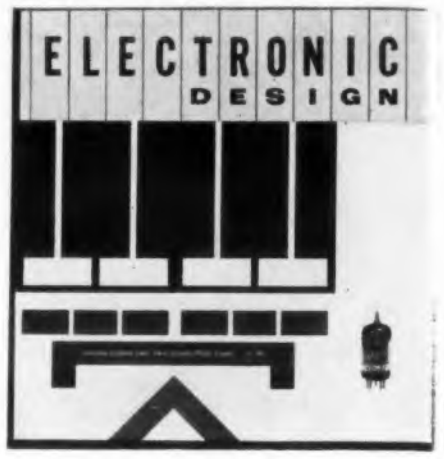
ELECTRONIC DESIGN

Isolated Outputs from Twin Double-Plate Triode . . . p. 82

HIGHLIGHTS OF ISSUE



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ELECTRONIC DESIGN Hayden Publishing Co., Inc., 830 Third Avenue, New York 22, N. Y.

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ELECTRONIC DESIGN is published bi-weekly by Hayden Publishing Company, Inc., 830 Third Avenue, New York 22, N.Y., T. Richard Gascoigne, President; James S. Mulholland Jr., Vice-President & Treasurer; and David B. Landis, Secretary. Printed at Hildreth Press, Bristol, Conn. Accepted as controlled circulation at Bristol, Conn. Additional entry, New York, N.Y.

Ferroelectric Converter Gives High-Voltage AC, DC

A NEW POWER SOURCE, the ferroelectric converter, may become available to designers if a long-recognized effect can be exploited efficiently.

At International Telephone and Telegraph Laboratories, Nutley, N.J., S. R. Hoh has directly converted thermal to electrical energy by alternately heating and cooling barium titanate and other ferroelectric materials incorporated in circuits as capacitive elements.

Power sources based on this pyroelectric-like principle could give designers high voltages at efficient power-to-weight ratios, reports Mr. Hoh. Practical work and theoretical studies indicate that ferroelectric conversion of heat to electrical energy could compare favorably in cost and power-weight-ratio with other methods. Mr. Hoh singles out space devices requiring high ac voltages as particularly appropriate applications of ferroelectric conversion.

ITT is writing proposals for Air Force support of the converter research on the basis of its suitability for space use. And Rome Air Development Center has started work on a program of its own, designed to give the Air Force first-hand knowledge of the potential of ferroelectric conversion. The Air Force researchers will make use of both ITT studies and materials.

The principle behind the converter has been known for some time in a ferromagnetic parallel and in relation to pyroelectric materials. If a ferroelectric, like barium titanate or strontium titanate is heated to its Curie temperature, permittivity rises to a peak.

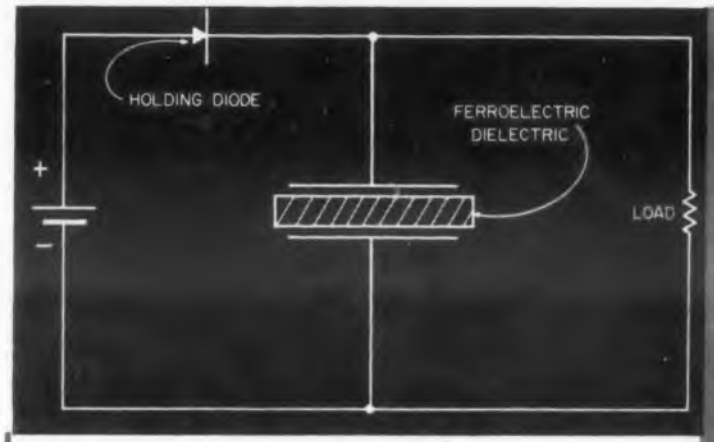
Further heating decreases permittivity, reducing capacitance and increasing voltage. Voltage rises because of the Q=VC relationship in a capacitor circuit.

It is this gain of potential between two faces of a ferroelectric crystal or film, caused by a temperature change, that makes the converter and its variations possible.

Another effect, which makes the ferroelectric converter attractive to designers, is that affecting energy in the system. Energy is gained in the same ratio as voltage when a given charge is raised to a higher potential by heating. This is because energy W of a charged capacitor equals 1/2 QV.

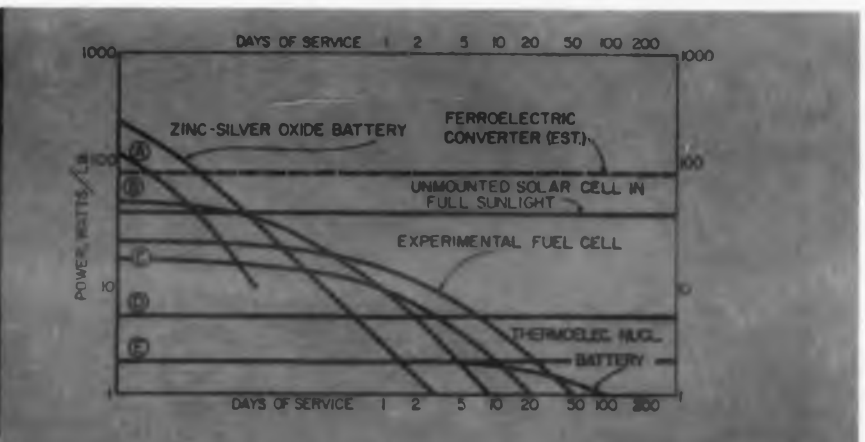
High field strengths make most efficient use of ferroelectric materials, reports Mr. Hoh. With strengths of roughly 100 v per mil, voltages range between 500 and 1000 for the ceramic ferroelectrics used at ITT. Cascading of stages, however, could provide 1,000,000 volts. But, states Mr. Hoh, materials with much higher dielectric strengths are needed.

With 5-mil barium strontium titanate of room-



How It Works

A ferroelectric capacitor, charged through a holding diode, is heated until its polarization is overcome. The capacitor's ability to maintain an electric field then decreases, reducing its capacitance. But because voltage on the capacitor is a direct function of charge and capacitance (Q=VC), the voltage rises with: decrease in capacitance, maintainance of the charge, and prevention of leakage by the diode. The cycle ends with discharge of the capacitor through the load and cooling to permit recharging.



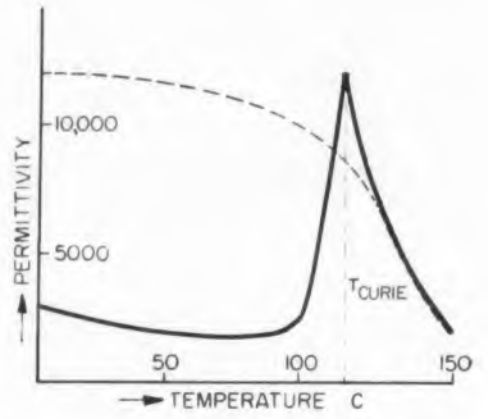
Why It's Significant

Length of service plotted against power-per-pound in this ITT-supplied graph shows how a ferroelectric converter can be expected to provide steady power at ratios exceeding those of other known sources. Presupposed is a space-type environment for the ferroelectric converter, where unlimited solar energy is available at no cost. Curves not labeled in the graph are: A-monopropellant fuel turbine; B-gas turbine; C-engine generator; D-turboelectric nuclear reactor; E-mounted and protected solar cell in full sunlight.

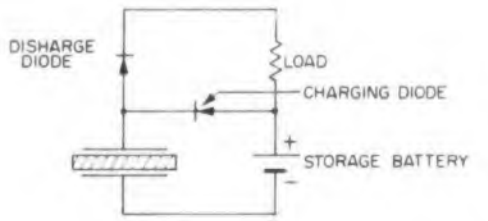
Four Types of Energy Converters Compared

Type	Area of Application Advantages	Disadvantage	Conversion Efficiency % Predicted	Watts Per Pound
Thermoelectric	up to 1300° K also cooling	High Weight	34 (Multistage)	2.5
Thermionic	1300° to 2500° K	Limited Life Low Voltage	90% of Carnot	?
Solar Cells	Solar Radiation	High Cost ($400/Watt) Temperature Limitations	20-30	40
Ferroelectric	High Voltages Alternating Current Low Cost	Requires Temp. Cycling	< Carnot	90?

NEWS



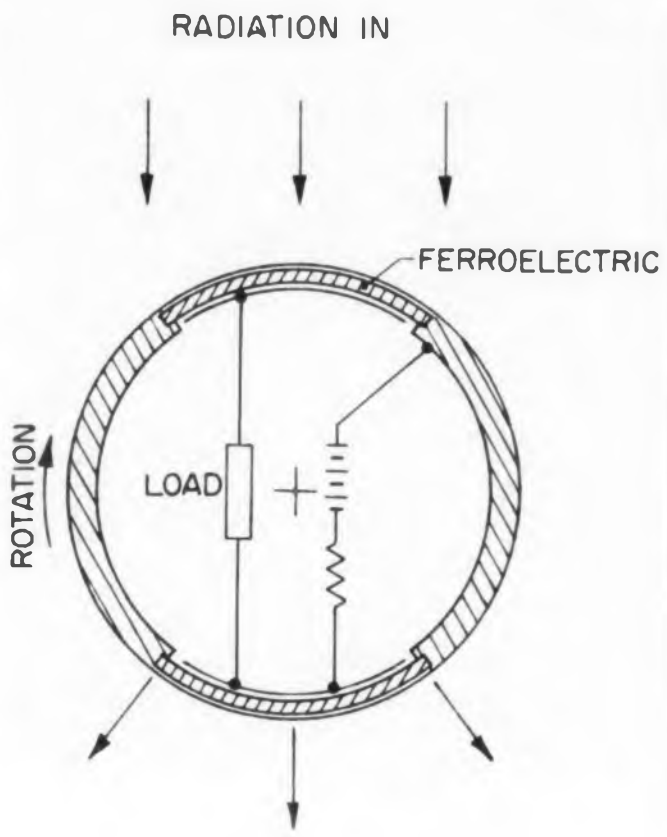
How permittivity of barium titanate varies with Curie temperature. Drop in permittivity caused by heating beyond T_c lowers capacitance of ferroelectric capacitor, thereby raising its potential. This effect is the basis of the new converter. Solid curve is for low field strength, dotted curve, for high field strength.



Simple ferroelectric converter requires no primary input power. The battery receives and delivers (through holding diode, load, battery) the same charge during each cycle, discharging potential built up during heating of capacitor.

temperature Curie point, voltage gains of from 3 to 10 times input have been achieved. Mr. Hoh believes still better gains are possible with specially developed materials. Barium titanate is being used primarily because it is one of the best known ferroelectrics.

Conversion efficiencies achieved in thermoelectric units (about 8 per cent), thermionic and solar-cell converters (about 13 per cent) and nuclear converters (about 10 per cent) could probably be exceeded soon with ferroelectric converters.



How ac is generated is illustrated in this suggestion for a satellite power source. Because the converter requires temperature cycling, the normal spinning of a satellite is put to work. The capacitors on each side of the rotating satellite are alternately heated and cooled, which charges and discharges them in sequence through the load. The battery makes up leakage. ITT is actually proposing a satellite incorporating many pairs of capacitors, and company researchers envision a satellite coated with a sprayed film of ceramic ferroelectric for maximum capacitance.

The Air Force is optimistically looking for efficiencies on the order of 20 per cent.

For space applications, however, Mr. Hoh points out, solar energy is limitless and free, and power-to-weight ratios are more important than efficiency.

Ferroelectric converters, he believes, could deliver about 90 watts per pound, compared with 40 for solar cells and only 2.5 for present thermoelectric devices.

Cost of ferroelectric materials is very low compared with that of solar cells, which deliver power at costs of $1000 per watt and more, and cost of ferroelectric converters should be low relative to other types of converters.

In addition to use in space, other advantageous applications for ferroelectric converters would be in portable X-ray units, portable high-powered radars, and signalling buoys, which could apply the bobbing induced by wave action to temperature cycling. ■ ■

NEWS

Quotes in the News . . .

"Possible benefits of an acceptable, inexpensive depotting technique for encapsulated electrical components would be reduced cost of repairs, reduced downtime, greater material savings through salvage, and reduced cost of design changes,"

. . . said G. C. Lehritter of the Air Materiel Command in a letter sent to the electronics industry to find out whether depotting is feasible and how it should be done.

"The systematic study of the binary semiconducting compounds is still in its infancy, yet products utilizing them are already on the market. Beyond this there are ternary, organic, and even more complex compounds which are known to be semiconductors and which, as the technology progresses, will add immeasurably to the scope and utility of solid-state electronics,"

. . . said T. S. Shilliday of Battelle Memorial Institute in the current issue of the Battelle Technical Review.

And a pre-Moon-Sputnik quote:

"There is no real evidence that Russian Science is seriously outpacing ours. But it may well be true that the Russians are putting their scientific progress to work faster than we are,"

. . . said F. B. Turck, an ASME consultant, during the announcement of ASME's study of the time lag in the U.S. between scientific discoveries and their practical application.

NASA Awards Electronic Industry Million Dollars in One Month

Latest contract awards announced by the National Aeronautics and Space Administration show that for July alone the electronics industry received $970,000 directly, and as part of other NASA industrial and research contracts probably more.

Money was obligated in July, 1959 to these organizations:

University of Illinois—$60,000 — and Stanford University—$90,000 — For continuing studies of satellite radio signals to study makeup of the ionosphere.

Massachusetts Institute of Technology—$200,000 — For asistance in evaluating Project Mercury tracking facilities and ground instrumentation.

Minneapolis Honeywell Co.—$70,000 — Acoustica Associates Inc.—$90,000 — To investigate the use of sound waves to control the burning rate of solid rockets.

Air Force Ballistic Missile Division (ARDC)—$280,000 — For installation of special radio acquisition equipment at the Kaena Point, Hawaii, tracking station for use in communications with Tiros, a meteorological satellite.

Army Ordnance Missile Command—$150,000 — For instrumentation to duplicate a 91-pound satellite payload that failed to get into orbit July 16, 1959, when its booster was destroyed because of an electronic failure five seconds after liftoff.

AOMC—$100,000 — Funds to cover the cost of the project Beacon payload launched August 14, 1959, which failed to get into orbit because of a guidance failure.

Packaged Switching Circuits Designed for On-Site Processing

The National Bureau of Standards has designed seven special-purpose transistorized computer packages for in-shop recording and processing of data.

The units, designed as building blocks can be combined to accept data from experimental equipment and adapt them for use in high-speed computers.

So far, seven logical components have been developed, all operating at 50-mc pulse repetition rates. They are: a flip-flop, a gating circuit, a one-shot pulse generator, a logical OR-inverter, an indicator, an analog switch, and a power gate driver.

Standard stock parts are used, and in most of the packages, some components or subassemblies are left unconnected and must be wired externally to the package.

Special-purpose computer packages developed at NBS are used for recording and processing experimental data.

NEWS

Component Tailored to Climate

This is the first in a series of temperature-controlled memory planes being developed for data-processing systems that operate in climatic extremes. The ferrite cores, insulated with pads of polyurethane, are enclosed, together with the temperature-control assembly, in a 4-by-5-by-1-inch magnesium case. This design for an airborne application functions at 85 C in an ambient temperature range from minus 55 C. Warm-up time from minus 55 C is less than five minutes, according to the developer, General Ceramics Corp. of Keasbey, N. J.

Infrared Horizon Sensor For Satellite Excludes Sun

A new wide-angle infrared sensor is designed to be carried aloft to detect the thermal horizon between the earth and space. With two of the sensors, it is planned to establish the stable vertical reference, vital for precise orientation control of a missile or satellite in space.

Developed by the Barnes Engineering Co. of Stamford, Conn., the sensor reacts to the earth's radiation and not to reflected solar radiation. It does this by using thermistor detectors that respond to far infrared wavelengths and filters that eliminate visible and near infrared radiation.

The detectors convert the incident radiant energy into electrical output signals to space-vehicle control systems. The output is precise and almost independent of variations in the temperature and radiance of the earth, the developer has reported.

Completely transistorized, weighing two and a half pounds and consuming only four watts, the sensor is destined for use in the National Aeronautics and Space Administration's manned satellite capsule, Project Mercury.

New Crystal Process Promises Transistors for 1800-F Operation

High-purity, single crystals of silicon carbide have been produced by a new process that promises to raise the temperature limit of transistors and diodes to about 1800 F.

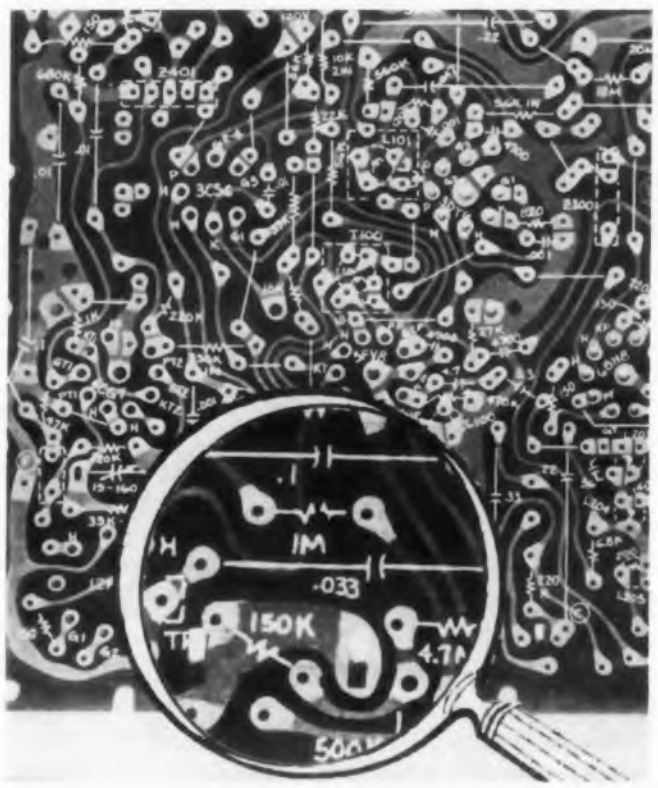
The process, developed at the Stanford Research Institute, works this way:

Pure silicon is melted in a carbon crucible of a modified crystal-pulling furnace. The carbon of the crucible diffuses into the molten silicon and saturates the solution. A cool spot produced in the solution by careful temperature control results in a portion of supersaturated solution, from which silicon carbide crystals can be grown.

Though crystals now produced by this method are too small for semiconductor use, the Navy has financed another year of research.

Pure single crystals of silicon carbide in transistors would make possible production of semiconductor devices that could operate in hot environments, and extremely small devices that would have minimal heat-dissipation problems.

Circuits Identified Easily



Printed circuit board for TV receiver has both circuits and identification on bottom of board. According to Westinghouse, which is using the new boards in its 1960 TV line, the new arrangement allows for these advantages: tube pins can be identified with respect to the elements they connect to, point-to-point connections can be shown, identifications can be placed where they are unobscured by soldering. It also provides space for special identifications. Values are yellow, circuits green.

NEWS

U.S. Sees Electronics Output Heading for New Peak in 1959

Electronics output this year should reach a new record of $8.5 billion—a billion and a half more than last year—according to an estimate by the United States Department of Commerce.

The department's Business and Defense Services Administration reports that all sectors of the electronics industry increased output in the first half of 1959. This contrasts sharply with 1958, when several sectors suffered setbacks in the early part of the year.

The anticipated output of consumer electronic equipment, at factory prices, is put at $1.7 billion for 1959, up 30 per cent from 1958.

Production of equipment for the military has accounted for the greatest single spurt in the industry this year.

Commercial and industrial electronic equipment continued to be produced in increasing amounts in the first six months of 1959. "In another decade," according to the report, "the commercial and industrial electronic industry may be the largest sector of all the electronic industries."

An increase of 10 per cent in electron tube manufacturing, or a new high of about $900 million, is forecast for 1959. Most of this rise is likely to be concentrated in transmitting and special-purpose tubes, the agency says. Receiving tubes are expected to show only a moderate increase.

The gain for semiconductor output is forecast at about 40 per cent—from an estimated $210 million to more than $300 million.

Other electronic components are expected to share in the prosperity, with an increase in production of $250 million, or 20 per cent over 1958.

Flywheel Converters Installed At Swedish Power Stations

To support Sweden's transition from wire to coaxial and microwave telephony links, the Swedish Board of Telecommunications is installing flywheel converters at repeater stations.

The converters, which consist of a three-phase induction motor joined through an energy-storing flywheel to a single-phase synchronous generator, supply continuous alternating current at constant voltage.

During power breaks, energy stored in the flywheel drives the generator until stand-by plants take over.

The wheel assures full output for 30 seconds with a voltage accuracy of 3 per cent and a frequency drop of from 3 to 20 per cent.

Direct-current converters are also used in some Swedish telecommunications applications.

Optical Scanning Standards Sought by Retail Group

The National Retail Merchants Assoc. is planning to draw up standards for optical scanning equipment in data-processing systems used by retail stores.

Forms and procedures will be surveyed, then a sub-committee of the retailing group will meet with electronics industry representatives to develop suitable equipment specifications. A final report is expected within one year.

Why Not Pigeon Guidance?

Harvard's Dr. B. F. Skinner told a meeting of psychologists that pigeons could be trained to guide a rocket to the moon.

He reported that in a World War II project he and his colleagues had trained pigeons in a missile to peck at a target image flashed on a screen. As the target moved off-screen, the pigeon's movements, transmitted by a harness, corrected the missile's flight.

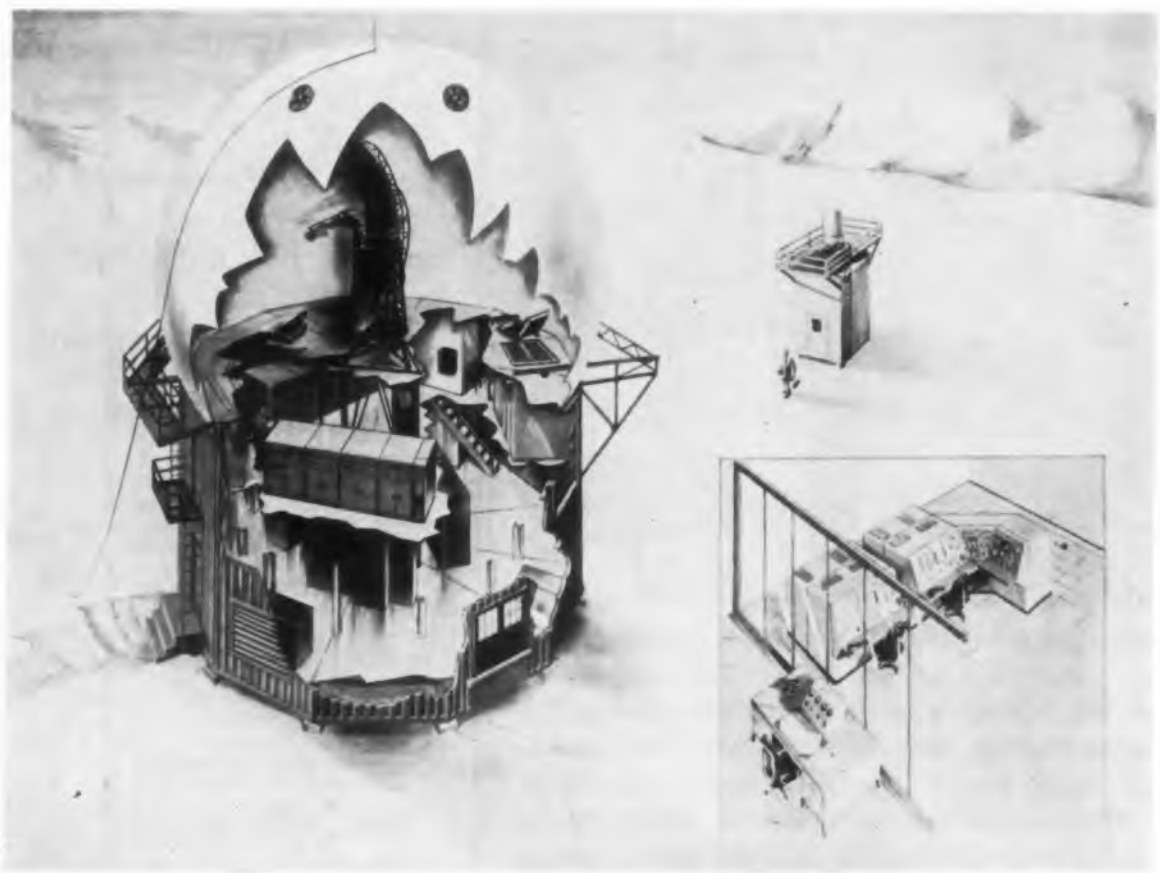
Though the pigeons performed well and could be trained in only 30 days, authorities were unimpressed. Dr. Skinner still has faith in the idea.

SVE Antenna Improves on Dish

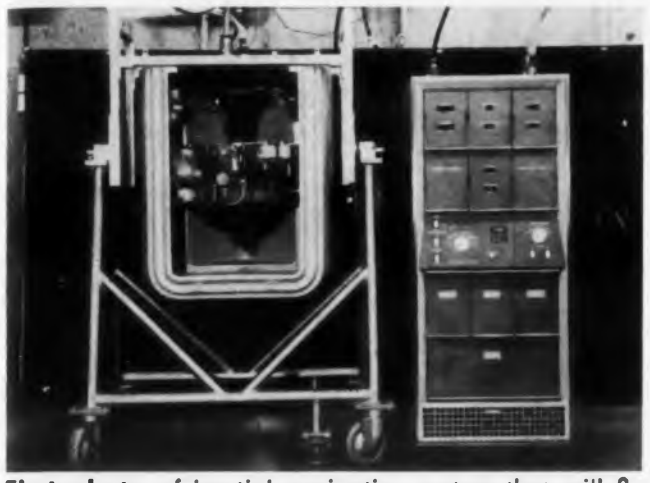
Space target acquisition is said to be easier and tracking more accurate with this swept-volume-efficiency uhf tracking antenna shown as a model and developed for the National Aeronautics and Space Administration by General Bronze Corp., Valley Stream, N.Y. The 40-inch lightweight array of 33 end-fire elements can be moved in azimuth and elevation and will be installed at NASA's Wallop Island, Va., test site, to replace a 60-inch parabolic dish.

How Minuteman-generation of missiles could be launched from mobile sites is shown in this railway car mockup by American Machine and Foundry and ACF Industries.

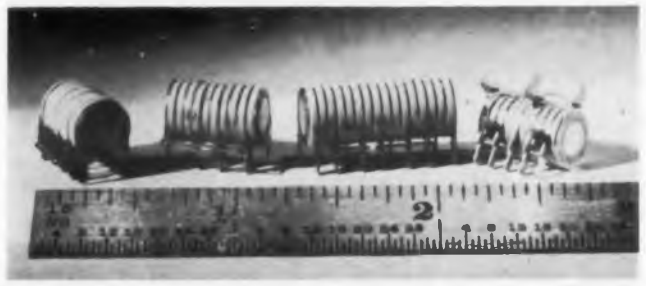
Design News in Photos



New radar for Dew-line will look like this. Now in production, the Avco FPS-26 will weigh 70 tons, be housed in a dome 50-feet across.



First photo of inertial navigation system that will fix submarine position for Polaris launching. System, developed by Autonetics, is being sea-tested aboard the USS Compass Island. In uncovered binnacle at left are stabilized platform, precision gyroscopes and velocity meters. Navigation console at right houses all other electronic equipment.



Engineering mockups of General Electric's TIMMS show degree of miniaturization possible with integrated modules. At left is a double cathode follower with two triodes, four resistors and two capacitors, next to it is a cascade amplifier incorporating two triodes, four resistors and one capacitor. The two modules at right are a multiple-element logic unit and a multivibrator.

Precast concrete acoustic horn weighing 53 tons will be part of a 100 ton assembly for directing sound to plane-wave and reverberant-type chambers. The entire assembly will be used by Goodyear Aircraft to test electronic components at Litchfield Park, Ariz.

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Folio 59-6

REFERENCE DATA FILE

SANGAMO

the significance of envelope delay in communication networks . . .

The design of electronic wave filters is an exact science requiring painstaking attention to even the most minute detail. Of no less importance is the preparation of filter performance specifications. The transmission of pulsed sinusoids, steep-front modulation envelopes and other complex wave forms in modern telemetry, speech and facsimile systems has made the preparation of adequate component specifications an absolute necessity. The omission of a single required performance detail can lead to serious malfunctioning of the component in the completed system.

Envelope delay is one of the important characteristics in filter applications requiring minimum distortion of the transmitted signal. The systems engineer must give proper attention to this requirement. Mathematically, envelope delay may be defined as:

$$T_d = -\frac{d\beta}{d\omega}$$

Where: T_d = envelope delay in seconds
β = phase shift in radians
ω = angular frequency in radians per second

To hold distortion to a minimum, the envelope delay must be nearly constant over the entire frequency spectrum of the transmitted signal. It is the constancy of envelope delay rather than the actual magnitude of the delay which governs a network's ability to transmit a complex wave form without introducing objectionable distortion. The distortion arising from non-constant envelope delay is termed envelope delay distortion. From the above equation it is apparent that T_d is constant as long as phase shift varies linearly with frequency. Unfortunately, the realization of a filter network with perfectly linear phase shift over its entire pass band is not always practical or even possible. For this reason, the systems engineer should carefully evaluate the degree of constancy of T_d which his system requires as well as the range of frequencies over which T_d must be maintained nearly constant.

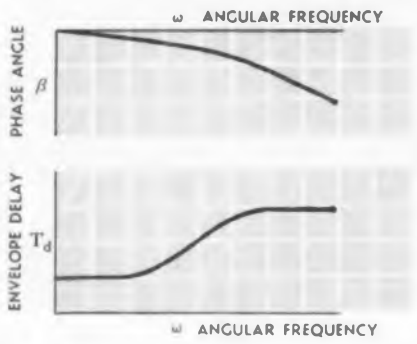

FIG. I *Illustrates the relationship between phase shift and envelope delay.*

The effect of envelope delay distortion on a transmitted signal is illustrated in figure 2. Figure 2 (a) shows the input signal. It is composed of a fundamental frequency plus the third and fifth harmonics. Figure 2 (b) shows the output signal. The network has shifted the fundamental frequency by 45°, the third harmonic by 90° and the fifth harmonic by 180°. The net result of such non-linear phase shift is a highly distorted output signal. If components of the wave had been shifted 45°, 135° and 225° respectively, the signal would have been transmitted without distortion.

FIG. II (a)

FIG. II (b)

Since envelope delay is defined as the derivitive of phase with respect to frequency, exact measurement of envelope delay is difficult. In practice, however, envelope delay may be approximated by the following definition:

$$T_{\Delta d} = -\left(\frac{\theta_2 - \theta_1}{f_2 - f_1}\right)\frac{1}{360}$$

Where: θ_2 = phase angle in degrees at f_2

θ_1 = phase angle in degrees at f_1

f_2 = frequency in cycles per second at which phase shift equals θ_2

f_1 = frequency in cycles per second at which phase shift equals θ_1

$T_{\Delta d}$ is the average envelope delay between f_2 and f_1. By convention, $T_{\Delta d}$ is assumed to be the envelope delay at a frequency equal to $\frac{1}{2}(f_1 + f_2)$. When the approximate formula is used to calculate envelope delay from empirical phase shift versus frequency data, it should be remembered that the approximation holds only for small differences between f_1 and f_2.

The IBM "650" computer services maintained at Sangamo materially aid our design engineers in solving complicated networks for envelope delay, phase shift and attenuation characteristics.

Write for Inductive Component Bulletin Series IC-260

SC-59-7

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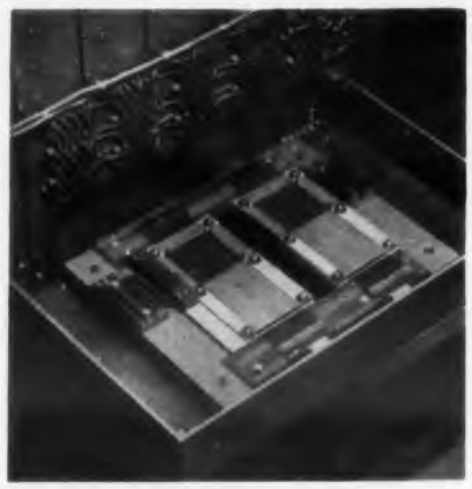
NEWS

First Magnetic-Film Memory Use Successful

After operating its TX-2 high-speed digital computer for three months with a magnetic thin-film memory, MIT's Lincoln Laboratory has announced that it is satisfied with performance of the component.

Read-and-write cycle times of 0.8



Prototype magnetic thin-film memory has capacity of 32 ten-bit words. Surrounding the memory are transistor drive and sense circuits.

microseconds have been achieved, though bench tests indicated potential speeds of 0.4 microseconds.

Net driving current for writing in the Permalloy-film memory is 150 ma. Output signals of 1 mv are produced by the Permalloy elements.

According to MIT, potential advantages of thin-film memories over ferrite toroidal cores are: faster cycle time, lower power dissipation, and greater compactness and simplicity.

Three-Way Thermoelectric Unit to be Designed

The Navy has contracted for an experimental thermoelectric system that will operate as an air conditioner, a space heater, and a refrigerator-freezer.

The solid-state system will be designed by Westinghouse so that it will lend itself to construction of a full-scale system.

For operating flexibility and ease of gathering test data, the system

will have separate heating and cooling units.

Capacity of the air conditioning unit will be one ton.

The refrigerator-freezer will be a two - cubic - foot unit capable of maintaining 0 F continuously.

Extended Visual Ranging Used in Recovery System

A direction-finding system for recovery operations locates low-intensity signals and provides visual-display homing of am, fm, or cw signals as weak as two microvolts.

This performance is said to be made possible by these features:

- A high-gain receiver (with crystal calibration oscillator) linked to directional, tuned antenna arrays,
- Dual trace and polarity switching methods that help lock on the beacon signal and provide directional information, and
- Phase-loop, lobe switching that provides left-right information without antenna rotation.

In the Lockheed LAS 103 system, the operator monitors a receiver output signal on an azimuth indicator and visually analyzes it for direction finding.

Largest RF Heating System Designed

A radio-frequency generation system that will concentrate 10 million watts of rf energy into an area of about 100 square feet has been designed for heat-testing space equipment.

The system, to be installed by General Electric at the Wright Field Air Force base, will consist of 40 power loops and associated load-matching networks. Each loop will be capable of inducing 250,000 watts of rf power into a test specimen at frequencies ranging from 200 kc to 2 mc.

Future extension to 5 mc generation will be provided for.

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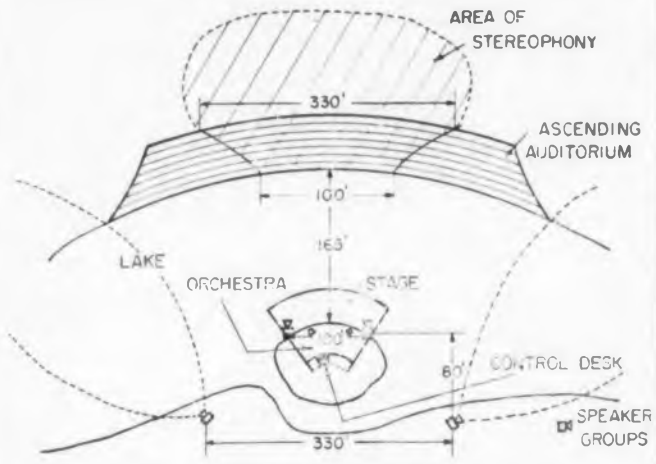
NEWS

Outdoor Stereo Installed in Germany



Open-air stereophonic setup in Dortmund, Germany, uses 300 watts for each channel. Sound is radiated from two towers of 48 loudspeaker systems each, permitting stereo seating for about 6000 listeners. According to Telefunken, the installation is the world's largest stereo system and Europe's first open-air stereo facility.

NEWS BRIEFS . . .

. . . **CARBOX AS WELL AS HYDROX** fuel cells will be developed in the U.S. by Universal Winding Co. under a licensing agreement with Britain's National Research Development Corp. (*ED* Sept. 16, p. 9). Prototype Hydrox cells have been built here; a prototype Carbox cell is still being developed.

. . . **CHAIN OF COMPUTER CENTERS** to be established by CEIR, Inc., Arlington, Va., will start off using IBM 7090 units. Added later will be one of the 1960-generation computers, and another unit to become available in 1961.

. . . **A COMMUNICATION NETWORK** for TV and telephony proposed by ITT is based on signal reflection from ultra-thin strips of aluminum shot into space.

. . . **HOW ROCKET EXHAUSTS** attenuate microwave signals will be studied by Stanford Research Institute under the Minuteman ICBM program.

. . . **MOST BASIC RESEARCH** money in industry goes to physics and mathematics research (54 per cent), reports the National Science Foundation. Of 1957's $241 million in industrial basic science funds, 36 per cent went to engineering, only 10 per cent to life sciences.

. . . **THE SOVIET MOON ROCKET** was tracked during the last five hours of its flight by Britain's Jodrell Bank radiotelescope, and trackers at Fort Monmouth, N.J. Jodrell Bank was able to measure with Doppler techniques, changes in the rocket's velocity caused by the moon's gravitational pull.

. . . **TREND IN SILICON** is toward lower purity according to a survey of semi-conductor device users conducted by Aries Associates. Survey suggests most silicon used in future will be of low purity, will cost less than $100 per ton. Reason: higher purity silicon costs more, competition in semiconductors is toughening.

. . . **CALIBRATION SERVICE** for vibration pickups has been established by National Bureau of Standards. Pickups can be calibrated from 10, to 2000 cps at accelerations up to 10 g, NBS reports.

. . . **BOOMING CITIZENS' BAND** radio is leading to abuse of FCC rules and may result in equipment manufacturers being advised not to encourage "fun" use of sets. According to FCC, too many people are talking too long in the Citizens' band.

. . . **GROUPS INTERESTED** in standards for nuclear instruments and controls have been asked by the American Standards Association to submit suggestions to an ASA committee working on nuclear standards.

SIGNIFICANT CONTRACT AWARDS

. . . **TO TELEMETER MAGNETICS, INC.,** Los Angeles, $200,000 from the Office of Naval Research for a large scale, high-speed computer memory with capacity in excess of 850,000 bits. Read-write speeds of 6 microwatts will permit 150,000 computer operations per second.

. . . **TO DATA-CONTROL SYSTEMS, INC.,** Danbury, Conn., about $750,000 in a subcontract from Boeing for the Minuteman ICBM test program fm/fm ground telemetry system.

. . . **TO BENDIX AVIATION CORP,** Ann Arbor, Mich., $8,500,000 from the Air Force for the communication system of the Notus space satellite relay program.

. . . **TO MELPAR, INC.,** Applied Science Div., Boston, from the Air Force, a contract for a study of long-range communications interference to evaluate interference between ground based systems and satellites.

WASHINGTON REPORT

Ephraim Kahn

Tighter Procurement Coming Especially in Subcontracting

Scandals aired in Congress are about to have an impact on electronics firms that deal with the military. With the Air Force taking the lead, a tightening of procurement practices all down the line can be foreseen. High officials figure that they must be able to point to significant progress under their own steam by early 1960 or the lawmakers will be tempted to jump in, make radical changes in Pentagon purchasing procedures, and, as a by-product, junk much of the experience that has been gained in working with today's rules.

Likely to have immediate and direct effect on electronics companies is the Air Force's determination to keep a tighter rein on subcontracting. Though the Air Force has had the right for many years to check into subcontractors, it has not chosen to use its money for this. Now that Congress is casting a jaundiced eye in its direction, there is every reason to expect that checks on spending will become more rigid and more frequent. In some areas of government, it is felt that auditing and inspection programs are not being efficiently run unless they save the government more money than it costs to operate them.

Primes and Subs to Feel Pressure

Monitoring of subcontracts will go through first tier, and possibly lower. Furthermore, pressure will be put on prime contractors—who are themselves subject to audit—to spend Air Force funds as carefully as they spend their own in making deals with subcontractors.

To make assurance doubly sure, the military will impose upon subcontractors the requirement that costs be certified as accurate and current. This must now be done by prime contractors where $350,000 or more is involved. In addition, pricing and cost data will be double-checked by Air Force teams. Cost certification will soon be extended to first tier subcontractors who, without effective competition, have obtained contracts worth $100,000 or more.

Types of contracts to be let will also be scrutinized with great care. Cost-plus fixed-fee contracts, which have drawn heavy Congressional fire, will be placed only after the government

is sure that the costs stated by the contractor leave no room for a windfall profit. Similar precautions will be observed in incentive-type contracts, so that the contractor will not be able to increase his fee unjustifiably by overstating costs in his original proposal.

Cost Control to Weigh Heavily

Cost control, as the Air Force sees it, will be a key element in doing business in the future. Budgets are tight, and prospects are bleak for obtaining enough money to do all the things that might be done. This puts a premium on getting as much for each dollar as is possible. Since the Air Force expects to be putting more and more dollars into the electronics industry, it will be under increasing pressure to cut its overhead and other costs.

Guidelines Set for Grants to Non-profit Institutions

Policy for making basic research grants to non-profit institutions—which sometimes compete with business for certain types of contracts—has been set by the Defense Department. Under the law, the Department can choose between research contracts or grants when it wants basic research done by a non-profit group.

Guidelines for grants have now been set. They may be made only for basic research concerned with a broad scientific area, not solution of specific problems. Grants may also be made, however, where the military desires to hold to a minimum its administrative and supervisory burdens, as well as when more latitude than can be conferred in a research contract is desired. Recipients of grants may also be given title to government-owned and supplied equipment when this is convenient or economical for the government.

Procurement Rules Won't Apply

Funds from military appropriations for Research, Development, Test and Evaluation will be used for these grants. As a rule, grantees will not be required to conform to military purchasing rules. The costing principles stated in the Armed Service Procurement Regulation will, however, be used in determining the amount of a grant.

Costing principles will not be followed slavishly. Proposals for grants must include budget estimates, but the Department says that the money may be spent "without strict adherence to the original budget estimates."

Service Secretaries may authorize grants up to $1 million, as may the Director of the Advanced Research Projects Agency, and the Director of Defense Research and Engineering. The Secretary of Defense must approve grants that exceed $1 million.

MEETINGS

Calendar of Events

October

6-9 High Temperature Symposium, Stanford Research Institute, Asilomar Conference Grounds, Calif.

7-9 Sixth National Symposium on Vacuum Technology, American Vacuum Society Inc., Sheraton Hotel, Philadelphia, Pa.

7-9 IRE Canadian Convention on Electronics and Nucleonics, Exhibition Park, Toronto, Canada.*

12-14 Fifteenth National Electronics Conference, AIEE, Illinois Institute of Technology, IRE Northwestern University, and University of Illinois, Hotel Sherman, Chicago, Ill.*

13-14 National Technical Conference, Society of Plastics Engineers, Ambassador Hotel, Los Angeles Calif.

22-23 Fifteenth Annual National Conference on Industrial Hydraulics, Illinois Institute of Technology and Armour Research Foundation, Hotel Serman, Chicago, Ill.

26-28 Sixth Annual East Coast Conference, IRE Professional Group on Aeronautical and Navigational Electronics, Baltimore, Md.

28-29 Michigan Industrial Electronics Exposition, Electronic Representatives, Inc., Detroit Artillery Armory, Oak Park, Michigan.*

28-30 Annual Industry Display, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

29-30 Fifth Annual Electron Devices, IRE Professional Group on Electron Devices, Shoreham Hotel, Washington, D. C.*

November

2-5 11th Exposition of the ARI, Air-Conditioning and Refrigeration Industry, Atlantic City, N. J.

3-5 Mid-America Electronic Conference, Kansas City Section of the IRE, Kansas City Municipal Auditorium, Kansas City, Mo.

4-6 National Automatic Control Conference, IRE, Sheraton-Dallas Hotel, Dallas, Texas.

4-6 Eastern Analytical Symposium and Instrument Exhibit, Baltimore-Washington, Delaware Valley, New York and New England Sections of the Society for Applied Spectroscopy, Analytical Groups of the N. Y. and N. J. Sections of the American Chemical Society, Metropolitan Microchemical Society, Hotel New Yorker, N. Y.

4-6 ANS Winter Meeting, American Nuclear Society, Sheraton Park Hotel, Washington, D. C.

*Includes meetings described herewith.

5th National Communications Symposium, October 5-7

The requirements, progress, and challenge of communications will be stressed at the 1959 symposium. Sponsored by the IRE PGCS, the sessions will cover two major areas: (1) communications systems and (2) communications equipment and related techniques. Approximately 50 engineering and manufacturing concerns from the communications field will exhibit their prod-

ucts during the three-day meeting. The symposium will be held at the Hotel Utica, Utica, N.Y. Technical program chairman is Ralph L. Marks, Griffiss Air Force Base, Rome, N.Y.

Value Engineering Symposium, October 6-7

The Electronic Industries Assoc. will sponsor this symposium at the University of Pennsylvania. Participating will be those industry members and military personnel acquainted with the successful use of value engineering tools. R. S. Mandelkorn of Lansdale Tube Co., a subsidiary of Philco Corp., is general chairman of the symposium.

4th IRE Canadian Convention, October 7-9

The Automotive Building at Exhibition Park, Toronto, Canada, will be the site of this convention. Over 100 papers covering the latest developments and techniques in electronics and nucleonics will be presented. Among the branches of the industry to be represented will be audio, components, computers, industrial electronics, transistors, and tubes. The Canadian Sections of the IRE are sponsoring the show. Eric L. Palin at Exhibition Park is general chairman.

15th National Electronics Conference, October 12-14

Virgil H. Disney, president, reports that the NEC will hold its sessions at the Hotel Sherman in Chicago, Ill. Sponsored by the AIEE, Illinois Institute of Technology, IRE, Northwestern Univ., and Univ. of Illinois, the conference will include discussions on circuit theory, communications systems, microminiaturization, servo mechanisms, value engineering, and other topics.

Michigan Industrial Electronics Exposition, October 28-29

Electronic Representatives, Inc. will sponsor this show at the Detroit Artillery Armory, Oak Park, Mich. Exhibitors will include manufacturers of industrial electronic equipment and components as well as Michigan electronics representatives. Technical papers will be presented at sessions scheduled to run concurrently with the exhibitions. Show manager is R. G. Wood, 830 W. Vernor, Detroit 1, Mich.

5th Electron Devices Meeting, October 29-30

To be held at the Shoreham Hotel, Washington, D.C. The conference, sponsored by the IRE PGED, will present papers dealing with material of an applied or developmental nature in the field of electron devices. This should include electron tubes, semiconductor devices, masers, parametric amplifiers, and other solid state device configurations. John A. Hornbeck of Bell Telephone Labs, Murray Hill, N.J., is technical program chairman for the meeting.

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EDITORIAL

Reliability—Our Goal, Too

Design engineers need accurate, authoritative information for their work. We spend most of our editorial efforts making sure that material published in ELECTRONIC DESIGN is reliable and therefore useful to design engineers. We do this by constantly checking all the data we get before it gets into print.

We check manuscripts before acceptance—not only with our staff, but often with outside authorities to be sure the information presented is correct. We check news releases to be sure we get the correct names, dates, places, and significance of the event. We question claims made in new product releases to be sure the items are new or basically improved and that their performance is correctly described.

Short of building the circuit or trying out the new product ourselves, we do all we can to make sure readers get accurate information. We usually take a manufacturer's word that the claims he makes for his product are honest. He has little to gain from exaggerated or false claims.

We check copy before it goes to the printer and again when it returns in galley form. We check copy when we send it to the printer in dummy form and again when it returns in page form.

We make these efforts because we realize the power of the printed word. In order to avoid misusing this power, we are guided by some simple rules: It is our policy

- To make all reasonable efforts to insure accuracy of editorial matter presented in ELECTRONIC DESIGN.
- To promptly publish corrections brought to our attention.
- To not knowingly publish misleading advertisements in ELECTRONIC DESIGN.
- To reserve the right to refuse any advertisement.

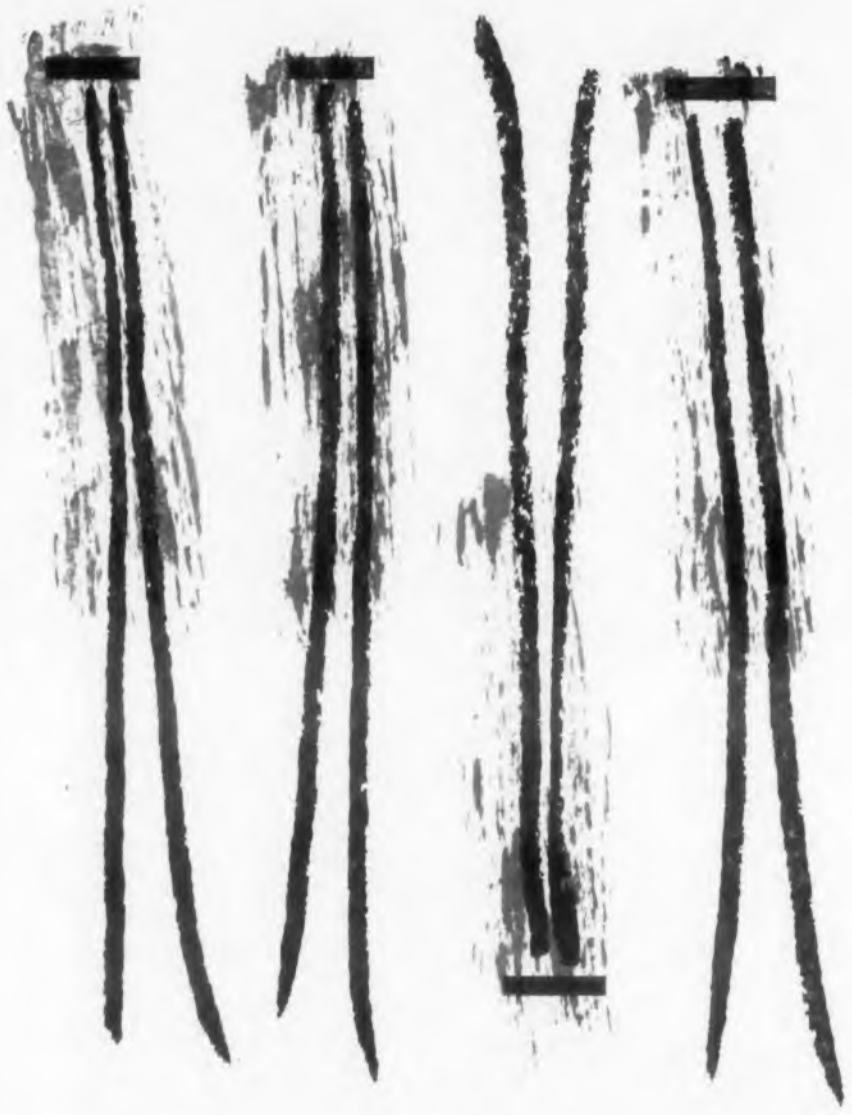
We have and will continue to operate under this policy.

