ELECTRONIC INDUSTRIES

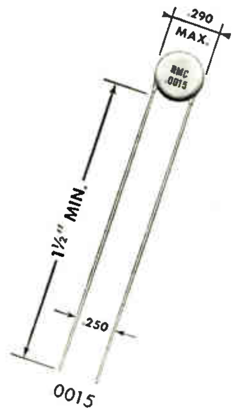
& TELE-TECH

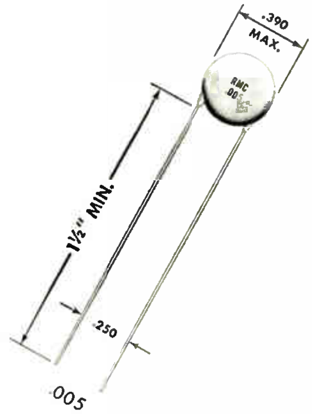
Electrically Zero-ing Synchros
Heat Transfer in Power Transistors

December • 1957
A Chilton Publication

TO CONQUER PROBLEMS OF "INNER" SPACE

Actual Size





Another RMC first

Type **S**UB **M**INIATURE

DISCAPS

SPECIFICATIONS

POWER FACTOR: 1.5% Max. @ 1 KC (initial)

WORKING VOLTAGE: 500 V.D.C.

TEST VOLTAGE: (FLASH): 1000 V.D.C.

LEADS: No. 22 tinned copper (.026 dia.)

INSULATION: Durez phenolic (⅛" max. on leads) —vacuum waxed

STAMPING: RMC—Capacity—Z5U

INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms.

AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms.

Designers who need true miniaturization in a ceramic capacitor can now specify RMC's new Type SM DISCAPS with assurance of the quality and dependability that is built in all RMC DISCAPS without sacrificing performance of electrical characteristics.

Type SM DISCAPS meet or exceed the RETMA REC-107-A specifications for Z5U ceramic capacitors. They are available in values of 800, .001, .0015 GMV and .005 · ± 20%.

An entirely new ceramic dielectric provides a high safety factor with steady or intermittent voltage. Type SM DISCAPS show minimum capacity change between + 10° C and + 65° C.

Write on your letterhead for samples and performance data.

DISCAP 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.

Circle 1 on Inquiry Card, page 101

ELECTRONIC INDUSTRIES

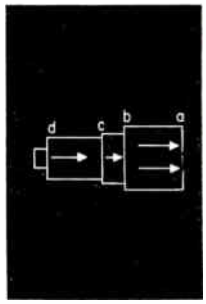
& TELE-TECH

Vol. 16, No. 12 **December, 1957**

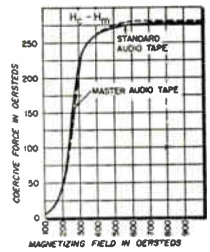
MONTHLY NEWS ROUND-UP

NEW ELECTRONIC EQUIPMENT

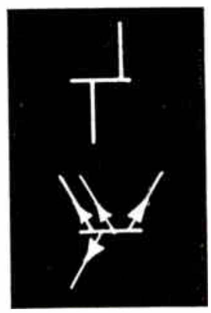
DEPARTMENTS



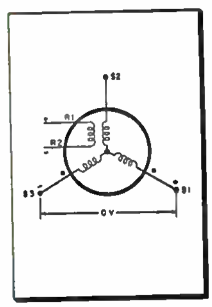
As transistors approach the medium - power applications, the maximum junction operating temperature — and the heat transfer mechanism—assume increasing significance.



Tape sensitivity is being greatly improved by reducing "print-through" the layer - to - layer signal transfer of spooled magnetic tape.



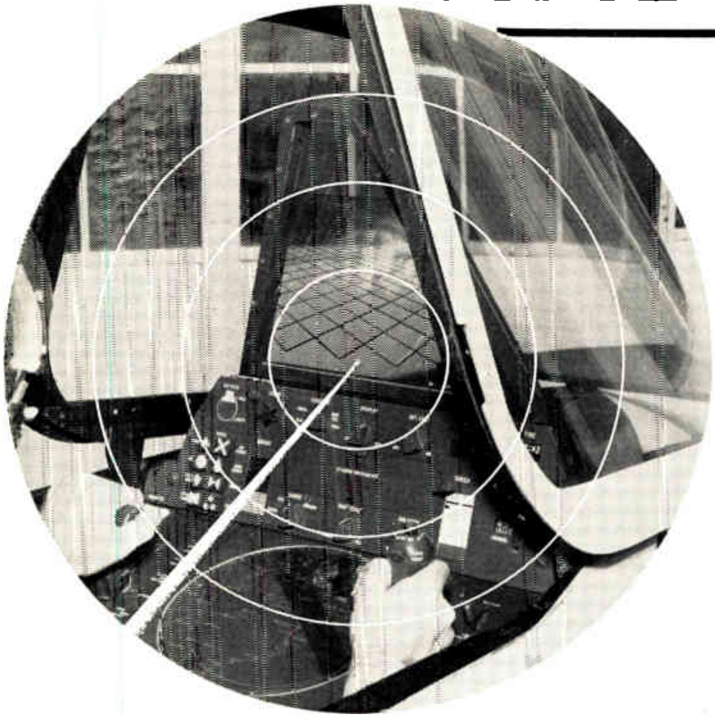
The I.R.E. is now releasing this first comprehensive list of standard semiconductor symbols, with variations to cover the many different types now appearing.



For high accuracy it is essential that synchros be electrically zeroed. Reviewed here are the various methods of achieving this for each type of synchro.

ELECTRONIC INDUSTRIES & Tele-Tech, December 1957, Vol. 16, No. 12. A monthly publication of Chilton Company, Executive, Editorial & Advertising offices at Chestnut & 56th Sts., Phila., Pa. Accepted as controlled circulation publication at Phila., Pa. 75¢ a copy; Directory Issue (June), $3.00 a copy. Subscription rates U. S. and U. S. Possessions: 1 yr. $5.00; 2 yrs. $8.00; 3 yrs. $10.00. Canada 1 yr. $7.00; 2 yrs. $11.00; 3 yrs. $14.00. All other countries 1 yr. $10.00; 2 yrs. $16.00.

RADARSCOPE



COCKPIT OF THE FUTURE

Army-Navy instrumentation experts are working towards this idealized cockpit layout. Transparent display device in front, already developed, provides pilot with a 3-D reproduction of the conditions outside his craft for bad weather flying. A less advanced version of this panel has been flight-tested by the Navy.

MISSILE FUNDS will increase from $1.5 billion to $2.8 billion during the present fiscal year.

THE OFFICE OF DEFENSE MOBILIZATION has been assigned six 400 KC frequency bands for the government's ionospheric "scatter" circuits. Three of the bands fall within spectrum space already assigned to the government. The other three are 46.6-47.0, 49.6-50.0, and 54.0-54.4 MC. The latter falls within Television Channel 2, but these frequencies will only be used in places remote from the U. S.

TELEVISION SETS may be fully transistorized by 1959, according to Sylvania.

UNIFIED FLIGHT INFORMATION region has been established by Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala and British Honduras. Headquarters is at Tegucigalpa, Honduras, and all reports on flight conditions are made available simultaneously to the capitals of each of the other countries over a network of radiotelephone facilities. It is the first time that a group of countries have joined together in such an operation. Air officials are hopeful that the example of these countries will spur similar movements among other groups of small countries. It is particularly desirable in view of the imminent flights of high-speed jet airliners.

THE MAJOR TV NETWORKS served notice last month, through NBC's Robert Sarnoff, that they will not be caught napping if pay-TV takes hold. "NBC," said Sarnoff, "like the public, will have no choice but to follow the pay tide." The other networks can be expected to follow. While this action appears natural, the threat had not previously been voiced by any high industry official. It remains to be seen whether pay-TV can earn a favorable decision in the face of the apparent complete loss of free television—or network television, at the very least.

TRANSATLANTIC TELEVISION has come much closer to becoming a reality through the successes achieved by tropospheric-scatter propagation. The proposed route can now be covered without a single water-based relay. The longest jump would be a 290-mile stretch between Iceland and the Faeroe Islands.

UNIFORM TRANSFORMER STANDARDS were called for at the AIEE Fall General Meeting. Transformer manufacturers complain that they are being forced to over-engineer units in order to meet specified test voltages which have little relation to actual operating voltages. The conflict between EIA and ASA standards is one source of trouble.

ENVIRONMENTAL TESTING

At the new half-million dollar lab of Canadian Westinghouse in Hamilton, Ont. engineers remove a test missile from the new Tenney Stratosphere Chamber supplied by Tenney Engineering Inc. The chamber is designed to test airborne electronic equipment.

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

NEW BATTERY designed for the Army can be worn as a vest. The battery supplies power for the GI's portable transceiver and also works especially well in cold regions where conventional battery's lifespan is very short.

HIGH LABOR COSTS are slowly catching up with manufacturers who have taken their operations to cheap labor markets. Last month Puerto Rico's electrical, instrument and related products industries got mass wage raises under the provisions of the Fair Labor Standards Act. The new minimum rates range from 75¢ to $1.00 an hour. The $1.00 rate applies to the storage battery, drafting machine, connector, TV antenna and lead-in cable, and portable hand tool industries. Workers in the radio-TV component line will now receive 85¢/hr. minimum.

PRIVATE AIRCRAFT COMPANIES working on the Air Force's ballistic missile programs are putting up one dollar of their own money for every two contributed by the Government for facilities to build the new weapons.

COMPLETELY NEW DIMENSION is being added to telephone communications with the new automatic dial radiotelephones introduced last month by Motorola and General Electric. Designed for use in rural areas, and for a wide variety of mobile applications, the systems permit unattended automatic handling of calls. In the GE system provision is also made for control of traffic lights, and other electrically controlled devices. The Motorola system uses push-button dialing; GE's has the conventional phone dial.

NUCLEAR INDUSTRY seems to have reached a strange plateau. There is little interest in power reactors because natural resources are still much too plentiful in this hemisphere, and what markets exist overseas are already being wooed by the British. "Fusion" experiments are having a dampening effect, too. The British already have an experimental fusion power reactor, and no one is willing to invest in fission development when it may be obsolete within a few years.

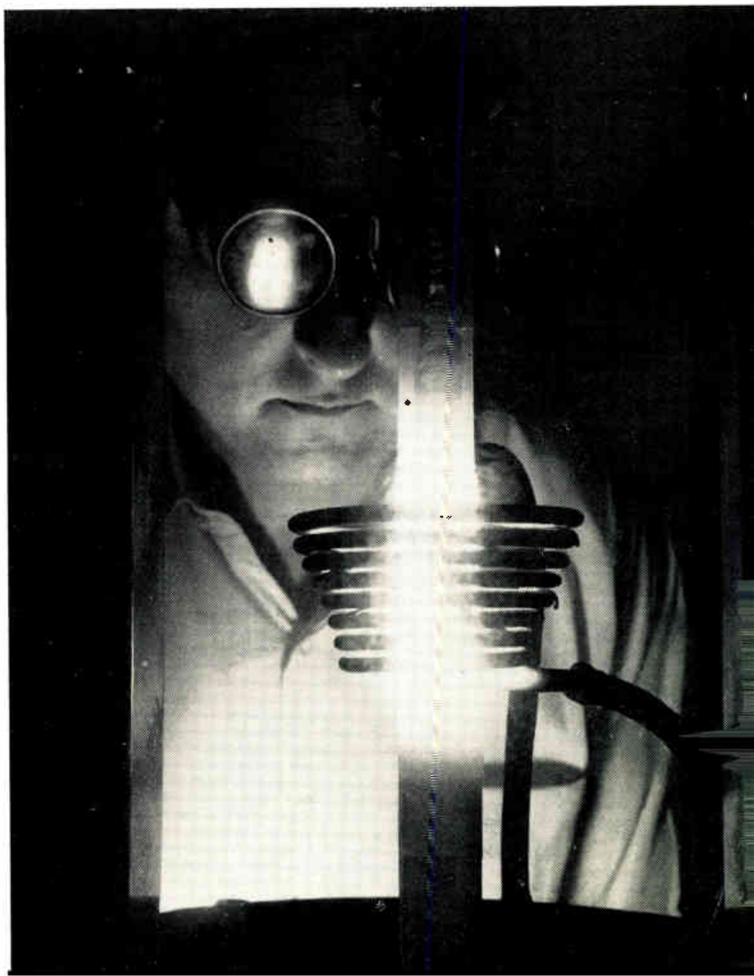
ONE JAPANESE FIRM has contracted to export 30,000 transistor radios to the U. S. by the end of the year. An additional 70,000 receivers will be delivered each year for the next two years.

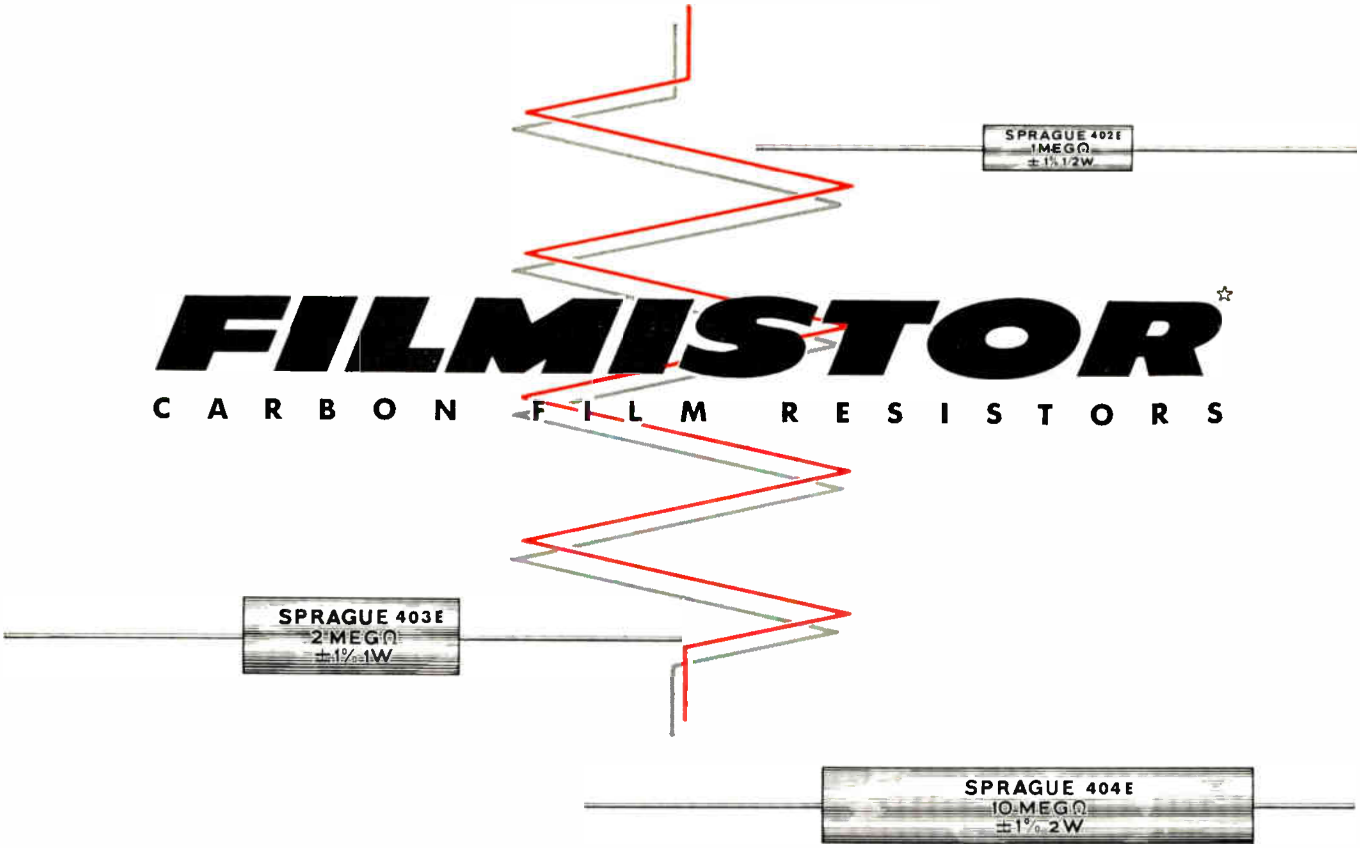
SINGLE MANAGER CONCEPT, being considered by the military, would make one service completely responsible for storing, warehousing and cataloging of any one certain logistics item. It would be expected to supply all other branches as needed.

SMALL FIRMS DOMINANT—Approximately two-thirds of companies belonging to the Electronic Industries Association engaged in the manufacture of electronic equipment and parts are "small business" by government procurement standards, according to a recent survey covering all EIA members by the Small Business Committee of the Association's Parts Division. For procurement set-aside purposes the government considers a company to be small, if, with its subsidaries and affiliates, it employs less than 500 persons and is not dominant in its field. Medium size companies, those employing between 501 and 1,000 persons, were found to be definitely in the minority, accounting for only 8.5% of the total. The remaining 25% of the companies employ over 1,000 in their manufacturing operations. The average per company employment of the firms surveyed was found to be just under 4,000. The average for the "small" companies, however, was only 133, while it topped 15,000 among the major manufacturers. The so-called "medium business" had an average employment level of 700 persons, the EIA survey showed. The number of plants operated per company was found to average 3.75.

NEW HIGH-TEMP METAL

Westinghouse scientists have devised this new method of purifying nobium (formerly columbium), a new structural metal for temperatures about 1800°F. Bar of nobium is induction-heated by "cage zone melting." Corners of the bar remain rigid, act as supports.





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As We Go To Press . . .

Sputnik II Keeps Pressure on U. S.

In another example of superb timing the Russians last month struck dramatically to re-impress on the world their leadership in the new field of space research. As the signals and the interest in month-old Sputnik I faded out, the Russians blasted another, and heavier satellite, even farther into space.

Sputnik II was not the familiar sphere shape, but the complete third stage of the rocket assembly. The weight of 1,120 lbs. includes the world's first space passenger, a small female puppy that would provide the first details on life under the weightless conditions of outer space.

The orbit of Sputnik II was very ellipsoid, approximately 1,000 mi. from the earth at the furthest point, and about 100 mi. from the earth at the closest.

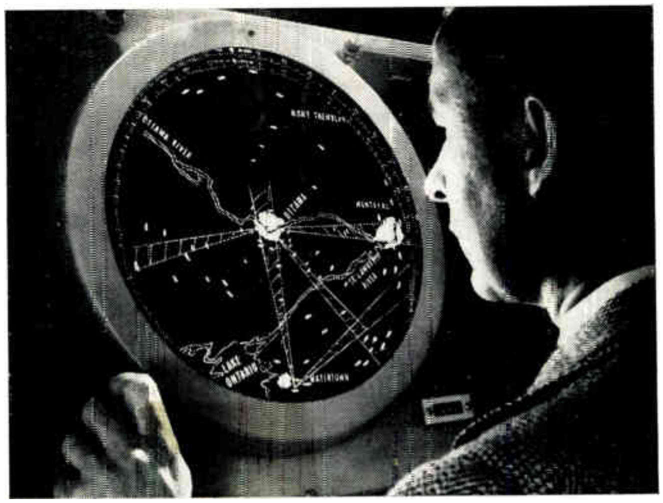
The extreme height raised some speculation as to whether the Russians were not already capable of sending a rocket to the moon. Following the launching of Sputnik II U. S. radars were reportedly busily scanning the skies on the pathway to the moon, to determine whether a Russian rocket was already on the way.

In other respects the two satellites were much the same. Sputnik II was travelling at 17,840 mph, compared to 18,000 mph for Sputnik I, and taking 103.7 minutes for one trip around the earth compared to 96.2 minutes for Sputnik I.

In announcing Sputnik II the Russians hinted at "a new source of power," interpreted by many scientists as meaning either atomic power, or newer and more powerful rocket fuels. The Russians denied the first and there was no concrete evidence to uphold the second.

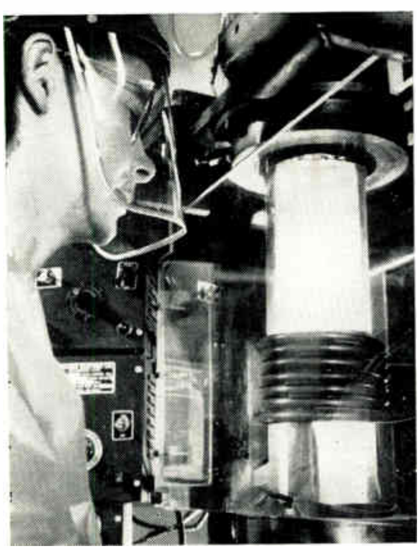
The radio signals from Sputnik II were being heard on exactly the same frequencies as Sputnik I, 20.005 MC and 40.002 MC. Instead of "beeps" Sputnik II was transmitting a steady tone which was obviously being modulated.

NEW AIRWAY RADAR



New Airport and Airways Surveillance Radar, capable of tracking large commercial airliners within radius of up to 200 miles has been ordered from Raytheon by the Canadian Dept. of Transport.

SILICON CRYSTALS



Pretty technician watches ladle of molten silicon during first stage of semiconductor manufacture at Hughes Aircraft Co. plant.

Hoffman To Lead EIA Spectrum Study

H. Leslie Hoffman of Hoffman Electronics Corp. has been designated chairman of the new Electronic Industries Associations Special Spectrum Study Committee.

The committee will prepare recommendations on the most effective method of bringing about a study of the entire radio spectrum.

A separate study group, headed by Paul L. Chamberlain, of G. E., is sounding out the attitude of key Washington officials concerned with frequency allocations.

Defense Secy. Spells Out Financing Plans

To clear up the confusion over the government's plans for the future handling and financing of defense contracts the Secretary of Defense last month sent the following memo to the Secretaries of the respective Services:

"I wish to confirm the understanding reached with regard to the policies and practices of the military departments in the handling of the financial relationships with contractors and suppliers of military items.

"1. In view of reports indicating apparent misconceptions of Department of Defense policy, the military Departments will make it clear that they will of course pay bills as they fall due under the terms of their respective contracts, in accordance with normal business practice.

"2. Some defense contractors will be asked to support on a continuing basis a somewhat greater proportion of their inventories and work-in-process with their own funds pending completion and delivery of the end items. This should give defense contractors a greater incentive to reduce their inventory and work-in-process to a level no higher than that required for efficient operations. These increases in contractor investment will be worked

(*Continued on page* 10)

ELECTRONIC INDUSTRIES & Tele-Tech

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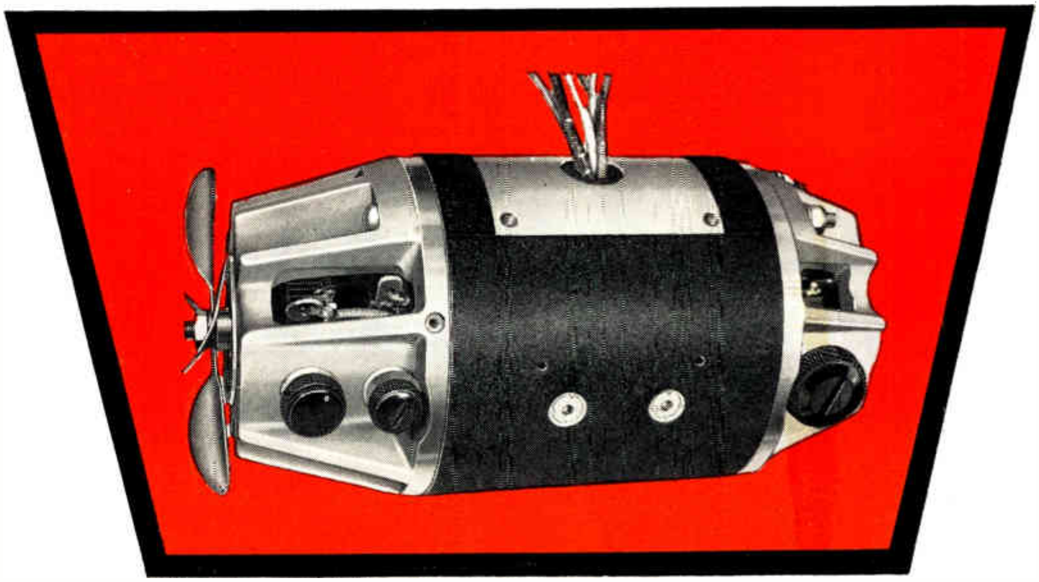
Case History from the files of the Wincharger Corporation

problem: PROVIDE FAULTLESS POWER TO GUIDE A FAMOUS MISSILE



All the engineering ingenuity built into a famous missile was threatened by a reliability problem in the guidance power supply.

Acceleration and vibration had produced shock that "unsettled" electronic components on which the missile relied for zeroing unerringly onto the target. Wincharger's Research and Engineering Group, well-known in the industry for problem-solving resourcefulness, was asked to tackle the power supply problem.

After extensive experimentation the answer came through re-design of a single sub-assembly, providing a new and heavier shaft, larger bearings, and strengthening of the end brackets.

This missile has since gone into production, to make headline news across the world, with the required FAULTLESS power provided to guide its flight.

If your work requires special purpose power supplies, alternators, inverters, or dynamotors, bring your problem to Wincharger's Research and Development Group. Their extensive experience in solving problems in all phases of these fields is your best assurance of a workable solution.

WINCO® CONVERTER BY WINCHARGER

Specifications

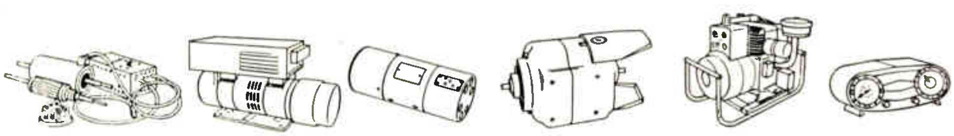
Input — Nominal 26.5 volts D.C.
Output No. 1 — 135 volts D.C. at 400 mils with 20 ohm choke
Output No. 2 — 280 volts D.C. at 150 mils without choke
Unfiltered Ripple Maximum — 10%
Duty — Continuous
Temperature Range — Minus 65° C to plus 125° C
Note: Must operate for 6 minutes at 246° C
R.P.M. — 6,000
Altitude — 80,000 feet
Meets all requirements military specifications MIL - D-24A

SPECIALISTS IN ELECTRONIC AND ROTARY ELECTRICAL DESIGN AND MANUFACTURE

WINCHARGER CORPORATION

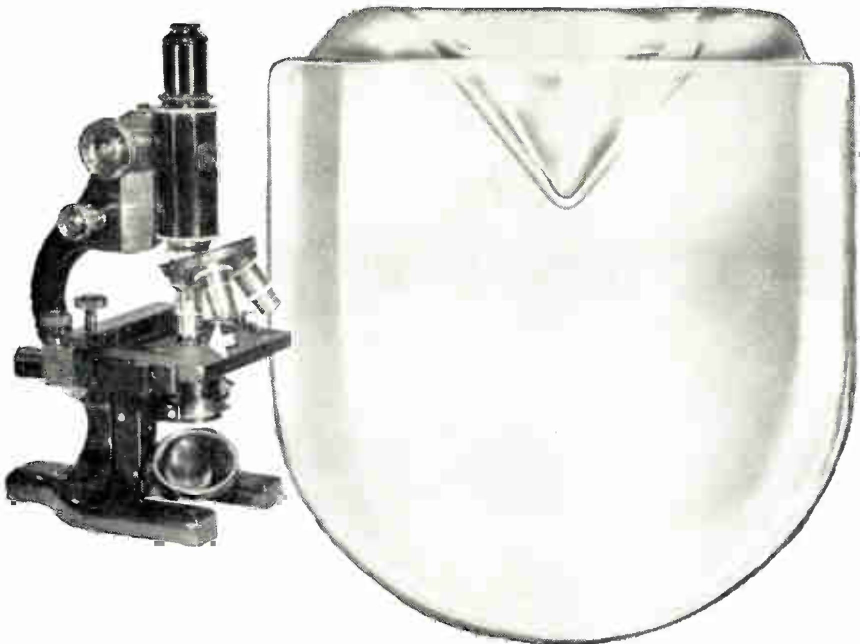
DEPT. TT 127, SIOUX CITY, IOWA

Subsidiary of ZENITH *Radio Corporation*



ALTERNATORS INVERTERS DYNAMOTORS UNIVERSAL MOTORS ENGINE-GENERATORS RADIOS

Circle 4 on Inquiry Card, page 101

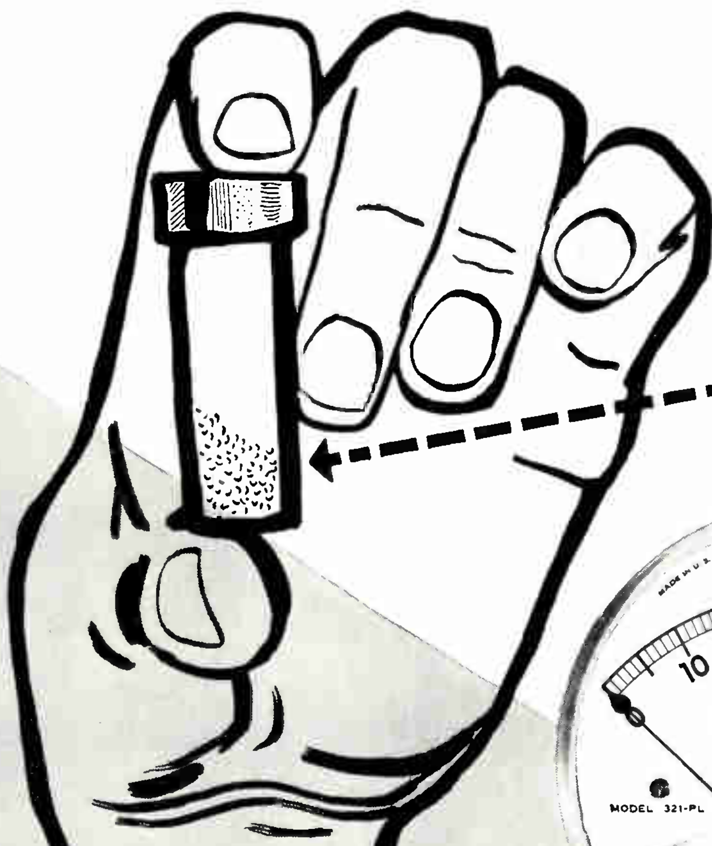


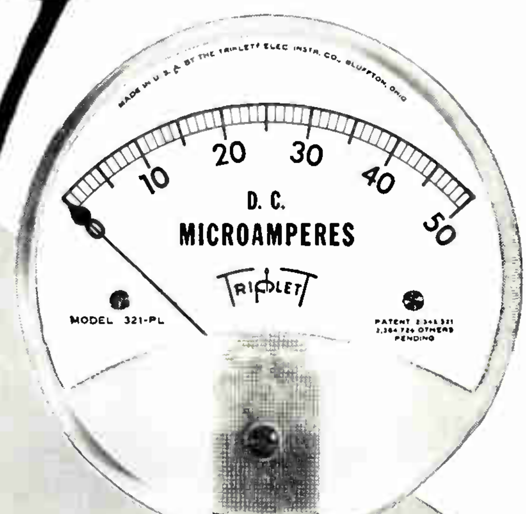
one important little detail 100 times enlarged!

Typical of the scientific technology that is behind Triplett's world wide reputation for reliability—these jewel pivot bearings are so minute that 1000 do not even half-fill this one-half inch bottle and every jewel is perfectly balanced with more painstaking care than the watchmakers' art.

Triplett current catalog offers more than 15,000 available types and ranges of clear plastic front and conventional design black plastic panel meters.

The identical careful accuracy and high reliability is available in the complete Triplett line of VOMs, VTVMs, scopes and other test equipment.





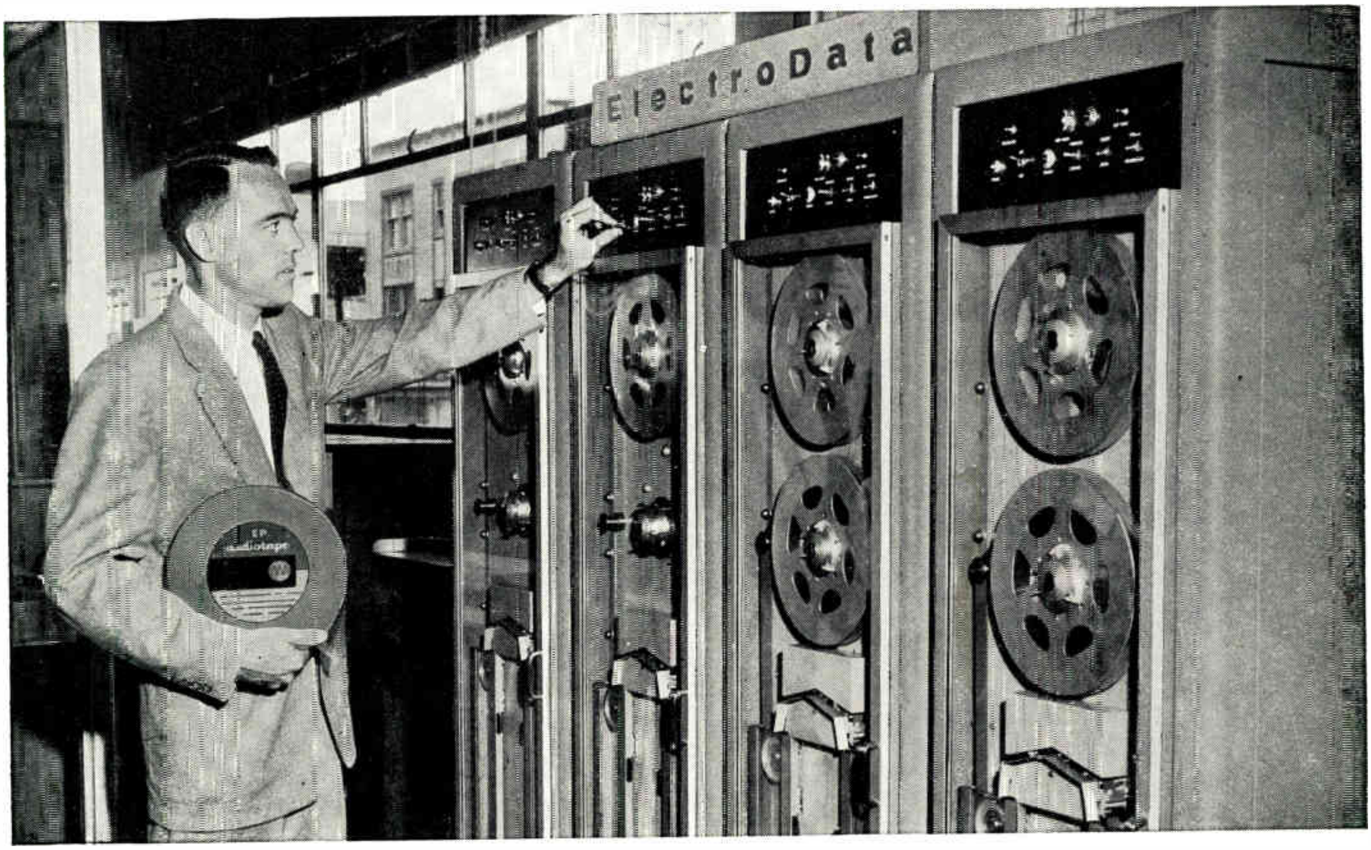
TRIPLETT

TRIPLETT ELECTRICAL INSTRUMENT COMPANY
Bluffton, Ohio

Over half a century of experience

General Insurance of America Tested

. . . and picked audiotape



Chief Engineer Cites Audiotape's "oxide dust-free coating, uniform signal output . . . high precision"

When General Insurance Company of America bought four Electrodata tape transports 18 months ago, they knew one thing: their computing system should have the finest magnetic recording tape available. It was decided that the best way to make the final decision was to test.

The tests started immediately. Every nationally known make of magnetic recording tape was used on the transports for at least a month. The result was clear; type EP Audiotape was chosen.

As D. G. Jessup, Chief Engineer of General's Computing Department, wrote in a letter to Audio Devices, "To obtain the optimum reliability and performance from our computing system we need the oxide dust-free coating, uniform signal output level correct in both directions of travel, and high precision reels which you supply. Keep up the good work!"

The extra precision Mr. Jessup found in type EP Audiotape is not a matter of chance. Rather it is the result of meticulous selection and inspections that start when the master rolls of base materials are examined for uniformity. The quality control is continued through the manufacturing process, ending only when the tape is checked by a defect counter, rejects discarded, and the defect-free tape packed in sealed containers. This high standard of control is backed up by our guarantee that every reel of type EP Audiotape is defect-free.

For more information on Type EP AUDIOTAPE, contact your nearest Audio sales engineer, or write for bulletin T112A.

it speaks for itself

audiotape TRADE MARK

AUDIO DEVICES, INC., 444 Madison Ave., New York 22, N. Y.
Offices in Hollywood and Chicago
Export Dept.: 13 East 40th St., New York 16, N. Y.

← Circle 5 on Inquiry Card, page 101

Circle 6 on Inquiry Card, page 101

ELECTRONIC SHORTS

▶ The New York State Commissioner of Commerce, Edward T. Dickinson has announced that Muirhead & Co., England and Canadian manufacturers of measuring instruments and fire-control apparatus, will build a plant in Huntington, L. I. It will take about two years to complete and will cover 17,500 square feet. The Commerce Department has sent a group of relocation experts to study about fifty potential industrial sites on Long Island. The purpose of their study is to start a long range effort to diversify industry. Aim is to take up the slack caused by recent heavy lay-offs in aircraft and related industries.

▶ A low-drive ferrite core for information-storing in digital computers has been improved by RCA. The core compares favorably to high-drive units in withstanding large disturbing current impulses without reversing its flux state. Faster turnover time, higher output signal, and driving current in 300-500 milliampere range are characteristics. The tiny ring-shaped device processed by ceramic techniques, has magnetic properties.

▶ A $62.1 million contract for continued development of the Navy's fleet ballistic missile, Polaris, has been awarded to the Missiles System Division of the Lockheed Aircraft Corporation. This contract award extends the work within this program through fiscal year 1958.

▶ With the belief that our missiles schedules now represent the best balance of technical knowledge, trained manpower, and test installations that can be made at this time, the Department of Defense has approved all of the requests for permission to utilize overtime in missile programs. Neil H. McElroy, the new Secretary of Defense, has requested the individual service secretaries to give continuing attention to the removal or modification of any regulations which could conceivably impede progress in missiles fields.

▶ A new standard dimensional system for automation requirements and a proposed standardized punch tape for control of machine tools have been cited as important steps toward realizing the goals of automation. Cyril P. Atkinson, assistant professor of engineering design, University of California, cited EIA's "Standard Dimensional System for Automatic Requirements," which provides a basic module of 0.025 and an all-purpose one-inch wide tape with capability for a maximum of eight levels or channels.

▶ The nation's defense producers have nearly exhausted today's bag of manufacturing tricks and now must overcome the "know-how barrier" in building the coming generation of aircraft and missiles according to Maj. Gen. William O. Senter, USAF procurement chief at the Air Materiel Command's headquarters in Dayton, Ohio.

▶ Among the groups of engineers viewing with alarm the continuing cry of engineering shortage is the Association of Professional Engineering Personnel, representing the engineers of RCA. The association emphatically disagrees with the standpoint that because we are graduating less engineers we therefore have a shortage. Its standpoint is that sheer numbers do not guarantee creativity, and at a time when the economy of the country requires that every scientifically trained individual be utilized, they, the scientists, are being laid off. Effective utilization of scientific personnel already developed within this country to the fullest capacity possible will win the technical race.

▶ A new technique for improvement of color television circuits which can also be used to improve camera tubes, kinescopes, and audio equipment uses a new differential phase and gain equalizer. J. H. Clark, Pacific Telephone & Telegraph Co., stated that the new equalizer employed the non-linear impedance characteristics of devices such as germanium or silicon diodes to compensate the undesirable nonlinearity of the circuits to which it is applied.

▶ A useful ion rocket engine can be built and operated, according to C. W. Guy, Rocketdyne Assistant General Manager. Such an engine—developing thrust through the high velocity discharge of ionized particles—would make possible unmanned space vehicles capable of sustained flight and directed orbits about any planet in the solar system.

As We Go To Press . . .

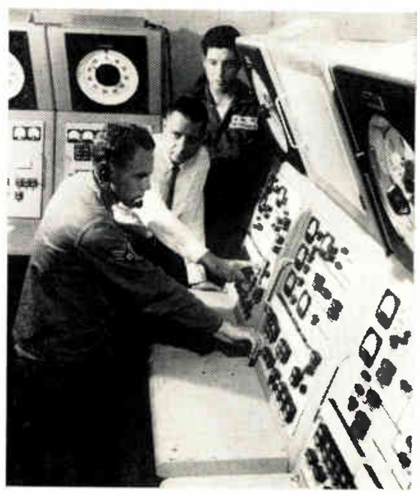
(Continued from page 5)

out through negotiations with contractors. Moreover, it is to be understood that capital investment by the contractor will be taken into consideration in determining fixed fee or allowable profits.

"Every effort should be made to insure that prime contractors do not place an undue hardship on their subcontractors (and particularly small business) or importantly affect the subcontractors' ability to continue production. Any subcontractor who feels he is not being fairly treated in this respect should be encouraged to communicate directly with the Assistant Secretary for Materiel in the Military Department concerned.

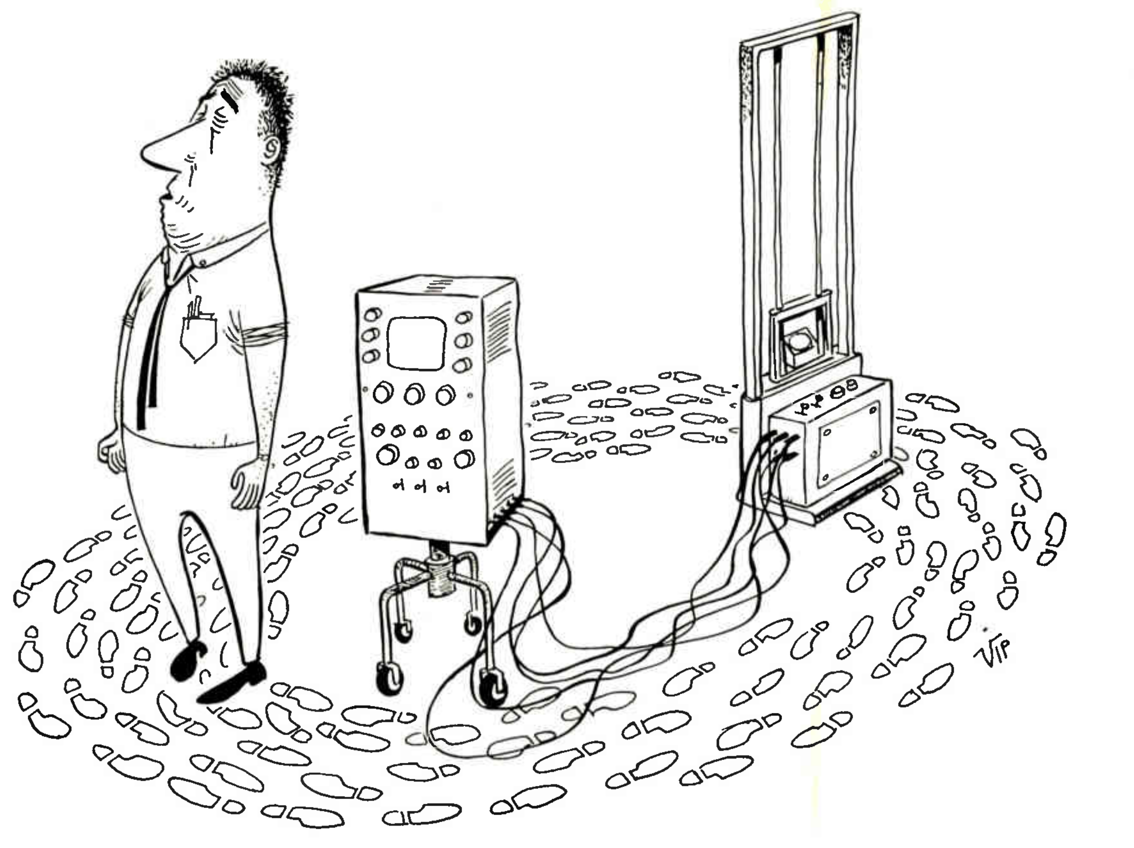
"3. I have been impressed by the job the three military Departments have done in distributing efficiently the funds available to them in Fiscal 1958. Although the $38 billion current budget objective must be kept in mind at all times, I expect you to advise me whenever you find that specific further cuts that may appear necessary to meet these expenditure objectives will jeopardize essential programs. I am confident each of you will continue to give his personal attention to the task.

FUELING THE ICBM



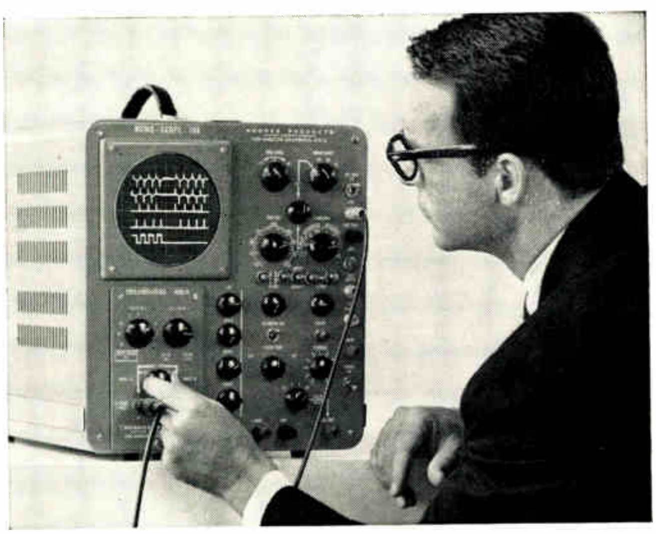
Air Force personnel simulate fueling of an Atlas ICBM missile at March AFB, Calif., as part of a human engineering study. Console of this type is used to prepare and fire missiles from a blockhouse.

MORE NEWS ON PAGE 12



PROBLEM: Duplication of Research Effort

Even the most patient veteran researchers are often irked in attempting transient analysis using conventional 'scopes. Time and effort wasted in repetitious trial and error to "capture" transients can be a problem of first magnitude.



SOLUTION: Now you no longer need to put up with elusive traces. The answer to your time-duplication dilemma is the new Hughes **MEMO-SCOPE® Oscilloscope.** A storage type oscilloscope, it can instantly "freeze" any number of selected transients—retain single or successive displays brilliantly *until intentionally erased.*

HUGHES MEMO-SCOPE OSCILLOSCOPE

STORAGE TUBE—5-inch diameter Memotron® Direct Display Cathode Ray Storage Tube. Writing speed for storage: 125,000 inches per second. The optional Speed Enhancement Feature multiplies writing speed approximately four times.

OPTIONAL PREAMPLIFIER EQUIPMENT—High Sensitivity, Differential Input, Type HS/6: 1 millivolt to 50 volts per division. Dual Trace Type WB/DI/11: 10 millivolts to 50 volts per division. Four independent positions may be selected for single or double channel performance and chopped or alternate sweeps.

You will want to see this "transient recorder with a memory" demonstrated. Send for Application Data Sheet No. MSAD-A3. and ask for a Hughes representative to arrange a demonstration in your company. Make request to:

HUGHES PRODUCTS MEMO-SCOPE Oscilloscope
International Airport Station, Los Angeles 45, California

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

Circle 7 on Inquiry Card, page 101

Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period December to May that are of special interest to electronic engineers

Dec. 1-6: Annual Meeting of ASME; at Hotels Statler, Sheraton & McAlpin, New York.

Dec. 3-4: National Symp. on Human Factors in Systems Engineering, by IRE & HFSA; at Penn Sherwood Hotel, Philadelphia.

Dec. 4-5: Annual Vehicular Communications Mtg., by IRE; at Statler Hotel, Washington, D. C.

Dec. 9-13: Eastern Joint Computer Conf., by IRE, ACM, and AIEE; at Park Sheraton Hotel, Washington, D. C.

Dec. 18-19: Conf. on Maintainability of Electronic Equipment, by EIA; at Univ. of Southern Calif., Los Angeles.

Jan. 6-8: 4th National Symp. on Reliability & Quality Control, IRE; at Hotel Statler, Washington, D. C.

Jan. 22-24: Conf. on Automation, by EIA; at Arizona State College, Tempe, Ariz.

Jan. 27-30: 11th Annual Symp. on Modern Methods of Analytical Chemistry; at Louisiana State Univ., Baton Rouge, La.

Feb. 10-14: Committee Week, by American Soc. for Testing Materials; at Hotel Statler, St. Louis, Mo.

Feb. 20-21: Conf. on Transistor & Solid State Circuits, by IRE; at Univ. of Pennsylvania, Philadelphia, Pa.

Feb. 20-24: Industrial Relations Conf., by EIA; at Town & Country Hotel, San Diego, Calif.

Mar. 11-13: 8th Annual Conf. on Instrumentation for the Iron & Steel Industry; at Roosevelt Hotel, Pittsburgh, Pa.

Mar. 16-21: Nuclear Engineering & Science Conf., IRE, ASME, EJC & ANS; Chicago, Ill.

Mar. 24-27: IRE National Convention; at Waldorf-Astoria Hotel & Coliseum, New York, N. Y.

Mar. 25-28: Packaging Machinery & Materials Expos.; at Convention Hall, Atlantic City, N. J.

Mar. 27-29: Electrical Industry Show; Shrine Exposition Hall, Los Angeles, Cal.

Mar. 31-Apr. 2: Instruments & Regulators Conf., by IRE, ASME, AICE & ISA; at Univ. of Delaware, Newark, Del.

Apr. 10-12: Regional Conf. & Electronics Show, by IRE; at Municipal Audit., San Antonio, Tex.

Apr. 14-16: Conf. on Automatic Techniques, by IRE; at Statler Hotel, Detroit, Mich.

Apr. 14-17: 15th Annual Radio Component Show; Grosvenor House & Park Lane House, London, W. 1, England.

Apr. 16-25: Instruments, Electronics & Automation Exhibition; at Olympia Hall, London, England.

Apr. 22-24: Electronic Components Conference, IRE, WCMA, AIEE, & EIA; at Ambassador Hotel, Los Angeles, Calif.

May 5-7: National Symp. on Microwave Theory & Techniques, IRE; at Stanford Univ., Stanford, Calif.

Apr. 30-May 2: Tech. Conf. & Trade Show, IRE; Sacramento, Calif.

May 6-8: 1958 Western Joint Computer Conf., IRE, ACM & AIEE; at Ambassador Hotel, Los Angeles, Cal.

May 7-17: 2nd U. S. World Trade Fair; at New York, N. Y.

May 12-14: National Aero & Navigational Electronic Conf., IRE; at Dayton, O.

May 19-21: 1958 Electronic Parts Distributors Show; Conrad Hilton Hotel, Chicago 3, Ill.

Abbreviations:

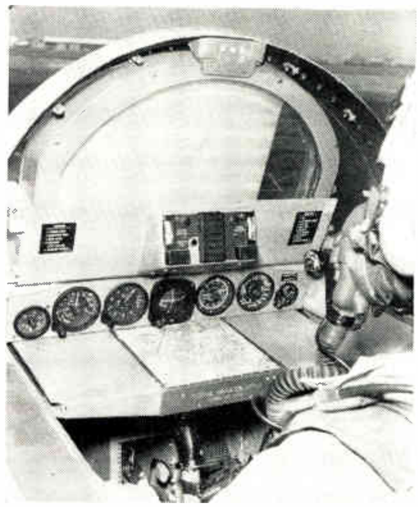
ACM: Association for Computing Machinery
AIEE: American Inst. of Electrical Engrs.
ASME: American Society of Mechanical Engineers.
EIA: Electronic Industries Assoc.
IAS: Inst. of Aeronautical Sciences
IRE: Institute of Radio Engineers
SPI: Society of Plastic Industries
WCMA: West Coast Manufacturers Association

As We Go To Press . . .

New Instrument Panel Has TV-Type Display

A completely redesigned aircraft instrument panel in which a broad, flat display tube reproduces for the pilot the exact conditions existing outside his aircraft was unveiled last month at the joint Army-Navy Instrumentation Conference in Los Angeles. The details of the 4½-year research project are now being let out to commercial airlines as a contribution to air safety.

The display device, called the contact analogue, is a flat, transparent television tube 2⅝ in. thick, 20 in. wide, and 11 in. high. It gets its information from a light



Pilot sees picture of outside conditions on panel-mounted flat TV-type tube.

weight, electronic computer and generates a picture which gives the perspective of the third dimension. When not in use it can be seen through as if it were a window.

The small computer not only shows the pilot his plane's true air speed, Mach number, altitude and rate of climb, but also makes cruise control computations (weight, fuel, time, and distance) and comes up with performance predictions for any given set of circumstances.

The ANIP (Army-Navy Instrumentation Program) equipment is expected to become operational in Navy aircraft in two to three years. In the meantime work is going ahead on further refinements of the system.

Douglas Aircraft Co. was the prime contractor in the development of the system.

Now, Stronger Than Ever . . . give up to 18 years of sure, rugged service!

Put through a series of rough tests, these tiny, tireless workhorses of the electronics industry came up with a record-smashing performance. El-Menco engineers found that El-Menco DM-15, smallest mica capacitor in the world, DM-20 and DM-30 Dur-Mica Capacitors beat all others for long life and tried reliability. Under accelerated conditions of 1½ times rated voltage at 125° C ambient temperature, El-Menco Dur-Micas kept on going strong even after 12,000 hours . . . equal to 18 years or more of service under normal operating conditions.

Write for FREE samples and catalog on your firm's letterhead.

El-Menco Dur-Mica DM-15, DM-20, DM-30, DM-40 and DM-42 Capacitors outlive, outperform, outshine . . .

Longer life . . . tremendous power . . . tiny size . . . terrific stability — silvered mica . . . perfect performance. Test them for yourself and see . . .

DM-15 — tiniest mica capacitor in the world . . . ideal for extreme miniaturization . . . up to 820 mmf at 300 VDCW . . . up to 400 mmf at 500 VDCW.

DM-20 — ideal for new miniatured designs and printed wiring circuits . . . up to 7500 mmf at 100 VDCW . . . up to 6200 mmf at 300 VDCW . . . up to 4300 mmf at 500 VDCW.

With newly-designed crimped leads . . . Parallel leads simplify use in TV, electronic brains, miniature printed circuits, guided missiles, and countless other applications. El-Menco Dur-Mica Capacitors meet all humidity, temperature and electronic requirements, including military specs.

El-Menco Capacitors

THE ELECTRO MOTIVE MFG. CO., INC.

Manufacturers of El-Menco Capacitors

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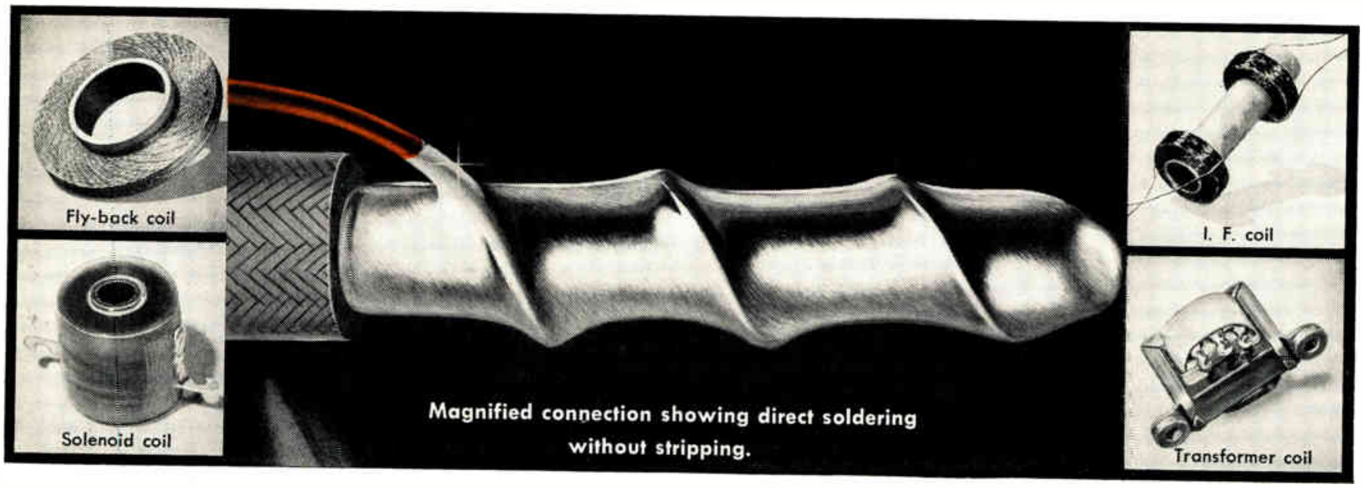
• molded mica • mica trimmer • dipped paper • tubular paper • ceramic • silvered mica films • ceramic discs

Arco Electronics, Inc., 64 White St., New York 13, N. Y.
Exclusive Supplier To Jobbers and Distributors in the U.S. and Canada

Circle 8 on Inquiry Card, page 101

PHELPS DODGE SODEREZE®
ENDS STRIPPING, CLEANING— CUTS SOLDERING COSTS !



Sodereze*—Phelps Dodge polyurethane magnet wire—provides:

1. Low temperature soldering—no damage to copper conductor.

2. A balance of physical, chemical and electrical properties permitting replacement of existing film wires.

3. Resistance to heat and solvent shock for safer wax or varnish treatment.

Any time magnet wire is your problem, consult Phelps Dodge for the quickest, easiest answer!

**Standard color, red.*

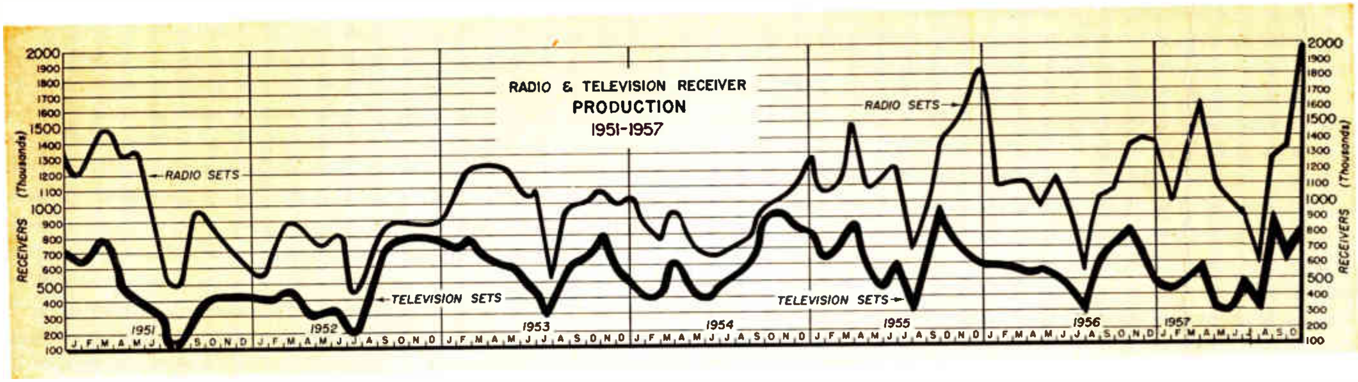
FIRST FOR LASTING QUALITY— FROM MINE TO MARKET!

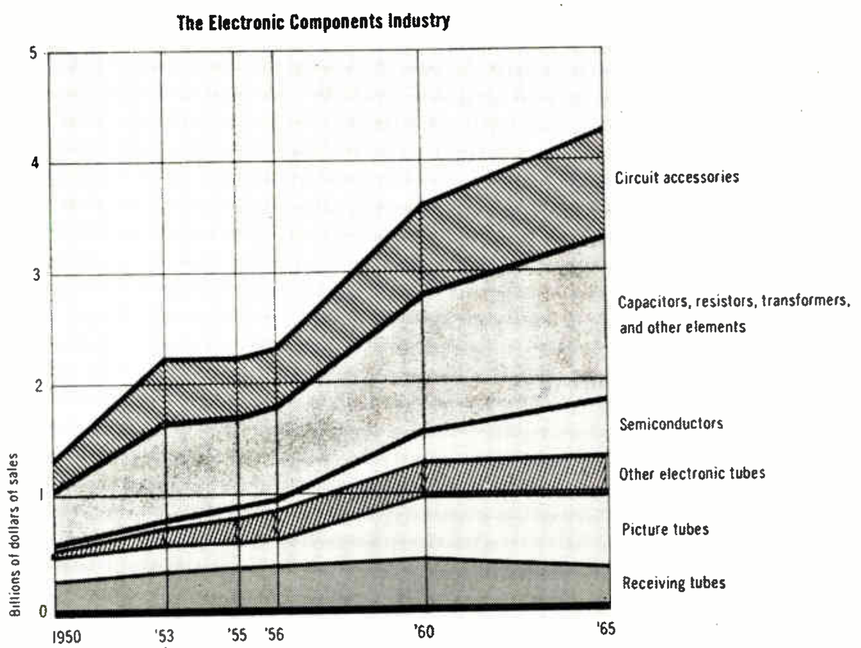
PHELPS DODGE COPPER PRODUCTS CORPORATION

INCA MANUFACTURING DIVISION

FORT WAYNE, INDIANA

TOTALS





—*NEDA Journal, Sept. 1957, Vol. 13—No. 9*

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in October 1957.

Amplifiers	275,685
Antennas	59,000
Batteries, Dry	1,677,190
Cable Assemblies	99,867
Cable Sets, Interconnecting	126,643
Computers & Accessories	4,411,643
Computers, Airborne	117,780
Facsimile Equipment	225,804
Fire Control Equipment	380,139
Galvanometers	90,035
Generators, Signal	606,325
Microphones	81,745
Microwave Equipment	135,144
Radar Equipment	2,047,806
Radio Direction Finders	1,305,982
Radio Receivers	489,458
Radio Receivers—Transmitters	1,192,467
Radio Sets	5,932,925
Radio Transmitters	677,600
Recorders—Reproducers	1,760,000
Test Sets, Radar	821,760
Tubes, Electron	845,903
Wire & Cable	450,142

U. S. OBLIGATIONS AND EXPENDITURES FOR SCIENTIFIC R & D

[Millions of dollars]

ITEM	Fiscal Years: Actual 1956	Estimated 1957	Estimated 1958[1]
Obligations			
Total, all items	2,693	3,358	3,377
Conduct of R&D	2,231	2,635	2,782
Pay and allowances of military personnel in R&D	188	196	239
Increase of R&D plant	273	527	356
Total, excluding pay and allowances of military personnel in R&D	2,505	3,162	3,138
Expenditures			
Total, all items	3,275	3,757	4,147
Conduct of R&D	2,146	2,462	2,671
Pay and allowance of military personnel in R&D	188	196	239
Procurement funds for R&D	740	775	800
Increase of R&D plant	200	325	437
Total, excluding reported procurement funds	2,535	2,982	3,347
Total, excluding reported procurement funds and pay allowances of military personnel	2,347	2,787	3,108

[1] Based on *The Budget, 1958.* Estimates do not reflect congressional action.
Note.—Detail will not necessarily add to totals because of rounding.

—*National Science Foundation's "Federal Funds for Science"*

Electronic Industries' News Briefs

Capsule summaries of important happenings in affairs of equipment and component manufacturers

EAST

NARDA ULTRASONICS CORP. is the new subsidiary formed by Narda Microwave Corp. as the latter makes its entry into the new fast-growing ultrasonics industry.

PHILCO CORP.'s G. & I. DIV. has opened a regional office in Washington, D. C., for marketing its large scale transistorized computer, the "TRANSAC" S-2000.

SPERRY GYROSCOPE CO. has been awarded Navy contracts totaling more than $47 million for TALOS missile guidance systems. TALOS will be major armament on the cruisers Galveston, Little Rock, and Oklahoma City, presently undergoing conversion to guided-missile cruisers.

SYLVANIA ELECTRIC PRODUCTS, INC., has changed the name of its Tungsten & Chemical Div. to "Chemical and Metallurgical Div." The new name provides a clearer indication of the broad line of products manufactured by the division.

NATIONAL CO., INC., manufacturers of the Atomichron, the atomic clock, indicate that this device may provide the key to solving many of the problems of space navigation.

PANORAMIC RADIO PRODUCTS, INC., will multiply its engineering and production facilities when it moves into its new one story brick and steel building at 520 So. Fulton Ave., Mt. Vernon, N. Y.

BROWN INSTRUMENTS DIV., MINNEAPOLIS-HONEYWELL, has been awarded the 1956 Public Relations News' annual "Achievement Award" for "its pioneering campaign to allay fears of automation by giving business the true facts about the economic and social benefits."

THE BRISTOL CO. has developed a new electronic transmission system based on the use of a differential transformer transmitter and an electronic Dynamaster receiver. The system measures such variables as pressure, differential pressure, liquid level, temperature, and mechanical motion.

WESTON ELECTRICAL INSTRUMENT CORP. has opened a Boston District Sales Office at 66 Central St., Wellesley, Mass. The new manager is Edward P. Reid.

ACE ENGINEERING & MACHINE CO., INC., has moved into its new one story air conditioned offices and plant, enclosing an area of 18,000 sq. ft., at Huntingdon Valley, Pa., a suburb of Philadelphia.

CORNING GLASS WORKS has shown for the first time a new high lead content glass, designed to stop ultra-high energy particles in a Cerenkov spectrometer.

RADIO RECEPTOR CO., INC., has completed consolidating semiconductor production under one roof at its main plant, 240 Wythe Ave., Brooklyn.

AUDIO DEVICES, INC., has leased an additional factory building which will raise its operating space for the manufacture of magnetic tape to a total of 60,000 sq. ft.

ALPHLEX TUBING DIV., Alpha Wire Corp., has been formed due to the large demand for Alphlex tubing and sleeving products.

MID-WEST

MOTOROLA SEMICONDUCTOR PRODUCTS DIV. has appointed Allied Radio, Inc., of Chicago, distributor of its devices.

CHICAGO STANDARD TRANSFORMER CORP. has begun construction on a 25,000 sq. ft. addition. This section will be devoted exclusively to the Chicago and Stancor Catalog Div.

NATIONAL VULCANIZED FIBRE CO. are supplying miniature insulators to the Warren Lamp Co., manufacturers of lamps for special surgical instruments.

RADIO CORPORATION OF AMERICA has installed a closed-circuit color television system at underground headquarters of the Strategic Air Command, Offutt AFB, Omaha, Nebraska. The installation will provide new speed and flexibility in the presentation of world-wide flight data.

PHILLIPS CONTROL CORP. has added a full line of sub-miniature relays to its already broad and well-known line of relays and solenoids. The move was made to keep pace with the missile, jet and atomic age.

COOK ELECTRIC CO. has been awarded a contract by the U. S. Army Signal Corps. for specification engineering to evaluate electronic components. Inland Testing Laboratories will perform the work.

PERFECTION INDUSTRIES, DIV. OF Hupp Corp., has developed a successful airborne electronics van for the U. S. Army Ordnance Dept. The 30 ft. insulated plastic trailer carries 3,000 pounds more payload than conventional vans.

FOREIGN

GULTON INDUSTRIES, INC., has begun international expansion of its manufacturing facilities with the acquisition of Titania Electric Corp. of Canada, Ltd., Gananoque, Ontario.

RADIO CORPORATION OF AMERICA reports that the world's first ore-gathering system with microwave-radio traffic control soon will move its 25-millionth ton of ore in Venezuela. The system controls the movements of all ore trains on the Orinoco Mining Company's 90-mile single track railroad.

TEXAS INSTRUMENTS LTD., a wholly-owned subsidiary of Texas Instruments, Incorporated, formally opened its new plant for the manufacture of transistors and other semiconductor devices at Bedford, England.

BENDIX AVIATION CORP. will supply dual automatic direction-finding equipment to Air France for installation on its new fleet of Caravelle transports.

LEEDS & NORTHRUP CO. has just received an order from the Univ. of Puerto Rico for an Atomic Reactor Simulator. The simulator will be used for the University's course in Reactor Instrumentation and Control.

MARCONI'S WIRELESS TELEGRAPH CO. LTD. has been awarded a contract by the CAA of New Zealand for the supply and installation of two complete surveillance radar systems.

WEST

STANFORD RESEARCH INST. is releasing its Mt. Lee site in the Hollywood hills. Potential availability of antenna test facilities adjacent to its Menlo Park headquarters prompts the move. The South Pasadena antenna laboratory operations will be consolidated with those at Menlo Park. Physical sciences and economics research activities will continue at South Pasadena.

GERTSCH PRODUCTS, INC., has established a Northern California sales office at 11761 Los Arboles, Sunnyvale, Calif. Office will be headed by Roy T. Cushman.

HOFFMAN ELECTRONICS CORP. has presented the world's first clock perpetually powered by the energy of the sun to the city of Palm Springs. With appropriate ceremonies, the clock was permanently placed on the front of the new Palm Springs Chamber of Commerce building.

AMPEX CORPORATION has signed an agreement with RCA for the exchange of patent licenses covering videotape recording and reproducing systems for both black and white and color.

ELECTRONIC ENGINEERING CO. OF CALIF. has closed its Florida Division offices and transferred R&D operations at Cape Canaveral, Fla., to the main laboratory in Santa Ana, Calif.

AEROJET-GENERAL CORP. has been awarded a contract by the USAF for propulsion units for the Titan. The award is a letter contract for $55,650,000.

AUTONETICS has been awarded a $1,760,000 contract by the Bureau of Aeronautics for pilot line procurement of an advanced airborne magnetic tape recorder. The recorder is planned for installation in several all-weather Navy interceptors.

KIERULFF ELECTRONICS, INC., Los Angeles, has been appointed to distribute Weston instruments in the Southern California area.

UNION SWITCH & SIGNAL engineers has installed its low-frequency carrier wave transmission system elevator control in the towers at the Nevada test site. The system eliminates the dangling control wires which would often become fouled.

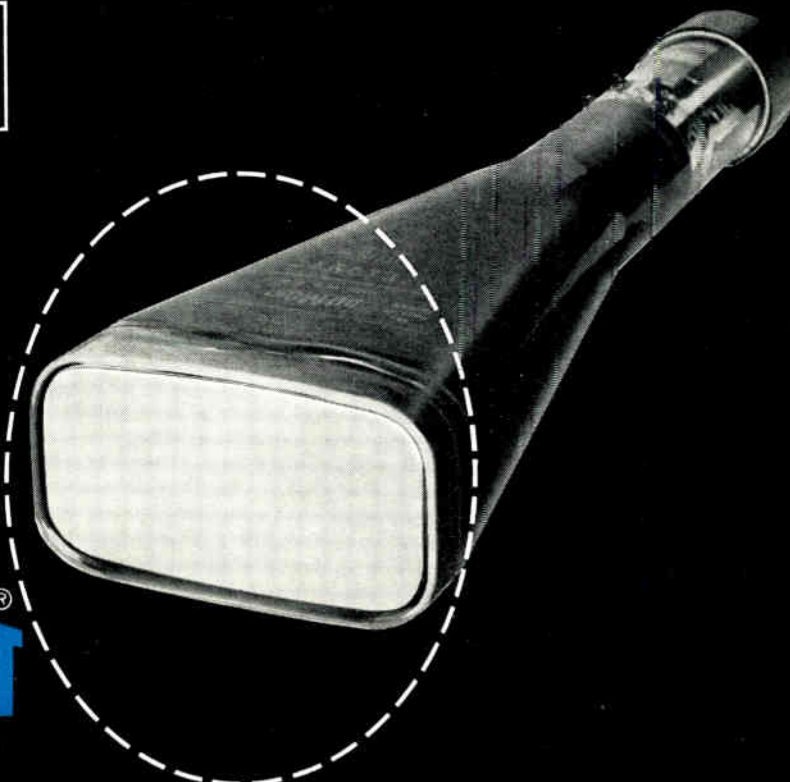
RAMO-WOOLDRIDGE CORP. now offers scientific computation and mathematical analysis service for business and industrial organizations. Computation Consulting and Service Bureau is the name of the new section.

LOCKHEED MISSILE'S X-7 ramjet missile has set three new speed records while completing its 10th successful flight. These three fastest speed records are for ramjet powered, ground controlled, and recoverable missiles.

INTERNATIONAL RECTIFIER CORP. has occupied two new facilities bringing the number of plant buildings in the El Segundo, Calif., area to seven. The new structure which covers 18,000 sq. ft. is located at 233 Kansas Street.

SIEGLER CORP. is the surviving corporation after the completion of the merger of Unitronics Corp. and The Hufford Corp.

SQUARE away your space problems with DU MONT®



RECTANGULAR CATHODE-RAY TUBES

Save valuable panel space by using Du Mont Rectangular Cathode-ray Tubes. These tubes permit a larger usable screen area in a given space by elimination of seldom-used segments of the circular screen.

Du Mont Rectangular Cathode-ray Tubes are available in electrostatic or electromagnetic types, in a wide range of screen sizes, shapes and materials. Write for complete technical details . . .

Rectangular screen for display of single, or superimposed patterns.

Square screen for display of two signals on a single time base.

	Tube Type	Screen Size	Focus	Deflection	Max. Anode Voltage	Length
DU MONT RECTANGULAR CATHODE-RAY TUBES	B1204	4⅝" x 2⅝"	Electrostatic	Electrostatic	6 KV	17⅝"
	K1206	3½" x 3½"	Electrostatic	Electrostatic	6 KV	12"
	B1167	6" x 7⅞"	Electrostatic	Electromagnetic	12 KV	10"
	B1194	3" x 1½"	Electrostatic	Electromagnetic	16 KV	10½"
	K1442	6½" x 6½"	Electrostatic	Electromagnetic	35 KV	12 3/16"

INDUSTRIAL TUBE SALES, ALLEN B. DU MONT LABORATORIES, INC., 2 MAIN AVENUE, PASSAIC, NEW JERSEY

Tele-Tips

SATELLITE TRACKERS trying to monitor Sputnik II discovered a wise guy. An unknown amateur came in on the 20 MC band and transmitted "bow - wow - wow" in Morse code.

DEFINITION DEP'T. We offer the translations below to help further scientific cooperation between West Germany and the U. S.

Public Relations — Das Braggen und schnoen grupe.

Inspection — Das pfaulterfinden grupe

Security—Das schnoopen bunche.

Flight Test — Das mor gutz den brainische grupe.

Management—Das ulzer and balden grupe.

Guided Missile—Das Skientifiker Gesstenwerkes Firenkrakker.

Rocket Engine — Firenschpitter mit Smoken-und-Schnorten.

Liquid Rocket—Das Skwirten Jucenkind Firenschpitter.

Guidance System (for missiles)—Das Schteerenwerke.

Celestial Guidance—Das Schrubbalische Schtargazen Peepenglasser mit Komputenrattracen Schteerenwerke.

Pre-Set Guidance — Das Senden Offen mit ein Pattenbacker und Finger Gekrossen Schteerenwerke.

Control System—Das Pullen-und-Schroven Werke.

Warhead—Das Laudenboomer.

Nuclear Warhead—Das Eargeschplitten Laudenboomer.

Hydrogen Bomb — Das Eargeschplitten Laudenboomer mit ein grosse Holengraund und Alles kaput.

Earth Satellite—Das Ruskie Propagandische Ferflowen Satellichten (or Das Grossen Pentagonische Goofen).

(With thanks to "Pulse," the journal of the Long Island, N. Y., section, IRE.)

TRANSISTOR OSCILLATORS using surface-barrier transistors are being oscillated at frequencies as high as 1100 MC.

(*Continued on page* 20)

Tele-Tips

(*Continued from page* 18)

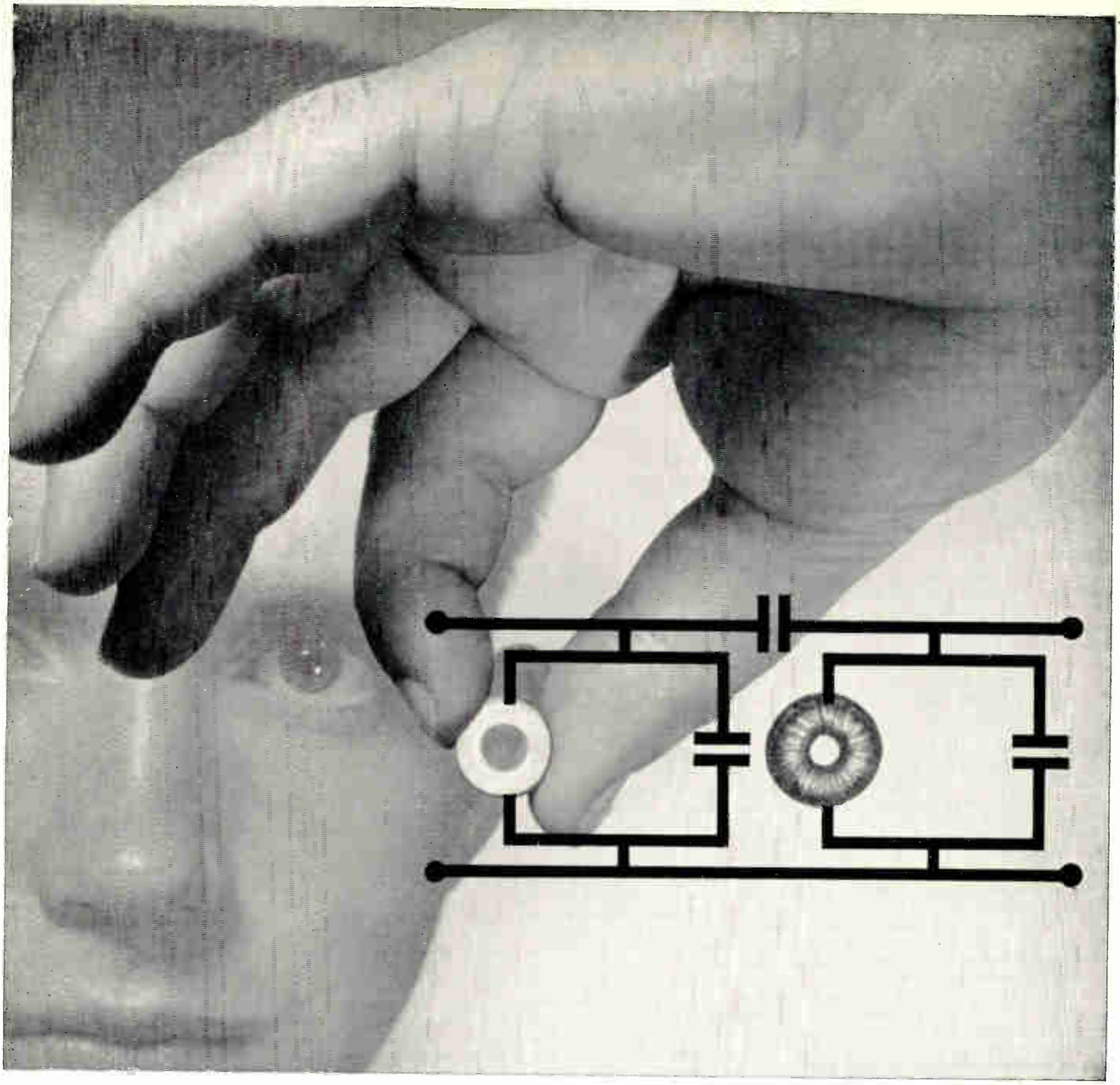
RUSSIAN SCIENTISTS apparently share many of the problems of their U. S. counterparts. One U. S. congressman, touring a Russian installation, asked the director how he and his colleagues got their funds. "American scientists," the director replied, "come over here and see what we have and then they go home and say 'They have so-and-so, give us money!." The congressman persisted, "Well, what do you do?" "The same thing," the Russian replied.

SPARE PARTS BONANZA was presented to Westchester County high school students by Westlab Electronics Inc., installers of sound systems. Instead of throwing away their many-years' accumulation of odd resistors, condensers, etc., they invited the high school youngsters in to take what they pleased, and offered a prize, too, for the finest piece of equipment constructed.

"GAME LAWS" have been drawn up by an association of 9 college groups to curb manpower recruiters. Specifically the rules prohibit: slipping bright students extra expense money for a trip to look over the home office, prying out another company's salary offer and raising it, and pressure tactics by old grads on behalf of their companies without the school's knowledge.

NEW VIDEO TAPE is subjected to truly amazing strains. The tape is pressed against the rotating heads with a calculated pressure of 20,000 lbs/sq. in. and the relative speed between the moving heads and moving tape is 1,500 ips. Minnesota Mining & Mfg. Co. manufactures the tape.

SCIENTISTS have finally come to a decision on the age of the earth's crust. The figure is 4.5 billion years. Meteorites that were analyzed are also considered to be the same age, indicating that the earth, other planets and meteorites were formed at the same time.



Now you can use molybdenum permalloy powder cores in miniaturized circuits

When your engineering neighbor talks about "Cheerios" these days, he's apt to be discussing a new breakfast cereal-sized molybdenum permalloy powder core which has found a happy niche as a miniaturized filter component. Guided missiles, which are filling the troposphere these days, typically use these little fellows in their amplifier circuits. Small (down to .300-in. ID), they are tough and easy to use. They also provide a markedly high degree of stability with time, temperature and magnetization.

