source to the matrix can cause glow points to appear at any predetermined point within the three dimensional matrixed space. Possible applications to the field of radar, sonar, radiation pattern mapping, etc. are suggested.

SEMICONDUCTORS

1957 Semiconductor Diode Specifications. "El. Ind." Jan. 1957. 6 pp. A complete listing of the 881 silicon and germanium diodes being manufactured in the United States by 26 manufacturers. Typical specifications are given for each diode.

Designing Transistor Circuits—Class B Amplifiers, Part 2, by R. B. Hurley. "El. Eq." Dec. 1956. 2 pp. Special types of Class B circuits are discussed from the design viewpoint.

Design Principles of Bilateral Transistors, by A. P. Kordalewski. "El. Eq." Dec. 1956. 2 pp. Theory and production techniques of bilateral transistors with high emitter efficiency are described.

Silicon Power Diode Also Handles H-F, Low-Level Signals, by A. L. Rossoff. "El. Eq." Dec. 1956. 2 pp. Newly developed silicon diodes have small junction with very high forward conductance, good cooling, and high temperature capabilities; give 85% min. rectification efficiency at 100 MC.

Transistor Thermal Resistance Measurement, by B. Reich. "El. Des." Dec. 1, 1956. Measurement of thermal resistance of power transistors is discussed both from theoretical and from practical points of view.

A Photo-Transistor Trigger Circuit, by J. H. McGuire. "El. Eng." Dec. 1956. 1 p. A transistor version of the Eccles-Jordan circuit is described in which one of the transistors is photo-sensitive. The circuit will trigger with rise in visible or thermal radiation. Components are chosen so the circuit will not be triggered by fluctuations in ambient daylight in a shaded portion of the experimenter's laboratory.

Transistorized Power Sources, by R. R. Smyth and M. G. Schorr. "El. Des." Nov. 15, 1956. 3 pp. Transistorized power sources suitable for dc to ac, and dc to dc conversion at power levels up to 30 watts have been developed. The basic transistor oscillator is described, and modifications to obtain additional desirable characteristics are explained.

Temperature Stability of Transistor Amplifiers, by G. Stuart-Monteith. "El. Eng." Dec. 1956. 4 pp. An analysis is made of the most general form of transistor dc amplifier circuit, and a figure of merit is proposed, in terms of which the current and voltage stability factors and the voltage gain can be expressed. The argument is extended to the stability of a multi-stage dc coupled amplifier.

Transistor Flip-Flops Have High Speed, by A. K. Rapp and S. Y. Wong. "El." Dec. 1956. 2 pp. Compares direct-coupled, resistance-coupled, and emitter-follower-coupled flip-flops.

A New Photocell for Long-Wave Infrared Radiation, by E. Suchel. "El. Rund." Nov. 1956. 3 pp. The photocell 61 SV consists of a lead-sulphide semi-conductor; the resistance of this conductor is proportional to the radiation intensity. The spectral sensitivity of this cell extends between 0.3 μ and 3.5 μ, the maximum is at 2.5μ. Performance data, applications, and a suitable relay circuit are presented.

Transistorized Regulated Power Supply, by M. Lillienstein. "El." Dec. 1956. 3 pp. Supply is characterized by 70 v, 1.5 amp. output with 100 mv regulation and 2.5 mv ripple. Circuits for 20 cps and 400 cps are described.

Temperature Compensation Method For Transistor Amplifiers, by A. N. DeSautels. "El. Des." Nov. 15, 1956. 2 pp. Article describes a three-stage transistor amplifier in which premature power gain losses at elevated temperatures are prevented by use of an inverse feedback loop containing a thermistor.

Push-Pull Transistor Servo Amplifier, by R. T. Henszey. "El." Dec. 1956. 3 pp. The amplifier is characterized by low signal-source impedance compared with input impedance, direct coupling of silicon transistors, and use of unfiltered collector supply.

TELEVISION

Closed-Circuit Color Trains Army Medicos, by L. E. Anderson and P. A. Greenmeyer. "El. Ind.—Operations Section." Jan. 1957. 4 pp. Army studies indicate TV has an hypnotic ability to focus students' attention. An extensive integrated system linking units of Walter Reed Army Medical Center with closed-circuit color TV is described.

How to Use NBC's New Color TV Test Signal, by R. C. Kennedy. "El. Ind.—Operations Section." Jan. 1957. 1 p. A carefully maintained standard signal, inserted during the vertical blanking interval of NBC color TV broadcasts, is explained in detail.

The Impact of Color on Video Switching, by A. D. Emurian. "El. Ind.—Operations Sect." Jan. 1957. 2 pp. A detailed analysis is given of the Philco Switching System for Television. Essential features of construction and operation are discussed, with emphasis on unusual operational features.

A Television Line Selector Unit, by P. L. Mothersole. "El. Eng." Dec. 1956. 3 pp. For observation of a single line of video signal on an oscilloscope, it is possible to use a trigger having a variable delay from some fixed point in the complete picture cycle, or the frame cycle. This article describes a unit designed to enable any normal triggered oscilloscope to display a selected line waveform.

Video Switching For TV Broadcast Centers, by E. B. Pores. "El." Dec. 1956. 4 pp. A survey of various methods of video switching, with problems and advantages of each.

TRANSMISSION LINES

Synthesis of Lossless Quadripoles from Lines with Varying Characteristic Impedance, by H. Meinke. "Nach. Z." Oct. 1956. 6 pp. Three methods to present an approximation of the characteristic impedance of such lines by the development of series are presented which reduce the problems to algebraic equations.

Cross-Talk Problems and Choice of Cable Pitch in Telephone Circuits, by J. Bourseau and H. Sandjivy. "Cab. & Trans." Oct. 1956. 26 pp. Experimental and theoretical studies of cross-talk in twisted telephone cables are reported.

A Short-Circuit Plunger for Coaxial Lines, by H. K. Ruppersberg. "Arc. El. Uber." Aug. 1956. 3 pp. The short-circuit plunger described has no fingers at the inner conductor. Its short-circuiting plane is at the terminating plane of the plunger for all wavelengths. For any wavelength above 5 cm the deviation does not exceed 1/10 mm.

Filters and Delay Equalizers for TV-Transmission Cables, by H. Keil. "Nach. Z." Oct. 1956. 7 pp. The problems of single-side band transmission over coaxial cables, such as the suppression of one side-band, the filter design for carrier frequencies and adjustable equalizers and the filter design for separation of the power and the TV signal, are the subject of this article.

Some Experiments of the Dielectric Strength of Normalized Coaxial Cables, by R. Belus. "Cab. & Trans." Oct. 1956. 9 pp. This is a report of experiments to establish the behavior of coaxial cables having a high voltage applied to their input terminals. The effects of a displacement of the center conductor, of polarization, of the length of the line, and of other pertinent factors are investigated.

The Low-Pass Filter as Coupling Element for Coaxial Cables, by U. Sandvoss. "El. Rund." Oct. 1956. 3 pp. The problem of feeding the signals from several channels, for instance TV channels, to one coaxial cable without mutual interference and with good matching conditions is presented in non-mathematical form.

TUBES

New Flat Color CRT Uses Folded-Beam. "El. Ind." Jan. 1957. 3 pp. A color TV tube having a front-to-back dimension of as little as 3½ in. is described. The tube is described as simpler to manufacture than conventional color tubes.

Cold-Cathode Trigger Tubes, by C. H. Tosseill. "Phil. Tech." Oct. 20, 1956. 14 pp. After a brief review of the operation and properties of cold-cathode trigger tubes, the author describes developmental work on two special trigger tubes for use in a radiation monitor. Molybdenum sputtering is used to get better stability, and a priming current eliminates the statistical lag. Both tubes are designed to work in self-quenching circuits.

Multiplier Photocells, by P. Thureau and G. Rouault. "Toute R." Nov. 1956. 4 pp. This is a short survey of the elementary theory and properties of multiplier photocells; dark current, background noise, etc., are discussed. A table contains the characteristics of available multiplier photocells.

Using Modern LF Tubes, by J. Bourciez. "Toute R." Nov. 1956. 4 pp. The use of modern low-frequency tubes is illustrated in the design of an amplifier. Preamplifier, amplifier, feedback, power supply and phase shift features are discussed.

Schottky Effect in Oxide-Coated Cathodes, by G. Déjardin, G. Mesnard and R. Uzan. "Vide" July-Aug. 1956. 12 pp. The current-voltage characteristic of diodes with oxide-coated cathodes have been measured in the region of normal operating temperatures. Short voltage pulses have been used. The effect of the activation and of the current on the Schottky effect is given and explained on the basis of the patches, the semi-conducting properties of the coating and its granular structure and porosity.

Guides to Tube Selection, by K. A. Pullen, Jr. "El. Des." Nov. 1, 1956. 4 pp. Included in this presentation are tube tables, calculation of peak plate dissipation, selection of current change in the tube, check list for design adequacy, design for reliability.

Plasma-Wavelength and Low-Noise Traveling-Wave Tubes, by J. Labus and R. Liebscher. "Arc. El. Uber." Oct. 1956. 3 pp. In conventional low-noise traveling-wave tubes a drift space and associated diaphragms are provided between the cathode and the helix of the tube. The length of the drift space depends on the plasma wavelengths and a reducing factor which accounts for the finite beam diameter. This reducing factor is evaluated as a function of the magnetic flux distribution along the beam, and the result is applied to the design of the drift region of a low-noise traveling-wave tube.

A Twin-Helix Traveling-Wave Tube with 50 db Gain at 4000 MC, by W. Klein and W. Friz. "Nach. Z." Oct. 1956. 7 pp. The power output tube in microwave links LW 53-V manufactured by Lorenz is described. Design considerations for a high-gain traveling-wave tube are set forth, constructional details given and test results included.

Microwave Tubes of a Wide-Band Relay System, by W. Kleen. "Arc. El. Uber." Oct. 1956. 6 pp. A relay system for either 600 telephone channels or one television channel using frequency modulation in a band between 3800 and 4200 MC is described. A reflex Klystron with very high modulation sensitivity and low distortion introduces the frequency modulation, while a traveling-wave tube is used as transmitter, feeding a directional line which leads to the antenna cable. Details of the Klystron, the traveling-wave tube and the directional line are presented.

U. S. GOVERNMENT

Research reports designated (LC) after the price are available from the Library of Congress. They are photostat (pho) or microfilm (mic), as indicated by the notation preceding the price. Prepayment is required. Use complete title and PB number of each report ordered. Make check or money order payable to "Chief, Photoduplication Service, Library of Congress," and address to Library of Congress, Photoduplication Service, Publications Board Service, Washington 25, D. C.

Orders for reports designated (OTS) should be addressed to Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Make check or money order payable to "OTS, Department of Commerce." OTS reports may also be ordered through Department of Commerce field offices.

When an agency other than LC or OTS is the source, use the full address included in the abstract of the report. Make check or money order payable to that agency.

Variables Affecting the Accuracy of Collision Judgments on Radar-Type Displays (PB 121376), by J. E. Manglesdorf. Ohio State University. Dec. 1955. 59 pp. $1.50. (OTS) The present study investigated judgments of collision courses with particular emphasis on the study of the variability of judgments as affected by the distance-to-go, the velocity, and the angle of intersection of two simulated radar targets. The psychophysical method of adjustment was employed by four subjects who made a total of 4480 judgments. Constant, average, and variable errors were calculated for each problem and were pooled for the four subjects. The resulting functions were markedly regular, and the constant and average error functions were nearly identical. matical model was developed to relate variable error and the three experimental variables of speed, distance, and angle. Both general and applied aspects of the mathematical model are discussed.

Radiation Characteristics of Circular and Semicircular Surface Sources (PB 120994), by A. I. Mahan. U. S. Naval Ordnance Laboratory, White Oak, Md. Dec. 1953. 45 pp. Mic $3.30, pho $7.80. (LC) A theoretical study of the radiation characteristics of circular and semicircular surface sources has been made, when these sources radiate uniformly over their surfaces and obey Lambert's Cosine Law. This study includes a presentation of the history of the development of such formulae from the time of Lambert in 1760 up to the present.

Radiowave Propagation. Part I: Theory of Radiowave Propagation Along the Earth's Surface (Ground Wave). Chapter VIII: Various Methods of Treating the Problems of Radiowave Propagation for a Plane, Homogeneous Earth (PB 121368), by Ia. L. Al'pert, V. L. Ginzburg, and E. L. Feinberg. 20 pp. 50¢. (OST) This report is a technical translation from Gosudarstvennoe izdatel'stvo tekhniko-teoreticheskoi literatury (1953) 1, 171-183.

Research and Development Work on Semiconducting Materials of Unusually High Electron Mobility (PB 121288), by A. C. Beer, T. C. Harman, R. K. Willardson, and H. L. Goering. Battelle Memorial Institute, Columbus, Ohio. July 1955. 54 pp. $1.50. (OTS) The compound indium antimonide was prepared in a state of high purity and its basic electrical properties were analyzed. Studies were made of the zone-refining process for InSb and the effect of a specified number of passes on both p- and n-type impurities. An investigation of impurity scattering effects was carried out by analyzing the electron mobility as a function of impurity concentration. Both theoretical and experimental studies were made of magneto-resistance effects.

Semiconducting Materials. Annual Report for the Period Dec. 1954-Nov. 1955 (PB 122683), by T. J. Gray. New York State College of Ceramics, Alfred, N. Y. Dec. 1955. 56 pp. Mic $3.60, enl pr $10.80. (LC) The zone purification technique of a simple nature can be employed to prepare starting materials suitable for the production of extremely pure single crystal specimens of semiconducting sulphides, selenides and tellurides using C.P. or even commercial materials. The feasibility of producing large crystals of certain selenides and tellurides by the Stockbarger method has been demonstrated and satisfactory specimens prepared for fundamental investigation.

Water Ripple Analogue of Electro-Magnetic Wave Propagation (PB 122131), by N. L. Walbridge, H. M. Smith, Jr., and L. A. Woodward. Vermont Engineering Experiment Station, Burlington, Vt. Sept. 1952. 88 pp. Mic $4.80, enl pr $15.30. (LC) An oscillator controlled a vibrating probe used to generate ripples on the surface of water in a tray with a glass bottom. The same oscillator controlled the pulsing of light which passed up through the tray. The ripples acting as lenses focused the light on a ground glass screen. A meniscus which was convex when viewed from above was produced around the head of the probe. This arrangement produced better ripples. A method of coincidence of images was developed which applies to attenuated ripples. This method and the use of an auxiliary lens improved the accuracy of measurement of amplitudes particularly for small ripples. Several feeds including dipole arrays were simulated and the field patterns were measured. The results of experiments on reflection can be explained by the assumption of a 180° phase change at a line behind the actual reflector. Ripple tanks can be used in the study of radar antennas since no unsolvable problems have been ecountered in the experimental developments of the analogy.

Transistor-Controlled Half-Wave Magnetic Amplifier (PB 120908), by J. J. Suozzi. U. S. Naval Ordnance Laboratory, White Oak, Md. July 1953. 24 pp. Pho $4.80, mic $2.70. (LC) A 60 cps, half-wave magnetic amplifier with transistor input is described. With this circuit a novel type of feedback for damping a servo system may be employed. In addition, the advantages of good gain with a comparatively high input impedance, and smaller time delay than are possible with a conventional two-stage, 60 cps, half-wave magnetic amplifier, can be realized.

Abstract Model for a Ferromagnet (PB 121247), by J. I. Kaplan, U. S. Naval Research Laboratory. July 1956. 8 pp. 50¢. (OTS) An abstract model for a ferromagnet is assumed in which each spin interacts with every other spin with an interaction $-(2J/N)S_1 \cdot S_2$. The energy levels and degeneracies for such a system can be calculated exactly. A correspondence principle argument shows that in the limit of large numbers the magnetization will be identical with that derived from the P. Weiss model for a ferromagnet. This is verified by a direct calculation from the partition function of the magnetization using the calculated energies and degeneracies.

Cloud Physics Research, Instrumentation of B-17 Airplane for Cloud Physics Research (PB 122351), by K. E. Newton, Chicago University. Nov. 1955. 126 pp. Mic $6.30, pho $19.80. (LC) A detailed description including photos, drawings, diagrams, graphs is given of the entire instrumentation system employed for cloud physics measurements using B-17 airplanes. Aside from meteorological information, the electronic engineer will find interest in determinations of electric field strength and the systems for time synchronization and data recording techniques. Operational difficulties experienced with some instruments under field conditions are mentioned and remedial measures are discussed.

Magnetic Tape Recording System for Pressure-Time Records of Underwater Explosions (PB 121042), by A. L. Howard. U. S. NRL. June 1956. 26 pp. 75¢. (OTS) A system was designed and successfully employed to measure pressure-time phenomena resulting from the underwater explosion of an atomic bomb, at various points between the bomb and the water surface. The data were obtained from piezoelectric pressure transducers suspended between the bomb and a barge on the surface, and were transmitted over wire circuits to a magnetic tape recording system located on the barge. As a result of an over-all recording system calibration, made automatically less than one minute before the explosion, the pressure-time measurements were highly accurate and reliable.

Piezoelectric Gauges for Underwater Pressure-Time Measurements (Part I: PB 120906), by E. A. Christian and C. R. Niffenegger. July 1953. 9 pp. Pho $1.80, mic $1.80. (LC) Deals with the aging of tourmaline gauges by underwater shockwaves. (Part II: PB 120905), by R. A. Astheimer. July 1953. 20 pp. Mic $2.40, pho $3.30. (LC) The piezoelectric sensitivity of polarized $BaTiO_3$ discs containing 4% $PbTiO_3$ was measured in the pressure range between 500 and 9000 psi and at temperatures between 0° and 44°C. The sensitivity was found to be only slightly pressure dependent but to increase sharply with decreasing temperature below about 25°C. A large relaxation effect was observed and studied.

International ELECTRONIC SOURCES

Natural Charge Distribution and Capacitance of a Finite Conical Shell (PB 122629), by S. N. Karp. New York University. Sept. 1956. 56 pp. Mic $3.60, pho $9.30. (LC) The natural charge distribution for a conical cup has been obtained without approximation. From the knowledge of the natural charge distribution the capacitance of the conical cup is obtained as well as the behavior of the charge densities at the apex and the circular edge of the cup.

Photoconduction in Phosphors. Final Report Covering the Period Sept. 1, 1949-Nov. 30, 1953 under Contract No. N6 onr-26313 (PB 122117), by J. J. Dropkin. Polytechnic Institute of Brooklyn, Brooklyn, N. Y. June 1954. 157 pp. Mic $7.50, enl pr $25.80. (LC) The basic theme of this report is that photoconducting phosphors have electrons in the conduction band. The first part of the report shows that the measured dc photocurrent is time dependent, and that the amplitude and phase of the measured ac photocurrent is frequency dependent. It is also shown that extrapolated conductances behave as though they were proportional to the number of electrons in the conduction band. Part two discusses the properties of two infrared sensitive storage phosphors, ZnS-Cu-Co and SrS-Ce-Sm, and shows how a study of trapping, luminescence, and photoconductivity helps to elucidate the mechanism of luminescense in these phosphors.

Hall Effect in the Silver-Palladium Alloy System (PB 121311), by A. I. Schindler. U. S. NRL. July 1956. 7 pp. 50¢. (OTS) Room-temperature Hall coefficient measurements have been made on the silver-palladium alloy system. A comparison of the effective number of conduction electrons calculated using a one-band model with the number obtained for the copper-nickel alloy system shows a similarity in behavior. The results cannot be explained using any of the multiband models proposed to date for the Hall coefficient.

High Purity Nickel Project (PB 122630), by S. R. Williams and P. J. Clough. National Research Corp., Cambridge, Mass. March 1954. 39 pp. Mic $3, enl pr $7.80. (LC) This report covers approximately one year's work in which a basic stock of high purity nickel was produced. Melting procedures were developed for the production of vinary alloys of closely controlled composition. Pure nickel and seventeen alloys of pure nickel containing 0 to 3% of Si, Al, Ti, Mg, B, W, RTa were produced and fabricated into tube parts for evaluation by Raytheon.

Investigation of Metallic Bonds for Barium Titanate, (PB 120983), by W. R. Turner. U. S. Nav. Ord. Lab. May 1955. 89 pp. Mic $4.80, pho $13.80. (LC) The report describes the experimental results of an investigation into the bonding of barium titanate to a metallic plate for use within a high vacuum tube. Methods tested and found unsatisfactory include silver brazing using zirconium hydride as a wetting agent, silver brazing using a silver-glass electrode fired onto the barium titanate as a base, and soft soldering using barium titanate metallized by evaporation. The principal work was on a metallic bond. The barium titanate was first coated with chromium by evaporation to form a metallic barrier. Then the bonding alloys were applied by evaporation.

Metallurgical Preparation of Fe-Si-Al Alloys (Sendust) for the Determination of Magnetic Properties (PB 121164), by J. F. Nachman and W. J. Buehler. U. S. Nav. Ord. Lab. June 1953. 24 pp. 75¢. (OTS) Contains a detailed description for the metallurgical preparation of high quality cast Sendust cores. Includes details for melting, precision casting of cylinders, and a cut-off grinding technique for cutting magnetic test rings from the cast cylinders.

Sendust Powder Magnetic Cores, a Non-Strategic Substitute for Powdered High Nickel Alloys (PB 121166), by E. Adams. U. S. Nav. Ord. Lab. June 1953. 19 pp. 50¢. (OTS) The powdered high permeability alloy, Sendust, has been investigated as a substitute material for powdered high nickel alloys, such as 2-81 molybdenum-permalloy now used in loading and filter coils. A negative temperature coefficient of permeability similar to that of cast Sendust was measured on powdered Sendust cores. The permeability of the powdered cores remains fairly constant over a wide range of flux density. The techniques for processing Sundust cores from the cast alloy are described along with the factors which most influence their magnetic properties.

Design of Magnetic Control Amplifier XM-13A (PB 120929), by H. H. Woodson, U. S. Naval Ordnance Laboratory, White Oak, Md. March 1953. 18 pp. Mic $2.40, pho $3.30.

Low Noise 215-225 MC Converter (PB 121214), by L. Hoffman. U. S. Naval Research Laboratory. June 1956. 7 pp. 50¢. (OTS) A 215-225 MC converter has been designed and developed utilizing the General Electric GL-6299 triode. The noise figure of the unit is 3.0 ± 0.2 db over the entire band, the bandwidth is in excess of one MC, and the output frequency is 30MC. The optimum source and output impedances are each 50 ohms. Special tube holders have been designed for the converter to permit quick changing of r-f amplifier tubes without disturbing the circuitry.

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

Electronic Telephone Systems, #2,769,865. Inv. A. H. Faulkner. Assigned Automatic Electric Labs., Inc. Issued Nov. 6, 1956. Conditioning of a plurality of electron tubes causes individual conversational and control paths to extend therethrough to a number storage device which is actuated by the transmission of a number representing pulse train over a subscriber line. A circuit is provided which causes completion of a conversational path through one of the tubes to the line circuit of a called line upon reception of the pulse train.

Subscription Television Receiver Translating Channel, #2,770,672. Inv. W. S. Druz. Assigned Zenith Radio Corp. Issued Nov. 13, 1956. Code signal components occurring during retrace intervals are added to the conventional TV signals. These code signals are within an amplitude range otherwise assigned to the video components. In the receiver three stages are designed to suppress this additional signal which would otherwise impair the retrace blanking.

High Frequency Amplifier with Anode to Grid Input and Anode to Cathode Output, #2,770,-720. Inv. T. Murakami and R. W. Sonnenfeldt. Assigned Radio Corporation of America. Issued Nov. 13, 1956. The input signal is applied between the grid and anode of a first tube, the cathode of which is grounded for signal frequencies and so is the grid of a second tube. The anode of the first tube is dc coupled to the grid of the second tube, and the output is derived between the anode of the second tube and ground.

Squelch Circuit, #2,770,721. Inv. J. M. Clark. Assigned Motorola, Inc. Issued Nov. 13, 1956. A first direct voltage is derived from a selected range of frequencies above voice frequencies and including higher voice frequencies, a second direct voltage of opposite polarity is derived from the received carrier, and a third direct voltage of the same polarity as the second voltage is derived from the low voice frequencies; the three voltages are combined to a control voltage which blocks the audio amplifier if the first voltage polarity is predominant.

Time-Shift Re-entrant Amplifier System for Carrier Pulses, #2,770,722. Assigned Radio Corporation of America. Issued Nov. 13, 1956. A pulse amplifier, such as a travelling wave tube, is provided with a re-entrant connection from its output coupling to its input coupling which connection includes a delay section introducing a delay greater than the duration of the input signal pulse. A signal component of a predetermined frequency is permitted to appear in the output coupling only after the input signal pulse has circulated a predetermined number of times through the amplifier; this predetermined frequency is selected at the output coupling.

Frequency Error Sensing and Signal System, #2,770,726. Inv. S. H. Fairweather. Assigned Thompson Products, Inc. Issued November 13, 1956. The variable frequency which is a measure for an error to be determined feeds in succession a phase shifter, a twin T network, a cathode follower, a delay line, and an energy coupling circuit to which the variable frequency signal is also fed. The coupling circuit supplies a comparison circuit.

Double Counter Demodulator Circuit, #2,770,-727. Inv. J. J. Hupert, A. B. Przedpelski and K. Ringer. Assigned A. R. F. Products, Inc. Issued Nov. 13, 1956. The beat frequency of the signal frequency with a higher and with a lower frequency is derived. The two difference frequencies are individually applied to two counter discriminators for producing a voltage proportional to each, which voltages are combined to result in a voltage varying in accordance with the frequency modulation of the signal.

Semi-Conductor Frequency Multiplier Circuit, #2,770,728. Inv. G. B. Herzog. Assigned Radio Corporation of America. Issued Nov. 13, 1956. The signal is connected in parallel across the input of two transistors of opposite polarity, rendering the transistors alternately conductive. A corresponding double-frequency push-pull output signal is derived from the two direct coupled collector electrodes of the transistors.

Frequency Control Circuit, #2,770,730. Inv. R. Urtel. Assigned International Standard Electric Corp. Issued Nov. 13, 1956. The phase difference between the outputs of the controlled oscillator and a standard frequency generator is measured and used as control voltage for the oscillator. The control voltage is further applied to a phase shifter inserted between the oscillator and the phase measuring device for rapid and direct frequency control.

Piezoelectric Devices, #2,769,930. Inv. R. H. Sturm. Issued Nov. 6, 1956. A moisture-proof piezoelectric transducer assembly is produced by positioning a pair of piezoelectric plates face to face, applying an electrode to one face of each plate, applying a coating of moisture-proofing material to all surfaces of the plates, and then cementing the moisture-proofed faces together.

Color Television System, #2,757,228. Inv. R. B. Tomer. Assigned CBS, doing business as Hytron Radio & Electronics Co. Issued July 31, 1956. The picture tube in a field sequential color television system has a transparent screen and three phosphor deposits for magenta, yellow and cyan light emission, respectively, symmetrically disposed on the inner screen surface. Three electron guns are arranged to each activate one of the deposits, the electron guns being mounted at a small angle with respect to one another and a perforated plate being placed in front of the screen. During reception of red field signals, the first and second guns are simultaneously energized during reception of green signals, the second and third gun, and during reception of blue signals, the first and third guns.

Carrier Frequency Control System #2,757,239. Inv. P. B. Patton. Assigned Lenkurt Electric Co., Inc. Issued July 31, 1956. A composite signal, each component having varying frequency and amplitude, is modulated at least partially onto a carrier frequency having constant amplitude. The amplitude of all components is varied inversely to its value to produce constant amplitudes, and the resulting signal transmitted over a single communication link. At the receiver, the carrier is separated and caused to vary the amplitude of the composite signal in such manner as to maintain the carrier amplitude constant.

Fig. 1: Doppler-type direction-finder, AN/TRD-8, uses 31 antennas in circular array. Shelter in middle houses equipment.

Applying the Doppler Effect to Direction Finder Design

The effect of a moving antenna is simulated by using a circular array of fixed antennas. By scanning the antennas in sequence and comparing the phase angle differences between the sampled voltages the direction of transmission can be determined and plotted.

By JOSEPH A. FANTONI and RICHARD C. BENOIT JR.

Part One of Two Parts

A direction finder classified as a Doppler type must either possess the equivalent of a moving antenna or simulate this motion by rapidly switching fixed antenna elements. From Doppler's principle for Wave Motion as applied to radio waves, we know that the frequency of a received signal differs from that of the transmitted signal when the receiver is moving in the direction of wave travel. In an idealized Doppler direction finder system, the motion is obtained by moving a receiving element in a circular path. (Fig. 2.)

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When a single signal is received by a moving antenna, the received signal frequency modulated. The peak frequency deviation of the signal in cycles per second, by Doppler's principle, is

$$\Delta f = \frac{R\omega}{C} f_c$$

where ω is the angular velocity of the antenna in radians/sec, R is the radius in feet of the circular path of the antenna, f_c is the frequency of the incident signal in CPS, and C is the velocity of light in ft/sec.

In a complete revolution of the antenna, the instantaneous frequency varies from

$$(\Delta f + f_c) \text{ to } (\Delta f - f_c) \cdot$$

When a single receiving element is uniformly rotated in a horizontal plane the received signal is phase-modulated sinusoidally at the frequency of rotation. In Fig. 2 at Position A, the antenna is moving perpendicular to the wave front, away from the source, and the induced signal has the same instantaneous frequency as the wave in space. Although the frequency change at Position A is zero, the rate of change is a maximum, and is negative. The frequency change at B is a maximum and is negative, but the rate of change of frequency is zero. At position C, the frequency change is zero. The rate of change is a maximum and is positive. At D, the antenna is traveling in the direction of arrival and toward the source. The induced signal has a maximum positive change of frequency and a zero rate of change.

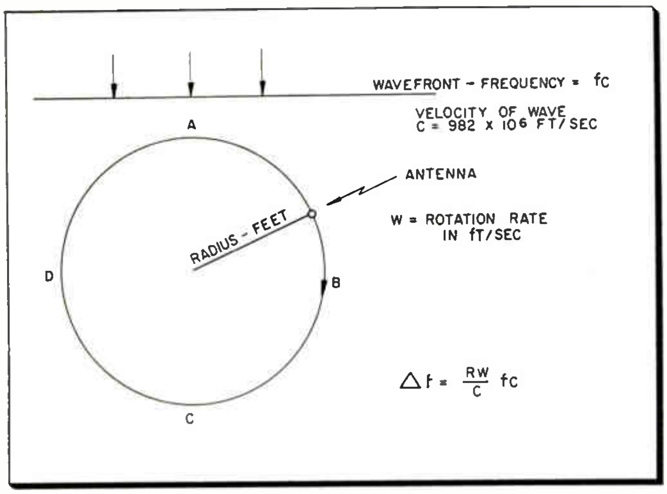

Fig. 2: The idealized Doppler system has the receiving element moving in a circular path.

By demodulating the phase-mod-

Direction Finder (cont.)

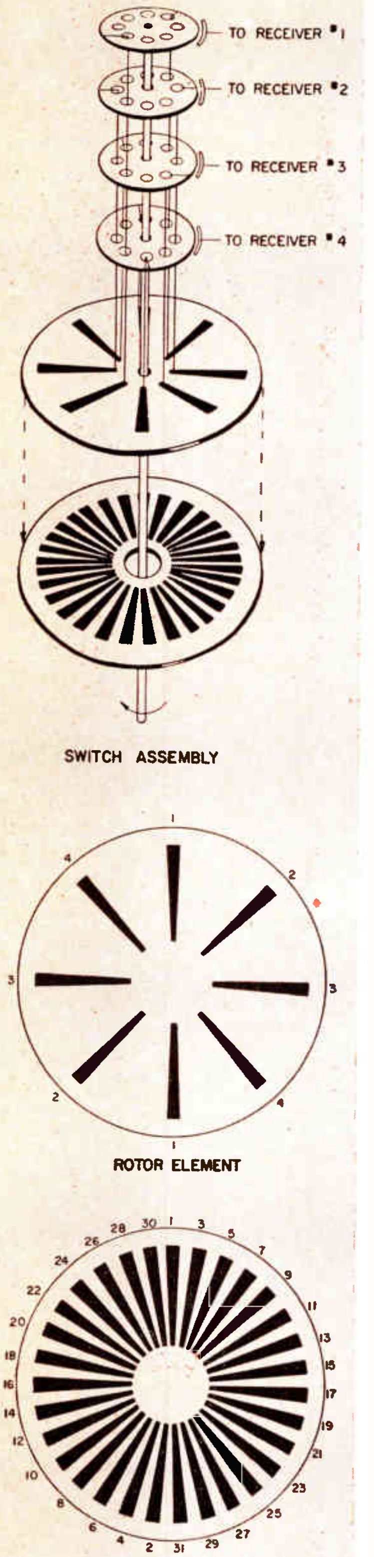

Fig. 3: Mechanical design of switch used for sampling voltages from various antennas

ulated, received signal and comparing the phase of this sinusoidal voltage to a reference phase generated by the antenna motion, the relative phase angle then can be measured. This is the bearing angle of the received signal.

Principle Of Operation

In the development of the AN/TRD-8, the equipment we are discussing, the antenna speed required to produce an adequate degree of frequency modulation over the range of 1.5 to 30 MC was considered to be virtually impossible to attain in a single rotating antenna system. Instead, the rotation was simulated by placing a number of fixed omnidirectional antennas in a circular array and scanning the antennas with a rotating switch. The use of fixed antennas made it possible to employ a larger aperture array—a necessary requirement for improvement of bearing accuracy.

An overall view of the Doppler h-f direction finding system is shown in Fig. 1. The operating shelter contains the system equipments, receivers, bearing indicators, etc.

A signal received from a distant transmitter induces voltages of equal amplitude in all antennas of the array. The phase difference between the signals in adjacent antennas is determined by the frequency and the direction of arrival of the signal. The word "phase" refers to the phase of an r-f signal at one point with respect to the phase of the same signal at a fixed reference point at the same instant.

For example, the signals in the various antennas, at any one instant of time, will have a phase relationship as shown in Fig. 5 for the frequency, antenna spacing, and direction of arrival specified.

The numbered crosses indicate antennas and the numbered vectors show how phase differences between adjacent antennas vary. The maximum phase step between adjacent antennas will be found between those which fall on a line most nearly parallel to the direction of wave travel. The minimum phase step occurs between antennas that are on a line perpendicular to the direction of wave travel.

The antennas of the array are scanned in sequence. It must be remembered that the vectors in Fig. 5 will be revolving very rapidly with respect to the motion of the mechanical switch take-off element. However, at any one instant the relative phase relationships between the various antennas would be as shown in Fig. 5 for a given signal frequency. The relative phase relationship between the various antennas remains fixed, regardless of the time of viewing, the motion of the scanning switch, or any other event in time.

Signals from adjacent antennas are, therefore, combined during the scan to produce a frequency modulated signal. The frequency deviation at every instant is proportional to the size of the phase step between adjacent antennas. The phase of the envelope of the frequency modulation is dependent only upon the direction of arrival of the signal from the distant transmitter. A bearing indicator compares the phase of the modulation envelope with a reference phase and presents the bearing indication on a crt.

Scanning Switch

To scan the circular array of fixed antennas required a suitable mathematical law by which signals from the antennas could be combined to produce the desired frequency modulated signal, and the selection of an electronic or mechanical approach for performing the switching function.

The mechanical, capacitively-coupled, scanning-switch was selected for its simplicity and ease of maintenance as compared to all-electronic scanning switch designs.

The capacitively-coupled-scanning switch was also suited to blended switching or a linear law of coupling. A linear law of coupling was found to closely approximate the sinusoidal variation of phase and frequency obtained in the case of the single rotating antenna.

Fig. 4 illustrates how signals from adjacent antennas are combined in the scanning switch.

At the time t_2, for example, the

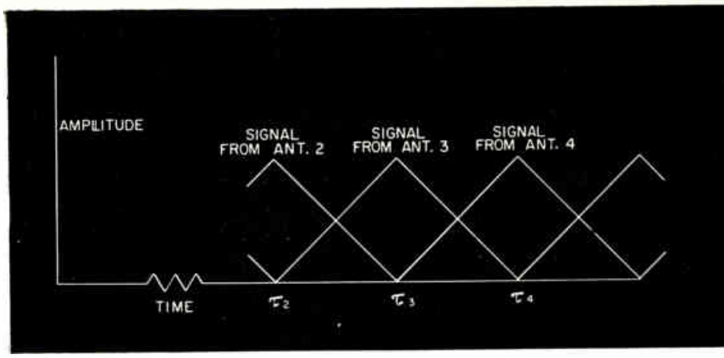

Fig. 4: Signals are combined in the scanning switch

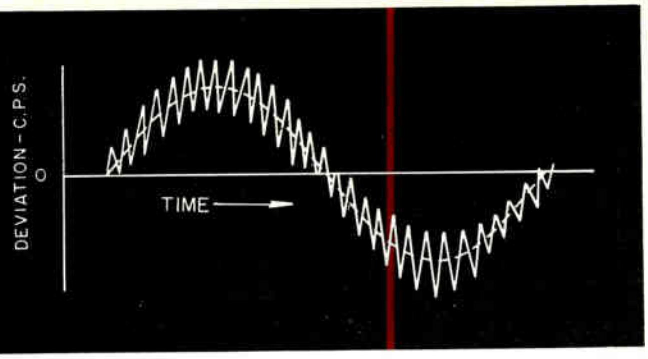

Fig. 6: Frequency deviation pattern for complete scan

signal from Antenna 2 only is coupled into the receiver. As time passes, the signal from Antenna 2 is linearly reduced until it reaches zero at t_3. Meanwhile, the signal from Antenna 3, which was zero at t_2, is linearly increasing until it reaches a maximum at time t_3. The time from t_2 to t_3 occupies 1/31 of the total time for one scan of the array, since 31 antennas are used.

The linear blending of the signals from antenna to antenna yields a signal output which changes its phase from that of the signal from Antenna 2 to Antenna 3, etc.

Fig. 3 shows the mechanical design of the switch.

The switch is composed of a motor-driven rotor consisting of a circular Mycalex plate with eight metallic segments connected in pairs, numbered and positioned as shown. Thirty-one similar metallic segments are positioned on the single Mycalex stator plate. The thirty-one antennas arranged in a circle are connected to the stator segments as numbered.