More Reader Convenience

Observant readers of ELECTRONIC DESIGN may have noticed the recent change in our binding. An experiment since the July 8 issue, or new method of binding (known as "Perfect Binding" in the trade) offers readers these advantages: a magazine that lies flat for easier reading, a spine that shows the dates for easier issue identification, and a pad-like back from which pages can be torn out easily for article filing.

All this in the name of more reader convenience.

Edward E. Grazda



DESIGN FORUM

Using Photoconductive Cells

Photoconductive cells offer advantages of light weight, small size and high sensitivity. These features offer many new opportunities for designers to utilize light operated devices. This article discusses the principal advantages of these cells and discloses some representative applications. Information contained in this article was supplied by Clairex Corp., 19 W. 26th St., New York, N. Y.

SENSITIVITY of conventional photocells has always been a problem. This problem has been alleviated through the development of a semiconductor light-sensitive component—the cadmium sulfide and cadmium selenide photoconductive cells. These photoconductive cells now offer the design engineer a component about a million times more sensitive than the conventional photoemissive tube.

The cell is basically a variable resistor in which the resistance varies with the light intensity. Therefore, by replacing a fixed resistor as a critical circuit element with a photoconductive cell, the circuit becomes a critical function of light. Note in Fig. 1 that these cells are useful over a wide range including very low light levels.

Design Parameters

One of the important advantages of cadmium sulfide and selenide cells is their small size and

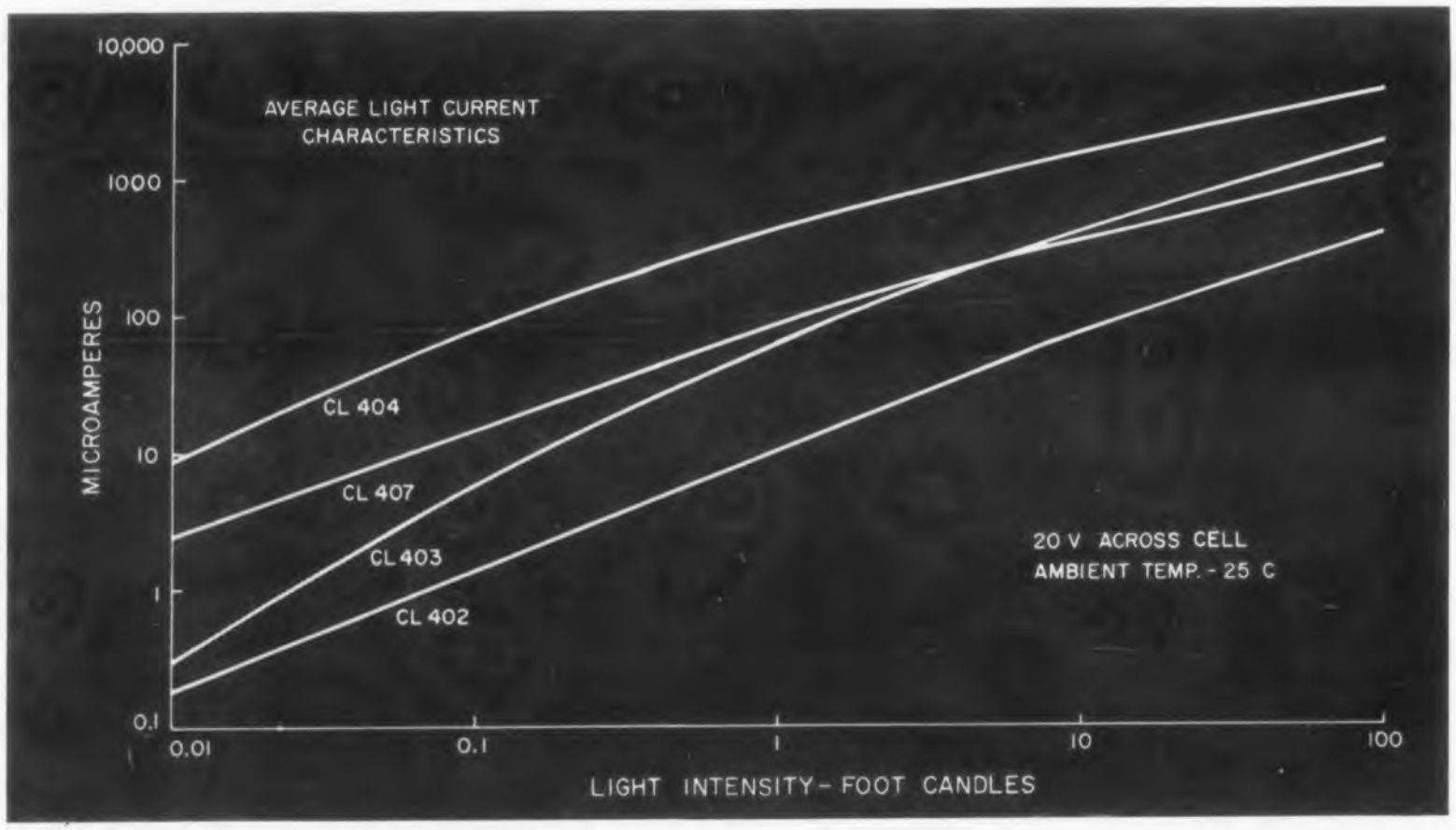


Fig. 1. Sensitivity of four typical Clairex cells.

Fig. 2. Small size and weight is one advantage of photoconductive cells. This is one packaging method.

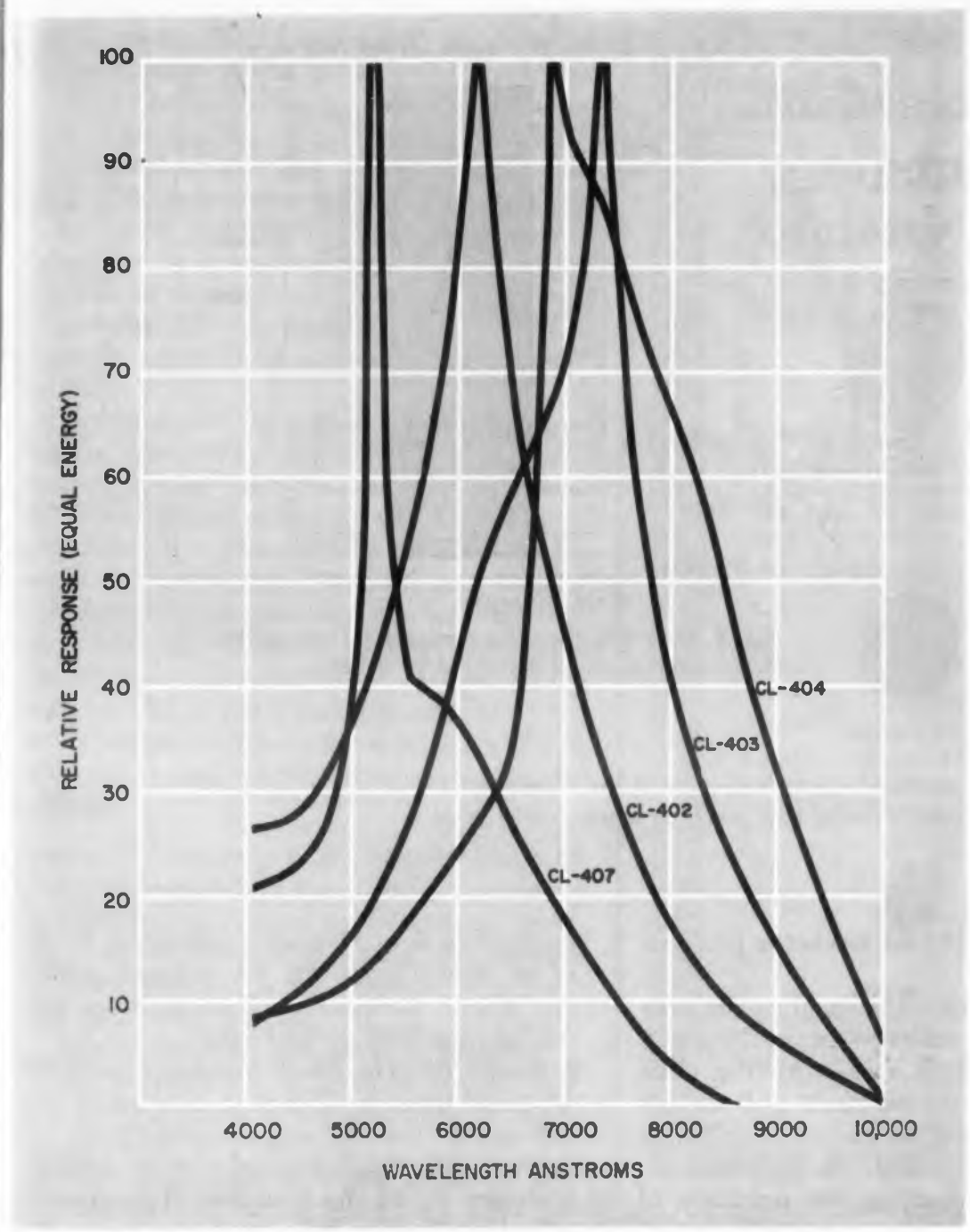


Fig. 3. Average spectral response of typical photoconductive cells.

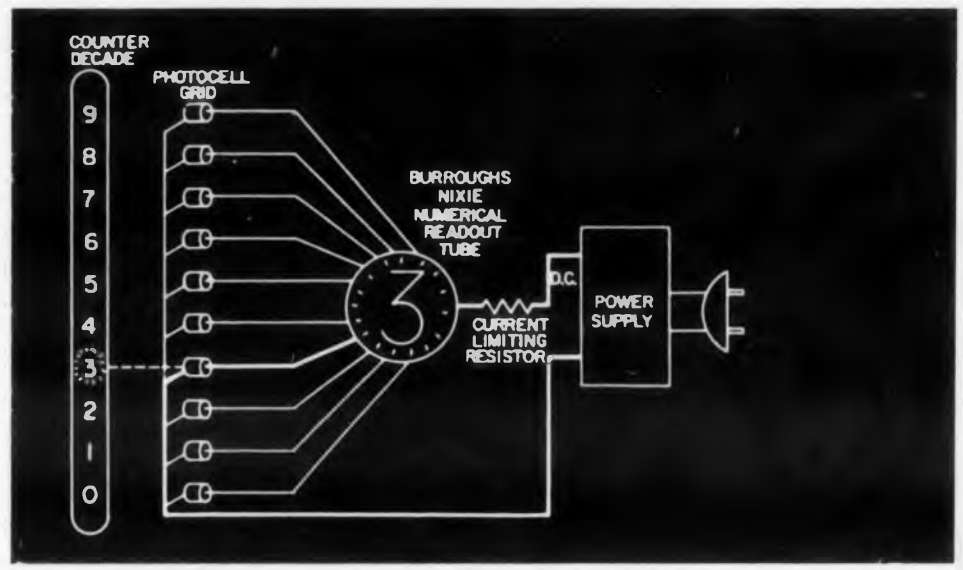


Fig. 4. Basic "Digi" system showing how photocells pick up neon light indication and convert it to numerals.

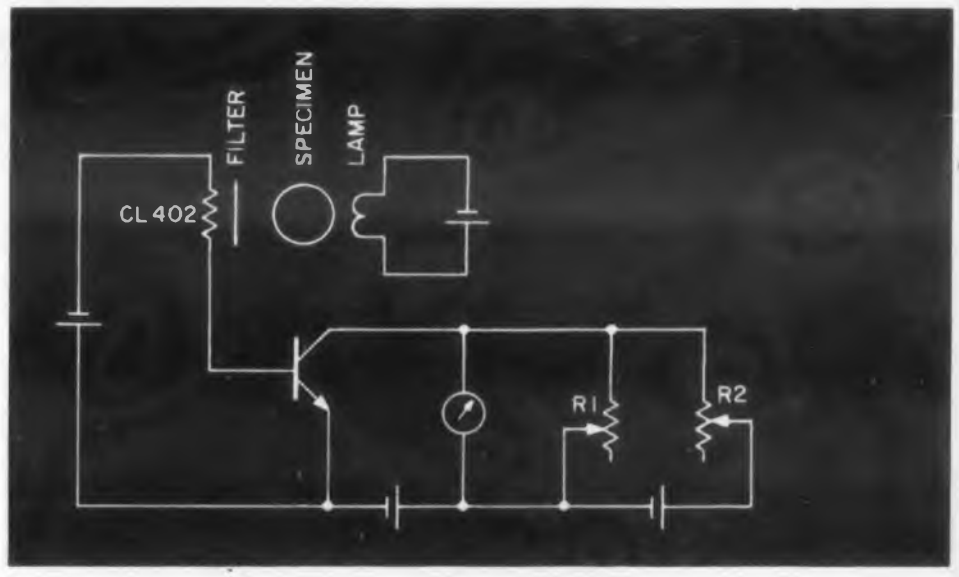


Fig. 5. Transistor Circuit of this blood hemoglobin tester uses a Clairex 402 photocell as detector.

weight (Fig. 2). Nucleus of the unit is the rectangular semiconductor element receiving the light; the balance of the cell consists of the carefully designed enclosure for this element, either glass or plastic.

In addition, the photoconductive cell has one of the widest ranges of application. Circuits may be transformed into functions of light by "switching resistors." Though all the cells are sensitive in the visual range, some types are also sensitive in the near infrared region, others, even into the ultraviolet region.

Various cells are also able to distinguish between visible colors. This may be of importance where many interfering light sources are available but only one is of controlling interest.

Another of the interesting facets of the photoconductive cell is that it can operate over a wide range of voltages from microvolts to a few hundred volts. In many instances, a 12 v battery is the power source for the unit. This feature again reduces the size of the system by reducing the related equipment needed.

Operating temperature characteristics of the photoconductor depends upon the exact formulation of the materials used, polycrystalline cadmium sulfide and cadmium selenide. The range is −50 to +75 C.

Power dissipation for the cells is in the range of 50 to 75 mw depending upon the enclosure. The cells may be soldered directly into a system's circuit without the use of a heat sink. Equal conducting properties irrespective of polarity permit the use of the cell as a modulator. This also facilitates production in that no polarity markings need be followed for correct usage.

Time constant may be rather large for some applications. It varies inversely with light intensity and is different for different cell types. The time constant is essentially the only limitation of cadmium sulfide and cadmium selenide photo-conductive cells.

The spectral response, shown in Fig. 3 is one of the most important parameters of the cells as it allows different cells to distinguish between different colors.

Applications

Digital-to-Digital Converter. Converting vertical decimal presentation into "in-line" direct reading presentation is accomplished with the circuit shown in Fig. 4. Its purpose is to provide the operator with numerals large enough for easy, rapid, nonambiguous reading.

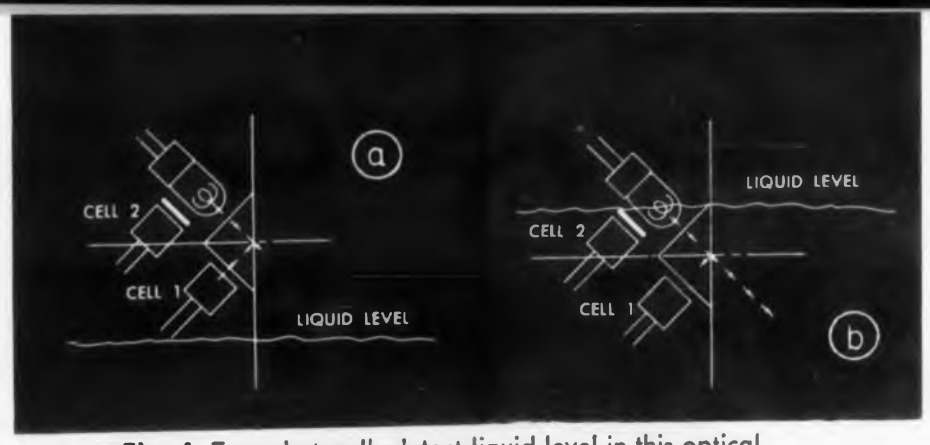


Fig. 6. Two photocells detect liquid level in this optical level indicator. Dry condition is at (a); wet condition at (b).

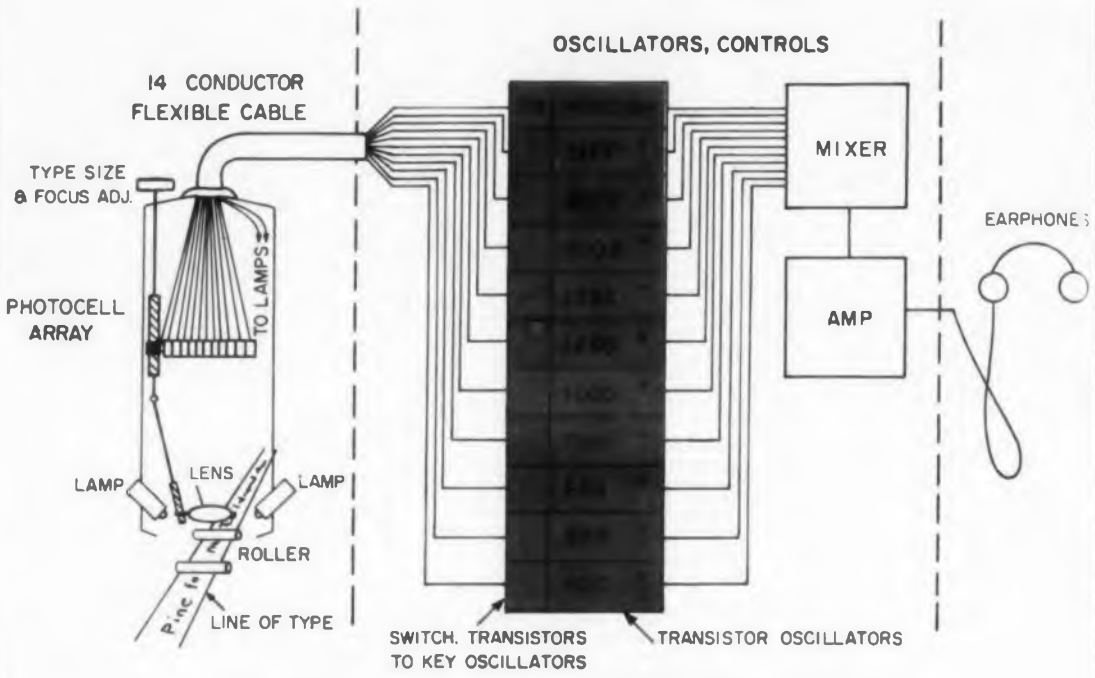


Fig. 7. Block diagram of the experimental type reading machine for the blind developed by Battelle.

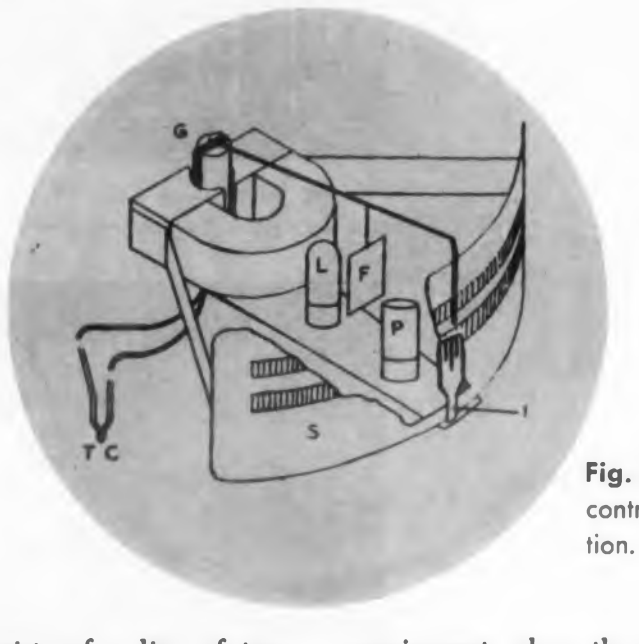


Fig. 8. Sketch of working parts of the West furnace controller showing how photocell senses pointer position.

Basically, the system consists of a line of ten photoconductive cells, each lined up so it is energized by one of the neon lamps. When the lamp is illuminated, the photocell allows the appropriate cathode of a Burroughs Nixie tube to fire.

Radio Frequency Laboratories, Inc., Boonton, N. J., manufacture two models of the converter, the Digidec and the Digiverter.

Photoelectric Colorimeter. For medical applications, Hughes Instrument, Berkeley, Calif., is marketing an Hg B Meter for rapid blood hemoglobin determinations. In the circuit of Fig. 5, a Clairex CL 402 cell was chosen as detector because its spectral peak is near the absorption peak of hemoglobin (5200 Angstroms). Output from the cell, which is proportional to the light transmission of the sample, is fed to the emitter base of the transistor, which acts as a simple current amplifier. Both ends of the meter scale are adjusted with *R1* and *R2* using known samples. An unknown sample may be read directly from the scale. Low input voltage and low current drain are features of this portable unit.

Optical Level Indicator. Two photoconductive cells are the heart of an optical level indicator made by Revere Corp. of America, Wallingford, Conn. Designed for use in water-alcohol mixtures, aviation gas, jet and hydrocarbon fuels, and hydraulic and lubricating oils, these units actuate indicator lamps, valves, pumps or other electrical equipment when the liquid reaches a predetermined level.

Detection of liquid level is based on the principle of total internal reflection. In the dry condition, Fig. 6(a), the light rays strike the plane between the prism of the surrounding air and are reflected on to the sensitive surface of cell *1*. In the wet condition, Fig. 6(b), the light rays are not reflected, thus changing the resistance of cell *1*.

This change in resistance is used to control a circuit in which a power transistor applies power to the load in the wet condition, and removes power in the dry condition. With different circuitry, the operation may be reversed.

A filter between the lamp and photocell 2 adjusts the light intensity so that the resistances of the two cells are about equal in the dry condition. Thus, temperature and voltage changes have little effect on the system.

Because operation of the unit does not depend upon lightrays passing through the liquid, the unit is not affected by coloring or contamination of the liquid.

Watthour Meter Tester. A cadmium sulphide cell provides the sensitivity necessary for accurately testing watthour meters. This General Electric Co. unit is able to measure light and dark variations caused by light shining through the anti-creep holes in the rotating disk. All relays are operated on dc to eliminate timing errors. Because of its greater sensitivity, the cadmium sulphide cell is able to detect the light impulses under conditions of high ambient light.

Reader For The Blind. Developed at Battelle Memorial Institute, Columbus, Ohio under sponsorship of the Veterans Administration, this machine utilizes a number of separate oscillators controlled by an equal number of photoelectric cells (Fig. 7). The cells, each responding to a specific level in the black areas making up a letter, cause their associated oscillators to produce tones whenever letter segments are present. The tones are heard for as long a time as the lens of the reader is held over a given letter segment. Thus, if a letter like lower-case "*l*" is being read, several tones would be heard simultaneously, whereas the vertical middle section of the letter "*o*" would activate only two tones, one of low and one of medium pitch.

In the design, it was necessary to determine the number of photocells to be used in the reader. Too few photocells would not provide a basis for discrimination among similar letters, while too many would increase the cost and complexity of the device. An analytical study of the problem revealed that there was no appreciable difference in the ability of subjects to discriminate letters with 8, 9, 10, 11, or 12 photocells. However, engineering work which was progressing concurrently with the psychological research indicated

that the reliability factor would be poor with less than 10 photocells. To insure high reliability of oscillator triggering for a variety of conditions that might be encountered, it was decided to include 11 photocells.

In operation, the lens projects a magnified image of the letter being read upon a linear array of 11 photoconductors mounted in the reading probe. The letter image normally is focused on only nine of the photocells, as the two end cells are provided primarily for tracking purposes. The combined height of the nine photocells receiving the image is 0.675 in.

The photoconductor is connected in a voltage-dividing circuit. When one or more of the photoconductors "sees black," i.e., when a dark image of a letter segment covers it, resistance and voltage across the photoconductor increase. This causes the base voltage of the switching transistor to become more positive than the collector voltage, closing the "switch." In this manner the photoconductor controls the output signal of the oscillator. The output signal is attenuated by the mixing circuit; therefore, a single stage of amplification is used before the signal reaches the earphones.

Furnace Controller. On a controller made by West Instrument Corp. the controlling action of the instrument is obtained by the use of a photocell. A manually operated setting arm carrying the index pointer may be positioned at any desired point along the scale (Fig. 8). On this arm, but behind the scale, are small light source (*L*) and the photocell (*P*), so arranged that the light from the light source is projected upon the sensitive surface of the photo cell.

As long as the light strikes the photocell, sufficient current flows so that it can be used to control a magnetic amplifier which in turn is used to activate a relay. The relay may control the fuel or power to the furnace. When the temperature reaches a point where the positions of the millivoltmeter and the preset pointers coincide, the opaque flag (*F*) on the millivoltmeter pointer arm interrupts the light beam and the current flowing in the photo cell circuit is insufficient to energize the relay so that it now drops out, shutting out the power to the furnace.

To obtain control action a slight movement of the indicating pointer is required; however, since the photocell permits varying degrees of current to pass depending upon the position of the opaque flag with respect to the light and cell, proportioning control action can be obtained. Proportioning control action is obtained by using a variable bias along with the photocell. In a reasonably balanced thermal system the on and off time of the instrument is maintained or varied by slight changes in photocell current. ■ ■

Seven Rules for Scaling Impedance Level and Frequency

E. Brenner and S. R. Parker
The City College of New York
New York City, N. Y.

Network transformations are easy with these seven rules.

SEVEN RULES, applied to linear passive networks, make it easy to extend existing network designs and synthesis procedures beyond their immediate purpose. In addition, these rules, essentially normalization procedures, enable the designer to do the bulk of numerical work with convenient numbers which minimize the chance of numerical error.

This article deals with four such procedures:

- Impedance level adjustment
- Frequency scaling
- Frequency inversion
- Frequency translation.

Objectives and Definitions

Impedance Level Adjustment. If a network has been designed for a particular value of a certain element (e.g. a load resistance of 1 ohm or a coupling capacitance of unit value) then the rule of impedance level adjustment makes it possible to use the same design for any value of that element. The procedure is also useful for adjusting the input impedance of networks to avoid the loading of sources.

Frequency Scaling. A network which has been designed to have a specified frequency response with a certain "critical" frequency (e.g. half-power point) can be converted to one having the same frequency response with any other critical frequency. For example, a low-pass filter with cut-off frequency f_1 and an attenuation α at a frequency f_2 can be converted to a low-pass filter with a cut-off frequency at f_1' and an attenuation α at $f_2' = f_2\,(f_1'/f_1)$.

Frequency Inversion. A design which results in a certain frequency response $H(j\omega)$, can be used to realize a network which has the frequency response $H(1/j\omega)$, so that the new frequency response curve can be obtained by replacing ω with $1/\omega$ on the abscissa of the old curve. Thus a low-pass network design can be converted into a high-pass network.

Frequency Translation. A network design which gives a certain frequency response between dc and f_1 can be converted to a network which has the same response curves in a different band of frequencies. Thus a low pass filter, with cut-off frequency f_1, can be used to realize a band-pass filter with center frequency f_0 and a band width

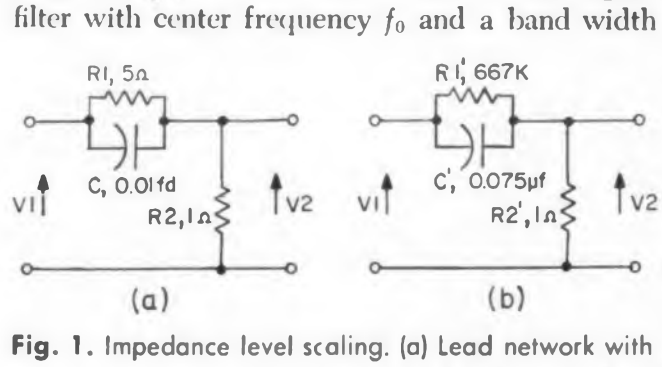


Fig. 1. Impedance level scaling. (a) Lead network with input impedance of six ohms at dc. (b) Network of (a) with impedance level changed to give 800 K at dc.

Rules for Network Conversions

Rule	Original Network Property	New Network Property	Obtain the new circuit by replacing in the original circuit every L by	C by	R by
1.	$Z(j\omega)$ or $\frac{Z(j\omega)}{Z_{max}}$	k_L, $Z(j\omega)$ or $\frac{Z(j\omega)}{Z_{max}}$	$k_L L$	C/k_L	$k_L R$
2.	$H(j\omega)$	$H(jk_F\omega)$	L/k_F	C/k_F	R
3.	Time constant τ. Natural freq f_o	Time constant τ/k. Natural freq kf_o	L/k	C/k	R
4.	$H(j\omega)$	$H\left(\frac{1}{j\omega}\right)$	1/C	1/L	R
6.	Low pass cut-off $\omega = 1$	Bandpass cut-off ω_1, $\omega_1 + 1$, $\omega_o^2 = \omega_1(\omega_1 + 1)$	Series LC circuit $(1/\omega_o^2 L)$ fd, L h	Parallel LC circuit $(1/\omega_o^2 C)$ h, C fd	R
7.	Bandpass Bandwidth B	Bandpass Bandwidth KB	L/K if in series with a C; LK if in parallel with a C	CK if in series with L; C/K if in parallel with L	R

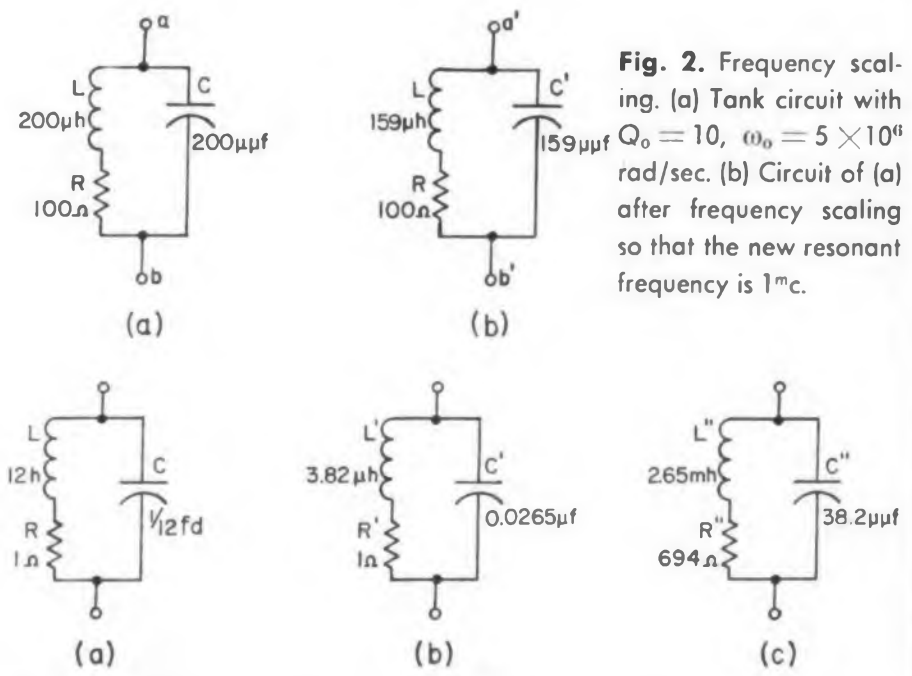


Fig. 2. Frequency scaling. (a) Tank circuit with $Q_o = 10$, $\omega_o = 5 \times 10^6$ rad/sec. (b) Circuit of (a) after frequency scaling so that the new resonant frequency is 1 mc.

Fig. 3. Combined frequency and impedance level scaling. (a) Tank circuit with $Q = 12$, $f_o = \frac{1}{2}\pi$ cps. (b) Circuit of (a) with frequency scaled so that $f_o' = 500$ kc (c) Circuit of (b) after impedance level is raised to give 100 K at resonance.

f_1. It is also possible to use frequency translation to expand or compress the bandwidth to kf_1.

Combinations. It is possible and usually necessary to apply several of these transformations in a single network to achieve the desired results. It is also noted that changes in the frequency response correspond to changes in the (transient) time response. These effects are also summarized here.

Impedance Level Scaling

Rule 1. "The impedance level of a linear, passive network is multiplied by a constant k_L if every resistance value and every inductance is multiplied by k_L and every capacitance value is divided by k_L."

A change in impedance level by the factor k_L means that, at every frequency, the new network requires k_L times as many volts from a source to produce the same current (in every branch of the circuit) as in the original network.

Thus the shape (amplitude and phase) of the frequency response curves remains unchanged—only the scale of the amplitude curves is changed by the factor k_L. A change in impedance level has no effect on the time constants, natural frequencies or frequencies of transient oscillations in the network.

Example. A "lead" network (Fig. 1a) is proportioned to give maximum phase lead of 45.5 deg at a frequency of 7.33 cps. Scale the network so that the dc input impedance is 800 K.

Solution. In the original network the dc input impedance (resistance) is 6Ω. Hence $k_L = 8 \times 10^5/6$, and the elements in the scaled network (Fig. 1b) are given as follows.

$$R_1' = 5(800\ K)/6 = 667\ K$$
$$R_2' = 1(800\ K)/6 = 133\ K$$
$$C' = (0.01)\ (6)/(8 \times 10^5) = 0.075\ \mu fd.$$

The network of Fig. 1b has the same amplitude and phase response for the voltage ratio V_2/V_1 as the network of Fig. 1a, but the impedance at terminal pair a'-b' is $8 \times 10^5/6$ times the impedance at terminals a-b at every frequency.

Frequency Scaling

Rule 2. "The frequency scale of any frequency response curve of a linear, passive network is multiplied by the factor k_F if every inductance value and every capacitance value is divided by k_F and every resistance value is left unchanged."

This rule follows from the observation that an inductance L has a reactance $\omega_1 L$ at the radian frequency ω_1; while an inductance, L/k_F, has the same reactance at the radian frequency $k_F\omega_1$. The same reasoning applies to capacitive susceptance and reactance. A change in frequency scale influences the time scale in accordance with Rule 3.

Rule 3. "When the frequency scale of the fre-

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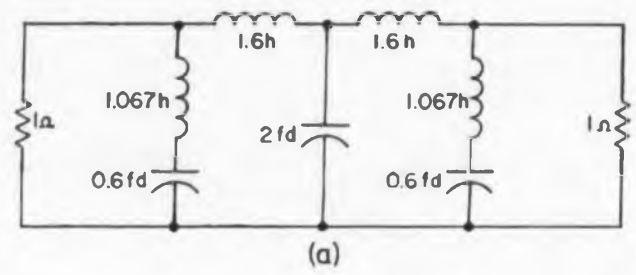

Fig. 4. Combined frequency inversion, amplitude response shifting, and impedance level scaling. (a) Constant *k* low-pass filter with radian cut-off frequency of 1 and nominal characteristic impedance of 1 ohm. (b) High pass filter obtained from (a) by frequency inversion. (c) Filter of (b) with cut-off shifted to 1000 cps. (d) Filter of (c) with impedance level raised to 600 ohms.

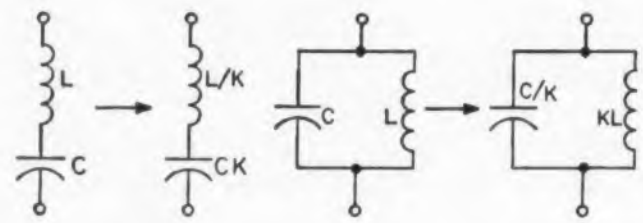

Fig. 5. Bandwidth multiplication by use of Rule 7.

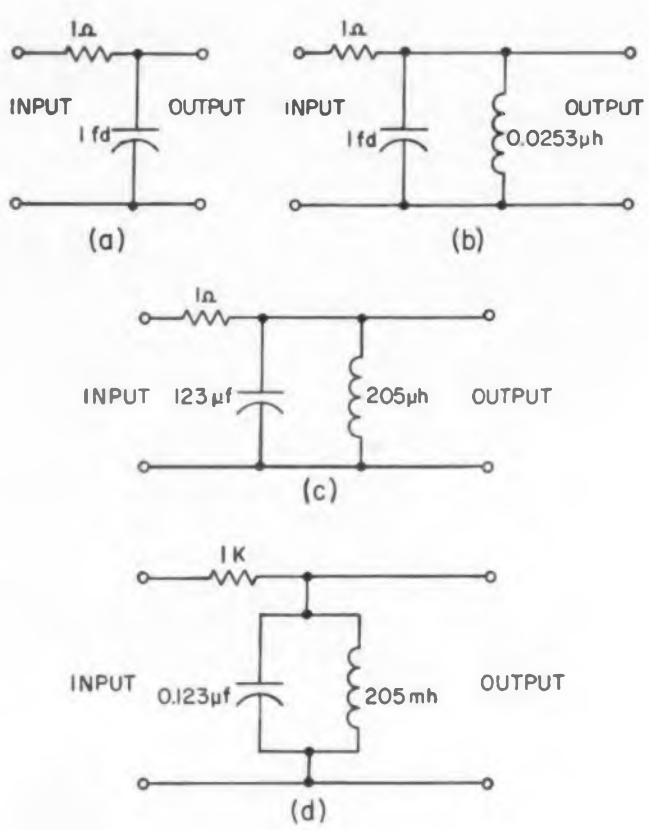

Fig. 6. Band shifting, band expansion, and impedance scaling. (a) An *RC* low pass filter with radian cut-off frequency of unity. (b) Bandpass revision of (a) with center frequency 1000 cps and bandwidth ½π cps. (c) Bandpass filter of (b) after expansion of band to 450 cps. (d) Filter of (c) with dc input resistance revised to 1 K.

quency response of a linear passive network is changed by the factor k_F in accordance with Rule 2, then the time scale of any transient response waveform is divided by k_F."

The interpretation of Rule 3 is illustrated by the following example: suppose that a sinusoidal source of frequency f_1 is applied to the original network and results in a steady state response of amplitude A, and a transient response which decays in t_1 seconds.

If the frequency scale of the frequency response curve is now multiplied by k_F, then a sinusoidal source of frequency $k_F f_1$ results in a response of amplitude A and a transient which decays in t_1/k_F seconds.

All time constants are divided by k_F and natural frequencies are multiplied by k_F independently of the source. It is also noted that the impedance level is not affected by frequency scaling since the frequency response curves of the scaled network have the same maxima and minima, etc., but each value occurs at k_F times the original frequency.

Example. A tank circuit (Fig. 2a) has a required $Q = 10$ and a resonant frequency $f_0 = 5(10)^6/2\pi$. It is desired to transform the resonant frequency of the tank to 1 mc and to maintain the Q at 10. The impedance level is to remain unchanged.

Solution. Since the new resonant frequency is $(2\pi/5)f_0$, $k_F = 2\pi/5 = 1.256$. The new circuit (Fig. 2b) is given by:

$$R' = R = 100 \text{ ohms}$$

$$L' = 200/1.256 = 159\ \mu h$$

$$C' = 200/1.256 = 159\ \mu\mu f.$$

Example. In this example, the combined use of impedance level adjustment and frequency scaling make it possible to use convenient but unrealistic numbers in the basic design.

Design a tank circuit which has a Q of 12, a resonant frequency of 500 kc, and a resonant impedance of 100 K.

Solution. Start with the circuit of Fig. 3a where $R = 1$ ohm. Let the resonant frequency be 1 rad/sec. Since Q is 12, $L = 12$ hy and $C = 1/12$ fd, the circuit of Fig. 3a has the desired Q, it has a resonant impedance (using the customary high Q approximation) of $Q^2R = 144\Omega$ at $\omega = 1$.

The frequency scale is now changed so that resonance occurs at a radian frequency of 2π x 500 x 10^3 rad/sec. Using $k_F = 3.14 \times 10^6$ the circuit of Fig. 3b results:

$$R' = 1 \text{ ohm}$$

$$L' = 12 \times 10^{-6}/3.14 = 3.82\ \mu hy$$

$$C = 10^{-6}/(12)\ (3.14) = 0.0265\ \mu fd.$$

The resonant impedance of this circuit is 144 ohms. Hence the impedance level must be raised by $k_L = 100 \times 10^3/144 = 694$. The desired circuit is shown in Fig. 3c.

$$R'' = 694\ R' = 694\Omega$$

$$L'' = 694\ L' = 2.65\ mhy$$

$$C'' = C'/694 = 38.2\ \mu\mu fd.$$

Frequency Inversion

Rule 4. "If in a linear, passive network every inductance of L henries is replaced by a capacitance of $(1/L)$ farads and if every capacitance of C farads is replaced by an inductance of $(1/C)$ henries then, provided that the resistance values remain unchanged, the amplitude response curves of the new network are identical to those of the old network if the radian frequency variable ω is replaced by $1/\omega$."

This rule is frequently combined with Rule 2 so frequency inversion and scale change can be carried out in one operation. Thus a radian "center" frequency ω_c is chosen, every inductance L is replaced by a capacitance $(1/\omega_c^2 L)$ and every capacitance C is replaced by an inductance $(1/\omega_c^2 C)$.

The two networks then have the same amplitude response but the "new" network, at a radian frequency ω_c^2/ω, has the response which the "old" network has at ω_1.

Rule 5. "The application of Rule 4 results in a new network whose phase response is the negative of the phase response of the original network."

Example. A constant *k* low-pass filter (Fig. 4a) has a radian cut-off frequency of unity. It is terminated at each end in an *m* derived half-section ($m = 0.6$) and the nominal characteristic impedance of

(Continued from page 29)

1 ohm. Very high ("infinite") attenuation results at $\omega = 1.25$. Convert Fig. 4a to a high pass filter with cut-off frequency 1000 cps with 600 ohm termination.

Solution. By application of Rule 4 the circuit of Fig. 4b is deduced. This high-pass filter has a radian cut-off frequency of unity. Rule 2 is now applied with $k_F = 6280$ to shift the cut-off frequency to 1000 cps and the circuit of Fig. 4c results. Rule 1 is now applied with $k_L = 600$ to shift the impedance level and the design is completed as shown in Fig. 4d. This filter has "infinite" attenuation at $f = 1000/1.25 = 800$ cps.

Frequency Translation (Low-Pass to Band-Pass)

Rule 6. "A linear, passive low-pass network with cut-off frequency $\omega = 1$ can be converted into a band-pass network with a bandwidth of 1 radian/sec, and cut-off frequencies ω_1 and $\omega_2 = \omega_1 + 1$, centered about ω_o such that ω_o is the geometric mean value

$$\omega_o = \sqrt{\omega_1 \omega_2}$$

or

$$\omega_{1,2} = \frac{1}{2}\left(1 \pm \sqrt{1 + 4\omega_o^2}\right)$$

if one connects in series with every inductance of value L henries a capacitance with value $(1/\omega_o^2 L)$ farads and if one connects in parallel with every capacitance C an inductance of value $(1/\omega_o^2 C)$ henries.

While one can use Rule 6 in conjunction with the preceding rules to convert either a low or a high-pass filter into band-pass filter with any desired value of ω_o, it is convenient to cite an additional rule which can be used to "expand" the band by a factor K (i.e. change the bandwidth from 2 radians/sec to $2K$ radians/sec).

Rule 7. "If in a bandpass filter every series LC combination is replaced by an L/K, CK series combination and every parallel LC combination is replaced by a KL, C/K parallel combination (see Fig. 5), the bandwidth of the filter is multiplied by K and the center frequency of the band remains unchanged.

Example. Convert an RC low pass filter with cut-off at unity radian frequency (Fig. 6a) to a band-pass filter whose band extends from 800 to 1250 cps. The dc input resistance is to be 1.0 K.

Solution. Applying Rule 6, $f_o^2 = 800 \times 1250$, $f_o = 1000$, $\omega_o = 6280$. Hence in Fig. 6b, $L' = 1/(6280)^2 = 0.0253$ μhy. The band in Fig. 6b is 1 rad/sec. It must now be expanded to 2π (450) radians/sec.

Apply Rule 7: The 1 fd capacitance is replaced by $1/900\pi = 123$ μfd and the inductance L' is replaced by $900\pi L' = 205$ μhy. The result is shown in Fig. 6c. The impedance level is now adjusted to 1 K (Rule 1) ($k_L = 1000$). The result is shown in Fig. 6d. ■ ■

Simple Aluminum Soldering

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Aluminum solders have not gained widespread usage in spite of the advertised ease in handling the solder process. Harry Hirst (below), author of this article, backs up these claims of easy handling and presents data to show how well aluminum solders work.

SOLDERING ALUMINUM presents tricky difficulties: the metal has high thermal conductivity (a problem in working with large sections); a large coefficient of expansion (severe distortions may result), and an oxide coating on the surface that forms rapidly in oxygen (preventing the solder from adhering).

Successful soldering calls for careful craftsmanship, removal of the coating and selection of the correct solder.

The oxide coating, Al_2O_3, essentially ceramic in nature, is thin and nonporous. It can be removed only by a strong flux, by abrasion in the absence of oxygen or by an electric arc. Since aluminum will melt before the oxide coating will, the best method for removal in soldering is either abrasion, a flux or a combination of the two. The electric arc process is used mainly in welding.

The oxide coating must be removed during the application of the solder; otherwise the solder will not adhere to the aluminum.

Removing Oxide Film

There are many methods for removal of the oxide film by the abrasion process. One method uses ultrasonics. This system is relatively expensive and consists of the solder gun and a high frequency power pack to vibrate the tip of the gun. A large joint requires a more powerful unit.

Other abrasion means use stainless steel wool or brushes, and brushes made of glass fibers. These materials are used to abrade the oxide film through the molten solder pool. This abrasion process loosens the oxide from the metal surface and allows it to come to the solder surface. The solder can then contact the surface of the aluminum. "Friction soldering" is the term used for this type of process which can also be accomplished by using the soldering stick itself to scrape the oxide loose beneath the solder pool. The solder stick in this case should be of a suitable shape to facilitate scraping and of a high melting point solder alloy.

The most common method of oxide removal is by use of fluxes. Two types of fluxes can be used depending on the solder and the temperature at which it is applied. The first type is made up of metallic salts, usually zinc chloride or another metal halide with smaller amounts of other chlorides and fluorides. These fluxes are extremely effective, highly hygroscopic, very corrosive, and must be thoroughly removed after the joint is made. The second type of flux is for use on items that do not lend themselves to thorough removal after the joint is made and contain no chlorides. These latter fluxes are used when the soldering temperature is less than 525 F with a soldering alloy containing four metals.

Choice of Solder

Solders that can be used on aluminum are made up of metals that will alloy with each other and to a certain extent with aluminum. In considering an aluminum solder, the combination of metals in the solder alloy should be known in order to define the working temperature, the strength of the joint, and the corrosion resistance of the alloy combination at the joint.

Four basic metals are used in the alloys for soldering aluminum. They are zinc, tin, cadmium, and lead, in various combinations and mixtures. Some of these combinations have been used as die casting alloys.

Zinc base solders of 90 per cent zinc minimum, have the highest strengths and melt points with the greatest corrosion resistance. One alloy of this type has a tensile strength of 51,000 psi, is used as a die casting alloy under the name of Zamak III and works well as a friction solder. These alloys are very useful in any atmosphere in which galvanizing is recognized as good corrosion protection. The soldering temperatures of these alloys are from 700 to 820 F.

Tin base alloys are set up usually in two combinations with zinc as the secondary metal. Some other alloys are now being used with the ultrasonic process consisting of tin in various percentages with copper or cadmium as the second metal in the alloy. These solders are easier to apply than the zinc base solders and provide medium strength joints with fair corrosion resistance. In humid atmospheres, these alloys should be used on long lap joints to prevent moisture penetration, but in salt atmospheres, the solder may swell and crack if the secondary element is incorrect for the required condition. One method of protection against corrosion is to seal the joint with adequate coats of paint. The melt points of these alloys is from 500 to 750 F.

Lead base solders are similar to those used for ordinary soft soldering but require extremely active special fluxes. These solders are very weak in comparison to the zinc base materials, will not withstand prolonged humidity, and should only be used for interior applications. These solders are applied at approximately 450 F.

Cadmium base solders have strengths slightly less than the zinc base solders. These solders are very susceptible to swelling and cracking if aged over a period of years in humid atmospheres. Soldering temperature of these alloys is from 510 to 750 F.

The strength of a joint made up of any of the solder alloys is dependent on the adhesion to the base metal, the strength of the solder alloy, the size of the fillet, and the penetration of the alloy through the joint. Zinc base alloys have tensile strengths of 15,000 to 41,000 psi. Tin base alloys have tensiles of 8000 psi, and the lead base solders are in the range of 5000 psi. All of the above strengths are for the alloys alone and will vary depending on the metal mixture in the alloys. If the metal items being joined are of 1100 series aluminum the maximum tensile of this material is 13,000 psi, and if the joined metals are of 6061 alloy, the maximum tensile is 18,000 psi. From the above figures it can readily be seen that it is possible to create a joint that is stronger than the ma-

Fig. 1. Typical sample used in the tensile testing of the aluminum solder joints. Joint section is 1 x ⅛ in.

Fig. 2. (left) View of lap joints made with aluminum solder. The joint on the bottom shows excellent capillary action and full penetration due to tinning. The joint on the top was not tinned and has very little penetration.