Made by Magnetics, Inc. (Performance-Guaranteed, of course) they provide the highest permeability and lowest core losses possible in use in filter, audio and carrier frequency circuits. We provide extras, too—you may specify our very exclusive feature—color-coding. Color-coding tells your assemblers how many turns to put on your cores without the lost time and extra expense of special testing.

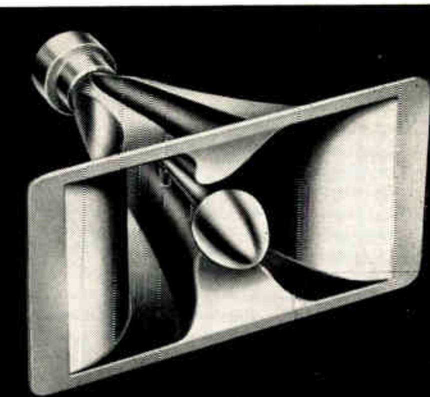
Want more facts? There's a brand new bulletin (PC-103A), full of important information. It's yours by writing *Magnetics, Inc., Dept. TT-35, Butler, Pennsylvania.*

MAGNETICS inc.

NEWEST *University* achievements in High Frequency reproduction!

NEW HYPERSONIC T-50 DRIVER*

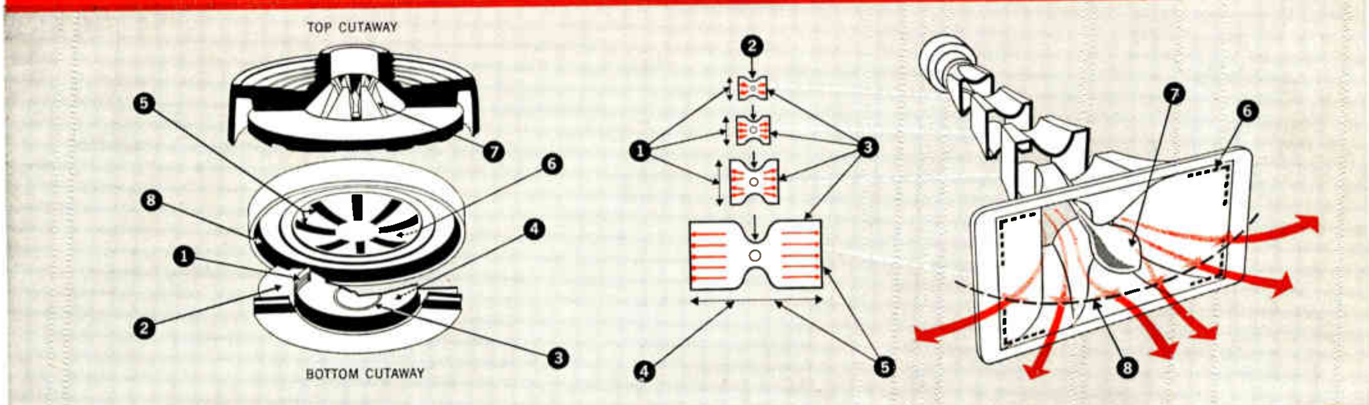
Smooth, distortion-free sound reproduction from 600 cps to inaudibility!



NEW RECIPROCATING-FLARE† H-600 HORN

Uniform, wide-angle dispersion of sound over the entire operating range!

T-50 Hypersonic H-600 — THE ONLY TWEETER IN THE WORLD WITH NO HIGH FREQUENCY PHASE CANCELLATION



Exclusive features of the T-50

1 2 Special type aluminum voice coil for high fidelity and long life

3 4 The only known "front concave" hypersonic diaphragm with absolutely uniform path lengths

5 6 The only hypersonic acoustic head with "radial slots" to achieve absolutely no high frequency cancellation

7 The only one piece integral hypersonic mixing chamber available today for super precision close tolerances

8 Rim-centering for long life

SPECIFICATIONS: Response: 600 cps to inaudibility; Recommended crossover: 700 cps; Power capacity: 50 watts, integrated program; Diameter: 4¼"; Depth: 4⅛"; Throat: 1⅜"-18; **$49.50 net**

* *Patent pending*

Exclusive features of the H-600

1 2 Initial expansion vertical

3 4 Horn contours** in horizontal direction

5 6 Ultimate expansion in horizontal direction

7 Front plane equalizer**

8 Uniform front wave pattern

** *Exclusive with University*

SPECIFICATIONS: Air column: 7¾"; Horn Cut-off: 600 cps; Recommended crossover: 700 cps; Dispersion: 125° horiz. x 55° vert.; Bell mouth: 8¾" x 4¾" over-all; Depth (less driver): 7¾"; Throat: 1⅜"-18 thread; **$18.00 net**

† *U.S. patent #2,690,231*

More University tweeters, mid-range horns and drivers . . . for maximum versatility of application and flexibility of operation

HF-206 Hypersonic Tweeter. Response to inaudibility. Crossover 5000 cps. Wide angle "reciprocating flare" die-cast aluminum horn. 8 ohms $33.00 net.

UXT-5 Super Tweeter. Crossover 5000 cps up. Wide-angle response to 17,500 cps. 8 ohms. $21.00 net.

4401 Tweeter. Crossover 2500 cps up. Wide-angle response to 15,000 cps. 8 ohms. $18.00 net.

T-30 High Frequency Driver. As tweeter with H-600 in 2-way system; as mid-range with H-600 or Cobreflex in 3 or 4-way. Response: 200-15,000 cps. 8 ohms. $30.00 net.

Cobreflex Horn. Crossover 350 cps up. Exclusive twin-flared 27" exponential air column. Dispersion: 120° x 60°. Heavy precision aluminum die casting. $23.00 net.

LISTEN *University sounds better*®

UNIVERSITY LOUDSPEAKERS, INC., 80 SOUTH KENSICO AVE., WHITE PLAINS, N. Y.

Circle 16 on Inquiry Card, page 101

Letters

to the Editor

"Sputnik—and its implications!"

Ed. Note: Among the top-ranking scientists that EI contacted last month for their views on the significance of "Sputnik" was Dr. Guy Suits, Director of Research of the General Electric Co. Unfortunately Dr. Suits' reply arrived just too late to appear in our November issue. Dr. Suits says:

In spite of the large shadow of gloom that the tiny Russian satellite has cast upon many people in the free world, there may be a proverbial silver lining in this shiny sphere. Sputnik has raised fears and alarms, and has given the free world the unfamiliar experience of being second in an area of technology that is basic to national defense. But the experience has not yet had fatal consequences, and if the existence of the satellite serves to lessen our smugness about our scientific superiority, and if it helps re-emphasize the need for truly fundamental research, then the sputnik can be a blessing in disguise for American science and the nation's security.

Reliable figures from the National Science Foundation show that the United States is spending about five billion dollars per year on "Research and Development." This is a huge sum, and it would be easy to jump to the conclusion that in comparison to our total defense expenditures it must provide an adequate allocation for research. These figures can be misleading, however, because we find it so convenient to lump together "research" *and* "development." There is no clue in the "five billion dollars for R & D" as to what portion is for research, and particularly what portion is for the basic research that provides the real foundation for our technological progress.

Some of the trouble lies in definitions. The simplest distinction between research and development is that the former seeks *new* scientific knowledge and the latter uses *existing* scientific knowledge. Although there is no common definition of research—or, as I would prefer, *learning work*—there is a strong and growing feeling in civilian and government scientific circles that we are dangerously deficient in this area. The Hoover Commission report of 1955 emphasized this. Numerous documents issued by high-level advisory committees of the Department of Defense have raised similar warning flags.

It will be argued that the Russian satellite is the result of a tremendous *development* effort and does not nec-

(*Continued on page* 28)

having your ups and downs?

... if they involve POTENTIOMETERS

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. These recent additions to the Dalohm line already have met with wide acceptance and enthusiasm:

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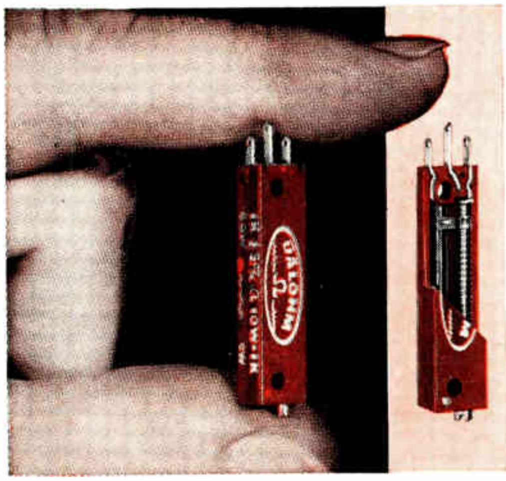


Mil-E-Trized A10-W TRIMMER POTENTIOMETER
Wire Wound, High Temperature, Humidity-Proof, Ruggedized

This Dalohm Trimmer is designed to meet the ever-increasing requirements of such specifications as MIL-E-5272A and MIL-R-12934. It provides precision adjustments in critical electronic circuits under extreme environmental conditions. It has an extended winding surface and assures high precision resolution without sacrificing sub-miniature design. Size is .220 x .310 x 1.250; weight is 2.25 grams.

- Resistance values 10 ohms to 100,000 ohms; standard tolerance 5%; power rating 0.8 watt; temperature coefficient of wire 0.00002/Deg. C. Other resistances, tolerances, leads available on special order.
- Completely sealed; housing of thermo-setting, glass filled material with heat resistance of 200° C continuous. Precious metal plating on all terminals; air evacuated and filled with silicone grease.
- Unique new type sliding contact; unique safety clutch.
- Unit holds set resistance values.
- Mounting flexibility provided for either stacked or multiple arrangements.

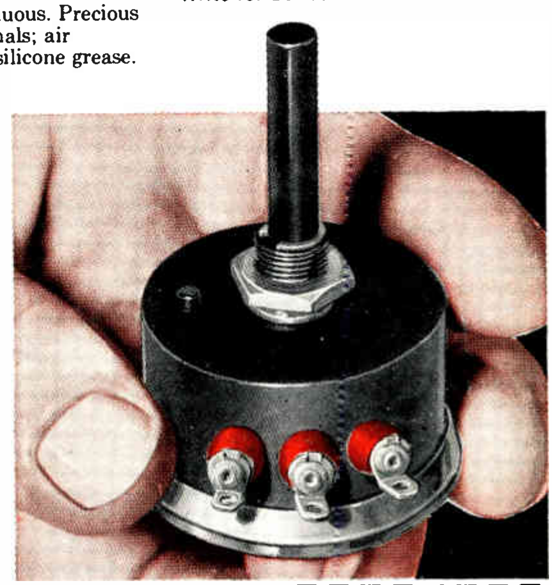
Write for Bulletin R-32B

Mil-E-Trized DP-12 POTENTIOMETER
Built to Surpass JAN-R-19
Hermetically Sealed, Moisture-Proof, Ruggedized

Completely protected from arctic cold or tropic damp, from shock, vibration, salt-laden air and ultra-high altitude. Powered at 4 watts, the DP-12 has a power rating of 100% at 40° C, derated to 0 at 125° C. Housing and shaft of black anodized aluminum with back plate of corrosive resistant aluminum. Unit designed for back panel mounting with integral threaded base.

- Operating temperature range—55° C to 125° C. Minimum rotational life is 25,000 mechanical cycles.
- Standard resistance range 100 ohms to 40K ohms with standard tolerance of 5%. Other ranges and tolerances available on special order.
- Precision winding gives excellent linearity with 3% maximum deviation.
- Temperature coefficient of wire 0.00002/Deg. C on values of 500 ohms and up; 0.00050/Deg. C on values below 500 ohms.
- Sensitive shaft adjustment.

Write for Bulletin R-31



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Circle 18 on Inquiry Card, page 101

What's *new* for you in CANNON PLUGS

DPJ-33S

DPG-34P

- Vibration
- Moisture
- Pressure

PROTECTION

with new DPJ and DPG Connectors

New DPJ and DPG Connectors feature sealing by means of a rubber seal around the insert faces. Exceptionally good protection against vibration and undesirable pressure and moisture conditions is provided. The DPG currently is available in 5 different insert arrangements, the DPJ with 3 insert layouts. **Write for Bulletin DP-101 TODAY!**

new

"EX" SEALED CONNECTORS

- **No Potting Required**
- **Light weight**

New EX Connectors feature a monobloc silicone insert into which the contacts are inserted after wiring. When the endbell is tightened over the insert, the contacts are completely sealed . . . giving a sealed connector of minimum weight without potting.

EX plug assemblies are currently available in four shell configurations with socket contact inserts . . . EX05, EX06, EXG06 and EX08. They are basically identical with the exception of endbell variations in each case. EX plugs mate and seal with standard AN, AN-E, and GS type receptacles, and are available in practically all AN layouts using #12 or #16 contacts from sizes 8S to 28. **Write for Bulletin PR-EX TODAY!**

new

Available in square-flanged receptacle, Q02, and straight plug, Q06. Insert Diameters: $^{31}/_{64}$", $^{51}/_{64}$", and $1^{3}/_{64}$"

"Q" MINIATURE CONNECTORS

- **Self-Locking**
- **Sealed**
- **Vibration Resistant**

Designed for control and instrumentation circuits of all types where space, vibration, moisture, or pressure conditions are limiting factors. Resilient grommets seal behind inserts . . . rubber sealing ring seals around the insert faces. Locking engagement accomplished by a beryllium copper latch within a spring loaded sleeve. Three shell sizes, with 7, 13, 19, 37 silver-plated brass 10-amp. contacts for #18 AWG wire. Alternate positioning. Cymel 592 insulators. External parts are cadmium plated aluminum. Hermetically-sealed, round-flanged receptacle, QH25, also available. **Write for Q Miniature Bulletin TODAY!**

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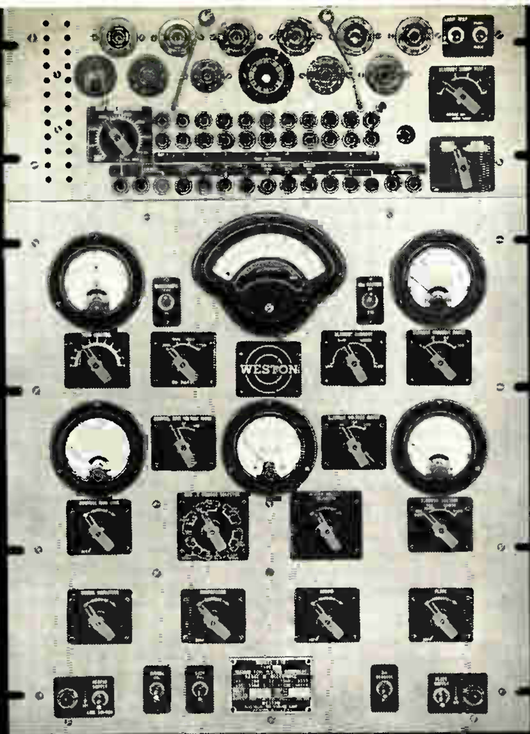


LABORATORY MODEL (686)

- A true mutual conductance analyzer that tests tubes under actual circuit operating potentials. Overall GM accuracy is 3% or better.
- Transconductance is measured directly without need for null adjustments or corrections, providing GM readings on all receiving type tubes.
- Circuit is mathematically calibrated and requires no calibrated tubes for GM circuit standardization.
- A real laboratory for electron tubes, Model 686 is entirely self-contained, with a filtered d-c power source, special circuitry to keep meter loading effects negligible, and a well regulated grid bias supply.

Tube Analyzers by WESTON

PORTABLE MODEL (981)

- Filtered d-c potentials provide better GM accuracy.
- Voltage divider network for better grid bias settings.
- Four signal levels provided protect against excessive grid current surges.
- Provision for tube interelectrode leakage measurements as high as 10 megohms.

Whether for production quality control . . . laboratory analysis of tube characteristics . . . or quick accurate servicing of electronic equipment, WESTON tubecheckers are acknowledged leaders for accuracy, time-saving facility, and long term dependability. These and other Weston test instruments are available through leading distributors. Bulletin available by writing WESTON INSTRUMENTS, Division of DAYSTROM, INC., 614 Frelinghuysen Avenue, Newark 12, New Jersey.

WESTON TEST EQUIPMENT

A DAYSTROM UNIT

Circle 20 on Inquiry Card, page 101

Letters

to the Editor

essarily incorporate any new fundamental knowledge that we do not possess. This is probably true for the most part, although we may be deceiving ourselves if we assume it is *entirely* true. The important thing about the sputnik is that it has focused the world's attention on the high level of Soviet technology. This and other accomplishments have made it clear that the Russians are performing a substantial amount of true research—they are *learning new scientific knowledge*, and their effort is significant both in size and competence.

Although there is some evidence to support a belief that Russian science threatens to assume world leadership, in fairness it should be said that thus far this leadership is only in selected areas of science, presumably where there has been a high priority based on military objectives.

One lesson for the Free World is clear. Those who support science—both government and industry—must constantly remind themselves of the importance of *learning* as well as *using*. Those who profit from the discovery of new scientific knowledge must recognize their responsibility for making voluntary contributions to the common pool of science.

The wide distribution of the benefits of research makes possible our technological progress. But, at the same time, this broad usefulness of research creates another problem—a problem best described simply as "buck-passing." Because the benefits of research are so widely available, there is sometimes a short-sighted tendency to "let George do it."

Performing research in industry is, of course, "good business" in the usual sense of the term. More than that, industrial research—if it is *real* research—can and must perform a major role in protecting our cherished freedom.

We must not "let George do it." George might turn out to be Ivan.

Dr. Guy Suits
Vice-Pres., Director of Research
General Electric Co.
Schenectady, N. Y.

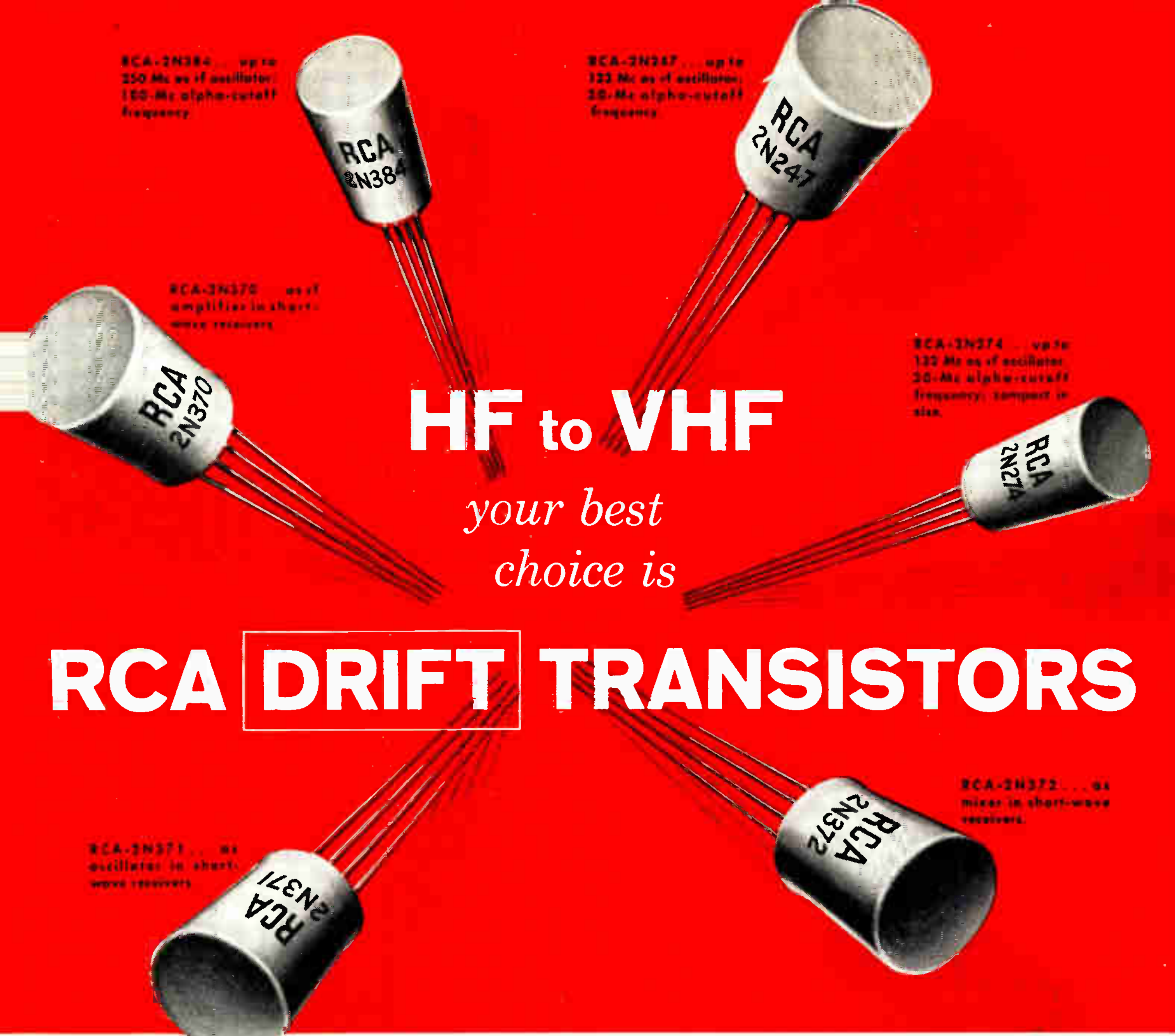
"Single-Sideband"

Editors, ELECTRONIC INDUSTRIES:

We note in your Letters to the Editor column of June, 1957 (Reference (a)), that the Kahn system is just one of many techniques capable of providing compatibility during the commercial airlines' transition from AM to Single-Sideband operation.

After discussing this letter with Mr. William T. Carnes, Jr., of AIRINC, it was suggested that we write a letter of clarification to your readers.

(Continued on page 32)



RCA offers a line of "DRIFT" TRANSISTORS specifically designed and controlled for operation in mass-produced electronic equipment at operating frequencies up into the VHF band.

New horizons in the design of mass-produced equipment operating well into the VHF band are now practical with the commercial availability of RCA p-n-p "Drift" transistors. These transistors offer many excellent features to equipment designers. Some of these features are: low base resistance, low feedback capacitance, high alpha-cutoff frequency, controlled input and output impedances, and controlled power gain characteristics to insure unit-to-unit interchangeability. Design benefits are: high input-circuit efficiency, excellent high-frequency operating stability, good signal-to-noise ratio, good automatic-gain-control capabilities, and wide range of input signal levels. Additional features include high power dissipation and rugged mechanical construction.

For superior-quality semiconductor devices, your best choice is always RCA. For sales information on these and other RCA TRANSISTORS, contact the RCA field Office nearest you. For technical data on specific RCA "Drift" transistor types, write RCA Commercial Engineering, Sect. L-50-NN, Somerville, N. J.

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA
Somerville, New Jersey

Circle 22 on Inquiry Card, page 101

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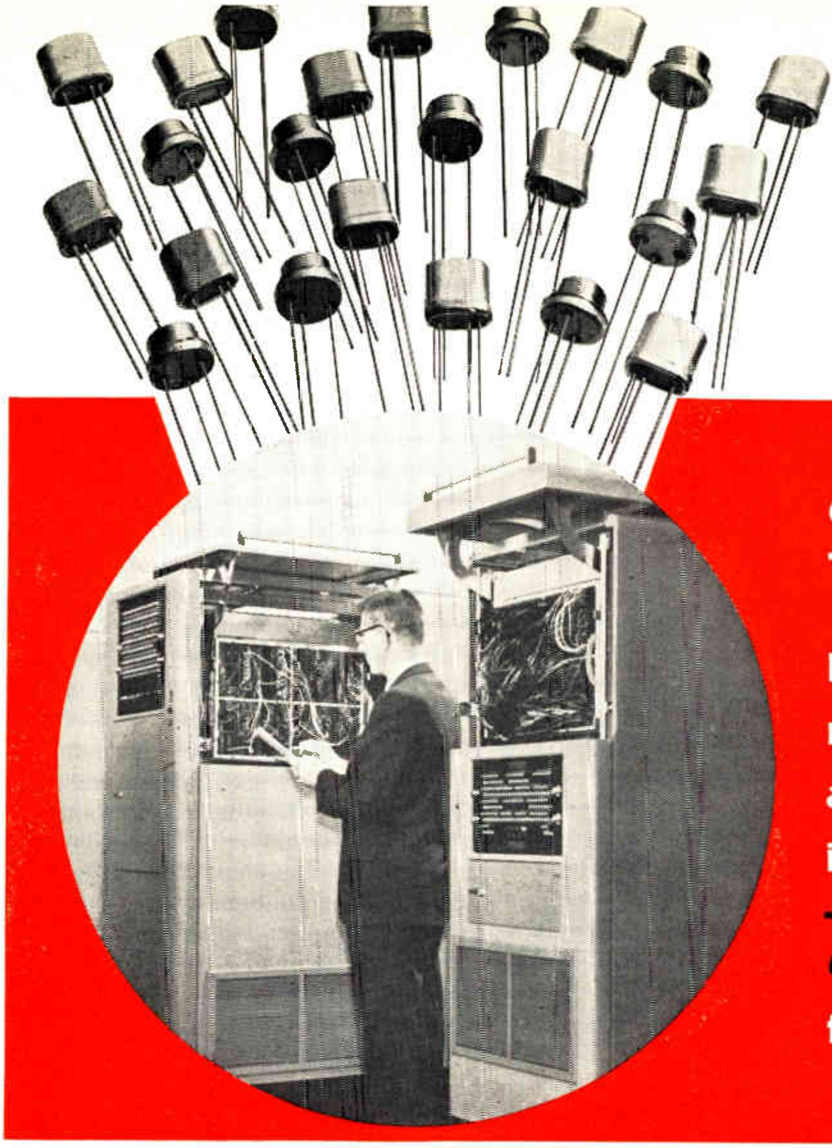


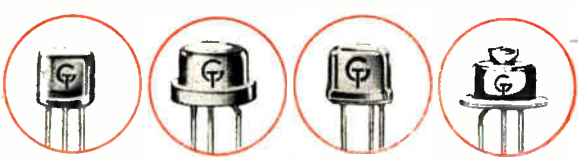
GENERAL TRANSISTOR

binds-in unerring reliability and high speed in Univac file-computers

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

The gigantic computing problems fed into the electronic brains of these data processing systems depend upon the undeviating consistency and reliability of each component used in the system. At General Transistor, computer reliability goes hand-in-hand with transistor quality. This philosophy dictates development and production procedures . . . experienced engineers, trained technicians, selective materials, exclusive methods of quality control . . . are typical of the caliber of quality inherent in GT transistors.

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



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Circle 24 on Inquiry Card, page 101

(Continued)

Actually, there is only one method per se other than the Kahn Compatible Single-Sideband system which could conceivably be described as offering compatibility. This is the conventional full carrier SSB system. As to its compatibility, the statement is only technically correct, since the system possesses shortcomings that would severely restrict its use in any practical communications application. Inherent distortion which is produced when a full carrier SSB signal is demodulated by a "compatible" AM detector is one of its severest limitations. The fact that this distortion amounts to over 23% cannot be easily dismissed. It is one thing, for example, to permit a certain amount of distortion as is normally experienced with speech clipping techniques. But in this case, the resulting improvement in signal-to-noise is more than sufficient to offset any distortion disadvantage It is quite another situation, however, when we are asked to justify a system possessing no advantages plus high inherent distortion. It should also be pointed out that the full carrier system is extremely sensitive to fold-over distortion, which must be added to the basic 23% figure with any slight amount of overmodulation. If we are to add the effects of speech clipping, overmodulation, and marginal conditions of a poor communications circuit to an already excessive amount of system distortion, the desirability of full carrier single-sideband becomes even less inviting.

What is even more significant is the associated 3.5 db loss in transmitted power caused by having to restrict modulation of the full carrier system to 67%. This means that a transmitter which can be rated at 1 kw on either AM or Kahn Compatible Single-Sideband can only be rated at 444 watts on full carrier SSB. Furthermore, if the percentage of modulation is increased, even higher distortion and greater power loss is experienced.

In view of the foregoing, we have taken the position that users of conventional AM equipment should not be placed in the position during the aforementioned transition period where they could unknowingly suffer a loss of intelligibility caused by inherent system distortion and associated loss of power due to restricted modulation.

Kenneth B. Boothe
Kahn Research Laboratories
22 Pine St.
Freeport, L. I., N. Y.

Ed: This is an abbreviated version of a much longer letter in which Mr. Boothe describes the technical superiority of the Kahn System. Complete copies of the letter can be obtained by writing on company letterhead to Editors: ELECTRONIC INDUSTRIES.

Electron Tube News
—from SYLVANIA

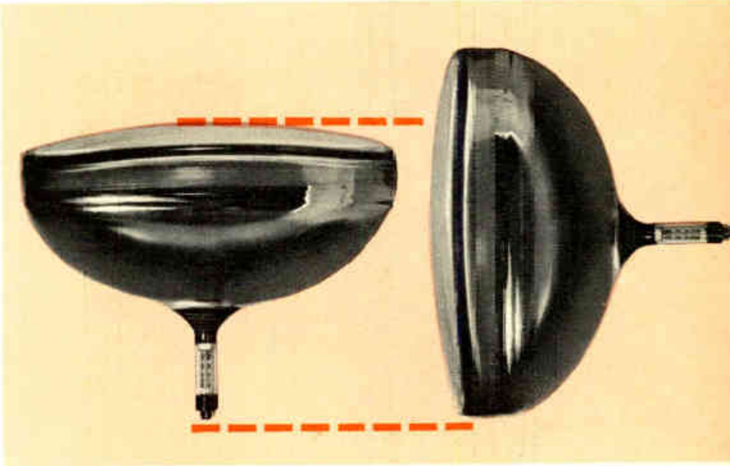
Creating New Design Trends—Everywhere in Electronics

IN 110° PICTURE TUBES . . .

Sylvania goes into production on the 24AMP4, a 24-inch 110° picture tube that fosters new concepts in set design

In 24-inch tubes—Sylvania applies the 110-degree deflection design to 24-inch picture tubes. The result is a tube 6″ wider than it is long. The new dimension permits interesting new concepts in TV chassis design as well as in cabinet styling. The new 24AMP4 presents a new opportunity for TV receiver manufacturers to score again with 110-degree TV sets.

The new 110° 24-inch tube weighs 26.5 pounds, some 6 pounds less than its 90° predecessors. It measures 15⅝ inches in length, 3½ inches shorter than 24″, short neck, 90° tubes. Useful width is 21¹⁄₁₆ inches. Picture area is approximately 332 square inches. It does not require an ion trap. The 24AMP4 employs a 6.3 V., 600 ma. heater and external conductive coating is rated at 2000 to 2500 uuf.



Sylvania's new 24-inch 110° picture tube, type 24AMP4, is 6 inches wider than long

In 21-inch tubes—Sylvania continues to lead the way in 110-degree, 21-inch picture tubes with the 21CQP4, the shortest 21-inch picture tube on the market. The tube measures 14⅞ inches in overall length and weighs 20 pounds. The new shorter length in this Sylvania original is made possible by the new non-ion trap gun with electrostatic focus that reduces tube length up to a full inch.

IN CATHODE-RAY TUBE DESIGN

Sylvania develops a 450 ma. 6.3 volt heater for "cooler" TV receivers using series string heaters

New heater uses straight tungsten wire

Sylvania, trend setter in electron-tube design, has developed a 450 ma., 6.3 volt heater for picture tubes. The new heater meets the needs of portable TV receiver designs and lowers component costs. It reduces heat with total set power savings of 18 watts and permits use of a lower wattage, less expensive series resistor.

Here are some of the outstanding features of the new heater development:

- Double helical coil is wound from straight rather than a coiled tungsten wire as in other 450 ma. heaters.
- Rigid mechanical structure virtually eliminates tendency of heater to sag away from cathode cap and cause slow heating and low emission.

Following are the Sylvania tube types that employ the new heater design:

In 90° tubes—14XP4, 14XP4A, 17BKP4, 17BKP4A, 17BSP4, 17CEP4, 21CDP4, 21CDP4A, 21CKP4.

In 110° tubes—17BYP4, 21CSP4.

IN SPECIAL CR TUBES . . .

Sylvania expands its line of cathode-ray tubes for commercial and military use

Sylvania announces an expanded line of cathode-ray tubes for both military and commercial applications. The additional types now or soon available include the 3JP7, 7AB series, 5AHP4A and 5AHP7A, 10WP7, 12SP7D, 5UP1 and 3RP1.

Sylvania is also now featuring its line of conventional and special picture tubes for studio monitors and closed circuit TV. The types range in size from 8 inches through 24 inches.

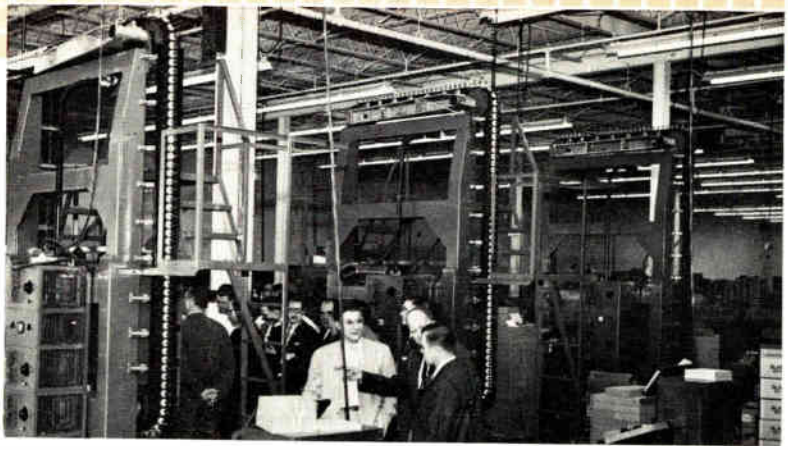
The entire Sylvania cathode-ray tube line incorporates electron guns with more precise parts made to 50 percent closer tolerances. This assures better performance and longer life whatever the application.

Sylvania's 7ABP7A—cathode-ray tube

Creating New Design Trends—

IN 100% TUBE TESTING . . .

Sylvania develops new automation equipment that makes possible full five-minute pre-heat testing of every receiving tube it makes



Sylvania customers view giant automatic tube tester

Sylvania now subjects each and every receiving tube it manufactures to an automatic five-minute pre-heat and tapping test. This gives added protection against shorts, noise, gas and other tube defects and reduces rejects on receiver-assembly lines.

At Sylvania's Williamsport plant, the giant machines shown, designed and built under the direction of Sylvania engineers, do the testing automatically. The tubes are loaded on a continuously rotating conveyor belt. Before the belt journey is completed, every tube is subjected to the pre-heat and tapping test. Then the tubes are automatically repacked for shipment.

This final extensive and intensive quality program at Williamsport combined with testing activities at each individual receiving-tube plant are reasons behind the high quality of Sylvania tubes.

IN TELEVISION . . .

Sylvania 6CK4—New Low-Mu Triode for Vertical Deflection Amplifier Service

Sylvania type 6CK4 is a low-mu triode designed for service as a vertical deflection amplifier in TV sets featuring wide-angle picture tubes and high cathode-ray tube accelerating potential.

Design factors including a T6 bulb provide a safety factor for conservative, reliable operation in such applications.

Ratings of type 6CK4 include 2,000 volts peak positive plate, a plate dissipation of 12 watts, and an average cathode current of 100 ma.

Average Characteristics:	
Plate Voltage	250 Volts
Grid No. 1 Voltage	−26 Volts
Plate Current	55 ma.
Transconductance	6500 UMHOS
Amplification Factor	6.7
Plate Resistance (Approx.)	1,000 OHMS
Grid Voltage for IB equals 0.5 ma.	−50 Volts
Plate Current at EC equals −38 VDC	10 ma.
Zero Bias Plate Current: EB equals 100V, EC equals 0 (instantaneous values)	125 ma.

New 110-degree damper types, 6DA4 and 12D4, have high peak current

Sylvania's new 110-degree damper types 6DA4 and 12D4 feature high peak current capabilities, low tube drop and adequate peak inverse plate voltage rating to make it a most desirable damper for 110° deflection. The 12D4 is a half wave rectifier for 600 ma series string usage. It is the 12-volt version of the 6DA4.

Maximum Ratings (Design Maximum System)	
Peak inverse plate voltage	4400 volts
Plate dissipation	5.5 watts
Steady state peak current	900 ma.
Average plate current	155 ma.
Tube voltage drop for IB-250 ma.	20 volts

Sylvania introduces the 6/8CY7 as a combined vertical deflection oscillator and amplifier in TV receivers

Sylvania adds the 6/8CY7 to its TV tube line as a supplement to the 10DE7. The new tube combines two dissimilar triodes in one T6½ envelope for use in 90-degree short neck picture tube circuits. The oscillator section features a high mu triode.

Maximum Ratings	Oscillator Section	Output Section
Plate dissipation	1.0 watts	5.54 watts
Peak-positive pulse plate voltage	—	1800 volts
Peak cathode current	—	120 ma.
Average cathode current	—	35 ma.

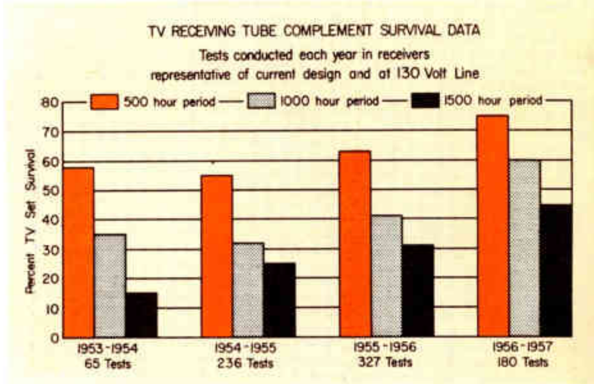
Everywhere in Electronics

IN TV LIFE TESTING RESULTS...

Percentage of Sylvania TV receiving tube complements surviving 1500 hours has tripled since 1954

Today Sylvania TV receiving tubes are setting new records in life tests. The percentage of TV tube complements surviving 1500 hours of operation at high line conditions has tripled since 1954 and is now at the highest rate in Sylvania history. This means assurance of a better field history as well as substantial savings in line operations for receiver manufacturers.

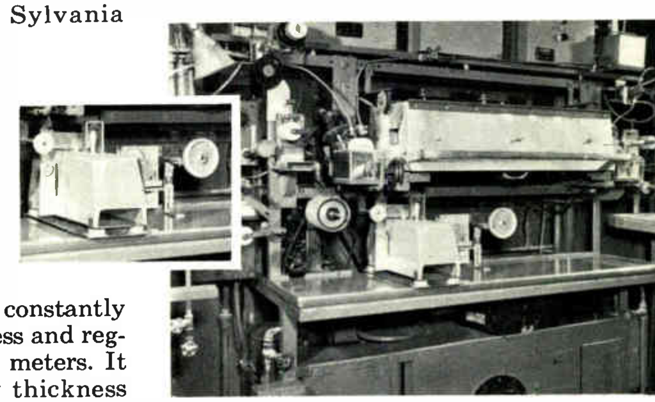
The overall survival rate for Sylvania TV receiver tubes has increased steadily through the years. In the past year alone there has been an average increase of 15 percent in TV tube complement survival. This represents the largest increase since 1953 and is a combined achievement of Sylvania's Dynamic Testing Program and better TV circuit design. Under the Dynamic Testing Program, individual Sylvania receiving tube types are evaluated in actual circuit environments in current TV set designs. Sylvania's Joint Engineering and Manufacturing Committee, JEMC, meets weekly to keep testing specs current. This kind of extraordinary care for receiving-tube quality is why Sylvania tubes last longer.



Increasing life of Sylvania tubes is a combined achievement of the Dynamic Testing Program and refinements in TV circuit design for better reliability

IN PROCESS CONTROL...

Sylvania uses an electronic micrometer to control filament coating thickness



Sylvania's electronic micrometer automatically controls filament coating thickness. It automatically stains improperly coated heater wire with colored dye

Precise control of heater wire coating is of paramount importance in producing top-quality electron tubes. Proper coating means longer tube life and higher emission.

Sylvania controls filament coating thickness to the most exacting tolerances with an electronic micrometer. The photoelectric device constantly monitors the coating process and registers thickness on electric meters. It immediately detects any thickness deviations and automatically stains the improperly coated heater wire with colored dye. The material can then be easily identified and rejected.

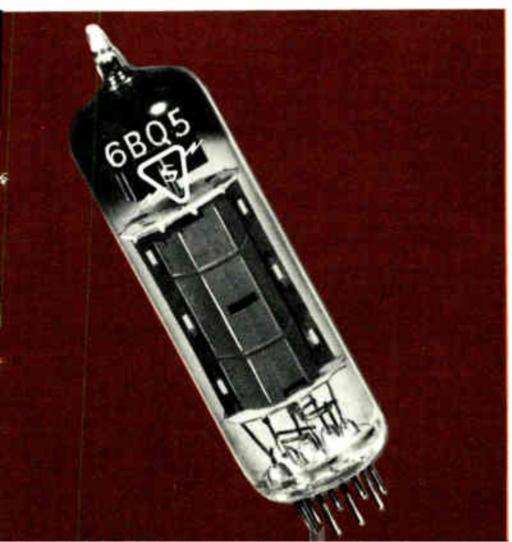
IN AUDIO TYPES...

New audio power pentode, type 6BQ5, has high sensitivity

Now Sylvania offers its version of one of the world's finest high-fidelity audio power amplifier tubes. Type 6BQ5 features high power output at extremely low distortion.

The high power sensitivity of type 6BQ5 makes it especially attractive.

The T6½ bulb used by this type is a desirable feature in compact high-fidelity equipment.



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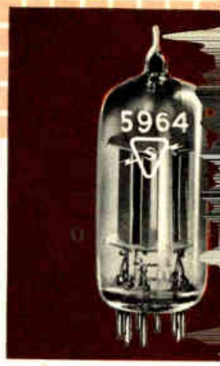


IN COMPUTER TUBES...

Sylvania expands the availability of types 5963 and 5964 to meet rising computer demands

Now Sylvania is ready to meet fully the heavy demands from electronic computer manufacturers for types 5963 and 5964.

Type 5963 is a T6½ duotriode featuring high zero bias plate current. The tube is used as a frequency divider as well as in computers.

It performs dependably in intermittent operation. The sharp cut-off twin triode has individual cathode connections for separate operation of each section. It has a center tapped heater for 6.2 or 12.6 volt operation.

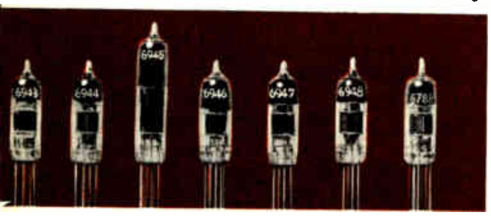
Type 5964 is a T5½ duotriode also featuring high zero bias plate current as in the 5963. The medium mu twin triode maintains its emission capabilities for long periods of operation under cut-off conditions.

	Computer Service Cutoff Conditions	Zero Bias Conditions
Type 5963		
Plate Supply Voltage	150 volts	150 volts
Grid Voltage	–15 volts	0 volts
Plate Circuit Resistance	20,000 ohms	20,000 ohms
Grid Circuit Resistance	47,000 ohms	47,000 ohms
Plate Current	0	5.1 ma.
Type 5964		
Plate Supply Voltage	150 volts	150 volts
Grid Voltage	–10 volts	0 volts
Plate Circuit Resistance	20,000 ohms	20,000 ohms
Grid Circuit Resistance	47,000 ohms	47,000 ohms
Plate Current	0	5 ma.

IN GUIDED MISSILE TYPES...

Sylvania builds its new guided missile line to meet the most severe requirements

Despite new extremes in heat, shock and vibration as today's missiles fly higher and faster, Sylvania's guided missile line is meeting top performance standards.



Behind this outstanding record stands one of the most comprehensive tube developmental programs in the industry. It incorporates radical new tube designs, new materials and techniques to offer the most reliable tubes obtainable today for missile service.

Sylvania now has the following guided missile types available:

Type No.	Description
6943	Sharp cutoff RF pentode
6944	Semi-remote cutoff RF pentode
6788	Pentode audio voltage amplifier
6945	Audio beam power pentode
6946	Medium mu single triode
6947	Double, medium mu triode
6948	Double, high mu triode

SYLVANIA

Please send additional information on the items checked below.

- ☐ Type 24AMP4
- ☐ Type 21CQP4
- ☐ 450 ma. 6.3 v Heater Picture Tubes
- ☐ Special Purpose C-R Tubes
- ☐ Type 6CK4
- ☐ Types 6DA4 and 12D4
- ☐ Type 6/8CY7
- ☐ Type 6BQ5
- ☐ Types 5963 and 5964
- ☐ Guided Missile Line

Name______________________________

Address______________________________

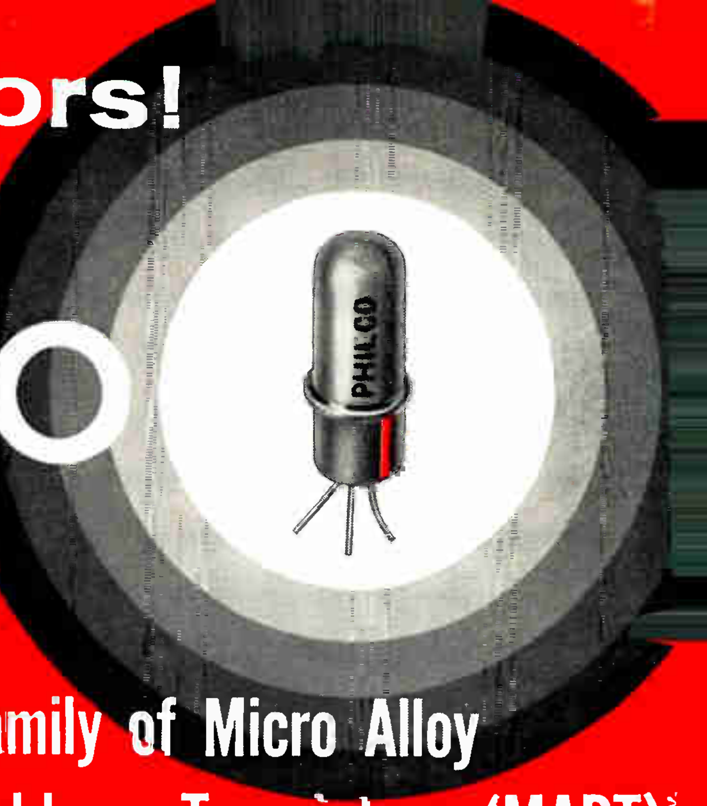
Company______________________________

Use this handy business reply card to request additional information on these important new Sylvania developments

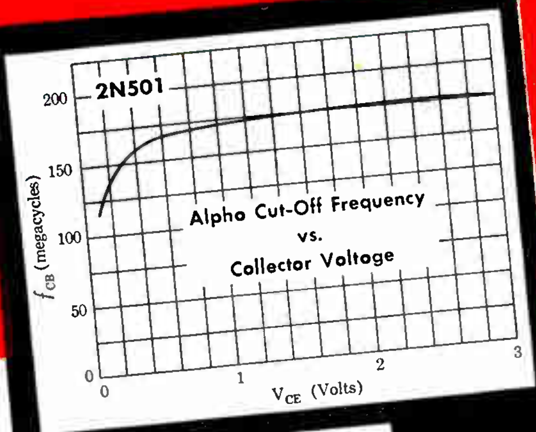
← Circle 46 on Inquiry Card, page 101

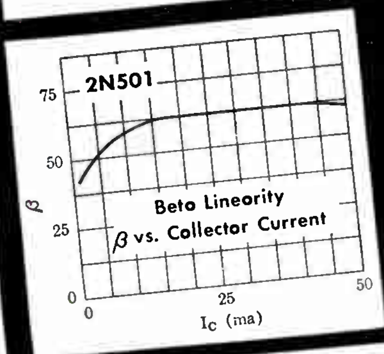
Circle 26 on Inquiry Card, page 101

VHF Transistors! First From PHILCO



New family of Micro Alloy Diffused-base Transistors (MADT)*





- Rise, Storage, Fall Time in Low mμsec Range
- High Oscillator efficiency at 200 mcs
- Amplifier gains of 10 db at 200 mcs

MADT FAMILY APPLICATIONS DATA

TYPE*	fmax	Power Gain	Oscillator Efficiency	Class of Use
2N499	250 mcs (min)	10 db at 100 mcs	[illegible]5% at 100 mcs (min)	oscillator and amplifier to 100 mcs
2N500			[illegible]5% at 200 mcs (min)	oscillator to 400 mcs
2N501	Ultra high-speed switch typical t_r = 12 mμsec; (18 max.); t_s = 7 mμsec; (12 max.); t_f = 4 mμsec; (10 max.). In circuit with current gain of 10 and voltage turnoff.			
2N502†	500 mcs	10 db at 200 mcs		amplifier to 250 mcs
2N503†		11 db at 100 mcs(min.)		amplifier to 100 mcs
2N504	50 mcs	46 db at 455 KC		high gain IF amplifier

*Available in voltage ratings up to 35V and dissipation ratings to 100 mw.
†In JETEC TO-5 Case (widely known as JETEC 30 Case).

Here is a major breakthrough in the frequency barrier . . . a new family of *field-flow* Micro Alloy Diffused-base Transistors. Philco MADT's extend the range of high gain, high frequency amplifiers; high speed computers; high gain, wideband amplifiers and other critical high frequency circuitry.

MADT's are available to various voltage and frequency specifications for design of high performance transistorized equipment through the entire VHF and part of the UHF spectrum. These transistors range in f_{max} from 250 mc to as high as 1000 mc. MADT gains are typically 10 db at 200 mc and greater than 16 db at 100 mc. A low cost general purpose unit is available which will deliver typically 18 db at 50 mc and 32 db at 10 mc.

Make Philco your prime source of information for high frequency transistor applications.

Write to Lansdale Tube Company, Division of Philco Corporation, Lansdale, Pa., Dept. CE-1257

*Trademark Philco Corporation for Micro Alloy Diffused-base Transistor

PHILCO® CORPORATION

LANSDALE TUBE COMPANY DIVISION

LANSDALE, PENNSYLVANIA

TRANSISTOR CENTER U.S.A.

FOR ELECTRONICS...
a new order of
chemical purity...

IF YOU MAKE THESE

YOU NEED THESE

B&A "Electronic Grade" Chemicals

- Acetone
- Acid Hydrofluoric, 48%
- Alcohol Methyl, Absolute (Methanol) Acetone Free
- Alcohol Propyl, Iso
- Aluminum Nitrate, Crystal and Basic
- Barium Acetate
- Barium Nitrate
- Calcium Nitrate, Tetrahydrate
- Carbon Tetrachloride
- Ether, Anhydrous
- Hydrogen Peroxide, 3%
- Hydrogen Peroxide, 30%
- Hydrogen Peroxide, 30% "Stabilized"
- Sodium Carbonate, Monohydrate
- Strontium Nitrate
- Trichloroethylene

B&A BAKER & ADAMSON QUALITY

"ELECTRONIC GRADE" CHEMICALS offer carefully controlled assay . . . remarkably low limits on impurities

B&A "Electronic Grade" chemicals are a special group of extremely high purity chemicals developed to meet the exacting requirements of the electronics industry. All the products listed above are "Electronic Grade." They are distinguished by closely controlled assay, and exceptionally low limits on metallic and other undesirable impurities.

Other high purity chemicals you may need are available from Baker & Adamson in Reagent A.C.S. grades, or can be custom-made to your requirements. As the country's leading producer of laboratory and scientific chemicals, we are well equipped to offer expert assistance with your problems . . . and products that meet your most stringent requirements.

Write today for free informative folder. Gives specifications for B&A "Electronic Grade" chemicals, other valuable information.

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ALLIED CHEMICAL & DYE CORPORATION
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← Circle 27 on Inquiry Card, page 101

Circle 28 on Inquiry Card, page 101


MILLIONS of crystals made to ANY
specifications but only ONE standard quality
Midland frequency control units are on the job in two-way communications on land, sea and in the air throughout the world. Now they're playing a leading role in color television. The range of applications Midland serves is wide, but every Midland crystal has one thing in common: a single level of quality.
That one quality is simply the highest that modern methods and machines can produce. It's assured by Midland's system of critical quality control—exacting inspection and test procedures through every step of processing.
Result: Your Midland crystal is going to give you the best possible service in frequency control—with stability, accuracy, and uniformity you can stake your life on . . . as our men in the armed forces and law enforcement do every day.
Whatever your Crystal need, conventional or highly specialized When it has to be exactly right, contact
Midland
MANUFACTURING COMPANY, INC.
3155 Fiberglas Road, Kansas City, Kansas
WORLD'S LARGEST PRODUCER OF QUARTZ CRYSTALS

Sperry's combination radar test sets integrate **all** testing functions

Faster, simpler radar maintenance is the pay-off with the Sperry Combination Test Sets. One set does the job of three or more standard test units but requires one-quarter the space and weighs half as much! Here are the five functions each Sperry test set performs:

POWER METER: Directly measures average power of radar transmitter with accuracy of ± 1.0 db.

FREQUENCY METER: Indicates directly the frequency of both receiver and transmitter.

SPECTRUM ANALYZER: Accurately displays power vs. frequency spectrum of transmitter signals from single or multi-pulse systems. Display is stable at all pulse widths and repetition rates.

SYNCHROSCOPE: Simple general-purpose synchroscope functions as an "A" scope and displays radar video signals or similar wave forms—no need for auxiliary synchroscope.

SIGNAL GENERATOR: Accurately and directly calibrated output signal level is variable over complete range. Choice of pulse, frequency or external modulation.

With no additional equipment you can also measure transmitter peak power, repetition rate, transmitter pulse width, T.R. recovery time, duplexer losses, transmission line VSWR. Designed for tough operating conditions, these sets comply fully with military specification MIL-T-945A. Your nearest Sperry district office will gladly supply you with complete operating data.

Microline Model 570
16⅝" L x 15⅝" W x 15⅞" H

COMPLETE LINE OF TEST SETS

Band	Microline* Model	Military Type	Frequency
L	670		400-450mc
S	590B	UPM-44B	2700-3500mc
C	551A	SPM-5	5100-5900mc
X	570	UPM-32	8500-10500mc
K	557		23500-24500mc
V	580A	UPM-14	34000-35600mc

*T. M. REG. U. S. PAT. OFF.

MICROWAVE ELECTRONICS DIVISION

SPERRY GYROSCOPE COMPANY
Great Neck, New York

DIVISION OF SPERRY RAND CORPORATION

Brooklyn • Cleveland • New Orleans • Los Angeles San Francisco • Seattle. In Canada: Sperry Gyroscope Company of Canada, Ltd., Montreal, Quebec.

Circle 30 on Inquiry Card, page 101

Books

Differential Equations, Applied in Science and Engineering

By Harold Wayland. Published 1957 by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 353 pages, xiii pages. Price $7.50.

In sharply defined terms, this new work ties together the processes of solving physical problems by means of mathematics. Not only does it analyze the translation of physical concepts into the mathematical language and carry through the formula solution; it also gives thoughtful consideration to the physical reasonableness of the result.

The study of partial differential equations is taken as the underlying theme of the book, since many problems of applied science can be described in terms of these equations. At the same time, the author introduces important topics from the advanced calculus to round-out the presentation.

Vector concepts receive full attention, since they are useful in deriving certain partial differential equations. This approach in turn gives physical motivation for the study of vector analysis. The author also emphasizes the method of separation of variables because it maintains close contact with physical considerations and closely relates to the techniques for solving ordinary differential equations. This treatment permits the logical introduction of power series expansions, special functions, and expansion in series of orthogonal functions.

Practicing engineers and scientists will find this book a challenging study of mathematics applied to a wide variety of physical situations.

Television Engineering Handbook

Edited by Donald G. Fink. Published 1957 by McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36. 1496 pages. Price $18.00.

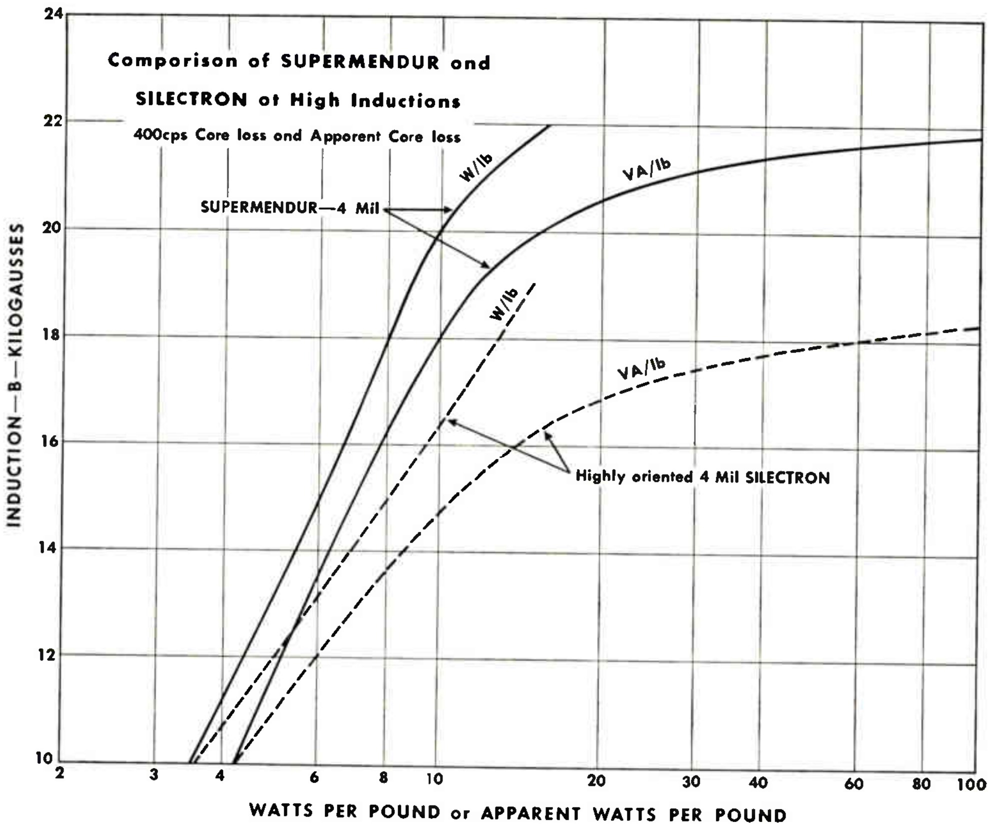
This handbook covers the entire subject of television technology, including the basic fundamentals as well as practical design data for transmitters, receivers, and networks. Thirty-three specialists have each contributed of their expert knowledge on some important aspect of the subject: standards, color, amplification, synchronization, transmitters, receivers, cables, etc. to name but a few of the section headings.

Atomic Radiation

Published 1957 by RCA Service Co., Inc., Camden 8, N. J. 120 pages, paper bound. Price $1.60.

This manual discusses the following topics pertinent to power and research applications of nuclear energy: nuclear physics, observed biological effects of radiation, shielding methods, monitoring instruments, medical evaluation of personnel, treatment of injuries, and permissible doses.

(*Continued on page* 48)



Announcing SUPERMENDUR

A New Rectangular-Loop Core Material

For Miniaturized Transformers and Magnetic Amplifiers

Supermendur, an oriented cobalt-iron-vanadium alloy, combines the high saturation flux density of the cobalt-iron alloys with the desired hysteresis loop rectangularity of the oriented 50% nickel-irons. This gives it unique characteristics in the range of inductions from 16 to 22 kilogausses which permit miniaturization and weight reduction for toroidal transformers and magnetic amplifiers.

Coercive forces substantially lower than those of previously available cobalt-iron alloys are obtained. In the graph above, the lower core losses and excitation obtained with Supermendur show a decided improvement in high density characteristics compared with oriented silicon steel.

Supermendur can be processed in tape form to thicknesses of 2 mils or less. Maximum utilization of its hysteresis loop rectangularity and high permeability at high induction requires a gapless or wound core type of construction particularly suited to thin tape.

Specific advantages of Supermendur cores in toroidal transformers are: high operating induction, low core loss, low exciting current and high permeability at high induction. In magnetic amplifiers or saturable reactors, they include: rectangular hysteresis loop, high saturation induction and moderate excitation at high induction. Advantages in all uses are: thin tape, small size and low weight.

Supermendur is manufactured under license arrangement with the Western Electric Company. • *Call on us for more information or engineering assistance.*

WSW 6921

Technical Information and Samples

Requests for sample toroidal cores of Supermendur in 4 and 2 mil thicknesses will be processed as rapidly as possible. Technical data will be released as it becomes available. When writing, state application, frequency, size, gage, characteristics desired and quantity required.

ADDRESS DEPT. T-712

THE ARNOLD ENGINEERING COMPANY

Main Office & Plant: Marengo, Illinois

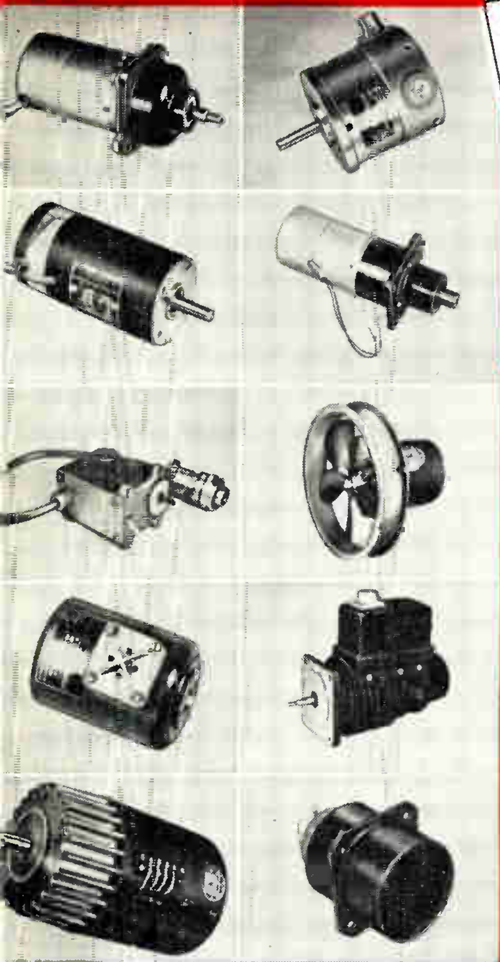
Repath Pacific Division Plant: 641 East 61st Street, Los Angeles, Calif.

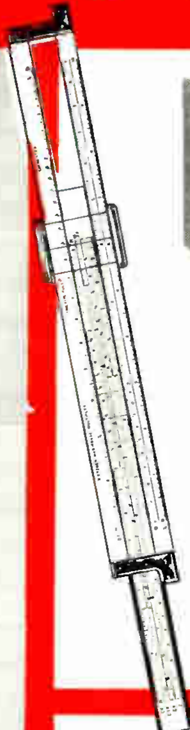
District Sales Offices:
Boston: 200 Berkeley St. Los Angeles: 3450 Wilshire Blvd.
New York: 350 Fifth Ave. Washington, D.C.: 1001-15th St., N.W.

Circle 34 on Inquiry Card, page 101

Here they are!

WESTERN GEAR answers to your electrical equipment problems...

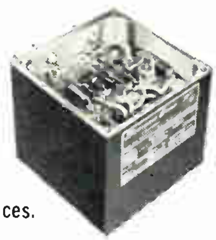




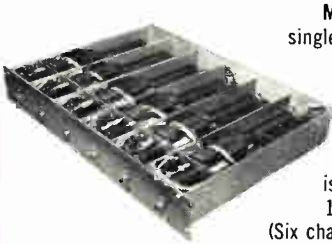
LABORATORY-TYPE POWER SUPPLY— New from Western Gear, Electro Products Division, is this lab-type, voltage-regulated power supply, available in either cabinet or rack type mounting. Input voltage is 105 to 125 volts at 50 to 60 cycles per second. Three output voltages are available . . . continuously variable 0 to 300V DC at 150 MA; continuously variable 0 to negative 150V DC at 5 MA; and 6.3V AC at 8 amperes. For full information, use the coupon below.

STROBOSCOPE UNIT— Now available, a reasonably-priced, compact, true-color stroboscope for viewing rotary, reciprocating or repetitive motion, as designed and manufactured by Western Gear's Electro Products Division. SPECIFICATIONS: Flash duration, 10 microseconds; light output, 5 Lumen seconds per flash; repetition rate, 0 to 100 pulses per second; dimensions, 6″ wide, 5″ high, 5¾″ deep. For complete information, mail the coupon below.

TRANSISTORIZED VOLTAGE REGULATOR— Rugged conditions are made to order for this precision unit, especially where performance, space and weight are of extreme importance. The circuitry employs a shunt power transistor and a temperature-compensated Zener diode reference voltage. Input voltage is 31V DC plus or minus 4V. Output of the 7VR12 is 5V DC at 100 to 200 MA. Regulation less than plus or minus .1 per cent for combined variations of input voltage, load current, temperature, drift and vibration. Dimensions 2 x 2 x 2. Weight 8.5 ounces. For more of the story, check and mail the coupon below.



Pictured above are only a few of Western Gear's complete miniature motor line, ranging from 1/500th to 4 HP. Choose from cycle ranges of 50 to 400 at any voltage required. Furthermore, if our basic designs do not meet your particular requirements, our engineers will be glad to work with you on your rotary electrical problems WITHOUT OBLIGATION!



MULTIPLE CHANNEL STRAIN GAGE POWER SUPPLY— Model 7P01 single or multiple channel strain gage power supply, 115 V, 60 cycle input, 10V DC output, adjustable from 9-11V DC with a 10-turn potentiometer. Output voltage changes less than plus or minus .05% due to temperature change from 0 to 45°C; output voltage changes less than .1% due to 2% change in load current. Output ripple is less than 300 microvolts RMS, isolated from ground as follows: insulation resistance to ground, 10,000 megohms; AC pickup voltage to ground, 5 microvolts peak. (Six channel unit shown.) For complete information, mail coupon below.

Glenn Malme • WESTERN GEAR CORPORATION • P.O. Box 182, Lynwood, California

Please send information checked:

- ☐ Electro Products Catalog No. 5721
- ☐ Data sheet on Voltage Regulator
- ☐ Data sheet on Strain Gage Power Supply
- ☐ Data sheet on Lab-type Power Supply
- ☐ Data sheet on Stroboscope Unit

Name____________________

Title____________________

Company____________________

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WESTERN GEAR Corporation

ENGINEERS AND MANUFACTURERS

Circle 35 on Inquiry Card, page 101

Airtron inc.

ferrite advances add new chapters to the microwave art

MICROWAVE AND ELECTRONIC ENGINEERS— OUTSTANDING OPPORTUNITY WITH AIRTRON, INC.

Since the close of World War II the big push has been toward the use of higher and higher frequencies to solve the many problems which threatened to limit modes and extent of radio communication as well as radar and other detection systems.

From LF to HF to VHF to UHF and beyond — from the 50 kilocycles radio band to the 10,000 megacycle weather radar is the distance we have traveled in the past fifteen years. Today our sights are set on the 30,000 to 90,000 megacycle bands.

Airtron, Inc. has been a leading contributor to the extension of the microwave state of the art. It has been Airtron who has written in the **new chapters** on ferrite components and material, double ridge waveguides, and high powered, miniature ferrite and non-ferrite microwave components, to the standard texts that are the only reference source for engineers and users of microwave equipment.

Industry's pressing need for non-reciprocal microwave components demanded applications for which there was no readily available theory, or reference source. With Airtron, Inc. it has been the application of **practical theory** that has **stamped solved** many of these new microwave **ferrite design problems.** The end results have been quality production items — some of which are in use today in every weather radar system — electronic devices operating with ferrite components — miniature ferrite isolators and duplexers — high powered ferrite components and special designs still under the wraps of security.

Today — there is only ONE organization which can offer you the complete range of microwave engineering and equipment . . . only one company which can point to the advances of the past decade in the microwave and ferrite art as being almost wholly its own . . . This is Airtron, Inc. creative leaders in the Microwave Art.

Airtron inc.

LINDEN, NEW JERSEY — AIRTRON CAMBRIDGE (FERRITE DIV.), CAMBRIDGE, MASSACHUSETTS

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Books

(*Continued from page 42*)

Books Received

TV Tube Location and Trouble Guide

Published 1956 by John F. Rider Publisher, Inc., 116 W. 14th St., New York 11. 46 pages, x pages, paper bound. Price $1.25.

Resonant Circuits

By Alexander Schure, Ph. D., Ed. D. Published 1957 by John F. Rider Publisher, Inc., 116 W. 14th St., New York 11. 66 pages, vi pages, paper bound. Price $1.25.

Introduction to Electrical Applied Physics

By N. F. Astbury. Published 1957 by Philosophical Library, Inc., 15 E. 40th St., New York 16. 241 pages, xi pages. Price $10.00.

Proceedings of the RETMA Symposium on Applied Reliability

Published 1957 by Engineering Publishers, G.P.O. Box 1151, New York 1. 105 pages plus 46 page supplement, paper bound. Price $5.00.

Proceedings of the 2nd RETMA Symposium on Applied Reliability

Published 1957 by Engineering Publishing, G.P.O. Box 1151, New York 1. 93 pages, paper bound. Price $5.00

Registry of Radio Systems in the Transportation Services

Published 1957 by Communication Engineering Book Co., Radio Hill, Monterey, Mass. 76 pages, paper bound. Price $4.00.

Scientific German

By George E. Comdoyannis. Published 1957 by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. 164 pages, x pages, paper bound. Price $2.50.

Scientific French

By William N. Locke. Published 1957 by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. 112 pages, x pages, paperbound. Price $2.25.

TV Picture Tube-Chassis Guide

Published 1957 by John F. Rider Publisher, Inc., 116 West 14th Street, New York 11. 72 pages, paper bound. Price $1.35.

The Industrial Chemistry, Properties, and Application of Silicones

By Charles E. Reed. Published 1957 by American Society for Testing Materials, 1916 Race Street, Philadelphia 3. 47 pages, paper bound. Price $1.50.

Understanding Hi-Fi Circuits

By Norman H. Crowhurst. Published 1957 by Gernsback Library, Inc., 154 West 14th Street, New York 11. 224 pages, paper bound. Price $2.90.

Survey of Electric Utility System Planning Practices

Published 1957 by Edison Electric Institute, 420 Lexington Ave., New York 17. 87 pages, iii pages, paper bound. Price $3.15.

Computing with Desk Calculators

By Walter W. Varner. Published 1957 by Rinehart & Co., Inc., 232 Madison Ave., New York 16. 108 pages, viii pages, paper bound.

DELCO'S FAMILY OF HIGH POWER TRANSISTORS

Typical Characteristics at 25°C

	DT100	**2N174A	2N174	2N173	2N443	2N278	2N442	2N277	2N441
Maximum Collector Current	13	13	13	13	13	13	13	13	13 amps
Maximum Collector Voltage (Emitter Open)	100	80	80	60	60	50	50	40	40 volts
Saturation Voltage (13 amp.)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7 volts
Max. Square Wave Power Output at 400 ~ P-P*	400	310	310	225	225	180	180	135	135 watts
Max. Sine Wave Power Output at 400 ~ P-P*	180	140	140	100	100	80	80	60	60 watts
Power Dissipation (Stud Temperature 25°C)	70	70	70	70	55	55	55	55	55 watts
Thermal Gradient from Junction to Mounting Base	1.0°	1.0°	1.0°	1.0°	1.2°	1.2°	1.2°	1.2°	1.2° °C/watt
Nominal Base Current I_B (V_{EC}=—2 volts, I_C=—1.2 amp.)	-19	-19	-19	-13	-24	-13	-24	-13	-27 ma

*Adequate Heat Sink

**Designed to meet MIL-T-19500/13 (USAF) 18 JUNE 1957

Offer a wide range of performance characteristics to meet your switching, regulation or power supply requirements

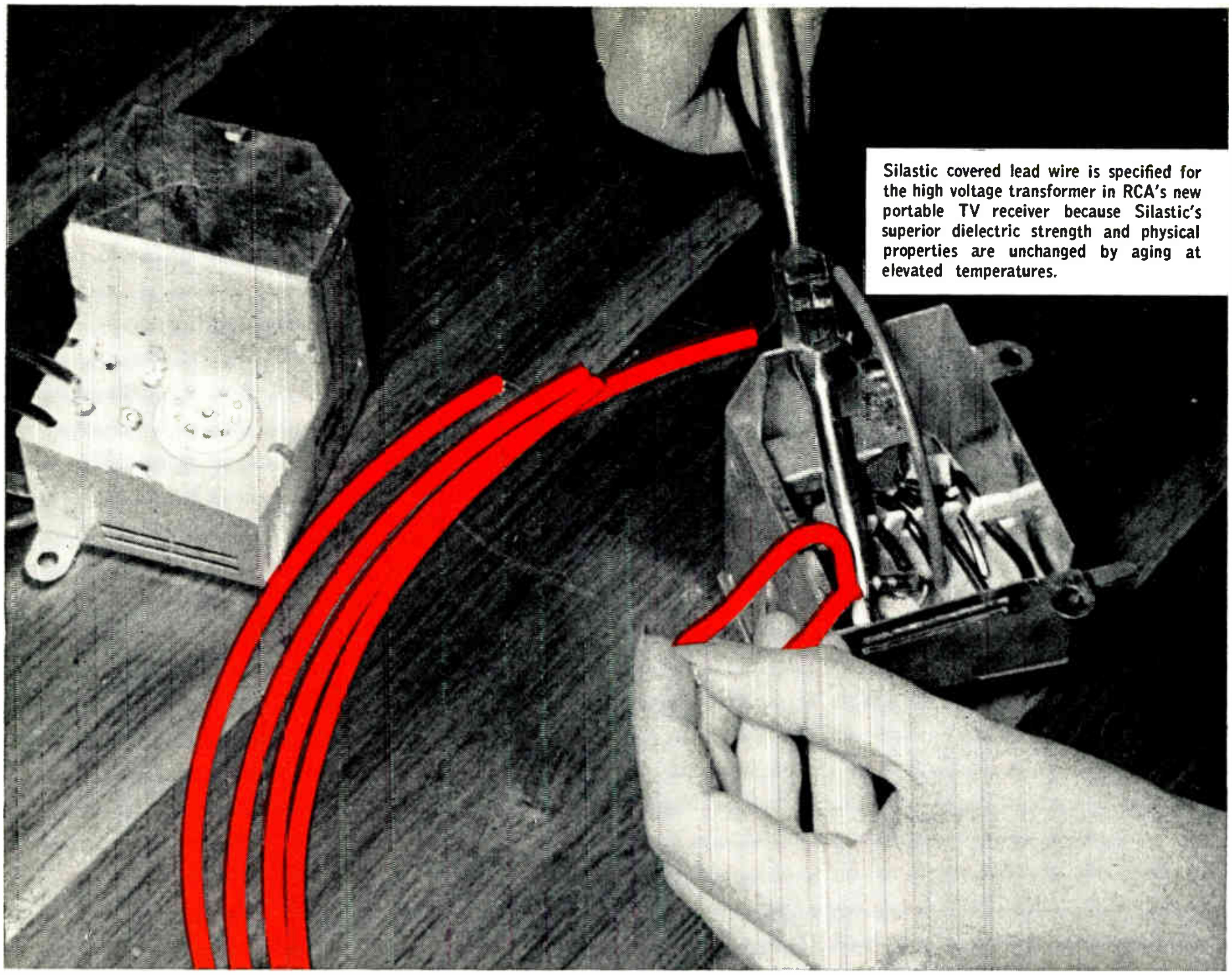
These nine Delco Radio alloy junction germanium PNP power transistors are now in volume production. They are characterized by high output power, high gain, and low distortion. And all are normalized to retain superior performance characteristics regardless of age.

Check the data chart above—see how they fit your particular requirements in current switching, regulation or power supply. Write for detailed information and engineering data. Delco Radio maintains offices in Newark, N. J. and Santa Monica, Calif. for your convenience.

DELCO RADIO

Division of General Motors
Kokomo, Indiana

Circle 38 on Inquiry Card, page 101



SILASTIC SILICONE RUBBER covered wire withstands high temperatures

Even after repeated exposure to temperatures as low as —130 F or as high as 500 F Silastic*, Dow Corning's silicone rubber, retains its flexibility, dielectric strength and resistance to ozone, weathering, moisture, certain hot oils and corrosive atmospheres. That's why Silastic, employed as a covering for all types of electric wire and cable, assures the ultimate in reliable service. Ask any leading rubber fabricator.

Typical Properties of Silastic for Wire and Cables

• Temperature range, °F	—130 to 500
• Tensile strength, psi	600 to 900
• Elongation, %	150 to 300
• Insulation Resistance, megohms/1000 ft.	1000 to 3000
• Dielectric strength, volts/mil	300 to 500
• Dielectric Constant, 10^2 cycles per second, nominal	3.2

If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC.

Get latest data on Silastic
Mail coupon today

Dow Corning Corporation, Dept. 1624
Midland, Michigan
Please send me latest data on Silastic

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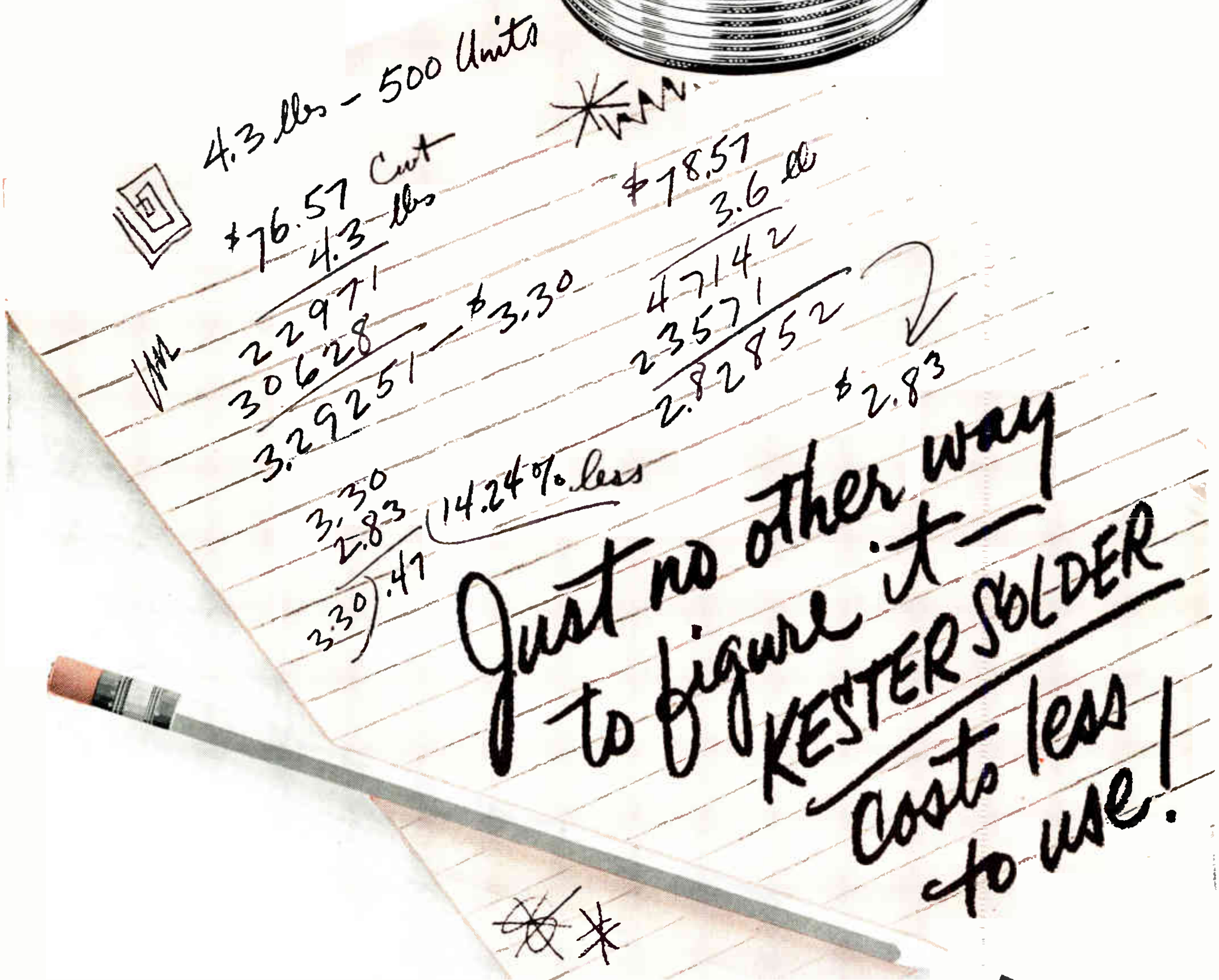
DOW CORNING CORPORATION • MIDLAND, MICHIGAN

Get More Information . . .

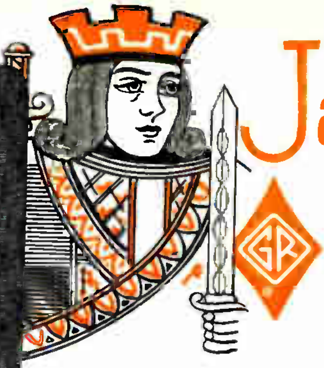
Write for your copy of the 78-page Kester book, "Solder . . . Its Fundamentals and Usage." Free!



