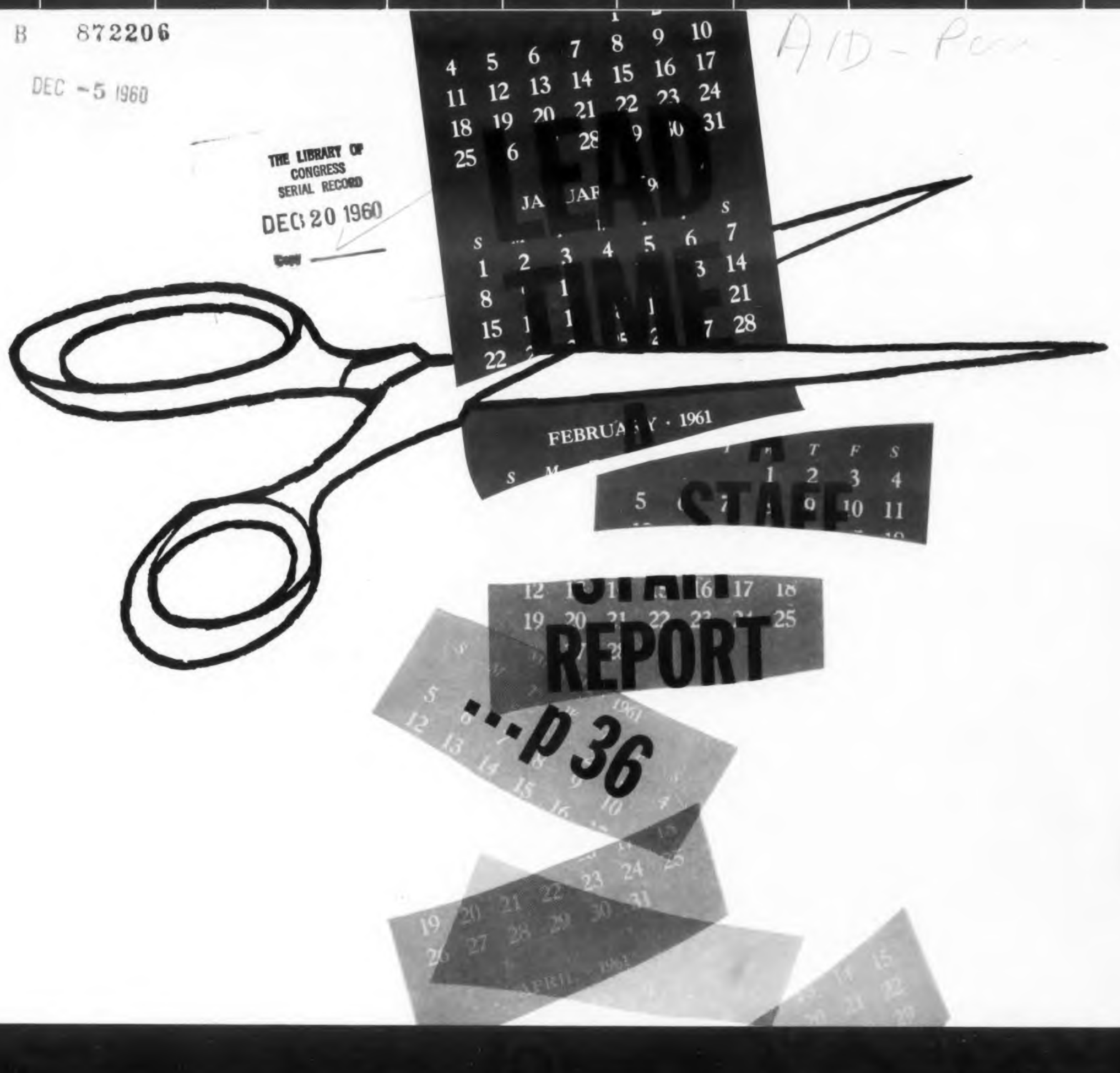
ELECTRONIC DESIGN



COVER: Not only the healthy state of competition in the electronic industry but survival of the whole free world may depend on cutting lead time between the concept of a design and its delivery to either the military or the private customer. The scissors cutting the calendar on the cover illustrate the ideal; how to achieve the ideal is explained in the story, which begins on p 36.

Selected Topics In This Issue

Sidelights of the Issue

Short and Happy

Shortening lead time is a touchy subject to the design engineer, but whether he likes it or not, the short-lead time project is becoming a fact of cold war preparedness.

ED's suggestions for getting better stuff out the back door quicker come from a survey of industry firms who have achieved reputations (and, in some cases, financial success) for doing just this. Rather surprising, it was noted that what looked like private tricks from a distance dissolved into "common sense in high gear," the closer one got to these firms.

Most noticeable was the manner in which short lead time pressures blurred the usual organizational distinctions, particularly the distinction between engineering and management.

Finally, it was noted that it may be just possible that despite the avowed dislike of engineers at being hustled through their design jobs, that a higher level of technical achievement may be arrived at through shortened lead times than through some of the red-tape laden conventional lead-time projects which drag on so long that all concerned tend to lose respect for each other and the project, "whatever it was."

There appeared to be a special pride of accomplishment in the short-lead-time firms, a conviction that though they were going at tremendously accelerated rates, they were doing honest technical jobs.

The Road Ahead

The electronic industry, like the rest of the world, is watching and wondering about what 1961 will bring. Cautious optimism is generally the watchword, according to an ELECTRONIC DESIGN survey of all segments of the industry.

During these waning weeks of 1960, *ED*'s editors have been checking all facets of the electronic industry and have come up with some interesting conclusions.

Watch for them in the issue of Jan. 4, 1961. In a report entitled "The Look Ahead to '61," ELECTRONIC DESIGN will show in detail what the top forecasters see for the months that lie ahead.

CONTENTS FOR DECEMBER 7, 1960 VOL. 8 NUMBER 25

Coming Next Issue

In the issue dated Dec. 21, ELECTRONIC DESIGN will inaugurate the first of its regular MicroWaves sections detailing news and features of developments in this expanding and highly important field. The first MicroWaves section will contain an article entitled "Design Approaches in Tomorrow's Microwave Sources," another entitled "Multiresonator Directional Finder Uses Strip Transmission Line," together with new products and news of the field. The regular MicroWaves section will appear henceforth in every second issue of ELECTRONIC DESIGN.

ELECTRONIC DESIGN

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Tunneltron May Be New Basic Component

Superconductivity, Tunneling, and Negative Resistance Are Combined in a Single New Experimental Device

A NEW basic electronic component may result from research under way in at least two organizations. Developed so far is a simple thin-film device that operates at cryogenic temperatures and exhibits superconductivity, tunneling and negative resistance. Because the three phenomena have been combined in one device, designers may have, by 1965, a basic component that could function as a switch, resistor, capactor, diode, triode, or negative-resistance diode.

This estimate was made by scientists of the General Electric Research Laboratories, Schenectady, N.Y., in reporting on how they achieve tunneling in superconductive devices. Researchers at Arthur D. Little, Inc., Cambridge, Mass., report they have independently achieved tunneling and negative resistance in similar devices, which they call tunneltrons. The ADL researchers believe tunneltrons will prove compatible with other low-temperature devices such as cryotrons.

In both GE's and ADL's devices tunneling takes place through a nominal dielectric rather than through the charge-depletion region of a semiconductor junction, as in the tunnel diode. In the thin-film device, the amount of negative resistance present can be controlled.

The basic device consists of a thin-film strip of aluminum evaporated or deposited through a mask onto a glass substrate. A naturally thin coating of oxide is allowed to form on the strip by exposure to air for a few minutes. ADL reports dielectrics other than aluminum oxide have proved practical as insulators, and that researchers are no longer limited to aluminum oxide. After the dielectric is deposited, a strip of lead is deposited across the first strip. This forms a capacitor-like sandwich of conducting aluminum and lead with a filler of insulating aluminum oxide. The area where the strips cross, in GE's experimental devices is about 1 mm sq.

Because the insulation film is only a few atoms in thickness (about 10^{-7} in.), the sandwich has unusual properties. If potential is applied between the two films, current will tunnel through the thin layer of aluminum oxide dielectric. The number of electrons that get through is a function of the thinness of the insulation and is related linearly to the applied voltage.

However, at temperatures between 1.2 and 7.2 K, the lead side of the sandwich becomes superconducting and the linear relationship no longer holds. At very low potentials, waves of conduction electrons at energy levels corresponding to certain electron densities of state in the superconductor are not accepted from the aluminum film, and are, in effect, reflected by the

NEREM Stresses Research Progress Reliability

Optical Communication, Super-Microwave Power Among Other Topics of Chief Interest

DESPITE reports on a very broad range of research progress, attention continually turned back to reliability during the recent 1960 North east Electronics Research and Engineering Meeting in Boston.

Interest was high at sessions on optical communications (*ED*, Nov. 23, p 4), microwaves including super-power generation, power sources, microminiaturization, and reliability engineering.

Everywhere, it seemed, there was urgent talk of reliability. This happened not just in the sessions billed as reliability conferences, but in the keynote address, in the booths, and in papers and meetings covering entirely different topics.

Rear Adm. Rawson Bennett, Chief of Naval Research, emphasized the importance of sound and simple engineering in this way: "The enemy said he would bury us. He did not specify the method. We may be entombed in beautifully over-engineered, complex systems, frantically shooting trouble as the wave of the future rolls over us."

During the evening, the panel discussion entitled "New Frontiers In Space Electronics," was embroiled a full hour in a discussion of reliability. Flat statements of viewpoint were heard, such as "miniaturization and reliability are opposed," "I don't believe in random failures," and "statistical reliability figures are really a figure of ignorance of the causes of failure."

Each of these was countered by an equally flat and diametrically opposed viewpoint. The only point of agreement was that from now on, progress toward more sophisticated systems will be possible only if the reliability barrier is overcome.

The air was lightened considerably when one panel member asked, "I hope there are no members of the press present, but have we ever found Explorer VI?" Even here, there was a difference of opinion of the fate of the long lost satellite. Was it burned up or is it still orbiting undetected?

IR Device to Find Vehicle Orientation; Understood to Be for Mariner Shots

An infrared system now under development for determining orientation of a space vehicle with respect to a planet was described at an IR session.

The IR device, in early development by Barnes

Experimental thin-film device that shows tunneling, superconductivity, and negative resistance is held by General Electric's Ivar Giaever, who made first experiments with it. Crossed strips are aluminum and lead separated by a dielectric of aluminum oxide. Leads are indium to hold circuit to glass substrate.

lead ordinarily contains no electrons at the critical levels of its energy gap. Therefore, because no electrons of certain low- and narrow-range energy levels are accepted by the superconductor, application of correspondingly low voltages does not cause significant current flow.

When a voltage, high enough to boost the electrons past the range of the energy gap, is applied, current flows into the superconductor. The current increases roughly in proportion to the voltage.

A third effect results when both sides of the

(continued on p 6)

Engineering Co., Stamford, Conn., is understood to be part of the instrumentation for the Mariner series of interplanetary probes expected in 1962.

The IR device, for use during the terminal phase of a mission, consists of two counter-rotating prisms which direct radiation toward a thermistor. The thermistor's small field of view is swept through a four-lobe rosette pattern 70 deg across. During an acquisition phase this pattern is rotated until one of the lobes intercepts the sharp thermal discontinuity between the planet's horizon and empty space.

At this time rotation of the rosette pattern ceases, and the pulses generated each time the thermistor field of view sweeps across the horizon are used to derive pitch and roll information. ■ ■

sandwich are made superconductive. Below 1.2 K, where aluminum as well as lead is superconducting, there is low-current flow as before at low voltage and roughly proportional flow at higher voltages. But at certain voltage levels in between, the current decreases with increasing voltage. This is the negative-resistance effect associated with tunnel diodes. Plots of voltage against current for lead-aluminum thin-film superconducting sandwiches show the characteristic S-bends of similar tunnel-diode curves.

A fourth useful electronic effect has been observed in the device by Ivar Giaever, who performed the first experiments in superconductive thin-film tunneling.

Mr. Giaever believes that operation of the devices he is working with could be controlled usefully by applying a strong enough magnetic field to them. A strong field, he reports, changes one or both of the films from superconducting to normal, with corresponding changes occurring in the voltage-current-resistance relationships. Use of the field would be similar to that in the cryotron.

Practical devices resulting from the current research efforts would operate at millivolt levels, would be almost noiseless, would use very little power, dissipate very little heat and could be made very tiny, states General Electric. Possible devices include:

- **Switches:** Current flow through a normal-state tunneltron could be made to increase by factors on the order of 100,000 by turning both conductors superconductive with a magnetic field. Therefore, the devices could be used as low-power, high-switching-factor switches.
- **Diodes.** The device has the nonlinear characteristics desirable in a diode. By keeping one side of it normal while making the other side superconducting, current could be made to flow in only one direction.
- **Negative-resistance diodes.** By operating both sides of the sandwich in a superconducting state, the device could be made to exhibit negative resistance. Many combinations of thin-film metals and intermetallics are believed capable of showing negative resistance. GE has worked with aluminum-aluminum, aluminum-tin, and aluminum-indium. Mr. Giaever believes he can also achieve the effect with tantalum and niobium. Such a device is predicted to operate at temperatures above 4 K, which is much more practical than liquid-helium temperatures. Unlike the tunnel diode, a thin-film negative-resistance cryogenic diode would operate independently of of the direction that current flows through the device. This fact is considered very important

by the Arthur D. Little researchers, who are concentrating on components in which both sides of the sandwich are superconducting.

▪ **Triodes.** A magnetic field could modulate current flow through the insulating layer by making one or both conductors superconducting. GE reports that current flow through an aluminum-dielectric-lead sandwich was made to increase by a factor of 100,000. At a temperature of 1 K and a voltage of 0.2 μv, current increased from 0.1 μa to 10 ma as the surrounding magnetic field was increased from 0 to 1,000 gauss. At 1,000 gauss, superconductivity of the metals involved was destroyed. As the field strength increases or decreases, the characteristics of such a device changes greatly. Tunneling activity, negative-resistance values and the superconductivity of first one and then the other side of the sandwich are all affected by the changing field strength.

▪ **Resistors.** At room temperature, current and voltage in the thin-film device are related linearly, so it may be used as a small-signal resistor.

▪ **Capacitors.** The device is essentially a capacitor, and must remain one, because it is formed of two conducting surfaces separated by a dielectric. Capacitance in the device could be increased by increasing the area of its surface.

General Electric representatives speculate that if the device and the techniques for making it are perfected, whole circuits for oscillators, amplifiers, and other subassemblies could be deposited in a few simple steps to make tiny, low-power, inexpensive assemblies. The devices would probably be stacked, rather than laid out alongside each other. The sandwiches being made now are only about 10^{-5}-in. thick. The small amounts of heat dissipated would be relatively easy to handle because the assembly would be operating in a controlled cryogenic environment.

The magnetic fields could be applied to individual sandwiches by deposition of a girdle of conducting film, such as niobium, as ADL is doing, or by other means. ADL reports that it is also applying fields through a grid laid on the sandwich. General Electric scientists are thinking of using the girdle method, they report.

Anticipated disadvantages of the device are its dependence on near-absolute-zero temperatures; the need to add conventional inductive elements to circuits that need them because no way to achieve induction in the device has as yet been found; and a relatively low frequency limit, imposed by the capacitor-like nature of the device. The sandwich would have to be made very tiny to operate at high frequencies, GE scientists say. They believe the new devices would be used in special circuits rather than as substitutes for conventional components. ■ ■

Microwave Gains Key Magnetics Conference

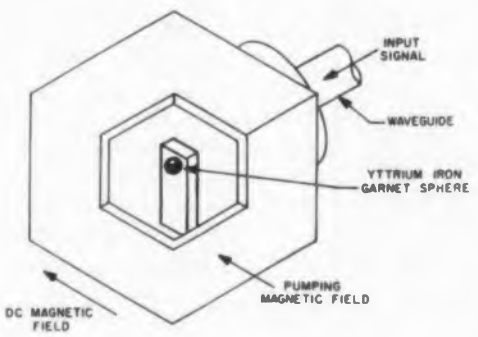
Bell Labs Building Magnetic Logic Computer; Millimetric Components Use Antiferromagnetics

ALL-MAGNETIC computers and advanced microwave devices resulting from magnetics research were high points of the few equipment-oriented sessions at the Sixth Annual Conference on Magnetism and Magnetic Materials in New York.

Others papers in the primarily theoretical meeting dealt with basic magnetic phenomena, fundamental properties of thin films and ferrites, and magnetic materials of special interest.

The chief advantages to be found in all-magnetic logic in comparison to semiconductor circuits, according to BTL's Dr. Gianola, is radiation resistance and high reliability. Both of these factors are of vital importance in space or satellite missions, he pointed out, so that use of magnetic logic should be seriously considered.

Bell Labs is building a military computer using 1,600 transfluxors in the logic section, he disclosed. Two pulsers, using pnpn controlled rectifiers, provide pulses of about 1 or 2 sec, at currents of about 2-3 amp and voltages of about 200-300 v for each pulser. Bit rates of about 100 kc are expected.



Quartz walls surround the cavity in this sketch of the Bell Labs ferrite parametric amplifier. A loop couples the signal to the YIG sphere, which is supported by a Teflon bulk block to avoid interference from the walls.

In another report, Roger H. Tancrell of MIT's Lincoln Laboratories described a technique to achieve flux gain in magnetic-logic circuits by using inherent properties of low-coercive-force ferrite cores rather than the conventional-turns ratios. A constant low-amplitude dc current, below that required for switching, is applied to the saturated cores in the logic circuits. When switching takes place, a high-current, short-duration impulse is applied to a selected core, lowering the coercive force and thereby allowing the dc current to continue the switching action.

The output of the selected core can then be used to initiate switching of another core.

Describe MM-Wave Components, YIG Paramp, at a Device Session

A family of antiferromagnetic components for operation at millimetric and submillimetric wavelengths were reported at a microwave-device session by G. S. Heller, J. J. Stickler and J. B. Thaxter of Lincoln Laboratories.

Devices such as resonance isolators, circulators, and phase shifters, with figures of merit comparable to those for ferrite devices at conventional microwave frequencies, should be possible using antiferromagnetic materials.

High internal magnetic fields of these materials cause them to have resonance frequencies in the millimeter and submillimeter region.

Control of materials properties is progressing, according to the Lincoln Labs researchers. Research on aluminum-substituted chromic oxide, for instance, indicates the possibility of tailor-making materials for the 2-mm region by varying internal fields.

Figures of merit for a resonance isolator made with chromic oxide

were described as being "almost good enough for a commercial item."

In another paper at the microwave device session, a parametric amplifier using yttrium-iron-garnet as the active material was described by Dr. R. T. Denton of Bell Labs.

Amplification at 5,000 mc was achieved using about 1/2-w of parametric pumping power at 9,000 mc, according to Dr. Denton. The amplifier was also operated at liquid nitrogen temperatures.

The pumping magnetic rf field in the amplifier is applied longitudinally to an applied dc field. Previous work on such devices, Dr. Denton commented, has been with transverse, pulsed fields.

A YIG sphere about 42 mils in diameter, with line width of about 0.3 oersted, is attached to a Teflon bulk block in a cavity in the Bell Labs amplifier. The ferrite material is resonated at a pair of magnetostatic modes, giving, in effect, a pair of resonant circuits coupled by a time varying reactance.

Noise was found to be rather high at both room and liquid-nitrogen temperature, according to Dr. Denton. However, since the figure was lower at the low temperature it is felt that much of the noise is thermal in origin. The YIG material heats up during operation because of the dissipation of power developed internally by spin-waves.

If the major portion of the noise is due to the spin-waves themselves, then there is nothing that can be done to eliminate it.

A Hughes Aircraft Co. researcher in the audience reported that his company had built a similar YIG parametric amplifier, using a heat sink to achieve a lower noise figure. Noise still remained high, however, indicating that spin-waves are a primary noise source. Since spin-waves are always excited before magnetostatic modes as a pumping field is applied, there does not seem to be any way to solve the problem without resorting to some alternate mode of operation, he said, such as using semi-static modes. ■ ■

CIRCLE 9 ON READER-SERVICE CARD ➤

NEWS

Subsurface Atom Blasts

Seismic Data Will Be Recorded By Extensive Electronic Equipment

THE FIRST seismological observatory for detection of underground nuclear tests has begun operation near Fort Sill, Okla. The new Wichita Mountains Observatory, the largest installation of its kind, is completely equipped with electronic gear to detect, measure, amplify and record seismic data.

The instrumentation includes a phototube amplifier for each of the 21 seismometers at the site, remote calibration gear, timing system, data routing equipment, and tape and film recorders. Much of the equipment was developed by the Geotechnical Corp., Garland, Tex., which will manage the $200,000 installation under the Advanced Research Projects Agency's VELA Uniform project (*ED*, July 20, p 38).

Phototube Amplifiers' Dynamic Range Exceeds 70 Db

The phototube amplifiers have a dynamic range of more than 70 db and an internal noise that is less than the thermal noise of the seismometer pickup coils. Seismometer output deflects a mirror galvanometer in the amplifier so as to vary the light intensity on two photocells in accordance with the magnitude of the earth tremors. To improve linearity of the system, the optics are designed so that, as the galvanometer deflects, the light does not change its position on the photocells.

The timing system includes a WWV receiver, a radio time signal converter, and a transistorized, crystal-controlled oscillator. Timing marks are automatically inscribed on the film and magnetic tape records.

Seven-Track For Recorder Has Response of 0-20 Cps at 0.3 Ips

Tapes are recorded on a seven-track fm recorder. Response is zero to 20 cps at 0.3 ips. A 14-track recorder and equipment to record several channels in digital form is to be added later.

Three 16-channel film recorders are also included. These contain automatic developing tanks so that records can be continuously examined.

Preliminary analysis of seismic events will be made directly off the film. Selected portions of the taped records can then be subjected to detailed spectrum analysis. Traces from several seismometers can be recorded side by side and

To Be Monitored Here

Control center of the 21-seismometer underground-bomb detection station. Seismic signals are monitored on two chart recorders in center and can be routed to magnetic tape and photographic recorders via patch board. Console also includes timing and remote calibration system for the seismometers.

compared for signal-to-noise ratio, phase shift, amplitude, frequency content, and the like.

The station was designed in accordance with recommendations by the 1958 Geneva Conference of Experts, and represents the first systematic attempt to determine the feasibility of detecting underground nuclear tests. ■ ■

New Photoemissive Material Aids Sight of 'Electronic Eyes'

A new photoemissive material that permits "electronic eyes" to operate at high temperatures has been developed by the Westinghouse Electric Corp.'s Electronic Tube Div., Elmira, N.Y.

Chief advantage of the new photo-emitter is its ability to function efficiently for long periods at temperatures twice the range of present types. In addition, its high sensitivity allows it to operate at low light levels.

Westinghouse researchers report that tests on the new material show excellent stability when operated as long as 140 hr at 120 C. Other photoemissive surfaces begin deteriorating at about 60 C and they suffer a large loss in sensitivity after 100 hr at the 120 C level.

Tiros II Features IR Radiometers

Latest Satellite Combines IR Measurements With Photographs Taken by Vidicon Cameras

Tiros II is mounted in a spherical cage for test of new magnetic orientation-control system which adjusts axis tilt.

Unique two-channel radiometer weighs only 1.5 oz, requires 50 μw for operation. It measures earth's efficiency in reflecting solar radiation.

A PAIR of infrared radiometers extends the meteorological value of the orbiting Tiros II satellite far beyond that of the first Tiros.

The newest weather-observation satellite contains a two-channel and a five-channel radiometer in addition to wide- and narrow-angle 0.5-in. vidicon cameras similar to those in Tiros I.

The infrared instruments, and an IR horizon sensor similar to the one in the first Tiros, were built by Barnes Engineering Co., Stamford, Conn. Radio Corp. of America, which built both satellites for the National Aeronautics and Space Administration, provided the TV cameras.

The five-channel radiometer will measure intensity of infrared radiation in five spectral bands, allowing simultaneous observation of a variety of meteorological parameters.

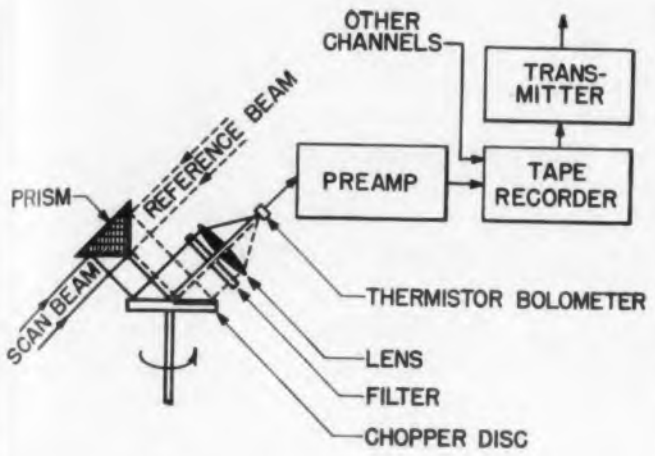
Unit Uses Space Radiation As Reference for Data-Gathering

This unit operates as shown in the diagram, using the radiation received from space as a reference. One side of a prism is directed into space, where temperature is essentially constant, and the other is directed toward the face of the earth.

A rotating mirror, which has half of its surface coated with an infrared absorbent paint, has the reference beam directed at half of its surface and the radiation being measured directed at the other half. Rotation of this mirror chops the input to the thermistor-bolometer sensor, so that the amplitude of the resulting ac signal gives a measure of the difference between the reference and observed radiation.

Five channels, each operating in this manner, have their output amplified, rectified, and stored on magnetic tape for playback on command.

The two-channel radiometer has been tucked into a 1.5-oz package, and requires 50 μw for operation. Two thin plastic cones, coated with aluminum on one side and gold on the other, direct received radiation toward two thermistor flakes fixed at the focal points of the cones. One of the thermistors is coated with a material which absorbs infrared radiation and reflects visible light. The other thermistor absorbs all radiation received. Comparison of these values permits



Radiation from space (dotted line) is used as a reference for radiation from earth in the five-channel radiometer. Each of the five channels operates in this manner although frequency range is different for each.

computation of the ratio of infared energy reflected by the earth to the total solar radiation received by the earth.

Magnetic Field Effects on Tiros I Used to Control Tilt on Tiros II

Unexpected effects of the earth's magnetic field on Tiros I caused the satellite to tilt gradually away from the predicted position of its axis in space. In the new Tiros this effect is being turned to good advantage in controlling axis tilt.

A 250-turn coil of wire around the lower sides of the cylindrical satellite will interact with the earth's magnetic field. The current through the wires can be varied by ground observers, allowing them to delicately readjust the angle of tilt of the satellite's axis. This permits better photographs to be obtained or solar cells to be put in a more favorable position.

To develop this technique, RCA engineers built a spherical test cage which can be used to duplicate the magnetic environment around the satellite in space. Lights are used to simulate solar energy that would reach the solar cells. Rotation of the actual satellite in this test cage permitted accurate simulation, so that results of the technique could be evaluated.

The magnetic orientation-control system was conceived and built by a group headed by Warren P. Manger, engineering manager for vehicle dynamics on the Tiros project for RCA.

Five radio transmitters will relay tape-stored or direct from the orbiting Tiros II on command from the ground.

(continued on p 14)

NEWS

Wavelengths and Functions For Five-Channel Infrared Radiometer

Channel	Wavelengths, Microns	Function
1	6.3 ± 10 per cent	Strong, water-vapor emission
2	0.55 to 0.75	Visible range, gives reference for IR channels
3	0.2 to 5.5	About 99 per cent of solar radiation
4	7.5 to 30	Earth's total emission
5	7.5 to 12	Atmospheric window. Measures earth or cloud cover temp.

The TV photographs will be relayed by two 235 mc transmitters providing output of about 2 w. A 237.8 mc transmitter will telemeter data gathered by the infrared instruments. Two 30-mw tracking beacons will operate continuously on 108 and 108.03 mc.

The beacon frequencies will be modulated by ground command to relay satellite environmental data such as temperature, pressure, and battery charge. Both frequencies carry the same data for back-up purposes.

Power for the instruments and the transmitters will be supplied by 63 nickel-cadmium batteries which are fed by 9,260 solar cells. Power conservation is expected to average about 20 w.

The satellite weighs about 280 lbs and measures 42 in. in diameter and 19 in. high. ■ ■

12-Gc Radio Transceiver In Production at Motorola

A 12-Gc transceiver designed for private, point-to-point radio services has entered production at Motorola, Inc., Chicago. Announcement of the new equipment comes in the wake of a recent FCC decision requiring that all Business Radio Service channels be placed above 10 Gc.

The Motorola unit, labeled MR-40, is a 0.5-w, klystron-driven system providing duplex, broadband radio service suitable for very high speed data transmission. The MR-40 can also carry voice, facsimile, teleprinter, and control signals. It can be multiplexed to handle 600 or more

channels of various types of intelligence simultaneously.

Under its old policy of restricted authorizations, the FCC had licensed less than 3,000 private microwave stations. These were limited to right-of-way companies such as railroads and pipelines and to government aviation agencies. The new FCC ruling extends licensing privileges to manufacturing concerns, truckers, and any other legitimate commercial activity or institution. In view of this potential for growth, EIA has predicted that there will be 18,000 microwave stations in use by 1976. Motorola spokesmen indicated that, "The MR-40 is expected to be a major growth item for the company's microwave organizations."

MR-40 microwave transceiver for 12 Gc is klystron-driven. Manufacturer predicts rapid growth of microwave business radio as result of new FCC policy.

Research-Missile System to Spur Advanced Concepts

Generalized Army Missile System to Cut Lead Time in Modernization; Improved Fuze System to Include 2-D Circuits, Self-Actuating Battery

Robert Haavind
News Editor

LAG TIME in adapting new electronic advances to operational tactical missiles may be cut significantly by an Army program to develop a generic tactical missile weapon system incorporating latest technological advances.

This "generalized system" approach to updating tactical weapons may provide a model for future major industrywide systems modernization programs. At least some of the techniques evolved should prove valuable in cutting lead time in project design stages (see p 36).

The electronic portion of the tactical system is being handled by the Army's Diamond Ordnance Fuze Laboratories, Washington, D. C., under its Copperhead fuze program. The over-all modernization program is being directed by the Army Ordnance Corps. Many phases of missile design, including mechanical, ballistic, propellant, aerodynamic, warhead, electronic, and guidance portions, are being integrated in development of a total tactical-weapon system.

When DOFL's fuze portion is completed, the integrated design will be applicable to many tactical missile systems, with only minor changes necessary to meet the geometric requirements of a particular missile.

It is generally agreed that present operational missiles lag about five years behind the current state-of-the-art in electronics. This occurs, it is felt, because of the necessity for complete redesign if a major improvement is added. This holds back use of new concepts because of the high costs involved, and when redesign does take place only a limited number of new ideas are incorporated. Furthermore, the new techniques are seldom well integrated into the total system.

Copperhead Fuze to Include Many Electronic Advances

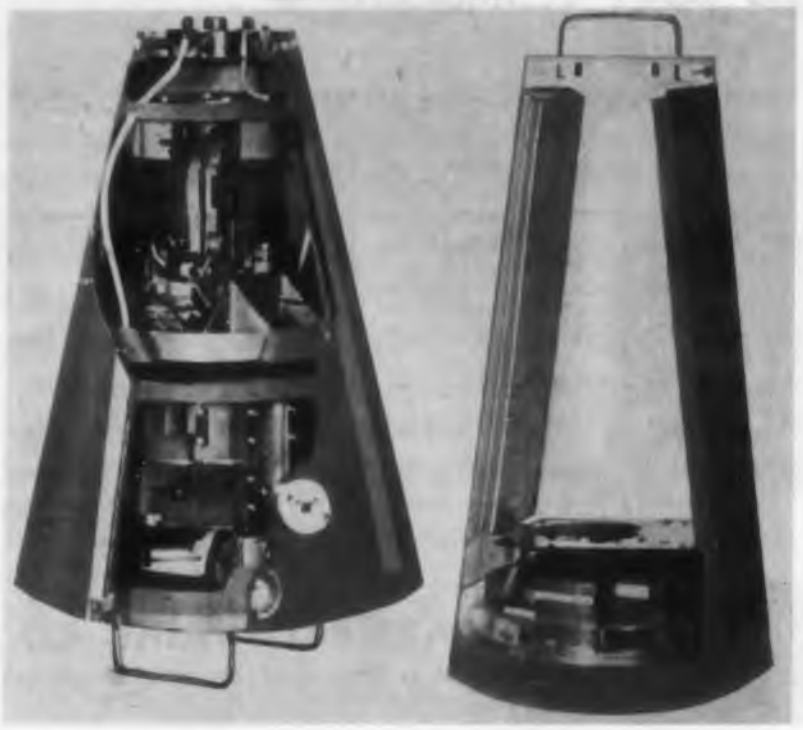
The Copperhead fuze will include a host of electronic advances, all highly integrated through a coordinated systems approach. Since the development applies to many tactical weapons, high development costs are divided among a number of programs.

DOFL's electronic package is about one-fifth the size of the fuze equipment used in present tactical missile systems. It weighs about 15 lb and will fit into the rear of the missile ogive. The entire ogive is filled with electronic gear.

In addition to size reduction, additional intelligence is being designed into the fuze mechanisms. Since accuracy in fuzing is a critical factor in tactical weapons, the Copperhead fuze should significantly increase operational effectiveness. With long-range strategic weapons, fuzing accuracy is not so critical and the benefits of size reduction would probably be applied in other directions. Functional redundancy is a major systems concept being applied to the Copperhead program. For example, programer signals, fuze intelligence, and some other inputs are provided by a single crystal oscillator which gives a time base for fuze operation. The replacement of a number of single-function devices by one multifunction device means that only a fraction of the total number of parts are needed.

Since fewer total parts are used, the reliability requirement for each part in the multifunction system is lower than it is in the single-function unit with many more parts, assuming that each part must work for the whole fuze system to function properly.

In addition to the functional redundancy concept, Copperhead designers hope to achieve system reliability through low mass, structural integration, and the elimination of moving parts.



Size reduction achieved in the Copperhead fuze system is dramatically illustrated by this comparison of a conventional guided missile fuze system, left, and the Copperhead version, right. The conventional fuze weighs 81 lb and the electronic and mechanical units occupy 1,200 cu in. The Copperhead fuze weighs 15 lb and occupies 266 cu in. Diamond Ordnance Fuze Laboratories, Washington, is developing the Copperhead unit.

Alternate Design Approaches Taken Where Concepts Not Fully Developed

Some parts of the Copperhead electronic package have been designed using advanced concepts which have not yet reached reliability or performance levels suitable for an operational system. In these cases alternate units have been designed using more conventional methods.

For instance, spiral antennas made of printed copper transmission line have been designed, but more conventional antennas are being used until performance of the spiral types improve. Some of the circuitry has been microminiaturized using DOFL's 2-D approach (*ED*, Nov. 9, p 66). The 2-D circuits are built on ceramic wafers using deposited resistors, flat capacitors, wound ferrite toroidal inductors and potted caseless transistors.

(continued on p 17)

(Advertisement)

NEW PRODUCT

Versatile Crimped Connector For Miniature Coax Cable

A highly versatile crimp-type snap-locked modular HYFEN® connector for miniature coaxial cable has been introduced by the Omaton Division of the Burndy Corporation, Norwalk, Connect. This modular HYFEN offers the facility of simple removal of individual snap-locked contacts or gang disconnect.

Both inner and outer contacts are crimped to the conductors, simplifying a previously complicated and difficult process. In addition this process eliminates many of the parts formerly used, and also eliminates any heat in the connection process. The result is a reliable coax connection, easily and quickly installed.

The new plug-and-receptacle unit will presently connect RG195U and #24 shielded miniature coax cable. Connectors for other sizes of miniature coax will be available soon.

Connector frames, of die-cast anodized aluminum, accommodate three, five, or eight inserts, snapped in from either front or back. Inserts for coax cable, of glass-filled diallyl phthalate, accommodate up to 21 contacts. A plug or receptacle insert may hold male or female contacts, or they may be intermixed. Coax cable inserts and standard wire inserts (35 contacts) may be mounted in the same frame.

Contacts can be crimped to cable ends either before or after the harness is in place. Engaging and disengaging forces of low magnitude make it easy to insert, remove, and replace contacts and inserts individually for flexibility and economy in circuit changes and checks.

Burndy Corporation, Norwalk, Connect.

CIRCLE 16 ON READER-SERVICE CARD

NEWS

Until reliability and performance of these circuits are better, however, their use is being simulated by miniature components packed into clusters.

When some of the latest developments being used reach operational status, even further size reductions can be expected in the Copperhead unit.

Miniaturization in Copperhead circuitry permits a 90 per cent decrease in interfaces and connections. Connection to all external elements is provided by a single plug because of the structural and electronic integration of many subsystems.

Mounting of circuits on a cellular aluminum block adds strength to the over-all missile structure. The cellular aluminum acts as a shock absorber and vibration isolator, provides a very high natural resonant frequency, and also serves as electrical shielding for circuits.

Self-Actuated Battery, Digital Timer Among Copperhead's Advanced Subsystems

A new type of self-actuating reserve battery is contained in the Copperhead fuze system. It provides the highest energy per volume or weight ratio of any known power source, according to a DOFL spokesman. Electrolyte is carried in a separate, but self-contained, chamber. At the proper time during flight a programed signal automatically trips a valve, in effect. This releases the electrolyte so that a galvanic reaction begins and the battery starts to supply electricity. The cell will supply 28 v at several amperes and is said to have indefinite storage life.

The miniaturized programing device in the system includes a digital timer in place of the conventional mechanical synchronous clock. The electronic timer is equivalent to a synchronous clock with five cam positions, allowing initiation of five events. Crystal oscillator precision and the elimination of moving parts significantly improves accuracy over present methods. Intervals up to about 200 sec can be timed.

Strip transmission line replaces waveguide or coaxial cable, and such conventional components as pass band and reject filters, power dividers, and diplexers have been converted to strip line. Microminiature diodes and mounts will also be imbedded in strip line.

Another Copperhead concept, now in the breadboard stage, is an automatic monitor and setting device small enough to be held in the hand. This is expected to replace the many consoles of electronic check-out and setting equipment used with present tactical missile systems.

All manual settings presently required in preparing missiles for launch would be eliminated with the new approach. Settings could be pro-

Cellular aluminum like this is being used to mount electronic units in the Copperhead fuze system. Density is about half that of solid aluminum.

gramed into the missile with the new external device up to the instant of launch. The usual field check-out and readiness inspection of missiles would also be done automatically by the new equipment.

The automatic monitoring and programing device now being designed uses digital techniques because transistors are still too voltage-sensitive for an adequate analog system. In the future, however, it is hoped that a shift to analog operation will be possible because this will reduce the number of parts required.

The fuze system itself will be almost completely transistorized. The use of transistors has been held back up to now because of high nuclear susceptibility. Improvements in semiconductor technology, however, are rapidly overcoming this draw-back, so that in many cases transistors are almost as radiation-resistant as the tubes they replace.

Solid-state switches are replacing conventional mechanical relays in the Copperhead fuze. Until recently it was felt that from the safety standpoint it was necessary to use a relay with an air gap for positive contact separation. Transistor leakage has now been reduced to such low levels that this precaution is no longer felt necessary.

The objective of the Copperhead fuze program is not the achievement of production-type reliability, but rather the inherent reliability of suitably chosen and integrated techniques. When a required number of satisfactory flights have been made the systems concept developed for Copperhead will become useful for any tactical missile system. ■ ■

New Sensitive Image Tube

Night-Vision Glasses, Periscopes To Use Westinghouse Astracon

THIN-FILM dynodes are given credit for the high sensitivity and resolution claimed for the Astracon, an experimental image-amplifier tube now in prototype production at Westinghouse's Electronic Tube Dept., Elmira, N.Y. The new tube has already been applied in photographing cosmic-ray scintillations, in astronomical observations, and may be used in binoculars and tank periscopes now under development for night warfare by the Army's Research, Engineering, and Development Laboratories located at Fort Belvoir, Va.

The input end of the Astracon uses a photocathode of cesium antimonide (S-11) or other suitable material depending on the light-frequency sensitivity desired. Electrons emitted from the photocathode are accelerated and focused onto a thin-film dynode which is the heart of the tube.

The dynode consists of a vapor-deposited aluminum film backed by a layer of potassium chloride or barium fluoride. Each layer is approximately 800-A thick; the dynode is self-supporting and said to be highly vibration and shock resistant.

Secondary electrons emitted from the first dynode are accelerated and focused onto a second, identical dynode. The process is repeated for a third and fourth dynode. Electrons emitted from the fourth dynode are imaged on a P-11 or

Astracon image amplifier is examined by Westinghouse scientist Dr. J. W. Coltman. Tube employs new thin-film dynodes and may be applied in night warfare devices, astronomy and nuclear science.

Uses Thin-Film Dynodes

other phosphor screen at the output end for viewing or photography.

The four circular dynodes are spaced at 1-cm intervals along the axis of the tube. Accelerating voltage between stages is 4.5 kv except for the last stage; where an 18-kv potential is used to maximize image brightness on the phosphor screen. Focusing is by a 500-gauss field from a barrel-shaped alnico magnet.

Minimum Gain of 5,000 Gauss Is Specified for Astracon

A minimum gain of 5,000 (with a P-11 phosphor) is specified for the Astracon. Dark noise is claimed to be equivalent to a 10^{-8} ft-c input. According to James Hall, manager of the camera and storage-tube department at Westinghouse's Elmira plant, the low-noise figure is largely due to the absence of light feedback and ion feedback achieved by the dynode structure of the tube.

In conventional image amplifiers, separate phosphor screens and photocathodes are used instead of dynodes and electon-to-light conversion occurs at each amplification stage. The compartmentization of the tube envelope by the dynodes also tends to reduce noise.

Resolution of the tube is 12 line pairs per millimeter. Distortion of the focusing field by the finned envelope (see photo), borrowed from another project, is given as the main reason for this low figure. Westinghouse designers plan eventually to use a different envelope and hope to double the present resolution.

Short Life of Thin-Film Dynodes Is One Drawback to Tube

One drawback to the tube is the apparently short life of the thin-film dynodes, particularly at higher light intensities. The potassium and barium salts tend to decompose; a company spokesman indicated that 200 hr is considered a reasonable life expectancy for present versions of the tube. (Pilot models of the Astracon are being marketed at about 7,500 per copy.) The Army is interested in rather longer operating times and Westinghouse hopes eventually to increase tube life to 500 hr.

In another project involving the Astracon, fiber optic disks are being developed for improved light coupling between scintillation crystal and photocathode. Similarly, these disks could be used to couple the phosphor screen of one tube to the photocathode of another. ■ ■

WASHINGTON REPORT

Ephraim Kahn

SPACE PROGRAM IS ACCELERATING, with current schedules calling for 24 to 30 "major launches" per year over the next several years. These will, presumably, include Scout firings, which require less time on the pad than do rockets with cryogenic fuels. In the third quarter of 1961, test flights of the Atlas-Centaur will begin. This, it is hoped, will put spacecraft weighing 8,500 lb into a 300-mile orbit. The Thor-Agena B (expected to be a workhorse of the space program) and the Atlas-Agena B will come into operation for the NASA and Space program late in 1961. They will lift between 1,600 and 5,000 lb. Early in 1961, NASA chief Glennan says, "one of the seven astronauts will be lofted about 125 miles above the surface of the earth and will land some 200 miles down-range." The flight will last 16 minutes and involve five minutes of weightlessness. If successful, this will shed light on most of the space-flight problems other than re-entry. It will not, of course, mark a breakthrough in rocketry; the Discoverer series of launches involves more thrust.

BIGGER MILITARY SPACE ROLE will be sought from the Kennedy Administration. First steps toward justifying expansion of the military's space activities have already been taken. A small (under $140,000) study contract has been awarded for design of a transport space vehicle—a part of the SLOMAR (Space Logistics, Maintenance, and Rescue) program. The proposed vehicle would supply manned satellites. Also in the works are contracts for other aspects of the program, including environmental subsystems, radar, navigation, homing devices, and the like. A major objective of the military will be to get an agreement from the new Administration that will, at the very least, enable it to keep a watchful eye on research.

NEW PROPRIETARY-DATA POLICY of the Defense Department is starting to take shape. Industry associations have been asked to comment on proposals to relate ownership of technical data and patent rights to the financing of their development. The new rules would apply to both prime and subcontractors, and comparable contract clauses relating to data rights would have to be used in each type of pact. The government expects to set up two classes of data ownership:

UNLIMITED RIGHTS would be granted to the government in technical data which was developed at federal cost. The government would be free to use this information as it wishes and to disseminate it as it sees fit to companies submitting bids on competitive purchases.

UNLIMITED RIGHTS in data will be given to the government when data has been paid for by private industry. This will bar government use of the data in letting competitive bids. It

will not, however, permit the contractor to set excessive prices. Note, however, that stiff criteria are set for taking "limited rights" in data. For example, this will normally be applied to products developed and sold (or offered for sale) by industry before performance of a related contract.

SHADOWY AREAS ARE MANY, and individual solutions will have to be found. But there are some general principles. Where it can be shown that data were developed in part at private expense and in part at government cost, the division of rights will fall along the lines of financial responsibility. But the government will have the power to negotiate "an equitable price" for the contractor's data. By preference, this will be done during negotiation of the initial contract in which the data may be involved. The government is aware that there would be limited value (if any) in having unlimited rights to only a part of necessary data. It may elect to renounce the rights it has or to obtain unlimited rights to everything it needs. As a general rule, unlimited rights in technical data will be taken under formally advertised contracts only when the data is to be developed under the contract.

SUBSEQUENT PURCHASES of items using contractor-developed technical data would be conducted under a proposed new order of preference after the new data-ownership policy goes into effect. First choice would be competitive procurement, but the government notes that this may be impossible in "complicated procurements" or where items of "obscure design" are sought. Competitive procurement includes both negotiation and formal advertising "using performance or other specifications which do not contain data developed at private expense to which the government does not have unlimited rights." This contemplates use of "brand name or equal" and use of a model. "Non-competitive procurement" is second choice only when competitive purchasing is impossible and "where the developer has adequate productive facilities and is not seeking to overcharge the government." The Defense Department says it "should not hesitate to state a policy encouraging the appropriate use of this method of procurement" provided safeguards against abuse are adequate.