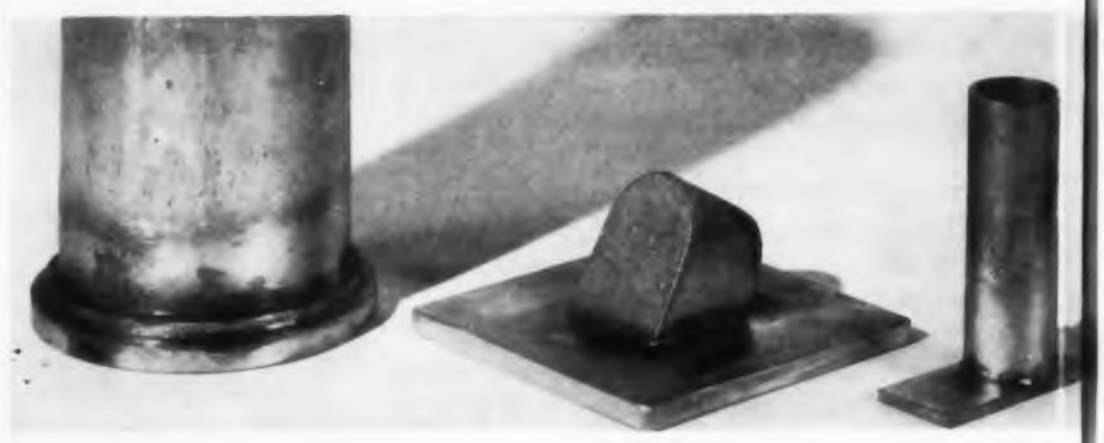

Fig. 3. (above) Various shapes that have been soldered with excellent results. The center is a casting soldered to 6061 aluminum sheet.

terials being joined if the proper solder alloy is correctly applied at the joint.

In using a solder on an aluminum joint, it must be remembered that the higher the solder temperature, the more fully annealed the materials being joined become. Temperatures over 400 F will create some annealing of aluminum during the solder process. The amount of the annealing is controlled by the temperature involved and the length of time this heat is applied to the work pieces.

Table 1. Tensile Test Results on "T" Joints

Melt Point, F.	Sample	Breaking Load, lb. before salt spray	Breaking load, lb. after 72 hr salt spray ASTMB117-49T
750 - 820	1A	2150	1730
600 - 750	1B	2130	2130
	2B	1650	997
	3B	1730	—
	4B	1400	1390
	5B	1350	1350
340 - 500	1C	1463	980
	2C	1837	705
	3C	910	905
	4C	100	—
	5C	1657	1600
	6C	760	745

Results of tensile test on "T" joints. Hours of salt spray are length of time that it took to cause failure of the 6061-T6 aluminum alloy test samples. Samples which show no tensile readings after salt spray were samples on which the solder had failed in the salt spray chamber.

Tensile Tests

To get the solder alloys that are described above was a problem in itself, for the producers of aluminum solders are much opposed to revealing the special mixtures that they use in their alloys. One manufacturer that was asked about the corrosion resistance of his solder admitted that it would not hold up under severe humidity conditions but that a new alloy they were working on would. Another manufacturer merely stated that their alloys had been used on some government work and proved satisfactory for the required application. Since listing the solders tested by the elements they contain was not feasible, it was decided to set up a list by melt points and numbers (Table 1). Fifteen solder alloys were tested for capillary action, strength, and corrosion resistance. All but two of the solders were readily obtained at local welding supply houses. In the solder tests on these alloys, only twelve of the fifteen operated in a satisfactory manner.

Soldering of the aluminum samples for the tests was done with a torch as the heat source. Flux, when used, was applied before heating, and in the case of the low temperature solders (600 F or less), the torch flame was not allowed to touch the flux coating. All grease, oil, and dirt was removed from the samples to be joined, and garnet cloth was used to partially remove the oxide coating. The samples that were flux soldered were rinsed with hot water after soldering. These samples were made up in the form of tees with the vertical leg of 1/8 by 1 inch 6061 T6 aluminum (Fig. 1). The horizontal leg was also of this material with the same dimensions.

Human Factor Important

The importance of the solderer cannot be overlooked in the soldering of aluminum. Three solderers were tried on this process and it was found that the best results were obtained by a solderer with considerable experience in soft solder and silver solder techniques on copper and brass, also one who had welded thin steel sections with a torch. The third solderer was one who had made very few solder joints on any type of material. This man was tried to test the saying, "now anyone can solder aluminum," and it was found that he could only produce worthwhile results with one of the solder alloys. These solderers had never soldered aluminum before, but the first two had made braze joints on aluminum using a torch as the heat source. The torch welder had made very few of these joints, but his experience on steel served him well on this new process.

Although the "T" joints were the only ones on which tensile tests were made, a considerable amount of other joints were also made to check the solders completely. On lap joints, Fig. 2, it was found that edge sealing would occur with no penetration of the joint. This condition occurred steadily in our trials until the pieces were first tinned and then slid together while still hot. Additional solder was then added which fully penetrated the joint. The joints referred to above were all horizontal lap joints in which the oxides floating on top of the molten pool of solder on the lower piece of aluminum prevented adhesion to the upper aluminum section. If both pieces are tinned the oxide will not form and adhesion to both surfaces does occur.

It was also found that no large build up of the fillet occurred when soldering with a torch. "T" joints made of 1/32-in. thick material had the same size fillets as those made of 1/8-in. material.

Some of the solder alloys used were recommended for use with and without flux. The flux was for use on joints that involved the filling of small cracks and the friction type of soldering over the fluxless or friction method. The most useful item provided by a flux is an indication of when to apply the solder. The solder fluxes, when heated, first dry out and then produce white fumes. When the fumes occur the temperature is said to be correct for solder application. In all of our tests with flux soldering we found this reaction to be extremely accurate.

Soldering of aluminum should not be compared to the soldering of copper or brass with soft solders for they are definitely not alike in appearance or actions. It was found that with most aluminum soldering alloys the time required to make an acceptable joint was longer than when soldering copper or brass and that more care had to be exercised in the handling of the torch and the solder. The solder joints are much different in appearance and tend to resemble a cold solder joint in some cases. The fuming of the flux and the oxide floating on the surface of the solder pool is confusing to an inexperienced operator who cannot understand where all the dirt is coming from on previous-clean metal. In one case with the above mentioned condition the operator gave up on the joint and was very surprised to find that when it was tested after cooling he had made a perfect joint.

Application of these aluminum solder alloys can be found in sheet metal work, plumbing, and wire joining Fig. 3 illustrates a few typical examples of pieces fabricated from aluminum. Model shop work on aluminum designs can be accomplished cheaply and easily with these solders. Further uses of these materials could be in the sealing of minor cracks and holes, reinforcing of a riveted seam for water tightness filling in dents, and reinforcing small framed structures.

In using these solders several aspects of these materials must be remembered. First, that the capillary action of the solders is very poor and secondly, that contact to the metal and the joint is dependent on the size of the fillet and that the proper solder choice can lead to a joint with equal or greater resistance to salt spray corrosion than the sections being joined. ■ ■

Acknowledgements

Aluminum Company of America
Kaiser Aluminum Inc.
Reynolds Metals Company
Modern Metals
Aluminium Company of Canada

DCDC

Design of Transistorized DC-to-DC Converters

Part II. Push-Pull Transformer-Coupled

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Complete procedures and equations are presented to enable the circuit engineer to design transistorized push-pull transformer-coupled dc-to-dc converters. A typical example is worked out to demonstrate the simplicity offered by the convenient step-by-step procedure together with tabulated key parameter data.

PUSH-PULL transformer-coupled converters, with full wave rectification, supply power to their load continuously and are, therefore, ideal for low-impedance, high-power applications.

Although not as economical and simple as the ringing-choke design (Part I, *ED* Sept. 16, 1959, p. 40), the push-pull configuration provides superior efficiency and output regulation.

Fig. 3 shows the basic circuit of a push-pull transformer-coupled dc-to-dc converter, using the common-emitter connection for the transistors. Fig. 4 shows typical waveforms in this circuit during a complete operating cycle.

Energy Transformation

During a complete cycle the flux density in the transformer core, Fig. 3, varies from one saturation value to the other and back. At the start of the conduction period for one transistor, the flux density in the core is at either its negative maximum value ($-B_{sat}$) or positive maximum value ($+B_{sat}$).

For example, transistor A switches on at ($-B_{sat}$) (Fig. 4a). During conduction of transistor A, the flux density changes from its initial level of ($-B_{sat}$) and becomes positive as energy is simultaneously stored in the inductance of the transformer and supplied to the load by the battery. When the flux density reaches ($+B_{sat}$), transistor A is switched off and transistor B is switched on. During the entire period of conduction through transistor A, energy is supplied to the load at a constant rate as a result of transformer action. This energy transformation cycle is repeated during the conduction period for transistor B.

Operating Details and Waveforms

Initially, sufficient bias is applied to transistor A to saturate it, with the result that a substantially constant voltage (Fig. 4b) is impressed across the upper half of the primary winding by the dc source V_{in}. This bias can be a temporary bias, a small fixed bias or even a small forward bias developed across the bias winding as a result of leakage and saturation current flowing in the primary. The constant primary voltage causes a dc component and a linearly increasing component of current to flow through transistor A (Fig. 4c). As in the ringing-choke converter, the linearly increasing primary current induces substantially constant voltages in the bias winding (Fig. 4d) and secondary winding. Also, as in the ringing-choke converter, the induced voltage in the base winding limits the maximum value of the base current and, therefore, of the collector current.

In the push-pull transformer-coupled circuit, the transition to switch-off is initiated when the transformer begins to saturate. As long as the transistor is saturated, the product of the transformer inductance and the time rate of change of the collector current remains constant. When the transformer core saturates, the inductance de-

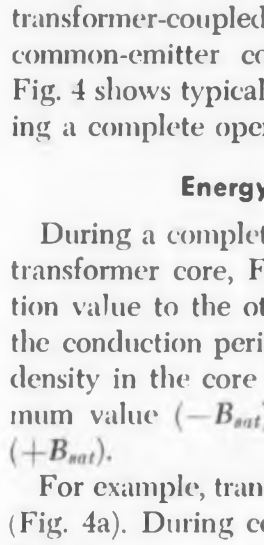


Fig. 3. Basic circuit of a push-pull, transformer-coupled dc-to-dc converter, using transistors with common-emitter connection.

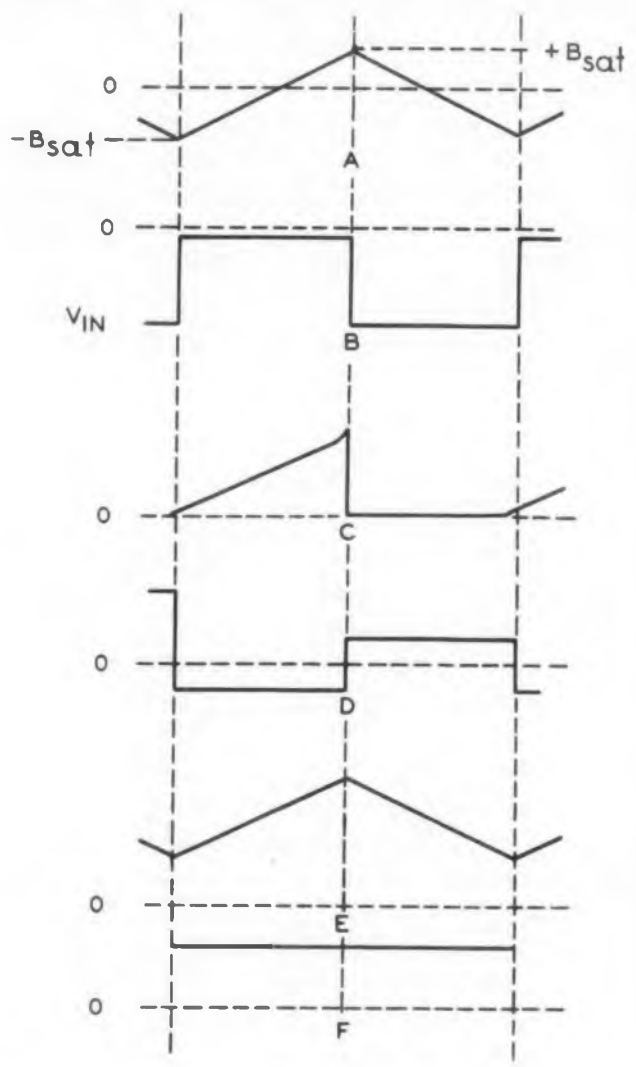


Fig. 4. Typical waveforms in the circuit of Fig. 3 during a complete operating cycle: (a) flux density in the transformer core, (b) collector voltage for one transistor, (c) collector current for one transistor, (d) base voltage for one transistor, (e) primary current, (f) secondary current.

creases rapidly toward zero, with the result that the time rate of change of the collector current increases towards infinity. When the collector current reaches its maximum value, transistor A moves out of its saturated condition, the winding voltages decrease and then reverse, thereby causing transistor A to switch off. The reversal of the winding voltages switches on transistor B, and the switching operation repeats. [1,2]

Design Procedure

1. The procedure for selection of a suitable transistor type, transformer core, and operating frequency is the same as for the ringing-choke type circuit (*ED*, Sept. 16, p. 40) except that the data in Table III is used. Because the transformer core must be operated in the saturation region, an air gap is not normally required.

2. Determine the maximum permissible value for the input voltage V_{in} (Eq. B11). Select a value of V_{in} less than this maximum value or use a different transistor type that will permit use of a higher value for V_{in}.

3. Determine the required number of turns for each half of the center-tapped primary winding N_P (Eq. B7).

4. Determine the required inductance for each half of the primary winding L_P.

$$L_P = \left(\frac{4\pi N_P^2}{10^9}\right)\left(\frac{\mu_1 A}{l_1}\right) \qquad \text{(Eq. A8, Part I)}$$

5. Determine the peak primary current $_{IP}$ (Eq. B3).

6. Determine from the published data for the transistor type selected, or from the transistor manufacturer, the maximum value of V_{BE} necessary to provide the peak primary current $_{IP}$ determined in Step 5.

7. Determine the required number of turns for each section of the base winding (Eq. B9).

8. Determine the required value for the external base resistance R_B.

$$R_B = \frac{V_{BE\ max} - V_{BE}}{I_B} \qquad \text{(Eq. A8, Part I)}$$

9. Determine the required number of turns for each half of a center-tapped secondary winding, or the total number of turns for an untapped secondary winding N_S (Eq. B10).

10. Select a transformer core having the magnetic circuit parameters determined in Step 1, and adequate winding space. The wire size for each winding is determined from the peak current, the maximum allowable copper losses, the minimum available transformer winding space, and the number of turns on each winding. If winding-space requirements indicate that an unduly large rectangular core is necessary, the use of a toroidal core should be considered. If EI, EE, CI, or CC cores are used, the approximate window area required can be determined from the Winding Data Chart (Table 70) given on pages 1416-1417 of the "Radiotron Designer's Handbook."[3]

11. Determine the peak secondary current I_S (Eq. B12) and peak secondary voltage V_S (Eq. B13).

12. Select a rectifier type meeting the peak secondary voltage and current requirements. Se-

Table III. Design Data for Push-Pull, Transformer-Coupled DC-to-DC Converters

Application Requirements			Transistor Requirements				Recommended Parameters				
							Transformer Core				
POWER OUTPUT (P_o) WATTS	MAX. OUTPUT VOLTAGE (V_{OUT})	DC INPUT VOLTAGE (V_{IN})	SATURATION RESISTANCE (R_{SAT}) MAXIMUM VALUE OHMS	COLLECTOR-TO-BASE BREAKDOWN VOLTAGE (V_{CBmax}) MINIMUM VALUE VOLTS	PEAK COLLECTOR CURRENT (I_C) MINIMUM VALUE AMPERES	PERMISSIBLE DISSIPATION AT CASE OR FLANGE TEMPERATURE OF 55°C MINIMUM VALUE WATTS	MATERIAL	CROSS-SECTIONAL AREA (A) CM^2	MAGNETIC-PATH LENGTH (l_1) CM	OPERATING FREQUENCY (f) KILOCYCLES PER SECOND	EXPECTED CIRCUIT-EFFICIENCY FACTOR (η)
2	250	6-12	2	30	0.5	0.1	Ferrite	0.5-4	2.5-10	1-5	0.85
	500	12-20	2	45	0.4	0.075					
10	400	12-18	1.5	45	2	1	Ferrite	0.5-5	2.5-10	1-5	0.85
	600	18-28	1.5	60	1	0.5					
25	400	12-18	1	45	5	3	S_i iron or grain-oriented S_i steel	1-5	5-15	0.1-0.8	0.85
	600	18-28	1	60	3	1.5					
50	250	8-18	0.5	45	12	10	S_i iron or grain-oriented S_i steel	2-7.5	7.5-20	0.1-0.8	0.85
	500	18-28	0.5	60	8	5					
	800	28-38	0.5	80	5	2					
100	400	12-18	0.5	45	18	15	S_i iron or grain-oriented S_i steel	3-12	10-25	0.1-0.8	0.85
	600	18-28	0.5	60	10	10					
	800	28-38	0.5	80	7.5	5					
200	400	12-24	0.2	60	20	25	S_i iron or grain oriented S_i steel	5-15	15-35	0.1-0.8	0.8
	600	24-36	0.2	80	15	15		7.5-20	20-40	0.1-0.8	0.75
	800	36-48	0.5	100	10	10					

lect a value for C_{OUT} which will provide the desired degree of filtering of the output (Eq. B14).

Example

To illustrate the use of the design procedure given above, the design of a push-pull transformer-coupled dc-to-dc converter is worked out below. The converter is to have a power output of 100 w and an output voltage of 400 v, and is to operate from a 28 v source.

1. From the transistor requirements given in Table III for $P_{out} = 100$ w, $V_{out} = 400$ v, and $V_{in} = 28$ v, a suitable transistor type would be the RCA-2N561. This transistor has a maximum saturation resistance P_{sat} of 0.2 ohm, a collector-current rating I_C of 10 amp, and a dissipation rating of 30 w at a case temperature of 55 C.

A suitable transformer core would be one made of grain-oriented silicon steel, having a cross sectional area A of 8.22 sq cm and a magnetic-path length of 17.14 cm, such as the Magnetic Metals Co., 112 EI type, "Crystaligned 33" core. This core has 0.014 in. thick lamination, a saturation flux density B_{sat} of 8000 gausses, and a permeability μ_i of 12,000.

A suitable operating frequency f would be 400 cps and the expected circuit efficiency would be 85 per cent.

2. From Eq. B11, the maximum permissible value for the supply voltage V_{in} is $V_{in} \leqslant 0.9$

$$\left(\frac{V_{CB\ max} - V_{BE\ max}}{2}\right) = 0.9\left(\frac{80 - 3.5}{2}\right) = 34.5 \text{ v}$$

The desired value of V_{in} (28 v) is substantially less than the maximum permissible value.

3. From Eq. B7, the required number of turns for each half of the primary is

$$N_P = \frac{V_{in}\ 10^8}{4\,f\,AB_{sat}} = \frac{28\ (10^8)}{(4)\ (4)\ (10^2)\ (8.22)\ (8)\ (10^3)} = 27 \text{ turns}$$

The total number of primary turns is, therefore,

$$2\ N_P = 2(27) = 54 \text{ turns}$$

4. The required inductance for one half of the primary is

$$L_P = \left(\frac{4\pi\ N_P^2}{10^9}\right)\left(\frac{\mu_1\ A}{l_1}\right) = \left[\frac{4\pi\ (7.3)\ (10^2)}{10^9}\right]\left[\frac{12\ (8.22)\ (10^3)}{17.14}\right] = 0.0529 \text{ henry}$$

5. From Eq. B3, the peak primary current is:

$$I_P = \left(\frac{V_{in}}{4\,f\,L_P}\right) + I_{AV}$$

$$I_P = \frac{28}{(4)\ (4)\ (10^2)\ (0.0529)} = \frac{100}{(85)\ (28)} = 0.33 + 4.20 = 4.53 \text{ amp}$$

6. From information furnished by RCA for its transistor Type 2N561 the maximum value of V_{BE} required to provide the calculated peak primary current of 4.53 amp is:

$$V_{BE\ max} = 3.5 \text{ v}$$

7. From Eq. B9, the required number of turns for each section of the base winding is:

$$N_B = N_P\left(\frac{V_{BE\ max}}{V_{IN}}\right) = \frac{27\ (3.5)}{28} = 3.4 \text{ turns}$$

(use 4 turns)

The total number of turns for the base winding,

$$2\ N_B = 2(4) = 8 \text{ turns}$$

8. The required value for the external base resistance R_B is $R_B = \dfrac{V_{BE\ max} - V_{BE}}{I_B}$ where V_{BE} and I_B are values required to obtain $I_P = 4.53$ amp for the 2N561. For a typical 2N561 transistor, the values of V_{BE} and I_B required to provide the calculated peak primary current of 4.53 amp are, respectively, 1.1 v and 200 ma. The required value of R_B for this typical 2N561, therefore, is

$$R_B = \frac{3.5 - 1.1}{0.2} = \frac{2.4}{0.2} = 12 \text{ ohms}$$

9. From Eq. B10, the required number of turns for each half of a center-tapped secondary winding or a total number of turns for an untapped secondary winding is

$$N_S = N_P\left(\frac{V_{out}}{V_{in}}\right) = \frac{27\ (400)}{28} = 385 \text{ turns}$$

10. A 112 EI core having the necessary magnetic parameters was selected. The peak currents in the primary and secondary windings are, respectively: $I_P = 4.53$ amp and $I_S = 0.25$ amp. The peak base current is dependent upon the dc current gain (β) at $I_P = 4.53$ for the specific 2N561 used. For a 2N561 having a minimum β, the peak base current I_B for $I_C = 4.53$ amp is 0.230 amp. For the purposes of this design, $I_B = 0.230$ amp will be used.

Because the core selected is an EI type, the Winding Data Chart of the "Radiotron Designer's Handbook"[5] is used to determine the required wire sizes, turns per layer, and number of layers on the core.

Based on the peak current requirements, the wire sizes are: primary—No. 15 AWG, secondary—No. 27 AWG and base—No. 28 AWG. For a lamination size of 1.5 in., the turns per layer on the primary is 28. Therefore, two layers $\left(\dfrac{2\ N_P}{28}\right)$ are required, and the primary will have a thickness of (2) (0.0588) = 0.1176 in.

The base winding is wound over the primary, and requires one layer having a total thickness of 0.0136 in. The secondary requires four layers having a total thickness of (4) (0.0152) = 0.0608 in. The height of the window, therefore, must be greater than 0.1176 + 0.0136 + 0.0608 = 0.1920 in. The 112 EI core has a window thickness of 0.562 in., and, therefore, provides adequate room for the wire, wire form, and insulating tape.

11. From Eq. B12, the peak secondary current

$$\hat{I}_S = I_{RL} = \frac{P_{out}}{V_{out}} = \frac{100}{400} = 0.25 \text{ amp}$$

and from Eq. B13, the peak secondary voltage is

$$\hat{V}_S = N_{IN}\left(\frac{N_S}{N_P}\right) = 28\left(\frac{385}{27}\right) = 400 \text{ v}$$

12. A suitable rectifier type is the RCA-1N1764 diffused-junction silicon rectifier. For a single-phase, full wave rectifier circuit using a center-tapped secondary winding, four of these rectifiers (two series-connected pairs) will be required. For a single-phase, full-wave rectifier circuit not using a center-tapped secondary winding, four of these rectifiers will also be required. From Eq. B14 a suitable value for C_{out} is

$$C_{out} \doteq \frac{1}{(R_L)\ (2\pi)\ (2F)} = \frac{1}{(2\pi)\ (1600)\ (800)} = \frac{10^{-6}}{0.803} = 0.122\ \mu f$$

Additional Considerations

In addition to the considerations listed in the foregoing design data for ringing-choke-type and transformer-coupled-type dc-to-dc converters, there are others, such as starting bias methods, the use of voltage-multiplication techniques, and maximum operating temperature, which may require consideration in practical designs. Excellent starting under heavy load conditions may be obtained by the use of a transistor-type switch which will provide a large starting bias and then be cut off by the buildup of the output voltage. It is also possible to obtain satisfactory starting by the use of a fixed bias resistance, provided the value of this resistance is high enough so that it does not materially affect normal switching.

If dc output voltages higher than those shown in Tables I and III are required, they should be obtained by the use of voltage-multiplier-type rectifier circuits rather than by the use of step-up ratios larger than those indicated in the data for transformer design. Although the use of a voltage-multiplier circuit results in a reduction in over-all efficiency, it is less disadvantageous than the higher copper losses, magnetic-coupling problems, and higher core losses resulting from the use of higher transformer step-up ratios.

The transistor requirements given in Tables I

and III are for operation at a case or flange temperature of 55 C. To convert case or flange temperature to ambient temperature, it is necessary to know the thermal resistance between the transistor and free air. This resistance is a function of the contact resistance between the transistor case or flange and the chassis, the thermal resistance of any insulating washer used, the size, thickness, and material of the chassis, and the method used to cool the chassis—for example, forced-air cooling, water cooling, or simple convection cooling.

To assure reliable operation at any permissible ambient temperature, care must be taken that the collector-junction temperature of the transistor is not greater than that specified by the manufacturer. The average temperature of the junction is equal to the ambient temperature plus the product of the average power dissipated in the transistor, and the thermal resistance between junction and case plus case and air

$$[T + P(R_{TJC} + R_{TCA})].$$

As a final note, it is important to emphasize that the material of the transformer core should have the highest permeability and permissible flux density that are economically practicable. These characteristics will permit the use of the fewest possible turns for the transformer windings. It is also desirable that the core material have the highest practical value of resistivity to allow operation with a minimum of core losses. ■ ■

References

1. L. H. Light and Prudence M. Hooker, "Transistor DC Converters," The Institution of Electrical Engineers' Paper No. 1862R, April 1955.
2. L. H. Light, "The Design and Operation of Transistor DC Converters," Mullard Technical Communications, Vol. 2, 17, Feb. 1956. Reprint pp. 12-17, p. 45.
3. C. R. Eshelman, RCA Semiconductor Div., Somerville, N. J. Private Communication.
4. W. D. Williams, RCA Semiconductor Div., Somerville, N. J. Private Communication.
5. "Radiotron Designer's Handbook," Fourth Edition, edited by F. Langford-Smith, pp. 1416-1417.

Equation Derivation for Push-Pull Transformer-Coupled DC-to-DC Converter

Assuming that the full dc supply voltage V_{in} is impressed across one-half of the primary winding, Fig. 3, the current flowing in the collector circuit of the conducting transistor may be determined from

$$L_P \frac{dI_P}{dt} = V_{in} \qquad \text{(B1)}$$

where L_P is the inductance of one-half the primary winding, in henries

dI_P is in amps

dt is in seconds

V_{in} is in volts.

For a triangular current waveform such as that shown in Fig. 4,

$$\frac{dI_P}{dt} = \frac{2\,\hat{I}_P}{0.5\,T} = \frac{4\,\hat{I}_P}{T} = 4f\,\hat{I}_P \qquad \text{(B2)}$$

where

T is in seconds

f is in cps

The peak value of the current in the collector of the conducting transistor is, therefore,

$$\hat{I}_P = \frac{V_{in}}{4f\,L_P} \qquad \text{(B3)}$$

From Eq. All the required inductance for one-half of the primary is

$$L_P = \left(\frac{N_P\,\Delta\phi}{\hat{I}_P}\right) 10^{-8}$$

In the push-pull transformer-coupled converter, however, the swing on the B-H saturation curve is symmetrical about the origin. The residual flux density ϕ_{res}/A, therefore, is zero and

$$\frac{\Delta\phi}{A} = \frac{\phi_{max}}{A} - \frac{\phi_{res}}{A} = \frac{\phi_{max}}{A} = B_{max} \qquad \text{(B4)}$$

The required inductance for one-half of the primary, may therefore, be expressed as

$$L_P = \frac{N_P\,B_{max}\,A}{\hat{I}_P}\,(10^{-8}) \qquad \text{(B5)}$$

where B_{max} is in gausses.

The value of N_P may be determined by combining Eqs. B3 and B5—i.e.,

$$V_{in} = 4N_P f B_{MAX} A\,(10^{-8}) \qquad \text{(B6)}$$

$$N_P = \frac{V_{in}}{4f\,B_{max}\,A}\,(10^8) \qquad \text{(B7)}$$

Because no air gap is required, the required inductance for one-half the primary is

$$L_P = \left(\frac{4\pi\,N_P^2}{10^9}\right)\left(\frac{\mu_1\,A}{l_1}\right) \qquad \text{(B8)}$$

To determine the required number of turns for each section of the base winding, it is necessary to know the maximum base-to-emitter voltage, $V_{BE\ max}$, at which the transistor type used will provide the peak primary current I_P. This voltage may be obtained from the published data for the transistor type or from the transistor manufacturer. The number of turns for each half of the base winding is, then

$$N_B = N_P\left(\frac{V_{BE\ max}}{V_{in}}\right) \qquad \text{(B9)}$$

The required number of turns for each half of the secondary winding is

$$N_S = \left(\frac{N_P}{V_{in}}\right)(V_{out} + R_{out}\,I_{out}) \qquad \text{(B10)}$$

where R_{out} is the resistance of the secondary and reflected primary resistance.

Because R_{out} is usually very small in transformer-coupled converters it can be neglected in the initial calculations.

The value of the external base resistance R_B is found in the same manner as for the ringing-choke converter (see Eq. A18, Part I). If extreme flexibility of operation is desired, a separate external resistor may be used in each base circuit.

In the push-pull transformer-coupled circuit, the dc input voltage V_{in} should not exceed the maximum collector-to-base-voltage rating for the transistor type used. The maximum permissible for V_{in} is given by

$$V_{in\ max} \leqq \frac{V_{CB\ max} - V_{BE\ wind}}{2} \qquad \text{(B11)}$$

where $V_{CB\ max}$ is the maximum collector-to-base-voltage rating for the transistor type used, $V_{BE\ wind}$ is the induced voltage in one-half of the base winding. Eq. B11 is based on the assumption that there is zero leakage inductance in the transformer. In practice V_{in} should not be more than about 90 per cent of the value given in Eq. B11.

The peak secondary current is approximately equal to the dc load current.

$$\hat{I}_S = I_{RL} = \frac{P_{out}}{V_{out}} \qquad \text{(B12)}$$

and the peak secondary voltage is given by

$$\hat{V}_S = V_{in}\left(\frac{N_S}{N_P}\right) \qquad \text{(B13)}$$

For good filtering of the output voltage, the value of C_{out} should be chosen to give an output time constant of at least one-half of the period of oscillator, therefore,

$$C_{out} \doteq \frac{1}{4\pi\,R_L\,F} \qquad \text{(B14)}$$

Multiphase Discriminator Uses Transformer Logic

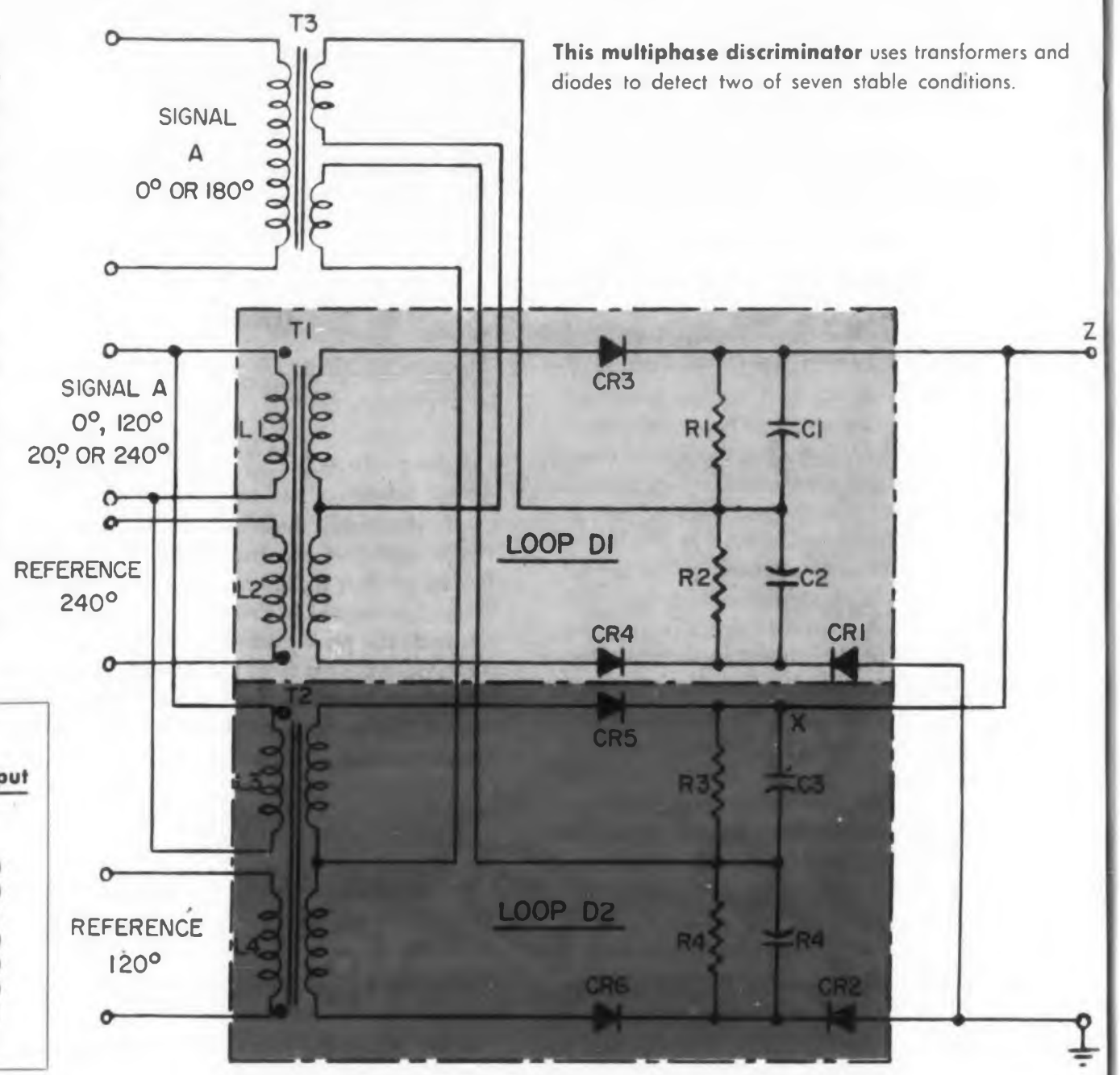
TRANSFORMERS CAN be used to implement some rather fancy logic. In this case they help sense the presence or absence of various 400 cps signals and help detect their phase relationships.

Two and three phase signals are involved. The discriminator must provide an output in accordance with the requirements of the truth table shown here. An analysis of the truth table shows the difficulty in distinguishing between stable states *4* and *5* and between stables states *6* and *7*.

The circuit shown in the figure solves the problem rather simply. It consists of two diode discriminators which are conventional except for the special transformers *T1* and *T2* and the addition of two diode gates (*CR1* and *CR2*) in the output.

Stable conditions *1*, *2*, and *3* are satisfied easily since the absence of any one input signal results in the absence of an output. Stable conditions *4* and *5* are obtained in the following way:

A signal at a 240 degree phase angle, applied



This multiphase discriminator uses transformers and diodes to detect two of seven stable conditions.

Truth Table for Multiphase Discriminator

Stable Conditions	Input					Output
	400 cps Signal "A"		400 cps Signal "B"			
	0°	180°	0°	120°	240°	
1	0	0	1	0	0	0
2	0	0	0	1	0	0
3	0	0	0	0	1	1
4	1	0	0	0	1	0
5	0	1	0	0	1	0
6	1	0	0	1	0	0
7	0	1	0	1	0	1

0 = absence or low level signals, 1 = presence or high level signals

to *L1* and *L3*, immediately desensitizes loop *D1* since *L1* and *L2* are wound "flux-opposing" and the presence of two equal signals on both windings cancels the magnetic flux. This results in a zero signal at the secondary winding, so there is no dc output from this discriminator section.

But loop *D2* operates normally since the 240 degree signal on *L3* adds vectorially to the 120 degree signal on *L4*. They combine to present a 180 degree signal on the secondary of *T2*.

Depending on whether the *A* signal is at zero or 180 degrees, the dc output between *X* and *Y* is either positive or negative. However *CR2* allows only the positive signal to appear at point Z.

Thus, conditions *4* and *5* are satisfied: an output signal appears at point Z if—and only if—signal *A* is at a phase angle of zero degree and *B* is at a phase angle of 240 degrees.

For stable conditions *6* and *7* the same performance is repeated, except that loop *D1* is operated while loop *D2* is deactivated.

Ernest Hartog, Project Engineer, Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N.J.

Semiconductors for Fast Brakes and Clutches

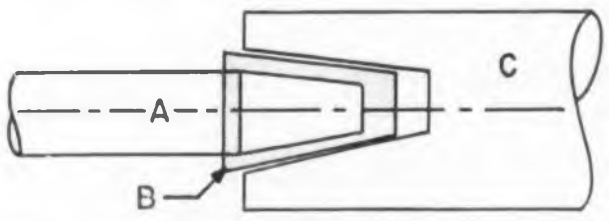
We needed a braking and/or coupling mechanism with a response faster than standard audio frequencies. It had to be both small and light. We solved our problem by using the little-known "Johnson-Rahbeck effect."

As shown in the figure, a conductive cone *A* is covered with a semiconductor *B* which, in turn, is surrounded by conductor *C*. Voltage, applied through slip rings across *A* and *C*, determines the coefficient of friction between the surfaces of *B* and *C*. Thus, the power of coupling or braking between the coaxial shafts can be varied in response to the output of a sensing mechanism.

The response time and torque required determine the voltage levels and the type of semiconductor.

The process is sensitive to changes in atmospheric conditions. Though this is often a problem, it can be used to advantage when readout is to be a function of the atmosphere.

Dr. Erwin J. Saxl, President, Tensitron, Inc., Harvard, Mass.



Voltage between conductors A and C varies coefficient of friction of semiconductor B.

CIRCLE 28 ON READER-SERVICE CARD

IDEAS FOR DESIGN

Reject Modulating Signal To Cut Modulator Distortion

Conversion of a single-ended low frequency signal to a modulated ac carrier is often attempted without adequate attention to the problem of rejecting the modulating signal itself. This can result in distortion in following stages due to the modulating signal causing additional grid modulation.

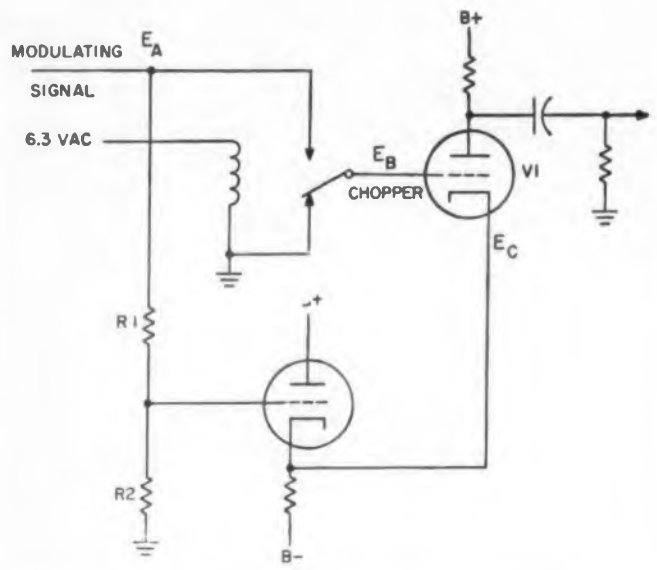


Fig. 1. Improved modulator cancels undesirable modulating signal through suitable choice of *R1* and *R2*.

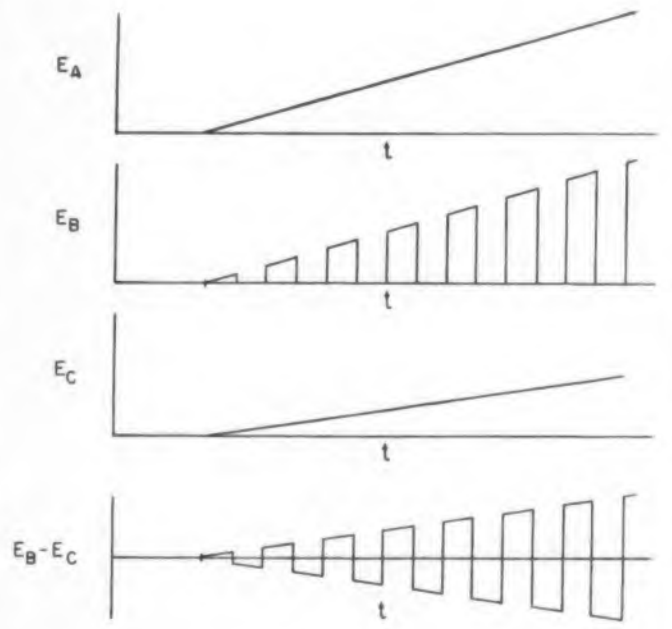


Fig. 2. Waveforms for the improved modulator.

The usual solution is to reject the modulating signal by means of high pass ac coupling networks. But where the modulated spectrum overlaps the modulating spectrum, this method re-

quires compromises. The schematic of Fig. 1 shows a more direct approach to canceling the modulating spectrum.

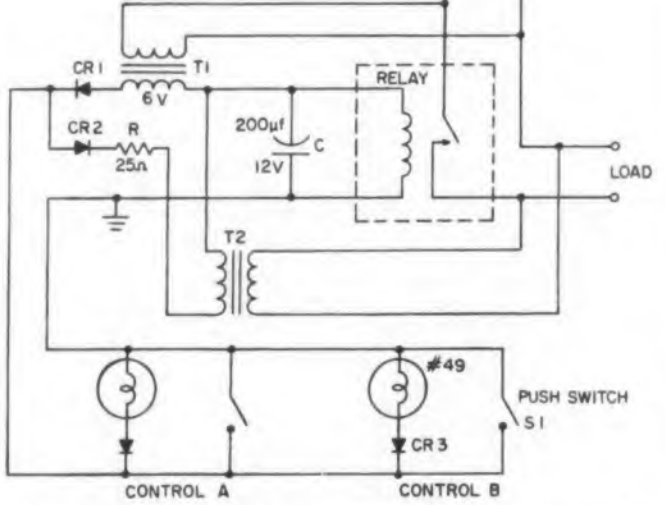
In this circuit, *R1* and *R2* are chosen so that the difference between E_B and E_0 results in the modulated signal alone appearing at the plate of *V1*.

Jack W. Goodwin, Unit Supervisor, Hoffman

One Pair of Wires For Relay Control From Many Points

We had to control an on-off cycling relay from several control points and to indicate the relay's position. We could only use one pair of wires. Since one wire was ground, a simplex system could not be used. It was desirable to have the remote control point as simple as possible.

The solution uses opposite polarity, half-wave signals to control the relay and to signal its position. In the drawing, transistor *T1* supplies the relay current which is rectified by *CR1* and filtered by *C*. The indicator lamps are not lit when the relay is open, since the series diode *CR3* opposes *CR1*.



The six-volt relay is operated from remote points A or B through only one pair of wires.

Momentarily depressing *S1* rocks the relay armature to its *on* position to operate the load. *T2* is then energized, supplying a small current through *CR2* and *R*. This signal is of the correct polarity to light the lamp through *CR3*, indicating closure of the relay.

The value of *R* depends on the type and number of lamps in the circuit. A value of 25 ohms is used with two type 49 lamps. Diodes are low voltage, 500 ma silicon units.

John T. Lamb, Research Engineer, The Tappan Co., Mansfield, Ohio.

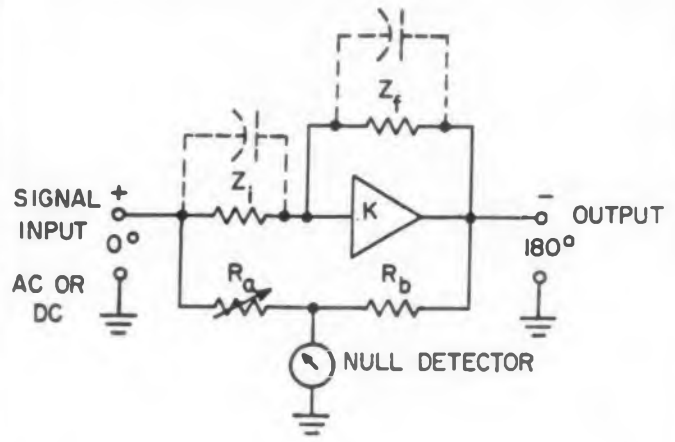
IDEAS FOR DESIGN

Phase Shift Must Be 180 Degrees To "Measure Gain of Operational Summer"

"Measure Gain of Operational Summer," published in Ideas for Design of July 8th, is based on an assumption which is not always valid.

The assumption that the output is exactly out of phase with the input allows one to use the decade resistor ratio R_b/R_a as the closed loop gain of the amplifier.

This assumption requires that the Z components are pure resistors or capacitors, or that they are networks whose phase shifts are matched. If this is not true, the resistor ratio at the null point is not equal to the closed loop gain and the error is a function of the difference between the actual output phase shift and 180 deg.



Adjustment of a variable capacitor across either Z_i or Z_f, and adjustment of R_a allows the phase shift of this operational amplifier to be brought to exactly 180 deg. Then the closed loop gain equals the ratio R_b/R_a.

A simple technique may be used to adjust the phase shift to exactly 180 deg. If Z_i and Z_f are both resistors with stray capacitance, the respective phase shifts may be equalized by adjusting a variable capacitor across one of the components.

Successive adjustment of the variable capacitor and resistor R_a for minimum null can bring the phase shift to 180 deg. Then the resistor ratio R_b/R_a equals the amplifier closed loop gain.

R. Nitzberg, Engineer, Defense Electronics Div., General Electric, Ithaca, N.Y.

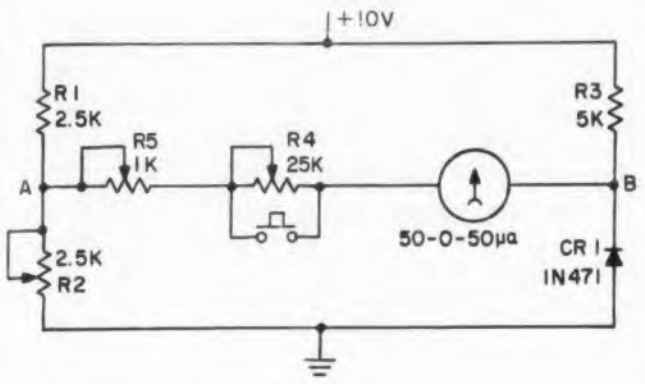
Simple Circuit Reads Per Cent Voltage Change

In circuit design work it is desirable to have a device which can read the change in power supply voltage directly as a percentage change. The cost should be low.

The figure shows a circuit which can read percentage on the high scale, 0 to 50 per cent with accuracy of 2.5 per cent, and on the low range, 0 to 10 per cent, within 1/2 per cent accuracy.

R1 and *R2* form a voltage divider and draw enough current so that meter loading is small. *R3* and *CR1* form a voltage reference.

Choosing a low voltage Zener helps to prevent serious nonlinear effects. *R3* zeros the meter for different Zeners.



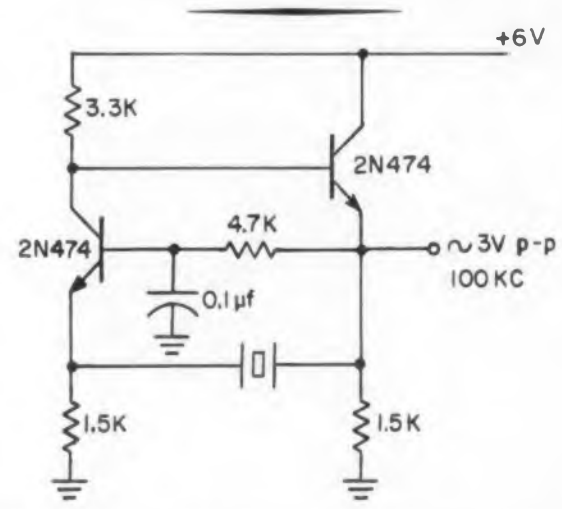
Line voltage percentage change reads out directly with this simple circuit.

Here's how the circuit works: If *CR1* is a four volt Zener, *R2* is adjusted so that the level at point *A* is 4 v with a 10 v input to the circuit. If the input swings high, say 50 per cent, point *A* rises to 6 v, leaving a net voltage drop of 2 v across *A-B*. The *R4* is adjusted for a full-scale reading of 50 μa.

A lower percentage meter reading is achieved by shorting *R4* and adjusting *R5* for full-scale reading with a smaller voltage variation.

The potentiometers will have to be readjusted for different line voltage references.

William T. Rhoades, Member Technical Staff, Hughes Aircraft Co., Fullerton, Calif.



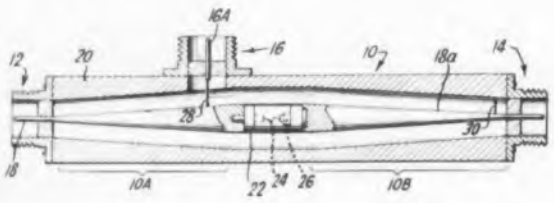
Ultra-simple crystal oscillator suitable for wide temperature range. Emitter currents are stabilized with dc feedback and are insensitive to changes in leakage currents and beta.

McKenny W. Egerton, Engineer, Hoover Electronics, Timonium, Md.

PATENTS

Branched Coaxial Waveguide Structure
Patent No. 2,896,075. Lloyd A. Addleman. (Assigned to Sylvania Electric Products Co., Inc.)

This patent describes how the heterodyne signal may be taken out from a broadband crystal detector which is flat from 1 to 12 kmc.

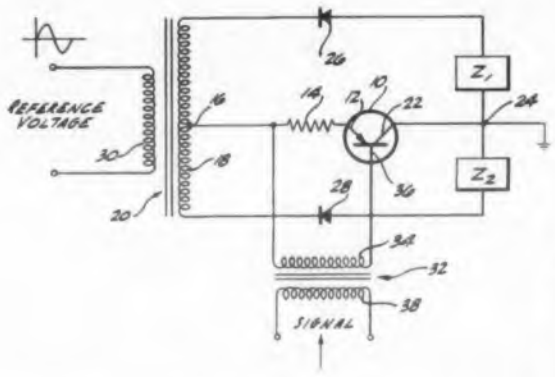


Center conductor *18a* of the coaxial device is tapered to support crystal *22* and to maintain constant impedance over the pass band. The signals to be mixed are inserted by means of connectors *12* and *14*. The beat signal is coupled out by a direct connection by means of a very fine wire *28*, for example, No. 36 AWG "Advance" high resistance alloy.