KESTER SOLDER

Company 4210 Wrightwood Avenue • Chicago 39, Illinois
Newark 5, New Jersey • Brantford, Canada

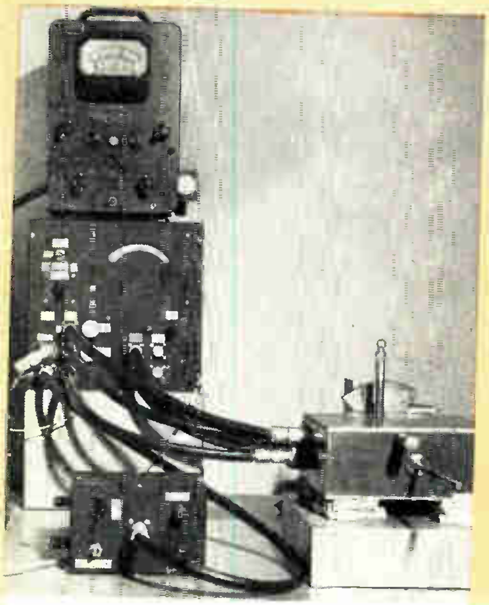
Circle 40 on Inquiry Card, page 101

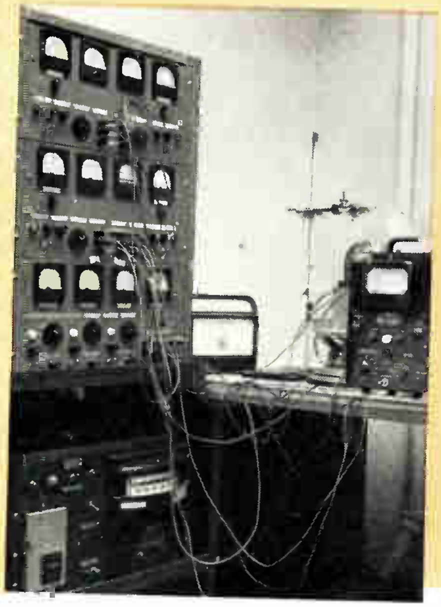


Jack-of-All-Trades

Type 1230-A D-C Amplifier and Electrometer

If your requirements call for the measurement of minute currents and voltages, or high resistances, you'll like the new General Radio D-C Amplifier and Electrometer. Its ability to measure currents down to 10^{-14} amps., voltages as small as 1 mv, and resistances up to 10^{13} ohms directly and with good stability makes it a laboratory *jack-of-all-trades*. The Electrometer can be easily converted from a high-impedance voltmeter to a low-impedance ammeter. This simplifies measuring circuits greatly, and is a definite advantage when low-voltage, well-shielded connections are required. At Minneapolis-Honeywell's Research Center in Hopkins, Minnesota, scientists have found the Electrometer indispensable for a wide variety of uses. These include:





Low-Voltage Measurements

In investigating effects produced by optical irradiation of semiconductor materials, the Electrometer is used to measure open-circuit photo voltage, short-circuit photo current, and the voltage-current characteristic at the metal-to-semiconductor contact.

Low-Current Measurements

Electrometer measures low-magnitude ion currents in a miniature mass spectrometer. Here, an omegatron-type mass spectrometer is used for the analysis of gases at low pressures.

High-Resistance Measurements

Electrometer's high-resistance ranges permit accurate measurements of insulation resistance between electrical leads entering vacuum systems or cryostats and the measurement of resistivity of pressed powders (10^{12} ohms or more).

Specifications

Voltage Ranges: ±30 mv, 100 mv, 300 mv, 1 v, 3 v, and 10 v; dc, full scale. Accuracy is ±4% of full scale on 30 mv range, ±2% on all other ranges.

Current Ranges: ±300 milli-micromicroamperes d-c (3×10^{-13} amp) full scale to ± 1 milliampere full scale in twenty ranges (two per decade). Full-scale accuracy is ±3% to ±10% depending on multiplier position.

Drift: Less than 2 mv per hour after one-hour warmup.

Resistance Ranges: 300 kilohms to 30 megamegohms ($3 \times 10^{13}\Omega$) in 16 ranges. Accuracy is ± 3% to ±10% depending on multiplier and on meter deflection. With external 600 v battery in place of the internal 9 v source, resistance range can be extended to read $1.2 \times 10^{17}\,\Omega$ at smallest meter division.

Write For Complete Information

Input Resistance: Determined by setting of resistance standards (ohms multiplier) switch: 10^4, 10^5, 10^6, 10^7, 10^8, 10^9, 10^{10} and $10^{11}\,\Omega$; also "zero" and "infinity" positions. At "infinity" position, it is approximately 10^{14} ohms.

Output: Voltage, current, and resistance are indicated on a panel meter. Terminals provided for use with graphic recorders having resistances up to 1500 Ω.

Temperature, Humidity, Line Voltage Effects: Negligible.

Price: $440

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Circle 41 on Inquiry Card, page 101

ELECTRONIC INDUSTRIES

& TELE-TECH

ROBERT E. McKENNA, Publisher • BERNARD F. OSBAHR, Editor

Divide and Conquer

The recent Third Aero-Com Symposium in Utica, N. Y., brought out two developments of special interest:

In a luncheon address, James D. McLean, President and General Manager of Hoffman Laboratories, Los Angeles, described a new approach for solving military electronic problems. In essence this consists of reviewing the problem to determine what specialized engineering talents would be required for its solution. The second step is to determine what electronic organizations have project engineering staffs or groups capable of coping with each specialty. By combining these groups from various manufacturers, a powerful composite development team results. There is no limit to the number of companies that may be involved, but under the plan one company assumes the overall development responsibility.

We believe this idea has a great deal of merit and we hope it will be given an opportunity to prove its effectiveness. It offers a way by which smaller and medium sized organizations can take a more dominant engineering role. It also appears to be a method for the more effective utilization of available engineering manpower . . .

Jr. Scientists

In previous editorials we have mentioned the importance of interesting American youth in science and in electronic activities. The Rome-Utica IRE group is to be congratulated for their highly effective Jr. Scientists program that was initiated at this year's symposium.

The committee from this IRE group selected some thirteen outstanding electronic exhibits prepared by students in local schools. The students ranged from 12 to 17 years of age. Token prize contributions collected from some 18 manufacturers came to about $100. Approximately 1,000 engineers from all parts of the United States attended the symposium and viewed the exhibits.

At the banquet the impact and effectiveness of these displays and this activity became known. H. L. Hoffman & Co., Inc. announced an annual scholarship of $500 for the Jr. Scientists. The Electronics Division of Westinghouse Electric Corp. is providing $400; Rome Air Development Center and Rome Air Force depot will provide $300; and Flying Magazine is donating $150.

This is certainly a great step forward. The Rome-Utica IRE will now have a definite influence in their local school system and the students have a definite and substantial incentive. How about a similar program in your locality?

Automated Directory

Questionnaires asking electronic manufacturers about the products they make will be in the mail in early December. The data provided us on these questionnaires will form the base for our 1958 Electronic Industries Directory (16th Edition). Each year this Directory is published in the June issue.

Something new about the questionnaires for this year. The format and the amount of information requested has been expanded considerably. This is to enable us to code all data received from each company onto IBM cards. By "automating" the Directory in this way we shall acquire an extremely flexible listing that can be sorted and/or computed for both directory and statistical purposes.

We ask all electronic manufacturers to be on the look-out for their EI Directory questionnaires and we respectfully urge the earliest possible return of the completed forms.

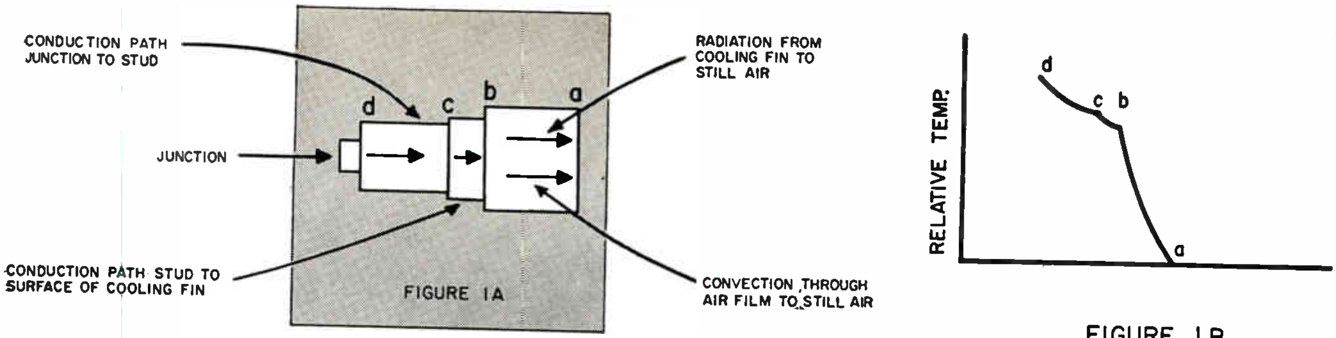

Fig. 1A: Thermal circuit of a power transistor; 1B: Relative temperature gradients from point to point through the circuit in Fig. 1A.

Heat Transfer in Power Transistors

Specific conditions and variable parameters must be determined before the whole mechanism of heat transfer can be evaluated. A main power transistor limitation, maximum junction operating temperature, precludes exaggeration of evaluation importance.

By **IOURY G. MALOFF**
Advanced Development,
RCA Victor TV Division
Camden 8, New Jersey

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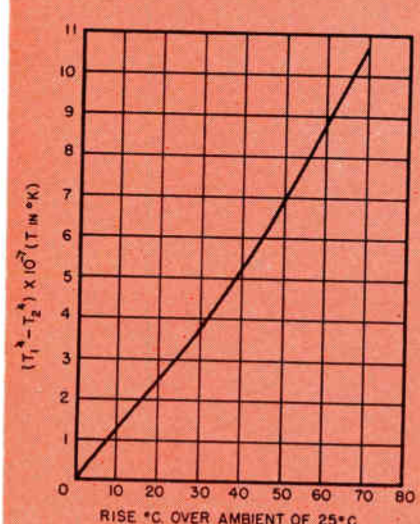


Fig. 2: Transfer by radiation over normally encountered range of temp. rise.

THE particular conditions of heat transfer in power transistors are rather involved and specialized and are such that applications of generalized laws of heat transfer may lead to erroneous deductions.

Statement of the Problem

The thermal time constant of power transistors is of the order of 0.1 sec. This removes the instantaneous power and heat as a possible limitation of the energy delivered.

With the time element removed, the problem is simplified to steady state and average power. The thermal circuit may be represented as in Fig. 1a.

The temperature gradients may be represented as in Fig. 1b.

The thermal problems in operating a power transistor in the range 25 to 85°C and in thermal equilibrium are twofold. *First,* to determine junction temperature (point "d") under operating conditions of power dissipation (from measurable values at points "a," "b," and "c" of Fig. 1b and some indirectly measured physical characteristics). *Second,* with the aid

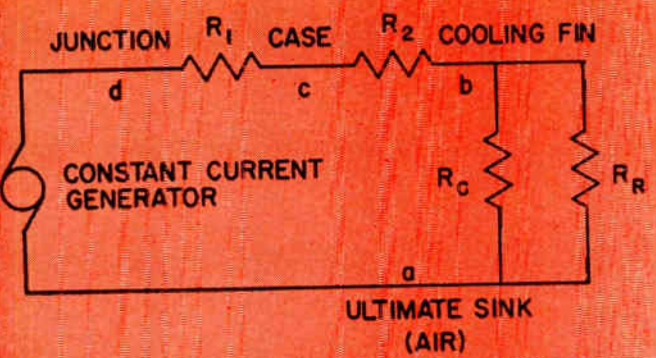


Fig. 3: The equivalent circuit for heat transfer considerations.

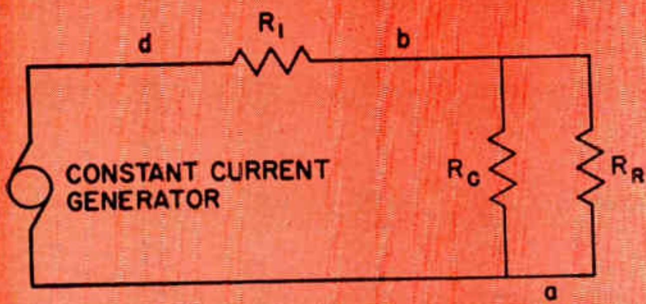
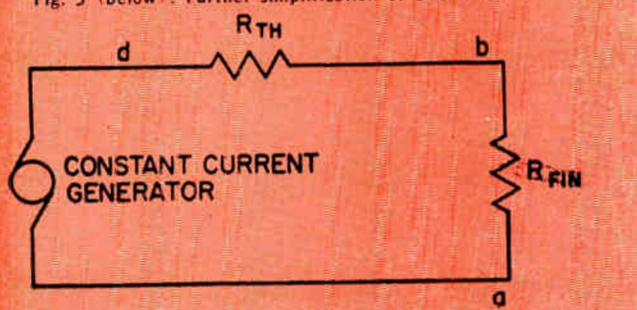


Fig. 4 (above): Simplification of heat transfer equivalent circuit.

Fig. 5 (below): Further simplification of circuit shown in Fig. 4.



of these measurable physical characteristics of a given transistor, to determine the maximum power that it can dissipate in a given environment. In other words, to give a unit a rating for a particular mode of operation.

The operating junction temperature should not exceed 85°C. The basis for this statement is the available results of a life test on power transistors in which a large number of germanium p-n-p units have been operating at 85°C for over 4000 hrs without one failure. Some manufacturers specify 90°C (and some venture 100°C) as the maximum junction temperature. While there is a reason to believe that 85° is rather conservative and 90°C as a maximum junction temperature is probably safe, there are no trustworthy life test data available for the latter value.

Applicable Laws of Heat Transfer

In a transistorized deflection circuit operating at a temperature higher than that of the ambient of the still air, all 3 principle modes of heat transfer take place as is shown in Figs. 1a and 1b. Heat is generated at the transistor junctions and is transferred by conduction to the surface of the case, then again by conduction it is transferred to surface of the chassis or some other cooling fin or fins.[1] Finally, it is transferred to the free still air (the ultimate heat sink) by a combination of convection through so-called "air convection film" and radiation.

The 3 applicable laws of heat transfer are those of conduction, convection, and radiation. Evaporation and condensation involving mass transfer, combined with heat transfer and generally classified under convection, do not enter into the problem.

The basic law of heat flow by ***conduction*** in the steady state is analogous to Ohms Law:

$$q = \frac{\Delta T}{\dfrac{L}{kA}} \qquad (1)$$

when q is the rate of heat transfer,
k is thermal conductivity of the material,
A is cross-sectional area of the heat conductor,
L is length of heat path,
ΔT is temperature difference causing the heat to flow,
where q is analogous to electrical current, ΔT to potential difference,
and $\frac{L}{kA}$ to electrical resistance.

The basic law of heat convection is

$$q = \frac{\Delta T}{\dfrac{1}{h_c A}} \qquad (2)$$

where q is the rate of heat transfer
h_c is a coefficient of heat transfer by convection,
A is the surface area exposed to convection,
ΔT is the temperature difference between the surface exposed and the free still air (ambient).

Here $\frac{1}{h_c A}$ corresponds to resistance in the analogous electrical circuit. In convection, a mass of cool and presumably still air surrounds a heated surface. At the surface there forms a relatively thin film of air varying in velocity from zero at the surface to a maximum and then again to zero (with absence of forced ventilation).

The basic equation for heat transfer by ***radiation*** between 2 non-black bodies is

$$q = F_e F_a A \sigma (T_1^4 - T_2^4) \qquad (3)$$

where q is the rate of heat transfer.
F_e is the emissivity factor allowing for departure from black body conditions,
F_a is a configuration factor based chiefly upon the geometry of the system,
A is the surface of the emitting area,
σ is a natural constant (constant of total black radiation),
T_1 is the absolute temperature in °Kelvin of the radiating body,
T_2 is the absolute temperature in °Kelvin of the receiving body.

In this equation $\frac{1}{F_e F_a A \sigma}$ corresponds to resistance in the analogous electrical circuit. The term in the parenthesis is analogous to voltage. For the range of the temperature rises encountered it is nearly a linear function of the rise in spite of the fourth power of temperatures involved since it is reckoned with respect to absolute zero. This is shown in Fig. 2.

(*Continued on page* 152)

New IRE Standard Semiconductor Symbols

BASIC SYMBOLS

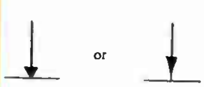
1. 1 Semiconductor region with one ohmic connection. (In the illustration, the horizontal line indicates the base region and the vertical line indicates the ohmic connection.

1. 2 Semiconductor region with a plurality of ohmic connections. (In the illustrations, the horizontal lines indicate base regions and the vertical line indicate ohmic connections).

1. 3 Transition between P and N regions (either P to N or N to P). (Slant lines indicating transitions shall be appreciably shorter than collector and emitter lines. Note that the transition is along the horizontal line and that no ohmic connection is made to the slant line. See 2. 9 and 2. 11 as examples)

1. 4 Intrinsic (I) region between regions of dissimilar conductivity type. (Slant lines indicating transitions shall be appreciably shorter than collector and emitter lines. Note that the transition is along the horizontal line and that no ohmic connection is made to the slant line. See 2. 14 and 2. 15 as examples).

1. 5 Intrinsic (I) region between regions of similar conductivity type. (Slant lines indicating transitions shall be appreciably shorter than collector and emitter lines. Note that the transition is along the horizontal line and that no ohmic connection is made to the slant line. See 2. 16 and 2. 17 as examples).



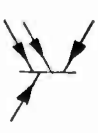
(a) or (b)

1.6

1.7

1. 6 P region on N region (rectifying junction).

1. 7 P emitter on N region. (The slant line with arrow head represents the emitter and the horizontal line represents the N region.

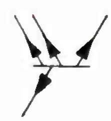


1. 8 Plurality of P emitters on N region. (When possible, the electrodes on the symbol drawing should have the same relative order as the electrodes on the device).

(a) or (b)

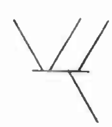
1. 9 N region on P region (rectifying junction).

1. 10 N emitter on P region. (The slant line with arrowhead represents the emitter and the horizontal line represents the P region).



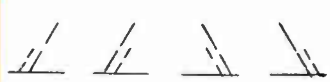
1. 11 Plurality of N emitters on P region. (When possible, the electrodes on the symbol drawing should have the same relative order as the electrodes on the device).

1. 12 Collector on semiconductor region of dissimilar-conductivity type. (The slant line represents the collector, and the horizontal line does not undergo a transition at the point where the slant line meets it).



1. 13 Plurality of collectors on semiconductor region. (When possible, the electrodes on the symbol drawing should have the same relative order as the electrodes on the device).

1. 14 Collector separated from a region of opposite-conductivity type by an intrinsic region. The intrinsic region is the region between the slant lines, and the collector connection is made to the long solid slant line.



1. 15 Collector separated from a region of the same conductivity type by an intrinsic region. The intrinsic region is the region between the slant lines.

1. 16 The line enclosing the device symbol is for recognition purposes and its use is recommended.

1. 17 Arrowheads on both N- and P-emitter symbols shall be of 45 degrees included angle. They shall be filled and approximately half their ength away from the semiconductor-region symbol. The emitter and collector symbols as well as the transition lines shall be drawn at approximately 60 degrees to the semiconductor-region symbol.

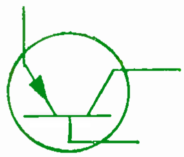
1. 18 The following device properties may be indicated with the aid of identifying letters placed within the enclosure or adjacent to the symbol:

B — Breakdown Device
T — Storage Device
T — Thermally Actuated Device
Λ — Light-actuated Device

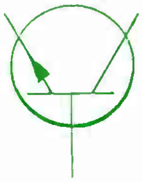
It is recognized that all semiconductor devices are light and temperature sensitive and exhibit breakdown and storage characteristics. The letters listed above are to be used only if these properties are essential to the operation of the circuit.

DEVICE SYMBOLS

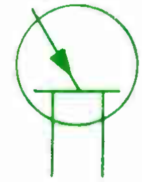
In this section, a listing is made of some semiconductor devices, together with their graphical symbols. It is recognized that in many cases it is possible to develop other device symbols using the standard symbol elements shown in Section 1. In general, the angle at which a connecting lead is brought to a graphical symbol has no particular significance. Orientation, including a mirror-image presentation, does not change the meaning of a symbol.



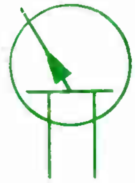
2. 1 P-N-P transistor (also P-N-I-P transistor, if omitting the intrinsic region will not result in ambiguity).



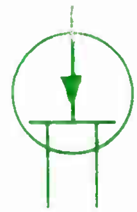
2. 2 N-P-N transistor (also N-P-I-N transsistor, if omitting the intrinsic region will not result in ambiguity).



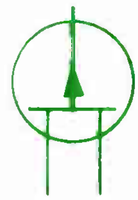
2. 3 P-type unijunction transistor (sometimes called double-base diode or filamentary transistor).



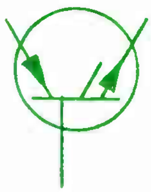
2. 4 N-type unijunction transistor (sometimes called double-base diode or filamentary transistor).



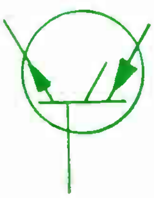
2. 5 P-type field-effects transistor.



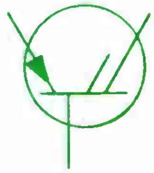
2. 6 N-type field-effects transistor.



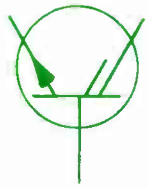
2. 7 P-N-P-N transistor (hook or conjugate-emitter connection).



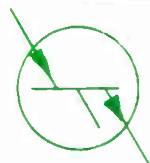
2. 8 N-P-N-P transistor (hook or conjugate-emitter connection).



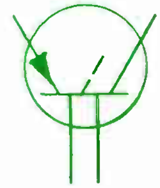
2. 9 P-N-P-N transistor (remote base connection).



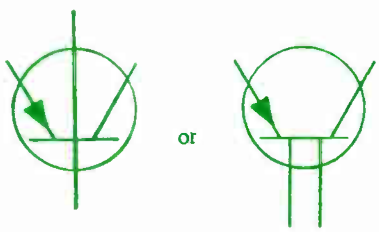
2. 10 N-P-N-P transistor (remote base connection).



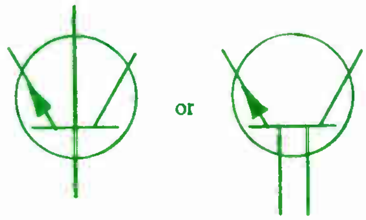
2. 11 P-N-P-N transistor without base connection.



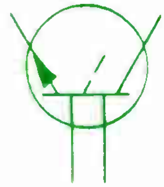
2.14 P-N-I-P transistor with ohmic connection to the intrinsic region.



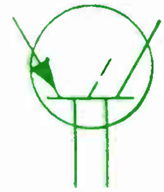
2. 12 P-N-P tetrode.



2. 13 N-P-N tetrode.

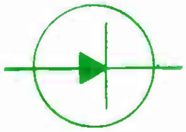


2. 15 N-P-I-N transistor with ohmic connection to the intrinsic region.

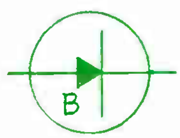


2. 16 P-N-I-N transistor with ohmic connection to the intrinsic region.

2. 17 N-P-I-P transistor with ohmic connection to the intrinsic region.

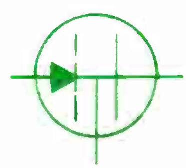


2. 18 P-N diode. (The arrowhead shall be of 60 degrees included angle; the point of the arrow head shall touch the adjacent element symbol).

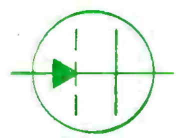


2. 19 Breakdown P-N diode. (The arrowhead shall be of 60 degrees included angle; the point of the arrowhead shall touch the adjacent element symbol).

2. 20 Bipolar voltage limiter. (The arrowhead shall be of 60 degrees included angle; the point of the arrowhead shall touch the adjacent element symbol).



2. 21 P-I-N triode*.



2. 22 P-I-N diode*.

* *It will be noted that these symbols do not conform exactly to the rules of Section 1. They are, in effect, the transition between the diode and the multielement-device symbols. Arrowheads shall be of 60 degrees included angle; the point of the arrowhead shall touch the adjacent element symbol.*

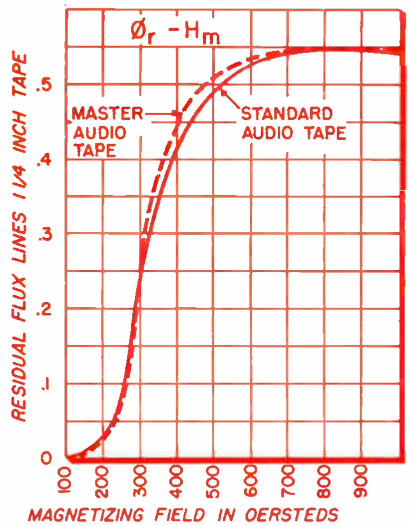


Fig. 1: Comparison of B-H characteristics, Master vs. Standard tape.

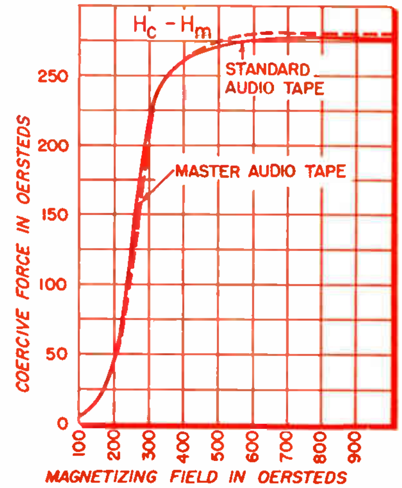


Fig. 2: Comparison of coercive force, Master vs. Standard tape.

Reducing Magnetic Tape Print-Through

Print-through, the layer-to-layer signal transfer of spooled magnetic tape, has placed a practical upper limit to tape sensitivity. Now, however, improved production and quality control techniques make possible much lower print-through, with no sacrifice of other characteristics.

By FRANK RADOCY
Director, Quality Control
Audio Devices, Inc.
New York, N. Y.

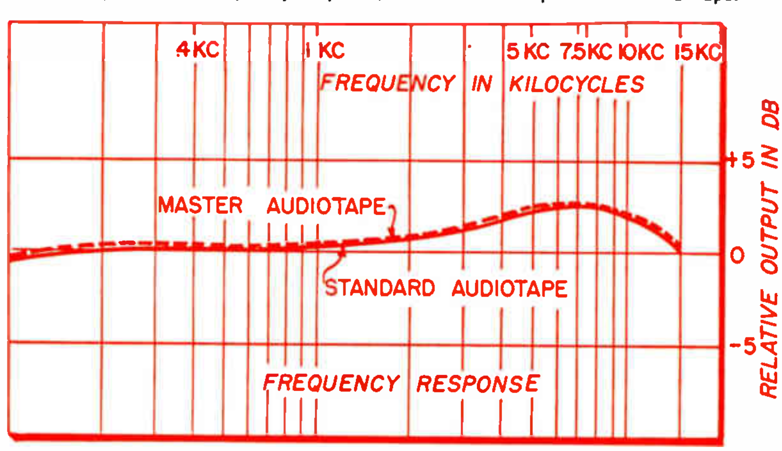
A GREAT deal of effort was expended, during the formative years of the magnetic tape manufacturing industry, to improve the signal-to-noise ratio of sound recording tape by increasing its sensitivity. Largely this was accomplished by orientation and tighter packing of the magnetic particles in the plastic binder. Several years ago when the trend to higher and higher output tapes was at a peak, we demonstrated to the industry that a lesser known characteristic, "print-thru" or layer-to-layer signal transfer, was nullifying the advantages of high output tapes.[1] It made little sense to manufacture tapes with greater signal-to-noise ratios, when recording studios were lowering recording levels in order to reduce print-thru to a level at which it would be hidden by machine noise.

Obviously, the solution for producing a magnetic tape with a usable increase in signal-to-noise ratio hinged on the ability to reduce print-thru, rather than on an increase of sensitivity.

Print-Thru

Print-thru occurs during storage when a magnetized (recorded) layer of magnetic tape is adjacent to another layer or layers of magnetic tape, as when wound on a reel.[2] The flux emanating from the

Fig. 3: Comparison of frequency response, Master audio tape vs. Standard tape.



recorded layer creates an image on the adjacent layer, producing an "echo" effect. When all the adjacent layers are recorded and print-thru occurs the effect may sound more like spurious noise or "fussiness"; it has often been wrongfully blamed on modulation noise. The extent of print-thru is linked to many factors including time, temperature, recording level and external fields.

Research which took more than three years to complete was undertaken to investigate all phases of the manufacture of magnetic recording tape with regard to their effect on print-thru. The objective was the development of a low-print magnetic recording tape with at least 8 db of reduction in print-thru without sacrificing any of the other desirable characteristics of standard tape. The new tape had to be completely interchangeable with standard material to be commercially acceptable.

Precise Control

The results of the study proved exceedingly fruitful. We found that the key to low-print characteristics was not a "miracle ingredient" that could merely be added to the mix to produce the desired results, but rather a costly control system involving every step in the manufacturing process up to and including the final coating of the product. Any relaxation of controls invariably resulted in erratic print-thru characteristics. The final two years of the program were spent on hundreds of laboratory quality tests in order to perfect techniques and controls necessary to turn out a low-print tape uniformly as well as economically. Uniformity as well as quality were finally achieved, and we were able to accelerate marketing the world's first regular production of low-print tape in April (1957).

The task of duplicating the characteristics of standard tape, other than print-thru, was perhaps the most difficult part of the development program. Those familiar with the art will appreciate the unique aspects of this problem. All the available theory and test data concerning the factors that control print-thru indicated failure. How, it was argued, was it possible to reduce the effect of the flux emanating from one magnetized tape layer to an adjacent tape layer, and not change the magnetic and performance characteristics, without shielding one or both layers? The following data derived from our lab tests will, however, make it evident that this has been accomplished.

Standard Characteristics

Fig. 1 is a set of curves comparing the B-H characteristics of "Master" low-print Audiotape with standard average tape, taken from a 60-cycle B-H curve tracer. The characteristics of the two tapes are almost identical. The slight variation is well within the accuracy of this type of test device. Fig. 2 confirms the amazing similarity of magnetic properties in the curves of the two tapes when coercive force (Hc) is plotted against magnetizing field (Hm). Again a 60-cycle B-H curve tracer was employed to develop the data.

Fig. 3 illustrates the identity of the frequency response characteristics of "Master" low-print and standard tapes when tested on a standard reference

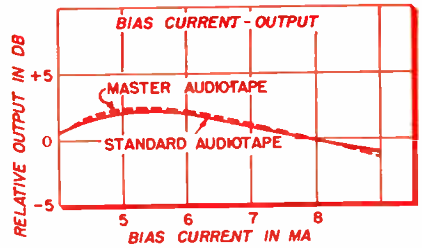


Fig. 4a: Comparison of bias characteristics, Master vs. Standard tape.

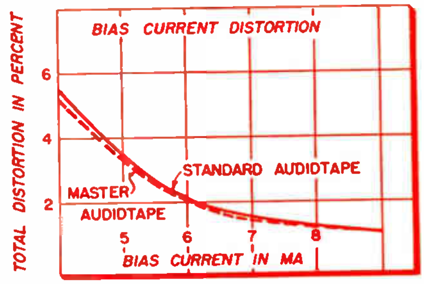


Fig. 4b: Comparison of distortion of Master and Standard tapes.

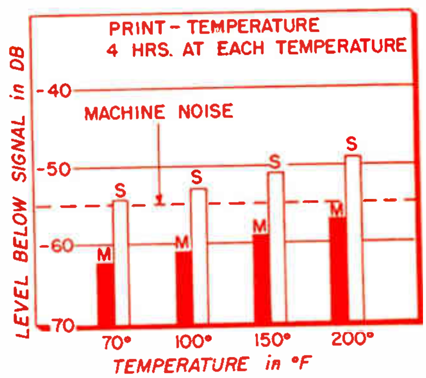


Fig. 5: Master tape shows significant improvement of print-through.

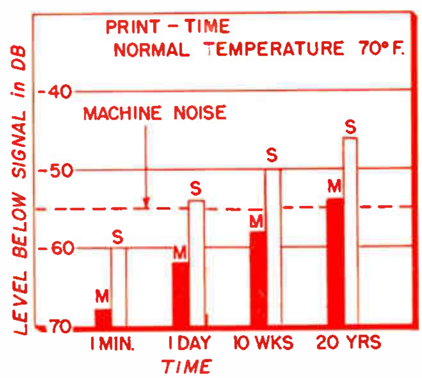


Fig. 6: Significance of lower print-through at critical machine noise levels.

TABLE 1

Property	*"Master" Tape*	*Standard Tape*
Base thickness	.0015"	.0015"
Coating thickness	.00055"	.00055"
Signal-to-noise ratio	63 db	63 db
Saturated signal-to-noise ratio	68 db	68 db
Signal-to-dc noise ratio	63 db	62 db

recorded at a speed of 7.5 IPS, peak bias current, and a level 30 db below 3% distortion at 1KC.

Figs. 4a and 4b complement the frequency response curves by demonstrating the identity of the bias-output-distortion characteristics of the two tapes. Figs. 4a and 4b were also plotted from data taken on a standard reference recorder, at a speed of 7.5 IPS, a frequency of 1 KC and at the 3% distortion level determined at peak bias current.

The overall similarity of the "Master" low-print

(*Continued on page* 140)

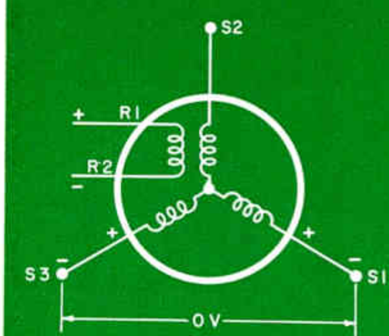
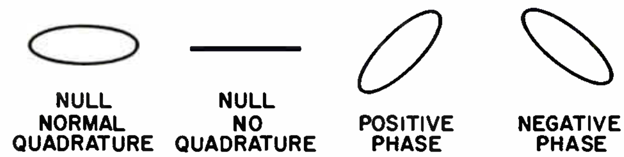


Fig. 1: Synchro at electrical zero.

Fig. 2 (r): Scope waveforms seen while zeroing synchros.



Procedures for Electrically Zeroing Synchros

For the high accuracy demanded by today's radars and missiles, it is important that synchros be accurately zero-ed. Two methods of achieving this are described for each type of synchro, with step-by-step procedures.

By PHILIP L. HILLMAN and FRANCIS J. GALVIN
General Precision Laboratory, Inc.
63 Bedford Rd.
Pleasantville, N. Y.

IN any synchro system that is expected to function with a degree of accuracy, it is highly important that the synchros be electrically zeroed. For a synchro to be in a position of electrical zero, (Fig. 1), the voltage between the S1 and S3 windings must be zero, and the phase of the voltage at the S2 winding must be the same as the phase of the voltage at the R1 winding.

This article comprises methods used to accurately zero synchro transmitters, control transformers, differentials, resolvers, and precision potentiometers. Alternate zeroing methods are included, but it is recommended for the sake of better accuracy that the first methods mentioned be used.

Zeroing Synchro Transmitter

The electrical zero of a synchro transmitter is that position of the rotor relative to the stator for which the rotor winding is parallel to the S2 winding of the stator. There are two positions 180 degrees apart which meet this condi-

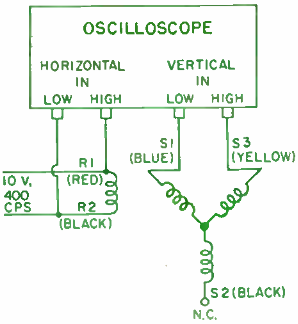


Fig. 3: Test setup using an oscilloscope for zeroing a synchro transmitter.

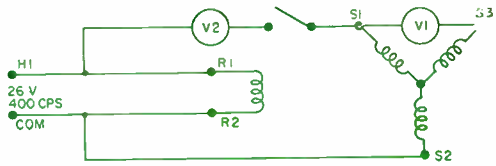


Fig. 4: Zeroing a synchro transmitter with the alternate or voltmeter method.

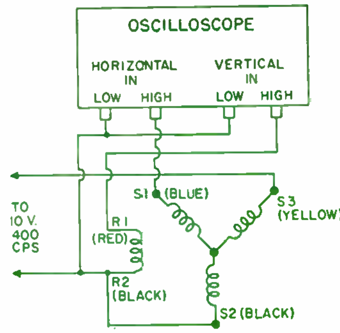


Fig. 5: Test setup using an oscilloscope for zeroing a synchro control transformer.

tion, one being arbitrarily defined as the true zero, the other as the false zero. In order to establish the true electrical zero, connect the Oscilloscope as shown in Fig. 3.

Rotate the synchro case or the synchro shaft, whichever is specified, until the scope pattern is as nearly horizontal as possible. (The presence of a quadrature voltage will open the pattern into an irregular ellipse.) When the synchro is at its true null, as opposed to its false null, clockwise rotation of the shaft as viewed from the shaft end of the synchro (or clockwise rotation of the case as viewed from the case end of the synchro) will rotate the scope pattern into the positive phase as shown in Fig. 2. Check that the null is indeed the true null, then rezero very carefully at the true null. If the first null is seen to be the false null, rotate the shaft or case 180 degrees and zero carefully at the true null.

Alternate Method of Zeroing Transmitter

To find the true electrical zero, connect the synchro transmitter as shown in Fig. 4. With the switch closed, turn the rotor shaft or case (whichever is specified), until the voltmeter V_2 reads a minimum. Then open the switch and rotate the rotor or case in the direction which causes a decreasing indication on V_1 and continue until a minimum reading is obtained.

Zeroing a Synchro Control Transformer

The electrical zero of a synchro control transformer is that position of the rotor relative to the stator for which the rotor winding stands at 90 degrees to the S2 winding of the stator. There are two positions 180 degrees apart which meet this condition, one being arbitrarily defined as the true zero, the other as the false zero. In order to establish the true electrical zero, connect an oscilloscope as shown in Fig. 5.

Rotate the control transformer case or shaft, whichever is specified, until the scope pattern is as nearly horizontal as possible. (The presence of a quadrature voltage will open the pattern into an ellipse.) When the control transformer is at its true null, clockwise rotation of the shaft as viewed from the shaft end of the transformer (or clockwise rotation of the case as viewed from the case end of the transformer) will rotate the scope pattern into the positive phase as shown in Fig. 2. Check that the null is indeed the true null, then rezero very carefully at the true null. If the first null is seen to be the false null, rotate the shaft or case 180 degrees and zero carefully at the true null.

Alternate Method for Control Transformer

Connect the synchro as shown in Fig. 6. With the switch in the B position, rotate the rotor shaft or case (whichever is specified), until vacuum tube voltage (V_1) reads a minimum voltage. With the switch in position A, voltmeter (V_2) should read approximately 5 volts at the true zero, or approximately 15 volts at the false zero. If the latter is true, return to position B and rezero to another null.

Zeroing a Synchro Differential

The electrical zeros of a synchro differential are defined as those positions where the electrical axis of the R2 winding on the rotor is aligned parallel to the electrical axis of the S2 winding on the stator. There are two rotor positions at which this condition is met. One position is arbitrarily called the true zero, the other the false zero. To locate the true electrical zero, connect the synchro as shown in Fig. 7 and proceed as follows:

Fig. 6: Zeroing a control transformer with the alternate or voltmeter method.

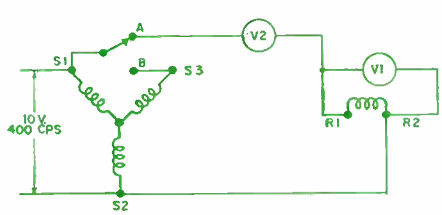


Fig. 7: Test setup using an oscilloscope for zeroing a synchro differential.

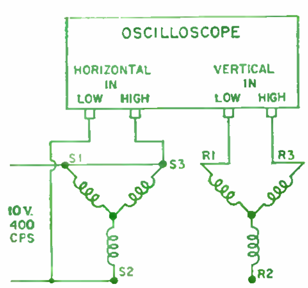
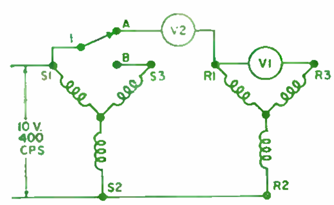


Fig. 8: Zeroing a synchro differential with the alternate or voltmeter method.



Zeroing Synchros *(Continued)*

a. Turn the synchro case to get a null pattern on the oscilloscope.

b. Turn the case a few degrees clockwise. A positive phase pattern should appear on the oscilloscope, if not, rotate the case 180°.

c. Rotate the case slightly to get a null pattern.

Alternating Method for Differential

To set the synchro differential on the true electrical zero, connect the synchro as shown in Fig. 8 and proceed as follows:

With the switch in the A position, rotate the synchro case or the rotor shaft, whichever is specified, until the voltmeter (V_2) reads a minimum. The synchro differential is now approximately zeroed. Throw the switch to the B position and rotate the rotor or case in the direction which causes a decreasing indication on vacuum tube voltmeter (V_1) and continue until a null is obtained.

Zeroing a Resolver

The electrical zero of a synchro resolver is that position of the rotor relative to the stator for which the S2-S4 rotor winding stands at 90 degrees to the P2-P4 stator winding and the S1-S3 winding stands parallel to the P2-P4 stator winding. There are two positions 180° apart which meet this condition, one being arbitrarily defined as the true zero, the other as the false zero. In order to establish the true electrical zero, connect the oscilloscope as shown in Fig. 9. Rotate the resolver case or the resolver shaft, whichever is specified, until the scope pattern is as nearly horizontal as possible. (The presence of quadrature voltage will open up the pattern into an ellipse.) When the resolver is at its true null, as opposed to its false null, clockwise rotation of the shaft as viewed from the shaft end of the resolver (or clockwise rotation of the case as viewed from the case end of the resolver) will rotate the scope pattern into the positive phase as shown in Fig. 2. Check that the null is indeed the true null; then rezero very carefully at the true null. If the first null is seen to be the false null, rotate the shaft or case 180° and zero carefully at the true null.

Fig. 9: Test setup using an oscilloscope for zeroing a synchro resolver.

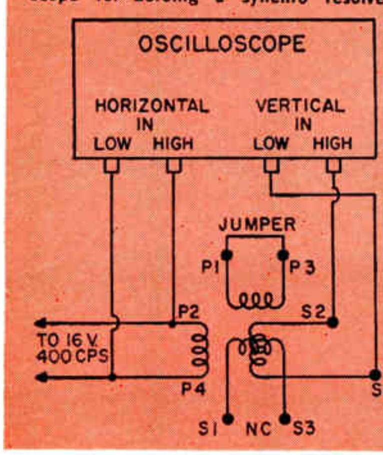
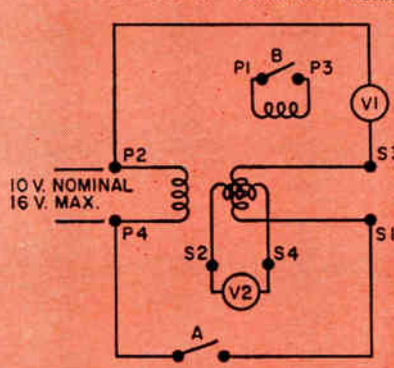


Fig. 10: Zeroing a synchro resolver with the alternate or voltmeter method.



Alternate Method for Resolver

Connect the resolver as shown in Fig. 10. Close switches A and B and rotate the rotor shaft or case (whichever is specified) until the vacuum tube voltmeter V_1, reads a minimum voltage. The resolver is now within a degree or two of electrical zero. Rotate the rotor shaft or case until vacuum tube voltmeter V_2 reads a minimum voltage. Open switches A and B. Tighten the shaft clamps or case clamps that were loosened.

Zeroing a Precision Potentiometer

The electrical zero of a precision potentiometer is that shaft position for which the rotor is at a tap on the potentiometer winding. This tap may be an end tap, a special tap, or a center tap. There are two general ways to zero a potentiometer. The first method may be used when the zero point is a tap on the potentiometer winding other than an end tap; the second method is preferred when the zero is the end of the potentiometer windings and may also be used to zero at any other tap on the winding. In the first method, an ohmmeter is connected between the wiper arm terminal and the tap being used as the zero reference. The potentiometer shaft or case, whichever is desired, is turned until the ohmmeter reads a minimum resistance. In the second method, the vertical input of an oscilloscope is connected between the wiper arm terminal and the desired end tap of the winding. The potentiometer is then excited from a 380-420 cps. 26 v (maximum source). (This excitation may be supplied from a 115 v line through a step-down transformer.) With the potentiometer excited and the scope on internal sweep, the potentiometer case or shaft, whichever is desired, is turned until the sine wave scope pattern is of minimum amplitude. The vertical gain should be gradually advanced to full sensitivity, at which point the sine wave amplitude will be seen to change as the wiper travels from wire to wire on the potentiometer winding. The null corresponds to the minimum amplitude of the scope pattern. When zeroing to an end-tap of a potentiometer winding, great care is needed to prevent running past the null point, since the scope signal will not begin to increase again as the null is passed. The approach to the null should be carefully observed and the null point selected when further rotation in the direction of the null produces no further decrease in scope amplitude. This null point may sometimes be the point at the very end of the windings when the wiper arm is just clear of the insulated sector of the potentiometer winding.

Page from an Engineer's Notebook

#40—Magnetic Drum and Tape Design Nomograph

By IRA L. RESNICK
Senior Electronics Engineer
Magnavox, Inc.
2255 Carmelina Ave.
Los Angeles, Calif.

FOR those concerned with special purpose computer design, it is often desirable to have a quick approximation of the drum characteristics. These are readily obtainable with a nomograph which we have used successfully on several occasions in order to optimize quickly on a drum design.

The notation used is as follows:

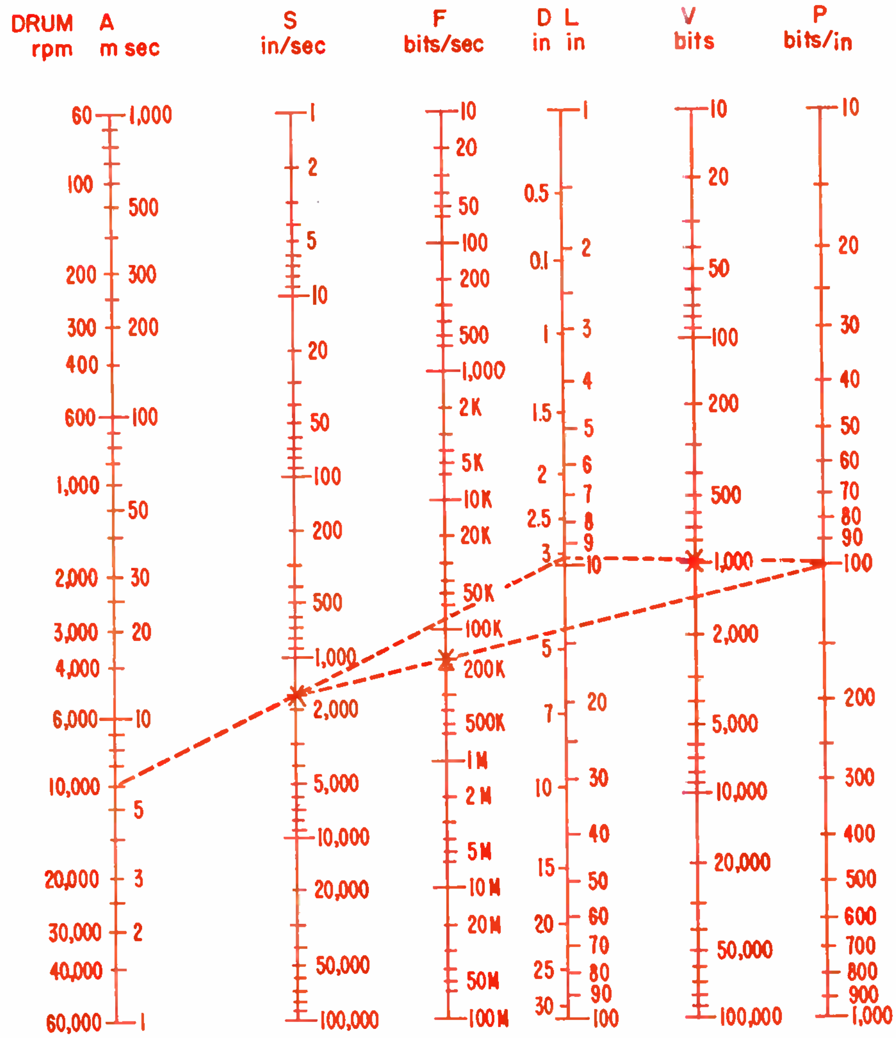
- A – Access time or the time in milliseconds for a complete drum revolution or time required to read *L* inches of tape
- S – Linear speed of drum or tape past heads in in./sec.
- D – Diameter of drum
- L – Circumference of drum or arbitrary length of tape
- F – Bit rate or binary bits/sec.
- V – Capacity in bits of single channel of drum or arbitrary length of tape *L*
- P – Packing factor or bits recorded per linear inch

The nomograph solves the following equations:

$$S = \frac{\pi D\,(\text{rpm})}{60} = \frac{L\,(\text{rpm})}{60} = \frac{L \times 10^3}{A}$$

$$F = SP$$

$$V = LP$$



To enter the nomograph when looking for optimum drum parameters, *S* is determined by a line intersecting the required values of drum diameter *D* and access time *A* or rpm. Any one of these values may be determined if the other two are known.

The bit rate *F* is determined by the line intersecting the required values of packing factor *P* and *S*. Again, *S*, *F*, and *P* form another equation which may be solved using the appropriate axes of the nomograph.

The variables *S*, *F*, and *P* apply with equal ease to problems of magnetic tape design.

Let's take a sample problem:

If our drum diameter, due to other limiting mechanical factors is 3.14 in. and revolves at the rate of 10,000 rpm, then by drawing a straight line from 10,000 on the left side of the first column (rpm) to 3.14 on the left side of the fourth column (D), we can read the linear speed directly from the point of intersection of the line with the second column (S). In this case, the speed is 1640.

Assuming that the packing factor is 100 bits/in., we can determine the bit rate and single channel capacity by drawing two more lines. A straight line from 3.14 in the D column to 100 in the P column intersects the capacity column (V) at 985. A straight line from our point of intersection of the first line and the S column to 100 in the P column will intersect the bit rate column (F) at 164.

Designing Low-Noise Microwave Receivers

A reliable microwave receiver with noise figure in the 6-db range can be designed on the basis of theory and practical suggestions resulting from low noise research studies over the past few years. The author includes experimental data on microwave crystal mixers.

By C. T. McCOY
Senior Research Specialist
Research Division, Philco Corp.
Philadelphia, Pa.

Part Two of Two Parts

LOW-NOISE receiver design is most often a compromise between theory and practicalities. Some of the performance deterioration is due to overlooking implications in phenomenological parameter definitions. This can be avoided when its causes are brought to light and understood. Other deteriorations are due to parameters which simply cannot be held in practice to the degree demanded in theory. Here the knowledge of the severity of control is necessary for a good compromise.

Linearity

The phenomenological parameters mentioned in Part One and shown in Fig. 1 apply only to linear amplifiers. Design must be done with special care to prevent any trace of overload if low noise measurements are to agree with theory.

Stability

Practically no amplifier designs are adequately stable. Regeneration always occurs from inadequate power lead filtering, electrostatic and electromagnetic interstage coupling, and vacuum tube interelectrode feedback. Regeneration in itself does not affect noise figure, but regeneration does cause impedances and bandwidths to differ from their assumed values and this does affect noise figure. Only with good amplifier stability is it possible to have the measured over-all performance of cascade stages agree with that calculated from the measurements on the individual stages as expressed in Eq. 1.

Single Frequency Definition

The definitions of noise figure F, gain G, and admittance Y of Fig. 1 are for incremental bandwidth at a single frequency. The parameters are frequency-dependent and so rigorous calculation of cascaded amplifier boxes involves integration with respect to frequency. The single frequency incremental definitions are perfectly rigorous for practical applications involving significant bandwidth if and only if the bandwidth selectivity of the later (non-noise-contributing) stages is narrow compared to the front noise-producing stages. This means that the noise-producing parameters are not frequency-dependent for the "increment" bandwidth of the remainder of the receiver.

Normalized noise figure degradation from inadequate front-end bandwidth can be estimated from Fig. 10. The curve has been theoretically calculated and experimentally verified for the particular frequency and simple circuit indicated. Fig. 10 significantly indicates that front-end noise-contributing boxes should have at least three times the bandwidth of the rest of the receiver. Noise figure is independent of receiver bandwidth as long as this design principle can be incorporated.

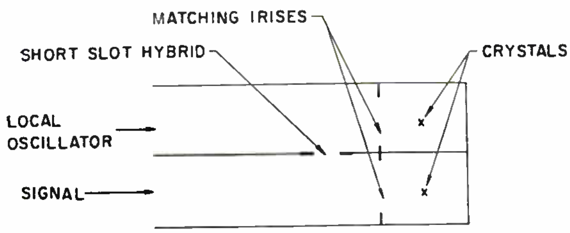


Fig. 11: Short-slot hybrid-balanced mixer for the low-noise receiver.

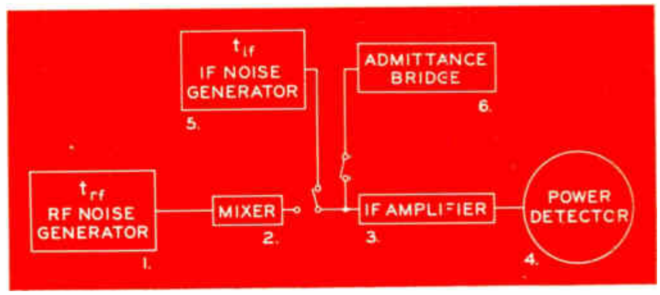


Fig. 12: Block diagram for absolute noise measurement of the receiver.

Forward & Backward Bandwidth

As just explained, backward bandwidth and terminations affect noise figure. Forward bandwidth and terminal considerations are familiar factors of the conventional amplifier passband design. Circuits are not always optimum for both and compromises must be made.

The double-tuned circuit between i-f and mixer gives the most backward bandwidth for avoiding noise figure degradations; however, with a Wallman circuit the i-f termination to the mixer has a sharp deep hole in the center of the passband.

For low conversion loss mixers this "hole" can be seen with little degradation at the r-f. A microwave filter terminated by such a mixer will not perform as expected. A compromise solution to this is a grounded-grid first i-f tube and/or single-tuned transformer.

Design Considerations

At present, receivers with over-all i-f bandwidth greater than 7 MC can expect bandwidth problems in the front low-noise stages. Eq. 1 shows that great attention must be given to the available gain design of the first stage and the noise figure of the remainder over wide bands. Better tubes are needed to achieve low noise and high gain in the first stage. The 417B and 416B are the best known.

Circuit loss degradation is minimized and bandwidths can be increased when optimum source conductance ($G_{s,\,opt}$) is higher. $G_{s,\,opt}$ of Eq. 8 increases with frequency (proportionally due to G_i) as well as with tube g_m.

Band width increases as the ratio of interstage conductance transformation decreases. For low conversion loss narrowband mixers, the transformer ratio can be considerably reduced by proper choice of image terminations.

Mixer Variations

The values in the complex mixer network of Figs. 5 and 8 change with variations in local oscillator level, bias, and crystal replacement; and the terminations can vary due to manufacturing tolerances, tuning (such as in TV uses), or with r-f in broad fixed tuning.

These variations from optimum are the reasons why mixers covering a range of frequencies have far worse noise figure than those of optimum design for a single frequency.

Some control over these deviations is possible. Local oscillator level and bias can be regulated; crystal uniformity is improving but further efforts for improvement are needed; termination frequency selectivity can be kept down by locating the terminations within fractional wavelengths of the crystal.

Oscillator Noise

Any loss of signal into the local oscillator network is charged against conversion loss. Local oscillator sideband noise can easily increase the effective mixer-noise temperature t_x to values as high as 5. Sharp filter networks or balanced mixer designs will completely eliminate this kind of noise figure deterioration.

Broadband Embodiment

The efficacy of incorporating the above practicalities is illustrated by an X-band front-end design which achieves an over-all maximum receiver noise figure of 7.5 db. A short-slot hybrid-balanced mixer was used, as shown in Fig. 11. Two 1N263 crystals were placed across the broad dimension of the guide at the positions marked by X.

The crystals were first matched to the guide impedance (by means of the proper dimensions in offset from the centerline and distance from end wall) for which a VSWR of less than 2 for a 200-MC bandwidth was achieved. The addition of the matching

(*Continued on page* 142)

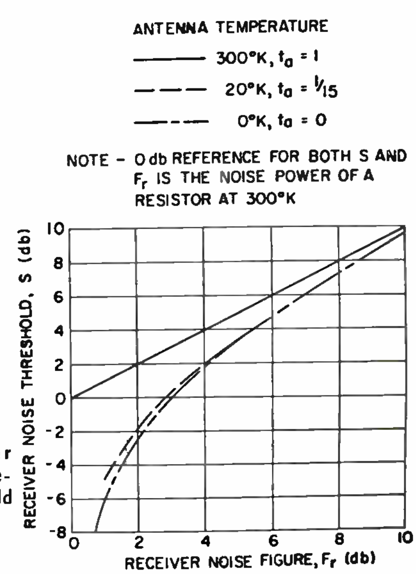


Fig. 13: Receiver sensitivity improvement from a cold antenna.

New Magnet Steel

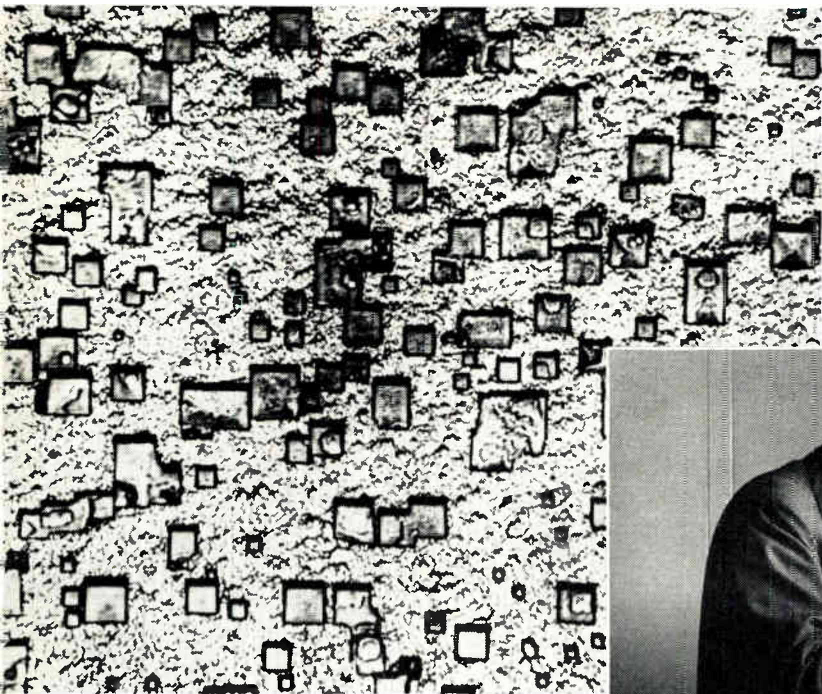


Fig. 1: Squares in the picture above are etch pits locating the silicon-iron crystals in a sheet of steel. The four-square orientation is a new metallurgical achievement and gives important magnetic properties to the steel.

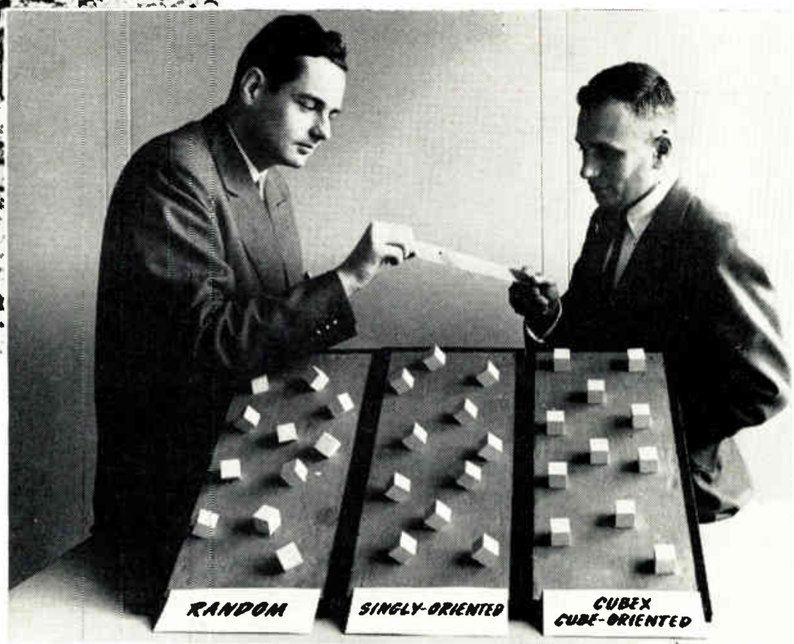


Fig. 2 (right): Dr. Klaus Detert (left) is from Siemens-Halske's Vacuumschmelze division in Hanau, Germany. Westinghouse's Dr. George W. Wiener is examining a strip of the new "Cubex" steel with Dr. Detert. Cubex is a joint development of Vacuumschmelze and Westinghouse.

THREE percent silicon-iron has a cubic crystal structure. The cube has three mutually perpendicular directions of magnetization. Minimum energy is required to magnetize the sample in any of these directions.

Three arrangements of the crystals are possible: random, singly-oriented, and cube-oriented.

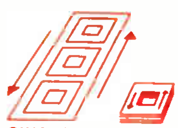
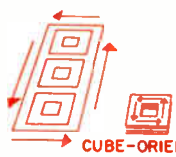
The random type is like a bag of blocks that has been thoroughly shaken. This is the type found in hot-rolled silicon steel sheets. With this random array the applied magnetic field cannot be oriented so it is parallel to one face of each cube. More energy is required to magnetize a random sample.

Singly-oriented steel has the cubes standing on edge; it is often called "cube on edge orientation."

The double, or cube type of orientation is like a tray of ice cubes. Then, the easy directions of magnetization are parallel to the length, width, and height of the strip. This cube orientation is not usually found in iron. Special processes had to be found to make it. A great advantage of "Cubex" is that flux can now turn corners easily.

Table 1 compares magnetic properties of transformer cores stamped from singly-oriented and cube-oriented silicon steel. The same heat was processed to give both types.

TABLE 1

INDUCTION (GAUSSES)	 SINGLY-ORIENTED MAGNETIZING FORCE (OERSTEDS)	 CUBE-ORIENTED MAGNETIZING FORCE (OERSTEDS)
2,500	0.50	0.15
5,000	0.64	0.20
7,500	0.83	0.33
10,000	1.20	0.55
12,000	2.45	1.00
14,000	10.75	1.75
COERCIVE FORCE (OERSTEDS)	0.40	0.175

Infra-Red Camera

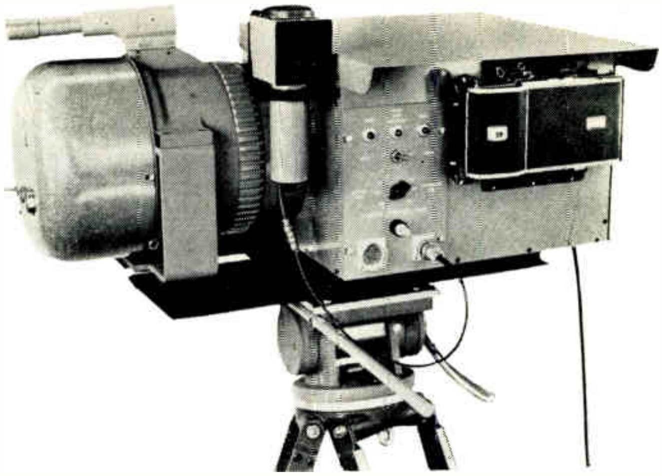


Fig. 1: The Barnes Infra-Red Camera.

HEAT is a major problem in modern electronic equipment. Hot spots and heat flow must be studied during design of reliable equipment. Barnes Engineering Co., Stamford, Conn., has developed an infra-red camera to diagnose temperature and heat distribution.

The new camera scans an object with a sensitive radiometer. The output is amplified and used to modulate a spot of light. This, in turn, scans a photographic plate. The result is a black and white record of temperature. Dark areas mean less heat; light areas show hot spots.

In use, a picture may be made in as little as two minutes, or as long as fifteen. It depends on the sensitivity and detail required—and on the temperature of the object.

Sensitivity of the camera is high. It can detect temperature differences as small as .02°C. A picture of a person can show the blood vessels—they are slightly warmer than the surrounding skin area.

The new camera uses the object's heat, no infra-red source is needed.

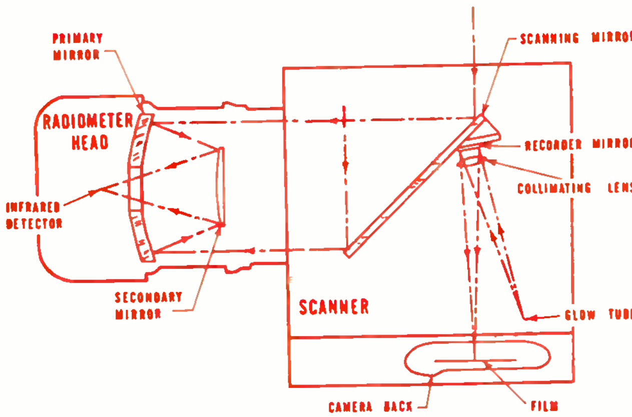


Fig. 2: The optical system shown here focuses I-R energy on a thermistor bolometer.

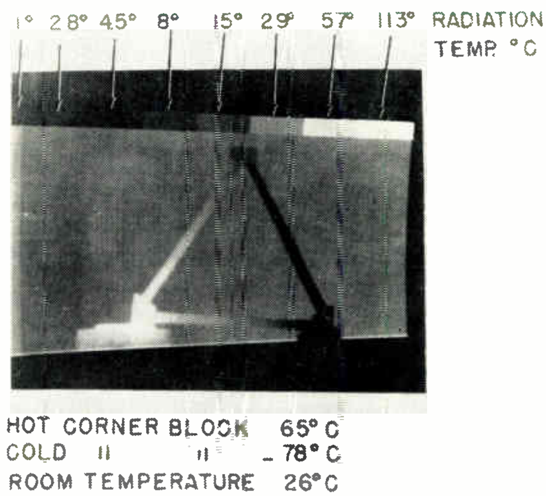


Fig. 3: One corner of triangle is on hot plate, the other on a block of dry ice.

More What's New on Page 118

Fig. 4: Hot spots show clearly in this photograph of an electronic chassis. Resistors, and the transformer are the hottest.

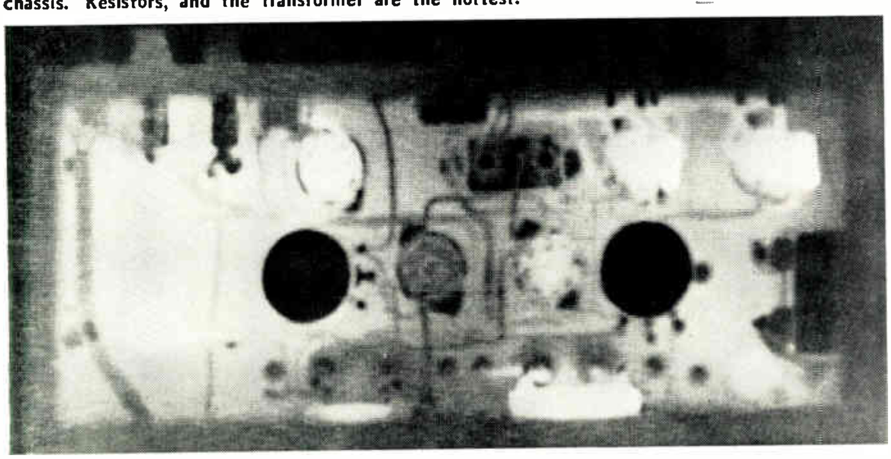


Fig. 5: Temperature drop through the stem of a pipe is shown by this I-R photograph.

20 Years Ahead In Air Force Electronics

Highly advanced components, many of them now in the research stage, will lead to a wide range of automatic switching, multiplexing and transmission media equipment. Semiconductors will pace the progress.

By JOSEPH H. VOGELMAN
Technical Director,
Directorate of Communications,
Rome Air Development Center,
Griffiss Air Force Base, N. Y.

THE purpose of this article is to stimulate new ideas in the development of communications equipment for the U. S. Air Force. To this end let us look into the future, to set up some of the characteristics that should be included in certain of the Air Force equipments being designed at that time. As in the case of all "science fiction," the author cannot be held responsible for the technical accuracy of his predictions. This article, however, attempts to extrapolate technical advances, now in the research stage, to equipment of the future.

The future must be examined in two parts: first, the components; and second, the equipments which can be created with these components.

Components

The future will need some special components; in addition, there is the never-ending requirement that all existing components be made smaller, more reliable, more efficient, have higher frequency, and be cheaper.

The first requirement is for a low-loss, high permeability, ferrite-

Fig. 1A: Each bank consists of an insulator board, with 100 vertical conductors and 100 horizontal conductors

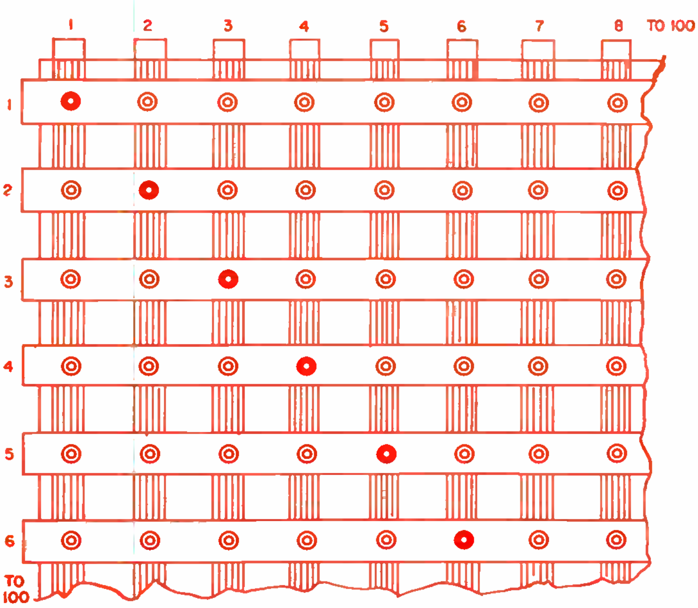
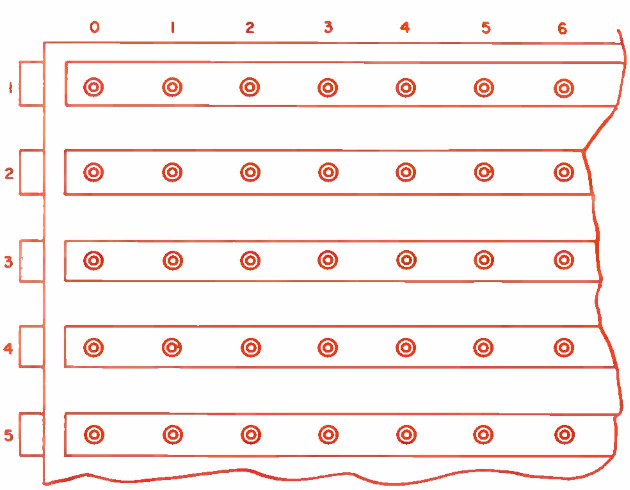


Fig. 1B: Line finder bank consists of 100 horizontal conductors on each side connected by hollow cylinder semiconductors



like material; the characteristics are such that the phase velocity in the material is a function of frequency; not just any function of frequency, but that function which will make a quarter wavelength plate of the material exactly a quarter wavelength over a very wide frequency band. When subjected to a magnetic field, the phase shift should remain constant over a wide frequency range.

The second requirement is for a small, simple device capable of ionizing gases that are fed into it, and ejecting the ionized gases in a controlled high-velocity stream. This is an application for the nuclear energy from radioactive materials.

The third requirement is for a bistable semi-conductor which is highly resistive to voltages under 1 v., but which changes to a very low resistance state when a high voltage is applied. This second stable state should continue after the high voltage is removed, as long as 1 v. of dc is continuously applied. Most readers will recognize this as a close relative of the newly-developed NPNP transistor. This semi-conductor should also have a counterpart which would change states when bombarded by an electron beam instead of having an application of high voltage.

Another component needed for the inventory of the future is a semiconductor which will be capable of operating as a linear amplifier of 10 w. power output, and which has an alpha cutoff of 2000 MC. A critical quality control requirement on this component is phase shift. The amplifier must be controlled in production to insure repeatability of linearity and phase shift within 1%.

Equipments

The equipment of the future is easy to design, by judicious use of the components, now that they are available in the future inventory. The U. S. Air Force communications system of the future will be made up of the following kinds of equipment:

1. Terminal Equipments
   a. Telephone transmitters and receivers
   b. Teletype encoders and page printers
   c. Facsimile scanners and printers
   d. Video cameras and displays.
   e. Data sources and stores
2. Multiplexing Equipments
3. Switching Equipment
4. Storage and Routing Equipments
5. Transmission Media Equipment
   a. Antennas and transmission lines
   b. Receivers
   c. Transmitters
   d. Frequency translation repeaters.

We will consider only switching and transmission media equipments here. The remainder are left to the reader as an exercise for his ingenuity and imagination.

A. Automatic Switching Equipment

This switching equipment of the future will have the usual parts: the two signal banks, T and R; the two control banks, S and HS; and the line finder. A one-hundred-line switching equipment will be considered as the basic building block. Each T, R, S, and HS bank (Figure 1a) will consist of an insulator board on which is printed 100 vertical conductors on one side and 100 horizontal conductors on the other side. At each crossing of the vertical and horizontal conductors a hollow cylinder is inserted, connecting the vertical conductor on the other side. The hollow cylinder is the bistable semiconductor previously described as the third component requirement.

When two lines of the same number intersect, the cylinder is a conductor. The line finder consists of 100 horizontal conductors on both sides of the insulator, with hollow cylinder semiconductors through the insulator connecting the two opposite conductors. The distribution of the cylinders is identical to those of banks T, R, S, and HS, except for one additional cylinder on each line (Figure 1b). The banks are then stacked with a line finder bank in the front and rear, and the assembly is mounted in front of a multiple-beam, multple-deflection plate, Cathode-ray gun (Fig. 2).

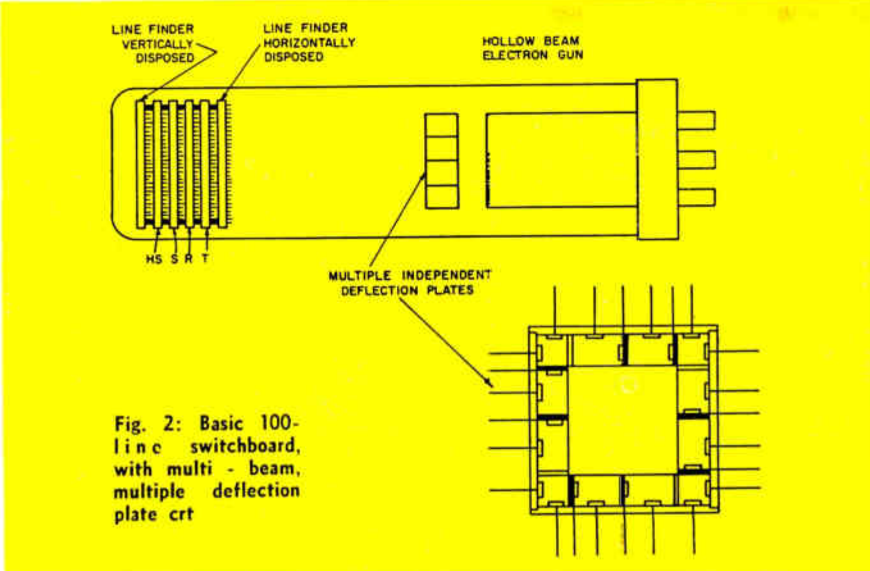
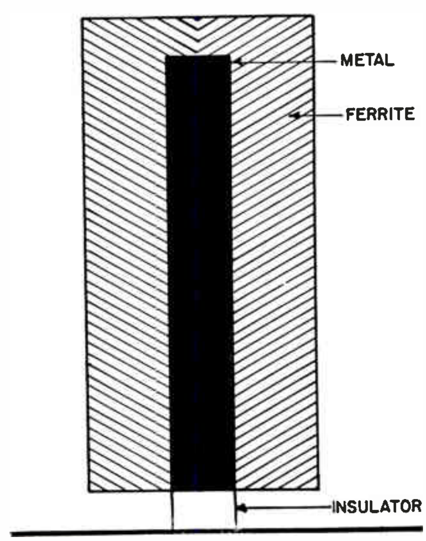


Fig. 2: Basic 100-line switchboard, with multi-beam, multiple deflection plate crt

There is now a basic one-hundred-line switchboard and its operation can be examined.

The calling party lifts his telephone. This applies a three-quarter volt to his line on the line-finder bank and starts any avail-

Fig. 3: Ferrite antenna structure



able electron beam scanning vertically line-by-line at the zero horizontal position. When the electron beam reaches the height of the calling line, the electron beam passing through the cylindrical changes the state of the semiconductor as a result of electron bombardment so that it becomes conducting, connecting the calling line to its corresponding line on banks, T, R, S, and HS. At the same time the current flowing in the circuit produces the dial tone in the receiver of the calling telephone.

When the number is dialed, a voltage corresponding to this number is applied to the horizontal deflection plates, deflecting the beam to a position corresponding to the horizontal position of the called number. The electron beam passing through each bank in turn changes the state of the semiconductor cylinder at the junction of the called and calling lines, causing the called phone to ring.

When the called party lifts his phone, he applies a ¾ v. across his line on the line-finder banks and at the same time releases the electron beam. Since more than 1v. is across each semiconductor on the various banks, the circuit is maintained until one party hangs up.

The total structure just described is suitable for incorporation in an evacuated envelope no larger than a 2-in. Cathode-ray tube, and probably as small as a Cathode-ray tube envelope. The basic structure and its operation has been described without any attempt to work out the detailed design.

B. Transmission Media Equipment

Of the various equipments making up the transmission media, a supersensitive, compact receiver will have been achieved in the time period under consideration, by combining the low noise level available from the superconducting maser as the input r-f stage, and transistors as the i-f and output stages. Accordingly, the remainder of this article will be devoted to the consideration of the antenna and transmission lines and the transmitter.

1. The Antenna and Transmission Lines—The LF and VLF radio bands have had severe limitations

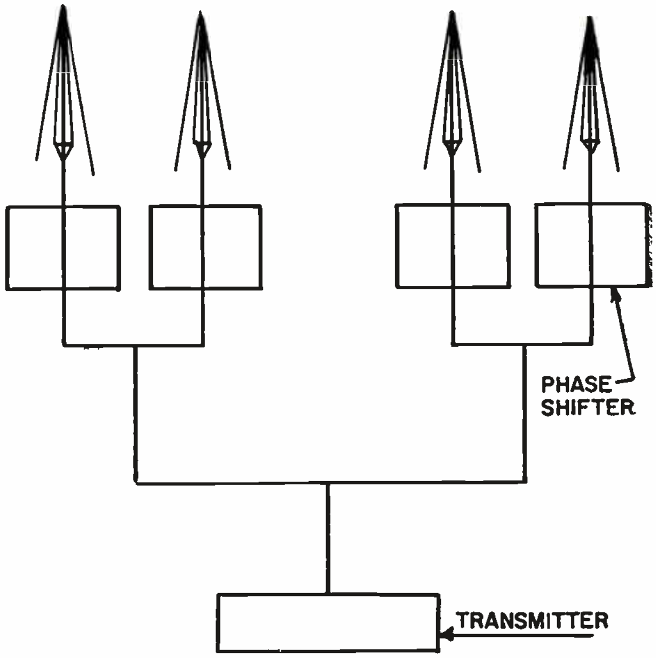


Fig. 4: Electronically steerable antenna array would use ferrites as phase shifters

imposed on their use by the need for extremely large antennas to achieve even moderate efficiencies. With the advent of high-Mach-number aircraft, the antenna has become a problem even at HF, VHF, and UHF, by imposing a range or speed reduction due to the additional drag resulting from its addition to the air frame. Even flush antennas have left much to be desired.