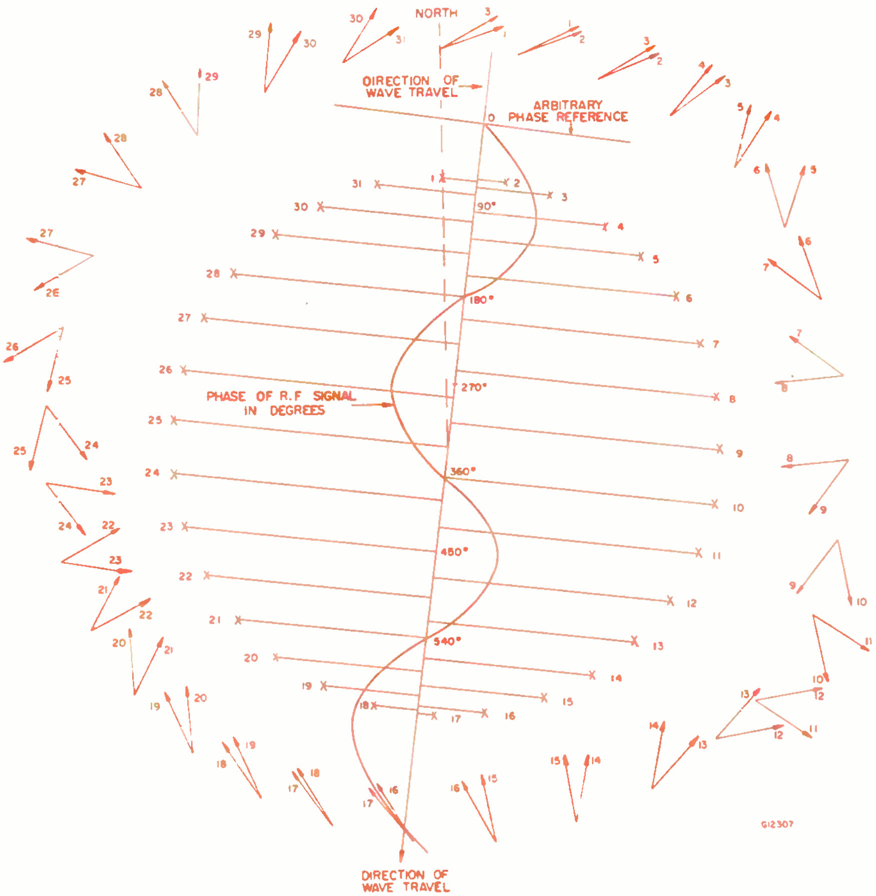

Fig. 5: Relative phase relationships at each antenna around the array

This scanning switch design permits the antenna array to be scanned twice during each revolution of the switch shaft. Four receivers are fed from a single antenna array, providing simultaneous direction-finding on four frequencies.

The rotor-to-stator spacing is approximately .005 in. in order to obtain sufficient capacitive coupling. Four Mycalex discs having metallic rims and rotating synchronously with the rotor are used for coupling the signals into four receivers. Coupling is accomplished by capacitive coupling from the stator to the main rotor section, then fed to the four upper discs having metallic rings and capacitively coupled to fixed take-off plates.

In Fig. 6 is the "spiked" shape frequency deviation pattern of the signal for a complete scan of the array.

In actual operation the number of "spikes" will depend upon the number of antenna elements employed in the array. The individual "spikes" represent the frequency deviation as the scanning switch moves from the signal phase of one antenna to the signal phase of the next.

The phase of the fundamental component of the waveform, as shown in Fig. 6, varies with the direction of arrival.

Its peak deviation varies with the frequency of the received signal. At 1.5 MC, the fundamental peak deviation for the described system is approximately 30 CPS. At 30 MC it is approximately 600 CPS.

The scanning rate of the switch was set at 42 CPS in order to keep the signal bandwidth at 30 MC within the conventional 3 KC bandwidth of the receiver.

The scanning switch voltage gain vs. r-f frequency characteristic for

(Continued on page 147)

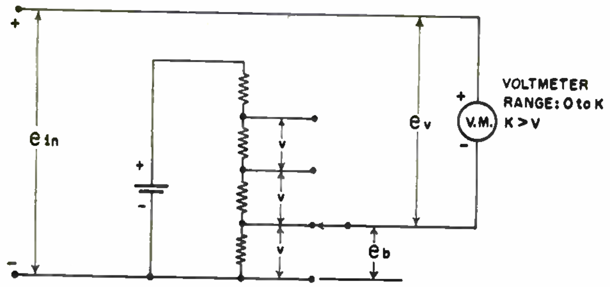

Fig. 1: Simple scale expansion (zero suppression) circuit

New technique utilizes automatic stepping switches to control the direction of chart movement and pen travel and provide a "folded-scale" which is a multiple of the recorder's basic range. A hundred-fold multiplication of the recorder's range can be attained.

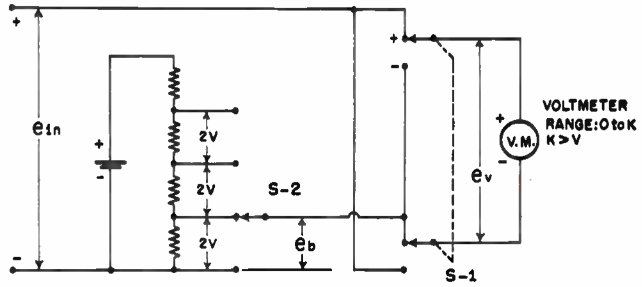

Fig. 2: "Up and down" scale expansion circuit

Wide-Range Recording On Narrow Strip Charts

BY H. B. KELLER AND C. G. DOLS

In normal recorder practice, wide range and high resolution are in conflict. It is possible, however, to devise a system which will provide wide range recording with no sacrifice of resolution. Consider the simple scale expansion circuit in Fig. 1. Here $e_{in} = e_b + e_v$, e_b is the "bucking potential" and e_v is the potential at the voltmeter terminals. If $e_b = nV$ (where n is any integer from zero to n inclusive), and if the voltmeter scale covers the range from zero to V, any e_{in} between zero and $(n + 1)$ V can be measured.

The circuit we use is shown in Fig. 2, in which $e_{in} = e_b \pm e_v$. When $e_b = 2nV$ (n as above) and the voltmeter scale covers the range from zero to V, any e_{in} between $-V$ and $(2n + 1)$ V can be measured. This circuit differs from the one shown in Fig. 1 in that: (1) for a given number of steps, twice the range is covered, and, more important, (2) with a slow voltmeter (such as a self-balancing potentiometer) the indication of e_{in} is interrupted only while the switches are moving from one position to another. (In the system of Fig. 1, the indication is interrupted while the voltmeter indicator moves from V to zero or from zero to V, when e_b is stepped.)

Table 1 is an example of the operation of our expansion system (Fig. 2).

H. B. KELLER & C. G. DOLS, Radiation Laboratory, Department of Physics, University of California, Berkeley, California.

Table 1: Increase e_{in} from zero to 2.5V.

Sequence	e_{in}	e_b	S-1	Relation	e_v
1	0	0	+	$e_{in}=0+e_v$	0
2	$0<e_{in}<V$	0	+	$e_{in}=0+e_v$	$0<e_v<V$
3	V	0	+	$e_{in}=0+e_v$	V
4	Reverse S-1, Step increase S-2 to 2V.				
5	V	2V	−	$e_{in}=2V-e_v$	V
6	$V<e_{in}<2V$	2V	−	$e_{in}=2V-e_v$	$V>e_v>0$
7	2V	2V	−	$e_{in}=2V-e_v$	0
8	Reverse S-1.				
9	2V	2V	+	$e_{in}=2V+e_v$	0
10	$2V<e_{in}<3V$	2V	+	$e_{in}=2V+e_v$	$0<e_v<V$
11	2.5V	2V	+	$e_{in}=2V+e_v$	.5V
Now reduce e_{in} to zero.					
12	$3V>e_{in}>2V$	2V	+	$e_{in}=2V+e_v$	$V>e_v>0$
13	2V	2V	+	$e_{in}=2V+e_v$	0
14	Reverse S-1.				
15	2V	2V	−	$e_{in}=2V-e_v$	0
16	$2V>e_{in}>V$	2V	−	$e_{in}=2V-e_v$	$0<e_v<V$
17	V	2V	−	$e_{in}=2V-e_v$	V
18	Reverse S-1, Step decrease S-2 to zero.				
19	V	0	+	$e_{in}=0+e_v$	V
20	$V>e_{in}>0$	0	+	$e_{in}=0+e_v$	$V>e_v>0$
21	0	0	+	$e_{in}=0+e_v$	0

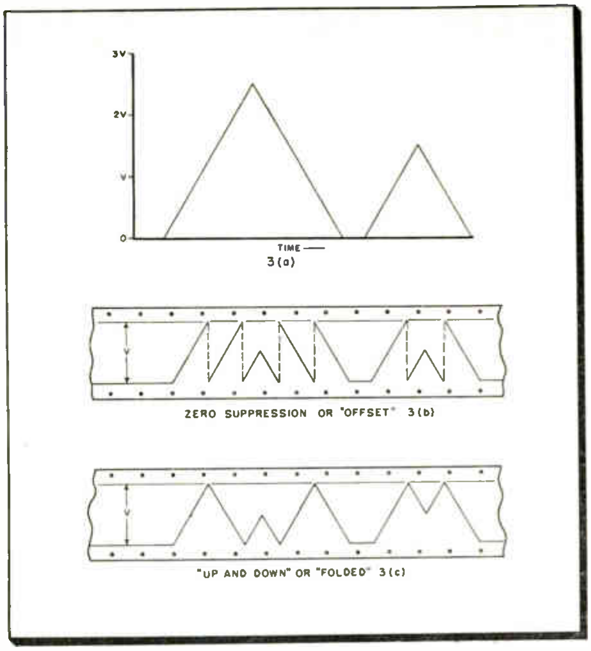

Fig. 3: Narrow charts display high resolution data

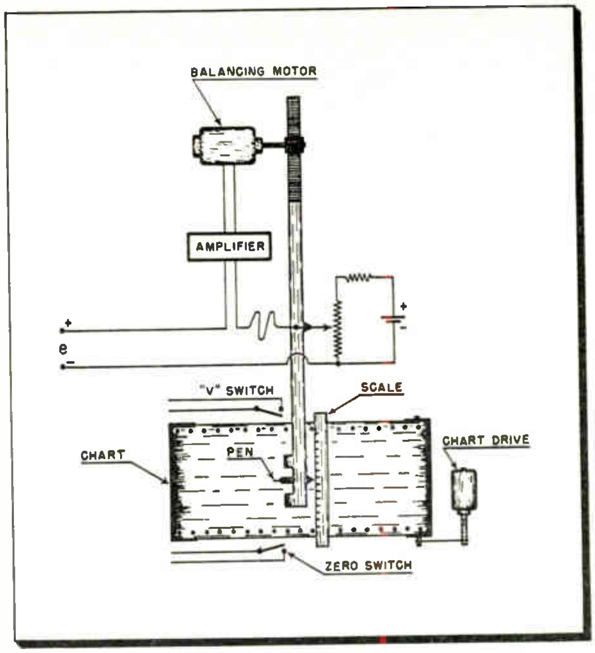

Fig. 5: Elements of self-balancing recording potentiometers

The sequence of Table 1 can be generalized as follows: (a) When the voltmeter reaches its lower limit, reverse its polarity. (b) If e_{in} is increasing and the voltmeter reaches its upper limit, reverse its polarity and increase e_b one step. (c) If e_{in} is decreasing and the voltmeter reaches its upper limit, reverse its polarity and decrease e_b one step.

In Fig. 3, a curve (a) is repeated on narrow charts (b, c). The system of Fig. 1 results in a series of offset segments of the original curve (Fig. 3b). The Fig. 2 method folds the curve between the lines $e_v = 0$ and $e_v = V$ (Fig. 3c).

Automatic Scale Expansion

The circuit of Fig. 1 lends itself readily to automatic scale expansion. If the voltmeter is equipped with switches which operate at zero and at V, operation of the "V" switch indicates that e_{in} is increasing (de/dt is positive) and calls for $e_{b2} = e_{b1} + V$ (S-2 steps up). Operation of the "Zero" switch (indicating de/dt is negative) calls for $e_{b4} = e_{b3} - V$ (S-2 steps down). This method is being used successfully with a slowly varying input. A one hundred times scale expansion, recording resistance thermometer has been described by D. C. Stull[1]. A. J. Williams of Leeds-Northrup Co. has described a preliminary commercial model of the Stull instrument[2].

Figure 4 is a generalized schematic representation of a device which operated S-1 and S-2 of Figure 2 automatically. We call this automatic device a Lobetrol. The Lobetrol senses and responds to the conditions a, b, and c listed under Basic Scale Expansion Circuit. Condition "a" is met by reserving the position of S-1 each time the "Zero" switch is operated (at $e_v = 0$). When the "V" switch is operated (at $e_v = V +$) the Lobetrol must decide whether condition "b" or condition "c" applies, and act accordingly. If S-1 is in normal (plus) position and the voltmeter pointer is moving toward "V" an increasing e_{in} (input voltage) is indicated. Therefore, if S-1 is *plus* when the V switch is closed S-1 is reversed and S-2 is stepped *up*. If S-1 is minus and the voltmeter

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Fig. 4: Automatic range extension system

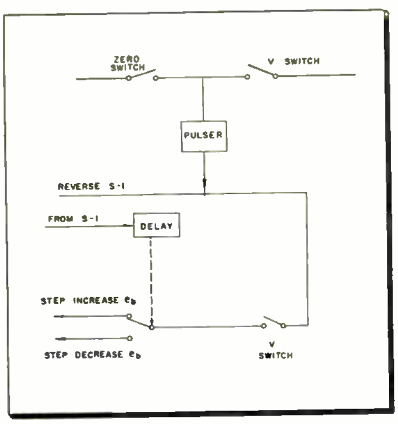
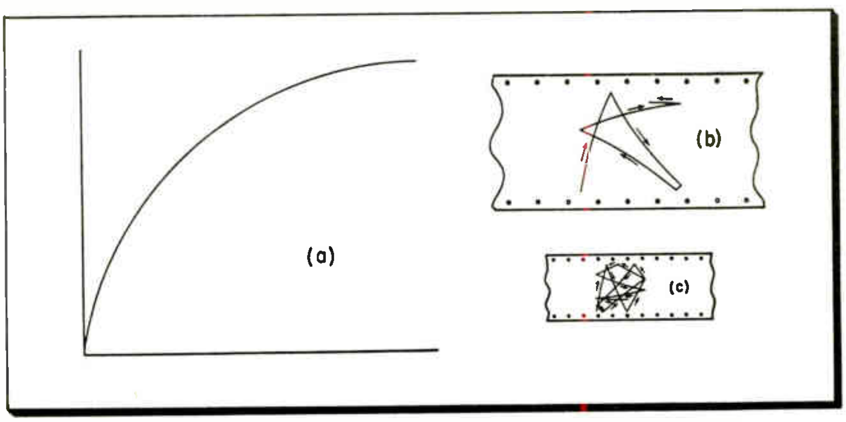


Fig. 6: Conventional vs. folded plots (resolution identical)



New Flat Color CRT Uses Folded-Beam

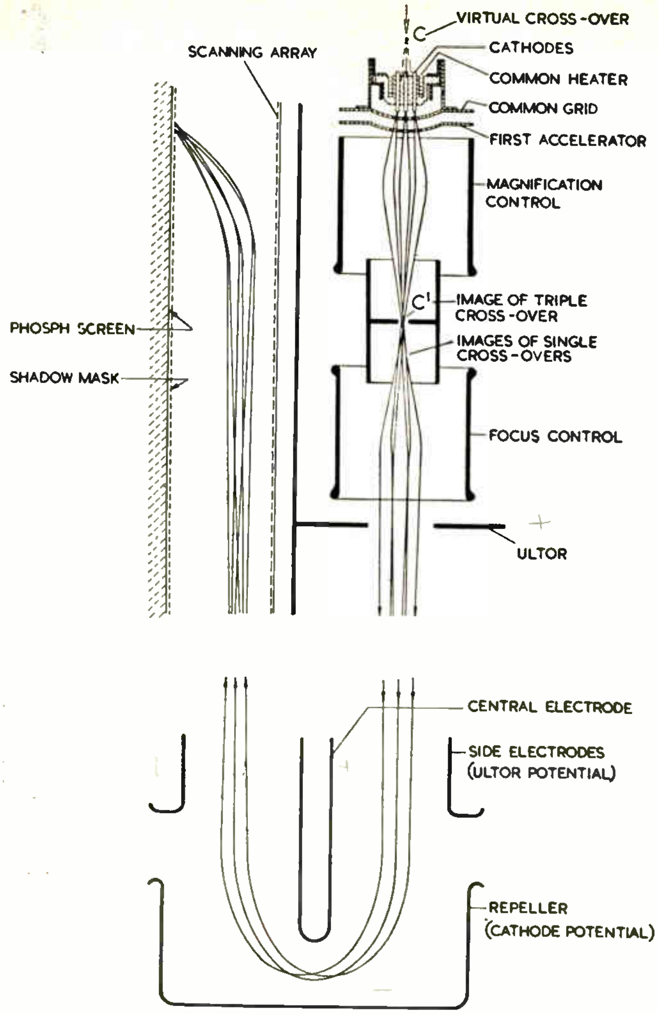


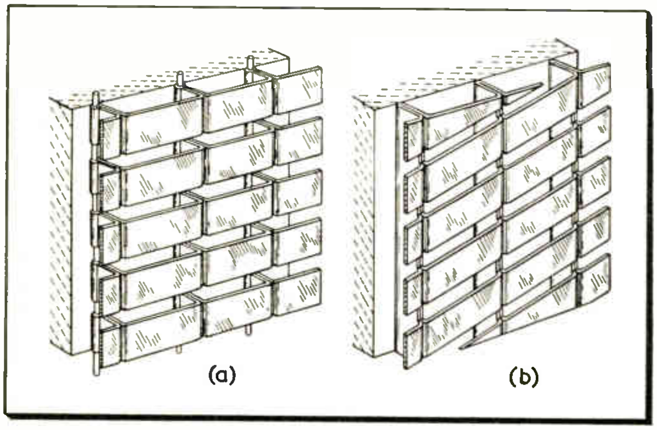
Fig. 1: The three electron guns and their beam paths.

FOR more than four years, Dr. D. Gabor, F.R.S., of the Imperial College of Science and Technology in London, Eng., has been working on his invention of a flat TV tube which has a depth of between 3½ to 4½ in., according to the size of picture required.

Dr. Gabor's first Patent application to cover this invention was made in Washington, D.C., on September 15, 1952.

The main interest of the new tube is its flat shape, which makes it possible to hang it on the wall like a picture or stand it on the mantelpiece. Even more interesting are its advantages as a color tube. From a manufacturing viewpoint, it is more complicated than a conventional monochrome TV tube, but simpler to make than the known color tubes. Associated production equipment is greatly simplified.

Fig. 2: Shadow masks; (b) slanting avoids moire effects.



A partly sectional view of a flat color tube is shown in Fig. 3. It has the shape of a flat glass box. The total depth can be made about 3½ in. for a screen with a 12 in. diagonal, and about 4½ in. for a 21 in. diagonal.

The tube is divided in depth into two halves by a metal tray which carries the whole electron optical system and serves at the same time as a magnetic screen. The electrons start vertically downwards from an electron gun behind this screen. The electron gun has three independently modulated cathodes, one for each color, but with a common lens system for handling them.

X-deflector

The beams next pass through an "X-deflector system" which deflects them horizontally, and then through two "trimmer" pairs which serve for compensating misalignments, and from these into the "reversing lens." The reversing lens can be considered as a lens with curved optic axis, of very unconventional design, which has four electron-optical functions. It converts the plane fan of rays issuing from the X-deflector into another plane fan, but with about four times greater divergence. Moreover, it compensates the over-focussing effect which is inseparable from electrostatic deflection to such an extent that the beam remains in perfect focus during the scanning of a horizontal line. The divergence of the beams after leaving the reversing lens may be as much as 110-120°.

The beams then pass through a "strong-focussing"

Key to this unique design is a "reversing lens" that bends the electron beam through 180°, permitting gun to be placed close to screen. Design eliminates need for vertical oscillator, and results in tube depth of 3½ to 4½ in.

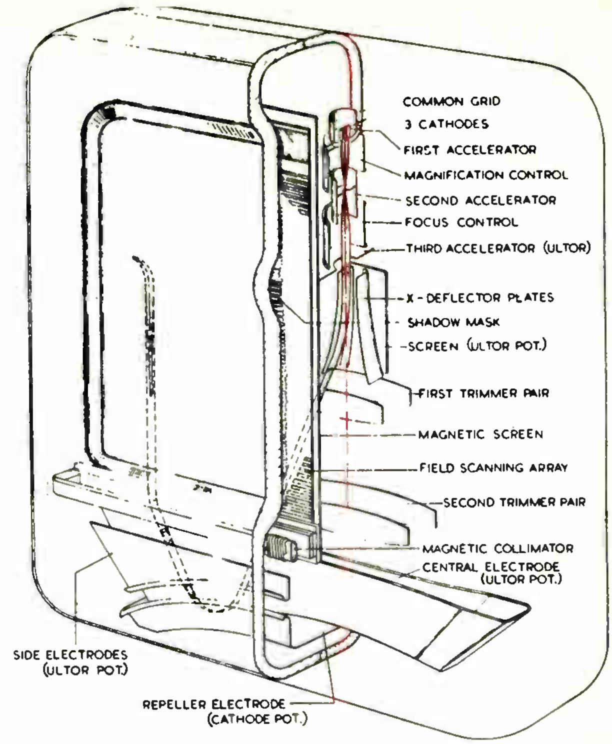


Fig. 3: Sectional view of the flat color tube.

electromagnetic lens, called the "collimator", which bends them back to the vertical so that the beams perform their scanning motion at the front side like vertical rods. Finally, on reaching a certain level, the beams are bent towards the horizontal and fall on the screen.

This final bending and the vertical scanning motion is achieved in an essentially novel way, which is illustrated in Fig. 4. In front of the metallic plate which acts as a magnetic screen, and at a distance of approximately ⅛-in. from it, there is a component called the "scanning array". This is a system of parallel conductors printed on a flexible, insulating base.

In the plane central part of this insulating foil, the array consists of horizontal conducting lines. Their number, about 120, has no direct relation to the line number in the picture. At the two sides, where the base is bent round in two U-shaped loops, the conducting lines are staggered upwards, as shown. They are not connected with anything; their charging and discharging is effected by the electron beam itself.

Operation

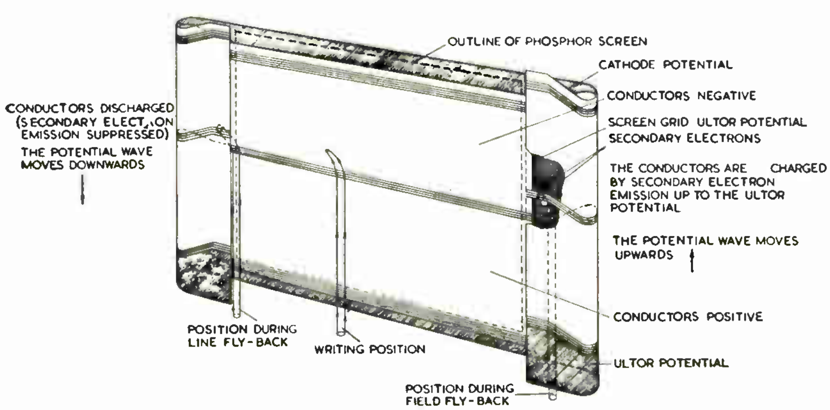
In operation, a potential wave travels down this array vertically. Up to a certain level, the conductors are charged up to the maximum positive potential; about this, with a transition zone extending over a few conductors only, they are at about one-quarter this voltage. When the beam on its upward travel reaches the transition zone, it is bent towards the screen (which is at the maximum positive potential all the time) and is focussed at the same time. This is because a strong electrostatic beam deflection always produces a certain amount of focussing.

When the beam has completed a line scan and flyback, it rests for a moment (5 to 6% of the time) in the loop at the left and falls on the conductors in the transition zone. These are partially discharged, thus moving the transition zone a little downwards. The current is so adjusted that this displacement is equal to one line width in the picture.

Once started, the transition zone automatically runs down as a wave of potential variation until it reaches the bottom of the picture. The line scan is now stopped so that the beam rests in the loop at the right. This is similar to the other loop, but with the difference

(*Continued on page* 110)

Fig. 4: A novel way of achieving bending and vertical scanning.



Permeability tuning and the use of a 6021 triode as a reactance modulator at 205 MC are the keys. Theory, design, and operation are disclosed.

By BERNARD B. BYCER

A New Approach in R-F

B. B. Bycer

With the advent of airborne electronics, the trend is to increase the reliability of equipment even though severe environmental conditions have been imposed. Simplicity and reduction has been the rule and with this in mind, the tuner shall require a minimum of components and still give optimum performance. A high degree of stability must exist with an ease of reproducibility.

The data presented here concerns only the tunable r-f head. To present a complete set of data, standard crystal control i-f amplifiers and output systems are utilized.

Oscillator Reactance Modulator

Sweep generators and reactance oscillators were investigated. One common factor about them was no cathode degeneration due to the modulation signal. For dc input to the reactance tube at a grid tie point, the tube would perform as a cathode follower if a cathode resistor was present. A Hartley osc. would give a larger reactance control at the expense of tracking difficulty and possible hum modulation from the heater cathode leakage.

BERNARD B. BYCER, was affiliated with Tele-Dynamics Corp., Phila., Pa. when this material was written. Mr. Bycer is presently a Staff Engineer, Radio Corp. of America, Camden, N. J.

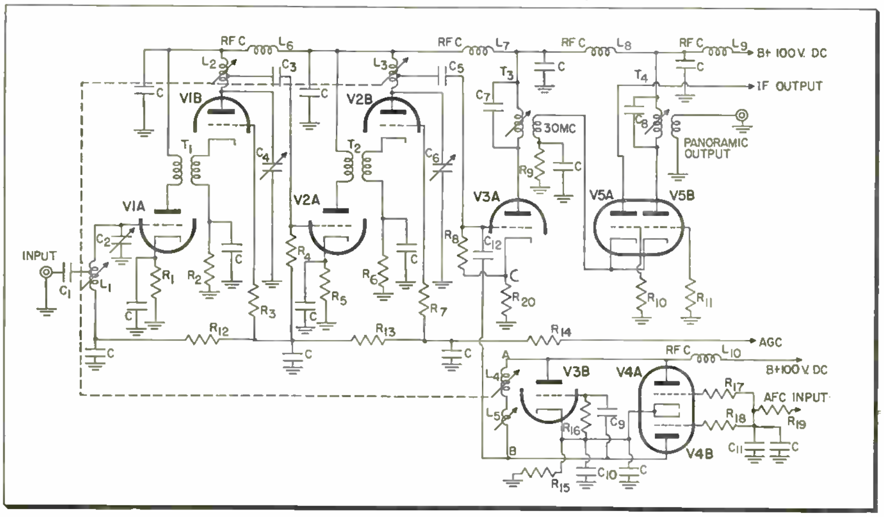
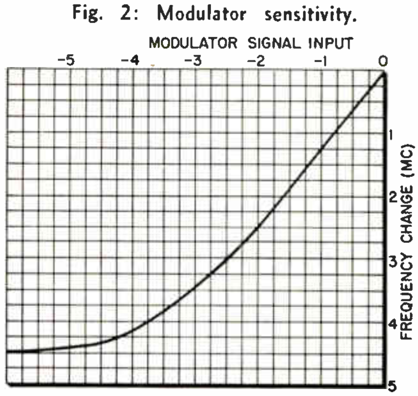


Fig. 1: Oscillator reactance modulator. Interelectrode capacities form tank capacities for Colpitts osc., V3B. Reactance modulators, V4A and V4B utilize grid-plate capacitance and grid resistor as phase shifting network.

A Colpitts osc. was desirable since more turns could be used while the interelectrode capacities formed the tank capacity. The cathode is at r-f ground reducing as much as possible any hum introduction occurring with ac filament operation. The tube type used is a 6021. Its low interelectrode capacitance and high g_m make it possible to use this tube as an osc. and as a modulator.

Referring to Fig. 1, tube V3B is a Colpitts osc. Since the anti-resonant tank is above r-f ground, and the phase relation of points A and B are 180°, there exists an r-f ground. This ground is established in feedback loop maintaining oscillation. It is the sum of all interelectrode capacities plus external condensers that help to achieve the

Fig. 2: Modulator sensitivity.



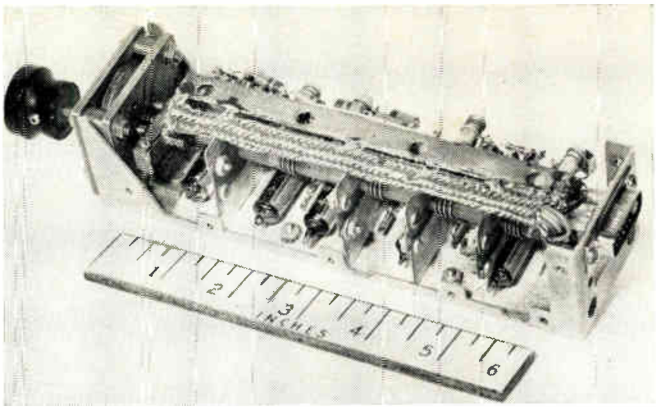


Fig. 3: Early model tuner achieved 3 MC reactance range.

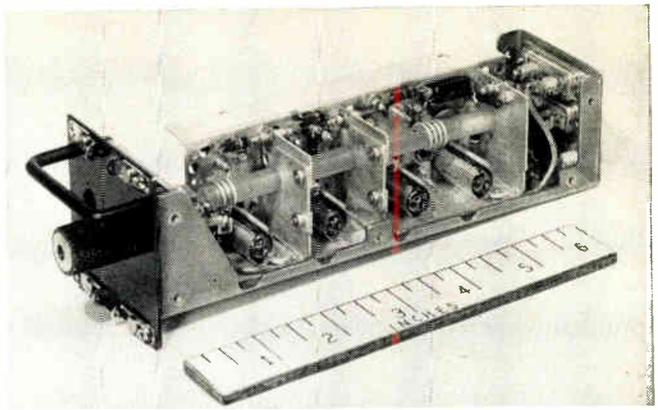


Fig. 4: Prototype head. Reactance range increased to 4.25 MC.

Front-End Design

proper feedback. Tube V4A is a reactance modulator utilizing its C_{PG} and grid resistor as a phase shifting network. This also applies to V4B. The operation of the modulators V4A and V4B is such as to present a variable capacity from points A and B respectively, to r-f ground.

Using a triode as a reactance modulator at 205MC is difficult. The C_{PG} is large reducing the permissible drive on the grid of the phase shifting network. Another difficulty, the R_p of the tube at or near zero bias is small.

In the case of the 6021, the value of the R_p near 6.5v bias is 70K while near zero bias it is only 5K. Preliminary work proved that oscillation failed when the modulator tubes were operated more positive than —2v. The range of grid swing of the modulator tubes V4A and V4B was small and critical. Any cathode resistor inserted in the modulator circuit such as R-15 of Fig. 1 to prevent exceeding the plate dissipation of V4A and V4B and maintaining a high R_p reduces the reactance presented to the osc. tank. This resistor is only necessary for zero-bias operation and is detrimental in operation for lower voltage operation of the modulator.

The oscillator and the reactance modulator are not in a common bottle, preventing mechanical reactance change in the circuit. At a B+ source of 100v, the osc. shift is ±25KC for $\mp$1v change of B+.

First Prototype

When the final layout, Fig. 4, was completed and checked, the r-f head had a pass-band from below 30MC to greater than 235MC. A band-pass filter could have been used, but an anti-resonant circuit with one resonant frequency was used to couple from one stage to another and the tracking coil was center-tapped. Three turns were needed as tuning elements in the r-f amplifiers. The osc. padding coil was placed between the reactance tube and osc., spreading the tubes apart. The net result was a reduction of all lead lengths concerning this circuit and reactance range increased from 3MC to 4.25MC.

R-F Coupling

Series tuning in the VHF region reduces the amount of shunt capacity across the coil permitting convenient magnitudes of lump constants. Instability and low gain are obtained with this type of circuitry. In Fig. 5a, the series tuning method is shown for the input and interstage coupling. The coil having terminals A and D is resonated by the capacity in series going from points A to D. As the voltages across C_{PK} and C_{GK} are in antiphase, there will be a point in L which is at zero r-f potential. The damping across the coil is the combination of the plate output impedance and the grid input impedance to r-f ground. The input is greater in capacity and has a lower impedance. This loads down the coil and voltage step-down exists. The terminal impedance of this network has a pole at zero frequency and a pole at the resonant frequency. By Foster's Theorem, there exists at zero impedance between the pole frequencies and at infinite frequency. This occurs at a series resonance of L and one side of the network. Although the terminal impedance is zero at one side, there is a high short circuit current through L and the other capacitor. The transmission through the network at zero terminal impedance is only 10 to 1 down in voltage (20 db loss) as compared to the desired resonant frequency. Broad characteristic of the circuit and the desired frequency at 215MC to 235MC made it impossible to meet the required electrical performance. Coupling between the output and input circuits is often due to the common ground lead. It should be recognized that the impedance of the chassis ground is by no means negligible. The layout should preferably be such that the currents of the output and input circuits do not flow through the same part of the chassis. In Fig. 5a when the grid lead is removed from point D, the tank circuit through ground points C and E are broken by the removal of C_{GK}.

The tuner was changed to the circuitry shown in Fig. 5b. One

(*Continued on page* 84)

turn had to be removed to obtain the desired frequency band. This circuit has one pole at the desired resonance and the ground loop is confined to its stage. At 240MC, if the grid lead is removed, the resonant frequency increased to 260MC. An external condenser of less than 0.5μμf across points A and D is all that is needed to lower the frequency back to 240MC. The shunting effect of the grid circuit has been considerably reduced. The merits of increased selectivity and gain are disclosed by a comparison of two tuners.

Noise Figure

In comparing a single frequency r-f head and the tunable head of this article, both used the tube type 6021 as Wallman Amplifiers (bifilar coupling), with the same values in the mixer circuit and output circuit. The single channel r-f head had a neutralizing coil in the first amplifier using series resonances double-pass filter and twice the tuning elements. Both used the same 30 MC amplifier and output systems and had a noise figure of 6db for the r-f and i-f amplifiers. The tunable r-f head was 20 db greater at the image frequency than the single channel tuner. The grid load on the tank circuit of the single channel head helped to give a wide response and lower gain. Under these conditions of identical circuitry, the noise factor of the tunable head should be 2.5 db greater. With high "Q" coils (175 unload) and less grid loading, it was possible to achieve these results by having a smaller band pass and higher gain. Better results could be obtained in the input circuitry, if the antenna input was tapped lower to ground and the grid input was centertapped rather than across the coil. Fabrication is difficult and so the circuitry remains as shown in Fig. 1.

To further substantiate the importance of narrow r-f bandpass with increased gain, and better noise figure, earlier laboratory reports have disclosed noise figures of the same magnitude of a tuner utilizing a triode-pentode combination but not subminiature in design nor conducive to airborne environmental conditions. The success of this head is the unique geometric configuration of the inductance. The unload "Q" of this coil is better than 200.

R-F Amplifier Circuit

The VHF r-f amplifier is a low-noise grounded-cathode grounded-grid stage using a 6021 twin triode. The relatively high g_m of this tube, 5400 micromhos per section, permits high gain and reduced equivalent noise resistance. The low grid-plate and plate to cathode interelectrode capacities must be considered at these frequencies.

The application of a Wallman circuit with the power supply of 100 volts is a problem. In television receivers, the cascode r-f amplifiers are direct coupled, eliminating the bifilar winding or ac coupling techniques. The two bifilar coils have self-resonant frequencies at 450 MC and 850 MC unloaded. The first bifilar coil in the circuit resonates at 215 MC and the other at 240 MC. Both coils have spurious frequencies in the region of 350 MC to 450 MC.

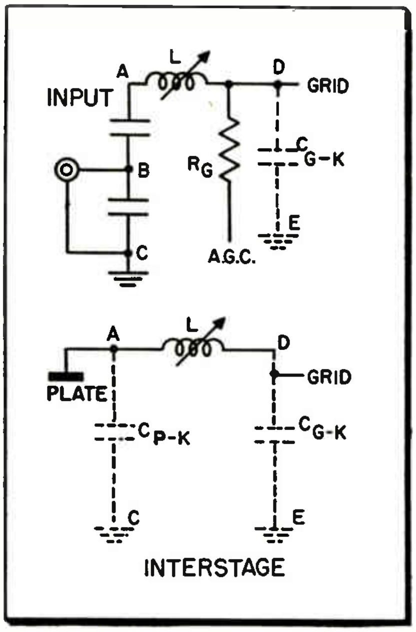


Fig. 5a: R-F coupling. Grid lead removal breaks tank circuit through C and E.

Actually, the 6021 is being used at the upper end of its capabilities as a grounded cathode amplifier. In tuning from 215 MC to 235 MC, the self resonance of the bifilar coils also shift better than 5 MC in the 215 MC to 240 MC region. Without any neutralizing coil, the grid to plate feed-thru of the grounded cathode stage presents a low impedance to the input circuit. At the high end of the dial, a spurious frequency better than 60 db can be increased by 20 db by putting in the proper type slug in the bifilar form at the expense of reducing the image frequency from an undetermined value to 80 db down. In other words, depending upon electrical specifications, a wide latitude of coil values, are available for the desired performance.

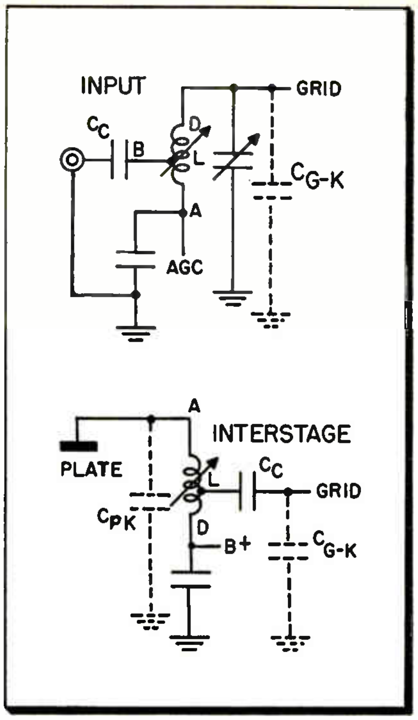


Fig. 5b: R-F coupling. Grid lead removal increases resonance from 240 to 260 MC.