This high resistance makes the connector a very high impedance so that very little reactance at operating frequency is inserted into the guide. The broadband characteristics are retained and the low frequency signal is easily removed.

Transistor Phase Discriminator
Patent No. 2,897,379. James G. Hinsdale (Assigned to Lear, Inc.)

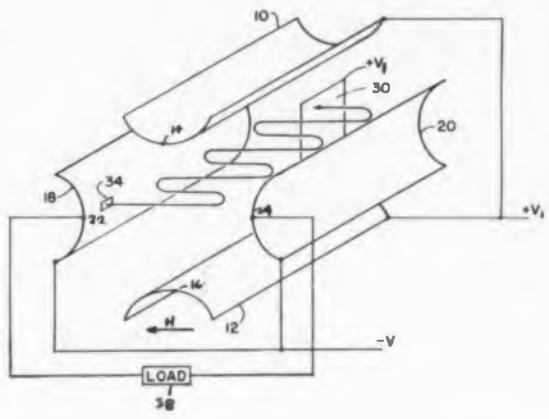
A semiconductor power amplifier delivers current to either one of two load impedances according to whether the control signal is in phase or out of phase with a reference signal. The improvement over prior circuits consists in the use of a



single transistor circuit; other circuits required at least two matched transistors.

Transformer *20* delivers power to the loads Z_1 and Z_2 through back-to-back forward conducting diodes *26* and *28*. When the emitter pnp transistor *10* is positive with respect to the base, the transistor conducts, effectively connecting the junction point of the loads to transformer midpoint *16*.

Suppose the relative phase of signal and reference voltage causes diode *26* to conduct. Current flows through Z_1 exclusively. When the reference voltage changes phase, Z_2 conducts. Since the transistor impedance varies with the applied signal, the phase discriminator amplifies the signal voltage.



Strophotron

Patent No. 2,897,393. Stanley A. Iorio. (Assigned to Sylvania Electric Products, Inc.)

Improvement in strophotron efficiency is obtained by orientating the plane collector so that it is perpendicular to both the magnetic and electric vectors. Electrons now strike the collector normally and are collected on both sides. In conventional strophotrons, electrons travel parallel to the collector surface and therefore few electrons are collected.

As shown in the illustration, the collector *30* is located midway between the hyperbolic accelerators *10* and *12* and reflectors *18* and *20* as well as perpendicular to magnetic field *H*. Electrons emitted from cathode *34* drift to the collector in a path which is a trochoid in one plane and a damped sine wave in the plane normal to the first plane. Collector *30* receives the electrons on either surface.

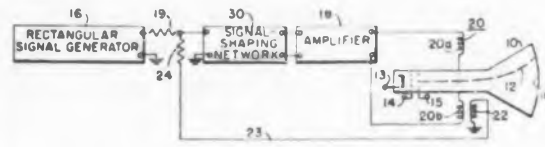
PATENTS

Linear Deflection System

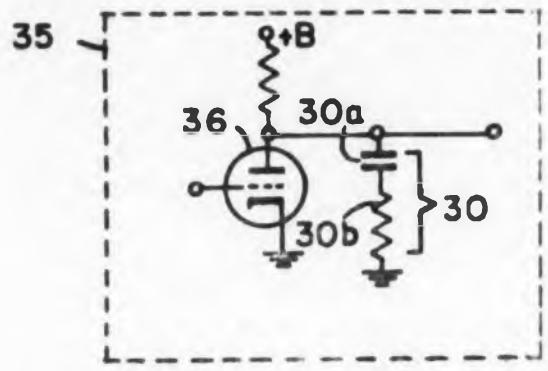
Patent No. 2,890,381. John Sinnott. (*Assigned to Hazeltine Research, Inc.*)

A pickup coil in the output of a pentode amplifier is combined with an integrating network to linearize the sweep in a magnetic deflection cathode ray tube indicator.

The applied rectangular waveform is integrated in amplifier-shaping network 35 to generate the sawtooth voltage wave-



form which is applied to the control grid of pentode amplifier *18*. A linear current flows in deflection coil *20* and part of the magnetic flux couples to pickup coil *22*. The rectangular voltage developed across the pickup coil is fed back degeneratively

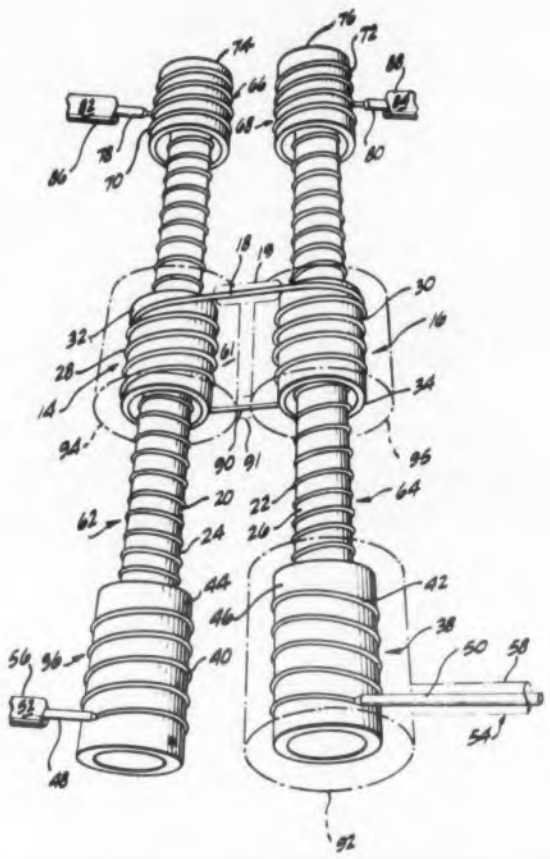


to linearize the sawtooth voltage waveform.

Phase Shifter

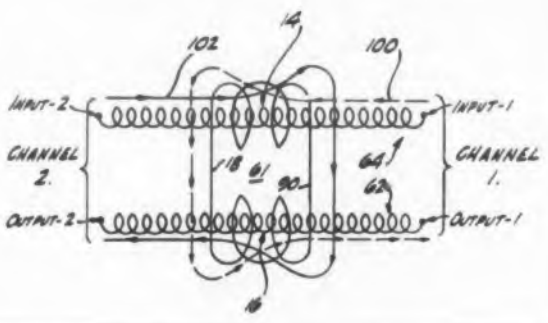
Patent No. 2,897,459. Louis Stark (*Assigned to Hughes Aircraft Co.*)

Adjustable coupled helices cyclically shift the phase of the rf energy fed to the elements of an antenna array so that the radiator may scan a region of space. In the spectrum range of 100 to 1000 mc, the



phase shifter has advantages of size, simplicity and efficiency of operation when compared to waveguide devices.

A double-ended trombone helical phase shifter is shown. Its operation is evident from the equivalent network. Energy coupled to input travels along helix *64*, transfers to section *14* and travels along helix *62* to output *1*. In like manner, input *2* travels along line *64* through section *14* and output *2* is connected through line *62*. As the trombone is caused to slide, one wave energy path shortens as the other path lengthens so that the corresponding phase changes.



CARD ➤ ➤ CIRCLE 38 ON READER-SERVICE CARD

Transistorized DC Millivoltmeter

K. B. Karandeev,
M. G. Mizyuk and
N. I. Smirnov

This transistorized dc millivoltmeter has the following features:

- A measurement range from several microvolts to one volt
- An input impedance not lower than 1 meg
- An error not exceeding 2.5%
- Direct reading
- Battery power

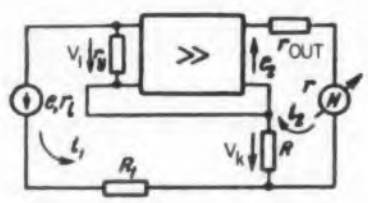


Fig. 1. Block diagram of dc millivoltmeter.

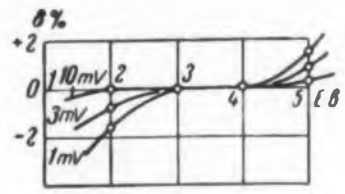


Fig. 3. Errors due to variations in the supply voltage.

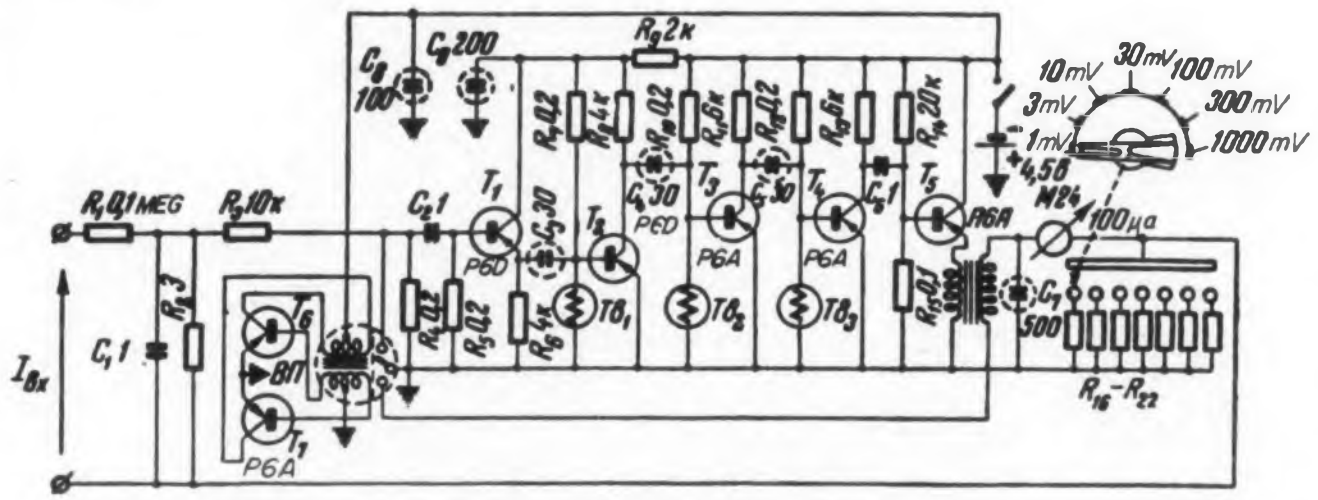


Fig. 2. Complete schematic of dc millivoltmeter.

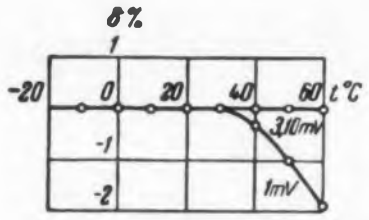


Fig. 4. Errors due to variation in the ambient temperature.

- Constancy of readings from −20 to +60 C
- Small dimensions, low weight
- Sufficient mechanical and vibration strength

A block diagram of the instrument is shown in Fig. 1. The input voltage is v_1; it is nulled by the voltage drop produced across feedback resistor R by the output current i_2. It may be shown that

$$i_2 = \frac{e}{R\,(1 + 1/\beta_1\beta_2\,K_\infty)}$$

where $\beta_1 = r_y/(r_y + r_i + R_1 + R)$,
$\beta_2 = R/(r_{out} + r + R)$, and K_∞ is the dc amplifier gain at no load, expressed in terms of the conversion, rectification, and ac-gain factors of the amplifier (K_c, K_r, and K_{ac}).

$$K_\infty = \beta_1 K_c K_{ac} K_r$$

If the gain is sufficiently large, $\beta_1\beta_2 K \gg 1$ and the current in the meter becomes $i_2 \approx e/R$, i.e., the meter scale can be calibrated in terms of the measured voltage and can be made linear. The range can be switched by including the set of resistances R.

The error in this instrument caused by changes in its parameters is given by the following equation:

$$\delta_e = \left(\frac{\Delta\beta_1/\beta_1 + \Delta\beta_2/\beta_2 + \Delta K_\infty/K_\infty}{1 + \beta_1\beta_2\,K_\infty} + \frac{\Delta R}{R} + \frac{\Delta c_i}{c_i} \right) 100\%$$

It is seen that by making $\Delta R/R$ small (use of manganese wire) and by making the meter error $\Delta c_i/c_i$ small, the accuracy can be made quite high. The use of large gain will make the factor $1 + \beta_1\beta_2\,K_\infty$ large and reduce the error further. This feedback factor also reduces the null drift.

The complete schematic is shown in Fig. 2. Figs. 3 and 4 show the errors due to variations in the supply voltage and the ambient temperature.

This article was abstracted from the Soviet journal Instrument and Measurement Engineering, *No. 2, March-April, 1959.*

GERMAN ABSTRACTS

E. Brenner

Ferrite Isolators

ISOLATING ELEMENTS which have a ratio of reverse to forward attenuation up to 150:1 can be constructed using ferrite and ceramic strips in a rectangular waveguide (Fig. 1). Moreover, the device may be made temperature insensitive.

Defining the damping in the reverse and forward directions as a_+ and a_- respectively, a practical figure of merit for the directional device in a given frequency band is:

$V = a_+/a_-$

Typical curves showing the dependence of this figure of merit (V) on the reverse attenuation per unit length (a_+/l) are shown in Fig. 2 for various geometrical arrangements and ferrite materials; the addition of ceramic strips increases V. Curve four (Fig. 2) shows this effect using ceramic material with a relative dielectric constant 40.

The cross-sectional dimensions of the ferrite strips may be chosen* to make the gyromagnetic resonance frequency independent of temperature (See German Abstracts, ELECTRONIC DESIGN, Aug. 5, 1959, p 100). Since, however, the slope of the reverse attenuation vs. frequency curve varies unsymmetrically with temperature, bandwidth considerations indicate choice of dimensions such that a small resonant frequency temperature variation is tolerated. Equal temperature variation at the upper and lower limits of the frequency band can then be achieved through correct choice of dimensions.

In Fig. 3, curves of a_+ as a function of frequency at two temperatures are shown for a 4 kmc isolator.

In the original paper, in addition to the 4 kmc isolator, a 6 kmc and a 7 kmc model are described in detail.

Abstracted from an article by J. Deutsch, W. Haken and Chr. V. Haza-Radlitz, Nachrichtentechnische Zeitschrift, *Vol. 12, No. 7, July, 1959 pp. 367-370.*

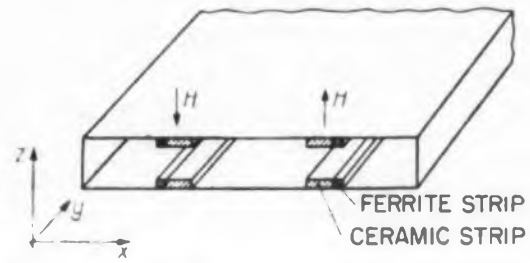


Fig. 1. Ferrite and ceramic strips in a waveguide.

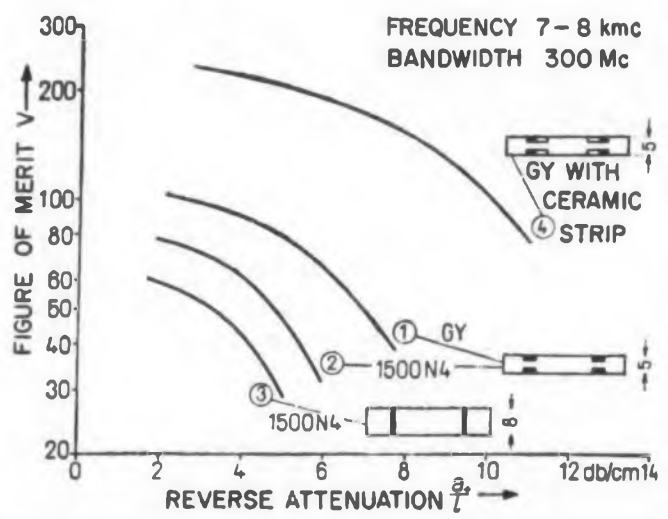


Fig. 2. Figure of merit as a function of reverse attenuation. The materials, 1500N4 and GY, are German trade designations.

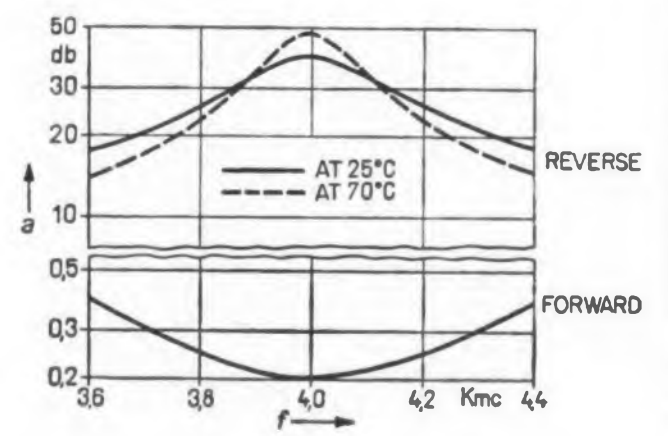
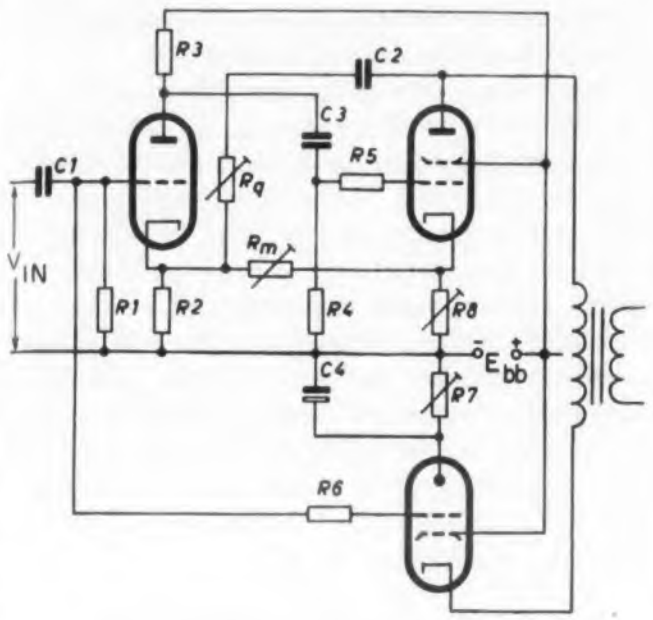


Fig. 3. Attenuation characteristics of a 4 mc isolator.

*See "Improved Rectangular Waveguide Resonance Isolators" M. T. Weiss, IRE, Trans. MTT 4, (1956), p 240.

Unsymmetrical Push-Pull Stage



An unsymmetrical push-pull stage

FEEDBACK may be used in the unsymmetrical output stage, shown in the Figure 1, to reduce the output impedance without affecting the symmetry of the output waveform. In this circuit, the first triode is not used for the generation of symmetrical driving waveforms but is considered part of the "upper" push-pull section.

The distortion in practical examples, for the unsymmetrical circuit, is only slightly more than for the conventional circuit. In class-A operation, the third harmonic distortion is less than in the conventional circuit while the second harmonic distortion is increased.

Although the values of the feedback resistors R_q and R_m can be calculated, adjustment can be made experimentally. The output transformer is replaced with two coils and with a small signal, the large R_m (about 50K) and R_q (200K) controls are adjusted for symmetrical output. Next R_m is adjusted until the desired low output impedance is obtained (e.g. the output amplitude is not changed when the output is shunted with, say 200 ohms). Finally R_q is readjusted for symmetrical operation.

In the original paper, the small signal equivalent circuit as well as large signal calculations and results are given.

Abstracted from an article by H. Voelz, Elektronische Rundschau, *Vol. 13, No. 7, July, 1959, pp. 242-442.*

REPORT BRIEFS

Analysis Of Carrier Systems

In this report a modulation-equivalent method of analysis is presented which applies to carrier systems employing suppressed-carrier amplitude modulation, such as ac analog computers, ac servo systems and ac control systems. The method presented is based on the Laplacian transfer function of the system and its components. By means of the theorem of complex translation, the modulation-equivalent 2 by 2 transfer matrix of a transfer function is derived. The system can then be directly analyzed with respect to the Laplace transforms of the modulating signals by means of matrix algebra. Rules and examples for the manipulation of the modulation-equivalent transfer matrices are given. *Analysis of Carrier Systems by Modulation-Equivalent Transfer Matrices, Hans H. Hosenthien, Army Missile Agency, Redstone, Ala., Mar. 1956, 58 pp, Microfilm $3.60, Photocopy $9.30. Order PB 137668 from Library of Congress, Washington 25, D.C.*

X-Band Propagation Beyond Line Of Sight

X-band tropospheric scatter measurements were made to determine the feasibility of a proposed 100-mile X-band link. The data and results are given for signal strength measurements up to 77 miles. Short-time amplitude distributions were determined. The operational capability and reliability of the 100-mile link is discussed, based on the results of the measurements. It was concluded that the increased gain necessary to meet the reliability requirements for the proposed X-band link would be prohibitive at the present time. *Study of X-Band Propagation Beyond Line of Sight, Joseph W. Page and Herbert E. Whitney, Air Force Cambridge Research Center, Bedford, Mass., July 1958, 31 pp, Microfilm $3.00, Photocopy $6.30. Order PB 140164 from Library of Congress, Washington 25, D.C.*

Magnetron Traveling-Wave Tube

A transition between a coaxial line and a biperiodic structure has been designed. Considerable work has been done on an electron gun to achieve spiral motion of electrons in a hollow beam. Several possibilities have been investigated. In the most promising device, the spiral lens, potential energy is converted into rotational kinetic energy; the axial kinetic energy is not influenced by the lens. To investigate cross-field flow, an experimental tube which employs a spiral lens has

been built. *Bi-Periodic Magnetron Traveling-Wave-tube Study, J. Berghammer and F. Paschke, David Sarnoff Research Center, Princeton, N.J., Sept. 1, 1957, 19 pp, Microfilm $2.40, Photocopy $3.30. Order PB 135519 from Library of Congress, Washington 25, D.C.*

Oscillator Circuits, I

Principles of nonlinear mechanics are applied to oscillatory systems of one and two degrees of freedom to determine a physical basis for their operation. The method of equivalent linearization is described briefly and is applied to these systems. Starting from simple relations between power supplied by the nonlinear element and power dissipated in the linear portion of the system, criteria for stability of oscillation are developed in general terms. *Theoretical Investigation of Oscillator Circuits, Norman R. Scott, Electrical Engineering Research Laboratory, University of Illinois, Oct. 1, 1949, 33 pp. Microfilm $3.00, Photocopy $6.30. Order PB 139945 from Library of Congress, Washington 25, D.C.*

Oscillator Circuits, II

The work during the period covered by this report has been devoted to an attempt to clarify the visualization of energy relationships in multiple-oscillating systems and also to generalize the stability criteria. The notation used is the same as in the first report, and the equations and figures are numbered in sequence following the numbers of the first report. *Theoretical Investigation of Oscillator Circuits, Norman R. Scott, Electrical Engineering Research Laboratory, University of Illinois, Urbana, Jan. 1, 1950, 14 pp, Microfilm $2.40, Photocopy $3.30. Order PB 139946 from Library of Congress, Washington 25, D.C.*

Oscillator Circuits, III

In extension of previous work, this report considers first a question of the stability of two simultaneous oscillations and then a generalization of the single-loop oscillator, as exemplified by a tuned-plate oscillator. The major part of the report is devoted to the question of frequency stability. The effect of amplitude perturbations on the emitted spectrum is considered first, and then the problem of instantaneous variations of frequency as a function of operating voltages is attacked. Work is continuing on this latter phase of the problem. *Theoretical Investigation of Oscillator Circuits, Norman R. Scott, Electrical Engineering Research Laboratory, University of Illinois, Urbana, Apr. 1, 1950, 20 pp, Microfilm $2.40, Photocopy $3.30. Order PB 139944 from Library of Congress, Washington 25, D.C.*

REPORT BRIEFS

High-Temperature Printed Circuitry, I

The findings of the program on high-temperature printed circuitry are summarized briefly, and the several techniques for circuit fabrication are evaluated in the light of the 200 C temperature specification for this year and the 750 C specification for the coming year. The conductivity of silver enamels has been found to remain high with silver contents as low as 26%. Platinum resistor films were found to have a linear temperature coefficient of resistance from 28 to 500 C, with a change in resistance of +18% over this temperature range. Boron carbide thermistor films are stable in air above 750 C, but crack when temperature cycles between 200 to 300 C. Silicon carbide and zirconium carbide enamel resistors were successfully formed using suitable wetting agents. Irreversible increases in resistance were observed in testing vacuum deposited gold-palladium resistors films to 500 C. Preliminary attempts to form aluminum oxide capacitor dielectric films are discussed. A simple method of attaching lead wires to high temperature printed ceramic circuits using properly formulated enamels is described. These connections function satisfactorily at least up to 750 C. *High-Temperature Printed Circuitry, I. G. H. Young, C. H. T. Wilkins, Mellon Institute of Industrial Research, University of Pittsburgh, Pa., Sept. 1957, 41 pp, Microfilm $3.30, Photocopy $7.80. Order PB 136579 from Library of Congress, Washington 25, D.C.*

High Temperature Printed Circuitry, II

Enamel resistors based upon molybdenum disilicide ($MoSi_2$) have been found to have excellent oxidation resistance at elevated temperatures. Vacuum evaporated gold-palladium resistor films from room temperature to 740 C are also under study. Two types of high temperature capacitors made were conducting silver enamel electrodes formed on opposite sides of a thin alumina substrate, and an air dielectric capacitor fabricated by means of enamel bonding techniques. *High Temperature Printed Circuitry, G. H. Young, C. H. T. Wilkins, Mellon Institute of Industrial Research, University of Pittsburgh, Pa., April 1958, 31 pp, Microfilm $3.00, Photocopy $6.30. Order PB 135871, Library of Congress, Washington 25, D.C.*

New Approaches to Printed Circuitry

Performance tests on vacuum evaporated chromium resistors and chemically deposited tin oxide resistors have been carried out. Silicon monoxide overcoating is effective in protecting glass-based chromium films to 300 C. Various overcoatings

for higher temperature service and protection of ceramic-based components have been tried without success. Quantitative measurements of corona charging characteristics of materials for use in making electrostatic printing masters have been made. *Performing Research On New Approaches to Printed Circuitry, Haloid Co., Rochester, N.Y., Sept., 1957, 27 pp, Microfilm $2.70, Photocopy $4.80. Order PB 135502 from Library of Congress, Washington 25, D.C.*

Radome Discontinuities

The effects of radome discontinuities on antenna patterns are investigated. Several studies were made on specific rib configurations. From this work it was seen that: (1) a dielectric rib may scatter as much as or more energy than a conducting rib of the same size; (2) metal ribs may exhibit very little scattering when the electric field is perpendicular to the axis of the rib; (3) when a radome framework is composed of conducting elements about five wavelengths or more in length, there is no appreciable difference in the scattered fields whether the ribs are insulated or connected to each other at their ends; (4) the effects of small metal objects with size and arrangement typical of the bolts of a reinforced, plastic, geodesic radome are negligible. *Effects of Radome Discontinuities on Antenna Patterns. Antenna Laboratory, Ohio State University, Research Foundation, Columbus, Ohio, Aug. 1957, 46 pp, Microfilm $3.30, Photocopy $7.80. Order PB 136557 from Library of Congress, Washington 25, D.C.*

Maximum Gain From Yagi Antennas

In conventional Yagi design, optimum performance requires separate adjustments in a number of parameters: the array length and the height, diameter and spacing of the directors and reflector. By introducing the notion of a surface wave traveling along the array, it is possible to demonstrate the interrelation between these parameters experimentally. The gain then depends only on the phase velocity of the surface wave (which is a function of the height, diameter, and spacing of the directors) and on the choice of the reflector. Maximum gain for a given array length, for any director spacing less than 0.5λ, can be obtained by suitable variation of the parameters to yield the desired phase velocity. A design procedure that provides maximum gain for a given array length is presented. *A New Method For Obtaining Maximum Gain From Yagi Antennas, H. W. Ehrenspeck and H. Poehler, Air Force Research Center, Bedford, Mass., Dec. 1958, 24 pp, Microfilm $2.70, Photocopy $4.80. Order PB 140142 from Library of Congress, Washington 25, D.C.*

BOOKS

Low-Frequency Amplifiers

Alexander Schure, Editor, John F. Rider Publisher Inc., 116 W. 14th St., New York 11, N.Y., 79 pp, $1.80.

The frequency band considered in this book ranges from 20 to 16,000 cps. Specific problems encountered at the very low ranges are treated.

In a rather elementary fashion, the book clarifies the application of vacuum tubes as well as transistors to audio frequency amplifiers. The chapter on transistor amplifiers covers a comparison of transistor characteristics, the establishment of operating points, biasing methods, and stabilization computations.

Other sections deal with principles of amplification, low-frequency voltage amplifiers, single-ended power amplifiers, and push-pull power amplifiers. Special emphasis is given to considerations underlying the design of systems, in addition to the solution of design problems.

Automation Cybernetics and Society

F. H. George, Philosophical Library, Inc., 15 E. 40th St., New York 16, N.Y., 283 pp, $12.00.

The author's aim is to study automation in relation to the advancement of science and society. A study of automation involves cybernetics, the science of communication and control.

Part Two, which presents chapters on communication theory, logic and machines, computers and computations, and servo-systems, should be of special interest to engineers. Parts One and Three are

concerned with: "Social Background of Automation" and "Operational Research and Automation," respectively.

Mathematical Programming and Electrical Networks

Jack B. Dennis, The Technology Press of M.I.T. and John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 186 pp, $4.50.

This is a new approach to mathematical programming based on an analogy with electrical networks. It is shown that any dc electrical network made up of current sources, voltage sources, ideal diodes, or ideal transformers is equivalent to a pair of dual linear programs. This relation is extended to include a correspondence between dc networks and quadratic programming.

A simple algorithm developed for solving diode-source networks, is applicable to network flow problems including the familiar transportation problem. Then, a procedure for algebraically tracing the breakpoint curve of a diode-source-resistor-transformer network is derived. It is used to obtain optimal solutions to general linear or quadratic programs.

Finally, it is shown that the direction of steepest descent appropriate to a general programming problem is determined by a quadratic program. A method using this result is suggested.

Basic Data of Plasma Physics

Sanborn C. Brown, The Technology Press of M.I.T. and John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 336 pp, $6.50.

This volume presents fundamental data of plasma physics. Only that material is covered which is necessary for work in gas discharges, controlled thermo-nuclear devices, and upper atmospheric research (including satellites).

Devices are discussed only as illustrations of the fundamental physics of the motion of charged particles. Background information is given in graphs and tables. The author discusses such topics as elastic and inelastic collisions, diffusion and mobility, electron attachment, glow discharges, and steady-state microwave discharges.

NEW LITERATURE

Electron Tubes 54

Four-page brochure "Nuvistor" describes three electron tubes. Electrical and physical data are given on a 1/2 in. high small signal triode, a 1-1/4 in. high beam power tube and a 3/4 in. high small signal tetrode. Plate characteristics and stability curves are given. Radio Corporation of America, Electron Tube Div., Harrison, N.J.

Delay Line Data 55

Advances and refinements in delay line techniques are given in two-page bulletins 201, 202, and 203. Higher storage capacity in smaller units, longer time delays, lines with polarity sensitivity, and servo-operated delay lines are discussed. Included in bulletin 203 are descriptions of general purpose delay line equipment. Deltime, Inc., 608 Fayette Ave., Mamaroneck, N.Y.

Relays 56

This catalog contains five data sheets which describe the firm's line of rotary relays. Mechanical, electrical, and environmental specifications and mounting arrangements are provided. These miniature relays range in contact rating from dry circuits to 10 amp; operating voltages are 6 to 300 v dc. Couch Ordnance, Inc., 3 Arlington St., N. Quincy 71, Mass.

Computer 57

The G-15 digital computer is described in six-page illustrated bulletin AB-059. Included are electrical and physical specifications and short descriptions of computer accessories, including a punched card and tabulator coupler, magnetic tape unit, differential analyzer, and graph plotter. Bendix Aviation Corp., Computer Div., 5630 Arbor Vitae St., Los Angeles 45, Calif.

Demodulation Techniques 58

Bulletin "LVDT Application Note 59-14," eight pages, describes demodulation techniques for linear variable differential transformers. Included is a description of a modified circuit incorporating special transformers in which the phase of the reference voltage shifts simultaneously with the signal voltage so that the relative phase angle between the two voltages remains constant. Also illustrated are simple demodulation circuits as well as direction-sensitive and multi-purpose types. Schaevitz Engineering, Pennsauken, N.J.

Flowmeters 63

A complete line of flowmeters from small purge meters to laboratory rotameters and calibrators is described in this eight-page bulletin. The firm's new flowmeters provide a reproducible method of flow measurement for a wide variety of flow ranges for various gases and liquids. Matheson Co., P.O. Box 85, E. Rutherford, N.J.

Plastics 64

Illustrated bulletin 5904, four pages, tells where and why to use plastics. Application, capacity, and tolerances are among the features described. Wilcox Products Co., 3455 Dakota Ave., Minneapolis 16, Minn.

Electrometers 65

This eight-page illustrated bulletin discusses linear, log, differential current, dual linear, and dual log electrometers. General features of the electrometer line and detailed specification data such as current ranges, stability and accuracy ratings, and dimensions are outlined. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Coaxial Choppers 66

Data sheet F-1522 provides complete electrical and mechanical specifications of the firm's coaxial choppers which cancel the external effects of shock and vibration. Diagrams and applications also appear. James Vibrapowr Co., 4050 N. Rockwell St., Chicago 18, Ill.

Robot Machines 67

Publication GER-1581, an eight-page reprint, explains how numerical control systems for machine tools direct completely automatic production of simple and complex parts in job-lot production. Numerical positioning control and numerical contouring control systems are discussed. The operations and applications of both systems are explained and illustrated. General Electric Co., Schenectady 5, N.Y.

Parts Selector Guide 68

This 36-page, illustrated catalog discusses the latest electronic component service replacements, which have been circuit and test-pattern tested in the original manufacturer's chassis to meet or exceed original specifications. Among the new components described are if coils, power and audio transformers, and filter chokes. Ram Electronics Sales Co., 600 Industrial Ave., Paramus, N.J.

New UNION readout instruments withstand shock, vibration and extreme temperature changes

Union Switch & Signal's new READALL* readout instrument replaces complicated systems of lights and relays for reading, storing or transferring all types of information for industrial and military applications. It is not to be confused with conventional indicating devices.

Designed to meet requirements of MIL-E-5422D. The new READALL readout instrument is precision-built and provides instantaneous and continuous operation under conditions of shock, vibration and extreme ranges in temperature. The digital display includes characters in numerical sequence from 0 to 9 plus two blank spaces. 7/32-inch characters can be illuminated red or white as desired; when not illuminated, they appear white against a black background.

Reliability. Performance through one million random operations is an inherent feature of the new READALL instrument. Each module is gasket-sealed in its case to exclude moisture and seal out foreign particles. An especially thin enclosed DC motor, containing ball bearings, permits more efficient operation.

Modular Construction. A unique feature of the readout instrument is its modular construction. It can be used individually or in groups to display multiple characters in a single case.

Direct Code Translation. The operation of the READALL readout instrument is based on a positioning system using a four-bit code. The visual display is the result of a direct electro-mechanical conversion of a binary signal to a decimal read-out. There is no need for additional conversion equipment. Separate code and motor circuits permit the use of the readout instrument in low-level circuitry.

Electrical and Visual Data Storage. Once positioned, the information is displayed until a new code is transmitted to the instrument. No power is consumed while the information is retained. This data may be stored or read-out electrically for further transmission or recording.

Operate Time. The operate time varies from 0.1 second to 1.0 second depending on character position.

Weight and Size. Maximum weight including case is seven ounces; without case, four and one-half ounces. Size encased is 5 13/64 inches long, 1 47/64 inches high and 39/64 inch wide. The new READALL instrument is designed for operation over a temperature range of −54°C to +71°C in humidities up to 100% and altitudes up to 70,000 feet. For more information, write for Bulletin 1019.

*Trademark

"Pioneers in Push-Button Science"

UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY
PITTSBURGH 18, PENNSYLVANIA

CIRCLE 73 ON READER-SERVICE CARD

NEW LITERATURE

Epoxy Resin 74

These catalog sheets illustrate and describe TC-459 epoxy resin. Electrical and physical properties, packaging, and uses are given. This resin seals and reinforces electrical connectors, wiring, cables and other equipment against corrosion, insulation failure and moisture contamination. Electronic Production & Development, Inc., Chemical Div., 501 N. Prairie Ave., Hawthorne, Calif.

Servovalves 75

Catalog 310, eight pages, describes operating principles, design features and performance characteristics of series 31 and 32 flow control servovalves. Dimensional diagrams, cut-away photographs, and a series of performance curves are included. A glossary of servovalve terminology is also given. Moog Servocontrols, Inc., E. Aurora, N.Y.

Encoders 76

Bulletin 300-5 is a four-page summary of the firm's standard shaft position encoders. Specifications and performance data are provided for C-100, C-200, C-700, C-800, and C-900 series encoders, the CG-200 and CG-700 series internally geared assemblies, and the GB-100 series externally geared assemblies. Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif.

Measuring Instruments 77

Six-page catalog WK-02 illustrates and describes instruments for electronic, physical, and chemical measurements. Electrical and physical specifications are given for transformer ratio-arm bridges, oscillators, transistor adaptors, milliwattmeters, vibration meters, an electronic micrometer, an attenuator calibrator, and a wide-band attenuator. Wayne Kerr Corp., P.O. Box 801, Philadelphia 5, Pa.

CIRCLE 78 ON READER-SERVICE CARD

Electrical Connectors 83

Single-conductor plugs and receptacles available in 50 and 100 amp ratings for use in portable or stationary power and distribution panels, are described in bulletin PR259. The eight-page, illustrated bulletin includes advantages, features, types, and colors in its discussion. The Superior Electric Co., 83 Laurel St., Bristol, Conn.

Combustion Safeguard 84

Used for heating and heat-treating applications, this combustion safeguard control is the subject of bulletin 659. Illustrations and a description of the operation procedures are provided in the four-page bulletin. Protection Controls, Inc., 6000 N. Legett Ave., Chicago 46, Ill.

Filter and Transformer Catalog 85

The general catalog covers over 800 stock items of filters and transformers. It gives specifications and applications. A separate catalog, consisting of specifications and pertinent data for filters and inductors, has been issued. United Transformer Corp., 150 Varick St., New York, N.Y.

Power Supplies 86

This two-page bulletin describes the firm's transistorized power supplies. It gives specifications and selective features for 64 basic models with continuously variable voltage ranges to 300 v and up to 25 amp dc output. Mid-Eastern Electronics, Inc., 32 Commerce St., Springfield, N.J.

TV Replacement Guide 87

Catalog TV-60 lists the firm's complete television replacement line. In addition to recommendations for replacement problems, the book contains a catalog of transformers for television and audio applications. Triad Transformer Corp., 4055 Redwood Ave., Venice, Ca

Miniature Relays 88

Two illustrated bulletins, BR-591 and BR-592, describe models BR-8 and BR-7 miniature relays, which are available in ac and dc models with various header and mounting styles. Performance specifications, dimensions and operating characteristics appear in each two-page bulletin. Babcock Relays, Inc., 1640 Monrovia Ave., Costa Mesa, Calif.

NEW LITERATURE

Handling Equipment 94

Materials handling equipment, parts handling equipment, power rectification equipment, mechanical shaft seals, paper joggers and portable power tools are discussed in catalog 596. Included in the 68 pages are descriptions, data and specifications, in addition to illustrations showing products in operation. Syntron Co., 283 Lexington Ave., Homer City, Pa.

Aluminum Clad Copper Wire 95

Technical booklet, "Aluminum Clad Copper 40 Per Cent," describes a high-conductivity wire developed by the company for high temperature magnet wire and a variety of applications in aircraft, missiles, and high-speed industrial equipment. The four-page booklet contains conductivity ratings, mechanical properties, and weight/length conversion tables for 40 gages of the new high temperature wire. Sylvania Electric Products, Inc., Parts Div., Warren, Pa.

Instrument Cases 96

Four-page bulletin 402G illustrates and describes a complete line of instrument cases. Dimensional diagrams and tables, and physical specifications are also provided. TA Manufacturing Corp., 4607 Alger St., Los Angeles 39, Calif.

Power and Gas Tubes

This 32-page booklet, PG-101D, contains data for 19 new tube types. Concise technical information on the firm's power tubes, rectifier tubes, thyratrons, and ignitrons is provided. Each of the 175 tube types is covered by a thumb-nail text description, charted dimensions, ratings, operating values, and a base or terminal-connection diagram. Photographs of representative tube types in each tube family are shown. *The booklet may be obtained from RCA electron tube distributors, or by sending 30 cents to Commercial Engineering, RCA Electron Tube Div., Dept. ED, Harrison, N.J.*

AC Timing Motors 103

These reversible ac timing motors, suitable for both military and industrial applications, are discussed in bulletin AWH MO-807. Specifications for the motors, along, with an illustration, wiring diagram, and outline and mounting dimensions appear in the two-page bulletin. A. W. Haydon Co., Waterbury, Conn.

Bonded Mica Insulation 104

This 16-page catalog describes and illustrates the firm's line of bonded mica insulation. It offers information about properties, tolerances, composition, and four new grades. Forms, sizes, weights, and specifications are covered, in addition to fabricating aids such as how to punch, turn, saw, and drill this material. Continental-Diamond Fibre Corp., Newark, Del.

Modular Control Systems 105

These matched systems, suitable for use in the aircraft, missile, electronic control, and related fields, are covered in bulletin PS-5A. Its four pages contain charts and photographs of units in the system which includes transducers, modular contactorless controls, and modular actuators. Airborne Accessories Corp., 1414 Chesnut Ave., Hillside 5, N.J.

Laminated Plastics 106

This 16-page engineering data book lists specifications on laminated plastics and associated products. Tables and charts present typical performance values for grades of laminated sheets, allowable thickness tolerances, design recommendations, and other information on the firm's printed circuits and copper-clad laminates. Northern Plastics Corp., LaCrosse, Wis.

Power Packs 107

Catalog sheet 118 describes a line of solid-state, miniaturized, high amperage power packs. Physical features, electrical and dimensional specifications, and illustrations of the unit are provided. Electronic Research Associates, Inc., 67 Factory Place., Cedar Grove, N.J.

NEW LITERATURE

Brush Maintenance 114

Practical tips on brush operation and maintenance on high-current, low-voltage generators used in electrolytic processes are contained in 16-page illustrated booklet CP-3004. Included is a discussion of metal-graphite brushes used in plating generators, together with explanations of contact drop, friction, resistivity, and commutator surfacing. National Carbon Co., 535 Fifth Ave., New York 17, N.Y.

Data Handling Systems 115

A line of precision electronic measuring and data handling systems is presented in eight-page illustrated bulletin G-101. These systems are used to measure weight, strain, force and thrust, flow, pressure, and temperature in the aircraft and missile, steel, automotive, and chemical processing industries. Gilmore Industries, Inc., 13015 Woodland Ave., Cleveland 20, Ohio.

Differential Voltmeter 116

A precision dc-ac differential voltmeter, model 803, is illustrated and described in four-page bulletin 335. A basic block diagram is given, as well as electrical, physical and dimensional specifications. John Fluke Manufacturing Co., Inc., 1111 W. Nickerson St., Seattle 99, Wash.

Multiplier-Divider 117

This two-page data sheet describes the model K5-M multiplier-divider. Electrical, physical, and mechanical specifications are given, as well as applications and a block diagram. George A. Philbrick Researches, Inc., 285 Columbus Ave., Boston 6, Mass.

Isolated Power Supply 118

Applications and specifications for the firm's model 21 isolated power supply appear in this four-page bulletin. Accuracy, durability, and performance are also described. Moeller Instrument Co., Electronics Div., 132nd St. & 89th Ave., Richmond Hill 18, N.Y.

Fastenings

This 88-page net price catalog gives prices for each of the thousands of corrosion-resistant fastenings the firm manufactures. Included in the catalog are bolts, nuts, screws, washers and rivets. *Write on company letterhead to H. M. Harper Co., Dept. ED, 8200 Lehigh Ave., Morton Grove, Ill.*

Precision Wire 120

Four-page bulletin 359 lists and describes various types of precision wire. Resistance thermometer wire, 1000 F insulated wire, semiconductor wire, and high tensile strength magnet wire are among the types included. Secon Metals Corp., 7 Intervale St., White Plains, N.Y.

Aluminum Spheres 121

Data sheet Z-101 describes 99.99% pure aluminum spheres used in forming alloy junctions in silicon semiconductor devices. General description, available sizes, instructions for ordering, and a photograph are included. Accuracy Specialties Co., Inc., 37-11 57th St., Woodside 77, N.Y.

Power Supply 122

Data sheet 336 illustrates and describes precision dc power supply model 301E. This power supply is chopper stabilized, calibrated, and standard-cell referenced. Electrical and mechanical specifications are given. John Fluke Manufacturing Co., Inc., 1111 W. Nickerson St., Seattle 99 Wash.

Rate Gyros 123

Information on three rate gyros that cover practically every application requirement can be found in bulletin RG-101, two pages. Specifications and dimensional diagrams are given, in addition to pictures of the instruments. Humphrey, Inc., 2805 Canon St., San Diego, Calif.

Interference Filters

Electrical and physical specifications and product information on interference devices for electronic equipment are given in this 350-page design and product catalog. *Write on company letterhead to Filtron, Inc., Systems Div., Dept. ED, 10023 W. Jefferson Blvd., Culver City, Calif.*

NEW LITERATURE

Modular Enclosure System 134

Technical and engineering data, specifications, drawings, photographs and illustrations of the units and component parts of the modular enclosure system appear in catalog 106, 108 pages. A 16-page condensed version of catalog 106 will answer requests. Elgin Metalformers Corp., 630 Congdon Ave., Elgin, Ill.

Electronic Parts and Equipment 135

This general catalog devotes over 300 pages to the latest electronic parts and equipment including a complete line of stereo high fidelity components. The firm offers its own line of stereo tuners, amplifiers, preamplifiers, tape recorders, speakers and enclosures. A full presentation of radio and TV parts, transistor kits and miniaturized components, antennas and installation accessories, relays, transformers, and rectifiers appears. Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N.Y.

Silver-Cadmium Batteries 136

This six-page brochure supplies data on physical and electrical characteristics of long-life silver-cadmium cells, which are smaller in size and weight than ordinary batteries. Graphs compare the performance of these cells with other types. Yardney Electric Corp., 40-50 Leonard St., New York 13, N.Y.

Protective Surface Coatings 137

Thermal, physical, chemical, and electrical characteristics of protective surface coatings for electronics applications appear on this chart. All characteristics can be seen at a glance on one side of the sheet. The chart breaks down the firm's ten types by the AIEE classification as well as 47 other characteristics. On the reverse side of the sheet is a selector table which enables the user to choose the type best suited for his application. Columbia Technical Corp., 61-05 31 Ave., Woodside 77, N.Y.

Thermistors

This 38-page booklet contains historical background, operating characteristics, electrical specifications, uses and applications, and typical circuitry for the firm's thermistors and varistors. Illustrations, graphs, and dimensional diagrams are included. *Send $1.00 to Victory Engineering Corp., Dept. ED, 519 Springfield Rd., Union, N.J.*

Servo Amplifier 143

An electronic servo amplifier and power supply for use in ac instrument servo systems are described in data sheet EE-1005. Electrical and physical specifications and applications of the units are provided, as are a block diagram and illustrations. Seneca Falls Machine Co., Electronics Div., Seneca Falls, N.Y.

Compression Terminals 144

Bulletin SCT-59-101, six pages, describes a series of glass-to-metal compression terminals. Electrical specifications, performance data, installation information, and dimensional diagrams are given, as well as a two-page terminal selection chart. Electrical Industries, 691 Central Ave., Murray Hill, N.J.

Delay Lines 145

A line of distributed constant delay lines and pulse test equipment is illustrated and described in this short form catalog. Electrical specifications and environmental characteristics are given, as well as physical dimensions and illustrations of the various available case styles. Technitrol Engineering Co., 1952 E. Alleghany Ave., Philadelphia 34, Pa.

Electro-Mechanical Parts 146

Over 20,000 electro-mechanical, developmental, electronic, gearing, and tool components are described in 512-page catalog No. 60. Dimensional diagrams, physical and mechanical specifications, and prices are given in this pocket-sized catalog. Sterling Precision Corp., Instrument Div., 17 Matinecock Ave., Port Washington, N.Y.

NEW LITERATURE

Basic Circuits 154

"Basic Circuits", 32 pages, serves as a guide to determine the availability of a circuit and its components. This pocket-sized catalog contains line drawings of slow-operating and slow-releasing circuits, relay locking circuits, pulse generators, pulse stretching, ac rectifier circuits, and rotary switch circuits. Automatic Electric Co., Northlake, Ill.

Shock and Vibration Environments

Entitled, "Electronic Designers' Shock and Vibration Guide for Airborne Application," this 250-page technical report was prepared for use by electronics contractors engaged in work for the Air Research and Development Command. The manual contains theory, vibration studies, electronic component parts and their characteristics, rack and chassis design, damping, equipment for simulating and measuring shock and vibration, laboratory test procedures, vibration and shock protective devices, and equipment mounting and installation techniques. It is available to Department of Defense contractors. *Armed Services Technical Information Agency, Dept. ED, ASTIA Document No. AD-204095.*

Remote Impulse Counters 156

Remote impulse counters manufactured by Sodeco of Geneva, Switzerland, are illustrated and described in this two-page data sheet. Dimensional diagrams, electrical specifications, operating instructions, and construction data are provided. Landis & Gyr, Inc., 45 W. 45 St., New York 36, N.Y.

Fiberglass Tubing 157

High frequency electronic insulating material is the subject of this two-page bulletin. Eletcrical and mecahnical properties, in addition to such data as size, length and tolerances, are given. Other structures of silicone and urethane fiberglass are also described. Chemfab Corp., 40-30 23 St., Long Island City 1, N.Y.

Casting Aluminum 159

This 32-page handbook covers the various casting processes suitable for aluminum. Recommendations on alloy selection are given, plus a discussion of alloying elements and their effects. Design of aluminum castings is explained fully. Tables on core sand mixes, tolerances, weight comparisons, annealing and stress relieving cycles, shrinkage data and machining information are included. Reynolds Metals Co., Box 2346, Richmond 18, Va.