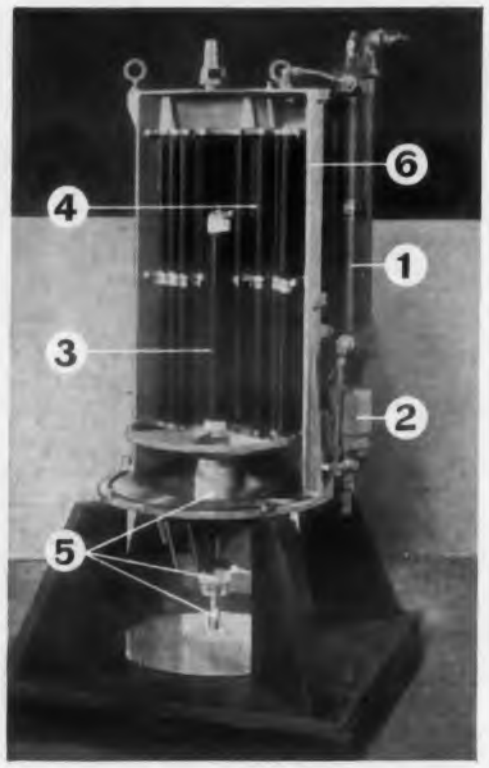
LICENSING BY THE DEVELOPER is the third proposed procurement method. It would be used when additional production is needed that cannot be obtained by competitive bidding.

"REVERSE ENGINEERING" would be available to the government as a last resort. It is considered "an inducement to fair pricing, and should be tightly controlled." Reverse engineering entails the setting of a design specification by the government based on inspection and analysis of an existing product. This specification would be used for competitive procurement, but only "in a few circumstances where there is an essential government requirement for items of identical design and where the developer is unreasonable in his price demands."

ESPECIALLY BROAD RIGHTS will be taken by the government when it has provided "unusual support to specific product improvement or research and development programs beyond the support normally provided as a reasonable overhead allowance." In such a case, the government will not only keep unlimited technical data rights, but it will retain patent licensing rights as well.

Electronic Products NEWS
by CARBORUNDUM®

Custom-built DUMMY MAGNETRON LOAD inserts in magnetron socket



(1) Heat exchanger (2) Pump — water and ethylene glycol (3) GLOBAR 500 watt resistor to simulate magnetron filament characteristics (4) Varistor load bank to simulate anode characteristics (5) Ceramic-to-metal assembly duplicating magnetron termination (6) "O" ring sealed aluminum cast housing.

CIRCLE 804 ON READER-SERVICE CARD

The dummy magnetron load at left, cut open to show construction, was designed by Hazeltine Corporation engineers and produced by Carborundum's Globar Plant. It is used as a stable termination of known characteristics for evaluating the pulse performance of the Hazeltine AN/APS-95 transmitter modulator, newest Air Force early warning radar development.

The dummy load dissipates 10 kw average power. Peak pulse amplitude is 50/70 kv. Unique features include provision for direct insertion of the load in magnetron socket, use of liquid heat exchanger and inclusion of a proportional viewing resistor.

This load is typical of custom-built devices by Carborundum, utilizing the non-linear characteristics of GLOBAR® resistors and varistors. Ceramic-to-metal assemblies and ceramic parts were produced at Carborundum's Latrobe Plant. For information on high power packaged loads to suit your requirements, write Globar Plant, Refractories Div., Dept. EDL-120, Carborundum Co., Niagara Falls, N. Y.

CIRCLE 805 ON READER-SERVICE CARD

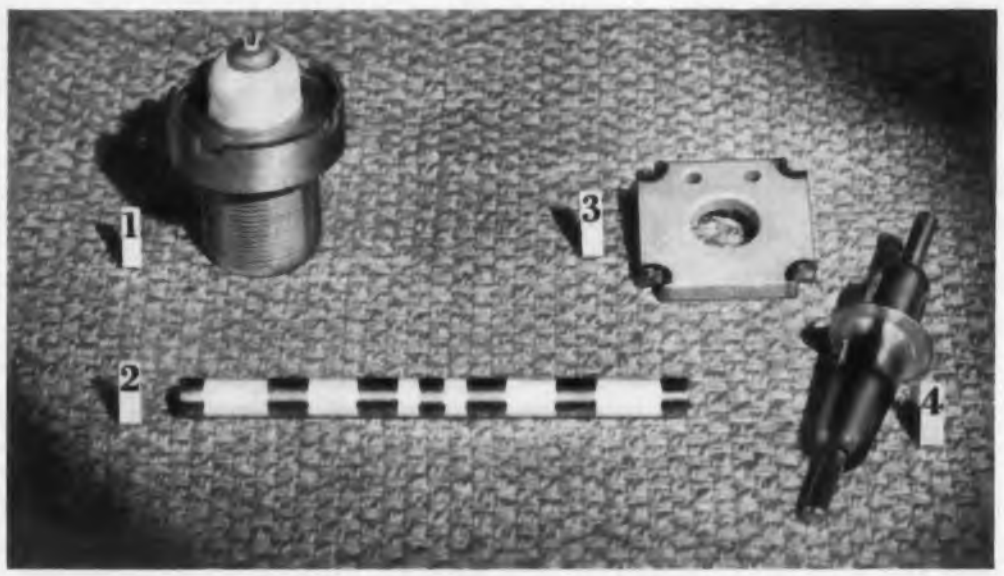
Crushable Ceramic Preforms
—Swaging tubes for thermocouples

These preforms are used for stringing on thermocouple leads, insertion in seamless stainless steel sheaths and subsequent crushing during swaging to produce densely packed ceramic powder insulation. They are now available in a choice of materials:
Low Boron Content Magnesium Oxide
High Purity Aluminum Oxide (Fused and Calcined)
Stabilized Zirconium Oxide
Low Hafnium Stabilized Zirconium Oxide

Preforms are offered for one, two and four hole applications, with other multiple four up to six hole tubing available on request. Sizes range from .022" O.D. with holes from .005" diam. as standard sizes. Special diameters made to specifications. For complete technical data, write Latrobe Plant, Refractories Div., Dept. EDP-120, Carborundum Company, Latrobe, Pa.

CIRCLE 806 ON READER-SERVICE CARD

CUSTOM-BUILT SEALS AND METAL-BONDED CERAMICS



offer advantages for your product

The samples shown at left are typical of the many types produced by Carborundum's Latrobe plant.
#1 is a metal-bonded ceramic-to-metal assembly with an operating range up to 500 C in air and 1080 C in controlled atmosphere. It's highly resistant to thermal and physical shock and can be readily brazed. Used for thermopile lead-throughs, pressure vessels, space capsules, canned nuclear pumps and reactors, heating elements, rectifier housings.
#2 is another example of metal-bonded ceramic with similar properties.
#3 is a silver metallized ceramic part for less severe requirements. Operating range up to 150 C.
#4 Vacuum-tight lightweight glass-to-metal assembly produced with KOVAR® matched expansion type glass seals. The glass and metal oxide interfuse to make a true chemical bond. For information, write Latrobe Plant, Refractories Div., Dept. EDS-120, Latrobe, Pa.

CIRCLE 807 ON READER-SERVICE CARD

CIRCLE 804, 805, 806, 807 ON READER-SERVICE CARD

NEWS

Two Additional Optical Masers Reported by Raytheon and MIT

Raytheon and the Lincoln Laboratories of MIT have become the newest members of the optical maser club, it was learned by ELECTRONIC DESIGN. Both organizations have recently achieved maser action in a ruby crystal in the manner first demonstrated by Dr. Theodore H. Maiman of the Hughes Research Laboratories. Including the Bell Telephone Laboratories, organizations producing optical masers now number four.

Other organizations reported close to the achievement of a maser include Philco and Technical Research Group, Inc.

Raytheon's device was demonstrated late last month before a private research seminar at MIT. As in previously demonstrated optical masers, pumping energy is supplied by a high intensity flash tube, resulting in intermittent operation. Average power during the 100 μsec operating cycle was reportedly 1 kw.

In demonstrating the maser, Dr. Hermann Statz, director of Raytheon's research in theoretical physics, noted that the output consisted of very short pulses. This supported observations first reported by the Bell Telephone Laboratories. Dr. Statz stated that this effect could be eliminated by using extremely high-intensity pumping light and also disclosed that Raytheon is experimenting with 500-w mercury-vapor tubes of "special design."

Raytheon Began Work Last August On Its Present Device

Company spokesmen were reluctant to elaborate on specific performance details or future direction of research in optical masers. It was pointed out that work on the present device was begun only last August. Drs. Clinton Shafer and Clarence Luck of Raytheon's research division were credited with a major role in development of the maser.

The Lincoln Laboratories maser is again essentially a duplication of the Hughes "Brute Force" maser. A slender ruby cylinder with interferometer mirrors plated at each end is pumped by a high-intensity light source and emits a relatively narrow and coherent signal at 6943 A. Public demonstration of the maser and release of performance data by Lincoln Laboratories is expected in the near future.

In a related development, it was learned that the Wright Air Development Division is considering acquisition of an optical maser from Hughes. The unit would be studied for possible use in light radar and optical doppler space navigation systems.

CIRCLE 24 ON READER-SERVICE CARD ▶

Bell Labs' Data-Phone System Uses Regular Telephone Hookup

"The Data-Phone concept of text and data transmission over the regular telephone network is one of the most significant and far-reaching business developments of the computer age, establishing a new milestone in communications leadership for the Bell Telephone System," according to R. F. Landry, assistant vice president, American Telephone and Telegraph Co.

Linking different locations together over regular telephone lines, Data-Phone, developed by Bell Laboratories, enables business machines to talk with each other. This highly flexible system now carries up to 1,200 bits per sec or roughly 1,600 wpm. It handles information from any media such as punched cards, paper, or magnetic tape—and even handwritten messages and diagrams.

Data-Phone sets receive information in the form of pulses or bits from the originating machine and convert the pulses to tones suitable for telephone circuit transmission. At the receiving end, Data-Phone sets convert these tones back to electrical pulses which feed into business machines, tele-typewriters or other equipment.

Four Data-Phone Sets Available from Bell System

The Bell System, thus far, has available four different Data-Phone sets—Data-Phone 100, 200, 400, and 600. Each has been especially designed to work with various types of business machines and transmit at speeds varying from 75 to 1,200 bits per sec, which is roughly the equivalent of 100 to 1,600 wpm.

Data-Phone 200, with a current capability of approximately 1,600 wpm, is the closest to a "universal" system because of the large number of business machines designed to work with it. These currently include Bell System 1,000 W.P.M. Teletype, RCA High-Speed DASPAN, Teleregister, several IBM Teleprocessing systems (Transceiver, 1009, 7701) and the Digitronic Corp.'s new Dial-O-Verter. Among them, these machines offer the choice of punched tape, magnetic tape, punched cards, computer-to-computer or interrogation of central computer.

Data-Phone's current maximum transmission rate is expected to be increased to 2,000 bits per sec within a year. Moreover, AT&T is reported to have developed a system with a capability of 1.5 million bits per sec using pulse code and pulse amplitude modulation.

The Bell System has made more than 1,000 installations of Data-Phone sets in the past two years. It expects to have 10,000 in operation by the end of 1961 and up to 200,000 sets functioning by 1965.

CIRCLE 24 ON READER-SERVICE CARD

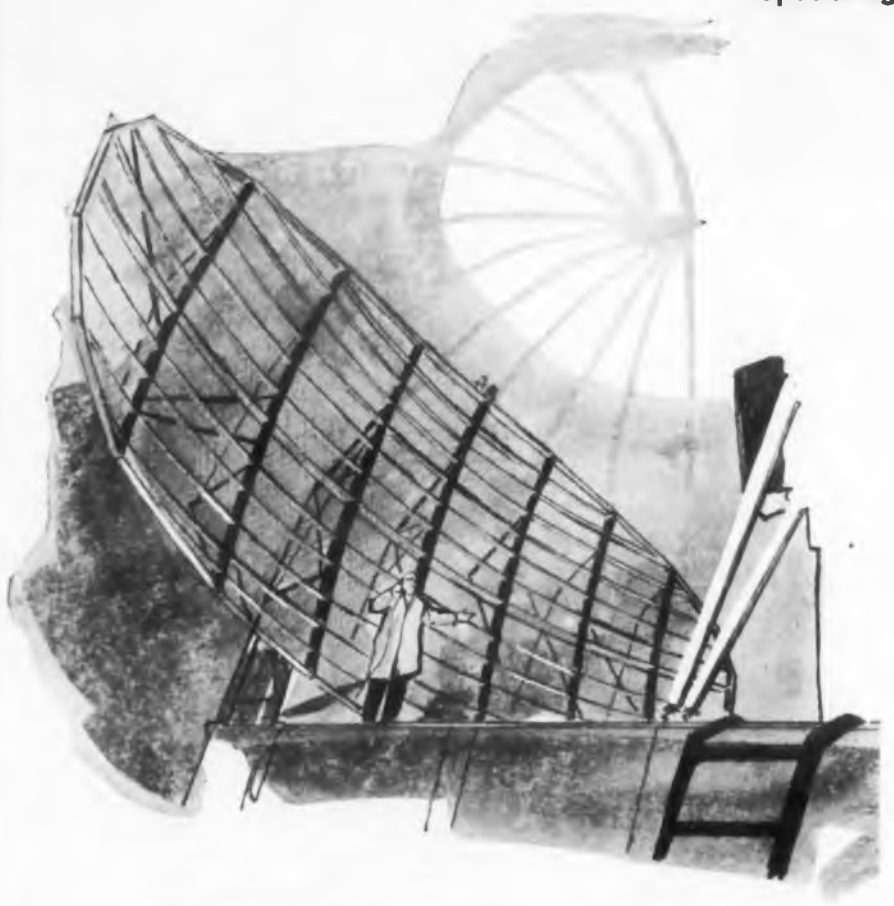
Design The Future Into Your Product With General Electric Electronic Components

Never has the designer been faced with more of a challenge. You must design for the future today. Specifications you pencil in on the blue print can automatically spell obsolescence for your design. If this is a problem with your product, you should specify General Electric electronic components . . . components designed with the future in mind. For example, see the . . .

FUTURE built into G-E high-frequency fluid-filled magnetic components

Designed to meet wave shape, inductance, and frequency requirements in modern radar and communication systems.

Special light weight, or conventional size Commercial or MIL-T-27A



Pulse Transformers

Pulse widths from below .1 μsec thru 2000 μsec
Rep rates up thru 10,000 pps
Peak kw up to and above 100,000 kw
Kv outputs up thru 500 kv
Monofilar, bifilar, trifilar
Droops, near zero to 20% as required
Rise times 10%—faster or slower as required
Resistive or biased diode loads

Associated equipment and added features

Capacitance dividers
Multiple-output windings
Trigger windings
Resetting for long-pulse-length units
Filament transformers
Tube-mounting compartments
Special mechanical design to fit application and location applicat Clipper (inverse) diodes

Charging Inductors

Resonant or linear charging
LI^2pk values from below .1 to over 5000
Voltages up thru 80 kv with 40 kv d-c supply, or higher
Frequency to specification

Modulation Transformers and Inductors

For high-level modulation

Modulation transformer frequency response for a typical 250 kw unit is 10 cycles to 20 kc (±3db). Lower or higher powers are available with good response. Shunt feed inductors to match the modulation transformer.

Saturable Reactors

For high-voltage and/or high-frequency application.

For more information, circle 840 on reader service card.

The complete line of General Electric Tantalytic® capacitors fills a wide range of critical electronic applications. Small in size and unsurpassed in reliability, G-E Tantalytics perform within specification requirements even at environmental extremes.

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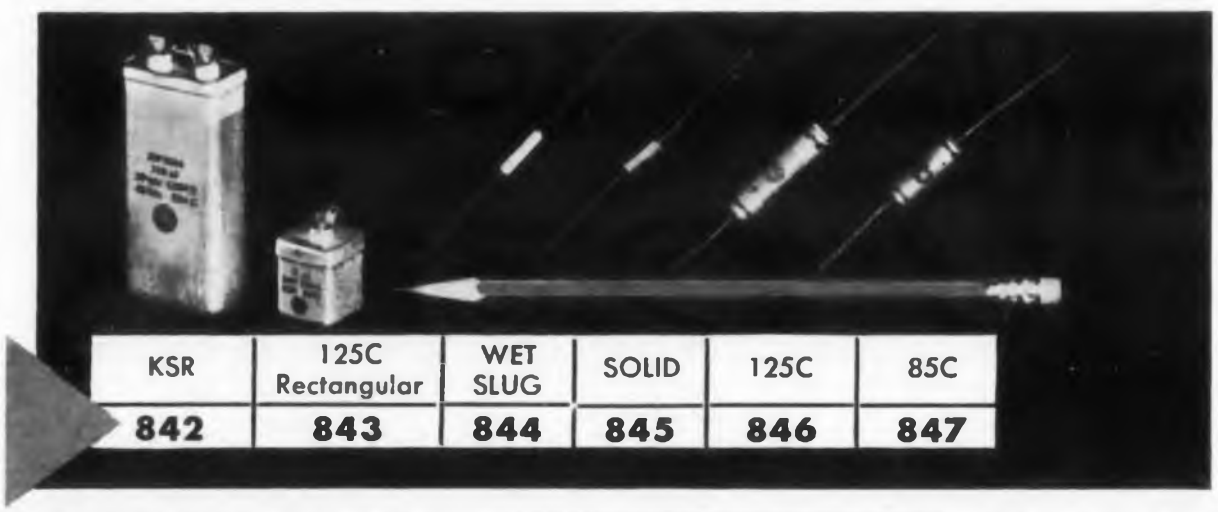
For more information about General Electric Tantalytic capacitors, circle these numbers on the reader service card.



KSR	125C Rectangular	WET SLUG	SOLID	125C	85C
842	843	844	845	846	847

GENERAL ELECTRIC

NEW PRODUCTS

NEW Light-weight Radar Transformer

Typical of General Electric's advanced custom-designed high voltage transformers, is this specially designed light-weight pulse transformer shown with its taller predecessor. Through advanced design techniques, this airborne pulse transformer weighs 22 lbs, 10 ounces and has 50% higher power than the previous 38 lb unit on the right. This is still another example of the future which is built into the wide range of High Voltage Specialty Transformer products from General Electric

For more information on these and other Specialty Transformers, circle 849 on the Reader's Service Card.

NEW Tantalytic Capacitors in ratings to 300 volts

The General Electric Company has announced the availability of a new high-voltage foil capacitor, rated to 300 volts at 85C and 250 volts at 125C, in both polar and non-polar designs. The new units are smaller than previously available capacitors with similar voltage ratings and also provide size and weight advantages over series arrangements of lower voltage units.

Circle 848 on reader service card.

671-02

EDITORIAL

Managing One's Own Time

Without wise management of time, company earnings slip, management becomes ineffective, and engineers find they are getting nowhere.

On the other hand, the fact that the rate of engineering accomplishment can soar when time is managed well was brought home to ELECTRONIC DESIGN's editors as they worked on this issue's Staff Report, "Cutting Lead Time in Design." During their visits to firms who were achieving short lead times, our editors noted that there was a strong consciousness of the necessity "to manage time" down the line. (They also noted that the rate of technical accomplishment and personal satisfaction could actually be higher than in some lackadaisically managed normal-paced projects.)

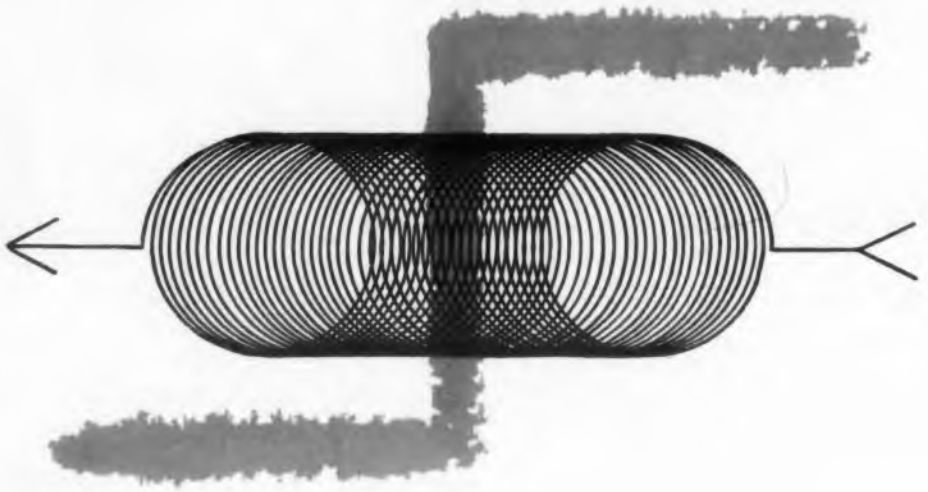
But what is the management of time?

A recent book, James T. McCay's "The Management of Time," pursues the interesting possibility that in our present age of technical innovation, today's management of time depends on yesterday's self-education. For, Mr. McCay reasons, time can best be managed by the creative-minded leader who can produce the novel approaches which lead personnel around time-consuming obstacles.

One can infer from Mr. McCay that the only way for a person to get ahead of the harassments of short-lead-time projects is continually to keep his knowledge up to date, and ironically enough, the only way to do this is to manage one's own time well enough that there is a part of every day left for self-development.

Certainly our editors found that those Engineers who were leading the most sure-footed short-lead-time projects were men of wide technical and managerial backgrounds who were able to make quickly the many decisions and suggestions needed to keep a short-lead-time effort continually forging ahead.

Robert H. Cushman



Designing Low-Pass Filters From Lossy Helical Coaxial Line

Here's another laboratory application of the coaxial approach. A previous design article (ED, April 13, 1960, p 66) described a high-pass filter employing a segmented, bead-supported center conductor. In this article, our neighbors across the border show how a low-pass filter can be made with simple equipment, by using a helical center conductor imbedded in a lossy dielectric.

Insertion loss and cut-off frequency can be controlled over a wide range by choice of length and pitch of the center conductor helix. Because the properties of the lossy material can vary from batch to batch, precise prediction of filter characteristics is not practical.

K. A. Steele, J. K. Pulfer
National Research Council of Canada,
Ottawa, Canada

A LOW-PASS filter which absorbs rather than reflects power in its stop band, and which has no undesirable high-frequency pass bands, is often in demand in the lab. A typical application is as a power line filter for shielded rooms. Another use might be as a filter to allow modulation of a vhf oscillator without allowing the oscillator output to feed back to the modulator. It is also very useful for controlling leakage in microwave oscillators. Such a filter can be made from a coaxial line which has a dielectric that becomes increasingly more lossy as frequency is increased.

The lossy material[1, 2, 3] used for the dielectric in the filters is a mixture of powdered iron and epoxy resin. Manufacturing details suitable for laboratory work are given separately. This material is easily made with a minimum of special equipment and is well suited to design-stage work. Similar devices may be made by using very high concentrations of ferrite or iron powder bonded under high pressure with a plastic binder. Such material is known to have very high loss at microwave frequencies and has been used as the dissipative dielectric in filters.[4] However, this type of material can only be made with special equipment and is difficult to machine.

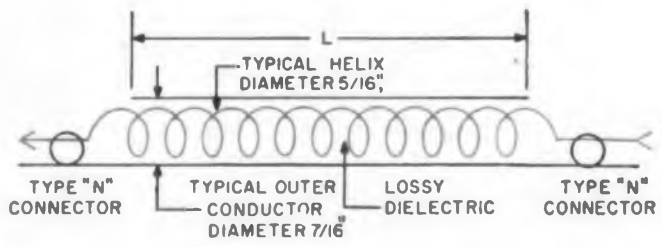


Fig. 1. The basic lossy coaxial line filter described in this article is 3-in. long, uses a 5/16-in. helix diameter.

The attenuation obtainable in a given length of line can be increased greatly by coiling the center conductor into a helix and imbedding it in the lossy material. Fig. 1 shows the structure of a helix filter. In Fig. 2 the filter insertion loss is plotted against frequency for a straight inner conductor and for a helical inner conductor. The two lossy filters have the same external dimen-

sions. The improvement shown makes the construction of a helix well worth the effort.

While coaxial line filters with a single center conductor have many uses, applications for balanced lines also occur and may be easily made by imbedding bifilar helices in lossy material. It is advisable that the center conductor wire be insulated for the full applied voltage. The lossy material is not a reliable insulator because of the high metal powder concentrations employed.

Filter Insertion Depends on Many Parameters

The insertion loss characteristic of these filters depends in a complicated way on many parameters. As a first approximation, the insertion loss in db is directly proportional to the length of conductor in the lossy dielectric and also varies logarithmically in db with frequency. It does not depend on diameter or pitch of the helix unless successive turns are sufficiently close together to allow coupling from turn to turn through the dielectric. Wire diameter is not highly important either, although it has a slight effect depending on frequency.

No attempt has been made to obtain design curves giving physical dimensions of a filter for a desired insertion loss versus frequency characteristic, since the electrical properties of the lossy

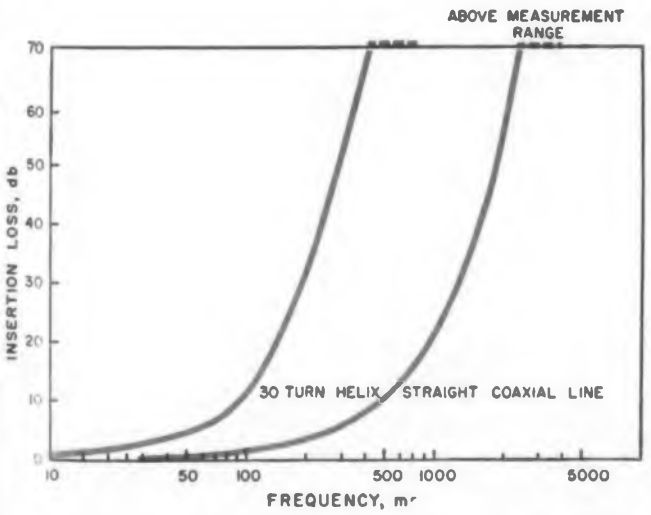


Fig. 2. A marked increase in insertion loss is gained by using a helical center conductor rather than a straight conductor.

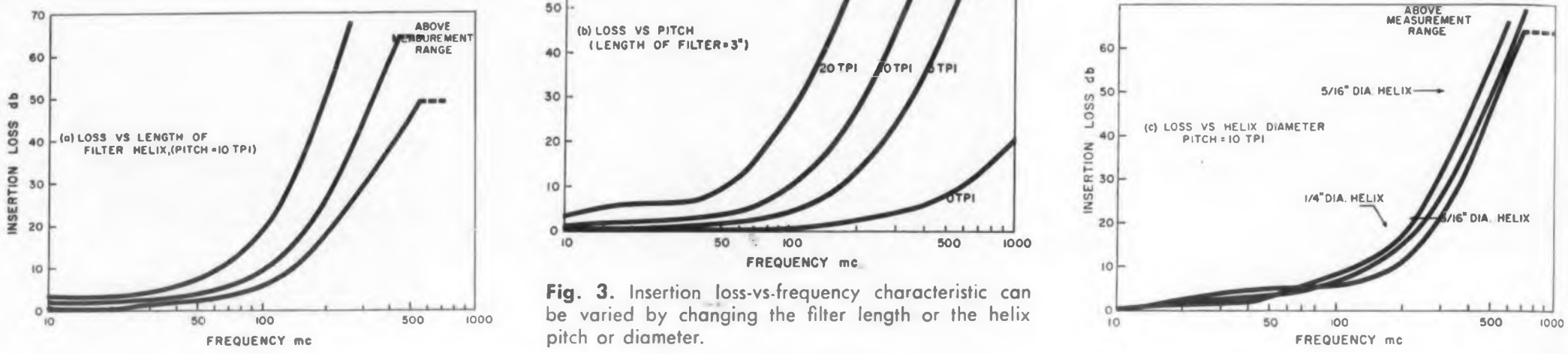


Fig. 3. Insertion loss-vs-frequency characteristic can be varied by changing the filter length or the helix pitch or diameter.

Manufacturing The Lossy Material

Ingredients:

These are the standard mixtures used:

Resin	Hysol 6020	16.1% by weight
Hardener	Hysol Type A	1.8% by weight
Filler	Carbonyl GQ 4 Iron Powder	82.1% by weight

Mixing:

1. Pour required amount of resin into a container.
2. Mix required amount of hardener (1.8% by weight of mixture into the resin thoroughly.
3. Place required amount of filler (82.1% by weight of mixture) into a separate container.
4. Sprinkle the filler into the resin slowly while mixing mechanically to obtain a uniform mixture. This may take about 15 min with a 200-g batch.
5. Vacuum the mixture for about 10 min, or until most of the air is extracted. The mixture is then ready for pouring into molds.

Pot Life:

The pot life of the mixture is about one hour at room temperature for a 200-g batch.

Molds:

The lossy dielectric for the filters should be cast in two stages. First cast the core on which the helix is to be wound. This may be done with bakelite or metal tubing molds of the correct inside diameter. After the material has cured the mold may be machined away or if a split mold and release compound is used the same mold may be used more than once. After the helix is wound on the core, the material between the helix and outer conductor of the filter is cast in another mold. Best results are usually obtained with a split mold since there is less chance of trapping air in the casting.

Mold Release:

Spread a thin layer of Emerson and Cuming type 122S release compound over the entire inner surface of the mold. Dow Corning high-vacuum grease is also a suitable release agent.

Curing:

After placing the mixture in a mold, it should be cured for one hour at 200 F or 24 hr at room temperature (70 F).

Finishing:

The material may be easily machined, although care must be taken that over-heating does not occur. A tungsten carbide tool is best.

Material Sources:

Hysol Products	Hysol Corp., Olean, N.Y.
Carbonyl GQ4 Iron Powder	General Aniline and Film Corp., Linden, N.J.
Mold Release 122S	Emerson and Cuming, Inc. 869 Washington St., Canton, Mass.

Alternative Iron Powders:

Some, but not all, of the following types of iron powder have been used in lossy dielectrics for the low-pass filters. The insertion loss obtained when using these powders will vary with type and is not likely to exceed that obtained with GQ4 iron powder at 80% by weight concentration. This opinion is based on data for lossy materials made with these powders for other applications. This concentration of filler is approximately the maximum which will produce a mixture which can be poured into molds.

Carbonyl Type L Carbonyl Type C Carbonyl Type SF	General Aniline and Film Corp., Linden, N.J.
IRN 31 IRN 2	Williams, C. K. and Co. Easton, Pa.

Alternative Resins:

The following resins have been used in similar applications with iron powder fillers. Mixing details vary and manufacturers instructions should be consulted.

Epoxy	— Araldite 502	— Ciba Co. Ltd.
Epoxy	— Epon 828	— Shell Chemical Co.
Polyester	GE 403	— General Electric Co.

dielectric vary, depending on the iron powder and resin used. Also, some differences between batches do not normally exceed ±2 db or ±10 per cent of the loss in decibels whichever is greater.

The effect on the insertion loss of changes in several physical parameters is shown on Fig. 3. These include (*a*) the effect of a change in helix length ("*L*" on Fig. 1) with the pitch held constant, (*b*) a change in the pitch with the length held constant, and (*c*) changes in helix diameter. The basic size of the filters used in these tests is as follows: length, 3 in., outer conductor diameter, 7/16 in., core diameter of helix, 5/16 in., inner conductor, No. 32 enamel. Measurements were made to 10 kmc, and indicated no low loss regions (< 50 db) above the low frequency pass band. All filters in these experiments and others discussed were made with lossy dielectric of the same material: 80 per cent by weight carbonyl GQ4 iron powder in Hysol 6020 resin.

Vswr measurements were also made on some of the filters and the effect of tapering the ends of the helix in pitch and diameter was investigated. The results (Fig. 4) show that tapering the pitch of the helix improves the input vswr below about 500 mc but has little effect above that frequency. ■ ■

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3. Staniforth, A. and Steele, K. A., "Casting Lossy Microwave Parts in Resin Aids Design Work," Canadian Electronics Engineering, May, 1958.
4. Radiation Laboratory Report (MIT) 906, "The Application of Powdered Iron Materials as Permeable Dielectrics at Microwave Frequencies."

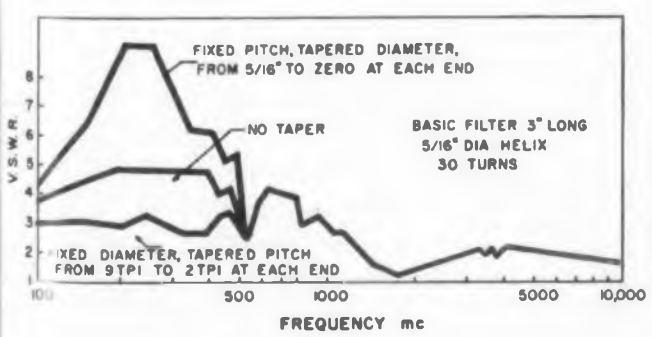
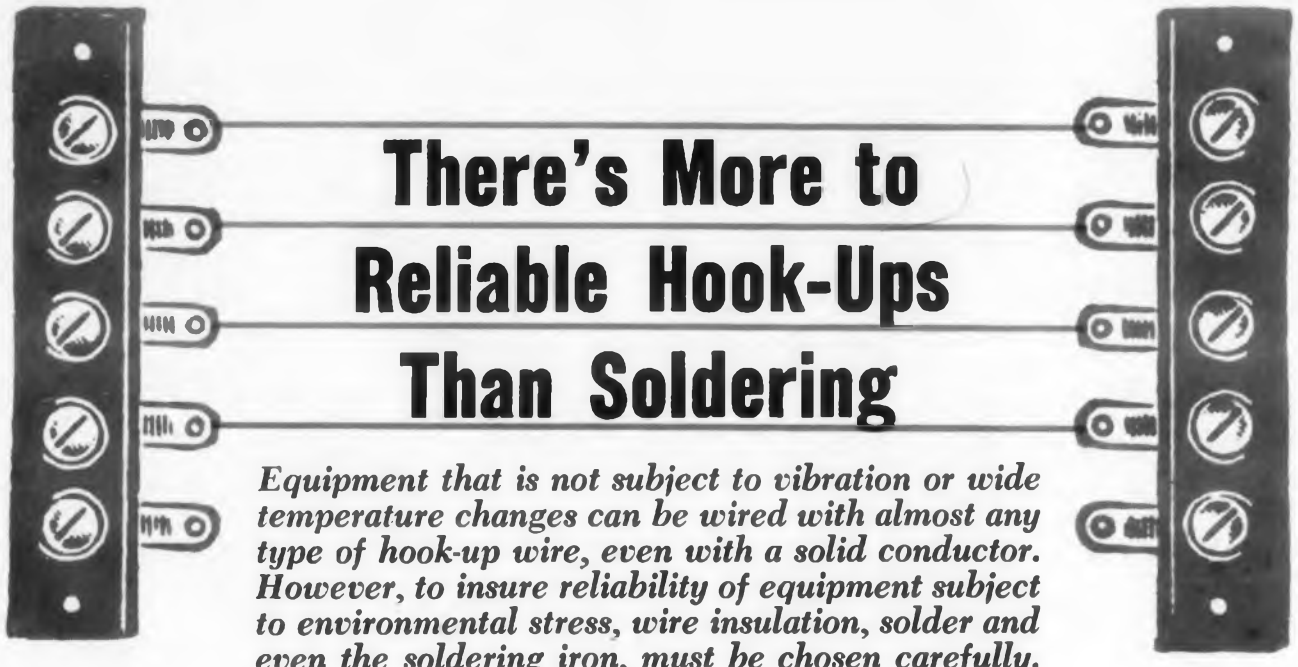


Fig. 4. Tapering the helix pitch affects the vswr of the helix below 500 mc.



There's More to Reliable Hook-Ups Than Soldering

Equipment that is not subject to vibration or wide temperature changes can be wired with almost any type of hook-up wire, even with a solid conductor. However, to insure reliability of equipment subject to environmental stress, wire insulation, solder and even the soldering iron, must be chosen carefully. C. W. Brown describes, here, factors that determine hook-up reliability.

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Laboratory for Electronics, Inc.
Boston, Mass.

RELIABLE hook-up wiring depends as much on the choice of wire, insulation, solder, and soldering iron as it does on soldering technique.

For acceptable flexibility, hook-up wire with at least 19 strands must be used. Strands smaller than 0.005 in. (36 AWG) should be avoided because the tin in the solder tends to alloy itself with the copper, thus weakening the strands.

For best endurance to bending due to handling or vibration, copper alloy wire with 0.8 to 1.2 per cent chromium is 2 to 3 times better than pure copper wire. However, the use of copper alloy wire on government contract work requires special permission.

The insulation on hook-up wire should be capable of being color-coded, and must be able to withstand the environmental conditions that will be encountered in operation. Commonly used insulation materials and their qualifications are listed in the accompanying table.

Some Properties Are 'Over-Specified'

In choosing the material best adapted to the operating requirements, it may be necessary to over-specify some properties so that other requirements will be met.

For example, very thin insulation may be necessary to reduce weight and bulk, especially when many wires must be crowded into a small space. For such a requirement, thin-wall Teflon insulation applied in tape form offers the smallest possible diameter.

For another assembly, completely non-flammable insulation may be a must, and Teflon will again be the choice, although diameter here is not an important consideration.

Strands of wire that are nicked during stripping, will break easily when bent. Most simple stripping tools nick the wire very severely; nicks often are hidden by the remaining insulation, which is pulled over the nicks during stripping.

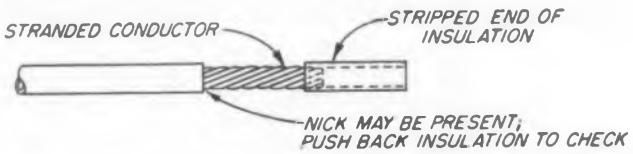


Fig. 1. Leaving small section of stripped insulation on end of wire obviates tinning, which can reduce reliability. Insulation should be pushed back to check strands for nicks, which are undesirable.

Rules for Reliable Hook-Up

1) Choose the most suitable type(s) of wire.
2) Strip insulation at connections without damage to the conductor.
3) Run wires correctly from point to point.
4) Choose solder of the most suitable composition, size and flux percentage.
5) Select soldering tools that furnish the RIGHT heat for the job.
6) Make proper soldered connections.
7) Check all connections for proper soldering.
8) Remove debris and surplus flux.
9) Apply protective coatings, if required.

A good wire-stripping tool must control the depth of cut to avoid nicking. Although only the best designed tools can give precise depth-control, many commercially available tools can do a good job.

Some types of insulation can be "heat-stripped," using hot-wire tools; however, some types of insulation release toxic gases under high-heat conditions, necessitating near-perfect ventilation where stripping is done.

If the small section of stripped insulation is left on the end of the wire, as in Fig. 1, it will prevent fraying and obviate "tinning" the ends of the wire; tinning can reduce the reliability of assembly because of "wicking" of the solder under the insulation.

50-50 Solder Generally Adequate

It is important to choose the proper composition, diameter and flux percentage of the wire solder to be used. Solder composed of 50 per cent tin and 50 per cent lead generally meets all requirements.

Solder that has more than 50 per cent tin attacks copper, especially at temperatures above 500 F, causing rapid erosion of soldering iron bits and finely-stranded copper wire. High-tin solders have reduced flow-temperatures but this is consequential in hand-soldering work. The reason is that commercial irons reach temperatures much higher than the melting point of any usable tin-lead composition.

Furthermore, in electronic devices, solder need not have high strength, either at extremely low or at usual operating temperatures. If operating

Properties of Common Insulation

Insulation	Useful Temp. Range	Cost	Flexibility	Flammability	Effect of Soldering	Remarks
Polyethylene	−65 to +80 C	Inexpensive	Flexible	(Depends on thickness)	Melts and shrinks back	Material is slippery
Polyvinyl chloride	−54 to +105 C		Flexible	Non-combustible (self-extinguishing)	Shrinks back under high or prolonged heat	Is tough Hardens somewhat on aging
Polyvinyl chloride with extruded Zytel Jacket	Characteristics as above except Useful Temperature Range is extended to 115 C					
Extruded Zytel	−54 to +125 C		Is stiff, cracks if bent sharply	May be flammable (depends on thickness)	Melts easily	Can be had in transparent colors
Cross-linked Polyolefins	−65 to +135 C	Medium cost	Flexible	Non-combustible if properly compounded	Resists melting during soldering, shrinks back only slightly	Smooth Hardens somewhat with heat-aging
Teflon	−65 to +200 C	High cost		Non-flammable	Resists soldering heat	Cuts through easily Poor endurance to corona. Can be had with very thin wall (0.004 in.)
Silicone Rubber	−54 to +200 C	High cost	Very soft and flexible	Combustible		Color coding not feasible by striping; printed-on numbers can be used

temperatures are extremely high, solders containing antimony should be used.

The diameter of the solder should be small enough so that an appreciable length (1/4 in.) is used for each connection. The flux content should be low enough to avoid an excess of flux on the work after soldering.

For small connections, solder diameter should be in the range 0.025 to 0.048 in. On very small work, such as soldering eyelets to printed circuit patterns, solder as small as 0.015 in. to 0.020 in. may be most suitable.

Steady-state soldering-iron temperatures above 700 F are undesirable unless the mass of the soldering tip is small enough so that the temperature will drop to about 500 F during soldering.

The temperature of soldering irons should be checked frequently, using a good pyrometer with a very small thermocouple. Irons that have temperatures above 700 F or below 600 F should not be used.

For work on transistorized equipment, it is advisable to use either a low voltage soldering iron or one that has the body and tip grounded through a third wire in the connection cord. Ungrounded irons can put damaging voltages on transistors.

Copper soldering-iron tips promote flow of solder to the working area, and are preferable to iron-clad tips. However, iron-clad tips do not erode as fast as copper tips. (Even with copper tips, erosion is greatly reduced if 50-50 solder, rather than high-tin solder is used.)

There is a "copper-bearing" solder that reduces tip erosion still further, but this solder does not entirely meet Government specifications. However, copper is picked up during soldering by any composition of tin-lead solder, so finished work contains a small percentage of copper.

At high-soldering temperatures the copper pick-up is fast. The wire strands weaken because of copper-tin alloying within the strand, and bend-endurance is reduced substantially (by as much as 75 per cent).

Repairs to soldered connections are best done with slender soldering irons that operate at about 800 F, so reheating will be quick and will not adversely affect near-by components. ■ ■

"Double-Dabble" Circuit Rapidly Converts N-Bit Binary Code to Decimal

Originally designed in connection with an airborne navigation computer readout, Ken Lally's circuit relatively simply and rapidly converted the computer's binary notation to a decimal display. Mr. Lally is presently working on applications of digital techniques in servo control systems and infrared control and reconnaissance systems.

Kenneth Lally
Development Engineer
Servo Corporation of America
Hicksville, L.I., N.Y.

THE PROBLEM of converting a binary number to its decimal equivalent comes up again and again in sampled data systems, computer outputs, electronic and shaft-angle analog-to-digital converters, and a variety of other applications. Often this problem is sidestepped by resorting to a quasi-binary digit-by-digit code. Such coding methods include binary-coded decimal, 2-4-2-1, 2 out of 5, bi-quinary, etc., where conversion is more easily accomplished.

However, with the circuit shown in Fig. 1, the more efficient pure binary notation can be easily converted to its decimal equivalent. Based on the so-called "double-dabble method"– a rapid pencil and paper technique for obtaining the decimal equivalent of any *N*-bit binary number–the circuit actually converts the binary number to binary-coded decimal, which can then be easily translated into normal decimal notation by a suitable arrangement of logical "and" gates.

Given an *N*-bit pure binary number, the double-dabble conversion method works thus:

1. Begin with the most significant bit.
2. If the next bit is 0, double your accumulated sum.
3. If the next bit is 1, dabble your accumulated sum, that is, double it and add 1.
4. Continue this process for all succeeding bits, carrying along the accumulated sum.

Example: Find the decimal equivalent of 1101001. Starting at the left, first dabble 1 to get 3 because the next bit is 1; then double 3 to get 6 because the next bit is 0; dabble 6 to get 13; double 13 to get 26; double 26 to get 52; dabble 52 to get 105. (Since 1101001 is 64 + 32 + 8 + 1, it is indeed 105.)

To understand how the circuit of Fig. 1 works, let us first discuss certain of the properties of binary numbers. A binary number may be doubled or halved by shifting the number left or right (a decimal number is multiplied or divided by 10). A binary-coded decimal number has the same property, but numbers which are doubled must be adjusted to take account of the fact that a radix of 10 is being imposed upon an array whose intrinsic radix is 16. Thus, in the doubling of any 4-bit digit which is 5 or greater, a digit results (10 or greater) which is outside our limits of constraint, that is, greater than 9, and should be replaced by a multiple digit number. This is readily accomplished by always adding 6 to any result outside the limits of constraint, thus completing the array's basic radix of 16, and re-establishing the number in the constrained radix of 10.

To illustrate, a number outside the limits of constraint may be expressed as $[0000]10^1 + [1010 + y]10^0$, where 1010 (decimal 10 is the number of states in our limit of constraint, and $0000 < y < 1001$ (decimal 9). By adding $[0110]10^0$ (decimal 6), the number becomes $[0000]10^1 + [(1)\ 0000 + y]10^0$. It is seen that a carry results in the 4th bit position, which is transmitted to the 5th bit position in the 2nd decimal digit. This results in $[0001]10^1 + [0000 + y]10^0$, which is the form we seek.

A better logical solution may be obtained by "pre-detecting" numbers which will fall outside the limits of constraint after they are doubled. That is, if any digit is 5 or greater, we will add 3 to it. This in effect, is equivalent to adding 6

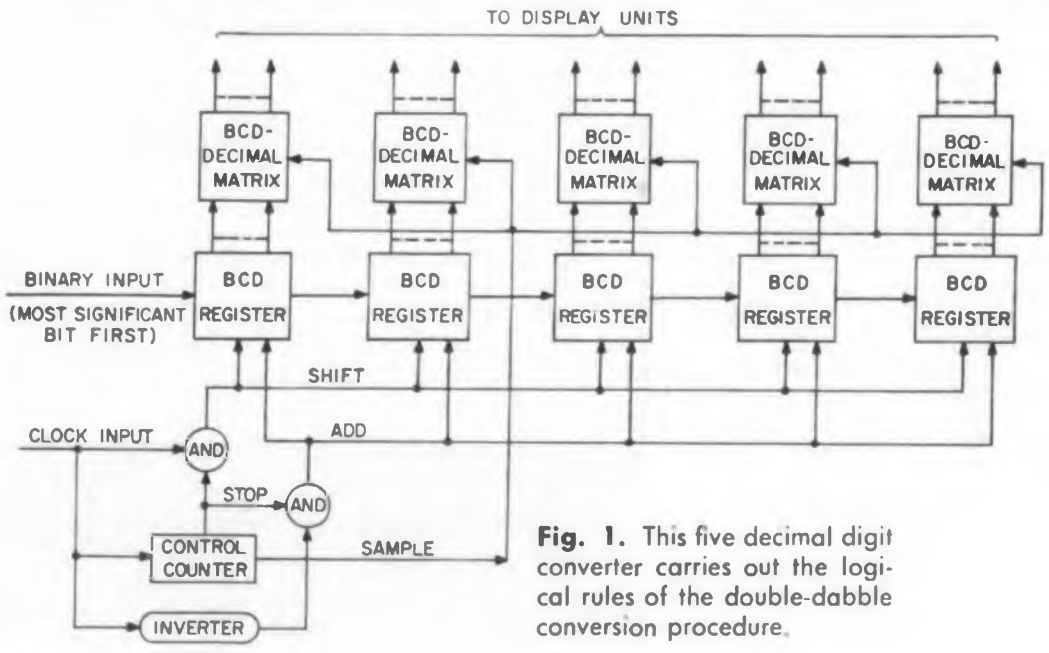


Fig. 1. This five decimal digit converter carries out the logical rules of the double-dabble conversion procedure.