Tracking

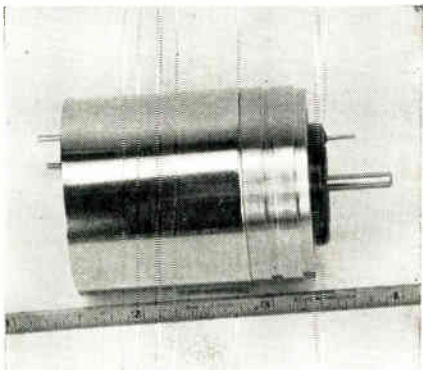
Tracking is not a problem. The oscillator is tracked with the dial calibration. The r-f selectivity is quite broad. A battery is used in the AFC input to shift the oscillator ±2 MC and the coils are spread and squeezed slightly so that a flat response of 4MC is achieved at each center frequency of the dial. The tracking coils allow for permeability tuning a ¼ in. silver plated

(*Continued on page* 132)

Plant & Laboratory New Products

PHASE SHIFTER

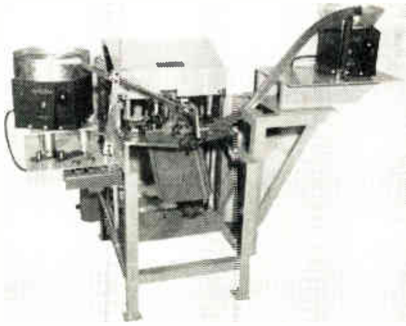
Model V 59 Variogon is one of a new group in which a continuously variable phase shifting capacitor and driving network, including the transformer, are combined. This provides



in one housing a complete system to give linear phase shift versus shaft angle continuously with an accuracy from ±0.5°. Only a sine wave power supply of good waveform is needed to drive this unit. Frequency of operation is approximately 20 KC to 500 KC. These units are used to establish accurate timing systems. Size is 2¼ in. x 1½ in. exclusive of shaft and terminals. **Nilsen Mfg. Co., Addison, Ill.** (Ref. No. 1-36).

CAPPING MACHINE

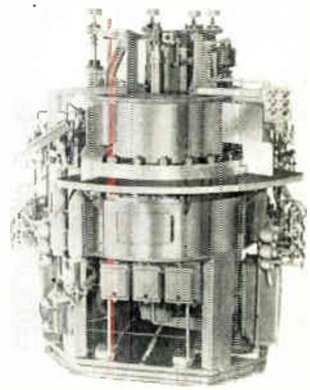
A machine of interest to resistor manufacturers is a fully automatic resistor capping machine. Designed for high production capping of resistor bodies with press fitted terminal



caps, this machine may be tooled for a variety of resistor bodies ranging in size from 1/16 in. to 5/16 in. in dia. Machine features vibratory hopper feeds which automatically maintain full chutes for uninterrupted operation. Caps are fed at 100 per minute so that 2000 resistors are assembled per hour. Also available is a machine to fit end leads internally. **Halm Instrument Co., Inc., Glen Head Rd., Glen Head, N. Y.** (Ref. No. 1-37).

BUTTON STEM MACHINE

To fill ever increasing needs for high-precision button stems of endless varieties, a new series of automatic machines has been designed. Typical of this group is number 2741 which



produces 8-wire, 10-wire, 20-wire button stems and a variety of other styles with tubulations. Number 2741 is a 24-hand machine incorporating 4 press positions with upper molds. It can manufacture from 500-600 precision units/hr. Provision is made for quick and easy stem style change. To further facilitate servicing, the machines' individual heads are removable. **Kahle Eng. Co., 1400 7th St., North Bergen, N. J.** (Ref. No. 1-38).

Obtain more information on these products by filling in the reference number on the inquiry card, p. 123

ELECTRON MICROSCOPE

A new 100 kv Electron Microscope (Type EM-100B) with many unique operating features including a hinged objective lens for quick change or cleaning of pole inserts, magnetic compensator, objective diaphragm with multiple apertures, and insert screen with binoculars for ultra-thin specimens, has been announced. Guaranteed resolving power of the new

instrument is better than 20 Angstroms. High resolution pole pieces permit continuously variable magnification from the control panel. **North American Philips Co., Inc., 750 S. Fulton Ave., Mt. Vernon, N. Y.** (Ref. No. 1-39).

RECLAIMING SOLVENT

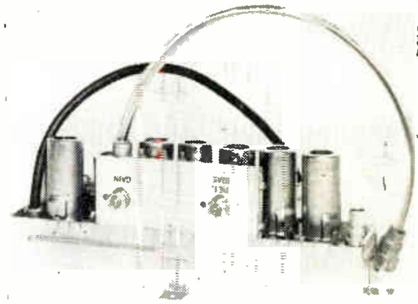
A new chemical disintegrates resins in which electronic components and electronic systems have been embedded, simply by immersing the units in the solution. Then the usable parts may be salvaged or the defective parts can be replaced before re-encapsulating. It is suitable for use with parts based on nylon, formvar and linen wrapped wire; all metallic

BEFORE AFTER

components; ceramic capacitors and resistors; as well as miniature and sub-miniature electronic tubes. Will not harm phenolic base systems such as printed circuits. Solution is non-inflammable. **Ram Chemicals, Box 192, Gardena, Calif.** (Ref. No. 1-40).

TARGET DEFINER

The new development, designed specifically to complement airborne radar equipment, is called the Clutter-Operated Anti-Clutter (COAC) Receiver. It uses impulses returned from a "cluttered" target to adjust automatically the radar set to each element of the target shown on the screen so that these elements are shown as well-defined individual images. The unit



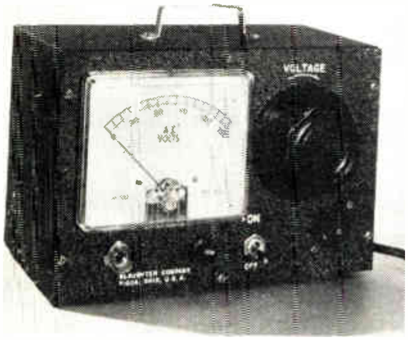
preserves high incremental gain for signals of narrow dynamic range and compresses stronger signals and signals having a large dynamic range (by as much as 80 db). **A. B. DuMont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J.** (Ref. No. 1-41).

New Products

Test Equipment

POWER SUPPLY

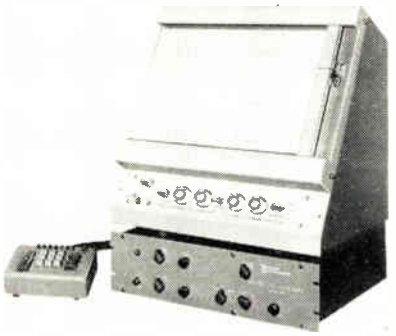
Intended for general utility service in the laboratory, the model shop, or on the test bench, the Model 109 A.C. Power Supply features a fuse protected variable autotransformer, a



neon pilot light, and a highly legible 4½ in. voltmeter with an essentially linear scale. Nominal input is 115 v., 60 cps, and output rating is 3 amp. With this unit it is practical to conduct all operating tests under controlled input voltage conditions, regardless of line voltage, as well as to simulate the effect of abnormally high and low voltages often found in service. **Slaughter Co., Piqua, O.** (Ref. No. 1-18).

KEYBOARD

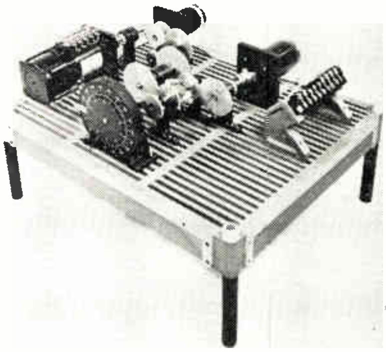
The keyboard (Model 175) consists of a 10-key keyboard 6 in. x 6 in. and a rack-mounted program and memory unit (5¼ in. x 19 in.). The keyboard uses the touch system and can be



operated by either left or right hand operators. Six digits are entered serially, with a point or symbol plotting automatically on the sixth digit entry. Indicator lights show the number of digits entered. A "minus" sign, "clear keyboard" and "hold X- hold Y" controls are added. No plot or plus operations are required. A symbol generator (Model 250) is optional. **Electro Instruments, Inc., 3791 Rosecrans, San Diego.** (Ref. No. 1-19).

BREADBOARD

Included in the product line are such basic components as grid plates, shaft couplings, shaft hardware, gears and differentials, as well as such special items as magnetic clutches and ball

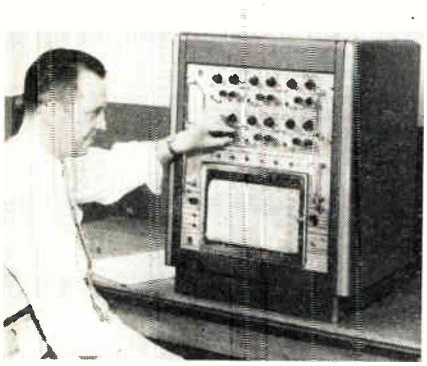


and disc integrators. Breadboarding with standard parts offers the advantage of step-by-step development of electromechanical devices or servo systems prior to final packaging. In this way, unpredictable design problems may be discovered and solved without the expense of building specially machined prototype parts which may not fill final requirements. **Helipot Corp., Newport Beach, Calif.** (Ref. No. 1-20).

Obtain more information on these products by filling in the reference number on the inquiry card, p. 123

PREAMPLIFIER

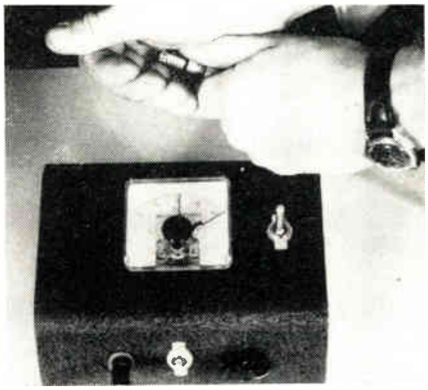
A vibration pickup preamplifier, Model BL-1606, was designed as a link between any type of vibration pickup and one of the Analyzers or Amplifiers. Thus, users are provided with absolute measurement or recording of acceleration, velocity or displacement. A two-stage preamplifier with high input impedance allows vibration measurements to be carried



out to very low frequencies. At set of integrating networks is provided for measurements of the velocity and displacement of the vibrations in consideration. **Brush Electronics Co., 3405 Perkins Ave., Cleveland.** (Ref. No. 1-21).

HUMIDITY DETECTOR

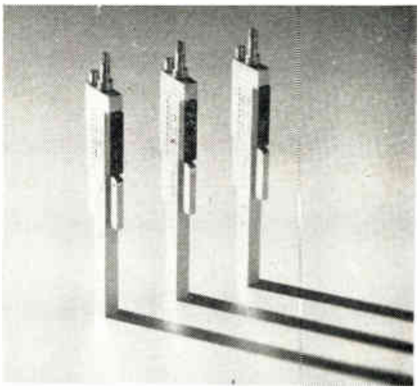
A ceramic may well prove to be the finest humidity sensing element yet found. The speed of response of the element has been measured with a resulting response to 90% of the full change of relative humidity in under 300 sec. It is a man-made ceramic with no natural counterpart, it exhibits a very marked change in electrical resistance with ambient humidity.



Change in resistance approximates 2500 fold for a change in relative humidity between 30% and 100% and a 2-fold change over the range from 90% to 100% relative humidity. **Horizons Inc., 2905 E. 79th St., Cleveland.** (Ref. No. 1-22).

GALVANOMETERS

Three new instruments with extended frequency and sensitivity ranges have been added to the series of high-performance galvanometers. These newest members of the 7-340 family of galvanometers provide higher frequency response without sacrifice of sensitivity. For the same frequency range (as compared to previous galvanometers), sensitivity is

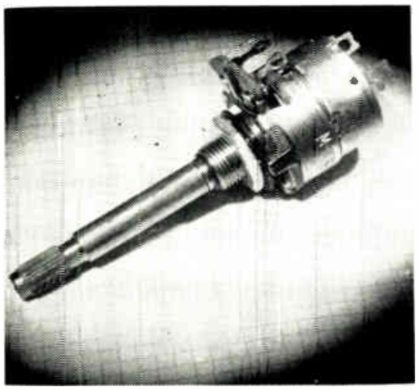


quadrupled. Two of the three new types (7-347 and 7-348) are designed to match the commonly-used strain-gage-bridge resistances of 120 ohms. **Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.** (Ref. No. 1-23).

Technical Components

PUSH-PULL-SWITCH

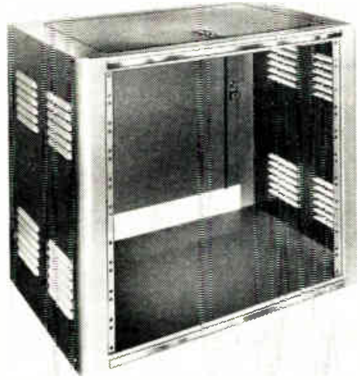
The concentric shaft push-pulls for the switching action, and rotates for the control setting, both functions being independent of one another. This switch is ideal for power-switch-



ing requirements from the smallest table model radio to color television. Switch is fully UL approved. The push-pull switch is available in three types: Series AC-17, SPST, .5 amp. 125 vdc or 1 amp. 125 vac; Series AG-18, SPST, .5 amp., 125 vdc or 3 amp. 125 vac; Series AG-19, SPST, .5 amp. 125 vac. Operating force is: AG-17, 3 to 7 oz.; AG-18 and AG-19, 5 to 14 oz. Clarostat Mfg. Co., Inc., Dover, N. H. (Ref. No. 1-24).

EQUIPMENT RACKS

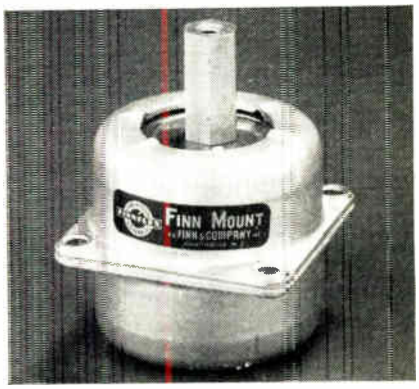
A complete new line of welded, one-piece steel housings for electronic equipment has been introduced. The new products—available immediately from stock—include transmitter racks



for 19-, 24- and 30-in. panels 18½ and 24-in. deep in standard and deluxe models. Cabinet relay racks for 19-in. panels are available in standard, round corner and deluxe models. The new line also includes 15-in. deep deluxe desk cabinet racks for 19-in. panel, desk panels, panel mounting drawers, roller trucks, truck casters, cabinet racks, and a variety of cases. Lowell Mfg. Co., 3030 Laclede Sta. Rd., St. Louis. (Ref. No. 1-25).

ALL-METAL MOUNT

An all-metal mount to successfully isolate vibration from airborne electronic equipment in helicopters has been developed. The problem of vibration in helicopters is an extremely

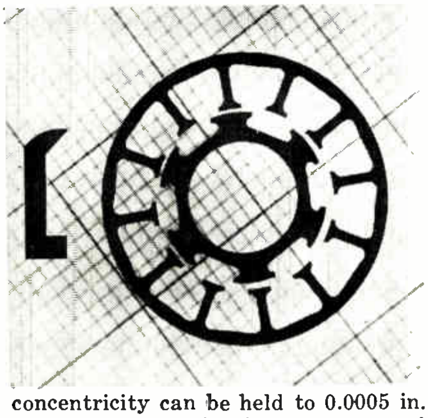


difficult one, and it is one that adversely affects reliability. Low speed rotating components and rapid changes in flying attitude, for example, set up severe vibrations which are characterized by low forcing frequencies and unusually high excursions. The new mount was designed with a low natural frequency. T. F. Finn & Co., Inc., Electronic Div., 200 Central Ave., Hawthorne, N. J. (Ref. No. 1-26).

Obtain more information on these products by filling in the reference number on the inquiry card, p. 123

LAMINATIONS

Rotor, stator and recording head laminations are being offered for rapid delivery. All laminations are made on sectional tungsten-carbide dies, carefully ground to eliminate burrs and provide good stacking characteristics. Concentricity of these high permeability, nickel alloy stator laminations can be held to 0.001 in. total indicator readings. On the rotor laminations,



concentricity can be held to 0.0005 in. All of these laminations are treated by dry hydrogen anneal. The dry hydrogen anneal removes carbon, oxygen, and sulphur. Tooling for production in one week. Magnetics, Inc., Dept. TT, Butler, Pa. (Ref. No. 1-27).

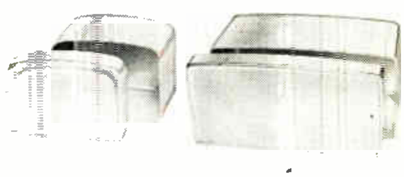
TUBE MOUNT

A new impact-resistant television tube mount, fabricated of soft steel wire, costs as low as one-third of conventional mounts. It accelerates tube installation on the assembly line. During drop tests, where a TV set is dropped from 12 to 30 in. from various positions, this welded wire tube mount holds the tube intact, even after extensive cabinet damage. The

soft, zinc-plated wire conforms closely to the tube contour. It will not etch glass, and consequently eliminates the necessity of material previously required to prevent implosion. E. H. Titchener & Co., 67 Clinton St., Binghamton, N. Y. (Ref. No. 1-28).

INSTRUMENT CASES

The availability of a complete line of inexpensive drawn aluminum instrument cases for electronic and instrument manufacturers has been announced. The cases come in 2 styles, featuring distinctive custom-designed appearance. Blank cases and covers are available for prompt shipment in any quantity. Use of standard dies completely eliminates tooling costs.



Cases and covers can be modified to customer specifications with holes, chassis slides, dimpled or rubber feet or other desired features. All cases have seamless construction. Zero Mfg. Co., 1121 Chestnut St., Burbank, Calif. (Ref. No. 1-29).

New Products Equipment Components

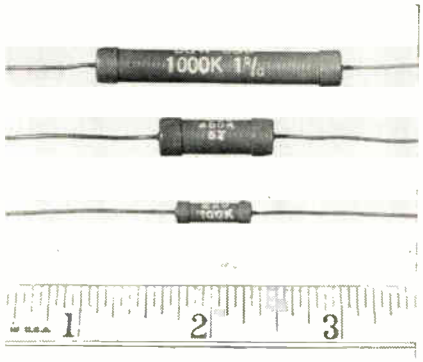
BEAM POWER TUBE

A high-perveance beam power tube of the glass-octal type was designed especially for use as a horizontal-deflection amplifier tube in television receivers. Utilizing a button-stem con-

struction in a T-12 envelope, the 6CD6-GA is smaller and more compact than the 6CD6-G, but features a modified mount design to maintain the same high perveance and to permit operation at higher ratings. The tube has a max. peak positive-pulse plate voltage rating of 7000 v. and a max. plate dissipation of 20 w. It is able to deflect fully picture tubes having a deflection angle of 90°. RCA Tube Div., Harrison, N. J. (Ref. No. 1-30).

GLASS RESISTORS

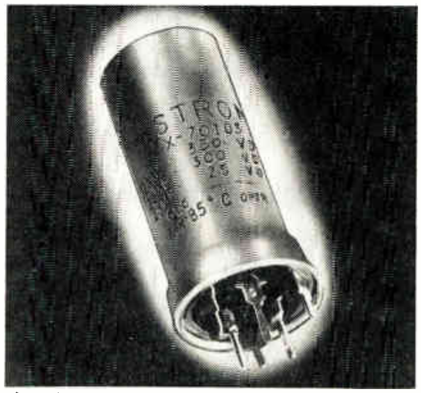
High temperature, precision, film-type glass resistors with widely increased resistance ranges are now available. Resistance ranges of the new Corning Type S resistors have



been increased by a factor of 10. Max. resistance has been increased in the ½-w. resistor to 100K ohms; in the 1-w. resistor to 400K; and in the 2-w. to 1 meg. The resistors are capable of operating at temperatures up to 200°C. Even at 120°C this resistor can carry the full room-temperature wattage of any standard precision film resistor of the same size. Corning Glass Works, Corning, N. Y. (Ref. No. 1-31).

ELECTROLYTIC

In keeping pace with modern methods and operations, manufacturers of capacitors and r-f noise suppression filters have manufactured an electrolytic specifically designed for printed

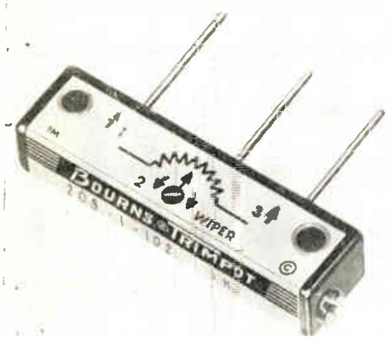


circuits and automatic assemblies. Style EY electrolytic features the now famous Astron "SM" Safety Margin construction which will withstand surge voltage and momentary overloads without permanent damage. Hermetically sealed, the EY is extremely reliable in tropical, not and humid climates. This electrolytic utilizes a special high-gain etch process. Astron Corp., 255 Grant Ave., East Newark, N. J. (Ref. No. 1-32).

Obtain more information on these products by filling in the reference number on the inquiry card, p. 123

POTENTIOMETER

Model 205 is a subminiature unit with round-pin terminals for printed circuit applications. Terminals can be inserted into punched holes in printed circuit boards. Terminals are gold-plated copper, ½ in. long, .028 in. dia. and spaced in 0.1 in. multiples. Unit will dissipate 0.25 w. at 50°C, and has a max. operating temperature of 105°C. In all other design features



the Model 205 is similar to the Model 130 Trimpot: 25-turn screwdriver adjustment, self-locking shaft, excellent shock, vibration and acceleration characteristics. Bourns Laboratories, Inc., 6135 Magnolia Ave., Riverside, Calif. (Ref. No. 1-33).

VOLTAGE DIVIDER

Two new models have been added in the precision ac voltage divider line, both sealed rotary shaft-driven units. One is a 100-turn model with a terminal linearity of .01%. The other, 1000-turn, has a terminal linearity of .005%. Both have continuous, transient free output. The new models have inherent characteristics of high input impedance, low output impe-

dance, and very low phase shift. Rotary shafts are precision ground, and mounted in ball bearings. Printed silver switches and precious metal wipers assure long life. Gertsch Products, Inc., 11846 Mississippi Ave., Los Angeles. (Ref. No. 1-34).

MULTIPLIER PHOTOTUBE

A head-on type of multiplier phototube intended especially for the detection and measurement of ultraviolet radiation, but also useful in other applications involving low-level radiation sources is now available. Featuring S-13 response, the 6903 is constructed with a fused-silica faceplate which transmits radiant energy in the ultraviolet region down to and

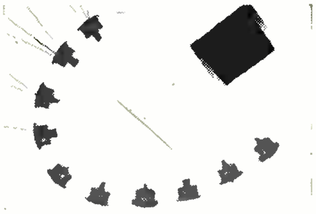
below 2000 angstroms. At 2000 angstroms, the spectral sensitivity is more than 50% of the maximum response. The spectral response covers the range from about 2000 to 6500 angstroms. RCA Tube Div., Harrison, N. J. (Ref. No. 1-35).

Semi-Conductors

Obtain more information on these products by filling in the reference number on the inquiry card, p. 123

TRANSISTORS

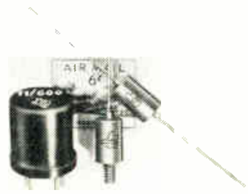
Ten new, pnp, junction transistors, for application in either hi-fi amplifiers or broadcast receivers. Current gain of the 6 output transistors is essentially a constant value for collector currents from 1 ma. to 200 ma.



Three of the audio are rated at a 180 mw. and may be used in push-pull circuits to obtain a power output of 750 mw. **General Electric Semiconductor Products, Syracuse, N. Y.** (Ref. No. 1-42).

SILICON RECTIFIERS

Five new silicon rectifiers feature a single grown junction element with 1500-v. breakdown voltage. Miniature rectifiers are available with stable operation up to 150°C and forward current ratings up to 100 ma. The axial



models allow point-to-point wiring; the stud-mounted are for maximum heat dissipation. The plug-in model can be used to replace the JAN 6 x 4. **Texas Instruments Inc., 6000 Lemmon Ave., Dallas, Texas.** (Ref. No. 1-45).

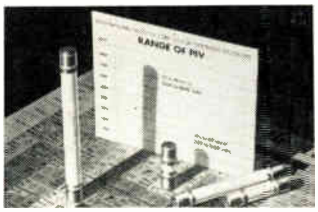
SILICON DIODES

A group of quick recovery silicon junction diodes is now available. Impervious to moisture and to other contaminants. Actual size, diode glass body: 0.105-in. by 0.265-in., max. Ambient operating temperature range:

from —55°C to +135°C. Max. power dissipation: 200 mw. at 25°C. All types recover to a minimum of 400K ohms in 1 μsec when switched from 30 ma. fwd to 35 v. rev. **Hughes Products, Los Angeles.** (Ref. No. 1-48).

16,000 V. DIODES

These diodes are a series of high voltage silicon rectifiers especially designed for high efficiency and miniaturization. Standard size silicon type diodes now available in production quantities have ratings ranging from



600 v. at 100 ma. half-wave dc output to 16,000 v. PIV at 45 ma. operating ambient temperature range —55°C. to +150°C. **International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.** (Ref. No. 1-43).

JUNCTION TRANSISTORS

Junction transistors of the germanium pnp alloy type utilize flexible leads which may be soldered or welded into the associated circuit. Each is hermetically sealed. Designed for i-f, mixer osc., and pre-amp application,

they provide a power gain of 30 db at 455 KC, 30 db at the center of broadcast band, and an exceptionally low wide-band noise factor (6 db maximum). **RCA, Semiconductor Div., Somerville, N. J.** (Ref. No. 1-46).

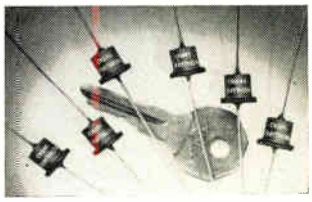
HIGH POWER TRANSISTORS

Two high power pnp germanium transistors, types 2N173 and 2N174, have been announced. These transistors are ideally suited for use in audio output stages, control applications, power supplies and other situations

where large currents must be controlled. They may also be employed in medium power applications where high reliability and low junction temperature are desired. **Delco Radio Div., Kokomo, Ind.** (Ref. No. 1-49).

DIFFUSED JUNCTION DIODES

The first solid state diffused junction silicon diodes are now available in production quantities. The diffusion process permits precise control. The 6 types now available (CK840 through CK845) have the following character-



istics at 100°C: PIV—100 to 600 v. in steps of 100; Reverse Current at PIV —0.2 ma. max; Forward Current—350 ma. max; Forward voltage drop at 350 ma.—0.75 v. **Raytheon Mfg. Co., Newton, Mass.** (Ref. No. 1-44).

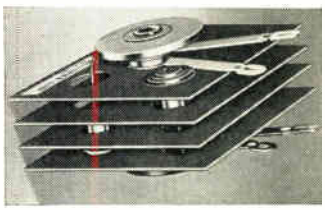
10-KW RECTIFIERS

A new series of miniature, 10-kw silicon rectifiers is now being mass produced. Operate in an ambient temperature range of from —65°C. to 200°C. Combinations of the new rectifiers will allow power output ratings

of 1000-kw and above. The silicon rectifiers are available in peak inverse voltage ratings of 50, 100, 200 and 300 v. and max. reverse current ratings of 50 ma. **General Electric Co., Syracuse, N. Y.** (Ref. No. 1-47).

RECTIFIER STACKS

The stacks are especially designed for power applications where high ambient temperature, reliability, high efficiency and miniaturization are of prime importance. These silicon rectifiers are now available in all circuit



types with rms inverse voltage ratings of 70 v, 105 v, 140 v, 210 v, 280 v, 350 v, and 420 v, with dc output currents up to 4.5 amp. at 75°C ambient. **International Rectifier Corp., El Segundo, Calif.** (Ref. No. 1-50).

WASHINGTON

News Letter

TV EXCISE RELIEF—Because of the world situation there is imperative need for continued high expenditure for national defense. Thus there is little chance of any tax reductions by the new Congress. The House Ways and Means Committee which originates all tax legislation had before it this month one of its most important taxation questions. Strong presentations were made for the reduction or removal of the Federal 10% excise tax on television receivers which are equipped to receive both VHF and UHF signals and particularly for color TV sets.

POTENT SUPPORT—One of the most potent statements before the House Ways & Means Committee was that of Senator Magnuson (D., Wash.), Chairman of the Senate Interstate Commerce Committee which determines communications-radio legislation. He informed the House body that the Senate Committee had unanimously concluded the excise tax should be eliminated for all-channel TV sets and "at the very least" on all-channel color sets. The FCC has taken a similar position. Such action also was emphatically advocated by the two major industry organizations—the Radio-Electronic-Television Manufacturers Association and the National Association of Radio and Television Broadcasters.

MICROWAVE ALLOCATIONS—Notices of appearances, together with summaries of positions to be taken, are to be filed by Jan. 15th for the important FCC proceeding on microwave radio allocations.

COMPLETE HEARING JULY 1—Two major microwave user organizations—the Operational Fixed Microwave Council and the Radio-Electronic-Television Manufacturers Association—had asked for a postponement on the appearances filings until mid-February; but the FCC, so as to meet a plan of completing the microwave allocations proceeding by July 1, only granted a delay until early January. A month after filing notices of appearances with position summaries, the participants in the microwave proceeding are to file written statements explaining the points to be covered by their witnesses and finally, after around three more weeks, reply comments to the statements on the scope of the other parties' testimony. Rule recommendations by the participants in the proceeding would be given the FCC by the end of this year, 1956.

TV MONOPOLY PROBE—The controversial inquiry by the House Judiciary Committee, headed by Rep. Celler (D., N. Y.), into the alleged controls of television by the networks moves a step forward early this year with the issuance of a report by that body to the House. The hearing record was not completed in printed form until December and the House Committee membership—several of whom are not in agreement with Chairman Celler—is reviewing the record this month to determine what kind of a report should be issued on the basis of the inquiry. Unless there is unanimity it is doubtful if the Celler investigation will result in anything more than a divided committee report which will be filed in the House without any legislative action.

NEW FCC PROCEDURE—Effective Jan. 11, the FCC establishes a new procedure under which the texts in major Commission decisions are to be distributed by the US Government Printing Office in weekly pamphlet form rather than the previous practice of FCC mimeographed copies. The printed pamphlets, which can be purchased at a yearly charge of $6.75 from the Superintendent of Documents of the Government Printing Office, will contain the decisions for the week preceding issue. The FCC, however, will continue to announce the results of its decisions in mimeographed releases each week after its regular meetings.

GOOD URBAN COVERAGE—Tests conducted by Motorola's engineers for submission to the FCC of vehicular mobile units' operations supported the conclusion that reliable urban coverage is achieved in the 890-900 megacycle band, but "less satisfactory" results in this portion of the spectrum occurred in heavily forested areas. The tests were submitted to the FCC Safety and Special Radio Services Bureau for the latter's aid in determining allocations matters. They were conducted by Motorola from March to August in the Greater Chicago area.

MOBILE RADIO VALUE—A warning note has been sounded by FCC Safety & Special Radio Services Bureau Chief Curtis B. Plummer that radio services have to justify their requests for increased frequency space on the basis of safety to life and property and not on grounds of economics or improved efficiency for their respective industries. The warning was issued at the 7th annual conference of the Institute of Radio Engineers' Professional Group on Vehicular Communications. Mr. Plummer cited aviation radio as dependent entirely for safety of life and property in contrast to vehicular mobile radio operations which produced greater economies or efficiency.

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ROLAND C. DAVIES
Washington Editor

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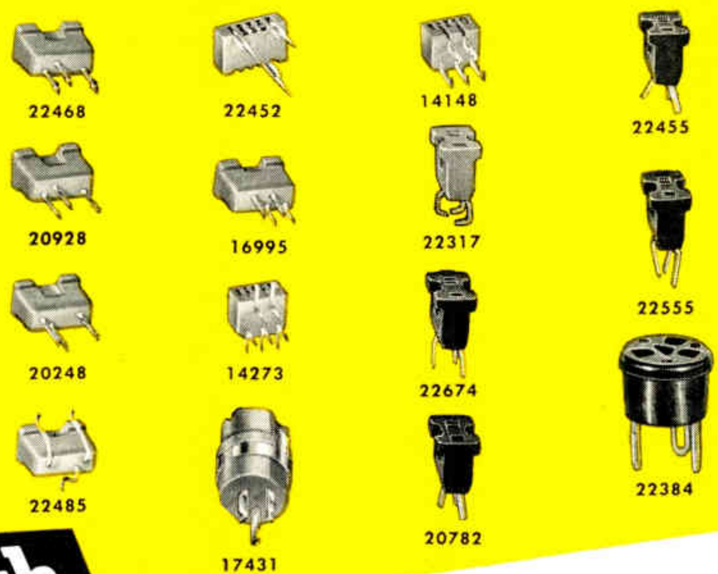

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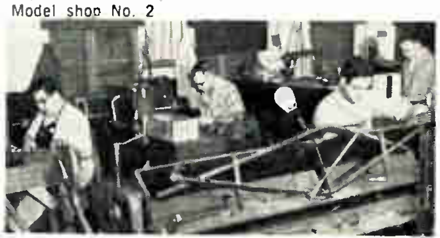
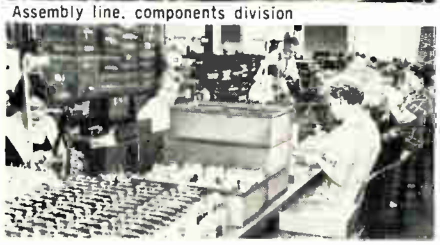
Model shop No. 1

Model shop No. 2



Assembly line, components division



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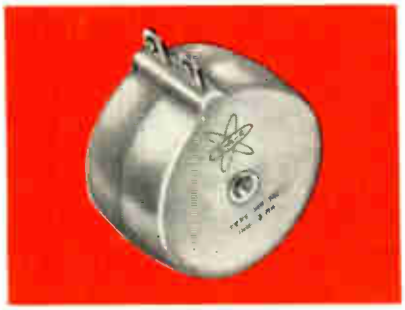

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For product information, use inquiry card on page 123.

AUTOMATIC

silicon power rectifiers

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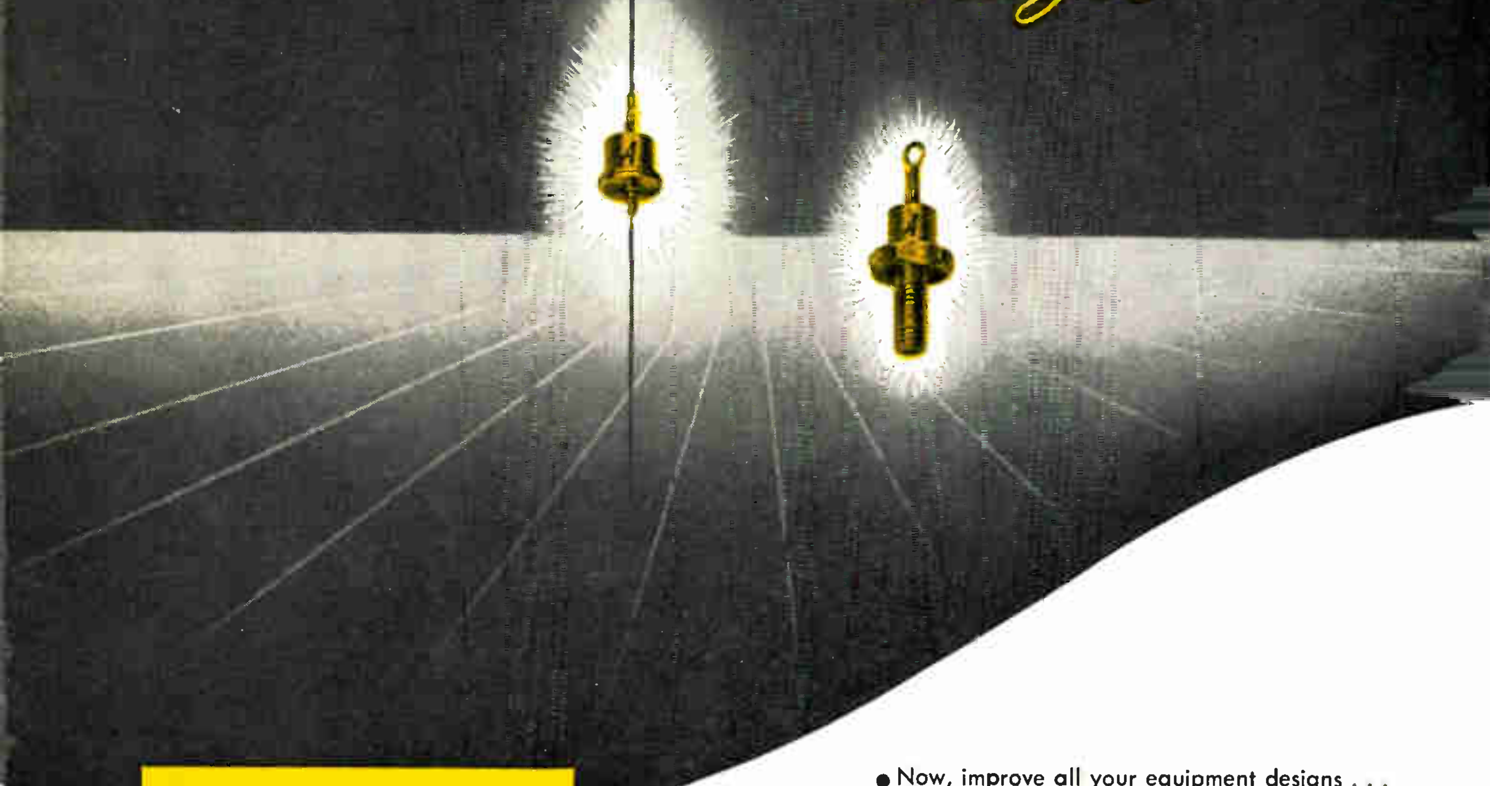

TYPICAL VALUES AT 100°C

Type No.	P. I. V. (volts)	Average DC Output Current (MA)	Reverse Leakage At Rated P. I. V. (μA)	Mounting
1N440	100	300	0.03	Pigtail Leads
1N441	200	300	0.075	"
1N442	300	300	0.10	"
1N443	400	300	0.15	"
1N444	500	300	0.18	"
1N445	600	300	0.20	"
1N530	100	300	0.30	"
1N531	200	300	0.75	"
1N532	300	300	1.00	"
1N533	400	300	1.50	"
1N534	500	300	1.80	"

TYPICAL VALUES AT 100°C

Type No.	P. I. V. (volts)	Average DC Output Current (MA)	Reverse Leakage At Rated P. I. V. (μA)	Mounting
1N535	600	300	2.00	Pigtail Leads
1N560	800	300	1.50	"
1N561	1,000	300	2.00	"
1N550	100	500	.05	Stud-Mount
1N551	200	500	.10	"
1N552	300	500	.15	"
1N553	400	500	.20	"
1N554	500	500	.25	"
1N555	600	500	.30	"
1N562	800	500	1.50	"
1N563	1,000	500	2.00	"

- Now, improve all your equipment designs . . . here from one complete source, both stud mount and pigtail rectifiers . . . designed for dependable operation at ambient temperatures in the range of – **55° to + 150° C** Twenty-two types are now *available in quantity.*
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ELECTRONIC INDUSTRIES'

1957 Semiconductor Diode Specifications

Latest technical specifications on the 881 germanium and silicon diodes now being commercially marketed. Grouping is by manufacturer. The RETMA-registered diodes produced by each manufacturer are indicated, and characteristics of the non-RETMA diodes are detailed. Technical specifications of the RETMA-registered diodes are listed separately at the end of the chart.