Precision Pulse Generator 160

A 256-step precision pulse generator is discussed in bulletin 3022-9. Suggested uses, principle of operation, features, specifications and performance data are given. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Electronic Tracer 161

Four-page bulletin 1287 describes an electronic tracer which uses simple line sketches to guide oxygen shape-cutting machines. This unit eliminates the need for expensive metal or plastic templates, photographic negatives, or complicated silhouettes. Linde Co., Div. of Union Carbide Corp., 420 Lexington Ave., New York 17, N.Y.

Capacitors 162

The firm's rectangular tantalum electrolytic capacitors are described in revised bulletin GEA-6766A, four pages. Performance data, outline drawings, tables of sizes and ratings for operation at 85 and 125 C, polar and non-polar applications are given. The bulletin discusses new terminal construction and high-vibration mounting brackets. General Electric Co., Schenectady 5, N.Y.

Indicating Recorders and Recorder-Controllers 163

Catalog 66, four pages, covers the sensitivity, accuracy, control and alarm function, installation, operation, maintenance and applications for indicating recorders and recorder-controllers. Illustrations of the units and instrument dimensions also appear. Thermo Electric Co., Inc., Saddle Brook, N.J.

New Series of Sprague Cylindrical-Style Radio Interference Filters: top row, l. to r.—4JX14, 5JX94, 1JX115, 20JX15, 50JX20 bottom row—5JX27, 1JX54, 1JX113, 1JX117, 2JX49, 1JX118.

New Series of Small, Light Radio Interference Filters

The new cylindrical-style radio interference filters recently announced by Sprague Electric Company are the smallest and lightest filters of their type available for military and industrial electronic and electrical equipment. Their basic design was pioneered by Sprague in order to achieve maximum miniaturization.

This new series of standard filters, believed to be the largest in the industry, ranges in current rating from 5 milliamperes to 50 amperes to cover the great majority of application needs.

The natural shape of the rolled capacitor section and of the toroidal inductors dictates the cylindrical form. All filters have threaded-neck mountings for use on panels or bulkheads. This assures both the proper isolation between input and output terminals as well as a firm peripheral mounting with minimum impedance to ground.

Listed in Sprague Engineering Bulletin 8100 (available upon request to the Technical Literature Department) are 68 of the more popular low-pass filter designs intended for use as three-terminal networks connected in series with the circuits to be filtered. The excellent interference attenuation characteristics reflect the use of Thrupass® capacitor sections.

Since maximum effectiveness of filtering involves elimination of mutual coupling between input or noise source and output terminals, filters should be mounted where the leads being filtered pass through a shielded chassis or bulkhead. The threaded neck mounting is designed to give a firm metallic contact with the mounting surface over a closed path encircling the filtered line and to eliminate unwanted contact resistance so that the theoretical effectiveness of these units is realized in practice.

Typical insertion loss is determined by measurements made in conformance with Military Standard MIL-STD-220. Minimum curves for specific filters are available upon request.

For assistance in solving unusual interference, rating, or space problems, contact Interference Control Field Service Manager, Sprague Electric Co., at 12870 Panama Street, Los Angeles 66, California; 224 Leo Street, Dayton 4, Ohio; or 347 Marshall Street, North Adams, Massachusetts.

CIRCLE 165 ON READER-SERVICE CARD

NEW LITERATURE

Beam Power Tube 174

Seven-page booklet AN-182 discusses the application of the 6EM5 beam power tube in vertical-deflection circuits of television receivers utilizing picture tubes with diagonal deflection angles of 110 deg and operating at ultor voltages of up to 20,000 v. A circuit is given and analyzed. Electrical characteristics of the 6EM5 are also given. Radio Corporation of America, Electron Tube Div., Harrison, N.J.

Power Pentodes 175

Seven-page booklet AN-180 discusses the application of a series of power pentodes designed for use in low-cost audio amplifiers. Electrical and mechanical characteristics are given for the 6EH5, 12EH5, 25EH5 and 50EH5 power pentodes. Included are circuit diagrams of typical applications. Radio Corporation of America, Electron Tube Div., Harrison, N.J.

Rotary Switch 176

Two-page illustrated data sheet S-1 describes multiple rotary switches. It provides complete specifications and design information on four types with a cross reference to the applicable BuShips drawing number. Couch Ordnance, Inc., 3 Arlington St., N. Quincy 71, Mass.

Environmental Testing 177

Four-page catalog illustrates and describes a series of temperature and humidity chambers for environmental testing. These units range from a 2 cu ft portable model up to a 10 cu ft production testing model. Physical and dimensional specifications are given. Harris Refrigeration Co., 308 River St., Cambridge 39, Mass.

Temperature Chambers 178

This illustrated two-page bulletin describes a bench-type temperature test chamber. Electrical, physical, and dimensional specifications are given. Missimers Inc., 3737 San Fernando Rd., Glendale 4, Calif.

Tape Transports 179

"Transistorized Tape Transports and Accessories," 12 pages, describes in detail a line of digital magnetic and perforated tape handlers and record/playback heads and amplifiers. Potter Instrument Co., Inc., Sunnyside Blvd., Plainview, N.Y.

Atomic Industry Directory

This 132-page directory provides product and service profiles of more than 200 industrial organizations in the nuclear field. Classifications included are radioactivity gages, laboratory instruments, process instrumentation, nuclear reactors, and control equipment and simulators. *Send $2.50 to Atomic Industrial Forum, Dept. ED, 3 E. 54th St., New York 22, N.Y.*

Mercury Relay 184

Four-page illustrated bulletin 410 describes a long-life mercury relay that operates swiftly and silently. Included in the brochure are electrical specifications, photos and diagrams of this relay. Also described is the operating principle of the normally open and normally closed type of mercury relay. Mack Electric Devices, Inc., Wyncote, Pa.

Semiconductors 185

Five illustrated bulletins describe the firm's MS-41 Magnetoresistor, HS151 Halltron, HR-31 Halltron, MC-1 Magnetic Circuit and TA-11 Thermoelectric Junction. Ranging from two to four pages, each brochure gives electrical and physical specifications, examples of applications, and charts showing performance characteristics. Ohio Semiconductors, Inc., 1035 W. Third Ave., Columbus 8, Ohio.

Recording System 186

Illustrated bulletin 350-3, two pages, describes a reactor temperature and pressure recording system. Included are electrical and physical information and a block diagram of the entire system. Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif.

Preamplifiers 187

Descriptions of the firm's line of preamplifiers are given in four-page illustrated bulletin 63. Electrical, mechanical and dimensional specifications of the units are provided, as well as graphs of selectivity vs. frequency, dynamic response, and gain vs. frequency. Rixon Electronics, Inc., 2414 Reedie Dr., Silver Springs, Md.

Megohmmeter 188

Illustrated bulletin 2-1.2, two pages, describes the firm's Vibrotest megohmmeter. This instrument offers stable resistance measurements up to 5 x 10^{12} ohms. Included are electrical and dimensional specifications and a block diagram. Associated Research, Inc., 3777 W. Belmont Ave., Chicago 18, Ill.

‹ CIRCLE 180 ON READER-SERVICE CARD

1959 Transistor Data CHART Revisions

Several changes to our Seventh Annual Transistor Data Chart are tabulated below. Please clip the sheet to the Chart or make the corrections directly on the listing.

TO VERIFY the validity of our Transistor Data Chart listings, we have solicited the help of all contributing manufacturers in advising us of any corrections to be made. The information presented should be added to the original tabulations appearing in the July 22 issue.

Clarification on Sources of Supply

In cases where several manufacturers submitted different data on a particular type, it was difficult to choose the set of data to be published for the type. It was decided that average, rather than extreme limits, should be given.

If, for example, the alpha cutoff frequency for a type was listed as 10 mc, 11 mc, and 12 mc by three manufacturers (A, B, and C), the data of company B using the average (11 mc) figure was given with Manufacturer's B abbreviation listed in the "Mfg." column; the other two companies (A and C) were indicated as alternate sources in the "Remarks" column.

Actually, manufacturer A or C may be the original or "prime" supplier for the particular type. There was no intention of stating or implying that the company listed under the "Mfg." heading was the original registrant for the particular type or produced superior or cheaper units that those companies listed in the "Remarks" column. Readers should be aware of this important fact and check pricing as well as full technical specifications of all listed suppliers before proceeding with their purchasing plans. ■■

Changes To Transistor Data Chart

TYPE NO.	CATEGORY	MANUF.	CORRECTION
2N696	LLS	FA	Since units are rated at 2w, they should be included in HLS category rather than LLS.
2N697	LLS	FA	
2N1131	LLS	FA	
2N1132	LLS	FA	
XT515	HF	PSI	2N1339 — Change power rating to 2.8 w, w/c to 0.023 and add to "Power" category. Also include new EIA numbers.
XT516	HF	PSI	2N1340
XT517	HF	PSI	2N1341
XT518	HF	PSI	2N1335
XT519	HF	PSI	2N1336
XT520	HF	PSI	2N1337
2N117	HF	TI	Add to "Audio" section and indicate TI as manufacturer.
2N118	HF	TI	
2N119	HF	TI	
2N332-36	HF, LLS	TI	
2N497	HLS		Add to "Power" category
2N389	HLS		Add TI as manuf.
903	Audio	TR	Add TR as source.
904	Audio	TR	Add TR as source.
904A	Audio	TR	Add TR as source.
905	Audio	TR	Add TR as source.
910	Audio	TR	Add TR as source.
2N118	Audio		
2N332-36	LLS	TR	Add TR as source.
2N1247	Audio	TR	NOTE: Change to "Special" as these are extremely low level devices.
2N1248	Audio	TR	
2N1249	Audio	TR	

The WESCON Winners!

Outstanding design earned awards for these products at the WESCON Industrial Design competition

The 18 designs shown here were judged to have best "clarity of function, ease of operation and and appropriateness of appearance" of the 140 entries submitted to the first Industrial Design Competition sponsored by the Western Electronic Show and Convention.

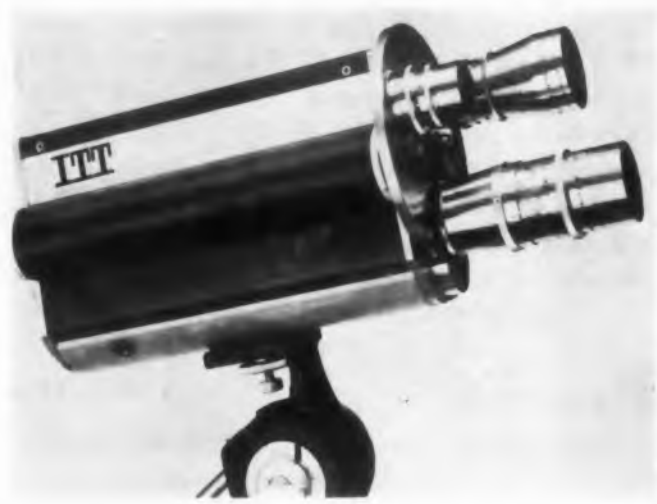
A jury of prominent industrial designers awarded certificates of excellence to seven of the winning products and certificates of merit to the rest. All the award winners were displayed in a special exhibit area at the WESCON show, where they attracted much favorable attention.

The contest, open to any company exhibiting at WESCON, will be conducted next year also.

Electropack standard cabinetry designed for Santa Anita Engineering Co. by Jim Powell Industrial Designers won an award for excellence.

Power oscillator, designed by Matt Jacobson of Jaycraft Co., won an excellence award for Electronics International Co.

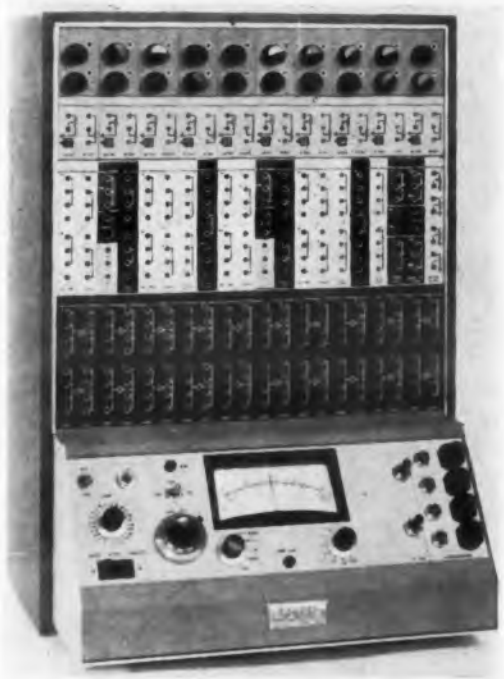
Digital tape handler (left, rear) earned excellence award for Ampex designer F. T. Walsh, who receives merit award from design show director O. H. Brown, right, for airborne tape recorder he designed with G. A. Smith. Another Walsh-designed product, Ampex' FR-400 digital tape recorder, also won an award for merit.



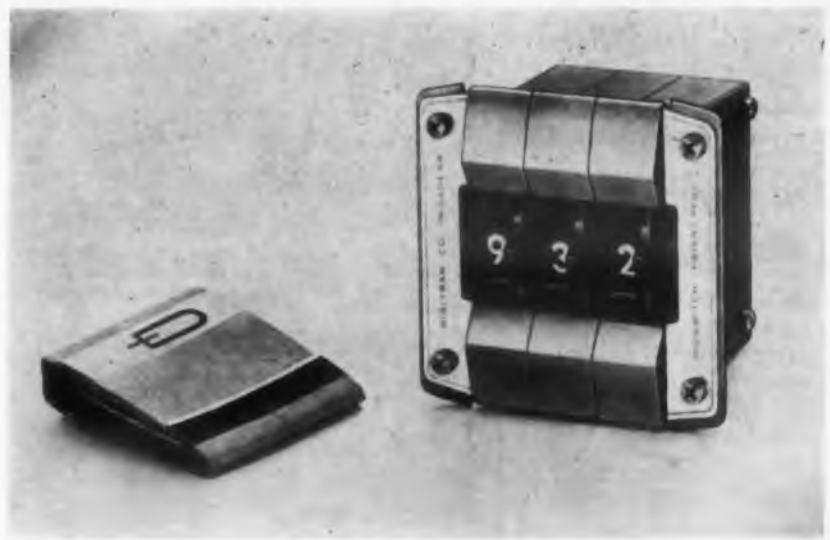
Closed Circuit TV camera with extruded aluminum and vinyl exterior won excellence award for Industrial Products Division of ITT. Designers: James Lee, Channing Gilson and William Brewer.

Computer for industrial process control, designed by Zierhut and Associates for Librascope, Inc., won an award for excellence.

Clip-on probe for dc, winner of excellence award, was designed by T. C. Lauhon for Hewlett-Packard Co.



Transistorized analog computer for desk-top use was one of two merit award-winners designed for Electronic Associates, Inc., by James Patmore.



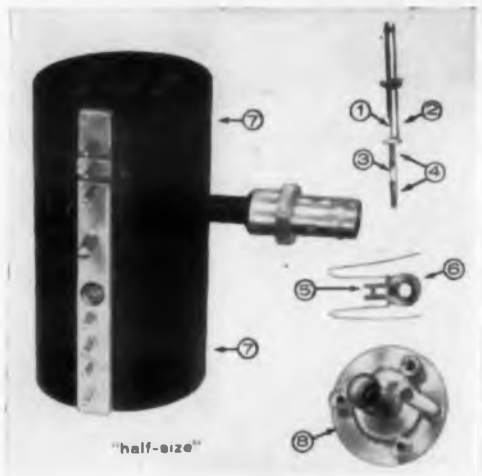
Digiswitch designed by Jim Powell, consultant, and H. D. Wright and Jack Reitzell, designers earned excellence award for Digitran Co.

General-purpose transistorized, digital computer won merit award for Autonetics designer R. E. Davis.

Videotape recorder designed for Ampex by company designers James Hackney and Roger Wilder and Melvin Best Associates won merit award. Ampex won four of the eighteen design awards.

Nickelonic News

DEVELOPMENTS IN NICKEL AND NICKEL ALLOYS AND THEIR APPLICATIONS



Designers insure magnetron reliability with 4 nickel alloys

WALTHAM, MASS: Recently announced by Raytheon Company, the #6177 Magnetron is compactly designed for height finding, other airborne radar uses. Size is small, weight only 1 lb, range is 4261-4300 megacycles at 1 watt.

To insure the magnetron's operating reliability, Raytheon designers use 4 nickel alloys in 13 critical parts. (8 parts are numbered in above photo.) Designers report why:

Electronic Grade "A" Nickel offers outstanding purity in ribbon (1).

Inco "220"* Nickel assures proper outgassing in washer ring (2), tube (3), tube shield (4).

Another nickel-chromium alloy retains non-magnetic characteristics in reed (5), and reed coil support (6).

Alnico (nickel-iron alloy) magnets provide stability (7); cupro-nickel pole support provides strength, non-magnetic characteristics (8).

Pertinent Literature: **Send for 51-B; "Nickel Alloys for Electronic Uses" (see box, below) and T-15; "Engineering Properties of Nickel."**

Circle 563 on Reader-Service Card

Metal that acts like air wraps half-mile vacuum

UPTON, N. Y. In the huge new 25-Bev Synchrotron at Brookhaven National Laboratory, Inconel "X"* age-hardenable nickel-chromium alloy—"a metal that acts like air"—is used to contain a ½-mile-long proton beam vacuum cavity.

Tube of low-magnetic Inconel "X" alloy carries Synchrotron's 25-Bev proton beam between magnet jaws. Tube's assembled, in sections, into a circle ½ mile around.

Inspecting one of Synchrotron's 240 magnets. This one weighs about 17 tons. Inconel "X" tube fits into narrowest gap between jaws.

Principal reason for the selection of Inconel "X" alloy, reports Brookhaven, was its high electrical resistivity. This resistivity, about 740 ohms per circular mil-foot, results in the avoidance of high eddy currents. In addition, the low magnetic permeability of Inconel "X" alloy, approximately the same as air, has virtually no effect on the strong magnetic field passing through the tube walls to guide the proton beam.

Inconel "X" also benefits vacuum cavity tube in other ways

Its high structural strength permits thin-wall construction—tensile strength after heat treatment, above 130,000 psi. Other physical properties important to this application—the alloy's low vapor pressure, good degassing, freedom from porosity.

Inconel "X" alloy provides good fabricability, too—tube is formed in sections from 0.078-inch sheet, welded and flanged.

Pertinent Literature: **Send for 51-B; "Nickel Alloys for Electronic Uses."**

Circle 564 on Reader-Service Card

Monel speeds sound brazing of resistor caps

Close-up of Monel caps soundly brazed to wire winding and leads of semi-finished resistor. Made by Sage Electronics Corporation, 302 N. Goodman St., Rochester 7, N. Y.

ROCHESTER, N. Y.: Monel* nickel-copper alloy now makes possible, fast, sure brazing of connections in resistors designed for severe service by Sage Electronics Corporation (see photo, left).

In the caps, Monel alloy also gives excellent resistance to corrosion in murderous environments... and provides essential strength for anchoring leads.

Monel boosts durability in other electronic components, too

In one magnetron, for example, Monel alloy provides an output flange and mounting plate with the toughness and strength needed for 6000-hr life. In fastenings, Monel alloy stands up against both corrosion and hard knocks. In backing for contact points, Monel alloy contributes important strength and brazing properties.

Pertinent Literature: **Send for 51-B; "Nickel Alloys for Electronic Uses" and T-5—"Engineering Properties of Monel and 'R' Monel."**

*Inco trademark

Circle 565 on Reader-Service Card

Newly Revised Booklet—"Nickel Alloys for Electronic Uses"—gives you facts on 17 freely available nickel alloys useful in the electronics industry ... facts on typical applications, physical and chemical properties, available mill forms. Ask us for your copy.

Our specialists can help you solve metal problems. Contact your Inco Alloy Products distributor or:

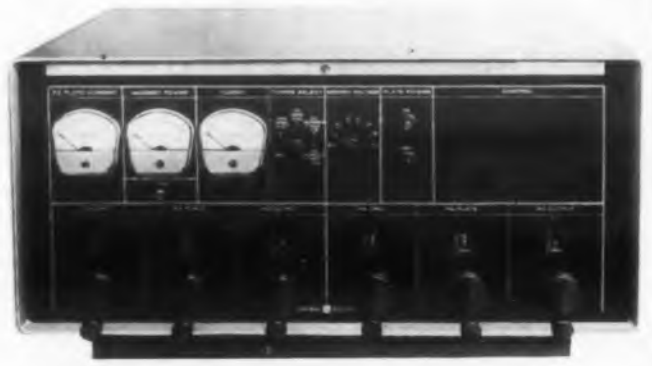
HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
67 Wall Street New York 5, N.Y.

INCO TRADE MARK **ALLOY PRODUCTS**

CIRCLE 563, 564, 565 ON READER-SERVICE CARD

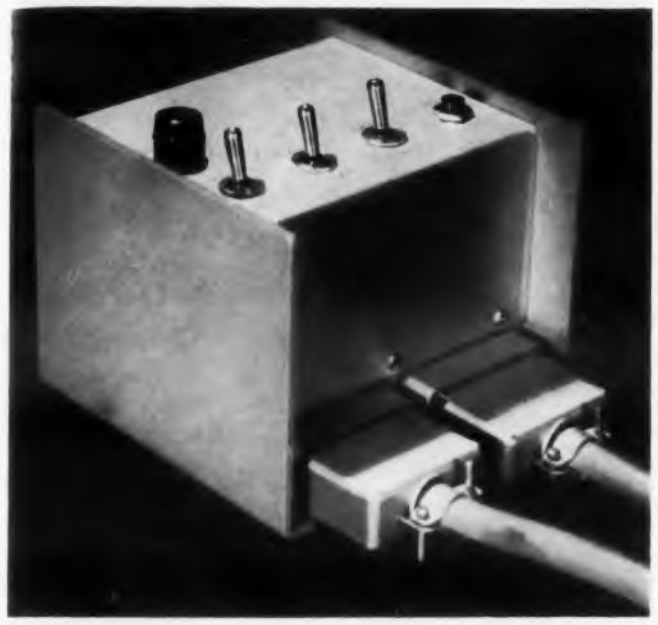
WESCON WINNERS

Portable wattmeter designed by Tor Patterson won a merit award for Voltron Products.

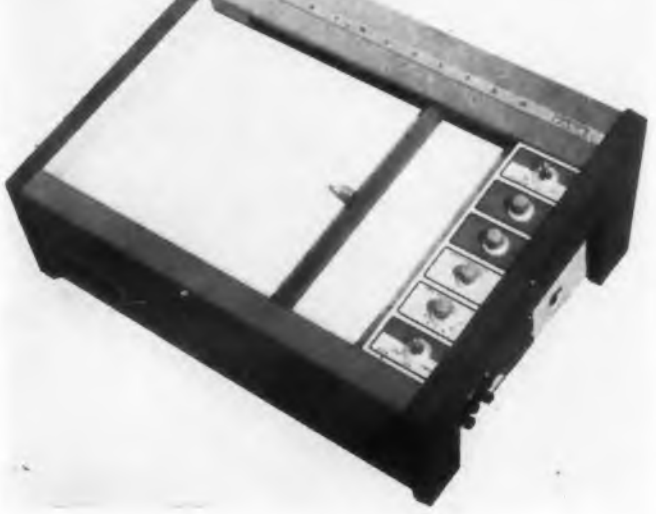


Airborne uhf transmitter, received one of two merit awards won by GE's Light Military Products Department. Designers: Noland Vogt, Robert Robb, and George Beck.

Mating connectors for audio/video received excellence award for Cannon Electric Co. designers Sam Arson and Carlos Beeck.



Sixty-cycle pulser designed for Tally Register Corp. by W. C. Vaughn received merit award.



Variplotter, a portable x-y recorder, won a merit award for James Patmore, Electronics Associates, Inc., designer.

Sight amplifier test set won a second merit award for Light Military Products Department of GE. Set was designed by Vogt, Robb and Beck.

NEW PRODUCTS

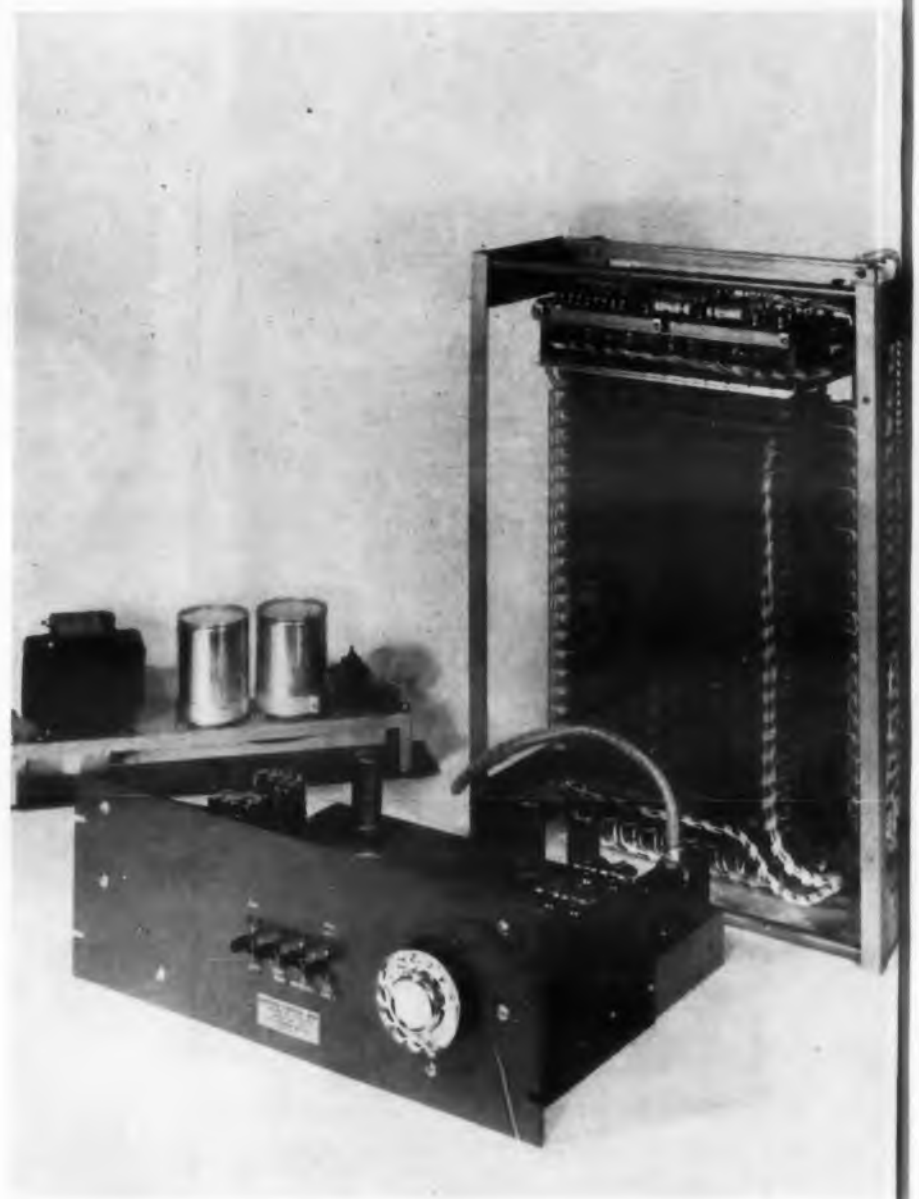
Covering all new products that might generally be specified by an electronics engineer engaged in the design of original equipment.

Silicon Power Rectifier Has 11/16 in. Ceramic Base

The ceramic base silicon power rectifier is available in an 11/16 in. configuration. The ceramic base eliminates the need for insulating hardware and reverse polarity units. The alumina ceramic disc is mounted between the top hat assembly and the hex base, insulating the mounting base from the rectifying junction. The disc has low thermal resistance. The rectifiers are rated up to 20 amp at 150 C case temperature.

Transitron Electronic Corp., Dept. ED, 168 Albion St., Wakefield, Mass.

CIRCLE 191 ON READER-SERVICE CARD



Self-Stepping Crossbar Scanner Operates at Frequencies to 10 mc

Model SC-5F self-stepping scanner is a modified crossbar switch with simplified circuitry which enables it to connect sequentially a six-wire circuit to each of 100 sets of six-wire terminals at up to 50 sets per sec. The unit takes up 27 in. of 19-in. relay rack space and operates reliably over millions of cycles with low crosstalk between adjacent circuits at frequencies up to 10 mc. This scanner is adaptable to thermocouple and strain gage scanning. It has a bridging capacity of 20 μμf to ground between conductors. Current carrying capacity is 100 ma non-inductive at 50 v dc for 2×10^7 operations.

James Cunningham Son & Co., Inc., Dept. ED, 101 Litchfield St., Rochester 8, N.Y.

CIRCLE 193 ON READER-SERVICE CARD

Printed Circuit Trimmer Potentiometer Measures 1/4 x 1/4 x 1-1/4 in.

The Ultrimmer printed circuit trimmer potentiometer measures 1/4 x 1/4 x 1-1/4 in. The resistance element is embedded in alkyd resin to permit the unit to withstand shock vibration. Use of this resin eliminates strain coefficient during temperature cycling. Maximum temperature coefficient is 25 ppm per deg C; the units can be supplied with a high positive temperature coefficient. Humidity and moisture are kept out with a silicon rubber 0 ring, which also maintains constant turning torque. A clutch arrangement prevents overtravel or jamming of the slider. Ranges run from 200 to 150,000 ohms with zero end resistance and standard tolerance of ±5%.

Ultronix, Inc., Dept. ED, 111 E. 20 Ave., San Mateo, Calif.

CIRCLE 192 ON READER-SERVICE CARD

Kit Contains All Equipment Needed to Wind Precision Resistors

This kit contains all necessary tools, materials and instructions needed to wind prototype quantities of precision resistors. Included are a bobbin winding machine, resistor wire, bobbins, lugs, tools and miscellaneous supplies. Sufficient materials are furnished to make more than 200 resistors.

Resistron, Dept. ED, 2487 E. Washington St., Pasadena, Calif.

CIRCLE 194 ON READER-SERVICE CARD

Tantalum Capacitors Have Certified Reliability

A written certification of pre-tested reliability is given on these Gold-Cap tantalum capacitors, eliminating the need for further testing by the user. The capacitors are polarized, tantalum electrolytic units capable of operating at full rated voltages in temperatures ranging from —55 to +85 C with voltage derating at ambient temperatures from 85 to 125 C. Included in the reliability tests are performance and stability checks at reduced and high temperatures, vibration, salt spray, temperature and immersion cycling, barometric pressure, surge voltage, moisture resistance, terminal strength, shock, and 2000-hr life tests. Results are supplied with each capacitor. The units are rated at 6 to 1000 wvdc max; capacitances are from 2 μf at 100 v to 330 μf at 6 v.

Fansteel Metallurgical Corp., Dept. ED, North Chicago, Ill.

CIRCLE 195 ON READER-SERVICE CARD

Beam-Deflection Tube Operates to 100 mc

This beam-deflection tube is designed for balanced-modulator, balanced-mixer, and product-detector service in single-sideband equipment. Called the RCA-7360, it is capable of operation up to 100 mc. Advantages include balanced push-pull output with single-ended input, high gain and large output-signal voltages, self-excited operation, 60 db carrier suppression in balanced-modulator service and 40 db oscillator-signal suppression in balanced-mixer service. The tube has two plates and two beam-deflecting electrodes, together with a screen grid, control grid, and cathode. Control-grid-to-plate transconductance is 5500 μmho, and deflecting-electrode-to-plate transconductance is 1000 μmho.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 196 ON READER-SERVICE CARD

NEW PRODUCTS

Tachometer Generator

Output linearity is 0.03%

Type U720-001 size 20 tachometer generator has an output voltage linearity of 0.03% at 0 to 3600 rpm without the need for compensation due to temperature variations. Temperature rise is 12 to 14 deg C and output voltage variation is ±0.1%. Output impedance is 1100 + j3800 ohms and input impedance is 1173 ohms. Required input is 115 v at 400 cps. The unit weighs 29 oz.

Kearfott Co., Inc., Dept. ED, 1500 Main Ave., Clifton, N.J.

CIRCLE 203 ON READER-SERVICE CARD

Relay

Rated at 10 amp

This 10 amp 4pdt relay is available in both ac and dc operation models. Called E 410 H, it meets MIL-R-5757C, MIL-R-25018 and MIL-R-6106C. It weighs 0.4 lb and measures 1.44 x 1.44 x 2.25 in.

Electro-Mechanical Specialties Co., Inc., Dept. ED, Banning, Calif.

CIRCLE 204 ON READER-SERVICE CARD

Secondary Frequency Standard

Frequencies from 10 kc to 1000 mc

Crystal-controlled time-frequency calibrator model 1213-D provides standard frequencies from 10 kc to 1000 mc for equipment calibration and the measurement of unknown frequencies. Short-time stability is 1 part in 10^7; timing markers are provided at decade intervals from 0.1 to 100 μsec. The unit has a touch-button deviator to introduce a small frequency decrease to establish sense in indications near zero-beat. The calibrator is 14-1/2 x 5-3/4 x 7 in. including a model 1203-B unit power supply.

General Radio Co., Dept. ED, West Concord, Mass.

CIRCLE 205 ON READER-SERVICE CARD

Silicon Rectifiers

Temperature range is −65 to +125 C

Operating in the temperature range of −65 to +125 C, these silicon rectifiers are designed for dc to ac inversion, dc static switching, pulse width modulation, power equipment frequency conversion, and current limiting circuit breaker use. The time required for the rectifier to regain its forward blocking state after forward current conduction is 12 μsec. The piv ratings are 100, 150, 200, 250, and 300 v. These rectifiers carry continuous average forward currents up to 16 amp and handle reverse recovery currents of 20 amp.

General Electric Co., Semiconductor Products Dept. ED, Liverpool, N.Y.

CIRCLE 206 ON READER-SERVICE CARD

Data Plotting Boards

For dc analog signals

Types MC-3301 and MC-3302 data plotting boards are designed to plot one dc analog signal, or two signals simultaneously, on a 30 x 30 in. surface. Type MC-3301 has a one arm-pen assembly; type MC-3302 has two. Equipped with 400-cps plug-in servo amplifiers and plug-in power supplies, they can receive input from two or four channels of analog input data. Maximum plotting sensitivity is 20 in. per v. The pens plot at 30 in. per sec. The plot in either direction is linear with respect to input voltage to within ±0.05% of full scale. Dynamic accuracy is ±0.05% at speeds to 0 in. per sec. The units are transistorized.

Computer Systems, Inc., Dept. ED, 611 Broadway, New York 12, N.Y.

CIRCLE 207 ON READER-SERVICE CARD

Isolated Outputs from Twin Double-Plate Triode

BY PROVIDING two plates for each triode section of a twin triode receiving tube, two well-isolated outputs can be taken from each stage. Registered as the 12FQ8, the "twin double-plate triode" also offers equipment designers economy in cost and space.

Applications

Currently produced in mass-production quantities by the General Electric Receiving Tube Dept. in Owensboro, Ky., the tube is being used by the Wurlitzer Co. in an electronic organ design featuring special effects.

Tone signals are taken from two separate plates of each frequency generator stage. One output is fed to a standard tone amplifier while the second output is available for switching to a "percussion effect" circuit. Due to the excellent isolation between outputs, there is virtually no interaction or degradation effects.

While the same results could be obtained from separate tubes, the availability and use of two anodes in each triode section permits a reduction in the total number of tubes required.

Although presently used in musical instrument devices, the 12FQ8 tube can materially reduce the tube quantity in equipment requiring minimum interaction between two outputs from a single input source.

Electrical Ratings

The 12FQ8 is a nine-pin miniature twin triode with each section having two

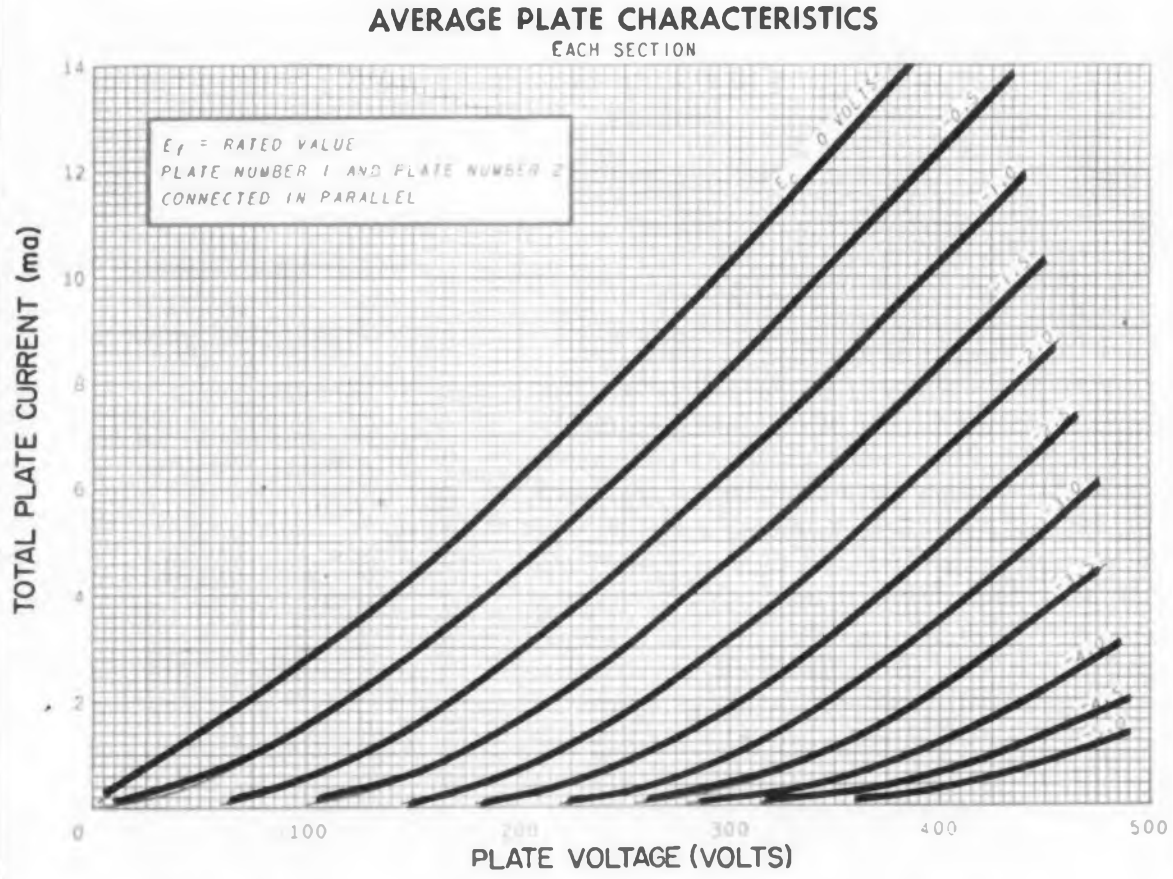
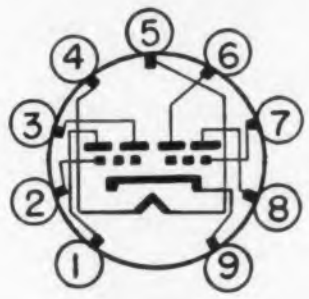


Fig. 1. Average transfer characteristics of each triode section of the 12FQ8.

BASING DIAGRAM



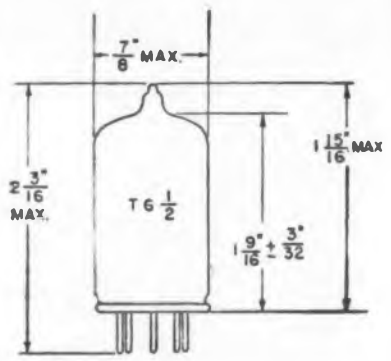
EIA 9KT

(a)

TERMINAL CONNECTIONS

Pin 1—Plate Number 2 (Section 2)
Pin 2—Grid (Section 2)
Pin 3—Plate Number 1 (Section 2)
Pin 4—Heater
Pin 5—Heater
Pin 6—Plate Number 2 (Section 1)
Pin 7—Grid (Section 1)
Pin 8—Plate Number 1 (Section 1)
Pin 9—Cathode

PHYSICAL DIMENSIONS



EIA 6-2

(b)

Fig. 2. (a) Base diagrams for 12FQ8 tube. (b) Physical outline of tube.

plates brought out to separate base pins. Each of the four plates is rated at a maximum of 330 v and 0.5 w dissipation. In typical operation with the plates at 250 v and grids at −1.5 v, the amplification factor of the grids to each plate is 95 and the transconductance is 1250 μmhos, measured with the other plate of the same section grounded. In this condition, each plate draws 1.5 ma and represents a plate resistance of 76K.

For more information on the 12FQ8, turn to the Reader-Service Card and circle 100.

NEW PRODUCTS

Tach Generator

Compact design

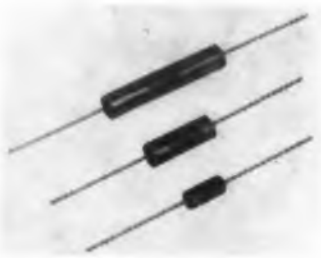
Designed for applications where space must be conserved, type 6227-03 tach generator with size 10 motor measures 1.281 in. long and weighs 2.5 oz. The ambient temperature range is −55 to +100 C and the rotor inertia is 0.65 g-cm². The motor section has 26 v fixed phase, 35 v center tap control phase, 0.3 oz-in. stall torque, and 6500 rpm no load speed. The generator section has 10 v input and 0.16 v per thousand output. The housing is stainless steel.

John Oster Mfg. Co., Avionic Div., Dept. ED, 1 Main St., Racine, Wis.

CIRCLE 211 ON READER-SERVICE CARD

Resistors

Wirewound type



These wirewound resistors have ratings at 25 C of 3, 5, and 10 w. At 200 C their ratings are 1, 1.5, and 3 w respectitvely. Temperature coefficient is ±ppm per deg C even at the maximum operating temperature of 275 C. These units meet MIL-R-9449 and the 1000 v V-block test of MIL-R-26C. Standard units have 1% tolerance; tolerances to 0.1% can be ordered. The resistors are wound helically on ceramic cores and have a jacket of silicone-ceramic pressure-molded around the core.

Ohmite Mfg. Co., Dept. ED, 3657 Howard St., Skokie, Ill.

CIRCLE 212 ON READER-SERVICE CARD

◀ CIRCLE 213 ON READER-SERVICE CARD

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The authorized distributors listed below carry a full stock of all General Instrument semiconductors — and can give you immediate delivery from stock.

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WASHINGTON
Seattle Radio Supply Co.
2115 Second Ave., Seattle

WISCONSIN
Radio Parts Co., Inc.
1314 N. 7th St., Milwaukee

CIRCLE 214 ON READER-SERVICE CARD

GENERAL INSTRUMENT SEMICONDUCTOR DIVISION

AUTOMATIC silicon rectifiers

JAN Type 1N538

JAN Type 1N540

JAN Type 1N547

all the available JAN TYPES to meet MIL-E-1 specifications


JAN Type 1N253


JAN Type 1N254


JAN Type 1N255


JAN Type 1N256

Maximum Values for AUTOMATIC Military Type Silicon Rectifiers

Type No.	Peak Reverse Voltage (VDC)	DC Output Current (MA) Av. @ 135° C. Case Temp.	@ 25° C. Ambient	@ 150° C. Ambient	Maximum Reverse Current (MA)	Mounting	MIL-E-1 Technical Spec. Sheet No.
1N253	100	1000	—	—	0.1*	Stud	1021A
1N254	200	400	—	—	0.1*	Stud	989B
1N255	400	400	—	—	0.15*	Stud	990B
1N256	600	200	—	—	0.25*	Stud	991B
1N538	200	—	750	250	0.350†	Axial Lead	1081A
1N540	400	—	750	250	0.350†	Axial Lead	1085A
1N547	600	—	750	250	0.350†	Axial Lead	1083A

*Averaged over 1 cycle for inductive or resistive load with rectifier operating at full rated current; case temperature 135° C.

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

Without qualification, these rectifiers are the finest available today, designed and manufactured to meet stringent government requirements and the exceedingly high quality control standards of General Instrument Corporation.

These JAN types are offered in volume quantities for *on time delivery* at prices that reflect General Instrument's years of production experience. Data sheets on these and other AUTOMATIC silicon rectifiers are available upon request.

AUTOMATIC

Semiconductor Division
GENERAL INSTRUMENT CORPORATION
65 Gouverneur Street, Newark 4, N. J.

GENERAL INSTRUMENT CORPORATION INCLUDES F. W. SICKLES DIVISION, AUTOMATIC MANUFACTURING DIVISION, RADIO RECEPTOR COMPANY, INC. AND MICAMOLD ELECTRONICS MANUFACTURING CORPORATION (SUBSIDIARIES)

GENERAL INSTRUMENT DISTRIBUTORS: Baltimore: D & H Distributing Co. • Chicago: Merquip Co. • Cleveland: Pioneer Electronic Supply • Los Angeles: Valley Electronics Supply Co., Burbank • Milwaukee: Radio Parts Co., Inc. • New York City: Hudson Radio & Television Corp., Sun Radio & Electronic Co. • Philadelphia: Herbach & Rademan, Inc. • San Diego: Shanks & Wright Inc. • San Francisco: Pacific Wholesale Co. • Seattle: Seattle Radio Supply • Tulsa: Oil Capitol Electronics

CIRCLE 215 ON READER-SERVICE CARD

NEW PRODUCTS

Voltage Comparator

Has three ranges

Model 5 voltage comparator has these three ranges: 0 to 10, 0 to 100, and 0 to 1000 v dc. Accuracy is 0.1%, response time is 0.1 sec, and sensitivity is better than 1 mv. Power requirements are 105 to 125 v ac at 60 cps. Applications include automatic system fault identification, automatic voltage calibration, and continuous monitoring of voltage or any electrical or physical variable that may be converted to a dc voltage.

Optimized Devices, Inc., Dept. ED, 864 Franklin Ave., Thornwood, N.Y.

CIRCLE 217 ON READER-SERVICE CARD

Resistance Wire

Diameters from 0.0031 to 0.0005 in.

This low density resistor alloy has a resistivity of 815 ohms per cmf at 20 C. Called 815-R, it is of iron-chromium-aluminum composition and is available precision drawn with diameters from 0.0031 to 0.0005 in. The alloy possesses a low temperature coefficient of resistance which is inherently controlled within limits of ±0.00001 ohm per ohm per deg C.

Hoskins Mfg. Co., Dept. ED, 4445 Lawton Ave., Detroit 8, Mich.

CIRCLE 218 ON READER-SERVICE CARD

Solid Tantalum Capacitors

Capacitances of 1 to 330 μf

Operating at a temperature range of −55 to +125 C, these solid tantalum capacitors are available with capacitances from 1 to 330 μf. When measured at 25 C and 120 cps, tolerance is ±20% of rated value. Leakage current at rated voltage and 25 C is below 0.03 μa per μf per v. The dissipation factor is under 6%.

Electronic Fabricators, Inc., Dept. ED, 682 Broadway, New York, N.Y.

CIRCLE 219 ON READER-SERVICE CARD

Pulse Generators

Modular Construction

Typical of this series of modular construction programmed pulse generators, type II-507B delivers four different pulse programs to two signal outputs with sync pulses at various pulse repetition frequencies. The units have a preset counter allowing choice of the number of pulses or words per program. The use of transistors and cold-cathode gas tubes keeps power consumption at 8 w.

Iconix, Inc., Dept. ED, 945 Industrial Ave., Palo Alto, Calif.

CIRCLE 220 ON READER-SERVICE CARD

Solder Preforms

For temperatures from 158 to 1800 F

For automatic soldering at temperatures from 158 to 1800 F, these soft solder preforms are available as rings, discs, washers, pellets, castings, balls, spheres, and special shapes. The rings and pellets have a core of acid or rosin flux and are available in wire diameters of 0.003 to 0.735 in. The ball or sphere-shaped preforms are made in a wide range of alloys and have diameters of 0.002 to 0.125 in.

Alloys Unlimited, Inc., Dept. ED, 21-01 43rd Ave., Long Island City, N.Y.

CIRCLE 221 ON READER-SERVICE CARD

Relay Actuator

Has no moving parts

This relay actuator senses the magnetic field created by the current in a wire placed in the hole of the toroid. Actuation can be as low as 4.5 amp, depending on the relay used. The toroid is enclosed in epoxy material. The actuator has no moving parts and eliminates the need for mechanical timers.

L and B Electronics, Dept. ED, 2424 Sixth St., Berkeley, Calif.

CIRCLE 222 ON READER-SERVICE CARD

NEW PRODUCTS

Wirewound Resistors

Have resistances of 130 to 5000 ohms

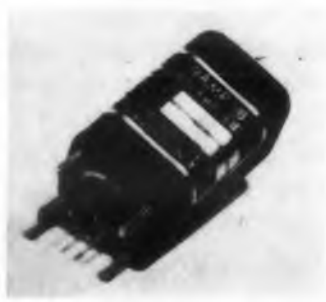
For use in control circuits, computers, and meters, series FM wirewound resistors are available with resistances from 130 to 5000 ohms. The temperature coefficient is 0.002% per deg C for resistors wound with Karma alloy and 0.015% per deg C for resistors wound with Nichrome. Standard tolerance is 1%. The units are equipped with pigtail wire axial leads using No. 20 tinned annealed copper wire. Insulation resistance between body and leads is 900 v min.

Precision, Inc., Dept. ED, 4748 France Ave. N., Minneapolis, Minn.

CIRCLE 224 ON READER-SERVICE CARD

Servo Amplifier

Plug-in type



Designed to receive signals from a synchro control transformer and to operate a servo motor, model 1800-3500 miniature servo amplifier is a hermetically-sealed, plug-in unit. Input impedance is 10,000 ohms, voltage gain is 0.8 v per mv, and power gain is 70 db. The phase shift is adjusted internally to provide 90 deg voltage required by the motor. The carrier frequency is 380 to 420 cps. Output is 20 v at 400 cps when used with a typical servo motor load. Required input is 28 v dc at 150 ma. The unit operates in a temperature range of −55 to +71 C. It measures 1-1/8 x 1-1/8 x 1-55/54 in. and weighs 3 oz.