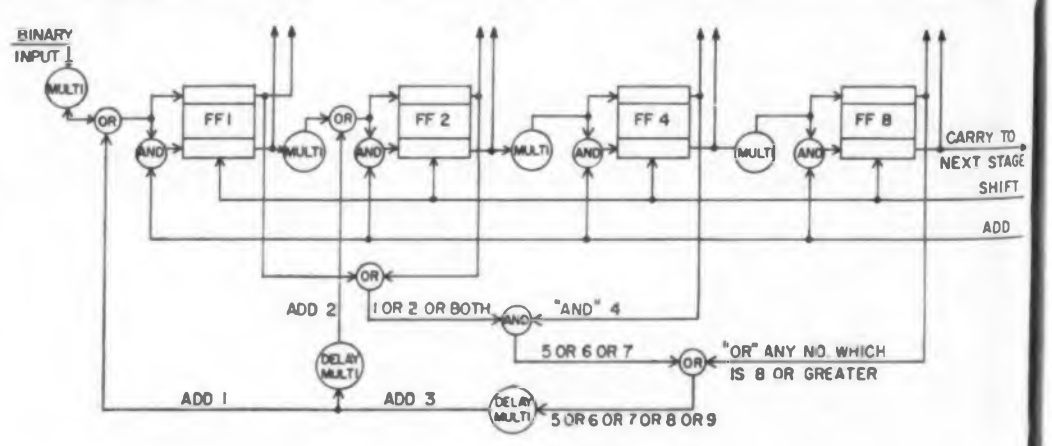


Fig. 2. Binary input is converted in BCD register to binary-coded decimal, which is then fed to binary-coded decimal-to-decimal decoders for decimal display.

) the original doubled number.

Thus we can effect Rule 2 (doubling) by shifting the binary number to the left and adding 3 between shifts where necessary. Inspection shows that Rule 3 (dabbling) is automatically completed by the shifting; if the next bit is 0, the number is doubled upon shifting; if the next bit is 1, the number is doubled and 1 added to it.

Circuit Performs Double-Dabble Logic Operations

The system shown in Fig. 1 is designed to carry out the logical rules of the double-dabble system. Some adaptive logic has been included to obtain the desired result. In effect, the circuit converts from pure binary to binary-coded decimal, and thence to decimal. The conversion from binary to binary-coded decimal is accomplished by the BCD (binary coded decimal) Register, shown in detail in Fig. 2. Here, a logical gating matrix produces an output in each decade whenever the number in the decade exceeds 4. This output is used to pulse the "1" and "2" flip-flops, effectively adding 3 to the number between shift pulses. Note that this may result in intermediate digits which exceed the limits of constraint (as high as 9 + 3). After each doubling-shift, the number once again "makes sense," reading correctly in binary-coded decimal. Consideration of carry pulses requires that 1 and 2 be added sequentially rather than simultaneously. Similarly, the flip-flops must be switched from a shift register array to a binary counter array between shifts so that a true addition is effected. The "add 3" pulses, if any, must be suppressed after the last bit has been shifted into the register. If this is not done the "impossible" intermediate number will result. Therefore, a tag bit in another channel should accompany the least significant bit. Or, if the number of bits is known beforehand, they may be counted, and the Nth count gated to suppress "add 3."

To illustrate the technique, we will examine the states of the register at each shift point and between shift points (denoted by 1/2) as we again decode 1101001 (decimal 105). These register states are listed in the table.

The technique described here will perform the entire binary to binary-coded decimal conversion in *n*-times the shifting rate, a significant improvement over present techniques. Each flip-flop must have the capability of switching at twice the shift rate. Once the conversion is completed, it is a simple matter to decode the result, by suitable "and" gates, into a "1-in-10" representation for display. Each decade is exactly the same as the others and, therefore, readily lends itself to modularization; the size of the instrument can be determined by the number of decimal digits anticipated in the application. ■ ■

Cutting Lead Time in Design

In the next decade, short-lead-time projects will be the key to survival both for the electronic industry and for the free world.

To keep ahead in the race against obsolescence, military products must move from design concept to delivery in the shortest possible time. To keep the industry healthy, companies producing non-military items must be efficient and competitive.

Most engineers are well aware of the urgency and benefits of short lead time—but how is short lead time achieved? Just yelling at a normal project only ends with feeding the scrap heap.

Speeding up an engineering project bears some semblance to speeding up a digital computer. After the components (the engineers) have been pushed to their dynamic limits, further increases can only be obtained by going to parallel and asynchronous operation. With both computers and engineering projects, however, parallel and asynchronous operation schemes demand additional attention to the organization, timing, and communication between the system elements.

In this staff report, ELECTRONIC DESIGN outlines some of the successful engineering and management methods for speeding up the project without overdriving the engineers or letting the system fall into disorganization.

Robert Cushman
Technical Editor

Alan Corneretto
News Editor

"We are all average people. There are no supermen," said one company spokesman. "Worry kills people, not hard work," said another.

The common sense implied in these quotations from engineer-managers (who have impressive short-lead-time projects under their belts), typifies the attitude found the closer one gets to engineers on short-lead-time projects. The stress is on logical planning to permit engineers and other project members to work hard without worrying that their efforts will not be useful.

The master plan which breaks the effort down into logical steps is the most important step in a compressed-lead-time project. ELECTRONIC DESIGN's survey of dozens of firms who have achieved short lead times indicated. The formulation of a good master plan requires individuals with unusual breadth of technical knowledge and managerial experience. Most such individuals questioned had obtained their wisdom and dynamic attitudes from the rigors and satisfactions of past short-lead-time projects.

Next to the importance of the master plan, the survey indicated, was the two-way communication which would inform other project members of the master plan and feed back control information to project management.

Speed, the survey indicated, is achieved by:

1—The accuracy of the master plan.

2—Overlapping the subdivision steps.

3—Education of all concerned to master plan.

4—Close communications to ensure that there is early warning of impending deviations from master plan.

5—Having as much as possible of the project run smoothly so that the creative efforts of the management-engineering group can be directed at achieving flexibility in technically critical portions of the project.

6—Using all the available shortcuts possible, such as standardized modules, automatic production tools.

7—Selecting subcontractors and suppliers who fit into the quality-time pattern.

Two over-all areas brought forth as crucial to shortening lead time were need for wisdom in the many technical decisions implicit in every stage of the master plan, and the necessity for a balanced integration of the complex of departments whose skills carry out the master plan.

Engineer Is Middleman In Technical-Management Operations

The more a project is to strain the bounds of the state-of-the-art, and the shorter the lead time allowed, the greater the experience and wisdom needed for the series of technical decisions used both in formulating and carrying out the master plan. Some order of logical planning, however, can be applied to these decisions, the survey showed.

The diagram at the top of p 41 tells the story. In the diagram, the degree of technical advancedness is plotted against time.

The engineer is the middle man. To satisfy customer problems from below, he reaches up to advanced theory above, and synthesizes a product.

The diagram, somewhat symbolically, indicates how the project starts when technical management believes that research developments have progressed to the point where they can be developed by engineering into a project which will solve a customer problem. This is the first of a series of technical decisions.

The next decision to be made is what portions of the project can be solved by existing technology and what portions must reach up to advanced developments from research.

For shortest lead time, those surveyed unanimously stressed that as much as possible of the project effort should be relegated to the lower mainstream of items which can be accomplished with known components, known subsystems and known methods. Most important, the schedule milestones on these "in-the-bag" elements can be estimated with assurance.

This frees top engineering on the project for concentration on those items whereon they must look "upstairs" to advanced research (traditionally carried on in an unscheduled manner) and try to pull out items which they judge to be ready for hardware realization.

But even for these forward-looking portions of the project, wise project management will have a back-up approach and a definite time milestone in the schedule at which to stop, examine the readiness of the new development, and to make the decision whether this new development can be counted on, or whether they must make-do with the backup. "Adequacy" is the keynote of the backup.

Too much of the effort on many late-delivery projects, those interviewed said, was consumed by engineers "too proud" to use available equipment. They wanted to do it all themselves. Worse yet, said a manager whose firm believes in information retrieval, the engineers probably

Short Cuts to Cutting Lead Time

Think of the Future

Keep a small, highly qualified, free-wheeling, creative group working ahead of the state-of-the-art in your field.

Conduct Market Research

Have a sales-oriented group working in conjunction with your advanced-research group. Market needs in your field will provide a goal for the research group.

Form a Project Team

Build the project around the smallest possible group with the largest possible knowledge and experience. Let this group formulate the master plan and carry it through to the end. Integrate all departments into the master plan by transferring individuals from the departments into the project team.

Prepare Clear Proposals

Make your bid proposals thorough enough to serve later as your master technical and scheduling plan. Not only will your bid sound more convincing but you will be able to begin right away if you are awarded the contract.

Engineer for Adequacy

Engineer the project details towards meeting the specifications, not item-by-item perfection. Perfection, if needed, can come later in the form of field retrofits.

Eliminate the Breadboard

Breadboarding is a luxury. Use it only for critical items. If there are too many critical items you probably don't have a short lead time project. Substitute computer simulation if possible.

Don't Misuse Manufacturing

If only a limited number of units are called for, all manufacturing should be done in a streamlined job shop. If a large number of units are called for, a combined model-shop, pre-production operation should get out the first deliveries and prepare the tooling for subsequent mass-production in the regular manufacturing operation. In general, regular manufacturing will best be able to contribute to short lead time if the project is designed around standard modules.

Start Purchasing Early

Bring in a few good purchasing men early. Isolate the long lead time items and purchase these ahead of time, even if that means risking possible waste.

Make the Model Shop Double for Pre-Production

Get double-duty out of the model shop by incorporating persons with product design experience so that the manufacturing problems are worked out along with the engineering feasibility. Short runs can then be manufactured in this group.

Follow Your Product into the Field

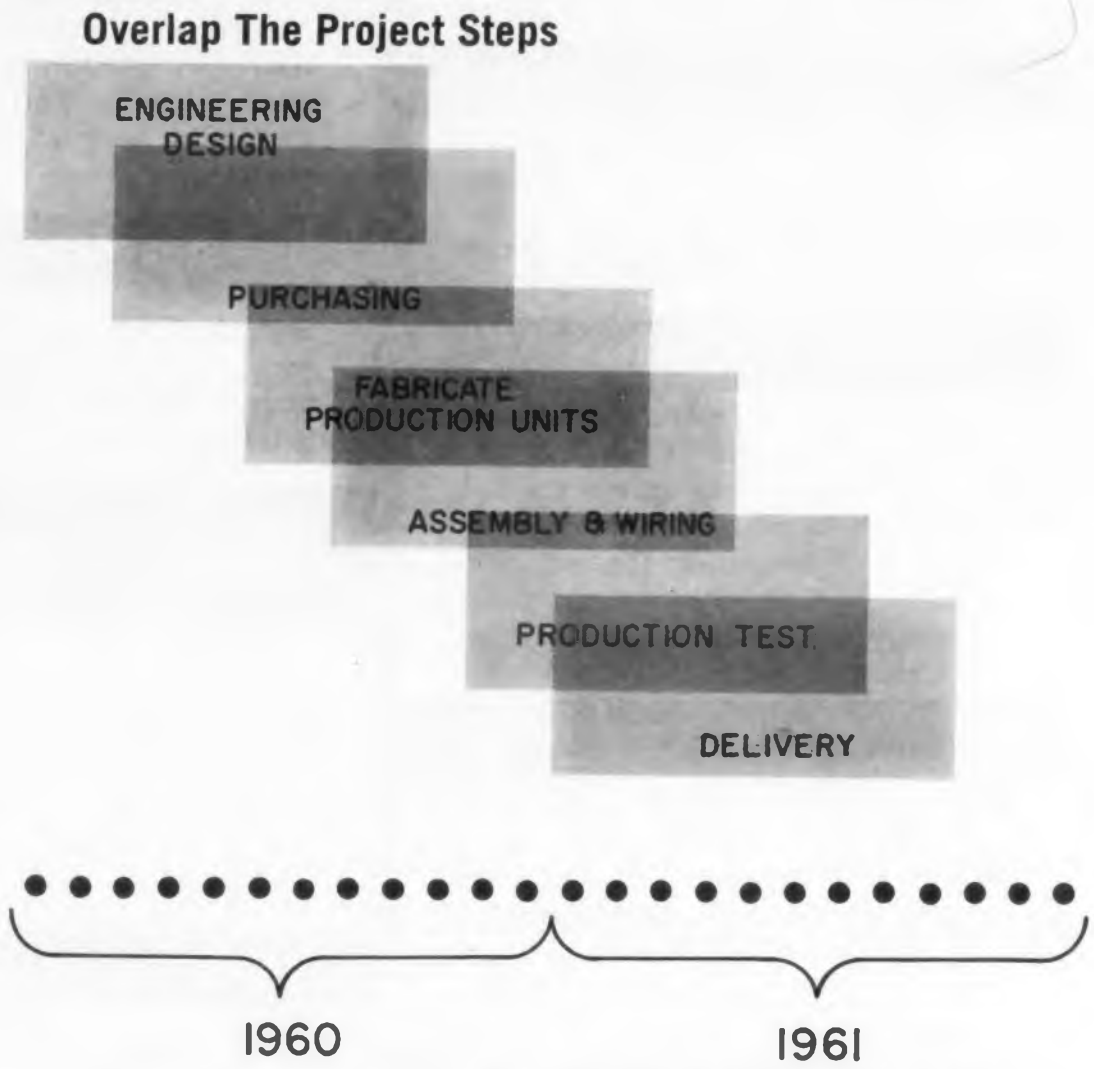
Follow-through is a must on short lead time projects. The lead-time stop-watch is still running until the customer is successfully using the equipment.

Get Test Surprises Early

Critical items should be put on test early in the program, in breadboard form if necessary, to build up reliability histories.

Use Super-Draftsmen

Take full advantage of the important creative possibilities inherent in graphic planning by using a small cadre of high-level design draftsmen working inside the project team. If procedure demands extensive drawings, let the regular drafting department do them later from the finished equipment.



Overlapping project phases are a basic approach to shortening lead time. This demands rapid, deft technical decisions at each project level to permit subsequent phases to get under way.

It Can Be Misused

Not everybody surveyed "bought" the current push for shorter lead times.

One engineer questioned remarked: "Compressed scheduling? That's like calculated misrepresentation of your readiness status on countdown. When the firing officer asks if you are ready, you say, 'Oh sure,' and then pray that someone ahead of you in the countdown sequence will have a failure."

F. Mansfield Young, president of Adage, Inc., Cambridge, Mass., said less humorously that most very short lead-time demands from his customers could be traced to poor planning somewhere along the line.

"It's not uncommon," he added, "for an engineer to pressure a vendor into quoting an unreasonable delivery time just to have a scapegoat when the engineer sees that his project won't make the schedule. More than once we have made deliveries ahead of time, only to find our customers disappointed. They no longer had a scapegoat."

Mr. Young felt that more real lead time could be bought by building increased reliability into standard items, rather than incessant "improvements" which always leave reliability one step behind. He estimated that 50 per cent of these "improvements" wind up in the warehouse anyway.

By way of example, he recalled seeing an engineering group sweating over a large, special-purpose system, unaware that the program had been canceled several months earlier.

The worst effect is upon the engineer himself, Mr. Young said. "He loses his self respect if he can't see his efforts going towards useful end products."

New Products committee meeting: key step in getting management backing for a short lead-time project. At International Rectifier Corp., El Segundo, Calif., Chief Engineer F. W. Parrish (standing left) and Consulting Engineer Edward Diebold (standing right) tell management members about increased power capacity of new rectifier columns.

(Continued from p 37)
didn't know the solution was available.

Don't Let 'Department Empires' Bog A Project Down

The other over-all area, project integration, was said to be the result of the stultifying trend towards "time departmentalization" of a project's flow which has come from the functional departmentalization. They admit that this functional departmentalization into engineering, drafting, manufacturing, etc., was natural enough as firms grew under leisurely paced "peacetime" production cycles.

But when a project must be laboriously "expedited" step by step through research, engineering, drafting, purchasing, production, test, field service, and the like, it ends up by "sitting" for a due time in each department. When, with great expediting effort, at long last it is wrenched free from one department, it usually hits the next completely cold. Management of the next department knows it is coming, of course, but those at the working level do not.

The suspicion, distrust, and misunderstanding with which the manufacturing department looks at the drawings and specifications from the engineering department is all too familiar.

Not only does step-by-step scheduling make total project lead time the sum of the dwelling times in each department, but lumped communication packages which carry the project from one department to the next are wholly inefficient. The final blow on this type of project progression usually comes when the product gets to final test and won't meet specifications.

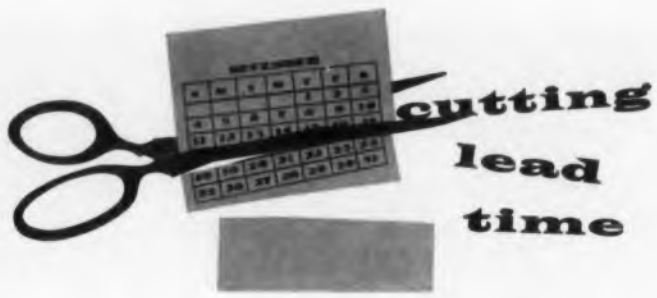
And when it is taken back to engineering, too often nobody remembers anything about it. Some of the engineers have by now left the firm and the rest are deep into launching new surprises down the sluggish and shoal-ridden manufacturing channel.

What follows is a series of examples taken from the survey. In three major groups they cover, management philosophies, design methods, and production tools which the firms named found cut their lead times.

(text continued on p 40)

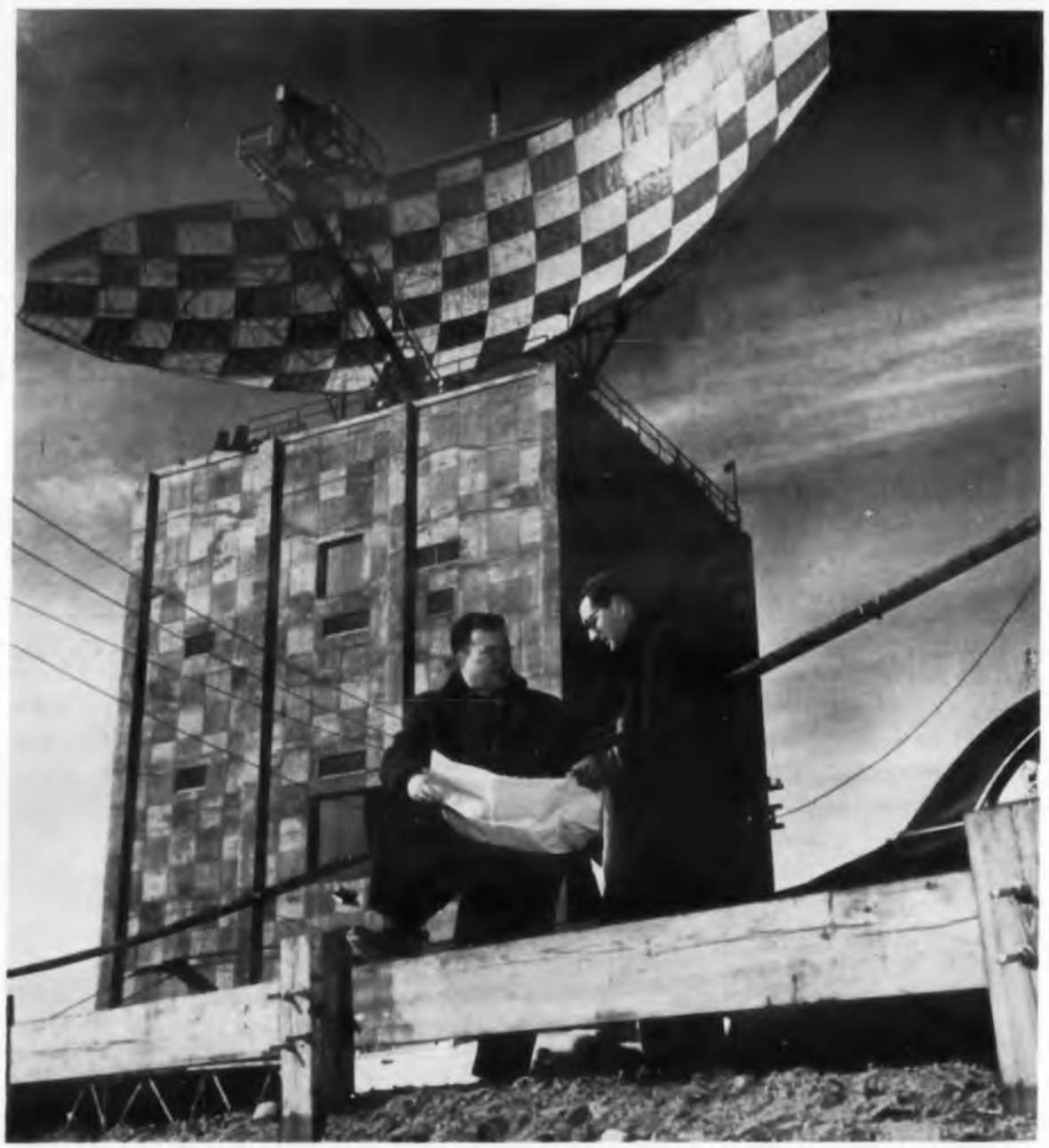
Cutting Lead Time— A Military View

Col. C. H. Burch, deputy commander of the Army's electronic proving ground at Fort Huachuca, Ariz., told ELECTRONIC DESIGN: "One of the most important aspects of lead time is for everyone concerned to have a clear understanding of the requirements of the system to be produced. It is extremely important to know what specific capability has to be produced at what specific time."



Engineers Must Be Management-Conscious

The shorter the lead time, the more engineers on a project become management-conscious. Not only do shorter lead times force management responsibilities on the engineers, but most engineers tend to believe that management decisions above them can make or break their own technical efforts. Here are some successful approaches to welding engineers to management.



Cold-war psychology demands that the enemy know the U.S. can accomplish projects like the AN/FPS-35 defense radar system within two years. Although the full scope and schedule of this multi-site system are classified, this picture of the second unit at Montauk Point, N.Y., was taken last spring. Sperry engineers Frank Mulligan (left) and Lawson Singer directed the assembly of the Sperry and subcontractor parts sent directly to the site.

Large Company Moves Fast

It is said that large companies cannot move swiftly. However, Joseph Emerson, engineering department head, search radar, Sperry Gyroscope Div., Sperry Rand Corporation, Great Neck, N.Y., explained how his group was able to break the large company rule and move the large AN/FPS-35 search radar project through Sperry's departmentalized organizational structure in record time.

"This was definitely not a panic program," Mr. Emerson emphasized. "Panic programs are 50 per cent doomed to failure before they start."

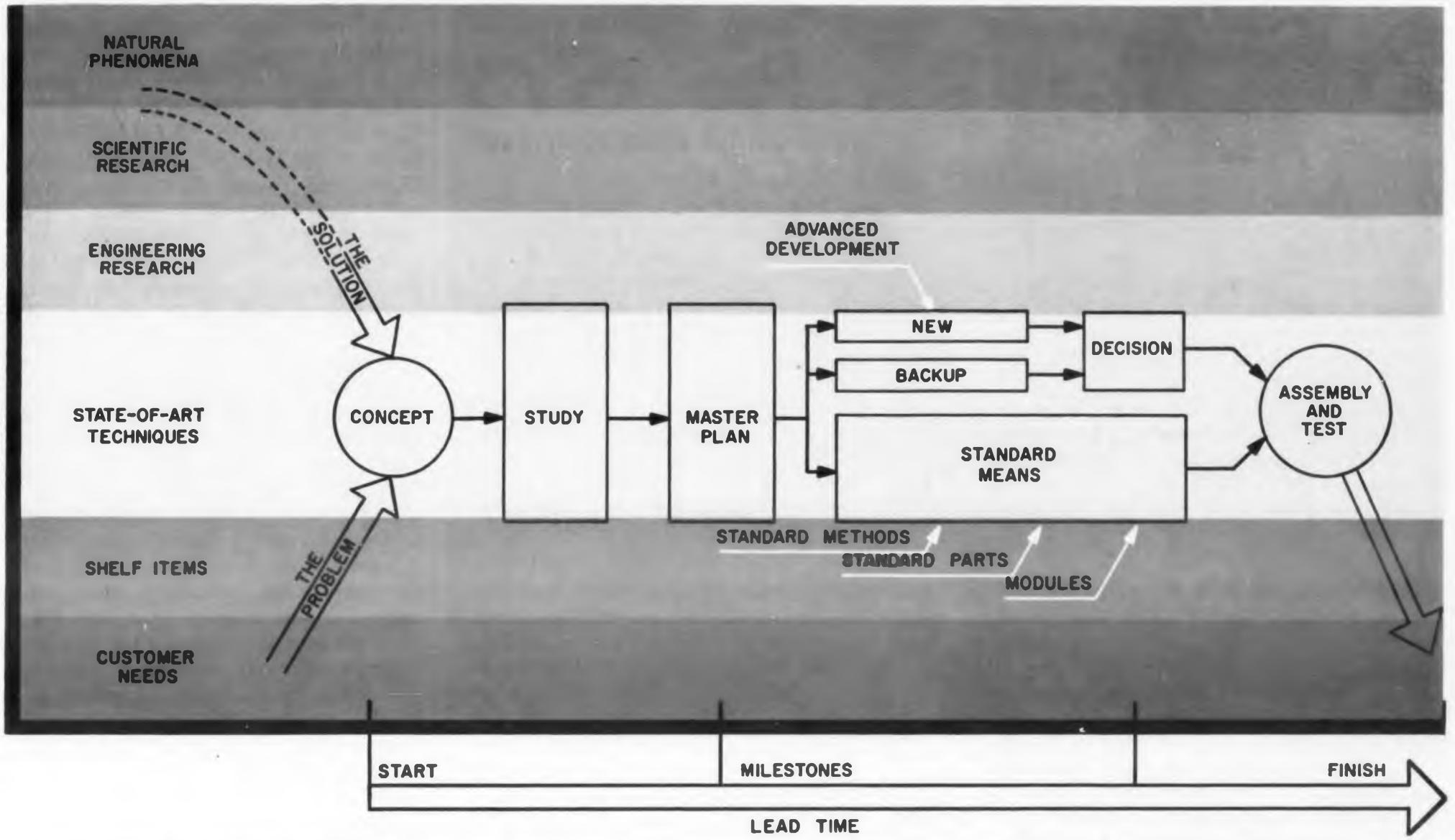
"We started by forming a small, highly experienced group, and this team pooled its thinking into the basic over-all plan of operation," he said. "Then, quite important, the same team carried the plan through to completion serving as the management and technical leadership basis for the much larger team needed for a project of this magnitude.

The team was formed, naturally enough, from a search-radar equipment group whose efforts were directed towards formulating Sperry's bid on the AN/FPS-35 competition during the winter of 1957-58. It was just prior to and during the short bid-preparation period that the key planning that was to direct the whole project took place, he recalled.

The quality of the original plan can make or break a short lead time project, Mr. Emerson stressed. In his opinion it was possible for his group to come up with a workable plan within two months because of its extensive experience and the fact that the group had already been studying the technical area and needs.

When, in early 1958, Sperry was notified by the Air Force that it had won the competition (partially on the basis of delivery promise date),

Getting the Hardware from Blue Sky onto the Loading Dock



Planning for a particular project must outline both the vertical and horizontal aspects of the effort shown in this chart. This planning culminates in a master plan. To achieve short lead time, a master plan must be conceived when management decides that engineering research has ripened enough so that a specific project can be put into the customer's hands within a given time. On the vertical axis, technical innovations should be isolated for special attention. As often as possible, known methods, standard parts, and modular building blocks should be used. On the horizontal time axis, project milestones must be set. An intelligently conceived master plan balances technical ambition against the production deadline and gives some sort of organization to the often-hectic phase overlap which follows.

Mr. Emerson said it was merely a matter of implementing the plan laid out in their proposal.

"For speed, we followed the rule of directing each element of the job towards the most experienced person or operation we could find," he recounted. "Because the AN/FPS-35 was a very large, inclusive 'turnkey' type project [an 85-ft-tall building was included], this meant that many outside consultants and subcontractors had to be drawn into the effort."

"One of the most frustrating aspects to this large-scale farming-out for our engineers," he said, "was having to give out the development work on some of the most technically inviting subsystems. Instead of tackling the engineering problems themselves, they found they were turning into administrators for the subcontractors."

"Despite our tight schedule, we did push the state-of-the-art," Mr. Emerson said. "But on the technically advanced items, we made sure we were also carrying along a backup approach."

In these cases, the advanced and backup approaches were carried along in parallel until the time leeway preset by the master schedule was used up. Then the project management evaluated the new development and made the decision whether it was sufficiently reliable for inclusion in the project, or should be scrapped in favor of the backup.

"On our day-to-day scheduling, our attitude was that of constant realistic re-evaluation of the probabilities that a date would be met, but on the other hand we held our major schedule milestones firm," Mr. Emerson said. "For example, if a schedule had a lower than 50 to 70 per cent probability of being met, it was revised and given immediate heavy effort."

A clever little twist on the schedule sheets for this project was to completely blackout due dates once a step was accomplished.

"This forced us to keep our thoughts on what remained to be done," Mr. Emerson said, "and discouraged us from dwelling on the mistakes and victories of the past."

Another form of backup was using two engineers for each project item, Mr. Emerson explained. An electronic engineer was paired with a mechanical engineer. This had the desirable effect of bringing the packaging along with the circuit design (it was also helpful on the many primarily mechanical elements of a project such as this).

But the real justification for assigning two engineers to each item was in having another man knowledgable on that item, in case one of the two men dropped out, according to Mr. Emerson.

Fortunately, the attrition of engineering man-

power was low during the fast-paced first one and a half years of the project. Mr. Emerson attributed this to the feeling of team and individual accomplishment engendered by seeing results follow fast upon one another.

One engineer, however, did drop out for three months because of nervous exhaustion, Mr. Emerson admitted.

A fringe benefit of the two-man approach was that it gave management the choice of pulling one of the engineers off the item if it became apparent that he was becoming too technically enamored with that item. There was always the other man to carry the project through without loss of continuity.

As with many other short-lead-time projects surveyed, breadboards were almost completely eliminated, except for the special technically-advanced portions of the system.

In fact, on this project, the subcontractors were told to ship their parts directly to the radar search tower erection sites. On the first installation, which was at Thomasville, Ala., the Sperry project engineers lived on the site to supervise the assembling and testing of the system.

Mr. Emerson said this was like no other post-war project he had seen: they were connected with the home plant by leased telephone line, teletypewriters, and a company airplane flying on a three day a week schedule. "As a result, the first 'turnkey' operation was achieved in a little over half the normal time for a program of this magnitude and complexity," Mr. Emerson said.

Continuity Comes From Individual

The same concept of assuring project continuity by having a nucleus of engineers follow through the complete project is used by Transitron Electronic Corp., Wakefield, Mass.

The "race" to get a new semiconductor out before the competition starts with the management decision that a device under development in the Transitron research laboratory is ripe for commercial exploitation.

The continuity chain is started by retaining a few men from the original research team as consultants on the development project. At the same time, some production people who will eventually supervise the production line are added to the development project.

Transitron feels that this overlapping of the people on the project, phasing the various levels in and out gradually, never turning the project abruptly from one group to the next in a lump, has cut 40-50 per cent off the lead time.

Computer Aids Management

What is at fault when a good master plan, a good engineering team, and an expert manufacturing operation fail to produce short lead times? Usually it is a series of little things which build up into one big final mess.

A design engineer forgets to work out completely the required transient response of a certain component, a draftsman doesn't put down all the parts needed on a bill of materials, a purchasing agent orders a wrong-size component for a long-lead-time item, a faulty manufacturing methods instruction causes a difficult assembly to be scrapped, parts aren't delivered on time by the subcontractors, or parts won't go together on assembly.

As long as human beings are running a project, many of these things will happen. The trick is to keep everything on schedule so that when the unforeseen does happen, it is discovered as soon as possible. It is also mandatory to have communications channels which enable management to know the minute the unforeseen happens.

But formal, quantitative, written communications can be the archenemy of people working night and day to get something done in a hurry.

One answer comes from Loral Electronics Corp., New York City, where formalized communications based rigidly on "the book," is the credo of Edward J. Garrett, vice president and general manager. Loral, incidentally, claims that the reason it has been able to more than double sales each year to reach its present $36 million level has been its reputation for on-schedule delivery of technically advanced military systems.

"Loral is tightly run and I believe in lots of reports," continued Mr. Garrett, pointing to three thick organization and procedure manuals.

"Pretty ambitious, aren't they, for a firm that made them up two years ago when we were still a little company. This is the foundation for prompt delivery and growth," he said.

The obvious question, of course, was whether such bulky procedures wouldn't completely bog

Loral's Vice President and General Manager Edward J. Garrett (center) believes in "lots of reports," and in using a computer, not engineers, to make them out. The computer is a Remington Rand Univac 60 data-processing system, and the seven girls (at right) work full time preparing the punched cards which feed it.

down a fast moving electronics firm. Mr. Garrett admitted that perhaps they would if Loral had not set up a Remington Rand Univac 60 electronic data-processing unit (EDP).

Loral's computer lead-time-control plan, which is still being extended, amounts to having management's master plan wired into the EDP's program routines. Then, as man-hours, material-availability status, and other information becomes available on projects, it is translated onto punched cards and processed, not with the idea of building up bushels of statistics, but to let the computer routines detect the "exceptions" to the master schedule. The whole purpose behind Loral's approach is to alert management to those spots which need top level attention.

Normally, complete reports are processed on a monthly basis, but, with the computer system, Loral can call for a status report on any project and have it within six hours. This is not a matter of having the whole plant stop and make up a report, but of stacking the cards in the computer's input, wiring in the organization of the report, and letting the computer do the rest.

"The machine will tell us, for example, if we have the parts in the stockroom to go right into production on an item which has become suddenly high priority," Mr. Garrett said.

When a department is unable to cope with an "exception" exposed by the computer, the company has a staff-level "Flying Squad" which is sent in to help.

The extent of Loral's computer production-control system is indicated by the fact that it has five girls at key-punch machines continuously translating plant paperwork into machine language. Roughly 50,000 punched cards are on file at this time. The firm, however, now needs 30 per cent less clerical help and future extensions of the system are expected to cut down clerical personnel further.

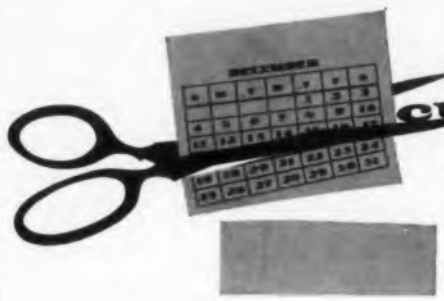
As a final indication of the present thoroughness of Loral's data system, nearly everybody in the plant is on the time clock. Only a dozen or so top management men don't actually punch in, but their secretaries fill in time cards for them. Very little in the plant is outside the EDP system's jurisdiction.

Possibly because of the sharp eye of the computer system, most of the management meetings are held after hours, evenings, and weekends.

"The best time to think and plan," said Mr. Garrett, "is after the day's rush of attending to the 'exceptions' exposed by the system is over."

Pilot Plant Bridges the Gap

The time from engineering release to off-the-shelf delivery was becoming too long for management at Polarad Electronics Corp., N.Y. Cash



was still flowing out for manufacturing revisions while customers were impatiently wondering why they couldn't get delivery on certain products.

The answer which Polarad has set up is an 80-man pilot plant group composed of product designers, technicians, tool designers, high-grade manufacturing types and enough engineers to eliminate the need for this group to run back to engineering with questions.

Polarad expects that because all of the skills needed to product-engineer a new model for manufacturability will be incorporated in the pilot group, they will cut the pre-production time in half and at the same time come out of the pilot phase with ten finished units.

The first of the 10 units should be ready within four months or less and will be used for show demonstrators and sales representatives.

"We expect to sell everything that comes off the pilot line," Polarad's George E. Kaufer told ELECTRONIC DESIGN.

Mr. Kaufer pointed that close teamwork between engineering and manufacturing was particularly important on microwave work where juggling components for ease of packaging can make a great deal of difference in the performance of an up to 100-Gc circuit. In addition, the mechanical plumbing elements of the equipment tend to generate their own lead-time problems.

'We Ship The Prototype'

A good example of fast-paced but high-level military contracting comes from Radio Engineering Laboratories, Inc., a subsidiary of Dynamics Corp. of America, in New York City.

In February, 1959, REL received a $6 million order for the NATO "Ace-High" troposcatter communication stations which are to stretch from Britain to Turkey. Now, less than two years later, REL has shipped most of the units of this 10 kw, 1 mc system.

"We start building the prototype within months after receiving the contract," Seymour Sinuk, assistant to the chief engineer, said. "We work out our engineering and manufacturing problems on the first prototype, then ship it as our first unit."

The engineering change notices (ECN's) developed for the prototype are progressively incorporated into the original designs of following

Just a month after this picture was taken, REL shipped this "Ace High" system unit to NATO. "We may have screw heads showing on our front panels, but we get advanced developments out working for our customers month and even years ahead of the usual schedules," an REL engineer said.

units (REL's orders run from a few orders to hundreds of units).

"We can get the prototype under way so fast because we are a close-knit, engineering-production team operating under one roof," Mr. Sinuk said, "and we use direct methods."

"For example, if an assembler on the prototype has a problem, he doesn't stop work; he walks over to the engineering department and gets his question answered by the engineer on that phase of the project.

"We don't let purchasing red tape hold us up on the prototype either. If a part is missing, a messenger gets on the subway and goes over to one of the electronics supply houses nearby and buys it off the shelf."

Realistic Lead Times

A program-evaluation system is used at GE's Light Military Electronics Dept., Utica, N.Y. to analyze programs in terms of critical events and the effects these events would have on the complete programs.

Important in this technique is the assignment of realistic lead times for the various phases of a program and the subsequent optimizing of the order of attack on the individual phases. How-

ever, the company points out, although lead times chosen for individual phases are realistic they are not what could be called low-pressure scheduling.

An Integrated System Project has been developed to help LMED keep track of program progress. The system makes use of computer to monitor a program through all its phases as it progresses through the very large department.

Quick Reaction Capability is another formal technique used at LMED. The system is based on having a variety of specialists available for rush jobs, each with experience in accelerated production. Under this system, the department reports, a 35-tube receiver for the AN/ALT-6 countermeasures set was delivered in a flyable version seven weeks after a design and breadboard had been completed. The receiver was built by manufacturing personnel working in the engineering laboratory. Sketches rather than schematics were used, and the engineering shop personnel were able to improve the basic designs while they monitored assembly.

Like other companies, GE uses advance ordering, under which parts and methods components for a particular project are ordered from suppliers very early in the program.

By ordering specific parts in specific quantities early, the department believes it gains in avoiding supply bottlenecks much more than it loses in occasionally having to return, stock, or waste parts.

Getting The Heads Together

The need for integrating engineering and the early stages of manufacturing was a constant theme running through the replies of most of the companies.

Most straightforward among the many approaches to arriving at engineering-manufacturing integration was that of intermixed layout of the plant.

"Merely by arranging our engineering offices in a semicircle around the work area, we made it possible for an engineer to communicate with a technician on his project by just leaning over the elbow-height partition," said John R. White, manager, Monitor and Controls Division, Fenwal, Inc., Framingham, Mass. "It's better than tying him up writing memos," Mr. White told ELECTRONIC DESIGN.

Plant layout at Daystrom's Control System Div. removes, in a very simple manner, one of the most notorious obstacles to shortening lead time—poor communications. Technician Emery Strong (left) has walked over to project engineer Dan Senuta's office with a circuit board to discuss a possible design change. Progress of electronic assembler wiring computer rack reminds both of project status.

Another firm which uses this configuration to advantage is the Control Systems Division of Daystrom, Inc., La Jolla, Calif. This group must move rapidly to fill its ambitious commitments in the area of computer control systems for complete industrial processes.

Not only does Daystrom place the engineers around the combined laboratory-factory area, but it gives each project a nickname (a secretary's name is chosen from a hat) and hangs that on a sign over the project.

With partially completed hardware staring them in the face as they come and go from their offices, the engineers are constantly reminded of lead-time realities.

How Do You Handle Engineers?

All through the survey it was noted that management was concerned about the best way to handle engineers on a short-lead-time project.

Should their natural personal interests in the product be encouraged or discouraged?

Most managers said yes, but only up to a point.

DeVar Systems, Inc., Glenbrook, Conn., went further in this direction than most. It said that it had cut the lead time on a recent transistorized miniature instrument from a customary 18 to 24 months to six months, from conception to marketing, by encouraging the engineers to follow their creation all the way, even to final marketing.

This was done on an individual basis by breaking the development-team goal down into goals for each engineer. The result, according to DeVar, was complete project continuity on all levels.

However, to prevent too much engineer involvement in less-essential detail, the group was encouraged to use outside shops for printed circuits, chassis, and general hardware.

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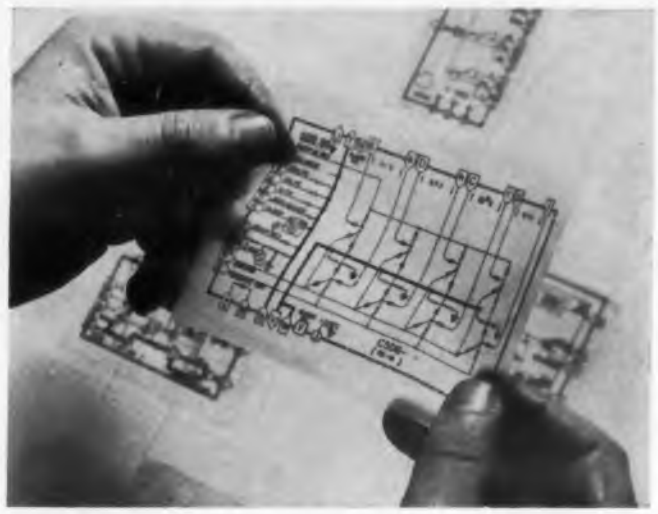
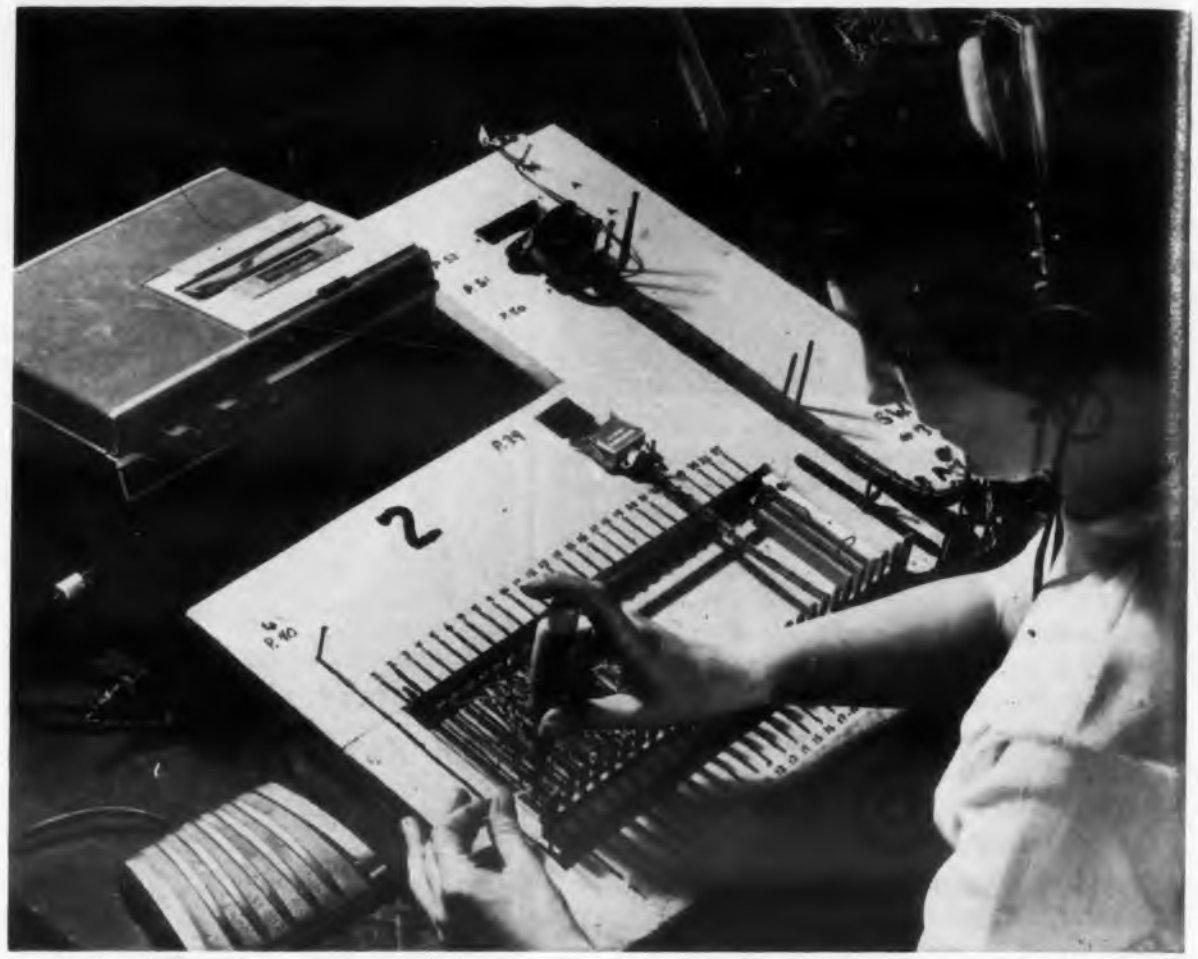


Application engineer at Adage "designs" the customer's special-purpose system by filling in his block diagram with stickers representing circuitry of the standard modules.



Harness wirer receives instructions from tape via earphones. The special harnesses unite the standard modules into one-of-a-kind customer systems.

Methods Complement Master Plan

Certain methods have become popular with short-lead-time projects. They fit into the conflicting pattern of maximum technical progress in minimum time and are available at every project level.

At Adage, Inc.

- ***Systems from standard modules***

The modular concept, which has been so important to the electronics industry, can be the basis of a fast lead-time operation.