AMPEREX ELECTRONIC CORP. (A), 230 Duffy Ave., Hicksville, L.I., N.Y. RETMA Diodes: 1N34, 1N34A, 1N38, 1N38A, 1N54, 1N54A, 1N58, 1N58A, 1N60, 1N63, 1N67A, 1N68A, 1N87, 1N88, 1N89, 1N90, 1N95, 1N99, 1N116, 1N117, 1N119, 1N120, 1N126, 1N128, 1N198, 1N476, 1N477, 1N478, 1N479, 1N480, 1N490, 1N541, 1N542, 1N616, 1N617, 1N618, and non-RETMA types below:

DIODE TYPE	MFGR.	INVERSE			FORWARD		TEMP.	
		E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
C60	A	30		25	500		25	
C67	A	100	50@-50	80	250	4	25	
C68	A	130	625@-100	100	350	3	25	
C89	A	100	100@-50	80	250	3.5	25	
C95	A	75	500@-50	60	300	10	25	
C99	A	100	50@-50	80	300	10	25	
C116	A	75	100@-50	60	300	5	25	
C117	A	75	100@-50	60	300	10	25	
G48	A	85	50@-10	70	400	4	25	
G63	A	125	50@-50	100	400	4	25	
G67	A	100	50@-50	80	250	4	25	
G68	A	130	625@-100	100	350	3	25	
G89	A	100	100@-50	80	250	3.5	25	

AUTOMATIC MANUFACTURING DIV. (GI), General Instrument Corp., 65 Gouverneur St., Newark 4, N.J. RETMA Diodes: 1N440, 1N441, 1N442, 1N443, 1N444, 1N445, 1N530, 1N531, 1N532, 1N533, 1N534, 1N535, 1N550, 1N551, 1N552, 1N553, 1N554, 1N555, 1N560, 1N561, 1N562, 1N563.

BOMAC LABORATORIES, INC. (B), Salem Rd., Beverly, Mass. RETMA Diodes: 1N21B, 1N21BR, 1N21C, 1N21CR, 1N21D, 1N21DR, 1N23B, 1N23BM, 1N23C, 1N23CMR, 1N23CR, 1N23D, 1N23DMR, 1N23DR, 1N78, 1N415B, 1N415C, 1N415D, 1N416B, 1N416C, 1N416D.

CBS-HYTRON (CBS), Danvers, Mass. RETMA Diodes: 1N34, 1N34A, 1N38A, 1N39A, 1N48, 1N51, 1N52, 1N54A, 1N55A, 1N55B, 1N56A, 1N58A, 1N60, 1N63, 1N64, 1N65, 1N67A, 1N68A, 1N69, 1N70, 1N75, 1N81, 1N82, 1N82A, 1N90, 1N119, 1N120, 1N126, 1N127, 1N128, 1N198, 1N497, 1N498, 1N499, 1N500, 1N501, 1N502.

CLEVITE TRANSISTOR PRODUCTS (C), 241 Crescent St., Waltham 54, Mass. RETMA Diodes: 1N34A, 1N51, 1N54, 1N55B, 1N56A, 1N58A, 1N63, 1N66, 1N68A, 1N75, 1N89, 1N90, 1N91, 1N92, 1N93, 1N95, 1N96, 1N97, 1N98, 1N99, 1N100, 1N107, 1N108, 1N111, 1N116, 1N117, 1N118, 1N126, 1N127, 1N128, 1N139, 1N140, 1N141, 1N143, 1N151, 1N152, 1N153, 1N158, 1N191, 1N192, 1N198, 1N270, 1N273, 1N278, 1N279, 1N283, 1N287, 1N288, 1N289, 1N290, 1N291, 1N292, 1N294, 1N315, 1N481, 1N615, and non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
CTP301	C	75	25@-50	60	400	40	25	90
CTP304	C	60	100@-20	50	500	200	25	90
CTP307	C	50	20@-30	40	500	300	25	90
CTP308	C	40	20@-15	30	500	300	25	90
CTP309	C	25	20@-6	20	500	300	25	90
CTP311	C	130	80@-80	100	500	4	25	90
CTP313	C	125	20@-100	100	450	100	25	90
CTP315	C	75	100@-50	50	500	200	25	90
CTP316	C	75	20@-50	60	450	100	25	90
CTP318	C	75		60	400	50	25	90
CTP319	C	125		90	450	150	25	90
CTP320	C	100	50@-50	80	300	5	25	90
CTP351	C	380	1.2ma@-380	270	25A		55	
CTP394	C	400		125	25A		55	

See Page 101 for RETMA Diodes

CLEVITE TRANSISTOR PRODUCTS Continued

DIODE TYPE	MFGR.	INVERSE			FORWARD		TEMP.	
		E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
CTP397	C	36	.03@-20			25	25	150
CTP398	C	18	.01@-10			25	25	150
CTP400	C	18	.01@-10			100	25	150
CTP401	C	22	.01@-10			100	25	150
CTP402	C	27	.01@-10			100	25	150
CTP403	C	33	.01@-10			100	25	150
CTP404	C	39	.01@-10			75	25	150
CTP405	C	47	.01@-10			75	25	150
CTP406	C	56	.01@-10			75	25	150
CTP407	C	68	.05@-10			50	25	150
CTP408	C	82	.05@-10			50	25	150
CTP409	C	100	.05@-10			40	25	150
CTP410	C	100	.05@-10			40	25	150

FRETCO, INC. (F), 406 N. Craig St., Pittsburgh 13, Pa. RETMA Diodes: 1N34, 1N38, 1N39, 1N43, 1N44, 1N45, 1N46, 1N47, 1N48, 1N51, 1N52, 1N54, 1N56, 1N58, 1N60, 1N63, 1N64, 1N65, 1N69, 1N70, 1N72, 1N82, 1N86, 1N87, 1N95, 1N97, 1N99, 1N116, 1N126, and non-RETMA types below:

DIODE TYPE	MFGR.	
PD3	F	70v Photodiode
PD5	F	22.5v Photodiode
PD5A	F	39v Photodiode
PD6	F	39v Photodiode
PD7A	F	140v Photodiode
PD8	F	6v Photodiode
PD9	F	Photodiode
PD10	F	6v Photodiode
PD11	F	6v Photodiode
PD12A	F	1.5 to 3v Photodiode

GAHAGAN, INC. (G), Esmond, R.I. RETMA Diodes: 1N34, 1N34A, 1N35, 1N38, 1N38A, 1N39, 1N48, 1N52, 1N54, 1N54A, 1N55, 1N55B, 1N56A, 1N58A, 1N63, 1N65, 1N67A, 1N68A, 1N72, 1N88, 1N89, 1N96, 1N97, 1N98, 1N99, 1N100, 1N117, 1N118, 1N127, 1N140, 1N141, 1N142, 1N143, 1N198, 1N270, 1N273, 1N277, 1N278, 1N279, 1N447, 1N448, 1N449, 1N450, 1N451, 1N452, 1N453, 1N454, 1N455.

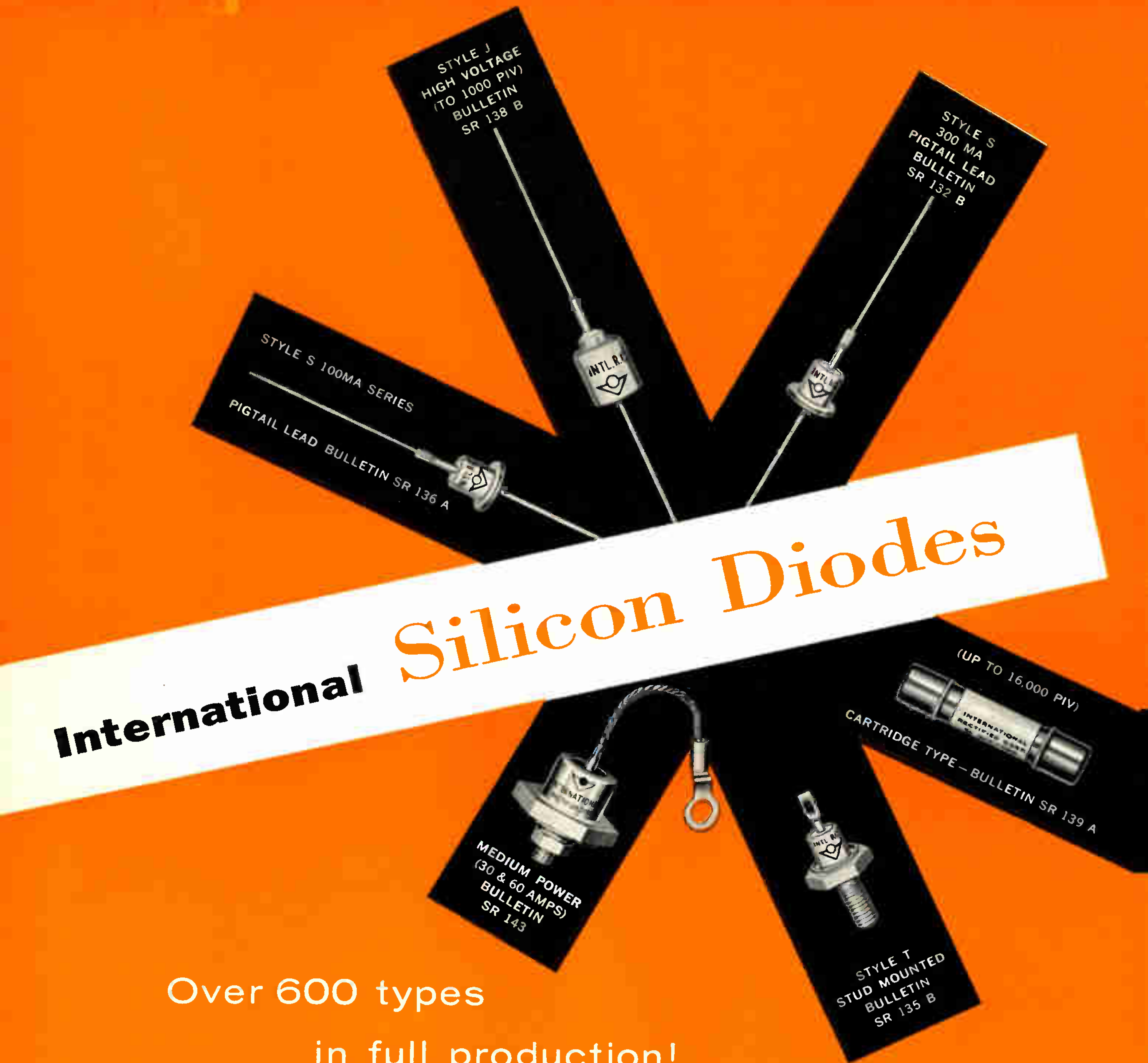
GENERAL ELECTRIC CO. (GE), Electronics Park, Syracuse, N.Y. RETMA Diodes: 1N72, 1N91, 1N92, 1N93, USN1N93, 1N151, 1N152, 1N153, 1N158, 1N285, 1N315, USAF1N315, 1N368, 1N536, 1N537, 1N538, 1N539, 1N540, and non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
G7A	GE				75			75
G7B	GE	5			75			75
G7C	GE	5			75			75

HOFFMAN ELECTRONICS CORP. (HE), 930 Pitner Ave., Evanston, Ill. RETMA Diodes: 1N137A, 1N138A, 1N200, 1N201, 1N202, 1N203, 1N204, 1N205, 1N206, 1N207, 1N208, 1N209, 1N210, 1N211, 1N212, 1N213, 1N214, 1N215, 1N216, 1N217, 1N218, 1N219, 1N220, 1N221, 1N222, 1N225, 1N226, 1N227, 1N228, 1N229, 1N230, 1N231, 1N232, 1N233, 1N234, 1N235, 1N236, 1N237, 1N238, 1N239, 1N249, 1N430, 1N430A, 1N430B, 1N431, 1N465, 1N466, 1N467, 1N468, 1N469, 1N470, 1N471, 1N472, 1N473, 1N474, 1N475, and non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
HMP1	HE	50		35		500	25	175
HMP1A	HE	50		35		500	25	175
HMP2	HE	100		70		500	25	175
HMP2A	HE	100		70		500	25	175
HMP3	HE	200		140		500	25	175
HMP3A	HE	200		140		500	25	175

(Continued on page 97)



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DIODE TYPE	MFGR.	INVERSE E_{PEAK} v	INVERSE I_{PEAK} ua @ v	INVERSE E_{CONT} v	FORWARD I_{SURGE} ma	FORWARD I_{MIN} ma @ +1v	TEMP. OPER °C	TEMP. MAX °C

HOFFMAN ELECTRONICS CORP. Continued

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
HMP4	HE	300		210		500	25	175
HMP4A	HE	300		210		500	25	175
HMP5	HE	400		280		500	25	175
HMP5A	HE	400		280		500	25	175
NSP1	HE	60	<5ma@60	42.5		40A@.9	50	200
NSP1R	HE	60	<5ma@60	42.5		40A@.9	50	200
NSP2	HE	100	<5ma@60	70		40A@.9	50	200
NSP2R	HE	100	<5ma@60	70		40A@.9	50	200
NSP3	HE	200	<5ma@60	141		40A@.9	50	200
NSP3R	HE	200	<5ma@60	141		40A@.9	50	200
ZA8	HE	Zener Voltage = 7.5 to 10v						
ZA10	HE	Zener Voltage = 9 to 12v						
ZA12	HE	Zener Voltage = 11 to 14.5v						
ZA15	HE	Zener Voltage = 13.5 to 18v						
ZA20	HE	Zener Voltage = 17 to 21v						
ZA25	HE	Zener Voltage = 20 to 27v						
ZA30	HE	Zener Voltage = 25 to 32v						
ZA35	HE	Zener Voltage = 30 to 39v						
ZA40	HE	Zener Voltagé = 37 to 45v						
ZA50	HE	Zener Voltage = 43 to 54v						
ZA60	HE	Zener Voltage = 52 to 64v						
ZA70	HE	Zener Voltage = 62 to 80v						
ZA90	HE	Zener Voltage = 75 to 100v						
ZA105	HE	Zener Voltage = 90 to 120v						
ZA125	HE	Zener Voltage = 110 to 145v						

HUGHES AIRCRAFT CO. (H), Culver City, Calif. RETMA Diodes: 1N67A, 1N68A, 1N89, 1N90, 1N95, 1N96, 1N97, 1N98, 1N99, 1N100, 1N116, 1N117, 1N118, 1N126, 1N127, 1N128, 1N191, 1N192, 1N198, 1N456, 1N457, 1N458, 1N459, 1N461, 1N462, 1N463, 1N464, 1N625, 1N626, 1N627, 1N628, 1N629.

INTERNATIONAL RECTIFIER CORP. (I), 1521 E. Grand Ave., El Segundo, Calif. RETMA Diodes: 1N596, 1N597, 1N598, 1N599, 1N600, 1N601, 1N602, 1N603, 1N604, 1N605, 1N606, 1N607, 1N608, 1N609, 1N610, 1N611, 1N612, 1N613, 1N614, and non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
DF1A6	I	1200	25@1200	1200	175		75	150
DF1B9	I	1800	25@1800	1800	175		75	150
DF1B12	I	2400	25@2400	2400	175		75	150
DF1B15	I	3000	25@3000	3000	175		75	150
DF1C18	I	3600	25@3600	3600	175		75	150
DF1C21	I	4200	25@4200	4200	175		75	150
DF1C24	I	4800	25@4800	4800	175		75	150
DF1C27	I	5400	25@5400	5400	175		75	150
DF1C30	I	6000	25@6000	6000	175		75	150
DF1C33	I	6600	25@6600	6600	175		75	150
DF1D36	I	7200	25@7200	7200	175		75	150
DF1D39	I	7800	25@7800	7800	175		75	150

KEMTRON ELECTRON PRODUCTS, INC. (K), 14 Prince Place, Newburyport, Mass. RETMA Diodes: 1N21, 1N21A, 1N21B, 1N21BM, 1N21BR, 1N21C, 1N21CM, 1M21CR, 1N21D, 1N21E, 1N23, 1N23A, 1N23B, 1N23BM, 1N23BR, 1N23C, 1N23CM, 1N23CR, 1N23D, 1N23DR, 1N23E, 1N23ER, 1N25, 1N25A, 1N25AM, 1N26, 1N28, 1N31, 1N32, 1N34, 1N34A, 1N35, 1N38, 1N38A, 1N39, 1N43, 1N52, 1N53, 1N53A, 1N53M, 1N54, 1N54A, 1N55, 1N55A, 1N56, 1N56A, 1N57, 1N58, 1N58A, 1N60, 1N61, 1N69, 1N70, 1N76, 1N78, 1N79, 1N81, and non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
K34	K	75	250@-40	60	500	20@2	50	70
K63	K	125	10@-10	100	500	4	25	70

LANSDALE TUBE CO. (P), a division of Philco Corp., Lansdale, Pa. RETMA Diodes: 1N147, 1N173A, 1N263.

MICROWAVE ASSOCIATES, INC. (M), 22 Cummington St., Boston 15, Mass. RETMA Diodes: 1N21B, 1N21BM, 1N21BMR, 1N21BR, 1N21C, 1N21CM, 1N21CMR, 1N21CR, 1N21D, 1N21DM, 1N21DMR, 1N21DR, 1N21E, 1N21EM, 1N21EMR, 1N21ER, 1N23B, 1N23BM, 1N23BMR, 1M23BR, 1N23C, 1N23CM, 1N23CMR, 1N23CR, 1N23D, 1N23DM, 1N23DMR, 1N23DR, 1N23E, 1N23EM, 1N23EMR, 1N23ER, 1N26, 1N32, 1N32R, 1N53, 1N53A, 1N53M, 1N78, 1N78A, 1N149, 1N149M, 1N149MR, 1N149R, 1N150, 1N150M, 1N150MR, 1N150R, 1N160, 1N160M, 1N160MR, 1N160R, 1N415B, 1N415C, 1N415D, 1N415E, 1N416B, 1N416C, 1N416D, 1N416E, and non-RETMA types below:

DIODE TYPE	MFGR.	Description
MA400	M	10,000mc, Reversible Polarity, Max.Conv.Loss=6db
MA401	M	Classified Mixer Crystal for use in RG-98/U Waveguide
MA407	M	10,000mc, Reversible Polarity, Max.Conv.Loss=6.5db
MA408	M	9000mc, Video Detector, Figure of Merit = 130
MA408A	M	9000mc, Video Detector, Figure of Merit = 160
MA408AR	M	9000mc, Video Detector, Reverse Polarity, Figure of Merit = 160
MA408R	M	9000mc, Video Detector, Reverse Polarity, Figure of Merit = 130
MA409	M	3060mc, Max.Conv.Loss=5.5db, Max.Noise Ratio = 1.5
MA409A	M	3060mc, Max.Conv.Loss=5db, Max.Noise Ratio = 1.3
MA409AM	M	3060mc, Matched Pair
MA409AMR	M	3060mc, Matched Forward and Reverse Polarity
MA409AR	M	3060mc, Reverse Polarity Type
MA409M	M	3060mc, Matched Pair
MA409MR	M	3060mc, Matched Forward and Reverse Polarity
MA409R	M	3060mc, Reverse Polarity Type
MA412	M	26.5-75Kmc, RG-98/U Waveguide Mounted for mixer or video
MA414	M	10,000mc, Reversible Polarity version of 1N149
MA417	M	3295mc, Reversible Polarity version of 1N32
MA418	M	9000mc, Reversible Polarity version of MA408
MA418A	M	9000mc, Reversible Polarity version of MA408A
MA419	M	6750mc, Reversible Polarity version of 1N160
MA419A	M	6750mc, Reversible Polarity version of 1N150

NUCLEONIC PRODUCTS CO., INC. (N), P.O. Box 5552, Metro. Sta., Los Angeles 55, Calif. RETMA Diodes: 1N34, 1N34A, 1N38, 1N38A, 1N39, 1N39A, 1N43, 1N44, 1N45, 1N46, 1N47, 1N48, 1N51, 1N52, 1N54, 1N54A, 1N55, 1N55A, 1N57, 1N58, 1N58A, 1N59, 1N60, 1N61, 1N63, 1N64, 1N65, 1N66, 1N67, 1N67A, 1N68, 1N68A, 1N69, 1N70, 1N75, 1N81, 1N86, 1N88, 1N89, 1N90, 1N111, 1N112, 1N113, 1N114, 1N115, 1N116, 1N126, 1N127, 1N128, 1N142.

PACIFIC SEMICONDUCTORS, INC. (PS), 10451 W. Jefferson Blvd., Culver City, Calif. RETMA Diodes: 1N34A, 1N38A, 1N63, 1N67A, 1N89, 1N95, 1N96,

See Page 101 for RETMA Diodes

PACIFIC SEMICONDUCTORS, INC. Continued
1N97, 1N98, 1N100, 1N116, 1N117, 1N118, 1N126, 1N127, 1N128, 1N191, 1N192, 1N198, and non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} us @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
PS208	PS	90	120@-60	60			25	
PS210	PS	125	100@-100	100		15	25	
PS211	PS	75	50@-50	60		30	25	
PS214	PS	75	10@-5	60		5	25	
PS530	PS	30	.025@-25	25	1A	100	25	150
PS531	PS	70	.025@-60	60	1A	100	25	150
PS542	PS	30	.5@-25	25	1A	250	25	150
PS543	PS	70	.5@-60	60	1A	250	25	150
PS550	PS	30	.5@-25	25	1A	100	25	150
PS551	PS	55	.5@-45	45	1A	100	25	150
PS552	PS	70	.5@-60	60	1A	100	25	150
PS553	PS	90	.5@-70	70	1A	100	25	150
PS554	PS	150	.5@-125	125	1A	100	25	150
PS560	PS	30	.025@-25	25	1A	250	25	150
PS561	PS	55	.025@-45	45	1A	250	25	150
PS562	PS	70	.025@-60	60	1A	250	25	150
PS563	PS	90	.025@-70	70	1A	250	25	150
PS564	PS	150	.025@-125	125	1A	250	25	150

RADIO CORPORATION OF AMERICA (RCA), Sommerville, N.J. RETMA Diodes: 1N34A, 1N38A, 1N54A, 1N58A.

RADIO RECEPTOR CO., INC. (RR), 240 Wythe Ave., Brooklyn 11, N.Y. RETMA Diodes: 1N34, 1N34A, 1N38, 1N38A, 1N48, 1N51, 1N52, 1N54, 1N54A, 1N55, 1N55M, 1N55B, 1N56, 1N56A, 1N58, 1N58A, 1N63, 1N67A, 1N69, 1N70, 1N81, 1N89, 1N90, 1N95, 1N96, 1N97A, 1N98A, 1N99A, 1N100A, 1N116A, 1N117A, 1N118A, 1N126, 1N127, 1N128, 1N191, 1N192, 1N198, 1N281, and non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
DR301	RR	125	100@-50	100		400	25	
DR302	RR	100	100@-50	80		400	25	
DR303	RR	75	50@-20	60		400	25	
DR305	RR	125	100@-50	100		200	25	
DR306	RR	100	100@-50	80		200	25	
DR307	RR	75	50@-20	60		200	25	
DR308	RR	100	50@-50	80		200	25	
DR309	RR	100	50@-50	80		400	25	
DR310	RR	120	50@-100	120		100	25	
DR311	RR	120	100@-100	120		100	25	
DR312	RR	100	20@-100	100		100	25	
DR313	RR	80	20@-50	80		100	25	
DR314	RR	80	50@-50	80		100	25	
DR315	RR	150	50@-100	120		50	25	
DR316	RR	125	100@-100	100		50	25	
DR317	RR	100	50@-50	80		50	25	
DR318	RR	75	2@-10	60		50	25	
DR319	RR	75	5@-10	60		50	25	
DR321	RR		125@-50	50		200	25	
DR323	RR		200@-50	50		100	25	
DR324	RR		500@-50	50		100	25	
DR325	RR		250@-50	50		100	25	
DR326	RR	75	250@-50	60		100	25	
DR327	RR	125	100@-50	100		300	25	
DR328	RR	100	100@-50	80		300	25	
DR329	RR	75	50@-20	60		300	25	
DR330	RR	100	50@-50	60		300	25	
DR401	RR			60		20@.5	25	
DR402	RR			60		20@.5	25	
DR403	RR			60		20@.5	25	
DR404	RR			60		20@.5	25	

RAYTHEON MANUFACTURING CO. (R), 55 Chapel St., Newton 58, Mass. RETMA Diodes: 1N66, 1N67, 1N68, 1N68A, 1N294, 1N295, 1N297, 1N298, 1N300, 1N300A, 1N301, 1N301A, 1N302, 1N302A, 1N303, 1N303A, 1N305, 1N306, 1N307, 1N432, 1N432A, 1N433, 1N433A, 1N434, 1N434A, 1N437, 1N437A, 1N438, 1N438A, and non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
CK715	R	VHF to UHF Multiplier						
CK774	R	25	5@-25	17		5A@1.5		150
CK775	R	60	5@-60	42		5A@1.5		150
CK775-1	R	125	5@-125	78		5A@1.5		150
CK776	R	200	5@-200	140		5A@1.5		150
CK777	R	325	5@-325	230		5A@1.5		150
CK840	R	120	200@70	100				150
CK841	R	240	200@140	200				150
CK842	R	360	200@210	300				150
CK843	R	480	200@280	400				150
CK844	R	600	200@350	500				150
CK845	R	720	200@420	600				150

SARKES TARZIAN, INC. (ST), 415 N. College Ave., Bloomington, Ind. Non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
10M	ST	100	2ma@100	70	30	500		100
20M	ST	200	2ma@200	140	30	500		100
30M	ST	300	2ma@300	210	30	500		100
40M(M500)	ST	400	2ma@400	280	30	500		100
5N1	ST	50	10@50	35	30	500	100	150
10N1	ST	100	10@100	70	30	500	100	150
15N1	ST	150	10@150	105	30	500	100	150
20N1	ST	200	10@200	140	30	500	100	150
30N1	ST	300	10@300	210	30	500	100	150
40N1	ST	400	10@400	280	30	500	100	150
5N2	ST	50	10@50	35	30	500	100	150
10N2	ST	100	10@100	70	30	500	100	150
15N2	ST	150	10@150	105	30	500	100	150
20N2	ST	200	10@200	140	30	500	100	150
30N2	ST	300	10@300	210	30	500	100	150
40N2	ST	400	10@400	280	30	500	100	150
5P1	ST	50	50@50	35	60	5000	100	150
10P1	ST	100	50@100	70	60	5000	100	150
15P1	ST	150	50@150	105	60	5000	100	150
20P1	ST	200	50@200	140	60	5000	100	150
30P1	ST	300	50@300	210	60	5000	100	150
40P1	ST	400	50@400	280	60	5000	100	150
5P2	ST	50	50@50	35	60	5000	100	150
10P2	ST	100	50@100	70	60	5000	100	150
15P2	ST	150	50@150	105	60	5000	100	150

(Continued on page 99)

DIODE TYPE	MFGR.	INVERSE E_{PEAK} v	INVERSE I_{PEAK} ua @ v	INVERSE E_{CONT} v	FORWARD I_{SURGE} ma	FORWARD I_{MIN} ma @ +1v	TEMP. OPER °C	TEMP. MAX °C
SARKES TARZIAN, INC. Continued								
20P2	ST	200	50@200	140	60	5000	100	150
30P2	ST	300	50@300	210	60	5000	100	150
40P2	ST	400	50@400	280	60	5000	100	150
5Q4	ST	50	10ma@50	35	150	15000	100	150
10Q4	ST	100	10ma@100	70	150	15000	100	150
15Q4	ST	150	10ma@150	105	150	15000	100	150
20Q4	ST	200	10ma@200	140	150	15000	100	150
30Q4	ST	300	10ma@300	210	150	15000	100	150

SYLVANIA ELECTRIC PRODUCTS, INC. (S), 100 Sylvan Rd., Woburn, Mass. RETMA Diodes: 1N34, 1N34A, 1N35, 1N38, 1N38A, 1N39, 1N40, 1N41, 1N42, 1N52, 1N54, 1N54A, 1N55, 1N55A, 1N56, 1N56A, 1N58, 1N58A, 1N59, 1N60, 1N63, 1N67, 1N69, 1N70, 1N71, 1N77A, 1N81, 1N82, 1N82A, 1N111, 1N112, 1N113, 1N114, 1N115, 1N119, 1N120, 1N193, 1N194, 1N195, 1N196, 1N417, 1N418, 1N419, 1N447, 1N448, 1N449, 1N450, 1N451, 1N452, 1N453, 1N454, 1N455, 1N571.

TEXAS INSTRUMENTS, INC. (TI), 6000 Lemmon Ave., Dallas 9, Texas. RETMA Diodes: 1N588, 1N589 1N590, 1N591, and non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
600C	TI	30	8@-10	30		3		100
601C	TI	50	.04@-10	50		3		150
604C	TI	5.5	.1@-4.7	4.7		60		150
606C	TI	7.5	.1@-6.8	6.8		35		150
608C	TI	11	.1@-10	10		25		150
610C	TI	17	.1@-15	15		12		150
612C	TI	25	.1@-22	22		7		150
614C	TI	37	.1@-33	33		5		150
616C	TI	52	.2@-47	47		3		125
618C	TI	75	.2@-68	68		1.5		125
620C	TI	110	.2@-100	100		.9		125
622C	TI	170	.2@-150	150		6.5@4		100
624C	TI	250	.4@-220	220		3@4		71
650C	TI		.1@-1	3.7-4.5		125		150
650C0	TI		.1@-1	3.7		125		150
650C1	TI		.1@-1	3.8		125		150
650C2	TI		.1@-1	3.9		125		150
650C3	TI		.1@-1	4		125		150
650C4	TI		.1@-1	4.1		125		150
650C5	TI		.1@-1	4.2		125		150
650C6	TI		.1@-1	4.3		125		150
650C7	TI		.1@-1	4.4		125		150
651C	TI		.1@-1	4.3-5.4		100		150
651C0	TI		.1@-1	4.5		100		150
651C1	TI		.1@-1	4.6		100		150
651C2	TI		.1@-1	4.7		100		150
651C3	TI		.1@-1	4.8		100		150
651C4	TI		.1@-1	4.9		100		150
651C5	TI		.1@-1	5.0		100		150
651C6	TI		.1@-1	5.1		100		150
651C7	TI		.1@-1	5.2		100		150
651C8	TI		.1@-1	5.3		100		150
651C9	TI		.1@-1	5.4		100		150
652C	TI		.1@-1	5.2-6.4		75		150
652C0	TI		.1@-1	5.5		75		150
652C1	TI		.1@-1	5.6		75		150
652C2	TI		.1@-1	5.7		75		150
652C3	TI		.1@-1	5.8		75		150
652C4	TI		.1@-1	5.9		75		150
652C5	TI		.1@-1	6.0		75		150
652C6	TI		.1@-1	6.1		75		150
652C7	TI		.1@-1	6.2		75		150
652C8	TI		.1@-1	6.3		75		150
659C9	TI		.1@-1	6.4		75		150
653C	TI		.1@-1	6.2-8		60		150
653C0	TI		.1@-1	6.5		60		150
653C1	TI		.1@-1	6.6		60		150
653C2	TI		.1@-1	6.7		60		150
653C3	TI		.1@-1	6.8		60		150
653C4	TI		.1@-1	7.0		60		150
653C5	TI		.1@-1	7.2		60		150
653C6	TI		.1@-1	7.4		60		150
653C7	TI		.1@-1	7.6		60		150
653C8	TI		.1@-1	7.8		60		150
653C9	TI		.1@-1	8.0		60		150
TI680	TI	1500	100@-1500	1500		50@10		150

TRANSITRON ELECTRONIC CORP. (TE), 168 - 182 Albion St., Wakefield, Mass. RETMA Diodes: 1N34, 1N34A, 1N35, 1N38, 1N38A, 1N48, 1N51, 1N52, 1N54, 1N54A, 1N55, 1N56A, 1N58, 1N58A, 1N63, 1N65, 1N67A, 1N69, 1N70, 1N75, 1N81, 1N111, 1N112, 1N113, 1N114, 1N115, 1N126, 1N127, 1N128, 1N139, 1N140, 1N141, 1N142, 1N143, 1N144, 1N145, 1N198, 1N248, 1N248A, 1N249, 1N249A, 1N250, 1N250A, 1N251, 1N252, 1N253, 1N254, 1N255, 1N256, 1N270, 1N277, 1N281, 1N332, 1N333, 1N334, 1N335, 1N336, 1N337, 1N338, 1N339, 1N340, 1N341, 1N342, 1N343, 1N344, 1N345, 1N346, 1N347, 1N348, 1N349, 1N411A, 1N412A, 1N413A, 1N457, 1N458, 1N459, 1N482, 1N482A, 1N482B, 1N483, 1N483A, 1N483B, 1N484, 1N484A, 1N484B, 1N485, 1N485A, 1N485B, 1N486, 1N486A, 1N487, 1N487A, 1N488, 1N488A, and non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
S4G	TE		10@-10	20	60	1	125	150
S5G	TE		10@-10	30	100	2	125	150
S6G	TE		10@-5	15	125	5	125	150
S9G	TE		10@-20	40	100	2	125	150
S10G	TE		10@-5	15	150	100@1.7	125	150
S320G	TE		15@2	6	500	100		85
S1010	TE		15@2	6	500	100		85
SG22	TE		.1@2	6	500	100		150
SM72	TE		25@2	6	6A	2A@2		125
T7	TE	75	100@-50	60	750	200	25	
T9	TE	75	20@-50	60	600	100	25	
T11	TE	40	20@-20	30	750	100	25	
T12	TE	75	500@-50	60	500	20	25	
T13	TE	25	2@-10	20	750	40	25	
T14	TE	25	5@-10	20	750	40	25	
T15	TE	125		90	750	125	25	
T16	TE	75		60	750	40	25	
T17	TE	125	500@-100	100	400	5	25	
T18	TE		125@-50	50	200	20	75	
T19	TE			60	350	200	75	
T20	TE		500@-50	50	200	20	75	

See Page 101 for RETMA Diodes.