M. Ten Bosch, Inc., Dept. ED, Pleasantville, N.Y.

CIRCLE 225 ON READER-SERVICE CARD

CIRCLE 226 & 227 ON READER-SERVICE CARD

Power Supplies

Have 20 to 230 v ac output

The series 500 power supplies provide adjustable outputs of 20 to 230 v ac. Output frequencies may be variable, fixed, or in combination; fixed frequency outputs range from 300 cps to 5 kc. Load regulation is 5%. Typical input specifications are: 115 v, 60 cps, single phase, for units with output to 500 va; 230 v, 60 cps, single phase, three wire, for units rated at 750 to 2000 va; and 230, 60 cps, three phase for units with over 2000 va output. The units are designed for use in production testing, ground check-out systems, and other applications.

Matrolog Corp., Dept. ED, 169 N. Halsted St., Pasadena, Calif.

CIRCLE 228 ON READER-SERVICE CARD

Test Chamber

Produces temperatures from −65 to +540 F

Designed for thermal shock and other controlled temperature testing, these chambers have temperature ranges from −65 to +540 F. Temperature uniformity and CO_2 dispersal is achieved by a built-in air circulation system. Temperature chart recorder provides 24 hr record of chamber temperatures. Units are equipped to accommodate through wall connections for test articles.

Electric Hotpack Co., Inc., Dept. ED, 5074 Cottman Ave., Philadelphia 35, Pa.

CIRCLE 229 ON READER-SERVICE CARD

NEW PRODUCTS

Cartridge Lamps

Rated at 12.8 v, 1.02 amp

Types 211 and 212 cartridge lamps are rated at 12.8 v, 1.02 amp and have a light output of 15 cp and 6 cp respectively. Each is rated for 100 hr continuous operation, is 1-3/4 in. long, and has a bulb diameter of 0.6 in. Steel end caps are 0.335 in. in diam. They are made for such uses as radio and panel lamps.

Tung-Sol Electric Inc., Dept. ED, 1 Summer Ave., Newark 4, N.J.

CIRCLE 231 ON READER-SERVICE CARD

Oscillators

Cover 1 to 18 kmc

The series 620 microwave oscillators, covering the 1 to 18 kmc frequency range, provide electronic sweep of rf output or extremely stable cw operation. All models have linear frequency sweep coverage over all or part of each band for evaluation of reflection coefficient, gain, attenuation, and other characteristics. Rise and fall response to am is 0.5 μsec. The units include two adjustable frequency markers.

Alfred Electronics, Dept. ED, 897 Commercial St., Palo Alto, Calif.

CIRCLE 232 ON READER-SERVICE CARD

◀ CIRCLE 233 ON READER-SERVICE CARD

Voltmeter

Measures to 100 kv static charge

Designed to measure static charges, model 250 electrometer voltmeter has full scale ranges of 10 and 30 kv when the detecting head is about 3/8 in. from the charged surface. Up to 100 kv can be measured with the detecting head at a distance of 6 in. The instrument has an accuracy of 5% and provides indication of both positive and negative voltages. It can be used to measure electrostatic charges on plastics, paper, and hydrocarbons.

Keithley Instruments, Inc., Dept. ED, 12415 Euclid Ave., Cleveland 6, Ohio.

CIRCLE 234 ON READER-SERVICE CARD

Toggle Switch

Bat handle travels 50 deg

Designed especially for control panels, this toggle switch permits the bat handle to travel 50 deg. A chrome-plated jam nut fastens the 15/32 in. bushing to the panel. The switch is available with dpdt or 3pdt. Each circuit is rated at 5 amp 125 v ac, 4 amp 30 v dc, and 2.5 amp 30 v dc inductive.

Electrosnap Corp., Dept. ED, 4218 W. Lake St., Chicago 24, Ill.

CIRCLE 235 ON READER-SERVICE CARD

CIRCLE 236 ON READER-SERVICE CARD ➤

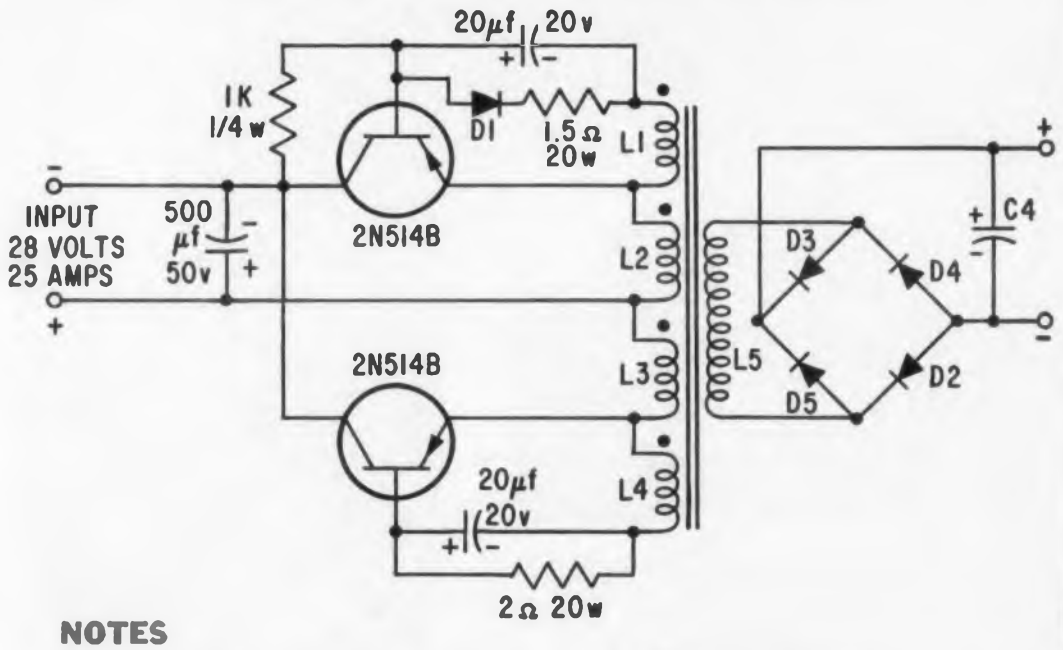
BUILT-IN RELIABILITY

Low R_{cs} (0.05Ω) at high temperatures insured by large ring emitter-base area. Leakage currents minimized by all welded construction . . . no contaminating solders or fluxes used!

High current-carrying capacity and maximum safety against over-heating provided by heavy 90-mil emitter lead.

GERMANIUM TRANSISTOR APPLICATION NOTES

630 WATT DC-TO-DC POWER CONVERTER 90% EFFICIENT



NOTES

L5 may be wound according to the output voltage desired, allowing about 0.639 turns per volt. The wire size should be large enough to allow one circular mil per millampere. The output current and load will then determine D2, D3, D4, D5, and C4.

L2, L3—17 turns each #10 bifilar wound

L1, L2—4 turns each #16

Core-type 50022-2A Magnetics, Inc.

Q1, Q2—2N514B 80 volt 25 amp each mounted on a minimum of 200 sq in. of ¼" aluminum for operation up to 50°C.

D1—1N1124 mounted on a minimum of 1 sq in. of exposed aluminum 1/16" thick. Operation to 50°C.

Frequency about 1 kc.

REDUCE YOUR COMPONENT COSTS WITH ONE TI POWER TRANSISTOR!

Save on overall costs and *up your circuit reliability* by selecting one *specific* TI germanium power transistor for your high power circuitry job. The need for transistor paralleling is greatly reduced . . . and, in many applications, eliminated . . . with TI's newest high current alloy-junction power transistor series. If you are using two types in parallel for a 25-amp job, save by using *one* TI high current alloy-junction transistor!

Ranging from 10 to 25 amps in 40, 60, or 80 volt types, all units feature guaranteed gain at maximum rated currents and *1.5 volts* V_{CE}. For your high current switching applications, all types highlight typical switching times at 25°C of 12.0 usecs (t_{on}) and 7.0 usecs (t_{off}).

Contact your nearest Texas Instruments sales engineer for applications assistance or your nearby TI distributor for off-the-shelf delivery at factory prices. For high reliability, high performance, and a full year product guarantee, you can rely . . . on TI!

maximum ratings at 25° C

		2N511	2N511A	2N511B	2N512	2N512A	2N512B	2N513	2N513A	2N513B	2N514	2N514A	2N514B	units
V_{CBO}	Collector-to-Base Voltage (I_C = −5ma, I_E = 0)	−40	−60	−80	−40	−60	−80	−40	−60	−80	−40	−60	−80	v
V_{CEX}	Collector-to-Emitter Voltage (V_{BE} = +0.2 v, I_C = −5ma)	−40	−60	−80	−40	−60	−80	−40	−60	−80	−40	−60	−80	v
V_{EBO}	Emitter-to-Base Voltage (I_E = −5ma, I_C = 0)	←	−30	→	←	−30	→	←	−30	→	←	−30	→	v
I_C	DC Collector Current	←	−10	→	←	−15	→	←	−20	→	←	−25	→	a
I_E	DC Emitter Current	←	10	→	←	15	→	←	20	→	←	25	→	a
I_B	Base Current	←					−5			→				a
	Total Dissipation	←					80			→				w
T_J	Junction Temperature	←					95			→				°C

germanium and silicon transistors
silicon diodes and rectifiers
tantalum capacitors
precision carbon film resistors
silicon resistors

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

NEW PRODUCTS

Oscillator

Frequencies are to 1 mc

For use as a master timing clock for data-handling, this frequency standard stable oscillator has an accuracy of 10 ppm in the range of a few cycles to 1 mc. Warm-up time is 20 min at 25 C ambient temperature. Stability is 0.1 cycle per day over the temperature range of −40 to +124 F. The output is 1.5 v rms into 1000 ohms; required input is 17 to 18 v dc regulated. The unit measures 3-1/2 x 3-1/2 x 3 in.

RCA Victor Co., Ltd., Technical Products Marketing Div., Dept. ED, 1050 Lacasse St., Montreal, Que., Canada.

CIRCLE 237 ON READER-SERVICE CARD

Voltmeter

Frequency range is 2 to 200,000 cps

Model 2409 voltmeter measures true rms, peak, and average values of voltages over the frequency range of 2 to 200,000 cps. An accuracy of 0.5 db is obtained for true rms indication of signals with crest factors to 5 and over a 20 db range. The unit may be used as a vtvm or as a calibrated decade amplifier with 60 db gain.

B & K Instruments, Inc., Dept. ED, 3044 W. 106th St., Cleveland 11, Ohio.

CIRCLE 238 ON READER-SERVICE CARD

◀ CIRCLE 250, 251, 252 ON READER-SERVICE CA

Delay Lines

Operate at −55 to +125 C

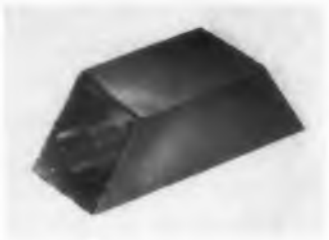
These miniature, distributed-constant delay lines operate in the temperature range of −55 to +125 C. The impedances are 50 to 2500 ohms, delay times are 0.02 to 1 μsec, and rise times are 0.02 to 0.085 μsec. Available with standard leads or terminals, the delay lines have barrel lengths of 1-1/8 to 9-3/8 in.

PCA Electronics, Inc., Dept. ED, 16799 Schoenborn St., Sepulveda, Calif.

CIRCLE 239 ON READER-SERVICE CARD

Servo Valve Amplifier

Weighs 8 oz



For proportional control of hydraulic transfer valves in missile and aircraft guidance systems, this servo valve amplifier measures 4 in. long x 1-1/2 in. sq, and weighs 8 oz. The output is 8 ma dc push-pull into two 1400-ohm loads; the control signal is 0.5 to 2 v dc into a 300-ohm load.

Vickers Inc., Electric Products Div., Dept. ED, 1815 Locust St., St. Louis 3, Mo.

CIRCLE 240 ON READER-SERVICE CARD

Adhesive

Bonds silicone rubber to metal

Type EX-B579-1 adhesive bonds a wide variety of silicone rubbers to steel, aluminum, brass, copper, and other metals as well as to glass, porous ceramics, cured epoxies, phenolics, and other resins, synthetic fabrics and treated teflon. Bonding occurs during the room-temperature cure of the silicone rubber compounds. This one-part, one-coat adhesive does not stain and is resistant to broad temperature conditions.

Hughson Chemical Co., Div. of Lord Mfg. Co., Dept. ED, Erie, Pa.

CIRCLE 241 ON READER-SERVICE CARD

CIRCLE 242 ON READER-SERVICE CARD ➤

NEW PRODUCTS

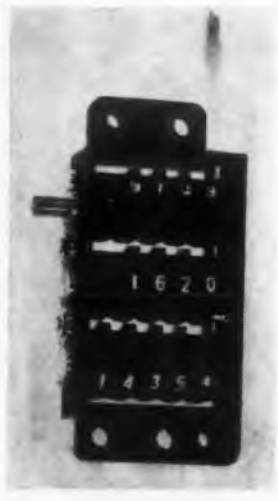
Sweep Generators

Variable Type

These four models of variable sweep generators are continuously adjustable from 0.01 to 100 cps per sec. Model LR-3 has a center frequency range of 4 to 15 mc; model LR-4, 10 to 35 mc; model LR-5, 20 to 75 mc; and model LR-6, 50 to 125 mc. For the first three models, the sweep width is variable from 0.05% to 40% of center frequency. The sweep width of model LR-6 is from 0.05% to 30%. Output is over 0.25 v rms into 50 ohms with better than 5% flatness over the maximum sweep width. Attenuation is from 1 to 120 db, in intervals of 1 db.

Telonic Industries, Inc., Dept. ED, Beech Grove, Ind.

CIRCLE 244 ON READER-SERVICE CARD



Ratio Counter

Has three banks

Developed for a military radio transmitter, this ratio counter tunes three bandwidths on one dial. The second bank displays a total equal to twice the reading of the first bank and the third bank shows twice the total of the second bank. The counter may be supplied in ratios to fit the customer's specifications. It meets military requirements for environmental testing of airborne instruments. Overall length is about 2-3/4 in., width including gear extension is 1-1/2 in., and depth is 1/2 in.

Veeder-Root Inc., Dept. ED, Hartford 2, Conn.

CIRCLE 245 ON READER-SERVICE CARD

Relay Device

For overtemperature uses

Originally made to protect three-phase ac motors, this relay device has a wide range of ac overtemperature applications. The unit consists of a magnetic relay, two transistor amplifiers, and a diode network for signal separation and a voltage regulated power supply. The thermistor is inserted in the windings of the motor, generator or transformer. Power supply ratings are 110, 208 to 220, 440 or 550 v, 60 cps. Contacts are pilot duty type, 600 v ac max.

Cutler-Hammer Inc., Dept. ED, 538 N. 12th St., Milwaukee, Wis.

CIRCLE 246 ON READER-SERVICE CARD

Potentiometer Recorder

Dual-channel

Type G-22 dual-channel potentiometer recorder has chart speeds from 1/8 in. per hr to 8 in. per min. Full span balancing time is 1 sec and accuracy is 1% of full scale. Two speeds are standard, four speed units can be supplied. The range is adjustable from 0 to 9 mv through 0 to 100 mv. Zero can be set anywhere across the 5-in. chart; both pens traverse the full width of the chart. The unit weighs 35 lb; portable and panel mount units are available.

Varian Associates, Instrument Div., Dept. ED, 611 Hansen Way, Palo Alto, Calif.

CIRCLE 247 ON READER-SERVICE CARD

CIRCLE 248 ON READER-SERVICE CARD

NEW PRODUCTS

Static Transformer Rectifier

Rated at 200 amp

Type W-1206-1 static transformer rectifier operates continuously at 200 amp with an input voltage of 190 to 210 v, three-phase, and an input frequency of 380 to 420 cps. Output voltage is 25 to 30 v when the output load is 20 to 210 amp. The core operates at flux densities to 20,000 gauss. Maximum no load voltage is 36.7 v dc.

Electrosolids Corp., Dept. ED, 13745 Saticoy St., Panorama City, Calif.

CIRCLE 253 ON READER-SERVICE CARD

Delay Lines

Produce delays to 100 msec

The DL-1000-10,000/25T series of delay lines produce delays from 0 to 100 msec, with negligible deterioration of the shape of the waveform. The 100 msec line consists of four identical 0 to 25 msec tapped delay lines in cascade. Each of these delay lines contains 25 sections of m-derived LC networks utilizing high-Q toroidal inductances and stable capacitors.

Eastern Precision Resistor Corp., Dept. ED, 675 Barbey St., Brooklyn 7, N.Y.

CIRCLE 254 ON READER-SERVICE CARD

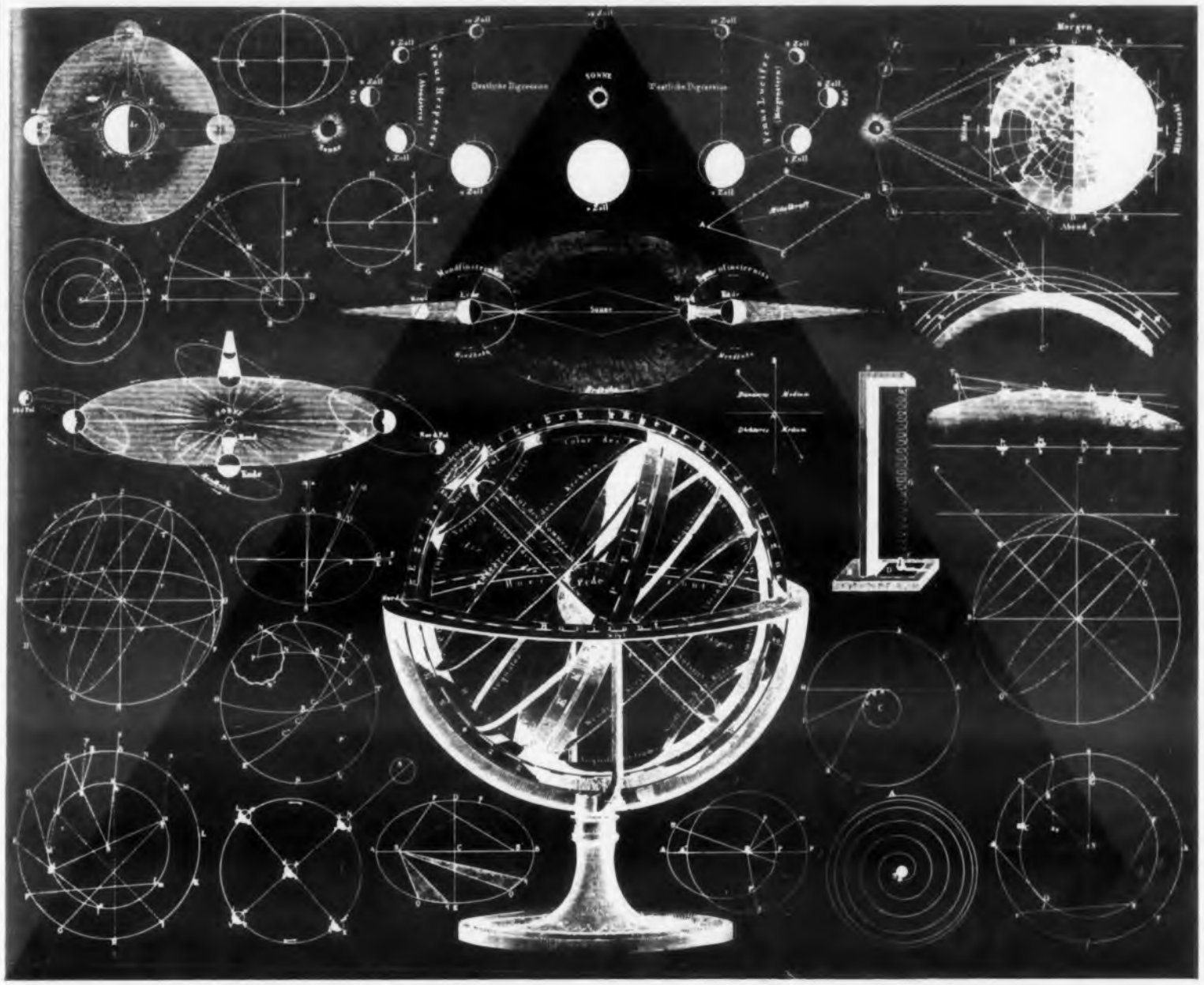
Strain Gage Recording System

Selection of up to 40 strain gages

This system records in digital form the output of strain gages. Rate of data recording is adjustable from 0.7 to 5 sec per point. The system provides for selection of up to 40 strain gages and may be expanded in modules of 10 points up to a capacity of 100 points or more.

Datex Corp., Dept. ED, 1307 S. Myrtle Ave., Monrovia, Calif.

CIRCLE 255 ON READER-SERVICE CARD



Guided tour of the solar system

The new NASA Thor-boosted research rocket, DELTA, now being constructed by Douglas, will set up big signposts for further space explorations. Combining elements already proved in space projects with an advanced radio-inertial guidance system developed by the Bell Telephone Laboratories of Western Electric Company, DELTA will have the versatility and accuracy for a wide variety of satellite, lunar and solar missions. Douglas insistence on reliability will be riding with these 90 foot, three-stage rockets on every shoot. At Douglas we are seeking qualified engineers to join us on this and other equally stimulating projects.

Maxwell Hunter, Asst. Chief Engineer—Space Systems, goes over a proposed lunar trajectory with Arthur E. Raymond, Senior Engineering Vice President of DOUGLAS

MISSILE SYSTEMS ■ SPACE SYSTEMS ■ MILITARY AIRCRAFT ■ JETLINERS ■ CARGO TRANSPORTS ■ AIRCOMB ■ GROUND-HANDLING EQUIPMENT

CIRCLE 900 ON CAREER INQUIRY FORM, PAGE 157

Back at the earth terminal . . .

DOUGLAS AIRCRAFT COMPANY
MISSILES AND SPACE SYSTEMS

has immediate openings in the following fields—

Electrical and Electronics:
- Control System Analysis & Design
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- Computer Application Analysis
- Computer Programming and Analysis
- Mathematical Analysis

For full information write to:

Mr. C. C. LaVene
Box 601 E
Douglas Aircraft Company, Inc.
Santa Monica, Calif.

NEW PRODUCTS

Weighting Network

For voice circuits

Type 601A weighting network adapts any high-impedance, vacuum-tube voltmeter to read F1A noise measurements. A 3-ft connecting cord with banana plugs connects the network to a vtvm. The meter reading is subtracted from a calibration factor to obtain noise measurements in dba. The set provides an insertion gain of 10 db, and may be used to measure noise as low as 10 dba on a +7 dbm drop level voice circuit. The unit is cased in aluminum and its dimensions are 8 x 3-1/4 x 4-1/4 in. Its shipping weight is about 4 lb.

Lenkurt Electric Co., Dept. ED, San Carlos, Calif.

CIRCLE 275 ON READER-SERVICE CARD

Universal Insulation Tester

Has range of 0 to 2100 v ac and dc

Model 103/105 universal insulation tester has a test voltage range of 0 to 2100 v ac and dc. The maximum short circuit current is 10 ma, the ac compensation range is 0 to 0.005 μf, and the megohm range is 0.1 to 400 meg. The leakage current ranges are to 5000 μa. For production testing, the instrument can be to predetermined limits and rejections are signaled by a buzzer and a lamp signal. For laboratory testing, the ac tests provide data for a complete analysis of insulation: total leakage, resistive leakage, ac resistance, power factor, inherent capacity, and breakdown strength. Required input power is 115 v ac, 60 cps. The unit measures 21-1/2 x 13 x 15 in. and weighs 50 lb.

Slaughter Co., Dept. ED, Piqua, Ohio.

CIRCLE 276 ON READER-SERVICE CARD

500 W Power Supply

Delivers up to 50 amp

The model P-87A 500 w power supply has current ranges of 0.75, 1.5, 3, 7.5, 15, 30, and 50 amp and 0.5% full scale regulation. An all solid-state unit 19 x 20 x 8-3/4 in., it is designed with silicon semiconductor rectifiers, power transistors, and short-circuit protection. The control unit may be mounted with the equipment or at a remote point, and the emitter current for each pass transistor is independently monitored at a front panel meter.

Foto-Video Labs, Inc., Dept. ED, 36 Commerce Rd., Cedar Grove, N.J.

CIRCLE 279 ON READER-SERVICE CARD

Tape Wound Cores

Have high permeability

Vacuum melted and processed to give high initial and maximum permeability, Super Hymu 80 nickel-iron tape wound cores are designed for use in low level input magnetic amplifiers, wideband toroidal transformers, and radar pulse transformers. They have an initial permeability of over 55,000 tested at 20 gauss, 100 cps. The units are oil damped and sealed in an aluminum case.

G-L Electronics, Inc., Dept. ED, 2921 Admiral Wilson Blvd., Camden 5, N.J.

CIRCLE 280 ON READER-SERVICE CARD

Pulse Transformer

Operates transmitting tube at 100 kv

This pulse transformer operates a transmitting tube at 100 kv with 10 amp filament supply. The case contains a bifilar choke for overload protection. Peak power output is 32 megawatts at 100 kv; step up ratio is 1:5. Primary impedance is 12.5 ohms; pulse duration is 0.5 to 5.5 usec and pulse repetition frequency is up to 2000 pps. The unit measures 14 x 19 x 12 in.

Stavid Engineering, Inc., Dept. ED, Plainfield, N.J.

CIRCLE 281 ON READER-SERVICE CARD

CIRCLE 282 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Capacitor

Retrace is within 0.02%

This Teflon capacitor has within 0.02% retrace for temperature range of −10 to +85 C. The temperature coefficient is 10 ppm per deg C with less than 0.06% total capacitance change from 25 to 85 C. Insulation resistance is 10^{13} ohms min from 25 to 85 C. The unit withstands vibration of 20 g rms from 5 to 5000 cps for 15 min. It is made for use in guidance computer integrator circuits; other models are available for network compensation.

Component Research Co., Inc. Dept. ED, 2639 S. La Cienega Blvd., Los Angeles 34, Calif.

CIRCLE 283 ON READER-SERVICE CARD

Zener Diodes

Are rated at 10 w

These Zener diodes have a voltage drop essentially independent of current. Junction and storage temperature range is −65 to +175 C. Dc power dissipation at 50 C case temperature is 10 w. Nominal Zener voltages range from 6.8 to 200 v. These units have a standard D0-4 package.

Motorola, Inc., Semiconductor Products Div., Dept. ED, 5005 E. McDowell Rd., Phoenix, Ariz.

CIRCLE 284 ON READER-SERVICE CARD

Reference Supply

Dual output

Reference supply CVR-610 has two separate outputs, and can deliver 6 or 10 ma by shunting and reconnecting the output posts. This unit replaces standard short-life 1-1/2 v batteries used in bridge-measuring circuits. Output is held to 0.1% over input voltage changes of 90 to 130 v and frequencies of 50 to 60 cps. A transformer within the unit shields the measuring circuit from line noises.

Performance Measurements Co., Dept. ED, 15301 W. McNichols Rd., Detroit 35, Mich.

CIRCLE 285 ON READER-SERVICE CARD

. . . designed to meet ALL your circuit requirements: current, voltage, temperature, size . . . now available from Transitron.

A complete description of the lead and stud mounted types, which are summarized below, is in bulletin TE-1351.

We welcome your inquiries concerning special requirements such as high frequency, fast recovery and high voltage applications.

SILICON CONTROLLED RECTIFIER

Handling 10 KW Power

Transitron's Silicon Controlled Rectifier is a PNPN High power bistable controlled switching device. It is analogous to a thyratron or ignitron, with far smaller triggering requirements and microsecond switching. The low forward voltage drop permits high current ratings and provides high efficiency with low cooling requirements. The PNPN design permits higher voltage ratings and lower saturation resistance than power transistors. This permits the smallest packaging for high power control yet made possible.

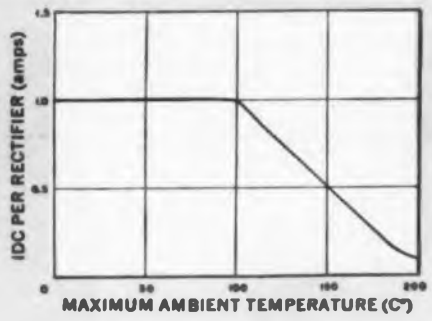
NOW AVAILABLE IN TRANSITRON'S NEW PACKAGE

Type	Minimum Peak Reverse Voltage (Volts)	Minimum Forward Breakdown Voltage (Volts)	Maximum Average Forward Current (amps)	
			at T case =100°C	at T case =25°C
TCR102	100	100	10	20
TCR202	200	200	10	20
TCR302	300	300	10	20
TCR402	400	400	10	20

Maximum Storage Temperature Range −65°C to +150°C
Maximum Operating Temperature Range −65°C to +125°C

Send for Bulletin TE-1356A

MIDGET RECTIFIER
1 AMP @ 100°C

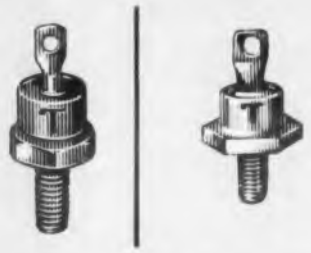


Transitron announces, higher ratings and *smaller* size in a lifetested lead mounted silicon rectifier. By establishing a high level of designed quality, these rectifiers feature reliable 200°C operation. Remember, the size is SMALLER, the flange is GONE! These units will meet all electrical and environmental requirements of the JAN-1N 547 series.

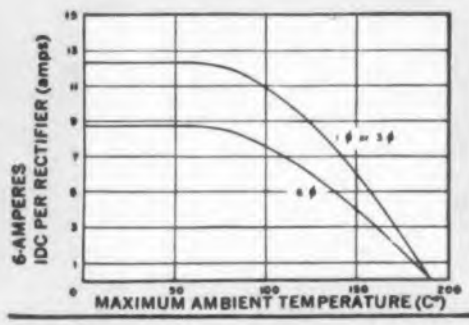
Type	Peak Recurrent Inverse Voltage (Volts)	Maximum Average Forward Current @ 200°C (Milliamps)	Maximum Average Forward Current @ 100°C (Amps)	Maximum Forward Voltage @ 25°C (Volts) (Milliamps)
TK61	600	100	1.0	1.0 @ 750
TK41	400	100	1.0	1.0 @ 750
TK21	200	100	1.0	1.0 @ 750

Write for bulletin PB-58

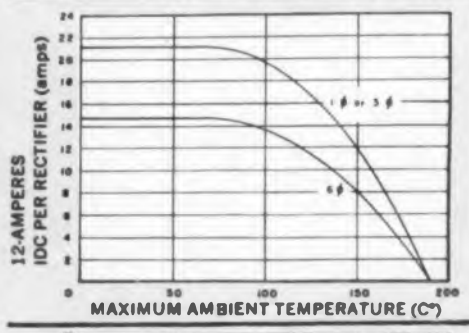
HIGH CURRENT RECTIFIERS



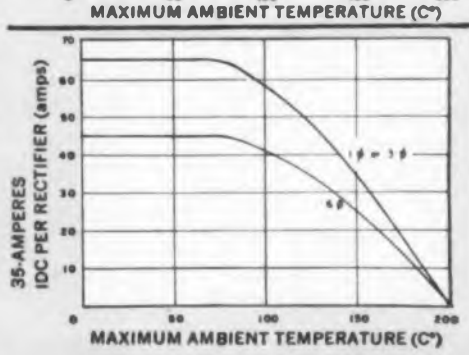
Now, from Transitron, stud-mounted silicon power rectifiers which combine high power handling ability with a minimum of size and weight . . . The extremely low forward resistance and thermal impedance of these units allow operation up to 12 amperes @ 150°C case temperature in the 1/16" hex base configuration, and similarly up to 35 amperes @ 150°C case temperature in the 1 1/16" hex base configuration. Still further, the inherently low leakage currents and high peak inverse voltage ratings allow flexibility in the design of both power supply and magnetic amplifier circuits.



Type	Peak Recurrent Inverse Voltage (Volts)	Maximum Forward Voltage @ 25°C (Volts) @ (Amps)	Maximum Average *Inverse Current 150°C (Milliamps)
TM68	600	1.1 @ 6	2
TM58	500	1.1 @ 6	2
TM48	400	1.1 @ 6	2
TM38	300	1.1 @ 6	2
TM28	200	1.1 @ 6	2
TM18	100	1.1 @ 6	2
TM8	50	1.1 @ 6	2



Type	Peak Recurrent Inverse Voltage (Volts)	Maximum Forward Voltage @ 25°C (Volts) @ (Amps)	Maximum Average *Inverse Current 150°C (Milliamps)
TM69	600	1.2 @ 12	2
TM59	500	1.2 @ 12	2
TM49	400	1.2 @ 12	2
TM39	300	1.2 @ 12	2
TM29	200	1.2 @ 12	2
TM19	100	1.2 @ 12	2
TM9	50	1.2 @ 12	2



Type	Peak Recurrent Inverse Voltage (Volts)	Maximum Forward Voltage @ 25°C (Volts) @ (Amps)	Maximum Average *Inverse Current 150°C (Milliamps)
TR603	600	1.5 @ 100	5
TR503	500	1.5 @ 100	5
TR403	400	1.5 @ 100	5
TR303	300	1.5 @ 100	5
TR203	200	1.5 @ 100	5
TR153	150	1.5 @ 100	5
TR103	100	1.5 @ 100	5
TR53	50	1.5 @ 100	5

*Averaged over one cycle with rectifier operating at full rated current and voltage into a resistance load.

Transitron

electronic corporation • wakefield, massachusetts

Leadership in Semiconductors SEE YOUR LOCAL AUTHORIZED TRANSITRON DISTRIBUTOR FOR QUANTITIES FROM 1-999.

Compatible Electronic Transmitter

Converts motion to dc signals

Fully transistorized, this compatible electronic transmitter converts motion to dc signals. Its output may be 1 to 5 ma dc into a 0 to 6 K load, 4 to 20 ma dc into a 0 to 1500 ohm load, or 10 to 50 ma dc into a 0 to 600 ohm load. The load may be any value between the limits stated without the addition of external resistance, and printed wiring cards permit changes in the field. The unit operates at ambients from −20 to +150 F.

Fischer & Porter Co., Dept. ED, 142 Jacksonville Rd., Hatboro, Pa.

CIRCLE 286 ON READER-SERVICE CARD

Circuit Equivalent

Has flip-flop characteristics

The silicon Trigistor, a circuit equivalent component, has flip-flop characteristics. It is a pnpn device with the property of triggered turn-off as well as triggered turn-on control at its base. A low-level positive pulse to the base turns it on; a negative pulse turns it off. It is designed for operation in the range of 1 to 8 ma collector current. Applications include memory, counting, timing, gating, and logic functions.

Solid State Products, Inc., Dept. ED, 1 Pingree St., Salem, Mass.

CIRCLE 287 ON READER-SERVICE CARD

Electronic Timer

Rated at 15 amp

Model 5231-B electronic timer is rated at 15 amp and operates on 115 v, 60 cps. Single and dual timing ranges are available, including 0.02 to 1 sec, 0.04 to 2 sec, 0.05 to 3 sec, 0.2 to 10 sec, 0.4 to 20 sec, and 0.5 to 30 sec. Maximum ranges available are 60 and 120 sec. Temperature range is from 0 to 100 F. The unit is designed for use in printed circuits and has two heavy contact, 4pdt relays. A modified version is available for 230 v, 50 or 60 cps.

Automatic Timing & Controls, Inc., Dept. ED, King of Prussia, Pa.

CIRCLE 288 ON READER-SERVICE CARD

CIRCLE 289 ON READER-SERVICE CARD

NEW PRODUCTS

Photoelectric Pulse Generator

Shaft driven

A shaft driven device that delivers electrical pulses at its output terminals, the model 8601 photoelectric generator may be used as a rate generator or as an angle measuring unit. In the first application, the output frequency is read in terms of shaft rpm; in the second, the total angle is determined by totalizing individual pulses. The pulses are generated by a light which passes to a photocell through a rotating disc with alternate opaque and clear sectors. The number of pulses per revolution is thus a function of the number of segments on the disc. The generator can be supplied with photoresistive cell or a photovoltaic cell. The output of the first cell consists of alternations between two levels of internal resistance, while the output of the second is a series of dc voltage pulses. In most cases the output voltage is 0.1 to 0.25 v at 10 K load impedance. There are several standard disc patterns providing up to 500 pulses per revolution.

W. & L. E. Gurley, Dept. ED, 514 Fulton St., Troy, N.Y.

CIRCLE 291 ON READER-SERVICE CARD

Megohmmeter

Hand-crank type

Model 5G1000 series B hand-crank megohmmeter operates at 500 v, has a range of 0 to 1000 meg, and meets both ASTM and Mil specs. Other models in this series have ranges from 0 to 50 through 0 to 2000 meg, at test potentials from 100 to 1000 v. All units have dual range and ohm scales. A generator with a 39-bar armature is used. The driving gear is mounted on needle bearings to reduce cranking torque.

The Winslow Co., Dept. ED, 701 Lehigh Ave., Union, N.J.

CIRCLE 292 ON READER-SERVICE CARD

Operations Recorder

Monitors digitized or sequential data

Operating upon a change in the incoming signal in analog or digital channels, this operations recorder monitors digitized, sequential, or special forms of analog type data. It has six off-on channels and one analog channel and operates at standard chart speeds. Frequency response is 0 to 600 cps for the analog, 0 to 200 cps for the off-on channels. The unit measures 17 x 17 x 17 in. and has an accuracy of ±2.5% for the analog channel. Its chart is 3-3/4 in. wide.

Hamilton Watch Co., Hathaway Instrument Div., Dept. ED, 5800 E. Jewell Ave., Denver 22, Colo.

CIRCLE 295 ON READER-SERVICE CARD

Paper Capacitors

Miniature

Type P161N miniature paper tubular capacitors have plastic case construction and a solid impregnant. They are available in a wide range of capacitances at voltages of 200, 400, 600, and 1000 wvdc. The operating temperature range is −30 to +85 C.

Aerovox Corp., Dept. ED, New Bedford, Mass.

CIRCLE 296 ON READER-SERVICE CARD

Current Source

Has a range of 0.1 μa to 20 ma

Designed for diode ageing and life testing, model CS-125 modulated constant current source has a range of 0.1 μa to 2 ma, up to 2250 v dc. With 21 independent supplies housed in one rack, 10,000 5 v Zener diodes can be aged or tested at one time. Input is 115 v ±10%, at 60 cps; stabilized ouput current is 0 to 20 ma. Typical regulation is 0.05% at 1 ma from 0 to 500 v. Accuracy is 1% ±0.1 μa and ripple is 0.15% +0.1 μa rms. Made for rack mounting, the unit measures 19 x 10-1/2 x 15 in.

North Hills Electric Co., Dept. ED, 402 Sagamore Ave., Mineola, N.Y.

CIRCLE 297 ON READER-SERVICE CARD

NEW PRODUCTS

Scaler

For digital and analog readout

Designed for digital and analog readout of spectrographic equipment, model ADRS2-5 scaler consists of one scaler for counting and another for data identification. Outputs from both scalers may be used to operate a printer and a recorder. Both scalers provide one digital output coded 1, 2, 2, 4. One scaler has two analog outputs of 0 to 100 v positive and 0 to 10 mv positive for the X-Y recorder. Negative analog outputs can be supplied. The other scaler has one analog output of 0 to 10 mv. The three-decade analog range is up to 10^3, 10^4, or 10^5 counts full-scale. Resolution is 5 μsec to pulse pairs. Power requirements are 2.5 amp at 115 v, 60 cps.

The Victoreen Instrument Co., Dept. ED, 5806 Hough Ave., Cleveland 3, Ohio.

CIRCLE 300 ON READER-SERVICE CARD

Transducer Control Unit

Has strain-gage balance and power supply

Type TC-1 transducer control unit combines a current regulated strain-gage power supply with strain-gage balance and calibration circuitry. It requires an input of 95 to 135 v ac; output voltage is 3 to 10 v and output current is continuously adjustable from 5 to 33 ma. The fully transistorized unit is of modular construction and is designed for dc instrumentation. It measures 5-1/4 x 2-1/2 x 8 in. and may be mounted on strip chart recorder panels or in 19 in. racks.

Anadex Instruments, Inc., Dept. ED, 14734 Arminta St., Van Nuys, Calif.

CIRCLE 301 ON READER-SERVICE CARD

◄ CIRCLE 299 ON READER-SERVICE CARD

THE MARK OF QUALITY

BARBER COLMAN

quick solutions to various electronic problems

Ultra-Sensitive Relays

Operating on input powers of 40 to more than 1,000 microwatts, the Barber-Colman Micropositioner polarized relay is ideal as a differential relay in electronic plate circuits, as a null detector in resistance bridge circuits, or as an amplifier in photoelectric circuits. Resonant relays also available from Barber-Colman

Reversible Small Motors

Shaded pole a-c type, up to 1/25 hp . . . adaptable to a variety of control circuits, including transistor and vacuum tube types. Ideal for use with servo mechanisms and other follow-up and positioning units. Available with or without gearheads. A wide range of gear ratios for gear motors . . . open or enclosed

Small Motors with Blowers

In both a-c and d-c types with cooling fans or blowers for quick, dependable dissipation of heat from tubes, circuit components and other equipment mounted in confined enclosures.

BARBER-COLMAN COMPANY
Dept. U, 1283 Rock Street, Rockford, Illinois

CIRCLE 303 ON READER-SERVICE CARD

Three-Channel Power Amplifier

Aids vibration data recording

Designed to drive fluid damped high frequency galvanometers from low level signals, the three-channel model 8003 power amplifier aids shock and vibration data recording in systems with crystal accelerometers. Response is flat from 1 cps to 20 kc, covering the entire accelerometer range. Noise is 20 μv rms; gain, 0.3 to 1000; input impedance, 1600 meg; and output impedance, 1 ohm. Output overload voltage is 10 v peak-to-peak with current up to 200 ma. The unit is accurate and permits the use of standard recording oscillographs. Used with the company's cathode follower probe, it can be used 100 ft or more from the accelerometer.

Columbia Research Labs, Dept. ED, MacDade Blvd. and Bullens Lane, Woodlyn, Pa.

CIRCLE 304 ON READER-SERVICE CARD

Circuit Wafers

For microminiature circuitry

Made from high-alumina ceramic, steatite, glass, or quartz, these microminiature wafers can be supplied in thicknesses down to 10 mils. Tolerances on hole diameters, slots, channels, and edge notches are held to within 0.0002 in. Available in custom and standard design, the units are drilled, ground, and finished to specifications, for end or substrate applications.

Zenith Optical Lab., Dept. ED, 1940 Great Neck Rd., Copiague, N.Y.

CIRCLE 305 ON READER-SERVICE CARD

test . . . test . . . test . . .

If you feel you *must* make your own pots to get exactly what you need, don't overlook quality control along the way! And this can be a messy business, what with special, elaborate techniques to quality-check *every* production stage! Oh, you'll get involved in maddening bouts with visual comparitors, ratiometers, environmental testing labs — and when you've finished — *and* made a few hundred revisions — you *might* have the quality you want!

So, before you go fly a kite — consider Ace. We've been all through this before, and have what is regarded to be the finest quality control system in the industry. It enables us to keep our final costs down, by rejecting sub-standards at each stage, without waiting for the final inspection. Although it's more work this way, we can offer a higher degree of resolution and linearity at a lower price. So, for precision-at-price, see your ACErep!

Here's 0.3% linearity in a ½" pot: the Series 500 ACEPOT®. Single-turn, −55° to 125°C range. As with all Ace components, tested in every stage of its manufacture!

ACE ELECTRONICS ASSOCIATES, INC.
99 Dover Street, Somerville 44, Mass.
SOmerset 6-5130 TMX SMVL 181 West. Union WUX

Acepot® Acetrim® Aceset® Aceohm® ®Reg. Appl. for

CIRCLE 306 ON READER-SERVICE CARD

NEW PRODUCTS

RECTIFIER TUBE.—Type 5R4-GYB full-wave vacuum rectifier tube is glass-octal type and is rated for service at altitudes to 40,000 ft. Maximum peak inverse-plate-voltage rating is 3100 v and maximum peak plate-current rating is 715 ma per plate. It is electrically identical with types 5R4-G, 5R4-GY, and 5R4-GYA.

Radio Corp. of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 308 ON READER-SERVICE CARD

DIGITAL MULTIMETER.—Patterned after model 520 dc voltmeter, model 500 digital multimeter also measures ac voltage and resistance. The ac and dc ranges cover 0 to 1200 v, and the resistance range covers 1 ohm to 1 meg. Absolute accuracy is 0.1% for dc, 0.5% for ac, and 0.2% for ohms.

Franklin Electronics Inc., Dept. ED, Bridgeport, Pa.

CIRCLE 309 ON READER-SERVICE CARD

MALFUNCTION DETECTOR.—Type 66, for use in rotating and reciprocating machinery, allows vibration above a preset level to activate an internal switch, which, in turn, activates an alarm or causes machinery shut-down.

Robertshaw-Fulton Controls Co., Dept. ED, 911 E. Broad St., Richmond 19, Va.

CIRCLE 310 ON READER-SERVICE CARD

TACHOMETERS.—This line of transistorized tachometers, designated the 7120 series, measure speed without physical loading and provide overspeed-underspeed control.

Electro Products Labs., 4500 N. Ravenswood Ave., Chicago 40, Ill.

CIRCLE 311 ON READER-SERVICE CARD

MINIATURE CAPACITORS.—Designed for aircraft, missiles, and radar units, these capacitors have a temperature range of −55 to +125 C. The use of silicones improves heat dissipation and resistance to cold.

San Fernado Electric Mfg. Co., Dept. ED, 1509 First St., San Fernando, Calif.

CIRCLE 312 ON READER-SERVICE CARD

VOLUME CONTROLS.—For the replacement of 500 K and 1 meg volume controls, these units improve bass and treble response by compensating for the Fletcher-Munson effect.

Centralab, Dept. ED, 900 E. Keefe Ave., Milwaukee, Wis.

CIRCLE 313 ON READER-SERVICE CARD

MATING JACK AND PLUG.—For breakaway-connector usages, SKT-31 jack is designed to accept PR-10, a 0.04 in. plug. They have solder cups and can be mounted on 0.187 in. centers.

Sealectro Corp., Dept. ED, 139 Hoyt St., Mamaroneck, N.Y.

CIRCLE 314 ON READER-SERVICE CARD

Blower

Provides 350 cfm of air

Model BP350-A provides 350 cfm of filtered air at 0 SP. The airflow is directed to the necessary location from either of the back blower outlets. Designed to be mounted in a standard 19 in. panel rack, the blower occupies 8.75 in. panel space and has 9.5 in. total depth.

Amco Engineering Co., Dept. ED, 7333 W. Ainslie St., Chicago 31, Ill.

CIRCLE 316 ON READER-SERVICE CARD

Transistorized Power Supplies

Have automatic protection

Series 36 transistorized, rack mounted power supplies provide a 0 to 36 v variable dc output at 1.5, 2.5, 5, 10, and 15 amp. They are automatically protected against overvoltage, short circuits, current overload, and thermal overload. Remote programming is available in all current ranges.

Trygon Electronics Inc., Dept. ED, Pleasant Ave., Roosevelt, N.Y.

CIRCLE 317 ON READER-SERVICE CARD

Coaxial Cables

Have impedances of 50 and 95 ohms

This series of 50- and 95-ohm cable, designated the T-line, has an expanded dielectric which approaches dry-gas-purged rigid or semi-rigid coaxial cable attenuation characteristics. Large solid copper conductors are used. Jacketed with a high molecular weight polyethylene, these cables have an anticipated life of over 20 yr. They are especially suitable for applications which require lighter weight and greater tensile strength.

Times Wire and Cable Co., Inc., Dept. ED, Wallingford, Conn.

CIRCLE 318 ON READER-SERVICE CARD

NEW PRODUCTS

CONTINUOUS LEVEL CAPACITANCE SYSTEM.—Made to detect, measure, and visually indicate media level changes, this unit has two-step calibration and unrestricted cable length between probe detector and transmitter. Linearity is ±10% of full range.

Robertshaw-Fulton Controls Co., Dept. ED, 911 E. Broad St., Richmond 19, Va.

CIRCLE 321 ON READER-SERVICE CARD

SOCKET MOUNTS.—For use in breadboard circuitry, these socket mounts include 7- and 9-pin miniatures, octals, and other standard tube bases. They may also be obtained for transistors and other multi-lead components. The unit consists of small plastic boards that fit over one or more elastic cores.

Plastic Associates, Dept. ED, 185 Mountain Rd., Laguna Beach, Calif.

CIRCLE 322 ON READER-SERVICE CARD

CERAMIC MIRROR BASE.—Composed of alumina and silica clays, this ceramic mirror base replaces glass mirrors in precision infrared optical systems.

Thompson Ramo Wooldridge, Inc., Dept. ED, P.O. Box 90534, Airport Sta., Los Angeles 45, Calif.

CIRCLE 323 ON READER-SERVICE CARD

DIGITAL COMPUTER.—Designed for laboratory or classroom use, this digital computer, designated SPEC, is modularized and transistorized. It can be converted into a digital differential analyzer.

Computer Control Co., Inc., Dept. ED, 2251 Barry Ave., Los Angeles 64, Calif.

CIRCLE 324 ON READER-SERVICE CARD

SPAGHETTI.—Made from Teflon, this high-temperature, corrosion-resistant spaghetti is available in standard or thin wall form with 0.01 to 0.33 in. hole diameter and 0.004 to 0.02 in. wall thickness.

Pennsylvania Fluorocarbon Co., Inc., Dept. ED, 1115 N. 38th St., Philadelphia 4, Pa.

CIRCLE 325 ON READER-SERVICE CARD

CATHODE REJUVENATOR TESTER.—Model CRT 440 tests and rejuvenates all black and white or color picture tubes at filament voltage from 1 to 12 v, including 110 deg tubes with 2.34, 2.68, 6.3, and 8.4 v filaments.

B & K Manufacturing Co., 3726 N. Southport Ave., Chicago 13, Ill.

CIRCLE 326 ON READER-SERVICE CARD

CABLES.—Designed for data transmission applications, the designated Datacable line includes low-capacitance miniaturized coaxial cables, low-loss coaxial cables, and shielded, low-capacitance twisted pairs. Multi-conductor cables are also available.

Times Wire and Cable Co., Dept. ED, Wallingford, Conn.