Adage, Inc., Cambridge, Mass., which specializes in one-of-a-kind digital-instrumentation systems, feels that it has arrived at a workable combination of modular manufacturing with custom engineering. Quick reaction to typically specialized customer demands is accomplished along side an even-paced and efficient manufacturing operation.

"A few talented application engineers get their hands dirty in every phase of the customer's system, from conception and negotiation to delivery and customer education," explained Adage president F. Mansfield Young.

It is the application engineer's function to marry standard modules coming out of manufacturing to special-purpose customer systems.

To permit the engineer to do this as effortlessly as possible, Adage has carried its modular concept into drafting by having applique stickers for each of its sixty standard modules. The engineer fills in his system-block diagram by pressing the appropriate module stickers down on the drawing. He completes the drawing by ruling in the wiring interconnections.

In this fashion, a system can be designed by one application engineer in from two hours to two days, with no inter-departmental fuss, Adage said.

The wiring harness is the implementation of the application engineer's interconnections. Here, time is cut from six days to two by directing the harness maker by taped audio instructions.

A production department technician breaks the engineer's drawing into, "connect module J-11, pin little p to module J-12, pin capital F," etc. At the wiring bench, the harness maker wears a headset and calls for a playback of the instructions, one by one, by pressing a foot pedal. The tape automatically halts at the end of each instruction, and there is a second pedal in case she wants an instruction repeated.

The complete harness, the standard modules, and a cast aluminum container are delivered to the applications engineer. He slides in the modules, connects the harness, and checks to see if his system meets specifications before release.

At General Electric

- ***Computer-designed welded matrices***
- ***GEESE—versatile analog simulator***
- ***Library of printed circuits***

Two methods are being combined into one important time-saver in the production of circuits at General Electric's Light Military Electronics Dept., Utica, N.Y. LMED is planning to elabo-

ate present techniques to produce automatically computer-designed welded-wire matrices. Production of the matrices would be tape-controlled with computers.

In choosing welded-wire construction for its matrices, LMED feels it gains flexibility over conventional printed-circuit boards, particularly because of the almost unlimited number of crossover possibilities available in the matrices, which makes layout design easier.

Two layers of parallel wires running perpendicular to each other and separated by an insulation sheet form the basic matrix. Welded connections at desired crossover points are made by burning through the insulation.

The welded-wire technique is said to lend itself to automatic methods. The company already has a unit for producing 30 ft per hr of the matrices and is working on a component placer and an automatic tester.

Eventually design engineers would transfer data from schematics to special forms, which programers would use in punching a computer tape. The program would enable the computer to consider the necessary number of connections, lead location, component size, junction points, and other factors in laying out the matrix.

The present combination of matrix machine and computer reportedly produces a breadboard matrix in about 90 min.

GEESE, GE's Electronic System Evaluator, is a special-purpose analog simulator said to save time at all stages of design. This tool, actually a roomful of specially designed equipment at the Defense Systems Dept., Syracuse, N.Y., permits the department to evaluate a circuit, subassembly, piece of equipment, or system at any stage in the production cycle from the first paper proposal to block diagram to schematic to prototype.

The key to its operation is said to be the way the system's designers were able to achieve simulation of proposed radio frequencies by use of audio frequencies. That is, the simulator uses audio frequencies where the actual equipment would use radio frequencies. Highest frequencies in GEESE are on the order of 20 kc. As a result, typical bandwidths and frequencies are scaled down by a factor of 1 million, and time is stretched by the same factor. One microsecond in the actual equipment becomes one second in the simulator, a major advantage in analyzing circuit and equipment functioning.

Because the simulator provides a relatively uncomplicated method of varying system parameters, these circuit-design factors can be optimized before construction of any hardware. Redesign is therefore minimized, the company claims.

The Defense Systems Dept. has used the simulator on a number of design projects, including radar and communications equipments and systems. Lead time on all these projects was said to be cut significantly.

In addition to its obvious use in cutting design lead time, the simulator is said to be capable of testing for interference problems, jamming susceptibility, waveform analysis and other factors. These features can be important in reducing lead time, the department believes.

A library of standard circuits plays an important role in cutting lead time at GE's Heavy Military Electronic Systems Dept., Syracuse, N.Y. The department is currently compiling a library of standard circuits, each designed by designer specialists in particular areas of circuit design. These circuits are in printed-board form. The department, however, is planning to start a library of actual circuits, so that time can be saved in trying out circuits. If a company user needed a circuit to complete a breadboard or to make some tests, rather than have the departmental shop make up a circuit, he would use the one on file in the library.

Standardized printed-circuit boards have been developed at HMED—with conservative features—to avoid production bottlenecks. The department's standard boards do not use plated-through holes or other relatively recently developed features.

Paper duplicates of blank printed-circuit boards are used by designers at GE's Heavy Military Electronics Dept. These paper forms duplicate the layout and dimensions of the actual standard printed-circuit boards. Layouts made on the forms are sent to the shop for fabrication. With this system, sample units are reportedly returned in about three days.

Computer-optimized wiring schemes is another technique used at HMED to save time. Because the department uses a sufficiently large number of solderless wrapped-wire connections, it has proved practical to figure out the optimum

A Garland of Timesavers

Accurate scale models of military planes are used by Melpar, Inc., to test electrical characteristics of antenna designs. The scaled-down antennas are used to transmit at frequencies scaled up by an appropriate, proportionate value. Melpar reports that the system permits duplicating full-scale antennas in actual flight. The scaling also saves test area by an amount proportional to the scaling factor.

Adaptive systems may soon be applied to cut lead time. Specialists at the Air Force's Wright Air Development Div., believe that because adaptive systems can be made to self-adjust to a new aircraft, as much as two years may eventually be cut off a typical flight-test program.

Kits of many types are being produced to give engineers pre-tested designs to use as expedients or as flexible tools in designing. For example, the Ferroxkits developed by Ferroxcube Corp. of America provide a selection of ferrite cores and other parts useful in building a variety of circuits.

Mathematical design formulas have been developed to permit an evaluation, on paper, of a basic design so that samples of equipment are necessary only for verification and not for developmental experimentation. According to Sperry Rand, using the special formulas permits final detail drawing to be made from preliminary calculations while the samples are being fabricated.

Spreading new information fast did a lot to cut lead time, reports Burroughs Corp.'s Electronic Tube Div. The decision to announce the division's then-newly developed Beam-X switch at the time of the 1960 IRE convention was made in conjunction with the decision to concentrate on informing design engineers of the product's characteristics. This was done by informing the technical press of the development and encouraging detailed articles on the switch's design *Electronic Design's* editorial treatment of the Beam-X switch is shown below.) Burroughs reports that this combination of factors produced good results.


Small Low-Cost
Decimal Switch
Simplifies Many Circuits

scheme on a computer. This has proved to be an important saver of both time and material.

Schematic changes sent via closed-circuit TV is another tool used at HMED. The large size of the department permits use of this novel time-saver, which eliminates time lost in inter-office and inter-ship mail channels. Also, extra copies of drawings are often eliminated.

At Magnetic Controls Co.

- ***Computer speeds amplifier designs***

Computation steps can be paralleled too. By setting up all the design equations for magnetic amplifiers in one simultaneous solution on an analog computer, Magnetic Controls Co., Minneapolis, Minn., engineers said they halved the time formerly consumed in plowing equation-by-equation through the design problem.

Formerly, the equations (gain, time constant, and voltage absorption) would be solved first, and then the engineers would calculate the practical considerations: Would the coil fit the core? Would the temperature rise be within bounds? Usually they weren't, and a series of tedious iterations of the calculations would be needed before a solution converged.

Now, a twist of one of the computer potentiometers changes a parameter, and the output meter indicates the total affect of the change immediately.

Greater rigor of design is encouraged for it is easy to incorporate non-linear functions in the computer set-up.

At Sierra Electronic Corp.

- ***Multi-source supply***
- ***Home-made parts***

Multi-source supply, in the sense that any part specified by company designers must be available, in compatible versions, from several suppliers, is one of the rules at Sierra Electronic Corp., Menlo Park, Calif, a division of Philco Corp. Sierra feels that because it insists on assured supply, it avoids time loss due to supplier problems.

In-house-built parts is another time-saver at Sierra. Wherever possible, the company makes

it's own parts to avoid dependance on suppliers. All metalwork, and even such items as special transformers, are made in the house.

At Hewlett-Packard Co.

▪ ***Drawings sent to tooling as finished***

Parallel operation is used at Hewlett-Packard Co., Palo Alto, Calif., to speed designs into hardware. In the past, the company waited until its design engineers had finished the designs and drawings on all elements of an equipment or a system before sending the complete package to manufacturing. Now, however, as individual assemblies are finished they are sent to the tooling designers as the first step in the manufacturing process. This is a significant change for H-P because the company concentrates on high-quality products, produced from carefully planned and debugged designs. General lead time at H-P is long rather than short, because of this.

Home-Made Test Equipment

Company-developed testing equipment often saves lead time. This test console ages and tests counter-decade units at Hewlett-Packard. A hand-held push-button device activates a stepping switch that temporarily substitutes a resistor to bring the decade into calibration. The resistor value is displayed on the readout in digital form. The older, slower way involved clipping on resistors until the right value was found.

(continued on p 52)

(text continued from p 51)

From the United Kingdom

Bookcase housing for printed-circuit modules from the electronic department of Sir W. G. Armstrong Whitworth, Ltd., Coventry, England, indicates that the British approach is not very different from the U.S. approach. One variation mentioned by the firm, however, was building up two prototypes: one by the usual skilled model-shop technicians and the other by production personnel. This dual approach, the British firm said, ensured that the final product was both electrically sound and manufacturable. A trick used in actual manufacturing was to guide the semi-skilled workers by extensive photographs of the prototypes.

Damper in One Week

This helicopter yaw damper (above) was produced by Lear's Astronic Div., Santa Monica, Calif., in one week's time. The sub-modules, one of which is removed, represent basic electronic circuits and they are packaged in precision-cast aluminum modules. A screw driver is the only tool needed. A second version (below) was produced within a few weeks, according to Lear. Payoff of this short lead-time project was that hits of anti-tank missiles fired from helicopters rose from 20 per cent to nearly 100 per cent.

At U.S. Army Signal Corps

▪ *Mechanized filing hastens retrieval*

A major concern of management in cutting lead time is to avoid redesigning circuits components and assemblies that have already been developed. Re-inventing the wheel, as this danger is known, has long been recognized as waste of money, talent, and especially, time.

Fortunately, just as the problem is reaching the critical stage in some areas, information retrieval and data-processing specialists are developing systems to make information available faster. In the military, where pressure to cut lead time is heaviest, several organizations have established mechanized systems for retrieving documents and engineering drawings.

At the Signal Corps' Materiel Support Agency, Fort Monmouth, N.J., about 300,000 Signal Corps drawings and about 500,000 manufacturers' drawings are already filed for mechanized retrieval. **The system used** is Minnesota Mining and Manufacturing's Filmsort, in which microfilm copies of drawings are mounted on aper-

Engineering drawings are available quickly to engineers at the Army Signal Corps' facilities at Fort Monmouth and elsewhere because of semi-automatic sorting, filing, and retrieval system. Microfilmed copies of drawings are mounted over apertures in IBM cards, which contain data useful to designers.

Ready-Made Modules

Because these modules are complete with front panels and controls, Electro-Pulse, Inc., Los Angeles, the manufacturer, said they permit an engineer to go directly from his block diagram to a complete functioning instrument or system.

tures in IBM punched cards. Drawings are retrieved semi-automatically, thus saving much time and wasted design effort, Signal Corps officials report.

Other agencies like Redstone Arsenal, with 800,000 active and 1.5 million historical drawings on file, Bell Telephone Laboratories, with 100,000 active drawings, and the Air Materiel Command, use this system.

BTL is processing its collection of technical documents for mechanized retrieval. A new system is being set up to cross-index by key words in titles all internally generated company reports produced in 1959. Bell's Permutation System Index is based on the method used by the American Chemical Society to produce quickly indexes to its abstracts. The main difference between the systems is the length of printed lines processed by the systems' computers and finally printed out. Bell Labs is using a 120-character line, ACS, a 60-character line.

In Bell's system, an IBM 7090 is programed to take the title of a report and make successive

permutations of it. Thus, the title "A New Transistor and Diode Chart," would be formed into "Transistor Diode Chart," "Diode Chart Transistor," and "Chart Transistor Diode."

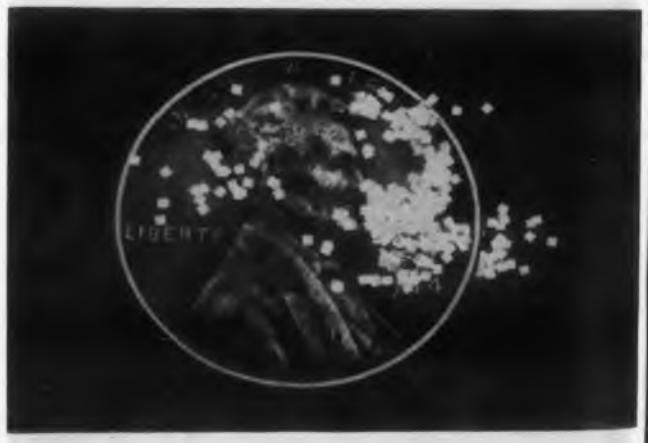
Each of these titles is alphabetized into its proper place in the index together with the identifying report number.

The laboratories expect great benefits from use of the system by its engineers, and is considering broader applications.

New Factor: Fast Supply

Another factor helping designers cut lead time is the growing number of suppliers able to deliver materials, parts and components in a very short time. Companies like Ohmite, Corning, Hoffman, C. P. Clare, Texas Instruments, Fan-

Semiconductor Short-Cut



Solder-coated base tabs help cut lead time in producing semiconductor devices. These tabs combine a solder preform and a rigid base tab in one piece of metal. This eliminates feeding and orienting separate parts. The Alpha Metals tabs are also said to eliminate fluxing the base metal.

Developed in anticipation of demand, this Markem 148A marker for power transistors, automatically marks and ejects transistors in automated production operations.

steel, Mesa Plastics, Stackpole and others offer 24-hr delivery on many products. Some companies and distributors are now offering less than 24-hr service. And a few companies are guaranteeing one-day service.

In general, it appears that engineers are able to get standard parts faster than previously. To aid in fast delivery of a product line, one company, Aero Research Instrument Co., Chicago, culls from incoming orders all requests for its ceramic insulated wire and ships the order at once. The remainder of the request is filled at the usual pace.

Some suppliers try to stay one step ahead of their customers. For instance, Huggins Laboratories, Inc., Sunnydale, Calif., reports that it has developed many tubes in advance of customer request. This is said to encourage designing improved systems around the new product rather than the converse.

This system was developed partially because of the difficulty of stocking traveling-wave tubes, an important Huggins product. These tubes are delicate and liable to damage when unmounted in a supporting structure. Therefore, Huggins chose continual R&D as one of its major lead-time reduction techniques.

Another company that anticipates industry needs and in so doing helps cut lead time is Markem Machine Co., Keene, N.H., which makes labeling and marking machines. By keeping one group of its design engineers working on developmental equipment, the company is able to have machines ready for customers who require new capabilities. The company's 148A marker, which prints and ejects transistors automatically, was developed in anticipation of automated production lines.

An earlier machine, the 13A for marking TV picture tubes, was likewise developed before a need existed. ■ ■

Function Generator Has High Accuracy

FUNCTIONS of two independent variables can be generated with ±1 per cent of full scale accuracy. This is accomplished by a new analog function generator that combines state of the art improvements in transistors, the invention of a metal-ceramic resistance plane, and a unique rectilinear servomechanism. Resolution is 0.02 per cent of full scale.

Developed for aircraft simulation equipment by Svein Rasmussen of Link Div. of General Precision, Inc., Palo Alto, Calif., the Model 201 analog generator is now being marketed as a product.

Analog function generator fits in a 19-in. rack, provides a voltage $z = f(x,y)$ with ±1 per cent accuracy.

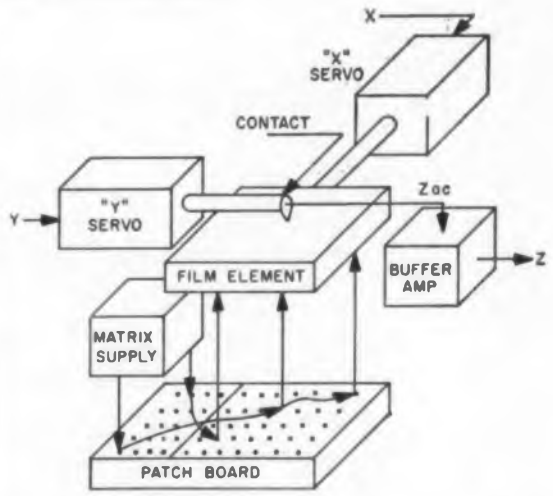


Fig. 1. When voltage is applied to the X servo an unusual resistance film element is displaced a distance proportional to it; input to the Y servo results in movement of a contact along the y-axis. Function is programed by patching 441 discrete voltages into the resistance film.

The equipment is capable of high accuracy, frequency response of 5 cps, and can generate numerous function types. Some of these include:

- $z = f(x, y)$
- $z = f[g(x), h(y)]$
- $z = f(u{\cdot}x, v{\cdot}y)$ and
- $z = f(x_1 + x_2 + y_1 + y_2 \ldots\ldots)$

Functions are represented in the generator by storing 441 discrete voltage values, proportional to the output variable of the function on a resistor film, in a 21 x 21 matrix configuration.

These excitation voltages are programed on a plugboard, which is connected to 201 outputs from a high precision, 1,000-cps transformer supplying integral voltage increments from −100 to +100 v.

A rectilinear servo is used to position the film element with a displacement proportional to one independent input variable. A second rectilinear servo, operating 90 deg from the first in the same plane, moves a sliding contact on the resistance plane in response to corresponding variations of the second input variable. Automatic interpolation between the preset points is accomplished inherently in the design of the film resistance element.

A development sparked by research on Cermet potentiometers at Helipot Div. of Beckman Instruments, Fullerton, Calif., the resistance plane consists of an alloy of ceramic and noble metals deposited on a ceramic substrate by precision film techniques. Resistance from point to point on the plane is closely controlled. The surface is continuous and smooth with no discontinuities, measuring 2-1/2 by 2-1/2 in.

Look at the drawing of Fig. 1: 441 terminals tap into the plane from underneath, spaced in 21 equidistant rows and columns. Connections to these terminals are brought out to the right two-thirds of the front panel patch board shown in the photo. The left-hand third is connected to a precision transformer that has 201 secondary taps and is part of the matrix supply.

By making appropriate patch-board connections, each of the 441 points on

the resistance plane is given the desired excitation voltage, dictated by the function to be generated.

The *X* servo shown in the drawing moves the resistance plane as noted above. All leads to the film are therefore made through flexible pigtails so it can be moved freely. The plane is displaced a distance proportional to the *X* input variable. To insert the *y* variable the voltage is applied to the *Y* servo, which is at right angles to the *X*, and which moves a sliding contact on the surface of the resistance film. With the proper potentials applied to the resistance film, the output from the sliding contact is a voltage $z = F(x, y)$. To have the output represented by a dc voltage (the matrix supply is at 1 kc), a scheme for synchronous demodulation is incorporated in the instrument.

No matter how accurate the resistance plane, system accuracy could not be held to ±1 per cent of full scale if the servomechanisms had the inherent backlash, friction and inertia problems of conventional servos. Engineer Rasmussen designed the rectilinear unit shown in Fig. 2. It consists of a shaft, free to move axially in a set of rectilinear ball bushings, and which carries a central plunger made of relay steel.

Two solenoids, each about three-quarters the length of the plunger, encircle the shaft such that the ferromagnetic plunger extends a little beyond the center of the solenoids when the plunger is in mid-position. Energizing either of the coils accelerates the plunger toward the left or right, depending on which one is energized. By connecting the two to the output of a push-pull dc amplifier, the plunger can be moved in the proper direction according to the polarity of the input to the amplifier.

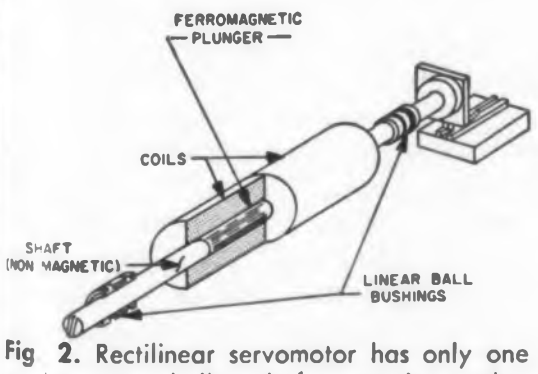


Fig 2. Rectilinear servomotor has only one moving part: a hollow shaft supporting a relay steel plunger, which is acted on by forces generated by current in solenoids.

There is adequate force on the plunger (0.4 lb per amp for a solenoid with 1,000 turns, 0.12 sq in. cross section and 3 in. length) to overcome the small friction and drag forces, inertia (due to the mass of the motor shaft assembly) and the resistance and inductance of the coils. To reduce the shaft mass, light weight materials in a hollow-tube configuration were used; linear ball bushings virtually eliminated bearing friction. "In fact," Rasmussen told ELECTRONIC DESIGN, "the only friction and drag forces present in any practical system are those resulting from the load alone, including feedback potentiometers. We don't know what the drag terms from eddy current, hysteresis and inductive coupling between coils are —but they're pretty small."

Both solenoids are encapsulated in a heat-conducting metal-filled plastic and enclosed in a fin-cooled assembly. According to Rasmussen the motor would never normally be subjected to high currents for long enough periods of time to make it run even moderately warm, "But," he said, "just in case of prolonged operation under overload conditions, the fin arrangement greatly helps heat dissipation."

Electrical specifications for the function generator include input and output of 100 vdc into 10 K; drift less than 0.04 per cent during 1 min and less than 0.1 per cent during 8 hr. Frequency response is asserted to be better than five cps for an output amplitude within ±1 per cent and a phase error of 5 deg. Function specification calls for a continuous, single valued function with maximum output change of ±10 v for an independent variable variation of ±1 v. Representation accuracy is, of course, 441 points on a 21 x 21 matrix.

Relatively small in size (8-3/4 x 19 x 15-1/2 in.) the analog function generator can be mounted on a standard 19-in. rack. It is available within 90 days from date of order. Price for a standard unit is set at $7,500.

For further information on this high-accuracy analog function generator, turn to the Reader Service Card and circle **251**.

Power Supply Is Based On A New Concept

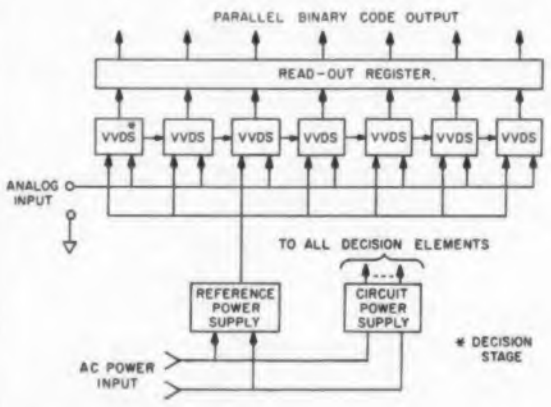
POWER SUPPLY voltage regulation can now be altered without changing any wires or even removing the supply from it's mounting. The units which make this possible are representative of a line of power supplies now available in models of 6, 12 and 28 volts at 2 amp, each with separate power supply and regulator, built in modular form.

Power supply reliability is enhanced through a modular concept that permits separation of the more reliable magnetic components from the less reliable transistors, and the easy replacement of the regulator. A great percentage of power

The Varitan Space Saver power supply has it's power unit and regulator separated

Analog-to-Digital Converter

UNTIL recently the fastest rate for analog-to-digital converters was in the neighborhood of 50,000 conversions per sec. The use of a new design principle has enabled Epsco, Inc. Boston, Mass. to develop a new instrument capable of performing 30 million conversions per sec. Models AV-6B, AV-7V and AV-8B are scheduled for mass production and are 6, 7, and 8-bit units respectively. These units operate at speeds up to 5 million conversions per sec.



Block diagram shows the flow of information in Epsco's Video Verter.

A super-speed device capable of 30 million conversions per sec has been built for laboratory purposes. Super-high speed analog-to-digital conversion problems not covered by the AV-6B, AV-7B or the AV-8B can be built on a custom basis, according to the companies spokesmen.

The operation of the Videoverter, as the devices are known, is simple. The extremely high speeds are reached by providing a separate comparator for each bit rather than the repeated use of the same comparator as is usually done. The input voltage is applied to all the comparators simultaneously. The amount of voltage to cause a "1" output from the nth comparator is $1/2^n$ of full scale voltage plus the sum of the voltages represented by the binary numbers generated in the higher order comparators.

This is accomplished by having the reference sides of the nth comparator

supply failure is caused by the regulator of a power supply. With the Victory Electronics, Inc., 50 Bond St., Westbury, N.Y., down time caused by such failure need be no more than the time required to pull out the disabled regulator and plug in another.

Another advantage is the choice of regulation given. Where close regulation is not of prime importance, for instance where regulation of one per cent is adequate, the power supply can operate by itself. But, where the voltage has to be more exactly controlled, the operating key can be removed from the supply and the regulator attached in it's place. One regulator now available provides a ±0.25 per cent regulation while another provides a ±0.05 per cent regulation over all conditions of line or load.

The unit is encased in a shell of unique diamond design which provides a maximum dissipation of heat in a smaller volume. It eliminates the need for a heat sink. The components are derated and protected against short circuits. For more information on these modular power supplies turn to the Reader Service Card and circle **253.**

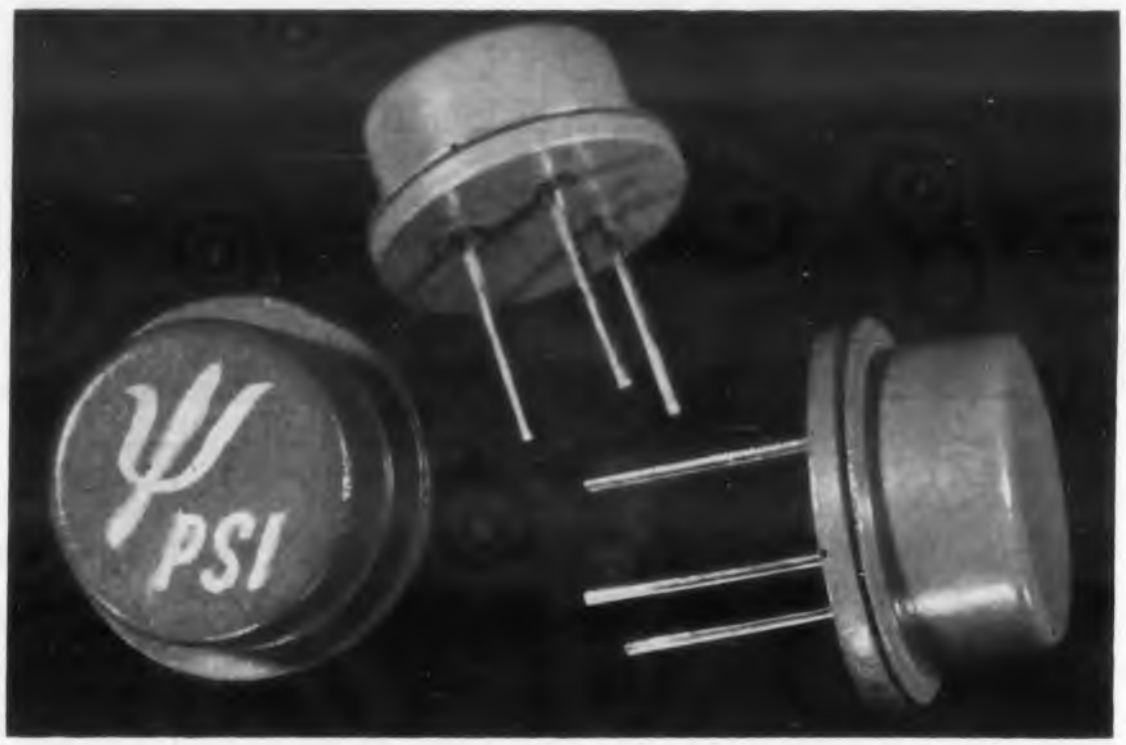
connected unconditionally to the reference by one conductance $G_n = \frac{G_0}{2^{n-1}}$ .It is connected by $n-1$ other conductances $G_{n-1}\, G_{n-2} \ldots . G$, through gates. The gate G_{n-k} is closed if the $(n-k)$th digit is a logical "*1*" and open if a logical "*0*". These conductances have the value $G_{n-k} = \frac{G_0}{2^{n-k-1}}$. This results in the operation previously described.

The specifications of these instruments are the same except for the number of binary bits in the output. They are as follows: analog input voltage range, 0 to +10 v full scale; analog input current range, 0 to +100 ma full scale; input impedance ohms; conversion accuracy, ±0.5% or 50 mv whichever is greater, ±1/2 the least significant bit; digital output form, parallel; digital readout voltage levels, 0 v = binary one, −6 v = binary zero; digital output source impedance, 600 ohms.

For further information on this high speed lone of digital-to-analog converters turn to the Reader Service Card and circle **252.**

NEW PRODUCTS

Covering all new products generally specified by engineers designing electronic original equipment. Use the Reader-Service Card for more information on any product. Merely circle number corresponding to that appearing at the top of each description.



Power Transistor Delivers 5 W At 30 Mc With Power Gain Of 10 Db — 783

Type PT530 silicon transistor, triple-diffused mesa type, delivers an output of 5 w at 30 mc with a power gain of 10 db min at a collector voltage of 28 v. It provides useful oscillator power up to 200 mc. Saturation resistance is very low and indicates possibilities in switching applications. Physical structure is an n-p-n-n+ configuration. Because of its high power output, the PT530 will perform as a transmitter final amplifier stage or as a driver for the type PT901 high frequency transistor. It can also be used with Varicap frequency-multiplier stages to obtain power levels of above 1 w in the 1,000 mc range. The PT530 is housed in a TO-8 industry standard package.

The manufacturing process includes an exclusive etch-rinse sequence which assures contaminant-free silicon surfaces.

Pacific Semiconductors, Inc., Dept. ED,1255 Chadron Ave., Hawthorne, Calif.
Price: *$125.*
Availability: *Immediate, in evaluation quantities.*

Frequency-To-Analog Converter Is Accurate To 0.1% At Up To 10 Kc — 787

Designed for advanced-instrumentation applications, model 574 frequency-to-analog converter has an accuracy of 0.1% at frequencies to 10 kc. It has variable and selectable time constants. Standard units have two channels; a one-channel unit can also be furnished. Each unit offers these ranges: 10 to 500 cps, 200 to 2,000 cps and 1,000 to 10,000 cps. Line stability is ±0.1% for a ±10% line voltage change. Long term stability is ±0.25% for eight hours. Sensitivity is 5 mv to 100 v. Input impedance is 30,000 ohms, nominal. Model 574H has a 10-v output and model 574L, a 1-v output.

Potter Aeronautical, Dept. ED, P. O. Box 1123, Union, N. J.
Price: *Model 574L, $1,100; model 574H, $1,250.*
Availability: *45 to 60 days.*

Panoramic Receiver Monitors Radiation From 0.05 to 100 Kc — 785

This panoramic field intensity receiver accurately monitors radiation from 0.05 to 100 kc. Designated type AN/URM-126, the instrument operates unattended and automatically produces photographic records. Its applications include measurement, display and recording of the intensities of noise and cw signals, both modulated and unmodulated. It defines signals that are separated by only 15 cps. The requirements of MIL-E-16400 are met.

Motorola, Inc., Military Electronics Div., Dept. ED, 8201 E. McDowell Rd., Scottsdale, Ariz.

Variable DC Power Supply Is Held within 1 Mv — 784

Model MS-50-2 variable dc power supply is held to 1 mv under all load conditions and over its entire variable voltage range of 0 to 50 v dc at 200 ma. It uses a high-gain differential amplifier, a stable reference and a series regulator to maintain a virtually constant dc output voltage. The module is for test equipment, transistor powering, computer systems, ground support equipment, automation control, recorders, strain gages and similar applications requiring super-regulated dc voltages. Specifications include: line regulation, ±0.002%; ripple, less than 1 mv; transient response, 20 μsec; temperature coefficient, 0.003% per deg C; ambient temperature, −10 to +60 C; size, 3.5 x 3.875 x 6.5 in.; weight, 3 lb 6 oz; and input, 105 to 125 v ac.

Valor Instruments, Inc., Dept. ED, 13214 Crenshaw Blvd., Gardena, Calif.

Price: $175.

Availability: One to two weeks.

Microwave Tetrode Produces A 40-W Output At 3,000 Mc — 786

Designed for cw applications, type Z-5267 planar tetrode produces an output of 40 w at 3,000 mc with a gain of 7.5 db. Primarily intended for grounded-grid cavity circuits, the tube can also be used as an rf power amplifier for telemetry and other communications applications. Typical specs are: dc plate voltage, 1,000 v; dc screen-grid voltage, 300 v; dc control-grid voltage, −6 v; dc plate current, 160 ma, dc screen-grid current, 8 ma; dc control-grid current, about 25 ma; drive power output, 7 w; bandwidth, 25 mc. Operating efficiency is 25% to 30%. The tube has been shock-tested at 450 g; it weighs 4 oz and measures 1-3/4 in. in diameter and less than 3 in. long.

General Electric Co., Power Tube Dept., Dept. ED, Schenectady 5, N. Y.

Price: $275.

Availability: In sample quantities to the OEM market.

NEW PRODUCTS

Crystal Filters 768

For 4-mc, single sideband equipment

These upper and lower sideband filters have the following specifications: center-frequency insertion loss, 6 db max; passband ripple ±1 db; stopband loss, at least 80 db; input impedance, 10,000 ohms, balanced and 3,000 ohms unbalanced. Four types are offered. A typical unit, model USB-4000-2.45 has a center frequency of 4001.5 kc, a bandwidth at 6 db of 2.45 kc and a bandwidth at 80 db of 4 kc.

Systems Inc., Dept. ED, 2400 Diversified Way, Orlando, Fla.

Price: *$125 to $300.*

Availability: *90 days.*

Medium-Power Diodes 763

Temperature range is —65 to +200 C

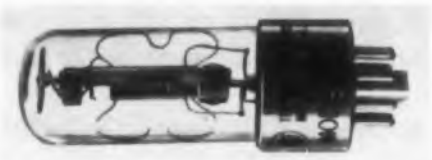
These medium-power diodes have an ambient temperature range of —65 to +200 C and can be mounted in any position. Four different package styles are offered. The general-purpose unit is offered in two types: a commercial and industrial type with a forward voltage drop of 1.3 v or less at 1 amp and a military type with a forward voltage drop of 1.3 v or less at 1 amp.

Controls Co. of America, Electron Div., Dept. ED, Tempe, Ariz.

Availability: *Immediate.*

Time-Delay Relay Switch 770

Provides 500,000 operations



Model 200 thermal time-delay relay switch, for military and industrial use, is guaranteed to provide a minimum of 500,000 operations at rated

load. Applications include: sequence operations, motor starting, hold-over circuits, ignition timing, cathode protection, sustained-over current, pulsing and flashing. Delay ranges are 5 sec to 3 min with tolerances of ±15%. Ambient compensation is −65 to +125 C. Standard models are rated at 3 amp at 115 v ac; 6 amp can be furnished on special order.

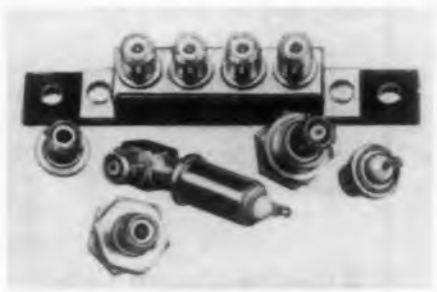
Thermal Controls, Inc., Dept. ED, 41 River Road, North Arlington, N.J.

Price: $4.45 in lots to 10.

Availability: Two to three weeks.

Coaxial Cable Connector 758

Provides a hermetically sealed ground



Series DM isolated-ground connector gives protection from circulating currents and ground loops that cause oscillation and faulty readings of current and voltage. A concentric, three-element, glass-to-metal seal provides a hermetically sealed, isolated ground without shoulder washers and other insulating or mounting devices.

Dage Electric Co., Inc., Dept. ED, 67 N. Second St., Beech Grove, Ind.

Delay Line 765

With special locking device

Type V887 miniature delay line has a special locking device to prevent delay changes under vibration without affecting the set delay. Designed for printed-circuit applications, the unit is continuously variable from 0 to 0.5 μsec. Characteristic impedance is 1,000 ohms, rise time is 0.08 μsec, attenuation is 0.3 db, resolution is 0.001 and temperature coefficient is better than 150 ppm.

Columbia Technical Corp., Dept. ED, 24-30 Brooklyn-Queens Expressway West, Woodside 77, N.Y.

Price: $35 in lots of 1,000.

Availability: 14 days.

Every time another American missile is fired, special new cables are put to the toughest test of all.

These cables *must* perform. If they failed there'd be no telemetering, data recording, circuit checks, electronic computing, etc.

To create such cables, you need special research and engineering skills, special experience, *and a hard-headed stubbornness about quality*.

That's why you find so many millions of feet of these specially designed instrumentation cables bear the label, "Rome Cable division of Alcoa."

Two places to look next time you need a cable that never existed before

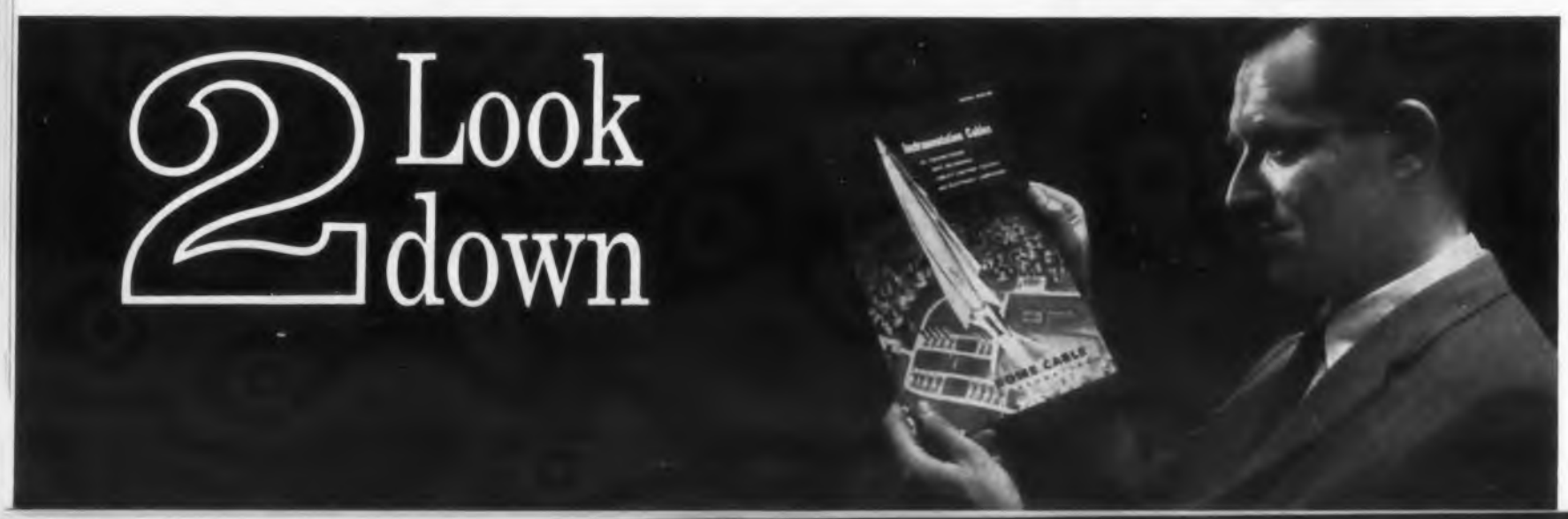
Look down.

Learn the capabilities of your cable maker, the types of insulations available, the standards to which his cables are built. Look over some typical cables—from 2 to 193 conductors in each—to get an idea of what he can do for you.

Arm yourself with a copy of our Bulletin RCD-400, "Instrumentation Cables". It even contains a "Cable Procurement Information Form," on which you can outline your needs.

No obligation, of course. Just write for a copy. Department 11-120, Rome, New York.

ROME CABLE
DIVISION OF **ALCOA**



NEW PRODUCTS

Elapsed-Time Indicators 778

Two ways available

The 19200 series elapsed-time indicators fitted with four-digit drum type counters and are powered by the firm's 19100 synchronous ac motor. One unit registers tenths of hours to 999.9; the other registers hours to 9,999. Maximum elapsed-time error is ±0.1 hr at 400 cps and 104 to 124 v. The units stand shock, vibrations, high altitudes and spray.

A. W. Haydon Co., Dept. ED, 232 N. Elm St., Waterbury 20, Conn.

Antenna Stabilization Assembly 751

For air weather-radar systems

This shock-mounted assembly consists of an output junction box and a two-axis, gravity-erected gyro. The junction box can be modified to channel the capabilities of the gyro into outputs that meet a wide range of weather-radar system requirements. The system meets FAA regulations and is designated type 18900-1-A.

Eclipse-Pioneer Div., The Bendix Corp., Dept. ED, Teterboro, N. J.

Germanium Power Transistors 775

Junction temperatures to 100 C

Offered in 11 types, these alloy-junction transistors are npn units using the JEDEC TP-36 single-ended package. Designed for industrial and military applications requiring units with high current,

◀ CIRCLE 50 ON READER-SERVICE CARD

voltage and dissipation ratings, these transistors are particularly useful in power switching, voltage regulators, dc-dc converters, and audio amplifier service. They are designated: types 2N173, 2N174, 2N277, 2N278, 2N441, 2N442, 2N443, 2N1099, 2N1100, 2N1358 and 2N1412.

Radio Corp. of America, Semiconductor & Materials Div., Dept. ED, Somerville, N.J.

Vacuum-Tube Voltmeter 771

Resistance range is to 1,000 meg

Model 850 vacuum-tube voltmeter offers resistance ranges to 1,000 meg. Full scale range on dc is 0.5 v. Frequency range is 15 cps to 3 mc. It has a 7-in. scale and electrical protection against meter burn-out. Input resistance is 11 meg on all dc ranges; ac impedance is 0.83 meg min. Applications of the instrument include in low-voltage transistor circuits.

Triplett Electrical Instrument Co., Dept. ED, Bluffton, Ohio.

Low-Temperature Thermocouples 777

Come in ranges to 300 K

This line of gold-cobalt vs copper thermocouples comes in open and closed well types in ranges from 0 to 300 K. Accuracy is ±1% of span or 2 K. All are interchangeable to ±4 K. Complementary indicating, recording and control instruments can also be furnished.

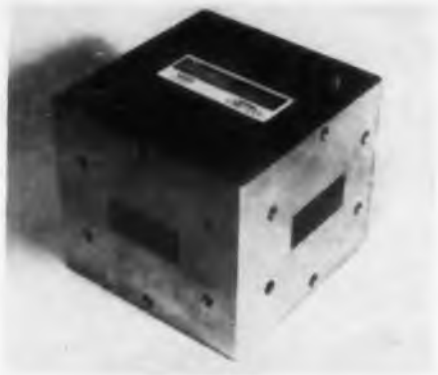
Cryogenics, Inc., Dept. ED, 1129 Vermont Ave., N. W., Washington 5, D.C.

CIRCLE 51 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Ferrite Circulators 769

Convertible to microwave switches



The C-band T-circulator and the stripline Y-circulator can be converted into microwave switches by replacing the permanent magnets with electromagnets. Model CM210 waveguide T-circulator has the following specs: frequency range, 6,150 to 7,550 mc; isolation, 20 db min; insertion loss, 0.2 db max; vswr, 1.15 db max. Connectors mate with UG/50/U. Model SL250 stripline Y-circulator, shown, has these characteristics: frequency range, 3,300 to 3,800 mc; isolation, 22 db min; insertion loss, 0.3 db max; vswr, 1.2 max; connectors, type N.

Micromega Corp., 4134 Del Rey Ave., Venice, Calif.

Price: *$250.*

Availability: *45 days.*

Time-Delay Control 754

Delay periods are 0.05 to 100 sec

Having fixed-time delay periods from 0.05 to 100 sec, these time-delay relays provide true delay on drop-out logic. No power is required during the timing cycle. Timing accuracy is ±10% of nominal time-delay rating under any combination of rated voltage variations, temperature, vibration, shock and acceleration. Temperature range is −55 to +71 C; vibration rating is 10 to 80 cps at 0.06-in. peak double amplitude from 80 to 2,000 cps at 20 g. Shock rating is 50 g for 11 msec and acceleration rating is 20 g, steady state, any axis. Mil specs are met.

Tempo Instrument Inc., Dept. ED, P. O. Box 338, Hicksville, L.I., N.Y.

Silicon Zener Reference Elements 762

Provide ±1% stability

Type 1N429 silicon Zener refernce elements provide a voltage stability of 1% or better over the temperature range of −55 to +100 C. Operating voltage is 6.2 v, making the unit suitable for precision instrumentation, computer and data processing equipment. Power dissipation is 200 mw at 25 C, maximum dynamic impedance is 20 ohms at 7.5 ma, and power derating factor is 1 mw per deg C. The unit measures 0.23 in. in diameter by 0.33 in.

International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

Price: *$7.20 in lots to 100.*

Availability: *From stock.*

High-Vacuum Diode 766

Has rugged construction

Type 7030 power triode can be used in rectifier and clipper service. Construction is free of internal insulators, spring tensioning devices and fragile elements. The cathode is a thoriated tungsten bifilar helix. Specifications include: heater voltage, 13 v; heater current, 36 amp; piv, 25 kv max; anode current, 6 amp; peak anode current, 20 amp; anode dissipation, 2.5 kw.

Central Electronic Manufacturers Div., Nuclear Corp. of America, Dept. ED, Denville, N.J.

Price: *$210.*

Availability: *From stock.*

Subminiature Relay 761

Weighs less than 3/4 oz

Type 1N429 silicon Zener reference elements center terminal configuration and a 3-amp contact rating. It is less than 1-in. long and weighs less than 3/4 oz. Designed for use at −65 C, it meets MIL-R-25018 and MIL-R-5757C and has an expected life of 100,000 operations minimum at rated load. Applications are in control systems, computers, aircraft and missiles.

Comar Electric Co., Dept. ED, 3349 W. Addison St., Chicago 18, Ill.

Mobile Radio Filter 767

Center frequency is 455 kc

Model F-124 filter, designed specifically for mobile radio equipment, has a center frequency of 455 ±1 kc. Other specifications are: insertion loss, 23 db max; bandwidth at 69 db, 10.5 kc; bandwidth at 60 db, 31 kc; maximum ripple, 0.5 db within the pass band; dimensions, 3-1/4 x 1-1/16 x 1-3/16 in. Connections are coaxial cables.