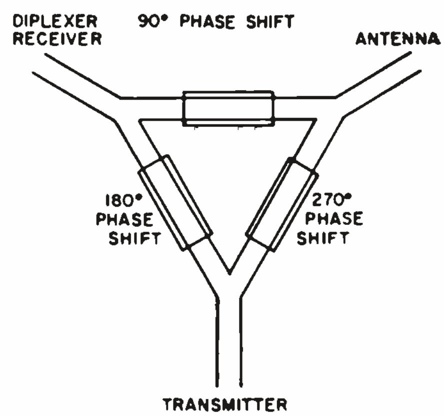
The future antenna needs a new look. The ferrite-like material considered as the first component requirement is ideally suited to solving the ground antenna problem for VLF and LF communications.

A conductor embedded in a medium will resonate at any given frequency when its length is one-quarter wavelength long above the ground plane in the medium. Where the medium is the ferrite-like component discussed, the length required would be on the order of one-hundredth of that required in free space. The antenna of the future would then consist of a broadband radiator embedded in this material, the thickness of which would be selected to match the composite impedance of the radiator and ferrite to free space. (Fig. 3). This type of antenna would be of a practical size (i.e., 30 meters), and extremely efficient in comparison with the top-loaded structures used at the present. With this type of antenna it would now be practical to build multi-element arrays which could be electronically steered. Our ferrite-like components would provide the necessary device to accomplish this. The output of the transmitter would be fed into n transmission lines, one for each antenna radiator. In each transmission line the ferrite component would be incorporated as a phase shifter whose phase shift would be controlled by means of an electromagnet, to form a beam in the desired direction. This technique could be applied to other types of phased arrays and would be extremely broadband because of the inherent constancy of phase shift for fixed length and magnetic field, independent of frequency (Fig. 4).

Another application of the ferrite-lke component would be in diplexing the receiver and the

(*Continued on page* 150)

Fig. 5: Ferrites in a 3-part ring of phase shifters make efficient diplexer



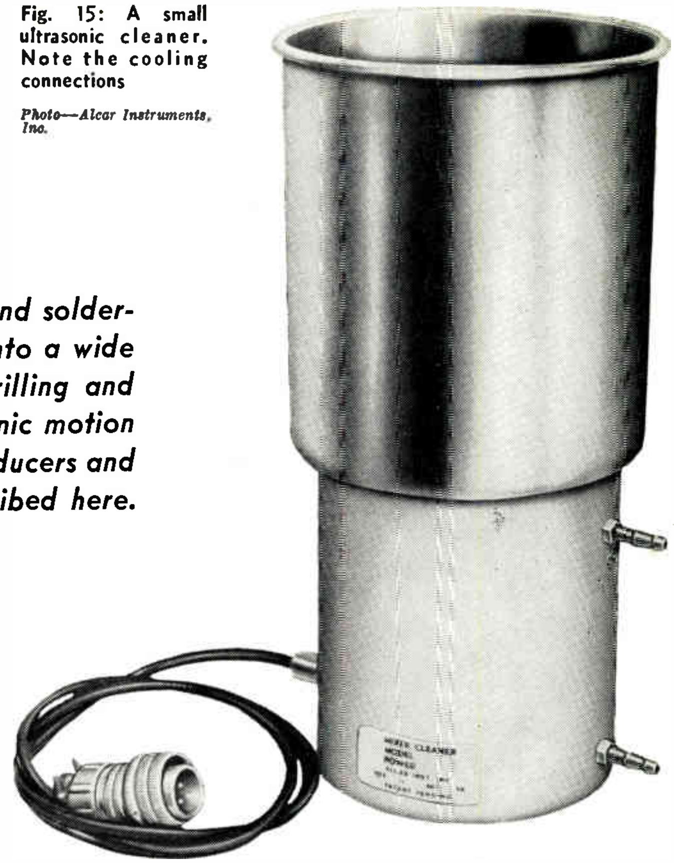


Fig. 15: A small ultrasonic cleaner. Note the cooling connections

Photo—Alcar Instruments, Inc.

After a brief apprenticeship as a cleaning and soldering tool ultrasonics has now branched out into a wide variety of slicing, machining, measuring, drilling and burglar alarm applications. How the ultrasonic motion is applied, and how to choose the right transducers and generators for a given operation, are described here.

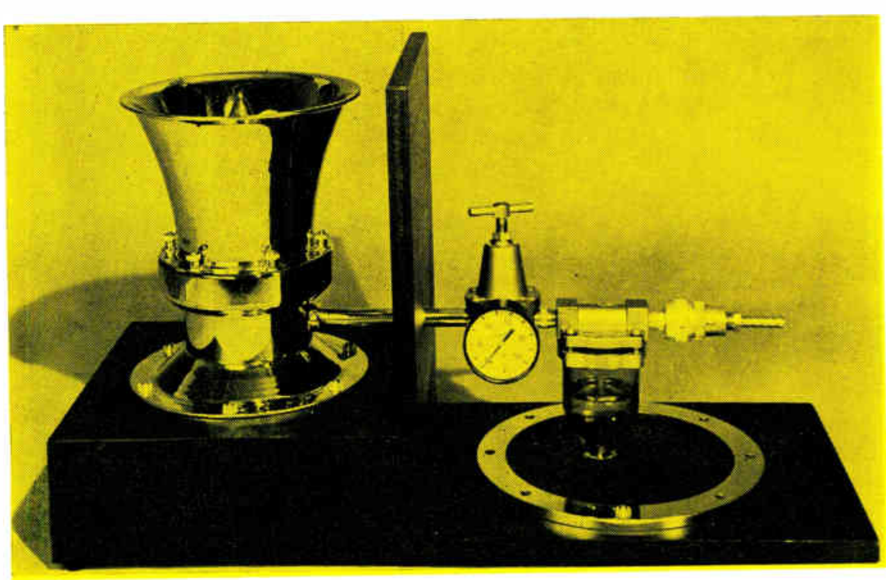
ULTRASONICS
—The New Electronic Art

By **JOHN E. HICKEY, Jr.**
Assistant Editor
ELECTRONIC INDUSTRIES & Tele-Tech

Part Two of Two Parts

Fig. 16: Ultrasonic multi-whistle is used for agglomerating smoke and mists

Photo—Gulton Industries, Inc.



ULTRASONIC cleaning is perhaps one of the most widely known applications of ultrasonics. This method of cleaning is used in almost every kind of manufacturing today. This type of cleaning has proved successful in cleaning grease, oil films, metal chips, and corrosion from intricate assemblies. It is ideally suited for intricate shapes and forms that are normally hard to clean by other means.

Cleaning Action

The cleaning action works on erosion principles. The cleaning liquid is placed in movement by a

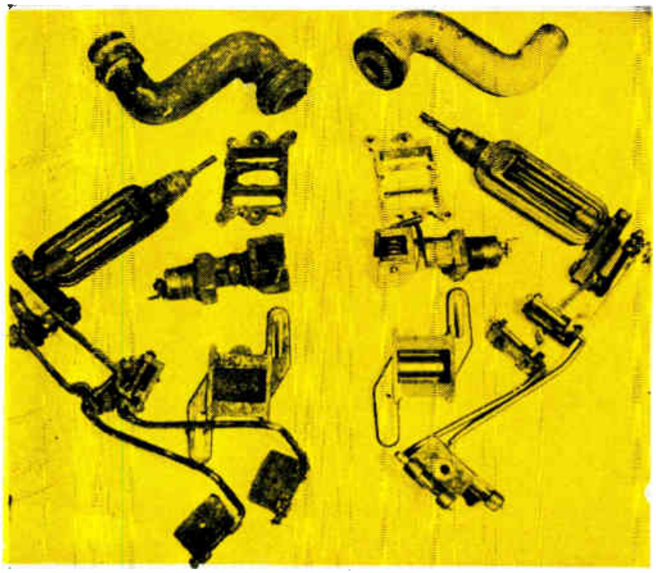


Fig. 17: Intricate shapes are readily cleaned ultrasonically
Photo—Branson Ultrasonics Corp.

Ultrasonics *(Continued)*

transducer which may be a clamped-on or dropped-in type. This effectively causes a scrubbing action. The cleaning solution is usually the same as that used prior to the introduction of ultrasonics.

When cavitation occurs at the inter-face between a liquid and a solid, the strong forces acting can disrupt the solid and produce a progressive erosion, presumably because the forces are so localized and the particles eroded away are extremely small. With coherent solid bodies, the action is a slow one, but in some circumstances it can become much more rapid. This is particularly so if the material to be cleaned is in the form of aggregates which are not bound together very closely.

Cleaning Transducers

The transducers used for cleaning are usually made of quartz or ceramic with ceramic types being more predominant. They operate on a power level of 40 watts to 1 kw. in the 40 to 50 MC region, although they may be obtained for almost any frequency in the ultrasonic spectrum for particular jobs.

Quite often forced air cooling is used to protect the transducers. Transducers may be of the focusing or non-focusing types. The lower frequencies are usually utilized on the non-focusing types.

Generally speaking most ultrasonic cleaning units are of small size, in the neighborhood of a quart to a gallon, but there are units that hold 10 gallons or more of liquid.

Fig. 18: 60 w. ultrasonic generator for cleaning operations has a modern look.
Photo—Narda Ultrasonics Corp.

While cleaning with ultrasonics shortens cleaning time and gives better quality cleaning job, the cleaning time itself is not cut down as greatly as commonly believed. The fact is, that if the cleaning time is merely cut in half, this is a great saving in time to a manufacturer. Reports of cutting cleaning time from hours to seconds have been heard and intimated. This is more an exception than a rule.

Some research and development has gone into the design of ultrasonic washers for general consumer use. At present the results have not been too good. It appears to be rather difficult to clean such flexible materials as cloth. While working models have been produced, the cost is still prohibitive.

Processing

Emulsification, dye dispersion, aging of alcoholic beverages, polarization, metallic plating and pickling are a few processes which have been encouraged or speeded up by ultrasound. When ultrasonic waves of high intensity are passed through some liquids, chemical changes occur. In some cases, reactions that would take place anyhow are accelerated while in other cases effects are brought about that would be completely absent with no ultrasonic application. While it is believed that the majority of reactions are caused by cavitation, it is still uncertain whether high temperature, electrical phenomena, or the high pressure in the cavitating void is the actual cause.

When heavy ultrasonic vibrations are applied to liquids, an emulsion is often formed. While some emulsions such as mercury/water do not require cavitation, others such as water/oil mixtures rely on cavitation.

Experiments show that many chemical reactions can be hastened by the use of ultrasonics but large-scale commercial applications still remain for the future. As an example of the industrial application problems facing this industry at the moment, pickling of steel plates would be impractical at present. Pickling processes (pickling is the cleaning of the plates at the steel mill prior to plating or coating these sheets) of large plates would require an equally large tank for holding the solution. This tank would require either a very large number of smaller transducers or several large, heavy power handling type transducers which are not readily available at this time. Transducers for small pickling operations, however, are available.

Multi-Whistle

The multi-whistle acoustic air-jet generator being used in France, is also available in this country. The multi-whistle may be used for the agglomeration of aerosols such as smokes and mists, acoustic drying, acoustic testing such as for the aircraft and missile field, chemical processing, and for emulsification and dispersion in liquids.

This type of generator can be operated at any frequency or group of frequencies from 3 KC to 40 KC and the whistles can be adjusted individually to give a desired complex wave spectrum. Whistles can be synchronized to a single frequency or to high intensity beat patterns. Materials of different sizes and substance do not react at the same frequencies. This fact then makes the multi-whistle highly desirable for smoke and mist use.

Based on the developments in France by Dr. R. Boucher, it makes use of a series of gas jets at supersonic velocity directed at a corresponding group of resonators. Frequency stability depends on a uniform air pressure supply. The operating air pressure is usually 40 to 75 psi. Their efficiency is approximately 20% which is considered quite good.

The multi-whistles are placed in a suitable chamber and the type of material to be acted-on is placed or passed through the area. In cases of liquid emulsification, the liquid is forced through the jets of the whistle. This gives a higher rate of emulsification than is obtainable with other types of transducers.

Machining

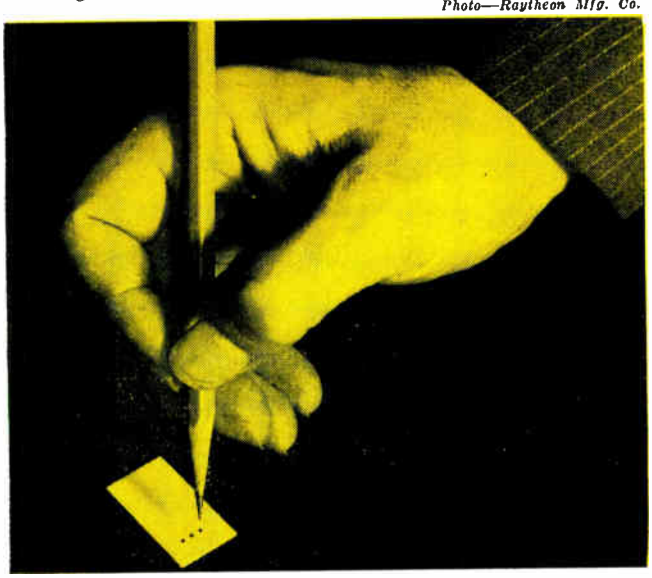
Another of the more recently developed applications of ultrasonics is the machining of very hard materials such as ferrites, sintered metals and glass. The operation has commonly been called ultrasonic drilling but is also used for slicing, cutting, routing, and engraving. The use of this type of equipment is very valuable in the manufacture of dies.

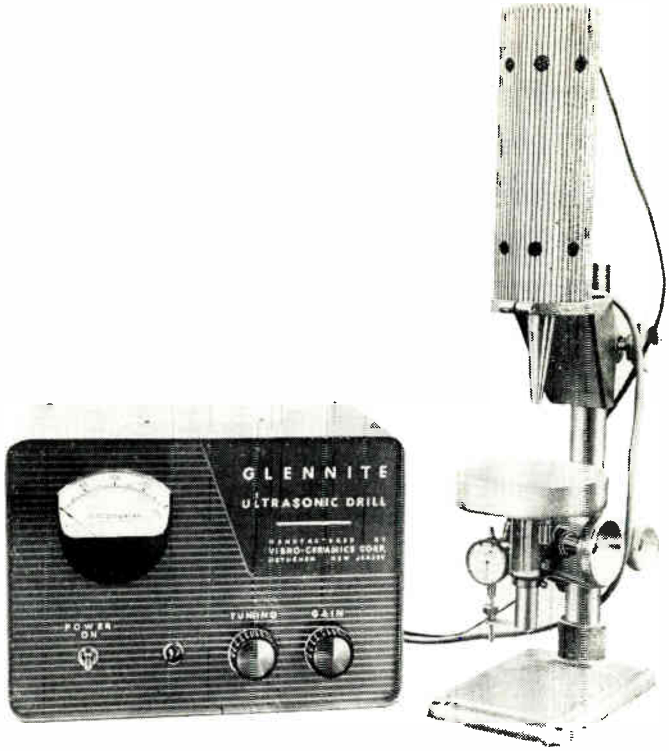
The transducers are usually of a magnetostrictive type operating in a frequency range of 20 to 25 MC. Ceramic transducers are also being used successfully. The transducer may be forced air or water cooled. The ultrasonic driving force is in the neighborhood of 40 to a few hundred watts.

Velocity Transformer

Fatigue strength sets a relatively low limit for the amplitude that can be obtained by a simple transducer. To increase the amplitude at the drilling bit, a velocity transformer is utilized. The velocity transformer generally consists of a tapered metal stub, of suitable high fatigue strength and high mechanical Q, which is rigidly bonded to the transducer face. They are designed to be resonant at the transducer

Fig. 19: Three ceramic spacer holes cut in one operation
Photo—Raytheon Mfg. Co.





Photo—Gulton Industries, Inc.
Fig. 20: Ultrasonic drill is used on very hard materials

frequency, as this not only simplifies the design calculations, but it also allows interchangeable stubs to be used without changing the distribution of the nodal planes in the system or its resonant frequency. Effectively the stub acts as a mechanical amplifier.

Quite often the tool bit will have a second velocity transformer on it which is made to screw into the first velocity transformer. Practically all types of ultrasonic machining are slight modifications of the above.

Basically there are two types of operations carried out with these ultrasonic machines. The two types are: stock removed by frictional forces (as in lapping or sizing in existing hole, where the abrasive is rubbed over the surface) ; or by hammer blows (as in direct slicing or piercing operations). In both cases the material removal is achieved essentially by a chipping action. This limits the technique to comparatively brittle materials and cannot be successfully applied to very soft or merely tough substances. On the other hand, the tool, which is also subject to wear, is best formed from a tough but not brittle metal in which the abrasive grains can inbed themselves without chipping.

Machining Action

The liquid medium holding the abrasive in suspension (slurry) plays a three-fold role: It acts as a coolant for the tool and work piece; by capillary action it allows the abrasive to flow to the work area and the worn material to escape; and it achieves a good acoustic bond between the tool and abrasive allowing for an efficient transfer of energy.

Machining is accompanied by a violent cavitation of the liquid between the tool and the work. Cavitation hiss can usually be distinguished above the noise of the actual machining. Cavitation occurs in the form of streamers of bubbles originating from points on the tool and work. In many cases, cutting rates have been found to correlate with cavitation intensity.

The equipment physically looks like a standard type of an industrial drill press. The drill bits or tools may be made to just about any shape. Microscopic sized and curved holes as well as multiple holes may be drilled. Drill bits have been used up to 200 times before replacing. This is determined by the material to be drilled and the bit material.

Testing and Detection

Probably the oldest form of ultrasonics is sonar, used by the Navy for detection of surface and submerged craft. Technically a sonic device, sonar measures the range, bearing and depth of an object. The word sonar means SOund Navigation And Ranging.

Aside from its use as a tactical weapon, sonar is also used commercially for depth measurement, searching for submerged objects and locating schools of fish. A form of sonar is even being used as an underwater telephone by the Navy for short ranges. The signal may be keyed like telegraph or voice modulated.

Flaw Detection

A form of sonar is being used to detect flaws in metals, rubber, and other materials. Flaw detectors operating from 500 KC to 100 MC are commercially available. The flaw detection device basically consists of a transducer, transmitter, time base generator, receiver, and a display device.

The transducer is normally made of quartz for these frequencies but barium titanate is also being used in some cases. The transmitter is of a simple design with plug-in coils to vary frequency. The time base generates a trigger for the transmitter and the display device. Receiver requirements are rather severe when it shares a common transducer with a transmitter, due to the need of quick recovery time. The receiver also requires good bandwidth with an amplifier gain at about 100 db. The display device is usually some form of a synchroscope.

The flaw detector may consist of one transducer which is used by both the receiver and the transmitter, or separate transducers for each. Where two transducers are used, they are either placed on the same side of the object to be tested—this case the receiver is working on an echo—or on opposite sides. The latter arrangement uses a transmitted method.

The detection equipment is made to operate at several frequencies. The frequency output of the transmitter is usually in multiples of harmonics or subharmonics of the transducer resonant frequency. In some cases the crystal section of the transducer may be interchanged at various frequencies.

The best way of testing for flaws is to submerge the object in a fluid, but there are times when this cannot be done. In these cases the coupling of the transducer to the material may be done with the use of oil or water on the surface of the object. Detected flaws are indicated on the display device.

This flaw detection equipment has the advantages of being readily portable and giving immediate indications.

Burglar Alarms

Ultrasonic burglar detection equipment which operates around 20 KC is commercially available for plant or office protection. The equipment consists of two transducers—one for transmitting, and one for receiving—and an ultrasonic transmitter, receiver, and comparator. The two transducers are connected to the electronic comparator which continuously compares the transmitted signal with the one received. As long as the waves are undisturbed the equipment remains silent. An intruder in the area disturbs the ultrasonic waves and triggers the alarm.

The alarm can be sounded in the room, outside the room, or at a central station. Equipment sensitivity can be controlled to eliminate the possibility of false alarms caused by the movement of rodents and other small animals. A movement of an air mass above a flame will actuate the alarm. Also a ruptured sprinkler pipe or steamline can be detected.

Photo—Raytheon Mfg. Co.

Fig. 21: An impact grinder for ultrasonic machining use

Flow Meter

The ultrasonic flow meter is expected to find a ready market with pipeline companies. It is now being used to measure fuel flow in aircraft, missiles and small pipelines.

The velocity of a flowing liquid can be determined by the change it produces in the relative phase between the transmitter and receiver when an ultrasonic beam is directed through it. It will measure precise mass flow rates under wide environmental conditions without placing any obstruction in the fluid path.

The transmitting and receiving transducers are placed in opposite sides of the pipe. The detected output of the receiver is fed into standard telemeter and recording systems. Flow rates to 4000 gallons per minute have been recorded.

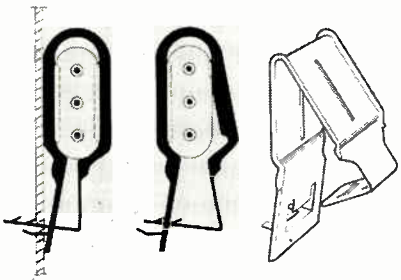
Another ultrasonic device still under development

(*Continued on page* 132)

New Products . . . for the Design Engineer

QUICK FASTENER

A new Speed Clip designed to accommodate and retain any of the popular single or multiple wire cord sizes for appliances and other products is available. Designed with 2



locking steps, it is merely slipped over a wire and prelatched, or compressed to the first locking position. Locking tabs on the underside of the clip locate and center the latching leg over the hole in the panel. On compression to the second locking position, the latching leg is forced rearward by the locking tabs to catch the underside of the panel. Tinnerman Products, Inc., Cleveland, Ohio.

Circle 201 on Inquiry Card, page 101

TRAVELING WAVE TUBE

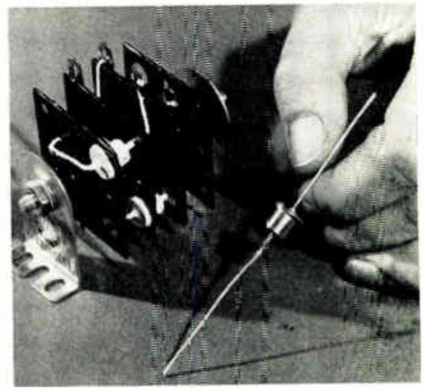
These tubes, a type of traveling wave tube, have applications in advanced types of multi-channel telephone and TV systems using circular waveguide for transmission, high

definition short range radar, highly directive communications, microwave spectroscopy, and as signal sources in the millimeter wavelength region. TE-57 typical electrical characteristics are: frequency range, 49 KMC-59 KMC; anode voltage, 1000-3000 v.; power output, 10 mw.; beam current, 10 ma; magnetic field, 1300 gauss; heater voltage, 6.3 ± 10%. Bendix Aviation Corp., Eatontown, N. J.

Circle 203 on Inquiry Card, page 101

SILICON RECTIFIERS

Three new silicon power rectifier diodes (Types 305, 320 and 321) are now available. Particularly designed for all types of power applications, these new hermetically sealed silicon

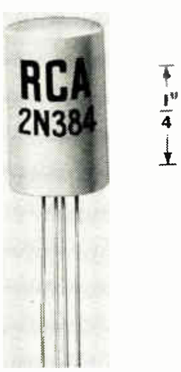


rectifying cells provide dc forward currents up to 1.6 a. with a maximum piv. up to 800 v. Maximum forward voltage drop at 1 a. and 125° C case temperature is 1.3 v. The peak leakage current at the same case temperature will not exceed 1.5 ma. Maximum operating frequency is 50 KC. Operating junction temperature is 175° C. Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

Circle 205 on Inquiry Card, page 101

DRIFT TRANSISTOR

The 2N384 is a hermetically sealed drift transistor of the germanium p-n-p type. It is designed primarily for military and industrial use as an oscillator up to 250 MC or as an r-f amplifier in compact mobile communications equipment. It features a frequency of 250 MC for unity power amplification, an alpha cutoff frequency of 100 MC, a collector transi-

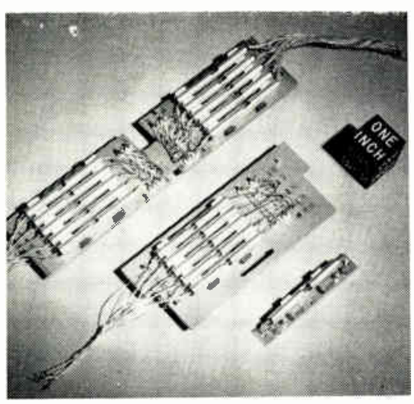


tion capacitance of 1.3 µf, a base resistance of 50 ohms, and a dissipation rating of 120 mw. at 25° C and 35 mw. at 71° C. Semiconductor Div., Radio Corporation of America, Somerville, N. J.

Circle 202 on Inquiry Card, page 101

MAGNETOSTRICTION FILTERS

These filters are now being produced in a variety of frequencies and bandwidths for use on spectrum analyzers, as narrow band circuit filters, as the frequency-determining element for oscillators, and for use as a comb-filter arrays in classified equipment. Magnetostriction filters and filter arrays are adaptable to either transistor or vacuum tube cir-

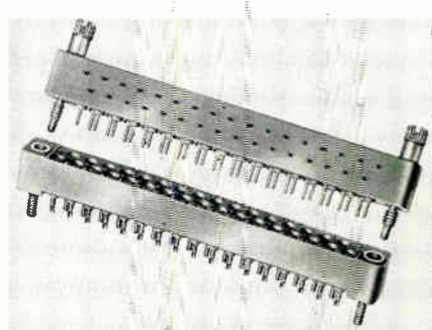


cuits. They can be used in telemeter systems, coding and decoding devices, and other systems where single or multiple narrowband filter channels are required. Raytheon Manufacturing Co., Bedford, Mass.

Circle 204 on Inquiry Card, page 101

P-C CONNECTORS

These right angle precision connectors are designed for printed board or printed cable applications, and meet airframe requirements for vibration and high altitude. Contact spacing is based on 0.100 grid in accordance with the latest E.I.A. (formerly RETMA) printed circuit specs. Series 683 connectors available in 11 or 33 contacts. Standard molding compound is min-



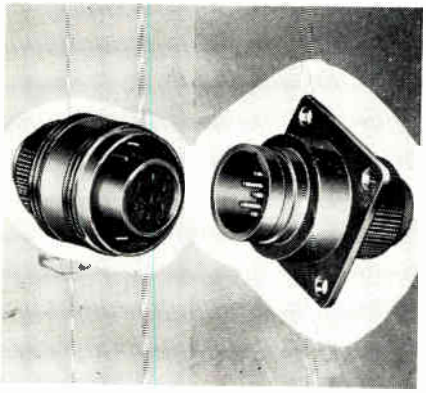
eral filled melamine, others on request. In addition to the regular solder cup, receptacles can also be supplied for solderless wiring. DeJur-Amsco Corp., 45-10 Northern Blvd., Long Island City 1, N. Y.

Circle 206 on Inquiry Card, page 101

New Products . . . for the Electronic Industries

CONNECTORS

The "Q" quick-disconnect series is the latest addition. It has environmental-resistant features making it adaptable for aircraft usage. Available in three sizes with 3 shell con-

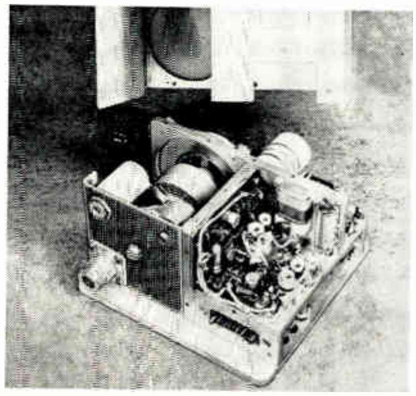


figurations: a QO2 square-flanged receptacle; a QH25 hermetically sealed round-flange receptacle; and a QO6 straight plug. The engagement is accomplished and locked by means of a beryllium copper latch within the plug coupler assembly. Connector is then completely sealed. Mated connector resists vibration without the use of safety wiring. Cannon Electric Co., 3208 Humboldt St., Los Angeles 31, Calif.

Circle 207 on Inquiry Card, page 101

TELEMETERING TRANSMITTER

Transistorized to practical limits, a new 200 w. PM transmitter increases substantially the effective range of FM/FM telemetering. The new equipment is complete in a

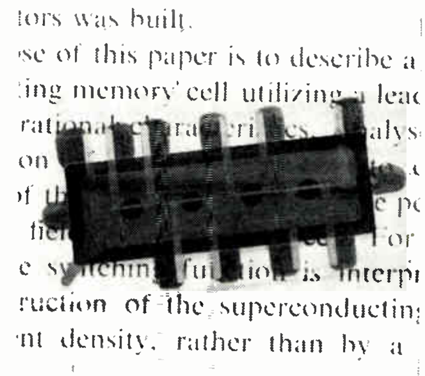


single unit. It occupies 67 cu. in. The new units transmit in the 215-235 MC range with frequency stability of ±0.01% up to 71° C. Higher frequencies are possible with minor modifications. Basic unit also can be modified to operate at power outputs as low as 25 w. Integral "heat sink" provisions are suited to missile requirements. Texas Instruments Incorporated. 6000 Lemmon Ave., Dallas 9, Tex.

Circle 209 on Inquiry Card, page 101

MEMORY DEVICE

Development of a super high speed memory device, which responds in a hundred millionth of a second has been announced. The device utilizes a miniature printed circuit of metallic



lead at temperatures close to absolute zero (−459.7° F.). It's for use in high speed, high capacity electronic computers. An advantage of the device is that it requires only about a third of the current needed to drive the ferrite memory units now widely used in electronic computers, while providing an increase in speed of about 100 times. International Business Machines Corp., 590 Madison Ave., New York 22, N. Y.

Circle 211 on Inquiry Card, page 101

METALLIZED CAPACITOR

The new mylar metallized capacitor, Type RQL is now available. This miniature unit in a hermetically sealed case is reliable at temperatures up to 125° without derating. Type RQL is available in a wide range of case styles and constructional variations similar to those from type CPO 4 thru CPO 11 in Mil-C-25A. Elec-

trical specifications of Mil-C-18312, the military specification recently issued by the U. S. Navy for metallized capacitors, are met. Astron Corporation, E. Newark, N. J.

Circle 208 on Inquiry Card, page 101

POWER PENTODE

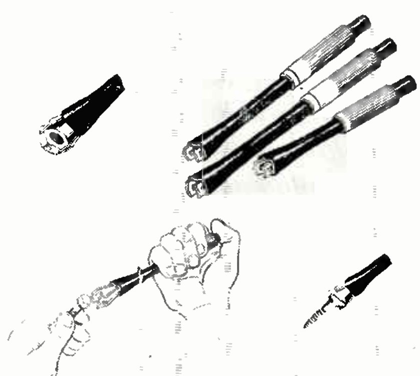
The type 6BQ5A tube, a 9 pin, miniature power pentode designed primarily for use as a class B power amplifier in hi-fi audio equipment of over 20 watt capabilities is available. The 6BQ5A delivers 24 watts output with only 4% distortion. The new type has incorporated internal construction improvements making for

higher power output with less distortion. It is not intended to replace the type 6BQ5 in all applications. Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y.

Circle 210 on Inquiry Card, page 101

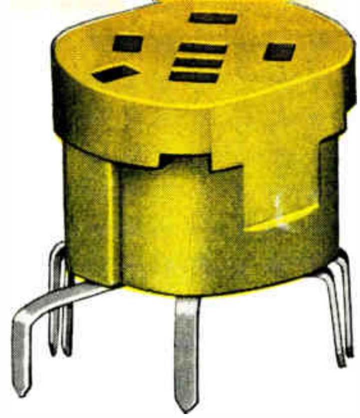
TIP WRENCH

The Tip Wrench tightens or loosens nuts, bolts, and slotted machine screws. It eliminates finger fumbling and makes it easy to get into hard-to-reach places. By applying thumb pressure on the plunger head, the jaws open and slide out to the desired size, as pressure is released the user is ready to go in and complete the



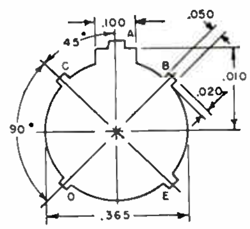
job. Capacity ranges from No. 2 to No. 12 nuts and bolts. The tool is completely shock proof. Tipco Manufacturing Co., 14758 Calvert, Van Nuys, Calif.

Circle 212 on Inquiry Card, page 101



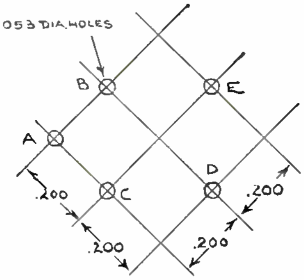
STAND-OFF Type Universal Transistor Socket. Shown four times actual size

NEW CINCH
UNIVERSAL TRANSISTOR SOCKETS

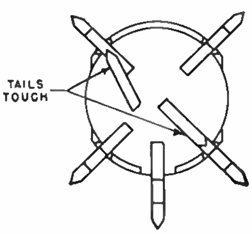


CHASSIS LAYOUT

SCALE TWICE ACTUAL SIZE



CHASSIS DRILL PATTERN

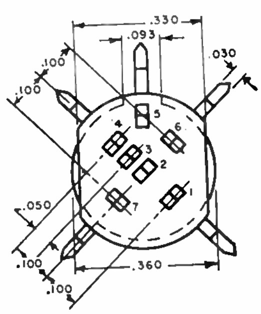


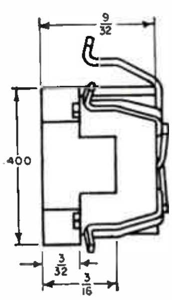
New Universal Transistor Sockets for use with the ten transistor bases illustrated and the five base types shown. Casting is mica-filled phenolic (MFE).

Contacts are beryllium copper, gold plated. Contacts may be used with either one or two sided 1/16" p. w. boards. Table at lower left lists the chassis cutout tabs required for the various base types.

STAND-OFF TYPE UNIVERSAL TRANSISTOR SOCKET

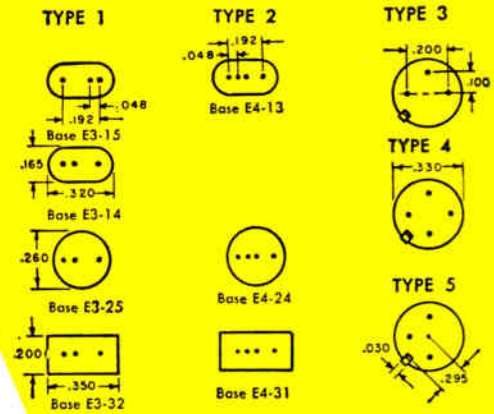
☆ "CINCH components for printed circuitry", 24 page catalog, available on request.





No. 24419

TRANSISTOR BASES FOR THE NEW UNIVERSAL TRANSISTOR SOCKETS



CHASSIS CUTOUT TABS REQUIRED FOR THE VARIOUS BASE TYPES

Part No.	Transistor Base Types	Chassis Cutout Tabs Used	Contact Positions Used
46T24443	All	A, B, C, D, E	All
46T24444	1 & 3	C, D, E	1, 3, 4, 7
46T24445	2 & 3	B, C, D, E	1, 2, 3, 4, 7
46T24446	3	C, D, E	1, 4, 7
46T24447	4	A, B, C, D, E	1, 4, 5, 6, 7
46T24448	5	B, D, E	1, 6, 7
46T24419	1 & 3	C, D, E	1, 3, 4, 7

In positions where contacts are not required, cavity for contact is also omitted except in position 5, on sockets 46T24444, 24445, 24446, and 24448.

CINCH will design, or re-design, components to fit specific needs, and will assist in the assembly of components through proven automation technique.

Cinch ELECTRONIC COMPONENTS

Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; La Puente, California; St. Louis, Missouri

CINCH MANUFACTURING CORPORATION
1026 South Homan Ave., Chicago 24, Illinois
Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

Circle 42 on Inquiry Card, page 101

New Products ...for the Electronic Industries

ELECTRONIC VOLTMETER

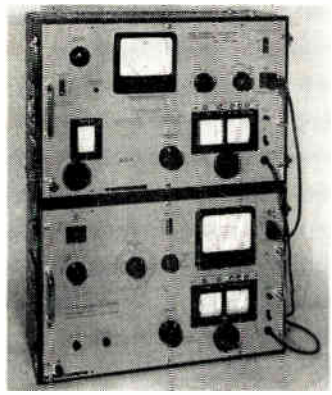
A new, stable, sensitive electronic voltmeter, designed for measuring ac voltage in systems where it is imperative to know the true RMS magnitude of nonsinusoidal periodic waveforms

or noise potentials is available. The model 14A true RMS voltmeter features accuracy in combination with rugged, compact construction. Low-current-consuming transistors, space-saving printed wiring, and dependable miniature components have been used. It operates on 115 volt, 60 cps ac. Indicates from 0.5 mv to 200 v. at 15 cycles to 500 kc. Alectra Div., Consolidated Electrodynamics Corp., 325 N. Altadena Dr., Pasadena, Calif.

Circle 213 on Inquiry Card, page 101

CARRIER MEASURING

A diversity of wide and narrow band carrier frequency level measurements and complex wave form analysis at frequencies from 2 KC to 1350 KC are made possible by a carrier

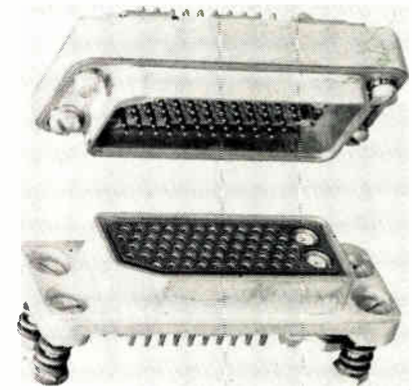


frequency level transmitter and a selective level meter introduced. The carrier frequency level transmitter is designated as Type TEPS-75. The meter is Type TEPM-76. The two instruments are always tuned to the identical frequency. Both have frequency range in 4 steps for narrow band and continuous tuning for wide band measurements. International Telephone and Telegraph Corp., 100 Kingsland Rd., Clifton, N. J.

Circle 215 on Inquiry Card, page 101

RACK & PANEL CONNECTORS

Environmentally sealed rack and panel connectors are designed for potting. Available with 57 electrical contacts and 2 coaxial connectors or 75 electrical contacts with 3 coaxial



connectors. Electrically rated at 7½ amps per contact at 600 vdc. Coaxial connectors have captivated contacts, accommodate RG-58/U or RG-141/U and have a nominal impedance of 50 ohms. Temperature ranges: −65° C to +125° C with appropriate potting compound. Features include: spring-loading of female connector; no air voids and hooded female contacts. Amphenol Electronics Corp., Chicago 50, Ill.

Circle 217 on Inquiry Card, page 101

HI-TEMP SWITCH

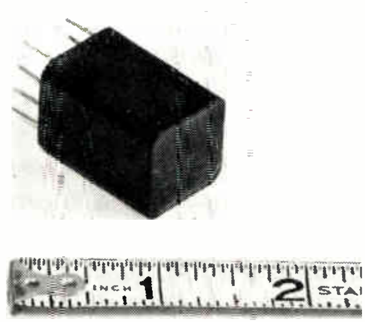
The new basic switch S9-4 provides precision tolerances in an ambient temperature range of −100° to +900° F. The ceramic case contains the switch mechanism for single pole, double throw two circuit electrical control with a probable mechanical life of 750,000 cycles of operation.

The staggered screw terminals, made of stainless steel, permit easy wiring. The switch case measures 1¼ in. long with standard 0.101 dia. mounting holes. Rated at 5 a. 125/250 vac., 30 vdc. Ind. Electro Snap Switch & Mfg. Co., 4218 W. Lake St., Chicago 24, Ill.

Circle 214 on Inquiry Card, page 101

SMALL TRANSFORMERS

Miniaturized transformers for handling a wide range of audio and carrier frequencies, and designed especially for mounting on printed wiring boards are being produced. Core structures of these are nickel-iron laminations for the audio frequency units, and ferrite for the carrier frequency

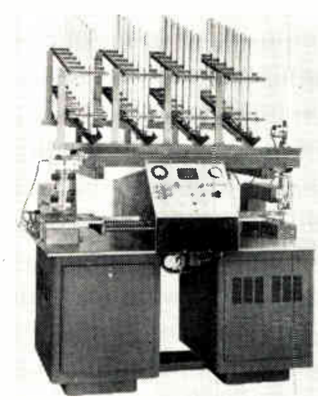


ranges. Windings are of polyurethane-insulated copper wire separated by Mylar. Cases are injection-molded phenolic in 2 sizes, 1 1/16 x ¾ x ¾ in., and 1 1/16 x 15/15 x 1⅛ in. Telecommunication Div., Stromberg-Carlson, Rochester 3, N. Y.

Circle 216 on Inquiry Card, page 101

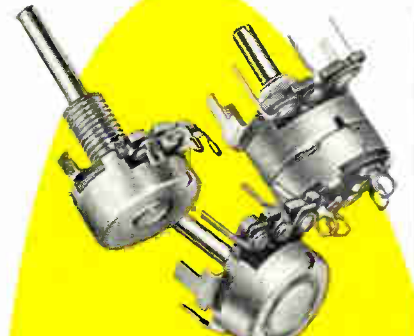
PRODUCTION MACHINERY

The Automatic Auto-Board positions circuit boards; drills holes; selects components; inserts components in proper sequence; and completes hundreds of operations in minutes. Circuit boards are set into place with precision accuracy. Information from punched tape is accurately translated



into automatic drill-positions. Selects components of up to 24 different values. Each component is inserted in proper engineering sequence. Eyelets, terminal pins are inserted securely, accurately. Design Tool Corp., 80 Washington St., New York 6, N. Y.

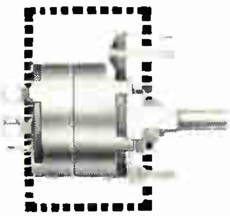
Circle 218 on Inquiry Card, page 101



WHEN IT COMES TO MINIATURE CONTROLS...

CHECK THE OVERALL SIZE...

including switch, if needed. For practical space-saving ability, Stackpole miniature "F" Controls lead the way — only 0.637" in diameter behind the panel for the entire length of *both* control and switch.



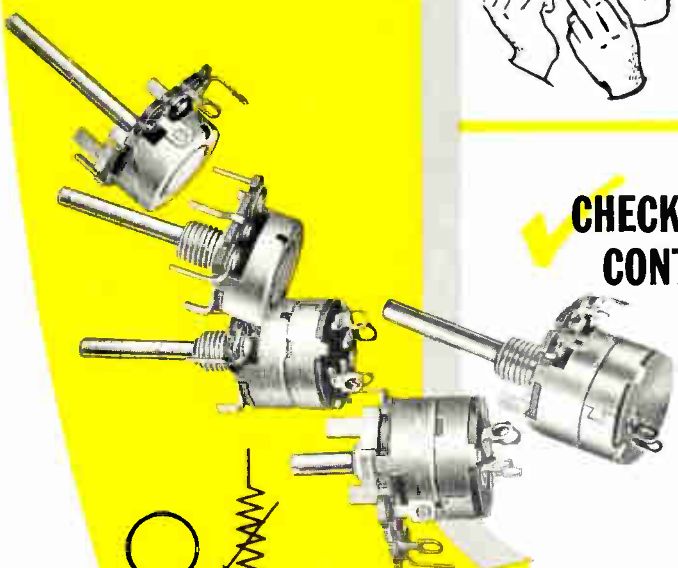
Photos show side and rear views of a Stackpole F Control with 2-pole switch. Dotted lines indicate behind-panel space occupied by a conventional "miniature" control.

Notice how Stackpole's small switch size perfectly complements the miniature control . . . saves precious chassis space where it's needed the most.

FEEL and HEAR THE SWITCH ACTION...

for the tease-proof, positive "feel" and audible "click" only a true snap-action switch provides. "B"-Series switches used on "F" Controls have the same time-proven mechanism as larger Stackpole control switches. They're U.L. Inspected for 1 amp. @ 125v ac-dc; 4 amps @ 25v dc.

CHECK THE COMPLETENESS OF BOTH CONTROL and SWITCH LINES



Printed wiring, wire-wrap, or standard lug terminals as well as fold-tab or threaded bushing mountings are available on all Stackpole miniature "F" controls. *Both* SPST and DPST switches can be supplied.

STACKPOLE

miniature "F"-series

VARIABLE RESISTORS

Electronic Components Division

STACKPOLE CARBON COMPANY, *St. Marys, Pa.*

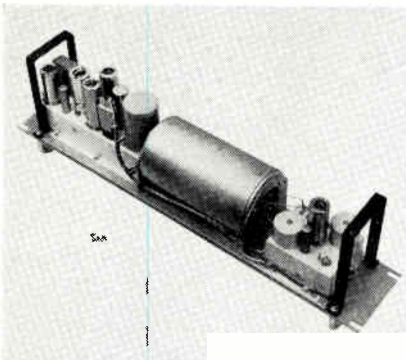
In Canada: Canadian Stackpole Ltd., 550 Evans Ave., Etobicoke, Toronto 14, Ont.

FIXED & VARIABLE COMPOSITION RESISTORS • SLIDE & SNAP SWITCHES • IRON CORES • CERAMIC MAGNETS
FIXED COMPOSITION CAPACITORS • CERAMAG® FERROMAGNETIC CORES
HUNDREDS OF CARBON, GRAPHITE, AND METAL POWDER PRODUCTS.

New Products . . . for the Design Engineer

1-MC OSCILLATOR

Precision temperature control, through a specially designed proportionally-controlled oven system, provides an output frequency stability of better than 1 part in 10^8 per day for



a new, low-cost 1 mc crystal oscillator now available. Called the RD-140, the instrument consists of a one-tube (6AH6) oscillator assembly, a thermo-oven, which houses the crystal, and an oven control amplifier, each of which are so compact in size that all 3 have been mounted on a 3½ in. high standard 19 in. relay-rack panel. Manson Laboratories, Inc., 207 Greenwich Ave., Stamford, Conn.

Circle 195 on Inquiry Card, page 101

PILOT LIGHT

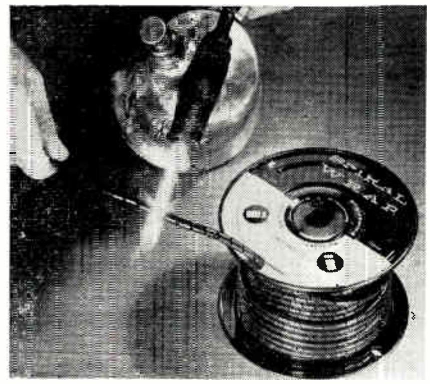
This newly designed Pilot Light provides a unit that offers the dual advantage of ultra-compactness and the features of sub-miniature neon glow lamps. It houses the NE2D.

Features are: overall size, ¾ x 1¼ in. mounts in 17/32 in. clearance hole from front of panel. The stovepipe shaped cap of high-heat plastic provides 180° visibility; it is available in clear red, amber, yellow, and white. All metal parts are made of brass with black nickel finish, or white nickel or chrome finish when so ordered. Dialight Corp., 60 Stewart Ave., Brooklyn 37, N. Y.

Circle 197 on Inquiry Card, page 101

HARNESS MATERIAL

The material used in Spiral Wrap-RN is a special formulation of polyethylene that is exposed to high energy radiation of an electronic beam generator after extrusion. The re-

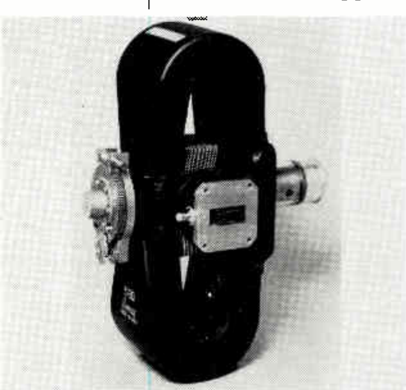


sultant product has no melting point. Spiral Wrap-RN can withstand continuous temperatures of 150° C., and will not "cold flow" under pressure at any temperature. It can also be exposed to higher temperatures for shorter periods of time. For instance, it can withstand 270° C. for 48 hours. Can also operate continuously as low as −320° F. Illumitronic Engineering, 680 E. Taylor, Sunnyvale Calif.

Circle 199 on Inquiry Card, page 101

TUNABLE MAGNETRON

The latest addition of microwave oscillator tubes is the 5780 tunable X-band magnetron. It is an integral magnet, air-cooled, pulse type magnetron, which is continuously tunable over a frequency range of 8500 to 9600 MC. Capable of reliable performance at over 300 kw (peak) power output. It is well adapted for use in short pulse, X-band applica-

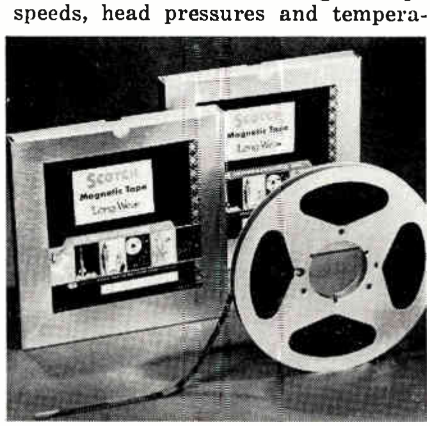


tions where high power output is desired. The cathode terminal and mounting plate are designed to fit the standard fixed-frequency 4J50 mounting socket. Bomac Laboratories Inc., Salem Rd., Beverly, Mass.

Circle 196 on Inquiry Card, page 101

INSTRUMENTATION TAPE

Long-wearing magnetic tapes for instrumentation use have been introduced. The new "Long Wear" magnetic tapes, latest addition to the "Scotch" brand instrumentation tape line, are designated No. 148 and No. 149. They are expected to find wide use throughout the instrumentation recording field wherever higher tape speeds, head pressures and tempera-

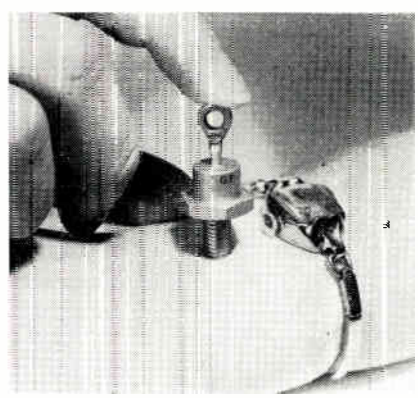


tures (up to 200°F.) are encountered. Such applications include airborne and telemetering recording, computers, tape control systems, and geophysical recording. Minnesota Mining and Mfg. Co., St. Paul, Minn.

Circle 198 on Inquiry Card, page 101

RECTIFIERS

A new series of 20-ampere stud-mounted 200° C. silicon rectifiers are on the market. They have been built to take extreme punishment and are designed to meet rigid military mechanical specifications. Presently there are four types which comprise the series. These have been JETEC type-designated 1N1301, 1N1302, 1N1304, and 1N1306. Respectively,



they have peak inverse voltage ratings of 50, 100, 200, and 300 volts. Maximum leakage current rating on the rectifiers is 5 milliamperes. General Electric Semiconductor Products, Electronics Park, Syracuse, N. Y.

Circle 200 on Inquiry Card, page 101

Specify

MOTOROLA POWER TRANSISTORS

for outstanding performance and proven reliability in military, industrial and commercial applications

GENERAL SPECIFICATIONS

TYPE NUMBER	BV_{CBO} volts	BV_{CES} volts	h_{FE}	G_e db	P_o class A @ 75°C watts	F_{ae} kc
MN21 (2N375 Reserved)	−80	−65	55	37	5	10
2N176	−40	−30	60	35	2	7
2N178	−40	−30	30	30	2	5
MN26 (2N376 Reserved)	−40	−30	80	36	4	7
MN25 (2N351 Reserved)	−40	−30	60	34	4	7
MN24 (2N350 Reserved)	−40	−30	40	32	4	7
MN28	−30	−20	65	32	2	8
MN29	−40	−30	65	35	2	8

- High power output — low distortion
- Reliable high-temperature performance
- More stable with heat cycling
- Maintain gain at high power
- Proven reliability — highest quality construction
  Millions of Motorola power transistors have successfully withstood the only real test of reliability — months of customer use with virtually no failures.
- "Productioneered" — Motorola power transistors are engineered for extreme quality . . . in quantity. You are assured a dependable supply at the most competitive prices. Motorola has produced more power transistors than any other manufacturer.

For complete technical information concerning these and other performance-proven Motorola Semiconductors, write, wire or phone
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High-Power Audio Transistors · High-Voltage Power Transistors · Silicon Power Rectifiers · Audio, Switching & RF Transistors

Circle 44 on Inquiry Card, page 101

WASHINGTON

News Letter

CONGRESSIONAL SPECTRUM STUDY—The House Interstate and Foreign Commerce Committee—which has jurisdiction over communications-radio-FCC matters—plans an examination of the frequency allocations problem during the new session of Congress, its Chairman Oren Harris (D., Ark.) has announced. Rep. Harris stated that "under the present law the FCC distributes among broadcasters, common carriers, and others, those frequencies which are left over after the Federal Government has had its pick of the spectrum for its own use by the armed forces, civil aviation and others."

DIVIDED RESPONSIBILITY—This situation, Congressman Harris emphasized, "requires an examination of whether the tremendous developments which have taken place in the field of communications require a new statutory approach to the problem of distributing available spectrum space among governmental as well as private claimants." The House Committee Chairman indicated he was particularly concerned with the divided governmental responsibility on frequency allocations—the Interdepartment Radio Advisory Committee (IRAC) established by the President to determine the government's spectrum needs, and the FCC to make the allocations for all civilian requirements.

SCIENTIFIC EDUCATION—In conformity to the strong editorial views of ELECTRONIC INDUSTRIES of the imperative need for the advancement of scientific education in the national interest both in defense preparedness and continued economic progress, the National Science Foundation—the independent federal government agency in that field—has awarded grants totaling $4,350,000 to 17 universities and colleges to aid 800 high-school science and mathematics teachers in pursuing advanced studies in their fields. The aid program starts in September, 1958, when the 800 teachers will enroll in seventeen colleges and universities which are "institutes" of the National Science Foundation selected for this program to stimulate scientific education.

INCREASE SCIENTIFIC INTEREST—The 17 "institutes" of the National Science Foundation have "two constructive end products" in this service, Director Alan T. Waterman states. Not only will it give greater knowledge and training to present science-mathematics teachers but it will encourage prospective teachers. It likewise has a major objective of being "the keystone in the bridge" between students and their motivation toward careers in science. Dr. Waterman stresses that through this program of advanced education for science-mathematics teachers the latter can render intelligent answers raised by their students about "atomic reactors and accelerators, computers, transistors, radio telescopes, and the other tools of advancing science."

MAY GO TO COURT—The Justice Department has informed the FCC that it will be "under an obligation" to resolve any "conflict" of interpretation of the Bell System anti-trust consent decree in regard to the lease-maintenance tariff of the American Telephone & Telegraph Co. Long Lines Department for private mobile radiotelephone systems by placing the matter before the federal court which issued the consent decree. The Justice Department stated that it would take this action if the FCC permits the tariff to become effective. It took the stand that antitrust considerations make it clear the FCC does not have regulatory jurisdiction over the tariff and therefore on the basis of antitrust considerations the FCC should reject the tariff.

AIR TERMINAL SERVICE—The size, complexity and variety of service operations carried on at a modern airport, Aeronautical Radio, Inc., emphasized to the FCC, urgently require establishment of a separate air terminal mobile radio service. ARINC petitioned the Commission to set up this new radio service with five pairs of exclusive frequencies in the 150-162 and 450-470 megacycle bands and stated that the spectrum space assigned to the citizens and low power industrial radio services and the proposed business radio service, presently being shared under FCC planning by airport terminals, are inadequate for the airports' requirements. The Arinc proposal for five exclusive channels to the FCC was based on a survey of the mobile radio requirements at the Idlewild and LaGuardia, N. Y., airports. Coordination of airport activities with the tremendous increase in flights can only be accomplished through radio communications, Arinc stated.

PAY-TV SITUATION—The new session of Congress, starting in January, may spell out to a large extent the future progress of pay or subscription television getting started as a public service. The FCC, as has been noted in this column, has granted the pay-TV industry the right to propose trials of their service after March, 1958, and in this action allowed Congress ample time to make its wishes clear. Two leading Congressmen, both chairmen of key House committees—Celler (D., N. Y.) of the Judiciary Committee and Harris of Interstate Commerce Committee—have announced their doubts as to whether or not pay-TV should ever be established.

National Press Building
Washington 4

ROLAND C. DAVIES
Washington Editor

Circle 45 on Inquiry Card, page 101 →

AUTOMATIC

for

ALL YOUR NEEDS IN

silicon power rectifiers

THE MOST COMPLETE
LINE OF SILICON RECTIFIERS
COVERING THE RANGE FROM
100 MA TO 20 AMPS

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AUTOMATIC silicon power rectifiers

STUD MOUNT TYPES

MILITARY TYPES — JAN SERIES 1N253, 1N254, 1N255 AND 1N256

This series meets all the rigid electrical, mechanical and environmental requirements of MIL-E-1 specification. You are assured of highest quality and reliable performance.
Peak inverse voltages of 100 to 600 are available with DC ouput currents of 200 ma to 1 amp.

GENERAL PURPOSE TYPES — 1N550 THROUGH 1N555 SERIES

This series is suitable for all magnetic amplifier, power supply and DC blocking applications requiring 500 MA average rectified current over the range of 100 through 600 volts peak inverse.

HIGH VOLTAGE TYPES — 1N562 AND 1N563

These rectifiers cover the range of 800 to 1000 volts peak inverse with a DC output current of 400 MA. They are single junction devices offering the lowest possible forward voltage drop for high voltage service.

PIGTAIL TYPES

MILITARY TYPES — 1N538, 1N540, AND 1N547

Peak inverse voltages of 200 to 600 are available with DC output currents of 250 ma at 150°C ambients. Meets all rigid requirements of MIL-E-1 specifications.

MAGNETIC AMPLIFIER TYPES — 1N440 THROUGH 1N445 SERIES

This series of rectifiers incorporate the most rigid electrical specifications currently being offered and has set the standard for the industry regarding quality for magnetic amplifier applications. Available with peak inverse voltages of 100 to 600 and DC output current of 300 MA.

POWER SUPPLY TYPES — 1N530 THROUGH 1N535 SERIES

Widely accepted for power supply applications, this series of rectifiers, which is available with peak inverse voltages of 100 to 600 and an average rectified current of 300 MA, has been used successfully in a multitude of military and commercial equipments.

GENERAL PURPOSE TYPES — IN1100 THROUGH IN1105 SERIES

This series of rectifiers, which is available with peak inverse voltages of 100 to 600 and an average rectified current of 250 MA at ambient temperatures of 150°C, is useful for all applications requiring a high quality rectifier. When used at lower ambient temperatures, rectifiers in this series can be operated at significantly higher DC output currents, namely, 750 MA at 25°C.

GERMANIUM REPLACEMENT TYPES — S-91 THROUGH S-93 SERIES

This series of rectifiers is designed to replace germanium types 1N91, 1N92 and 1N93. The advantages of silicon are offered at prices comparable to germanium, thus making this series admirably suited for use in commercial equipments where component cost is a factor.

HIGH POWER TYPES

5 AMPERE TYPES — AM0505 THROUGH AM3505 SERIES

This series of rectifiers covers the range of 50 to 350 volts with an average rectified current of 5 amperes at a case temperature of 135°C. Low leakage current makes high rectification efficiencies possible. These devices are very useful for the construction of various types of high power rectifier assemblies where a minimum of space is available and high operating temperatures encountered.

10 AMPERE TYPES — AM0510 THROUGH AM3510 SERIES

This series of rectifiers covers the range of 50 to 350 volts with an average rectified current of 10 amperes at a case temperature of 135°C. Low leakage current makes high rectification efficiencies possible. These devices are very useful for the construction of various types of high power rectifier assemblies where a minimum of space is available and high operating temperatures encountered.

20 AMPERE TYPES — AM0502 THROUGH AM3520 SERIES

This series of rectifiers covers the range of 50 to 350 volts with an average rectified current of 20 amperes at a case temperature of 135°C. Low leakage current makes high rectification efficiencies possible. These devices are very useful for the construction of various types of high power rectifier assemblies where a minimum of space is available and high operating temperatures encountered.

AUTOMATIC MANUFACTURING

AUTOMATIC MANUFACTURING
DIVISION OF GENERAL INSTRUMENT CORPORATION
65 GOUVERNEUR STREET
NEWARK 4, NEW JERSEY

MASS PRODUCERS OF ELECTRONIC COMPONENTS

ELECTRONIC INDUSTRIES' 1958 Semiconductor Diode Specifications

Here are the latest specifications of germanium and silicon diodes now available in the American market. Company-coded diodes are listed by manufacturer. Diodes registered with Electronic Industries Association (ex-RETMA) are detailed separately at the end of the chart. Manufacturers of each are indicated.

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
AMPEREX ELECTRONIC CORP. (A), 230 Duffy Ave., Hicksville, L.I., N.Y. EIA Diodes, and non-EIA types below:								
C60		30		25	500		25	75
C67		100	50@50	80	250	4	25	75
C68		130	625@100	100	350	3	25	75
C89		100	100@50	80	250	3.5	25	75
C95		75	500@50	60	300	10	25	75
C99		100	50@50	80	300	10	25	75
C116		75	100@50	60	300	5	25	75
C117		75	100@50	60	300	10	25	75
G48		85	50@10	70	400	4	25	75
G63		125	50@50	100	400	4	25	75
G67		100	50@50	80	250	4	25	75
G68		130	625@100	100	350	3	25	75
G89		100	100@50	80	250	3.5	25	75
OA5		100	11@100	100	500	200	25	75
AUTOMATIC MANUFACTURING DIV. (AM), General Instrument Corp., 65 Gouverneur St., Newark 4, N.J. EIA Diodes, and non-EIA types below:								
AM1		50	300	50	10A	2A@2	100	125
AM2		50	300	50	5A	800@2	100	125
AM3		50	300	50	3A	200@2	100	125
AM4		50	500	50	20A	2A@2	150	175
AM5		50	500	50	10A	.8@2	150	175
AM11		100	300	100	10A	2A@2	100	125
AM12		100	300	100	5A	800@2	100	125
AM13		100	300	100	3A	200@2	100	125
AM21		200	300	200	10A	2A@2	100	125
AM22		200	300	200	5A	800@2	100	125
AM23		200	300	200	3A	200@2	100	125
AM24		200	500	200	20A	2A@2	150	175
AM31		300	300	300	10A	2A@2	100	125
AM32		300	300	300	5A	800@2	100	125
AM33		300	300	300	3A	200@2	100	125
AM34		300	500	300	20A	2A@2	150	175
AM41		400	300	400	10A	2A@2	100	125
AM42		400	300	400	5A	.8@2	100	125
AM43		400	300	400	3A	.2@2	100	125
AM44		400	500	400	20A	2@2	150	175
AM51		500	300	500	10A	2@2	100	125
AM52		500	300	500	5A	.8@2	100	125
AM53		500	300	500	3A	.2@2	100	125
AM54		500	500	500	20A	2@2	150	175
AM55		500	500	500	10	.8@2	150	175
AM56		500	500	500	5	.4@2	150	175
AM61		600	300	600	10	2A@2	100	125
AM62		600	300	600	5	.8@2	100	125
AM63		600	300	600	3	.2@2	100	125
AM64		600	500	600	20	2@1.75	150	175
AM65		600	500	600	10	.8@2	150	175
AM66		600	500	600	5	.4@2	150	175
AM0505		50	5ma @50	50	15A	15A@1.25	150	200
AM0510		50	5ma @50	50	25A	25A@1.25	150	200
AM0520		50	5ma @50	50	50A	50A@1.25	150	200
AM1005		100	5ma @100	100	15A	15A@1.25	150	200
AM1010		100	5ma @100	100	25A	25A@1.25	150	200
AM1020		100	5ma @100	100	50A	50A@1.25	150	200
AM1505		150	5ma @150	150	15A	15A@1.25	150	200
AM1510		150	5ma @150	150	25A	25A@1.25	150	200
AM1520		150	5ma @150	150	50A	50A@1.25	150	200
AM2005		200	5ma @200	200	15A	15A@1.25	150	200
AM2010		200	5ma @200	200	25A	25A@1.25	150	200
AM2020		200	5ma @200	200	50A	50A@1.25	150	200
AM2505		250	5ma @250	250	15A	15A@1.25	150	200
AM2510		250	5ma @250	250	25A	25A@1.25	150	200
AM2520		250	5ma @250	250	50A	50A@1.25	150	200
AUTOMATIC MANUFACTURING DIV. Continued								
AM3005		300	5ma @300	300	15A	15A@1.25	150	200
AM3010		300	5ma @300	300	25A	25@1.25	150	200
AM3020		300	5ma @300	300	50A	50@1.25	150	200
AM3505		350	5ma @350	350	15A	15@1.25	150	200
AM3510		350	5ma @350	350	25A	25@1.25	150	200
AM3520		350	5ma @350	350	50A	50@1.25	150	200
AMS91		100	1ma @100	50	5A	200@1.5	85	150
AMS91H		100	500@100	80	5A	250@1.5	85	150
AMS92		200	1ma @200	100	5A	200@1.5	85	150
AMS92H		200	500@200	160	5A	250@1.5	85	150
AMS93		300	1ma @300	150	5A	200@1.5	85	150
AMS93H		300	500@300	240	5A	250@1.5	85	150
AMS315		300	500@300	150	5A	200@1.5	85	150
AMS368		200	500@200	100	5A	200@1.5	85	150
BENDIX AVIATION CORP. (B), Semiconductor Prods., Red Bank Div., 201 Westwood Ave., Long Branch, N.J. Non-EIA types below:								
X-403		250	150@200	250	250A	60A@1.5V	150	175
X-408		200	1ma @100	100	250A	10A@1.0V	150	175
BOMAC LABORATORIES, INC. (BO), Salem Rd., Beverly, Mass. EIA Diodes.								
CLEVITE TRANSISTOR PRODUCTS (C), 241 Crescent St., Waltham 54, Mass. EIA Diodes, and non-EIA types below:								
CTP301		-75	25@-50	-50	400	40	25	100
CTP313		-125	20@-100	-100	450	100	25	100
CTP316		-75	20@-50	-60	450	100	25	100
CTP319		-150	180@-90	-90	450	150	25	100
CTP358		-85	250@-45	-70	200	40	60	100
CTP395		-35	400@-20	-25	400	90	25	100
CTP396		-100	300@-80	-80	500	100	25	100
CTP411		-23	4@-3	-6		1.6@.3v	25	100
CTP420		-90	120@-60	-60	400	50@3v	25	100
CTP422		-25	50@-15	-15		40	25	100
CTP427		-100	150@-50	-50		10@.5v	75	100
CTP435		-25	75@-15	-15	400	5@.4v	55	100
CTP440		-60	40@-20	-40		10	50	100
CTP447		-25	20@-10	-15	200	40	75	100
CTP453		-60	100@-25	-50		50	25	100
CTP454A		-25	40@-10	-20		15@.5v	40	100
CTP456		-50	150@-40	-40		15	50	100
CTP459		-100	400@-80	-80	300	30	75	100
CTP460		-30	20@-10	-20	400	100	70	100
CTP470		-75	40@-20	-60		5	65	100
CTP473		-40	150@-30	-30	400	1@.35v	65	100
CTP484		-25	2@-5	-15		40	60	150
CTP485		-75	50@-50	-60	500	100	75	150
CTP490		-60	500@-50	-50	175	20	75	100
CTP504		-40	400@-30	-30		200	25	100
CTP522		-75	40@-30	-60		200	25	100
CS2300		-3	1@-2	-2		4@.7v	25	200
CS2301		-6	.1@-2	-4	500	100	25	200
CBS — HYTRON (CBS), Division of CBS Inc., Danvers, Mass. EIA Diodes, and non-EIA types below:								
DD4-37		Detector diode at 600kc, for experimenters and toys						
DT-46		15	30@-1.5	15		1@-12	25	75
DD4-51		30	150@-30	30		1@0.35v	25	75
DD4-55		90	80@-80	80	300	4.0	25	75
DT-61		90		60		50	25	75
GAHAGAN, INC. (G), Waterman Avenue, Esmond 17, R.I. EIA Diodes, and non-EIA types below:								
G87		50	2@-6V@25°C	30	500	10	55	70
G87B		50	5@-5V	35	500	10	25	70

PACIFIC SEMICONDUCTORS, INC. *announces*

a new dimension in circuit design...

a new subminiature component for

VOLTAGE TUNING

FREQUENCY MODULATION

AUTOMATIC FREQUENCY CONTROL

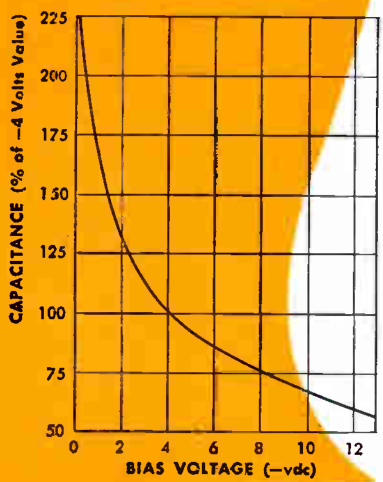
and many other applications

THE PSI *Varicap* T.M.

VOLTAGE-VARIABLE CAPACITOR

A new approach to circuit design is now made possible by the introduction of the new PSI Varicap... a silicon p-n junction device, capacitance of which can be varied by changing bias voltage, permitting extensive circuit simplification.

Constant capacitance throughout the temperature range from −65°C to 150°C. Relatively high-Q.



ELECTRICAL SPECIFICATIONS

VARICAP TYPE NUMBER	CAPACITANCE @ −4 VOLTS ($\mu\mu$ f)	MAXIMUM OPERATING VOLTAGE (VOLTS)	SERIES RESISTANCE		TYPICAL Q @ 50mc
			MAXIMUM (ohms)	TYPICAL (ohms)	
V20	20	−20	18	8.5	18.7
V27	27	−20	14	7.5	15.7
V33	33	−20	12	6.6	14.6
V39	39	−20	10	5.4	15.1
V47	47	−20	7.5	4.4	15.4
V56	56	−15	7	4.2	13.5

Write for complete specifications and additional applications.

Varicaps are now being shipped in sample and production quantities.

Specifications on germanium point contact diodes, silicon fast recovery diodes, silicon general purpose diodes, silicon high conductance diodes, silicon rectifiers.

pacific semiconductors, inc.

PSI T.M.

10451 WEST JEFFERSON BOULEVARD, CULVER CITY, CALIFORNIA

Circle 47 on Inquiry Card, page 101

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

GENERAL ELECTRIC CO. (GE), Semiconductor Dept., Syracuse, N.Y. EIA Diodes, and non-EIA 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
4JA60F		50	50ma@50	50	900A		160 120	
4JA60A		100	50ma@100	100	900A		•	
4JA60G		150	50ma@150	150	900A		•	
4JA60B		200	50ma@200	200	900A		•	
4JA60H		250	50ma@250	250	900A		•	
4JA60C		300	50ma@300	300	900A		•	
4JA61F		50	50ma@50	50	900A		160	
4JA61A		100	50ma@100	100	900A		160	
4JA61G		150	50ma@150	150	900A		160	
4JA61B		200	50ma@200	200	900A		160	
4JA61H		250	50ma@250	250	900A		160	
4JA61C		300	50ma@300	300	900A		160	
4JA62F		50	50ma@200	50	900A		120	
4JA62A		100	50ma@200	100	900A		120	
4JA62G		150	50ma@200	150	900A		120	
4JA62B		200	50ma@200	200	900A		120	
4JA62H		250	50ma@250	250	900A		120	
4JA62C		300	50ma@300	300	900A		120	
4JA62J		350	50ma@350	350	900A		120	
4JA63F		50	50ma@50	50	900A		120	
4JA63A		100	50ma@100	100	900A		120	
4JA63G		150	50ma@150	150	900A		120	
4JA63B		200	50ma@200	200	900A		120	
4JA63H		250	50ma@250	250	900A		120	
4JA63C		300	50ma@300	300	900A		120	
4JA63J		350	50ma@350	350	900A		120	
4JA3011A		100	10ma@100	100	120A		55	
4JA3011B		200	10ma@200	200	120A		55	
4JA3011C		300	7ma@300	225	120A		55	

HOFFMAN SEMICONDUCTOR DIV. (HE), Hoffman Electronics Corp., 930 Pitner Ave., Evanston, Ill. EIA Diodes.

HUGHES PRODUCTS (H), Hughes Aircraft Co., Semiconductor Div., Los Angeles 45, California. EIA Diodes.

INTERNATIONAL RECTIFIER CORP. (I), El Segundo, California. EIA Diodes, and non-EIA 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
1S1		60	15@-26v	26	5		85	100
2S1		120	15@-52	52	5		85	100
1T1		60	15@-26	26	10		85	100
2T1		120	15@-52	52	10		85	100
1U1		60	27@-26	26	80		85	100
2U1		120	27@-52	52	80		85	100
3U1		180	27@-78	78	80		85	100
4U1		240	27@-104	104	80		85	100
5U1		300	27@-130	130	80		85	100
6U1		360	27@-156	156	80		85	100
7U1		420	27@-182	182	80		85	100
8U1		480	27@-208	208	80		85	100
1V1		60	108@-26	26	250		85	100
2V1		120	108@-52	52	250		85	100
3V1		180	108@-78	78	250		85	100
4V1		240	108@-104	104	250		85	100
5V1		300	108@-130v	130	250		85	100
1Y1		60	240@26	26	550		85	100
2Y1		120	240@52	52	550		85	100
30LM1		50					100	150
30QM1		75					100	150
30SM1		100					100	150
30TM1		150					100	150
30UM1		200					100	150
30VM1		300					100	150
30WM1		400					100	150
150A20		30					40	75
150A26		39					40	75
150A33		50					40	75
150A42		63					40	75
150A52		78					40	75
150A66		100					40	75
330A20		30					40	75
330A26		39					40	75
330A33		50					40	75
330A42		63					40	75
330A52		78					40	75
330A66		100					40	75
500A20		30					40	75
500A26		39					40	75
500A33		50					40	75
500A40		63					40	75
500A52		78					40	75
500A66		100					40	75
670L20		30					40	75
670L26		39					40	75
670L33		50					40	75
670L42		63					40	75
670L52		78					40	75
670L66		100					40	75
D5410		380		130				
D5411		440		160				
D5412		380		130				
D5413		440		160				
D5414		380		130				
D5415		440		160				
D5416		380		130				
D5417		440		160				
D5418		380		130				
D5419		440		160				
D5420		380		130				
D5421		440		160				
66-0706		600	25@600		10A		75	150
66-0708		800	25@800		10A		75	150
66-0710		1000	25@1000		10A		75	150
66-0712		1200	25@1200		10A		75	150
Z1-3.9	1-watt Zener diode, 3.6-4.3V, 250ma max.						25	150
Z1-4.7	1-watt Zener diode, 4.3-5.1V, 200ma max.						25	150
Z1-5.6	1-watt Zener diode, 5.1-6.2V, 175ma max.						25	150
Z1-6.8	1-watt Zener diode, 6.2-7.5V, 150ma max.						25	150
Z1-8.2	1-watt Zener diode, 7.5-9.1V, 120ma, max.						25	150
Z1-10	1-watt Zener diode, 9.1-11V, 100ma max.						25	150
Z1-12	1-watt Zener diode, 11-13V, 80ma max.						25	150
Z1-15	1-watt Zener diode, 13-16V, 65ma max.						25	150
Z1-18	1-watt Zener diode, 16-20V, 55ma max.						25	150
Z1-22	1-watt Zener diode, 20-24V, 45ma max.						25	150
Z1-27	1-watt Zener diode, 24-30V, 35ma max.						25	150
Z3-3.9	3.5-watt Zener diode, 3.6-4.3V, 850ma max.						25	150
Z3-4.7	3.5-watt Zener diode, 4.3-5.1V, 700ma max.						25	150
Z3-5.6	3.5-watt Zener diode, 5.1-6.2V, 625ma max.							
Z3-6.8	3.5-watt Zener diode, 6.2-7.5V, 525ma max.							
Z3-8.2	3.5-watt Zener diode, 7.5-9.1V, 425ma max.							
Z3-10	3.5-watt Zener diode, 9.1-11V, 350ma max.							
Z3-12	3.5-watt Zener diode, 11-13V, 275ma max.							

INTERNATIONAL RECTIFIER 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
Z3-15	3.5-watt Zener diode, 13-16V, 225ma max.							
Z3-18	3.5-watt Zener diode, 16-20V, 200ma max.							
Z3-22	3.5-watt Zener diode, 20-24V, 160ma max.							
Z3-27	3.5-watt Zener diode, 24-30V, 125ma max.							

INTERNATIONAL RESISTANCE CO. (IR), 401 N. Broad St., Philadelphia 8, Pa. Non-EIA 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
9GA1[1]		36	1@20	22	3	.3	35	90
9GA125		4500	1@2500	2750		3@125		
19PA1[1]		36	15@20	22	20	2	35	90
19PA125		4500	15@2500	2750		2@125		
25PA1[1]		36	35@20	22	40	5	35	90
25PA200		7200	35@4000	4400				
28PA1[1]		36	45@20	22	60	10	35	90
28PA200		7200	45@4000	4400		10@200		
44PA1[1]		36	110@20	22	80	20	35	90
44PA200		7200	110@4000	4400		20@200		

1. Intermediate ratings available in increments of 36 PIV.

KEMTRON ELECTRON PRODUCTS, INC. (K), 14 Prince Place, Newburyport, Mass. EIA Diodes.

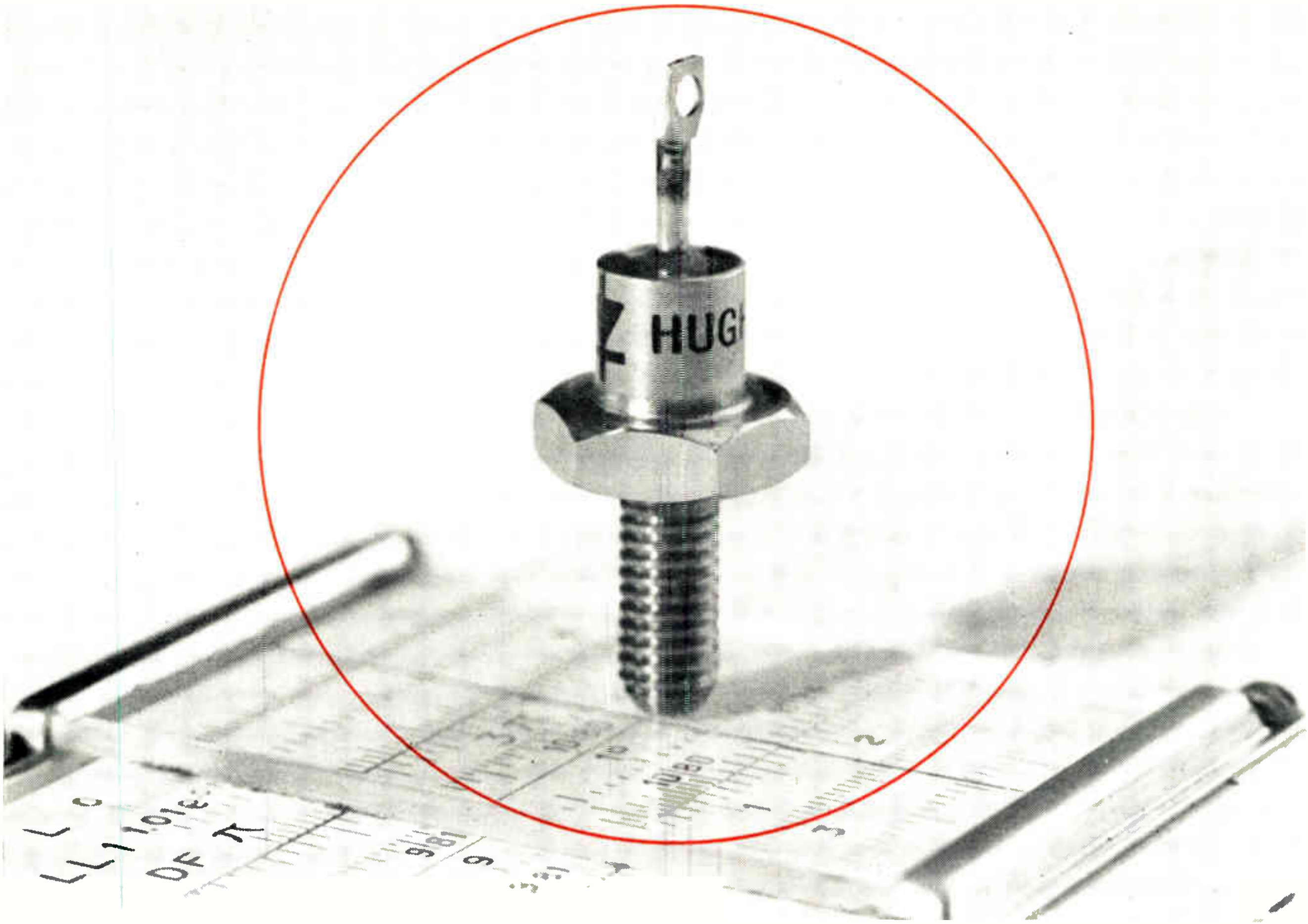
MICROWAVE ASSOCIATES INC. (M), Burlington, Mass. EIA Diodes, and non-EIA types below:

DIODE TYPE	MFGR.
MA400	10,000mc, Reversible Polarity, Max. Conv. Loss = 6 db
MA401	Classified Mixer Crystal for use in RG-98/U Waveguide
MA407	10,000mc, Reversible Polarity, Max. Conv. Loss = 6.5 db
MA408	9,000mc, Video Detector, Figure of Merit = 130
MA408A	9,000mc, Video Detector, Figure of Merit = 160
MA408B	9,000mc, Video Detector, Figure of Merit = 220
MA408R	9,000mc, Video Detector, Reverse Polarity, Figure of Merit = 130
MA408AR	9,000mc, Video Detector, Reverse Polarity, Figure of Merit = 160
MA408BR	9,000mc, Video Detector, Reverse Polarity, Figure of Merit = 220
MA409	3,060mc, Max. Conv. Loss = 5.5 db, Max. Noise Ratio = 1.5
MA409A	3,060mc, Max. Conv. Loss = 5 db, Max. Noise Ratio = 1.3
MA409AM	3,060mc, Matched Pair
MA409AMR	3,060mc, Matched Forward and Reverse Polarity
MA409AR	3,060mc, Reverse Polarity Type
MA409M	3,060mc, Matched Pair
MA409MR	3,060mc, Matched Forward and Reverse Polarity
MA409R	3,060mc, Reverse Polarity Type
MA412	26.5-75 Kmc, RG-98/U Waveguide Mounted for mixer or video
MA414	10,000mc, Reversible Polarity version of 1N149
MA417	3,295mc, Reversible Polarity version of 1N32
MA418	9,000mc, Reversible Polarity version of MA408
MA418A	9,000mc, Reversible Polarity version of MA408A
MA419	6,750mc, Reversible Polarity version of 1N160
MA419A	6,750mc, Reversible Polarity version of 1N150
MA421A	3,060mc, Mixer, Max. Receiver Noise Figure = 6.5 db
MA421B	3,060mc, Mixer, Max. Receiver Noise Figure = 6 db
MA423A	9,375mc, Mixer, Max. Receiver Noise Figure = 7 db
MA424	9,000mc, Instrument Diode
MA425	Reversible Polarity version of MA424
MA426	9,375mc, Ruggedized Mixer, Max. Receiver Noise Figure = 7.5 db

NUCLEONIC PRODUCTS CO., INC. (N), 1601 Grande Vista Ave., Los Angeles 23, Calif. EIA Diodes.