CIRCLE 327 ON READER-SERVICE CARD

On-Off Indicator

Weighs 3.7 g

Of a coil and armature construction, this on-off indicator is resistant to shock and withstands ambients of 350 F. It will operate directly on any voltage up to 120 v ac or dc at frequencies up to 2500 cps. The unit weighs 3.7 g, is easily mounted, and features low power consumption. Either a pointer or an enclosed, hermetically sealed shutter arrangement can be provided as an indicator.

Leetronics, Inc., Dept. ED, 30 Main St., Brooklyn 1, N.Y.

CIRCLE 329 ON READER-SERVICE CARD

Capacitor

Has leakage time constant of 100 yr

This capacitor uses polystyrene dielectric having a dc resistance of more than 10^9 megohm-μf or a leakage time constant greater than 100 years. Individual 0.1 μf capacitors charged to 2000 v and disconnected from the power supply are still charged to 1990 v after 2 years. Uncased developmental models with voltage ratings from 1000 to 10,000 v are available.

Radiation Research Corp., Dept. ED, 1114 First Ave., New York 21, N.Y.

CIRCLE 330 ON READER-SERVICE CARD

Static Contactor

Has no moving parts

Made entirely of semiconductors and solid state components, this static contactor has no moving parts. It is switched on by a 10 v step input at 10 ma and turns on or off in 0.5 to 1 cycle. The unit has a long, maintenance-free life and is designed to operate in adverse environments, including explosive atmospheres. The controlled silicon rectifier is used as the main contact to achieve high average power capabilities and good overload characteristics.

Walter Kidde & Co., Inc., Dept. ED, 9 Brighton Rd., Clifton, N.J.

CIRCLE 331 ON READER-SERVICE CARD

◀ CIRCLE 332 ON READER-SERVICE CARD

NEW PRODUCTS

AMPLIFIER.—Has a gain of 10,000 with delay line clipping, and 20,000 with RC clipping. Model N-300 is used for nuclear applications and may be rack-mounted. It has a rise-time of less than 0.2 μsec and a gain stability of 0.027% with a 1% line voltage change.

Hamner Electronics Co., Inc., Dept. ED, Princeton, N.J.

CIRCLE 333 ON READER-SERVICE CARD

SOLID STATE RELAY.—Ruggedized, model 530-B has no moving parts, replaces polar relays in teletypewriters and communication systems. Design uses silicon diodes and transistors for switching functions.

Trepac Corporation of America, Dept. ED, 30 W. Hamilton Ave., Englewood, N.J.

CIRCLE 334 ON READER-SERVICE CARD

VINYL ELECTRICAL TAPE.—Used as insulation, it will protect against moisture, surface contamination, corona, and excessive heat. Dielectric strength is 10 kv, and it is flameproof.

Reeves Soundcraft Corp., Dept. ED, Great Pasture Rd., Danbury, Conn.

CIRCLE 335 ON READER-SERVICE CARD

MAGNETIC SHIELDING FOR TOROIDS.—Netic and Co-Netic foils are non-shock sensitive, non-retentive and require no periodic annealing. This lightweight shielding permits high density packaging.

Magnetic Shield Div., Perfection Mica Co., Dept. ED, 1322 N. Elston Ave., Chicago 22, Ill.

CIRCLE 336 ON READER-SERVICE CARD

AC TO DC CONVERTERS.—NLS 125 series operate from 30 cps to 10 kc; voltage range is 0.001 to 999.9 v. Scale multiplier, voltage linearity, and frequency linearity are all accurate to ±0.1%.

Non-Linear Systems, Inc., Dept. ED, Del Mar, Calif.

CIRCLE 337 ON READER-SERVICE CARD

HIGH-VACUUM SYSTEM.—Develops pressures to 10^{-9} mm Hg within a work chamber 12 in. in diam 18 in. high, equipped with two 2 in. in diam windows, rotary motion and electrical feed-throughs.

Kinney Manufacturing Div., New York Air Brake Co., Dept. ED, 3529 Washington St., Boston 30, Mass.

CIRCLE 338 ON READER-SERVICE CARD

FLIP-FLOP MODULE.—Model 110B-NRZ has ten flip-flops which drive double pole transistor switches for bi-directional current signals to magnetic heads. It is a standard 100 series Navcor slide-in module 2-1/4 x 10-3/4 x 7 in.

Navigation Computer Corp., Dept. ED, 1621 Snyder Ave., Philadelphia 45, Pa.

CIRCLE 339 ON READER-SERVICE CARD

Digital Plotter

Accepts X-Y data

The model GP-1 digital plotter can be supplied to accept X-Y data in any original format such as binary, decimal, binary coded decimal, or analog. Accuracy is 0.1% of full scale and slewing speed is 50 in. per sec. The chart size is 8.5 x 11 in. and 11 x 16 in. The unit weighs 150 lb and measures 19 x 17 x 22 in. Power requirement is 115 v, 60 cps, at 250 w.

Gerber Scientific Instrument Co., Dept. ED, 89 Spruce St., Hartford, Conn.

CIRCLE 341 ON READER-SERVICE CARD

Seal

Glass-ceramic

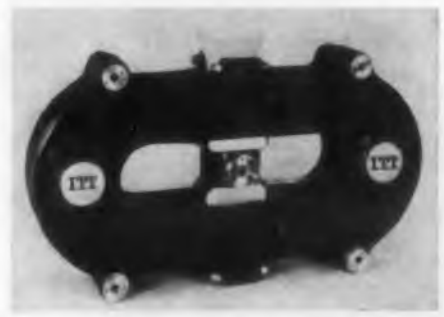
Having a sealing and service temperature of 750 C, this glass-ceramic frit seals aluminosilicate glass to itself, to molybdenum, or to tungsten, and molybdenum to tungsten. Other materials in the expansion range of 40 to 50 x 10^{-7} can also be sealed. The frit is made principally for the stack mount tube construction, but can also be used in magnetron, klystron, and traveling wave tubes.

Corning Glass Works, Dept. ED, Corning, N.Y.

CIRCLE 342 ON READER-SERVICE CARD

Magnetron

Has 100 kw peak power



Having a 100 kw peak power output, this magnetron operates in the 35 kmc band. Mean power outputs are 40 and 100 w, depending on the model.

International Telephone and Telegraph Corp., Dept. ED, 67 Broad St., New York 4, N.Y.

CIRCLE 343 ON READER-SERVICE CARD

NEW PRODUCTS

Servo Amplifier and Actuator System

Has 200-lb force output

This servo system consists of a clutch type actuator and a transistorized dc servo amplifier which can be supplied separately or as an integral unit. It has a 14-cps natural frequency, a force output of 200 lb, and an output velocity of 3.125 ips. Operating with a 54-db gain, the unit requires less than 35 w. It occupies about 35 cu in. and meets MIL-E-5272B specifications.

Natel Engineering Co., Dept. ED, 15336 Roscoe Blvd., Van Nuys, Calif.

CIRCLE 345 ON READER-SERVICE CARD

Silicon Rectifiers

Are pnpn controlled

These silicon pnpn controlled rectifiers, designated the type-130 series, have applications in power supplies, reversing drives, light dimming devices, surge voltage suppression, and latching relays. A third lead is utilized to control the current passing through the unit. A firing current of 5 ma is required. These units have 50 to 400 v in both piv and breakover voltage. The average rectified forward current is 3 amp at 50 C, 1 amp at 125 C. They will operate to 150 C stud temperature and can tolerate a maximum one-time surge current of 30 amp.

Texas Instruments Inc., Dept. ED, P.O. Box 312, Dallas, Tex.

CIRCLE 346 ON READER-SERVICE CARD

Tube Tester

Portable

Model 78 grid circuit and tube tester detects grid emission and tube faults; it also checks filament continuity and provides an open element test. Five sockets are furnished, including one 9 pin type. The dimensions of this portable unit are 9 x 10-1/2 x 5 in. and the shipping weight is 6 lb.

Seco Manufacturing Co., Dept. ED, 5015 Penn Ave. S., Minneapolis, Minn.

CIRCLE 347 ON READER-SERVICE CARD

Keyboard

Has ten digit keys

Having applications in remote numerical transmission and inventory work, this ten-digit keyboard weighs 12 oz and measures 3-3/4 x 1-1/2 x 4-1/4 in. The digit capacity depends on the receiving device which may be a calculator, printer, any solenoid activated business machine, tape punches, or other electronic data recording device. The unit is encased in gold-anodized aluminum.

Victor Adding Machine Co., Dept. ED, 3900 N. Rockwell St., Chicago 18, Ill.

CIRCLE 350 ON READER-SERVICE CARD

Silicon Power Rectifier

Rated at 1 to 15 amp

Style 20 silicon power rectifier is designed for operation at current levels from 1 to 15 amp, single-phase half-wave average. Surge ratings are 90 amp average at 60 cycles (0.1 sec) and 50 amp average at 60 cycles (1.0 sec). Peak inverse voltages range from 50 to 400 v in 50 v steps. Temperature range is from −65 to +175 C. The unit is mounted on a 7/16-in. hexagon stud case. Maximum height is 1-3/16 in.

Syntron Co., Dept. ED, 283 Lexington Ave., Homer City, Pa.

CIRCLE 351 ON READER-SERVICE CARD

RF Filter

For screen room power lines

This low-pass unit filters out interference conducted by power lines entering a screen room. The attenuation of the filter equals or exceeds that of the screen enclosure. The unit is rated at 50 amp, 250 v, 0 to 60 cps. It measures 19-1/2 x 3-5/8 x 3-9/16 in. One filter is used for each incoming wire. Case is heavy-gage steel, hot tin dipped.

International Electronics Mfg. Co., Antran Div., Dept. ED, Second St. Extended, Greenwood Acres, Annapolis, Md.

CIRCLE 352 ON READER-SERVICE CARD

NEW PRODUCTS

Circuit Tester

For two- and four-terminal networks

Polyskop type SWOB tester for two- and four-terminal network measurements has a two-channel frequency-response display, a 0.5 to 400 mc frequency range, and a sweep width of ±0.2 to ±50 mc. It displays two quantities as a function of frequency in the form of continuous curves. Range of attenuation measurement is 45 db. The unit consists of a sweep signal generator, precision attenuator, electronic switch, and large screen oscilloscope assembled in a compact pull-out cabinet.

Rhode & Schwarz Sales Co., Inc., Dept. ED, 111 Lexington Ave., Passaic, N.J.

CIRCLE 355 ON READER-SERVICE CARD

Germanium Mesa Transistors

For use at fm and TV frequencies

These pnp germanium mesa transistors are used at fm and TV frequencies. The TI-361 has high gain at 200 mc for rf amplifiers and a typical noise figure of 6.5 db at 200 mc. The TI-360 has a typical circuit gain of 15 db in 100-mc rf amplifier applications and a 5.5 db typical noise figure. Both types have an all-glass header and are packaged in a TO-9 case with a fourth lead grounded to the can to minimize circuit radiation. Temperature operating range is −55 to +85 C.

Texas Instruments Inc., Dept. ED, P.O. Box 312, Dallas, Tex.

CIRCLE 356 ON READER-SERVICE CARD

Warming Box

Temperatures to 400 F

This continuous duty, gravity convection warming box for drying, baking and heating provides controlled heat to 400 F. This unit is available with 800 and 1500 w heating elements. It operates on 120 v, single phase input and measures 18 x 18 x 24-1/2 in.

Trent, Inc., Dept. ED, 201 Leverington Ave., Philadelphia 27, Pa.

CIRCLE 357 ON READER-SERVICE CARD

NEW PRODUCTS

Centrifugal Blower

For electronic equipment

Made for such applications as cooling electronic tubes or ventilating small electronic equipment cabinets, type 89C21 centrifugal blower delivers 106 cfm of air at 0 SP and 20 cfm of air at 1 in. wg-SP. The 1/4 hp shaded pole electric motor operates at 3000 rpm using 115 or 230 v, single phase, 50 or 60 cps. The complete assembly weighs 6 lb; its overall dimensions are about 6 x 6 x 8-1/2 in.

American-Standard, Industrial Div., Dept. ED, Detroit 32, Mich.

CIRCLE 361 ON READER-SERVICE CARD

Target Simulator

Moving video type

Moving video target simulator model RP-175PM provides a complete dynamic test of a long range ballistic missile tracking radar. Up to 90% of the spacing between main bangs is available for target return with this unit. The simulated target may be programmed at ranges up to 500 miles with scales reading 0 to 40, 0 to 250, and 0 to 500 nautical miles. Target velocities up to 30,000 ft per sec and accelerations up to 30 g may be programmed.

Remanco, Inc., Dept. ED, 1630 Euclid, Santa Monica, Calif.

CIRCLE 362 ON READER-SERVICE CARD

Transducer Elements

Piezoelectric ceramic

Made of piezoelectric ceramic, these ultrasonic transducer elements have a resonant frequency of 38 kc. At a temperature of 25 C and a frequency of 1 kc, capacitance is 280 μμf and dissipation factor is 0.6%. The Curie temperature is 138 C. Type 10C21 is furnished with tabs; type 10C21A, without tabs. The standard block measures 2 x 1-7/8 x 1-1/16 in. Various other shapes are available.

Sprague Electric Co., Dept. ED, North Adams, Mass.

CIRCLE 363 ON READER-SERVICE CARD

XTVE

TAM

XTL

HAT

TAF

XTLS

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Type	Description	Capacity Range	W. Volts DC Rating at 85°C	Temperature Range	Case Style	Body Length	Body Diameter
HAT	Pellet Anode—Liquid Electrolyte	1-10 mfd.	16-1V.	—20 to +85°C	Metal Case—Axial Leads—Insulated Case	.210" max.	.075" max.
TAS	Pellet Anode—Solid Electrolyte	.33-330 mfd.	35-6V.	—80 to +85°C	Metal Case—Axial Leads	.250" to .750"	.125" to .341"
TAM	Pellet Anode—Solid Electrolyte	6.8-56 mfd.	25-6V.	—55 to +85°C	Dip Coated Resin—Upright Mounting	.175" thick	.313" square
TAF	Foil Anode—Semi-Liquid Electrolyte	.25-440 mfd.	150-3V.	—55 to +85°C	Metal Case—Axial Leads	.688" to 2.750"	.188" to .375"
STNT	Pellet Anode—Liquid Electrolyte	2-40 mfd.	50-3V.	—55 to +85°C	Metal Case—Axial Leads	.350"	.155"
TNT	Pellet Anode—Liquid Electrolyte	4-80 mfd.	50-3V.	—55 to +85°C	Metal Case—Axial Leads	.500"	.155"
TAP	Pellet Anode—Liquid Electrolyte	2-30 mfd.	90-6V.	—55 to +85°C	Metal Case—Axial Leads	.500"	.238"
TAP2	Pellet Anode—Liquid Electrolyte	11-140 mfd.	90-6V.	—55 to +85°C	Metal Case—Axial Leads	.660"	.238"
M2	Pellet Anode—Liquid Electrolyte	11-140 mfd.	90-6V.	—55 to +150°C	Metal Case—Axial Leads	.500"	.290" (Body) .484" (Flange)
XTK	Pellet Anode—Liquid Electrolyte	2-70 mfd.	340-8V.	—55 to +175°C	Metal Case—Axial Leads or Terminal	.438" to 1.313"	.650"
XTM	Pellet Anode—Liquid Electrolyte	4-140 mfd.	340-8V.	—55 to +175°C	Metal Case—Axial Leads or Terminal	.563" to 1.781"	.650"
XTL	Pellet Anode—Liquid Electrolyte	3.5-120 mfd.	630-18V.	—55 to +200°C	Metal Case—Axial Terminal	.500" to 2.595"	.875"
XTH	Pellet Anode—Liquid Electrolyte	7-240 mfd.	630-18V.	—55 to +200°C	Metal Case—Axial Terminal	.688" to 4.063"	.875"
XTV	Pellet Anode—Liquid Electrolyte	18-1300 mfd.	630-30V.	—55 to +175°C	Metal Case—Axial Terminal	.563" to 2.750"	1.125"
XTO	Pellet Anode—Liquid Electrolyte	7-240 mfd.	630-18V.	—55 to +200°C	Metal Case—Axial Terminal	.563" to 2.750"	1.125"

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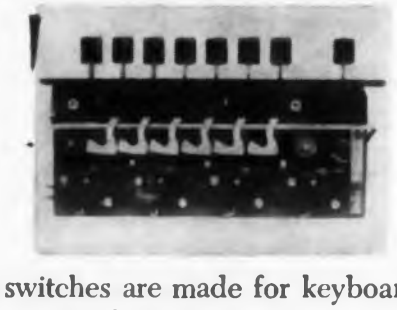
NEW PRODUCTS

Switches

Have binary-coded output



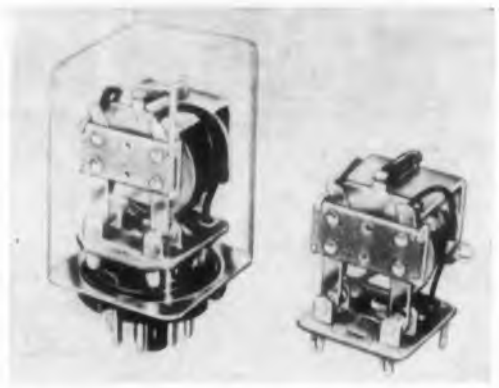
These switches are made for keyboard use and eliminate multiple relay contact arrangements. Model DS-1 has a ten-button decimal bank with 1-2-4-8 binary output contacts. Models OS-1 and OS-2 have eight-button octal banks with 1-2-4 binary output contacts. Model OS-2 has a spdt switch coupled to the zero or clear button. For all models output is through double throw contact arrangements.

Computer Control Co., Inc., Western Div., Dept. ED, 2251 Barry Ave., Los Angeles 64, Calif.

CIRCLE 366 ON READER-SERVICE CARD

Relay

Rated at 8 amp



Available in all voltages to 230 v ac and 110 v dc, the model RG relay has 8 amp silver contacts and spdt to 3pdt arrangements. Special alloy contacts may be provided on request. This low cost unit comes in a 1-3/4 oz open model or in a 2-1/2 oz dustproof model that has a clear plastic enclosure with plug-in mounting.

Artisan Electronics Corp., Dept. ED, 171 Ridgedale Ave., Morristown, N.J.

CIRCLE 367 ON READER-SERVICE CARD

Integrator-Computer

Square root type

Type C3A/1 integrator-computer consists of two separately housed assemblies: a computer package and an electro-magnetic six-digit indicator. The indicator measures 1-7/8 x 4-7/16 in. and

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is located remotely from the computer. The normal counting rate is 20,000 counts per day, but can be from 4000 to 100,000 counts per day. Digital totalization is continuous and accurate from 1 to 100% of the input signal. Installed in parallel with a flow indicator, recorder, and controller, it operates from a common 0 to 0.5 v ac signal and has no effect upon control loop.

Swartout Co., Dept. ED, 18511 Euclid Ave., Cleveland 12, Ohio.

CIRCLE 370 ON READER-SERVICE CARD

Oscillator

Covers 10 cps to 5 mc

Model GO-20F oscillator covers 10 cps to 5 mc in these six ranges: 10 to 100 cps, 100 to 1000 cps, 1 to 10 kc, 10 to 100 cps, 100 to 1000 kc and 1 to 5 mc. The output impedance is 50 ohms and the output voltage is 2 v rms max. Distortion is less than 2%. Frequency stability is 1% after warm-up and amplitude stability is 2%. The attenuator covers 50 db in 10 db steps; continuous variable fill-in control is provided. This model has a vtvm output monitor. Power requirement is 115 v, 60 cps, at about 40 w. The unit is available in rack panel mounting measuring 8.75 x 19 x 13 in., or cabinet mounting, 9.5 x 24 x 15 in.

Gerber Scientific Instrument Co., Dept. ED, 89 Spruce St., Hartford 1, Conn.

CIRCLE 371 ON READER-SERVICE CARD

Precision Potentiometers

Have concentric shafts

Two types of concentric-shaft precision potentiometers are available: type APC 1-1/8, having a 1-1/8 in. diam, offers a resistance range of 25 ohms to 350 K; type APC 7/8, having a 7/8 in. diam, offers a resistance range of 10 ohms to 250 K. For both types, standard resistance tolerance is ±5%; when specified, ±1% may be obtained. Standard independent linearity is ±2% for APC 1-1/8 and ±3% for APC 7/8; ±0.25% may be obtained. Both types have a temperature range of −55 to +125 C.

Waters Manufacturing, Inc., Dept. ED, Wayland, Mass.

CIRCLE 372 ON READER-SERVICE CARD

There's no question about it—if there were a dropout in this inch of tape it could cost you plenty. That's why our customers invariably demand perfection from our EP Audiotape —the *extra precision* magnetic recording tape for computers, automation, telemetry and seismography.

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CIRCLE 373 ON READER-SERVICE CARD

NEW PRODUCTS

Silicon Transistors

Rated at 50 w at 25 C

Types 2N1060 and 2N1070 silicon transistors are rated at 50 w at 25 C and have an operating temperature range of −65 to +175 C. Maximum collector current is 4 amp for both types. Maximum saturation for the 2N1070 is 0.67 ohms at 1.5 amp collector current. The transistors are diffused junction, npn type. Typical applications are: relay replacements and controls, solenoid actuators, power converters, power switches, high level dc amplifiers, class A or B power amplifiers, and power supply regulators.

Silicon Transistor Corp., Dept. ED, Carle Place, N.Y.

CIRCLE 374 ON READER-SERVICE CARD

High Vacuum Gage Control

Combines two gages

Designed for measuring pressures of 5 millimicrons to 1000 microns Hg, model DG 2-2T high vacuum gage control combines a thermocouple gage and a Philips type cold-cathode discharge gage. The thermocouple unit measures pressure response between 1 and 1000 microns from either of two thermocouple gage tubes. The Philips type cold cathode unit is sensitive to pressures from 5 millimicrons to 10 microns. Dimensions are 19.2 x 5.25 x 3.75 in. and shipping weight is less than 15 lb. This model is suitable for table or rack mounting and requires a 110 v ac supply.

Veeco Vacuum Corp., Dept. ED, 86 Denton Ave., New Hyde Park, L.I., N.Y.

CIRCLE 375 ON READER-SERVICE CARD

Printer Relay

Transistorized

Type 237, model 1, printer relay is used as a coupling device between a dc teleprinter signal loop and the printer selector magnet. It isolates the reactance of the printer selector magnet, presenting a resistive termination to the signal loop. The relay may be used with either polar or neutral keyed signals.

Northern Radio Co., Inc., Dept. ED, 147 W. 22nd St., New York 11, N.Y.

CIRCLE 376 ON READER-SERVICE CARD

Backward Wave Oscillator

Voltage range is 400 to 1800 v

Model HO 22 backward wave oscillator is focused in a periodic permanent magnet structure and has a tuning voltage range of 400 to 1800 v. Frequency is 8.5 to 12 kmc with a minimum power output of 10 dbm, and 8.2 to 12.4 kmc with 5 dbm. Measuring 11-1/2 x 2-1/2 in. and weighing 3.5 lb, this unit replaces solenoid and power supply. No cooling is required.

Huggins Laboratories, Dept. ED, 999 E. Arques Ave., Sunnyvale, Calif.

CIRCLE 378 ON READER-SERVICE CARD

Tritium Monitor

Measures radioactivity

Model 34 tritium monitor measures and records radioactivity in the air and sounds an alarm when the safe limit is exceeded. It detects 10^{-12} curies of tritium per ml of air. Four ranges are provided: 10^{-11}, 10^{-12}, 10^{-13}, and 10^{-14} amp full scale. Ion chamber volume is 850 ml; readings are self-consistent to 2% of full scale between all ranges. The monitor requires 100 w of power with 117 v, 50 to 60 cps source. The instrument consists of two units, a control unit, pictured here, and a sampling unit. Both measure 19 x 11 x 13 in.

Applied Physics Corp., Dept. ED, 2724 S. Peck Rd., Monrovia, Calif.

CIRCLE 379 ON READER-SERVICE CARD

Controlled Temperature Bath

For 12-cell bank

Model 66 controlled temperature bath is designed to maintain a bank of 12 standard cells at a constant temperature. The standard cells are immersed in a tank of neutral oil which has a constant temperature of 35 ±0.01 C. A thermoregulator detects any temperature deviation and turns the heater on or off as required. Operating at 115 v cps ac, 300 w, the unit weighs 30 lb without oil, measures 13-1/4 x 14 x 18 in., and has a tank capacity of 5 gal.

Weston Instruments Div., Daystrom, Inc., Dept. ED, 614 Frelinghuysen Ave., Newark 12, N.J.

CIRCLE 380 ON READER-SERVICE CARD

NEW PRODUCTS

Converters

Analog-digital type

These analog-digital converters operate at temperatures from −80 to +350F, and can withstand 5 to 500 cps vibration at ±10 g. These shaft position-to-digital units are available for a wide range of applications including latitude, longitude, azimuth or conventional angular shaft displacement conversion. Typical units provide for non-ambiguous conversion up to 2^{15} in a unit diameter less than 1.5 in. and a length of 1-15/16 in.

Kearfott Co., Inc., Dept. ED, 1500 Main Ave, Clifton, N.J.

CIRCLE 382 ON READER-SERVICE CARD

Vacuum Gage

Range of 0.001 to 1 mm of mercury

Used for continuous measurements of gas pressures in a vacuum system, this thermocouple vacuum gage is self-regulating, and has a pressure range of 0.001 to 1 mm of mercury. The gage tube is installed in the vacuum system with a special connector which can be inserted in either glass or metal. The instrument operates from 115 v, 60 cps ac current. It measures 5-1/2 x 6-1/4 x 4-1/2 in., and weighs 5 lb.

Central Scientific Co., Dept. ED, 1700 Irving Park Rd., Chicago, Ill.

CIRCLE 383 ON READER-SERVICE CARD

Gray-to-Binary Translator

Has data storage

Type TR-702 gray-to-binary translator is a fully transistorized unit with data storage. It is packaged in an enclosure measuring 4-1/4 x 6-3/4 x 6-1/4 in. Four of these units will fit into a standard 19 x 8-3/4 in. panel. A companion power supply model PS-701 has a regulated 20 v output plus a bias output and is capable of operating three translators simultaneously.

Datex Corp., Dept. ED, 1307 S. Myrtle Ave., Monrovia, Calif.

CIRCLE 384 ON READER-SERVICE CARD

Dosimeter

For X and gamma rays

The sensitive element in this X and gamma-ray dosimeter is radiophoto-luminescent glass which emits luminescent light under near-ultraviolet radiation after exposure to X or gamma radiation. Called DT-60/PD, it weighs one ounce, and is worn about the neck as a pendant. It records exposure to radiation cumulatively from 10 to 600 roentgens. The companion radiac computer-indicator CP-263/PD operates on five 1-1/2 v, size D batteries. This portable unit can handle about 200 readings an hour. It weighs 12 lb, and measures 7-1/4 x 9-1/2 x 6 in.

Specialty Electronics Development Corp., Dept. ED, Syosset, N.Y.

CIRCLE 385 ON READER-SERVICE CARD

Tube Drivers

Self-contained

The series TND tube drivers are self-contained units with complete housing, Nixie tubes, up to ten transistor drive circuits, and mounting hardware. Signals required are 4 v for the on condition and 0 v for the off condition; both are referenced to the common terminal. Power supply requirements for standard units are 180 v and 2 to 4 ma. Units with built-in power supplies may also be ordered. Input is normally through ten input lines. Designed for panel mounting, the unit measures 1-1/4 in. sq and is 2-3/8 to 3-1/2 in. long.

Transistor Electronics Corp., Dept. ED, 3357 Republic Ave., Minneapolis 26, Minn.

CIRCLE 386 ON READER-SERVICE CARD

NEW PRODUCTS

Tube Furnaces

Heat to 1500 C

Model VL tube furnace heat to 1500 C max, with close temperature control and uniformly heated work zone. Heating time from room temperature to 1000 C is about 25 min; 1300 C is reached in 45 min or less; and 1500 C is reached in about 90 min. Furnaces can be supplied with operating temperatures of 1500 to 1000 C and lower. This model is available in three sizes with standard tube bores up to 3.5 in. It has heating chambers 18 in. long.

The Sentry Co., Dept. ED, Foxboro, Mass.

CIRCLE 388 ON READER-SERVICE CARD

Data Processing System

Prints up to seven channels

Model GDPS 821-N data processing system is designed to sample analog voltage information, digitize, and print up to seven channels. Sampling, digital conversion, and printing are at 3 channels per sec. Nixie lamp banks are used for visual output. The minimum input impedance is 2 meg. The unit has a range of 0 to 999 and is adaptable to yield punched paper tape or IBM cards. Its accuracy is ±1 digit. Measuring 21 x 19 x 16 in., the standard model is for rack mounting. A console model is also available.

The Gerber Scientific Instrument Co., Dept. ED, 89 Spruce St., Hartford, Conn.

CIRCLE 389 ON READER-SERVICE CARD

c-magnetic voltage regulators

Sola Normal-Harmonic type Constant Voltage Transformers now specifically designed and priced for component use

End-bell unit with separate capacitor typical of structures engineered for component use.

Re-design of Sola "Normal-Harmonic" type static-magnetic voltage regulators has resulted in a significant reduction in their size and weight. Prices on many of these units have been reduced. Now it's possible for you to improve equipment performance by using them in many new fields at less cost than ever before. Redesign has in no way sacrificed the performance of these units—they provide all the outstanding benefits which have made them the standard of the industry for more than fifteen years.

Sola Normal-Harmonic type voltage regulators provide ±1% output voltage with line voltage variations as great as ±15%. This group has an average of 14% total rms harmonic content in its output voltages and is suited to equipment not extremely sensitive to voltage wave shape.

Sola Normal-Harmonic type voltage regulators are available in nineteen stock ratings from 15va to 10kva, including those mechanical designs specially engineered for use as built-in components. With many of the most popular ratings now reduced in price, these Sola Constant Voltage Transformers provide one of the most economical means of close voltage regulation in a broad range of applications.

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Sola Manufactures: Constant Voltage Transformers, Regulated DC Power Supplies, Constant Wattage Mercury Lamp Transformers and Fluorescent Lamp Ballasts

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IN CANADA, Sola Electric (Canada) Ltd., 24 Canmotor Ave., Toronto 18, Ontario

CIRCLE 390 ON READER-SERVICE CARD

Frequency Decades

Two types available

This precision calibration line of frequency decades includes two models. Schomandl ND-5 provides discrete frequencies between 50 cps and 31 mc at intervals of 100 cps. Maximum reading error is 1 or 0.1 cps, depending upon the associated decade. Reference frequency is obtained from 100 kc with a stability of better than 2 x 10^{-8} over 24 hr. Schomandl FD-3 microwave decade provides frequency and full reference accuracy between 300 and 10,000 mc, with a tuning error of ±300 cps. This unit may be used in harmonic operation to beyond 30,000 mc with the same accuracy.

Electronic Applications, Inc., Dept. ED, 194 Richmond Hill Ave., Stamford, Conn.

CIRCLE 391 ON READER-SERVICE CARD

Battery Voltage Regulator

Magnetic amplifier type

This transistorized, magnetic amplifier type battery voltage regulator maintains outputs constant to ±2%, even with a battery supply voltage drop of 20 to 30%. The unit has 85 to 90% efficiency and operates in a temperature range of −20 to +165 F. It weighs about 4 lb and meets the requirements of MIL-E-5272A, MIL-I-6181, and others. Possible applications are with ground check-out equipment.

Gulton Industries, Inc., Dept. ED, 212 Durham Ave., Metuchen, N.J.

CIRCLE 392 ON READER-SERVICE CARD

NEW PRODUCTS

Shock and Vibration Isolators

For use at temperatures to 500 F

Designed to provide shock and vibration protection in aircraft and missiles, these shock and vibration isolators can be used at temperatures to 500 F. The units consist of two load carrying springs mounted in opposite positions, with a built-in damper assembly to restrict resonant build-up. Requirements of MIL-E-5272A are met.

MB Electronics, Dept. ED, 20 Fitch St., New Haven 11, Conn.

CIRCLE 395 ON READER-SERVICE CARD

Precision Potentiometers

Maximum resistance ranges from 45 to 200 K

Series GC precision potentiometers have a maximum resistance of 45 to 200 K per 360 deg, and a maximum resolution of 0.015 to 0.059%. Standard linearities are 0.08 to 0.2%; best linearities available are 0.03 to 0.15%. Operating temperature range is −55 to +120 C, torque is 0.05 to 0.5 oz-in., and noise level is 100 ohms at 4 rpm. Typical of this series, model GC 30 has a standard electrical angle of 350 ±1 deg, maximum continuity angle of 375 deg, and a dielectric strength of 1500 v rms at 60 cps. The entire series meets environmental qualifications of MIL-E-5272A. Mounting is standard servo-type; other types can be furnished as specified.

Guidance Controls, Dept. ED, 119 Duffy Ave., Hicksville, N.Y.

CIRCLE 396 ON READER-SERVICE CARD

Geared Encoder Assembly

Resolves 1 million shaft positions

Built with three shaft position encoders and two gear boxes, the model CG-704 assembly can resolve 1 million shaft positions. The encoder on the input shaft provides 1000 positions of the least significant digit per 360 deg rotation. It is then geared 100 to 1 to a 100-position encoder which is in turn geared to a 10-position encoder. The unit is 5 in. long without the shaft and has a diameter of 3 in. It weighs under 2 lb and operates accurately at temperatures from 32 to 150 F and under 8 g, 2000 cps vibration.

Datex Corp., Dept. ED, 1307 S. Myrtle Ave., Monrovia, Calif.

CIRCLE 397 ON READER-SERVICE CARD

Transistor Checker

Collector currents of 5 to 50 ma

Model 100 transistor checker provides a go-no/go test at a collector current of 5 to 50 ma or more. Transistors which can be tested include small signal, drift types, medium power types, and power types. It also provides a check for opens, shorts, and gain, and will identify and check pnp and npn models. A 1.5 v dc battery is contained in the unit. A glow lamp indicator shows test results. Dimensions are 3-1/4 x 6-1/4 x 2-1/4 in. and shipping weight is 1-1/2 lb.

Seco Manufacturing Co., Dept. ED, 5015 Penn Ave. S., Minneapolis, Minn.

CIRCLE 398 ON READER-SERVICE CARD

NEW PRODUCTS

Power Supplies

For microwave tr tubes

Offering keep-alive power for microwave tr switch tubes in radar systems and production test installations, Mini-Keep power supplies can be mounted to a chassis, bulkhead, or waveguide section next to the tube assembly. Their low output impedance permits the use of any series resistor called for under tr tube specifications. One unit, the model K-800, has an output voltage of —1 kv dc, an output current of 200 μa, and a peak-to-peak ripple of 5%. Its input is 115 v rms at 60 or 400 cps and its volume is about 8 cu in.

Burmac Electronics Co., Inc., Dept. ED, 142 S. Long Beach Rd., Rockville Center, N.Y.

CIRCLE 403 ON READER-SERVICE CARD

Automatic Nyquist Diagram Plotters

Have 1 deg phase angle accuracy

Series 100 automatic Nyquist diagram plotters are self-contained transfer function analyzers for designing and testing ac and dc servo systems. With 1% amplitude accuracy and 1 deg phase angle accuracy, they complete a 10 in. diam graph in 5 min, or, if the response below 1 cps is not required, in 90 sec. Model 103 of the series covers the 0.5 to 250 cps range, while other models extend the low range to 0.025 cps.

British Industries Corp., Dept. ED, 80 Shore Rd., Port Washington, N.Y.

CIRCLE 404 ON READER-SERVICE CARD

Dual Connectors

Shielded or unshielded

Made for use with binding posts mounted on 3/4 in. centers, these dual connectors are available shielded or unshielded. Gold-plated conducting metal parts, color-coded thumbnuts, and recessed twin banana plugs are furnished with both types. The shielded model has a chrome-plated metal case. For use where shielding is unnecessary, the nylon plastic type provides for connection by stud hole clamping, looping and clamping, or by spade lug or clip-lead.

The Superior Electric Co., Dept. ED, Bristol, Conn.

CIRCLE 405 ON READER-SERVICE CARD

Integrating Capacitor

Tolerance of ±0.25%

These precision integrating capacitors are available only in matched pairs with tolerances to ±0.25%. Operating temperature is −35 to +100 C; insulation resistance is greater than 6 x 10^{12} μf at 100 C. Absorption is less than 0.05%; temperature coefficient maximum is 150 ppm per deg C.

Dearborn Electronic Labs., Dept. ED, 1421 N. Wells St., Chicago 10, Ill.

CIRCLE 406 ON READER-SERVICE CARD

Pressure Transducer

0 to 5000 psi

Model CS-5 pressure transducer changes resistance from 0 to 5000 psi and can be read on any ohmmeter that will read from infinity to 2.6 meg. This unit operates on either ac or dc; the sensitivity and resolution may be controlled by changing the applied voltage. Deflection at full load is less than 0.005 in. The resistance at no load is infinity; at 80 F and 5000 lb, resistance is 2.6 meg. This low-cost instrument will sense oil leakage of 1 lb in 5000. It is 3/4 in. in diam and 5/16 in. thick.

Clark Electronic Labs., Dept. ED, Palm Springs, Calif.

CIRCLE 407 ON READER-SERVICE CARD

NEW PRODUCTS

Pulse and Marker Generator

Continuously variable

The Vari-Marker is a combined pulse and pip marker generator for use with the company's Vari-Sweep oscillator. Equipped with a direct reading frequency dial calibrated to within ±1%, it generates a pip that is continuously variable from 1.6 to 442 mc in eight overlapping bands. A ten-position switch can select up to 30 pulse-type, crystal-controlled markers placed three to a band at specified frequencies in the above range. A high level, automatic gain-controlled cw signal covering the same range is also available.

Kay Electric Co., Dept. ED, Maple Ave., Pine Brook, N.J.

CIRCLE 410 ON READER-SERVICE CARD

Oscillator

Calibrates fm discriminators

For calibration of fm discriminators used in data processing systems, model 350 oscillator can be programmed to generate up to 11 different frequencies in any required sequence. Accuracy is within 0.01% from 100 cps to 100 kc. Any one of three operating modes may be selected by means of switches. In full automatic operation, the oscillator steps through the complete program. In the automatic-manual mode, stepping to the next frequency occurs when a push button is depressed. In the manual mode, adjustment is made by positioning six decimal switches.

Digital Instrument Labs., Dept. ED, 152 S. Atlantic Blvd., Los Angeles 22, Calif.

CIRCLE 411 ON READER-SERVICE CARD

a good way to measure 0.00003 ohm

The Keithley 502 Milliohmmeter offers speed, ease, and accuracy in the measurement of low resistances. Typical uses are corrosion tests, checking resistivity of metals, semi-conductors, printed circuits, switch and relay contacts.

Battery operation, a ruggedized meter, and protective cover make the 502 ideal for field tests of squibs, carbon bridges and other explosive devices. Features include:

- **13 overlapping ranges** from 0.001 ohm to 1000 ohms full scale.
- **accuracy within 3%** of full scale; a four-terminal measuring system eliminates errors due to clip and lead resistance.
- **2 microwatts** maximum dissipation across sample.
- **no calibration** or zero adjustments.
- **instantaneous** indication of resistance without zero drift or errors due to thermal EMF's.
- **lightweight and portable.** Furnished with protective cover and set of four test leads.

Details about the Model 502 Milliohmmeter are available in Keithley Engineering Notes, Vol. 6 No. 3. Write for your copy today.

KEITHLEY INSTRUMENTS, INC.
12415 Euclid Ave., Cleveland 6, Ohio

CIRCLE [illegible] READER-SERVICE CARD

Thyratron

Has 12 megawatts peak power

Designed for application in moving target indicator radar systems, type 5948A hydrogen thyratron is rated at 12 megawatts peak power, 25 kv peak voltage, and 1000 amp peak current. Only a three-minute warm-up is needed to reach maximum operating efficiency. Jitter is less than 5 mμsec.

International Telephone and Telegraph Corp., Dept. ED, 67 Broad Street, New York 4, N.Y.

CIRCLE 414 ON READER-SERVICE CARD

Silicon Diodes

Rated at 400 piv, 200 to 500 ma

Low cost units for commercial equipment, these silicon diodes are rated at 400 piv and 200 to 500 ma. They operate at ambients to 70 C and case temperatures to 100 C. Included in the line are types 2E4 and 5E4 rated at 200 and 350 ma, respectively. All units are multisealed with successive layers of humidity resistant, insulating resins and sealants.

International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

CIRCLE 415 ON READER-SERVICE CARD

Synchro Positioner

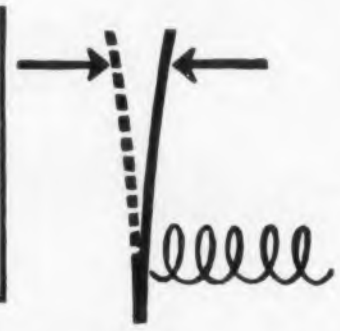
Has 360 deg range

This synchro positioner has a range of 360 deg and an angular accuracy of 20 sec at the coupling output. Positioning is at 5 deg intervals by means of a detent mechanism. Positioning at other angles is by means of a continuous, fine-angle device. Adapters are available in sizes 8 to 37. Made for angular positioning of synchros, gimbal-mounted components, and other rotating devices, the unit conforms to MIL-S-20708A.

Theta Instrument Corp., Dept. ED, 48 Pine St., E. Paterson, N.J.

CIRCLE 416 ON READER-SERVICE CARD

Design Economies with Vibrating Reeds



TIMING OR WARNING ALARMS

Vibration on case or housing creates buzz alarm for appliances, such as automatic washers, dryers, ranges, etc.

TOY SOUND EFFECTS

Remotely controlled train whistles and engine noises generated by repetitive electrical or mechanical pulses.

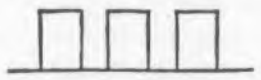
VIBRATION GENERATOR

Mechanical tapper tests for microphonics of tubes or other components.

LIGHT CHOPPER

Interrupts a beam of light at frequencies of 20 to 120 cps to provide a pulsating photoelectric output proportional to the light intensity.

PULSE POWER GENERATOR

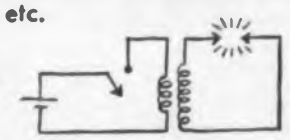


Typical application is for life testing devices such as relays which must be cycled rapidly. Cost is much lower than a geared motor with cam actuated switch performing a like function.

FREQUENCY SENSITIVE RELAY

Used with frequency generators as low cost remote controls for garage doors, television, etc.

IGNITION DEVICES



Used as independent breaker points for car and aircraft heaters, jet engines, and other ignition jobs.

ECONOMICAL CHOPPERS

Available with power interrupting capability, low-noise and low-resistance variations.

Provides 100 cps from DC power source. Driving circuit isolated from chopper contacts. Now being used in medical and aircraft equipment. Frequency doubler chopper operates at 120 cps when driven by a 60 cps supply. Low cost 60 cps chopper for commercial use. Polarized, will follow a 60 cps source.

FREQUENCY GENERATOR

Typical uses include: 20 cps bell ringers; 60 cps timing motors for jobs such as operating taxi meters (eliminates ticking); 60 cps *constant frequency* unit (±½ cps over a voltage range of 4 to 1) for precision timers, clocks, tape recorders, meters, etc. The latter is an exclusive, Oak patented design.

TEST EQUIPMENT

Used in instruments to check for "holidays" in insulation on pipe lines, measure insulation resistance, and test ignition systems and timing of cars.

HIGH POWER CONVERTER

In addition to units for all standard power ranges, Oak supplies a special high power vibrator (patented) which allows any number of vibrators to be operated simultaneously at the same frequency. Using this system, four vibrators have handled as much as 500 watts on an intermittent duty cycle.

There are many ingenious ways to use vibrating reeds, which can lower costs through simplified design.

If you've got an idea you'd like to develop, Oak's engineering specialists will be glad to help you work it out. Contact them today.

Oak also supplies a complete line of conventional vibrators, custom-built for any application.

OAK MFG. CO.
1260 Clybourn Ave., Dept. D
Chicago 10, Illinois
Phone: MOhawk 4-2222

Specialized Applications with Vibrating Reeds

CIRCLE 417 ON READER-SERVICE CARD

NEW PRODUCTS

Multiplexer

High speed

Model TMX-841-S multiplexer allows a maximum of 20 input channels to be sampled at any rate to 10 kc; sampling rates as high as 44 kc may be obtained. The full scale input voltage range is 0 to ±10 v peak. Noise is less than 2 mv up to 30 C with 50 K source impedance. Input impedance is load plus 70 ±10 ohms. Output internal impedance is source impedance plus 70 ±10 ohms. Unity gain is within a tolerance of ±0.05%. This model can be provided to handle 2 to 40 channels utilizing a single power supply; more than 40 channels can also be provided. The unit is solid state, measures 5-1/4 x 19 in. for standard relay rack mounting, and weighs 25 lb.

Epsco, Inc., Dept. ED, 275 Massachusetts Ave., Cambridge, Mass.

CIRCLE 419 ON READER-SERVICE CARD

Time Code Generator

Produces eight timing signals

Model 1021 time code generator produces timing signals during the recording of test data on magnetic tape. It consists of a crystal-controlled oscillator and seven decades of frequency division. The instrument produces eight separate timing signals of from 0.01 to 100,000 cps. Use of a variable pulse width to code each timing signal permits mixing of signals to identify elapsed test time; mixed output range is 100 to 0.01 cps on a single channel.

Computer-Measurement Co., Dept. ED, 12970 Bradley Ave., Sylmar, Calif.

CIRCLE 420 ON READER-SERVICE CARD

Silicon Transistors

Seven types available

These seven npn silicon transistors permit complementary circuitry to 100 mc and have low collector capacitance. Type 2N1199 is used in high-speed saturated switching circuits at frequencies to 5 mc. The frequency at which beta equals unity is 125 mc. Maximum temperature is 150 C. Types 2N1267, 2N1268, and 2N1269 have

beta ranges of 6 to 18, 11 to 36, and 28 to 90. Intended for 4.3 mc amplifier applications, they have a typical power gain of 25 db. Typical units oscillate at 90 mc. Types 2N1270, 2N1271, and 2N1272 have the same beta ranges and are for 12.5 mc amplifier applications. Minimum power gain is 20 db. Typical units oscillate at 200 mc.

Philco Corp., Lansdale Tube Co. Div., Dept. ED, Lansdale, Pa.

CIRCLE 421 ON READER-SERVICE CARD

AC Voltmeter

Portable, transistorized type

Battery operated, model 403A ac voltmeter has a frequency range of 1 cps to 1 mc. Transistorized, it weighs less than 5 lb, and measures ac voltages from 1 mv to 300 v full scale with an accuracy of ±3% for 5 cps to 500 kc, and ±5% for 1 to 5 cps and 500 kc to 1 mc. The instrument has 12 voltage ranges and also reads db from −72 to +52 db. This portable unit has a 400-hr battery life; battery voltage is checked by a front panel switch. Noise is less than 50 μv.

Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif.

CIRCLE 422 ON READER-SERVICE CARD

Time Indicators

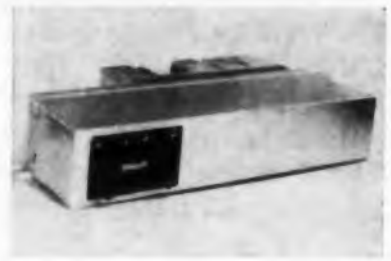
For 115 v 60 cps supplies

Series 23200 miniature hermetically sealed time indicators are made for operation on 115 v 60 cps supplies. Two dial type models are offered: one reading to 2500 hr in 5 hr increments and one reading to 10,000 hr in 10 hr increments. A digital model providing a maximum reading of 9999.9 hr is also available. The voltage range is 105 to 125 v and the frequency range is 57 to 63 cps. The timers will not be damaged with frequency variations of 45 to 75 cps at the maximum rated voltage. The instruments are filled with a dry nitrogen atmosphere and are enclosed in a 1-1/4 in. diam housing. The standard mounting flange has two ears which permit installation in a 1-1/4 in. square; a square flange is also available for mounting in a 1-3/4 in. square panel area.

A. W. Haydon Co., Dept. ED, Waterbury, Conn.

CIRCLE 423 ON READER-SERVICE CARD

NEW PRODUCTS



Amplifier

Automatic gain adjusting type

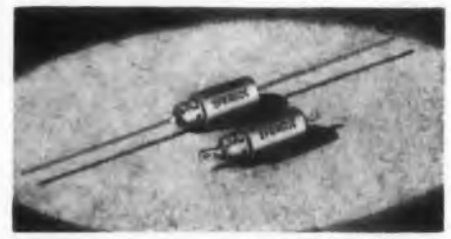
This automatic gain adjusting amplifier may be used on any voice circuit to maintain a constant voice level over a 40-db input level range. Reacting to syllabic speech, the unit does not clip excess-volume speech, but shifts the entire range to 0 vu to avoid distortion. The input range can be attenuated to a maximum loss of 20 db in 4-db increments. Output volume is 0 vu ±4 vu; frequency range is 300 to 3000 cps. The unit operates on 48 v and occupies 3-1/2 in. in a standard 19-in. rack.

Lenkurt Electric Co., Dept. ED, San Carlos, Calif.

CIRCLE 426 ON READER-SERVICE CARD

Miniature Capacitors

Rated at 5 amp



Developed for use in radio interference reduction in communication and radar equipment, these capacitors are rated at 5 amp. Voltage ratings available are 100 to 600 v dc, capacitance is 0.001 to 1 μf, and sizes are 3/4 to 2-3/8 in. Type 102P has an operating temperature of −55 to +85 C; type 103P, −55 to +125 C. The capacitors are all hermetically encased and have glass-to-metal solder-seal terminals. Tab or lead type terminals can be furnished. Requirements of MIL-C-11693 are met.

Sprague Electric Co., Dept. ED, North Adams, Mass.

CIRCLE 427 ON READER-SERVICE CARD

Voltage Monitors

Solid State

These voltage monitors, model L102, are solid state sensors followed by amplification to either close or open relays. They have a range of 5 to 40 v dc and a response time of 100 msec. Repeatability of trip is within 0.1% of voltage setting. The output relay rating is 2 amp resistive load, and the trip point changes less than ±3% over a

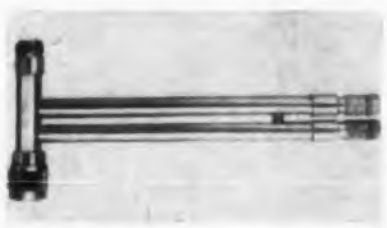
temperature range of −20 to +54 C. Typical applications are for voltage comparators in incoming inspection, voltage indicators for automatic checkout, and voltage detection in ground power systems. Three types are available.