ESC Electronics Corp., Dept. ED, 534 Bergen Blvd., Palisades Park, N.J.

Availability: *45-day delivery.*

Heat Dissipators 752

For cooling solid-state packages

Designed for cooling transistors and other solid-state electronic packages in airborne and ground-support equipment, model T heat dissipators come in various sizes and shapes to suit

individual requirements. They use gas or air as the cooling element, eliminating the need for ducts or tubes. Capacities range from 1 to 10 w and thermal resistance can be as low as 1 F, with pressure losses as low as 0.025 in. H_2O. The units are designed to become an integral part of the unit to be cooled.

Horkey-Moore Associates, Dept. ED, 24660 Crenshaw Blvd., Torrance, Calif.

Power Transistors 757

Rated for high-power operation

Type 2N174 pnp, 85-w transistor replaces two 40-w or four 20-w paralleled units. Eight other units (designated types 2N173, 2N277, 2N278, 2N442, 2N443, 2N1099 and 2N1100) are also offered. They provide 30-w, Class A; 100-w, Class B; or 1,000-w switching. Collector voltages up to 100 v are available. A large signal-current gain of 70 at 5 amp can be achieved. Maximum working current is 15 amp. The emitter has a low-distortion ring construction. Units are housed in a welded JEDEC TO-36 case.

CBS Electronics, Dept. ED, 100 Endicott St., Danvers, Mass.

Sealed Switches 764

Provide double-circuit control

The DA60 switches perform dpdt switching or can be used as two independent spdt switches. Sealing provides protection against dust, dirt, condensation and splashing of liquids. The switches are listed by UL and CSA for spdt operation at 125 or 250 v ac; 3/4 hp, 125 v ac; or 1-1/2 hp, 250 v ac. Quick connect terminals for snap-on connections are standard.

Unimax Switch, Div. of W. L. Maxson Corp., Dept. ED, Ives Road, Wallingford, Conn.
Price: $2.40 to $3.25.
Availability: Four to five weeks.

NEW PRODUCTS

Multi-Trace Oscilloscope 760

Displays eight waveforms

Model 769 monitoring oscilloscope simultaneously displays up to eight waveforms on a vertically mounted, 17-in. crt. Repetitive and single-sweep speeds are 5, 2.5 and 1.25 in. per sec. A 25-sec single sweep is also available for use when slowly varying waveforms are monitored. Sweep linearity is better than 3%. The number of traces displayed depends on the number of gating amplifiers used. Model 779-100 companion gating amplifier has a frequency response of dc to 3 db down at 1,000 cps.

Sanborne Co., Industrial Div., Dept. ED, 175 Wyman St., Waltham 54, Mass.

Fixed-Composition Resistors 486

These fixed-composition resistors are available in 1/2, 1 and 2-w ratings. Resistance values range from 10 ohms to 22 meg in all standard E.I.A. values. The manufacturer claims the resistors meet the requirements of MIL-R-11.

Hamilton-Hall, Inc., Dept. ED, 227 N. Water St., Milwaukee 2, Wis.

Aluminum Cases 351

The Dwarf 1/4-A T R case measures 2-1/4 x 3-11/32 x 12 or 19 in. long. Adapted to the use of miniature electrical components, it uses DPA or DPX2 multi-prong connectors.

Churchill Lighting Corp., Dept. ED, 344 Franklin St., Melrose, Mass.

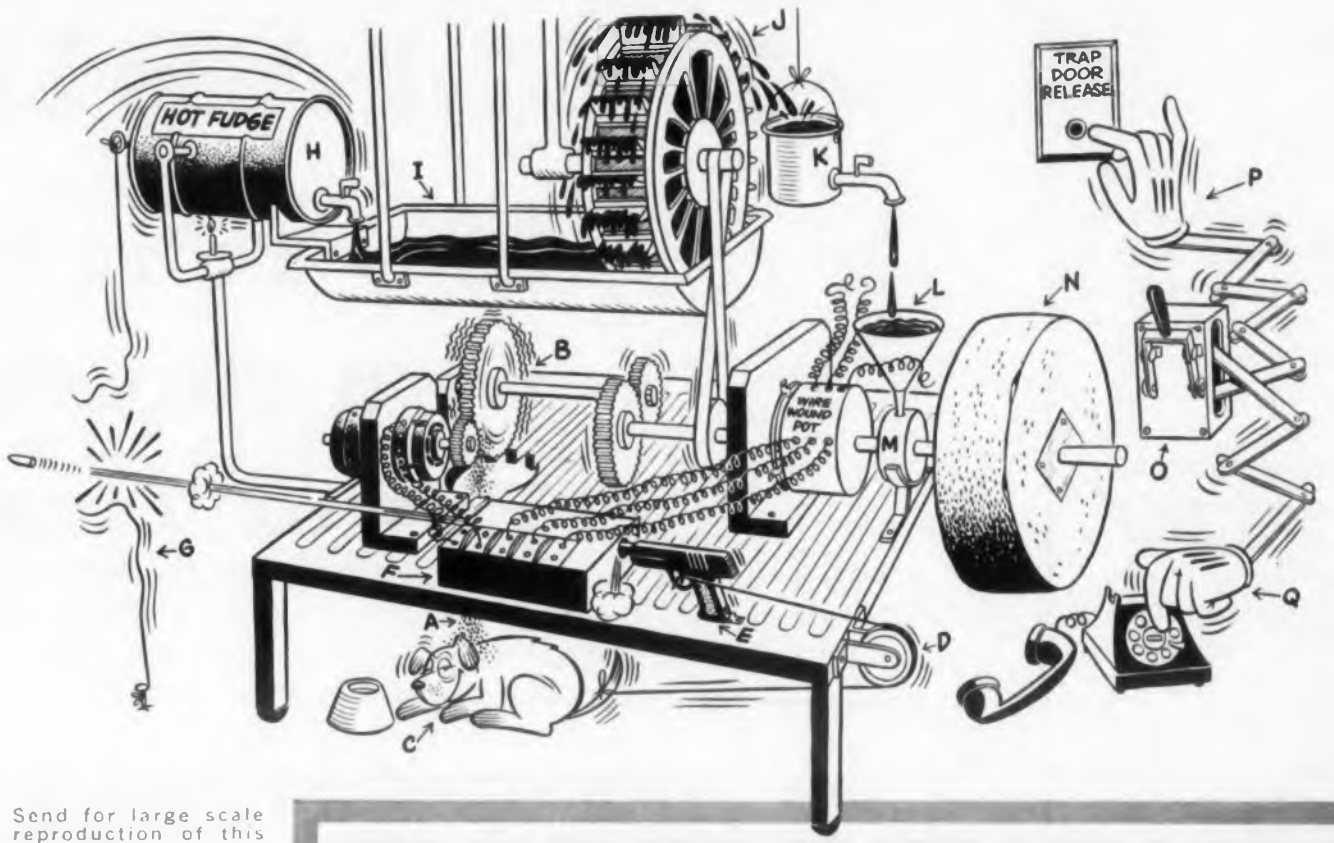
Availability: Immediate, for standard cases.

Radiator For TO-8 Case Transistors 494

This radiator, model 3AL-705, is designed for all transistors having TO-8 packages and mounts on printed-circuit boards or metal chassis. It can be mounted horizontally or vertically. Overall dimensions are 1-in. max diam. x 0.312-in. thickness. Inside diameter is 0.480 in. with a counterbore for the transistor base. Material is aluminum with black anodize finish.

The Birtcher Corp., Dept. ED, 745 S. Monterey Pass Road, Monterey Park, Calif.

HERE'S ONE WAY TO SOLVE SERVO "HUNTING" PROBLEMS...



Send for large scale reproduction of this unique Servo System.

ENERGIZED SERVO SYSTEM IMMEDIATELY STARTS "HUNTING" AS A RESULT OF POOR RESOLUTION WIRE-WOUND POT. METALLIC DUST (A), CREATED BY WEARING DOWN OF OSCILLATING GEARS (B) IN "HUNTING" SERVO SYSTEM, FALLS UPON HEAD OF OFFICE DOG (C). DOG ENJOYS PLEASANT SENSATION AND PROCEEDS TO HAPPILY WAG TAIL. STRING ATTACHED TO DOG'S TAIL RUNS AROUND PULLEY WHEEL (D) AND ACTUATES TRIGGER OF "AUTOMATIC GAIN KILLER" (E) ATTACHED TO AMPLIFIER (F). [FIRST STEP IN REDUCING SERVO HUNTING.] PROJECTILE, AFTER LEAVING AMPLIFIER, BREAKS STRING (G) THEREBY ALLOWING DRUM (H), FILLED WITH SPECIAL VISCOUS DAMPING FLUID, TO TILT FORWARD. FLUID FLOWS INTO TROUGH (I). DAMPING PADDLE WHEEL (J) TAKES EFFECT. [SECOND STEP IN REDUCING SERVO HUNTING.] EXCESS FLUID ON PADDLE WHEEL DRIPS INTO RESERVOIR (PAINT CAN—K), THEN PASSES THROUGH FUNNEL (L) INTO FLUID CLUTCH (M) CONNECTING SCIENTIFICALLY SELECTED INERTIAL LOAD (GENUINE MILLSTONE, ON LOAN FROM SMITHSONIAN INSTITUTE—N.) [FINAL STEP IN REDUCING SERVO HUNTING.] IF SYSTEM STILL "HUNTS"—ENGINEER THROWS EMERGENCY SWITCH (O) ACTIVATING HAND (P) WHICH PRESSES TRAP DOOR RELEASE, DUMPING ENTIRE SYSTEM INTO LOCAL RIVER (NOT SHOWN). HAND (Q) PROCEEDS TO DIAL C.I.C.'S PHONE NUMBER (IVANHOE 3-8200) FOR AN INFINITE RESOLUTION "NON-HUNTING" FILM POT.


1/2" to 5" Diameters

- INFINITE RESOLUTION
- INHERENT RELIABILITY
- PRECISION LINEARITY
- LOW OPERATIONAL NOISE
- MULTI-MILLION CYCLE LIFE
- VIDEO FREQUENCY OPERATION

BUT THE BEST WAY YET...

Use **C. I. C.** Film Pots for High Performance Servo Systems!

Not only do **C. I. C.** Film Pots offer the infinite resolution necessary to eliminate servo hunting problems, but they guarantee you the greatest linearity possible in any given size or diameter. They provide the reliability inherent in a single broad band film element as opposed to the high failure rate of today's wire wound pots. **C.I.C.** Film Pots do even more... They actually run as high as 1000 rpm and still retain reliability, while assuring many millions of cycles of operation.

FIRST IN FILM POTS

COMPUTER INSTRUMENTS CORPORATION

92 MADISON AVENUE • HEMPSTEAD, L. I., NEW YORK

CIRCLE 55 ON READER-SERVICE CARD

CIC PRECISION FILM POTS

AVAILABLE FROM STOCK!

You can have any of these precision film pots on their way to you within hours. No need to wait for "custom" pots.

LINEAR SINGLE TURN FILM POTENTIOMETERS

Diameter	Resistance	Linearity
1/2"	1K	± .5%
	10K	± .5%
	50K	± .5%
7/8"	1K	± .5%
	10K	± .5%
	50K	± .5%
	1K	± .25%
	10K	± .25%
	50K	± .25%
1-3/32"	1K	± .5%
	10K	± .5%
	50K	± .5%
	1K	± .25%
	10K	± .25%
	50K	± .25%
2"	5K	± .25%
	20K	± .25%
	50K	± .25%
	5K	± .1%
	20K	± .1%
	50K	± .1%
3"	5K	± .1%
	20K	± .1%
	50K	± .1%
	5K	± .05%
	20K	± .05%
	50K	± .05%

SINE-COSINE SINGLE TURN FILM POTENTIOMETERS

Diameter	Resistance	Conformity
1-3/32"	10K	± .75%
	20K	± .75%
2"	10K	± .25%
	20K	± .25%
3"	10K	± .15%
	20K	± .15%

LINEAR MOTION FILM POTENTIOMETERS

Size	Resistance	Stroke	Linearity
1" Sq.	10K	1" Stroke	± .5%
	20K	1" Stroke	± .5%
	10K	2" Stroke	± .25%
	20K	2" Stroke	± .25%
	10K	3" Stroke	± .1%
	20K	3" Stroke	± .1%

Write or call in your order! Potentiometers will be in your plant within 24 hours.

COMPUTER INSTRUMENTS CORPORATION

90 MADISON AVE., HEMPSTEAD, L. I., N. Y.

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Partially-Coated Base Metals 782

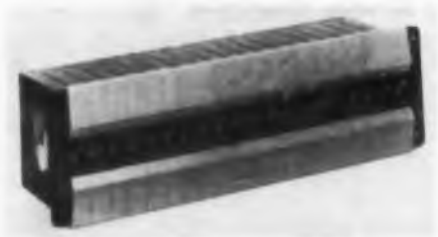
For transistor tabs

Partially coated metals used as base tabs in the manufacture of transistors are available coated on one side, along either edge, in the center only or over-all. Typical metals that can be coated in this way are tin, tin-antimony, tin-gallium, lead, lead-antimony, tin-lead-gold, tin-lead, silver, indium, indium-gallium. Materials which can be coated with these solder alloys are copper, nickel, kovar, rodar, therlo, and other iron-nickel alloys.

Alpha Metals, Inc., Dept. ED, 56 Water St., Jersey City, N.J.

Digital Switches 753

With binary coding



The 7350 series Digiswitch is available with 16 positions of binary coding. Model 7363, shown, provides both the binary number and the binary complement for decimal dial-settings of 0 to 15. Also offered, model 7351 is a 17-position, single-pole switch.

The Digitran Co., Dept. ED, 660 S. Arroyo Parkway, Pasadena, Calif.

Die-Stamped Circuits 772

For control applications

These die-stamped circuits are made by die cutting the conductor pattern from metal foil that is coated on one side with a thermo-responsive adhesive and simultaneously bonding the circuit to the insulating base material. The same conductor patterns can be produced in die-stamped circuits as in printed and etched circuits.

Dytronics, Inc., Dept. ED, 115 Main St., Rochester, Mich.

Crystal-Case Relay 776

General-purpose, 4 pdt type

This 4 pdt crystal case relay, meeting MIL-R-25018 and MIL-R-5757C, is cube shaped with a base 0.8 x 0.8 in. and a height of 0.875 in. Terminals are spaced on a 0.2-in. grid pattern; the connections are the same as those of two 2 pdt relays mounted side by side.

Union Switch & Signal, Div. of Westinghouse Airbrake Co., Dept. ED, Swissvale, Pa.

Linear Transformer 755

Delivers 1/2 w into 500-ohm load

Model 9708-005 linear transformer delivers 1/2 w into a 500-ohm load while retaining a linearity of 0.33% over a range of ±30 deg. Working into a 3,000-ohm load, the unit is linear to ±50 deg. It has an input of 26 v at 400 cps. Temperature range is −55 to +125 C; short-time exposure to 200 C is possible.

Imc Magnetics Corp., Western Div., Dept. ED, 6058 Walker Ave., Maywood, Calif.

***Availability:** 30 to 45 days for production quantities.*

Silicon Transistors 774

Operate at case temperatures to 200 C

Types 2N497 and 2N656 silicon transistors are designed for medium-power switching. Each has a collector-to-base rating of 60 v, a collector-to-emitter rating of 60 v and a dissipation of 4 w. They are housed in the TO-5 package.

Radio Corp. of America, Semiconductor & Materials Div., Dept. ED, Somerville, N.J.

NEW PRODUCTS

"Memory" Relay 460

For industrial control uses

Model 255 frame-mechanical latch, electrical-reset relay is designed with clear plastic cover, 12-pin plug and matching heavy-duty socket to provide control simplification and minimum size for industrial-control panels. Contact reliability throughout a minimum life of 10,000,000 operations is claimed. Contacts are rated 10 amp at 115 v ac. Three types are available: with dpdt contacts; with 3 pdt contacts; and with two normally-open and two normally-closed contacts. Standard dielectric test is 1500 v ac.

Struthers-Dunn Inc., Dept. ED, Pitman, N.J.

Cathode Ray Tubes 745

Use standard 9-pin miniature bases

Types NUP122P1 and NUP123P11 miniature crt's use standard 9-pin miniature bases. The NUP122P1 measures 7/8 in. OD, 3-3/4 in. long. It is for transistorized monitoring, data readout, and constant-light-source equipment. The NUP123P11 is a 1-in. post accelerator unit which permits accelerating voltages of 3 kv or higher. The 3-3/4-in.-long tube is for photographic applications in data readout and monitoring work.

National Union Electric Corp., Electronics Div., Dept. ED, Bloomington, Ill.

Price: *NUP122P1, $17.50 ea; NUP123P11, $25 ea.*
Availability: *From stock.*

Silicon Diodes 577

For computer use

These diodes measure 0.08-in. long and 0.07 in. in diameter. The leads measure 0.004 x 0.02 in. and are of gold-plated ribbon that can be soldered, tweezer-welded or compression bonded. For a high-reliability hermetic seal, the glass is

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fused directly to the silicon junction. Recovery time is 2 nsec, leakage current is 0.015 μamp at −40 v, and power dissipation is 50 mw at 25 C.

Microwave, Inc., Dept. ED, Burlington, Mass.

Availability: In engineering quantities for evaluation.

Motor Generator 667

Size 11

Suitable for use in ground support equipment, industrial controls and automation applications, this generator can be furnished integrally with the 60-cps motor or as a separate unit. Generator characteristics include: scale factor, 2.7 v per 1,000 rpm; signal-to-noise ratio, 100; and input power, 2.5 w. Motors and generators can be furnished with voltage ratings from 25 to 115 v.

Daystrom, Inc., Transicoil Div., Dept. ED, Worcester, Pa.

Solid-State Commutator 691

Accommodates up to 100 channels

The series ES/35 solid-state commutator is available in standard scan rates of up to 25 kc and can accommodate from 2 to 100 channels. Input signal ranges from 0 to 10 mv to 0 to 5 v with 0.1% crosstalk. Linearity is within 0.1%; contact resistance is 25 ohms max. Operating temperature range is −35 to +125 C. Military environmental and MIL-Q-9858 quality-control specifications are met.

Electronic Systems Development Corp., Dept. ED, 1484 Main St., Ventura, Calif.

NEW PRODUCTS

Magnetic SCR Triggers 719

Weigh 8 and 12 oz

The 3A12 single-output scr trigger weighs 8 oz and measures 2-1/8 x 1-1/2 in.; the 3A22 dual-output model weighs 12 oz and measures 3-23/32 x 1-1/2 in. These magnetic-type units are for general purpose and experimental use in triggering scr's to obtain uniformly variable output power in response to dc or ac control signals. The 3A12 is used in half-wave applications and the 3A22 is used in full-wave or half-wave, push-pull applications. Both units operate from 105 to 125 v, 55 to 65 cps. Operating temperature range is —22 to +55 deg C. Other units are available for 400-cps operation.

Ovitron Corp., Dept. ED, 37-05 48th Ave., Long Island City, N.Y.

Chopper Amplifier 664

Provides a 400-cps signal

Model 1801-0100 chopper amplifier converts a low-level dc signal to a proportionate 400-cps signal at a much higher power level. The output can be used in the operation of a transistor amplifier. The unit requires 28 v dc at 3 ma with an ac reference voltage of 115 v, 400 cps, 3 ma. Nominal input impedance is 5,000 ohms. Linear range is 0 to ±1 v dc. Dimensions are 1-3/16 x 1-11/16 x 3-15/16 in. and weight is 6 oz.

M. Ten Bosch, Inc., Dept. ED, 80 Wheeler Ave., Pleasantville, N.Y.

High Power Attenuator Discs 527

Designed for low and high frequency use

These high power attenuator discs are deposited-carbon film devices designed for low and high frequency use. They are applicable to ter-

minations, coaxial line attenuators and waveguide attenuators. Solderable silver-plated terminals allow rigid assembly without pressure clips. Units are varnish-protected to withstand 200 C and resist humidity. They are available with ceramic, alumina and vycor cores.

Pyrofilm Resistor Co., Inc., Dept. ED, U. S. Highway 46, Parsippany, N.J.

AC to DC Converters 665

Are magnetic-amplifier regulated

These magnetic-amplifier regulated ac to dc power converters are provided in both low-and high-voltage types. Design is solid-state. Stabilized over a range of inputs from 115 ±15 v ac and temperatures from −65 to +160 F, the units provide excellent wave form and low distortion. Static regulation remains within ±0.2% in the output when a line voltage change of ±15 v occurs under a full load.

Arnoux Corp., Dept. ED, 11924 W. Washington, Blvd., Los Angeles 66, Calif.

Linear and Rotary-Motion Transducers 686

Input ranges are ±60 deg and ±30 deg

The types 15-R-60-1-D and the 15-R-30-1-D transducers have input ranges of ±60 deg and ±30 deg. Both models accept standard size 15 servo mountings. Designed for 400-cps power, they operate at frequencies between 300 and 3,000 cycles with modified input voltage. Transfer sensitivity is 0.35 v rms per deg in the 15-R-60-1-D and 0.7 v rms per deg in the 15-R-30-1-D.

Arnoux Corp., Dept. ED, 11924 W. Washington Blvd., Los Angeles 66, Calif.

NEW PRODUCTS

Two-Channel Oscillographic Recorder 682

For dc and low-frequency applications

Specifications for the model 320 two-channel oscillographic recorder are: frequency response, dc to 125 cps; sensitivity ranges, from 0.5 mv per mm to 20 v per cm; chart speeds, 1 to 100 mm per sec. The instrument has two current-feedback amplifiers with floating and guarded inputs, and a rugged, two-channel recorder assembly with low-impedance, enclosed galvanometers. A 1-sec timer and marker is included. The system measures 12-3/4 x 12-3/4 x 8-3/4 in. and weighs 55 lb.

Sanborn Co., Industrial Div., Dept. ED, 175 Wyman St., Waltham 54, Mass.

Four-Channel Analyzer 668

Counts pulses of random spacing and amplitude

Model 716 channel analyzer counts pulses of random spacing and amplitude. Pulses terminating between the settings of the upper limit and lower limit discriminators of each channel are passed to the output of that channel. Channel widths are front-panel adjusted from 0 to 10 v or 0 to 20 v and are held constant within 1% through a range of 0 to 100 v.

Interstate Electronics Corp., Dept. ED, 707 E. Vermont Ave., Anaheim, Calif.

Time Delay Relay 729

Has timing periods to 15 min

This solid-state, time-delay relay can be furnished with timing periods of up to 15 min with adjustment ranges of 100:1 in the low time periods and 10:1 in the high time periods. Military versions meet ±5% tolerances over a range of −65 to +160 F and 22 to 30 v dc. Static output versions have up to 4pdt 10-amp ratings; relay versions are also available.

Autronics Corp., Dept. ED, 180 N. Vinedo Ave., Pasadena, Calif.

Signal-Conditioning Amplifier 428

Amplifies crystal accelerometer output

Model 2-182 ac signal-conditioning amplifier amplifies crystal accelerometer output for use in telemetering systems. Characteristics include: input impedance, 300 meg up to 50 cps; frequency response, 5 cps to 4 kc; output ±2.5 v biased to +2.5 v dc; power 28 v dc, 65 ma. Gain is adjustable from 0.5 to 50. The unit stands ballistic missile environments.

Electro Development Corp., Dept. ED, 3939 University Way, Seattle 5, Wash.

VHF-Coaxial Phase Shifter 597

Drives three channels

Model 1063 phase shifter provides 360-deg phase shift for three independent coaxial line channels in the 215 to 235 mc range. Trombone construction allows input and output connectors, type N female, to remain stationary. The channels track ±1 deg, and vswr is below 1.2. A 16 threads-per-in. lead screw drives all three channels simultaneously. A drive motor can be attached easily. Total length of the unit is 66 in.

Radar Design Corp., Dept. ED, P. O. Box 38, Syracuse 11, N.Y.

Price & Availability: *Delivery is 30 days at $2,500 in small quantity.*

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NEW PRODUCTS

Infinite Resistance Voltmeter 605

Works in megohm region

Model 82490 infinite resistance voltmeter, designed for laboratory work, measures resistance in the megohm region. It is essentially an electrostatic voltmeter with a range of 0 to 20 v dc. The dial readings are in microamperes graduated from 0 to 500. The circuit is a modification of an inverted triode voltmeter. A mercury battery supplies the grid voltage while the filament draws from a conventional A battery.

Central Scientific Co., Dept. ED, 1700 Irving Park Road, Chicago, Ill.

Price: $49.50.

Encapsulating Shells 734

For wirewound resistors

These plastic-molded encapsulating shells are for wirewound resistors with axial or radial leads. The shells, molded to a uniform wall thickness, can be made of mineral-filled alkyd that meets Mil spec M14EMAG or diallyl phthalate that meets 18794SDG. They stand continuous temperatures up to 450 F.

Milton Ross Co., Dept. ED, Hatboro, Pa.

Glass-To-Metal Connectors 726

For pyrotechnic use

These glass-to-metal connectors have been developed for such pyrotechnic hardware as electric primers and squibs, igniters and explosive cartridges. They are hermetically sealed to 10^{9} cc per sec helium, and withstand 35,000 to 80,000 psi impact. On the bridgewire end connectors are made to specifications to suit the explosive package requirements.

Electronic Seals Co., Inc., Dept. ED, 13766 Saticoy St., Van Nuys, Calif.

Strip Chart Recorder 738

Cartridge type

This cartridge-type strip chart recorder provides a record of flow, pressure and temperature measurements for periods of up to 36 days without attention. Each cartridge, including chart, storage spool and rewind spool, can be removed as a unit so that chart changes can be made in a few seconds. Chart capacity is 38 ft; chart speeds are 1/2 to 6 in. per hr.

American Meter Co., Dept. ED, 920 Payne Ave., Erie, Pa.

Go-no-go Comparator 735

For checkout systems

Suitable for use in a variety of checkout systems, model ABV-4A GO-NO-GO comparator accepts digitally coded high-low limit instructions from accessory digital storage and compares them with an unknown input analog voltage or resistance. As a result of the comparisons, logical circuitry causes a Lo, Go or Hi output contact closure to be activated. Using mercury-wetted contact relays in a precision digital bridge, the unit is capable of more than 5 decisions per sec at accuracies to 0.01%.

Auto Data, Dept. ED, Box 9146, San Diego 9, Calif.

Price & Availability: *From $3,850; 30 to 45 days.*

Multi-Range Meters 384

Several types offered

A typical unit in this series, the Unigor 3, has the following specifications: 25,000 ohms per v dc and 2,000 ohms per v ac, maintaining accuracies of 1% and 1.5%; current measurements of 100 μa to 5 amp dc and 500 μa to 5 amp ac; voltage measurements of 100 mv to 5,000 v dc and 500 mv to 5,000 v ac; resistances to 50 meg and capacitance from 100 pf.

Physics Research Laboratories, Dept. ED, 1 Bond St., Westbury, N.Y.

Price: *$98.50 fob Hempstead.*

NEW PRODUCTS

DC Motor 670

Uses a starting voltage of 0.3 v

This miniature motor has the following typical characteristics: running current (no load), 3 ma; power, 18 mw, weight, 55 g; temperature range, −55 to +80 C; output rpm, 800 ±10%; and rotor inertia, 3.7 g-cm². Similar to a D'Arsonval meter movement, the armature consists of a copper wire rotating in a permanent-magnet field. The unit stands 50-g shock and 20-g random noise vibration.

Giannini Controls Corp., Dept. ED, 1600 S. Mountain Ave., Duarte, Calif.

Silicon Glass Diodes 649

All units meet military specifications

These silicon-glass diodes meet military specifications. Types 1N456 through 1N464 and 1N456A through 1N464A general purpose diodes provide output currents from 30 to 200 ma at 25 C. Maximum reverse current is 0.025 to 0.5 μamp at maximum operating voltage at 25 C. Types 1N482 through 1N488, 1N482A through 1N488A and 1N482B through 1N486B are high-conductance units. They provide 100 to 200 ma output currents at 25 C. Maximum reverse current is from 0.1 to 0.250 μamp at specified test voltage at 25 C. All units operate from −55 to +200 C.

International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

Price: $1.20 to $8.20 for 1 to 99 units.

Availability: From stock.

Fixed Delay Lines 650

Life of 100,000 cycles

Type A fixed delay line has delays of 0.1 to 30 sec and types B through E have delays of 0.1 to 60 sec. Dielectric strength is 750 v rms between open contacts and 1,000 v rms between pins and case. The units have a life of 100,000 cycles at rated voltage and load. Contact arrangements are spdt for types A, B, and D; dpdt for types C and E.

The Victoreen Instrument Co., Jordan Electronics Co. Div., Dept. ED, P.O. Box 2047, Alhambra, Calif.

Vibration Meter 425

Frequency range is 5 to 1,200 cps

Type PR-9252 vibration meter reads peak amplitudes of both absolute and relative vibrations on a meter dial. Readings are in microns from 5 to 1,200 cps. Measuring range is 0 to 1,000 microns in five steps. Sensitivity is 0 to 10 microns full scale. In every range, internal calibration is available. The unit weighs 5 lb and measures 9-1/2 x 5 x 4 in.

Korfund Co., Inc., Dept. ED, Cantiague Road, Westbury, N.Y.

Inertially Damped Servo Motor 684

For high-speed, high-gain systems

This size 11 precision high-temperature, inertially-damped servo motor is designed for high-speed and high-gain servo systems. Designated type 5752-03, the device is corrosion-resistant and meets military environmental specifications. No-load speed is 5,800 rpm. Torque at stall is 0.6 oz-in. Flywheel magnet inertia is 2 gm-cm².

John Oster Manufacturing Co., Avionic Div., Dept. ED, Racine, Wis.

NEW PRODUCTS

Signal-Distortion Meter 669

Is battery operated

Type DMS-1A signal-distortion meter measures all types and speeds of ordinary teleprinter signals. The unit is half the size of a carton of cigarettes. In normal use it operates over a year on one battery. Readings are accurate to ±2%. The instrument handles neutral and polar loop currents at 60, 75 and 100 words per min.

Atlantic Research Corp., Dept. ED, Alexandria, Va.

Storage Oscilloscope 687

Sweep range is 50 μsec to 100 sec

Having a sweep range of 50 μsec per cm max to 100 sec full scale, type 430 dual-service unit can be used as a storage scope for freezing recurrent or transient signals, and as a conventional, general-purpose unit. Life of the magnetically-deflected crt is about 1,000 hr avg. Bandwidth of the device is nominally 10 kc in both axes, scan is 9 x 12 cm with 10-kv acceleration, and nominal spot size is 0.018 in. Applications include transient response, pulse distortion, tracking displays, high-speed X-Y plotter, shock recorder and dynamic semiconductor inspection.

Fairchild Camera and Instrument Corp., Allen B. Du Mont Labs. Div., Dept. ED, 750 Bloomfield Ave., Clifton, N.J.

Subcarrier Oscillator 690

Has transformer-coupled, floating input

Model 199B transistorized, millivolt-controlled subcarrier oscillator operates in IRIG-standard telemetry channels from 2.3 to 22 kc, in missile or aircraft environments. Common-mode rejection is better than 100 db; harmonic distortion is less than 1%. Output of this 10-oz units is 5 v rms into a 5,000-ohm load.

Electro-Mechanical Research, Inc., ASCOP Div., Dept. ED, Princeton, N.J.

Price: $1,475 ea.

Availability: 90 days.

AC Power Supply 416

For test applications

This ac power supply can be furnished with ratings of up to 50 kva. Specifications for a typical 35-kva unit are: input, 220 v at 60 cps, single-phase; output, 0 to 35,000 v ac at 1 amp. Dimensions of this unit are 43 x 34 x 61 in.

Light Electric Corp., Dept. ED, 212 Lackawanna Ave., Newark 4, N.J.

Availability: 60 to 90 days.

Power Supply Regulator 651

For ac or dc from 100 w to 50 kw

This unit will automatically regulate an ac or dc power supply of any capacity from 100 w to 50 kw. The ac model has no distortion in output and regulation is available from zero to any desired voltage. The dc models are made to any desired ripple output for any ac input voltage, 1, 2 or 3 phase and to any frequency, including 400 cps. The ac unit has nearly 99% efficiency in ratings of 1 kva and over. It is not affected by and does not change power factor.

American Rectifier Corp., Dept. ED, 95 Lafayette St., New York City, N.Y.

NEW PRODUCTS

Magnetic Tape Tester 680

Detects one-bit defects

This magnetic tape tester, model 3320, detects tape defects as small as one-bit length at speeds up to 150 ips and packing densities as high as 1,500 bits per inch. The package consists of a model M-906II tape transport, a control unit, a dual record-playback head, amplifiers, and logic chassis with fault detector plug-in cards and space for up to 16 channels.

Potter Instrument Co., Inc., Dept. ED, Sunnyside Blvd., Plainview, L.I., N.Y.

Power Pack Series 659

Are high voltage, low current types

This series of high-voltage, low-current power packs consists of three types. The 6 to 28 v dc input transistorized type is available in from 2 to 50 kvdc outputs and is suitable for portable equipment. The tube oscillator type operates from 200 to 300 v dc with 2 to 30 kvdc output available, and is designed for use with radar indicators, scopes and other applications. The third type includes a large number of line voltage 60 to 400 cps power packs which are used in laboratory equipment.

Plastic Capacitors, Inc., Dept. ED, 2620 North Clybourn Ave., Chicago 14, Ill.

Power Supply 671

Provides 500 to 6,010 v

Model 408A power supply provides direct readout of output voltage to an accuracy of better than 0.25%. Resolution is 10 mv over the entire output range plus a 0 to 20 ma current rating. Line and load regulation is better than 0.01%; output ripple is less than 5 mv rms. Stability is 0.005% per hr or 0.03% per day. The unit provides either a positive or negative output plus 1.02 v for potentiometric monitoring.

John Fluke Manufacturing Co., Inc., Dept. ED, P. O. Box 1761, Seattle 33, Wash.

Noise Generators 631

Have plug-in units

Models 100P and 101P noise generators are basic units that generate random voltages having an accurate gaussian distribution and accurately specifiable frequency spectrums: dc to 27 cps and dc to 500 cps, respectively. Models 12P, 13P and 14P are plug-in units for laboratory and system evaluations. They generate noise having a rayleigh distribution of dc to 27 cps, dc to 500 cps, and amplitude modulated with gaussian or rayleigh-disturbed noise, respectively. The rms value of the random signal is adjustable and is regulated to within 0.1 db.

Automation Laboratories, Inc., Dept. ED, 80 Urban Ave., Westbury, L.I., N.Y.

Price: *100P and 101P, $995 ea; 12P and 13P, $395 ea; 14P, $345 ea.*

Availability: *60 days.*

Linear-Motion Potentiometer 652

Sensitive to 0.001 in. movement

Miniature, linear-motion potentiometer, model 141, is designed for use in short travel actuators, control valves and other accurate measuring applications. A ceramic mandrel, wound with a special alloy resistance wire, makes output sensitive to movement as small as 0.001 in. Specifications are: travel, 3/16 to 7/16 in.; linearity, ±1%; resistances, 500 to 10 K; resolution, to 0.001 in. This carbon unit offers continuous resolution in resistances from 10 K to 1 meg.

Bourns, Inc., Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

Miniature Clutch 432

Measures 7/8 in. in diameter

Model MC523 clutch is made of steel alloy, nylon housing and an aluminum universal drive. It operates in the temperature range of —60 to +85 C and is available with coils rated from 6 to 110 v dc. Both clutch body and the driven universal attachment have a 1/4-in. bore. The unit is suitable for in-line applications.

Altair Research and Manufacturing Co., Dept. ED, Box 106, Baldwin Park, Calif.

Price: $12 fob factory.

Availability: Small quantities, from stock.

Test Plug-In 642

Provides signals for adjustments

Test plug-in type 4207, is designed for use with the manufacturers 425 direct-digital readout, high-frequency oscilloscope. It provides signals for precision adjustments and can be switched into either or both channels of the oscilloscope. The unit generates both positive and negative step functions.

Fairchild Camera and Instrument Corp., Allen B. Du Mont Laboratories Div., Dept. ED, Clifton, N.J.

Price: $120.

NEW PRODUCTS

Crystal Filter 643

Has less than 1/2-cubic in. volume

This 10-mc bandpass crystal filter has a volume of less than 1/2-cubic in. Specifications are: center frequency, 10 mc; bandwidth at the 3 db point, 2 kc; bandwidth at the 40 db point, 20 kc; insertion loss, 3 db; dimensions, .80 x .675 x .780 in. Selected crystal cuts and temperature compensating components allow an operating temperature range of −60 to +90 C.

Electronic Laboratories Corp., Dept. ED, 4221 Spencer St., Torrance, Calif.

Limit Switch 462

Is magnet operated

Designated the CR115A19, the magnet-operated limit switch is available with contact ratings of 0.75 amp make, 0.2 amp carry and break, at 115 v ac. Response time is 0.001 sec. The switch is designed for operation without physical contact. The controlling is done by passing a permanent magnet near the face of the switch. This causes the normally open contact to close and remain closed until the magnet is withdrawn sufficiently to allow the contact to reopen.

General Electric Co., Dept. ED, Schenectady 5, N.Y.

Dual Reference Power Supply 658

Delivers balanced +10 and −10 v dc

Model 4010 dual power supply delivers a balanced +10 and −10 v dc reference at 10 ma from a 115 v, 400 cps supply. The output ripple is less than 2 mv rms at the rated output load. The output voltage varies less than 0.1% for load variations between 1 ma and 10 ma or line variations between 120 v and 110 v. The output

voltages track each other in magnitude within 1 mv for 5% variations in input voltage and 1% variations in frequency.

Power-Tronic Systems, Inc., Dept. ED, Pine Court, New Rochelle, N.Y.

Standard Potentiometer 624

Mechanical travel range is 0.50 to 9.90 in.

The RP38 standard rectilinear potentiometer has mechanical travels ranging from 0.50 to 9.90 in. in 0.10 increments. Total resistance is from 100 to 20,000 ohm per in. of mechanical travel in 100-ohm-per-in. increments. Life exceeds 500,000 cycles. The unit stands vibration of 10 g from 10 to 2,000 cps on all axes. It resists steady-state acceleration of 20 g and shock of 100 g for 3 μsec on all axes.

Humphrey, Inc., Dept. ED, 2805 Canon St., San Diego 6, Calif.

Price: $100 ea.

Availability: 3 weeks.

Pulse Transformer Test Kits 656

Provide 86 test pulse transformers

These three test kits provide a total of 86 test pulse transformers for in-plant research, design and breadboarding. The type MPT kit has 18 miniature pulse transformers that cover a wide range of winding ratios and open circuit inductances for 112 and 521 winding ratios. Pulse widths are from 0.1 μsec through 25 μsec. Type TT limit kit contains 28-subminiature end limit transformers that provide 112 and 521 winding ratios with pulses ranging from 0.05 to 5 μsec. Type TT range kit contains 40 samples of 2, 3 and 4 winding subminiature transistor transformers with winding ratios of 101 and 521. Pulse widths are 0.2 through 3 μsec.

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

NEW PRODUCTS

Electronic Counter-Timer 628

220-meg unit

This 220-meg electronic counter-timer consists of a solid-state, 10-mc universal counter-timer, a plug-in vacuum-tube heterodyne converter, and two converter plug-ins. Model 731A plug-in ranges from 10 to 100 mc and 732A ranges from 100 to 220 mc. The complete instrument weighs 53 lb. It requires 125 w of power and measures 14 x 17 x 13 in. Model 727A counter section has a 220-mc frequency range. Time interval is 0.1 μsec to 10^7 sec. Accuracy is ±1 count, plus or minus oscillator stability. Sensitivity is 0.25 v rms.

Computer Measurements Co., Dept. ED, 12970 Bradley Ave., Sylmar, Calif.

Price: *Model 727A, $2,750; Model 731A, $250; Model 732A, $250.*

Gaussian-Noise Generators 632

Produce low-frequency gaussian output voltage

These gaussian-noise generators produce low-frequency gaussian output voltages. Output frequency spectrum is flat to within 1 db from dc to 27 cps (Model 100-A) or dc to 500 cps (Model 100-B). The output signal is gaussian to within 1% and is 5 v rms, regulated to within 0.1 db. Output impedance is 2,000 ohms. Power requirement is 117 v ±10 v, 1.5 amp, 60 cps. Applications include simulation, testing designs and quality control.

Automation Laboratories, Inc., Dept. ED, 80 Urban Ave., Westbury, L.I., N.Y.

Price: *$875.*

Availability: *60 days.*

Voltage Calibrators 626

For high input-impedance instruments

These voltage calibrators are for calibration of self-balancing potentiometers, oscillographs and other instruments having a high input impedance. Standard ranges are: Model VC-01, 0 to 100 mv; model VC-001, 0 to 10 mv; model VC-1, 0 to 1,000 mv. Voltage stability is ±0.01% for line voltage variations of 94 to 140 v. Temperature stability is ±0.002% per deg C over a 0 to 40 C range. Linearity is ±0.05%; over-all accuracy is 0.1% of full scale. Battery-powered portable units and rack-mounted units are available.

Dynage, Inc., Dept. ED, 75 Laurel St., Hartford, Conn.

Availability: *4 weeks, fob Hartford.*

Current Pulse Generator 660

Delivers programed current pulses

Millimicrosecond programed current pulse generator, model 1200, is a multiple-output pulse generator. It delivers programed, high-amplitude, ultra-short current or voltage pulses for research and development of high-speed magnetic materials, solid-state materials and computer devices. Positive or negative output pulses are generated in a ten step, preset, periodically repeated pattern. Pulse repetition frequencies range from 500 pps to 5 mc, continuously variable over four decades and four ranges per decade. Pulse widths range from 20 μsec to 15 μsec, continuously variable over 5 ranges, maximum current pulse amplitudes are 2 amp.

Rese Engineering, Inc., Dept. ED, 731 Arch St., Philadelphia 6, Pa.

NEW PRODUCTS

Magnetic Tape Recorder-Reproducer 662

Weighs 5 lb.

This 5-lb magnetic tape recorder-reproducer will record, reproduce and erase teletype communications between the ground and a satellite. It has a capacity for recording 5 min on one channel at 30 ips, after which the tape can be reversed and will reproduce on the return. Erasing is accomplished by a permanent-magnet erase head both after reproduce and before record to insure reliability. The entire unit is packaged in a hermetically sealed aluminum case built to hold 15 psia helium pressure. The case measures 6.5 x 6.25 x 4 in. The unit operates on 5 w and is within 0.25% accurate over its full scale.

Consolidated Electrodynamics Corp., Dept. ED. 360 Sierra Madre Villa, Pasadena, Calif.

Transistorized DC Power Supply 646

Has interchangeable plug-in modules

Transistorized power supply model ST36-10 has interchangeable plug-in modules and standard sub-assemblies. The bias supply, amplifier and overload circuitry are off-the-shelf, plug-in units. The heat sink assembly, isolation transformer, rectifier assembly and filter capacitor group are standard sub-assemblies. Output voltage is 0 to 36 v dc and output current is 0 to 10 amp, both continuously variable over the full range. Regulation is 0.03% for load changes and 0.005% for line variations. Ripple is less than 500 μv. Overshoot is less than 1% of voltage setting and recovery is 50 μsec for half current step changes.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.

Price: *$795.*

Availability: *30 days.*

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CIRCLE 75 ON READER-SERVICE CARD

NEW... from MOTOROLA

JAN 2N174
POWER TRANSISTORS

MOTOROLA TO-36 15 AMP POWER TRANSISTORS

MAXIMUM RATINGS						Electrical Characteristics		
						h_{FE} @ I_C		
Type	P_C watts	T_J °C	BV_{CB} volts	BV_{CES} volts	I_C amps	min	max	amps
2N441	150	100	40	40	15	20	40	5
2N442	150	100	50	45	15	20	40	5
2N443	150	100	60	50	15	20	40	5
2N174	150	100	80	70	15	25	50	5
JAN 2N174	150	100	80	70	15	25	50	5
2N1358	150	100	80	70	15	25	50	5
2N1100	150	100	100	80	15	25	50	5
2N1412	150	100	100	80	15	25	50	5
2N277	150	100	40	40	15	35	70	5
2N278	150	100	50	45	15	35	70	5
2N173	150	100	60	50	15	35	70	5
2N1098	150	100	80	70	15	35	70	5

WIDEST SELECTION OF STANDARD POWER TRANSISTOR TYPES AVAILABLE

In addition to TO-36 power transistors, Motorola offers over 118 power transistors in the industry-standard TO-3 case. 3, 5, 10, 15 and 25 amps . . . up to 120 volts . . . 90 watts power dissipation . . . 0.8° C/W maximum thermal resistance . . . 100° C junction temperature . . . 3 military types . . . special "Meg-A-Life" units provide military quality for industrial use.

Motorola is your most complete and most dependable power transistor source for industrial and military applications.

For complete technical information and applications assistance, contact your Motorola Semiconductor distributor or your Motorola district office.

in the improved...

"low silhouette" TO-36 case

Now, Motorola offers you a JAN 2N174! It's one of twelve 15-amp power transistors in Motorola's much-improved TO-36 case . . . transistors that provide outstanding design advantages.

- "low silhouette" case requires 30% less headroom than other TO-36 packages
- 0.5° C/W maximum thermal resistance (0.35° C/W typical) — 43% less than other TO-36 devices
- 150 watts power dissipation . . . the highest rated germanium power transistor
- 100° C continuous junction temperature
- h_{FE} ranges from 20 to 70—in 2 to 1 spreads
- 40 to 100 volts BV_{CB}
- Improved internal construction and cold weld
- 100% lot life-tested to assure maximum reliability

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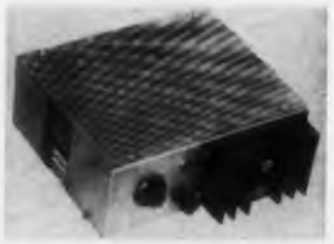
CIRCLE 76 ON READER-SERVICE CARD

NEW PRODUCTS

DC Power Supply 653

Ripple is 5 mv peak-to-peak



The SV-2A series of power supplies have outputs from 6 to 28 v at 2 amp, each variable to ±1 v. Ripple is 5 mv peak-to-peak with line regulation of 5 mv and load regulation of 30 mv max. Response time is 50 μsec or less, no load to full load. They operate with an input of 105 to 125 v and a frequency range of 60 to 400 cps. Operating temperature is 0 to +50 C.

Elasco Inc., Dept. ED, 5 Prescott St., Roxbury 19, Mass.

Reference Magnets 422

Have from 0.5% to 2% calibration

These magnets are pre-aged and stabilized magnetically and mechanically by means of controlled demagnetization cycling and temperature cycling. They stand shock, temperature extremes and stray fields. Calibration accuracy, which varies with different units, is established with reference to a nuclear resonance magnetometer.