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
TRANSITRON ELECTRONIC CORP. Continued								
T21	TE		50@-20	25	200	20	75	
T22	TE		20@-10	15	250	40	75	
T23	TE		200@-50	50	300	20	60	
T24	TE		300@-30	35	300	20	60	
T25	TE	30	20@-10	20	750	200	25	
TH152	TE	150	5ma@105	105	400A		150	175
TH252	TE	250	5ma@-175	175	400A		150	175
TH302	TE	300	5ma@-210	210	150A	100A@1.5	150	175
TH352	TE	350	5000@-350	350	150A	100A@1.5	150	175
TH402	TE	400	5ma@-280	280	150A	100A@1.5	150	175
TJ5A	TE	50	.5@-35	35	1A	500@1.5	150	200
TJ10A	TE	100	.5@-70	70	1A	500@1.5	150	200
TJ15A	TE	150	.5@-105	105	1A	500@1.5	150	200
TJ20A	TE	200	.5@-140	140	1A	500@1.5	150	200
TJ25A	TE	250	.5@-175	175	1A	500@1.5	150	200
TJ30A	TE	300	.5@-210	210	1A	500@1.5	150	200
TJ35A	TE	350	.5@-245	245	1A	500@1.5	150	200
TJ40A	TE	400	.5@-280	280	1A	500@1.5	150	200
TM1	TE	50		35		2A@2	25	125
TM2	TE	50		35		800@2	25	125
TM3	TE	50		35		200@2	25	125
TM4	TE	50	500@-35	35	6A	2A@2	150	175
TM5	TE	50	500@-35	35	10A	800@2	150	175
TM7	TE	50	500@-35	35	20A	6A@1.5	150	175
TM11	TE	100		70		2A@2	25	125
TM12	TE	100		70		800@2	25	125
TM13	TE	100		70		200@2	25	125
TM17	TE	100	500@-70	70	20A	6A@1.5	150	175
TM21	TE	200		140		2A@2	25	125
TM22	TE	200		140		800@2	25	125
TM23	TE	200		140		200@2	25	125
TM24	TE	200	500@-140	140	6A	2A@2	150	175
TM27	TE	200	500@-140	140	20A	6A@1.5	150	175
TM31	TE	300		210		2A@2	25	125
TM32	TE	300		210		800@2	25	125
TM33	TE	300		210		200@2	25	125
TM34	TE	300	500@-210	210	6A	2A@2	150	175
TM37	TE	300	500@-210	210	20A	6A@1.5	150	175
TM41	TE	400		280		2A@2	25	125
TM42	TE	400		280		800@2	25	125
TM43	TE	400		280		200@2	25	125
TM44	TE	400	500@-280	280	6A	2A@2	150	175
TM47	TE	400	500@-280	280	20A	6A@1.5	150	175
TM51	TE	500		350		2A@2	25	125
TM52	TE	500		350		800@2	25	125
TM53	TE	500		350		200@2	25	125
TM54	TE	500	500@-350	350	6A	2A@2	150	175
TM55	TE	500	500@-350	350	10A	800@2	150	175
TM56	TE	500	500@-350	350	5A	400@2	150	175
TM61	TE	600		420		2A@2	25	125
TM62	TE	600		420		800@2	25	125
TM63	TE	600		420		200@2	25	125
TM64	TE	600	500@-420	420	6A	2A@2	150	175
TM65	TE	600	500@-420	420	10A	800@2	150	175
TM66	TE	600	500@-420	420	5A	400@2	150	175
TR151	TE	150	5ma@-105	105	40A	25A@1.5	150	175
TR152	TE	150	5ma@-105	105	60A	50A@1.5	150	175
TR251	TE	250	5ma@-175	175	40A	25A@1.5	150	175
TR252	TE	250	5ma@-175	175	60A	50A@1.5	150	175
TR301	TE	300	5ma@-210	210	40A	25A@1.5	150	175
TR302	TE	300	5ma@-210	210	60A	50A@1.5	150	175
TR351	TE	350	5ma@-245	245	40A	25A@1.5	150	175
TR352	TE	350	5ma@-245	245	60A	50A@1.5	150	175
TR401	TE	400	5ma@-280	280	40A	25A@1.5	150	175
TR402	TE	400	5ma@-280	280	60A	50A@1.5	150	175

UNITED STATES DYNAMICS CORP. (USD), 1250 Columbus Ave., Boston 20, Mass. RETMA Diodes: 1N73, 1N74, 1N248, 1N248A, 1N249, 1N249A, 1N250, 1N250A, 1N314, and non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
USD5051A	USD	50	5000@-50	50	80A	15A	150	200
USD5051B	USD	100	5000@-100	100	80A	15A	150	200
USD5051C	USD	150	5000@-150	150	80A	15A	150	200
USD5051D	USD	200	5000@-200	200	80A	15A	150	200
USD5051E	USD	250	5000@-250	250	80A	15A	150	200
USD5051F	USD	300	5000@-300	300	80A	15A	150	200
USD5051G	USD	350	5000@-350	350	80A	15A	150	200
USD5051H	USD	400	5000@-400	400	80A	15A	150	200
USD5051J	USD	450	5000@-450	450	80A	15A	150	200
USD5051K	USD	500	5000@-500	500	80A	15A	150	200
USD5091A	USD	50	5000@-50	50	50A	6A	150	200
USD5091B	USD	100	5000@-100	100	50A	6A	150	200
USD5091C	USD	150	5000@-150	150	50A	6A	150	200
USD5091D	USD	200	5000@-200	200	50A	6A	150	200
USD5091E	USD	250	5000@-250	250	50A	6A	150	200
USD5091F	USD	300	5000@-300	300	50A	6A	150	200
USD5091G	USD	350	5000@-350	350	50A	6A	150	200
USD5091H	USD	400	5000@-400	400	50A	6A	150	200
USD5091J	USD	450	5000@-450	450	50A	6A	150	200
USD5091K	USD	500	5000@-500	500	50A	6A	150	200

WESTERN ELECTRIC CO., INC. (WE), 195 Broadway, New York 7, N.Y. Semiconductor products available only to U. S. Govt. Agencies, and their contractors. RETMA Diodes: 1N137, 1N138, 1N330, 1N331, and non-RETMA types below:

DIODE TYPE	MFGR.	E_{PEAK} v	I_{PEAK} ua @ v	E_{CONT} v	I_{SURGE} ma	I_{MIN} ma @ +1v	OPER °C	MAX °C
GA52838[1]	WE	200	1@-160	160	600		25	100
GA52843[1]	WE	250	1@-200	200	450		25	100
GA52844[1]	WE	16	.1@-10	10	900		25	100
GA52861[1]	WE	250	.005@-200	200	75		25	100
GA52865[1]	WE	100	.01@-80	80	90		25	100
GA52931[1]	WE	12	20@-9	12	3A		25	135
GA52932[1]	WE	15	10@-12	15	2.5A		25	135
GA52933[1]	WE	18	10@-14	18	2A		25	135
GA52934[1]	WE	20	10@-16	20	1.8A		25	135
GA52935[1]	WE	150	300@-120	150			25	135
GA52936[1]	WE		20@-200	200	5A	100	25	135
GA52937[1]	WE		20@-200	200	10A	1A	25	135

(Continued on page 101)

For product information, use inquiry card on page 123.

DIODE TYPE	MFGR.	INVERSE E_{PEAK} v	INVERSE I_{PEAK} ua @ v	INVERSE E_{CONT} v	FORWARD I_{SURGE} ma	FORWARD I_{MIN} ma @ +1v	TEMP. OPER °C	TEMP. MAX °C
WESTERN ELECTRIC CO., INC. Continued								
GA52998[1]	WE		1000@-200	200	50A	1A	25	135
GA52999[1]	WE	20	100@-20	20	20A		25	135
WESTINGHOUSE ELECTRIC CORP. (W), Youngwood, Pa. Non-RETMA types below:								
N5051A	W	50	20@50	50	500	45	25	180
N5051B	W	100	20@100	100	500	45	25	180
N5051C	W	150	20@150	150	500	45	25	180
N5051D	W	200	20@200	200	500	45	25	180
N5051E	W	250	20@250	250	500	45	25	180
N5051F	W	300	20@300	300	500	45	25	180
N5051G	W	350	20@350	350	500	45	25	180
N5051H	W	400	20@400	400	500	45	25	180
N5082A	W	50	40@50	50	200	160	25	180
N5082B	W	100	40@100	100	200	160	25	180
N5082C	W	150	40@150	150	200	160	25	180
N5082D	W	200	40@200	200	200	160	25	180
N5082E	W	250	40@250	250	200	160	25	180
N5082F	W	300	40@300	300	200	160	25	180
N5082G	W	350	40@350	350	200	160	25	180
N5082H	W	400	40@400	400	200	160	25	180
N5091A	W	50	10@50	50	200	25	25	180
N5091B	W	100	10@100	100	200	25	25	180
N5091C	W	150	10@150	150	200	25	25	180
N5091D	W	200	10@200	200	200	25	25	180
N5091E	W	250	10@250	250	200	25	25	180
N5091F	W	300	10@300	300	200	25	25	180
N5091G	W	350	10@350	350	200	25	25	180
N5091H	W	400	10@400	400	200	25	25	180
WP5051A	W	50	200@50	50	1A	1A@1.4	150	200
WP5051B	W	100	200@100	100	1A	1A@1.4	150	200
WP5051D	W	200	200@200	200	1A	1A@1.4	150	200
WP5051F	W	300	200@300	300	1A	1A@1.4	150	200
WP5051H	W	400	200@400	400	1A	1A@1.4	150	200
WP5051K	W	500	200@500	500	1A	1A@1.4	150	200
WP5051M	W	600	200@600	600	1A	1A@1.4	150	200
WP5052A	W	50	200@50	50	1A	1A@1.4	150	200
WP5052B	W	100	200@100	100	1A	1A@1.4	150	200
WP5052D	W	200	200@200	200	1A	1A@1.4	150	200
WP5052F	W	300	200@300	300	1A	1A@1.4	150	200
WP5052H	W	400	200@400	400	1A	1A@1.4	150	200
WP5052K	W	500	200@500	500	1A	1A@1.4	150	200
WP5052M	W	600	200@600	600	1A	1A@1.4	150	200
WP5053A	W	50	200@50	50	1A	1A@1.4	150	200
WP5053B	W	100	200@100	100	1A	1A@1.4	150	200
WP5053D	W	200	200@200	200	1A	1A@1.4	150	200
WP5053F	W	300	200@300	300	1A	1A@1.4	150	200
WP5053H	W	400	200@400	400	1A	1A@1.4	150	200
WP5053K	W	500	200@500	500	1A	1A@1.4	150	200
WP5053M	W	600	200@600	600	1A	1A@1.4	150	200

RETMA DIODES

DIODE TYPE	MFGR.	INVERSE E_{PEAK} v	INVERSE I_{PEAK} ua @ v	INVERSE E_{CONT} v	FORWARD I_{SURGE} ma	FORWARD I_{MIN} ma @ +1v	TEMP. OPER °C	TEMP. MAX °C
1N21	K	3000mc, Max.Conv.Loss.=8.5db, Max. Noise Ratio=4						
1N21A	K	3000mc, Max.Conv.Loss=7.5db, Max.Noise Ratio = 3						
1N21B	K,M,B	3000mc, Max.Conv.Loss = 6.5db, Max.Noise Ratio=2						
1N21BM	K,M	3000mc, Matched Pair						
1N21BMR	M	3000mc, Marched Forward and Reserve Polarity						
1N21BR	K,M,B	3000mc, Reverse Polarity Type						
1N21C	K,M,B	3000mc, Max.Conv.Loss = 5.5db, Max.Noise Ratio=1.5						
1N21CM	K,M	3000mc, Matched Pair						
1N21CMR	M	3000mc, Matched Forward and Reverse Polarity						
1N21CR	K,M,B	3000mc, Reverse Polarity Type						
1N21D	K,M,B	30,000mc, Max.Conv.Loss=5db, Max.Noise Ratio=1.3						
1N21DM	M	30,000mc, Matched Pair						
1N21DMR	M	30,000mc, Matched Forward and Reverse Polarity						
1N21DR	M,B	30,000mc, Reverse Polarity Type						
1N21E	K,M	3000mc, Max. Noise Ratio = 5						
1N21EM	M	3000mc, Matched Pair						
1N21EMR	M	3000mc, Matched Forward and Reverse Polarity						
1N21ER	M	3000mc, Reverse Polarity Type						
1N23	K	10,000mc, Max.Conv.Loss = 10db, Max.Noise Ratio = 3						
1N23A	K	10,000mc, Max.Conv.Loss = 8db, Max.Noise Ratio = 2.7						
1N23B	K,M,B	10,000mc, Max.Conv.Loss=6.5db,Max.Noise Ratio = 2.7						
1N23BM	K,M,B	10,000mc, Matched Pair						
1N23BMR	M	10,000mc, Matched Forward and Reverse Polarity						
1N23BR	K,M	10,000mc, Reverse Polarity Type						
1N23C	K,M,B	10,000mc, Max.Conv.Loss = 6db, Max.Noise Ratio = 2						
1N23CM	K,M	10,000mc, Matched Pair						
1N23CMR	M,B	10,000, Matched Forward and Reverse Polarity						
1N23CR	M,B	10,000mc, Reverse Polarity Type						
1N23CR	K	10,000mc, Reverse Polarity Type						
1N23D	K,M,B	10,000mc, Max.Conv.Loss = 5db, Max.Noise Ratio = 1.7						
1N23DM	M	10,000mc, Matched Pair						
1N23DMR	M,B	10,000mc, Matched Forward and Reverse Polarity						
1N23DR	K,M,B	10,000mc, Reverse Polarity Type						
1N23E	K,M	10,000mc						
1N23EM	M	10,000mc, Matched Pair						
1N23EMR	M	10,000mc, Matched Forward and Reverse Polarity						
1N23ER	K,M	10,000mc, Reverse Polarity Type						
1N25	K	1000mc, Max.Conv.Loss = 8db, Max.Noise Ratio = 2.5						
1N25A	K	1000mc, Max.Conv.Loss = 7db, Max.Noise Ratio = 2						
1N25AM	K	1000mc, Matched Pair						
1N26	K,M	25,000mc, Max.Conv.Loss=8.5db, Max.Noise Ratio=2.5						
1N28	K	3000mc, Max.Conv.Loss = 7db, Max.Noise Ratio = 2						
1N31	K	10,000mc, Video Detector, Min. Figure of Merit = 55						
1N32	K,M	3000mc, Video Detector, Min. Figure of Merit = 100						
1N32R	M	3000mc, Reverse Polarity Type						
1N34	A,CBS,F,G,K,N,RR,S,TE	75	30@-10	60	500	5	25	75
1N34A	A,CBS,C,G,K,N,PS,RCA,RR,S,TE	75	30@-10	60	500	5	25	75
1N35	G,K,S,TE	75	10@-10	50		7.5		90
1N38	A,F,G,K,N,RR,S,TE	120	6@-3	100		4		90
1N38A	A,CBS,G,K,N,PS,RCA,RR,S,TE	120	6@-3	100	500	4	25	75
1N39	F,G,K,N,S	225	600@-200	200		4		90
1N39A	CBS,N	225	200@-100	200	200	5	25	75
1N40	S	75	35@-10	25		12.75@1.5		90
1N41	S	75	40@-10	25		12.75@1.5		90
1N42	S	120	800@-100	100		12.75@1.5		90
1N43	F,K,N	60	850@-50			5		
1N44	F,N	115	1000@-50			3		
1N45	F,N	75	410@-50			3		
1N46	F,N	60	1500@-50			3		
1N47	F,N	150	500@-50			4		
1N48	CBS,F,G,N,RR,TE	85	833@-50	70	400	4	25	75
1N51	CBS,C,F,N,RR,TE	50	1660@-50	40	300	2.5	25	75
1N52	CBS,F,G,K,N,RR,S,TE	85	150@-50	70	400	4	25	75
1N53	K,M	34,000mc,Max.Conv.Loss=8.5db,Max.Noise Ratio=2.5						
1N53A	K,M	34,000mc,Max.Conv.Loss=6.5db,Max.Noise Ratio=2.5						
1N53M	K,M	34,000mc, Matched Pair						
1N54	A,C,F,G,K,N,RR,S,TE	75	7@-10	50		5		90
1N54A	A,CBS,G,K,N,RCA,RR,S,TE	75	7@-10	50	500	5	25	75
1N55	G,K,N,RR,S,TE	170	500@-150	150		4		90
1N55A	CBS,K,N,RR,S,TE	170	300@-100	150	500	4	25	75
1N55B	CBS,C,G,RR	190	500@-150	150	500	5	25	75
1N56	F,K,RR,S	50	300@-30	40		15		90
1N56A	CBS,C,G,K,RR,S,T	50	300@-30	40	1000	15	25	75
1N57	K,N	90	500@-75	80	500	4		
1N58	A,F,K,N,RR,S,TE	120	600@100	100		4		90
1N58A	A,CBS,C,G,K,N,RCA,RR,S,TE	120	600@-100	100	500	5	25	75
1N59	N,S	275	800@250	250		3		90
1N60	A,CBS,F,K,W,S	30	67@-10	25	500	3	25	75
1N61	K,N	140	300@-100	130	500	5		
1N63	A,CBS,C,F,G,N,PS,RR,S,TE	125	500@-50	100	400	4	25	75
1N64	CBS,F,N	20	200@-10	15			25	75
1N65	CBS,F,G,N,TE	85	200@-50	70	400	2.5	25	75
1N66	C,N,R	70	800@-50	60	500	5		100
1N67	N,R,S	100	50@-50	80	500	4		100
1N67A	A,CBS,G,H,N,PS,RR,TE	100	5@-5	80	500	4	25	75
1N68	N,R	120	625@-100	100	500	3		100
1N68A	A,CBS,C,G,H,N,RR	130	625@-100	100	500	3	25	75
1N69	CBS,F,N,RR,K,S,TE	75	30@-10	60	400	5	25	75
1N70	CBS,F,K,N,RR,S,TE	125	25@-10	100	350	3	25	75
1N71	S	50	300@30	40		15		90
1N72	GE,G,F				75			75
1N73	USD	75	50@-10	75	100	15	70	100
1N74	USD	75	50@-10	75	100	15	70	100
1N75	CBS,C,N,TE	125	50@-50	100	400	2.5	25	75
1N76	K	Specially Tested Video Rectifier						
1N77A	S	Junction Photodiode, 50v max.						
1N78	K,M,B	16,000mc,Max.Conv.Loss=7.5db,Max.Noise Ratio=2.5						
1N78A	M	16,000mc,Max.Conv.Loss=7db,Max.Noise Ratio=1.5						
1N79	K	0-10,000mc, instrument rectifier						
1N81	CBS,N,RR,K,S,TE	50	10@-10	40	350	3.5	25	75
1N82	CBS,F,S	5	N.F. <16db					
1N82A	CBS,S	5	N.F. <15.5db					
1N86	F,N	70	50@-10			4		
1N87	A,F	30	25@-1.5	25	400	1@.25	25	
1N88	A,G,N	110	100@-50	85	400	2.5	25	
1N89	A,C,G,H,N,PS,RR	100	8@-5	80		3.5		90
1N90	A,CBS,C,H,N,RR	75	800@-50	60	500	5	25	75
1N91	C,GE	100		30	25,000		55	85
1N92	C,GE	200		65	25,000		55	85
1N93	C,GE	300		100	25,000		55	85
USN1N93	GE	300		100	25,000		55	85
1N95	A,C,F,H,PS,RR	75	500@-50	60	250	10		90
1N96	C,G,H,PS,RR	75	500@-50	60	250	20		90
1N97	C,F,G,H,PS	100	8@-5	80	250	10		90
1N97A	RR	100	8@-5	80		20	25	
1N98	C,G,H,PS	100	5@-5	80	250	20		90
1N98A	RR	100	8@-5	80		40	25	
1N99	A,C,F,G,H	100	5@-5	80	300	10		90
1N99A	RR	100	5@-5	80		20	25	
1N100	C,G,H,PS	100	5@-5	80	300	20		90
1N100A	RR	100	5@-5	80		40	25	
1N107	C		200@-10	10		150		90
1N108	C		200@-50	50		50		90
1N110	F							
1N111	C,N,S,TE	75		60		5		90
1N112	N,S,TE	75		60		5		90
1N113	N,S,TE	75		60		2.5		90
1N114	N,S,TE	75		60		2.5		90
1N115	N.S.TE	75		60		2.5		90
1N116	A,C,F,N,H,PS	75	100@-50	60	250	5		90

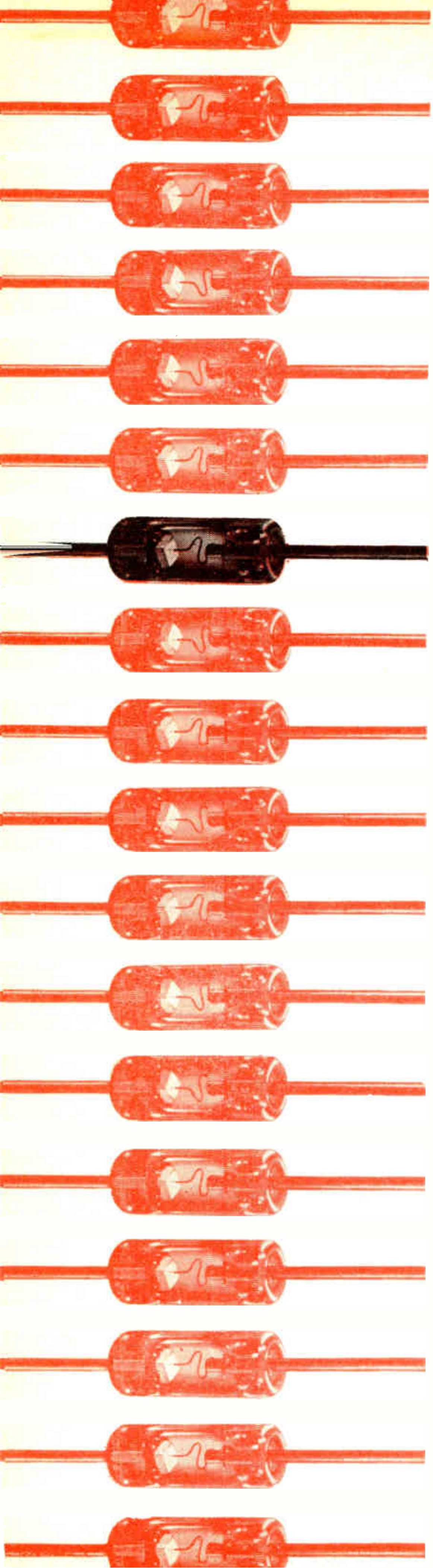
(Continued on page 103)

 For product information, use inquiry card on page 123.

DIODE TYPE	MFGR.	INVERSE E_{PEAK} v	INVERSE I_{PEAK} ua @ v	INVERSE E_{CONT} v	FORWARD I_{SURGE} ma	FORWARD I_{MIN} ma @ +1v	TEMP. OPER °C	TEMP. MAX °C
1N116A	RR	75	100@-50	60		10	25	
1N117	A, C, G, H, PS	75	100@-50	60	250	10		90
1N117A	RR	75	100@-50	60		20	25	
1N118	C, G, H, PS	75	100@-50	60	250	20		90
1N118A	RR	75	100@-50	60		40	25	
1N119	A, CBS, S	75	25@-10	60	500	5		75
1N120	A, C, S	75	50@-10	60	500	5		75
1N126	A, CBS, C, F, H, N, PS, RR, TE	75	50@-10	60	350	5	25	75
1N127	CBS, C, G, H, N, PS, RR, TE	125	25@-10	100	300	3	25	75
1N128	A, CBS, C, H, PS, RR, TE	50	10@-10	40	300	3	25	75
1N137[1]	WE	70	.03@-20	32	150	3	25	100
1N137A	HE	70	.03@-20	36		3	25	
1N138[1]	WE	43	.01@-10	16	250	5	25	100
1N138A	HE	43	.01@-10	18	500	5	25	70
1N139	C, TE	50	1500@-50	40	500	20	25	90
1N140	C, G, TE	85	300@-50	70	750	40	25	90
1N141	C, G, TE	85	50@-50	70	500	20	25	90
1N142	G, N, TE	125	100@-100	100	400	5	25	80
1N143	C, G, TE	120	100@-100	100	750	40	25	90
1N144	TE	40	200@-20	30	750	100	25	80
1N145	TE	40	100@-10	30	750	40	25	70
1N147	P	1000mc mixer; N.F.=10db.						
1N149	M	10,000mc, Max.Conv.Loss=5.5db, Max.Noise Ratio=1.5						
1N149M	M	10,000mc, Matched Pair						
1N149MR	M	10,000mc, Matched Forward and Reverse Polarity						
1N149R	M	10,000mc, Reverse Polarity Type						
1N150	M	6750mc, Max.Conv.Loss = 6db, Max.Noise Ratio = 2						
1N150M	M	6750mc, Matched Pair						
1N150MR	M	6750mc, Matched Forward and Reverse Polarity						
1N150R	M	6750mc, Reverse Polarity Type						
1N151	C, GE	100		30	28,000		55	85
1N152	C, GE	200		65	25,000		55	85
1N153	C, GE	300		100	25,000		55	85
1N158	C, GE	380		130	25,000		55	85
1N160	M	6750mc, Max.Conv.Loss=6.5, Max.Noise Ratio = 2.7						
1N160M	M	6750mc, Matched Pair						
1N160MR	M	6750mc, Matched Forward and Reverse Polarity						
1N160R	M	6750mc, Reverse Polarity Type						
1N173A	P	1000mc mixer; N.F. = 12.5db.						
1N191	C, H, PS, RR	90	25@-10		400	5	25	90
1N192	C, H, PS, RR	70	250@-50		400	5		90
1N193	S	70	40@-40	40		1@2v		150
1N194	S	70	10@-40	40		1.5@2v		150
1N195	S	70	10@-40	40		2@2v		150
1N196	S	70	10@-50	50		1@2v		150
1N198	A, CBS, C, G, H, PS, RR, TE	100	10@-10	80	300	4	25	75
1N200	HE	7.5	.5@-6.8	6.8	260		25	150
1N201	HE	9	.5@8.2	8.2	230		25	150
1N202	HE	11	.5@10	10	210		25	150
1N203	HE	13.5	.5@12	12	190		25	150
1N204	HE	17	.5@15	15	170		25	150
1N205	HE	20	.1@18	18	150		25	150
1N206	HE	25	.1@22	22	135		25	150
1N207	HE	30	.1@27	27	120		25	150
1N208	HE	37	.1@33	33	105		25	150
1N209	HE	43	.1@39	39	95		25	150
1N210	HE	52	.1@47	47	85		25	150
1N211	HE	62	1@56	56	72		25	150
1N212	HE	75	1@68	68	60		25	150
1N213	HE	90	1@82	82	50		25	150
1N214	HE	110	1@100	100	40		25	150
1N215	HE	135	1@120	120	35		25	150
1N216	HE	170	5@150	150	30		25	150
1N217	HE	200	5@180	180	28		25	150
1N218	HE	250	5@220	220	26		25	150
1N219	HE	300	5@270	270	24		25	150
1N220	HE	370	5@330	330	22		25	150
1N221	HE	430	5@390	390	20		25	150
1N222	HE	520	5@470	470	18		25	150
1N225	HE	Double Anode, Zener Voltage = 7.5 to 10						
1N226	HE	Double Anode, Zener Voltage = 9 to 12						
1N227	HE	Double Anode, Zener Voltage = 11 to 14.5						
1N228	HE	Double Anode, Zener Voltage = 13.5 to 18						
1N229	HE	Double Anode, Zener Voltage = 17 to 21						
1N230	HE	Double Anode, Zener Voltage = 20 to 27						
1N231	HE	Double Anode, Zener Voltage = 25 to 32						
1N232	HE	Double Anode, Zener Voltage = 30 to 39						
1N233	HE	Double Anode, Zener Voltage = 37 to 45						
1N234	HE	Double Anode, Zener Voltage = 43 to 54						
1N235	HE	Double Anode, Zener Voltage = 52 to 64						
1N236	HE	Double Anode, Zener Voltage = 62 to 80						
1N237	HE	Double Anode, Zener Voltage = 75 to 100						
1N238	HE	Double Anode, Zener Voltage = 90 to 120						
1N239	HE	Double Anode, Zener Voltage = 110 to 145						
1N248	TE, USD	50	5000@-50	50	100A	15A	150	200
1N248A	TE, USD	50	5000@-50	50	90A	50A@1.5	150	175
1N249	TE, USD	100	5000@-100	100	100A	15A	150	200
1N249A	TE, USD	100	5000@-100	100	90A	50A@1.5	150	175
1N250	TE, USD	200	5000@-200	200	100A	15A	150	200
1N250A	TE, USD	200	5000@-200	200	90A	50A@1.5	150	175
1N251	TE	30	1@-10	30	125	5	150	150
1N252	TE	20	.1@-5	20	150	10	150	150
1N253	TE	100	100@-95	100	4000	1000@1.5	135	150
1N254	TE	200	100@-190	200	1500	500@1.5	135	150
1N255	TE	400	150@-380	400	1500	500@1.5	135	150
1N256	TE	600	250@-570	600	1000	500@2	135	150
1N263	P	12,000mc, X-Band mixer; N.F. =7.8 ; Conv. Loss = 6db max.						
1N270	C, G, TE	100	100@-50	80	500	200	90	90
1N273	C, G	35	20@-20	30	450	100	25	90
1N277	G, TE	125	250@-50	100	400	100	90	90
1N278	C, G		125@-50	50		20	75	
1N279	C, G	35	200@-20	30	450	100	25	90
1N281	RR, TE	75	500@-50	60	400	100	90	90

DIODE TYPE	MFGR.	INVERSE E_{PEAK} v	INVERSE I_{PEAK} ua @ v	INVERSE E_{CONT} v	FORWARD I_{SURGE} ma	FORWARD I_{MIN} ma @ +1v	TEMP. OPER °C	TEMP. MAX °C
1N283	C	25	20@-10	20	500	200	25	90
1N285	GE				75			75
1N287	C		1500@-50	40	500	20	25	90
1N288	C		350@-50	70	750	40	25	90
1N289	C		50@-50	70	500	20	25	90
1N290	C		100@-100	100		5	25	90
1N291	C		100@-100	100		40	25	90
1N292	C		200@-50	60	150	100	25	90
1N294	C, R	70	800@-50	60	500	5		100
1N295	R	50	200@-10	40	300			100
1N297	R	100	100@-50	80	500	3.5		100
1N298	R	85	250@-40	70	500	30@2		100
1N300	R	15	.001@-10	12	500	15		150
1N300A	R	15	.001@-10	12	650	30		150
1N301	R	70	.05@-50	65	350	5		150
1N301A	R	70	.05@-50	65	500	18		150
1N302	R	225	0.2@-200	215	250	1		150
1N302A	R	225	0.2@-200	215	350	5		150
1N303	R	125	0.1@-100	115	300	3		150
1N303A	R	125	0.1@-100	115	400	12		150
1N305	R	60	20@-50	50	500	100@.8		70
1N306	R	15	2@-10	12	500	100@.8		70
1N307	R	125	20@-100	100	500	100		70
1N314	USD	75	50@-10	75	100	15	85	125
1N315	C, GE	100		50	25,000		85	95
USAF 1N315	GE	100		50	25,000		85	95
1N330[1]	WE	70	.03@-20	32	150	3	25	100
1N331[1]	WE	43	.01@-10	16	250	5	25	100
1N332	TE	400	200@280	280	10A		150	175
1N333	TE	400	200@280	280	5A		150	175
1N334	TE	300	200@210	210	10A		150	175
1N335	TE	300	200@210	210	5A		150	175
1N336	TE	200	100@140	140	10A		150	175
1N337	TE	200	100@140	140	5A		150	175
1N338	TE	100	200@70	70	6A		150	175
1N339	TE	100	100@70	70	10A		150	175
1N340	TE	100	100@70	70	5A		150	175
1N341	TE	400	500@280	280	10A		150	175
1N342	TE	400	500@280	280	5A		150	175
1N343	TE	300	500@210	210	10A		150	175
1N344	TE	300	500@210	210	5A		150	175
1N345	TE	200	500@140	140	10A		150	175
1N346	TE	200	500@140	140	5A		150	175
1N347	TE	100	500@70	70	6A		150	175
1N348	TE	100	500@70	70	10A		150	175
1N349	TE	100	500@70	70	5A		150	175
1N368	GE	200		1	25,000		55	55
1N411A	TE	50	5000@-50	50	500A	100A@1.5	150	175
1N412A	TE	100	5000@-100	100	500A	100A@1.5	150	175
1N413A	TE	200	5000@-200	200	500A	100A@1.5	150	175
1N415B	M, B	10,000mc, Reversible Polarity version of 1N23B						
1N415C	M, B	10,000mc, Reversible Polarity version of 1N23C						
1N415D	M, B	10,000mc, Reversible Polarity version of 1N23D						
1N415E	M	10,000mc, Reversible Polarity version of 1N23E						
1N416B	M, B	3000mc, Reversible Polarity version of 1N21B						
1N416C	M, B	3000mc, Reversible Polarity version of 1N21C						
1N416D	M, B	30,000mc, Reversible Polarity version of 1N21D						
1N416E	M	3000mc, Reversible Polarity version of 1N21E						
1N417	S	70		60				70
1N418	S	70		60		7.5		70
1N419	S	100		80		150		70
1N429	HE	6.2v Zener Reference Diode					25	200
1N430	HE	8.4v Zener Reference Diode					25	150
1N430A	HE	8.4v Zener Reference Diode					25	150
1N430B	HE	8.4v Zener Reference Diode					25	150
1N431	HE	75	1@-68	68	22			150
1N432	R	40	.005@-10	35	450	10		150
1N432A	R	40	.005@-10	35	550	20		150
1N433	R	145	.1@-125	135	300	3		150
1N433A	R	145	.1@-125	135	400	10		150
1N434	R	180	.1@-150	170	300	2		150
1N434A	R	180	.1@-150	170	400	7		150
1N437	R	5	.1@-1	5	500	100@1.2		150
1N437A	R	5	.1@-1	5	500	100		150
1N438	R	7	.1@-1	7	500	100@1.2		150
1N438A	R	7	.1@-1	7	500	100		150
1N440	GI	100	.3@100	100	3000	250	150	200
1N441	GI	200	.75@200	200	3000	250	150	200
1N442	GI	300	1@300	300	3000	250	150	200
1N443	GI	400	1.5@400	400	3000	250	150	200
1N444	GI	500	1.75@500	500	3000	250	150	200
1N445	GI	600	2@600	600	3000	250	150	200
1N447	G, S	75	20@-10	30		25		75
1N448	G, S	120	30@-30	100		25		75
1N449	G, S	50	10@-10	30		50		75
1N450	G, S	120	30@-30	100		50		75
1N451	G, S	170	150@-150	150		50		75
1N452	G, S	50	30@-30	30		100		75
1N453	G, S	120	30@-30	100		100		75
1N454	G, S	75	50@-50	50		200		75
1N455	G, S	50	30@-30	30		300		75
1N456	H	25	.025@-25		700	40		200
1N457	H, TE	60	.025@-60		600	20		200
1N458	H, TE	125	.025@-125		500	7		200
1N459	H, TE	175	.025@-175		400	3		200
1N461	H	25	.5@-25		500	15		200
1N462	H	60	.5@-60		500	5		200
1N463	H	175	.5@-175		400	1		200
1N464	H	125	.5@125		400	3		200
1N465	HE		100@-1	50			100	200
1N466	HE		100@-1				100	200
1N467	HE		100@-1				100	200
1N468	HE		100@-1.5				100	200
1N469	HE		100@-1.5				100	200
1N470	HE		50@-3.5				100	200
1N471	HE	Double Anode, Zener Voltage = 3.0 to 3.9						
1N472	HE	Double Anode, Zener Voltage = 3.7 to 4.5						
1N473	HE	Double Anode, Zener Voltage = 4.3 to 5.4						

(Continued on page 140)



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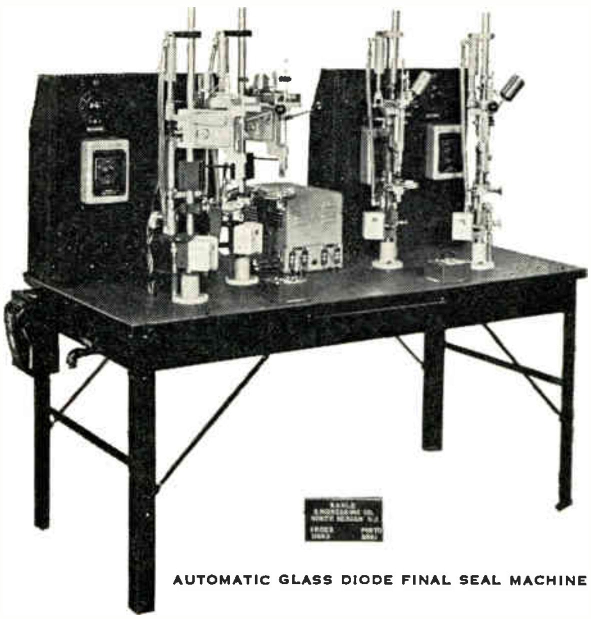

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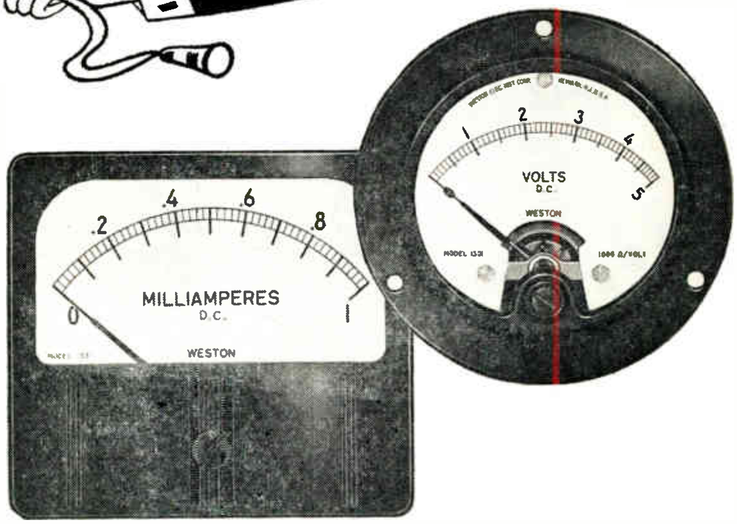

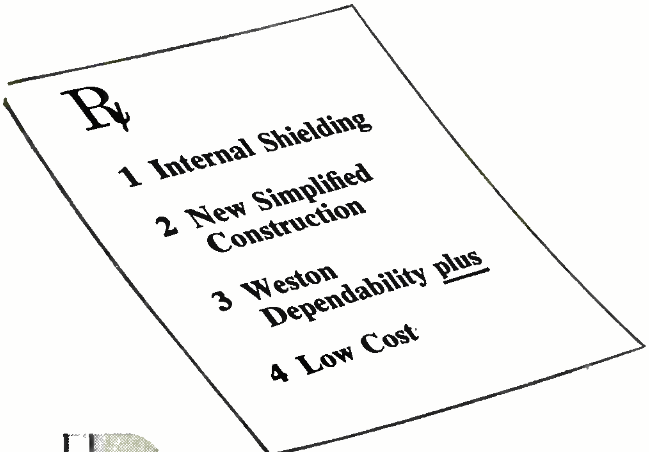

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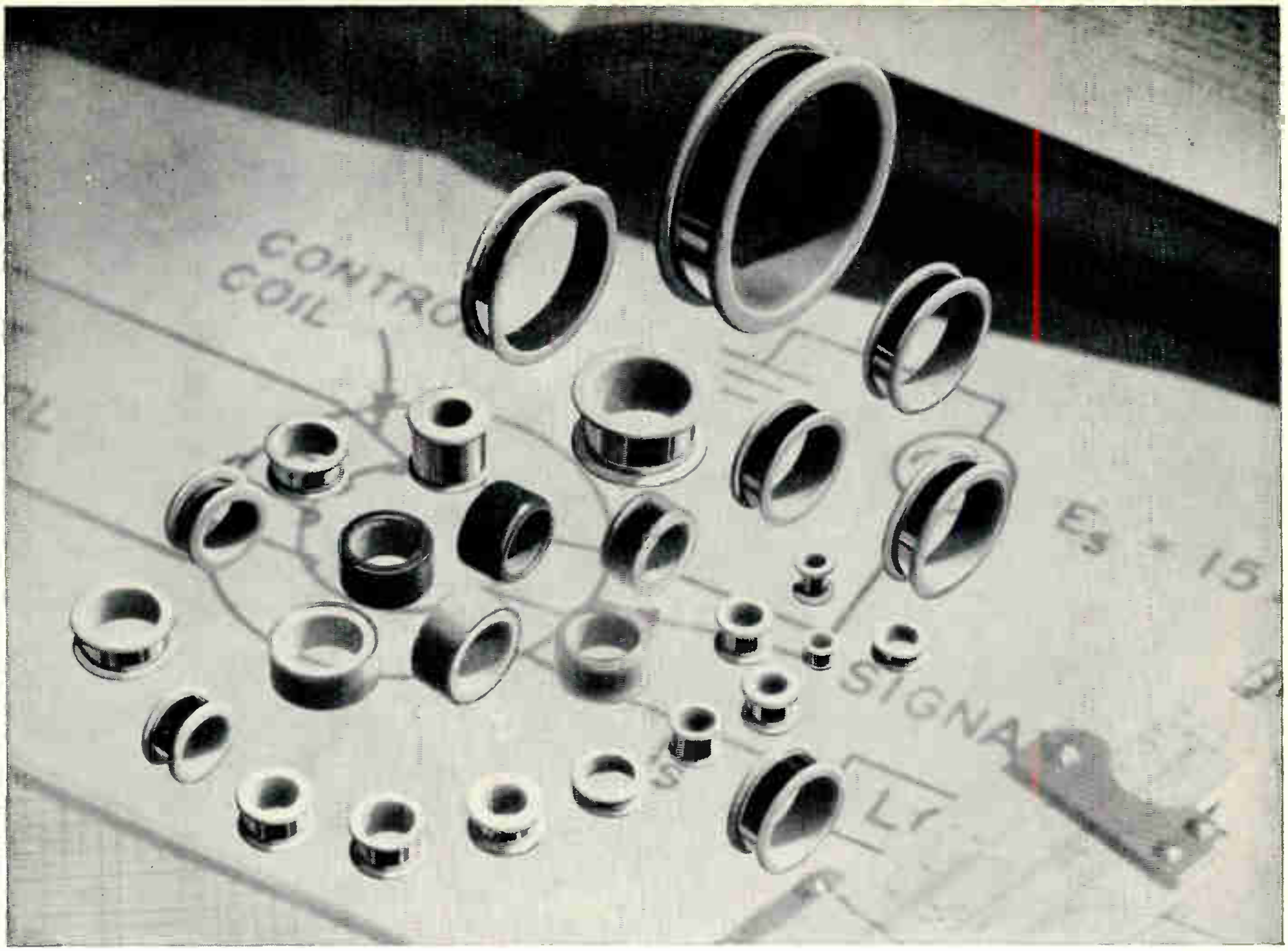
WESTON INSTRUMENTS

 For product information, use inquiry card on page 123.