Alto Scientific Co., Inc., Dept. ED, 855 Commercial St., Palo Alto, Calif.

CIRCLE 428 ON READER-SERVICE CARD

Coaxial Stub Tuners

From 200 to 10,000 mc



These broadband coaxial stub tuners cover the frequency ranges from 200 to 1000 mc and from 1000 to 10,000 mc. They consist of a length of 3/8 in. concentric line with one, two or three short-circuited variable-length stubs at right angles to the main line. These stubs are axially separated by 1/2 or 3 in., depending on the frequency range; each stub is a sliding tube with tempered beryllium contact springs. Six types of tuners are available; input and output connectors are type N male and female.

Empire Devices Products Corp., Dept. ED, Amsterdam, N.Y.

CIRCLE 429 ON READER-SERVICE CARD

Limit Switch

No moving parts

The Amplet magnetic limit switch has no moving parts; it acts on proximity of its two sensing elements. The device consists of a probe, which is mounted on a stationary part of the machine being controlled; a magnetic trigger, which is mounted on a moving part of the machine; and a power amplifier. The response time is less than 1 msec. Power amplifier units are available normally off or normally on. Power input is 7 w, 115 v, 60 cps; output signal is 50 μa in the off condition and 5 w, 24 v dc in the on condition.

Consolidated Controls Corp., Dept. ED, Bethel, Conn.

CIRCLE 430 ON READER-SERVICE CARD

NEW PRODUCTS

Comb Filters

For operation at 100 to 3000 cps

These 16-parallel-element filters operate in the range of 100 to 3000 cps and have a 180 cps interval between each of the center frequencies. The center frequency for the first filter element begins at 200 cps. Equal input and output impedances are obtained. One of the models has a frequency response of 135 cps at 3 db bandwidth, 180 cps at 8 db bandwidth, and crossovers at 8 db. Insertion loss is 8 ±1/2 db at the passband center frequency. The other model has a frequency response of 60 cps at 3 db bandwidth, 135 cps at 8 db bandwidth, and crossovers of 10 to 18 db. Insertion loss is 11 ±1/2 db at the passband center frequency. The range of operating level for both filter models is −60 to +15 dbm. Units adaptable to any frequency range, including microwave, are also available.

Rixon Electronics, Inc., Dept. ED, 2414 Reedie Dr., Silver Spring, Md.

CIRCLE 433 ON READER-SERVICE CARD

Ultrasonic Delay Line

For use as target simulator

Designed for application as a target simulator for doppler radar calibration and other uses where variable data storage capacity is required, this variable ultrasonic delay line has continuous variation from 100 to 300 μsec. Simulated target velocity is 20,000 ft per sec max. The center frequency is up to 40 mc and the bandwidth is 45% of center frequency. Static attenuation is 50 db into 100 ohms; rise time is 0.1 μsec or better. Variation is servo-controlled. Requirements of MIL-T-5422 and MIL-T-945 are met.

Andersen Laboratories, Inc., Dept. ED, 501 New Park Ave., W. Hartford 10, Conn.

CIRCLE 434 ON READER-SERVICE CARD

Displacement Gyro

For control and telemetering purposes

This cageable free gyroscope provides accurate angular intelligence for control and telemetering purposes. Caging and uncaging functions are performed electrically with indicating switches signaling the caged or fully uncaged position of the instrument. A motor driven caging device or a solenoid operated caging mechanism can be supplied. It withstands up to 60 g shock along the gimbal axis and up to 10 g vibration. Temperature is —58 to +185 F. The basic unit measures 5-7/8 in. long and is 3-9/16 in. in diam.

Telecomputing Corp., Whittaker Gyro Div., Dept. ED, 16217 Lindbergh St., Van Nuys, Calif.

CIRCLE 435 ON READER-SERVICE CARD

Molded Choke Coils

Miniature

Molded choke coils in the Ring Ding series combine high Q and low distributed capacity with a marked reduction in size. The 1000 μh model is 0.14 cu in., or 0.645 cu in. less than a standard model of the same value. Hermetically sealed through molded encapsulation, the coils are available in current ratings from 100 to 150 ma and in values up to 10,000 μh. They contain no ferrite materials and operate at temperatures to 125 C.

Delevan Electronics Corp., Dept. ED, 77 Olean Rd., East Aurora, N.Y.

CIRCLE 436 ON READER-SERVICE CARD

NEW PRODUCTS

Antenna

Circularly polarized

Designed to cover the range of 300 to 520 mc, this circularly polarized antenna has a beam width of 55 deg at the low end and 29 deg at 520 mc. It has a circularity of ±1.3 db over the frequency band, and better than ±0.6 db over most of the range. Vswr from 360 to 520 mc is under 1.5. The gain of the antenna ranges from 11.5 to 15.0 db. Developed for telemetry applications, this six-turn helical antenna can be used for data reception from orbital bodies.

Technical Appliance Corp., Dept. ED, Sherburne, N.Y.

CIRCLE 441 ON READER-SERVICE CARD

Ceramic Capacitors

Fit within 1/10 in. modular spacing

The Narrow-Caps series of subminiature ceramic capacitors are 0.095 in. wide to fit within 1/10 in. modular spacing. Capacitance values are 100, 250, 500, 750, and 1000 μμf. Tolerance is ±20%. Body length of the first four sizes is 0.250 in. max; the length of the 1000 μμf unit is 0.30 in. max. Temperature range is −60 to +125 C; power factor is less than 2.5%.

Mucon Corp., Dept. ED, 9 St. Francis St., Newark 5, N.J.

CIRCLE 442 ON READER-SERVICE CARD

Snap Switch Relay

Solenoid operated

This multi-pole solenoid operated snap switch relay is available in contact arrangements up to

6pdt. Called SS 101, it is used to control several circuits handling inductive loads. Each contact is rated at 10 amp, 125 v ac, or 5 amp, 250 v ac. Quick-connect or solder terminals are available on both switches and coil. This unit can be furnished for either top or bottom mounting and will operate in any position. It is 3-1/4 in. long and 1-7/8 in. in diam.

Warco Industries, Inc., Dept. ED, 6625 Delmar Blvd., St. Louis, Mo.

CIRCLE 443 ON READER-SERVICE CARD

Servo Analyzer

For transfer function characteristics

Model 203 servo analyzer, designed for either direct reading or automatic plotting of transfer function characteristics, has a frequency range of 0.5 to 50 cps with 2% accuracies. Phase angle is ±180 ±2 deg. Accuracy and amplitude ratio is read over a ±40 db range with ±0.5 db accuracy. The basic carrier frequency is 400 cps and operating signals are either ac or dc. Bode plots, Nyquist diagrams and Nichols' charts may be recorded directly by using the appropriate plotters. Testing is go/no-go type.

Metrolog Corp., Dept. ED, 169 Halstead St., Pasadena, Calif.

CIRCLE 444 ON READER-SERVICE CARD

Multiplexer

Magnetic

This magnetic multiplexer, designated Magneplexer, samples voltages of thermocouples, strain gages, and other low level sensors without the use of external preamplifiers. Flexible programming permits scanning groups of sensors at different rates within a single system. Some sensors might be scanned 4096 times per sec while others are being measured once each second in a synchronized pattern. A typical magamp requires 50 μa input current to give full scale output voltage. Input resistance is 40 ohms, input noise level is 0.1 μa, and basic linearity of the system is better than 0.05%. The standard model is built in modular form and housed in a cabinet which fits into a standard 19 in. rack. The cabinet contains a control module and four matrix modules handling 64 channels each.

San Diego Scientific Corp., Dept. ED, 3434 Midway Dr., San Diego 10, Calif.

CIRCLE 445 ON READER-SERVICE CARD

NEW PRODUCTS

Cleaning Systems

Three types available

Type D-601 one-gallon capacity vapor degreaser suspends parts to be cleaned in the condensing vapors of pure distilled solvent. Type G-10001 ultrasonic generator and type NT-10001 1 kw, 35 gal capacity tank have barium titanate transducer elements to generate uniform ultrasonic vibrations. Type DVC-3000 ultrasonic vapor degreaser has a 300 w cleaning chamber, distillate reservoir, power spray rinse, and filter recirculation system with all stainless steel plumbing. The immersion sump has a six-gallon capacity.

Narda Ultrasonics Corp., Dept. ED, 625 Main St., Westbury, L.I., N.Y.

CIRCLE 517 ON READER-SERVICE CARD

Microwave Step Attenuators

Are remotely operated

These 6 or 12 position automatic microwave step attenuators are powered by a motor-operated driving mechanism. Actuation of a rotary switch or push buttons causes the mechanism to produce the rotary and linear movements required to insert the desired attenuation value. They are available with attenuation values from 0.1 to 60 db and handle 1 or 4 w rf power. Frequency range is from dc to 4 kmc. These units operate from a 28 v dc.

Empire Devices Product Corp., Dept. ED, Amsterdam, N.Y.

CIRCLE 518 ON READER-SERVICE CARD

Oscillogram Scanner

Scans up to four records

Model S-25 oscillogram scanner permits the independent or simultaneous scanning of up to four records. It consists of a 90 x 30 in.-tabletop with guide rails for each channel. A control panel permits the operator to drive any one or all rolls, separately or jointly, in either direction. A backlighted viewing screen is provided in the center of the table. Input power is 110 v, 60 cps, 250 w. Record width is 0 to 6 in. with standard 1/2-in. spaced perforations; maximum roll diameter is 3 in.

Gerber Scientific Instrument Co., Dept. ED, 89 Spruce St., Hartford 1, Conn.

CIRCLE 519 ON READER-SERVICE CARD

Ultrasonic Cleaner

Multi-purpose

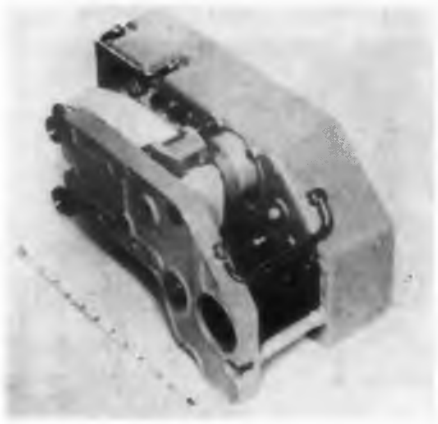
The series 400 SonBlaster ultrasonically agitates the contents of two 400 ml glass beakers, making it possible to wash and rinse parts simultaneously, or use two different solutions at the same time. Units include an ultrasonic generator model G-401, a transducerized ultrasonic tank model NT-401, and two beakers. Items to be cleaned may be placed in separate beakers or directly in the tank.

Narda Ultrasonics Corp., Dept. ED, 624 Main St., Westbury, N.Y.

CIRCLE 453 ON READER-SERVICE CARD

Transistorized Digital Printer

Puts out 10 lines per sec



Completely transistorized and designed for integration into preflight checkout systems, the model 3303 printer is 8-1/2 x 8 x 15-7/8 in. and weighs 34 lb. It is built to MIL-E-16400 and has print-out rates in excess of 10 lines per sec. Its custom designed format offers a choice of character or symbol types and any number of columns up to 20. Storage and programming are supplied in a separate housing that may be integrated with the printer on a RETMA standard structure for rack mounting.

Potter Instrument Co., Inc., Dept. ED, Sunnyside Blvd., Plainview, N.Y.

CIRCLE 454 ON READER-SERVICE CARD

Noise Sources

L-Band to V-Band

These waveguide and coaxial miniature gas tube noise sources cover the L-Band to V-Band frequencies. Designed for installation in branch circuits, series T44-A two-terminal waveguide elements, designed for use as series elements in the receiver circuit, provide noise signals of 10 to 13 db.

Tucor, Inc., Dept. ED, 18 Marshall St., S. Norwalk, Conn.

CIRCLE 455 ON READER-SERVICE CARD

NEW PRODUCTS

Magnetic Clutch

Size 8

The size 8 OR precision magnetic clutch has a total torque output of 20 in.-oz at 3.5 w and zero backlash. It weighs 2.4 oz and has a response time of 8 msec. It is available in reverse or direct acting types in any combination of brake and/or clutch actions. This unit can be supplied for voltage applications of 6 to 115 v dc, and meets MIL-E-5272B specs.

Orbit Instrument Corp., Dept. ED, 131 Eileen Way, Syosset, N.Y.

CIRCLE 460 ON READER-SERVICE CARD

Bandpass Cavity Filters

Adjustable over 20% range

Series TCF bandpass cavity filters are available with 200 to 2400 mc center frequencies which may be tuned over a ±20% range. Impedance may be specified at 50, 75, or 93 ohms, or as required. Insertion loss is within 1 db and ripple is less than 0.5 db in the bandpass area. The weight of the assemblies is 32 oz for two-cavity units with 14 oz extra for each additional cavity. BNC or N type connectors are standard, and power rating is 100 w. Selectivity depends on the number of cavities specified.

Telonic Engineering Corp., Dept. ED, Laguna Beach, Calif.

CIRCLE 461 ON READER-SERVICE CARD

Oscillogram Amplitude Tabulator

Range of 0 to 9999 counts

The oscillogram amplitude tabulator is an automatic data reduction instrument composed of two parts: a stationary unit consisting of a printing counter and the necessary servos, and a hand-held rectangular frame. Called the GOAT, this instrument reads oscillogram and strip chart amplitudes up to 6-1/2 in. and prints this information on an adding machine tape. A sequential count for each reading is also recorded. The counter range is from 0 to 9999; time line print is 0 to 99.

Gerber Scientific Instrument Co., Dept. ED, 89 Spruce St., Hartford 1, Conn.

CIRCLE 462 ON READER-SERVICE CARD

Data Reduction System

Analog to digital

This analog-to-digital data reduction system is designed to read any type of oscillogram record. Modules include a scanner, a reading head, and a basic control console. The R-2 scanner reads and scans oscillograms up to 16 in. wide; the record speed can be varied from 0 to 200 ft per min. This system is compatible with reading heads R-2-EP, R-2-EM, and R-2-E-X,Y. The R-2-E-X,Y can be moved from left to right to compensate for any shift in the base reference line. The values of X or Y may be determined by intersecting two cross-hairs at a given point on the trace. The basic control console consists of a digital voltmeter with an accuracy of 0.01%. It measures the proportional voltages of either the X-Y or frequency potentiometers and displays the value in a projection lamp bank.

Gerber Scientific Instrument Co., Dept. ED, 89 Spruce St., Hartford 1, Conn.

CIRCLE 463 ON READER-SERVICE CARD

Pulse Power Calibrator

Frequency range of 925 to 1225 mc

The PCS-1 pulse power calibrator measures the instantaneous power in pulsed radio frequency energy. It measures peak pulse power by comparing the signal amplitude to that of an internally generated 1 mw rf signal. The production unit PCS-1A covers the frequency range of 925 to 1225 mc.

General Communication Co., Dept. ED, 677 Beacon St., Boston 15, Mass.

CIRCLE 464 ON READER-SERVICE CARD

Microwave Sweep Generator

Has constant output to within ±½ db

Power output of model 6002A microwave sweep generator is adjustable from 10 mw to 1 w and is constant to within ±1/2 db over the entire frequency band. It provides either electronically swept or precise continuous wave, rf power from 2 to 5 kmc. The unit includes a backward wave oscillator, a 10 w traveling wave amplifier, a microwave leveler, and a power supply. Single or recurrent sweep rates are suitable either for oscilloscope or recorder display. Relay contacts are included for single sweep controls of the chart recorder. An internal 800 to 1200 cps square wave generator may be selected to amplitude modulate rf output. Another model is available for 1 to 2 kmc operation.

Alfred Electronics, Dept. ED, 897 Commercial St., Palo Alto, Calif.

CIRCLE 465 ON READER-SERVICE CARD

NEW PRODUCTS

Linear Actuator

Stroke is 31 in.

Model D-1870 linear actuator has a 31 in. stroke. Normal load is 300 lb at a travel rate of 3.5 in. per sec. The electrical load sensing mechanism permits the actuator to sense, shut off, and hold a predetermined load of 500 to 800 lb. An electromagnetic clutch brake provides irreversibility within the design load range to 1000 lb with no current. Any of the three major sub-assemblies, the motor and clutch brake assembly with integral thermal protector, the junction box with electrical components or the gearbox and jackscrew, can be removed without disassembling the entire actuator. The radio noise filter meets MIL-I-6181B. The actuator operates at 28 v dc.

Hoover Electric Co., Dept. ED, 2100 S. Stoner Ave., Los Angeles 25, Calif.

CIRCLE 469 ON READER-SERVICE CARD

Silicon Diode

Has 4 μsec recovery time

The miniature model MA-4223 silicon junction diode is designed for use in computer circuits which require low capacity and fast recovery time components. When switched from the forward bias with 10 ma current flowing to a reverse bias of −5 v, its complete recovery time is 4 μsec maximum. Forward current is 50 ma dc; peak surge current is 100 ma dc; reverse voltage is 30 v dc; and power dissipation is 100 mw. The glass packaged units operate from −65 to +100 C and have axial wire leads.

Microwave Associates, Inc., Dept. ED, South Ave., Burlington, Mass.

CIRCLE 470 ON READER-SERVICE CARD

Flexible Copper-Clad Laminate

For printed circuits and cables

Made of 1-oz, electro-deposited copper foil bonded to polyester film 0.002 of 0.005 in. thick, CuFlex Lamicoid is a highly flexible laminate for flexible printed circuits, cables, and harnesses. It permits complicated, space-consuming circuits to be coiled in corners and printed cables or harnesses to be wrapped around fixed components. The laminate is 99.5% pure and designed for 130 C operation. In continuous rolls, it can be supplied in widths from 1/4 to 36 in.

Mica Insulator Co., Div. of Minnesota Mining & Mfg. Co., Dept. ED, 797 Broadway, Schenectady 1, N.Y.

CIRCLE 471 ON READER-SERVICE CARD

Clock Counter

Normal operating speed is 0.1 rpm

Type X-950 clock counter provides indications in minutes and hours for elapsed time readout applications and has a normal operating speed of 0.1 rpm at the input shaft. It has continuous and reversible operation from 0 to 2359 hours. The minute drum is graduated in increments of 0.2 min for fine readings. The counter operates at speeds to 300 rpm for zeroing purposes. The temperature range is from −30 to +71 C; at −30 C input torque is 0.75 oz-in. The characters are white, 0.25 in. high; the frame and drums are black anodized aluminum alloy.

Bowmar Instrument Corp., Dept. ED, 8000 Bluffton Rd., Fort Wayne, Ind.

CIRCLE 502 ON READER-SERVICE CARD

Electric Cartridge Heaters

Operate at 750 F

These electric cartridge heaters operate at 750 F max, 60 w per sq in., and are equipped with brass sheaths. Sizes range from 2-1/2 to 12 in. in length and from 1/2 to 1-19/64 in. in diam. The units are rated from 200 to 2800 w.

General Electric Co., Dept. ED, Schenectady 5, N.Y.

CIRCLE 503 ON READER-SERVICE CARD

Rotary Switch

Takes 1/2 in. panel space

Taking only 1/2 in. panel space, this printed circuit type rotary switch can be removed and replaced without unsoldering, or disassembling. For 10 position type TS-175, dimensions are 3/8 x 1-3/4 in. and for 20 position type TS-225, dimensions are 3/8 x 2-1/4 in. Other types can be furnished for specific requirements. A modular bank of 25 switches can contain up to 500 separate switching circuits.

Chicago Dynamic Industries, Inc., Precision Products Div., Dept. ED, 1725 Diversey Blvd., Chicago 14, Ill.

CIRCLE 505 ON READER-SERVICE CARD

CIRCLE 506 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Rectifier Assemblies

Use printed circuits

This series of printed circuit silicon rectifier assemblies are available for single- and three-phase power supply applications, in half-wave doubler, center tap and bridge circuits. The rectifiers are hermetically sealed and will operate up to temperatures of 150 C. Basic ratings are up to 3 amp dc, 800 v in a single-phase assembly, and 4.5 amp dc in three-phase assemblies. Higher voltages and currents may be obtained by putting the rectifiers in parallel or series.

International Telephone and Telegraph Corp., Components Div., Dept. ED, Clifton, N.J.

CIRCLE 508 ON READER-SERVICE CARD

Thermocouple Tubing

Ceramic

This ceramic thermocouple tubing is available in sizes down to 0.03 OD. The alumina body shows a boron content of less than 9 ppm; cadmium, less than 10 ppm; and hafnium, less than 80 ppm. Various types and shapes are available, including single and multi-bore.

Saxonburg Ceramics, Inc., Dept. ED, Saxonburg, Pa.

CIRCLE 509 ON READER-SERVICE CARD

Relay

Has 2 mw sensitivity

Designed for low power input circuits where available current is at a premium, the series 300 Microamp relay has a 2 mw sensitivity. It is field adjustable to handle currents up to 3 amp at reduced sensitivity and may be applied in high speed keying, remote control, or battery operated devices. It has a plastic dust cover and mounts on two 0.196 in. clearance holes on 2-1/8 x 2-1/8 centers.

Kurman Electric Co., Dept. ED, 191 Newel St., Brooklyn 22, N.Y.

CIRCLE 510 ON READER-SERVICE CARD

◀ CIRCLE 511 ON READER-SERVICE CARD

Time Delay Relays

Transistorized

Designed for use in printed circuits, each of these four transistorized time delay relay weighs 2 oz and measures 1.25 cut in. Time delays range between 0.05 sec and 90 sec; an increase in size will allow time delays to 950 sec. Accuracy is between ±5% and ±20%. Operating voltages are 18 to 50 v dc. Maximum power required is 50 ma, insulation resistance is 1000 meg, and life is 100,000 operations at rated contact load. The temperature range of the units is −55 to +71 C. Types 50-089 and 50-093 have straight pin terminations; types 50-087 and 50-091 employ hook pins in a glass hermetic header. The contacts for each type are rated at 2 amp.

Hydro-Aire Co., Electronics Div., Dept. ED, 3000 Winona Ave., Burbank, Calif.

CIRCLE 512 ON READER-SERVICE CARD

Static Inverter

Supplies 100 va

Model W1298-2 static inverter supplies 100 va of 3 phase ac power at 115 v per phase. The output frequency is 400 ±2 cps, with a maximum distortion of 5% at any load. Efficiency of the inverter is more than 70% with a phase balance of 120 ±5 deg. Designed to be cooled by radiation, it is capable of operating at altitudes in excess of 100,000 ft without special cooling considerations. The inverter weighs 8 lb and measures 7-3/4 x 4-1/2 x 4-1/2 in. MIL-1-7032 specifications are met.

Electrosolids Corp., Dept. ED, 13745 Saticoy St., Panorama City, Calif.

CIRCLE 513 ON READER-SERVICE CARD

Pressure Switch

Has only one moving part

Having only one moving part, model 655 pressure switch can be used to perform electrical control functions at required altitudes or pressure, to detect loss of pressure in hermetically sealed electronic equipment or in aircraft cabin pressure and oxygen demand systems. The temperature range is −65 to +150 C and the pressure range setting is 2 to 14.7 psia. The proof pressure is 0 to 35 psia; higher pressure may be ordered. Consistent performance is maintained at 0.2 amp, maximum at 28 v. The switch has two metal contacts in an evacuated hermetically sealed chamber; a thermo-setting plastic housing is used. It weighs 2.2 oz without bracket and 2.7 oz with bracket.

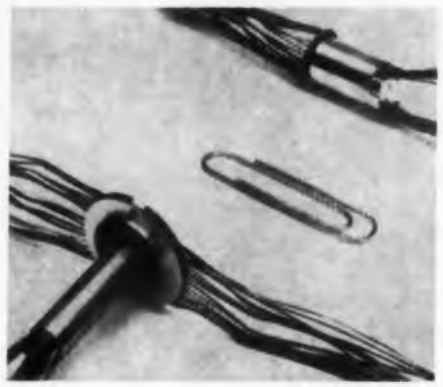
Bendix Aviation Corp., Friez Instrument Div., Dept. ED, Baltimore, Md.

CIRCLE 514 ON READER-SERVICE CARD

NEW PRODUCTS

Miniature Slip Ring Assemblies

Handle 12 to 100 circuits



Available in miniature and subminiature sizes, these cartridge-type slip ring assemblies operate from −65 to +350 F and comply with MIL-E-5400C. Noise levels are kept below 50 μv. The miniature units, under 2 in. long with 0.499 to 0.75 diam, are rated 1 to 3 amp and handle 12 to 100 circuits. The subminiature units, under 1 in. long with 0.249 to 0.499 diam, are rated 0.5 to 2 amp and handle 12 to 50 circuits. Rotors of both series are double bearing mounted.

Slip Ring Company of America, Dept. ED, 13000 S. Avalon Blvd., Los Angeles 61, Calif.

CIRCLE 449 ON READER-SERVICE CARD

Modular Control System

Transistorized

Consisting of a transistorized preamplifier, power amplifier, and module case, this modular control system has no moving contacts or relays. Circuitry for the preamplifier and the power amplifier is mounted in a compact chassis which can be slid in or out of the standardized module case by means of a connect-disconnect plug. Three input channels enable the preamplifier to be used in a control system having an input command, and rate and feedback loops. Power amplifiers drive ac and dc servo motors at up to 200 w. The preamplifier has a chassis operating temperature range of −55 to +71 C with an option to 120 C. Gain for 1 input is 200; for 2 inputs, 125; and for 3 inputs, 100. Power output is about 50 mv. The power amplifier operates in the same temperature range and has 25 w continuous power output or 50 w peak for lower load resistance. Gain is 11.

Airborne Accessories Corp., Dept. ED, 1414 Chestnut Ave., Hillside 5, N.J.

CIRCLE 450 ON READER-SERVICE CARD

Corona Test Set

Output is 0 to 10 kv rms

Model CT10-0.2 corona test set has a continuously adjustable output of 0 to 10 kv rms at 0.25 kva. The unit includes a three-scale kilovoltmeter at output terminals and a three-position scope sensitivity switch. It has zero start provision on powerstat output control. It measures 22 x 16 x 15 in. and weighs 60 lb. This unit may be used on transformers, bushings, terminals, and short lengths of cable. It may also be used for dielectric breakdown tests without disconnecting the sample being tested for corona. It conforms to military specifications.

Peschel Electronics, Inc., Dept. ED, Towners, Patterson, N.Y.

CIRCLE 475 ON READER-SERVICE CARD

Operational Amplifier

Chopper stabilized

Model D6 chopper stabilized, medium gain, wide-band dc amplifier is designed to simplify dc and ac signals and to provide power to drive direct-writing oscillographs. It has ten fixed gain settings from 1 to 1000, continuously variable gain control, and an input impedance of 100 K. Positive and negative overload indicators are included. Impedance matching of loads as low as 20 ohms with output of 100 ma is provided with model D7 high current amplifier. Model D6 is available in single amplifier units or in modules of six and eight amplifiers for standard rack mounting.

Photron Instrument Co., Dept. ED, 6516 Detroit Ave., Cleveland 2, Ohio.

CIRCLE 476 ON READER-SERVICE CARD

Square Root Circuit

Has accuracies of ±1%

These square root diode circuits have accuracies of at least ±1% of output with an input voltage of 1 to 100 v. The frequency response is from dc to 30 kc, 3 db point. Input impedance is greater than 100 K and load impedance is 1 meg or greater. A bias voltage of 12 v dc with current drain of under 10 ma is required. These circuits have applications in control and instrument systems for such purposes as extracting square roots or logarithms. When used in the correct feedback circuit of dc amplifiers, they perform inverse functions.

Plug-In Instruments, Inc., Dept. ED, 1416 Lebanon Rd., Nashville 10, Tenn.

CIRCLE 477 ON READER-SERVICE CARD

NEW PRODUCTS

Indicator Lamp

Draws under 50 ma at 1.3 v

This microminiature incandescent indicator lamp operates directly from the output of a transistor. It operates at less than 1.5 v and draws less than 50 ma. This lamp is 0.110 in. long and 0.050 in. in tliam, with two platinum leads extending from one end. Applications include computers and military electronic devices where size and low current are important.

Minitron Components Corp., Dept. ED, 67 Illinois Ave., Paterson, N.J.

CIRCLE 480 ON READER-SERVICE CARD

Recorder

Has up to eight channels

This instrument is used to record any electrical variables on up to eight channels. The oscillogram is transported on a belt along the top of the read-out table allowing the operator a full and undisturbed view of almost three feet of record. A time stamp prints the year, month, day, hour, minute, and tenths of a minute at preset intervals. The oscillogram width is up to 12 in.; its speed is from 1 to 50 mm per sec.

Gerber Scientific Instrument Co., Dept. ED, 89 Spruce St., Hartford 1, Conn.

CIRCLE 481 ON READER-SERVICE CARD

Silicon Rectifiers

High power

The series N, S, and M high power silicon rectifiers have basic ratings of 150 amp, up to 600 piv; 250 amp, up to 600 piv; and 400 amp, up to 400 piv, respectively. These ratings apply at a case temperature of 150 C. The units have low forward drop, and low reverse leakage. Uniformity is assured through the use of advanced diffusion processes, and high reliability results from conformity to stringent military and industrial specifications.

International Telephone and Telegraph Corp., Dept. ED, Clifton, N.J.

CIRCLE 482 ON READER-SERVICE CARD

Precision Potentiometer

Has a 1/2 in. diam

These precision potentiometers have 1/2 in. diam. Called the RP35 series, they have stainless steel pressure-sealed cases and stainless steel pushrods. Designed for missile actuator applications, they are available in strokes up to 8 in., with resistance values from 500 to 20,000 ohms per in. The units are able to withstand temperatures from −65 to 400 F.

Humphrey, Inc., Dept. ED, 2805 Canon St., San Diego, Calif.

CIRCLE 483 ON READER-SERVICE CARD

Electrical Heat Control

Handles 300 to 3000 w

This electrical heat control, designated Hott-Watt, is available in a range of 10 capacities from 300 to 1500 w for 110 v circuits and in 10 capacities from 600 to 3000 w for 220 v circuits. Full load flows through the circuit at all times, is shut off completely at a fixed temperature level and stops immediately with a drop of 0.5 deg F. No external probe or thermo sensing device is required. The unit includes fuse protection pilot indicating light, and is cabinet mounted.

Industrial Steam Equipment Co., Div. of Industrial Shoe Machinery Corp., Dept. ED, 5 Gaston St., Roxbury 21, Mass.

CIRCLE 486 ON READER-SERVICE CARD

Complex Wave Analyzer

Resolves harmonics from 0.5 cps to 15 kc

Model 1053 wave analyzer reduces, in real time, a complex electrical wave to the information necessary to produce a time series of power plots. This unit is capable of resolving harmonics from 0.5 cps to 15 kc. Internal timing is provided, but if the system is used with a recorder, the unit can be synchronized with external sync pulse. The input attenuator amplifier varies the input sensitivity from 1 mv to 100 v peak-to-peak.

Briggs Associates, Inc., Dept. ED, 10 DeKalb St., Norristown, Pa.

CIRCLE 487 ON READER-SERVICE CARD

Input Conditioning Module

For data acquisition systems

This transducer input conditioning module for data acquisition systems is used with any type of resistance transducer containing one, two, or four active arms. Called model 6-200B, it provides the means to calibrate out the effects of long input cables. It can be used with four- to eight-wire input cabling systems. Balance potentiometers are fitted for servo gun balancing; when used with servo gun and amplifier, a null of ±10 μv may be obtained.

B & F Instruments, Inc., Dept. ED, 3644 N. Lawrence St., Philadelphia 40, Pa.

CIRCLE 488 ON READER-SERVICE CARD

← CIRCLE 485 ON READER-SERVICE CARD

CIRCLE 489 ON READER-SERVICE CARD

NEW PRODUCTS

Power Supply

Transistorized

This 1000 w power supply is transistorized and has a continuously variable output of 0 to 600 v dc. The input is 115 v ac at 60 cps. For load variations from zero to full load and input line variations of ±10%, the output regulation is within 0.01%. Ripple is less than 3 mv rms. Maximum drift is 0.1 v over an 8-hr operating period. Made for use in ground support and checkout equipment, the unit has standard rack-console type construction.

Aerolab Development Co., Semiconductor Systems Div., Dept. ED, 330 W. Holly St., Pasadena, Calif.

CIRCLE 492 ON READER-SERVICE CARD

Amplifier

Input impedance is 1600 meg

Designed for use with crystal type transducers, type 6000 amplifier has an input impedance of 1600 meg and an output impedance of 150 ohms. Frequency response is 1 cps to 1 mc, outut voltage is 60 v peak-to-peak and output current is 2 ma peak-to-peak. The rms noise level when referred to the shorted input is 40 μv. Power requirements are 115 v, 60 cps. The unit measures 7 x 9-1/4 x 13 in.

Columbia Research Laboratories, Dept. ED, MacDade Blvd., & Bullens Lane, Woodlyn, Pa.

CIRCLE 493 ON READER-SERVICE CARD

Cavity Filter

Available from 400 to 2000 mc

Model 410 cavity filter is available for any frequency in the 400 to 2000 mc range. It is tunable over a limited range of 3 to 10% depending on center frequency. Response curve and bandwidth are about the same for any pass frequency. Power is 20 to 50 w, according to pass frequency; insertion loss is 1 db. The unit has a 3 db bandwidth over 8 mc and a 30 db bandwidth over 60 mc. It is airtight and will withstand shock, vibration, and temperature extremes. It measures 3 x 3 x 5-1/2 in. and weighs 28 oz.

Adams-Russell Co., Inc., Dept. ED, 200 Sixth St., Cambridge 42, Mass.

CIRCLE 494 ON READER-SERVICE CARD

Potentiometers

Linearity is about ±0.2%

These cylindrical rectilinear potentiometers have about ±0.2% independent linearity and high resolution. Shock, acceleration, and vibration resistance are over 50 g without opening or discontinuity. Models 3091, 3090, 3080, 3258, 3257, 3254, and 3255 are available with single or dual elements and stroke from 2.5 to 10.

Markite Products Corp., Dept. ED, 155 Waverly Place, New York 14, N.Y.

CIRCLE 497 ON READER-SERVICE CARD

Hybrid Garnet

Microwave type

Type M-062 hybrid garnet has microwave applications over a frequency spectrum of 4000 meg to several hundred megacycles. The line width is 30 oersteds at X band, the saturation moment is 670 gausses, and the Curie temperature is 180 C. It has the usual loss factor required of microwave ferrites. Standard sizes are 6 x 1 x 0.5 in., 6 x 0.5 x 0.45 in., and 6 x 0.5 x 0.25 in.

Motorola Inc., Solid State Electronics Dept., Dept. ED, 3102 N. 56th St., Scottsdale, Ariz.

CIRCLE 498 ON READER-SERVICE CARD

High Voltage Test Sets

Have both ac and dc output

The KS series of high voltage test sets have both ac and dc output with separate kv meters for dc and ac, and a common ac-dc current meter. Other features include simple control circuitry with main switch, pilot-light and hi-speed circuit breaker, continuously adjustable output, and current meter in ground lead. The meters are 4-1/2 sq in. Model KS2-50 is available with 0 to 2 kv at 50 ma and model KS50-40 with 0 to 50 kv at 40 ma, with 2 kva max capacity.

Peschel Electronics, Inc., Dept. ED, Patterson, N.Y.

CIRCLE 499 ON READER-SERVICE CARD

Dual Centrifuge

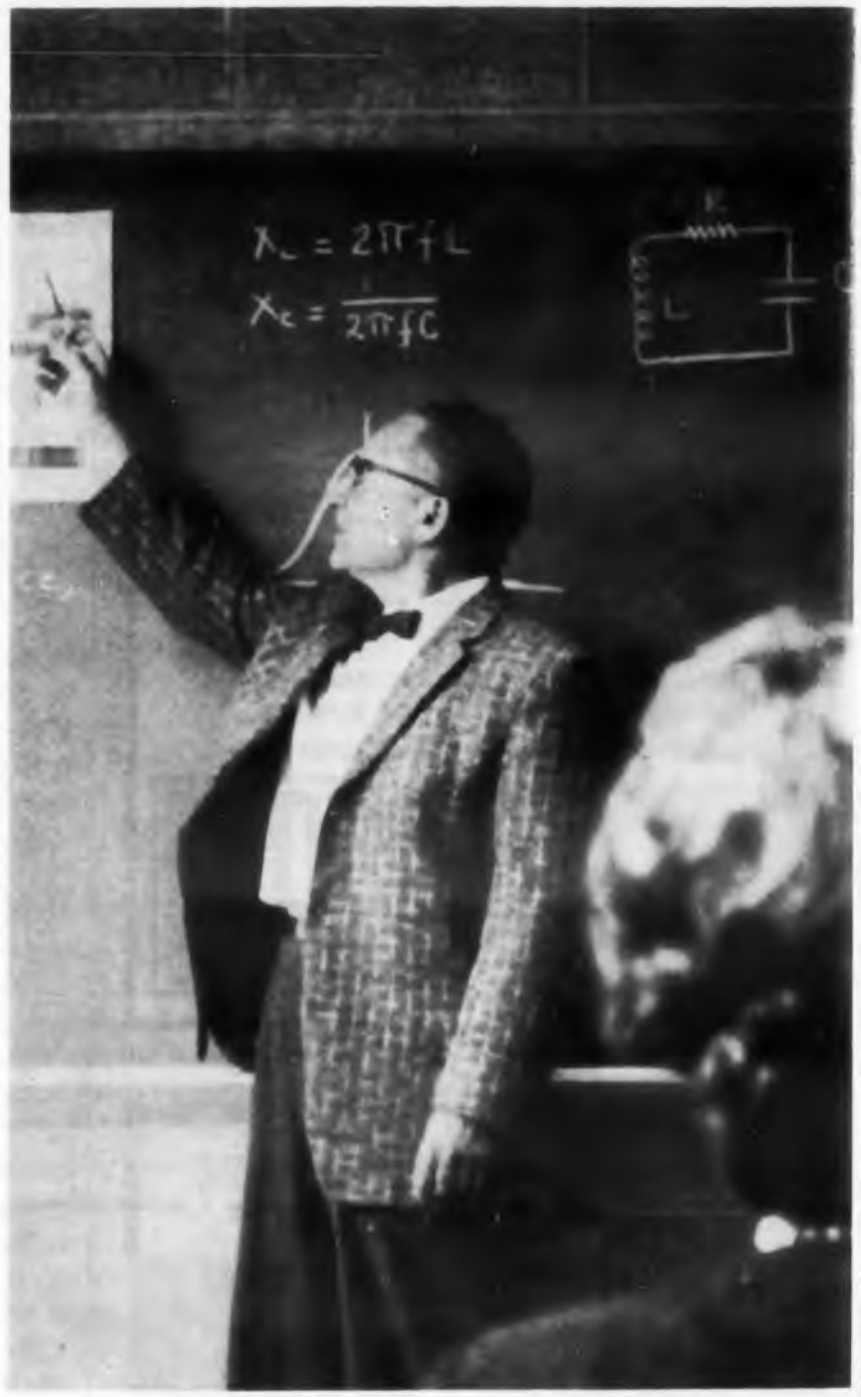
Rotary type

Model DC-3 dual rotary centrifuge generates sinusoidal accelerations at frequencies from 0 to 20 cps. The unit consists of a small satellite table mounted on a large turntable; the angular velocity of the turntable is zero while it orbits around the main spindle. The radial displacement of the satellite table relative to the main spindle is 0 to 12 in. The range of steady accelerations is 0 to 500 g. Rated load of the satellite table is 2-1/2 lb and rated load of the main turntable is 5 lb at each of 2 stations.

Schaevits Machine Works, Dept. ED, Pennsauken, N.J.

CIRCLE 500 ON READER-SERVICE CARD

The ABC Of Teaching Engineering



Joseph Leeb swings into action as a teacher.

Not every expert engineer is an expert instructor. And here is why —

When he isn't working as a project engineer (Bulova Watch Co.), spending time in Paramus, N.J., with his family (wife, three boys) or pursuing one of his hobbies (amateur radio station W2WYM photography, writing, gardening, house construction), Joseph Leeb may be found practicing what he preaches in this article. He teaches radio and television repair in the Paramus Evening Adult School.

Nor is this his first venture into teaching. During World War II he instructed in electronics in the War Industries Training Program. Besides an EE degree from Polytechnic Institute of Brooklyn he holds a diploma from the Vocational Teachers Training College, University of the State of New York.

At Bulova's plant in Jackson Heights, N.Y., Mr. Leeb designs equipment for testing electronic components, trains personnel in the use of production test equipment and sets up inspection requirements for quality control.

A BRILLIANT ENGINEER was assigned by a company to teach a course in servomechanisms. The choice seemed to be a natural: not only had the specialist attained an outstanding record, but word of his achievement had spread to his co-workers in the plant. He commanded respect. Company officials were pleased when nearly a hundred junior engineers registered for the course.

Excellent facilities were provided for the classroom, including an amplifier for the instructor's flawless diction. As classes progressed, however, it became apparent that something was radically wrong. Some students found the instructor's concepts hard to understand. Others understood, but not without difficulty: they had to consult reference books and other outside sources to keep abreast of the lessons. Some merely found the company expert boring. Students dropped out.

Toward the end of the course, the instructor announced that he would give a written examination at the following session of the class. Only seven students showed up for the test. Five left after reading the questions, and only one of the two who took the test handed in his paper.

The instructor was chagrined, the company embarrassed. But the lesson would be clear to any educator: outstanding engineers—or specialists in any non-educational field—do not necessarily make outstanding teachers. Some persons have great stores of knowledge but cannot convey it clearly to anyone else. Others with limited knowledge and a knack for filling in the gaps can teach and inspire their fellow men. The critical determinant is not knowledge of the subject alone but knowledge also of teaching.

What A Good Teacher Does

The capable instructor knows the established principles of learning and applies them in the classroom. Among his methods, he:

- Establishes clear goals that he intends to reach through his instruction.
- Molds teaching methods to facilitate achievement of these goals.
- Motivates the students so they are receptive to learning.
- Presents the subject clearly, a step at a time.
- Helps the students link new material to what is already familiar.
- Gives extra help to students who are having trouble learning.
- Repeats assignments to enable students to acquire skills through habit.
- Keeps tabs on the progress of his students and reviews material that they have not fully grasped.

Rules for Good Teaching

There are simple general rules for good teaching of engineering. They can be stated as follows:

Determine the level at which the instructing is to be done. Is it intended for the mathematically inclined engineer or physicist, for the practical man, or for the sales engineer? Even with a homogeneous group, the instructor will do well to probe the background of his students with a series of carefully chosen general questions. The responses will prove invaluable for establishing a common ground for the ensuing lessons. The educator's technical term for this introductory maneuver is Determining the Apperceptive Mass.

Before presenting the subject, prepare the student's mind by linking the new material to something he already knows. For example, if the lesson is on servo motors, it would be wise to begin with a brief review of electric motor operation. This step is called, logically, Preparation.

Unfold the subject step by step, beginning with the simple and working toward the complex. Maintain smooth continuity between steps. Information should be elicited from the students with skillful oral questions; it helps, too, to have the responses written on the blackboard by one of the students rather than by the instructor. Class participation is a wonderful stimulant to learning in this stage, called Presentation.

List applications of the newly imparted facts. Tell how servo motors are used in industry, if

DESIGNING YOUR FUTURE

Key Principles of Learning

Psychologists and educators recognize that learning is accomplished easiest when certain established principles are utilized. Here are some major ones:

- We tend to learn best by doing.
- We learn faster when the experience gives us satisfaction.
- We learn one thing at a time.
- We relate new concepts to those we already know.
- We are stimulated through the senses—hearing, sight, touch, taste, smell.
- We learn when we are mentally and emotionally ready to learn.
- We learn thoroughly when we understand what we learn.
- We differ in the speed with which we assimilate new ideas.

that is the subject. This portion of the lesson is called Application.

Test the students to gage the success of the teaching. An engineer who designs and builds a piece of equipment can be sure of its success only after testing it. Likewise the instructor must examine students on the salient points of the lesson. This is the Testing phase.

A Summary, written on the blackboard, completes the lesson. And an assignment for the following meeting of the class will furnish a link to restart the educative cycle.

Six Ways to Fail

Getting back to the brilliant engineer who conducted a course in servomechanisms, we now can say that he failed as a teacher because:

1. He made no attempt to determine the background of the students in relation to the course.
2. He did not define the basic terms of the subject.
3. He presented the subject on too high a plane for most students.
4. He proceeded at too fast a pace, demonstrating formulas on the blackboard and erasing them before the students could copy them.
5. He gave too few applications of the principles he presented.
6. He did not solicit answers to questions as he went along. ■ ■

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Recent Special Training _____

Employment History

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Outstanding Engineering and Administrative Experience _____

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Minimum Salary Requirements (Optional) _____

Use section below instead of Reader Service Card. Do not write personal data below this line. This section will be detached before processing.

Circle Career Inquiry numbers of companies that interest you

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925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949

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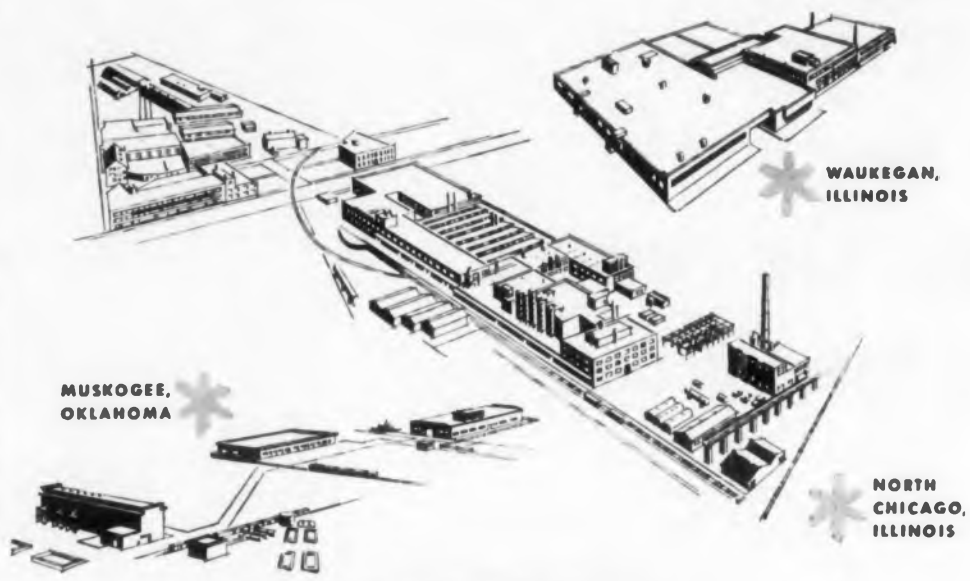

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YOUR CAREER
NEWS, NOTES, NOTIONS

The rugged individualist, a vanishing breed in much of America, is losing further ground as a leader in business organizations, according to a Stanford University psychologist. The psychologist's views, presented in a paper at WESCON in San Francisco, may offer a plausible explanation for the "they" concept of leadership in industry. (Ask any employe why he is performing a task the way he is, and he will say "they" want it done that way. But few employes have been able to discover who "they" are.)

"The trend of management has been to remove as many of its decisions as possible from the area of hunch and intuition to that of rational calculation," the psychologist, Alex Bavelas, reported. "More and more, organizations are choosing to depend less on the peculiar abilities of rare individuals, and to depend instead on the orderly processes of research and analysis. The occasions and opportunities for 'personal' leadership in the old sense still exist, but they are becoming increasingly rare and circumscribed."

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That is not to say that the role of personal leadership has been abolished, Mr. Bavelas concedes. But he believes the new emphasis has "significantly redefined it."

"Under normal conditions of operation," he says, "leadership in the modern organization consists not so much in the making of decisions *personally* as it does of maintaining the operational effectiveness of the decision-making systems which comprise the management of the organization.

"The picture of the 'leader' who keeps his own council and in the nick of time pulls the rabbit out of the hat is out of date. The popular stereotype now is the thoughtful executive discussing 'in committee' the information supplied by a staff of experts. In fact, it may be that the brilliant innovator, in the role of manager, is rapidly becoming as much an organizational embarrassment as he is an asset."

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Trait studies of leaders, based on physical, intellectual and social characteristics, show that such persons tend to be brighter, better adjusted psychologically and inclined to display better judgment, the psychologist notes. In social be-

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CAREER NEWS

(Continued from page 159)

havior, leaders have been found to "interact" more highly than non-leaders. They tend to give more information, ask for more information and take the initiative in summing up or interpreting a situation, Mr. Bavelas says.

But these personal traits of leadership, he cautions, are tempered by the environment:

"The degree to which an individual exhibits leadership depends not only on his characteristics but also on the characteristics of the situation in which he finds himself."

Thus:

"A man who shows all the signs of leadership when he acts as the officer of a well-structured, authoritarian organization, may give no indication of leadership ability in a more fluid 'democratic' situation.

"A man may become immediately influential in a situation requiring deliberation and planning, but show little evidence of leadership if the situation demands immediate action with no opportunity for weighing alternatives or thinking things out.

"A man may function effectively and comfortably in a group whose climate is friendly and cooperative, but retreat and become ineffective if he perceives the atmosphere as hostile."

Thus company environment can foster or hinder personal leadership.

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The trend toward calculated, well-organized decisions, based on research and analysis, is reasonable on the surface, Mr. Bavelas admits. Efficiency has become a byword in industry and has contributed to technological advances. But the trend "conceals two serious dangers," the psychologist warns:

"First, we may be systematically giving up the opportunity of utilizing the highest expressions of personal leadership in favor of managerial arrangements which, although safer and far more reliable, can yield at best only a high level of mediocrity.

"And, second, having committed ourselves to a system which thrives on the ordinary, we may, in the interests of maintaining and improving its efficiency, tend to shun the extraordinary.

"It is no accident that daring and innovation wane as an organization grows large and successful. On different levels, this appears to have been the history of men, of industries, of nations and even of societies and cultures." ■ ■

ADVERTISERS' INDEX
September 30, 1959

IDEA

Quantizing Photographs—electronic surveillance pictures are a source of information, but the usefulness of such information when transmitted over long distances depends upon the faithfulness of the data link. Amplitude modulation, as the data-link approach, cannot be relied upon as signals are oftimes attenuated to almost useless levels.

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