F. W. Bell, Inc., Dept. ED, 1356 Norton Ave., Columbus 12, Ohio.

Availability: *One-week delivery.*

Precision Potentiometers 635

For high reliability applications

Types 223F and 223H precision potentiometers are for high reliability applications. They meet original specifications after 2,000 hr of operation at 150 C. Standard resistance values range from 100 to 50,000 ohm. Resistance tolerance is ±5%; linearity is 0.4%. Ambient temperature range is −65 to +150 C; power dissipation is 3 w up to 75 C, derated to zero at 150 C.

Carter Mfg. Corp., Dept. ED, 23 Washington St., Hudson, Mass.

Price: *$50.*

Availability: *2 to 4 weeks.*

Signal Switching Rack 648

For routing telemetry signals

Model 248 signal switching rack is for routing telemetry signals to recording or timing devices and oscillographs. One input can be fed to several outputs by using parallel jacks. Characteristic impedance is 53.5 ohm. The unit weighs 322 lb.

E D P Corporation, Dept. ED, 3501 S. Orange Blossom Trail, Orlando, Fla.
Price: *$5,800 to $6,800 ea.*
Availability: *4 to 6 weeks.*

Control Fader 414

Provides 30 steps

For audio and video use, this control fader provides 30 steps of attenuation and a spare set of contacts for auxiliary use. Cross-talk is —70 db at 1 mc and —48 db at 10 mc. The faders are fitted with plug and socket connectors to facilitate removal from the control panel.

Interlab Inc., Dept. ED, 116 Kraft Ave., Bronxville, N.Y.
Price: *$24.50 to $79.50 for 10 units or more.*
Availability: *60 days.*

Ceramic Capacitors 647

For low voltage circuitry

Hypercon capacitors rated at 3 v have a capacitance tolerance of +100, —0%; 12-v units have a tolerance of +80, —20%. Capacitances of the 3-v units are 0.1, 0.22, 0.47, 1.0 and 2.2 μf; the 12-v units have 0.047, 0.1, 0.22 and 0.47 μf. Diameters of the 3-v units are 0.225, 0.275, 0.400, 0.595 and 0.840 in.; the 12-v units come with 0.275, 0.400, 0.595 or 0.840-in. diameters. Operating temperature range for all units is —55 to +85 C.

Sprague Electric Co., Dept. ED, North Adams, Mass.

NEW PRODUCTS

DC Power Supplies 685

Range in output from 3 to 1,000 v

The 132 power supplies of the RD series range in output from 3 to 1,000 v and from 50 to 3,000 w. They are available in six sizes for standard rack mounting. Voltage regulation is obtained using a ferroresonant, line-regulating transformer in conjunction with low forward-drop silicon rectifiers.

Raytheon Co., Dept. ED, Keeler Ave., South Norwalk, Conn.

Spring-Return Air Clamps 431

Two types offered

Models ACM-110 and ACM-120 clamps are of Zamak alloy with piston rods of ground and polished stainless steel. Sizes are 1-1/8 in. bore and 1- or 2-in. stroke. Holes are provided in the body and the base for horizontal or vertical mounting.

Allenair Corp., Dept. ED, 255 E. 2nd St., Mineola, N. Y.

***Price:** $7.75 for ACM-110; $9 for ACM-120.*
***Availability:** From stock.*

Transistorized DC Converter 637

For microwave system use

Transistorized converter, model 526Z-1 is designed for use in microwave systems. The unit enables complete dc operation of the manufacturers Microwave and Carrier from float charged 28/48-v batteries without any rotating machinery. The converter supplies 130 v dc at 1.4 amps, drawing 8 amp at 24 v dc or 4 amp at 48 v dc. Output ripple is less than 0.1 mv with 0.4 mv average input ripple. Either 24 or 48 v dc may be accommodated by a simple strapping arrangement.

Collins Radio Co., Texas Div., Dept. ED, 1930 Hi-Line Drive, Dallas 7, Tex.

Resistance Thermometers 661

Measure from absolute zero to +2,000 F

The APM series of surface temperature thermometers permits measurements over a usable range from absolute zero to +2,000 F. The units consist of platinum wire encapsulated in pure aluminum oxide. Mounted on a thin stainless-steel shim, the thermometer may be cemented, bolted or welded to surfaces of which temperature is to be measured. Response speed of the series is 1/2 sec or better.

Arthur C. Ruge Associates, Inc., Dept. ED, Hudson, N.H.

Digital Readout 590

Uses high-speed stepping motor

The series 9D digital readout device uses a high-speed stepping motor to drive a number display drum. Code signals developed for the device include a 5-wire, 10-position code and a four-digit, excess-three binary code. Operating power is 4 w, ac or dc pulse. Up to 11 characters are displayed. Operating speed is proportional to input frequency. Unit measures 5/8 x 9/32 in. or 1 x 15/32 in.

Sigma Instruments, Inc., Dept. ED, 80 Pearl St., S. Braintree 85, Mass.

Audio-Type Delay Line 627

Delay is 1,000 μsec

Model F-483 audio-type delay line has a 1,000-μsec delay. Attenuation is 3 db at 15 kc. Delay is held to 0.5%. Impedance is 600 ohms. Rise time is 40 μsec; cutoff frequency is at 20 kc. Phase linearity is better than 0.5% to 10 kc. Applications include study of special wave forms, sonar returns, sonar ranging and survey analysis.

Control Electronics Co., Inc., Dept. ED, 10 Stepar Pl., Huntington Station, L.I., N.Y.

Price: On request.

Availability: 6 weeks.

NEW PRODUCTS

Silver Circuits Printed on Ceramics 683

Have heat stability to 1,000 F

These silver circuits, which are direct-printed on ceramics or glass, have heat stability to 1,000 F, high bond strength and scratch resistance. Patterns can be applied on flats, rods, tubes, cones and other geometric shapes. Thickness of the circuits ranges from 0.0003 to 0.001 in. Pattern tolerance is ±0.002 in. Volume resistivity is 5 x 10^{-6} ohm-cm.

J. Frank Motson Co., Dept. ED, Flourtown, Pa.

Parametric Amplifier 689

Provides bandwidth of 35 to 40 meg

Type V-8350 parametric amplifier has an overall noise figure of 2 db and stable gain of 20 db. It uses two wideband variable reactance up-converters for simultaneous amplification and frequency conversion of a signal and its associated source of local oscillator power. By pumping both converters from the same source of X-band power, the if frequency stability is maintained even with variations in pump frequency or phase. Channel capacity is 40 meg when used with a wideband if amplifier.

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

Coercive-Force Ceramic Magnet 705

For making stacks for twt's

Model F-610 high intrinsic coercive-force ceramic magnet is designed for making stacks for periodically-focused twt's. Typical properties include: coercive force, 2,850 oersted; intrinsic

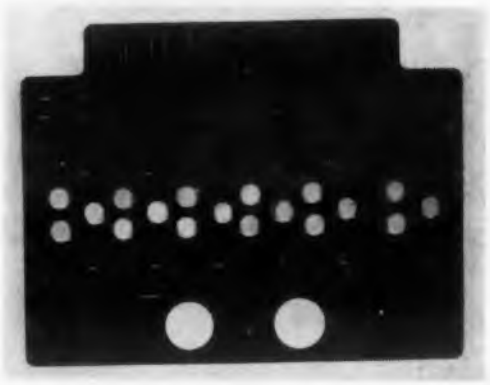
coercive force, 3,050 oersted; residual induction, 3,025 gauss; maximum energy product, 2.10 gauss-oersted; permeance coefficient, 1.07 at B_d H_d max.

D. M. Steward Mfg. Co., Dept. ED, Chattanooga, Tenn.

Price: $1 to $3.50 ea, over 1,000 units.
Availability: 25 to 30 days.

Digital-to-Analog Converter 633

Output impedance is 2,250 ohm



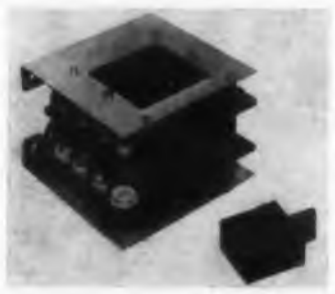
Model BDA-6 digital-to-analog converter has an output impedance of 2,250 ohm. Two identical modules can be interconnected to form a 12-bit converter having 0.1% accuracy. Each plug-in, etched module contains six stages and can be used as a 6-bit converter. Settling time for a full-scale voltage change at 10 v is 2 μsec.

Abacus Inc., Dept. ED, 3040 Overland Ave., Los Angeles 34, Calif.

Price: $275 per module, $550 per converter.
Availability: 3 weeks.

Modular Heat Sink 645

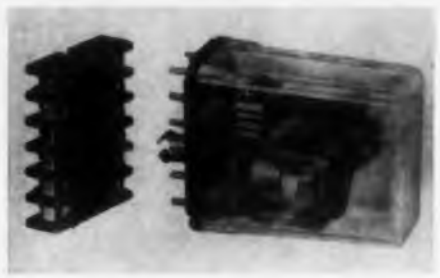
Dissipates almost 60 w at 25 C



Modular aluminum heat sink, model 2401, dissipates almost 60 w at 25 C ambient temperature. It has a thermal resistance between transistor shelf and air of less than 0.8 C per watt. Individual heat sinks are electrically insulated from one another and no mica washers are needed for mounting. Flexibility is provided by assembling the modules in incremental combinations for greater cooling capacity. Performance curves accompany each delivery.

Astro Dynamics, Inc., Dept. ED, 200 Sixth St., Cambridge 42, Mass.

NEW PRODUCTS



Sequence Relay 502

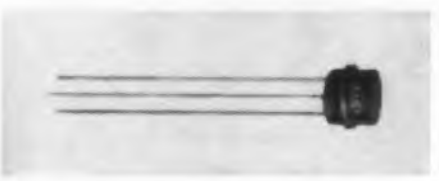
Frame 211 sequence relay is suited for industrial control, automatic process and machine-tool control. Available in dpdt or dpst types, contacts are rated 5 amp at 115 v ac, 5 amp at 24 v dc and 0.5 amp at 115 v dc. Ambient temperature is 40 C max; life is 10 million operations. Struthers-Dunn, Inc., Dept. ED, Pitman, N. J.

Pushbutton Switches 503

These snap-action, pushbutton switches, in illuminated and non-illuminated versions, have momentary or alternate-action configurations. Included are one or two spdt switches having ratings of 5 amp at 220 v ac and 0.25 amp at 220 v dc. Life is 1,100,000 operations. Truco Engineering Co., Dept. ED, 289 Fairfield Ave., Hartford 6, Conn.

Axial Fan 504

This fan meets Mil specs for airborne and ground equipment. All models have these ranges: frequency, 50 to 60 or 400 cps; variable frequency, 50 through 440 cps and 50 through 1,000 cps; voltages, 115, 208, 230 and 115 or 230; cfm at 0 in. SP, 90 to 300; SP, up to 4 in. H_2O. Rotating Components, Inc., Dept. ED, 267 Green St., Brooklyn 22, N. Y.

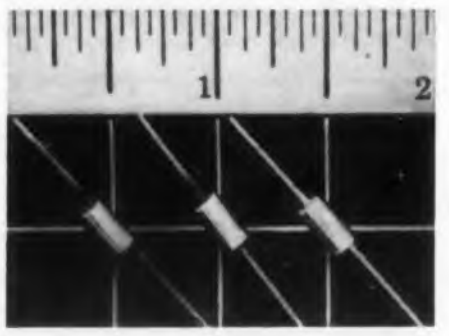


Silicon Trigistors 505

Types 3C100 through 3C100A silicon trigistors have ratings to 100 v. Features include: reliable operation down to 1 ma, high sensitivity below 50 ua and isolated leads. Meeting MIL-S-195, the units are for the design of four-layer logic and control circuitry. Solid State Products, Inc., Dept. ED, 1 Pingree St., Salem, Mass.

Current Source 506

Model CS-51 portable current source is a battery-operated unit having an accuracy of 1.5%. It is for use where constant accuracy of an electrometer is necessary. A ten-step vernier current multiplier varies the current from 1 to 10, extending the maximum range to 1 x 10^{-6} amp. Gyra Electronics Corp., Dept. ED, Washington & Elm Sts., La Grange, Ill.



Silicon Diodes 507

Series BC-100 ceramic-case diodes measure 0.11 in. in diameter and 0.25-in. long. They are rated at 1 amp at 50 C, operate at temperatures to 180 C and stand storage temperatures to 200 C. PIV ratings are 50 to 1,000 v. The diodes are adaptable to printed-circuit use. Bradley Semiconductor Corp., Dept. ED, 275 Welton St., New Haven 11, Conn.

Fixed DC Supply 508

This supply delivers 2,000 v regulated to within ±1% under these conditions: changes in load current from 0 to 2.4 ma; input-voltage variation from 102 to 124 v over a range of 380 to 420 cps; and ambient temperature changes from −54 to +71 C. ITT Corp., Industrial Products Div., Dept. ED, 15191 Bledsoe St., San Fernando, Calif.

Coaxial Crystal Mount 509

Model CNB302A video-detector mount is for use in applications where extreme sensitivity is not needed. Nominal tangential sensitivity is −40 dbm from 50 mc to 12 kmc using an AEL10 or 1N23B crystal. Using an AEL10 crystal from 50 mc to 7 kmc, sensitivity can be −50 dbm. American Electronic Laboratories, Inc., Dept. ED, 121 N. 7th St., Philadelphia 6, Pa.

Input Conditioner 510

For use with strain gages and transducers, model 1-202-AM cancels effects of long lines by using the six-wire, single-shunt calibration technique. It accommodates 1, 2 or 4 active arms. Design is modular. B & F Instruments, Inc., Dept. ED, 3644 N. Lawrence St., Philadelphia 40, Pa.

Transistor Heat Radiator 511

Type 3AL-692 fits 6-32 stud-mounted transistors. It has a 0.5-in. ID to fit units with a 0.42-in. case diameter. The radiator material is type 2011 aluminum alloy. Mounting hole is 9/64-in., and lead-wire slot is 3/32 × 9/32 in. The Bircher Corp., Industrial Div., ED, 745 S. Monterey Pass, Road, Monterey Park, Calif.

Universal Connectors 512

Typical of these connectors for solderless installation are the MS units with removable pins and sockets. Basic connectors, pins and sockets for wire gage sizes 8 through 22 and coaxial cables are offered. Hughes Aircraft Co., Industrial Systems Div., Dept. ED, P. O. Box 90904 Airport Station, Los Angeles 45, Calif.

Toroidal Inductors 513

Having an induction tolerance of ±1%, these units come in styles such as open-coil and plastic-dipped encapsulated inductors with tapped or through-hole mountings. Five types are offered. All but the open-coil type meet MIL-T-27A. Temperature range for all units is −55 to +125 C. Sprague Electric Co., Dept. ED, Marshall St., North Adams, Mass.

DC Wideband Amplifier 501

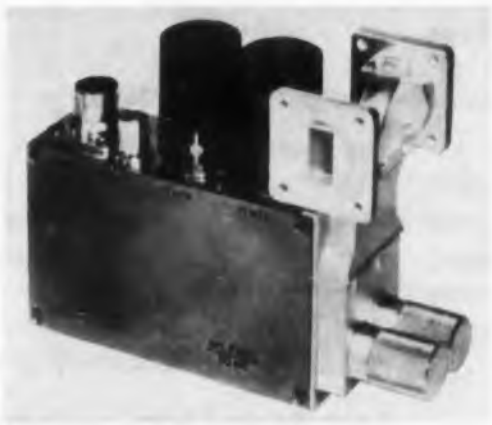
Common-mode rejection is 120 db to 1.5 kc

Model 1-155 amplifier, using driven-shaft techniques to block out spurious signals, attains a common-mode rejection of 120 db from dc to 1.5 kc and 140 db at 60 cps. It is designed to amplify low-level transducer signals over the dc to 10 kc range and to operates as an all-purpose laboratory instrument. Output is 200 ma, peak-to-peak, and 20 v, peak-to-peak. Frequency response is ±1% from dc to 5 kc, ±3% from dc to 10 kc and 30% down at 100 kc. Drift is less than ±2 μv max in 200 hr.

Consolidated Electrodynamics Corp., Dept. ED, 360 Sierra Madre Villa, Pasadena, Calif.

Mixer-Preamplifier 483

For microwave and guidance systems



Model 62MB-362F1 mixer-preamplifier is for microwave and guidance systems. The 15-to-17-kmc unit is for use as a low-noise, wideband down converter for maser and parametric rf amplifiers. Noise figure is less than 10 db; minimum gain is 25 db. Preamplifier output is matched to 50 ohm.

Microwave Development Laboratories, Inc., Dept. ED, 92 Broad St., Babson Park 57, Wellesley, Mass.

Price: *$1,275 ea, 1 to 9; $1,025 ea, 10 to 24.*
Availability: *30 to 60 days.*

Recovery-Time Reader 423

Output is go/no-go

This recovery-time reader eliminates the need for an operator to make decisions from an oscilloscope. The unit provides a red, no-go light and a green, go light. The reader is extremely stable. The go/no-go limits are set on a precision potentiometer. Specifications are: speed, 4,000 readings per hr; reverse voltage range, 5 to 40 v; sensitivity, 100 mv.

Contronics, Inc., Dept. ED, 37 Leon St., Boston, Mass.

Price: *$505.*

Availability: *Three weeks.*

Tape Search Display Units 644

For rapid manual search

The 840 and 850 series of manual magnetic-tape search display units are solid-state units designed to display time code recorded previously on magnetic tape. The units enable an operator to manually search rapidly reels of multi-channel tape to locate critical segments of recorded tape. The time code is displayed continuously when the tape moves in forward or reverse direction and at rewind or record speed. A 2,500-ft tape reel can be searched in about 2 minutes. Playback speed is from 1-7/8 to 150 in. per sec regardless of original recording speed.

Electronic Engineering Co. of California, Dept. ED, 1601 E. Chestnut Ave., Santa Ana, Calif.

Germanium Transistors 419

Stands 5,000-g constant acceleration

Type JAN-2N158 is designed for use in automation devices to operate relays, control servo motors and drive magnetic amplifiers. Ratings at 25 C include: collector-to-emitter voltage, —60 v; emitter current, 2 amp; dissipation, 17 w; and storage-junction temperature range, —65 to +85 C. The transistor has a minimum-current gain of 21 and a maximum-input voltage of 0.85 v for an I_c of 0.5 amp and a V_{ce} of —2 v. The unit meets Mil specs.

CBS Electronics, Dept. ED, 100 Endicott St., Danvers, Mass.

NEW PRODUCTS

Silicon Power Rectifier 736

Is rated at 5 amp

Type 1N2153 silicon power rectifier, made to meet MIL-S-19500/91, is rated at 5 amp dc continuous duty, at 150 C. The piv rating is 500 v. At rated current the forward drop is 1.2 v max. The reverse leakage is 4 μa at 25 C and 500 μa at 150 C. Surge current rating is 150 amp for 1/120 sec for a 60-cps sine wave.

Bradley Semiconductor Corp., Dept. ED, New Haven, Conn.
Price & Availability: *$7 to $15; two weeks.*

Transistorized Relay Driver 521

Will switch a resistive load to 1 kc

This transistorized relay driver provides the power to operate most of the general-purpose relays now available. It will switch a resistive load at frequencies up to 1 kc, at currents up to 1 amp and voltages up to 28 v max. Diode clamping is provided to protect against back surges when used as a relay driver. The turn-on signal is −11 v nominal; turn-off is −3 v nominal. The unit is packaged in a container measuring 7/8 in. diam × 2-3/16 in. seated height and plugs into a standard 9-pin miniature tube socket.

Engineered Electronics Co., Dept. ED, 1441 E. Chestnut Ave., Santa Ana, Calif.

Latching Relays 739

Single- and dual-coil types

Type JP single-coil and type JPA or JPB dual-coil, polarized, magnetic latching relays are for electronic logic circuits, computer storage elements, and automated machines. Five mounting variations are supplied with eight 0.2-in. grid-spaced terminals and with one or two additional coil terminals for the two-coil type. Contact rating is

2 amp at 29 v dc and 1 amp at 115 v ac. Units stand shock and vibration.

Allied Control Co., Inc., Dept. ED, 2 East End Ave., New York 21, N.Y.

Price & Availability: $22 for type JP; $24 for types JPA and JPB. Delivery is 8 to 10 weeks for production quantities.

Voltage-Regulator Diodes 427

Have silicon-diffused junctions

These 10-w voltage-regulator diodes have silicon-diffused junctions. These vr diodes, designated types 1N1808, 1N2044 through 1N2049 and 1N1351 through 1N1362, have metal-and-glass hermetic seals. Voltage regulation is from 7.5 to 30 v; tolerance is ±10% on standard types and 5% on "A" versions. Operating temperatures are up to 175 C. Applications include high-current and high-voltage power supplies, and use as coupling devices and biasing elements. The units are also suited for surge protection and voltage limiting and clipping.

General Instrument Corp., Semiconductor Div., Dept. ED, 65 Gouverneur St., Newark 4, N.J.

Cam-Action Brake 385

Rapidly stops precision motors

This cam-action brake is said to stop precision motors ten times faster than most conventional brake assemblies. In tests, the brake halted an armature rotating at 24,000 rpm within two revolutions. Action is caused by four dimples that register in precision-shaped grooves. These dimples also locate and center the brake shoe without locating pins. Torque can be adjusted by changing the angles of dimples and grooves.

American Electronics, Inc., Electro-Mechanical Div., Dept. ED, 4811 E. Telegraph Road, Los Angeles 22, Calif.

Availability: Basic parts are available for assembly to customer's specifications; delivery is 30 to 90 days.

CIRCLE 87 ON READER-SERVICE CARD ▶

NEW PRODUCTS

Telephone Circuit Tester 379

Examines 14 circuits simultaneously

The Swept-Band transmission measuring set indicates if there is a defect in a telephone circuit, and, in some cases, determines the type of defect and location. It can test 14 circuits simultaneously.

The Siegler Corp., Hallamore Div., Dept. ED, Anaheim, Calif.
Price: *$2,000 or with auxiliary units, $2,500.*

Rotary Trimmer Potentiometer 426

For severe environmental conditions

Type 5001 single-turn, rotary trimmer potentiometer is designed to operate under severe environmental conditions. The unit, having an 0.5-in. diam, is available with bushing or servo mounting. Specifications include: power rating, 2 w at 60 C; standard resistance, 10 ohm to 20 K; resistance tolerance, ±5%; linearity tolerance, ±3%.

International Resistance Co., Dept. ED, 401 N. Broad St., Philadelphia 8, Pa.
Price: *Approximately $10 ea.*
Availability: *From stock.*

Guarded Wheatstone Bridge 526

Has range of 0.01 ohm to 1,111 meg

Model 4735 guarded wheatstone bridge has a range of 0.01 ohm to 1,111 megohms with a limit of error of ±0.05% +0.001 ohm up to 100 megohms and 0.5% above 100 megohms. The instrument has complete guarding of the measuring circuit to minimize the effects of stray electrostatic fields. A single-multiplier dial is used and a table is provided for ratio settings for each resistance-decade value throughout the range of the bridge.

Leeds and Northrup Co., Dept. ED, 4934 Stenton Ave., Philadelphia, Pa.

Polystyrene Capacitors 421

Comes in phenolic case

Type 26P capacitor is housed in a moisture-resistant phenolic case. An insulation resistance of better than 1 x 10^6 meg is possible, even after the unit has been subjected to a 500-hr, 90% to 95% humidity test at 40 C with full rated voltage. Typical applications are: calculators, computers, control circuits, filters and frequency standards.

Atlee Corp., Dept. ED, 330 Bear Hill Rd., Waltham, Mass.

Price: *$0.24 to $2 ea in lots of 100.*
Availability: *30-day delivery.*

Miniature Ceramic Switches 638

Will withstand 175 C

These miniature ceramic switches are designed with high temperature alloys and incorporate new assembly techniques that assure operation to +175 C. The switches provide up to 22 terminals per section, maximum switching combinations per section range from 1 pole, 2 to 12 positions to 6 poles, 2 positions. Voltage breakdown between critical parts is 1500 v rms.

Globe-Union, Inc., Centralab Div., Dept. ED, 900 E. Keefe Ave., Milwaukee 1, Wis.

Bimetal Disc Thermostats 565

Have differentials of 1 to 4 F

Type MX bimetal disk thermostats provide differentials, as measured on the disk, of 1 to 4 F on special order. Standard units are available with differentials of 2 to 6 F. They weigh about 5 g and resist high accelerations as specified in MIL-E-5272C. Among the applications for the units are: missile, avionic, and astrionic equipment. Available in either semi-enclosed or hermetically sealed types, the devices are rated, based on non-inductive loads, at 3 amp for 25,000 operations, 30 v ac or dc and 115 v ac and to 1 amp, at the same voltage, for 250,000 operations.

Stevens Manufacturing Co., Inc., Dept. ED, P.O. Box 1007, Mansfield, Ohio.

Availability: *Samples available a week or less after receipt of request; production quantities furnished 3 to 4 weeks after receipt of order.*

◀ CIRCLE 89 ON READER-SERVICE CARD

NEW PRODUCTS

Transistorized Power Supply 675

Continuously variable from 0 to 40 v dc

Model HC40-50 dc power supply is continuously variable from 0 to 40 v dc, and from 0 to 50 amp. Line regulation is 0.05% and regulation for load changes from 0 to full scale is 0.05%. Ripple does not exceed 2 mv. Input power is 208 v, 60 cps, 3-phase, four-wire wye. The unit measures 17.5 x 20 x 19 in.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.

Price: *F.O.B. Springfield $2495.*

Availability: *60 days.*

Wire Wound Potentiometers 655

Resistance values from 30 ohms to 200 K

This series of precision, wire-wound potentiometers has 1-1/16-in. body diameters and resistance values from 30 ohms to 200 K. Designed to operate within the temperature range from −55 C to +125 C, the 2 w nominal rating derates to 0 at +125 C. Specifications are: insulation resistance, 500 meg; linearity accuracy, ±0.1%; normal resistance tolerance, ±5%; equivalent noise, 100 ohms. The units have a life expectancy of 2 x 10^6 turns.

Duncan Electronics, Inc., Dept. ED, 1305 Wakeham Ave., Santa Ana, Calif.

Amplifier and Sweep Expander 410

Plugs into oscilloscope

This amplifier and sweep expander plugs into the firm's model 425 hf oscilloscope. Sweep expansion is in steps of 1, 2, 5, 10 and 20 times. The maximum calibrated sweep rate is 10 nsec per cm and expansion accuracy is nominally within 5%. Vernier sweep positions are provided by a 10-turn potentiometer. The amplifier has a bandwidth of 2 mc and a sensitivity of 0.1 to 20 v per cm. Input impedance is 1 meg, shunted by 25 pf.

Fairchild Camera and Instrument Corp., Allen B. DuMont Laboratories, Dept. ED, Clifton, N.J.

Availability: *By March 1961.*

Delay Unit 411

Trigger delay is 0 to 100 nsec

Type 4209 plug-in delay unit provides a precise trigger delay of 0 to 100 nsec and resolution within 0.1 nsec. A ten-turn helical delay line with four-digit in-line readout is provided. The unit is inserted electrically into the external trigger of the firm's model 425 oscilloscope. A selector switch permits trigger source selection from the internal signal, from an external source or from the internal fast-rise generator.

Fairchild Camera and Instrument Corp., Allen B. DuMont Laboratories, Dept. ED, Clifton, N.J.

Availability: By March 1961.

High-Speed Stepping Switch 681

Operates at up to 240 steps per second

The series 9C Cycloswitch is a stepping switch for high-speed operation at up to 240 steps per second. Switch decks are flush-printed. Brush arrangements can be common to 10-ring, to 20-ring, or both on one or two decks. Operating power ranges from 1/3 to 40 w. Capacity is 1.5 amp at 250 v dc. Average life is 25 million revolutions.

Sigma Instruments, Inc., Dept. ED, 42 Pearl St., S. Braintree 85, Mass.

Thermocouple Vacuum Gage 415

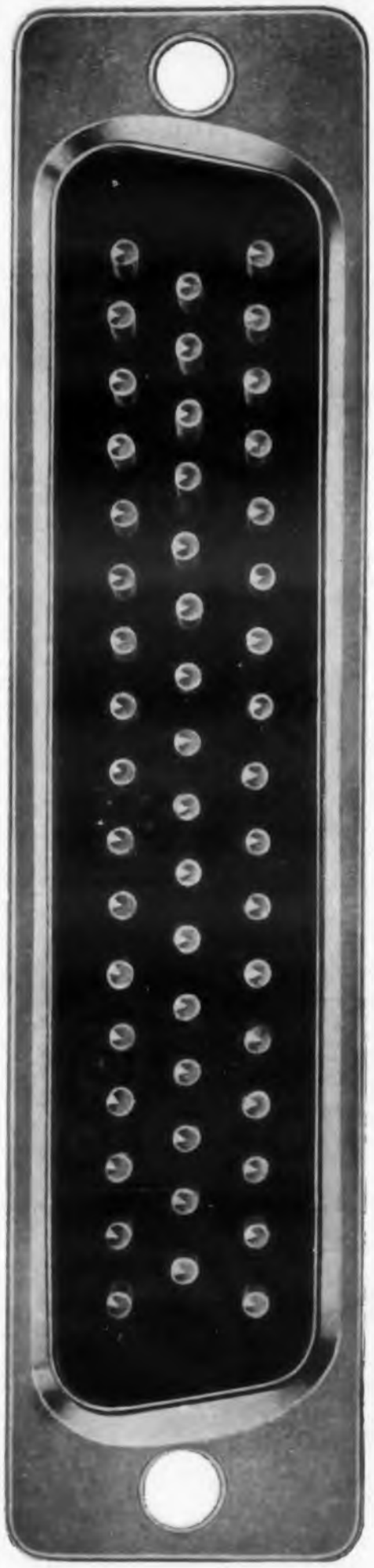
For ac or battery operation

This portable thermocouple vacuum gage can be operated for 60 hr on the self-contained 1.3-v nickel-cadmium battery or it can be plugged into any 120-v line. The battery recharges when the gage operates on ac. It is calibrated from 1 to 1,000 microns and can be used in a variety of industrial and laboratory applications, including vacuum systems for tube manufacture, metallizing and heat treating.

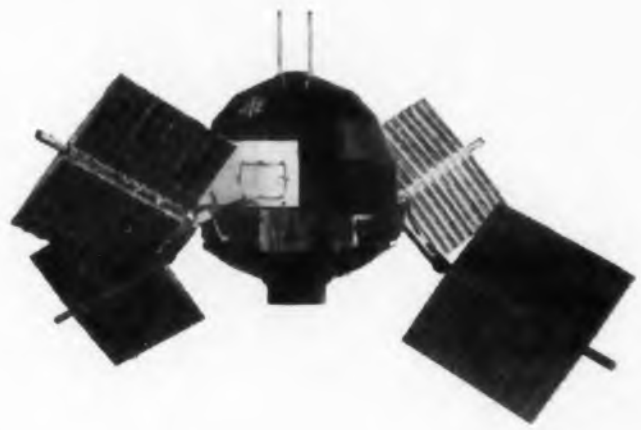
General Electric Co., Dept. ED, Schenectady 5, N.Y.

Price: $141 (to user).

Availability: From stock in West Lynn, Mass.



THREE AND ONE-HALF TIMES ACTUAL SIZE.



NEW PRODUCTS

Hermetically-Sealed Electric Counter 484

Meets military specifications

Model 5-YE-9156-ER hermetically-sealed electric counter meets military specifications. Applications include missile ground-support equipment and aircraft instrumentation. High-speed units operate to 2,400 cpm; standard units operate to 40 cps. The units reset electrically in 105 msec. They can operate under water.

Durant Manufacturing Co., Dept. ED, 1993 N. Buffum St., Milwaukee 1, Wis.

Motor-Driven Fan 420

Has a two-pole motor

Designed to provide ground cooling for electronic gear at a low noise level, this fan has a two-pole motor which operates with a 60-cps, three-phase power supply of 115 or 200 v at 0.6 amp per phase. The axial flow machine turns at 3,375 rpm and obtains a static pressure rise of 3.2 in. of water at a flow rate of 120 cfm.

The Garrett Corp., AiResearch Manufacturing Div., Dept. ED, 9851 Sepulveda Blvd., Los Angeles, Calif.

Availability: *21 days for delivery of samples.*

Neon Indicator Light 482

Generates its own firing voltage

This neon indicator light generates its own firing voltage from any applied dc voltage of 4 v or is switched from signals as low as −2 v dc. It can be operated directly from the basic power supply or additionally controlled by a high-impedance signal. For portable, battery-operated or low-voltage equipment, this miniature unit can show visually the logical condition of high-speed computer flip-flop modules.

Telex, Inc., Special Products Div., Dept. ED, 1633 Eustis St., St. Paul, Minn.

Price: *$7.35 ea, 1 to 499; $6.90 ea, 500 to 999; $6.50 ea, 1,000 and over.*

Availability: *4 weeks.*

Immersible Transducers 413

Complete line offered

These immersible transducers operate on a feedback sensing principle which eliminates the need for constant tuning of the ultrasonic cleaning equipment to suit changing load conditions. Three units are available for use with the Autosonic 300-w generator and two units are for use with the 700-w generator.

Powertron Ultrasonics Corp., Dept. ED, Patterson Place, Roosevelt Field, Garden City, N.Y.

Price: *$425 to $975 for one.*

Availability: *From stock, in large quantities.*

Mobile Dynamotors 491

For dc-dc power conversion

Series 601 mobile Dynamotors are for environments where dc-to-dc power conversion is required under severe ambient stress, shock and vibration conditions. The units operate from 24 to 30 v dc, and generate 1 to 3 outputs from 0 to 1,500 v dc. Load regulation is 4%, no load to full load. Ripple is 3.5% max, peak-to-peak, full load. Temperature range is −55 to +65 C.

Electric Specialty Co., Dept. ED, 211 South St., Stamford, Conn.

Silicon Diodes 396

Meet Mil specs

These units are available in 35 types to meet Mil specs. All are for operation to 200 C. Types 1N482A through 1N488A and 1N482B through 1N486B are high-conductance, high-resistance

units; types 1N482 through 1N488 are high-conductance units; types 1N456A through 1N459A and 1N461A through 1N464A are general-purpose, high-conductance units; types 1N456 through 1N459 and 1N461 through 1N464 are general-purpose units. Size is 0.265 x 0.105 in. and upper temperature limit is 200 C.

Raytheon Co., Semiconductor Div., Dept. ED, 200 First Avenue, Needham, Mass.
Availability: Immediate.

Welding Unit 424

Heat is developed in 3 to 16 msec

Designed for welding delicate assemblies, this unit can be used for joining metals of high thermal conductivity. Heat is developed in 3 to 16 msec. The unit requires 200 w.

Product Engineers Inc., Dept. ED, Pickwick & Salmon St., Philadelphia, Pa.

Strain-Gage Power Supply 474

Output drift is less than 0.1% to 50 C

Type 3-139 power supply has an output drift of less than 0.1% from 0 to 50 C for all load and output voltage conditions. Long-term drift is less than 0.1% for 200 hr. Output is 2 to 15 v, continuously variable, at 0 to 200 ma. Output voltage varies ±0.05% for 10% line changes from 95 to 135 v. Ripple is 0.5 mv peak-to-peak for all load and output conditions. The unit is designed for plug-in mounting.

Consolidated Electrodynamics Corp., Dept. ED, 360 Sierra Madre Villa, Pasadena, Calif.

Blower Motor 611

For vane axial blowers

Model C-20-37 blower motor is suitable for both military and industrial applications. Specifications include: horsepower, 3/4 hp; voltage, 200 v at 400 cps, three-phase; speed, 22,300 rpm; torque, 2.83 oz-in. The unit weighs 3-5/8 lb.

Kearfott, Div. of General Precision, Dept. ED, 1150 McBride Ave., Little Falls, N.J.

NEW PRODUCTS

Linear Amplifier 727

For pulse amplitude spectroscopy

Model 30-16 linear amplifier is designed for pulse amplitude spectroscopy. Input pulses from 0 to 80 v are accepted; discriminator output pulses are 15 v negative or 25 v positive. The unit has a gain of 10,000. Its internal pulse generator has three operating positions: two fixed positions of +20 and +40 v; an output position variable between 0 and 45 v.

Radiation Instrument Development Laboratory, Inc., Dept. ED, 61 E. North Ave., Northlake, Ill.

Current Detecting System 378

For hf use

Model P6016 ac probe and model 131 amplifier are for use with a wide-band oscilloscope. The system provides accurate displays for observation and measurement of current wave-forms of low amplitude and fast rise-time. Current range is 1 ma to 10 amp. Pass-band, with a 30-mc oscilloscope, is 50 cps to 17 mc.

Tektronix, Inc., Dept. ED, P. O. Box 500, Beaverton, Ore.

***Price:** Probe, $75; amplifier, $160.*
***Availability:** From stock.*

DC-to-DC Power Converter 434

Supplies 12 v dc from 6-v battery

This power converter operates 12-v electronic equipment in vehicles with 6-v electrical systems. With input voltage nominally at 6.3 v, the unit will supply output currents from 2 to 25 amp at 12.6 to 14.0 v. It operates over an ambient temperature range of −30 to +65 C. A 6-v continuous-duty relay is provided to turn the converter on and off. The unit measures 5-1/2 x 8 x 4 in. and weighs 6 lb.

Hoover Electronics Co., Dept. ED, 110 W. Timonium Road, Timonium, Md.

◀ CIRCLE 96 ON READER-SERVICE CARD

Translator-Converter 364

For between IBM cards and tape

Model 312 translator-converter provides tape-to-card or card-to-tape conversion at 20 card columns per sec. Code-to-code conversion is at the rate of 60 tape characters per sec. Paper tape input is from the firm's model 420 PR, in any code at up to eight channels. For card-tape conversion, the system is linked to an IBM 024-026 key punch.

Tally Register Corp., Dept. ED, 1310 Mercer St., Seattle 9, Wash. *Price: $9,300.*

DC Null Detector 525

Offers four degrees of sensitivity

Model 9834 guarded dc null detector offers four degrees of sensitivity, over a range of 1,000 to 1, and has a noise level of less than ±0.1 μv. When used with guarded potentiometers and bridges its guarded circuit eliminates errors that might result from leakage currents under adverse humidity conditions. The unit has an input impedance of 40,000 ohms, and is designed to provide maximum sensitivity around the null point. The detector amplifier can saturate on large signals, in conjunction with the non-linear meter circuit, this prevents off-scale deflections.

Leeds and Northrup Co., Dept. ED, 4934 Stenton Ave., Philadelphia, Pa.

Patchcords 368

Contact resistance is 0.3 milliohms

A silver-plated plug gives these patchcords a contact resistance of 0.3 milliohms. They feature flexibility through the use of a conductor consisting of 56 strands of 0.006 in. diameter copper and a two-layer soft PVC insulation. Type 1120 has dual branching in line and crosswise for multiple connections, type 109 does not have branching. The patchcords are available in six colors.

Kurt Roedl Co., Dept. ED, 1378 Crest Drive, Encinitas, Calif.

CIRCLE 97 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Germanium Transistors 381

For amplifier and switching applications

Types 2N650, 2N651 and 2N652 pnp transistors are designed for amplifier and switching applications in the af range. Maximum collector-to-base voltage is 45 v, collector-to-emitter voltage is 25 v, collector current is 250 ma, and junction temperature is 100 C. The units are housed in a TO-5 JEDEC package and have a maximum free-air power dissipation of 200 mw.

Sylvania Electric Products Inc., Dept. ED, 730 Third Ave., New York 17, N.Y.

Price: *2N560, $1.88; 2N651, $2.10; 2N652, $2.40.*

Availability: *Through distributors.*

Band-Shift Modulator 732

Contains 35 translator units

This band-shift modulator filters and translates the audio spectrum into frequency bands that can be examined individually and simultaneously with a high degree of resolution. Thirty-five individual translator units are assembled into a two-rack assembly to provide complete instrumentation for 35 140-cps spectrum segments falling between 150 and 5,000 cps. The over-all unit consists of 7 five-channel assemblies operating from a common power supply.

Rixon Electronics, Inc., Dept. ED, Silver Spring, Md.

Pulse Transformer 546

For use in airborne-radar system

This unit, weighing less than 22 lb, delivers 50% more power than the 38-lb unit it replaces. It has a trigger-winding pressure switch, an rf-filter choke and an additional 400-w cooling capacity.

General Electric Co., Light Military Electronics Dept., Dept. ED, Schenectady, N. Y.

◀ CIRCLE 98 ON READER-SERVICE CARD

Electronic Scanner 528

Switches 50,000 data points per sec

This scanner sequentially switches data points in the form of contact closures or voltage levels at the rate of 50,000 points per sec. It switches output lines by a pulse of −10 v, minimum amplitude, of 5-μsec duration. The unit is made up of type CM-115 decade scanner and type CM-113 gate-circuit modules. Maximum switching capacity is 199 points.

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

Sensitive DC Relay 537

Adjusts for marginal operations

Relays RSH-3D and RSH-6D have integral-adjustment screws which permit changing the ratio of drop-out to pull-in up to 50% before the relay is hermetically sealed. High resistance coils, to 28,500 ohms are designed for plate circuit use. Operating conditions are: initial contact resistance, 0.05 ohms max; insulation resistance, 1,000 meg min; operate time, 20 msec max; release time, 10 msec max. Operate time and release time are figured at nominal current and +25 C.

Allied Control Co., Inc., Dept. ED, 2 East End Ave., New York 21, N.Y.

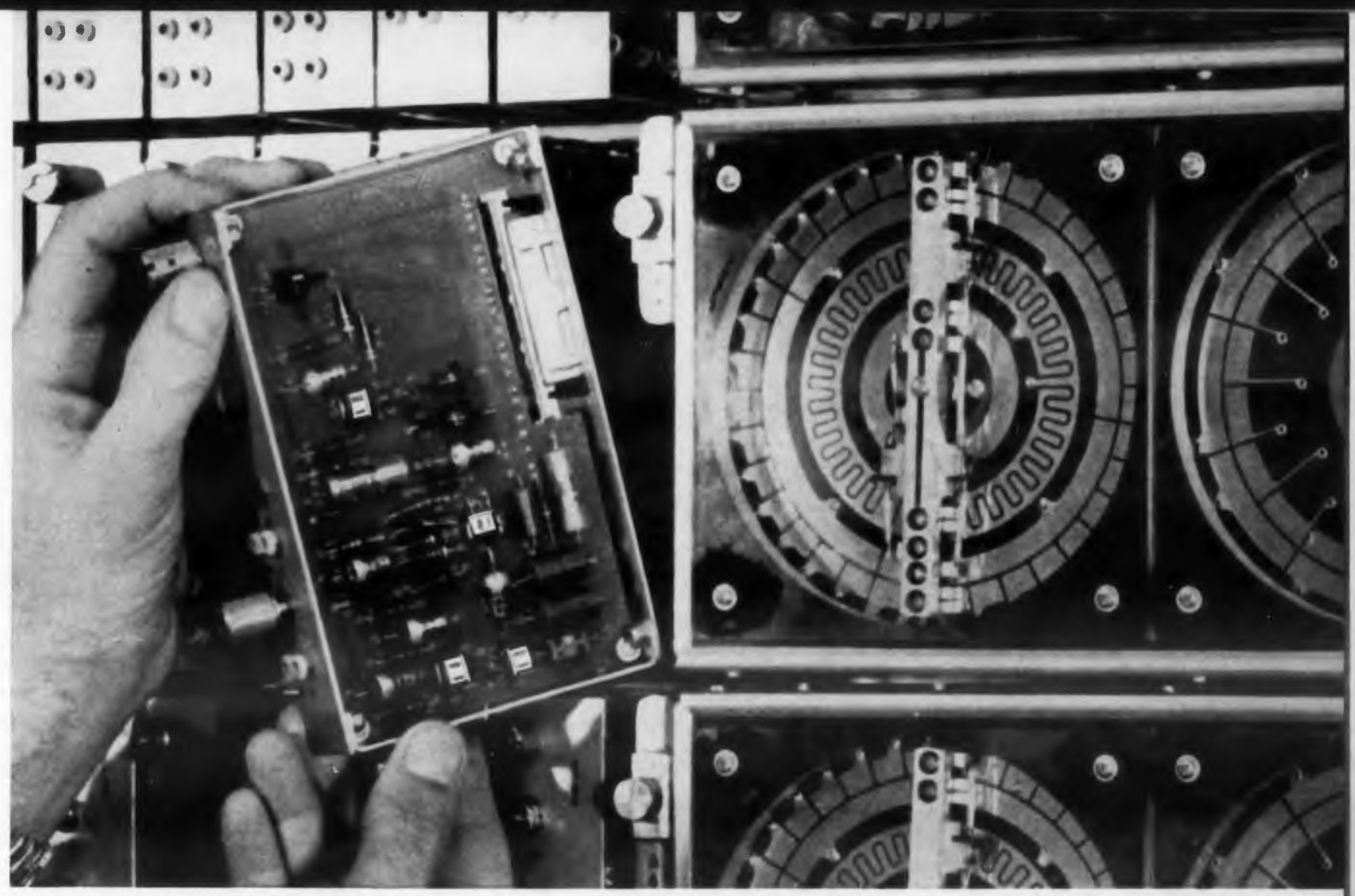
Miniature Commutator 547

Measures 2-3/16 x 3-1/4 x 1 in.

Model 6-15 commutator measures 2-3/16 x 3-1/4 x 1 in. and weighs 11 oz. Contact life is 50 x 10^6 cycles at 500 rpm; equivalent noise resistance is less than 14 ohms. Continuous current rating is 50 ma. The unit has a variable sweep rate and an open-circuit resistance greater than 5 x 10^9 ohms. It meets MIL-E-5272C specifications.

Acton Labs, Inc., Space Instrumentation Div., Dept. ED, 533 Main St., Acton, Mass.

CIRCLE 99 ON READER-SERVICE CARD ➤



NEW PRODUCTS

Fotoceram Wafers 524

For microelectronics use

Shaped by a photographic process, these wafers can be made in intricate detail without dies or drills. The pattern for the wafer is implanted on photosensitive glass and the image etched away by acid. The glass is then heat treated to form a rugged ceramic material that takes metallizing well. One wafer, measuring 1.25 x 0.6 x 0.055 in., contains eight protruding contact bars, three slots and 19 tiny holes. Several wafers can be stacked for complex circuitry.

Corning Electronic Components, Corning Glass Works, Dept. ED, Bradford, Pa.

Sonic-Delay Lines 531

Delays are from 2 μsec to 20 msec

Available to military electronic design engineers, these sonic-delay lines can provide delays of 2 μsec to 20 msec. Typical loss for a sonic-delay line of 1-msec fixed delay is 30 to 35 db. Temperature coefficients of delay are as low as 1 ppm per deg C. Maximum bandwidth is 1.25 mc.