PACIFIC SEMICONDUCTORS, INC. (PS), 10451 W. Jefferson Blvd., Culver City, Calif. EIA Diodes, and non-EIA 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
PS005		50	100		1.5A	125	200	
PS010		100	100		1.5A	125	200	
PS015		150	100		1.5A	125	200	
PS020		200	100		1.5A	125	200	
PS025		250	100		1.5A	125	200	
PS030		300	100		1.5A	125	200	
PS035		350	100		1.5A	125	200	
PS040		400	100		1.5A	125	200	
PS105		50	500		1.5A	200	200	
PS110		100	500		1.5A	200	200	
PS115		150	500		1.5A	200	200	
PS120		200	500		1.5A	200	200	
PS125		250	500		1.5A	200	200	
PS130		300	500		1.5A	200	200	
PS135		350	500		1.5A	200	200	
PS140		400	500		1.5A	200	200	
PS600		40	.25@30	30	1.5A	100@1.1	200	
PS601		40	.025@30	30	1.5A	100	200	
PS602		40	.025@30	30	1.5A	100	200	
PS603		40	.25@30	30	1.5A	200	200	
PS604		40	.025@30	30	1.5A	200	200	
PS605		40	.025@30	30	1.5A	200	200	
PS606		80	.25@60	60	1.5A	100@1.1	200	
PS607		80	.025@60	60	1.5A	100	200	
PS608		80	.025@60	60	1.5A	100	200	
PS609		80	.25@60	60	1.5A	200	200	
PS610		80	.025@60	60	1.5A	200	200	
PS611		80	.025@60	60	1.5A	200	200	
PS612		150	.25@125	125	1.5A	100@1.1	200	
PS613		150	.025@125	125	1.5A	100	200	
PS614		150	.025@125	125	1.5A	100	200	
PS615		150	.25@125	125	1.5A	200	200	
PS616		150	.025@125	125	1.5A	200	200	
PS617		150	.025@125	125	1.5A	200	200	
PS618		200	.25@175	175	1.5A	100@1.1	200	
PS619		200	.025@175	175	1.5A	100	200	
PS620		200	.025@175	175	1.5A	100	200	
PS621		200	.25@175	175	1.5A	200	200	
PS622		200	.025@175	175	1.5A	200	200	
PS623		200	.025@175	175	1.5A	200	200	
PS624		250	.25@225	225	1.5A	100@1.1	200	
PS625		250	.05@225	225	1.5A	100	200	
PS626		250	.05@225	225	1.5A	100	200	
PS627		250	.25@225	225	1.5A	200	200	
PS628		250	.05@225	225	1.5A	200	200	
PS629		250	.05@225	225	1.5A	200	200	
PS630		330	.25@300	300	1.5A	100@1.1	200	
PS631		330	.1@300	300	1.5A	100	200	
PS632		330	.25@300	300	1.5A	200	200	
PS633		330	.1@300	300	1.5A	200	200	
PS634		420	.25@380	380	1.5A	100@1.1	200	
PS635		420	.1@380	380	1.5A	100	200	
PS636		420	.25@380	380	1.5A	200	200	
PS637		420	.1@380	380	1.5A	200	200	
PS720		30	5@20	25	500	3	150	
PS721		60	5@45	50	500	5	150	
PS722		100	5@75	85	500	5	150	
PS723		200	20@175	180	500	3	150	
PS724		150	20@125	125	500	4	150	
V20	Varicap, 20 pf @ -4V, series resistance 18 ohm max.							
V27	Varicap, 27 pf @ -4V, series resistance 14 ohm max.							
V33	Varicap, 33 pf @ -4V, series resistance 12 ohm max.							
V39	Varicap, 39 pf @ -4V, series resistance 10 ohm max.							
V47	Varicap, 47 pf @ -4V, series resistance 7.5 ohm max.							
V56	Varicap, 56 pf @ -4V, series resistance 7 ohm max.							



announcing a new Hughes series—high efficiency, medium power silicon rectifiers

For the first time, you can obtain high forward conductance and a high breakdown voltage, together in one rectifier. High forward conductance increases the efficiency of the rectifier, thereby providing *more* power to the load at lower junction temperatures. And low junction temperatures ensure long life plus reliable rectifier operation.

The unique combination of high forward conductance and high breakdown voltage permits rectifier performance never before achieved in the standard EIA Group 20 (7/16" hex.) stud mounted package. This package is welded and hermetically sealed with a glass-to-metal seal to provide complete protection from contamination and moisture penetration. Inside, where it counts, protection like this is essential.

The **HR10681**, a typical rectifier in the series.

Min. Breakdown Voltage	= 600V
Max. Average Rectified Current @ 25°C	= 2A*
Average Reverse Leakage Current @ 2A and 420V_{rms} @ 25°C	≦ 100μA
Typical Full Load Average Forward Voltage Drop	≦ 1.0V
Typical Dynamic Forward Resistance	≦ 0.2ohm

*Higher currents obtainable with heat sink.

actual size

Our sales engineers welcome the opportunity to discuss application of these new units to your circuitry. For address of sales office nearest you, or for complete information, write:

SEMICONDUCTOR DIVISION • HUGHES AIRCRAFT CO.
International Airport Station, Los Angeles 45, California

Creating a new world with ELECTRONICS

HUGHES SEMICONDUCTORS

HUGHES PRODUCTS

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

PHILCO CORP. (P), Lansdale Tube Co. Division, Lansdale, Pa. EIA Diodes.

RADIO CORPORATION OF AMERICA (RCA), Semiconductor Div., Somerville, N.J. EIA Diodes.

RADIO RECEPTOR CO., INC. (RR), 240 Wythe Ave., Brooklyn 11, N.Y. EIA Diodes, and non-EIA types below:

DIODE TYPE	MFGR.	E_{PEAK}	I_{PEAK}	E_{CONT}	I_{SURGE}	I_{MIN}	OPER	MAX
DR301		125	100@-50	100		400	25	
DR302		100	100@-50	80		400	25	
DR303		75	50@-20	60		400	25	
DR305		125	100@-50	100		200	25	
DR306		100	100@-50	80		200	25	
DR307		75	50@-20	60		200	25	
DR308		100	50@-50	80		200	25	
DR309		100	50@-50	80		400	25	
DR310		120	50@-100	120		100	25	
DR311		120	100@-100	120		100	25	
DR312		100	20@-100	100		100	25	
DR313		80	20@-50	80		100	25	
DR314		80	50@-50	80		100	25	
DR315		150	50@-100	120		50	25	
DR316		125	100@-100	100		50	25	
DR317		100	50@-50	80		50	25	
DR318		75	2@-10	60		50	25	
DR319		75	5@-10	60		50	25	
DR321			125@-50	50		200	25	
DR323			200@-50	50		100	25	
DR324			500@-50	50		100	25	
DR325			250@-50	50		100	25	
DR326		75	250@-50	60		100	25	
DR327		125	100@-50	100		300	25	
DR328		100	100@-50	80		300	25	
DR329		75	50@-20	60		300	25	
DR330		100	50@-50	60		300	25	
DR385		60	10@-10	50	500	10@.37	25	
DR401				60		20@.5	25	
DR402				60		20@.5	25	
DR403				60		20@.5	25	
DR404				60		20@.5	25	
DR434		40	10@-10	30	500	10@.37	25	
DR435		30	10@-10	20	500	10@.37	25	

RAYTHEON MANUFACTURING COMPANY (R), 55 Chapel St., Newton 58, Mass. EIA Diodes, and non-EIA types below:

DIODE TYPE	MFGR.	E_{PEAK}	I_{PEAK}	E_{CONT}	I_{SURGE}	I_{MIN}	OPER	MAX
CK705		70	800@-50	60	500	5	100	125
CK705A		70	800@-50	60	500	5	100	125
CK706A		50	200@-10	40	300		100	125
CK707		100	100@-50	80	500	3.5	100	125
CK708		120	625@-100	100	500	3	100	125
CK709[1]		60	1.5@-10	60	500	2.5@1.5V	100	100
CK711[1]		80	30@-50	80	500	matched	100	100
CK713A		85	250@-40	70	500	30@2	100	125
CK715				40	300		100	125
CK717[1]		60	10@-10	60	500	2.5@1.5V	100	100
CK719[1]		80	30@-50	80	500	matched	100	100
CK739		60	20@-50	50	500	100@.8	70	70
CK740		15	2@-10	12	500	100@.8	70	70
CK742		125	20@-100	100	500	100	70	70
CK772		70	10@-10	60	500	10@1.5	100	100
CK774		25	5ma@25	25	25A	5A@1.5	160	170
CK775		60	5ma@60	60	25A	5A@1.5	160	170
CK775-1		125	5ma@125	125	25A	5A@1.5	160	170
CK776		200	5ma@200	200	25A	5A@1.5	160	170
CK777		325	5ma@325	325	25A	5A@1.5	160	170
CK840		100	2@100	100	10A	300	165	175
CK841		200	2@200	200	10A	300	165	175
CK842		300	2@300	300	10A	300	165	175
CK843		400	2@400	400	10A	300	165	175
CK844		500	2@500	500	10A	300	165	175
CK845		600	2@600	600	10A	300	165	175
CK846		100	2@100	100	20A	300	165	175
CK847		200	2@200	200	20A	300	165	175
CK848		300	2@300	300	20A	300	165	175
CK849		400	2@400	400	20A	300	165	175
CK850		500	2@500	500	20A	300	165	175
CK851		600	2@600	600	20A	300	165	175
CK863		300	.3@-275	285	175	1	150	150
CK863A		300	.3@-10	285	250	3	150	150

1.Assemblies of 4 diodes.

SARKES TARZIAN (ST), 415 North College Avenue, Bloomington, Indiana. EIA Diodes and non-EIA types below:

DIODE TYPE	MFGR.	E_{PEAK}	I_{PEAK}	E_{CONT}	I_{SURGE}	I_{MIN}	OPER	MAX
10L		100	2ma@100	70[1]	60A[2]	1500[3]	100	100
20L		200	2ma@200	140[1]	60A[2]	1500[3]	100	100
30L		300	2ma@300	210[1]	60A[2]	1500[3]	100	100
40L		400	2ma@400	280[1]	60A[2]	1500[3]	100	100
10M		100	2ma@100	70[1]	30A[2]	500[3]	100	100
20M		200	2ma@200	140[1]	30A[2]	500[3]	100	100
30M		300	2ma@300	210[1]	30A[2]	500[3]	100	100
5N1		50	200@50	35[1]	30A[2]	500[3]	100	150[4]
10N1		100	200@100	70[1]	30A[2]	500[3]	100	150[4]
15N1		150	200@150	105[1]	30A[2]	500[3]	100	150[4]
20N1		200	200@200	140[1]	30A[2]	500[3]	100	150[4]
30N1		300	200@300	210[1]	30A[2]	500[3]	100	150[4]
40N1		400	200@400	280[1]	30A[2]	500[3]	100	150[4]
5N2		50	200@50	35[1]	30A[2]	500[3]	100	150[4]
10N2		100	200@100	70[1]	30A[2]	500[3]	100	150[4]
15N2		150	200@150	105[1]	30A[2]	500[3]	100	150[4]
20N2		200	200@200	140[1]	30A[2]	500[3]	100	150[4]
30N2		300	200@300	210[1]	30A[2]	500[3]	100	150[4]
40N2		400	200@400	280[1]	30A[2]	500[3]	100	150[4]
5N3		50	200@50	35[1]	30A[2]	500[3]	100	150[4]
10N3		100	200@100	70[1]	30A[2]	500[3]	100	150[4]
15N3		150	200@150	105[1]	30A[2]	500[3]	100	150[4]
20N3		200	200@200	140[1]	30A[2]	500[3]	100	150[4]
30N3		300	200@300	210[1]	30A[2]	500[3]	100	150[4]
40N3		400	200@400	280[1]	30A[2]	500[3]	100	150[4]
5P1		50	1500@50	35[1]	60A[2]	1500[3]	100	150[4]
10P1		100	1500@100	70[1]	60A[2]	1500[3]	100	150[4]
15P1		150	1500@150	105[1]	60A[2]	1500[3]	100	150[4]
20P1		200	1500@200	140[1]	60A[2]	1500[3]	100	150[4]
30P1		300	1500@300	210[1]	60A[2]	1500[3]	100	150[4]
40P1		400	1500@400	280[1]	60A[2]	1500[3]	100	150[4]
5P2		50	1500@50	35[1]	60A[2]	5000[3]	100	150[4]
10P2		100	1500@100	70[1]	60A[2]	5000[3]	100	150[4]
15P2		150	1500@150	105[1]	60A[2]	5000[3]	100	150[4]
20P2		200	1500@200	140[1]	60A[2]	5000[3]	100	150[4]
30P2		300	1500@300	210[1]	60A[2]	5000[3]	100	150[4]
40P2		400	1500@400	280[1]	60A[2]	5000[3]	100	150[4]
5RN		50	25ma@50	35[1]	200[2]	20A[3]	100	100
10RN		100	25ma@100	70[1]	200[2]	20A[3]	100	100
20RN		200	25ma@200	140[1]	200[2]	20A[3]	100	100
30RN		300	25ma@300	210[1]	200[2]	20A[3]	100	100
5RP		50	25ma@50	35[1]	200[2]	20A[3]	100	100
10RP		100	25ma@100	70[1]	200[2]	20A[3]	100	100

SARKES TARZIAN Continued

DIODE TYPE	MFGR.	E_{PEAK}	I_{PEAK}	E_{CONT}	I_{SURGE}	I_{MIN}	OPER	MAX
20RP		200	25ma@200	140[1]	200[2]	20A[3]	100	100
30RP		300	25ma@300	210[1]	200[2]	20A[3]	100	100
80SM		800	2ma@800	560[1]	30A[2]	500[3]	100	150[4]
120SM		1200	2ma@1200	840[1]	30A[2]	500[3]	100	150[4]
160SM		1600	2ma@1600	1120[1]	30A[2]	500[3]	100	150[4]
200SM		2000	2ma@2000	1400[1]	30A[2]	500[3]	100	150[4]
240SM		2400	2ma@2400	1680[1]	30A[2]	500[3]	100	150[4]
280SM		2800	2ma@2800	1960[1]	30A[2]	500[3]	100	150[4]
5SN		50	40ma@50	35[1]	350[2]	35A[3]	100	100
10SN		100	40ma@100	70[1]	350[2]	35A[3]	100	100
20SN		200	40ma@200	140[1]	350[2]	35A[3]	100	100
30SN		300	40ma@300	210[1]	350[2]	35A[3]	100	100
5SP		50	40ma@50	50[1]	350[2]	35A[3]	100	100
10SP		100	40ma@100	70[1]	350[2]	35A[3]	100	100
20SP		200	40ma@200	140[1]	350[2]	35A[3]	100	100
30SP		300	40ma@300	210[1]	350[2]	35A[3]	100	100
5VN		50	100ma@50	35[1]	1000A[2]	100[3]	100	100
10VN		100	100ma@100	70[1]	1000A[2]	100[3]	100	100
20VN		200	100ma@200	140[1]	1000A[2]	100[3]	100	100
30VN		300	100ma@300	210[1]	1000A[2]	100[3]	100	100
5VP		50	100ma@50	50[1]	1000A[2]	100[3]	100	100
10VP		100	100ma@100	70[1]	1000A[2]	100[3]	100	100
20VP		200	100ma@200	140[1]	1000A[2]	100[3]	100	100
30VP		300	100ma@300	210[1]	1000A[2]	100[3]	100	100
5WN		50	150ma@50	35[1]	1500A[2]	150[3]	100	100
10WN		100	150ma@100	70[1]	1500A[2]	150[3]	100	100
20WN		200	150ma@200	140[1]	1500A[2]	150[3]	100	100
30WN		300	150ma@300	210[1]	1500A[2]	150[3]	100	100
5WP		50	150ma@50	35[1]	1500A[2]	150[3]	100	100
10WP		100	150ma@100	70[1]	1500A[2]	150[3]	100	100
20WP		200	150ma@200	140[1]	1500A[2]	150[3]	100	100
30WP		300	150ma@300	210[1]	1500A[2]	150[3]	100	100
5XN		50	150ma@50	35[1]	2000A[2]	200A[3]	100	100
10XN		100	150ma@100	70[1]	2000A[2]	200A[3]	100	100
20XN		200	150ma@200	140[1]	2000A[2]	200A[3]	100	100
30XN		300	150ma@300	210[1]	2000A[2]	200A[3]	100	100
5XP		50	150ma@50	35[1]	2000A[2]	200A[3]	100	100
10XP		100	150ma@100	70[1]	2000A[2]	200A[3]	100	100
20XP		200	150ma@200	140[1]	2000A[2]	200A[3]	100	100
30XP		300	150ma@300	210[1]	2000A[2]	200A[3]	100	100
M-500		400	2ma@400	280[1]	30A[2]	500[3]	100	100
S-5011		1600	2ma@1600	1100[1]	8000A[2]	.75A[3]	100	100
S-5017		1600	2ma@1600	1100[1]	8000A[2]	.75A[3]	100	100
S-5018		1600	2ma@1600	1100[1]	8000A[2]	.75A[3]	100	100
S-5019		2800	2ma@2800	1950[1]	5000A[2]	.5A[3]	100	100

1.RMS volts. 2.For 4 ms. 3.At 1.5 v dc. 4.With current derating.

SYLVANIA ELECTRIC PRODUCTS INC. (S), 100 Sylvan Rd., Woburn, Mass. EIA Diodes, and non-EIA types below:

DIODE TYPE	MFGR.	E_{PEAK}	I_{PEAK}	E_{CONT}	I_{SURGE}	I_{MIN}	OPER	MAX
D817		75	250@-50	60	500	2.5	25	90
D894		190	500@-150	150	250	3	25	90
D951		100	100@-300	80	350	20	25	75
D953		75	120@-60	60	150	Computer	55	75
D965		100	50@-50	80	300	5	25	75
D966		130	80@-80	80	500	4	25	75
D967		60	100@-25	50	400	50	25	75
D989		120	550@-100	100	500	4.5	25	90
D1042		50	500@-30	40	250	25@4.0	25	75
D1045		30	15@-15	25	500	40@.8	25	90
D1046		25	30@-10v	15	350	20	25	90
D1082		125	500@-100	100	300	4	25	75
D1094		50	40@-40	40	100	2@2.0	90	100
D1108		40	150@-30	30	400	1@.35	55	85
D1126		70	10@-10	60	150	30-5.5@.6	25	75
D1130		120	50@-30	100	300	40	25	75
D1131		70	10@-10	50	500	10@1.5	25	100
D1132		30	50@-15	20	350	40	25	80
D1153		120	250@-50	100	400	250	55	90
D1164		15	12@-6	10	300	25	25	85

TEXAS INSTRUMENTS, INC. (TI), P.O. Box 312, Dallas, Texas. EIA Diodes, and non-EIA types below:

DIODE TYPE	MFGR.	E_{PEAK}	I_{PEAK}	E_{CONT}	I_{SURGE}	I_{MIN}	OPER	MAX
TI600C			8@-10			3	150	150
TI601C			04@-10			3	150	150
TI604C		4.7	.1@4.7	4.7		60	150	150
TI606C		6.8	.1@6.8	6.8		35	150	150
TI608C		10	.1@10	10		25	150	150
TI610C		15	.1@15	15		12	150	150
TI612C		22	.1ma@22	22		7	150	150
TI614C		33	.1ma@33	33		5	150	150
TI616C		47	.2ma@47	47		3	150	150
TI618C		68	.2ma@68	68		1.5	150	150
TI620C		100	.2ma@100	100		0.9	150	150
TI622C		150	.2ma@150	150		6.5@4	150	150
TI624C		220	.4ma@225	220		3@4	150	150
650C[1]		3.7 to 4.5	.1@-1	3.7to4.5		125	150	150
651C[1]		4.3 to 5.4	.1@-1	4.3to5.4		100	150	150
652C[1]		5.2 to 6.4	.1@-1	5.2to6.4		75	150	150
653C[1]		6.2 to 8	.1@-1	6.2 to 8		60	150	150
654C9[1]		8.5 to 9.5	.1@-1	8.5to9.5		60	150	150
655C9[1]		9.5 to 10.5	.1@-1	9.5to10.5		60	150	150
TI680		1500	100@-1500	1500		50@10	150	150

1.All low voltage reference diodes are available from TI with ±5% tolerances between 3.7 & 10 volts.

THERMOSEN, INC. (TH), 375 Fairfield Ave., Stamford, Conn. Non-EIA types below:

DIODE TYPE	MFGR.	E_{PEAK}	I_{PEAK}	E_{CONT}	I_{SURGE}	I_{MIN}	OPER	MAX
P1005		50	< 5ma@50		10A[1]			175
P1010		100	< 5ma@100		10A[1]			175
P1015		150	< 5ma@150		10A[1]			175
P1020		200	< 5ma@200		10A[1]			175
P1505		50	< 5ma@50		15A[1]			175
P1510		100	< 5ma@100		15A[1]			175
P1515		150	< 5ma@150		15A[1]			175
P1520		200	< 5ma@200		15A[1]			175
P2005		50	< 5ma@50		20A[1]			175
P2010		100	< 5ma@100		20A[1]			175
P2015		150	< 5ma@150		20A[1]			175
P2020		200	< 5ma@200		20A[1]			175
P2505		50	< 5ma@50		25A[1]			175
P2510		100	< 5ma@100		25A[1]			175
P2515		150	< 5ma@150		25A[1]			175
P2520		200	< 5ma@200		25A[1]			175
P3005		50	< 5ma@50		30A[1]			175
P3010		100	< 5ma@100		30A[1]			175
P3015		150	< 5ma@150		30A[1]			175
P3020		200	< 5ma@200		30A[1]			175
P3505		50	< 5ma@50		35A[1]			175
P3510		100	< 5ma@100		35A[1]			175
P3515		150	< 5ma@150		35A[1]			175
P3520		200	< 5ma@200		35A[1]			175

1.Max. fwd. current, 6 x 6 heat sink, 25°C Ambient.

GENERAL INSTRUMENT
SEMICONDUCTOR DIVISION

proudly announces

the industry's most versatile silicon diode

Uniform excellence in all parameters permitting a far wider range of applications

- REDUCES EXPENSIVE INVENTORY
- REDUCES NUMBER OF DIODE TYPES REQUIRED
- RESULTS IN GREATER STABILITY AND LONGER LIFE

RADIO RECEPTOR'S

silicon diode 1N658

- HIGH FORWARD CONDUCTANCE 100 mA @ 1V.
- LOW REVERSE LEAKAGE .05 μa @ –50V @ 25° C; 25 μa @ –50V @ 150° C.
- HIGH PEAK INVERSE VOLTAGE 120V.
- FAST REVERSE RECOVERY 80K ohms in .3 μsec.*
- HIGH OPERATING TEMPERATURE 175° C.

*When switching from 5 mA to–40V. RL = 2K. CL = 10 $\mu\mu$f.

RATINGS

Maximum inverse working voltage: 100V.
Average forward current: 200 mA.
Maximum power dissipation: 200 mW.

Latest achievement of the GI team of semiconductor specialists is this universal silicon diode 1N658. Radio Receptor's newly developed process combines in skillfully balanced proportion every desirable characteristic you've sought in silicon diodes. Result is a fully reliable component that does a better job in almost every standard application.

In addition to the 1N658, Radio Receptor offers to the industry a full range of RETMA subminiature silicon diode types to meet other applications. Full information is available upon request to Section T-12.

RRco. 1N658 is available now in production quantities for immediate delivery from our factory. Small quantities for testing and evaluation can be purchased from any authorized RRco. distributor and orders sent direct to Radio Receptor will be handled promptly.

RADIO & ELECTRONIC
PRODUCTS SINCE 1922

Semiconductor Division

RADIO RECEPTOR COMPANY, INC.

Subsidiary of General Instrument Corporation

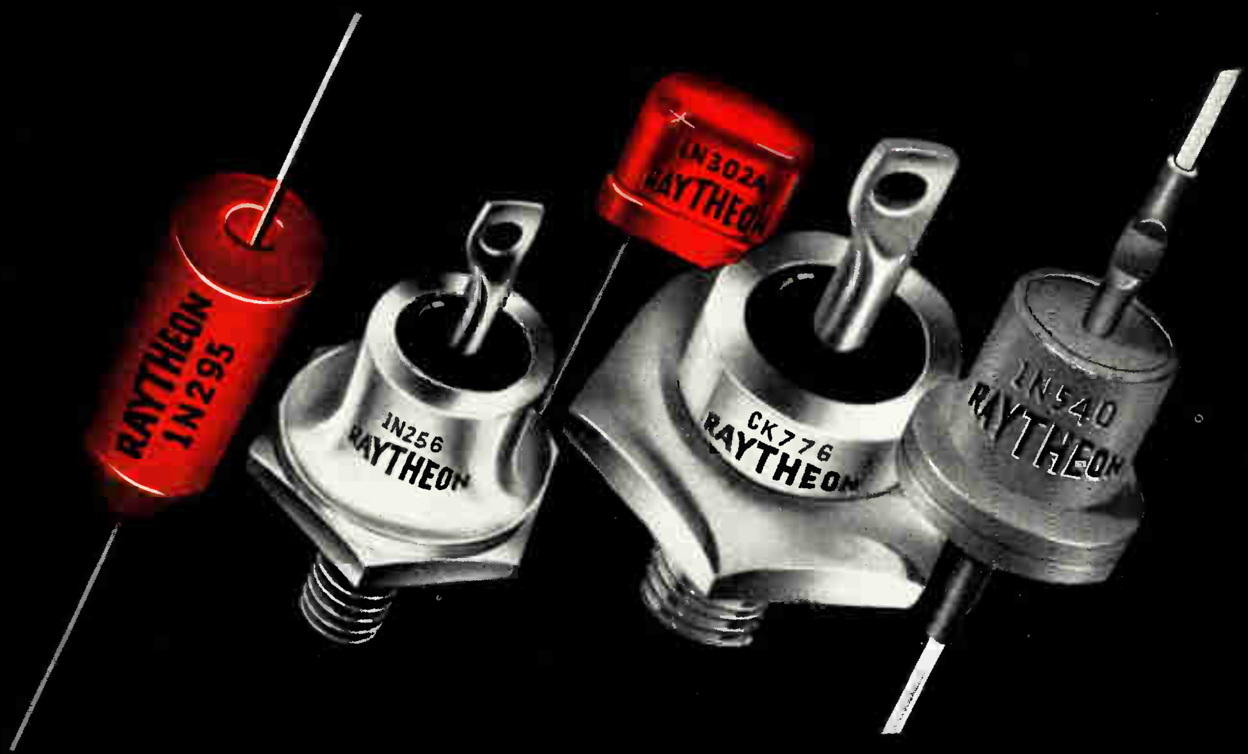
240 Wythe Avenue, Brooklyn 11, N. Y. EVergreen 8-6000

Germanium & Silicon Diodes • Dielectric Heating Generators and Presses
Selenium Rectifiers • Communications, Radar and Navigation Equipment

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
TRANSITRON ELECTRONIC CORP. (TE). 168-182 Albion St., Wakefield, Mass.								
EIA Diodes, and non-EIA types below:								
2W3		400	.3@-350	360	2A	100@2	125	150
2W4		500	.3@-450	450	2A	100@2	125	150
2W5		600	.3@-525	540	2A	100@3	125	150
2W6		750	.3@-675	675	2A	100@3	125	150
2W7		800	.3@-700	720	2A	100@4	125	150
2W9		1000	.3@-900	900	2A	100@4	125	150
2W12		1320	.3@-1200	1200	2A	100@4	125	150
2W15		1680	.3@-1500	1500	2A	100@4	125	150
Q2		75	100@-50	50		20@1	75	75
S4G		20	10@-10	15	60	1	125	150
S5G		30	10@-10	20	100	2	125	150
S6G		15	10@-5	10	125	5	125	150
S9G		40	10@-20	30	100	2	125	150
S10G		15	10@-5	10	150	100@1.7	125	150
S320G		6	15@-2	2	500	100		85
S1010		6	15@-2	2	500	100		85
SG22		6	.1@-2	2	500	100		150
SG211		80	.25@-60	70	100	5@1.5	100	150
SG212		150	.25@-125	130	100	5@1.5	100	150
SG213		200	.25@-175	180	100	5@1.5	100	150
SG215		40	.25@-30	36	100	5@1.5	100	150
SG216		80	.25@-60	70	100	5@1.5	100	150
SG217		150	.25@-125	130	100	5@1.5	100	150
SG218		200	.25@-175	180	100	5@1.5	100	150
SG221		80	.25@-60	70	300	30@1.5	100	150
SG222		150	.25@-125	130	300	30@1.5	100	150
SG223		200	.25@-175	180	300	30@1.5	100	150
SG225		40	.25@-30	36	600	100@1.5	100	150
SG226		80	.25@-60	70	600	100@1.5	100	150
SG227		150	.25@-125	130	600	100@1.5	100	150
SG228		200	.25@-115	180	600	100@1.5	100	150
SM72		6	25@-2	2	6A	2A@2		125
T1G		50	1500@-50	40	350	20	25	100
T2G		75	300@-50	60	400	40	25	100
T3G		75	50@-50	60	350	20	25	100
T4G		125	100@-100	100	300	5	25	100
T5G		125	100@-100	100	400	40	25	100
T6G		35	200@-20	30	450	100	25	100
T7		75	100@-50	60	750	200	25	80
T7G		75	100@-50	60	500	200	25	100
T8G		125	20@-100	100	450	100	25	100
T9		75	20@-50	60	600	100	25	80
T9G		75	20@-50	60	450	100	25	100
T11		40	20@-20	30	750	100	25	80
T11G		35	20@-20	30	450	100	25	100
T12		75	500@-50	60	500	20	25	80
T12G		75	500@-50	60	350	20	25	100
T13		25	2@-10	20	750	40	25	80
T13G		25	2@-10	20	400	40	25	100
T14		25	5@-10	20	750	40	25	80
T14G		25	5@-10	20	400	40	25	100
T15		125	180@-90	90	750	125	25	80
T15G		125	180@-90	90	450	125	25	100
T16		75	100@-50	60	750	40	25	80
T16G		75	100@-50	60	400	40	25	100
T17G		125	500@-100	100	400	5	25	80
T18			125@-50	50	200	20	75	80
T18G			125@-50	50	175	20	75	100
T19		60	220@-40	40	350	200	75	80
T19G		60	220@-40	40	300	200	75	100
T20			500@-50	50	200	20	75	80
T20G			500@-50	50	175	20	75	100
T21			50@-20	25	200	20	75	80
T21G			50@-20	25	175	20	75	100
T22			20@-10	15	250	40	75	80
T22G			20@-10	15	200	40	75	100
T23			200@-50	50	300	20	60	80
T23G			200@-50	50	250	20	60	100
T24			300@-30	35	300	20	60	80
T24G			300@-30	35	250	20	60	100
T25		30	20@-10	20	750	200	25	
T25G		25	20@-10	20	500	200	25	100
T26G		25	10@-10	20	400	40	25	100
T27G			100@-10	15	200	40	75	100
TH152		150	5ma@-150	150	500A	100A@1.5	150	175
TH252		250	5ma@-250	250	500A	100A@1.5	150	175
TH302		300	5ma@-300	300	500A	100A@1.5	150	175
TH352		350	5ma@-350	350	500A	100A@1.5	150	175
TH402		400	5ma@-400	400	500A	100A@1.5	150	175
TJ5A		50	.5@-50	50	3A	500@1.5	150	200
TJ10A		100	.5@-100	100	3A	500@1.5	150	200
TJ15A		150	.5@-150	150	3A	500@1.5	150	200
TJ20A		200	.5@-200	200	3A	500@1.5	150	200
TJ25A		250	.5@-250	250	3A	500@1.5	150	200
TJ30A		300	.5@-300	300	3A	500@1.5	150	200
TJ35A		350	.5@-350	350	3A	500@1.5	150	200
TJ40A		400	.5@-400	400	3A	500@1.5	150	200
TM1		50	300@-50	50	20A	2A@2	100	125
TM2		50	300@-50	50	10A	800@2	100	125
TM3		50	300@-50	50	5A	200@2	100	125
TM4[1]		50	500@-50	50	20A	2A@2	150	175
TM5[1]		50	500@-50	50	10A	800@2	150	175
TM7		50	500@-50	50	30A	6A@1.5	150	175
TM11		100	300@-100	100	20A	2A@2	100	125
TM12		100	300@-100	100	10A	800@2	100	125
TM13		100	300@-100	100	5A	200@2	100	125
TM17		100	500@-100	100	30A	6A@1.5	150	175
TM21		200	300@-200	200	20A	2A@2	100	125
TM22		200	300@-200	200	10A	800@2	100	125
TM23		200	300@-200	200	5A	200@2	100	125
TM24[1]		200	500@-200	200	20A	2A@2	150	175
TM27		200	500@-200	200	30A	6A@1.5	150	175
TM31		300	300@-300	300	20A	2A@2	100	125
TM32		300	300@-300	300	10A	800@2	100	125
TM33		300	300@-300	300	5A	200@2	100	125
TM34[1]		300	500@-300	300	20A	2A@2	150	175
TM37		300	500@-300	300	30A	6A@1.5	150	175
TM41		400	300@-400	400	20A	2A@2	25	125
TM42		400	300@-400	400	10A	800@2	25	125
TM43		400	300@-400	400	5A	200@2	25	125
TM44[1]		400	500@-400	400	20A	2A@2	150	175
TM47		400	500@-400	400	30A	6A@1.5	150	175
TM51		500	300@-500	500	20A	2A@2	100	125
TM52		500	300@-500	500	10A	800@2	100	125
TM53		500	300@-500	500	5A	200@2	100	125
TM54[1]		500	500@-500	500	20A	2A@2	150	175
TM55[1]		500	500@-500	500	10A	800@2	150	175
TM56[1]		500	500@-500	500	5A	400@2	150	175
TM61		600	300@-600	600	20A	2A@2	100	125
TM62		600	300@-600	600	10A	800@2	100	125
TM63		600	300@-600	600	5A	200@2	100	125
TM64[1]		600	500@-600	600	20A	2A@2	150	175
TM65[1]		600	500@-600	600	10A	800@2	150	175

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
TRANSITRON ELECTRONIC CORP. Continued								
TM66[1]		600	500@-600	600	5A	400@2	150	175
TM84		800	500@-800	800	20A	2A@2	125	150
TM85		800	500@-800	800	10A	800@2	125	150
TM86		800	500@ 800	800	5A	400@2	125	150
TM104		1000	500@-1000	1000	20A	2A@2	125	150
TM105		1000	500@-1000	1000	10A	800@2	125	150
TM106		1000	500@-1000	1000	5A	400@2	125	150
TR151[1]		150	5ma@-150	150	100A	25A@1.5	150	175
TR152		150	5ma@-150	150	200A	50A@1.5	150	175
TR251[1]		250	5ma@-250	250	100A	25A@1.5	150	175
TR252		250	5ma@-250	250	200A	50A@1.5	150	175
TR301[1]		300	5ma@-300	300	100A	25A@1.5	150	175
TR302		300	5ma@-300	300	200A	50A@1.5	150	175
TR351[1]		350	5ma@-350	350	100A	25A@1.5	150	175
TR352		350	5ma@-350	350	200A	50A@1.5	150	175
TR401[1]		400	5ma@-400	400	100A	25A@1.5	150	175
TR402		400	5ma@-400	400	200A	50A@1.5	150	175
1. Available with reversed polarity. Add suffix "R" to number.								
UNITED STATES DYNAMICS CORP. (USD), 1250 Columbus Ave., Boston 20, Mass.								
EIA Diodes, and non-EIA types below:								
USD 111A		50	100@50	50	3A	400@2	150	200
USD 111B		100	100@100	100	3A	400@2	150	200
USD 111C		150	100@150	150	3A	400@2	150	200
USD 111D		200	100@200	200	3A	400@2	150	200
USD 112E		250	200@250	250	3A	400@2	150	200
USD 112F		300	200@300	300	3A	400@2	150	200
USD 112G		350	200@350	350	3A	400@2	150	200
USD 115A		50	500@50	50	3A	400@2	150	200
USD 115B		100	500@100	100	3A	400@2	150	200
USD 115C		150	500@150	150	3A	400@2	150	200
USD 115D		200	500@200	200	3A	400@2	150	200
USD 115E		250	500@250	250	3A	400@2	150	200
USD 115F		300	500@300	300	3A	400@2	150	200
USD 115G		350	500@350	350	3A	400@2	150	200
USD 121A		50	100@50	50	5A	800@2	150	200
USD 121B		100	100@100	100	5A	800@2	150	200
USD 121C		150	100@150	150	5A	800@2	150	200
USD 121D		200	100@200	200	5A	800@2	150	200
USD 122E		250	200@250	250	5A	800@2	150	200
USD 122F		300	200@300	300	5A	800@2	150	200
USD 122G		350	200@350	350	5A	800@2	150	200
USD 125A		50	500@50	50	5A	800@2	150	200
USD 125B		100	500@100	100	5A	800@2	150	200
USD 125C		150	500@150	150	5A	800@2	150	200
USD 125D		200	500@200	200	5A	800@2	150	200
USD 125E		250	500@250	250	5A	800@2	150	200
USD 125F		300	500@300	300	5A	800@2	150	200
USD 125G		350	500@350	350	5A	800@2	150	200
USD 132A		50	200@50	50	12A	2A@2	150	200
USD 132B		100	200@100	100	12A	2A@2	150	200
USD 132C		150	200@150	150	12A	2A@2	150	200
USD 132D		200	200@200	200	12A	2A@2	150	200
USD 132E		250	200@250	250	12A	2A@2	150	200
USD 132F		300	200@300	300	12A	2A@2	150	200
USD 132G		350	200@350	350	12A	2A@2	150	200
USD 135A		50	500@50	50.	12A	2A@2	150	200
USD 135B		100	500@100	100	12A	2A@2	150	200
USD 135C		150	500@150	150	12A	2A@2	150	200
USD 135D		200	500@200	200	12A	2A@2	150	200
USD 135E		250	500@250	250	12A	2A@2	150	200
USD 135F		300	500@300	300	12A	2A@2	150	200
USD 135G		350	500@350	350	12A	2A@2	150	200
USD 142A		50	200@50	50	30A	5A@1.5	150	200
USD 142B		100	200@100	100	30A	5A@1.5	150	200
USD 142C		150	200@150	150	30A	5A@1.5	150	200
USD 142D		200	200@200	200	30A	5A@1.5	150	200
USD 142E		250	200@250	250	30A	5A@1.5	150	200
USD 142F		300	200@300	300	30A	5A@1.5	150	200
USD 142G		350	200@350	350	30A	5A@1.5	150	200
USD 145A		50	500@50	50	30A	5A@1.5	150	200
USD 145B		100	500@100	100	30A	5A@1.5	150	200
USD 145C		150	500@150	150	30A	5A@1.5	150	200
USD 145D		200	500@200	200	30A	5A@1.5	150	200
USD 145E		250	500@250	250	30A	5A@1.5	150	200
USD 145F		300	500@300	300	30A	5A@1.5	150	200
USD 145G		350	500@350	350	30A	5A@1.5	150	200
USD 152A		[illegible]	2ma@50	50	45A	5A@1.5	150	200
USD 152B		[illegible]	2ma@100	100	45A	5A@1.5	150	200
USD 152C		150	2ma@150	150	45A	5A@1.5	150	200
USD 152D		200	2ma@200	200	45A	5A@1.5	150	200
USD 152E		250	2ma@250	250	45A	5A@1.5	150	200
USD 152F		300	2ma@300	300	45A	5A@1.5	150	200
USD 152G		350	2ma@350	350	45A	5A@1.5	150	200
USD 774		25	2ma@25	25	45A	5A@1.5	150	200
USD 775		60	2ma@60	60	45A	5A@1.5	150	200
USD 775-1		125	2ma@125	125	45A	5A@1.5	150	200
USD 776		200	2ma@200	200	45A	5A@1.5	150	200
USD 777		325	2ma@325	325	45A	5A@1.5	150	200
USD 5091A		50	5ma@50	50	45A	5A@1.5	150	200
USD 5091B		100	5ma@100	100	45A	5A@1.5	150	200
USD 5091C		150	5ma@150	150	45A	5A@1.5	150	200
USD 5091D		200	5ma@200	200	45A	5A@1.5	150	200
USD 5091E		250	5ma@250	250	45A	5A@1.5	150	200
USD 5091F		300	5ma@300	300	45A	5A@1.5	150	200
USD 5091G		350	5ma@350	350	45A	5A@1.5	150	200
USD 162A		50	2ma@50	50	90A	5A@1.2	150	200
USD 162B		100	2ma@100	100	90A	5A@1.2	150	200
USD 162C		150	2ma@150	150	90A	5A@1.2	150	200
USD 162D		200	2ma@200	200	90A	5A@1.2	150	200
USD 162E		250	2ma@250	250	90A	5A@1.2	150	200
USD 162F		300	2ma@300	300	90A	5A@1.2	150	200
USD 162G		350	2ma@350	350	90A	5A@1.2	150	200
USD 5051A		50	5ma@50	50	90A	5A@1.2	150	200
USD 5051B		100	5ma@100	100	90A	5A@1.2	150	200
USD 5051C		150	5ma@150	150	90A	5A@1.2	150	200
USD 5051D		200	5ma@200	200	90A	5A@1.2	150	200
USD 5051E		250	5ma@250	250	90A	5A@1.2	150	200
USD 5051F		300	5ma@300	300	90A	5A@1.2	150	200
USD 5051G		350	5ma@350	350	90A	5A@1.2	150	200
U. S. SEMICONDUCTOR PRODUCTS, INC. (U), 3536 W. Osborn Rd., Phoenix, Ariz.								
Non-EIA types below:								
R-10		10	.5@10	7	210	30	25	150
R-20		20	.1@20	14	150	12	25	150
R-50		50	.1@50	35	85	3.5	25	150
R-100		100	1@100	70	40	1.2	25	150
R-150		150	5@150	105	30	.7	25	150
R-200		200	5@150	140	28	6.5@4	25	150
R-300		300	5@150	210	24	3@4	25	150
R-400		400	5@150	280	20	2@4	25	150
R-500		500	5@150	350	18	1.5@4	25	150
Z-3.9	Zener Voltage = 3.6 to 4.3V							
Z-4.7	Zener Voltage = 4.3 to 5.1V							

DIODES and RECTIFIERS



DIFFUSED JUNCTION SILICON RECTIFIERS

A — STUD TYPE

Type	Peak Inverse Volts	Average Rectified Current Amps. (150°C)	Reverse Current (max.) at PIV μA
CK846	100	1.0	2
CK847	200	1.0	2
CK848	300	1.0	2
CK849	400	1.0	2
CK850	500	1.0	2
CK851	600	1.0	2

Type	Peak Inverse Volts	Average Rectified Current Amps. (135°C)	Reverse Current (max.) at PIV μA
1N253	95	1.0	10
1N254	190	0.4	10
1N255	380	0.4	10
1N256	570	0.2	20

B — WIRE-IN TYPE

Type	Peak Inverse Volts	Average Rectified Current Amps. (150°C)	Reverse Current (max.) at PIV μA
1N537	100	0.25	2
1N538	200	0.25	2
1N539	300	0.25	2
1N540	400	0.25	2
CK844	500	0.25	2
CK845	600	0.25	2

RAYTHEON

SEMICONDUCTOR DIVISION

Silicon and Germanium Diodes and Transistors • Silicon Rectifiers

Newton, Mass.: 55 Chapel St., Bigelow 4-7500
New York: 589 Fifth Ave., PLaza 9-3900
Chicago: 9501 Grand Ave., Franklin Park, TUxedo 9-5400
Los Angeles: 5236 Santa Monica Blvd., NOrmandy 5-4221

Circle 50 on Inquiry Card, page 101

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

U. S. SEMICONDUCTOR PRODUCTS, INC. Continued

Z-5.6	Zener Voltage = 5.1 to 6.2V
Z-6.8	Zener Voltage = 6.2 to 7.5V
Z-8.2	Zener Voltage = 7.5 to 9.1V
Z-10	Zener Voltage = 9.1 to 11V
Z-12	Zener Voltage = 11 to 13V
Z-15	Zener Voltage = 13 to 16V
Z-18	Zener Voltage = 16 to 20V
Z-22	Zener Voltage = 20 to 24V
Z-27	Zener Voltage = 24 to 30V
Z-33	Zener Voltage = 30 to 36V
Z-39	Zener Voltage = 36 to 43V
Z-47	Zener Voltage = 43 to 51V
Z-56	Zener Voltage = 51 to 62V
Z-68	Zener Voltage = 62 to 75V
Z-82	Zener Voltage = 75 to 91V
Z-100	Zener Voltage = 91 to 110V
Z-120	Zener Voltage = 110 to 130V
Z-150	Zener Voltage = 130 to 160V
Z-180	Zener Voltage = 160 to 200V
Z-220	Zener Voltage = 200 to 240V
Z-270	Zener Voltage = 240 to 300V
Z-330	Zener Voltage = 300 to 360V
Z-390	Zener Voltage = 360 to 430V
Z-470	Zener Voltage = 430 to 510V
Z-560	Zener Voltage = 510 to 620V
ZT-3.9	Double Anode Zener Voltage = 3.6 to 4.3V
ZT-4.7	Double Anode Zener Voltage = 4.3 to 5.1V
ZT-5.6	Double Anode Zener Voltage = 5.1 to 6.2V
ZT-6.8	Double Anode Zener Voltage = 6.2 to 7.5V
ZT-8.2	Double Anode Zener Voltage = 7.5 to 9.1V
ZT-10	Double Anode Zener Voltage = 9.1 to 11V
ZT-12	Double Anode Zener Voltage = 11 to 13V
ZT-15	Double Anode Zener Voltage = 13 to 16V
ZT-18	Double Anode Zener Voltage = 16 to 20V
ZT-22	Double Anode Zener Voltage = 20 to 24V

WESTERN ELECTRIC COMPANY, INC. (WE), 120 Broadway, N.Y. 5, N.Y. EIA Diodes, and non-EIA types below. *Western Electric semiconductor products are available only to U.S. Government Agencies and their contractors.*

DIODE TYPE	MFGR.	E_{PEAK}	I_{PEAK}	E_{CONT}	I_{SURGE}	I_{MIN}	OPER	MAX
GA-52999[1]		20	100@-16	20	Max Po = 3W		25	135
GA-53338		200	20@-200	200		10A	100	150
GA-53339-11		150	5@-120	150	Max Po = 3W		25	150
GA-53340		200	0.5@-200	200	10A	1A	25	150
GA-53341-8[1]		27	.5@-21.5	27	Max Po = .5W		25	150
GA-53341-9[1]		68	.5@-55	68	Max Po = .5W		25	150
GA-53341-10[1]		100	.5@-80	100	Max Po = .5W		25	150
GA-53342-4[1]		12	.5@-10	12	Max Po = .25W		25	150
GA-53342-5[1]		15	.5@-12	15	Max Po = .25W		25	150
GA-53342-6[1]		18	.5@-15	18	Max Po = .25W		25	150
GA-53342-7[1]		22	.5@-18	22	Max Po = .25W		25	150

1. Voltage limiting diodes.

WESTINGHOUSE ELECTRIC CORP. (W), Youngwood, Pa. EIA Diode, and non-EIA types below:

DIODE TYPE	MFGR.	E_{PEAK}	I_{PEAK}	E_{CONT}	I_{SURGE}	I_{MIN}	OPER	MAX
302-A		50	20ma	50	35A[1]		150	190
302-B		100	20ma	100	35A[1]		150	190
302-C		150	20ma	150	35A[1]		150	190
302-D		200	20ma	200	35A[1]		150	190
302-E		250	20ma	250	35A[1]		150	190
302-F		300	20ma	300	35A[1]		150	190
302-G		350	20ma	350	35A[1]		150	190
302-H		400	20ma	400	35A[1]		150	190
302-K		500	20ma	500	35A[1]		150	190
302-M		600	20ma	600	35A[1]		150	190
303-A		50	10ma	50	22A[1]		135	190
303-B		100	10ma	100	22A[1]		135	190
303-C		150	10ma	150	22A[1]		135	190
303-D		200	10ma	200	22A[1]		135	190
303-E		250	10ma	250	22A[1]		135	190
303-F		300	10ma	300	22A[1]		135	190
303-G		350	10ma	350	22A[1]		135	190
303-H		400	10ma	400	22A[1]		135	190
303-K		500	10ma	500	22A[1]		135	190
303-M		600	10ma	600	22A[1]		135	190
304-A		50	10ma	50	12A[1]		150	190
304-B		100	10ma	100	12A[1]		150	190
304-D		200	10ma	200	12A[1]		150	190
304-F		300	10ma	300	12A[1]		150	190
304-H		400	10ma	400	12A[1]		150	190
304-K		500	10ma	500	12A[1]		150	190
304-M		600	10ma	600	12A[1]		150	190
305-A		50	1.5ma		1.6A[1]		140	175
305-B		100	1.5ma		1.6A[1]		140	175
305-C		150	1.5ma		1.6A[1]		140	175
305-D		200	1.5ma		1.6A[1]		140	175
305-F		300	1.5ma		1.6A[1]		140	175
305-H		400	1.5ma		1.6A[1]		140	175
305-K		500	1.5ma		1.6A[1]		140	175
305-M		600	1.5ma		1.6A[1]		140	175
305-P		700	1.5ma		1.6A[1]		140	175
305-S		800	1.5ma		1.6A[1]		140	175
306-A		50	500	50	1.6A[1]		140	175
306-B		100	500	100	1.6A[1]		140	175
306-C		150	500	150	1.6A[1]		140	175
306-D		200	500	200	1.6A[1]		140	175
306-F		300	500	300	1.6A[1]		140	175
306-H		400	500	400	1.6A[1]		140	175
306-K		500	500	500	1.6A[1]		140	175
306-M		600	500	600	1.6A[1]		140	175
307-A		50	500	50	1.6A[1]		140	175
307-B		100	500	100	1.6A[1]		140	175
307-C		150	500	150	1.6A[1]		140	175
307-D		200	500	200	1.6A[1]		140	175
307-F		300	500	300	1.6A[1]		140	175
307-H		400	500	400	1.6A[1]		140	175
307-K		500	500	500	1.6A[1]		140	175
307-M		600	500	600	1.6A[1]		140	175
308-A		50	500	50	1.6A[1]		140	175
308-B		100	500	100	1.6A[1]		140	175
308-C		150	500	150	1.6A[1]		140	175
308-D		200	500	200	1.6A[1]		140	175
308-F		300	500	300	1.6A[1]		140	175
308-H		400	500	400	1.6A[1]		140	175
308-K		500	500	500	1.6A[1]		140	175
308-M		600	500	600	1.6A[1]		140	175
319-A		50	40ma	50	150A[1]		125	190
319-B		100	40ma	100	150A[1]		125	190
319-C		150	40ma	150	150A[1]		125	190
319-D		200	40ma	200	150A[1]		125	190
319-E		250	40ma	250	150A[1]		125	190
319-F		300	40ma	300	150A[1]		125	190
319-G		350	40ma	350	150A[1]		125	190
319-H		400	4ma	400	150A[1]		125	190
319-K		500	4ma	500	150A[1]		125	190

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

WESTINGHOUSE ELECTRIC CORP. Continued

DIODE TYPE	MFGR.	E_{PEAK}	I_{PEAK}	E_{CONT}	I_{SURGE}	I_{MIN}	OPER	MAX
320-A		50	1.5ma		1.6A[1]		140	175
320-B		100	1.5ma		1.6A[1]		140	175
320-C		150	1.5ma		1.6A[1]		140	175
320-D		200	1.5ma		1.6A[1]		140	175
320-F		300	1.5ma		1.6A[1]		140	175
320-H		400	1.5ma		1.6A[1]		140	175
320-K		500	1.5ma		1.6A[1]		140	175
320-M		600	1.5ma		1.6A[1]		140	175
320-P		700	1.5ma		1.6A[1]		140	175
320-S		800	1.5ma		1.6A[1]		140	175
321-A		50	1.5ma		1.6A[1]		140	175
321-B		100	1.5ma		1.6A[1]		140	175
321-C		150	1.5ma		1.6A[1]		140	175
321-D		200	1.5ma		1.6A[1]		140	175
321-F		300	1.5ma		1.6A[1]		140	175
321-H		400	1.5ma		1.6[1]		140	175
321-K		500	1.5ma		1.6[1]		140	175
321-M		600	1.5ma		1.6[1]		140	175
321-P		700	1.5ma		1.6[1]		140	175
321-S		800	1.5ma		1.6[1]		140	175
322-A		50	40ma	50	150A[1]		125	190
322-B		100	40ma	100	150A[1]		125	190
322-C		150	40ma	150	150A[1]		125	190
322-D		200	40ma	200	150A[1]		125	190
322-E		250	40ma	250	150A[1]		125	190
322-F		300	40ma	300	150A[1]		125	190
322-G		350	40ma	350	150A[1]		125	190
322-H		400	40ma	400	150A[1]		125	190
322-K		500	40ma	500	150A[1]		125	190
326-A		50	40ma	50	150A[1]		125	190
326-B		100	40ma	100	150A[1]		125	190
326-C		150	40ma	150	150A[1]		125	190
326-D		200	40ma	200	150[1]		125	190
326-E		250	40ma	250	150[1]		125	190
326-F		300	40ma	300	150[1]		125	190
326-G		350	40ma	350	150[1]		125	190
326-H		400	40ma	400	150[1]		125	190
326-K		500	40ma	500	150[1]		125	190
341-A		50	10ma	50	6A[1]		175	190
341-B		100	10ma	100	6A[1]		175	190
341-C		150	10ma	150	6A[1]		175	190
341-D		200	10ma	200	6A[1]		175	190
341-F		300	10ma	300	6A[1]		175	190
341-H		400	10ma	400	6A[1]		175	190
341-K		500	10ma	500	6A[1]		175	190
341-M		600	10ma	600	6A[1]		175	190

1. Average half wave forward current.

DIODES REGISTERED WITH ELECTRONIC INDUSTRIES ASSOCIATION

DIODE TYPE	MFGR.	E_{PEAK}	I_{PEAK}	E_{CONT}	I_{SURGE}	I_{MIN}	OPER	MAX
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,BO	3000mc, Max. Conv. Loss = 6.5db, Max. Noise Ratio = 2						
1N21BM	K,M	3000mc, Matched pair						
1N21BMR	K,M	3000mc, Matched Forward and Reverse Polarity						
1N21BR	K,M,BO	3000mc, Reverse Polarity Type						
1N21C	K,M,BO	3000mc, Max. Conv. Loss = 5.5db, Max. Noise Ratio = 1.5						
1N21CM	K,M	3000mc, Matched Pair						
1N21CMR	K,M	3000mc, Matched Forward and Reverse Polarity						
1N21CR	K,M,BO	3000mc, Reverse Polarity Type						
1N21D	K,M,BO	30,000mc, Max. Conv. Loss = 5db, Max. Noise Ratio = 1.3						
1N21DM	K,M,BO	30,000mc, Matched Pair						
1N21DMR	K,M	30,000mc, Matched Forward and Reverse Polarity						
1N21DR	K,M,BO	30,000mc, Reverse Polarity Type						
1N21E	K,M	3000mc, Max. Noise Ratio = 5						
1N21EM	K,M	3000mc, Matched Pair						
1N21EMR	K,M	3000mc, Matched Forward and Reverse Polarity						
1N21ER	K,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,BO	10,000mc, Max. Conv. Loss = 6.5db, Max. Noise Ratio = 2.7						
1N23BM	K,M,BO	10,000mc, Matched Pair						
1N23BMR	K,	10,000mc, Matched Forward and Reverse Polarity						
1N23BR	K,M,BO	10,000mc, Reverse Polarity Type						
1N23C	K,M,BO	10,000mc, Max. Conv. Loss = 6db, Max. Noise Ratio = 2						
1N23CM	K,M	10,000mc, Matched Pair						
1N23CMR	K,M,BO	10,000mc, Matched Forward and Reverse Polarity						
1N23CR	K,M,BO	10,000mc, Reverse Polarity Type						
1N23CR	K,	10,000mc, Reverse Polarity Type						
1N23D	K,M,BO	10,000mc, Max. Conv. Loss = 5db, Max. Noise Ratio = 1.7						
1N23DM	K,M	10,000mc, Matched Pair						
1N23DMR	K,M,BO	10,000mc, Matched Forward and Reverse Polarity						
1N23DR	K,M,BO	10,000mc, Reverse Polarity Type						
1N23E	K,M,BO	10,000mc						
1N23EM	K,M	10,000mc, Matched Pair						
1N23EMR	K,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	K,M	3000mc, Reverse Polarity Type						
1N34	A,G,N,RR,TE	75	30@-10	60	500	5	25	75
1N34A	A,CBS,C,G,K N,RCA,RR,S, TE	75	30@-10	60	500	5	25	90
1N35	CBS,G,K,S, TE	75	10@-10	50		7.5	25	75
1N38	A,C,G,K,N, RR,R,TE	120	6@-3	100		4	25	90
1N38A	A,C,G,K,N, RCA,RR,S,TE	120	6@-3	100	500	4	25	75
1N38B	S	120	6@-3	100	500	4	25	90
1N39	G,K,N	225	600@-200	200		4	25	90
1N39A	CBS,G,K,N,S	225	200@-100	200	200	5	25	90
1N40	CBS,K,S,TE	75	35@-10	25		12.75@1.5	25	75
1N41	K	75	40@-10	25		12.75@1.5		90
1N42	CBS,K,TE	120	800@-100	100		12.75@1.5		90
1N43	K,N,RR	60	850@-50			5		
1N44	K,N,RR	115	1000@-50			3		
1N45	K,N	75	410@-50			3		
1N46	K,N	60	1500@-50			3		
1N47	K,N	150	500@-50			4		
1N48	CBS,G,K,N, RR,TE	85	833@-50	70	400	4	25	75
1N51	CBS,G,K,N, RR,TE	50	1660@-50	40	300	2.5	25	75
1N52	CBS,G,K,N, RR,TE	85	150@-50	70	400	4	25	75
1N53	K,M,BO	34,000mc, Max. Conv. Loss = 8.5db, Max. Noise Ratio = 2.5						

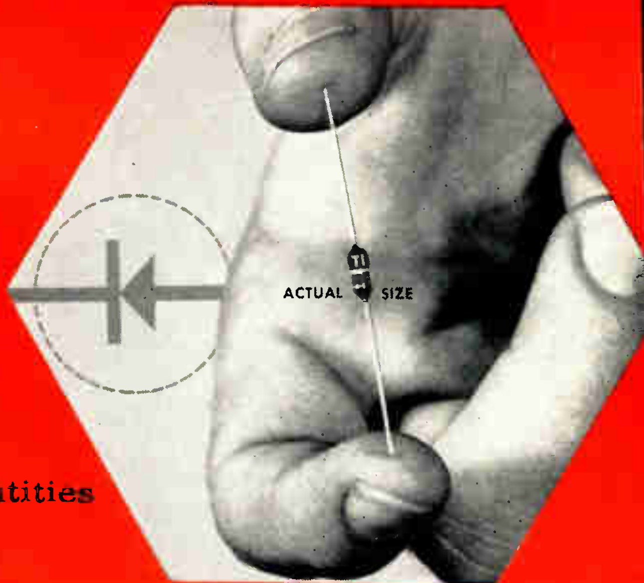
DIODE TYPE	MFGR.	INVERSE E PEAK v	INVERSE I PEAK ua @ v	INVERSE E CONT v	FORWARD I SURGE ma	FORWARD I MIN ma @ +1v	TEMP. OPER °C	TEMP. MAX °C
1N53A	K,M	34,000mc, Max. Conv. Loss = 6.5db, Max. Noise Ratio = 2.5						
1N53M	K,M	34,000mc, Matched Pair						
1N54	A,G,K,N,RR,	75	7@-10	50		5		90
1N54A	A,CBS,G,K,N,RCA,RR,S,TE	75	7@-10	50	500	5	25	75
1N55	G,K,N,RR,TE	170	500@-150	150		4		90
1N55A	CBS,G,K,N,RR,S,TE	170	300@-100	150	500	4	25	75
1N55B	CBS,G,RR	190	500@-150	150	500	5	25	75
1N56	K,RR	50	300@-30	40		15		90
1N56A	CBS,C,G,K,RR,S,TE	50	300@-30	40	1000	15	25	75
1N57	K,N	90	500@-75	80	500	4		
1N58	A,G,K,N,RR,TE	120	600@100	100		4		90
1N58A	A,CBS,G,K,N,RCA,RR,S,TE	120	600@-100	100	500	5	25	75
1N59	G,K,N	275	800@250	250		3		90
1N60	A,CBS,K,N,R,S	30	67@-10	25	500	3	25	75
1N61	G,K,N	140	300@-100	130	500	5		
1N63	A,CBS,G,K,N,RR,S,TE	125	500@-50	100	400	4	25	75
1N64	CBS,K,N,RR	20	200@-10	15			25	75
1N65	CBS,K,N,RR,S,TE	85	200@-50	70	400	2.5	25	75
1N66	K,N,RR,R	70	800@-50	60	500	5		100
1N67	G,K,N,R	100	50@-50	80	500	4		100
1N67A	A,CBS,C,G,H,N,RR,S,TE	100	5@-5	80	500	4	25	75
1N68	K,N,RR,R	120	625@-100	100	500	3		100
1N68A	A,G,H,N,RR,TE	130	625@-100	100	500	3	25	75
1N69	G,K,N,RR,S,TE	75	30@-10	60	400	5	25	75
1N69A	CBS,S	75	30@-10	60	400	5-25	25	75
1N70	K,N,RR,S,TE	125	25@-10	100	350	3	25	75
1N70A	CBS,S	125	25@-10	100	350	3	25	75
1N71	CBS,S,TE	50	300@30	40	1A	15	25	75
1N72	G	UHF Mixer diode equiv. to 1N82					25	75
1N73	CBS,TE,USD	75	50@-10	75	100	15	70	100
1N74	CBS,TE,USD	75	50@-10	75	100	15	70	100
1N75	CBS,N,R,TE	125	50@-50	100	400	2.5	25	75
1N76	K	Specially Tested Video Rectifier						
1N77B	S	Junction Photodiode, 50v max.						
1N78	K,M,BO	16,000mc, Max. Conv. Loss = 7.5db, Max. Noise Ratio = 2.5						
1N78A	K,M	16,000mc, Max. Conv. Loss = 7db, Max. Noise Ratio = 1.5						
1N79	K	0-10,000mc, instrument rectifier						
1N81	K,N,RR,S,TE	50	10@-10	40	350	3.5	25	75
1N81A	CBS,S	50	10@-10	40	350	3	25	75
1N82	K,S	5	N.F. <16db					
1N82A	CBS,K,S	5	N.F. <15.5db					
1N86	N	70	50@-10			4		
1N87	A	30	25@-1.5	25	400	.1@.25	25	
1N87A	A	30	25@-1.5	25	400		25	
1N88	A,G,N	110	100@-50	85	400	2.5	25	
1N89	A,G,H,N,RR,TE	100	8@-5	80		3.5		90
1N90	A,CBS,H,N,RR,S,TE	75	800@-50	60	500	5	25	75
1N91	GE	100		30	25,000		55	85
1N92	GE	200		65	25,000		55	85
1N93	GE	300		100	25,000		55	85
USN1N93	GE	300		100	25,000		55	85
1N95	A,G,H,TE	75	500@-50	60	250	10		90
1N96	C,G,H,RR,TE	75	500@-50	60	250	20		90
1N96A	TE	75	500@-50	60	400	40	90	100
1N97	G,H,RR,TE	100	8@-5	80	250	10		90
1N97A	RR	100	8@-5	80		20	25	
1N98	G,H,RR,S,TE	100	5@-5	80	250	20		90
1N98A	RR,TE	100	8@-5	80		40	25	
1N99	A,G,H,RR,TE	100	5@-5	80	300	10		90
1N99A	RR	100	5@-5	80		20	25	
1N100	C,G,H,RR,S,TE	100	5@-5	80	300	20		90
1N100A	RR,TE	100	5@-5	80		40	25	
1N111	N,RR,TE	75		60		5		90
1N112	N,RR,TE	75		60		5		90
1N113	N,RR,TE	75		60		2.5		90
1N114	N,RR,TE	75		60		2.5		90
1N115	N,RR,S,TE	75		60		2.5		90
1N116	A,C,CBS,H,N,TE	75	100@-50	60	250	5		90
1N116A	RR	75	100@-50	60		10	25	
1N117	A,G,H,RR	75	100@-50	60	250	10		90
1N117A	RR	75	100@-50	60		20	25	
1N118	G,H,RR,S,TE	75	100@-50	60	250	20		90
1N118A	RR,TE	75	100@-50	60		40	25	
1N119	A,RR,S	75	25@-10	60	500	5		75
1N120	A,S	75	50@-10	60	500	5		75
1N126	A,C,G,H,N,RR,S,TE	75	50@-10	60	350	5	25	75
1N126A	CBS,S	75	50@-10	60	350	5	25	90
1N127	C,G,H,N,RR,S,TE	125	25@-10	100	300	3	25	75
1N127A	CBS,S	125	25@-10	100	300	3	25	90
1N128	A,C,CBS,G,H,N,RR,S,TE	50	10@-10	40	300	3	25	75
1N137A	HE,TE	70	.03@-20	36		3	25	
1N137B	TE	36	.03@-20	25		20	125	150
1N138A	HE,TE	43	.01@-10	18	500	5	25	70
1N138B	TE	18	.01@-10	12		40	125	150
1N139	TE	50	1500@-50	40	500	20	25	90
1N140	C,G,RR,S,TE	85	300@-50	70	750	40	25	90
1N141	G,RR,TE	85	50@-50	70	500	20	25	90
1N142	G,N,RR,TE	125	100@-100	100	400	5	25	80
1N143	G,RR,TE	120	100@-100	100	750	40	25	90
1N144	RR,TE	40	200@-20	30	750	100	25	80
1N145	RR,TE	40	100@-10	30	750	40	25	70
1N147	P	1000mc mixer; N.F. = 10db						
1N147A	P	2	UHF Mixer					
1N149	K,M,BO	10,000mc, Max. Conv. Loss = 5.5db, Max. Noise Ratio = 1.5						
1N149M	K,M	10,000mc, Matched Pair						
1N149MR	K,M	10,000mc, Matched Forward and Reverse Polarity						
1N149R	K,M	10,000mc, Reverse Polarity Type						
1N150	K,M	6750mc, Max. Conv. Loss = 6db, Max. Noise Ratio = 2						
1N150M	K,M	6750mc, Matched Pair						
1N150MR	K,M	6750mc, Matched Forward and Reverse Polarity						
1N150R	K,M	6750mc, Reverse Polarity Type						
1N151	GE	100		30	28,000		55	85
1N152	GE	200		65	25,000		55	86
1N153	GE	300		100	25,000		55	85
1N158	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						
1N173	P	UHF mixer						
1N191	C,CBS,H,RR,S,TE	90	25@-10		400	5	25	90
1N192	C,H,RR,TE	70	250@-50		400	5		90
1N193	S		40@-40	40	100	1@2	100	150
1N194	S		10@-40	40	100	1.5@2	100	150
1N194A	S		10@-40	40	100	1.5	100	150
1N195	S		10@-40	40	100	2@2	100	150
1N196	S		10@-50	50	100	1@2	100	150
1N198	A,CBS,C,G,H,RR,S,TE	100	10@-10	80	300	4	75	90
1N198A	S	100	50@-50	80	300	4	75	90
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						
1N248	AM,TE,USD	50	5000@-50	50	100A	15A	150	200
1N248A	AM,TE,USD	50	5000@-50	50	90A	50A@1.5	150	175
1N249	AM,TE,USD	100	5000@-100	100	100A	15A	150	200
1N249A	AM,TE,USD	100	5000@-100	100	90A	50A@1.5	150	175
1N250	AM,TE,USD	200	5000@-200	200	100A	15A	150	200
1N250A	AM,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	AM,GE,HE,M,R,TE,USD	100	100@-95	100	4000	1000@1.5	135	150
1N254	AM,GE,HE,M,R,TE,USD	200	100@-190	200	1500	500@1.5	135	150
1N255	AM,GE,HE,M,R,TE,USD	400	150@-380	400	1500	500@1.5	135	150
1N256	AM,HE,M,R,TE,USD	600	250@-570	600	1000	500@2	135	150
1N263	P	12,000mc, X-Band mixer; N.F. = 7.8; Conv. Loss = 6db max						
1N268	K	40	850@-30	30	300	2.5	25	85
1N270	C,G,RR,TE	100	100@-50	80	500	200	90	90
1N273	G,TE	35	20@-20	30	450	100	25	90
1N276	C,RR,TE	75	100@-50	60	400	40	90	100
1N277	C,G,RR,TE	125	250@-50	100	400	100	90	90
1N278	C,G,TE		125@-50	50		20	75	
1N279	C,G,TE	35	200@-20	30	450	100	25	90
1N281	C,RR,TE	75	500@-50	60	400	100	90	90
1N283	C,RR,S,TE	25	20@-10	20	500	200	25	90
1N287	RR		1500@-50	40	500	20	25	90
1N288	RR		350@-50	70	750	40	25	90
1N289	RR		50@-50	70	500	20	25	90
1N290	RR		100@-100	100		5	25	90
1N291	RR		100@-100	100		40	25	90
1N292	RR		200@-50	60	150	100	25	90
1N294	C,K,RR,R	70	800@-50	60	500	5		100
1N295	K,RR,R	50	200@-10	40	300			100
1N297	C,R	100	100@-50	80	500	3.5		100
1N298	G,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	.2@-200	215	250	1		150
1N302A	R	225	.2@-200	215	350	5		150
1N303	R	125	.1@-100	115	300	3		150
1N303A	R	125	.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	GE	100		50	25,000		85	95
USAF1N315	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
1N316	AM	50				200@2		
1N317	AM	100				200@2		
1N318	AM	200				200@2		
1N319	AM	350				200@2		
1N320	AM	500				200@2		
1N330[1]	WE	70	.03@-20	32	150	3	25	100
1N331[1]	WE	43	.01@-10	16	250	5	25	100
1N332	AM,TE	400	200@280	280	10A		150	175
1N333	AM,TE	400	200@280	280	5A		150	175
1N334	AM,TE	300	200@210	210	10A		150	175
1N335	AM,TE	300	200@210	210	5A		150	175
1N336	AM,TE	200	100@140	140	10A		150	175
1N337	AM,TE	200	100@140	140	5A		150	175
1N338	AM,TE	100	200@70	70	6A		150	175
1N339	AM,TE	100	100@70	70	10A		150	175
1N340	AM,TE	100	100@70	70	5A		150	175
1N341	AM,TE	400	500@280	280	10A		150	175
1N342	AM,TE	400	500@280	280	5A		150	175
1N343	AM,TE	300	500@210	210	10A		150	175
1N344	AM,TE	300	500@210	210	5A		150	175
1N345	AM,TE	200	500@140	140	10A		150	175
1N346	AM,TE	200	500@140	140	5A		150	175
1N347	AM,TE	100	500@70	70	6A		150	175
1N348	AM,TE	100	500@70	70	10A		150	175
1N349	AM,TE	100	500@70	70	5A		150	175
1N350	TE	70	.03@-60	70		20	125	150
1N351	TE	120	.03@-100	120		8	125	150

T/I PROGRESS REPORT ON GLASS DIODE/RECTIFIERS

now! 400 mA 600 volts PIV

in a glass package

immediately available in production quantities



a new solution to your inventory and spare parts problems:

You can now get *big* voltage operation (to 600 V) plus a new high in forward conductance (400 mA) along with a 2 million-to-1 forward-to-reverse current ratio . . . from new TI diffused silicon glass diode/rectifiers! This means you can eliminate scores of diodes and rectifiers from your inventories . . . and stock only five TI diode/rectifiers for virtually *all* your requirements. For your magnetic amplifiers, modulators, demodulators, networks or subminiature power supplies, this new TI diode/rectifier series — with its extremely wide 225 to 600 voltage range — will meet your exacting circuitry needs.