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and precision is the word for ARNOLD

Ultra-thin tape for bobbin cores is rolled to high precision standards for thickness and finish on our own 20-high Sendzimir cold reducing mill, beta-ray controlled.

Write for **BULLETIN TC-108**

"TAPE-WOUND BOBBIN CORES FOR COMPUTER APPLICATIONS"

Includes essential data on applications and properties, fabrication and testing of Arnold Bobbin Cores; lists standard sizes, etc.

ADDRESS DEPT. T-71

For use in shift registers, coincident current matrix systems, pulse transformers, static magnetic memory elements, harmonic generators and similar equipment, Arnold Bobbin Cores meet the most exacting requirements.

Quality and uniformity? *You'll find them no problem*—because, as a fully integrated producer with highly modern facilities, we're able to maintain close control over every step.

Arnold Bobbin Cores are available in a wide range of sizes, tape thicknesses, widths and number of wraps depending on the ultimate use of the core. Magnetic materials usually employed are Deltamax, Permalloy and Supermalloy, in standard thicknesses of .001″, .0005″, and .00025″. Core properties include quite rectangular hysteresis loops, relatively low coercive values and high saturation densities, plus the ability to shift in a few microseconds from negative remanence to positive saturation, and vice versa, under conditions of pulse excitation. • Let Arnold supply your requirements for Bobbin Cores—or other tape-wound cores, powder cores, permanent magnets, etc.—from the most complete line of magnetic materials in the industry.

WSW 6399

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Repath Pacific Division Plant: 641 East 61st Street, Los Angeles, Calif.

District Sales Offices:

New York: 350 Fifth Ave. Los Angeles: 3450 Wilshire Blvd. Boston: 200 Berkeley St.

Personals

George Rappaport appointed Director, Special Projects, Govt. Electronics Div. at Emerson Radio & Phonograph Corp., Jersey City.

R. H. Severance named Chief Engineer of the new Urbana, Ill., Div. of The Magnavox Co., Fort Wayne.

Walter Y. Fish named Chief Engineer for Arnoux Corp., Los Angeles.

Ralph S. White named Manager-Research and Engrg., at Spinco Div., Beckman Instruments, Inc., Belmont, Calif.

Arthur N. Corner to Project Manager, Missile Test Equipment, at Farnsworth Electronics Co., Fort Wayne, an IT&T Div.

A. N. Corner

N. L. Harvey

Norman L. Harvey has been appointed Operations Manager - Tubes at the Electronics Div., Sylvania Electric Products, Inc., Woburn, Mass., and **Verlis H. Wiley** has been named Engineering Manager, TV Chassis, for Sylvania's Radio & TV Div., Buffalo.

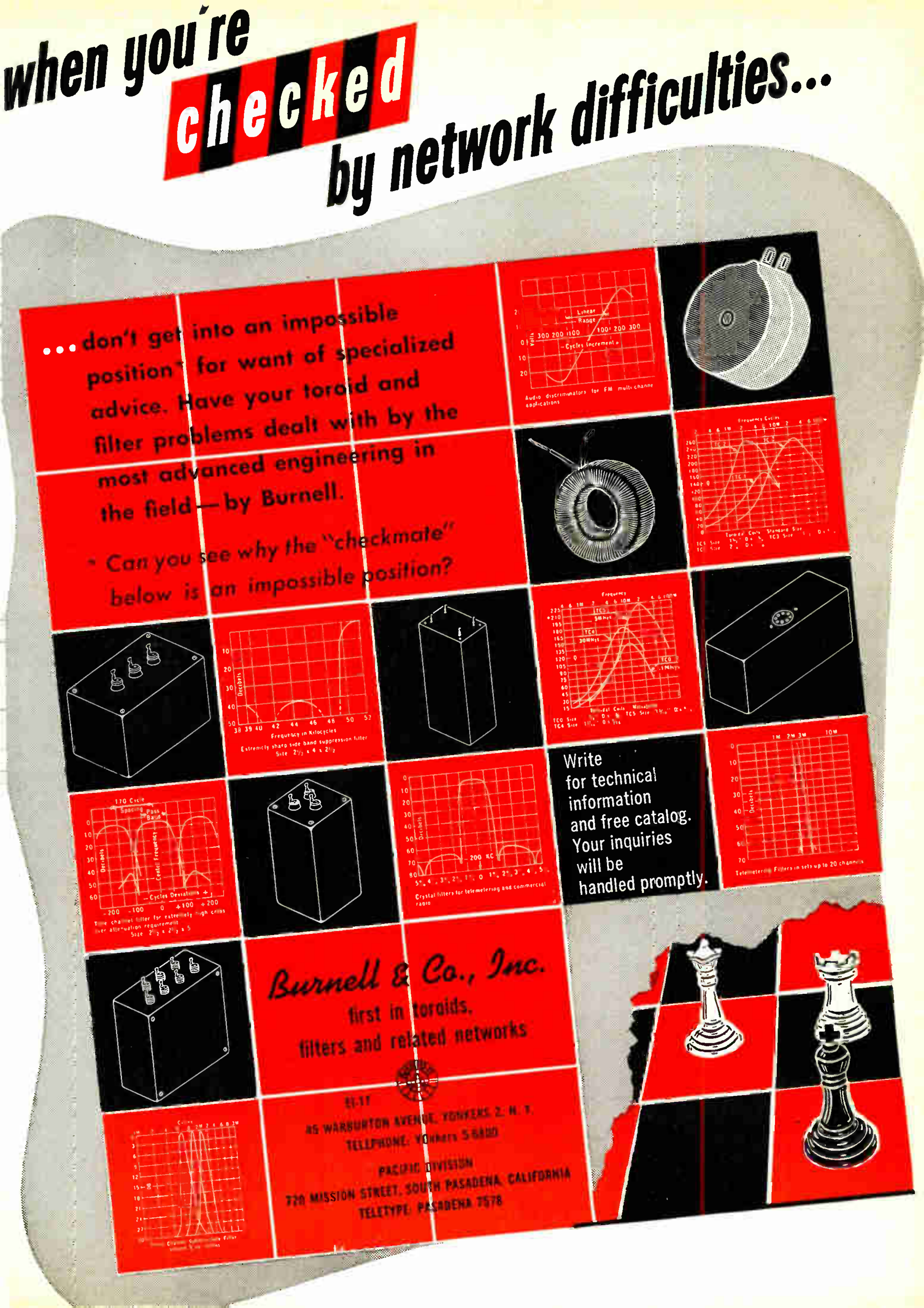
William P. Bartley has been made Manager Communications Sub-section, at General Electric's Lab in Syracuse.

Walter P. Selsted has been elected an officer of Ampex Corp., Redwood City, Calif. His activities as Director of Research are unchanged.

Dr. Herbert C. Corben has joined the staff of the Electronic Research Lab, The Ramo-Wooldridge Corp., Los Angeles.

Hugh E. Webber is now Chief Engineer of the Microwave Electronics Div., Sperry Gyroscope Co. He holds patents on microwave and accelerometer equipment.

Thomas J. Riggs, Jr., has been elected Executive Vice President and General Manager of The Gabriel Co., Cleveland; he had been President of F. L. Jacobs Co., Detroit, since 1954. Gabriel has an Electronics Div. in Boston.



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... don't get into an impossible position* for want of specialized advice. Have your toroid and filter problems dealt with by the most advanced engineering in the field — by Burnell.
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TELETYPE: PASADENA 7578

Flat Color CRT

(*Continued from page* 81)

that it contains a screen grid, held at maximum positive potential.

The array conductors will now charge themselves up to this same potential by secondary emission. This is the same mechanism by which the screen potential is stabilized in conventional non-aluminized TV tubes. Thus, during the interval between two field-scans the beam creeps up in the right-hand loop until it reaches the top, and then the cycle starts again.

This self-scanning process, though it unavoidably makes the tube more complicated, simplifies the circuitry since there is no need in the set for the usual vertical oscillator. The horizontal oscillator is still necessary, but significantly, it requires far less power than oscillators in the conventional (magnetic) TV tubes.

Color Control

The color control is explained in Figs. 1 and 2. Fig. 1 shows the electron trajectories in a color tube. Note that the three color beams, from independently modulated cathodes, merge during most of their course. This is an important feature of the new tube.

In the conventional shadowmask color tubes, the three beams start from three rather widely separated guns, which aim at one point. This requires great accuracy which in fact cannot be achieved without a great number of corrections (at least nine) and the adjustment is easily upset by local magnetic fields.

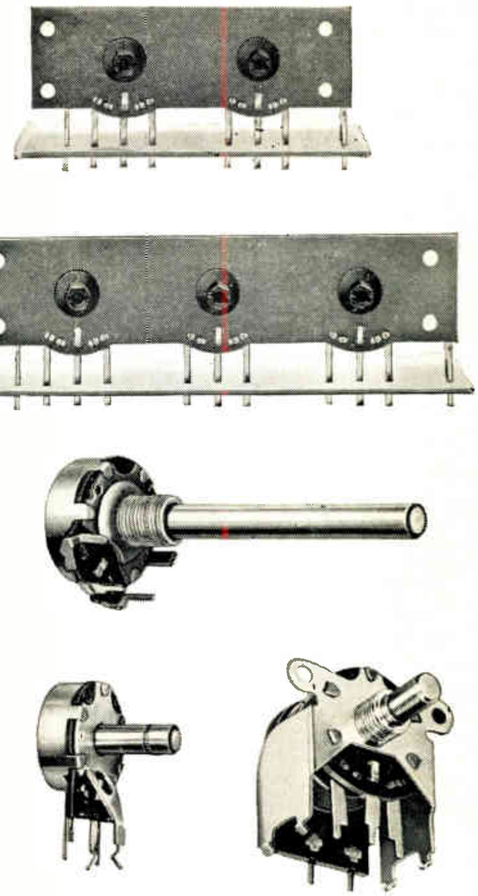
In the new tube, the three beams stay so closely together that local magnetic fields influence them substantially as if they were a single beam. The convergence is not upset and the magnetic field effects (strongly reduced in any case by the effective screening of the central plate) can be easily compensated by the "trimmer" electrodes.

The three color beams separate just before the final bend. At the end of this they come together again, but at different angles to the screen. This is the basis of the color control. It is based on the

(*Continued on page* 116)

Printed Circuit Controls by Mallory

Newest in the Mallory line of simplified controls for printed circuit applications—single or multiple resistance wafers applied directly on a phenolic panel which can be mounted by standard printed circuit construction techniques. Terminals are also available for solderless wire wrap assembly!



Any way you look at it . . .

Mallory controls are best for your printed circuit design

Here's good price and performance news for equipment manufacturers—a way to save on component cost and save on assembly cost wherever single or multiple secondary controls are used. Featuring the same high-stability resistance material as conventional Mallory controls, these elements are bonded direct to phenolic panels which can be mounted by simple printed circuit assembly methods.

Units of up to three controls can be mounted and wired in a single operation. Resistance values up to 10 megohms per single control, and numerous combinations of controls are available.

Other Mallory controls for printed circuit equipment, using the same high-stability resistance element made by Mallory's own special process, offer the designer and manufacturer a wide choice of mounting techniques. Included are models for mounting horizontal to, or vertical to the printed circuit.

All models have precision positioned mounting lugs designed for fast, accurate assembly. All are available in a wide range of circuit values and resistance tapers to suit specific design requirements. Special low end taper for transistor volume control is now available.

Solve a problem—and save

And now—available on standard models, Mallory's new floating-ring line switch. Pull, it's on—push, it's off. Long-life contacts, reduced volume control wear, and clean, crisp switch action give your design another modern merchandisable touch.

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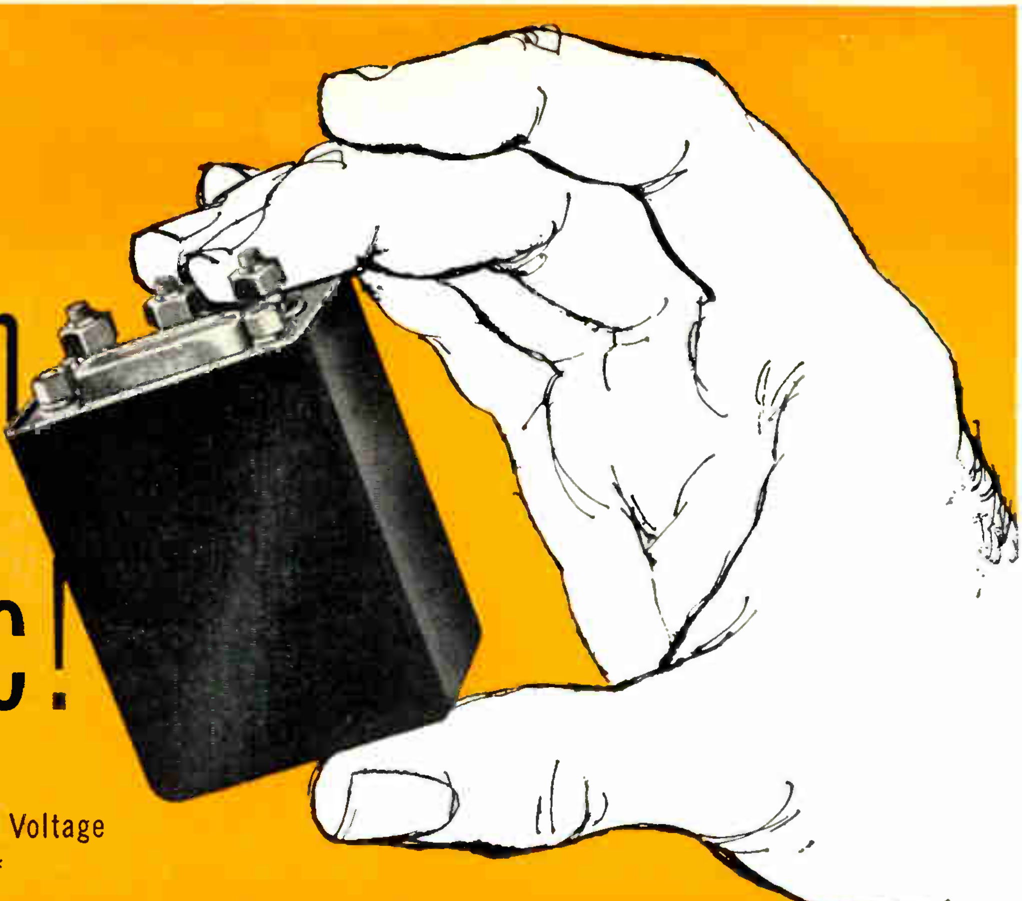
Metallurgical — Contacts • Special Metals • Welding Materials

Parts distributors in all major cities stock Mallory standard components for your convenience.

For product information, use inquiry card on page 123.

Tiny, Tough and Terrific!



New TDI Type 1202A Voltage Controlled Oscillator*

Actual Size of Unit (Height: 3⅛", Width: 1 15/16", Depth: 1 7/16", Weight: 8 ounces).

*Pat. Pending

This new TDI voltage-sensing subcarrier oscillator weighs in at only 8 oz.—is approximately one-half the size of previous oscillators—contains only two tubes, compared to present day five-tube circuits—but these are no indication of its outstanding performance! Reliability under typical (and that means extreme) environmental conditions is nothing short of amazing.

Interested? You can learn more by sending today for free technical data and detailed specifications of TDI's newest precision component for in-flight telemetering. Bulletins of other TDI remote instrumentation products sent on request.

BUILT FOR ENDURANCE

TEMPERATURE—Designed for operation from −65° C to +100° C

ALTITUDE—Center frequency stability within ±1% of design bandwidth with variation in altitude from sea level to 80,000 feet (temp. constant)

ACCELERATION—Center frequency stability within ±1.0% of design bandwidth under constant acceleration of 50g in each direction of each major axis

SHOCK—Center frequency stability within ±3% of design bandwidth after being subjected to 60g, 10 millisecond duration impact shock in each direction of major axis

VIBRATION—Center frequency stability within ±3% of design bandwidth when subjected to sweep vibration of 0.06 inches double amplitude from 10 to 55 cps and 10g from 55 to 2000 cps (three minute duration total) in each major axis. Noise output less than 3% peak to peak of DBW.

TDI's newest office is now located at 305 Washington Avenue S.E., Albuquerque, New Mexico

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- GROUND ELECTRONICS SYSTEMS
- AIRBORNE ELECTRONICS SYSTEMS

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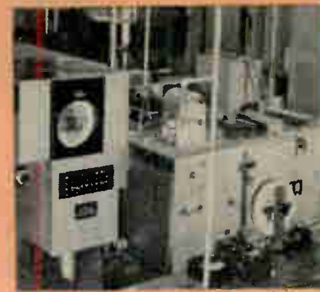
High temperature globar furnace; muffle furnace for enamel testing; hydrogen atmosphere sintering furnace.



Humidity chambers using program-controlled cycles; here Ohmite products are tested under a wide range of temperature and humidity conditions.

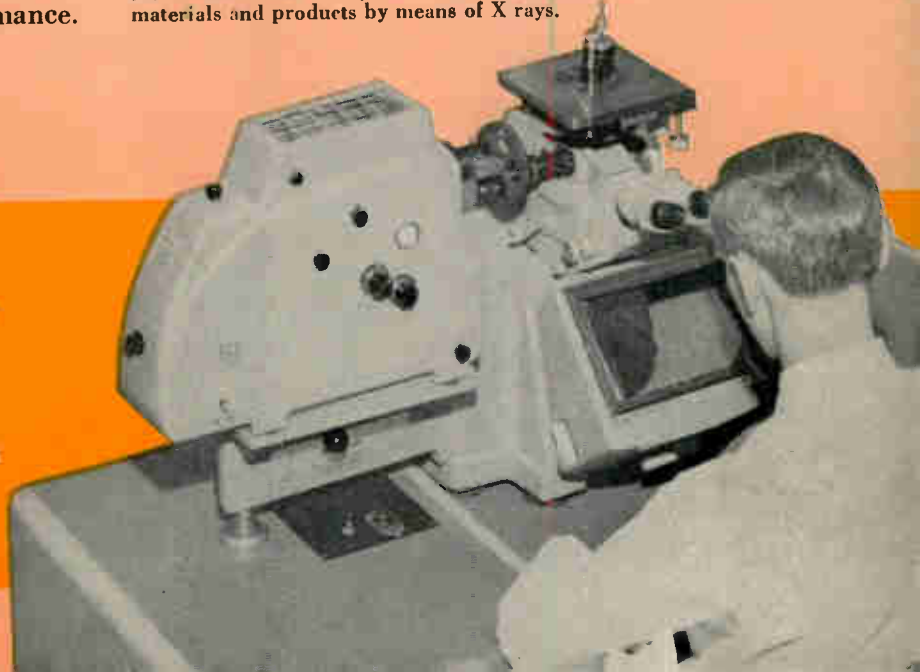
Microscopic and petrographic equipment used in Ohmite laboratories for optical examination of materials and products.

Microscopic analysis of structure using metallograph. Thermal expansion of ceramics and vitreous enamels can be determined with interferometer equipment.

Instruments shown above are used to check and standardize the many pieces of Ohmite electrical test equipment.

This power panel provides AC or DC in a wide range of currents, voltages, and frequencies . . . permits testing Ohmite products under operating conditions.

X-ray Diffractometer and X-ray Fluorescence Spectrometer make possible the determination of crystal structure, as well as elemental composition of materials and products by means of X rays.



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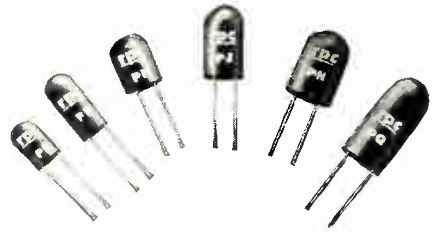
Printed Circuit Precision Resistors



To meet the requirements for printed circuitry, RPC has developed Type P Encapsulated Wire Wound Precision Resistors. Miniature, single ended units designed for easy rapid mounting on printed circuit panels with no support other than the wire leads. Many newly developed techniques are employed in the manufacture of Type P Resistors. These units can be operated in ambient temperatures up to 125°C. and will withstand all applicable tests of MIL-R-93A, Amdt. 3. Available in 6 sizes, rated from 1/10 watt to .4 watt. 1/4" diameter by 5/16" long to 3/8" diameter by 3/4" long. Resistance values to 3 megohms. Tolerances from 1% to 0.05%.

rpc

HIGH QUALITY RESISTORS FOR ELECTRONICS

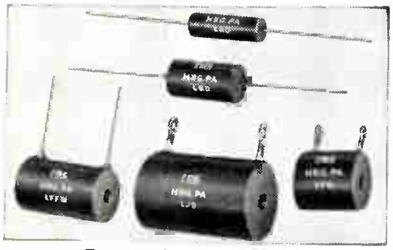
RPC is a widely recognized supplier of high quality resistors to industry, Government Agencies and the Armed Forces. Advanced production methods, modern equipment and scientific skill enables RPC to manufacture resistors of *highest quality* in *large quantities* at *reasonable cost.* Modern manufacturing plant is completely air conditioned and equipped with electronic dust precipitators to insure highest production accuracy. RPC resistors are specified for use in instruments, electronic computers, radiation equipment, aircraft equipment and scientific instruments.

Test equipment and standards for checking and calibrating are equalled by only a few of this country's outstanding laboratories. Our ability to produce resistors of highest quality coupled with prompt delivery have established RPC as a leading manufacturer of resistors. Small or large orders are promptly filled.

Representatives in principal cities. For full information send for latest catalog.

High Frequency Resistors

Used where requirements call for very low inductance and skin effect in circuits involving pulses and steep wave fronts. Depending on size and resistance value, these resistors are usable at frequencies to over 400 mc. Resistance values range from 20 ohms to 100 megohms with tolerance of 20% to 5%. 2 types available.
TYPE F resistors (shown) in 8 sizes from 9/16" long x 0.10" diameter to 6½" long x 9/16" diameter, with lugs or wire leads. Power ratings ¼ to 10 watts.
TYPE G resistors (not shown), in 6 sizes up to 18½" long. Power ratings 10 to 100 watts.

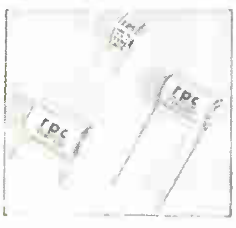


Encapsulated Precision Wire Wound Resistors

RPC Type L Encapsulated Resistors will withstand temperature and humidity cycling, salt water immersion and extremes of altitude, humidity, corrosion and shock without electrical or mechanical deterioration. Type L resistors are available in many sizes and styles ranging from sub-miniature to standard with lug terminals, axial or radial wire leads. Available for operation at 105° C. or 125° C. ambient temperatures. These resistors will meet all applicable requirements of MIL-R-93A, Amdt. 3. Type L can be furnished with all resistance alloys and resistance tolerances from 1% to .02%.

High Voltage Resistors

Type B Resistors are stable compact units for use up to 40 KV. These resistors are used for VT voltmeter multipliers, high resistance voltage dividers, bleeders, high resistance standards and in radiation equipment. They can be furnished in resistance to 100,000 megohms. Available as tapped resistors and matched pairs. Sizes range from a 1 watt resistor 1 inch long x 5/16 inch diameter rated at 3500 volts, to a 10 watt resistor 6½ inches long x 9/16 inch diameter rated at 40 KV. Low temperature and voltage coefficients. Standard resistance tolerance 15%. Tolerances of 10%, 5% and 3% available. Tolerance of 2% available in matched pairs.



Wire Wound Precision Resistors

Type A Precision Resistors are widely used for all general requirements. They are available in a wide variety of sizes, styles and terminal types. They can be furnished with all resistance alloys in tolerances from 1% to .02%. Type A will meet the requirements of MIL-R-93A, Amdt. 2, Characteristic B. Special winding techniques, impregnation and thermal aging result in resistors of exceptional stability. Matched resistors, networks and special assemblies can be supplied.

High Megohm Resistors

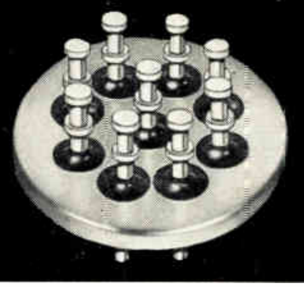
Type H Resistors are used in electrometer circuits, radiation equipment and as high resistance standards. Resistance available to 100 million megohms, (10^{14} ohms). For utmost stability under adverse conditions Type HSD and HSK Hermetically Sealed are recommended. Eight sizes from 7/8 inch to 3 inches long are available. Voltage rating to 15,000 volts. Low temperature and voltage coefficients. Standard resistance tolerance 10%. Tolerance of 5% and 3% available. Also matched pairs 2% tolerance.

RESISTANCE PRODUCTS CO.

914 S. 13th Street
HARRISBURG, PA.

SOLID GLASS HEADERS VS. MULTIPLE BEAD TERMINALS

Val Cichowski
V. P. Manufacturing



Andy Wyzenbeek
V. P. Engineering

There are several reasons that Fusite customers have for going to a solid glass header. Compact size is one of them. While 1″ diameter is about maximum for this type terminal, we can pack 21 electrodes into this space with the same voltage limits that would require either a much larger disc or fewer pins in a multiple bead terminal. Size for size this is a more rugged terminal than one using a light gage stamping. Where the terminal serves as a structural part of an electrical assembly, solid glass is better able to support stress. Before resting the case for solid glass, it is worthy of mention that it costs less per pin. Fusite offers a complete line of solid glass headers.

While our friend Cichowski presents a strong case for the solid glass header, a large percentage of Fusite Terminal business is still done in multiple bead terminals. There are good reasons. Wherever weight is a factor, you'll usually find a multiple bead terminal in a light gage stamping with its remarkably favorable weight to strength ratio.

This type construction is more versatile. When large sizes are needed, where very heavy pressures are involved or extreme conditions of any nature exist, they can best be coped with by using multiple beads in a heavy gage body.

While speaking of unusual conditions, it gives me an excuse to mention our special engineering section. Our line of standard terminals is very large but we are constantly at work developing special custom designs to solve specific problems. We solicit yours.

Jim Marsh
V. P. Sales

If you found anything helpful in the words of wisdom from Val and Andy, I'm real happy for you. But frankly, I can't get too excited over which kind of terminal you buy. As long as it comes from Fusite, you can be sure it's the best of its type available. We develop our own glass formulas and do our own smelting right here at the plant. It gives us the best control over quality in the industry.

Complete literature on all Fusite Terminals is yours for the asking. Write Fusite, Department U-1.

INSULATE ELECTRICALLY GLASS TO METAL
FUSITE TERMINALS
PROTECT PRODUCT PERFORMANCE
SEAL HERMETICALLY

THE FUSITE CORPORATION
6026 FERNVIEW AVE., CINCINNATI 13, OHIO

 For product information, use inquiry card on page 123.

(*Continued from page* 110)

shadowmask principle, but with the important difference that, while in conventional tubes the distance of the shadowmask from the phosphor screen is of the order ½ in., here it is only about 0.025-in. (This is made possible by the large convergence angle of the beams and also partly by their slanting incidence.) Consequently, it now becomes possible for the first time to fix the shadowmask directly on the phosphor screen. This avoids all the difficulties which arise in other tubes from the necessity of very accurately aligning two independent, precision-made components.

Fig. 2 shows two suitable designs of shadowmasks fixed directly on the screen. The second one (b) is the simplest. A thin metal foil (0.0013—0.002 in. thick) is sharply folded in vertical folds so close together as to be invisible to the eye. These folds form ribs for the accurate spacing and fixing of the plane portion which carries a great number of slits, horizontal or slanting (40-60/in.). A slanting angle avoids moiré effects. The slits are produced by etching, either before or after the mask is fixed on the glass. A resist pattern is printed on the metal foil before the folding operation. The adhesive for fixing the mask on the screen may be any tacky substance which can be hardened by subsequent heating.

Phosphor Screens

The preparation of the phosphor screen, which in present-day color tubes consists of a long series of delicate processes, is very simple. The three finely-ground phosphors corresponding to red, green and blue are dropped vertically from air suspensions through stagnant air on to the tacky surface, at three different inclinations of the screen to the vertical, through the slits of the shadowmask.

This operation would not succeed at the usual distance (½ inch) of the shadowmask, but it gives very sharply defined color strips with a spacing of the order of 0.025 in. It is possible to make the strips 0.005 inches wide, or even thinner, if

(*Continued on page* 118)

For product information, use inquiry card on page 123.

(*Continued from page* 116)

desired in high-definition television systems.

Technological Problems

Two other rather difficult technological problems had to be solved in the development of this tube. One was the preparation of the scanning array. A suitable, if unconventional, insulating support was found in glass fabric coated with a very heat-resisting silicone varnish of the trade name MS 994 (Midland Silicones Ltd.). The difficult problem of producing a printed circuit on this material was solved by a new process of the Metropolitan Vickers Ltd. Research Department, invented by Dr. Ashworth and Mr. Alderson.

Another technological problem of considerable importance was posed by the flat screen. If this were made of ordinary annealed glass it would have to be about one-inch thick in a 21-in. tube, which is prohibitive. The difficulty was solved by a pre-stressing (toughening) process which increases the apparent tensile strength of the glass by at least a factor of three or four. This is capable of further improvement.

The electron-optical development has so far been carried out in demountable vacuum tanks, but it is now nearly completed. Further work is in progress toward producing sealed-off tubes.

All the patent rights in Dr. Gabor's invention have been assigned to the National Research Development Corporation, a Government-sponsored body. NRDC is the sole supporter and financier of the development work which has been going on in the Electronics Laboratory in the Imperial College of Science and Technology, in South Kensington, London.

A flat television tube in which the field scan is effected by a travelling electric wave was independently invented by W. Ross Aiken of Kaiser Aircraft and Electronics Corporation of Oakland, California.

"A Tetrode Transistor Amplifier for 5-40 MC"

On page 62, November issue, in the above article, Re is defined as "emitter resistance." It should be read as "the real part of."

For product information, use inquiry card on page 123.

Intercom System

(*Continued from page* 58)

with weak electrical currents. Thus a sparate lead marked "stimulator signal" is brought to an earphone of one of the assistant surgeons so that he may monitor the delivery of stimulus current as well as monitor electrical brain activity picked up by suitable amplifiers.

Special Considerations

There are a number of special considerations. The apparatus in the operating room must not jeopardize sterility requirements. Our procedures require the use of a hood covering everything but the eyes. However, in those surgical situations where only a mask and cap are worn, the head-set-microphone assembly must be of such a nature that it can be easily cleaned (although not necessarily sterilized).

Junction box or connectors must be clear of the floor to avoid scrub-down and splashed liquids. Switches must be explosion-proof or have potentials across them too small to produce ignition.

The emphasis on comfort of the headset-microphone assembly cannot be stressed too much, since once gowned and hooded there is little relief or adjustment possible without considerable interference with normal procedures or sterility.

Noise-canceling microphones would be of some advantage, particularly for the surgeon and assistants because of the noise produced by the suction apparatus used to remove fluids and tissues.

A Wireless System

We are presently exploring the possibilities of a wireless system which would eliminate the cable "tails" that must now be so carefully watched. There are a number of serious considerations, however.

A practical transmitter-receiver must be small, light, and rugged, must be able to operate continuously for at least twelve hours, and must be free of operational adjustments. Automatic volume control would probably be neces-

(*Continued on page* 126)

now you can meet every tape recording need

with this **COMPLETE audiotape LINE**

1. PLASTIC-BASE AUDIOTAPE on 1½-mil cellulose acetate meets the most exacting requirements of the professional, educational and home recordist at minimum cost. Known the world over for matchless performance and consistent uniform quality. Series 51, in the red box.

2. AUDIOTAPE ON 1½-MIL MYLAR* — a premium-quality professional tape with maximum mechanical strength and immunity to heat and humidity. Will not dry out or embrittle with age. Series 71, in the green box.

3. "LR" AUDIOTAPE ON 1-MIL "MYLAR" — 50% more recording time per reel. Strong, super-durable polyester film base assures trouble-free operation even under extreme heat and humidity. Series 61, in the black and red box.

4. PLASTIC-BASE "LR" AUDIOTAPE provides 50% more recording time on low-cost 1-mil cellulose acetate base, affording maximum economy where high strength is not required. Series 41, in the blue box.

5. SUPER-THIN AUDIOTAPE on ½-mil "Mylar" gives twice as much recording time per reel as standard plastic-base tape. For long-play applications where tape tension is not excessive. Series 31, in the yellow box.

6. COLORED AUDIOTAPE on green or blue 1½-mil plastic base provides fast, easy color cueing and color coding, at no extra cost.

7. COLORED AUDIOTAPE REELS — 7" and 5" reels in jewel-tone colors — red, yellow, green and blue — for color coding, at no extra cost.

8. HEAD ALIGNING TAPE pre-recorded with precise head alignment, giving a highly accurate reference for aligning recording heads.

9. TYPE "EP" AUDIOTAPE provides extra precision and guaranteed freedom from defects, for computers, telemetering and high-speed magnetic data recording.

10. AUDIOFILM extends Audiotape's unsurpassed sound quality to motion picture and TV film recording. Available in 35mm, 17½mm and 16mm sizes.

11. "HOW TO MAKE GOOD TAPE RECORDINGS" The complete handbook of tape recording, containing 150 pages of up-to-the-minute information of practical value to every tape recordist. $1.50 paper bound, $2.50 cloth bound.

12. AUDIO HEAD DEMAGNETIZER removes all permanent magnetism from recording and reproducing heads in a matter of seconds.

13. AUDIO HEAD CLEANER, especially formulated for use on magnetic recording heads — superior to carbon tetrachloride.

14. ADHESIVE REEL LABELS provide positive identification of your tapes right on the reel. Press to apply, pull off to remove.

15. AUDIO SELF-TIMING LEADER TAPE A strong, durable leader tape of white "Mylar" with spaced markings for precise timing of leader intervals.

New 5-Reel Cellophane Package

gives *extra protection* against dust and dirt — keeps tape and boxes factory fresh.

Ask your dealer for genuine, professional-quality Audiotape . . . it now costs no more than ordinary tape!

AUDIO DEVICES, Inc.

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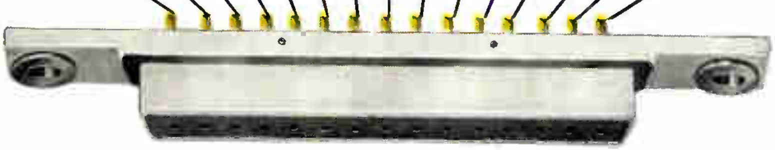
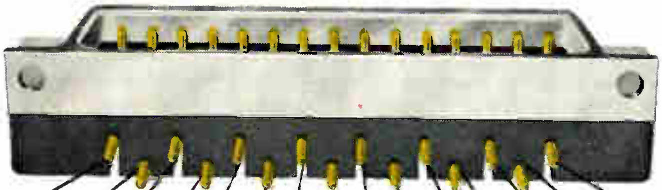
*DuPont Trade Mark



UNUSUAL PROBLEMS IN PRINTED CIRCUIT CONNECTIONS



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Of course we have our standard Printed Card Connectors, darn-good ones, too —over 101 different types. But we also have a group to conquer your really "tough" connection problems . . . skillfully designed and executed in various unique configurations . . . or U.S.C. will custom-design one to your specifications.