General Electric Co., Heavy Military Electronics Dept., Dept. ED, Court Street Plant, Syracuse, N.Y.

Availability: *Sample and production quantities, 4 to 6 weeks.*

Crossbar Switch 373

Handles up to 1,200 circuits

This crossbar switch is offered as an accessory package module. The module combines the switch with the multi-contact connectors in a package measuring 24 x 8-3/4 x 12-1/2 in. It can be mounted in a standard 24-in rack or two units can be mounted in a 19-in. rack.

North Electric Co., Dept. ED, Galion, Ohio.

Price: *$1,000.*

◀ CIRCLE 100 ON READER-SERVICE CARD

Modules Remote-Readout 516

Provide six-digit in-line readouts

These 3 remote-readout modules provide six-digit in-line Nixie readout for numerical data display. Model 342 reproduces the output reading of the firm's line of "Aptimeters." Model 343 is equipped with integral amplifiers and power supply for ten-line-per-digit input such as might be obtained from an ADC, decade counter or other digital-output device. Model 344 is equipped with integral amplifiers, power supply and a binary-decimal decoding network to permit driving the Nixies from 1, 2, 2, 4 or 1, 2, 4, 2 binary-coded-decimal devices.

Transistor Specialties Inc., Dept. ED, Terminal Drive, Plainview, Long Island, N.Y.

Price: For model 342, $345.

Availability: For model 342, 60 days.

Data Digitizing System 557

Automates microscope readings

This data acquisition and recording system is intended to automate microscope readings. The system converts translational motions of a film-scanning microscope along three axes into coded digital data on punched paper tape. These provide 1,000 counts per shaft revolution and have a capacity of 100,000 counts. Visual display of total count is provided.

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

High Frequency Filter 436

For ground and airborne radar if systems

This filter can be built for any adaptation up to a 40-mc range. Typical specifications are: bandwidth, 150 kc to 3 mc; insertion loss, inversely proportional to bandwidth; impedance, 73 to 10,000 ohms; center frequency, 15 or 30 mc; shape factors (60 to 6 db), 3:1 to 12:1.

Electro Networks, Inc., Dept. ED, 1920 Park St., Syracuse, N.Y.

CIRCLE 101 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Magnetic Shield 380

For electron and proton beams

This 18-piece Netic, Co-Netic magnetic shield acts as a divisionary shield against magnetic effects on electron or proton beams conveyed axially through the shield. The unit consists of three coaxial cylindrical enclosures spaced 1/4 in. apart. Outer shield is constructed of Netic S3 with 0.049 in. cadmium iridite finish; two inner shields are made of Co-Netic AA. The system can be evacuated. Sectional construction facilitates installation.

Magnetic Shield Div., Perfection Mica Co., Dept. ED, 1322 N. Elston Ave., Chicago 22, Ill.

Availability: *Made to order; delivered in 4 to 6 weeks.*

Audio-Output Transformer 429

Frequency response is ±0.5 db

Model 16595 audio-output transformer has a frequency response of ±0.5 db from 20 cps to 5 kc. The secondary of this push-pull unit consists of four separate windings, each rated 67 v rms at 97 amp. Efficiency rating is 99.2%. The 3,000-lb unit is for applications requiring high current and efficiency.

Ling-Altec Electronics, Inc., Altec Lansing Div., Dept. ED, 1515 S. Manchester Ave., Anaheim, Calif.

Translator Circuit Module 441

Translates 4-bit binary codes to decimal

The CM-104 circuit module translates 4-bit binary codes to decimal. The transistorized printed-circuit unit, for plug-in mounting, contains 10 AND-gates with NOT-AND inverters. The 5 x 4 x 0.093-in. module operates at ambient temperatures from −45 to +55 C.

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

◀ CIRCLE 102 ON READER-SERVICE CARD

Power Supply 440

Provides 12 currents

Model CS-309A precision current source provides 12 currents of positive or negative polarity over a 1 ma to 2 mμa range. Accuracy is 1%. The unit is for use in calibrating current-measuring instruments that have relatively low input impedance. Source of the current is a 1.34-v mercury cell combined with precision resistors.

Elcor, Inc., Dept. ED, 1225 W. Broad St., Falls Church, Va.

Zener-Diode Regulated Power Supplies 438

Outputs range from 6 to 24 v dc

These Zener-diode, regulated power supplies have outputs ranging from 6 to 24 v dc. The 5-oz, hermetically-sealed units measure 1-5/8 x 1-3/4 x 2-1/4 in. The dc output is isolated to have a total distributed capacitance-to-ground of 25 pf. The units are for use in transistor and vacuum-tube circuits that require a dc power or voltage source that is capacitively and conductively isolated from ground. Leakage resistance between output and ground exceeds 50 x 10^3 meg, breakdown voltage exceeds 1,000 v. The units can be furnished for operation from 6.3 v ac or 117 v ac. Maximum dc output current varies from 8 ma at 6 v to 2 ma at 24 v.

Elcor, Inc., Dept. ED, 1225 W. Broad St., Falls Church, Va.

Isolated Power Supplies 439

Shunt-to-ground capacitance is 25 pf

Three isolated power supplies, called Isoplys, have output ratings of 300 v at 20 ma, 255 v at 25 ma and 215 v at 25 ma. The units have shunt-to-ground distributed capacitance of 25 pf. Hum and noise in ungrounded applications is less than 4 mv rms per K, impedance-to-ground. Leakage resistance exceeds 100 x 10^3 meg; breakdown voltage exceeds 3,000 v.

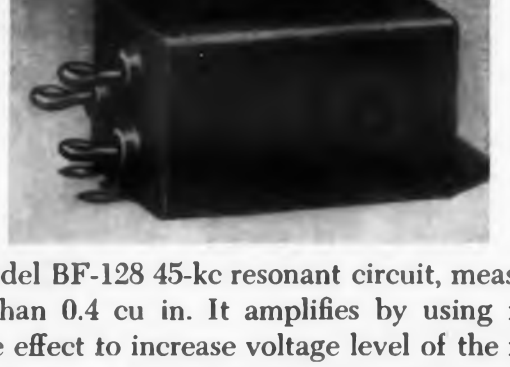
Elcor, Inc., Dept. ED, 1225 W. Broad St., Falls Church, Va.

CIRCLE 103 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Resonant Circuit 467

For triggering and timing circuits



Model BF-128 45-kc resonant circuit, measures less than 0.4 cu in. It amplifies by using resonance effect to increase voltage level of the resonant frequency signal while rejecting other frequencies. It has a maximum 3-db bandwidth of 4,500 cps and a source impedance of 3,000 ohms.

Control Electronics Co., Inc., Dept. ED, 10 Stepar Place, Huntington Station, L.I., N.Y.

Size 5 Magnetic Starter 604

Handles heavy current surges

These size 5 magnetic starters have parallel double-break contacts that provide four contact points to handle heavy current surges. Epoxy-cast current transformers and low-current overload relays are employed. The instrument measures 13 x 15-3/16 x 6-1/8 in.

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

Glass Header 469

Meets mil specs

The Sentriseal hermetic, metal-to-glass header and base cover meets Mil-C-3098. It is made to fit an HC-6/U crystal holder and has a small disk of Kovar metal attached to the pins at the outer surface of the glass. The glass bead is sealed to both disk and pin. Seal strength exceeds the 25-lb push-pull test required.

Wallace E. Connolly & Co., Dept. ED, P. O. Box 295, Menlo Park, Calif.

Availability: From stock.

Modular Photorelay 629

Operating voltage is 115 v ac

The Cyclops modular photorelay has an operating voltage of 115-v ac. It can be used for control, limit switch, counting, sorting, detection, and go-no-go circuits. Normally open or closed contacts are available having 5-amp ratings at 115-v ac. The unit measures 4 x 3 x 3-1/2 in.

Berkeley/Dynamics, Dept. ED, P.O. Box 1098, Burlingame, Calif.

Price: *$35 ea.*

Garnet Materials 405

For use from 350 to 3,000 mc

This series of yttrium-gadolinium garnets is for use from 350 to 3,000 mc at temperatures from −65 to +125 C. Power levels are from a few mw to the megawatt level. They are most suitable for high average power applications. Five different compositions are available in bars measuring 1 x 1/2 x 6 in.

Sperry Microwave Electronics Co., Dept. ED, Clearwater, Fla.

Price: *From $125 for yttrium garnet to $145 for 60% gadolinium garnet.*

Availability: *30 to 60 days.*

Electronic Frequency Meter 639

Has 3 cps to 1.65 mc range

Electronic frequency meter, type 1142-A, has a range of 3 cps to 1.65 mc. It is also a linear, low noise discriminator. Logarithmic meter indication with 1% accuracy is provided. Any 10% segment of the scale can be expanded to cover the entire scale. Output dc current is available up to 5 ma ±0.2%. Sensitivity is 10 to 20 mv.

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

NEW LIGHT is shed daily on microwave tube state-of-the-art by the engineers and scientists at Sperry's Gainesville, Florida plant. If existing hardware doesn't readily solve your tube application problem, call Gainesville, FRanklin 2-0411 collect, for full information about Sperry capabilities.

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A COMPLETE LINE of klystron tubes is manufactured and marketed by Sperry Electronic Tube Division, Gainesville, Fla. The division also performs extensive research and development toward advances in klystron state-of-the-art.

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CIRCLE 106 ON READER-SERVICE CARD

SPERRY ELECTRONIC TUBE DIVISION

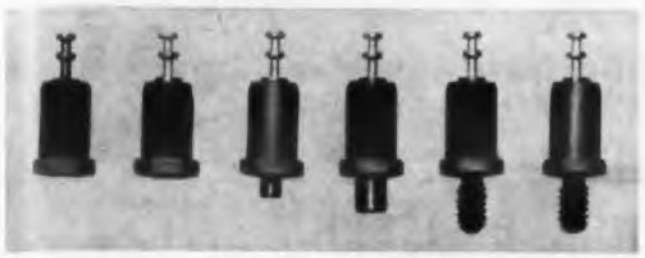
GAINESVILLE, FLORIDA
A Division of Sperry Rand Corporation

CIRCLE 107 ON READER-SERVICE CARD

NEW PRODUCTS

Standoff Terminals 481

Two types offered



Series 4800 terminals have diallyl phthalate insulators and series 4900, melamine. They can be furnished with external threaded, internal threaded and rivet type mounting studs. Terminals are brass and are finished in 0.0003-in. electro-tin lead plate or 0.0003-in. silver plate.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

Direct-View Storage Tube 692

Writing speed is 36,000 ips

Type WL-7268 direct-view storage tube has a writing speed of 36,000 ips. It is for airborne fire-control radar, weather radar, transient studies, data transmission, telemetering, facsimile and visual displays. Brightness is up to 2,500 ft-L with 10,000 v applied to the phosphor. The tube operates in military environments. Diameter is 5-1/4-in. max and length is 15-3/4 in.

Westinghouse Electric Corp., Electronic Tube Div., Dept ED, P.O. Box 284, Elmira, N.Y.
Price: $1,850 ea, 1 to 9 units.
Availability: Samples from stock.

Miniature Tube Sockets 640

For high-frequency service

This series of 7- and 9-pin miniature tube sockets is designed for high-frequency service in electronic equipment where low loss factor and dielectric constant are required. The socket bodies are fabricated of plastic insulating materials that will not carbonize under arcing and will not dc-plate. Shield and saddle bases are made of steel, cadmium plated or brass, nickel plated. The contacts are beryllium copper and silver plated.

Garlock, Inc., Dept. ED, Camden 1, N.J.

NEW PRODUCTS

Cathode-Ray Tubes 369

In all standard phosphors

These two 5-in. cathode-ray tubes are available in all standard phosphors. The manufacturer claims up to 50% more brightness at standard instrument voltages is possible with these replacements for the 5ADP and 5ABP crt's. Spot or trace drift due to face charging is eliminated. Tolerances on trace alinement, pattern distortion and deflection factor uniformity have been tightened up to 40%.

Electronic Tube Dept. Allen B. DuMont Laboratories, Divisions of Fairchild Camera and Instrument Corp., Dept. ED, Clifton, N.J.
Price: *$35.30 to $36.30.*
Availability: *From stock at franchised distributors.*

High-Gain Amplifiers 465

For relay operation

Models MA-31, 400-cps, and MA-36, 60-cps amplifiers, are for operating relays from low-energy dc signal sources. They can be used as linear or bi-stable amplifiers with dc or ac output. The 400-cps unit measures 1-1/2 in. in diameter and 1-1/2-in. long; the 60-cps unit measures 2-3/4 in. in diameter and 3-1/2-in. long. Operating temperature is −55 to +100 C. Both hermetically sealed units have a maximum power output of 0.85 w and power gain exceeding 100,000.

Magnetico, Inc., Dept. ED, 6 Richter Court, East Northport, N.Y.
Price: *On request supplied with requirements.*
Availability: *30 days, small quantities.*

Natvar

TERAGLAS®

A NEW CLASS B INSULATION WITH RESILIENT WEAVE AND HIGH DIELECTRIC STRENGTH UNDER STRETCH

Natvar Teraglas is a new flexible insulating material comprising a base fabric, woven from polyester (polyethylene terephthalate, or "Dacron") warp yarns and continuous filament glass filler yarns, coated with an improved varnish, possessing exceptional dielectric strength under elongation. It will withstand Class B (130°C) operating temperatures.

In view of the higher dielectric strength of Natvar Teraglas compared to bias varnished cambric, thinner sections or fewer layers may be used to provide the voltage breakdown protection desired. Consequently, at comparable tape prices, a significant saving may be realized in production costs, while permitting up-grading to Class B (130°C) temperatures.

Natvar Teraglas will prove advantageous in many applications—for insulating motors, generators, transformers, cables, switch gear, busbars, and other apparatus and equipment where resiliency and high dielectric strength are desirable.

Natvar Teraglas is available in four thicknesses, .008, .010, .012 and .015"—in tapes, in full width rolls (36"), or in sheets. Ask for Data Sheet and Samples.

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CIRCLE 111 ON READER-SERVICE CARD

NEW WAY *to improve* **circuit stability**

actual size

Now, CAMBION® ceramic coil forms, with internal Perma-Torq® provide increased stability and decreased chance of oscillation in high gain IF strips. (Perma-Torq tensioning device allows locking of tuning cores while still tunable.) By providing a direct path to ground the internal Perma-Torq coil form materially reduces the possibility of stray intermodulation.

Ideal for IF strips and RF stages, these new, space-saving coil forms are available in sizes 1-7/32" and 1-11/16". For your production and prototype requirements count on the *reliability* of quality CAMBION components. Write Cambridge Thermionic Corporation, 457 Concord Avenue, Cambridge 38, Mass., for full details on these and other products in the wide line of

CAMBION®

The guaranteed electronic components

CIRCLE 112 ON READER-SERVICE CARD

One source manufacturing and assembly from cores through memory planes, stacks, and memory systems provide Lockheed Electronics customers with maximum reliability through the entire manufacturing cycle.

LEC manufactures all of its own printed circuit frames and mass-produces any size memory plane and stack to meet varied customer requirements.

This complete control of every facet of manufacture and assembly guarantees you the highest performance and reliability in cores, stacks and memory systems.

Other LEC Ceramic Products for both military and commercial use include Multi-Aperture Ferrite Products, Logic Modules and Recording Heads.

For further information regarding your electronic ceramics requirements, write Dept. C-4, Marketing Department, Lockheed Electronics Company, Avionics and Industrial Products Div., 6201 E. Randolph St., Los Angeles 22, California.

LOCKHEED ELECTRONICS COMPANY LEC

Rotary Switches 538

Have modular design

These "Blue Line" rotary switches employ a modular design. Switches with any practical contact arrangement can be assembled quickly from modules. The units are built around a stage which contains up to four isolated, double-break, silver-alloy contacts. Up to 12 stages can be contained in a column, and up to three columns arranged in tandem, can be used in a switch assembly. As many as 96 double-break contacts over 36 positions can be controlled from a single point. All components except current-carrying parts are made of insulating materials. Standard ratings are available at 20, 32, 40, 63, 100 and 200 amp, 600 v ac.

American Solenoid Co., Inc., Dept. ED, U.S. Highway and Madison Ave., Union, N.J.

Mixer-Preamplifier 459

Has 5.15 to 5.85-kmc band

Model 187MB-360F1 mixer-preamplifier has a 5.15 to 5.85-kmc band. For microwave and guidance systems, the unit serves as a low-noise, wide-band down-converter for maser and parametric rf amplifiers. Noise figure is less than 7 db; gain is 25 db min. Preamplifier output is matched to 50 ohms.

Microwave Development Labs., Inc., Dept. ED, 92 Broad St., Babson Park 57, Wellesley, Mass.

◀ CIRCLE 113 ON READER-SERVICE CARD

NEW PRODUCTS

Transistorized DC Power Supply 722

Covers 0.05 to 500 ma

Model 151B transistorized dc power supply covers 0.05 to 500 ma. It is regulated to within 0.25% for 0 to 20 v loads and 0.25% for 105 to 125 v lines. Ripple and noise does not exceed 50 μamp for peak output and is as low as 1.5 μamp on lower ranges. Applications include semiconductor testing, diode-aging and life test, beta tests, potentiometer and current-sensitive relay testing, electrolytic work and strain gage systems.

Quan-Tech Laboratories, 60 Parsippany Blvd., Dept. ED, Boonton, N.J.
Price: *$290 ea F.O.B. Boonton.*

Sealed Power Supply 720

Operates continuously at full power

Model PI 12-2 sealed power supply can be operated continuously at full power without forced-air cooling or external heat dissipation. The transistorized unit is for applications requiring high-power output, close regulation and resistance to environmental conditions met in missile ground support equipment. It delivers 2 amp at 12 v in still air to 40 C. Specifications include: regulation, 0.05% for 0 to full load changes, 0.02% for ±10% line variations; ripple, less than 1 mv rms; recovery, less than 50 μsec. Input power is 105 to 125 v ac, 50 to 440 cps, single phase. The unit measures 4-1/16 x 6-5/8 x 5-1/2 in.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.
Price: *$155 F.O.B. Springfield.*

Miniature Resistors 412

Offered in 10, 15 and 20-w

These wirewound, vitreous enameled units are available in 10, 15 and 20-w sizes. Cores are 1/8-in. thick. Ends of the brackets terminate in hollow studs for compact stacking by means of bolts passed through the studs. A wire range of resistance values can be furnished.

Ohmite Manufacturing Co., Dept. ED, 3609 Howard St., Skokie, Ill.

Availability: From stock.

Dual-Channel Oscillograph Amplifier 630

Converts voltage signals

Model T249 dual-channel oscillograph amplifier converts voltage signals from high-impedance recorders. Power supply is 115 v ±10%, 60 cps, 30 w. Input impedance is 100 K; frequency response is dc to 10 kc. Maximum output is 8 ma; sensitivity is 2 ma per v max.

Avtron Manufacturing, Inc., Dept. ED, 10409 Meech Ave., Cleveland 5, Ohio.

Price: $220 ea.

Coaxial Slide-Screw Tuner 740

Matches a 10:1 vswr

Type ST-10 tuner is capable of matching vswr's up to 10:1. A true analog of waveguide devices, the unit is designed for high-power operation in the frequency range of 1 to 8 kmc.

Merrimac Research and Development, Inc., Dept. ED, 517 Lyons Ave., Irvington, N.J.

AC Voltmeter 742

Voltage range is 0.0003 to 300 v

Model 300E voltmeter has a voltage range of 0.0003 to 300 v. Accuracy over the entire scale is better than 2 per cent. Frequency range is 30 cps to 100 kc. The unit measures 5-1/4 x 9-1/2 x 4-1/2 in. The meter is large and easily read.

Ballantine Laboratories, Dept. ED, Boonton, N.J.

Price: $225 fob Boonton.

NEW PRODUCTS

Regulated High-Voltage Supply 672

Output accuracy is within 0.05%

Model 241 regulated high-voltage supply has an output accuracy within 0.05% above 2 v, within 1 mv below 2 v. Output voltage is 0 to 1,000 v (plus, minus or floating) in 100, 10, 1, 0.1 or 0.01-v steps. Output impedance is less than 0.05 ohm at dc. Ripple and noise is less than 1 mv rms. Applications include calibration and leakage-resistance testing.

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

Price: *$775 ea.*

Dual-Directional Coupler 677

Has LT main fittings

Model 1088 20-db dual-directional coupler is available with LT main-line fittings for the 1,000 to 2,000 mc and the 2,000 to 4,000 mc ranges.

Radar Design Corp., Dept. ED, Pickard Dr. Syracuse 11, N.Y.

Price: *$395.*

Availability: *Five weeks.*

FM Discriminator 721

Operates most recording instruments

Model D8001 solid-state fm amplifier-discriminator can operate most recording instruments. Specifications include: linearity, better than 0.5% ripple, less than 1%; stability, to ±25 mv ove

10 hr; output impedance, 100 K max; frequency, 5.4 kc ±7.5%; input impedance, 100 K, nominal; input voltage, 2 v ±1 v, rms; output voltage, 0 to 5 v, dc; power supply, 1 w max at 28 v dc; operating temperature, 0 to +71 C. The unit measures 2-5/16 x 2-1/16 x 2-1/2 in. and weighs 0.5 lb max.

Natel Engineering Co., Inc., Dept. ED, 15922 Strathern St., Van Nuys, Calif.

Price: $150 to $200 ea.

Availability: 2 weeks.

Microwave Filter 730

Covers the 2- to 4-kmc band

Type WJ-501 electronically tuned microwave filter covers the 2 to 4-kmc band and has a 3-db bandwidth of approximately 25 mc showing insertion losses from 3 db at 2 kmc to 1 db at 4 kmc. The unit measures 15 cu in. and weighs 2-1/2 lb.

Watkins-Johnson Co., Dept. ED, 3333 Hillview Ave., Stanford Industrial Park, Palo Alto, Calif.

Price: $870 ea F.O.B. Palo Alto.

Availability: 4 weeks.

Basic Switch 403

Is rated at 25 amp

Type E basic switch has a steady-state current rating of 25 amp without a sacrifice in repeatability and performance. Up to 75-amp in rush currents can be handled. A variety of terminal designs, actuators, operating characteristics and circuitry can be furnished.

Micro Switch, Dept. ED, Freeport, Ill.

Price: List, $1.95.

Selector-Counter 452

For conveyor-line use

This electronic selector and counter optically selects and counts up to 31 different types of items for discharge or routing. Designated model 10-C, it senses the codes printed on containers and actuates the counting unit and conveyor switch control.

Atronic Products Inc., Dept. ED, 1 Bala Ave., Bala-Cynwyd, Pa.

NEW PRODUCTS

Solid-State Staging Switch 430

For channel switching

Model 2-184 solid-state staging switch is for channel switching to increase the capacity of telemetering systems. Input power is 28 v dc, 70 ma. The unit has four double-throw signal poles and two double-throw monitoring and indicating poles. There is complete isolation between all poles, power and actuating circuits. The unit can be used in ballistic missile environments.

Electro Development Corp., Dept. ED, 3939 University Way, Seattle 5, Wash.

Impulse Counter 548

Has 1 to 120 counts at 500 cpm

Type 310 impulse counter has a range of 1 to 120 impulse counts at 500 cpm. Minimum pulse duration is 50 msec; reset time for full scale count range is 0.1 sec with minimum pointer rebound. Available for 115 v, 50 or 60 cps, it has two sets of spdt contacts rated at 10 amp.

Automatic Timing & Controls, Inc., Dept. ED, King of Prussia, Pa.

Miniature Proportional Amplifier 464

For precise temperature control

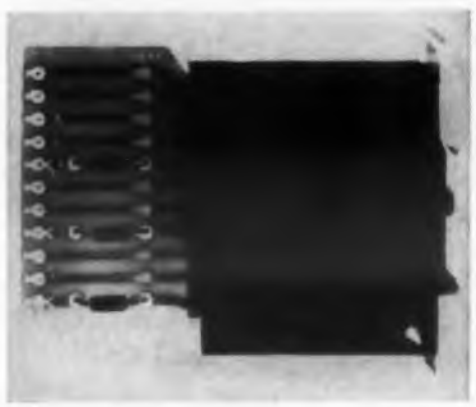
Model PA8 miniature proportional amplifier, for precise temperature control, controls up to 100 w of dc power. The unit has a control accuracy of 0.2 to 0.5 F. It measures 4.5-cu in. and weighs 6.8 oz.

Magnetic Controls Co., Dept. ED, 6405 Cambridge St., Minneapolis 26, Minn.

Price: *$300 to $350 ea, 1 to 4 units.*
Availability: *60 days.*

Digital Switches 461

Capabilities have been extended



The capabilities of Digiswitch series 7300 digital switches have been extended by providing space on the circuit board for the installation of components such as diodes, resistors and miniature logic modules. Model 7316 has three common leads and binary-coded plus complementary output. Model 7317, with resistors installed on the circuit board, provides a method of setting variable resistance to nine incremental values. A similar method may be used for setting variable capacitance.

The Digitran Co., Dept. ED, 660 S. Arroyo Parkway, Pasadena, Calif.

Data Converter 372

Converts data three ways

The ZA-753 paper tape/magnetic tape-data converter performs three different data conversion jobs: paper tape can be converted to magnetic tape, magnetic tape to paper, and any paper tape can be converted to any other type of paper tape. The data converter reads and punches paper tape 160 characters per sec. A ferrite-core memory permits the selection of

data block lengths up to 720 characters long. A manual-visual check of the mode conversion and the memory is incorporated. The unit is completely transistorized.

Electronic Engineering Co. of California, Dept. ED, 1601 E. Chestnut Ave., Santa Ana, California.

Price: *$62,500 fob Santa Ana.*

Isolation Transformer 457

Output is up to 25 w

The Isoformer isolation transformer has an output up to 25 w. Capacitance between the secondary winding and all other elements is 15 pf. Leakage resistance exceeds 100 x 10^3 meg; breakdown voltage exceeds 4 kv. Applications include use in dc power supplies with low shunt capacitance-to-ground, supply of filament or heater power of a vacuum tube when a high signal potential exists on the cathode, and isolation of sensitive circuits from power-line disturbances.

Elcor, Inc., Dept. ED, 1225 W. Broad St., Falls Church, Va.

Geared Induction Motor 533

Is explosion proof

The DEF-15-1 induction motor is designed for military and industrial use. Thermally protected and explosion proof, this continuous duty motor is totally enclosed, fan cooled, base mounted and ruggedly constructed. It conforms to the specifications of MIL-E-5272A in humidity, salt spray, sand, dust, shock and vibration. Design features are: voltage, 200 to 400 v, 400 cps; speed, 1490 rpm; torque, 14.2 in.-lb full load, 71.25 in.-lb starting; weight 11 lb.

General Precision Inc., Kearfott Div., Dept. ED, 1150 McBride Ave., Little Falls, N.J.

Radiant-Energy Standards 463

For infrared radiometric instruments

These six black-body radiant-energy sources are for precision calibration of infrared radiometric instruments. Temperature ranges are: 50 to 1,000 C; 200 to 600 C; 325 to 1,000 K. Temperature stability is one degree.

Infrared Industries, Inc., Dept. ED, P.O. Box 42, Waltham 54, Mass.

Micro-Miniaturized Preamplifier 437

Measures 0.4 x 0.5 x 0.190 in.

This micro-miniaturized preamplifier measures 0.4 x 0.5 x 0.190 in. It is for use in close proximity to tape-recorder playback heads in conjunction with instrument monitoring. The unit contains five resistors, three capacitors and two transistors. Frequency response is from 200 to 200,000 cps. Input signals are amplified by 54 db to an output of 1 mw on a 600-ohm line. Harmonic distortion is 0.5%; noise figure is 3 db.

Halex, Inc., Dept. ED, 310 E. Imperial Highway, El Segundo, Calif.

NEW PRODUCTS

Telemetering Switch 456

Provides up to 450 channels

This microminiature telemetering switch provides up to 450 channels in various combinations of circuitry. For missile and satellite applications, the 8-oz switch measures 1-3/8 x 1-3/4 x 2-1/2 in. Life expectancy exceeds 1,000 hr. The unit permits combinations of circuitry up to a maximum of five poles with 90 channels per pole. Standard speed is from 1 to 20 rps. A drive motor draws 60 ma at 28 v dc.

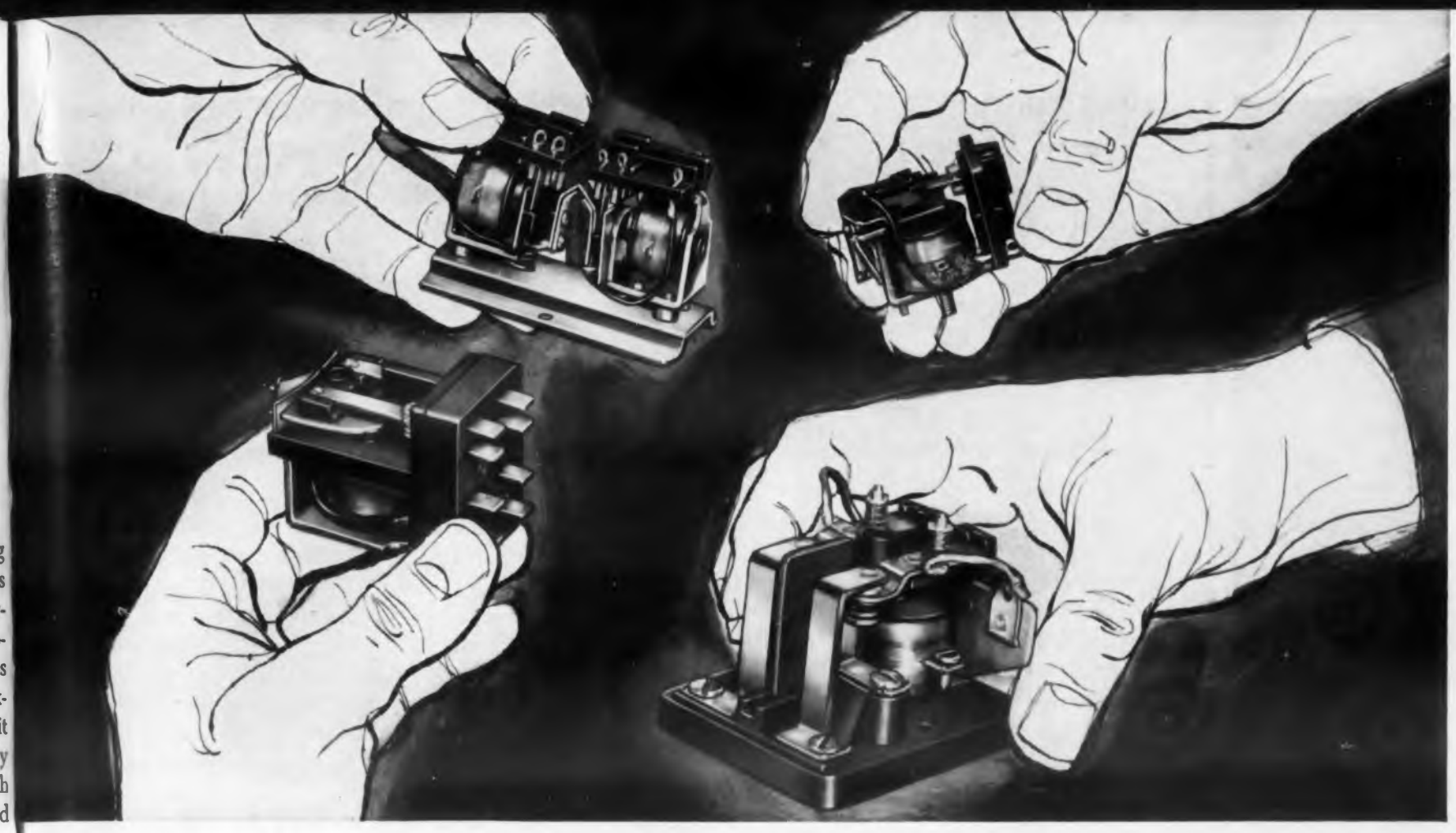
Electro-Tec Corp., Dept. ED, 10 Romanelli Ave., South Hackensack, N.J.

Subminiature Relays 448

Weigh 1-1/2 oz

Series 9200 and 9234 4-pdt relays weigh 1-1/2 oz and measure approximately 0.6 x 1 x 0.925 in. The Polemite IV units can be used wherever crystal-can relays are specified. Prototype units are immediately available. Tentative specifications are: contact rating, 2 amp at 28 v dc and 115 v ac; temperature range, —65 to +125 C; vibration, 30 g to 2,000 cps; shock, 50 g; life, 100,000 operations per minute rated load; and minimum operating power, 300 mw at 25 C.

Leach Corp., Relay Div., Dept. ED, 5915 Avalon Blvd., Los Angeles 3, Calif.



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These important savings are yours when you order—from your Electronic Parts Distributor—P&B relays listed with Underwriters' Laboratories, Inc. and Canadian Standards Association:

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SAVE MONEY. You save the cost of getting relays listed with U/L or CSA . . . and you need have no big investment in shelf inventory, either. Remember, you pay no premium over factory prices in quantities to 249.

More than 40 different standard P&B relays in 450 different coil voltages and contact arrangements are available from the leading Electronic Part Distributors in your area. For special applications, call your nearest P&B sales engineer.

PR Series

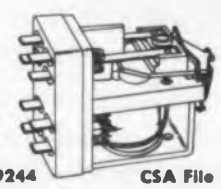
Type	Contact Arrangement*	Type	Contact Arrangement*
PR1AY	SPST-NO	PR5AY	SPDT
PR3AY	SPDT-NO-DM	PR7AY	DPST-NO
		PR11AY	DPDT

These relays are available in any of the following operating voltages: 6, 12, 24, 115, 230 volts 50/60 cycles AC.

Contacts are rated at: 25 amps, 115/230 V. AC 1 phase. 1 hp for 115/230 volt AC motors 1 phase.

*Read: NO normally open, NC normally closed, DB double break, DM double make.

U/L File E22575 CSA File 15734



AB Series

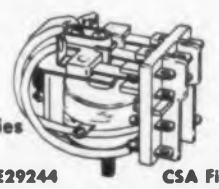
U/L File E29244 CSA File 15734

For appliance and general purpose operations requiring long life and quiet operation. Quick connect terminals. Screw terminal adapters also furnished with each relay. Contact arrangement: DPDT. Rated at 10 amps, 115 V., 5 amps, 230 AC non-inductive by U/L and CSA.

ABC Series

U/L File E29244 CSA File 15734

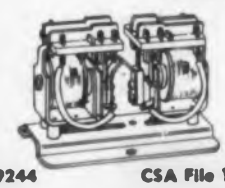
Medium duty power relay in dust cover. For small motors, industrial controls and similar applications. Contact arrangement: DPDT. Rated at 10 amps, 115 V., 5 amps, 230 AC non-inductive by U/L and CSA.



KA Series

U/L File E29244 CSA File 15734

Small, low cost, general purpose relay for handling automation work, small motors, solenoids, other relays. Contact arrangements: SPDT, DPDT and 3PDT. Rated at 5 amps, at 115 V., AC non-inductive by U/L and CSA.



KB Series

U/L File E29244 CSA File 15734

Compact latch relay ideal for memory work and overload applications. Operates on momentary impulse to either coil. Contact arrangements: 4PDT and 6PDT. Rated at 5 amps at 115 V., AC non-inductive by U/L and CSA.

POTTER & BRUMFIELD

DIVISION OF AMERICAN MACHINE & FOUNDRY COMPANY, PRINCETON, INDIANA

IN CANADA: POTTER & BRUMFIELD CANADA LTD., GUELPH, ONTARIO

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POTTER & BRUMFIELD
Princeton, Indiana

NEW PRODUCTS

Rotary Solenoid Drive 560

Control switches

This rotary solenoid drive remotely controls any of the firm's Blue Line switches. Operation can be single steps, continuous steps or completely automatic. The solenoid can be actuated by any device that transmits an electric impulse. Guaranteed minimum life of the drive is 5,000,000 operations.

American Solenoid Co., Inc., Dept. ED, U. S. Highway 22, Union, N.J.
***Availability:** Three weeks.*

DC Power Supply 618

Provides 0 to 100 v

Model 880 laboratory-type supply provides 0 to 100 v dc at 0 to 1 amp. Load regulation is 0.1% or 5 mv and line regulation is 0.02% or 5 mv. Ripple is less than 1 mv. Input required is 105 to 125 v ac at 50 to 440 cps.

Harrison Laboratories, Inc., Dept. ED, 45 Industrial Rd., Berkeley Heights, N. J.
***Price:** $375.*

Multiplier Phototube 704

For electronic star tracking

Model FW-118 photo-multiplier is for use in stellar trackers for guidance and attitude control of space vehicles. The unit has an S-1 cathode peaked at 8,000 A. S-11 and S-20 surfaces are available. The equivalent noise input at 25 C is 5×10^{-11} lumen.

ITT Laboratories, Components and Instrumentation Laboratory, Dept. ED, Fort Wayne, Ind.
***Price:** $275 ea.*
***Availability:** 30 days.*

Reset Transfer Control 724

Has three independent multivibrators

Model 328B reset transfer control, a transistorized digital systems module, has three independent multivibrators that are adjustable from 3 to 30 μsec. The non-inverted outputs provide up to 750 ma. Standard output voltage levels are —6.8 v for one and —0.2 v for zero.

Navigation Computer Corp., Dept. ED, 1621 Snyder Ave., Philadelphia 45, Pa.
***Price:** $149 ea.*
***Availability:** 4 to 6 weeks.*

Dc-to-Ac Inverter 688

Operates from 12 v dc

This transistorized, solid-state device, designated model 1329, converts a dc voltage to a 115 v, 60 cps output. It handles continuous loads of 250 va max. Applications include tape recorders, amplifiers, radio gear, and ac devices in planes.

Power Instruments Corp., Dept. ED, 235 Oregon St., El Segundo, Calif.
***Price:** $148 ea, 1 to 100; $124 ea, 100 to 1,000; $116 ea, over 1,000.*
***Availability:** From stock.*

Portable Oscillograph 698

Has five speeds

Model 5-124 portable oscillograph has a push-button controlled transmission providing speeds of 0.25, 1, 4, 16 and 64 in. per sec. Any speed may be selected while the motor is running without interrupting the recording operation. The unit furnishes records by the print-out process and has a 200-ft record capacity for 7-in. paper. It can be loaded and placed in operation in less than 10 sec.

Consolidated Electrodynamics Corp., Dept. ED, 360 Sierra Madre Villa, Pasadena, Calif.
Price: *$2,290.*
Availability: *From stock by mid-December.*

High-Current Adapter 728

For use with type 575 transistor-curve tracer

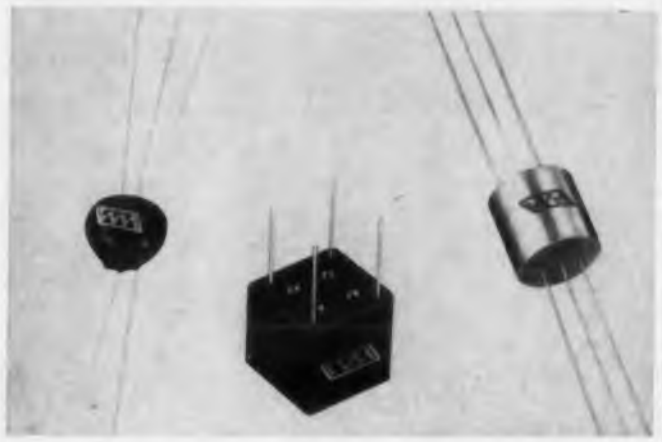
Type 175 high-current adapter is for use with the firm's type 575 transistor-curve tracer. It provides 200-amp collector displays, three ranges of collector supply and 12-amp base supply. It permits the tracer to plot and display the characteristic curves of high-powered transistors and diodes.

Tektronix, Inc., Dept. ED, P.O. Box 500, Beaverton, Ore.
Price: *$1,425 ea.*
Availability: *From stock.*

NEW PRODUCTS

Pulse Transformers 673

Come in spherical, cylindrical and cube styles



These pulse transformers are encapsulated and can be used from −55 to +105 C. In typical blocking oscillator applications, standard pulse widths are 0.15, 0.22, 0.33, 0.47, 0.68, 1, 1.5, 2.2, 3.3, 4.7, 6.8, 10, and 15 μsec. The spherical style, suited for point-to-point wiring has a maximum body dimension of 0.625 in. The cylindrical type, for terminal-board wiring, has a body diameter of 0.625 in. The other style is a 0.578-in. cube designed for printed-circuit applications.

Wilcox Magnetic, Wilcox Electric Co., Dept. ED, 1400 Chestnut St., Kansas City 27, Mo.

Vacuum-Tube Voltmeter 620

Accuracy is 0.02%

The TS-E6 slide-back, vacuum-tube voltmeter maintains an accuracy of 0.02% on ranges of 0.001 to 100 v and 100 to 1,000 v. It operates on 60, 400 and 1,600 cps at 110 v ac. A standard cell is built in for immediate calibration. Requirements of MIL-T-945A are met. The entire unit is self-contained with leads and probes mounted on the lid; it weighs 25 lb.

Electrical Engineering Research and Development Laboratory, Dept. ED, 381 W. 7th St., San Pedro, Calif.

Availability: *In limited quantities.*

Shift of scope pattern is measured to calculate gain. Formula:

$$\text{gain} = \frac{\text{system output}}{\text{system input}} = \frac{\text{SERVOSCOPE "input"}}{\text{SERVOSCOPE "output"}} = \frac{\text{information grid reading}}{1}$$

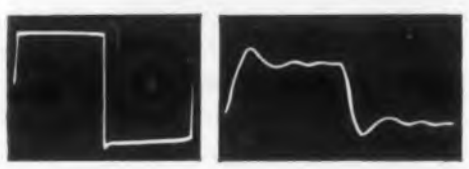
Probing analyses

Because the investigator can easily plot his system's phase and amplitude response to various frequencies, SERVOSCOPE is being used for penetrating servo analyses.

The instrument analyzes transfer functions of open and closed loops and of damping and filter networks. Transient response and frequency response of systems and sub-systems components containing multi- and single-loop circuits can be observed.

Similarly, frequency response of portions of systems can be determined. SERVOSCOPE is also used for locating sources of non-linear distortion and establishing servomotor time constants.

With SERVOSCOPE, *even a new man can plot Nyquist, Bode, and Nichols diagrams after only a few minutes demonstration.*



Typical scope patterns, measuring transient response. Overshoot, response time, rise time, setting time may be determined from patterns.

Fast direct setting and readout together with high-accuracy measurement give precise and rapid results. No calibration is required, making the analyzer immediately applicable to new problems.

Vital defense role

In test stands, ground support equipment, and other critical applications, virtually every major missile and weapons system program finds SERVOSCOPE in the shadow of its success. The instrument has military acceptance in the leading missile programs and other vital defense projects.

With SERVOSCOPE, investigators can easily perform:

Complete 5-minute analyses of any servo system, whether electronic, electrohydraulic, electromechanical, or electropneumatic.

Go—No Go production testing of control systems and components.

Ready analyses of radar and other tracking servo systems—in the field, as easily as at the breadboard stage.

6 models cover all ranges, provide the utmost reliability, from .001-100 cps.

Model A—frequency range: 0.1-20 cps.

Model B—frequency range: 0.15-30 cps.

Model C—frequency range: 0.3-60 cps.

Model D—frequency range: 0.001-20 cps.

Model F—frequency range: .005-100 cps.

Model H—small, lightweight, production line servo tester. Frequency range: 0.1-20 cps.

Send for free SERVOSCOPE worksheets

Servo has designed a set of SERVOSCOPE worksheets which provide an easy and permanent method of dynamic analyses through recording and plotting phase and amplitude of any servo component system. Each of these worksheets is a reproducible master, so that you can make as many working copies as you need. Send for a set. You should find them useful. Just fill in the coupon below.

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CIRCLE 125 ON READER-SERVICE CARD

AF Spectrograph 542

Has automatic sweep

Type FNA af spectrograph offers selectivity that retains its absolute value over the entire frequency range. At 20 kc, measurements of hum modulation sidebands can be made with the full resolving power of the set. Inherent distortion is low, permitting measurements even on low-distortion passive and active networks. Measured values are plotted by the recorder which is equipped with an automatic frequency sweep. A synchronous oscillator is available for use with the spectrograph for a frequency-response test assembly.

Rohde & Schwarz, Dept. ED, 111 Lexington Ave., Passaic, N.J.

Price: *$5,950.*

Availability: *From stock.*

Modular Power Supplies 617

Four types offered

These four modules have the following ratings: 0.5 to 30 v at 100 ma, 25 to 55 v at 90 ma, 50 to 80 v at 85 ma and 75 to 100 v at 75 ma. They can be connected in series for higher outputs. Completely transistorized and short-circuit protected, the units are packaged to make components easily accessible. They can be furnished with octal plugs or solder terminals.

Dressen-Barnes Corp., Dept. ED, 250 Vinedo Ave., Pasadena, Calif.

Price: *$155 with solder terminals; $157 with octal plug.*

Availability: *From stock.*

NEW PRODUCTS

Thermocouple Selector Switches 517

Will switch from 1 to 144 sensing elements

These rotary, key and push-button selector switches provide rapid, accurate switching for from 1 to 144 thermocouples, resistance thermometers or measuring instruments. Key and push-button switches will also average temperatures, or switch a measuring instrument to different measuring points. Push-button switches have interlocking action.

Thermo Electric Co., Inc., Dept. ED, Saddle Brook, N.J.

Thermal Resistance Tester 466

For semiconductors and transistors

Model 149, thermal-resistance tester, measures resistance of semiconductors, power diodes and transistors. Measurements can be made within 5% under standard conditions. Heating current is 1 to 5 or 1 to 50 amp; measuring current is 1 to 100 ma; measuring pulse width is 100 μsec. Cooling time is 650 μsec max; sampling rate is 10 per sec.

Wallson Associates, Inc., Dept. ED, 912 Westfield Ave., Elizabeth, N.J.

Price: *$5,000 to $8,000 ea.*
Availability: *30 days.*

Power Supply 522

Is transistor regulated

Model V-410 power supply has a load current of 200 ma to 1.5 amp, an output voltage of 275 to 285 v dc, and a maximum ripple of 5 mv rms. Line regulation and load regulation are ±0.5%. Additional modules are available for centering of a broadcast-master monitor or TV camera and for monitoring the constant current.

Foto-Video Electronics, Inc., Dept. ED, 36 Commerce Road, Cedar Grove, N.J.