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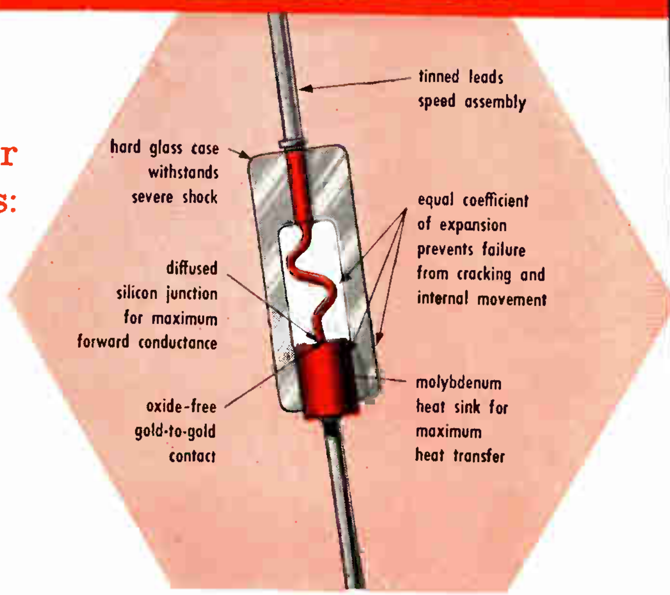

maximum ratings

	1N645	1N646	1N647	1N648	1N649	
Peak Inverse Voltage at −65 to +150°C	225	300	400	500	600	V
Average Rectified Forward Current at +25°C	400	400	400	400	400	mA
Average Rectified Forward Current at +150°C	150	150	150	150	150	mA
Recurrent Peak Forward Current at +25°C	1.25	1.25	1.25	1.25	1.25	amp
Surge Current, 1 Second DC at +25 to +150°C	3	3	3	3	3	Amp
Power Dissipation at +25°C	600	600	600	600	600	mW

specifications

	1N645	1N646	1N647	1N648	1N649	
Minimum Breakdown Voltage at +100°C	275	360	480	600	720	V
Maximum Reverse Current at PIV at +25°C	0.2	0.2	0.2	0.2	0.2	μA
Maximum Reverse Current at PIV at +100°C	15	15	20	20	25	μA
Maximum Voltage Drop at I_O = 400 mA; at +25°C	1.0	1.0	1.0	1.0	1.0	V

Put TI diode/rectifiers to work for you now! Write today for Bulletin No. DLS-770

TEXAS INSTRUMENTS
INCORPORATED
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Circle 51 on Inquiry Card, page 101

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
1N352	TE	170	.05@-150	170		5	125	150
1N353	TE	225	.1@-200	225		3	125	150
1N354	TE	325	.1@-300	325		1	125	150
1N355	S		5@-5	80	400	4		
1N360	AM	100				10@2		
1N361	AM	200				10@2		
1N362	AM	350				10@2		
1N363	AM	500				10@2		
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, BO	10,000mc, Reversible Polarity version of 1N23B						
1N415C	M, BO	10,000mc, Reversible Polarity version of 1N23C						
1N415D	M, BO	10,000mc, Reversible Polarity version of 1N23D						
1N415E	M, BO	10,000mc, Reversible Polarity version of 1N23E						
1N416B	M, BO	3000mc, Reversible Polarity version of 1N21B						
1N416C	M, BO	3000mc, Reversible Polarity version of 1N21C						
1N416D	M, BO	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
1N431	HE	75	1@-68	68	22		25	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
1N435	K,S	50	300@-30	40	1A	varistor	25	75
1N440	AM,GE	100	.3@100	100	15A		100	175
1N440B	AM,GE	100	.3@100	100	15A		100	175
1N441	AM,GE	200	.3@200	200	15A		150	175
1N441B	AM,GE	200	.3@200	200	15A		150	175
1N442	AM,GE	300	.3@300	300	15A		150	175
1N442B	AM,GE	300	.3@300	300	15A		150	175
1N443	AM,GE	400	.3@400	400	15A		150	175
1N443B	AM,GE	400	.3@400	400	15A		150	175
1N444	AM,GE	500	.3@500	500	15A		150	175
1N444B	AM,GE	500	.3@500	500	15A		150	175
1N445	AM	600	2@600	600	3A	25	150	200
1N445B	AM	600		600		25	150	200
1N447	G	75	20@-10	30		25		75
1N448	G	120	30@-30	100		25		75
1N449	G	50	10@-10	30		50		75
1N450	G, S	120	30@-30	100		50		75
1N451	G	170	150@-150	150		50		75
1N452	G	50	30@-30	30		100		75
1N453	G	120	30@-30	100		100		75
1N454	G	75	50@-50	50		200		75
1N455	G	50	30@-30	30		300		75
1N456	HE, H, PS	30	.025@-25	25	1.5A	40		200
1N456A	PS	30	.025@-25	25	1.5A	100		200
1N457	HE, H, PS, TE	70	.025@-60	60	1.5A	20		200
1N457A	PS	70	.025@-60	60	1.5A	100		200
1N458	HE, H, PS, TE	150	.025@-125	125	1.5A	7		200
1N458A	PS	150	.025@-125	125	1.5A	100		200
1N459	HE, H, PS, TE	200	.025@-175	175	1.5A	3		200
1N459A	PS	200	.025@-175	175	1.5A	100		200
1N460	R	90	.01@-10	85	350	5	150	150
1N460A	R	90	.01@-10	85	450	15	150	150
1N461	HE, H, PS, TE	30	.5@-25	25	1.5A	15		200
1N461A	PS	30	.5@-25	25	1.5A	100		200
1N462	HE, H, PS, TE	70	.5@-60	60	1.5A	5		200
1N462A	PS	70	.5@-60	60	1.5A	100		200
1N463	HE, H, PS, TE	200	.5@-175	175	1.5A	1		200
1N463A	PS	200	.5@-175	175	1.5A	100		200
1N464	HE, H, PS, TE	150	.5@125	125	1.5A	3		200
1N464A	PS	150	.5@125	125	1.5A	100		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						
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	
1N482	PS, TE	40	30@-30	36	1A	100@1.1	150	200
1N482A	PS, TE	40	15@-30	36	2A	100	150	200
1N482B	PS, TE	40	5@-30	36	2A	100	150	200
1N483	PS, TE	80	30@-60	70	1A	100@1.1	150	200
1N483A	PS, TE	80	15@-60	70	2A	100	150	200
1N483B	PS, TE	80	5@-60	70	2A	100	150	200
1N484	PS, TE	150	30@-125	130	1A	100@1.1	150	200
1N484A	PS, TE	150	15@-125	130	2A	100	150	200
1N484B	PS, TE	150	5@-125	130	2A	100	150	200
1N485	PS, TE	200	30@-175	180	1A	100@1.1	150	200
1N485A	PS, TE	200	15@-175	180	2A	100	150	200
1N485B	PS, TE	200	5@-175	180	2A	100	150	200
1N486	PS, TE	250	50@-225	225	1.5A	100@1.1	150	200
1N486A	PS, TE	250	25@-225	225	2A	100	150	200
1N486B	PS	250	10@-225	225	1.5A	100	200	200
1N487	PS, TE	330	50@-225	300	1A	100@1.1	150	200
1N487A	PS, TE	330	25@-225	300	2A	100	150	200
1N488	PS, TE	420	50@-380	380	1A	100@1.1	150	200
1N488A	PS, 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	AM	100	3@100	100	3000	250	150	200
1N531	AM	200	7.5@200	200	3000	250	150	200
1N532	AM	300	10@300	300	3000	250	150	200
1N533	AM	400	15@400	400	3000	250	150	200
1N534	AM	500	17.5@500	500	3000	250	150	200
1N535	AM	600	20@600	600	3000	250	150	200
1N536	AM, GE, HE, TE	50		50	15,000		150	175
1N537	AM, GE, HE, R, TE	100		100	15,000		150	175
1N538	AM, GE, HE, R, TI, TE	200		200	15,000		150	175
1N539	AM, GE, HE, R, TI, TE	300		300	15,000		150	175
1N540	AM, GE, HE, R, TI, TE	400		400	15,000		150	175
1N541	A	45	150@-30	30	200	1.5		
1N542	A	Matched Pair of 1N541						
1N547	AM, TE	600	10@-600	600	15A	500@1.2	150	175
1N550	AM	100	.5@100	100	4000	350	150	200
1N551	AM	200	1@200	200	4000	350	150	200
1N552	AM	300	1.5@300	300	4000	350	150	200
1N553	AM	400	2.5@400	400	4000	350	150	200
1N554	AM	500	3.5@500	500	4000	350	150	200
1N555	AM	600	5@600	600	4000	350	150	200
1N560	AM, TE	800	15@800	800	2000	200	150	200
1N561	AM, TE	1000	20@1000	1000	2000	200	150	200
1N562	AM	800	15@800	800	3000	300	150	200
1N563	AM	1000	20@800	1000	3000	300	150	200
1N571	S	20	100@-10	15		200	55	75
1N588	TI	1500	100@-1500	1500		10@10		150
1N589	TI	1500	100@-1500	1500		50@8		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	AM, I	50	25@50	50	2A		100	150
1N599A	AM, I	50	1@50		2A		100	150
1N600	AM, I	100	25@100	100	2A		100	150
1N600A	AM, I	100	1@100		2A		100	150
1N601	AM, I	150	25@150	150	2A		100	150
1N601A	AM, I	150	1@150		2A		100	150
1N602	AM, I	200	25@200	200	2A		100	150
1N602A	AM, I	200	1@200		2A		100	150
1N603	AM, I	300	25@300	300	2A		100	150
1N603A	AM, I	300	1@300		2A		100	150
1N604	AM, I	400	25@400	400	2A		100	150
1N604A	AM, I	400	1.5@400		2A		100	150
1N605	AM, I	500	25@500	500	2A		100	150
1N605A	AM, I	500	2@500		2A		100	150
1N606	AM	600	25@600	600	2A		100	150
1N606A	AM	600	2.5@600	420	2A			
1N607	AM, I	50	25@50	50	2A		100	150
1N607A	AM, I	50	1@50		2A		100	150
1N608	AM, I	100	25@100	100	2A		100	150
1N608A	AM, I	100	1@100		2A		100	150
1N609	AM, I	150	25@150	150	2A		100	150
1N609A	AM, I	150	1@150		2A		100	150
1N610	AM, I	200	25@200	200	2A		100	150
1N610A	AM, I	200	1@200		2A		100	150
1N611	AM, I	300	25@300	300	2A		100	150
1N611A	AM, I	300	1@300		2A		100	150
1N612	AM, I	400	25@400	400	2A		100	150
1N612A	AM, I	400	1.5@400		2A		100	150
1N613	AM, I	500	25@500	500	2A		100	150
1N613A	AM, I	500	2@500		2A		100	150
1N614	AM, I	600	25@600	600	2A		100	150
1N614A	AM, I	600	2.5@600		2A		100	150
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	HE, H, TE	30	1@-10			4@1.5		135
1N626	HE, H, TE	50	20@-35			4@1.5		135
1N627	HE, H, TE	100	20@-75			4@1.5		135
1N628	HE, H, TE	150	20@-125			4@1.5		135
1N629	HE, H, TE	200	20@-175			4@1.5		135
1N631	S	90	120@-60	60	Computer Type		55	75
1N632	S	90	120@-60	60	100	7	55	75
1N633	S	120	180@-90	80	150	125	55	75
1N634	S	120	35@-30	100	300	50	55	75
1N635	S	170	175@-150	150	200	50	55	75
1N636	CBS	60	10@-10	40	400	2.5	25	75
1N643	PS	200	1@100	175	50	10	150	
1N645	TI	225	.2@225	225	3000	400	150	150
1N646	TI	300	.2@300	300	3000	400	150	150
1N647	TI	400	.2@400	400	3000	400	150	150
1N648	TI	500	.2@500	500	3A	400	150	150
1N649	TI	600	.2@600	600	3A	400	150	150
1N659	TI	50	5@50	50		6	150	150
1N660	TI	100	5@100	100		6	150	150
1N661	TI	200	10@200	200		6	150	150
1N662	PS	100	1@100	175	50	10	150	
1N663	PS	100	20@50	80	500	10	150	
1N1028	ST	50	200@50		30A		100	150
1N1029	ST	100	200@100		30A		100	150
1N1030	ST	150	200@150		30A		100	150
1N1031	ST	200	200@200		30A		100	150
1N1032	ST	300	200@300		30A		100	150
1N1033	ST	400	200@400		30A		100	150
1N1034	ST	50	200@50		30A		100	150
1N1035	ST	100	200@100		30A		100	150
1N1036	ST	150	200@150		30A		100	150
1N1037	ST	200	200@200		30A		100	150
1N1038	ST	300	200@300		30A		100	150
1N1039	ST	400	200@400		30A		100	150
1N1040	ST	50	200@50		30A		100	150
1N1041	ST	100	200@100		30A		100	150
1N1042	ST	150	200@150		30A		100	150
1N1043	ST	200	200@200		30A		100	150
1N1044	ST	300	200@300		30A		100	150
1N1045	ST	400	200@400		30A		100	150
1N1052	ST	50	1500@50		60A		100	150
1N1053	ST	100	1500@100		60A		100	150
1N1054	ST	150	1500@150		60A		100	150
1N1055	ST	200	1500@200		60A		100	150
1N1056	ST	300	1500@300		60A		100	150
1N1057	ST	400	1500@400		60A		100	150
1N1058	ST	50	1500@50		60A		100	150
1N1059	ST	100	1500@100		60A		100	150
1N1060	ST	150	1500@150		60A		100	150
1N1061	ST	200	1500@200		60A		100	150
1N1062	ST	300	1500@300		60A		100	150
1N1063	ST	400	1500@400		60A		100	150
1N1081	ST	100	2@100		30A		100	100
1N1082	ST	200	2@200		30A		100	100
1N1083	ST	300	2@300		30A		100	100
1N1084	ST	400	2@400		30A		100	100
1N1085	ST	100	2@100		60A		100	100
1N1086	ST	200	2@200		60A		100	100
1N1087	ST	300	2@300		60A		100	100
1N1088	ST	400	2@400		60A		100	100
1N1093	S	25	25@-5	15	400	Computer	55	75
1N1095	AM, GE, HE, TI, TE	500	.3ma@500	500	400		135	75
1N1096	AM, TI	600	.25ma@600	600			150	
1N1100	AM							
1N1101	AM							
1N1102	AM							

Sarkes Tarzian

SILICON RECTIFIERS *are available with current ratings (as single units) from 500 ma to 200 amps and voltage ratings from 50 to 2800 volts peak inverse*

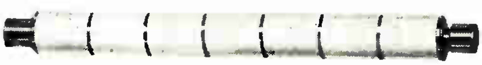
Tarzian Silicon Rectifiers offer dependability and excellent performance at low unit cost. Mass production techniques, carefully controlled on quality and process have resulted in low cost silicon rectifiers for commercial and military applications.

TUBE REPLACEMENT SERIES

Direct plug-in replacements for rectifier tubes are available in four types that cover 95% of the popular octal types in use. The additional efficiency, ruggedness and long life makes this series popular in equipments where unattended service and dependability are prime considerations.

HEAVY CURRENT SERIES

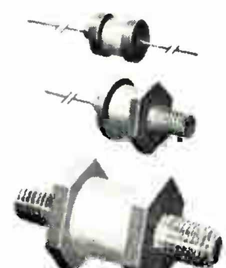
The high current series covers current ratings of 25, 35, 100, 150 and 200 amperes at peak inverse voltage ratings of 50, 100, 200 and 300 volts. The unique package design provides maximum heat transfer from the junction to the heat sink through the shortest possible path.



HIGH VOLTAGE SERIES

Series junctions provide the solutions to the high voltage problems, when dependability is also a prime requirement. The peak inverse voltage range is from 800 to 2800 volts and the dc current ratings are from 325 to 450 milliamperes at 100°C.

HERMETICALLY SEALED SERIES



This series, ranging in voltage ratings from 50 to 400 volts peak inverse and current ratings from 500 milliamperes to 15 amperes, is completely hermetically sealed to meet military requirements. Both axial lead and stud mounted types are available.

L AND M SERIES

Type L and type M silicon rectifiers are designed primarily for commercial use and are provided with end ferrules that fit standard fuse clips. A grooved ferrule at the positive end identifies polarity. The current ratings are: 500 milliamperes on the M series and 1.5 amperes on the L series. The peak inverse voltage range is from 100 to 400 volts.

Send for specific catalog or design information.

Sarkes Tarzian, Inc.

RECTIFIER DIVISION

DEPT. EE-4, 415 NORTH COLLEGE AVE., BLOOMINGTON, IND. • PHONE 2-1435-6-7

IN CANADA: 700 WESTON RD., TORONTO 9, TEL. ROGERS 2-7535 • EXPORT: AD AURIEMA, INC., NEW YORK CITY

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
1N1103	AM							
1N1104	AM							
1N1105	AM							
1N1108	ST	800	2@800		30A		100	150
1N1109	ST	1200	2@1200		30A		100	150
1N1110	ST	1600	2@1600		30A		100	150
1N1111	ST	2000	2@2000		30A		100	150
1N1112	ST	2400	2@2400		30A		100	150
1N1113	ST	2800	2@2800		30A		100	150
1N1115	AM,GE,HE	100	.4ma@100	100	15A		150	
1N1116	AM,GE,HE	200	.4ma@100	200	15A		150	
1N1117	AM,GE,HE	300	.4ma@300	100	15A		150	
1N1118	AM,GE,HE	400	.4ma@400	200	15A		150	
1N1130	TI	1500	900ma@1500				150	
1N1131	TI	1500	900ma@1500				150	
1N1133	I	1500	25@1500		10A		75	150
1N1134	I	1500	25@1500		10A		75	150
1N1135	I	1800	25@1800		10A		75	150
1N1137	I	2400	25@2400		10A		75	150
1N1138	I	2400	25@2400		10A		75	150
1N1139	I	3600	25@3600		10A		75	150
1N1140	I	3600	25@3600		10A		75	150
1N1141	I	4800	25@4800		10A		75	150
1N1142	I	4800	25@4800		10A		75	150
1N1143	I	6000	25@6000		10A		75	150
1N1143A	I	6000	25@6000		10A		75	150
1N1144	I	7200	25@7200		10A		75	150
1N1145	I	7200	25@7200		10A		75	150
1N1146	I	5650	25@5650		10A		75	150
1N1147	I	8500	25@8500		10A		75	150
1N1148	I	9900	25@9900		10A		75	150
1N1149	I	11300	25@11300		10A		75	150
1N1150	ST	1600	2@1600		8000A		100	100
1N1157	ST	50	25@50		200A		100	100
1N1158	ST	100	25@100		200A		100	100
1N1159	ST	200	25@200		200A		100	100
1N1160	ST	300	25@300		200A		100	100
1N1161	ST	50	40@50		350A		100	100
1N1162	ST	100	40@100		350A		100	100
1N1163	ST	200	40@200		350A		100	100
1N1164	ST	300	40@300		350A		100	100
1N1165	ST	50	100@50		1000A		100	100
1N1166	ST	100	100@100		1000A		100	100
1N1167	ST	200	100@200		1000A		100	100
1N1168	ST	300	100@300		1000A		100	100
1N1169	W	400	3.5ma				150	175
1N1171	ST	50	25@50		200A		100	100
1N1172	ST	100	25@100		200A		100	100
1N1173	ST	200	25@200		200A		100	100
1N1174	ST	300	25@300		200A		100	100
1N1175	ST	50	40@50		350A		100	100
1N1176	ST	100	40@100		350A		100	100
1N1177	ST	200	40@200		350A		100	100
1N1178	ST	300	40@300		350A		100	100
1N1179	ST	50	100@50		1000A		100	100
1N1180	ST	100	100@100		1000A		100	100
1N1181	ST	200	100@200		1000A		100	100
1N1182	ST	300	100@300		1000A		100	100
1N1237	ST	1600	2@1600		8000A		100	100
1N1238	ST	1600	2@1600		8000A		100	100
1N1239	ST	2800	2@2800		5000A		100	100
1N1240	HE	70		50			175	175
1N1241	HE	125		100			175	175
1N1242	HE	250		200			175	175
1N1243	HE	375		300			175	175
1N1244	HE	500		400			175	175
1N1244A	HE	500		400			175	175
1N1245	HE	625		500			150	175
1N1246	HE	750		600			150	175
1N1247	HE	850		700			150	175
1N1248	HE	950		800			150	175
1N1249	HE	1050		900			150	175
1N1250	HE	1150		1000			150	175
1N1251	HE	70		50			175	175
1N1252	HE	125		100			175	175
1N1253	HE	250		200			175	175
1N1254	HE	375		300			175	175
1N1255	HE	500		400			175	175
1N1255A	HE	500		400			175	175
1N1256	HE	625		500			150	175
1N1257	HE	750		600			150	175
1N1258	HE	850		700			150	175
1N1259	HE	950		800			150	175
1N1260	HE	1050		900			150	175
1N1261	HE	1150		1000			150	175
1N1263	ST	50	150@50		1500A		100	100
1N1263A	ST	50	150@50		2000A		100	100
1N1264	ST	100	150@100		1500A		100	100
1N1264A	ST	100	150@100		2000A		100	100
1N1265	ST	200	150@200		1500A		100	100
1N1265A	ST	200	150@200		2000A		100	100
1N1266	ST	300	150@300		1500A		100	100
1N1266A	ST	300	150@300		2000A		100	100
1N1267	ST	50	150@50		1500A		100	100
1N1267A	ST	50	150@50		2000A		100	100
1N1268	ST	100	150@100		1500A		100	100
1N1268A	ST	100	150@100		2000A		100	100
1N1269	ST	200	150@200		1500A		100	100
1N1269A	ST	200	150@200		2000A		100	100
1N1270	ST	300	150@300		1500A		100	100
1N1270A	ST	300	150@300		2000A		100	100
1N1301	GE	50	5ma@50	50	300A		160	
1N1302	GE	100	5ma@100	100	300A		160	
1N1304	GE	200	5ma@200	200	300A		160	
1N1306	GE	300	5ma@300	300	300A		160	
1N1313	HE	Zener voltage @.2ma, 7.5-10					150	200
1N1314	HE	Zener voltage @.2ma, 9-12					150	200
1N1315	HE	Zener voltage @.2ma, 11-14.5					150	200
1N1316	HE	Zener voltage @.2ma, 13.5-18					150	200
1N1317	HE	Zener voltage @.2ma, 17-21					150	200
1N1318	HE	Zener voltage @.2ma, 20-27					150	200
1N1319	HE	Zener voltage @.2ma, 25-32					150	200
1N1320	HE	Zener voltage @.2ma, 30-39					150	200
1N1321	HE	Zener voltage @.2ma, 37-45					150	200
1N1322	HE	Zener voltage @.2ma, 43-54					150	200
1N1323	HE	Zener voltage @.2ma, 52-64					150	200
1N1324	HE	Zener voltage @.2ma, 62-80					150	200
1N1325	HE	Zener voltage @.2ma, 75-100					150	200
1N1326	HE	Zener voltage @.2ma, 90-120					150	200
1N1327	HE	Zener voltage @.2ma, 110-145					150	200
1N1328	WE	250	.3@200	200	3A	250	100	150
1N1351	HE	Zener regulator 10volt ±10%@500ma					155	155
1N1351A	HE	Zener regulator 10volt ±5%@500ma					155	155
1N1352	HE	Zener regulator 11volt ±10%@500ma					155	155
1N1352A	HE	Zener regulator 11volt ± 5%@500ma					155	155
1N1353	HE	Zener regulator 12volt ±10%@500ma					155	155
1N1353A	HE	Zener regulator 12volt ± 5%@500ma					155	155
1N1354	HE	Zener regulator 13volt ±10%@500ma					155	155
1N1354A	HE	Zener regulator 13volt ± 5%@500ma					155	155
1N1355	HE	Zener regulator 15volt ±10%@500ma					155	155
1N1355A	HE	Zener regulator 15volt ± 5%@500ma					155	155
1N1356	HE	Zener regulator 16volt ±10%@500ma					155	155
1N1356A	HE	Zener regulator 16volt ± 5%@500ma					155	155
1N1357	HE	Zener regulator 18volt ±10%@500ma					155	155
1N1357A	HE	Zener regulator 18volt ± 5%@500ma					155	155
1N1358	HE	Zener regulator 20volt ±10%@150ma					155	155
1N1358A	HE	Zener regulator 20volt ± 5%@150ma					155	155
1N1359	HE	Zener regulator 22volt ±10%@150ma					155	155
1N1359A	HE	Zener regulator 22volt ± 5%@150ma					155	155
1N1360	HE	Zener regulator 24volt ±10%@150ma					155	155
1N1360A	HE	Zener regulator 24volt ± 5%@150ma					155	155
1N1361	HE	Zener regulator 27volt ±10%@150ma					155	155
1N1361A	HE	Zener regulator 27volt ± 5%@150ma					155	155
1N1362	HE	Zener regulator 30volt ±10%@150ma					155	155
1N1362A	HE	Zener regulator 30volt ± 5%@150ma					155	155
1N1363	HE	Zener regulator 33volt ±10%@150ma					155	155
1N1363A	HE	Zener regulator 33volt ± 5%@150ma					155	155
1N1364	HE	Zener regulator 36volt ±10%@150ma					155	155
1N1364A	HE	Zener regulator 36volt ± 5%@150ma					155	155
1N1365	HE	Zener regulator 39volt ±10%@150ma					155	155
1N1365A	HE	Zener regulator 39volt ± 5%@150ma					155	155
1N1366	HE	Zener regulator 43volt ±10%@150ma					155	155
1N1366A	HE	Zener regulator 43volt ± 5%@150ma					155	155
1N1367	HE	Zener regulator 47volt ±10%@150ma					155	155
1N1367A	HE	Zener regulator 47volt ± 5%@150ma					155	155
1N1368	HE	Zener regulator 51volt ±10%@150ma					155	155
1N1368A	HE	Zener regulator 51volt ± 5%@150ma					155	155
1N1369	HE	Zener regulator 56volt ±10%@150ma					155	155
1N1369A	HE	Zener regulator 56volt ± 5%@150ma					155	155
1N1370	HE	Zener regulator 62volt ±10%@50ma					155	155
1N1371	HE	Zener regulator 68volt ±10%@50ma					155	155
1N1372	HE	Zener regulator 75volt ±10%@50ma					155	155
1N1373	HE	Zener regulator 82volt ±10%@50ma					155	155
1N1374	HE	Zener regulator 91volt ±10%@50ma					155	155
1N1375	HE	Zener regulator 100volt ±10%@50ma					155	155

1. Semiconductor products of Western Electric Co. are available only to U.S. Government agencies, and their contractors.

DIODE MANUFACTURERS

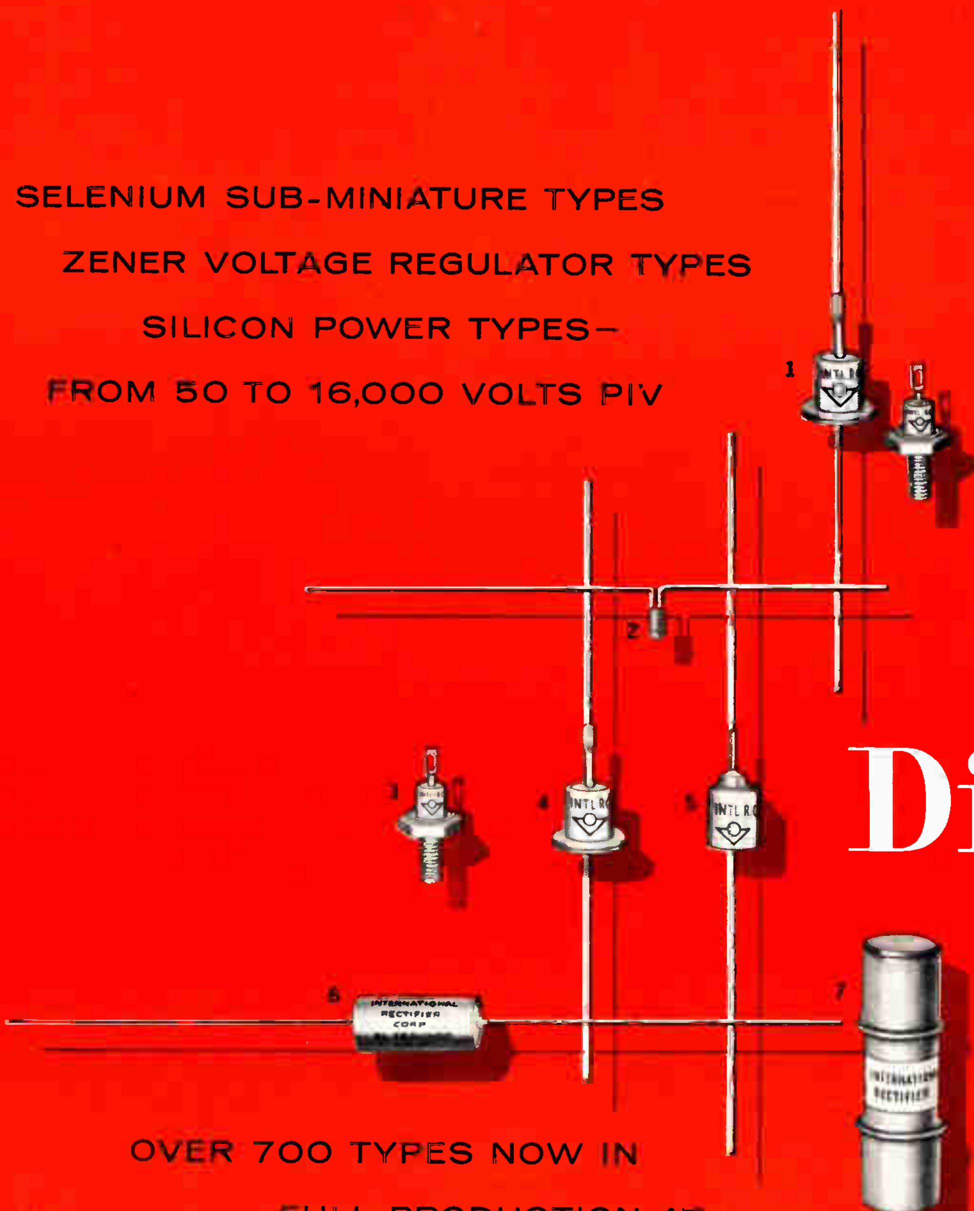
A—Amperex Electronic
AM—Automatic Manufacturing
B—Bendix Aviation
BO—Bomac Laboratories
C—Clevite Transistor Products
CBS—CBS-Hytron
G—Gahagan
GE—General Electric
HE—Hoffman Electronics
H—Hughes Products
I—International Rectifier
IR—International Resistance
K—Kempron Electron Products
M—Microwave Associates
N—Nucleonic Products
PS—Pacific Semiconductors
P—Philco
RCA—Radio Corp. of America
RR—Radio Receptor
R—Raytheon Manufacturing
ST—Sarkes Tarzian
S—Sylvania Electric Products
TI—Texas Instruments
TH—Thermosen
TE—Transitron Electronic
USD—United States Dynamics
U—U. S. Semiconductor Products
WE—Western Electric
W—Westinghouse

SELENIUM SUB-MINIATURE TYPES

ZENER VOLTAGE REGULATOR TYPES

SILICON POWER TYPES—

FROM 50 TO 16,000 VOLTS PIV



1 Silicon Zener Diodes Pigtail Type: 1.0 Watt Rated. Stud Mounted: 3.5 Watt Rated Series in each type. 3.9 volts to 30 v. in 10% voltage steps. Hermetically sealed. Bulletin SR-155.

2 Selenium Sub-Miniature Diodes High inverse resistance. Ideal for bias supplies-computer matrices. Output voltages: 20 to 160 v., output currents: 100 microamperes to 11 ma. Complete series. Bulletin SD 1B.

3 Stud Mounted Silicon Power Diodes Style T. For power supply and mag amp applications. PIV ratings from 50 to 600 v. at 800 ma dc output. All-welded, hermetically sealed. Bulletin SR-135C.

4 Silicon Power Diodes — Pigtail PIV range: 50 to 600 v. at 300 ma dc output current. For power supply and mag amp application. All-welded, hermetically sealed. Complete series. Bulletin SR 132E.

5 High Voltage Silicon Power Diodes Style J. Hermetically sealed. A complete series with PIV ratings from 600 to 1000 v. at 125 ma dc output current. Bulletin SR 135E.

Diodes

6 High Voltage Silicon Power Diodes Style K. Hermetically sealed. PIV from 600 to 1500 v. at 100 ma dc output current. Bulletin SR 144A.

7 High Voltage Cartridge Types For tough miniaturization problems! A series with ratings from 1000 volts PIV at 100 ma to 16,000 volts PIV at 45 ma (Half-Wave). Hermetically sealed. Bulletin SR 129B.

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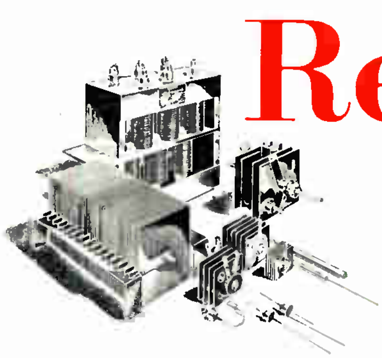

The diodes listed are typical of the wide selection available at International Rectifier to solve your rectification problem...*with excellent reliability!* Your letterhead inquiry will bring the bulletin you specify and—if you include the details of your project—a recommendation stating the diode best suited to your need. The illustration at left suggests the scope of our complete line of selenium, germanium and silicon rectifiers for all dc needs from microwatts to megawatts, literally the widest range in the industry.

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Circle 53 on Inquiry Card, page 101

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CIRCLE THE NUMBERS OPPOSITE THE NAMES OF TH

36 Airtron, Inc.—Microwave components

67 Alford Manufacturing Co., Inc.—Standby TV transmitting antennas

12 American Lava Corporation — Alumina ceramics

32 Amperex Electronic Corporation—Broad-band twin triode

33 Arnold Engineering Company, The—Rectangular-loop core material

6 Audio Devices, Inc.—Magnetic recording tape

45 Automatic Manufacturing, Div. of General Instrument Corp.—Silicon power rectifiers

95 Automatic Metal Products Corp.—Sub-miniature coaxial connectors

14 Blaw-Knox Company, Equipment Div.—Microwave towers

105 Bomac Laboratories, Inc.—Magnetrons

92 Borg Equipment Div., The George W. Borg Corp.—Potentiometers and precision turn-counting dials

94 Borg Equipment Div., The George W. Borg Corp.—Trimming micro-potentiometers

11 Bourns Laboratories, Inc. — Sub-miniature potentiometers

90 Bulova Watch Company, Electronics Division—Crystal filters

58 Burnell & Co., Inc.—Adjustable toroids

74 Bussmann Mfg. Division McGraw-Edison Co.—Fuses and fuseholders

19 Cannon Electric Co.—Connectors

55 Chatham Electronics Div. of Tung-Sol Electric Inc. — Vacuum & gas-filled electron tubes

85 Chilton Company—Electronic Abstracts

104 Chilton Company—Electronic Industries Circulation

42 Cinch Manufacturing Corporation—Universal transistor sockets

101 Columbian Carbon Co., Mapico Color Unit—Red ferric oxides for ferrites

87 Connecticut Hard Rubber Co.—Pressure-sensitive TEFLON tape

13 Cornell-Dubilier Electric Corp.—Miniature capacitors

69 Corning Glass Works—Glass capacitors

18 Dale Products, Inc. — Moisture-proof trimmer potentiometers

82 De JUR-Amsco Corporation—Precision potentiometers

38 Delco Radio Division of General Motors —High power transistors

84 Dexter Machine Products—Aluminum or stainless steel missile gears

90 Diamond Power Specialty Corp., Electronics Dept.—Television camera tube

39 Dow Corning Corporation—Silicone rubber

10 Du Mont Laboratories, Inc., Allen B., I dustrial Tube Sales—Cathode-ray tub

26 Du Mont Laboratories, Inc., Allen B Technical Sales Dept.—VTVM

8 Electro-Motive Mfg. Co., Inc., The-Mica capacitors

3 Erie Resistor Corporation, Electroni Div.—Ceramic disc capacitors

24 E S C Corporation—Delay lines

62 Fairchild Controls Corp., Componen Div.—Precision potentiometers, pressure transducers and accelerometers

503 Federal Telecommunications Labs., Div I T & T—Engineering personnel

17 Federal Telephone & Radio Co., Div I T & T—Engineering personnel

91 Ferroxcube Corporation of America—Pre-adjusted filter cores

71 Filtors, Inc.—Sub-miniature relays

103 Freed Transformer Co., Inc.—Telemetering components

34 Fusite Corporation, The—Solid glass terminals

28 General Chemical Div., Allied Chemical & Dye Corp.—Electronic chemicals

80 General Electric Corp., Receiving Tube Dept.—Receiving tubes

21 General Electric Corp., Apparatus Dept. —Voltage regulators

41 General Radio Company—D-C Amplifier and Electrometer

23 General Transistor Corporation—Transistors

102 Gertsch Products, Inc.—Test equipment

81 Heath Company, Subsidiary of Daystrom, Inc.—Analog Computer Kit

54 Hoffman Semiconductor Div., Hoffman Electronics Corp.—Diodes

86 Howard Industries, Inc.—Capacitor or 2 phase type servo motor

7 Hughes Aircraft Co., Products Div.—Storage type oscilloscope

48 Hughes Aircraft Co., Semiconductor Div. —Medium power silicon rectifiers

60 Institute of Radio Engineers—Proceedings of the I R E

57 International Electronic Research Corp. —Tube shields for printed circuits

53 International Rectifier Corp.—Diodes

37 Johnson Co., E. F.—Variable capacitors

68 Jones Div., H. B., Cinch Manufacturing Corp.—Terminal panels

63 Kennedy & Co., D. S.—Radar antennas

40 Kester Solder Company—Flux-core solder

89 Kulka Elec. Mfg. Co., Inc.—Toggle switches

77 Lenz Electric Manufacturing Co.—Wires & Cables

93 Lerco Electronics, Inc.—Electronic hardware

15 Magnetics, Inc. — Molybdenum powder cores

73 Mallory & Co., Inc., P. R.—Vibrators

99 Measurements Corp., Div. McGraw-Edison—Test equipment

501 Melpar, Inc., Subsidiary of Westinghouse Air Brake Co.—Engineering personnel

29 Midland Manufacturing Co., Inc.—Crystals

72 Minneapolis Honeywell Regulator Co., Transistor Div.—Power transistors

59 Minnesota Mining & Manufacturing Co. —Recording tapes

44 Motorola, Inc., Semiconductor Products Div.—Power transistors

70 Narda Ultrasonics Corp. — Ultrasonic equipment

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National Cash Register Co.—Engineering personnel
Onan & Sons, Inc., D. W.—Electric power plants
Pacific Semiconductors, Inc.—Voltage-variable capacitors
0 Permag Corporation—Magnets
9 Phelps Dodge Copper Products Corp., Inca Manufacturing Div. — Magnet wire
4 Phelps Dodge Copper Products Corp.—Coaxial cable
7 Philco Corp., Lansdale Tube Company Division—Transistors
0 Polarad Electronics Corp. — Microwave spectrum analyzer
11 Polarad Electronics Corp. — Microwave receiver
25 Potter Instrument Corp.—Magnetic recording equipment
06 Radio Corporation of America, Electron Tube Div.—Computer tubes
65 Radio Corporation of America, Electron Tube Div.—Transmitting tubes
22 Radio Corporation of America, Semiconductor Div.—Transistors
1 Radio Materials Corporation—Disc capacitors
49 Radio Receptor Co., Inc., Semiconductor Div.—Diodes
50 Raytheon Semiconductor Division—Diodes and rectifiers
68 Rohn Manufacturing Co.—Communication towers
52 Sarkes Tarzian, Inc., Rectifier Division—Silicon rectifiers
30 Sperry Gyroscope Co., Div. of Sperry Rand Corp., Microwave Electronics Div.—Radar test sets
2 Sprague Electric Co.—Carbon film resistors
48 Stackpole Carbon Co., Electronic Components Div.—Variable resistors
83 Sta-Warm Electric Co.—Melting tanks
98 Stewart Corp., F. W.—Flexible shaft coupling
46 Sylvania Electric Products, Inc.—Cathode ray tubes
78 Sylvania Electric Products, Inc.—Electron tubes for radar
61 Texas Instruments, Incorporated—Glass diode/rectifiers
76 Transval Engineering Corp.—Power supplies
6 Triplett Electrical Instrument Company—Panel meters
61 Tung-Sol Electric, Inc., Electroswitch Div.—Thermal relays
79 United States Gasket Plastics Div. of the Garlock Packing Company—Fluorocarbon molding
56 United Transformer Corporation—Transistor transformers
97 Universal Manufacturing Co., Inc.—Toroid winding machine
16 University Loudspeakers, Inc. — Loudspeakers
81 Waters Manufacturing, Inc.—Miniature potentiometers
86 Western Gear Corporation — Motors, voltage regulators and strain gage power supplies
76 Westinghouse Electric Corp., Electronic Tube Division—Cathode ray tube
20 Weston Instruments Div. of Daystrom, Inc.—Tube analyzers
4 Wincharger Corporation, Subsidiary of Zenith Radio Corporation — Missile power supply

Employment—Use the handy card below to get more information on the engineering positions described in the "Professional Opportunities" Section which begins on page 107 of this issue.

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PROFESSIONAL ENGINEERING OPPORTUNITIES

Please send me further information on the engineering positions I have circled below.

501	506	511	516	521
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New Products & Technical Data

141 Antenna rotor—Cornell-Dubilier Electric Corp.
143 Antenna, side mount—Andrew Corp.
208 Capacitor, metallized—Astron Corp.
207 Connectors—Cannon Electric Co.
206 Connectors, p-c—DeJur-Amsco Corp.
217 Connectors, rack & panel — Amphenol Electronics Corp.
201 Fastener, quick — Tinnerman Products, Inc.
204 Filters, magnetstriction—Raytheon Mfg. Co.
145 Generator, sweep—Kay Electric Co.
199 Harness material — Illumitronic Engineering
218 Machinery, production — Design Tool Corp.
196 Magnetron, tunable—Bomac Labs, I
215 Measuring equipment, carrier—Interi tional Telephone and Telegraph Coi
211 Memory device — International Busin Machines Corp.
142 Microphone, recorder — Elgin Nation Watch Co.
223 Movie projector—Eastman Kodak Co.
220 Multimeter—Simpson Electric Co.
140 Orthicon life extender—General Electr Co.
195 Oscillator, 1 mc—Manson Labs., Inc.
197 Pilot light—Dialight Corp.
222 Radio, industrial—Motorola, Inc.
200 Rectifiers—General Electric Co.
205 Rectifiers, silicon — Westinghouse Ele tric Corp.
214 Switch, high temperature—Electro Sna Switch & Mfg. Co.
198 Tape, instrumentation—Minnesota Min ing & Mfg. Co.
221 Transformer, plug-in — United Trans former Corp.
216 Transformers, small—Stromberg-Carlsoi
202 Transistor, drift—Radio Corp. of America
209 Transmitter, telemetering—Texas Instruments Incorporated
203 Tube, electron—Bendix Aviation Corp.
210 Tube, power pentode — Amperex Electronic Corp.
144 Tube, ssb tetrode—Eitel-McCullough, Inc.
213 Voltmeter, electronic—Consolidated Electrodynamics Corp.
212 Wrench, tip—Tipco Mfg. Co.

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NEW TECHNICAL DATA

178 Antennas, mobile radio—Communication Products Co.
187 Bearings, precision—Miniature Precision Bearings, Inc.
192 Bulletin, engineering, capacitors—Pyramid Electric Co.
162 Bulletin, engineering, epoxy resins—Synthane Corp.
174 Bulletin, technical, ferrite devices — Sperry Gyroscope Co.
171 Bulletin, technical, panoramic techniques —Radio Products, Inc.
166 Calculator, tape core—Magnetics, Inc.
173 Capacitors—Astron Corp.
165 Capacitor, polystyrene film — Sprague Electric Co.
188 Circuits, packaged—Centralab
176 Components — Cambridge Thermionic Corp.
184 Connector assembly methods—Amphenol Electronics Corp.
164 Connectors, locking — Harvey Hubbell, Inc.
185 Connectors & Tube sockets—Elco Corp.
193 Cores, tape wound—G-L Electronics
177 Electronic instruments—John Fluke Mfg. Co.
170 Ferrites—General Ceramics Corp.
179 Generator, pulse—Burroughs Corp.
175 Plating, gold—Sel-Rex Corp.
190 Radio equipment, mobile—General Electric Co.
186 Reactors, saturable—Barber-Colman Co.
169 Servomotor, 400 cycle—Beckman Instruments, Inc.
189 Shears, power—Peck, Stow & Wilcox Co.
167 Strain gages—Micro-Test, Inc.
172 Syncros & Resolvers—Induction Motors of Calif.
180 Transformer and bobbin winder—Geo. Stevens Mfg. Co., Inc.
182 Transformers, pulse—Pulse Engineering
191 Transistor chart—Bendix Aviation Corp.
168 Transistor literature—General Transistor Corp.
163 Toroidal components — Communication Accessories Co.
181 Tube, electron—Radio Corporation of America
183 Tube wall chart—Sylvania Electric Products, Inc.
161 Tubing catalog, zipper — Alpha Wire Corp.
160 Waveguide and connectors — WaveLine, Inc.

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Characteristics: Available with tolerances of 10% and 5% at zener voltages between 10 volts and 100 volts; maximum dissipation 10 watts for 25°C case temperature; typical dynamic resistance — 1 ohm for unit with 20 zener volts at 500mA.

Please write for our Technical Information Bulletin which gives limits of Zener Impedance for all voltage ranges as well as information on temperature coefficient of voltage.

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HOFFMAN ELECTRONICS CORPORATION

930 Pitner Avenue, Evanston, Illinois

MANUFACTURERS OF: *silicon junction diodes - zener reference elements - medium and high power rectifiers - silicon solar cells*

Circle 54 on Inquiry Card, page 101

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

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

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

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

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

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

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100,000 Square-Foot Addition
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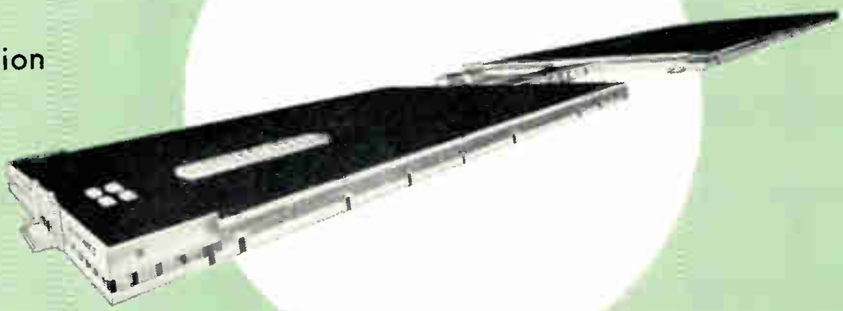
The creative engineering that has been responsible for many Chatham "originals", now has larger and improved facilities to help you solve your special purpose tube problems.



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

General Office and Plant: Livingston, New Jersey

SALES OFFICES: CHICAGO, DALLAS, LIVINGSTON, LOS ANGELES

PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

**Design Engineers • Development Engineers • Administrative Engineers • Engineering Writers
Physicists • Mathematicians • Electronic Instructors • Field Engineers • Production Engineers**

Chicago Area Layoffs

More than 10,000 electronics workers have been laid off in the Chicago area in the past 12 months, estimates the International Brotherhood of Electrical Workers. More than 2,000 have been laid off in the past 30 days.

The union blames the layoffs on softening of the radio and television market, sharp cutbacks in government spending and diversion of many sub-contracts to plants in the south where wages are lower.

Lincoln Lab Slashed

About 160 permanent employees of the Lincoln Lab of the Massachusetts Institute of Technology have been notified that their employment will be terminated effective Feb. 1, 1958. Lab officials said that the cuts were made necessary by "current budgetary actions of the Dept. of Defense, and other factors."

Curtiss-Wright Cuts 6,000

Layoffs at the four New Jersey plants of the Curtiss-Wright Corp. have affected a total of 6,000 production, maintenance and white collar workers since Jan. 1957. The company is estimated to employ approximately 20,000 persons.

Engineer from Abroad

New face at Instruments For Industry, Mineola, N. Y., is Age Hollander, Dutch engineer. I.F.I. helped him emigrate.

Survey Raps Recruiting Practices Of Cost-Plus Defense Contractors

A team of nine Harvard graduate students which surveyed ways of improving productivity of engineers in industry is highly critical of "pirating" of scarce manpower by cost-plus defense contractors, but blames Government "allowance" of recruiting costs (including advertising) for "permitting, if not encouraging" raiding by some companies. Other findings of the Business School group:

1. Recruiting is "big business." Costs vary for some industries from $1-5,000 per man hired. Aggressive recruiting by some industries (aircraft, electronics, guided missiles, as well as automobiles and machine tools) forces the rest of industry into intensive competition. The petroleum industry is given high marks for healthy recruiting practices.
2. "Hoarding" of manpower may be nothing more than miscalculation of needs and requirements by "well-meaning, but untrained defense contract administrators."
3. Advertising is a big item in recruiting cost. Yet many executives admit recruiting ads are one way to advertise the institution — especially since they are reimbursable under Government cost-plus contracts.

The team also found that, since salary levels for engineers of comparable background, age and experience are fairly well standardized, "bonuses, fringe benefits, and other tangible and intangible extras are becoming more important as bargaining weapons in recruiting." Sample extras:

a. Opportunity for overtime work. Free housing assistance. Subsidized education.
b. Free sick and hospitalization plans. Stock option plans. Sick leave with pay.

(Continued on page 114)

"Graduate Work An Obligation"—Everitt

To fulfill the nation's need for leaders and professional men "the most able students" should recognize graduate work as an "obligation" and the engineer, who may become the future's leading professional man, might even plan on advance work in such distant fields as law and theology.

These were the comments of Dr. W. L. Everitt, dean of the College of Engineering, Univ. of Illinois, upon receiving the AIEE Medal In Electrical Engineering Education.

Dr. Everitt called for educational methods which will provide the student with enough experience in "meeting the unexpected" so that he will have "the eagerness to tackle" new and difficult problems and be able "to work out his own salvation through the exercise of judgment and imagination."

Toward this end, Dr. Everitt proposed wider use of the laboratory method of learning by experience, of which the engineer is the leading exponent. However, he pointed out that to date situations presented in classes and laboratories have generally been too near the ideal. Thus he proposed a more realistic laboratory approach.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 103.

Engineers, Do Your Own Writing

This article points out why the technically trained man should write his own memoranda, reports, and articles and not leave this important job to the technicians.

By JOHN L. KENT
Chief, Editorial Bureau
Consolidated Electrodynamics Corp.
Pasadena, Calif.

AMONG the suggestions made for easing the engineer shortage is that engineers should be relieved of as much administrative and routine duties as possible. That is good.

But, with the active cooperation of engineers themselves, an extremely important function is being relegated to technicians—that of writing reports, articles and other important communications.

Technical Writer

A new type of professional—the engineering writer, or technical writer—has taken over this important part of the engineer's job. More accurately, the engineer is losing this work by default. Generally not knowing how to write efficiently and effectively, he has no desire to write. So he has offered little argument when others have stepped in to do this work. This is bad for the engineer and his future. If the engineer lets this work be done by others he is eventually going to lose an important part of his professional status—authority.

A similar problem is showing up in scientists' writings. Because they have failed to write for their audience, a new group of "middlemen" the science writers—were pressed into the service of interpreting science.

In almost every organization, engineers are called upon to do a fair amount of writing. Douglas Washburn of the Rensselaer Polytechnic Institute studied Westinghouse design and development engineers and found that they spend 5-20% of their working time writing. Some even spend as much as 30%. They were found to write anything from a letter to a complete instruction book.

In all cases, they wrote what they did because they knew the subject and it was part of their administrative function to do the writing.

The advice, that the engineer should be the writer, is so obvious to the professional writer that the professional is constantly amazed that such important work is often turned over to "substitutes."

Reasons Why

The reason why the scientist and engineer himself should be the writer can be summed up under these headings: (1) Accuracy, (2) Completeness, (3) Prestige, and (4) Service to his profession.

There is no doubt that even the most careful reporter, correspondent, and technical writer will send for publication, reports and articles which contain—to the engineer—obvious errors. To the engineer these errors would ring a mental bell and lead to

JOHN L. KENT is also President of the Technical Writing Improvement Society.

Gunning's Ten Principles of Clear Writing

1. Keep sentences short.
2. Prefer the simple to the complex.
3. Prefer the familiar word.
4. Avoid unnecessary words.
5. Put action in your verbs.
6. Write the way you talk.
7. Use terms your reader can picture.
8. Tie in with your reader's experience.
9. Make full use of variety.
10. Write to express not impress.

—From "Techniques for Clear Writing" by Robert M. Gunning

correction. They ring no such bell in the mind of the reporter or technical writer.

The technically trained man, knowing the subject, is also in a better position to write a complete story —whether it's a report, article, or other type of technical literature.

In a report, completeness is extremely important. It is not so important in an article except that completeness often gives significance which the engineer may fail to bring out (because of his intensive interest and submergence in his subject).

The third most important reason is personal. The scientist or engineer, having done the work, should enjoy some of the fruits of his labors. The report for example, is usually the major formal announcement of his success. He should be the one to make it.

Yet, often someone else writes the report, and he has the unpleasant job of editing it and putting life into a piece of writing which rightfully should be his.

There is another facet to the personal angle. The engineer whose writings are published becomes an authority. He attains stature in his organization and inevitably is in line for faster promotions, better assignments and so forth.

Audience Alienation

Engineers and scientists have accelerated the move to have their writings done by technicians because they had failed to write for their audience. As a result, they had also alienated a large segment of the population.

Professional societies and many individual scientists are aware of a ground-swell of antagonism against the scientist. Many people regard science and scientists with suspicion. This suspicion is chiefly the result of the average person's inability to understand what the scientists are doing. It is only normal to suspect what we do not understand.

Part of this lack of understanding is the scientists' own fault of not being able to write clearly for the general-level consumption. In his presidential address to the American Association for the Advancement of Science, Dr. Warren Weaver said that scientists in using the jargon of their profession "give to science an external appearance of incomprehensibility which is very unfortunate."

Neither the editor nor the science writer expects the scientist to be a popular science writer. That is for the science writer to do. But because both the editor and science writer are pressed for time, it would help them if the scientists had prepared understandable accounts of their work which they—the editors and writers—could use as a basis for writing accurate articles for popular consumption.

Because he has never learned to write for an audience, the typical learned man writes in a jargon that few can understand. This has been pointed out many times.

Authoritative Comments

L. C. Beard, Jr. of Socony-Vacuum Laboratories and president of the American Society for Testing Materials (1954-55), said that "a chemist has difficulty in understanding a physicist; the biologist can't talk to the geologist; none of them can talk plainly to the engineer. Sometimes the engineer can't get his ideas across to management; and few technical people can explain their aims and what they have done, to the public."

Dr. Vannevar Bush of the Carnegie Institute of Washington says two concrete things can be done about it. First, scientists could be intelligible. He said they have a moral obligation to express themselves so that they can be quickly understood by those within their profession or closely related professions. Second, those who possess that unique skill should be encouraged to gather, integrate and interpret the information developed so that great masses of seemingly confused data become useful to their fellows.

That scientists and engineers don't like to write reports or more understandable popular accounts is known to all research administrators. This is understandable. They don't know how. And, when you don't know how, you make all kinds of excuses for not doing it because you are afraid of being criticized.

As the editors of *Chemical and Engineering News* point out (Dec. 5, 1955, p. 5326) "it is a sad commentary on our professional schools that the training of a young scientist rarely includes practical instruction in the fundamentals of good writing."

Yet, the scientist and engineer who can make himself understood in his writing, who can make his associates and superiors see his thinking and reasoning on paper, is given the best jobs and biggest promotions. There is another reason why the engineer should write and why he should be the one to write. He ought to communicate with his peers—his fellow engineers. Through technical journals and trade magazines he can make his problems, and solutions, known to others. He in turn will learn of the solutions to similar problems from the writings of other engineers. This information exchange is necessary to make progress in industry.

So, for all these reasons, including the most important one to him—that of personal progress—the engineer should learn to write.

* * *

Industry News

Horace W. Thue has joined International Business Machines Corp. as Director of Manufacturing Planning. Mr. Thue was previously with Douglas Aircraft Co. in Calif.

William H. Forster will now serve as Director of Research in charge of the newly formed Solid State Electronics Dept. of the Research Div. at Philco Corp.

Donald A. Sutherland has moved to Elgin National Watch Co. as General Manager of the Electronics Div. He was formerly general manager of the Star-Kimble Motor div., Miehle Printing Press & Mfg. Co.

D. A. Sutherland

W. L. Bayer

Brig. Gen. William L. Bayer, USA, (Ret.) has been appointed Manager—Military Marketing in the Electronics Div. of Stromberg-Carlson. Gen. Bayer formerly commanded the U. S. Army Signal Supply Agency.

Berkeley S. Boyd is the new Regional Representative in Dayton, Ohio, for Avien, Inc.

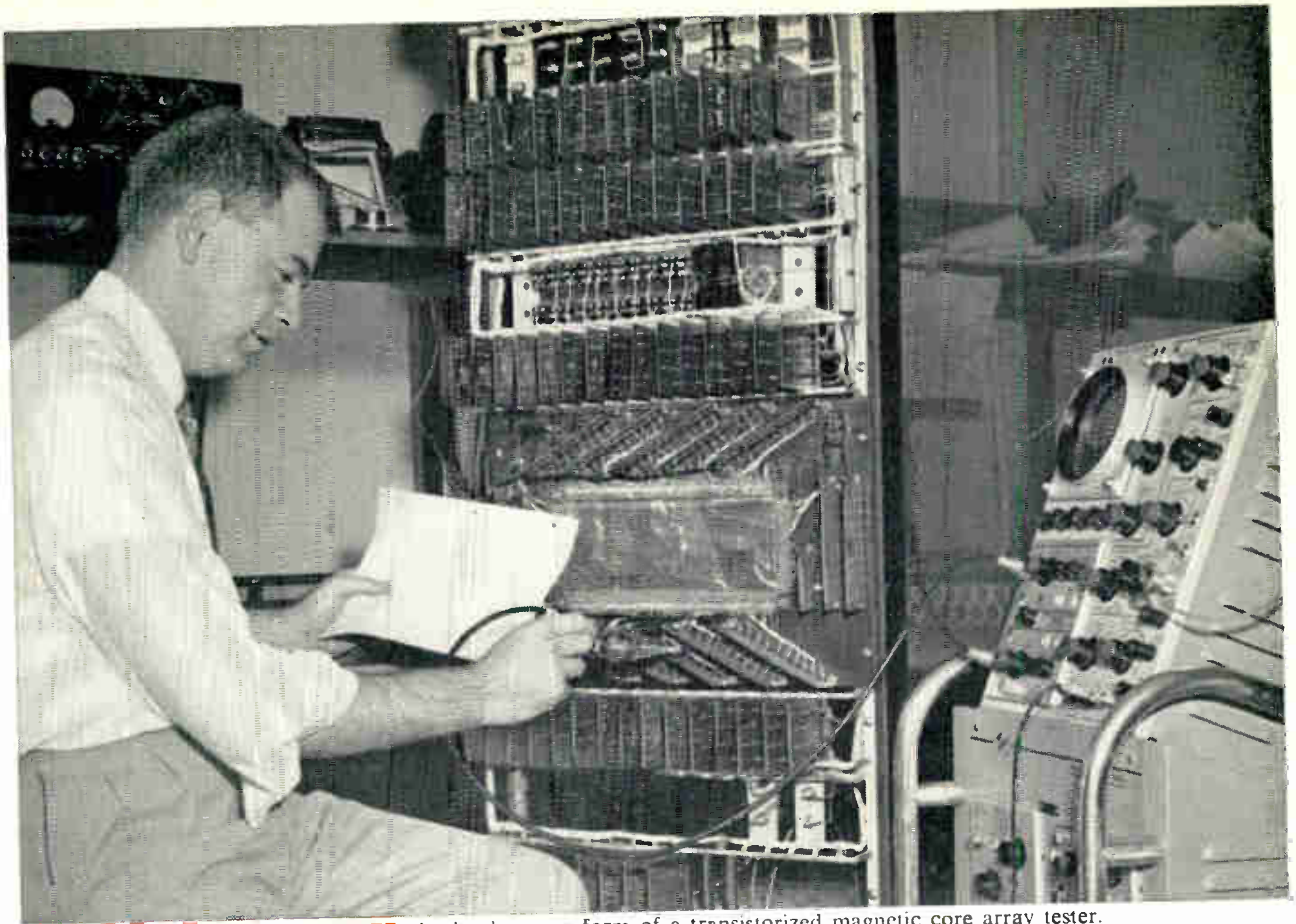
Robert E. Rider is the new Manager of West Coast operations for the Printed Wiring Engineering and Equipment Division of Dry Screen Process, Inc.

Roger A. Swanson is now a Sales Engineer for the Semiconductor Div. of Sylvania Electric Products, Inc. Mr. Swanson has New York City, Long Island, Westchester County and New Jersey as his territory. His headquarters will be at 1000 Huyler St., Teterboro, N. J.

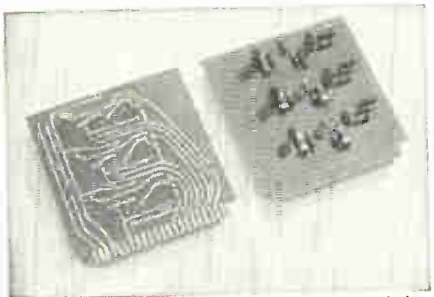
John M. Grofik has been appointed a Sales Engineer in the New York office for C. P. Clare & Co.

Edward Alpert, Communications Field Sales Administrator, and **Joseph J. Sedik**, Communications Product Planning Manager, are the latest promotions from Ratheon Mfg. Co.

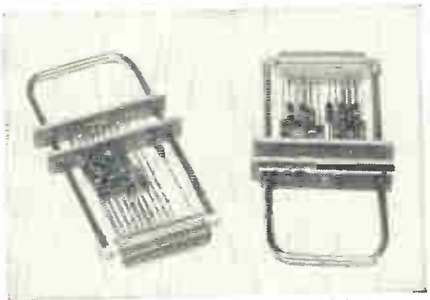
(*Continued on page* 112)



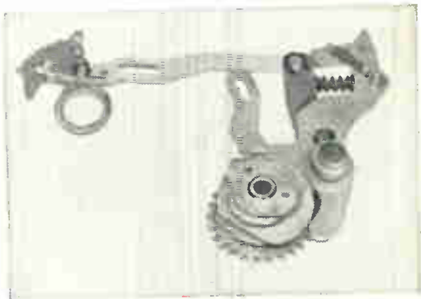
AN NCR ELECTRONIC ENGINEER checks the wave form of a transistorized magnetic core array tester.



TRANSISTOR printed circuit for digital computer development program.



MAGNETIC character recognition matrix for check sorters.



MECHANISMS for intricate in-put, out-put devices.

ENGINEERING UNLIMITED

AT ONE OF THE WORLD'S MOST SUCCESSFUL CORPORATIONS

LOGICAL DESIGN, CORE AND TRANSISTOR CIRCUITRY—DIGITAL COMPUTER DEVELOPMENT—New projects in core memories and advanced core logic, magnetic and transistor circuitry—these and other advanced NCR computer efforts promise wide latitudes of technical advancement. Interesting new positions are open in these fields at NCR in Dayton for qualified engineers at senior, intermediate and associate levels.

ACT AT ONCE! Send résumé! Employment Department, Technical Procurement Section L, The National Cash Register Company, Dayton 9, Ohio.

*TRADE MARK REG. U. S. PAT. OFF.

National*

ACCOUNTING MACHINES

ADDING MACHINES • CASH REGISTERS

NCR PAPER (NO CARBON REQUIRED)

Circle 502 on Inquiry Card, page 103

Industry News

(*Continued from page* 110)

Linwood A. Walters will now serve in the newly-created post of Manager of research and development of National Vulcanized Fibre Co.

Frederick H. Guterman has accepted the position of General Manager of the Technical Products Div., A. B. Du Mont Laboratories. Mr. Guterman was formerly assistant Vice President, Sales and Planning, American Bosch Arma Corp.

Robert A. Bailey will now serve as Marketing Manager of Norden-Ketay's Western Division, Gardena, Calif.

R. A. Bailey

Chas. B. Brown

Col. Charles B. Brown, USA (Ret.) has joined ESC Corp. as Administrative Assistant to the President. His last assignment, prior to retirement, was First United States Army Signal officer.

Steve Manning has joined Pacific Semiconductors, Inc., as District Sales Engineer of the western region.

David E. Laughlin will now serve as Manager of the Digimatic Marketing Section of Electronic Control Systems, Inc.

M. E. Darrin has been Sales Manager of the Greater Philadelphia-Camden territory for Erie Resistor Corp. His office will be in Camden, N. J.

Richard E. Love has joined Weston Electrical Instrument Corp. as Manager of Recorders-Controllers Sales. Mr. Love was formerly Sales Manager of the Control Valves Div. at W. S. Rockwell Co.

John T. Allen has been appointed Field Engineering Supervisor in the Dallas, Tex., District of the Electro-Data Div. of Burroughs Corp.

Mort A. Maurer has become Manager, RCA Electronic Instruments and Parts Marketing.

(*Continued on page* 114)

DO-TS

Deci-Ouncer Transformers

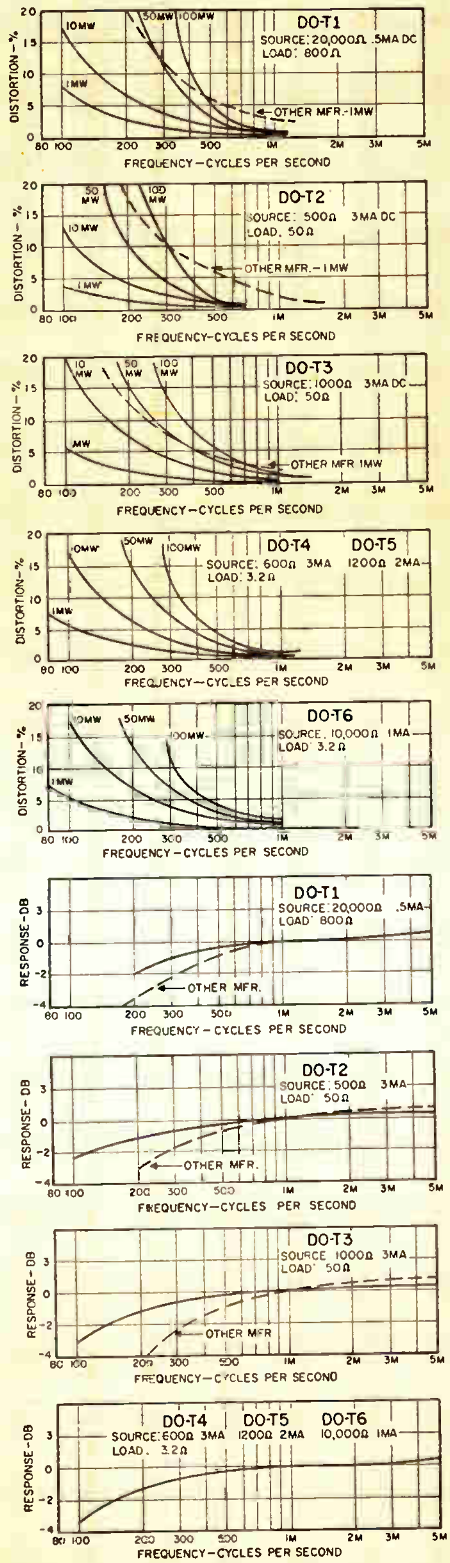
REVOLUTIONARY TRANSISTOR TRANSFORMERS

of unequalled power handling capacity and reliability

Hermetically Sealed to MIL-T-27A Specs.

TYPICAL DO-T PERFORMANCE CURVES

Power curves based on setting output power at 1 KC, then maintaining same input level over frequency range.



*DO-T units have been designed for transistor application only . . . not for vacuum tube service. **Pats. Pending

Conventional miniaturized transistor transformers have inherently poor electrical characteristics, perform with insufficient reliability and are woefully inadequate for many applications. The radical design of the new UTC DO-T transistor transformers** provides unprecedented power handling capacity and reliability, coupled with extremely small size. Twenty-five stock types cover virtually every transistor application*. Special types can be made to order.

High Power Rating . . . up to 100 times greater.

Excellent Response . . . twice as good at low end.

Low Distortion . . . reduced 80%.

High Efficiency . . . up to 30% better.

Moisture Proof . . . hermetically sealed to MIL-T-27A.

Rugged . . . completely cased.

Anchored Leads . . . will withstand 10 pound pull test.

Printed Circuit Use . . . (solder melting) plastic insulated leads.

ACTUAL SIZE

DO-T CASE Dia. . . . 5/16"
Length . . 13/32"
Weight . . 1/10th oz.

Type No.	MIL Type	Application	Pri. Imp.	D.C. Ma.‡ in Pri.	Sec. Imp.	Pri. Res.	Le M
DO-T1	TF4RX13YY	Interstage	20,000 30,000	.5 .5	800 1200	850	
DO-T2	TF4RX17YY	Output	500 600	3 3	50 60	60	
DO-T3	TF4RX13YY	Output	1000 1200	3 3	50 60	115	
DO-T4	TF4RX17YY	Output	600	3	3.2	60	
DO-T5	TF4RX13YY	Output	1200	2	3.2	115	
DO-T6	TF4RX13YY	Output	10,000	1	3.2	1000	
DO-T7	TF4RX16YY	Input	200,000	0	1000	8500	
DO-T8	TF4RX20YY	Reactor 3.5 Hys. @ 2 Ma. DC				630	
DO-T9	TF4RX13YY	Output or driver	10,000 12,500	1 1	500 CT 600 CT	800	
DO-T10	TF4RX13YY	Driver	10,000 12,500	1 1	1200 CT 1500 CT	800	
DO-T11	TF4RX13YY	Driver	10,000 12,000	1 1	2000 CT 2500 CT	800	
DO-T12	TF4RX17YY	Single or PP output	150 CT 200 CT	10 10	12 16	11	
DO-T13	TF4RX17YY	Single or PP output	300 CT 400 CT	7 7	12 16	20	
DO-T14	TF4RX17YY	Single or PP output	600 CT 800 CT	5 5	12 16	43	
DO-T15	TF4RX17YY	Single or PP output	800 CT 1070 CT	4 4	12 16	51	
DO-T16	TF4RX13YY	Single or PP output	1000 CT 1330 CT	3.5 3.5	12 16	71	
DO-T17	TF4RX13YY	Single or PP output	1500 CT 2000 CT	3 3	12 16	108	
DO-T18	TF4RX13YY	Single or PP output	7500 CT 10,000 CT	1 1	12 16	505	
DO-T19	TF4RX17YY	Output to line	300 CT	7	600	19	
DO-T20	TF4RX17YY	Output or matching to line	500 CT	5.5	600	31	
DO-T21	TF4RX17YY	Output to line	900 CT	4	600	53	
DO-T22	TF4RX13YY	Output to line	1500 CT	3	600	85	
DO-T23	TF4RX13YY	Interstage	20,000 CT 30,000 CT	.5 .5	800 CT 1200 CT	850	
DO-T24	TF4RX16YY	Input (usable for chopper service)	200,000 CT	0	1000 CT	8500	
DO-T25	TF4RX13YY	Interstage	10,000 CT 12,000 CT	1 1	1500 CT 1800 CT	300	

‡DCMA shown is for single ended useage (under 5% distortion—100MW—1KC) . . . for push pull, DCMA ca any balanced value taken by .5W transistors (under 5% distortion—500MW—1KC)

UNITED TRANSFORMER CORP.

150 Varick Street, New York 13, N. Y.

PACIFIC MFG. DIVISION: 4008 W. JEFFERSON BLVD., LOS ANGELES 16, CALIF.
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"

Industry News

(*Continued from page* 112)

Alan H. Bodge was elected a Vice-President of Audio Devices, Inc. He will continue as head of the company's expanding Los Angeles office in charge of West Coast sales.

George W. Sinclair was recently named Plant Manager at the Tucson, Ariz., facility of Hughes Aircraft Co.

Dr. William L. Everitt, dean of the College of Engineering, University of Illinois, has been awarded the AIEE medal in Electrical Engineering Education for outstanding service as a teacher.

Dr. John D. Kleis has been appointed Vice President and Director of research of Fansteel Metallurgical Corp. He is replacing Dr. Leonard F. Yntema, who is retiring.

Dr. R. J. Creagan has been named to head the nuclear program of the Bendix Aviation Corp.

Recruiting Practices

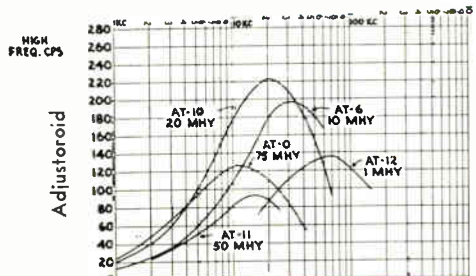
(*Continued from page* 107)

c. Personal time off. Free insurance. Bonus plans. Free lunch. Per diem.
d. Private schooling for dependents. Attractive geographic location.
e. Company financing of car and appliance purchases. Jobs for wives.
f. Free transportation between plant and home. Expense accounts. Credit unions.

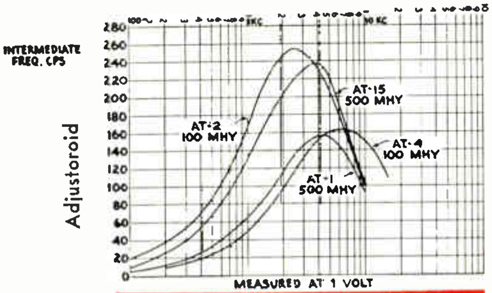
The growing emphasis on fringe benefits and extras downgrades the engineer, the team concludes. Fringe benefits may be effective in attracting some engineers, but "emphasis on extras, rather than on the nature of the work and the challenges it offers, tend to rob the engineer of his professionalism. This overemphasis puts him more and more into the class of the skilled production worker in the eyes of the public. . . . Pride and motivation are sapped."

(The survey is titled, "Engineering Manpower — How To Improve Its Productivity." — Engineering Manpower reports. P. O. Box 161. Cambridge 38, Mass. $16.50.)

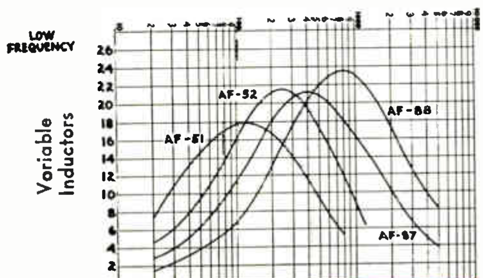
NEW SUBMINIATURE BURNELL ADJUSTOROIDS® HANDLE BIG JOBS



typical Q vs. frequency characteristics



typical Q vs. frequency characteristics



typical Q vs. frequency characteristics

*PAT. 2,762,020

The new subminiature **Burnell Adjustoroids** utilizing an ingenious patented method of magnetic biasing cover a wide range of frequencies, occupy less space and are available at low cost.

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

Precise continuous adjustment of inductance over a 10% range.
No need for external control current.
Hermetic sealing to meet Government MIL E # 15305-A specifications.

If your adjustoroid needs can't be met from our stock catalogue, we'll be glad to manufacture to your specifications.

	Length/ Dia.	Width	Hgt.	Wt.	Useful Freq. Range	Max Q	Max L in hys
AT-0	$1\frac{1}{16}$		1"	2 oz	1 kc to 20 kc	10 kc	3 hys
AT-1	$1\frac{3}{4}$	$1\frac{3}{4}$	$1\frac{1}{4}$"	$7\frac{1}{4}$ oz	2 kc to 10 kc	4 kc	15 hys
AT-2	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{1}{4}$"	24 oz	Below 2.5 kc	2.5 kc	125 hys
AT-4	$1\frac{19}{64}$		$1\frac{1}{4}$"	4 oz	1 kc to 16 kc	6 kc	15 hys
AT-6	$1\frac{1}{16}$		1"	2 oz	10 kc to 100 kc	30 kc	.75 hys
AT-10	$1\frac{19}{64}$		$1\frac{1}{4}$"	4 oz	3 kc to 50 kc	20 kc	.75 hys
AT-11	$\frac{45}{64}$	$\frac{45}{64}$	$\frac{3}{4}$"	.83 oz	2 kc to 25 kc	15 kc	5 hys
AT-12	$\frac{45}{64}$	$\frac{45}{64}$	$\frac{3}{4}$"	.83 oz	15 kc to 150 kc	60 kc	.5 hys
AT-15	$1\frac{21}{32}$		$1\frac{7}{8}$"	14 oz	Below 5 kc	4 kc	125 hys
AF-51	$1\frac{19}{64}$		2"	5 oz	30 cps to 500 cps	120 cps	1000 hys
AF-52	$1\frac{19}{64}$		2"	5 oz	50 cps to 1 kc	250 cps	1000 hys
AF-87	$\frac{45}{64}$	$\frac{45}{64}$	$1\frac{1}{4}$"	1.7 oz	90 cps to 2 kc	400 cps	80 hys
AF-88	$\frac{45}{64}$	$\frac{45}{64}$	$1\frac{1}{4}$"	1.7 oz	1.6 kc to 4 kc	800 cps	42 hys

Burnell & Co., Inc.

first in toroids, filters and related networks

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

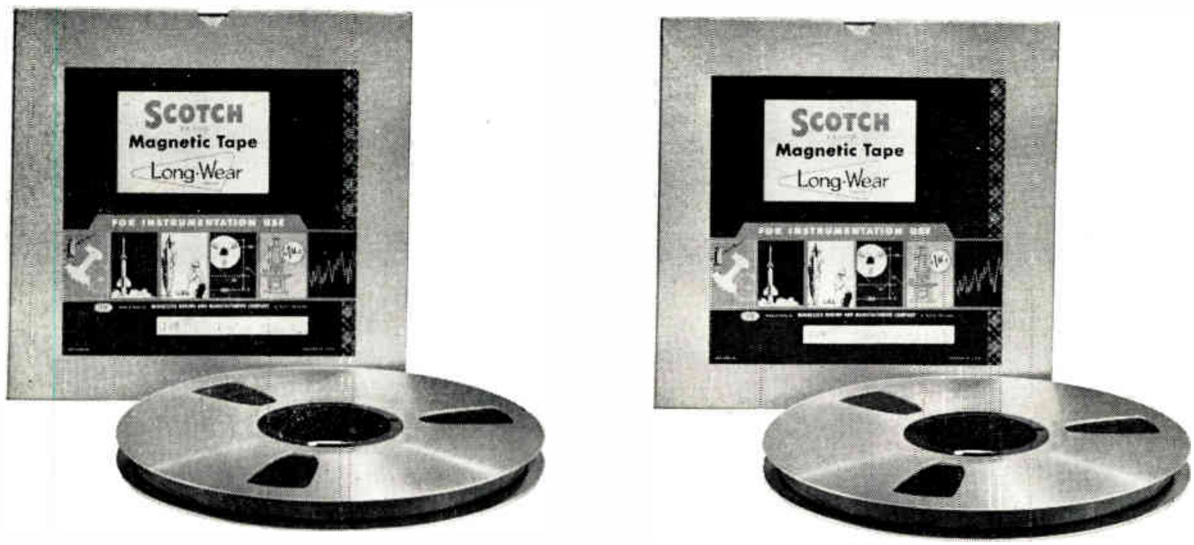
Dept. T-137

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

Circle 58 on Inquiry Card, page 101

TOUGH!

Introducing two new "Long-Wear" "Scotch" Brand Instrumentation Tapes made to last an average of 6 TIMES LONGER



Let new "SCOTCH" Brand Instrumentation Tapes 148 and 149 solve your heat-wear-rub-off problems! Unlike conventional tapes, these two will not wear out under severe operating conditions—high speeds, temperatures and pressure. Their exclusive "Long-Wear"* binder construction minimizes rub-off, softening of the binder and buildup of abrasive oxide particles on the recording head.

148 FOR STRENGTH—1.5 mil polyester backing offers super-strength and dimensional stability to protect multi-channel recordings from physical distortion. Made with "Long-Wear" binder and a high potency oxide which offers 3.5 db greater output at short wave lengths than conventional instrumentation tapes.

149 FOR LENGTH! New "SCOTCH" Brand Instrumentation Tape 149 gives you the advantages of 148 Tape ("Long-Wear" binder, high potency oxide coating), except that it has 1 mil polyester backing. This superior tape records 50% longer than 148 tape on similar size reels, providing additional length with normal strength.

Available as optional extra-cost accessory in 10½" and 14" diameter.

ALL ¼, ½, ¾ AND 1 INCH "SCOTCH" Instrumentation Tapes can be ordered on this new "SCOTCH" Brand PRECISION REEL. Offers many advantages: rugged 100 mil-thick tapered and machined aluminum flanges which hold their shape under most exacting circumstances and protect tape from edge nick; fine 15/1000" tape clearance from each flange, thus eliminating rough winding pattern. Reel incorporates revolutionary threading concept which prevents distortion, speeds thread-up.

FREE BOOKLET outlines specifications on all types of instrumentation tape. Write: Minnesota Mining and Mfg. Co., Magnetic Products, Dept. PT-127, St. Paul 6, Minn.

MINNESOTA MINING AND MANUFACTURING COMPANY

...WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

*TRADEMARK

Circle 59 on Inquiry Card, page 101

Proceedings of the IRE

looks into outer space with RADIO ASTRONOMY

RADIO ASTRONOMY is responsible for a rich harvest of new information about the sun and certain solar phenomena, meteors and meteor showers recorded in broad daylight, the galaxy of stars of which our own sun is a part, and other galaxies infinitely distant from us. Regions of the universe invisible to the eye and the photographic plate can now be seen via their measurable radiation at radio wave lengths. New developments in antennas, propagation, low-noise receivers and the ionosphere are occurring because of progress in radio astronomy.

January 1958 Special Issue

Here is the revolutionary technique which is carrying us to uncharted regions of the universe. Discoveries in this field during the last decade have created another vitally important branch of science.

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"Excitation of the Hydrogen 21 cm Line" by G. B. Field, Princeton.

"Extra Galactic 21 cm Line Studies" by H. S. Heeschen, Greenbank Nat. Obs., N. H. Dieter, Harvard.

"Radio Stars and the Milky Way at 440 mc" by N. G. Roman & B. Yaplee, N. R. L.

"A High Resolution Radio Telescope for Use at 3.5 M" by B. Y. Mills, et al, Australia.

"The Sydney 19.7 Mc/s Radio Telescope" by C. A. Shain, Australia.

"Radio Telescope Antennas of Large Aperture" by J. D. Kraus, Ohio State.

"An Antenna Array for Studies in Meteor and Radio Astronomy at 13 Meters" by P. B. Gallagher, Stanford U.

"A Wide Band Antenna System for Solar Noise Studies" by H. Jasik, Jasik Labs.

"Radio Interferometry of Discrete Sources" by R. N. Bracewell, Stanford U.

"A Polarimeter in the Microwave Region" by K. Akabane, Tokyo Obs.

"The Cornell Radio Polarimeter" by M. H. Cohen, Cornell.

"10.7 cm Solar Radio Flux Measurements" by W. J. Medd & A. E. Covington, Canadian Res. Council.

"Absorption Techniques as a Tool for 21 cm Research" by A. E. Lilley & E. F. McClain, Yale.

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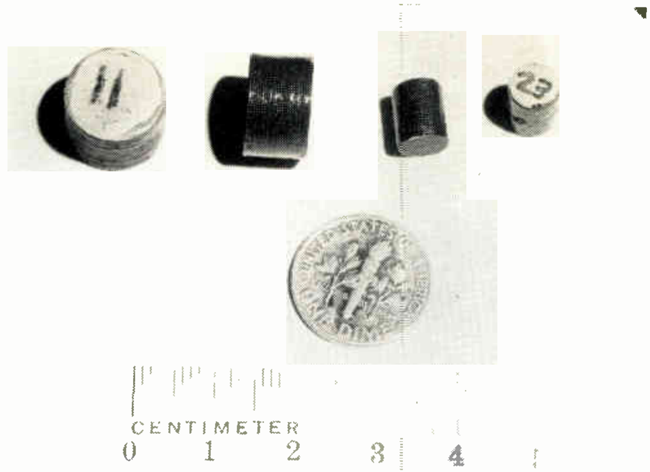


Fig. 1: Wax-electrolyte batteries developed by NBS for ordnance applications show promise for charge and bias use in commercial equipment.

What's New *(Continued)*

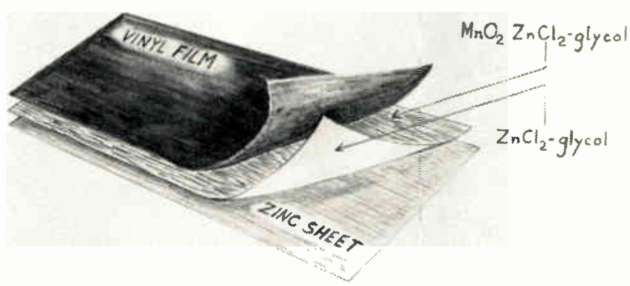
New Cells Use Wax Electrolyte

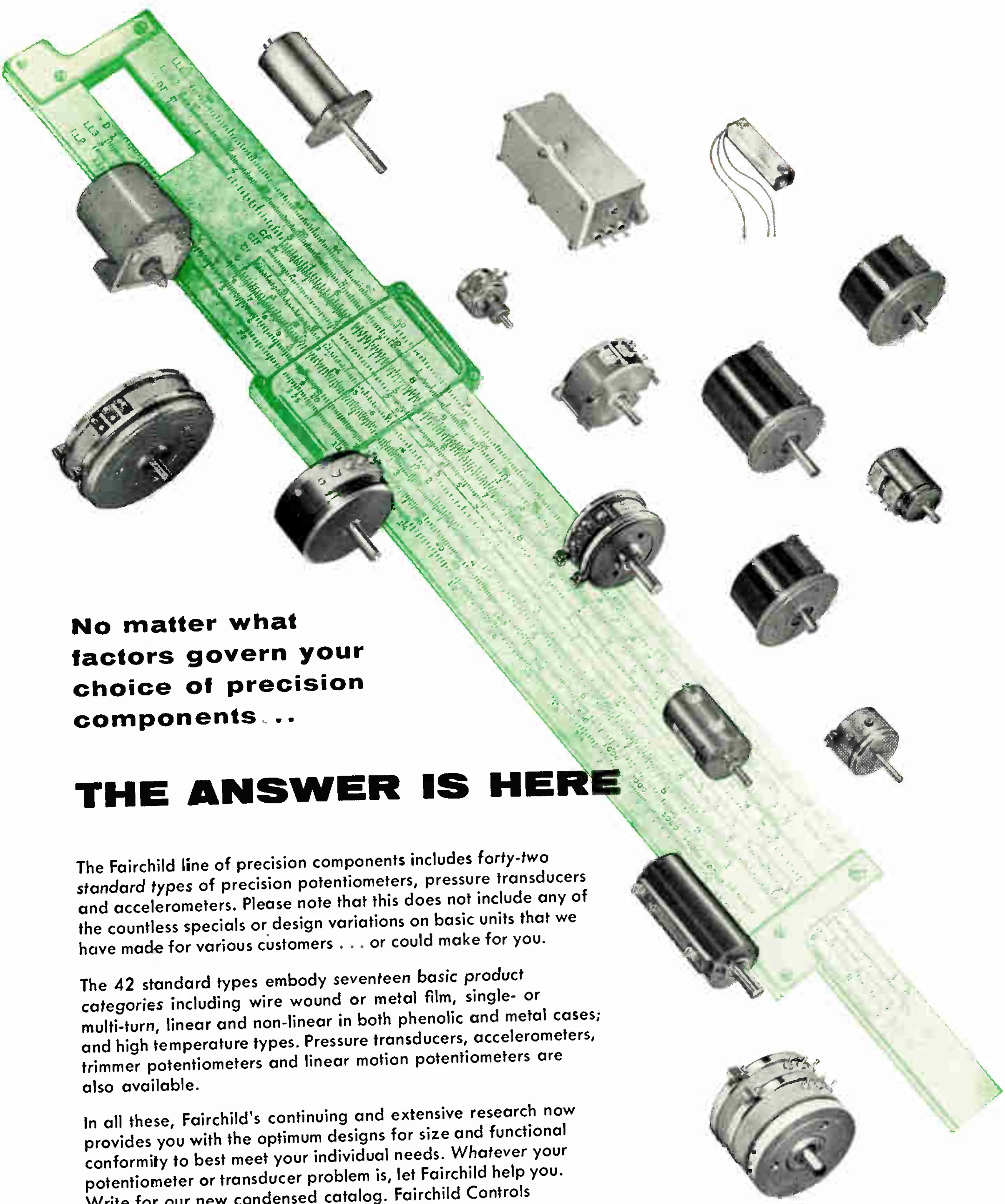
A THREE-YEAR study at National Bureau of Standards has demonstrated the usefulness of a new wax-electrolyte cell developed at NBS. An inexpensive sandwich is formed of a conductive vinyl film, an etched zinc sheet, and a separator impregnated with zinc chloride-glycol wax—with a manganese dioxide coating painted or electrodeposited on one side. The sandwich is heated and pressed, and then tiny "coin" cells are punched from it. The cells are stacked and lacquered to seal the edges of the cells and hold them together as a battery.