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- SNAP-IN CONTACT CONSTRUCTION
- FATIGUE PROOF, BERYLIUM COPPER CONTACTS
- PROPER CONTACT RETENTION FORCES
- EASY CARD INSERTION
- RUGGED, COMPACT, LIGHTWEIGHT

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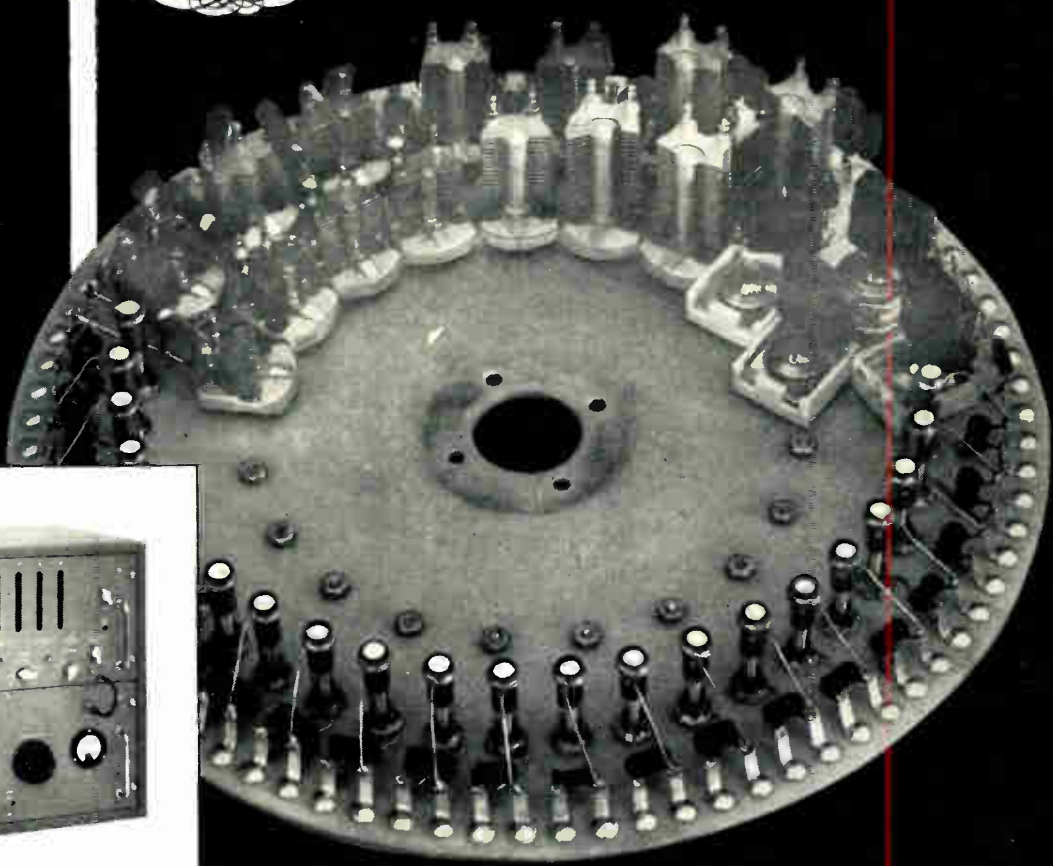
number 6

PISTON CAPACITORS AT WORK



trimmers achieve maximum measurement, accuracy and stability in BERKELEY frequency meters

actual size

del VC11RGA*

-10 mmf-glass dielectric-invar rotor)

PROBLEM: To combine functions of precision wide-range frequency meter and universal counter and timer in one compact instrument—to measure frequency from 0 to 42 megacycles with an accuracy of ±1 cps or greater and elapsed time from 1 microsecond to 10 million seconds with a maximum accuracy of ±1 micosecond.

SOLUTION: *Berkeley engineers specified 22 model VC11RGA JFD Trimmer Piston Capacitors in the O-42 mc. harmonic frequency turret to assure precise repeatable selection of reference frequencies.* The reasons *JFD Variable Trimmer Capacitors were selected? . . . Because an ultra-stable compact, trimmer capacitor was needed to afford rapid and accurate tuning capacity in the reference oscillator circuit.*

RESULT: Performance so outstanding that Berkeley, division of Beckman Instruments, Inc., has continued to specify JFD Piston Capacitors in their model 5571 Frequency Meters for 3½ years.

MORAL: If you are seeking *stability*, *shock-resistance*, *ultra-linear tuning* and *wide operating temperature range* in a trimmer capacitor, you'll find the best answer at JFD.

Why don't you take advantage of JFD Piston Capacitors in solving your circuit tuning problems?

**One of the miniature and subminiature JFD Piston Capacitors now serving in printed and conventional electronic circuits. Write for literature.*

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Go Forward with JFD Engineering!

(*Continued from page* 120)

sary to stabilize the output regardless of head position or body location.

Radiation Interference

Operationally, there are two kinds of interference to be considered: (1) interference with communication reception from such equipment as the electrocautery apparatus; and of a more serious nature, (2) interference by the communication transmitters to such apparatus as the electroencephalograph, which operates at levels in the tens of microvolts at input impedances in the tens of thousands of ohms. Further, magnetic induction methods of transmission might introduce direct interference and possibly stimulate the brain when electrodes or instruments were touching its surface.

Oscillator

(*Continued from page* 59)

tion with a standard reference DC voltage so that the resulting difference is applied to the control grid of the DC amplifier. The gain of the latter is approximately 40.

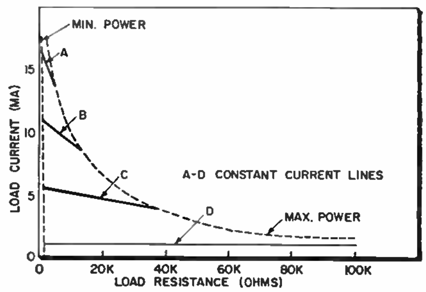

Fig. 4: Performance for various outputs.

In Fig. 4, the boundaries of operation corresponding to minimum and maximum power outputs for the unit are shown on a graph of I_L (load current) vs. R_L (load resistance). It is seen that for each I_L value there exists a minimum and maximum value of R_L permissible. Examples of the performance of the oscillator for various nominal current outputs are also shown in Fig. 4. The accuracy obtained is approximately $\pm 10\%$, but could be improved by increasing the gain of the feedback loop.

The author wishes to thank Dr. L. M. Vallese for the general idea of the constant current oscillator.

* * *

For product information, use inquiry card on page 123.

Radome Error

(Continued from page 66)

Fig. 1, and its operation may be described as follows:

Energy is accepted by the tracking radar antenna system which, in this particular case, is a conical scanning antenna operating at a spin rate of 35 cps. This signal is detected by a crystal video detector and is applied to a two-stage video amplifier. The output of this amplifier is detected by means of a simple "boxcar" type of detector using a keyed detection scheme. This method of detection is useful in reducing the 1,000 cycle noise in the amplifier and it also helps to alleviate certain overloading and blocking conditions that might exist under extreme transient errors.

This detector extracts the spin frequency modulation and amplifies it. The 1,000 cycle carrier frequency is rejected by a series filter arrangement and the smoothed output is applied to a narrow band, 35 cycle amplifier filter, which discriminates against spin frequency second harmonic noise.

The resulting signal is phase detected, using as a reference two voltages derived from the scanner spin generator which are indicative of the azimuth and elevation beam position. The two dc outputs of the phase sensitive detectors are fed through servo compensated networks, and then chopped at 60 cycles before being applied to their respective motor drive amplifiers.

Two feed back loops are provided around the motor drive amplifiers. The first loop is employed to reduce the output impedance to prevent single phasing of the servo motors. The second loop employs tachometer feed back to reduce the motor time constant and therefore allows a higher loop gain with a resulting improved static accuracy. Tachometer feed back also improves the high frequency response thereby reducing the effects of wind loading.

Typical response curves for such a system are shown in Fig. 2. These curves indicate that the dynamic error, as limited by servo response, for a ramp boresight

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For product information, use inquiry card on page 123.

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shift pattern with a slope of 3 mils/degree, is somewhat less than 0.3 mil for a rotational rate of 180°/10 min.

If tachometer feed back is employed, the max. error can be reduced to less than 0.2 mil for a rotational rate of 180°/5 min., and to less than 0.1 mil for a rotational rate of 180°/10 min.

Accuracy Factors

The factors which ultimately determine the accuracy of the boresight measurement can be conveniently divided into static and dynamic system accuracies. The static errors include such factors as motor sensitivity, noise due to spin frequency second harmonic and carrier demodulation, drift of balance, wind loading, mechanical friction and magnetron instabilities. The sum total of these errors is relatively small, probably of the order of 0.075 milliradians.

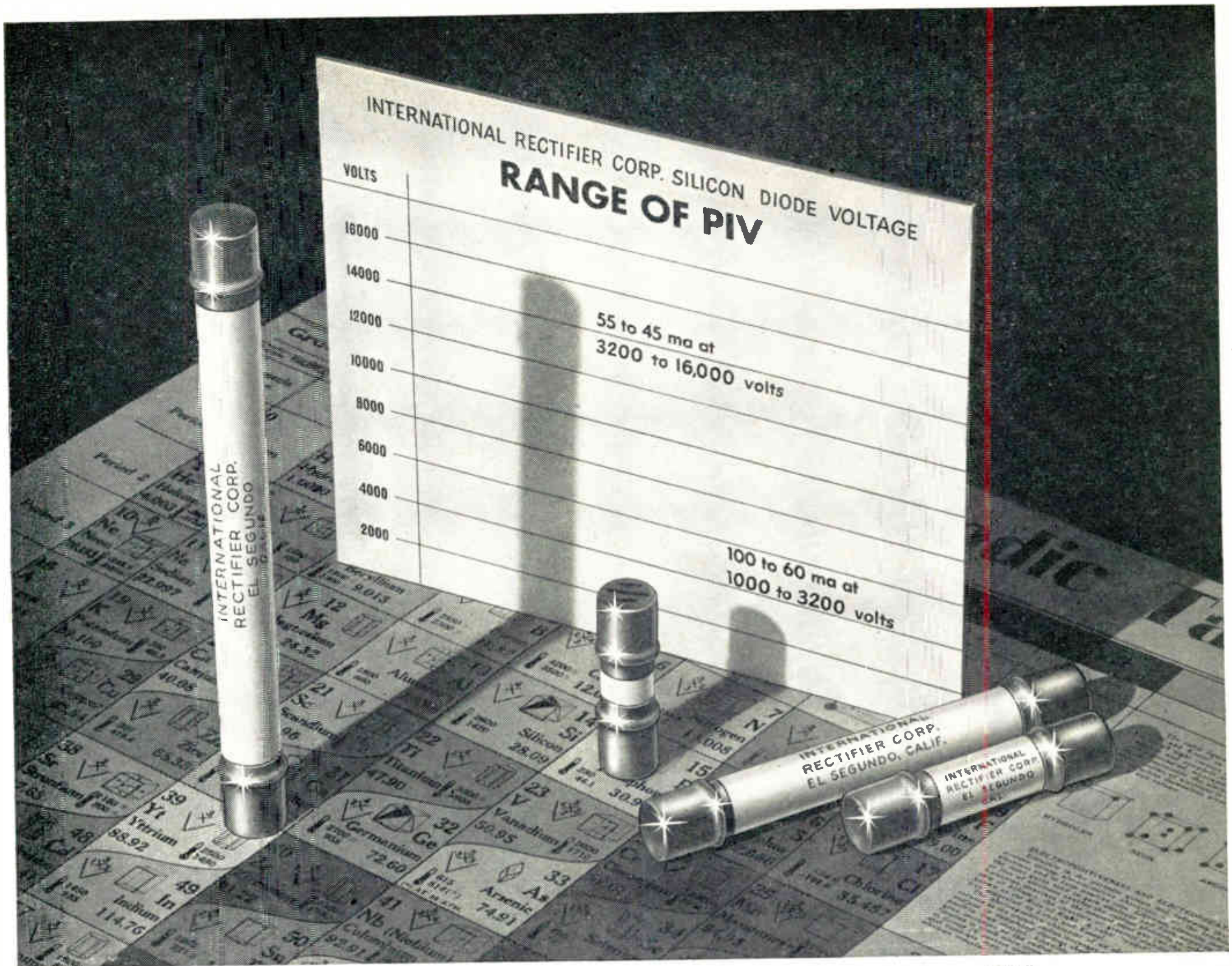
The dynamic inaccuracies include such factors as servo system response, reference generator phasing and wind loading. As described above, the servo response depends somewhat on the slope of the boresight error; for an extremely poor radome (boresight shift rate of 3 milliradians/degree) with a 3 min. data collection period, the max. error due to servo response was less than 0.2 mil.

The proper adjustment of the reference generator phasing is important in reducing cross talk. Experiments to date indicate that small inaccuracies in spin generator phasing do not materially affect the overall accuracy. Wind loading is a problem that must be considered on an individual site basis. The frequency spectrum of most wind gusts is sufficiently high to cause jitter in the tracking system unless extremely high servo frequency response is obtained.

The use of a high gain, rapid response tachometer feed back loop immediately around the motor and its driving amplifier has been instrumental in reducing wind gust effects to a tolerable minimum.

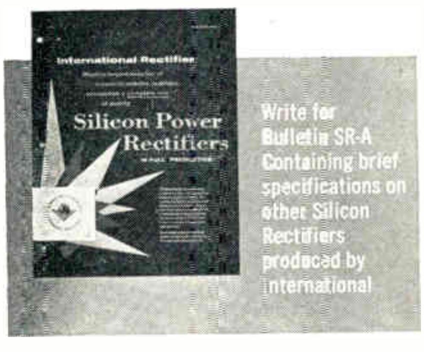
On an overall basis, the boresight measurement equipment is

(*Continued on page* 132)



Pictured are the 4 sizes available, ranging in length from 1¹³⁄₁₆" to 6¹⁄₁₆". Diameter ³⁷⁄₆₄".

International Silicon Diodes feature ratings to 16,000 volts PIV...require up to 95% less space!



Here is the answer to tough miniaturization problems where high temperature and high efficiency are prime design factors. International's high-voltage silicon diode series, now in full production, offers ratings ranging from 600 volts at 100ma half-wave dc output, to 16,000 volts PIV at 45ma, over a temperature range of −55°C to +150°C. Constructed from selected silicon junction diodes connected in series, hermetically sealed within a metalized ceramic housing, these rectifiers feature ferrule terminals for clip-in applications into standard 30-ampere fuse clips.

This new series is ideal for those "compact-packaging" jobs. For example, the 16,000 volt unit, with a diameter of ³⁷⁄₆₄", measures only 6¹⁄₁₆" in length. This represents a size ratio of 20 to 1 over rectifiers of other types. This marked size and weight savings over conventional units of comparable rating cuts engineering time normally spent "designing around" bulky units... can sharply reduce the dimensions and weight of your equipment.

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able to operate with an accuracy of better than ±0.25 mil. On the average, the accuracy of the system is probably better than 0.2 mil. Obviously, the accuracy of the system will depend in a large measure on the boresight rate of the radome and the speed with which the boresight data is collected.

Data Collection Rates

The automatic boresight measuring equipment described above provides the radome designer with a tool that will quickly and accurately determine the boresight shift characteristics of a given radome. The various points on the radome may be explored by taking azimuth cuts, elevation cuts and/or circumferential (roll) cuts.

The data collection rates depend on the max. boresight shift slope likely to be encountered and the required measurement accuracy.

For a rather poor boresight radome (max. shift slope of 3 mils/degree) and a measurement accuracy of ±0.25 mil, a 100° azimuth or elevation cut would require 2.8 min. For a reasonably good boresight radome (max. shift slope of 0.5 mil/degree) and a measurement accuracy of ±0.25 mil, a 100° azimuth and elevation cut would require 0.5 min. For radomes with small boresight shift rates, one can employ a long data collection period and possibly realize boresight accuracies of 0.1 mil.

Acknowledgment

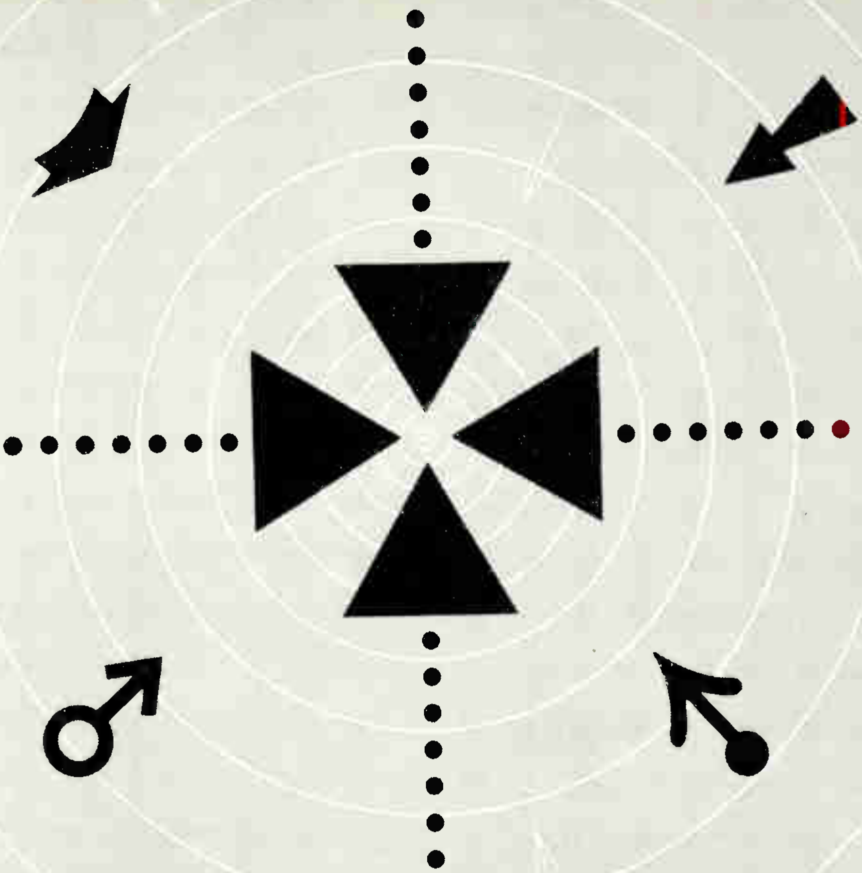
The authors would like to acknowledge the contributions of Gordon L. Shepherd (Mechanical Engineer) and Sanford Evans, Jr. (Systems Engineer) to the design of the automatic boresight measuring equipment, and Glenn A. Walters (Director of Research) who was instrumental in the development of a working model.

RF Head Design

(*Continued from page* 84)

aluminum cylinder and the traverse distance is ¼ inch. Unloaded and out of the circuit with the use of a "Q" Meter, the frequency shift as a function of slug traverse distance is quite linear from 215 MC to 225 MC or there-about. A fast rate of frequency change takes place when the slug is fully engaged in

(*Continued on page* 134)



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(*Continued from page* 132)

the coil. Restriction of too sharp a rise is accomplished in this manner. In the oscillator section, the fixed value of the padding coil becomes a larger part of the total inductance at the upper band. In the selective circuits, the bifilar coils help load down the tracking coils along with the shunt capacity of the trimmer condensers, restraining the fast rate of change. The dial calibration is fairly linear at each end of the band with a slight compression in the center.

Oscillator Performance

The oscillator voltage is coupled into the mixer by condenser C-12, Fig. 1. At first, it was placed at point B because it was thought to be a lower impedance point. Investigations proved that this point was more desirable under high r-f input levels, because the mixer load did not pull the oscillator as greatly as point A. The oscillator shift as a function of r-f input was investigated in the following manner. A transmitter tuned to 235 MC and using a T coupler, drove a Berkley counter and this r-f head joined with a 30 MC i-f with a crystal control second mixer having an output of 500 KC. The oscillator did shift approximately 25 KC at levels of 0.2 v. input. The grid resistor and cathode lead of the mixer were joined to a ground point. (Point C in Fig. 1). This point was lifted above ground and R-20 was inserted. This presented a higher input impedance for the mixer grid circuit. The experiment was repeated with levels in input greater than 0.5v. and the shift was slightly more than 15 KC. This is graphed and shown in Fig. 6. The sensitivity of the receiver was reduced 0.5 μv with R-20.

Although the reactance control of the oscillator is better than 1 MC/v. over a range of 4 MC, it is preferable not to depend entirely on the AFC loop for temperature drift. As stated earlier, the drift over the temperature range —45°C to +70°C is ±.5% or ±1 MC at a fundamental frequency of 205 MC. There is no performance deterioration if the oscillator grid coupling condenser C-9 is changed from 5.6

(*Continued on page* 136)

(*Continued from page* 134)

μμf to 4.7 μμf. The oscillator frequency is shifted 500 KC higher. A temperature compensating condenser with a negative coefficient of 20% capacitance change about ambient temperature will reduce the drift by one half. The coupling condenser C-12 between the mixer grid and the oscillator tank was changed to a temperature compensating capacitor with a coefficient of NP 200. Without any performance change, the oscillator drift was corrected an additional 200 KC. This means the oscillator can be corrected to the extent of a drift of ±.25%. A condenser with a higher negative temperature coefficient could be used, and the sensitivity would be altered.

As stated earlier, the oscillator stability was investigated and means found to correct any poor performance without any dependence upon the AFC loop. In normal AFC frequency conversion, the center frequency output is zero (Crossover point). A rising B+ voltage and an increasing negative voltage at the AFC input of the r-f

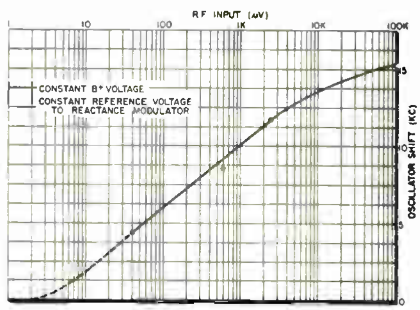


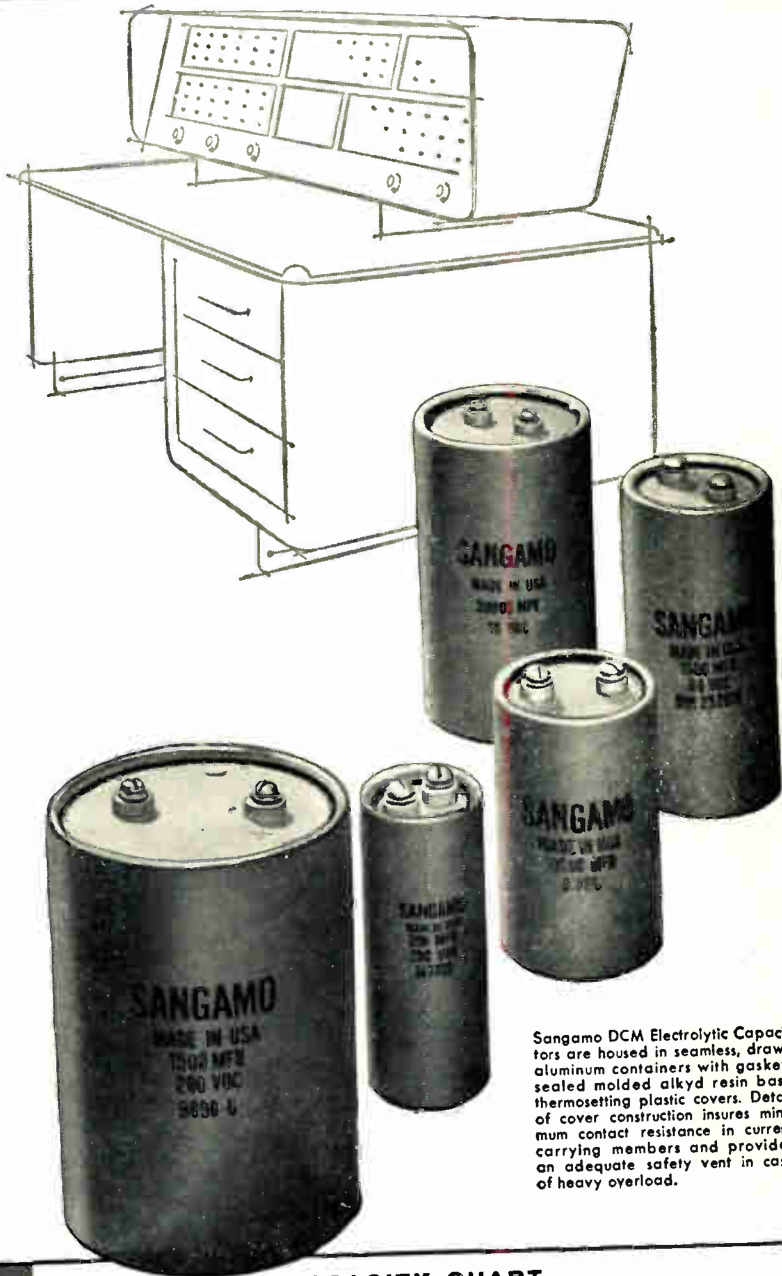
Fig. 6: Oscillator performance with input levels greater than 0.5 v.

head tend to cancel one another's effect of shifting the oscillator frequency. In varying the line voltage over the range of 105 ac v. to 125 ac v., the B+ increases about 1 v. and the negative bias of the second crystal mixer increases 1.5 v. The negative voltage is attenuated and used as a reference voltage at —1.8 v. with the use of a zener diode. The input impedance of the reactance tube circuit at this voltage is about 8MΩ voltage variation, the reference voltage changes 1/10 v. The oscillator shift is only 25 KC when operating at fundamental frequency of 205 MC. Hence, filament compensation can be achieved in the

(*Continued on page* 138)

for low voltage power supply...

SANGAMO Type DCM Electrolytic Capacitors



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They minimize ripple voltage and insure steady, stable DC voltage. They save space by eliminating any need for heavy, bulky choke components with their substantial and often-varying load voltage drops.

Maximum Voltage Rating: 450 VDC

Sangamo DCM Electrolytic Capacitors provide exceptionally low equivalent series resistance . . . assure extremely high capacity for case size in low voltage ranges . . . and are specially designed to permit high ripple current without overheating. They can be supplied in maximum energy content rating of 80-watt seconds in voltage ratings from 15 to 450 VDC. Maximum capacity value of 33,000 mfds. can be supplied at 15 WVDC.

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Sangamo DCM Electrolytic Capacitors are housed in seamless, drawn aluminum containers with gasket-sealed molded alkyd resin base thermosetting plastic covers. Detail of cover construction insures minimum contact resistance in current carrying members and provides an adequate safety vent in case of heavy overload.

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Rated Voltage DC	Surge Voltage	Max. Cap. in 2⅛ x 4⅝ Can	Max. Cap. in 2⅝ x 4½ Can	Max. Cap. in 3⅛ x 4½ Can
15	20	12,500	20,000	25,000
30	40	9,000	15,000	20,000
50	75	4,800	8,000	10,000
100	125	2,000	3,500	5,000
150	175	1,500	2,500	3,500
200	250	1,000	1,500	2,500
250	300	800	1,250	1,750
300	350	700	1,000	1,500
350	400	600	1,000	1,250
400	475	400	500	1,000
450	525	350	400	800

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(*Continued from page* 136)

following manner. This reference voltage can be coupled in the frequency conversion circuit of the AFC loop and shift the cross over point from zero to —1.8 v. Since the components in a AFC discriminator is unaffected by filament variation, the cross over point will shift and hold the oscillator frequency without the dependence of the feedback circuitry of the AFC loop.

Circuit Description

AGC is applied to both triodes of the Wallman circuit for more uniform performance and symmetry of layout. Originally, chokes instead of resistors were used for decoupling, but their natural self-resonance created a problem. Variable padding condensers account for tube variations and replacements.

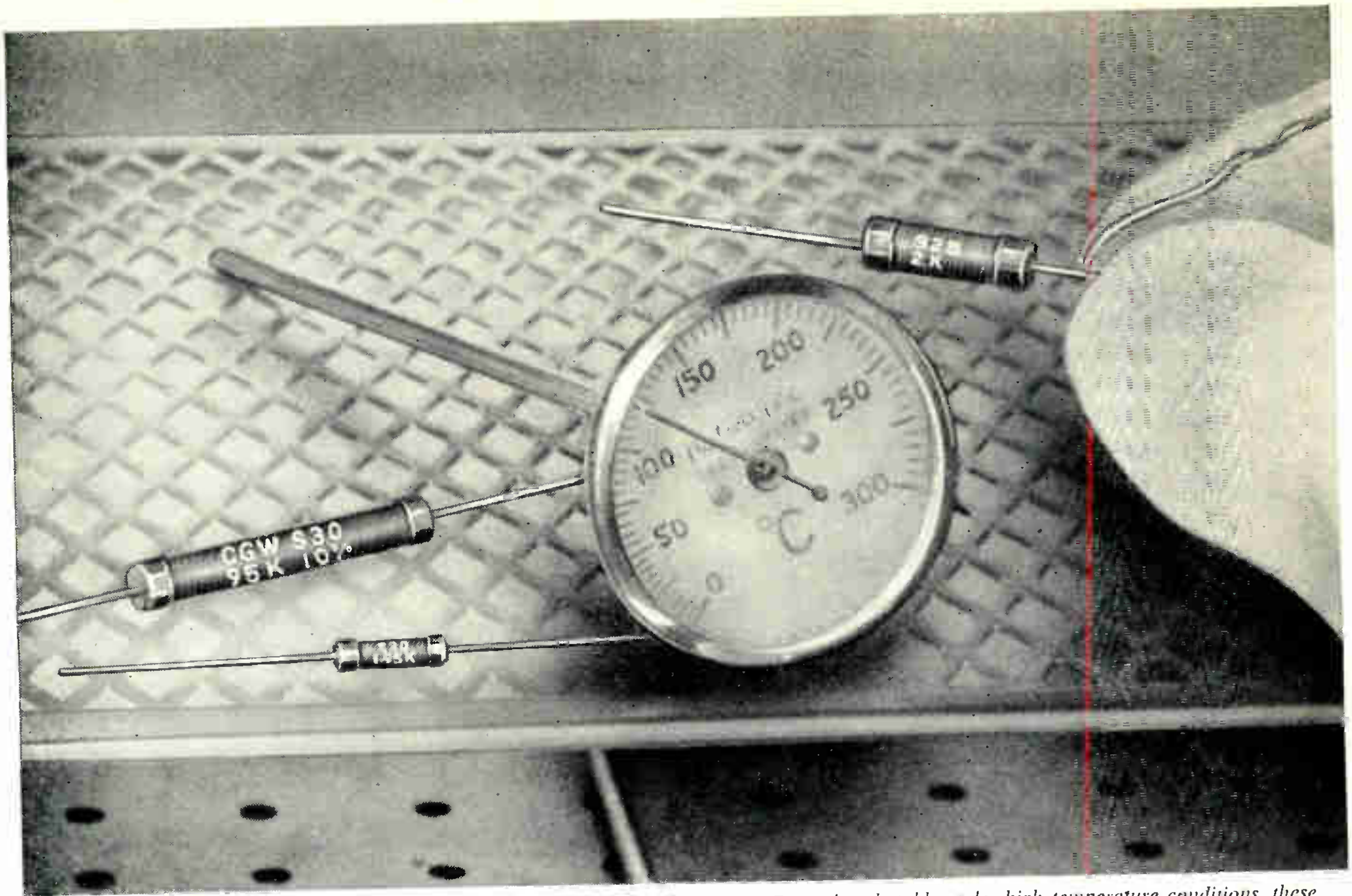
Transformers T-3 and T-4 are bifilar in construction and are identical in wire size. They perform the necessary matching function from high impedance to a low impedance. Slight interaction between both coils exist when adjusting them. Although the two triodes show a common cathode resistor, it is felt that coupling within the tube is the major source of disturbance.

At every tie point in the tuner, 470μμf bypass feed-through is used except where a signal carrying tie point exists. This component reduces space, shortens lead inductance and adds to the beauty of this subassembly.

The unit after proper tracking is exceptionally stable. Under weak signals of the order of 1 μv. or less, noise generation while tuning is not visible on the scope. This type of tuning is superior over capacity tuning for noise generation at low input levels. For wide band quieting, the sensitivity of the laboratory model receiver is approximately 3 μv. over the band for 20 db quieting.

The use of subminiature tube type 6021 covering the telemetry band of 215 MC to 235 MC has been discussed. The noise factor, gain, selectivity and stability has been given. This tuner has utilized shunt-tuned and series-tuned circuits and has shown the relative

(*Continued on page* 141)



Rugged and stable under high temperature conditions, these Corning S-Type resistors provide savings in space and cost.

Now you can have resistors with all these advantages . . .

1. 120° C. operation with 100% power, derating to 200° C. 2. Same size as deposited carbons 3. Wide resistance range 4. Economical cost

To help you solve the problem of small space and high ambient temperature Corning has developed these Type S resistors.

These are not ordinary film-type resistors. They are integral units made by bonding a metallic oxide to a PYREX glass rod at red heat. They're non-inductive and completely impervious to moisture.

Three sizes are now available in production quantities:

S-20—½-watt at 120° C. (or 1-watt at 40° C.). Range from 10 ohms to 100,000 ohms.

S-25—1-watt at 120° C. (or 2-watts at 40° C.). Resistance range from 10 ohms to 400,000 ohms.

S-30—2-watts at 120° C. (or 4-watts at 40° C.). Resistance range from 30 ohms to 1 megohm.

Corning Type S resistors have an average change in resistance of less than 1.5% after 1,000 hours at rated power.

Tolerances of 1%, 2%, 5% and 10% are available to meet your exact applications.

And how does a volume price of 25¢ each for the S-20 ± 1% tolerance sound to you?

Write for detailed descriptive bulletin.

Ask for information on these other Corning resistors:

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Type WC-5—Water-cooled. Range—35 to 300 ohms. Versatile and adaptable.

Type N—Accurate grade. Made to meet all requirements of MIL-R-10509B.

Other products for Electronics by Corning Components Department: Fixed Glass Capacitors*, Transmitting Capacitors, Canned High-Capacitance Capacitors, Subminiature Tab-Lead Capacitors, Special Combination Capacitors, Direct-Traverse and Midget-Rotary Capacitors*, Metallized Glass Inductances, Attenuator Plates.

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Diode Specifications

(Continued from page 103)

DIODE TYPE	MFGR.	INVERSE E_{PEAK} v	INVERSE I_{PEAK} ua @ v	INVERSE E_{CONT} v	FORWARD I_{SURGE} ma	FORWARD I_{MIN} ma @ +1v	TEMP. OPER °C	TEMP. MAX °C
1N474	HE	Double Anode, Zener Voltage = 5.2 to 6.4						
1N475	HE	Double Anode, Zener Voltage = 6.2 to 8.0						
1N476	A	115	275@-100	90	500	3	25	
1N477	A	115	275@-100	90	500	3	25	
1N478	A	115	150@-30	90	500	5	25	
1N479	A	115	150@-30	90	500	5	25	
1N480	A	90		60	500	5	25	
1N481	C	200		65	25A		55	
1N482	TE	40	30@-30	36	1A	100@1.1	150	200
1N482A	TE	40	15@-30	36	2A	100	150	200
1N482B	TE	40	5@-30	36	2A	100	150	200
1N483	TE	80	30@-60	70	1A	100@1.1	150	200
1N483A	TE	80	15@-60	70	2A	100	150	200
1N483B	TE	80	5@-60	70	2A	100	150	200
1N484	TE	150	30@-125	130	1A	100@1.1	150	200
1N484A	TE	150	15@-125	130	2A	100	150	200
1N484B	TE	150	5@-125	130	2A	100	150	200
1N485	TE	200	30@-175	180	1A	100@1.1	150	200
1N485A	TE	200	15@-175	180	2A	100	150	200
1N485B	TE	200	5@-175	180	2A	100	150	200
1N486	TE	250	50@-225	225	1A	100@1.1	150	200
1N486A	TE	250	25@-225	225	2A	100	150	200
1N487	TE	330	50@-225	300	1A	100@1.1	150	200
1N487A	TE	330	25@-225	300	2A	100	150	200
1N488	TE	420	50@-380	380	1A	100@1.1	150	200
1N488A	TE	420	25@-380	380	2A	100	150	200
1N490	A	90		60	500	5		
1N497	CBS	25	20@-20	20		100	25	75
1N498	CBS	50	25@-40	40		100	25	75
1N499	CBS	65	30@-50	50		100	25	75
1N500	CBS	75	40@-60	60		100	25	75
1N501	CBS	100	40@-80	80		100	25	75
1N502	CBS	125	40@-100	100		100	25	75
1N530	GI	100	3@100	100	3000	250	150	200
1N531	GI	200	7.5@200	200	3000	250	150	200
1N532	GI	300	10@300	300	3000	250	150	200
1N533	GI	400	15@400	400	3000	250	150	200
1N534	GI	500	17.5@500	500	3000	250	150	200
1N535	GI	600	20@600	600	3000	250	150	200
1N536	GE	50		50	15,000		150	200
1N537	GE	100		100	15,000		150	175
1N538	GE	200		200	15,000		150	175
1N539	GE	300		300	15,000		150	175
1N540	GE	400		400	15,000		150	175
1N541	A	45	150@-30	30	200	1.5	150	175
1N542	A	Matched Pair of 1N541						
1N550	GI	100	.5@100	100	4000	350	150	200
1N551	GI	200	1@200	200	4000	350	150	200
1N552	GI	300	1.5@300	300	4000	350	150	200
1N553	GI	400	2.5@400	400	4000	350	150	200
1N554	GI	500	3.5@500	500	4000	350	150	200
1N555	GI	600	5@600	600	4000	350	150	200
1N560	GI	800	15@800	800	2000	200	150	200
1N561	GI	1000	20@1000	1000	2000	200	150	200
1N562	GI	800	15@800	800	3000	300	150	200
1N563	GI	1000	20@800	1000	3000	300	150	200
1N571	S	20	100@-10	15		200	55	75
1N588	TI	1500	100@-1500	1500		10@10v		150
1N589	TI	1500	100@-1500	1500		50@8v		150
1N590	TI	1500	100@-1500	1500		50@8v		150
1N591	TI	1500	100@-1500	1500		50@8v		150
1N596	I	600	25@600	600	1000		75	150
1N597	I	800	25@800	800	1000		75	150
1N598	I	1000	25@1000	1000	1A		75	150
1N599	I	50	25@50	50	2A		100	150
1N600	I	100	25@100	100	2A		100	150
1N601	I	150	25@150	150	2A		100	150
1N602	I	200	25@200	200	2A		100	150
1N603	I	300	25@300	300	2A		100	150
1N604	I	400	25@400	400	2A		100	150
1N605	I	500	25@500	500	2A		100	150
1N606	I	600	25@600	600	2A		100	150
1N607	I	50	25@50	50	2A		100	150
1N608	I	100	25@100	100	2A		100	150
1N609	I	150	25@150	150	2A		100	150
1N610	I	200	25@200	200	2A		100	150
1N611	I	300	25@300	300	2A		100	150
1N612	I	400	25@400	400	2A		100	150
1N613	I	500	25@500	500	2A		100	150
1N614	I	600	25@600	600	2A		100	150
1N615	C	300		100	25A		55	
1N616	A	40	150@-30	30	200	8		
1N617	A	115	275@-100	90	500	3		
1N618	A	115	250@-100	90	500	5		
1N625	H	30	1@-10			4@1.5		135
1N626	H	50	20@-35			4@1.5		135
1N627	H	100	20@-75			4@1.5		135
1N628	H	150	20@-125			4@1.5		135
1N629	H	200	20@-175			4@1.5		135

[1]Western Electric semiconductor products are available only to U. S. Govt. agencies, and their contractors.