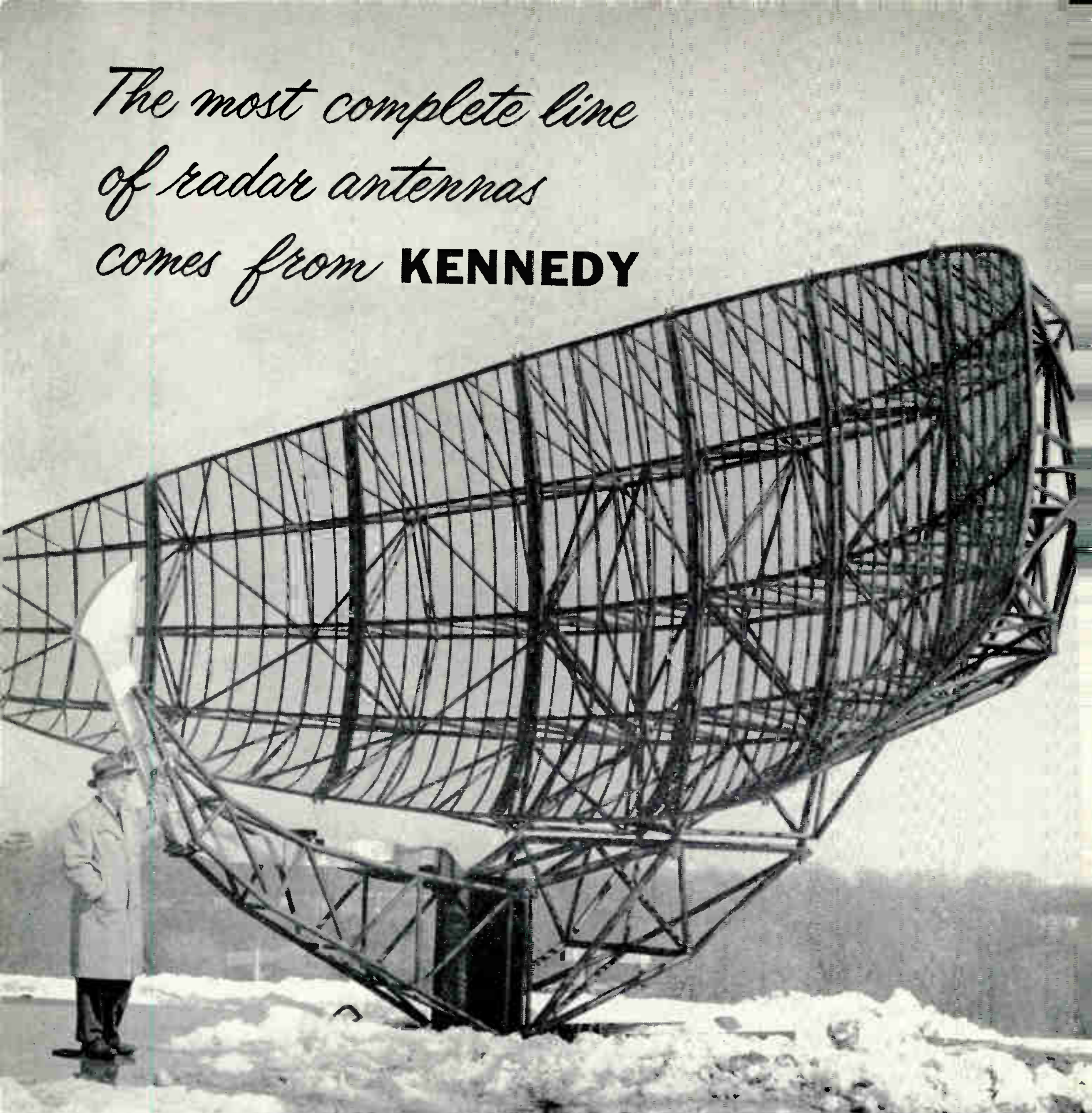
Several 25-cell wax-electrolyte batteries have been constructed and tested at the Bureau. They are .3 inch in length and have an emf of 37.5 volts. Two different sizes of batteries were made: One is .25 inch in diameter, weighing .05 ounce and having a short-circuit capacity of 3×10^{-8} ampere; while the other is .5 inch in diameter, weighs .2 ounce, and has a short-circuit capacity of 3×10^{-7} ampere.

The low-current cells maintain emf even after long-term storage. Possible applications include maintaining a charge on a capacitor and providing bias voltages.

Fig. 2: The miniature "coin" cells are punched from laminated sheets containing all the necessary elements in solid or gel form.







ONE of many designs that have helped make the name Kennedy synonimous with advanced radar antenna development, this new long range reflector measures 40′ from tip to tip, features sectionalized aluminum construction for ease of transportation and erection, meets military specifications for all-weather reliability.

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ANTENNAS

Directional Panel Antenna and Its Application to TV Transmitters, S. Drabowitch. Onde. Vol. 37, No. 364, July 1957, 15 pp. The author elaborates on new radiating structures and associated feeders. He makes special reference to directional panels with slots for producing specific radiation pattern. Among others, the author describes a variable power dividing network and a broad band junction which permits a continuous variation of the radiation pattern of the TV antenna.

A New Technique in Ferrite Phase Shifting for Beam Scanning of Microwave Antennas, F. Reggia and E. G. Spencer. "Proc. IRE." November 1957. 8 pp. This paper discloses a new design for a phase shifter which affords a simple electrical means of beam scanning with a stationary antenna at X-band frequencies.

A Helical Transmission Line with a Coaxial Cylindrical Damping Layer, G. Landauer. Arc. El. Uber. Vol. 11, Issue 7, July 1957, 11 pp. The paper gives an analysis of a damped helical line with the aid of Maxwell's theory. Highlighted are attenuation and phase rotation in the direction of propagation as a function of the surface resistance of the damping cylinder. Two different surface resistances can provide the same attenuation but different phase velocities.

A Broadband Diplexer for TV Transmitter, R. Chesneau. Onde. Vol. 37, No. 364, July 1957, 6 pp. The author presents a study of a diplexer for television which makes it possible to use a single feeder and a common aerial for sound and TV. The reasons for the device of wide band elements are given. Construction and characteristics of diplexer are described.

CIRCUITS

Designing Transistor Circuits Sinusoidal Transistor Oscillators—Part 2, Richard B. Hurley. "El. Eq." October 1957. 8 pp.

Transistor Receiver Video Amplifiers, M. C. Kidd. "RCA." September 1957. 14 pp.

Traveling-Wave Amplifiers and Backward-Wave Oscillators for VHF, D. A. Dunn. "IRE Trans. PGED." July 1957. 19 pp.

The Equivalent Circuit of the Drift Transistor, J. Almond and R. J. McIntyre. "RCA." September 1957. 24 pp.

* Those articles marked with an asterisk are available as reprints to EI readers. Requests should be sent, on company letterhead, to Sources Editors, Electronic Industries, Chestnut & 56th Sts., Philadelphia 39, Pa.

A Stabilized D. C. Power Supply Using Transistors, T. H. Brown and W. L. Stephenson. "El. Eng." September 1957. 5 pp. This article discusses the design of a mains operated d.c. stabilized power supply using transistors and incorporating negative feedback to provide a low output resistance. The output voltage is variable over the range 0 to 30V at currents of up to 1A, and the change in output voltage over this current range is less than 40mv.

An Improved F.M. Discriminator, V. B. Hulme. "El. Eng." September 1957. 4 pp. An improved f.m. discriminator of the constant-area type has been developed. The circuit has been used in several applications where a frequency demodulator, having a linear characteristic over a wide deviation band, has been required. It has been proved to possess the advantages of simplicity, reliability and superior noise performance, when compared with other examples of this type of discriminator.

Make Your Signal Generator More Accurate and Versatile, Irving Dlugatch. "El Eq." October 1957. 3 pp.

Circuit Techniques Associated with Transistor Broadcast Receivers, Part 2, J. N. Barry. "El. Eng." October 1957. 6 pp.

Error-Predicting D.C.-Restoring Circuits for Television Signals, E. L. C. White. "El. Eng." October 1957. 6 pp. The performance of d.c.-restoring circuits of direct and negative feedback types is analyzed. It is shown that, by a combination of techniques, the low frequency cut-off of the circuit prior to d.c.-restoring may be raised by a factor of 11 compared with that required with methods commonly employed, for a specified degree of distortion.

Some Aspects of Permeability Tuning, W. D. Meewezen. "Proc. AIRE." August, 1957. 13 pp. In the first part of this paper, permeability tuned circuits are analyzed and compared with capacity tuned circuits. Attention has been given mainly to aerial circuits for the broadcast band. The second part of the paper deals with the construction of permeability tuners. The causes of law and tracking errors are discussed and an indication is given of the manner in which these errors can be reduced and corrected. Finally, a tuner is described.

Uni-Control Wide-Range Oscillator, S. N. Das. "E. & R. Eng." October 1957. 4 pp. The article describes a wide-range oscillator using a single tank circuit between the grid and anode of a triode. A variable LC circuit, containing a variable inductor formed by two parallel rectangular strips bent in the form of a semicircle and two variable capacitors having semicircular rotors and stators, is connected to the grid and anode of the triode through a pair of transmission lines.

Drift-Corrected D.C. Amplifier, M. H. McFadden. "E. & R. Eng." October 1957. 7 pp. The need is explained for drift correction in d.c. amplifiers, especially those used in real-time analogue computers, and a continuously drift-corrected amplifier is described which is suitable for use in either a repetitive or real-time computer.

Principles of Filtering—II, L. S. Schwartz. "El. Des." October 15, 1957. 4 pp.

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 Telemakhanika
AWA Tech. Rev. AWA Technical Review
BBC Mono. BBC Engineering Monographs
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
E. & R. Eng. Electronic & Radio Engineer
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
Freq. Frequenz
GE Rev. General Electric Review
Hochfreq. Hochfrequenz-technik und Electroakustik
IBM J. IBM Journal
Insul. Insulation
IRE Trans. IRE Transactions of Prof. Groups
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 News Bulletin
NBS J. Journal of Research of the NBS
NRL. Report of NRL Progress
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
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, Pa.

A Simple Physiological Stimulator, Using a Transistor Oscillating Circuit, W. T. Catton, et. al. "El. Eng." October 1957. 3 pp. The instrument described is designed to replace the conventional induction coil in experiments in which a simple stimulator is required. A single-point-contact transistor is used as a relaxation oscillator and operation may be single pulse or repetitive.

A Transistorized Horizontal-Deflection System, Hunter C. Goodrich. "RCA." September 1957. 15 pp. A completely transistorized developmental horizontal-deflection system is described consisting of an oscillator, driver, output stage with ultor supply, and phase detector.

The Minimum Noise Figure of Amplifiers with Matched Amplifiers, H. Poetzl. Vol. 11, Issue 4, April 1957, 5 pp. Gain and minimum noise figure which can be represented by a scattering matrix, are calculated for any desired operating conditions. The conditions under which an amplifier can be represented by a scattering matrix.

Distortion Measurements of Frequency Modulated Relay Amplifiers, H. Hartbaum. Arc. El. Uber. Vol. 11, Issue 6, June 1957, 14 pp. A measuring method is described which can determine the transmission distortion of frequency modulated systems and separate the static from the dynamic non-linearities. This method can be applied to individual elements of the radio link as well as to the complete system.

Improved Frequency Stability of Crystal Oscillators by Compensating Networks, G. Becker. Arc. El. Uber. Vol. 11, Issue 7, July 1957, 4 pp. The frequency stability of crystal oscillators is examined. It is shown that the advantages that can be attained by compensation are opposed by serious drawbacks which highly questions their use for precision crystal oscillators, such as crystal blocks.

The Calculation of the Overvoltage Regime of the Vacuum Tube Oscillator, U. V. Bogolovsky. "Radiotek," August, 1957. 7 pp. Analyzing the methods of calculation of the overvoltage condition of the vacuum tube oscillator, based on the use of calculating graphic charts prepared for the discrete values of a low-angle cut-off $\theta_1 = 75°$, $80°$, and $90°$. Given parameters are oscillating power P_1, or the direct component of the plate current I_{ao}, intensity of condition p, and low-angle cut-off θ_1. The results of calculation using graphic charts is compared with calculation by the graph-analysis method.

RC and LC Resonance Filters and Their Application in Selective Amplifiers, H. H. Rabben. "El. Rund." October 1957. 5 pp. In the present 2nd part of the article counter coupling RC resonance amplifiers are dealt with, and the superiority compared to the corresponding LC filter circuits, of amplifiers with three stage RC band filters is mentioned. A 200 cps narrow band amplifier with two circuit band filter for the measurement of solar magnetic fields is considered. The RC filter calculation, also essential points of the design of a two stage band filter are entered upon.

A Low Voltage Stabilizer Employing Junction Transistors and a Silicon Junction Reference Diode, D. Aspinall. "El. Eng." September 1957. 5 pp. A series voltage stabilizer using junction transistors is described. A Zener diode is used as a reference voltage source. Approximate equations for the output impedance and stabilizing factor of the circuit are obtained and found to check with experiment. The change of output impedance with frequency is also investigated experimentally.

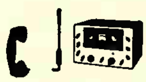
A Degenerative R-C Amplifier With No Overshoot, K. Franz. Arc. El. Uber. Vol. 11, Issue 4, April 1957, 4 pp. The paper calculates the time constant of a degenerative amplifier with W-stages for which no overshoot occurs. Zero overshoot can be attained if the ratio of the highest time constant τ_1 and lowest time constant τ_n exceed the value $n^2\beta A_o$.

An All-Pass Network, W. Proctor Wilson. "E. & R. Eng." October 1957. 4 pp.

Transients in Smoothing Filters of High-Power Rectifiers, T. Konopinski. "Prace ITR." Zeszyt 2, 1957. 15 pp. The paper contains an analysis of transients in supply units with choke-input filters occurring on rapid application of anode voltage as well as during stepped variations of the load resistance. The deduced formulae permit determining maximum values of overvoltages and overload currents.

Principles of Filtering—1, L. S. Schwartz. "El Des." October, 1957. 3 pp.

Circuit Techniques Associated with Transistor Broadcast Receivers, Part I, J. N. Barry. "El. Eng." September 1957. 8 pp. This article outlines some of the special circuit problems which arise due to the use of transistors in sound broadcast receivers, and discusses technical solutions which can be adopted to overcome them. The particular cases of battery portable and car receivers are both considered in some detail.



COMMUNICATIONS

***Designing Low-Noise Microwave Receivers,** C. T. McCoy. "El. Ind." Part I Nov., Part II Dec. 1957. A reliable microwave receiver with noise figure in the 6-db range can be designed on the basis of theory and practical suggestions resulting from low noise research studies over the past few years.

***20 Years Ahead in Air Force Electronics,** J. H. Vogelman. "El. Ind." Dec. 1957. 2 pp. New components, many now in the lab. will lead to a wide range of automatic switching, multiplexing, and transmission equipment.

***Reliable Multiplexing Circuits, J. B. Naugle.** "El. Ind. Ops. Sect." Dec. 1957. 3 pp. Communications systems for DEW, White Alice, and the Texas Towers have been able to use commercial channelizing equipment to reduce construction time and insure reliability.

***Continuously Tuneable VHF Receiver,** H. Benson and J. Cardon. "El. Ind. Ops. Sect." Dec. 1957. 4 pp.

Noise of Magnetic Tapes, Paul A. Mann. "Arc. El. Uber." Vol. 11, Issue 3. March 1957. 4 pp. The active layer of magnetic recording tape consists of a random arrangement of grains of magnetic material, which in turn is composed of Weiss domains of different orientations. Under the assumption of a complete random arrangement, the magnetic domains in respect to position and orientation, a formula is derived for the squared voltage which exhibits a maximum at a certain frequency, and approaches zero at the frequencies zero and infinite.

An Introduction to Radio Aids to Air/Sea Rescue, G. W. Hosie. "J. BIRE." September 1957. 8 pp. The paper surveys developments in radio aids to air/sea rescue since 1940, and discusses the medium frequency c.w. and v.h.f. radar beacons in general use during the second world war, together with later post-war developments of these equipments.

A V.H.F. C.W. Radio Aid for Air/Sea Rescue, W. Kiryluk. "J. BIRE." September 1957. 12 pp. General consideration of personal beacons for air/sea rescue are discussed, and the search techniques briefly described. Suitable battery types are reviewed. The mechanical and circuit design of two c.w. beacons is described: a dinghy transmitter without speech or reception facilities, and a personal type (TALBE—Talk and Listen Beacon) giving these facilities.

The Equalization of Base-Band Noise in Multichannel FM Radio Systems, Charles A. Parry. "Proc. IRE." November 1957. 8 pp. This paper presents an excellent analysis of the effects of equalizing networks on signal-to-noise improvement, and provides a practical method of adjusting a system having these networks for maximum improvement.

The Calibration of Vibration Pick-ups, K. C. Foster. "El. Eng." October 1957. 4 pp. Basic principles for the measurement of amplitudes of vibration are outlined and are suitable in varying degrees for applications within the audio frequency range. The methods described can also be adapted for the measurement of any form of vibration provided that due account is taken of the waveform to be measured.

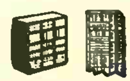
COMPONENTS

Applications of High-Temperature Components, Charles E. Doyle and Amos H. Dicke. "El. Eq." October 1957. 4 pp.

High-Temperature Film Resistors, Charles Wellard. "El. Eq." October 1957. 2 pp.

Electromechanical Multiplier, Samuel E. Dorsey. "El. Eq." October 1957. 3 pp.

Electronic Analog of a Wire Potentiometer, M. A. Shnaidman. "Avto. i Tel." July 1957. 9 pp. The paper describes and analyzes an analog for a wire potentiometer which is a transmitter element in an automatic controller. The analog takes into account the backlash of the slider and the stepped nature of the potentiometer winding.



COMPUTERS

***Reducing Magnetic Tape Print - Through,** Frank Radocy. "El. Ind." Dec. 1957. 2 pp. Improved production and quality control techniques reduce the layer-to-layer signal transfer of spooled magnetic tape, raising the upper limit of tape sensitivity.

The Magnetic Tape Store for Pegasus, T. G. H. Braunholtz and D. Hogg. "El. Eng." October 1957. 6 pp. The design of the magnetic tape store attached to Pegasus was started two years ago, and the first model has now been in operation for about six months. A general description of the tape store is given first, followed by a brief description of some of the principal anticipated applications. This is followed by more detailed description and discussion, first of the engineering design and then of system design.

The Recording of Digital Information on Magnetic Drums, D. G. N. Hunter and D. S. Rider. "El. Eng." October 1957. 7 pp. Methods of representing binary digital information on magnetic drums are discussed with regard to their reliability, cost and technical merits.

Approximating Non-Linear Functions by Shunt Loading Tapped Potentiometers in Analogue Computing Machines, D. W. C. Shen. "El. Eng." September 1957. 6 pp.

The Utilization of Domain Wall Viscosity in Data-Handling Devices, V. L. Newhouse. "Proc. IRE." November 1957. 9 pp.

A Statistical Approach to Mechanized Encoding and Searching of Literary Information, H. P. Luhn. "IBM J." October 1957. 9 pp.

A Binary-Weighted Current Decoder, E. J. Smura. "IBM J." October 1957. 7 pp. A novel method for driving cathode-ray-tube deflection yokes from digital equipment has been found. The system is compared with other methods and outstanding features are described.

Computer Control from Engineering Test Data, Harry E. Burke, Jr. "Auto. Con." September 1957. 5 pp.

Maintainability Computation for the Operational Reliability of Systems Containing a Large Number of Elements, G. V. Druzhinin. "Avto. i Tel." July 1957. 3 pp. Basic and generalized mathematical approach to the analysis of the above problem. Factors governing individual elements, statistical reliability under various conditions, methods of failure of individual elements and random factors are all taken into account.

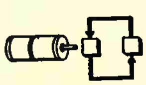
Electronic Computors—Anglo-American Technical Terms. "El. Rund." October 1957. 4 pp. An alphabetic list of those anglo-American technical terms used in the electronic computor field is given which owing to their specific meaning make it difficult for the German reader to understand the pertinent literature. Special attention is given to programming, coding and storage.

An Automatic Digital Curve Plotter, M. P. Young, et. al. "NRL." September 1957. 7 pp. A curve plotter has been devised that reads the punched-tape output of the N A R E C computer and plots automatically the "X" and "Y" coordinates which describe a curve.

Are Automatic Computer Speeds Faster Than Business Needs?, Ned Chapin. "Comp." October 1957. 5 pp.

Trapped-Flux Superconducting Memory, J. W. Crowe. "IBM J." October 1957. 10 pp. A memory cell based on trapped flux in superconductors has been built and tested. The cell is constructed entirely by vacuum evaporation of thin films and can be selected by coincident current or by other techniques with drive-current requirements less than 150 ma.

The Design of the Ferranti Pegasus Computer, Part 2, G. Emery. "El. Eng." September 1957. 6 pp.



CONTROLS

Designing Stability Into Hydraulic Governors, E. Y. Soomil and V. G. Guins. "Con. Eng." October 1957. 6 pp.

Frequency Response Plots to Linear Co-Ordinates As Applied to Feedback Control System Analysis, A. Straszak. "Roz. Elek." Tom III Zeszyt 2. 18 pp. A general outline is given of the analysis of feedback control system by means of frequency response methods. The above methods are handled as a particular case of conformal mapping of the s-plane; their relations with dominating responses of the closed loop and the configuration of zerioes and poles of the closed loop transfer function are discussed as well as the conclusions involved.

Servo-Modulators—II, Basil T. Barber. "Con. Eng." October 1957. 9 pp.

The Design of Sampling Servomechanisms (Part 2), S. Demczynski. "El. Energy." October 1957. 5 pp.

Triggering Electronic Flip-Flops from Mechanical Switches, Roland Yii. "Con. Eng." October 1957. 3 pp.

Designing Cooling Systems for Airborne Electronic Equipment, C. A. Hathaway. "El. Des." October 15, 1957. 10 pp.

Fast Waves in a Helical Coaxial Line, L. N. Loshakov, E. B. Ol'derogge. "Radiotek." June 1957. 6 pp. The paper examines fast waves in a helical coaxial line on the assumption that it is possible to replace the inner conductor of the line (the helix) by an anisotropically-conducting surface. The properties of certain of the lowest types of fast waves are investigated, and the critical frequencies are determined as a function of the geometric parameters of the line.

An Approximate Definition of the Process Involved in Establishing Self-Oscillations in Certain Nonlinear Automatic Control Systems, A. A. Voronov. "Avto. i Tel." July 1957. 9 pp. The paper examines a method for the approximate definition of the process involved in the variation of the amplitude and phase of the fundamental self-oscillations in certain nonlinear systems for the case where this variation is sufficiently slow. A method is given for approximating the higher-order equation by means of two nonlinear first-order equations which are similar to equations which have been derived for second-order systems. A sectionally-linear approximation of a function obtained during the process of solution is used to obtain an approximate solution of the problem in a simple manner. The method is often satisfactory even in cases when the oscillations are practically damped out after 1-3 periods.

INDUSTRIAL ELECTRONICS

***Ultrasonics—The New Electronic Art,** John E. Hickey, Jr. "El. Ind." Part I Nov., Part II Dec. 1957. Ultrasonics has now branched out into a wide variety of slicing, machining, measuring, drilling, and alarm applications. Details of this new technology are presented in this article.

***Procedures for Electrically Zeroing Synchros,** P. L. Hillman and F. J. Galvin. "El. Ind." Dec. 1957. 3 pp. Practical methods of obtaining accuracy from synchro systems are detailed.

Load Cells Solve Industrial Weighing Problems, David Vandeventer. "El. & Comm." September 1957. 4 pp.

Industrial Magnetron Application, W. Schmidt. "El. Rund." October 1957. 4 pp. Comparative requirements to be met by radar and industrial magnetrons implied by their different applications are given. Those involved by industrial application are the basis for the development of a new group of magnetrons. The advantages available at the application of magnetrons as microwave generators are considered and application possibilities for industrial magnetrons are specified.

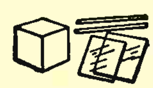
Automatic Positioning Systems for Machine Tools, C. R. Borley, et. al. "J. BIRE." September 1957. 9 pp. The factors affecting the selection of numerical input automatic positioning systems are considered. A review of current technique is given to indicate the order of system cost and complexity. Various economic and operational features, such as cost, speed, accuracy, life, and flexibility are emphasized and input, measurement and control schemes are classified according to basic principles.

Application of X-Ray Image Intensification to Industrial Problems, A. Nemet and A. Hewett-Emmett. "J. BIRE." September 1957. 5 pp. The improvements in resolution that can be achieved with the X-ray image intensifier compared with conventional fluoroscopic methods are considered. Industrial applications in which the intensifier has been successfully used include examination of engineering stores in their packages, continuous weld examination of pipelines, and inspection of castings and reactor fuel elements. The economy of some of the methods is pointed out.

The Role of Gamma-Ray Level Detection Systems in Chemical Plant Instrumentation, E. W. Jones. "J. BIRE." September 1957. 7 pp. There is a wide diversity of requirements for fluid gauges in chemical manufacturing processes. Gamma-ray instruments have the outstanding feature that they can operate entirely from outside the vessel. While they are admirably suited to on/off control at a fixed level or continuous indication over a short range, installations become expensive and cumbersome for continuous vertical ranges greater than about 3 ft. Radiation safety aspects are discussed and a typical installation for a glass melting furnace is described.

Automate Your Small-Lot Electronic Production—Part 2, William A. Schneider. "El. Eq." October 1957. 5 pp.

Recent Advances in Automatic Assembly, L. H. Gipps and K. M. McKee. "J. BIRE." September 1957. 11 pp. Reference is made to recent and probably future development of machines for the preparation of electronic components and their automatic assembly into printed wiring boards. The design of components and the processing of printed wiring boards is discussed in relation to the requirements of automatic assembly and mention is made of current practice with regard to the problem of interconnection and the incorporation of sub-assemblies.



MATERIALS

The Effect of an Electric Field on the Transitions of Barium Titanate, M. E. Drougard, E. J. Huibregtst. "IBM J." October 1957. 12 pp.

A Solid Electrolyte Battery, Burton F. Wagner. "El. Des." October 1, 1957. 4 pp.

Solderable Magnet Wire, Ralph Hall. "El. Ees." October 1, 1957. 3 pp.

Electronic Materials at Elevated Temperatures, James W. Ballard. "El. Eq." October 1957. 5 pp.

MEASURING & TESTING

Pulse Frequency Meter, H. Schoenmen. "Prace ITR." Zeszyt 2, 1957. 12 pp. The present work contains a description of a complete integrator for measuring purposes having high stability, high precision and wide range of measurement. The equipment consists generally of a counter device and an electronically stabilized high voltage power supply.

A Vacuum Plant for the Frequency Calibration of Quartz Vibrators, J. Green, et. al. "El. Eng." September 1957. 5 pp. A vacuum evaporation plant is described for the final frequency calibration of quartz vibrators.

How to Increase Contact Reliability, S. T. East. "Auto. Con." September 1957. 4 pp.

Thermal Design—1, Harry M. Passman. "El. Des." October 15, 1957. 4 pp.

A Mechanical Heart-Lung Apparatus, R. Taylor. "IBM J." October 1957. 11 pp. An apparatus is described for taking over the functions of the human heart and lungs for short periods of time to permit a surgeon to perform certain open-heart surgical procedures in a blood-free field.

Measurement of Magnetization on Magnetic Sound Tape, O. Schmidbauer. "El. Rund." October 1957. 4 pp. After an explanation of the advantages of defining the magnetization of a tape by the short-circuit flux as characteristic magnitude a method is described for its measurement, possible error sources (especially by traverse magnetization) and means for their elimination are considered.

Variable Mercury Delay Line Simulates TV Flutter, C. F. Brockelsby. "El. Des." October 1, 1957. 3 pp.

Tables of Vertical Group Velocities of Ordinary Echos from the Ionosphere, W. Becker. "Arc. El. Uber." Vol. 11, Issue 4, April 1957. 7 pp. The accuracy of the calculation and values given by the author have been proven to at least 1 decimal place.

Sporadic Ionization in the E-Layer of the Ionosphere, Walter Becker. "Arc. El. Uber." Vol. 11, Issue 3, March 1957. 4 pp. The article proves that the various sporadic ionizations in the E-layers cannot be correlated into ultraviolet solar radiation, and are independent of each other. A different cause must be assumed.

Iteration Process for Calculating Electro-Magnetic Fields, A. Redhardt. "Arc. El. Uber." Vol. 11, Issue 6, June 1957. 4 pp. The calculations outlined in this article are based on the theory of discontinuity in the transmission path. The method involves but moderate computation work.

Matrix Transformation for the Investigation on a Network Analyzer, H. Edelman. "Arc. El. Uber." Vol. 11, Issue 4, April 1957. 10 pp. The paper shows how transformation of components can be carried out with the aid of real and complex transformers. Matrices are employed for presenting the theory. With non-singular transformer matrices the currents and voltages can be chosen arbitrarily, while with singular matrices certain conditions must be fulfilled according to their rank.

Precision Measurements by a Substitution Method of Thermal Noise Temperatures of Dipoles for Decimeter Wave Length, L. Mollwo. "Arc. El. Uber." Vol. 11, Issue 7, July 1957. 12 pp. The paper relates in particular to radio-astronomical equipment. General formulas for the measurement errors caused by impedance mismatch are given.

Echos of HF and VHF Frequencies from an Aurora Borealis, G. Lange-Hesse. "Arc. El. Uber." Vol. 11, Issues 6 and 7. June and July 1957. 15 pp. The report is a summary of the observations and findings over the past ten years. Included in the study are pulse as well as continuous wave transmissions.

The Assessment of Reliability, T. R. W. Bushby. "Proc. AIRE." August 1957. 9 pp. A program for the assessment of the reliability of airborne electronic equipment was instituted in 1949. The methods of adopted in the collection, analysis, presentation and utilization of the data are described.

The Dielectric Disc as a Four Pole Transformation Network to Magnify the Node Displacement for Measuring Purposes, L. Breitenhuber. "Arc. El. Uber." Vol. 11, Issue 6. June 1957. 4 pp. The paper deals with the dielectric disc on the basis of transmission line equations. The analytical representation of the maximum node displacement is derived as a function of the thickness of the disc, and its dielectric constant. The displacement becomes a maximum when the phase shifts 45°.

Equivalent Electric Parameters of Piezoquartz Plates Effecting Harmonics, M. M. Pruzhanski. "Radiotek." August 1957. 6 pp. Giving the description and theory of two independent methods of measuring the equivalent parameter of quartz in harmonics; the first method by replacing quartz in an oscillating circuit and the second, the resonant method of measurement with the aid of a Q-meter. The results of measurement of the parameters of quartz in harmonics are given. Showing that the quality of quartz at first increases with the increase of the ordinal number of harmonic, reaches a maximum, but then begins to diminish.

Portable Plenum Test Chamber, G. H. Siegel. "El. Des." October 15, 1957. 5 pp.

A New Evaporative Cooling Technique, Robert Berner. "El. Des." October 15, 1957. 4 pp.

RADAR & NAVIGATION

Flight Control System for Jet Transports, H. Miller and R. H. Wagner. "IRE Trans. PGANE." September 1957. 9 pp. The recently developed SP-30 control system for commercial and military jet transport aircraft is discussed in this paper in terms of its operation, design, and performance.

Application of the Decca Navigation System as an Approach and Landing Aid, H. W. Mitchell. "IRE Trans. PGANE." September 1957. 5 pp. This paper is a report on a joint Bell-Bendix-Decca program to investigate the problems of flying a helicopter in remote areas under instrument flight conditions with presently available machines, the Decca navigator system, and other sensory equipment.

The Nature of Doppler Velocity Measurement, F. B. Berger. "IRE Trans. PGANE." September 1957. 10 pp. This paper deals with airborne Doppler velocity measuring systems. In particular, it deals with the character and limitations of the velocity data provided by such systems.

Tacan Coverage and Channel Requirements, Martin T. Decker. "IRE Trans. PGANE." September 1957. 9 pp. A study has been made of some of the problems involved in the implementation of the system. Predictions are made of the coverage to be expected in the air space surrounding a Tacan ground facility.

Coding Requirements for the ATC Radar Beacon System, Tirey K. Vickers. "IRE Trans. PGANE." September 1957. 4 pp. This paper outlines the desired functional characteristics of an expanded beacon system for air traffic control and explains the operational factors involved.

Inertial Guidance, Walter Wrigley, et. al. "Aero. Engr. Rev." October 1957. 4 pp. Guidance without the use of any radiation; describably by the laws of mechanics and involving measurements of time, gravitation, acceleration, and angular velocity.

A Transistor Marker Beacon Receiver, R. G. Erdmann. "IRE Trans. PGANE." September 1957. 5 pp.

Doppler Progress Sets Fast Pace for Hardware Development, James Holahan. "Aviation Age." October 1957. 7 pp.

Telemetering for Interplanetary Flight, Dr. E. H. Krause. "ISA. J." October 1957. 3 pp.

SEMICONDUCTORS

***Heat Transfer in Power Transistors,** Ioury G. Maloff. "El. Ind." Dec. 1957. 4 pp. The factors involved in transistor heat transfer are discussed.

***Basic Semiconductor Symbols,** "El. Ind." Dec. 1957. 2 pp. A logical system for constructing semiconductor symbols is presented.

***Semiconductor Diode Specification Chart.** "El. Ind." Dec. 1957. 8 pp. Basic parameters for semiconductor diodes now available are presented in this designers' reference chart. Sources of the diodes are indicated in the chart.

Quasi-electric and Quasi-magnetic Fields in Nonuniform Semiconductors, H. Kroemer. "RCA." September 1957. 11 pp.

A Three-Dimensional Analytic Solution for Alpha of Alloy Junction Transistors, A. J. Wahl. "IRE Trans. PGED." July 1957. 5 pp.

Junction Capacitance and Related Characteristics Using Graded Impurity Semiconductors, L. J. Giacoletto. "IRE Trans. PGED." July 1957. 9 pp.

Aluminum-Junction Transistors for High-Power Operation, Gene Strull. "El. Eq." October 1957. 4 pp.

The Elemental Semiconductors—Silicon and Germanium (Part I), J. Shields. "El. Energy." October 1957. 6 pp. Impurities and crystalline imperfections greatly influence the electrical properties of small conductors. A simply physical picture of their roles in electrical conduction processes is given in terms of the band theory of solids. The techniques, for the preparation of monocrystals of silicon and germanium of a high degree of purity and perfection, are reviewed.

High-Frequency Semiconductor Spacistor Tetrodes, H. Statz, et. al. "Proc. IRE." November 1957. 9 pp. This paper presents a full technical description of an important new type of semiconductor device which received considerable public attention when it was announced last summer.

Design of Transistor Regulated Power Supplies, R. D. Middlebrook. "Proc. IRE." November 1957. 8 pp. A new form of transistor series regulated power supply is presented which boasts an extremely low output resistance, excellent transient response to sudden changes in load, and yet simple and economical circuitry.

Future Circuit Aspects of Solid-State Phenomena, E. W. Herold. "Proc. IRE." November 1957. 12 pp.

Theory of a Wide-Gap Emitter for Transistors, Herbert Kroemer. "Proc. IRE." November 1957. 3 pp. This paper points out that a significant increase in the performance capabilities of transistors is possible by using an emitter material with a higher energy-band gap than the base material.

Shot Noise in Transistors, G. H. Hanson and A. Van Der Ziel. "Proc. IRE." November 1957. 5 pp. This clear, well written account presents experimental verification of a previously published and important theory that describes the generation of noise in transistors.

Nonlinear Distortion in Transistorized Amplifiers, G. Meyer-Brotz and K. Felle. "El. Rund." October 1957. 5 pp. Nonlinear distortion of emitter base operated amplifiers characterized by the distortion factor is investigated in relation to operation point, load and source resistance and temperature. The primary causes of distortions are the curved shape of the base voltage characteristic and base current vs. collector current characteristic.

Transistor Characteristics and Circuits, Harry C. Likel. "Tech. Rev." October 1957. 10 pp.

Production of Ultrapure Germanium and Silicon Crystals, H. F. Matare. "El. Rund." October 1957. 4 pp. After a compilation of some important electrical data for germanium and a short description of a modern germanium crystal drawing equipment the special difficulties encountered in the production of ultrapure silicon are dealt with. After consideration of the problem of crystal drawing from crucibles the floating zone process excluding contact between crucible material and molten mass is described.

Transistors Boost Video for TV Studio Monitors, L. N. Merson. "El." October 1957. 1 p.

TELEVISION

***An Electronic System for Reducing Image Orthicon Sticking, Lavoy Hooker.** "El. Ind. Ops. Sect." Dec. 1957. 3 pp. A simple phase shift oscillator provides orbital motion to reduce burn-in, and even permits return to service of tubes discarded for sticking.

A Portable and Self-Powered TV Camera, J. Polonsky. "Onde." Vol. 37, No. 364. July 1957. 8 pp. The article describes a portable miniature TV camera including a transmitter, developed by C.S.F. The equipment is transistorized and battery powered. It was successfully operated from airplanes, helicopters, and moving cars.

The VHF Voltage Distribution in the Equipment of Community Antennas, A. Flebranz. "Nach. Z." July 1957. 8 pp. Simple approximation formulae, tables and computing devices, based on the conventional transmission line theory, are provided for calculating the voltage distribution in the equipment of community antennas in the VHF broadcasting and TV bands.

Performance Test of Color TV Equipment and Systems, G. A. Boutry and P. Billarde. Onde. Vol. 37, No. 364, July 1957, 12½ pp. The paper presents the results of experiments which were conducted to determine the amount of degradiation of color images by color TV systems. Special tests were conducted during which the observers were limited to express their opinions only to yes or no. The experiments try to analyze linearity and extent of luminance scale, cross-talk between primary colors, colometric fidelity, and resolution of details in the presence or absence of luminance contrast. The described method can be applied to the study of different types of color TV systems.

New Developments in Color Television, L. C. Jesty. Arc. El. Uber. Vol. 11, Issue 3, March 1957. 18 pp. The paper describes equipment developed by Marconi's Wireless Telegraph Corp. Systems as well as terminal equipments are described. Various methods of coiling luminance and chrominance for transmission are discussed. Camera and receiver equipment are described.

Reproduction of Colors by a Two-Color System, P. Billarde. Onde. Vol. 37, No. 364, July 1957. 8 pp. The article describes the colorimetric properties of a two-color TV system. The author proves that γ correction is of prime importance. A crosstalk produces distortions in both color and luminance. By means of simple correction devices these distortions can be made negligible.

Industrial Color TV Systems, J. Perilhou. Onde. Vol. 37, No. 364, July 1958. 8½ pp. The article reviews technical and economic factors of color TV systems. Receivers for color TV systems are considerably more expansive than black and white receivers. The article analyzes the color TV system based upon mixed line-frame sequence where only two colors per frame are transmitted. Green appears in every frame; red and blue appear in alternate frames. The two colors are transmitted by line sequence. This allows a receiver construction analogue to black and white TV.

The Influence of Transmission Level and Various Disturbances on Color TV, W. Dillenburger. Arc. El. Uber. Vol. 11, Issue 5, May 1957. 19 pp. The article outlines the influence on a transmitted color picture caused by slight variations in amplifier characteristics of the individual color channels. Exacting demands are placed on the constance of the differential group delay as a function of the picture brightness. Equipment is described which has been developed to investigate these effects. Results of these measurements are given.

High-Voltage Regulator Tubes for Color Television Receivers, R. E. Bryam. "IRE Trans. PGED." July 1957. 3 pp.

ΔG = ΔG/enjupδ

THEORY

Experimental and Theoretical Analysis of Semi-Conductor HALL-Effect Conductors, Max J. O. Strutt and F. S. Sun. Arc. El. Uber. Vol. 11, Issue 6. June 1957. 5 pp. The article deals with a feedback circuit incorporating an indium-antimonide pellet, and a ferrite core. At room temperature D-C amplification is achieved with this circuit. An oscillator circuit was designed with a frequency range of 13 to 330 cps. The power output was 12 milliwatts, and the efficiency 22%. The influence of temperature is discussed.

Some Characteristics of Transients in Resonant Amplification with Nonlinear Load, I. Y. Kraemer. "Radiotek," August, 1957. 3 pp. The characteristic peculiarities of transients in resonant amplification with nonlinear load are examined. The relationship of the delay signal and the time of increase in voltage at the outlet from the level of the input signal. Examination and application to logarithmic amplifiers used in radar, pointing out the influence of the examined characteristics of transients on radar accuracy.

The Influence of Electro-Magnetically-Coupled Systems, W. Dahlke. Arc. El. Uber. Vol. 11, Issue 6, June 1957. 8 pp. Each compound system can be considered as a primary system with an electro-magnetically-coupled secondary system, and can be represented by a parallel-converted primary admittance, and a reflected admittance. The theory outlined in this paper is based on Maxwell's equations, and explained by reference to the examples of the magnetic coupling and the conducting diode.

The Level Theory for Electrical Conductivity of a Solid Body, T. Lipowiecki. "Roz. Elek." Tom III Zeszyt 2. 42 pp. The aim of this paper is to acquaint the reader with the basis of the modern level theory for electrical conductivity. The structure of different types of lattices of a solid body is described and a special attention is drawn to the structure of the lattice of the elements of group 4; carbon (diamond), silicon, and germanium. Energetic levels of the isolated atom are discussed as well as the arising of energetic zones in crystals of a solid body. The Pauli principle is given and applied to the consideration of the arising of energetic zones. The solid bodies are classified in relation with the mutual position of the basic and conductivity zones; they are divided into conductors, semiconductors and insulators.

Electrons, Photons, and Radio Emission, L. B. Slepyan. "Radiotek," August, 1957. 5 pp. Radio emission seen from the point of view of the possible role played therein by electrons and photons. Analyzing the possibility of experimental verification of the actual existence of radiophotons.

The Solution of Special Heat Conductivity Problems Arising in the Field of Electrotechnic with the Aid of Two Laplace Transformations, Hofmann. "Arc. El. Uber." Vol. 11, Issue 7, July 1957. 5 pp. The advantage of two-dimensional Laplace transformations is high-lighted to solve special heat conducting problems.

Some Questions of Resonant Amplification, A. G. Amisinov. "Radiotek." August 1957. 2 pp. Adduced appraisal of ration S″/S′, defining the intensity of nonlinear effects during resonant amplification, which allows us to draw conclusions about the selection of conditions of tubes and about amplification control.

Point Contact Rectifier Theory, Melvin Cutler. "IRE Trans. PGED." July, 1957. 6 pp.

A Three-Phase Magnetic Amplifier, V. V. Gorsky. "Avto. i Tel." July 1957. 5 pp. The paper discusses the principle of operation of a three-phase magnetic amplifier circuit proposed by the author. The construction is described in detail and certain experimental results are cited.

Analysis of Diversity Reception, E. Henze. Arc. El. Uber. Vol. 11, Issue 5, May 1957, 12 pp. The paper aims at two goals: (1) general equations are set up for the characteristics of signals obtained with certain receiver and antenna diversity methods, (2) the receiver diversity method and the antenna diversity method are investigated for statistically dependent individual signals. Attained improvements in transmission performance are high-lighted. Also investigated is the influence of external noise.

TRANSMISSION

The Modulation of Traveling-Wave Tubes, G. F. Steele. "El. Eng." September 1957. 5 pp. The simple theory of traveling-wave tube modulation is discussed and some expressions derived for the cases of phase and amplitude modulation. Details are given of the experimental procedure used to measure phase shift, and the sideband power resulting from a 60Mc/s modulation.

Deflection at the Junction of Wave Guides, G. Piefke. Arc. El. Uber. Vol. 11, Issue 3, March 1957, 12 pp. The article analyzes thoroughly the reflection coefficients at junctions of wave guides and sector horns. The magnitude of the reflection coefficient increases with increasing 2a/λ O, i.e. with increasing frequency.

A New Surface Wave Guide with a Broad Band Characteristic, D. Marcuse. Arc. El. Uber. Vol. 11, Issue 4, April 1957. 3 pp. A surface wave guide made up of thin circular metal discs alternated with discs of dielectric material is investigated. It is found that this axially stacked wave guide can carry only certain frequency bands. Phase and attenuation constants are calculated.

Circular Electric Wave Transmission in a Dielectric-Coated Waveguide, H. G. Unger. "Bell J." September, 1957. 26 pp.

Artificial Transmission Lines, A. C. Hudson. "E. & R. Eng." August 1957. 3 pp. Some relations are derived between the dimensions of the coils for negative mutual inductance transmission lines and the constants of such lines.

Influence of External Agents on Propagation Along a Surface Wave Guide, B. Chiron. "Cab. & Trans." July 1957. 8 pp. The object of the paper is the determination of the influence on the propagation of surface waves, of certain external agents as atmospheric disturbances, obstacles along the surface wave guide and couplings between guides or with other radiating elements.

Waveguide Characteristics, A. E. Karbowaik. "E. & R. Eng." October 1957. 9 pp. Application of the surface impedance approach to the analysis of the wave propagation in parallel land waveguides, rectangular waveguides and circular waveguides is shown to lead to a general expression for the propagation coefficient.

Circular Electric Wave Transmission Through Serpentine Bends, H. G. Unger. "Bell J." September, 1957. 13 pp.

Normal Mode Bends for Circular Electric Waves, H. G. Unger. "Bell J." September, 1957. 16 pp.

TUBES

Applications of a New Type of Cold Cathode Trigger Tube, Part I, K. F. Gimson, and G. O. Crowther. "El. Eng." October 1957. 7 pp. Primarily, this tube has a trigger ignition voltage which is very stable over long periods; it is, therefore, suitable for use in accurate RC timers, overvoltage detectors, voltage regulators, relaxation oscillators and sensitive relay units. The article describes the mode of operation of tubes of this type and outlines the design techniques needed for several applications.

On The Performance of High Perveance Electron Guns, L. E. S. Mathias, and P. G. R. King. "IRE Trans. PGED." July 1957. 7 pp.

A New Type of Powerful Generating Tetrode, Z. M. Liphshitz, G. M. Moskovskaia, and M. I. Pass. "Radiotek." August, 1957. 2 pp. A description of a new type of powerful generating tetrode of 10 kw., intended for use in short-wave.

An Image-Converter Tube For High-Speed Photographic Shutter Service, R. G. Stoudenheimer, and J. C. Moor. "RCA." September 1957. 10 pp. A developmental image-converter tube having electrostatic focus, a shutter grid, and electrostatic deflection is described.

Pencil Tubes, L. Jarasse. Onde. Vol. 37, No. 364, July 1957. 7 pp. Described are the tubes 5876, 6263 and 6264 designed by the Société Francaise Radio Electrotechnique. The tubes have a frequency range from 100 to 3,000 MC.

Beam Perturbations in Confined Flow Electron Beams With Planar Symmetry, D. A. Dunn, and W. R. Luebke. "IRE Trans. PGED." July 1957. 6 pp.

Design and Calculation Procedures for Low-Noise Traveling-Wave Tubes, L. D. Buchmiller, et. al. "IRE Trans. PGED." July 1957. 9 pp.

The Development of a Tunable CW Magnetron in the K-Band Region, Zeev Fraenkel. "IRE Trans. PGED." July 1957. 10 pp.

The Transient Response of Photoconductive Camera Tubes Employing Low-Velocity Scanning, R. W. Redington. "IRE Trans. PGED." July 1957. 6 pp.

Mutual Coupling Coefficient in Traveling Wave Tubes, F. Paschke. Arc. El. Uber. Vol. 11, Issue 4, April 1957. 9 pp. The article analyzes the mutual coupling in traveling wave tubes. The analysis shows that for low noise operation the amplifier should have: (1) large beam diameter, (2) low beam velocity, and (3) large coupling impedance K. The maximum attainable gain per beam wave length of an ideal TWT is shown to be G/N=37.5 (W_{poo}/w) ⅔ decibel.

Noise Wave Excitation at the Cathode of a Microwave Beam Amplifier, W. R. Beam. "IRE Trans. PGED." July 1957. 9 pp. General equations are derived, giving the amplitudes of noise current and velocity for the many modes of space-charge wave propagation in an electron beam.

Biperiodic Electrostatic Focusing in High-Density Electron Beams, Kern K. N. Chang. "Proc. IRE." November 1957. 6 pp. A focusing scheme employing two counteracting periodic fields without the use of any magnet is shown to be superior to schemes which involve only one periodic focusing field.

Slalom Focusing, J. S. Cook, et. al. "Proc. IRE." November 1957. 6 pp. An ingenious method is proposed for electrostatically focusing high density electron beams by which a sheet-shaped beam is made to weave sinusoidally through an array of positive rods or wires placed midway between two negative plates.

Concerning the Frequency Characteristics of Compound Crystal Triodes, A. G. Philipov. "Radiotek." August 1957. 3 pp. Accounts and experimental data given showing the peculiarities of the frequency response of the coefficient of current amplification of compound crystal triodes, comparing them with ordinary (not compound) triodes.

The Influence of a Finite Magnetic Field on a Space-Charge Wave Near the Cathode of a Cylindrical Electron Beam, B. Liebscher. Arc El. Uber. Vol. 11, Issue 5, May 1957. 8 pp. The paper calculates the plasma wave length of a finite magnetic focusing field at the cathode. The boundaries of the investigation are (1) an infinite strong magnetic field throughout the beam generating system and (2) magnetic field along the electron beam, but no magnetic field at the cathode of the electron gun.

A New Tube for TV Motion Picture Cameras, The Vidicon, J. Tafflet. Onde. Vol. 37, No. 364, July 1957. 4 pp. Motion picture equipment using a Vidicon is described. The technical and economical advantages of this system are discussed and photographic illustrations are given.

An Account of the Integrated Characteristics of the Eye and Luminophor Screen during the Observation of a Television Image in the Presence of Fluctuation Noises, I. A. Krasilnikov. "Radiotek." August 1957. 3 pp. The article analyzes the process of averaging fluctuation noise observed on the screen of the television receiving tube, conditioned by the finite time of the luminophor afterglow and lag of visual susceptibility. Deduced equations with the aid of which one can find the signal-to-noise ratio by using averaging calculations.

PATENTS

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

Video Amplifier Bridge Circuit for Minimizing Supply Voltage Variations, #2,800,528. Inv. H. B. Beste. Assigned Allen B. Du Mont Laboratories, Inc. Issued July 23, 1957. An impedance bridge is connected between the cathode and the output electrode of a TV amplifier tube, the amplifier tube comprising one arm of the bridge. The four arms are balanced to compensate voltage variations of the supply.

Delay System, #2,800,580. Inv. R. S. Davies. Assigned Philco Corp. Issued July 23, 1957. An information conveying signal is converted into a series of amplitude-modulated equispaced pulses and fed to a delay line having a delay time differing from an integral multiple of the time spacing of the pulses by at least the time width of one of the pulses. The output and input of the delay line are connected by a feedback circuit and the signal traverses the delay line a predetermined number of times before leaving it and being reconverted into a signal having characteristics similar to the initial signal.

Noise Suppression and Limiter Circuits, #2,800,582. Inv. K. E. Doriot. Assigned Westinghouse Air Brake Co. Issued July 23, 1957. The output voltage from the plate of a carrier amplifier for an intermittent carrier signal is used to control a relay in accordance with the signal amplitude. The relay controls the connection between the demodulator and the transducer of the system to render the transducer inoperative during intermissions in the application of the carrier signal.

Artificial Inductor, #2,800,586. Inv. G. H. Towner. Assigned Northrop Aircraft, Inc. Issued July 23, 1957. A first amplifier stage takes its input from a resistor and feeds a second amplifier stage. A third amplifier stage is connected to the output of the second amplifier stage over a differentiating network, its output being connected in series with the input resistance. A capacitance bridges the series connection of the resistance and the third amplifier stage output terminals.

Electron-Tube, #2,800,599. Inv. O. Sternbeck and W. E. M. Uhlmann. Assigned Telefonaktiebolaget L. M. Ericsson. Issued July 23, 1957. An information storage tube consists of an accelerator grid surrounding a cathode, a further more positive grid surrounding the accelerator grid and a plurality of secondary emissive elongated conducting electrodes arranged parallel to the cathode and both grids. Each secondary emissive electrode is provided with an individual lead through the envelope. A further screen surrounding the secondary-emissive electrodes and the second screen collect a portion of the primary electrons.

Magnetron Tuner Device, #2,800,609. Inv. Chas. V. Litton. Assigned Litton Industries. Issued July 23, 1957. The anode in a magnetron defines a wall of the cavity resonator. A tuning plunger can be moded into the resonator in a direction parallel to the anode defining wall; the wall and the plunger are conductively connected.

Semiconductor Device, #2,800,617. Inv. J. I. Pankove. Assigned Radio Corporation of America. Issued July 23, 1957. A rotating field is established in a semiconducting body, and a first electrode in rectifying contact with the body is defined by the area between two concentric similar boundaries. A plurality of other electrodes in rectifying contact with the body is positioned about the first electrode. The current flow between the first electrode and each of the pluralities of other electrodes is controlled by the rotating field.

Antenna for Broadcasting Two Signals, #2,800,656. Inv. D. W. Peterson. Assigned Radio Corp. of America. Issued July 23, 1957. An antenna array has a vertically mounted pipe having a plurality of layers of slots fed with relatively high-frequency signals. The array further has a plurality of layers of four radiator elements extending at right angles from the pipe and fed with relatively low-frequency energy.

Oscillator Synchronizing Circuit, #2,801,282. Inv. R. W. Sonnenfeldt. Assigned Radio Corporation of America. Issued July 30, 1957. The synchronizing sine wave burst of oscillations of a color TV signal are injected into the tank circuit of a free-running oscillator. A voltage representative of the phase difference between the burst oscillations and the oscillations of the free-running oscillator is derived and used to control the frequency and phase of the free-running oscillator.

Series-Connected Transistor Amplifier, #2,-801,298. Inv. R. N. Mital. Assigned North American Phillips Co., Inc. Issued July 30, 1957. The input is applied to the grid of an electrode having a grounded cathode, its plate being directly connected to the base electrode of a first transistor. The emitter electrode of the first transistor is directly connected to the base electrode of a second transistor. A voltage source is connected between ground and the emitter electrode of the second transistor and the load is inserted between the collector electrode and ground of the same transistor.

Improved Ultra-High Frequency Amplifier, #2,801,299. Inv. K. S. Knol and J. Davidse. Assigned North American Phillips Co., Inc. Issued July 30, 1957. A first neutralizing capacitor is connected between the no-grid end of the input impedance and the plate and a second neutralizing capacitor and series-connected resistor are connected between the same end of the input impedance and the cathode; the capacitances being dimensioned to compensate for the respective internal tube capacities. The neutralizing resistor has a value to compensate for the input tube conductance to extend the neutralizing effect over a wider frequency range.

Self-Calibrating Limit Indicator, #2,801,333. Inv. A. D. Jordan. Assigned Sylvania Electric Products Inc. Issued July 30, 1957. A series-connected resistor, capacitor and impedance are in the cathode lead of a gas-filled tube. An intermittent voltage is applied to the plate of the tube. A d.c. calibrating voltage and a test voltage are applied to the grid circuit with the positive terminal of the calibrating voltage connectible to the grid.

Circuit-Arrangement for Synchronizing an Oscillator, #2,801,336. Inv. P. A. Neetson. Assigned North American Philips Co. Issued July 30, 1957. The controlling oscillation is applied to one control grid and the generated oscillation to a second control grid of a multi-grid tube. The phase-indicative output is converted into a voltage indicative of the frequency difference which is applied to the control grid of a second tube, the two anodes being interconnected and supplying the synchronizing voltage.

The Design of an Electron Gun for a Strip-Beam Device, A. B. Cutting, I. Fraser. "Vide." Vol. 12, No. 67. 1957. 9 pp. Outlined in detail is the construction of an electron gun designed for a millimeter wave oscillator tube, using cavities. The gun provides a current of 115 ma at a potential of 2,000 kv through a tunnel with a cross-section of .4 mm x 3 mm, and 7 mm long. The beam current density is 12.5 amp/cm^2 and the purviance is 1.68 x 10^{-6}.

The Space Charge Distribution in a Static Magnetron, J. Verweel. "Vide." Vol. 12. No. 67. 1957. 11 pp. The article analyzes the space charges and potentials in the non-oscillating cylindrical section of the tube. The orbits of the individual electrons are largely dependent upon the initial velocities, but for most cases can be assumed to be parallel to the cathode surface. The results are compared with the theoretical work by Twis, the experiments by Mathias, and the experiments by Nedderman.

The Large-Signal Behavior of Crossed-Field Traveling-Wave Devices, J. Feinstein, and G. S. Kino. "Proc. IRE." October 1957. 10 pp. This paper considers a class of traveling-wave devices in which the electron beam flow is perpendicular to both the dc electric and magnetic fields.

Magnetless Magnetron, R. Versnel. "Vide." Vol. 12. No. 67. 1957. 4½ pp. The article starts with a brief description of the normal magnetron with the electrons traveling in combined electric and magnetic fields. Then the fully electrostatic magnetron is described.

Low Noise Traveling Wave Tube, Type ECL1138, M. Higushi, K. Kawazura, J. Koyama. "Vide." Vol. 12. No. 67. 1957. 6 pp. The Nippon Telegraph and Telephone Public Corporation is studying an all traveling wave tube system for use in a radio relay system transmitting TV programs and telephone signals at 4,000 mc from Tokyo to Sendai, and Fukuoka. Several types of tubes were tested, and the ECL1138 was adapted. It has a gain of over 20 db, and the noise figure is less than 13 db.

Certain Specific Features of Aperture Correction in Charge-Storage Cathode-Ray Tubes, D. A. Novak. "Radiotek." July 1957. 6 pp. On the basis of determining the transient responses of charge-storage cathode-ray tubes, the paper examines the special features of aperture correction in these tubes. These features are characterized by taking into account the phase distortion which is intrinsic to charge-storage cathode-ray tubes (in contrast to tubes which do not store charges and which do not introduce phase distortion).

A Gas Evolution Servo-System for Processing Oxide Cathodes, R. P. Misra and W. H. Moll. "Vide." Vol. 12. No. 68. 1957. 9 pp. The paper describes a system which was developed for processing oxide coated cathodes. The device controls automatically the rate of carbon break-down to achieve optimum results during processing. A mass production processing schedule can be based on the data which are collected during the controlled processing of a few sample tubes. The device also permits close control of the grid cut-off voltage.

Plug-In T-R Tubes for Use in S-Band Duplexes, T. L. Dutt. "Vide." Vol. 12. No. 67. 1957. 15 pp. Construction and operating characteristics of a number of T-R tubes are given.

Compatible Color Television Receiver, #2,-803,698. Inv. F. W. de Vrijer. Assigned North American Philips Co., Inc. Issued August 20, 1957. The compatible television receiver contains three picture tubes, a first one of which produces a conventional black-and-white picture, the other two tubes producing two of three component color pictures. A filter to produce the third component color picture is mounted in front of the first picture. An optical system is provided to combine the three component color pictures for simultaneous viewing; this optical system can be removed and only the black-and-white tube operated if a black-and-white picture is desired.

Amplitude Selection Circuit with Noise Cut-Off, #2,803,701. Inv. E. G. Clark and F. Bernstein. Assigned Philco Corp. Issued August 20, 1957. The synchronizing signal separator is designed to obtain the synchronizing signal from a composite signal containing noise components exceeding it in amplitude. For this purpose the composite signal is applied in a negative sense to a first grid of a multigrid tube over a network passing only the peaks of the noise signal pulses. The composite signal is also applied in a positive sense to a second grid of the tube over a network having a parallel connected diode to transmit the synchronizing pulses and noise signals at substantially equal amplitude. These two signals are added in the output. Further provisions for doubling the signal by combining two outputs of opposite polarity are included.

Helix-Type Traveling Wave Tube for 24,000 Mc, T. Miwa, J. Koyama, M. Mishima, I. Yanaoka. "Vide." Vol. 12, No. 67. 1957. 4 pp. To extend the operation of TWT to millimeter wave length, a tube with a single helix and a solid beam is constructed for operation at 24,000 mc. The results obtained with this tube provide a gain of 20 db and an output power of 76 milliwatts. The power output is limited by the cathode current density. Some design features and experimental results are described.

Power and Gain Limitations of Helix-Type Traveling Wave Tubes, C. W. Barnes. "Vide." Vol. 12. No. 67. 1957. 6 pp. The article calculates the gain limitations due to backward wave interactions. Estimates are made of the saturation output power as a function of ka and beam purviance.

Influence of Argon Content on the Characteristics of Glow-Discharge Tubes, F. A. Benson, et al. "Proc. BIEE." September 1957. 9 pp. Measurements have been made to determine the effects of carrying the argon content of glow-discharge stabilizer tubes on the striking and running voltages, the magnitudes and durations of the initial drifts, the running-voltage/temperature and running-voltage/current curves and the impedance/frequency and noise characteristics. Neon-filled and helium-filled tubes, with argon contents varying from zero to 3.5% and having cerium cathodes, have been specially manufactured for the investigations. The results of the work are presented here and discussed.

General Treatment of Millimeter-Wave Klystron Cavities, Kazuo Fujisawa, et al. "J. IECE. of Japan." May 1957. 8 pp. In this paper a cavity is generally treated and its equivalent circuit is determined theoretically, and is checked experimentally. The formulas for the resonant frequency, the internal Z and the external Z are derived.

Transistor Amplifier, #2,803,712. Inv. C. Hannigsberg. Assigned Lignes Telegraphiques & Telephoniques. Issued August 20, 1957. The collector of a first transistor is directly connected to the base of a second transistor. The emitter of the first resistor and the collector of the second resistor are each connected to one winding, respectively, of a three-winding transformer, the third winding supplying the output. Suitable biasing voltages are provided.

Unidirectionally Conducting Element, #2,804,-580. Inv. J. M. N. Hanlet. Assigned J. Visseaux S.A. Issued August 27, 1957. At least one layer of semiconductive material such as germanium carries a dielectric layer which is made discontinuous by having at least at the molecular scale a network of tightly joined meshes. A continuous conducting film is superposed on this discontinuous dielectric layer.

Double Signal Amplifying System, #2,805,289. Inv. P. K. Buijs. Assigned North American Philips Co. Issued September 3, 1957. A continuous musical signal and an intermittent speech signal of larger average amplitude are simultaneously applied to a variable-gain amplifier. A gain control voltage is derived when the average signal amplitude increases and applied to the variable-gain amplifier to reduce the gain such that the musical signal is substantially suppressed and the louder speech signal is audible.

Subminiature Portable Crystal Radio Receiver, #2,805,332. Inv. K. L. Bell. One-half assigned G. Miller. A thin dielectric diaphragm carries an inductive tuning winding. A low reluctance permanent magnetic field having low core loss at r.f. is arranged adjacent the winding. The winding feeds the received r.f. signal to a detector, the audio signal being fed back to the winding to react with the permanent magnetic field in dynamically producing sound waves.

Synchronized Microwave Generator, #2,803,-750. Inv. Al H. A. Dayem. Assigned Patelhold. Issued August 20, 1957. Two substantially identical microwave oscillators of the same operating frequency are individually controlled by the same synchronizing signal source. The oscillators have a common output circuit.

Device Comprising a Television Pick-up Tube, #2,803,753. Inv. J. C. Francken. Assigned North American Philips Co., Inc. Issued August 20, 1957. The picture generated by a photoelectric cathode is projected by an electron-lens system having adjustable magnification onto a screen. A light-impermeable screen is positioned in front of the cathode to keep electrons away from correspondingly-positioned sections of the target. The movable screen and the adjustable magnification are coupled to maintain these sections free from electron bombardment.

Transistor Amplifier Clipping Circuit, #2,803,-758. Inv. R. M. Whitenack. Assigned International Business Machines Corp. Issued August 20, 1957. The amplifier is intended to produce a large, relatively square output signal in response to a small, relatively sinusoidal input signal. Two transistors are transformer coupled in tandem. The negative collector potential of the first transistor is small compared to that of the second transistor. A clipping diode is inserted between the collector of the second transistor and the negative terminal of the collector potential of the first transistor.

Radio Frequency Matching Devices, #2,803,-777. Inv. J. H. Bryant. Assigned International Telephone and Telegraph Corp. Issued August 20, 1957. The broadband r.f. matching device for use between a low impedance transmission line of the coaxial type and a high impedance traveling wave tube comprises a transfer transmission line including a conducting cylinder surrounding a coupling helical conductor. In a first section of the transfer line the conducting cylinder surrounds the helical conductor with a narrow constant spacing there between; for a second section a wide constant spacing is provided; and for a third section the spacing is gradually varied between the wide and the narrow dimension.

Color Television Transmitting System, #2,804,-495. Inv. L. C. Jesty. Assigned Marconi's Wireless Telegraph Co. Ltd. Issued August 27, 1957. A color television or color telecinematograph system in which a plurality of color component images are stored in succession upon a storage electrode independent of unwanted image components; all the stored energy is wiped out and only the desired signals are fed to the output circuit.

Background Control for Color Television Receiver, #2,804,496. Inv. L. R. Kirkwood. Assigned Radio Corporation of America. Issued August 27, 1957. A voltage source is connected across the diagonal of a bridge circuit, three adjustable voltage dividing networks providing three adjustable output voltage. Each of these voltages is applied to the voltage control input terminal of one color system in a color television set.

Gamma Control for Flying Spot Scanner, #2,-804,498. Inv. R. Theile. Assigned Pye Ltd. Issued August 27, 1957. A light-spot scans the C.R.T.-picture to be transmitted and is subsequently intercepted by a photocell. The picture signal thus generated is amplified and fed negatively to a modulating electrode of the C.R.T. Gamma is controlled by varying this amount of feedback and the gain of the picture-signal amplifier is controlled; this control is ganged with the gamma control.

Traveling Wave Tube Amplifier, #2,804,511. Inv. Rudolf Kompfner. Assigned Bell Telephone Labs Inc. Issued August 27, 1957. A plurality of pairs of coaxially and substantially concentric helices several wavelength long and having unequal radii is spacedly arranged along the path of the electron beam. At least one helix of each concentric pair is maintained at a d.c. potential, the potential increasing in the upstream direction of the beam path, whereby electrons are accelerated to maintain the average velocity substantially constant.

Electrostatic Storage of Digital Information, #2,804,570. Inv. G. I. Thomas and B. W. Pollard. Assigned National Research Development Corp. Issued August 27, 1957. A first digit is recorded on a first elemental area of a cathode-ray tube storage surface by bombarding first the elemental area, later a region adjacent thereto and then again the first elemental area. A second digit is recorded on a second elemental area by first bombarding the second elemental area, later an adjacent region and still later a region closer to the second region than to the second elemental area.

Frequency Discriminator Circuit Arrangement for Ultra High-Frequency Oscillations, #2,-805,334. Inv. J. Cayzac. Assigned North American Philips Co. Issued Sept. 3, 1957. The frequency to be controlled is simultaneously applied to two cavity resonators tuned to two frequencies oppositely spaced from the nominal oscillator frequency, respectively. The resonator dampings are alternately varied. The combined cavity output is amplitude detected and then phase detected in a phase detector in which the detection polarization varies as the damping of the two resonators. The phase dectector thus provides an output voltage varying with the deviation of the frequency of the oscillator from its nominal value.

Traveling Wave Tube Mixer, #2,805,333. Inv. R. H. Waters. Assigned Sylvania Electric Products Inc. Issued September 3, 1957. Two slow wave circuit elements are arranged in succession along the electron path. The first slow wave circuit has an input at the electron-gun side and an energy absorber at its other end. A local oscillator is coupled to the electron-gun side of the second slow wave circuit and a collector exposed to the electron beam. The two slow wave circuits are connected for d.c., and the device is operated for saturation in the region of the second slow wave circuit.

Semiconductive Devices, #2,805,347. Inv. J. R. Haynes and J. A. Hornbeck. Assigned Bell Telephone Laboratories, Inc. Issued September 3, 1957. A semiconductive body of a material having a large concentration of temporary traps enabled to entrap charge carriers is connected across a voltage supply and load in series. Minority carriers are injected, for instance by incident light, into the body at a region intermediate the voltage supply terminals.

Color Television Image Reproducing System, #2,806,899. Inv. V. K. Zworykin. Assigned Radio Corporation of America. Issued September 17, 1957. The screen of a picture tube comprises groups of subelemental size areas, each area in a group reproducing a different color. An additional device provides secondary electrons in an amount proportional to the instantaneous signal amplitude, and an additional deflection system directs this secondary electron beam towards the subelemental area of the group which reproduces the color corresponding to the instantaneous signal.

Pulse Coincidence Circuit, #2,806,946. Inv. S. R. Rich. Assigned Raytheon Manufacturing Co. Issued September 17, 1957. A first and second pulse are electronically added and their sum is differentiated to obtain a wave form having unbalanced peaks. This wave form is fed to a further circuit including a balanced peak rectifier to derive a voltage indicative of coincidence between the first and second pulse.

Electric Counting Circuits, #2,805,363. Inv. G. T. Baker and W. Bezdel. Assigned British Telecommunications Research Ltd. Issued September 3, 1957. The single-stage binary counting circuit consists of a single cold-cathode gas discharge tube, a capacitor and at least two resistors. The capacitor and the resistors are so dimensioned that a suitable pulse applied to the trigger electrode causes the tube to strike and continue to pass reduced current after the pulse ceases and that a subsequent similar pulse causes the tube to extinguish when the pulse ceases.

Means for Detecting and Indicating the Activities of Bees and Conditions in Beehives, #2,806,082. Inv. E. F. Woods. Issued September 10, 1957. A microphone is positioned within the beehive. The microphone output is amplified and applied to an indicator over a system of filters which can be selectively switched into the circuit to isolate the three sounds known as normal hum, hiss and warble. This permits to detect and indicate the activities of bees and conditions in beehives.

Controlled Modulation Circuit, #2,806,136. Inv. B. Harris, F. S. Beale, and H. B. Dobyns. Assigned Westinghouse Electric Corp. Issued September 10, 1957. The d.c. voltage obtained from the discriminator detector in a receiving and transmitting system is applied to the screen grid of a modulator tube. The cathode of a triode is also coupled to the screen grid. A source of audio voltage is connected to the grid of the triode and a second triode is directly connected to the first triode, the output of said second triode being fed to a full-wave voltage doubler rectifier also feeding the screen grid but in phase opposition.

Electric Trigger Circuit, #2,806,153. Inv. T. H. Walker. Assigned International Standards Electric Corp. Issued September 10, 1957. The emitter electrode of each of two similar crystal triodes is connected to the base electrode of the other crystal triode. The two collector electrodes are connected to one terminal of a voltage source and the two emitter electrodes to the other terminal, each over a resistor. The resistors are of a magnitude to provide equal and opposite emitter-base potentials for the crystal triodes of sufficient value to hold one crystal triode in the "on" and the other in the "off" position.

Circuit Arrangement to Change the Characteristic Curve of Multi-Electrode Tubes, ffl2,806,-154. Inv. K. Steinbuch. Assigned International Standard Electric Corp. Issued September 10, 1957. To sharpen the flanks of pulses, the base electrode of a crystal triode is connected over a resistor to the cathode of an electron discharge tube. The emitter electrode is directly coupled to the cathode, while the signal is applied between the collector electrode and the grid of the discharge tube.

Signal Amplitude Limiting Circuits, #2,806,-173. Inv. D. E. Sunstein. Assigned Philco Corporation. Issued September 10, 1957. The screen in a cathode-ray tube has two secondary emission regions of different secondary electron emissivity, the beam being deflected alternately from one region into the other by a signal containing a high and a low frequency component. The output is proportional to the difference of the impinging and the leaving electrons on the screen. The low-frequency output component is used to deflect the beam in a direction opposite to the deflection produced by the original signal.

Device for Converting and Reinscribing Magnetically Recorded Data, #2,807,005. Inv. J. A. Weidenhammer. Assigned International Business Machines Corp. Issued September 17, 1957. An electron beam generator in the storage tube is adapted for horizontal and vertical scanning. Independent circuits are provided for entering data into the electrostatic storage device and for reading data out of the electrostatic storage device.

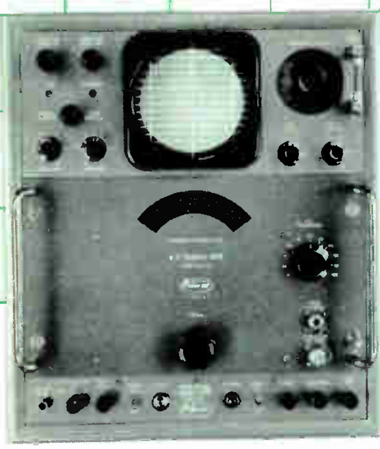
'SCOPE for VISUAL MICROWAVE ANALYSIS

Saves Engineering Manhours

Polarad Model TSA Spectrum Analyzer enables new visual techniques for checking and testing of microwave equipment with the same ease as standard oscilloscopes used in lower frequency work.

This instrument displays on a frequency base: pulse modulation components, frequency differences, attenuation and band width characteristics, leakage detection, radiation and interference signals, and VSWR information, with high sensitivity on a bright easily defined CRT.

Frequencies are read directly on the linear dial with 1% accuracy as the set is tuned. Maximum reliability and long life is assured through special, non-contacting oscillator choke sections. A stable frequency marker with both frequency and amplitude adjustment is provided.



POLARAD

Model TSA

Write for your copy of the Polarad "Handbook of Spectrum Analyzer Techniques". It includes discussion of operation, applications and formulae for analysis techniques.

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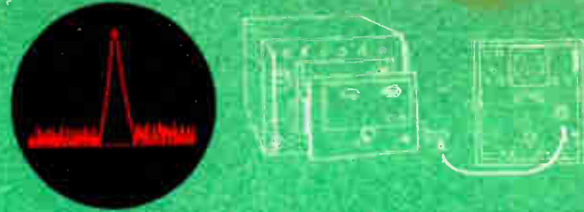
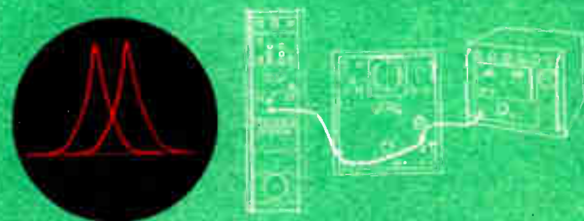


LEAKAGE AND INTERFERENCE MEASUREMENT

A simple, quick method of determining component leakage in microwave equipment is to watch the Spectrum Analyzer CRT while probing with a microwave test antenna. Because of high sensitivity of the TSA, CW signals will appear on the scope when the area of leakage has been found.

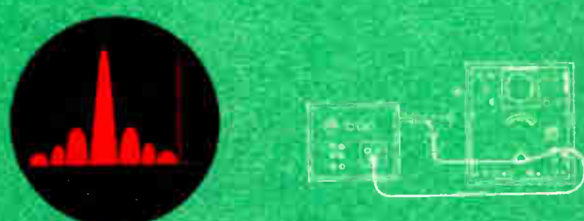


VISUAL FREQUENCY CALIBRATION

The Model TSA Spectrum Analyzer calibrates frequency by comparing the signal from a frequency standard as a reference, with that of an unknown. When signal coincidence occurs on the CRT, the unknown frequency is precisely shown. With a resolution of 25 kc, two 10 kmc signals can be compared with an error of less than 0.00025 percent.

MEASUREMENT OF PULSE MODULATION

The output of a pulse modulated microwave system can be received and displayed, as shown, on the CRT of the Polarad Model TSA Spectrum Analyzer. The presentation is a measure of the quality of modulation and points up undesirable modulation components which can then be corrected by adjusting the modulator and observing the correction visually.



CHECKING AFC OF RADAR SYSTEMS

AFC can be checked readily by observing the manner in which the radar local oscillator signal tracks the transmitter spectrum on the spectrum analyzer.

CHECKING OUTPUT OF FM GENERATORS

Modulation index of frequency modulated signals can be checked.

POLARAD
PROVEN RELIABILITY

IN ACTION

A microwave receiver with large dynamic range; excellent gain stability for these applications:

- General communications.
- Field intensity meter.
- Frequency meter.
- Measurement of radiation and leakage of microwave devices.
- Measurement of bandwidth of microwave cavities.
- Measurement of relative power of fundamental and harmonic signal frequencies.
- Measurement of noise figure.
- Antenna field patterns.

AM, FM, CW, MCW and PULSE RECEPTION

High video output — low impedance
Trigger output
Special recorder output

Model R

Output level reading directly in db
High sensitivity

Seven interchangeable plug-in r-f tuning units cover the entire frequency range:

*†RR-T	400- 1,000 mc
*†RL-T	950- 2,040 mc
*†RS-T	1,900- 4,340 mc
*†RM-T	4,200- 7,740 mc
*†RX-T	7,300-11,260 mc
†RKS-T	9,500-15,600 mc
†RKU-T	14,700-22,000 mc

*Microwave preselection, tracked and double-tuned
†U.S. Patent No. 2,774,243

Direct reading UNI-DIAL control, Broadband coverage

Audio output,
Audio output control
AFC switch

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Four distinct receivers in one:

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- a field intensity receiver
- a pulse, pulse time or pulse position demodulator
- a sensitive microwave power meter

This receiver is designed for quantitative analysis of microwave signals and is ideal for the reception and monitoring of all types of radio and radar communications within the broad band 400 to 22,000 mc. It permits comparative power and frequency measurements, by means of its panel-mounted meter, of virtually every type of signal encountered in microwave work.

It is compact and functional, featuring 7 integrally designed plug-in, interchangeable RF microwave tuning units to cover 400 to 22,000 mc; non-contacting chokes in pre-selector and microwave oscillator to assure long life and reliability, and large scale indicating meter for ease of measurement.