★ ★ ★

(*Continued from page* 138)

merits of each. It is expected that the advantages of this tuning method such as mechanical and electrical stability, compactness and low cost will be of value to others.

Acknowledgment

The author wishes to acknowledge the guidance and work contributed by Charles J. Weidnecht. The mechanical design of the tuner is credited to Robert Raby.

Wideband Recording

(*Continued from page* 79)

pointer is moving toward V a decreasing e_{in} is indicated. Thus if S-1 is *minus* when the V switch is closed S-1 is reversed and S-2 is stepped *down*.

A relay controlled by the position of S-1 chooses either the step-up or the step-down mechanism and the operation of this relay is delayed to prevent a change in choice while S-2 is stepping.

Recorder

The voltmeter we use in the scale expansion system is a self-balancing, recording potentiometer (commonly called a recorder). Recorders are being mass-produced by several manufacturers and are built with a variety of characteristics. Specifications of the instruments we use with this scale expanding accessory include:

Range: —1 through zero to +11 mv.

Accuracy: better than 0.25%.

Chart width: approximately 10 in.

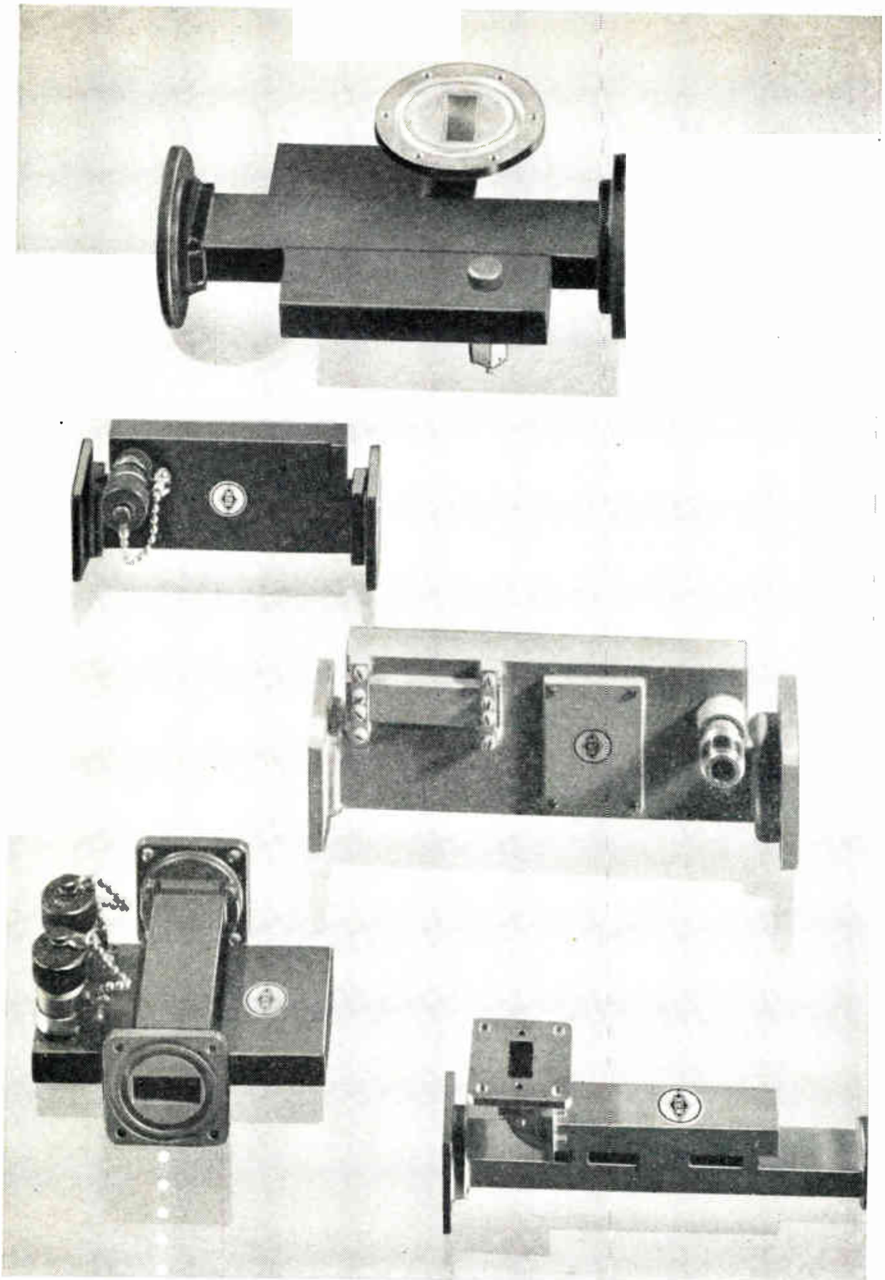
Max. pen speed: 10 ips.

The elements of a recorder are displayed schematically in Fig. 5. The amplifier (in the position of the galvanometer in the usual potentiometer circuit) senses the direction of unbalance and drives the motor in the direction to correct the unbalance. The chart is driven by a choice of:

1. Synchronous motor.
2. Synchro.
3. Balancing motor (such as drives the pen).

Leeds and Northrup Company refers to the direction of motion of the pens in their Speed-O-Max recorders as the "x" direction; thus the chart moves in the "y" direction. With a synchronous motor

(*Continued on page* 142)



(*Continued from page* 141)

drive, y = kt. The pen position is proportional to the input voltage, $x = k_1e_x$. Thus $e_x(t)$ (input voltage as a function of time) is plotted.

When the chart is driven by a synchro, the position of the chart equals $k_2\theta$, where θ is the angular position of the transmitting synchro. A rack and pinion can be used to convert "s" (distance) into angle "θ" so that $e_x(\theta)$ or $e_x(s)$ may be plotted.

When the chart is coupled to a self-balancing potentiometer, similar to the system driving the pen, $y = k_3e_y$ and $e_x(e_y)$ is plotted. We use this combination to draw magnetization curves automatically. A motor drives a potentiometer in the magnet current regulator circuit to increase the current uniformly; a 200 mv. shunt in series with the magnet winding is the source of e_y, while e_x is the voltage drop in a bismuth resistor whose resistance is a function of magnetic field. A curve equivalent to a 48 x 48 in. graph can easily be folded within an 8 in. square when both e_x and e_y are expanded with Lobetrols. See Fig. 6.

References

[1] D. R. Stull, An Automatic Recorder for Resistance Thermometry, RSI Vol. 16, No. 11, pp. 318-321, Nov. 1945.

[2] A. J. Williams, Jr., Electronic Recorder With Range and Precision Adequate for the Platinum Resistance Thermometer, *Communication and Electronics* (AIEE), No. 2, p. 289, Sept. 1952 (includes a bibliography).

[3] UCRL Drawing 3V8665, Magnetic Measurements Lobetrol Schematic.

Thermistor Thermometer

(*Continued from page* 55)

perature coefficient of these materials at room temperature. In order to remain within a reasonable range of the specific resistivity, with an upper limit of 1 megohm-cm, for instance, only materials with rather low temperature coefficients are eligible. Considering the fact that the usual thermistor materials have at room temperature specific resistivities of 1 ohm-cm or more, it becomes evident that the temperature coefficient must be below 2%/degree. If the application calls for still lower specific resistivities than 1 megohm-cm at −183°C, either very low coefficient materials or low resistivity materials have to be used.

Fig. 2 shows the dependence of

the resistivity at —183°C upon the resistivity at room temperature for various temperature coefficients. This graph emphasizes the preceding conclusions.

Commercial thermistors do not normally fall into the useful region described with Fig. 1. Special development work has been necessary to create a new series of thermistors with very low resistivities at room temperature and simultaneously low temperature coefficients. It has been found possible to make materials with specific resistivities of 0.03 to 1 ohm-cm and temperature coefficients of the order of 1%/°C. The resulting resistivities at —183°C range from 200 to 3500 ohm-cm. Their temperature coefficient at low temperatures is rather high and ranges from 15-35%/°C. This high temperature coefficient must be kept in mind if considerations are made as to the spread of the low temperature resistivity; a temperature error of 0.1°C involves a resistance change of the order of 2-3%.

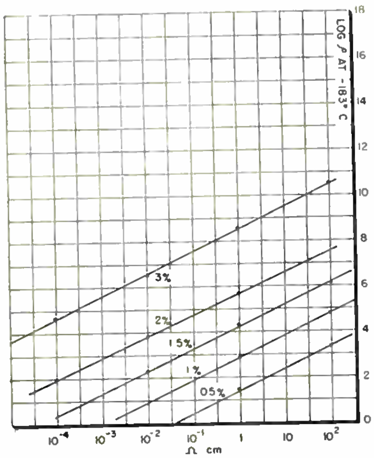


Fig. 2: Dependence of resistivity at —183°C on resistivity at room temperature

By proper selection and improved production methods, it is possible to make thermistors with these resistivities within ±10%.

The temperature characteristics of semiconducting materials are usually expressed by an exponential formula:

$$\log \frac{\rho_2}{\rho_1} = \frac{-B \cdot (T_2 - T_1)}{2.303 \cdot T_1 \cdot T_2} \qquad (2)$$

in which ρ_1 and ρ_2 represent resistivities at the respective absolute temperatures T_2 and T_1. If corre-

(*Continued on page* 146)

News of Reps

REPS WANTED

Sales Reps wanted for microwave units and components. In Washington and Oregon, Texas and vicinity, Florida-Alabama, and as far north as Virginia. Manufacturer is well known in the field. (Ask for R1-2).

Technical Sales Reps wanted for high quality and custom made transformers, voltage regulators, power supplies, high voltage test sets and reactors. In Midwest, Northeast and New England areas. Manufacturer is nationally known and respected producer of electronic products. (Ask for R1-1.)

Burt C. Porter Co., 4310 Roosevelt Way, Seattle 5, Wash., appointed to represent RCA's line of precision instruments; also, the **G. S. Marshall Co.** of Pasadena, Cal., will handle the line in Cal., Ariz., and Nev.

Koessler Sales Co., 697 Melrose Ave., Los Angeles, Cal., is the new W. C. rep for Components Corp. of Denville, N. J. **C. H. Lucas Sales Co.**, Dallas, Texas, is representing the firm in Texas, Oklahoma, Arkansas, and Louisiana.

C. O. Brandes, Inc., Cleveland, has been appointed export representative for Dage Television Div., Thompson Products, Inc., Michigan City, Ind.

Thermo-Panel Div., Dean Products, Inc., Brooklyn, N. Y., makers of thermo-plate coils, announces these appontments: Cameron Engrg. Co., San Francisco, for No. Calif. and Washoe County, Nevada, only; Allan Edwards, Inc., Tulsa, for Okla., Ark., and the Panhandle area of Texas (northern); Thermal Specialties Co., Harrisburg, Pa., for Central Pa.; Merlo Steam Equipment, Detroit, to cover Eastern Michigan; and J. F. Munn Co., Pittsburgh, for Western Pa., most of West Va., and the Western tip of Maryland.

Dougherty Enterprises, a manufacturers' representative, has been formed by Gordon Dougherty to serve Hawaiian distributors from suburban Honolulu. Office is at 149 Eaimi St., Lanikai, Hawaii.

Frazar & Hansen, Ltd., 301 Clay St., San Francisco, and 120 Broadway, New York, has been made exclusive export rep by Northeastern Engineering, Inc., Manchester, N. H., for sale of electronic products outside the U. S., excluding Canada, but including Hawaii, Guam, Puerto Rico and Alaska.

Charles R. Long appointed to head No. Calif. industrial sales for J. W.

News of Reps

Marsh Co., electronic component reps in Los Angeles and San Francisco.

M. P. Odell Co., 26614 Center Ridge Rd., Westlake, O. (Cleveland suburb), with offices in Dayton, Detroit and Pittsburgh, named rep for Ohio and Western Pa. by Spencer-Kennedy Labs, Inc., Boston.

Richard B. Hackenberger named Administrative Coordinator for Yewell Associates, Inc., Waltham, Mass., and **Lawrence D. Freeman** joined the Yewell staff as a sales engineer.

Mrs. Tina Levin added to staff of Anderson Sales Co., 177 State St., Boston.

R. W. Gray, Inc., Wellesley, Mass., added **Harold O. Ruth** to staff in charge of office at 47 DeForest St., Watertown, Conn.—'phone CRestwood 4-2363.

Henry Lavin Assoc., Meriden, Conn., added **Alan B. Houghton** to office staff.

Abbett & Hustis moved from Boston to 16A Eaton Square, Needham 92, Mass., and has been appointed rep for Standard Electric Products Co., Dayton.

Art Cerf & Co., Newark, N. J., awarded plaque for outstanding sales record as Mid-Atlantic States rep for Lowell Mfg. Co., St. Louis.

Phil Piltch and **George G. Wolfe**, of **Electro-Rep Sales Co.**, 187 Culver Rd., Rochester 7, named reps for Up-State New York by Radio Merchandise Sales, Inc., New York. Piltch covers Western half of N. Y. and south to Erie, Pa., while Wolfe handles Eastern N. Y.

M. K. Widdekind Co., 216 First Ave., No., Seattle 9, appointed Pacific Northwest rep by Foto-Video Labs, Inc., Little Falls, N. J.

Frazar and Hansen, Ltd., 301 Clay St., San Francisco, named export reps for Hycon Electronics, Inc., Pasadena, for all foreign countries except Canada.

Jack J. Carney Associates, Dayton, appointed rep by Instruments for Industry, Inc., Mineola, N. Y., for Ohio and Indiana.

Warren LaMack and **Richard L. "Rick" Martin** appointed reps for Sound Div. of Webster Electric Co., Racine, Wis. LaMack is covering New England, with headquarters in Boston; Martin is handling So. Calif., Ariz. and Clark County, Nev., with Los Angeles hq.

Frank A. Emmet Co., Los Angeles reps, adds three for Ariz., So. Nevada and So. Calif.: Glad Day Development Co., Burbank; Wright Electronics, Inc., Kansas City; and Leonard's Precision Mfg. Co., Dunellen, N. J.

(*Continued from page* 143)

sponding values of ρ and T are known, B can be calculated as

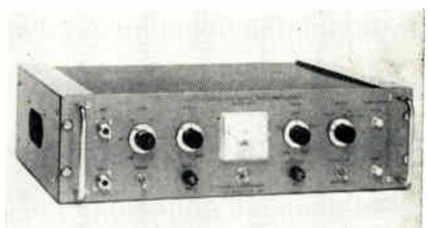
$$B = 2.303 \cdot \frac{T_1 \cdot T_2}{T_2 - T_1} \log \frac{\rho_1}{\rho_2} \quad (3)$$

B is a typical material constant describing completely the slope resistivity vs. temperature. It is sometimes a function of temperature, however, in most cases the behavior of a semiconducting material can be calculated for a rather wide range with the same B value. B is commonly used as a constant of the dimension "°K." In the scientific literature the temperature characteristics of semiconductors are described by a similar constant considered as activation energy for the formation of the carriers which are responsible for the electrical conduction, either electrons or defect-electrons. This activation energy is normally expressed in the energy unit "electron-volt" (ev). Between the conventional B constant and the activation energy in ev, the following numerical relation exists:

(*Continued on next page*)

TW AMPLIFIER

The Model 504 is a high gain, broad band amplifier of microwave signals in the frequency range of 7 to 12.5 KMC. Small signal gain is 30 db, and maximum power output



is at least 10 mw. The unit consists of a TWT, focusing solenoid, and a power supply for all required operating voltages. Extremely stable noise-free operation results from heavy magnetic shielding of the solenoid and low-ripple, precisely regulated electrode voltages supplied to the traveling wave tube. Alfred Electronics, Palo Alto, Calif.

Write No. 1-53 on inquiry card on p. 123.

$$ev = \frac{B}{11604} \qquad (4)$$

It may be mentioned that the outlined specifications for measurements at very low temperatures within a reasonable resistance range call for thermistor materials with activation energies between 0.08-0.14 ev. The developed materials fall into this range.

The author is indebted to Mr. G. W. Vollmer for his assistance in this project and Keystone Carbon Co. for granting permission to publish this article.

Direction Finder

(*Continued from page* 77)

the switch is shown in Fig. 7. This characteristic was obtained by calibrating the receiver over the required frequency band and using it as a level indicator at the output of the switch while using a signal generator and attenuator to supply a signal of known amplitude to the input of the switch.

As indicated in Fig. 7, a resonance occurs in the region of 30 MC and provides a gain of more than unity at this frequency. The gain

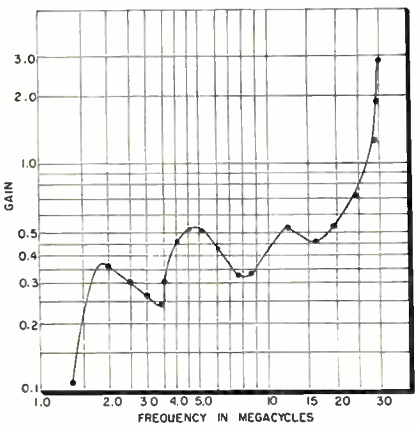


Fig. 7: Resonance occurs at 30 MC

of the multiple output switch for the frequency range below 15 MC is approximately equal to that of the single output switch built for early Doppler type equipment.

(*To be continued next month*)

Power Supply

(*Continued from page* 63)

$$-\beta = \frac{A - A^1}{AA^1} \qquad (1)$$

where A is the open-loop gain of the regulator and A^1 the closed-loop gain.

(*Continued on page* 148)

(Continued from page 147)

Simple Circuits

The basic regulator circuit is the cathode follower, and cathode followers alone make surprisingly good regulators, particularly when it is desired to derive an odd intermediate regulated voltage from another regulated supply. For this purpose they are superior to gaseous regulators, since they do not suffer from relaxation oscillations, any number may be used in parallel, they waste no current as do shunt regulators, and they are not limited to particular voltages, as are the 105 and 150-v. gas tubes. See Fig. 2.

By far the most common regulator circuit is the cathode follower preceded by one stage of pentode voltage amplification. If properly designed, this circuit is capable of excellent performance, as far as stability with regard to line and load changes are concerned. It is also capable of good transient response. It is not very good with regard to drift, since most pentodes are not very good in this respect. This circuit is adequate for probably 9 out of 10 purposes.

To illustrate the design procedure, let us consider a typical supply, say 250 v. at 200 ma. There are 3 conditions to analyze: the dc condition, the low frequency ac condition, and the high frequency ac condition. First, we must choose an output cathode follower, and the 6AS7G or 6080 is a good choice. From the tube curves, we find that we can operate this at $E_p = 125$ v., $I_p = .1$ a. per section. Under these conditions, $\mu = 2$, $r_p = 280$ ohms, $G^M = 7{,}000$, and $E_{c1} = -55$ v. Using both sections in parallel, we may imagine this a single tube having $G^M = 14{,}000$ and $r_p = 140$. The first step is to design the rectifier-filter section. This must obviously produce 375 v. at 220 ma. The extra 20 ma is for the two gas tubes, V3 and V4. Such a regulator is diagrammed in Fig. 3.

The 6AS7G, as a cathode follower, will have a gain of:

$$A^1 = \frac{\mu R_k}{(\mu + 1) R_k + r_p} \qquad (2)$$

$$A^1 = \frac{2\,(1250)}{(2 + 1)\,1250 + 890}$$

$$A^1 = .55$$

R_k, of course, being the load resistance.

The cathode follower is preceded by a 6AU6 pentode, where R_L = 180,000 ohms, and with the plate and screen voltages shown, I_p = 1 ma., $E_{C2} \approx 150$ v., $E_B \approx 100$ v., $E_{C1} \approx -4$, $G_M \approx 1000$, all this information being taken from the tube curves.

The gain of this stage is therefore:

$$A = G_M R_L$$

$$A = 180$$

The total open-loop gain (A) of both stages is therefore (180) (.55) = 99. The closed-loop gain (A^1) is 250/86 = 2.9. The 86 v. is the voltage of the 5651 reference tube in the cathode of the 6AU6. The 6AU6 is actually a differential amplifier, with the signal on the cathode and the feedback voltage on the grid. Since the 5651 has negligible impedance for small current changes, there is no cathode degeneration and the gain on cathode is the same as the gain on the grid.

The tap on the output voltage divider to which is connected the grid of the 6AU6 is 86 —4 v., or 82 v. From this we derive β, the feedback factor. This is 82/250, or .328.

We now know the open-loop gain, the closed-loop gain, and the feedback factor. In any voltage feedback circuit,

$$R_o = \frac{r_p}{1 - \beta A_1 \mu} \qquad (3)$$

Where rp = plate resistance of output stage

A_1 = gain to grid of output stage

μ = μ of output stage.

$$R_o = \frac{890^*}{1 - (-.328)\,(180)\,(2)}$$

*140 Ω + 750 Ω

$$R_o = 7.48\ \Omega$$

Change of output voltage with respect to line voltage variations would be diminished by the factor

$\frac{R_o}{r_p + R_o}$ (approximately).

In the supply which we are considering, a 10% change of input voltage would produce an output

(*Continued on page* 152)

For product information, use inquiry card on page 123.

New Tech Data for Engineers

To obtain these Bulletins, fill in reference number on the inquiry card, page 123.

Clad Laminates

Various metal-clad grades of laminates for printed circuits described in folder from Continental Diamond Fibre Div. of Budd Co., Wilmington, Del. Details included are tolerances, bond strength, capacities and hot solder resistance. (Ask for B-1-1)

Time Delay Relay, etc.

Data sheets on G Series Glass Thermal Time Delay Relay are illustrated and carry specs and applications; types are listed in detail. Type 8102 Series "Snapper" Thermostat is on another data sheet which includes an illustration, specs and features. (Ask for B-1-2)

Antenna Handbook

A selected group of curves of antenna characteristics, prepared by I-T-E Circuit Breaker Co., Philadelphia, offered as aid to engineers working with microwave antennas or systems involving such antennas. (Ask for B-1-3)

General Catalog

Instruments for analysis, control and data processing described and illustrated in 32-page brochure offered by Consolidated Electrodynamics Corp., Pasadena. Specs and details of various products are included. (Ask for B-1-4)

Attenuator Pads

Bulletin #56, issued by Weinschel Engineering, Kensington, Md., describes Models 502 and 503 attenuator pads, which cover frequency range of 1,000-10,000 MC and are designed for high power. Bulletin gives specs, unit prices, and other pertinent details. (Ask for B-1-5)

Electronic Facts Handbook

Pocket-sized, 20-page brochure, Electronic Facts Handbook, contains reference data for Government and industrial research and development activities. Subjects include: Army and Navy synchros, AN nomenclature for communication equipment, radar terms, and frequency bands and wavelength. Published by American Machine & Foundry Co., Greenwich, Conn. (Ask for B-1-6)

General Bulletin

Electronic Research Associates, Inc., Nutley, N. J., have issued an illustrated brochure giving details and prices of product line, including transistor test equipment, transistor application power supplies, transistor packaged circuits, Transpac miniaturized power packs, converters and generators. (Ask for B-1-7)

Power Supplies

Specs, special features and prices are included in illustrated catalog sheet on the Com-Pak Series of power supplies made by Lambda Electronics Corp., College Point, N. Y. (Ask for B-1-8)

Sensitive Relays

Long-Life relays, with sensitivity starting as low as 5 milliwatts per contact up to several watts, are described in new literature provided for line by Hedin Tele-Technical Corp., Livingston, N. J. (Ask for B-1-9)

Parabolic Antennas, etc.

Bulletin No. 435 concerns tropospheric scatter antennas and Bulletin 433 discusses microwave transmission line. Issued by Prodelin, Inc., Kearny, N. J., both bulletins are illustrated and give features, specs and applications. (Ask for B-1-10)

Microwave Test Equipment

A two-fold brochure in color lists microwave test equipment in detail, including model descriptions and prices. List of U. S. sales reps is included in material provided by Waveline, Inc., Caldwell, N. J. (Ask for B-1-11)

Packaged Frequency Source

Technical data, detailed specs and ordering information are included in four-page flyer, FS-1 Tech Bulletin, on packaged frequency sources from Hill Electronic Eng'g. & Mfg. Co., New Kingstown, Pa. Material includes outline drawings. (Ask for B-1-12)

Transistor Brochures

For the designer of transistorized radios, phonographs and other audio amplifiers, General Electric in Syracuse has published package Number GP-71 of brochures containing complete spec information on 17 standard, high performance entertainment transistors, and application notes on transistor audio amplifiers. (Ask for B-1-13)

Ferrite Isolators

Bulletin W-103 discusses various types of ferrite isolators. Literature is illustrated and lists typical characteristics. Kearfott Co., Inc., Western Div., Pasadena. (Ask for B-1-14)

Standard Reflections, etc.

Two data sheets published by Narda Corp., Mineola, N. Y., on new standard reflections line and on coaxial slotted lines. Sheets are illustrated and carry both spec tables and prices. (Ask for B-1-15)

Electrical Insulation

Made from continuous mica sheet, electrical insulation products are described in a 16-page illustrated booklet, What Every User of Electrical Insulation Should Know Amout Isomica. Material gives background on continuous sheet mica, and includes detailed information on various types of Isomica. Mica Insulator Co., Schenectady. (Ask for B-1-16)

Magnetic Memory Planes

General Ceramics Corp., Keasbey, N. J., has prepared Bulletin MP-105 on Ferramic magnetic memory planes. Material includes specs and data on standard configurations, plus computer applications and mechanical data. (Ask for B-1-17)

Silicon Power Rectifiers

One-page bulletin including specs and basic information on Stavolt silicon power rectifiers issued by Christie Electric Corp., Los Angeles. (Ask for B-1-18)

Scope Dolly

Illustrative catalog sheet, containing specific information and prices of a portable scope dolly, available from P. B. R. Mfg. Co., Philadelphia. Dolly has three power outlets and storage pan, and is adaptable for any popular type of lab scope. (Ask for B-1-19)

Instruments, etc., Catalog

Sweeping oscillators, frequency markers, noise generators, pulse and pulsed carrier generators, generators for TV, miscellaneous instruments, and sound analysis equipment are included in 1957 catalog of Kay Electric Co., Pine Brook, N. J. The 48-page publication is illustrated and gives detailed specs and prices. (Ask for B-1-20)

Miniature Camera Tube

Operating characteristics are given in illustrated one-page flyer describing the #6912 miniature photoconductive camera tube used in TV broadcast, industrial TV, and aircraft and military applications. From Resitron Labs, Inc., Santa Monica. (Ask for B-1-21)

Ceramic Magnets

Characteristics of Indox ceramic magnets (permanent magnet material) are described in Applied Magnets for July-Sept., 1956, a publication of Indiana Steel Products Co., Valparaiso. Special properties of Indox I in relation to the electronics field are discussed. (Ask for B-1-22)

Data File for Mica

Technical information, design considerations and suggested applications are included in a revised engineering data file on Supramica ceramoplastic and Mycalex glass-bonded mica products. File issued by Mycalex Corp. of America, Clifton, N. J., and includes comparison chart detailing properties of these materials and other plastic and ceramic insulators. (Ask for B-1-23)

Binding Posts

In color, and giving basic types and applications, a four-page Bulletin (No. BP656) describes 5-way binding posts, made by Superior Electric Co., Bristol, Conn. Bulletin is illustrated and lists other company products, including variable transformers, power supplies and automatic voltage regulators. (Ask for B-1-24)

Connectors Supplement

Four-page illustrated Alden Handbook Supplement describes IMI (integrated molded insulation) connectors, which are high voltage and multi-wire. Alden Products Co., Brockton, Mass. (Ask for B-1-25)

Turns-Counting Dials

Changes in spec of Duodial turns-counting dials, made by Helipot Corp. Div. of Beckman Instruments, Inc., Newport Beach, Calif., are listed in Data Sheet 54-78, which supersedes 54-77. Duodial is used for setting multi-turn devices, such as helical potentiometers and variable capacitors. (Ask for B-1-26)

Encapsulated Resistors

Bulletin No. LC-1030BX, issued by Cinema Eng'g. Div., Aerovox Corp., Burbank, Calif., covers entire Cinema line of wire wound, fixed encapsulated resistors. This annual catalog has 20 pages and contains a military spec tabulation, plus line drawings of products. (Ask for B-1-27)

Tubes Selection Chart

Revised to include both 600 and 450 milliampere controlled heater warm-up tubes, the Quick-Selection Chart for Series-String Receiving Tubes classifies 52 tube types in the 600-milliampere series, and 24 types in the 450 series, according to elements, typical service, heater voltages, maximum ratings, and gives average characteristics. Published by General Electric's Tube Dept., Schenectady. (Ask for B-1-28)

Octave Filter Set

Brush Electronics Co., Cleveland, has issued a single-page catalog sheet illustrating and describing its one-third octave filter set, Model BL-1609. In general, instrument is designed for any audio signal analysis or telemetry data reduction. (Ask for B-1-29)

For product information, use inquiry card on page 123.

(*Continued from page* 149)

voltage change of less than 0.1%, not counting drift and change in tube characteristics due to the 10% change in their heater voltages. That is the dc condition.

The low-frequency ac condition is arrived at similarly, except that R_{PS} drops out. Also, β becomes unity, because of the presence of C. The output impedance then becomes:

$$R_o = \frac{r_p}{1 - \beta A_1 \mu} \qquad (4)$$

$$= \frac{140}{1 - (-1)(180)(2)}$$

$$= .388\Omega$$

Therefore, any ripple appearing at the input to the regulator will be diminished by the factor $\frac{.388}{140.388}$ or .0028.

We can now see why pentode cathode followers give superior ripple reduction. Using, instead of the 6AS7G, three 6L6's in parallel would give us an output impedance of

$$R_o = \frac{12000}{1 - (-1)(180)(190)} \qquad (5)$$

$$= \frac{12000}{1 + 34{,}200}$$

$$= .35\Omega$$

The ripple reduction factor would be $\frac{.35}{12{,}000\ .35}$ or approximately .00003, but only, of course, if they were truly operated as pentodes.

The high-frequency ac case is arrived at similarly, except that here the effective output impedance at the frequency band of interest is important. This, of course, is related to the gain-bandwidth characteristics of the amplifier. The technique is the same as is used in the design of any wideband feedback amplifier, with one exception. If we design the amplifier for wide-band response, we would deteriorate the dc stability, due to the low-value plate load resistances which would have to be used. A regulator which had very high loop gain from dc to very high frequencies would be quite complex and in most cases would not be justified.

We might make some additional final comments on the circuit we have been examining. We have operated the 6AU6 amplifier from two gas-tube regulators. It is more common to tie the cold end of the 6AU6 plate load resistor to the plate of the output cathode follower. At ac, this does not change the analysis, but at dc the presence of R_{PS}, which is common to both stages, introduces degeneration and reduces the loop gain (Fig. 4).

The dc loop gain may be raised considerably by introducing a positive feedback loop. This is most easily done by running the screengrid of the 6AU6 from a voltage divider across the input to the regulator (Fig. 5). In some cases, this can be carried to the point where the output impedance of the regulator is zero or negative. The point is that subsidiary feedback loops must be taken into account in any analysis. All feedback formulae apply directly.

More Complex Circuits

If better performance is required than the simple 2-stage circuit is capable of giving, there is only one thing to do: add more gain. Unfortunately, an additional

pentode stage would give a phase inversion and thereby would be difficult to utilize. The best circuit to use would be a differential amplifier of the configuration shown in Fig. 6. This could use either triodes or pentodes. The big problem here will be stability. While it is improbable that a 2-stage feedback amplifier will oscillate, it is almost certain that a 3-stage amplifier will. These, of course, will be high-frequency oscillations, since the direct-coupled configuration is not conductive to low frequency instability.

Tube Exhaust

(*Continued from page* 61)

is obvious that a large increase in flow of gas could be obtained by lowering p_2. A larger dia. tubing for the plumbing, the addition of a booster, or the addition of a diffusion pump could lower p_2. On the other hand, if p_1 and p_2 are very different and, especially, if p_2 is very small, there is little to be gained by decreasing it.

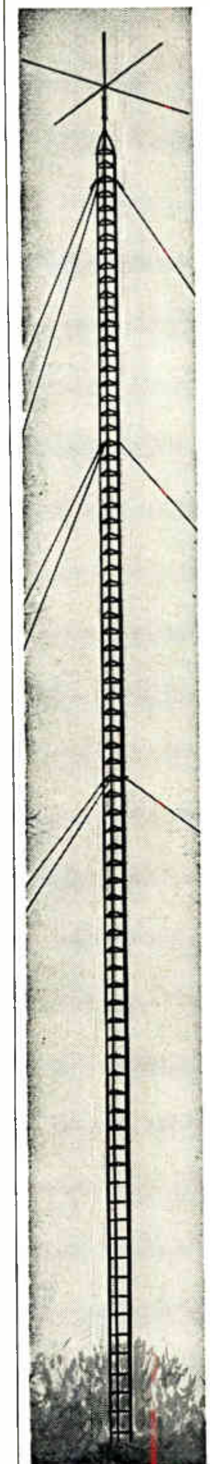
System Accuracy

The question might arise as to whether the thermistor reads the pressure in the tube envelope accurately, since it is separated by a long, small dia. tubulation. The formula for the time (sec.) necessary to pump a volume from a pressure p_1 to p_2 is

$$T = \frac{2.3V}{S_s} \log \left(\frac{p_1}{p_2}\right).$$

If this formula were applied to a condition where the pressure in the thermistor was 1000 microns and the pressure in the tube was 10 microns, it would be possible to solve for the time it would take for the thermistor to reach the tube pressure or equilibrium condition. In our application the volume of the termistor was 0.00625 liter (.381 cu. in.). The speed of the system (S_s) was taken as the conductance of the tubulation $80d_3/(L+4d/3)$ for a value of .00161 liters/sec. Solving the formula gives a value of 0.0178 sec. This time is small enough so that it can be concluded that the small tubulation connecting the 2 volumes does not introduce any appreciable inaccuracy.

(*Continued on page* 154)



(*Continued from page* 153)

Another Application

The second application of this method was on a 21-in. CRT (Fig. 4). The thermistor in this case was supplemented with an ionization gauge to permit pressure readings below 1 micron. An examination of Fig. 5 shows that each time a new operation is commenced, e.g., r-f heating, filament lighting, the pressure curve is shifted toward the right, the end result being an increase in time to reach the same ultimate vacuum. The effect of the grid outgassing and filament conversion appears to be more pronounced than the r-f. This is easily explained by the fact that an increase in pressure of 0.1 micron at a tube pressure of 0.5 micron represents a greater percentage increase than a change in pressure of 0.1 micron at 10 microns tube pressure.

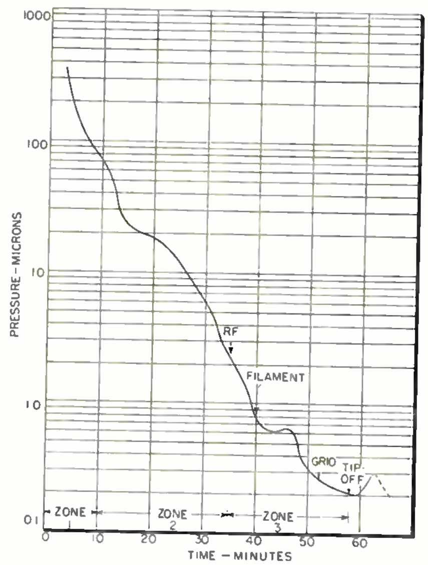


Fig. 5: Pressure time curve for CRT.

The pressure rise at tip-off is due to the evolution of gas from the molten glass. It is apparent any change which would shift the curve to the left would permit one to shorten the time to reach a given pressure, or if the ultimate pressure of the system has not been reached, a lower pressure could be obtained in the same given time.

The CRT differs from the 5U4GB previously discussed in the following:

1. Very large volume.
2. Small quantity of metal parts.
3. Considerable glass surface, and screen constituents which must be outgassed.

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4. Tubulation is relatively large.
5. Filament is very small and produces little gas.

The exhaust system for a CRT is composed of an individual diffusion and mechanical pump for each tube. Heat must be added by an oven to bring the tube to a temperature sufficiently high to outgas the envelope. The exhaust process can be broken down into three zones.

1. Pumping from atmospheric pressure to a point where the pressure is low enough for the diffusion pump to start operation.
2. Pumping to a low enough pressure to permit r-f heating to start.
3. Lowering the pressure to a satisfactory ultimate.

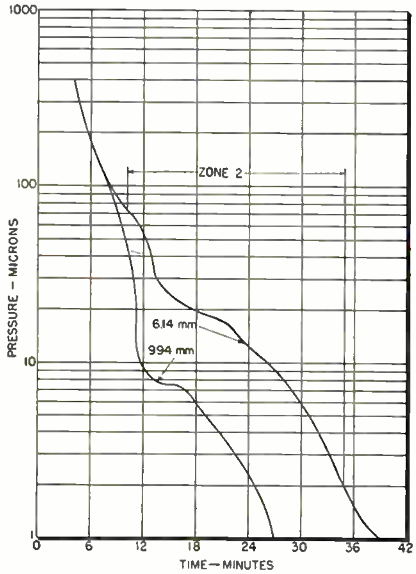

Fig. 6: Enlarged tubulation effect.

Pressure Curve Analysis

Either of two factors can be limiting. First, the speed of the tubulation, or second, $(p_1\text{-}p_2)$ may be small. Investigation of p_1 and p_2, revealed that p_2 was considerably lower than p_1 which minimized its effect on the flow. Here again the tubulation proves to be the restriction as verified by Fig. 6. This also could have been predicted from the formula

$$\frac{1}{S_s} = \frac{1}{S_p} + \frac{1}{S_t} + \frac{1}{S_{ct}}$$

where S is the speed in liters/sec. The speed of the system, S_s, can only be smaller than the smallest speed of the components, which is the speed of the tubulation, S_t. S_p = pump speed and S_{ct} = connecting tube speed.

* * *

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