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SPECIFICATIONS:

Sensitivity:
(a) For Model RR-T: Minus 85 dbm
(b) For Models RL-T, RS-T, RM-T and RX-T: Minus 80 dbm
(c) For Models RKS-T and RKU-T: Minus 65 dbm

Frequency Accuracy: ±1%

IF Bandwidth: 3 mc

Image Rejection:
(a) For frequency ranges 400-11,260 mc: Greater than 60 db
(b) For frequency ranges 9,500-22,000 mc: (RKS-T and RKU-T tuning heads) Spurious response rejection obtained through the use of a bandpass filter

Gain Stability with AFC: ±2 db

Automatic Frequency Control: Pull-out range 10 mc off center

Recorder Output: 1 ma full scale (1,500 ohms)

Trigger Output: Positive 10-volt pulse across 100 ohms

Audio Output: 5 volts undistorted, across 500 ohms

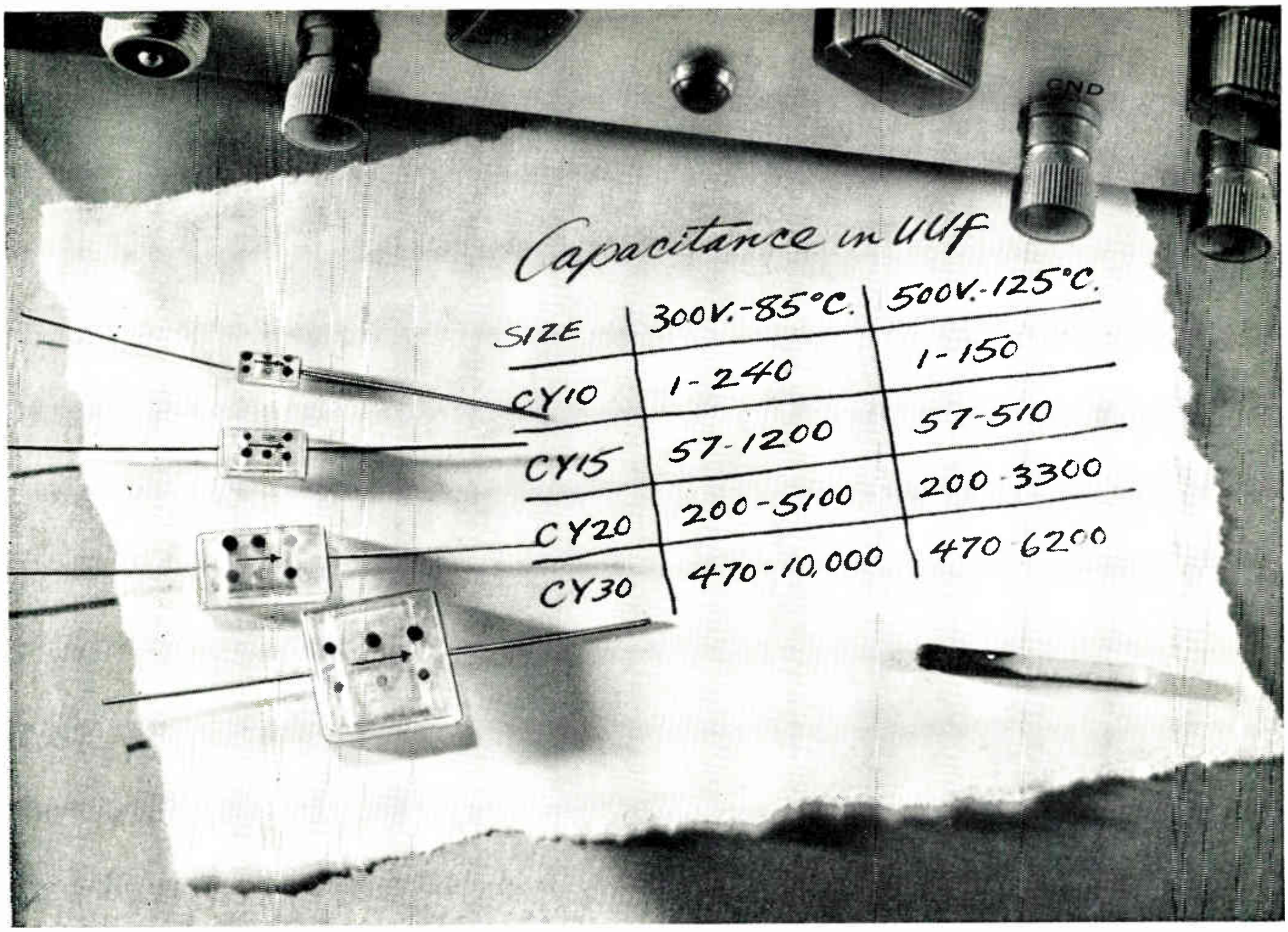
FM Discriminator:
Deviation Sensitivity: .7 v./mc

Skirt Selectivity:
60 db — 6 db bandwidth ratio less than 5:1

IF Rejection: 60 db

Maximum Acceptable Input Signal Amplitude: 0.1 volts rms, without external attenuation

Video Response: 30 cps to 2 mc



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These are *glass* capacitors—probably as much as one-third smaller than those you're used to; certainly much lighter.

Though made with glass, they are *not* fragile. In fact, the layers of glass dielectric, the metal foil plates and the leads are fused into a surprisingly rugged, inseparable unit.

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Small size, light weight. If you're at work on guided missiles, fire controls, computers, and similar devices, you can cut valuable ounces and inches from your assemblies with these capacitors. See table above for some indications.

Exceptional stability. After a load life test at 50% more than rated voltage at 85° C., the average change in capacitance of these units is less than 0.4% after 1,000 hours, less than 0.6% after 10,000 hours.

Capacitance in uuf

Size	300 V. —85° C.	500 V. —125° C.
CY10	1-240	1-150
CY15	57-1200	57-510
CY20	200-5100	200-3300
CY30	470-10.000	470-6200

Very low drift. This drift is so slight that it's generally within the normal error of measurement. Taking MIL-C-11272A as a standard, capacitance drift is less than 0.1% or 0.1 *uuf* (whichever is greater).

Predictable, retraceable TC. The difference in TC between any units at any given temperature is less than 15 ppm/° C. It is well within the limits of 140 ± 25 ppm/° C. from —55° C. to +85° C. and referred to 25° C.

Low loss. Even at elevated temperatures, the dielectric loss is relatively low. Dissipation factor at 1 kc. and 25° C. is about 0.055% and independent of capacitance.

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Medium Power Transmitting—CY60 and CY70. Ideal for mobile RF transmitters.

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Other electronic products by Corning Components Department: Glass Film Type Resistors*, LP, LPI, H, R, N, S, HP and Water Cooled Styles. Direct Traverse and Midget Rotary Trimmer Capacitors*. Metallized Glass Inductances, Delayline Coil Forms, Bushings, Enclosure Tubes, Rectifier Tubes and Attenuator Plates.

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Electronic Components Department

Ultrasonics

(*Continued from page* 72)

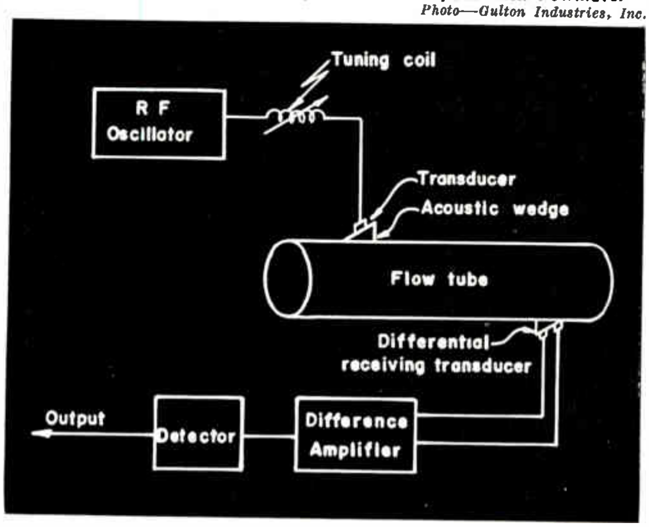
is the liquid level indicator. It is a pulse type ultrasonic depth gauge system with the transducer mounted on the outside bottom of the tank and using the reflective surface produced by the liquid-air interface. A pulse emitted by the transmitter through the transducer is reflected back from the surface and retriggers the pulse transmitter. The pulse repetition rate is a direct measure of the height of the liquid. The output can be calibrated in volume as the dimensions of the tank are known. This equipment is expected to be useful in the monitoring of liquid oxygen tanks, gasoline tanks, and similar large storage tanks.

Both fixed and variable ultrasonic delay lines are being utilized in radar, electric computers and memory systems in general. The electrical signals are converted into sonic type signals and allowed to travel a distance on the delay line before being converted back into an electrical signal. Delays up to several thousand microseconds can be obtained in this manner, much greater than those which can be practically obtained by using conventional lumped electrical elements. Quartz crystal or barium titanate transducers are used to couple to the liquid or solid. The signal, after traveling the sonic path, is converted back by a similar transducer.

New applications of ultrasonics are cropping up almost daily. Ultrasonics may be used for aging liquors and is presently being used to drive the air out of beer just prior to capping the bottles or cans. A manufacturer of TV uses an ultrasonic device to turn TV sets on and off, change channels or silence the sound during a long and annoying commercial. Ultrasonics have been used to drive birds away from areas. At high intensities ultrasonic stresses have been used to test adhesion strengths.

There is still a great deal of work to be done on ultrasonics and knowledge to be gained. Commercial applications of the field are still quite new and most of the equipment is still in the custom category. The future of ultrasonics is definitely not "cut and dried" yet.

Fig. 23: No obstructions are placed in flow path with flowmeter
Photo—Gulton Industries, Inc.



Photo—Walter Kidde & Co.
Fig. 22: Ultrasonic burglar alarm guards valuable displays

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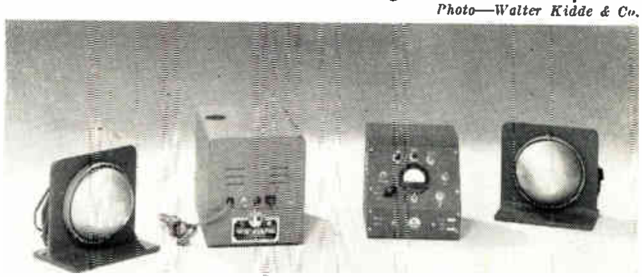
The sales brochures of many companies were also used. A list of these companies may be obtained by writing on company stationery to Editor of Electronics Industries.

Fig. 24: Burglar alarm equipment using ultrasonics is compact
Photo—Walter Kidde & Co.



Circle 70 on Inquiry Card, page 101 →

The Narda Time Saver Proposal Work Sheet is designed to conserve your valuable time in the selection of ultrasonic equipment best suiting your requirements. Every detail which we consider necessary to the intelligent understanding of your problem and the precise determination of ultrasonic techniques and apparatus required is incorporated in this work sheet. Merely fill-in and check off the appropriate information. The work sheet will be given prompt review and thorough analysis by Narda's select staff of ultrasonic specialists—the industry's most outstanding generator and transducer design and applications engineers. If ultrasonics can be applied beneficially to your process, Narda will recommend the finest, most dependable ultrasonic equipment available at any price—a Narda model exactly adapted to your needs.

Get measured for
ULTRASONICS
by a narda
specialist...

Product nomenclature ______________ ☐ Delicate ☐ Rugged ☐ Precision ☐ General Service ☐ Unit ☐ Assembly

Basic composition of product:

☐ Precious or semi-precious stones
☐ Ceramic materials
☐ Natural or synthetic textile fibres
☐ Leather
☐ Plastics
☐ Rubber or synthetic
☐ Wood or wood composition
☐ Paper and paper products
☐ Stone, granite, rock products
☐ Optical glass
☐ Technical glass
☐ Glassware and flat glass
☐ Aluminum or magnesium & alloys
☐ Copper and alloys
☐ Ferrous metals
☐ Nickel
☐ Chromium
☐ Stainless steel
☐ Lead
☐ Zinc
☐ Tin
☐ Titanium
☐ Tungsten
☐ Precious metals
☐ Carbide Tungsten
☐ Diecasting alloys
☐ Zirconium
☐ Other (describe ______________)

Metal product classification (check if applicable to product)

☐ Forged
☐ Drop forged
☐ Sandcast
☐ Die cast
☐ Investment cast
☐ Shell molded
☐ Impact molded
☐ Permanent molded
☐ Extruded
☐ Spun
☐ Formed
☐ Machined
☐ Cold rolled
☐ Deep drawn
☐ Drawn
☐ Stamped
☐ Mesh
☐ Other ______________

Unit product classification (check all appropriate items)

☐ Sheet ☐ Solid ☐ Tube ☐ Hollow ☐ Bar ☐ Flat ☐ Round ☐ Complex ☐ Blind hole ☐ Threaded

Assembled product classification

☐ **Mechanical assembly** *(atomic reactor rods and bundles, industrial automotive and aviation parts and structures, dies, machine tools, jewelry, filters, gear trains, bearings, valves, pumps)*
☐ **Electrical assembly** *(motors, generators, and components such as armatures, rotors and other windings, appliances, relays and switches)*
☐ **Electronic assembly** *(tubes, semi-conductors, printed circuits, potentiometers)*
☐ **Electro-mechanical assembly** *(electrically operated movements, galvanometers, counters, servos)*
☐ **Horological assembly** *(timers, clocks, watches, parking meters)*
☐ **Instrument assembly** *(gas, electric and water meters, leak detectors, optical devices, pneumatic and hydraulic gages)*
☐ **Medical instrument assembly** *(needles, syringes, laboratory glassware, clamps, surgical instruments)*

Size and Weight Range

(Smallest) height.......... width.......... length.......... diameter.......... lbs..........
(Largest) height.......... width.......... length.......... diameter.......... lbs..........

IF CLEANING TREATMENT IS REQUIRED, DESCRIBE CONTAMINANTS

☐ Rust or oxides
☐ Shop dirt
☐ Dust and lint
☐ Preservatives
☐ Finger prints
☐ Machining chips
☐ Extrusion lubricants
☐ Paraffin or wax
☐ Paint, varnish, lacquer
☐ Graphite
☐ Starches
☐ Grease
☐ Cutting oils
☐ Heat treat scale
☐ Color stains
☐ Foundry sand
☐ Abrasives
☐ Solder flux
☐ Plastic residue
☐ Resists
☐ Silicone oils, greases
☐ Cooked food residues
☐ Plaster of paris
☐ Lapping compounds
☐ Carbon
☐ Radioactive particles
☐ Polishing compounds
☐ Quenching oil
☐ Salts
☐ Burrs
☐ Pitch, asphalt, tar
☐ Inks
☐ Adhesives
☐ Jewelers rouge
☐ Tripoli
☐ Others ______________

IF TREATMENT OTHER THAN CLEANING IS REQUIRED

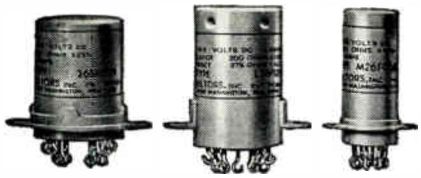
☐ Brighten
☐ Quench
☐ Impregnate
☐ Polish
☐ Decontaminate
☐ Deburr
☐ Plate
☐ Degass melts
☐ Sterilization
☐ Dip coat
☐ Pickle
☐ Etch

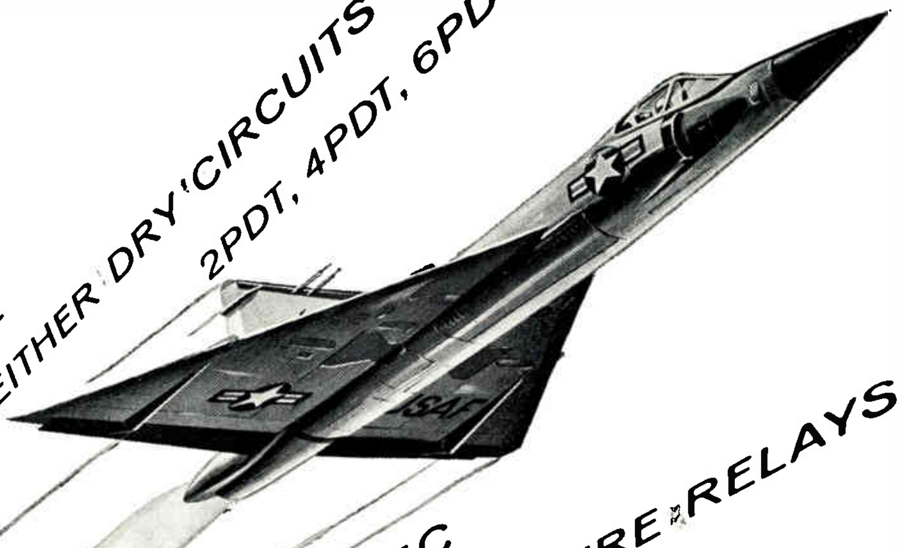
the narda ultrasonics corporation

Subsidiary of The Narda Microwave Corporation

160 HERRICKS ROAD, MINEOLA, L. I., N. Y., PIONEER 6-4650

NAME ______________ TITLE ______________
COMPANY ______________
ADDRESS ______________
____
PHONE ______________ DATE ______________

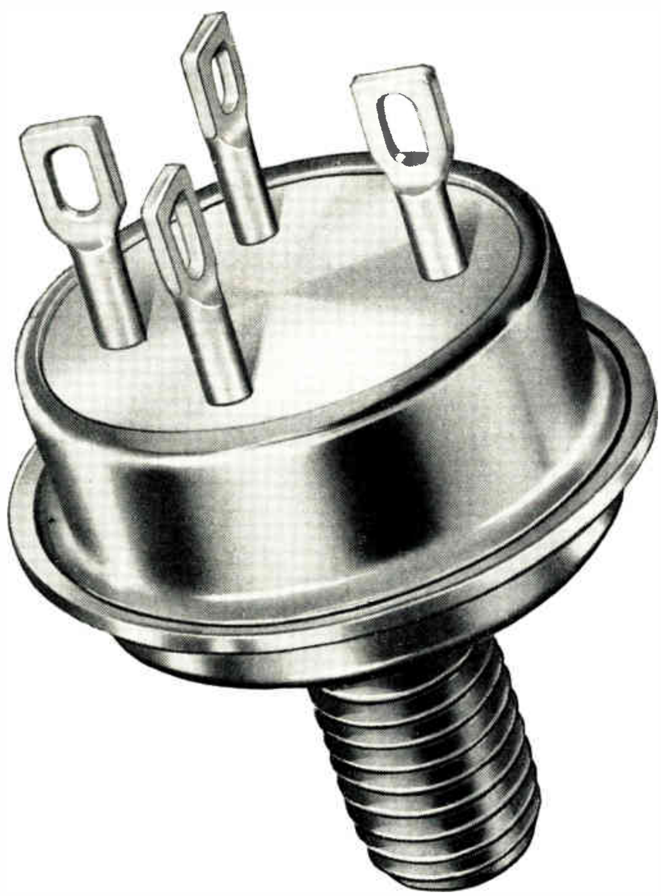




 Circle 71 on Inquiry Card, page 101

Honeywell develops new transistor for high-fidelity equipment

First Power Tetrode!



Faithfully reproduces input signals—frequency response improved 50%!

Now, for the first time, you can get a transistor that gives low audio distortion, high efficiency and high power output—with high impedance drive and without feed-back.

This performance is now provided by the new Honeywell H200E Tetrode Power Transistor. The Power Tetrode has *two* separate base connections permitting control of the device characteristics.

In addition to improved linearity, *Frequency Response* is increased 50% over triode transistors!

Also, *Thermal Stabilization* of the Power Tetrode is achieved more easily than with triode transistors because of the second base connection. This stabilization can be achieved even with high impedance drive, allowing high temperature operation of direct coupled circuits using Power Transistors.

The H200E is a germanium PNP alloyed junction power transistor designed to operate on 28-volt systems with currents up to 10 amperes. Its thermal resistance is less than 1°C/watt.

The Power Tetrode is available in sample quantities. Get complete information by writing Honeywell, Dept. EI-12-262, Minneapolis 8, Minn. Regional representatives may be reached in Union, N. J. (MUrdock 8-9000), Boston (ALgonquin 4-8730), Chicago (IRving 8-9266), and Los Angeles (RAymond 3-6611 or PArkview 8-7311).

Honeywell

H HONEYWELL *First in Controls*

Circle 72 on Inquiry Card, page 101

New Tech Data for Engineers

Waveguide and Connectors

Waveline Inc., Caldwell, N. J., has just issued a plastic wallet-sized card which contains in tabular form on one side the various waveguides and their physical dimensions along with flange connectors and the frequency of operation. The reverse side contains cutoff frequency and attenuation ranges of these waveguides.

Circle 160 on Inquiry Card, page 101

Zipper Tubing Catalog

Alpha Wire Corp., 200 Varick St., New York 14, N. Y. has published a comprehensive brochure (Z-1) on its new Alphlex Zipper Tubing. The brochure describes how this product can be used to harness, enclose, encase, and identify as well as replace worn jackets.

Circle 161 on Inquiry Card, page 101

Engineering Bulletin

Glass base heat-resisting epoxy resins are described in this engineering bulletin issued by Synthane Corp., Oaks, Pa. Complete electrical and mechanical properties are included.

Circle 162 on Inquiry Card, page 101

Toroidal Components

A 6-page, 2-color brochure has been issued by Communication Accessories Co., Lee's Summit, Mo., describing their line of toroids, filters, magnetic amplifiers and transformers. Brochure is complete with photographs.

Circle 163 on Inquiry Card, page 101

Locking Connectors

A 24-page, 2-color booklet describing Hubbell interlock self locking connectors is available from Harvey Hubbell, Inc., Interlock Electronic Connector Dept., Bridgeport, Conn. Booklet describes a complete line of panel jacks and plugs, quick disconnect terminal strips, flexible terminal strips and miniature connectors and jacks. Booklet is complete with electrical and mechanical specifications, and photographs.

Circle 164 on Inquiry Card, page 101

Polystyrene Film Capacitor

A 6-page brochure issued by Sprague Electric Co., North Adams, Mass., describes their Type 194P Styracon capacitors. Bulletin contains complete electrical and mechanical information with tables, graphs and photographs.

Circle 165 on Inquiry Card, page 101

Tape Core Calculator

A tape wound core slide rule which provides a rapid means of solving the equations relating voltage to flux, current to magnetizing force, and wire to space factor is available from Magnetics, Inc., Butler, Pa. The calculator and instruction book have been designed to enable engineers working with tape wound cores to calculate rapidly a variety of problems.

Circle 166 on Inquiry Card, page 101

Strain Gages

Micro-Test, Inc., 657 N. Spaulding Ave., Los Angeles 36, Calif., has issued a 4-page, 2-color brochure describing their weldable strain gages. Brochure is complete with specifications, graphs and photographs.

Circle 167 on Inquiry Card, page 101

Transistor Literature

Bulletin G-120 issued by General Transistor Corp., Jamaica, N. Y., describes their complete line of pnp and npn transistors for radio, rf and if applications. Brochure contains complete information along with circuit diagrams.

Circle 168 on Inquiry Card, page 101

400 Cycle Servomotor

Data sheet 909 giving complete details of the new Beckman Model 11 SM 460, which is a size 11, 115 volt, 400 cycle servomotor, is now available from Helipot Corp., a division of Beckman Instruments, Inc., Newport Beach, Calif. Complete specifications, characteristics, 3 view drawing, torque-speed curve, and schematic tell the whole story.

Circle 169 on Inquiry Card, page 101

Ferrites

An 8-page bulletin describes "Ferramics" for general applications up to 200 MC. The booklet is an easy to follow technical description on ferrites. It is complete with graphs, tables and photographs. General Ceramics Corp., Keasbey, N. J.

Circle 170 on Inquiry Card, page 101

Technical Bulletin

A bulletin series covering technical notes on applications of panoramic techniques in the solution of measurement problems has been inaugurated by Panoramic Radio Products, Inc., 520 S. Fulton Ave., Mt. Vernon, N. Y. These technical bulletins contain no advertising.

Circle 171 on Inquiry Card, page 101

Synchros & Resolvers

A new catalog, especially designed to aid in the selection and application of precision synchros, resolvers and rotating components, has been published by Induction Motors of California, 6058 Walker Ave., Maywood, Calif. Of particular interest to the design engineer, the catalog covers synchro sizes and types for a wide range of applications. Dimensional data, materials and electrical data are given on the various types described and illustrated.

Circle 172 on Inquiry Card, page 101

Capacitors

Astron Corp., 255 Grant Ave., East Newark, N. J., has just released four engineering bulletins on their new capacitors. These bulletins include charts and graphs demonstrating the performance characteristics in temperature ranges, voltage ratings, and capacitance stability, as well as the various test specifications.

Circle 173 on Inquiry Card, page 101

Technical Bulletin

"Microwave Ferrite Devices" is the title of a technical bulletin issued by the Sperry Gyroscope Co., Great Neck, N. Y. The bulletin covers completely the basic operation of ferrite devices. Complete with graphs, photographs, and drawings.

Circle 174 on Inquiry Card, page 101

Gold Plating

An 8-page paper on industrial gold plating is available from Sel-Rex Corp., P. O. Box 187, Nutley 10, N. J. The booklet treats, in detail, such topics as bath composition, equipment and operating conditions, and comparative metallurgical characteristics of 24K gold plate on various base metals. Complete with illustrations, graphs, and tables.

Circle 175 on Inquiry Card, page 101

Components

The Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass., has just issued a new 75-page catalog. Catalog 600 completely describes CTC's electrical and electronic components with detailed specifications and actual size illustrations. The products include new varieties of solder terminals, terminal boards, hardware, insulated terminals, coil forms, shielded coil forms, coils, and capacitors for design and product application engineers.

Circle 176 on Inquiry Card, page 101

Circle 73 on Inquiry Card, page 101

New Tech Data for Engineers

Electronic Instruments

John Fluke Mfg. Co., Inc., 1111 West Nickerson St., Seattle 99, Wash., has just issued a new short form catalog (C-57) describing their VAW meters, power supplies, precision potentiometric D.C. voltmeters and true RMS vacuum tube voltmeters. Catalog is complete with photographs and specifications.

Circle 177 on Inquiry Card, page 101

Mobile Radio Antennas

A 40-page, 2-color catalogue No. 457 describes a complete line of 2-way mobile radio antennas, accessories and towers. Contains photographs, radiation patterns, electrical and mechanical specifications and graphs. Communication Products Co., Marlboro, N. J.

Circle 178 on Inquiry Card, page 101

Pulse Generator

A new technical bulletin describing the Type 1050 high frequency pulse generator has just been released by the Electronic Instruments Div. of Burroughs Corp., 1209 Vine St., Philadelphia 7, Pa. The bulletin provides complete specifications, both electrical and physical along with photographs.

Circle 179 on Inquiry Card, page 101

Transformer and Bobbin Winder

A bulletin issued by Geo. Stevens Mfg. Co., Inc., Pulaski Rd. at Peterson, Chicago 30, Ill., describes their new Model 149-AM heavy duty transformer and bobbin winder which handles wire sizes 4 to 23. Full technical details on dimensions, weights, types of windings, maximum coil OD and length are included.

Circle 180 on Inquiry Card, page 101

Electron Tube

Electron Tube Division, Radio Corporation of America, Harrison, N. J., has issued a new technical bulletin on their 12DL8 twin diode 9-pin miniature "hybrid" tube for use in automobile receivers. Complete information is given.

Circle 181 on Inquiry Card, page 101

Pulse Transformers

A new 12-page, 2-color catalog describing pulse transformers, toroids and filters is now available from Pulse Engineering, 2657 Spring St., Redwood City, Calif. Catalog provides detailed circuit applications and design hints using schematic diagrams to outline typical uses.

Circle 182 on Inquiry Card, page 101

Tube Wall Chart

The latest series string reference chart for identifying the numerous 450 ma. and 600 ma. series string tube types, along with their prototypes is available from Sylvania Electric Products, Inc., Emporium, Pa. The 2-color wall chart includes all series string type numbers that have been released through the Electronics Industries Association to date.

Circle 183 on Inquiry Card, page 101

Connector Assembly Methods

Manual C4, new edition of its "OK Methods Manual," has been released by Amphenol Electronics Corp., 1830 S. 54th Ave., Chicago 50, Ill. Designed to further the acceptance of good assembly practices, the manual contains 44 pages devoted to AN, miniature AN, power, audio microphone and RF connectors. Wire preparation and soldering techniques are also illustrated and discussed.

Circle 184 on Inquiry Card, page 101

Connectors and Tube Sockets

A 20-page catalog issued by the Elco Corporation, "M" Street below Erie Ave., Philadelphia 24, Pa., describes their complete line of electrical and electronic connectors, tube sockets and shields for conventional chassis and printed circuits. The catalog is complete with photographs, electrical and mechanical specifications and pertinent information relating to the components.

Circle 185 on Inquiry Card, page 101

Saturable Reactors

A new 32-page bulletin F-8383, an application guide for the use of saturable power reactors, is available from Barber-Colman Co., Rockford, Ill. The booklet discusses saturable power reactor uses, turn down characteristics and the application of automatic control to these units.

Circle 186 on Inquiry Card, page 101

Precision Bearings

A new 24-page catalog outline the type and functions of miniature precision ball bearings is now available from Miniature Precision Bearings, Inc., Keene, N. H. Catalog describes in detail, the standard radial miniature bearings produced which range in size from 1/10 inch to ⅜ inch outside diameter. There is descriptive matter and bore dimension charts on all the radial types including radial retainer, flanged radial retainer, single and double shield flanged radial retainer, radial, flanged radial, high speed and flanged high speed.

Circle 187 on Inquiry Card, page 101

Packaged Circuits

A new 12-page packaged electronic circuit guide containing schematics and specifications on all 96 types of Centralab P.E.C.'s sold through electronic parts distributors is available from Centralab, 900 E. Keefe Ave., Milwaukee 1, Wis. There is also a section containing the proper test procedure for checking all listed packaged circuits.

Circle 188 on Inquiry Card, page 101

Power Shears

The Peck, Stow & Wilcox Co., Southington, Conn., offers a complete line of precision power squaring shears for the electronic industry. Shears described in bulletin cut sheet metal, fiberboard, printed circuit material, and plastics, cleanly and accurately for the manufacture of electronic products. Complete information is contained in the bulletin.

Circle 189 on Inquiry Card, page 101

Mobile Radio Equipment

General Electric Communication Products Dept., Electronics Park, Syracuse, N. Y., has published a new brochure on two-way mobile radio equipment available to both the technically-inclined and to those who are interested in appearance features. The booklet shows the wide range of equipment designed to fit individual needs based on present FCC rulings. The 38-page publication, ECR-497 gives complete information.

Circle 190 on Inquiry Card, page 101

Transistor Chart

Bendix Aviation Corp., Semiconductor Products, Long Branch, N. J., has just issued a new transistor chart which provides information in a convenient form about typical performance and ratings of many of their transistors.

Circle 191 on Inquiry Card, page 101

Engineering Bulletin

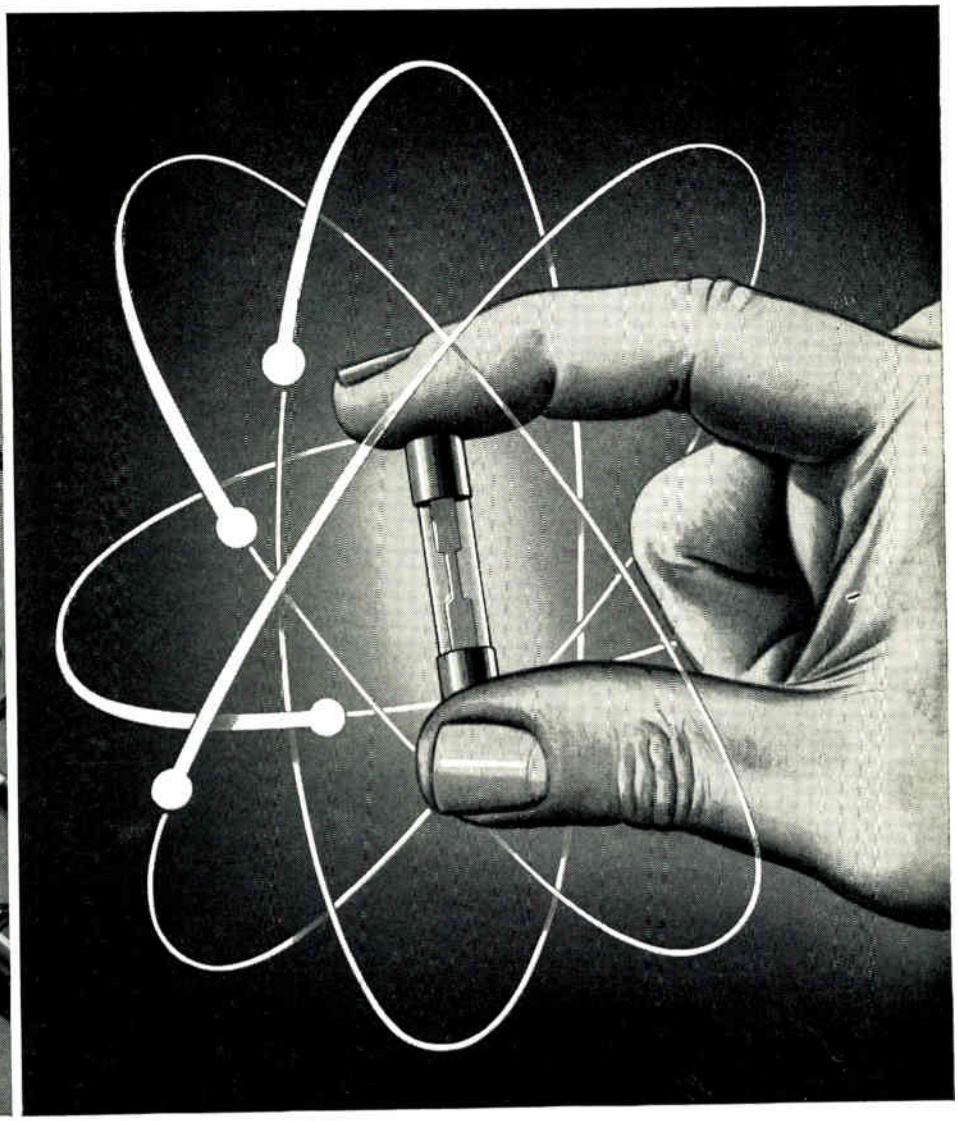
Pyramid Electric Co., 1445 Hudson Blvd., N. Bergen, N. J., have just issued a new bulletin on their type BTS plastic tubular capacitor for printed circuits. Complete specifications are included.

Circle 192 on Inquiry Card, page 101

Tape Wound Cores

G-L Electronics, 2921 Admiral Wilson Blvd., Camden 5, N. J. has just issued a two-color, 8-page brochure describing their precision-made tape wound cores. Bulletin TB102 contains complete specifications, graphs and tables.

Circle 193 on Inquiry Card, page 101



ELECTRONICALLY TESTED BUSS FUSES

can help safeguard you against troubles and complaints

With BUSS fuses, dependable electrical protection is not left to chance. Every BUSS fuse is tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

As a result, when you specify BUSS fuses you are sure the fuse will operate properly under all service conditions. You avoid 'kicks' or complaints from users about faulty fuses failing to protect or causing needless shutdowns.

By their unfailing dependability, BUSS fuses help you safeguard the reputation of your equipment for quality and reliability.

Should you have an unusual problem in electrical protection . . .

. . . the BUSS fuse engineers are at your service — and in many cases can save you engineering time by helping you choose the right fuse for the job. Whenever possible, the fuse selected will be available in local wholesalers' stocks, so that your device can be serviced easily.

For more information on BUSS and FUSETRON Small Dimension fuses and fuseholders . . . Write for bulletin SFB. Bussmann Mfg. Division McGraw-Edison Co., University at Jefferson, St. Louis 7, Mo.

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

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

MAKERS OF A COMPLETE LINE OF FUSES FOR HOME, FARM, COMMERCIAL, ELECTRONIC, AUTOMOTIVE AND INDUSTRIAL USE.

1257

Circle 74 on Inquiry Card, page 101

Magnetic Tape

(*Continued from page* 59)

tapes to the standard tapes with respect to other important properties is shown in Table 1. It can be seen that no properties of the low-print tape were compromised to achieve the low-print characteristics.

Advantages

Fig. 5 is a graph illustrating the consistency of the 8 db advantage in print-thru the new tape enjoys over standard tape at various temperatures. The test procedures followed to obtain these data are as follows: Each reel of tape was mass-erased and then recorded with a 400 CPS signal, at peak bias, with 7.5 IPS tape speed and at a level of 3% distortion, for one revolution out of every four of the tape-up reel at a 6.5-inch diameter. The reels of tape were then placed in an oven at the specified temperature for four hours.

After removal the tapes were played and the print-thru measured through a 400 CPS band pass filter into a VTVM. The level of the loudest print-thru on each tape was taken and recorded in terms of the number of db below the test signal, i.e., signal-to-print ratio. These values were plotted in Fig. 5. To emphasize the importance of an 8 db advantage in print-thru a broken line is drawn horizontally across the graph representing the noise level of an average semi-professional tape recorded of —55 db.

You can readily observe that at a normal temperature of 70°F the print-thru of the standard tape (s) protrudes about .5 db above the noise level of the recorder, while the "Master" low-print tape (M) remains 8 db below this point. At 200°F the standard tape (S) print is 6 db above the noise level of the recorder with the "Master" low-print tape (M) remains 2 db below the noise level, and is thus still masked by the machine. The level of the print-thru of the "Master" low-print tape (M) at the extreme temperature of 200°F is below that of the standard tape (S) at a normal temperature of 70°F, leaving no doubt as to which tape is desirable for hot weather or extremely high temperature operations.

Fig. 6 is a graph showing the reliability of the 8 db advantage in print-thru the low-print tape has over the standard tape when plotted against time. The test procedures are the same for Fig. 6 as for Fig. 5, except that the 4 hr. baking has been omitted. The tapes used for Fig. 6 were kept at 70°F for the duration of the test. Again the machine noise level of —55 db is represented by a horizontal broken line. The standard tape rises 1 db above the machine noise after one day, whereas, the low-print tape would require 20 years to reach the same level. The broken lines around the 20-year columns indicate that this is a projection. Tests on 5-year-old samples indicate this projection to be accurate.

Applications

There are many other advantages to using low-print tape, which cannot be shown on a graph, such as the enjoyment of listening to clear, crisp recordings completely devoid of noticeable print-thru, or the peace of mind that comes with the knowledge that your valuable recordings will not be destroyed by print-thru after many years of storage. We thought originally that our "Master" Audiotape would be sold almost entirely to phonograph recording companies who would be willing to pay the difference in price in order to be able to store their master recordings for years without any danger of harmful effects. But we have been amazed to find that the demand for low-print tape has also been extremely heavy for radio use. The improved sound has proven to be important to broadcasters.

References

1. C. J. LeBel, Audio Record, June-July 1955.
2. Frank Radocy, Tape Storage Problems, Journal of the Audio Engineering Society, January 1958.

First all-glass 16" **RADAR DISPLAY TUBE** commercially available!

Here's the first all-glass 16" cathode ray tube available to the military equipment designers. Built by Westinghouse for radar, missile and computer display equipment . . . it outperforms 16" metal cone tubes.

The Westinghouse 16AKP7 has higher resolution. It is more reliable. It means less equipment complication (no need to insulate entire cone of tube). It features magnetic deflection, low-voltage electrostatic focus, and P7 phosphor.

Typical operating characteristics: Anode voltage: 12,000 volts. Grid 4 (focus) voltage: –300 to +250 volts. Line width: 0.025" at 100 microamps anode current. Grid 1 volts for cut-off: –35 to –75 volts.

Write for detailed data today on the new 16AKP7. Also write for information on type 12ABP7A, which will soon be available.

YOU CAN BE SURE...IF IT'S

Westinghouse

Electronic Tube Division Elmira, N.Y.

CLIP AND MAIL COUPON

Commercial Eng. Dept., Electronic Tube Div.
Westinghouse Electric Corp., Elmira, N. Y.

Please send me complete information on the following tubes: ____16AKP7____12ABP7A.

NAME ____________________

TITLE ____________________

COMPANY ____________________

ADDRESS ____________________

Circle 76 on Inquiry Card, page 101

Low Noise Receiver

(*Continued from page* 65)

iris increased the bandwidth to 1100 MC. One of the crystals is reversed so that the i-f termination can be parallel-connected. This balanced design gives more than 20-db isolation of the signal from the local oscillator arm, and more than 15-db rejection to local oscillator sideband noise.

The i-f preamplifier is at 30 MC, is composed of No. 5702 subminiature tubes, and has a noise figure of 1.5 db. To ensure precise control of the coupling network between mixer and i-f, the preamplifier is rigidly attached directly beneath the short-slot hybrid.

Narrowband Embodiment

At X-band, no practical narrowband mixer has been designed. The principles have been proved precisely at only a single frequency. The image terminations are isolated with difficulty by high-Q filters. The practical narrowband mixer undoubtedly awaits the development of a balanced mixer design.

Measurement

All measuring systems meeting the definition of noise figure parameters are of equal merit in principle. In practice, to date, there has been considerable difficulty in measuring relative performance of crystals, and even greater difficulty in establishing absolute performance. There has been need for noise figure parameter measurement that is absolute, simple enough for factory test of crystals, and yet comprehensive for receiver design.

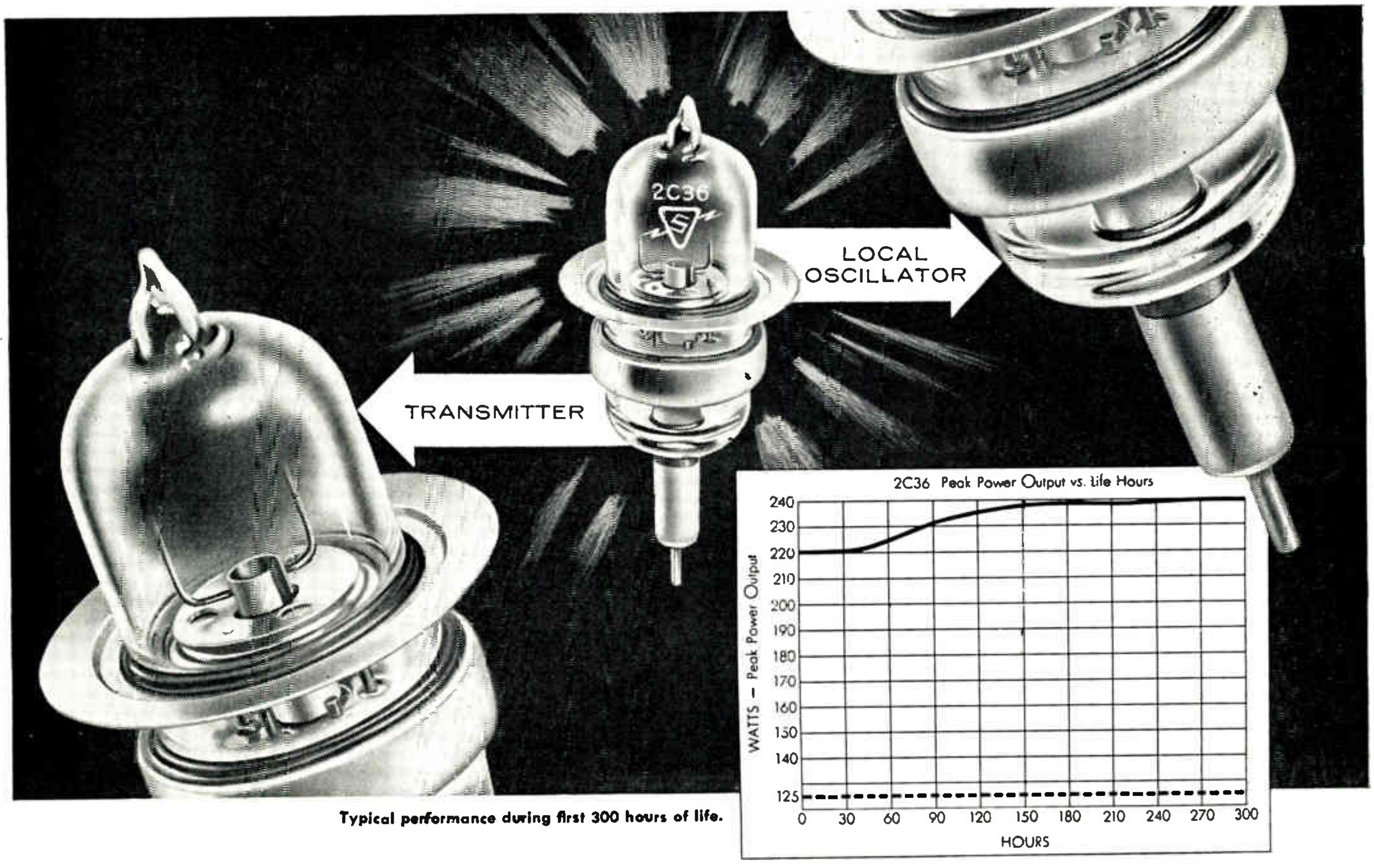
One noise figure measurement system[6] which, it is believed, closely meets these needs, measures F_r, L_x, t_x, and F_{if} on an absolute basis with three measurements, which Eq. 3 would indicate to be the minimum theoretically possible[8]. Fig. 12 shows a block diagram form.

A variation on the "white" noise generator method is used, with accuracy and absoluteness determined only by the power ratio detector and the temperature of the 2 noise generators t_{rf}, t_{if}. Blocks 2 and 3 of Fig. 12 represent an actual

(*Continued on page* 144)

SYLVANIA'S 2C36

ROCKET® PLANAR TRIODE



Typical performance during first 300 hours of life.

...performs two jobs in short-range radar...

This Sylvania medium-mu, pulse modulated oscillator with built-in internal feedback is finding applications in both the local oscillator *and power stages* of short-range and proximity radar.

The 2C36 was designed for use in simple cavities and is ruggedized against shock and vibration, making it suitable for missile applications as the local oscillator in the r.f. head section.

Important design features of the 2C36 are:

- broadband operation up to 5,000 Mc in proper cavity
- negligible power drop-off over the usable band
- high stability as oscillator, with minimum of supply voltage regulation
- low lead inductances
- a low-cost, compact tube cavity package

Here are a few of the wide variety of applications in which this Sylvania Rocket-planar can be used:
Radar altimeter—Speed trap radar—Anti-collision systems—Beacons—Proximity radar—Microwave relay networks—Signal generators—Spectrum analyzers

RATINGS AND CHARACTERISTICS

Ratings

Heater Voltage (ac or dc)	6.3 Volts
Heater Current	400 Ma
Maximum Plate Dissipation	5.0 Watts
Maximum Seal Temperature	175° C
Maximum Plate Voltage (Pulsed)	2000 Volts
Maximum Operating Frequency	5000 Mc
Max. peak plate current	2 A
Max. average plate current	35 Ma

Characteristics

Conditions: (E_b - 180 volts dc, R_K - 400 ohms)

Transconductance	4500 umhos
Amplification Factor	25
Plate Current	12.0 Ma
Grid Voltage for I_b = 10 ua	−20 V

ELECTRICAL DATA

Direct Interelectrode Capacitances

Grid to Plate	1.90 uuf
Grid to Cathode	1.20 uuf
Plate to Cathode	0.40 uuf

MECHANICAL DATA

Maximum Overall Length	2.375 inches
Maximum Overall Diameter	1.005 inches

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(*Continued from page* 142)

microwave superheterodyne receiver with a "broadband" mixer. The procedure is rapid and simple enough so that it has been used for 100% factory measurement of crystal diodes.

For the receiver designer, the measurements are phenomenologically correct and absolute for any receiver design. The system applies in principle to any microwave frequency, and has been used satisfactorily at Philco for all frequencies between 500 MC and 35,000 MC.

The "white" noise generator method of noise figure measurement has a practical potential error when very good h-f mixer crystals, such as at X-band, are tested at low frequency, such as UHF. This error can come from not taking into account the noise entering the receiver at the second harmonic image channel. As already explained, the conversion loss in this channel can be of the same order as that in the conventional image channel.

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Possibilities

As indicated by the theoretical discussion, low-noise design complications and difficulties increase as the perfection of zero db noise figure is approached. Many receiver applications have narrow-beam antennas pointing into space whose noise-producing terminal temperature approaches absolute zero. Fig. 13 shows that for such a condition the receiver sensitivity S increases exponentially as the receiver noise figure approaches the perfection of 0 db. The explanation of Fig. 13 is as follows:

The definition of the phenomenological parameters is such that the effective noise at the input of a receiver is defined to be F_r times the noise power from a resistor at 300° Kelvin. If the receiver antenna is effectively at a small fraction t_a of room temperature (300°

(*Continued on page* 146)

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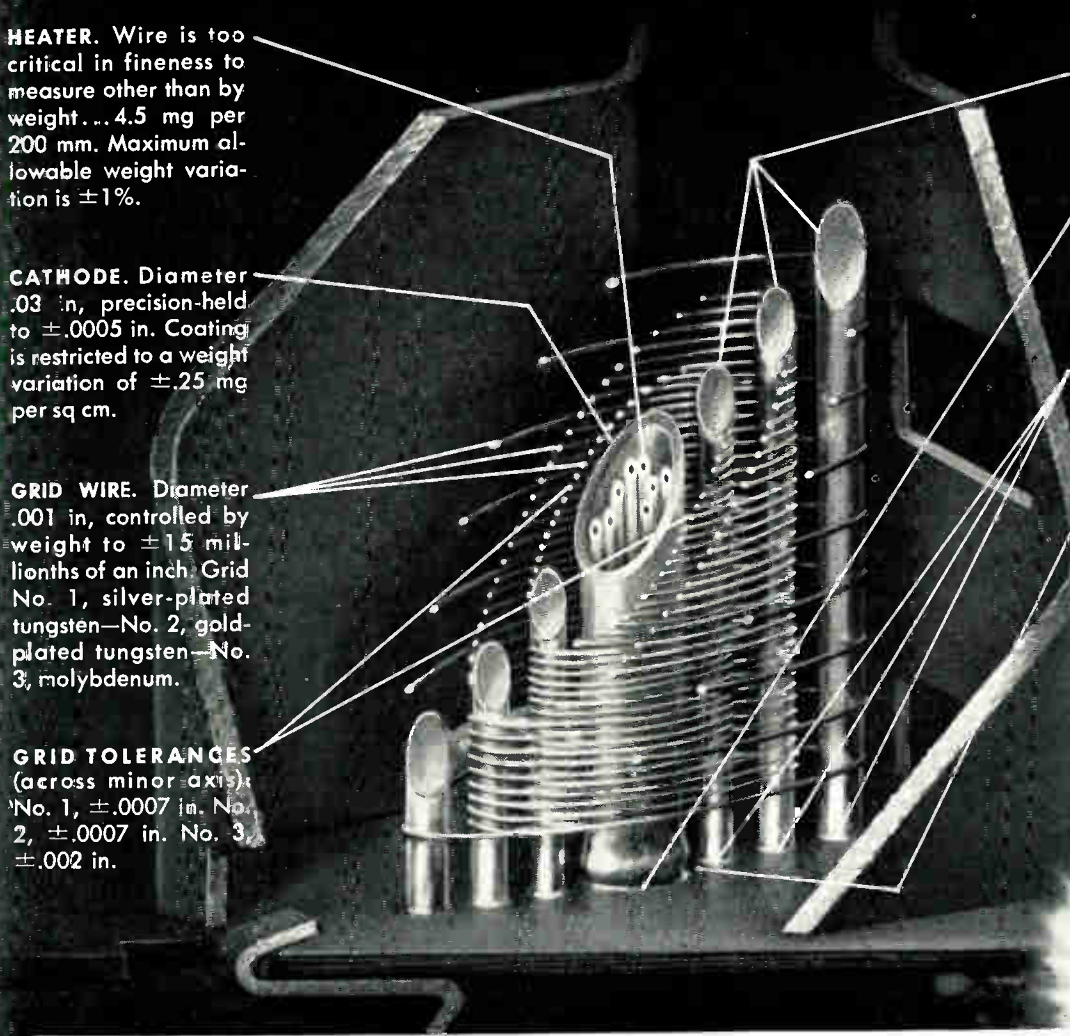

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ABOVE: greatly enlarged sectional view of a General Electric 5-Star high-reliability 5654. This tube was taken from current production.

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(Continued from page 144)

Kelvin), the effective noise at the input of the receiver is here defined to be S times the noise power of a resistor at room temperature. S, F_r, and t_a, in dimensionless power ratio terms, are related by

$$S = F_r + t_a - 1 \qquad (13)$$

Fig. 13 is a graph of this formula with S and F_r in db. Clearly, receiver sensitivity does not improve much with "cold antenna" until the receiver noise figure is 6 db or less. Over-all receiver noise figures F_r can be lowered still further by cooling the crystals[7] "Cold" antennas and crystals seem to be the avenues for future significant improvement in receiver sensitivities.

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6. Norman G. Hamm and Nisson Sher, Philco Corporation, "The Absolute Measurement of Receiver Noise Figure Parameters," Paper Presented at Second Symposium on Microwave Crystal Diodes, SCEL, Hexagon, Fort Monmouth, February 27-29, 1956.
7. George Messenger, Philco Corporation, "Cooling of Microwave Crystal Mixers and Antennas," Paper Submitted to IRE Transactions, MTT.
8. All formulas in this paper use the dimensionless terms of power ratio. However, when values for F_r, L_x, or F_{if} are mentioned individually, it is often expressed in db: i.e., 10 times the common logarithm of the power ratio.

News of Manufacturers' Reps

REPS WANTED

A leading manufacturer of a complete line of **ultrasonic equipment for cleaning, metal joining, automation, chemical and processing** desires reps in some choice territories. (R12-1, Editor of ELECTRONIC INDUSTRIES.)

A well known manufacturer desires reps for a complete line of **miniature computer components such as servo systems, repeaters, right angle resolvers, differentiators, integrators, and power supplies.** Territories are open in the Southwest, Michigan, Illinois, Florida and Washington, D. C. (R12-2, Editor of ELECTRONIC INDUSTRIES.)

Ralph E. Helper and **Emmet Dancy** are now staff engineers with **Neely Enterprises.**

Earl W. Fleehart has joined the staff of the **Burt C. Porter Co.,** Seattle 5, Wash.

Richard C. Warner & Assoc. have been named reps for Magnetics, Inc. in the states of Indiana and Michigan.

Jack Entis of **Entis Associates** has announced the opening of their office at 11 Babcock St., Brookline, Mass. They now have 3 men as reps in the New England area.

William Theisner, 11161 Sameda St., Cupertino, Calif., will represent Ransom Research in Northern California and **J. J. Gray Co.,** 216 Via Lorca, Newport Beach, Calif., are representing them in Southern California.

The Universal Transistor Products Corp. has appointed 5 new sales reps in the United States and Canada. The **A. B. Electronic Laboratories,** San Francisco, is representing them in Northern California; **Design and Sales Engineering Co.,** St. Louis, in Missouri, Kansas, Iowa, and Southern Illinois; **Electronic Enterprises Regd.,** Toronto, represents all divisions in Canada and Northwest Territories; **M. M. Newman Co.,** Boston, represents them in New England and most of New York state and **Wallace & Wallace,** Los Angeles, are their reps on the West Coast.

Milton N. Leventhal has joined **C. H. Mitchell Co.** a Southern California electronics rep firm.

The Kenneth E. Hughes Co., Union City, N. J., have opened a new office in Syracuse, N. Y.

Jack Rife, 7019 Lynford St., Philadelphia 49, Pa., has announced his appointment as rep in Eastern Pennsylvania, Southern New Jersey, and Delaware for the Claremont Tube Corp. and the Walco Products Co., Inc.

A. C. Wahl Co., 416 W. Benson St., Cincinnati 15, Ohio, has announced the election of **George W. Thelen** and **Robert P. Morrison** to its Board of Directors.

Farnsworth Associates, 228 N. LaSalle St., Chicago, Ill., have been appointed reps for Pentron Tape recorders in Illinois and Wisconsin.

Wild & Associates, Inc., Roslyn, N. Y., have been appointed Atlantic Coast sales reps for Mid-Century Instrumatic Corp.'s line of analog computers and simulators.

California Chassis Co. has appointed **Harry More,** Phoenix, Ariz., rep in Arizona, New Mexico and El Paso areas and **Wes Alderson Co.,** Los Angeles, has the Southern California territory.

S and S Associates, 10 DeKalb St., Norristown, Pa., has just been formed to act as technical reps and consultants for manufacturers of electronics, electromechanical, nuclear and scientific equipment.

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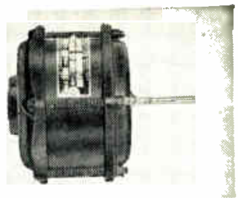
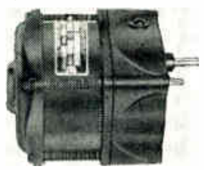
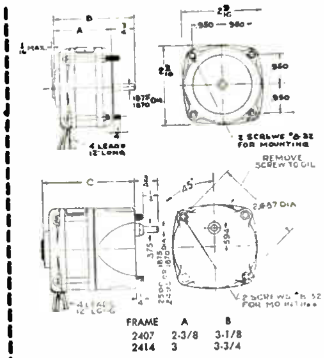




CAPACITOR OR 2 PHASE TYPE SERVO MOTOR



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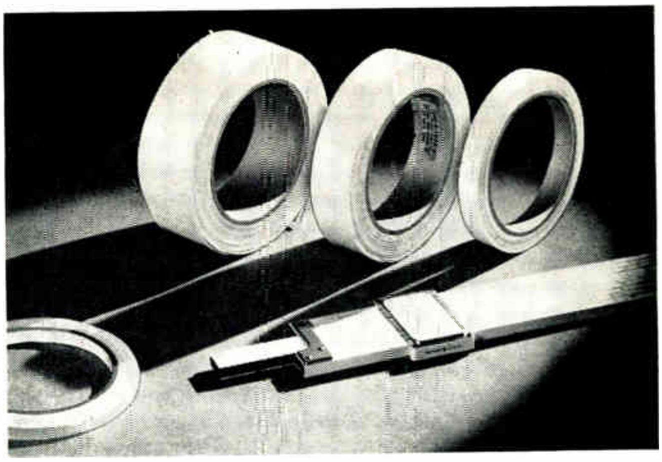

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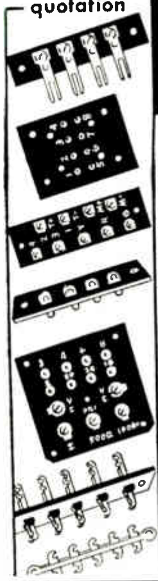

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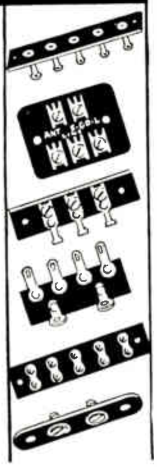

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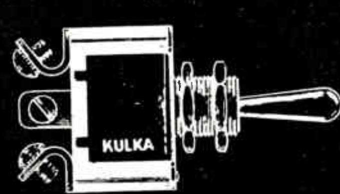

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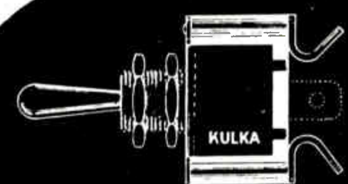

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20 Years Ahead

(*Continued from page* 70)

transmitter to the same antenna. Using the ferrite component to form a three-part ring of phase shifters (Fig. 5), with the phase shifters set at 90°, 180° and 270°, a diplexer results which isolates the receiver from the transmitter, regardless of the frequencies of reception and transmission.

In the case of airborne antennas, the gasionizing component serves as the vehicle for creation of non-drag antennas. An ionized gas is a conductor of electromagnetic energy. To obtain the equivalent of a trailing-wire antenna for a high-Mach-number air vehicle, either intake air (if available) or fuel exhaust gases are ionized and ejected rearward in a stream, to form an ionized conducting column which will efficiently couple the transmitter to free space. Adjustment of the velocity of the ionized gas will control the length of the conducting radiator to provide maximum radiated power. For the first time there will be an antenna which not only has no drag, but also actually provides thrust. When vertical radiators are desired, the ionized gas can be ejected downward. Effective arrays can be achieved by means of multiple orifices and appropriate power-distributing devices.

2. Transmitter—The major problem in transmitting equipment is the low efficiency of vacuum tube operation. If the power needed to heat the filament and operate the blowers (forced air or liquid cooling systems) is included as part of the input, the radiated output power proves to be only a relatively small percentage. Further, the life expectancy and reliability are lowered as a result of this extremely hot operation of power amplifier tubes.

The elimination of the filament and its associated power supply would result in a large reduction of equipment and would significantly reduce the cooling requirements. In present operation, a large percentage of the heat is generated at the filament. (Try touching a transmitter tube with only the filament operating).

For this purpose, the 10-w., linear, semiconductor amplifier offers an attractive solution. Even for 40-KW total output, the 4100 semiconductors required would not result in an equipment as large as half the size now needed. Using present audio power transistors as a size comparison, the resultant bulk of the 4100 amplifier would not exceed three cubic feet. This compares favorably with any 40-KW tubes in the present inventory.

The low voltage required to operate semiconductor amplifiers will result in a large reduction in the power supply, and in the tuned circuit components. A comparison of presently-used capacitor banks in 5000-v. power supplies used in existing transmitters to a bag of 5000, 10-v., tantalum capacitors (20 pounds and 1/3 cubic foot), each of equal capacity, will serve as a measure of the reduction in size and weight that can be achieved.

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The reliability of the transmitter is increased many fold. The individual increase in reliability of the semiconductor over the vacuum tube has already been adequately discussed. In this case, however, the major increase in reliability results from the large number of components in parallel. The failure of a component or amplifier does not result in more than 0.02 per cent decrease in output power.

This paper has completely served its purpose if it has caused the reader to disagree, or has stimulated his imagination. Communication in this rapidly changing air age is proving to be the major stumbling block in almost all operations. If our scientific minds are stimulated to think about future problems, a vast improvement in performance will not be long in coming.

The author wishes to acknowledge the debt owed to members of the staff of the Directorate of Communications, Rome Air Development Center, for having stimulated the ideas discussed in this paper.

Heat Transfer

(*Continued from page 55*)

The Mechanism of Heat Transfer

The steady-state heat flow or heat transfer in power transistors may be represented by the analogous electrical circuit consisting of (1) the constant current generator equivalent to a steady supply of heat and (2) a purely resistive network since in steady state the reactive elements have constant amounts of energy stored in them and play no part in the flow. The equivalent circuit in the case of a transistor, mounted on a chassis or equipped with some other suitable cooling fin, surrounded by still air at room temperature, is relatively simple and is shown in Fig. 3.

Here, R_1 is the thermal resistance causing a temperature drop between the junction and the transistor casing (heat transfer by conduction); R_2 is the thermal resistance causing a temperature drop between the casing and a place on the surface of the cooling fin from which a further transfer of heat to air takes place[2]; R_c and R_r are the thermal resistances corresponding to heat transfer from the cooling fins to the ultimate sink by means of convection and radiation respectively.

It may be recalled that Eq. 2 indicated that in Item 4 of Table 1 only the difference in temperatures determines the rate of heat transfer; while Eq. 3 indicates that in Item 5 the absolute (°K) temperatures enter in the picture and that radiation becomes an important factor in the final stage of heat transfer to the ultimate heat sink. Table II gives heat conductivities, densities, and comparison on the weight basis of various materials likely to be used as materials for fins or chassis.

The analogous electrical circuit shown in Fig. 3 reduces to that shown in Fig. 4.

The nature of R_1 is entirely due to the mode of heat transfer by conductance and is therefore a simple physical constant of the particular transistor.

It is often denoted as θ_j of a transistor or the thermal resistance from the transistor junctions to its casing. It is conveniently expressed in °C per watt dissipated at the junction and transferred to the case. θ_j *is a physical constant of a particular transistor and is independent of the type of the cooling fin.*[4]

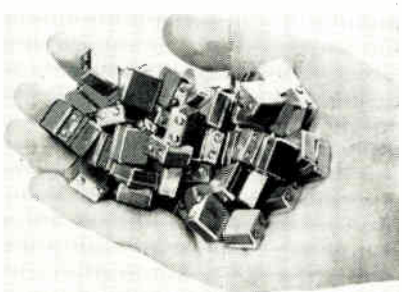
Reliable experimental methods of determining θ_j with good accuracy have been published. Briefly it consists of 2 steps. The first step is that of determination of I_{co}, the collector to base current with emitter open, as a function of temperature. This is done in an oven, where the temperature is raised in steps and the oven allowed to reach a thermal equilibrium. The second step is essentially that of applying a known power to the junctions from a dc source, bringing the unit to a thermal equilibrium and quickly switching the power off and observing I_{co}.

The reciprocal of θ_j is the rate of heat transfer between the junctions and the casing of a particular transistor. It is conveniently expressed in watts per °C.

The nature of R_c and R_r in Fig. 4 is due to 2 combined modes of heat transfer from the cooling fin to the ultimate sink; namely, that of convection and that of radiation. They depend on the geometry and condition of the fin surfaces and particular surroundings; such as, still air, draft due to heat in adjoining apparatus, radiation from adjoining apparatus, etc. These 2 thermal resistances are rather difficult to disentangle, but their combined value for any particular case can be measured with comparative

(*Continued on page* 154)

TINY MIKES



One hundred of these new tiny Shure microphones will fit in the palm of one hand. For hearing aids, and tape recorders, they measure ½ x ½ x ¼ in.

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(*Continued from page* 153)

ease. In the equivalent circuit then they are replaced by one thermal resistance θ_c.

Experimental Data

The thermal resistance θ_j of a particular transistor is readily measured by the methods described in literature. The equipment designer has no way of influencing its value; the fin-to-the-final-sink resistance θ_c, however, is within limits, under his control.

A rather large number of experimental heat runs have been taken on various transistors with various cooling fins and in various surroundings. The mechanism of heat transfer as described in the preceding section and conclusions formulated in the section following this are based on the experimental investigation described below.

The temperature drop from the center of the fin and extreme edge was never more than 2°C. The temperatures given below were measured by a copper constantan thermo-couple attached with putty to the transistor casing. A small negative bias was applied to the base, and a larger negative voltage was applied to the collector. DC voltage and current were measured at the terminals of the transistor. Transistor-to-fin-thermal contact was assured by application of heavy silicone oil.

The results of heat runs are shown by curves in Fig. 6. These curves substantiate the statement previously made that the thermal resistance between the cooling fin is a constant unaffected by the type of transistor used. More important, however, these curves show that radiation plays a very important role and cannot be neglected.

When compared in the same environment, the different finishes of the same copper fin 5 x 5 x 1/16 in. and dissipating the same number of watts gave the following values of temperature rises:

Mirror polish	100%
Coarse wire wheel finish shiny	90%
Tarnished, unpainted	87%
Dull gray	70%
Dull black	65%

Junction temperature and thermal ratings for power transistors are determined as follows:

With a known power dissipated

Table 1

Mode of Heat Transfer	Magnitude of Heat Transfer in Watts per Sq. In. per °C
1. Conduction through copper 0.1 inch thick	95.2
2. Conduction through pyrex glass 0.1 inch thick	0.322
3. Conduction through cork board 0.1 inch thick	0.011
4. Free convection from 6 inch high vertical plate at 120°C, air at 80°C	0.00348
5. Radiation between two black bodies at 100°C and 50°C	0.0063

Table 2

Heat Conduction Data for Various Materials at Approximately 65°C*

Material	Density lbs./cu. in.	Heat Conductivity K Watts/sq. in./°C/in.	Comparison with Soft Steel on Weight Basis**
Silver	0.380	10.6	6.7
Copper	0.322	9.7	7.25
Beryllia***	0.09 approx.	5.6 approx.	15.0
Aluminum	0.098	5.5	13.6
Magnesium	0.063	4.0	15.2
Yellow Brass	0.316	2.4	1.83
Pure Iron	0.284	1.3	1.11
Soft Steel	0.284	1.18	1
Mica	0.101	0.015	0.036
Paper Base Phenolic	0.0497	0.007	0.036
Polystyrene	0.038	0.0027	0.017

* Computed from data published in NavShips 900, 190 (unclassified).

** Computed as:

$$\frac{k\ (\text{material})}{k\ (\text{soft steel})} \times \frac{\text{Density (soft steel)}}{\text{Density (material)}} = \frac{k\ (\text{material})}{\text{Density (material)}} \times 0.241$$

*** Beryllium Oxide ceramic insulating material of high thermal conductivity. Relatively new.

in the transistor the temperature on its junctions is the temperature of the casing plus the product of θ_j and watts dissipated. With a fin of known thermal properties in given surroundings the watts dissipated may be found from a curve such as is shown in Fig. 6b. The temperature of the junctions is the product of watts dissipated and θ_j plus the temperature of the casing.

The maximum power dissipation rating for a given transistor with a given cooling fin in known surroundings is arrived at in the following way:

First, suppose that the casing of the unit is kept at ambient temperature by forced air or liquid cooling, then maximum permissible dissipation will be 85°, less an ambient of, say, 26.5°, this difference divided by θ_j of the unit. In the

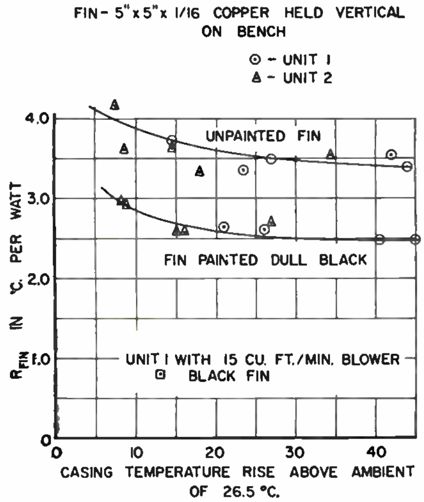

Fig. 6a: The results of heat runs.

case of unit 1 the maximum power the unit can dissipate is

$$\frac{85 - 26.5}{0.5} = \frac{58.5}{0.5} = 117 \text{ watts}$$

With the ambient of 85°C the unit may not dissipate any power lest the safe junction temperature be exceeded.

With normal ambient say at 26.5°C and no forced cooling with rises above 20°C the θ_c is nearly constant or may be taken from the curves in Fig. 6a. The value of the resistance θ_j is either supplied by the manufacturer or measured. The following relations hold:

$$W_{max} \times \theta_j + W_{max}\,\theta_c = T_{jmax} - T_A$$

$$W_{max} = \frac{T_{jmax} - T_A}{\theta_j + \theta_c} \qquad (4)$$

(*Continued on page* 156)

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(*Continued from page 155*)

where W_{max} is the maximum allowable dissipation,

T_{jmax} is the maximum allowable junction temperature, at present 85°C,

T_A is the ambient temperature.

For unit 1, with the fin used and painted dull black and the ambient of 26.5°C

$$W_{max} = \frac{58.5}{0.5 + 2.5} = 19.5 \text{ watts}$$

while for unit 2

$$W_{max} = \frac{58.5}{2 + 2.5} = 13 \text{ watts}$$

The corresponding temperatures of the casing under conditions stated are

for unit 1 — 75°C
and unit 2 — 59°C

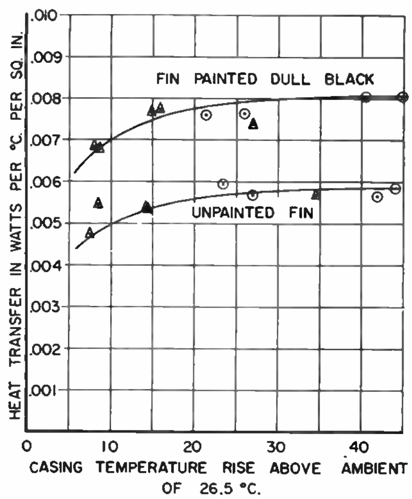


Fig. 6b: Units for heat transfer are the same as those used in Table 1.[5]

Another conclusion follows that the curves in Fig. 6 indicate the often overlooked and neglected importance of the radiation in the whole mechanism of heat transfer taking place. A definite need for surface finish of the cooling fins, dull and preferably black, is indicated by these curves.

For determination of the maximum permissible operating temperature of the case of a transistor operating at maximum dissipation in a chassis mounted in a cabinet, the following procedure may be used:

1. Obtain the thermal resistance θ_c from the transister case through the chassis and its cabinet to the ambient still air (heat ground).
2. Obtain the value of thermal resistance from transistor junction

to its case from the manufacturers specifications for a given transistor type. For a particular transistor it can be measured in labs specializing in such measurements. This value, θ_j, may have a spread in value of 3 to 1 in transistors of one type or design.

3. The maximum permissible operating temperature of the case T_{cmax} at maximum dissipation is then determined from the relation:

$$T_{camx} = \frac{T_{jmax}\,\theta_c + T_a\,\theta_j}{\theta_c + \theta_j}.$$

where: T_{jmax} is the maximum safe operating temperature of the junction and is 85°C (based on available reliable life tests), and T_a is the temperature of the ambient still air (heat ground).

References

1. Lately the cooling fins have been loosely called "heat sinks." The latter term is somewhat ambiguous and its use will be avoided in this article except as "the ultimate heat sink." In general the ultimate heat sink is the earth's atmosphere or the earth itself. In our case the ultimate sink is the free air surrounding the device and unaffected by the heat dissipated by the device. The heat is not sinking in the cooling fins. It is merely conducted by them to their surfaces to be transferred by convection and radiation to the ultimate sink. Recent Army and Navy publications indicate preference for the interpretation of "heat sink" as used in this article.

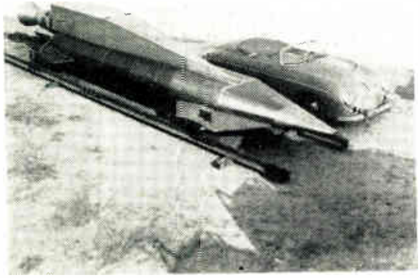
2. For copper and aluminum of limited dimensions this resistance is very small as will be shown later.

3. In cases of large thin chassis of relatively high thermal resistance the equivalent electrical network involves additional resistive components. While being somewhat more complicated these cases may be analyzed by the general methods described.

4. Like many other constants such as electrical resistance, the thermal resistance varies somewhat with temperature. The thermal conductivity of copper drops 2½% for temperature change from 0 to 100°C. For iron it drops 5% for the same change, while aluminum stays the same for the interval.

5. This "hybrid" system of units using the watt, the degree C and the inch is the one used by the Armed Services in dealing with "electronic" heat transfer.

1000 MPH SLED



New liquid oxygen-alcohol propelled sled built for Edwards AFB Supersonic Track Facility by Century Engineers is expected to top 1,000 mph. North American lox-alcohol engine develops 50,000 lbs. thrust.

Electronic Industries'

ANNUAL INDEX—1957

The annual Article index of ELECTRONIC INDUSTRIES & Tele-Tech has been arranged by subjects for easy reference to related topics. The first figure indicates the month in which the article appeared; the second figure indicates the page number.

AIRCRAFT, MOBILE AND MARINE, RADIO

AMPLIFIERS

BOOKS

BROADCAST

CHARTS, NOMOGRAPHS, DIRECTORIES

CIRCUITS, NETWORKS AND FILTERS

COMMUNICATION SYSTEMS

COMPONENTS, CHASSIS ELEMENTS

Personals

Robert P. Crago is now director of engineering for the Military Products Division of the International Business Machines Corp. He has been with IBM since 1949.

George M. Russell has joined Packard-Bell Electronics as liaison engineer attached to the Washington, D. C., office. He was originally with RCA Service Co.

William G. Fockler has been named Manager of technical products engineering at Allen B. Du Mont Laboratories, Inc. In his new post he is responsible for engineering programs for cathode-ray oscilloscopes and associated electronic test equipment, automotive test equipment, industrial television, and two-way mobile radio communications.

W. G. Fockler

Dr. G. H. Brown

Dr. George H. Brown has been appointed Chief Engineer, Industrial Electronic Products, Radio Corporation of America. In his new capacity he will have engineering responsibility for all industrial equipment and systems, including broadcast, communications, and industrial electronic equipment, and computer, telecommunication, and industrial control systems.

Don P. Caverly, lighting authority and engineer, formerly with Sylvania Electric Products, Inc., has been appointed director of engineering and development of Harvey Hubbell, Inc. He is the author of two books.

Richard M. Bloniarz has been appointed to the position of director of engineering for Gertsch Products, Inc. He will direct R & D activities in the fields of frequency and AC voltage ratio measurements.

Alvaro D. Biagi has been made executive engineer at Federal Telecommunication Laboratories. He was formerly senior project engineer at IT&T Research Center.

Raymond Davis has been named assistant chief engineer for systems for BJ Electronics. He was formerly with Ramo-Wooldridge Corp.

ELECTRONIC INDUSTRIES & Tele-Tech Advertisers—Dec. 1957

* In Operations Edition Only.

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Annual Article Index (Cont.)

Memorial Award To Honor S. Helt

The IRE Professional Group on Broadcast Transmission Systems has set up an annual award in honor of Scott Helt, authority on television engineering practices and a charter member of the group, who died on August 9, 1956.

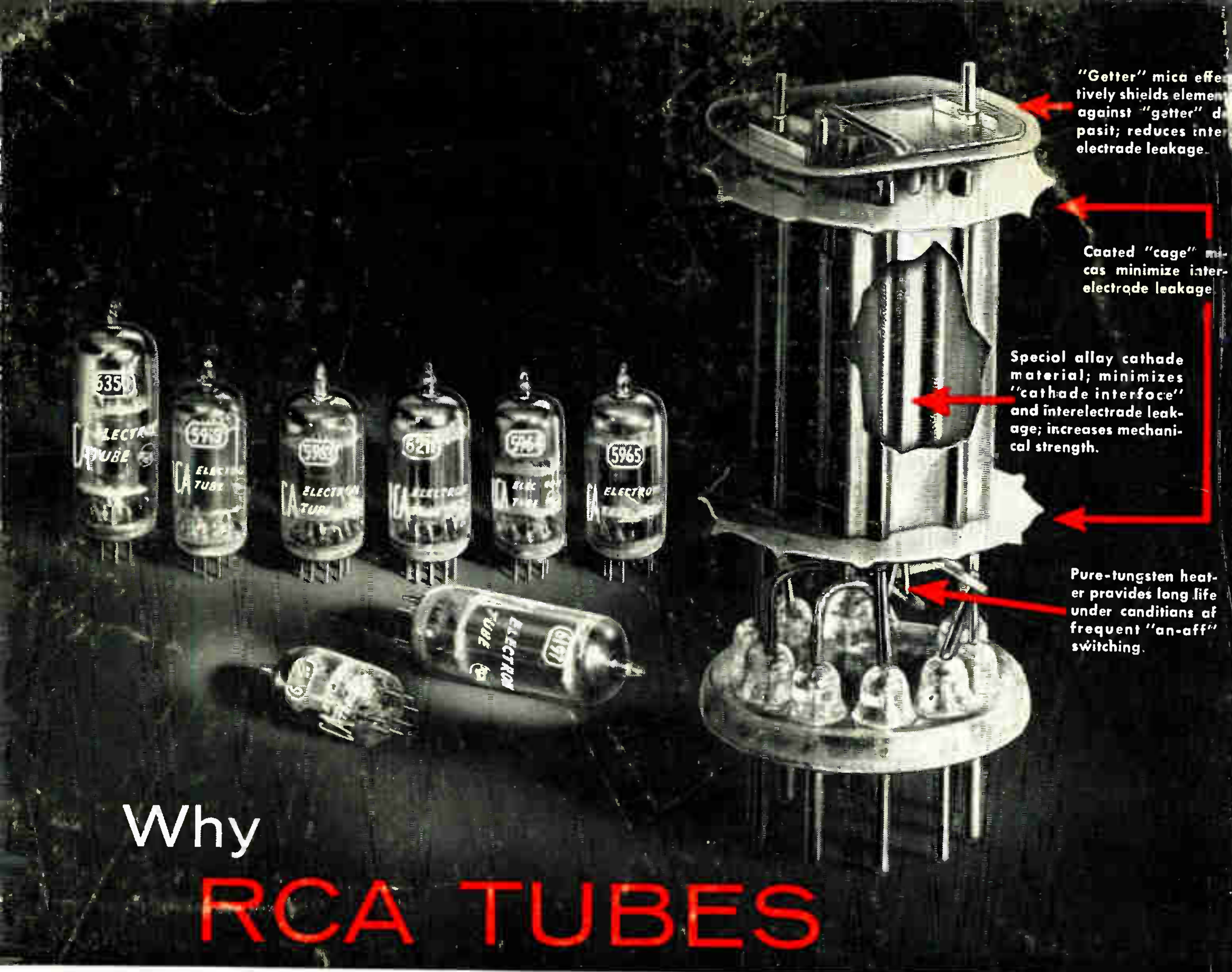
The Scott Helt Memorial Award will be awarded annually for the best paper published in the Group's Transactions.

ELECTRONIC BOOKKEEPING MACHINE designed for Young's Market Co., the West's largest liquor distributor, by IBM will keep track of sales and stocks by means of punched tapes which will be transmitted over Western Union lines. At terminals they will be converted to punched cards on an IBM tape-to-card converter. The RAMAC bills the order and prices, extends and totals the invoice, and also keeps track of credit extended and the credit limits.

NEW 'PHONE SYSTEM

Phone service for isolated rural areas becomes practical with this new push-button dialing radiotelephone developed by Motorola. System uses automatic exchanges.

Circle 105 on Inquiry Card, page 101



Why RCA TUBES are specified for COMPUTER DESIGNS

Long-life reliability ...the result of selected materials, rigid quality controls, and exacting inspection and test procedures...makes RCA tubes the right choice for electron computer designs. *Materials* are selected and processed to assure low gas-evolution and to provide relative freedom from "cathode interface". *Quality Control* extends from purity-control of manufacturing areas, through careful selection and training of personnel, to 100% microscopic inspection of tube structures at more than a half-hundred check points. *Sample Testing* of tubes from each production run makes certain that no tubes are released for shipment until long-life test data are complete for the "lot". Super-Sensitive tests for high resistance shorts, 100-hour survival-rate life tests and 5000-hour life tests on a continuous sampling basis weed out potential early-hour failures and provide a "quality monitor" to assure *long-life reliability*.

RCA tubes for computers are ideally suited to applications as gated amplifiers, frequency dividers, pulse amplifiers, cathode followers, "on-off" switching. Illustrated above are medium-mu twin triodes: 5963, 5964, 5965, 6211, 6350; pentagrid amplifier: 5915; power pentode: 6197; twin diode: 6887.

SEND FOR NEW BOOKLET RIT-104A— "Receiving-Type Tubes for Industry and Communications." Includes descriptions and basic data on RCA Computer and other special tube types. Designers of computer equipment are invited to discuss tube requirements with their RCA Field Representative at the nearest RCA Field Office. For your copy, write RCA Commercial Engineering, Section L-50-Q, Harrison, New Jersey.

RCA FIELD OFFICES:

744 Broad Street, Newark 2, N.J., HUmboldt 5-3900

Suite 1181, Merchandise Mart Plaza, Chicago 54, Ill., WHitehall 4-2900

6355 E. Washington Boulevard, Los Angeles 22, Calif., RAymond 3-8361

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