Price: *$795.*
Availability: *From stock.*

Current Indicator 458

Wide-range current-measuring instrument

Model I-309A current indicator is designed for measurement of electron or positive-ion beam current and general laboratory use. Full-scale sensitivity can be varied from 1 ma to 3 μa in 12 switch settings. Drift is less than 0.01% per hr; over-all accuracy is 1% of full scale. An auxiliary output drives a 1-ma recorder. Response time is 10 msec. The unit can be used as a low-drift dc amplifier.

Elcor, Inc., Dept. ED, 1225 W. Broad St., Falls Church, Va.

Phase Controllers 529

Are solid state and modular

The basic modules of these solid-state, modular-silicon controlled-rectifier phase controllers can be combined to provide power control from watts to kilowatts. For low power-servo applications, up to 300 w, silicon-controlled rectifiers can be added to the phase controller package resulting in a miniature,

all semiconductor silicon-controlled rectifier servo amplifier. Variations of the basic modules number about 50 and can be combined to form thousands of different control amplifiers.

General Electronic Control, Inc., Dept. ED, 1015 South Sixth St., Minneapolis 4, Minn.

Wideband Preamplifier Plug-In 383

Sensitivity is 5 mv per cm

Type 4205 plug-in is for the firm's type 425 oscilloscope. It can select nine attenuator positions up to 2 v per cm. A coarse and fine balance control permits rapid, precise adjustment. The unit has a 2-v signal output for attenuator probe calibration, and two inputs which accept ac or dc.

Fairchild Camera & Instrument Corp., Allen B. Du Mont Laboratories Div., Dept. ED, 750 Bloomfield Ave., Clifton, N. J.

Glass-Bonded Mica 554

For potentiometer coil forms

Designated Mykroy 1116, this grade of glass-bonded mica can be finished to 10 to 18 μ in. finishes for smooth potentiometer coil forms. Brushes will not bump or chatter on windings of 0.0003-in. diameter wire on the material. The coefficient of thermal expansion is close to that of stainless steel. The material is available in ground solid rods or in tubular form with a minimum wall thickness of 0.07 in.

Electronic Mechanics, Inc., Dept. ED, Clifton, N.J.

Multiplex Converter 435

Accuracy is within 0.05%

This voltage-to-digital conversion system incorporates a multiplexer. Computation and conversion loops are integrated into a single system. The solid-state unit has 100 channels. Accuracy is within 0.05%.

General Precision, Inc., Link Div., Dept. ED, Binghamton, N.Y.

Time-of-Event Marker 450

Permits sampling by a telemetry system

Model 2-164A event-marker is an ultra-linear ramp generator triggered at the time of an event to permit sampling by a telemetry system. The unit resets automatically in less than the sampling period for repetitive event-marking. Characteristics include: linearity, 0.25%; triggered by positive and/or negative pulses or waveforms; nominal ramp slope, 0.05 v per msec; available in ranges of 0.005 to 0.5 v per msec; output voltage, 6.5 v max. The unit can be used in ballistic missile environments.

Electro Development Corp., Dept. ED, 3939 University Way, Seattle 5, Wash.

Continuity Checker 376

Transistorized

The Con-Chek produces a clear, distinctive audible tone for continuity, a higher pitched tone for low-resistance circuits, and a crackled tone for intermittents. Open circuits and circuits having more than 100 ohms of dc resistance produce no tone. The device is pocket size and weighs 11 oz.

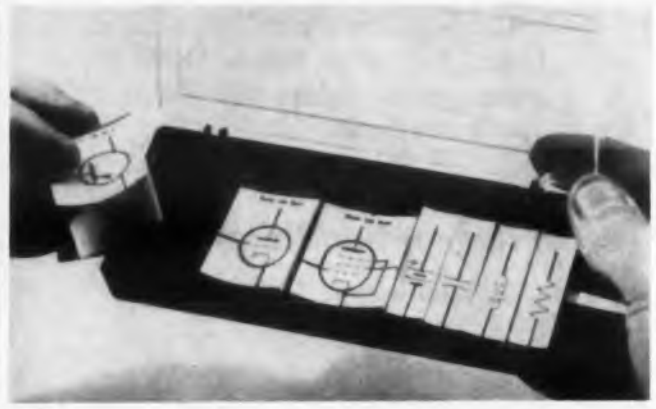
E D P Corp., Dept. ED, 3501 S. Orange Blossom Trail, Orlando, Fla.

Price: $10 to $15 with battery.

NEW PRODUCTS

Electrical Symbols 623

Printed on adhesive matte acetate



The Select-A-Circuit consists of ASA and IRE symbols printed on self-adhesive matte acetate. The symbols are individually printed; pads of 100 symbols are available.

Engineering and Science Aids Co., Dept. ED, 392 Jackson Ave., Jersey City 5, N. J.
Price: Begins at $1.85 per 100.

Silicon Battery Chargers 355

Charging current and voltage of these silicon battery chargers are automatically controlled through a stepless transition from beginning to end. Voltage regulation is within 1%, and end charging current is about 1/20 of rated capacity. All units operate from single phase power. Models are available in capacities of 1 and 3 amp for battery systems from 6 to 120 v.

Hughes Electronics Co., Dept. ED, 5343 Crenshaw Blvd., Los Angeles 43, Calif.

Soldering Tools 365

These soldering tools have bayonet-type probes with insertion or removal accomplished by a 90-deg turn. Tips are furnished in curved and straight designs. A supply of wire solder for several shifts of use is contained in the handle.

International Electronic Research Corp., Commercial Products Div., Dept. ED, 135 W. Magnolia Blvd., Burbank, Calif.
Price: $5.95 for the tool and standard probe tip.

Heat-Reactive Tubing 356

ScotchTite vinyl tubing shrinks under heat to provide a tight covering for symmetrical or contoured shapes. Full transparent tubing, identified as Temflex 105, as well as No. 3025 black tubing is offered. For applications such as covering harness cables, condensers, coils, and high-voltage leads, the tubing can be used on objects from 3/64 to 5 in. in outside dimension.

Minnesota Mining and Manufacturing Co., Dept. ED, 900 Bush Ave., St. Paul 6, Minn.

NEW PRODUCTS

Power Supply 374

Output is 0 to 100 v dc

Model SC 100-.1 transistorized supply, designed for use in ground-support systems and automatic test equipment, has an output of 0 to 100 v dc at 0 to 100 ma. The output is completely programable from a distant point. Regulation is 0.1% for changes from no-load to full-load and 0.1% for 10% line changes. Ripple is 1 mv rms. Input is 115 v at 60 cps. The unit is a plug-in type and measures 4-1/8 x 5-1/2 x 6-9/16 in.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.
Price: *$295.*
Availability: *30 days.*

Thermionic Converter 544

Produces 1 w

Type Z-5386 sealed-off thermionic converter can be precision spaced consistently at 0.5 mil. Minimum power density is 0.2 w per sq cm of cathode surface; minimum thermal efficiency is 2.5%. The unit operates at a cathode temperature of about 1,100 deg C. It weighs 3 oz and can be used in space power supplies for military and scientific purposes.

General Electric Co., Power Tube Dept., Dept. ED, Schenectady 5, N. Y.
Availility: *October, 1960.*

Transistorized Frequncy Standard 433

Stability is ±5 parts in 10^{10} per day

Model RD-180 transistorized frequency standard has a stability of ±5 parts in 10^{10} per day. The unit is for use in frequency control systems. Output frequencies of 1 mc and 100 kc have simultaneous output levels of 1 v rms +50, −10%; the 5-mc output frequency has an output level of 25 mv into 1 K-ohm load. Output impedance is 1 mc and 100 kc into 50 ohms. Ambient temperature range is to 50 C. Input voltage requirement is 115 v ac ±10%, 50 to 400 cps.

Manson Laboratories, Inc., Dept. ED, 375 Fairfield Ave., Stamford, Conn.

Coaxial RF Switch 536

For missile applications

This coaxial rf switch stands 50-g sustained acceleration and 20-g vibration from 75 to 2,000 cps, encountered in missile and other airborne applications. The device weighs 75-g and switches in 0.006 sec. Units are spdt, fail-safe, and are available for 6- to 30-v dc and 115-v, 400-cps operation. The type TNC, N, and HN coaxial connectors operate in an rf-frequency range of 100 to 5,000 mc.

Don-Lan Electronics Inc., Dept. ED, 1131 Olympic Blvd., Santa Monica, Calif.

Data Converter 371

For on-line unimode translation

Data converter model ZA-752 translates standard five-level teletype paper tape to magnetic tape and can be used as an on-line unimode translator for the preparation of magnetic tapes using data transmitted from distant points via teletype. The unit contains a 128-character ferrite-core memory and a manual-vision check of code conversion and memory is provided. All solid-state circuitry is employed.

Electronic Engineering Co. of California, Dept. ED, 1601 E. Chestnut Ave., Santa Ana, Calif.
Price: *$36,000 fob; Santa Ana, Calif.*

Twin-Blower Unit 530

For computer cabinets

Model MSA-11112 twin-blower unit provides a broad air flow pattern particularly suitable for computer cabinets and other equip-

ment where large numbers of heat-producing components are stacked or placed in long rows. With a 3,100-rpm motor, the unit provides 400 cfm at a static pressure of 0.8 in. Available motor speeds are 1,550, 3,100 and 3,450 rpm at 115 or 230 v.

Torrington Manufacturing Co., Specialty Blower Div., Dept. ED, Torrington, Conn.

Electronic Tachometer 370

Completely transistorized

This completely transistorized tachometer operates on the detection of radio waves from the ignition system of an engine. No direct connections to the motor or electrical system are required. It has no moving parts and the transistor circuit is encapsulated in waterproof plastic. The unit has a 0 to 6,000 rpm calibrated dial. Weight is 5 oz, accuracy is ±2%, required voltage is 12 v dc.

Electronics Systems, Inc., Dept. ED, 105 Chauncy St., Boston, Mass.
Price: *$39.50.*

Wirewound Potentiometer 520

Measures 1/2 x 1/2 x 3/16 in.

Model 3250 wirewound potentiometer measures 1/2 x 1/2 x 3/16 in. and weighs approximately 0.05 oz. Resistance range is 100 ohms to 50 K, ±5%. Power rating is 1 w at 70 C. Operating temperature is —65 to +175 C. The unit has wafer configuration and humidity-proof construction.

Bourns, Inc., Dept. ED, 6135 Magnolia Ave., Riverside, Calif.
Price: *$4.97 to $7.80 ea.*
Availability: *From stock.*

Blower Assembly 539

Life of 2,000 hr guaranteed

The "Powair" series of blowers has a guaranteed life of 2,000 hr at 22,000 rpm. The motor is a removable unit and can be slipped out of the blower easily for simple field servicing. All parts are interchangeable and available as spares. Bearings for the 400 cps motors are larger than normally found in motors of comparable size and the motors are constructed of stainless steel to give assurance of longer life.

Dean and Benson Research, Division of the Benson Manufacturing Co., Dept. ED, Kansas City 27, Mo.

Electrical Insulating Tape 586

Withstands 150 C

Type 870 polyester film pre-set electrical insulating tape provides class B insulation which will withstand up to 150 C. It does not require baking for curing, and the adhesive resists the solvent action of electrical varnishes. The tape has high tensile and tear strength, and wraps snugly on irregular surfaces. Applications are principally in banding field and armature coils, holding lead wires in motor and generator manufacture, and wrapping capacitors and coils.

Permacel, Dept. ED, New Brunswick, N.J.
Availability: *From stock.*

Magnetic Pick-up Kit 519

Subminiature to standard sizes

This experimental magnetic pick-up assortment is designed to solve control- and speed-measurement problems. Indication applications include motion, rpm, sequences and vibration. Actuation applications include electronic counters, recorders and servo-mechanisms. Control applications include magnetic amplifiers, relays and thyratron circuits. The pick-ups also provide data for telemetering in missiles, aircraft and satellites.

Electro Products Labs., Inc., Dept. ED, 4500 N. Ravenswood Ave., Chicago 40, Ill.
Price: *$64.50 ea.*
Availability: *From stock.*

NEW PRODUCTS

Null Indicator 634

Has sensitivities of 10, 100 and 1,000 μv

Having three ranges of sensitivity, model NI-2 null indicator can be combined with any of the firm's ratio transistors to form an ac ratio bridge. Frequency range is 50 cps to 10 kc. The unit can be used as an amplifier from 25 cps to over 100 kc with gains of 50, 500 and 5,000. It is portable.

Gertsch Products, Inc., Dept. ED, 3211 S. La Cienega Blvd., Los Angeles 16, Calif.
Price: *$380.*
Availability: *30 days.*

Ultra-Miniaturized Jacks 717

Model TR-2A ultra-miniaturized jack accepts phone tips for use on transistorized radios and other miniaturized applications. The Micro-Jack model TR-2 is a two-conductor single-closed-circuit unit that can be used as a two-conductor open-circuit type.

Switchcraft, Inc., Dept. ED, 5555 N. Elston Ave., Chicago 30, Ill.

Coil Cans 579

These coil cans range in size from large types to transistor types as small as 1/4 in. in diameter. They are slotted, hole-punched, or shaped to meet a variety of applications.

The Staver Co., Inc., Dept. ED, 47 N. Saxon Ave., Bay Shore, L.I., N.Y.
Availability: *From stock or made to order.*

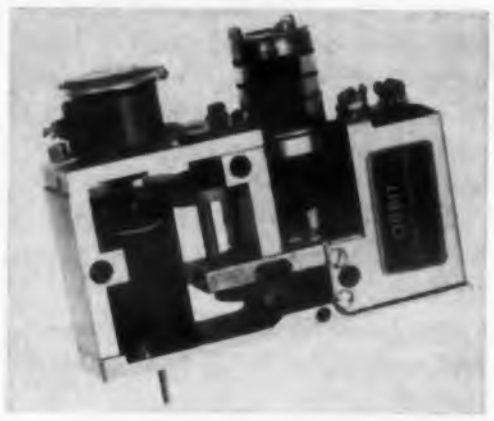
Insulated Wires and Cables 444

These wires and cables, insulated and jacketed with Teflon 100 FEP, permit continuous service at temperatures between 175 and 200 C intermittent service at 250 C. They meet the specifications of Mil-W-16878C, possess good insulation resistance regardless of environmental conditions, and are completely non-flammable.

American Enka Corp., William Brand-Rex Div., Dept. ED, 31 Sudbury Road, Concord, Mass.

Synchro Repeater 612

Has a 1,000-hr min life



This synchro repeater consists of a control transformer, amplifier, damper, servo motor, dc-power supply and gear train. A wide range of speed and torque outputs is available from size 11 to 15 synchro inputs. Specifications include: input power: 10 w nominal at 115 v, 400 cps; static error, ±0.3 deg max at the input shaft; sensitivity, 0.3 deg max.

Orbit Instrument Corp., Dept. ED, 131 Eileen Way, Syosset, L.I., N.Y.

Availability: 60-day delivery.

Microphone Connectors 714

This line of microphone connectors consists of models 4011, male type; 4012, female type; 4013, panel mounted connector; 4015, panel-mounted closed circuit connector. All are of rugged design in solid brass, nickel plated, with knurled grips for engaging and disengaging couplings.

Zoron, Inc., Dept. ED, 612 W. Monroe St., Chicago, Ill.

Work Holder 382

The Tronic-Hold T-310 is a floor model able to hold 400 lb. Its sliding frame enables it to handle large chassis or harness boards of any length.

Flotron Industries, Inc., Dept. ED, 1608 Centinela Ave., Inglewood 3, Calif.

Antennas 366

Spin-casting antennas, having a near-optical surface quality, are useful as radiators. They can be furnished for frequencies to 100,000 mc.

D. S. Kennedy & Co., Dept. ED, Cohasset, Mass.

Miniature Jack 497

This miniature, J5-type jack is available in open, closed, and transfer circuit configurations. It is fully enclosed in color-coded thermoplastic. The design eliminates pile-up construction and hand adjusting.

Carter Parts Co., Dept. ED, 3401 Madison St., Skokie, Ill.

NEW PRODUCTS

Stacking Machine 443

Operates automatically

This machine stacks coil-form terminals to paper and nylon tubes used in TV and radio coils. The tubes can be from 3/16 to 5/8-in. ID. Change-over times are as follows: spacing of terminals, 30 sec; one terminal to another, 40 sec; and one size tube to another, 2 min. The terminals are plated with special reflowed solder plate and have a self life of 6 mo.

Berg Manufacturing Corp., Dept. ED, New Cumberland, Pa.

Isolation Power Transformer 523

For laboratory use

Model L131 power transformer is for general purpose laboratory use and for mounting as a component in equipment. The 350-w isolation transformer has a shunt capacitance of 40 pf. Signals from dc to several meg can be applied between the chassis of a conventional instrument and ground. Leakage resistance value for the secondary winding exceeds 100 x 10^3 meg; breakdown voltage exceeds 5,000 v. The unit can isolate a complete instrument or a component circuit.

Elcor, Inc., Dept. ED, 1225 W. Broad St., Falls Church, Va.

Commutator-Amplifier 442

For m.v. inputs

Known as the Magne-Plexer, this multiple input commutator-amplifier produces full scale output voltages up to 10 v from mv level sources such as thermocouples. Scanning speeds can range from less than one to many thousands of samples per sec. The basic unit is a module of 16 channels. Larger systems are obtained by combining amplifier modules with several power-supply control modules. Specifications are: operating speed, from less than 1 cps to 20 kc and above; output, unbalanced ±2.5 v into 5,000 ohm load with a load capacitance of 0.02 uf max; dc isolation, greater than 150 meg between inputs and to output; linearity, ±1%; noise, ±0.5%.

San Diego Scientific Corp., Dept. ED, 3434 Midway Drive, San Diego 10, Calif.

Price: *From $9,500 for a 16-channel system to $26,000 for a 96-channel system.*

Calibrating Unit 418

For corona test sets

Model CT-CAL-1 calibrating unit is for corona test sets. It is composed of a pulse generator having a continuously adjustable and regulated output, and a corona-free calibrating capacitor rated at 25 kv rms. The output control has a linear scale and is calibrated directly in micro-micro coulombs. Output of the pulse generator is 10- to 20-μsec wide; rise time is 0.5 μsec; repetition rate is 60 cps. The amplitude control is continuously adjustable from zero to 100 mv. The calibrating capacitor is 100 pf ±5%.

Peschel Electronics, Inc., Dept. ED, Towners, Patterson, N.Y.

Price: *$700 ea.*

Availability: *30 days.*

DC Power Supplies 417

Transistorized units

Models 800A-2 and 802B dc power supplies are transistorized units. Output for the units is 0 to 36 v at 0 to 1.5 amp. Ripple and noise is less than 200 μv rms. Load and line regulation for the 800A-2 is less than 0.005 v from no load to full load and from 105 to 125 v ac, respectively. Load and line regulation for the 802B is less than 0.0036 v from no load to full load and from 105 to 125 v ac, respectively. Operating temperature for both models is 50 C max. Input for the 802B is 105 to 125 v, 50 to 440 cps, single phase, 2.5 amp at 117 v;

for the 800A-2 it is 105 to 125 v, 55 to 65 cps, single phase, 2.4 amp at 117 v.

Harrison Laboratories, Inc., Dept. ED, 45 Industrial Road, Berkeley Heights, N.J.
***Price:** Both models are $580 ea.*

DC Power Supply 386

For fixed-voltage applications

Model 812C dc power supply is for high-current, fixed-voltage applications. Output is 0 to 32 v at 0 to 10 amp. Load regulation is less than 0.02 v from no load to 10 amp. Line regulation is less than 0.01 v from 105 to 125 v ac. Ripple and noise is less than 1 mv rms at any line voltage, output voltage and load current from no load to 10 amp. Input is 105 to 125 v, 50 to 65 cps, single phase. The unit weighs 52 lb and measures 5-1/4 x 16 x 19 in.

Harrison Laboratories, Inc., Dept. ED, 45 Industrial Road, Berkeley Heights, N.J.
***Price:** $550 ea.*

Platinizing Kit 363

For replatinizing electrodes

Model PK-1 platinizing kit is for electrode stripping, electro-cleaning and replatinizing nickel or platinum electrodes of solution conductivity cells. The kit contains a 4-1/2-v battery supply, a meter, a reversing switch, a rheostat, binding-post terminals and a cut-out for a bottle of platinizing solution. The solution is sufficient for 25 average replatinizations.

Burrell Corporation, Dept. ED, 2223 Fifth Ave., Pittsburgh 19, Pa.
***Price:** Kit, $21.50 ea; solution, $15.50 ea.*

Silicon Diodes 377

Range is 6.8 to 200 v

These 10-w silicon Zener diodes cover the voltage range of 6.8 to 200 v. They are for regulating dc voltages, low-impedance dc-level changing, unbiased clamping, clipping, limiting and surge protection. All units contain single pn junctions. Other 10-w types available from this line include: 10M6.8Z5 through 10M200Z5; IN2970B through IN3015B; IN1351A through IN1375A; IN1806A through IN1836A; and IN1603A through IN1609A. Most types are available with 10 and 20 per cent tolerances and/or reverse polarity.

Dickson Electronics Corp., Dept. ED, Scottsdale, Ariz.
***Price:** From $5.85 ea, 1 to 24 units.*
***Availability:** 4 weeks.*

Pressure Transducer 375

Static error is ±1.5%

Model 304 pressure transducer uses a Bourdon tube as the sensing element. Static error band (including linearity, friction, hysteresis, resolution and repeatability) is as low as ±1.5%. Power rating is 0.5 w at 160 F. Operating temperature range is −65 to +212 F. The unit measures 2.27 x 1.161 x 84 in. and weighs 2.2 oz.

Bourns, Inc., Dept. ED, 6135 Magnolia Ave., Riverside, Calif.
***Price:** $142.50.*
***Availability:** Immediate.*

Coaxial Attenuator 676

Unit is remote controlled

This miniature coaxial remote-controlled attenuator operates at a 0.005-sec rate. The device produces a straight-through coaxial connection on application of voltage, either 28 v dc or 115 v ac. When power is removed, the unit becomes a 20-db, bi-directional attenuator operating from 50 to 3,500 mc. Weight is 2.85 oz; MIL-E-5272C environmental specifications are met.

Don-Lan Electronics Inc., Dept. ED, 1131 Olympic Blvd., Santa Monica, Calif.
***Price:** $150–$200, up to 500; $145, over 500.*
***Availability:** 30 to 45 days.*

NEW PRODUCTS

Power-Transistor Test Set 654

Measures dc characteristics

Model TTS-100 test set is for measuring dc characteristics on medium- and high-power, npn transistors. Collector current can be up to 10 amp. The meters, which are provided for voltage, collector-current and leakage-drive, are 50-division type with 2% accuracy. Voltage range is 1, 10, 100 and 200 v full scale, at 10,000 ohms per v. Punch-through voltage is determined without damaging the transistor.

Command Systems, Inc., Dept. ED, 1135 N. Stanford Ave., Los Angeles 59, Calif.

Price: *$695.*

Availability: *From stock.*

Low-Inertia Motors 748

Fractional-horsepower type

The 1060 series of fractional-horsepower motors is for installation where rugged, reliable control motors are needed. They are designed for single-phase, 115-v, 60-cps operation. Extended rotor bearing preload adjustments are provided for minimum starting-voltage control. Gear trains are optional.

Amphenol-Borg Electronics Corp., Dept. ED, 120 S. Main St., Janesville, Wis.

Price: *$38.12 for one to nine units.*

Availability: *From stock.*

Silicon Rectifiers 723

Current ratings are 1.1 amp

These double-diffused silicon rectifiers have current ratings of 1.1 amp in voltages from 50 to 1,000 v piv. The units are hermetically sealed.

Solitron Devices, Inc., Dept. ED, 67 S. Lexington Ave., White Plains, N.Y.

Availability: *From stock.*

Digital Data System 555

Accuracy is 0.1%

This digital data system, intended for shipboard use, has an accuracy of 0.1% on magnetic tape. The unit has multiple-channel input and is fully transistorized.

Communications Control Corp., Dept. ED, 14707 Keswick St., Van Nuys, Calif.

Availability: Units are now in production for industrial and military applications.

Variable Time Delay 743

Delays are to 160 μsec

Delays to 160 μsec at frequencies up to 30 mc can be furnished with these photo-elastic time delays. In operation, an acoustical signal in the solid transparent delay line is detected by optical means. The units can be used in target-detection radar systems and in computers.

Corning Electronic Components, Corning Glass Works, Dept. ED, Bradford, Pa.

Availability: Made on order.

Computing Resolvers 559

Accuracy is 0.05%

These computing resolvers have non-bifilar compensating winding capable of standing 500 v dc between stator and compensator for 1,000 hr. In 23, 15, and 11 frame sizes, the units have an inter-axis error of 2.5 min. All units meet MIL-R-14346.

Vernitron Corp., Dept. ED, 123 Old Country Road, Carle Place, L.I., N.Y.

Availability: Immediate.

NEW PRODUCTS

DC-DC Current Monitor 747

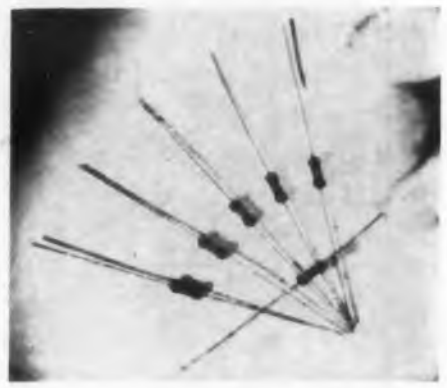
Measures up to 250 amp

These current monitors, series 870 through 874, measure the flow of bus current to 250 amp with an accuracy of ±0.2%. Output from the monitor can be used to regulate a dc source or as an over-load protection for a dc circuit. Models available have measurement ranges of 0 to 5, 0 to 100, 0 to 200 and 0 to 250 amp. The units are fully encapsulated and meet the environmental requirements of MIL-E-5272C.

Arnold Magnetics Corp., Dept. ED, 6050 W. Jefferson Blvd., Los Angeles 16, Calif.
Price: *$167.*
Availability: *21 days.*

Miniature Resistors 556

Are rated at 1/4 w



The N-12 resistors, rated at 1/4 w, are designed for applications in airborne computers or in missile circuitry. Resistance range is 100 ohms to 133 K, voltage rating is 250 v and derating is 140 C. The units meet MIL-R-10509B, Char X. Standard tolerance is ±1% and dimensions are 0.355 in. in length and 0.131 in. in diameter.

Corning Electronic Components, Corning Glass Works, Dept. ED, Bradford, Pa.
Availability: *From stock.*

Chart Drive 750

For use with twin recorders

Particularly suitable for use with the firm's E-A twin recorders in relay-rack installations, this chart drive is housed entirely within the recorder case. It provides speeds to 3 in. per sec and can be shifted from hour to minute to second speeds. It operates on 120 v at 60 cps.

The Esterline-Angus Co., Dept. ED, P.O. Box 596, Indianapolis 6, Ind.
Price: *$385.*
Availability: *10 days.*

Angular-Position Servo System 746

Range is to 359.999 deg

The ST/SR-100 series of two-speed servo systems measure the angular position of remote shafts. They provide a range of 0 to 359.999 deg; resolution and repeatability are to 0.001 deg. The rms accuracy is ±5 sec of arc and absolute accuracy is ±15 sec. The systems consist of the ST-100 transmitter and the SR-100 receiver. The transmitter includes a 27-cycle resolver sensor and a single-cycle resolver, mounted in an integral package.

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

Temperature Probe 615

For transistor-circuit work

The Thermo-Probe replaces soldering irons and other sources of local heating. The temperature-setting control is calibrated from 25 to 150 C. The probe tip fits neatly over a transistor; tips are interchangeable so that various components can be handled. Temperature calibration is accurate to ±3 C and temperature is maintained closer than ±1 C. Heater power is 6 w.

Kennedy Co., Dept. ED, Altadena, Calif.
Price: $72.50.
Availability: Two weeks.

Insulating Tape 402

Made of Teflon and glass cloth

Designated Lamoflex type TC, this insulating tape is constructed of Teflon FEP on one side of glass cloth reinforcement. Tape currently in production has 0.002-in. Teflon on 0.002-in. glass cloth. The thicknesses of both the Teflon and the glass cloth may be varied. The tape can be used on transformers and motor coils. It comes in widths from 0.5 to 6 in.

International Resistance Co., Dept. ED, 401 N. Broad St., Philadelphia 8, Pa.
Price: $14.47 per 36-yd roll in the 1-in. width.

BROADBAND COAX ISOLATORS FOR L&S BANDS

NEW COMPACT DEVICES PROVIDE MINIMUM ISOLATION OF 20 DB OVER EXTENDED BANDS

A single Raytheon L-band coaxial ferrite isolator now covers the full frequency range from 1,250 through 1,600 mc while its S-band sister covers the band from 2,000 to 4,000 mc.

The new units, designated I_cLM3 and I_cSM2, open new design possibilities in L and S band equipment. Where performance over narrow frequency ranges is specified, increased isolation is possible with either unit.

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

TYPICAL SPECIFICATIONS		
	IcLM3	IcSM2
Frequency range	*1,250-1,600 mc*	*2,000-4,000 mc*
Isolation		
Minimum	*20 db*	*20 db*
Maximum	*40 db*	*31 db*
Insertion loss		
Minimum	*.8 db*	*1.3 db*
Maximum	*1.0 db*	*2.0 db**
Power		
Peak	*10 kw*	*5 kw*
Average	*25 watts*	*5 watts*
VSWR		
Minimum	*1.10*	*1.02*
Maximum	*1.25*	*1.25*
Weight (max.)	*3.8 lbs.*	*2.25 lbs.*
Max. dimension	*12 in.*	*9.8 in.*
Connectors	*Type N*	*Type N*

*1.0 db over narrow band.

THE MOST MODERN FACILITY devoted exclusively to microwave ferrite device and materials development, testing and production.

RAYTHEON COMPANY
SPECIAL MICROWAVE DEVICE OPERATIONS
WALTHAM INDUSTRIAL PARK
WALTHAM 54, MASSACHUSETTS

In Canada, contact Raytheon Canada, Ltd.
P. O. Box 152, Waterloo, Ontario

RAYTHEON EXCELLENCE IN ELECTRONICS

CIRCLE 142 ON READER-SERVICE CARD

NEW PRODUCTS

Trimming Potentiometers 390

Have ceramic-metal construction

These trimming potentiometers have a conductive resistance element fused to a steatite frame, permitting the units to be used at −55 to +200 C. They are also insensitive to vibration and stand 100-g shock. Similar to the firm's model 50 trimmer, these units are designated model 53 (with pins for printed circuitry) and model 54 (with solder lugs).

Beckman Instruments, Inc., Dept. ED, 2500 Fullerton Road, Fullerton, Calif.

Rectilinear Writing Oscillograph 562

Chart width Is 15 In.

Model RD 2684 20 oscillograph has two channels of high-speed coded event or time data in addition to the eight 40-mm channels of analog data. Chart width is 15 in. The thermal writing recorder has 13 chart speeds ranging from 0.01 to 100 mm per sec. All functions including speed control can be remotely operated. Analog response is flat from dc to 100 cps.

Brush Instruments, Div. of Clevite Corp., Dept. ED, 37th and Perkins, Cleveland 14, Ohio.
Price: *$3,885 fob Cleveland.*
Availability: *30 days.*

PNPN Transistor 588

Operates in the 1 to 8 ma range

The Trigistor is a pnpn transistor designed for logic circuitry operation at a 1 to 8 ma level. The device provides on-off control at one base terminal, with drive requirements in the microampere level. Active elements are insulated from the case. MIL-S-19500 specifications are met.

Solid State Products, Inc., Dept. ED, 1 Pingree St., Salem, Mass.

Bolometer Mounts 614

Have high-efficiency rating

These bolometer mounts have over-all accuracies of 1%. Model X2299 S/N 1 and 2 gold-plated mounts show efficiencies of 98.3% and 97.2% at 9,000 mc. Models covering C through L bands may be used with both bolometers and thermistors.

Narda Microwave Corp., Dept. ED, 118-160 Herricks Road, Mineola, N.Y.
Price: $60 to $235.
Availability: From stock.

Reset Counter 389

Reset time is 2 sec

Type CE-620 electric reset counter has a total reset time of 2 sec. The six-digit counter registers one count for each actuating impulse and is operated at speeds to 1,000 counts per sec. A seven-digit counter and other variations can be furnished.

General Controls Co., Automation Controls Div., Dept. ED, 8078D McCormick Blvd., Skokie, Ill.

Ten-Turn Counting Dial 700

Has 100 graduations

This ten-turn, rotating, counting dial has 100 graduations. It operates in either direction. Diameter is 1-13/16 in. The unit is connected directly to the potentiometer by a mounting screw.

S.A. Asquith Co., Dept. ED, 427 W. Chevy Chase, Glendale 4, Calif.
Price: $5.75 ea.

NEW PRODUCTS

Precision Potentiometers 409

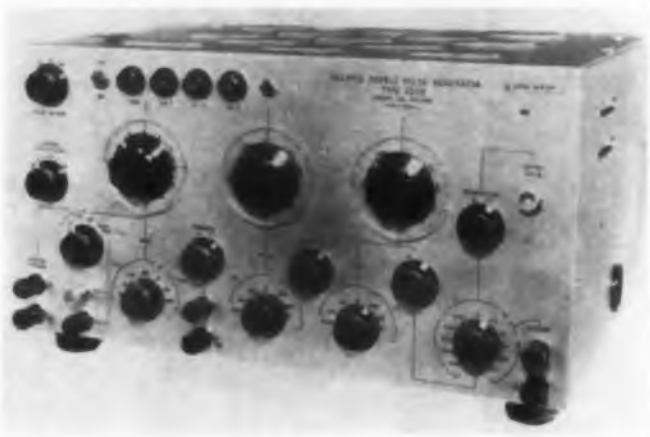
Resistance range is 5 to 250 K

The P32 series potentiometers have a resistance range of 5 to 250 K ±5%. Electrical angle is 320 ±3 deg; mechanical angle is continuous. Linearity is ±0.25%. Three taps are standard; up to eight taps can be furnished with a 0.032-in. increase for each tap. Taps can be set to 1/2 deg.

Accuracy, Inc., Dept. ED, 4 Gordon St., Waltham 54, Mass.
Price: *$25 to $30.*
Availability: *30 days.*

Pulse Generator 553

Supplies pulses of 10-nsec risetime



Type 5002 delayed double-pulse generator features a 10,000,000:1 range of repetition rate, pulse width and delay. The main output consists of either a single or double pulse as required, of either polarity and of controllable amplitude calibrated to ±2%. Pulse repetition frequency is 0.1 cps to 1 mc; pulse width is 0.2 μsec to 2 sec. Delay between the two pulses of the pulse pair is 0.2 μsec to 2 sec.

Instrument Corp. of America, Dept. ED, 1545 Kennewick Road, Baltimore 18, Md.
Price: *$1,450.*

Shaft-Position Encoder 574

Provides 1,024 counts per rotation

This device is for use where minimum size is important and where computer circuitry for code translation is available. The Gray Code configuration guarantees a non-ambiguous output signal without the need for V-scan or other complex circuitry. The unit is packaged in a standard BuOrd size 33 synchro mount.

United Aircraft Corp., Norden Div., Dept. ED, Wiley St., Milford, Conn.

Programable Comparator 551

For aircraft and missile checkout

Called the GEPAC, this automatic programer is suitable for military use in missile checkout and can also be used for factory test and quality control. Using punched-tape test programs, the unit checks eight basic electrical parameters of equipment under test. Measured values are compared to high and low limits which have been programed on the tape. Test results can be visually displayed or printed out.

General Electric Co., Light Military Electronics Dept., Dept. ED, French Road, Utica, N.Y.

Absolute Pressure Transducer 695

For airborne applications

This absolute pressure transducer is for airborne, missile and wind-tunnel applications. The flush-diaphragm unit has frequency response ranges of 0-10 to 0-100 psia. It measures 0.590 in. in diameter by 0.050 in. thick.

Statham Instruments, Inc., Dept. ED, 12401 W. Olympic Blvd., Los Angeles 64, Calif.
Availability: Production in February, 1961.

Hand Tachometer 514

Available in three types

Series 27 Tripletach hand tachometers are available in three types: type A measures from 200 to 10,000 rpm; type B, from 100 to 5,000 rpm; and type C, from 20 to 1,000 rpm. Accuracy is ±1% of full scale deflection.

Metron Instrument Co., Dept. ED, 432 Lincoln St., Denver 3, Colo.
Price: $95 ea.
Availability: From stock.

NEW PRODUCTS

System Analyzer 595

For checking R, L and C parameters

This modular instrument checks R, L and C parameters in any combination. Operation is automatic. A few or several thousand systems can be accommodated. Hi-pot, leakage, continuity, impedance, voltage and other characteristics are tested in automatic sequence.

A. W. Haydon Co. of Calif., Dept. ED, 4060 Ince Blvd., Culver City, Calif.

Tachometer 552

Low-speed type

This tachometer indicates speeds of 10 rpm and lower with an accuracy of better than 2% of full scale. This system is self-powered with a low-torque dc generator. The 4.5-in. panel meter is shielded to minimize the effects of surrounding magnetic material. The complete package consists of indicator, tachometer generator, 15 ft of connecting cable and accessories for mounting.

Servo-Tek Products Co., Dept. ED, 1086 Goffle Road, Hawthorne, N.J.

Price: *$107.*

Availability: *From stock.*

Silicon Diodes 619

Switching speeds are 0.3 μsec

These silicon computer diodes, with switching speeds to 0.3 μsec, are for applications such as flip-flop, gating, modulator, discriminator and detector circuits. Designated types 1N659, 1N660 and 1N661, the units have piv ratings of 50, 100 and 200 v, respectively. Maximum reverse current is 5 μa for the first two units and 10 μa for type 1N661.

Hoffman Electronics Corp., Dept. ED, 3761 S. Hill St., Los Angeles, Calif.

Price: *$2.53, $2.63 and $3.16 for 1 to 99 units.*

Transistor Amplifier 558

Has a gain of 0 to 100

Model 48 eight-channel transistor amplifier has a continuously variable gain of 0 to 100. Frequency response is within ±0.2 db from 5 to 100,000 cps and within ±1 db from 2 to 500,000 cps. The input impedance is 100,000 ohms shunted by 40 pf; the output impedance is 600 ohms in series with 100 mf, with an output capability of 4 v rms, open circuit, or 1 v rms into a 1,000-ohm load. The unit requires 75 v at 100 ma of unregulated external power.

Zacharias Electronics Corp., Dept. ED, Livingston, N.J.

Price: *$750.*

Availability: *6 to 8 weeks.*

Logic Blocks 397

With data rates from dc to 5 mc

Series 2011 Logic Blocks is a complete set of plug-in cards for digital computers, data processing equipment, high-speed magnetic memories, digital communication links, digital simulation and related equipment. Measuring 3.5 x 6 in., the blocks are held in place by slotted guides. No auxiliary cooling is needed.

Rese Engineering, Inc., Dept. ED, 731 Arch St., Philadelphia 6, Pa.

Price: *The flip-flop, for example, $90.*

Availability: *Varies with type of blocks.*

Rectifier Tube 550

Is rated at 920 piv

Type NL-610/7723 rectifier tube is filled with xenon for quick starting and operation over a wide temperature range. It is rated at 2.5 amp, 920 piv. Filament voltage is 2.5 v, filament current is 9 amp and peak anode current is 30 amp.

National Electronics, Inc., Dept. ED, Geneva, Ill.

Price: *$11.40.*

Availability: *From stock.*

NEW PRODUCTS

RF Inductors 398

Cover from 0.5 to 100 μh

The 900 series of shielded rf inductors covers the range of induction from 0.5 to 100 μh in 10 steps. Designed for military and high quality commercial applications, the units are most useful from 0.5 to 60 mc where the average Q factor is 70.

North Hills Electronics, Inc., Dept. ED, Glen Cove, L.I., N.Y.

Price: *$3.75 in lots to 100.*

Availability: *30-day delivery.*

AF Transformers 545

For multiplex equipment

These wide-band transformers are encased in thermosetting plastic and meet the requirements of MIL-T-27A, grade 5, class R. Typical specs are: frequency response, ±0.1 db from 300 to 110,000 cps; longitudinal balance, 50 db at 110,000 cps; insertion loss, 0.3 db max; and reflected impedance control, ±3%. Units can be used in bilateral amplification, switching circuitry, telemetry and other applications as well as multiplexing.

Columbus Process Co., Inc., Dept. ED, Columbus, Ind.

Availability: *Made on order for three-week delivery.*

Breakdown Tester 407

High-voltage type

This three-range unit has full-scale outputs of 5 v, 15 v and 50 kva with a 10-kva output on each range. Range switching is by means of an oil-immersed switch integral with the transformer. Dual circuit breakers are provided. Metering accuracy is better than ±1.5% of full scale value.

Industrial Instruments Inc., Dept. ED, 89 Commerce Road, Cedar Grove, N.J.

Availability: *From stock.*

Band-Pass Filter 587

Frequency range is 5,400 to 5,900 mc

This three-section, individually tuned, coaxial band-pass filter has these specifications: frequency range, 5,400 to 5,900 mc; insertion loss, 1.9 db max; bandwidth at 3 db of 15 mc min; rejection at 40 mc from center frequency, 38 db; input vswr, 1.3 to 1 max. Connectors are female type TNC. Dimensions of the unit are 3 x 3 x 1-5/16 in. without connectors.

Waveline Inc., Dept. ED, Caldwell, N.J.

Servo Motors 549

For use with transistorized amplifiers

The RBC 2407 motors are 115-v, 60-cps reversible induction motors with high torque-to-inertia ratios. Typical rating is 0.75 oz-in. at 1,000 rpm. Gear reductions are 5:1 to 3,600:1. The control windings are split into two sections, each having an impedance of 16 ohms. Each section has separate leads, permitting connection in parallels or in series, with impedances of 8 to 32 ohms, respectively.

National Pneumatic Co., Inc., Holtzer-Cabot Div., Dept. ED, 125 Amory St., Boston 19, Mass.
Price: *$45.*
Availability: *Two weeks.*

SPDT Relay 702

For printed-circuit application

Model C spdt relay, measuring 1/2 x 1/2 x 1/2 in., is for printed-circuit application. Specifications include: cubic volume, 8 per cu in. and 13,824 per cu ft; temperature, −65 to +125 C; insulation resistance, 1,000 meg at 125 C; dielectric, 1,000 v rms. The unit is rated from dry circuit to 1 amp resistive.

Hi-G, Inc., Dept. ED, Bradley Field, Windsor Locks, Conn.
Availability: *Catalog-type, from stock by January 1, 1961; non-catalog specs, on order only; delivery, 30 to 60 days.*

looking for a product?

Diodes

See also Rectifiers, Tubes

CRYSTAL: all-glass diodes designed for military and commercial electronic applications; Sylvania Electric Products, Inc. ED 6:70 Write In 906.

1 – 1:7:59 4 – 2:18:59 7 – 4:1:59
2 – 1:21:59 5 – 3:4:59 8 – 4:15:59
3 – 2:4:59 6 – 3:18:59 9 – 4:29:59

reach for EDC'S PRODUCT LOCATOR

It's easy to use the "Product Locator" (Section I of EDC). Here's how it works:

1. *Products are described alphabetically* by major product category from **Abrasives** to **Yokes**. Each category is further sub-divided from A to Z by type. For example: sub-listings for **Diodes** range from "CO-AXIAL" to "ZENER."
2. *Check the code numbers* that follow each listing. "More data in catalog section" means that you can find more catalog data about this product in Section II of EDC. Look for it *alphabetically by manufacturer's name.*

In the example shown at left, "DIODES, CRYSTAL," code numbers follow which read:

"ED 6:70—Write In 906"

The "ED 6:70" means this product was reviewed in the 6th issue of *Electronic Design* on page 70.*

The "Write In 906," is the number to fill in on EDC's Reader Inquiry Card if you want the manufacturer to mail you more information on this product.

EDC is designed to be of service to you. The more you *use* EDC, the more information manufacturers *will* place in EDC. EDC will welcome your constructive comments and suggestions.

*You can find the exact date of issue by referring to the key which is repeated on the bottom of each page of the locator. In this case, March 18, 1959.

ELECTRONIC DESIGNERS CATALOG **EDC**

the industry's basic information and reference source

NEW PRODUCTS

Thermostat 388

Snap-action type

This thermostat is UL approved after 100,000 cycles at 25 amp, 240 v ac. Both preset and adjustable units can be supplied for temperatures to 300 F. It can be provided with either screw- or spade-type terminals in nine different positions. Differential can be as low as 5 F.

Pace, Inc., Dept. ED, 584 Wayne St., P. O. Box 1244, Mansfield, Ohio.

Vibration Calibrator 532

For vibration pickups

Type 1557-A battery-operated vibration calibrator permits calibration of accelerometers, vibration pickups and vibration meters, and other vibration-measurement systems that use small, crystal-type accelerometers as sensing elements. It consists of a transistorized electromechanical oscillator and a battery-operated cylindrical shaker. The instrument provides a standard acceleration for 1 g rms at 100 cps. Acceleration accuracy is ±10%; frequency accuracy is ±1%. Power is supplied by four RM-Y mercury cells having a life of 100 hr. The unit weighs 3-1/4 lb and measures 4 x 8 x 4 in.

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

Price: *$225 ea, fob West Concord.*

Digital-Analog Converters 401

For military and industrial applications

These solid-state digital-analog converters have a maximum clock rate of 300,000 pps. Units are self-contained, including storage, power supply, reference transformer and forced-air cooling. Reference voltage is 115 v at 60 or 400 cps, 1 w. Six units can be mounted in a standard 19-in. rack in 3.75 in. of panel height.

Dynamic System Electronics Corp., Dept. ED, 2001 N. Scottsdale Rd., Scottsdale, Ariz.

Availability: *Large quantities, 60 days.*

Magnetic Reed Switches 602

Measure 2.5-in. long

Type DRS-5 magnetic-reed switches measure 2.5-in. long; one rod end is solid and the other end is a hollow tube. The silver-plated contacts operate in 20 lb of pure hydrogen pressure. The contact rating is 50 va max, resistive, up to 3 amp and up to 250 v. Actuating time is 1 msec avg.

Hamlin, Inc., Dept. ED, Lake and Grove Sts., Lake Mills, Wis.
Availability: *From stock.*

VHF Frequency Meter 744

Measures and generates 20 to 1,000 mc

Having a range of 20 to 1,000 mc, model FM-7 frequency meter maintains an accuracy of 0.0001%. It meets FCC tolerance requirement of ±0.0005% with a minimum safety factor of 5:1. Both am and fm modulation are supplied. The unit can be combined with the DM-3 deviation meter and RFA-1 attenuator to provide a complete communication service package.

Gertsch Products, Inc., Dept. ED, 3211 S. La Cienega Blvd., Los Angeles 16, Calif.
Price: *$1,540; with DM-3, $1,850.*
Availability: *From stock by December.*

Vibration Calibrator 566

For field testing of pickups

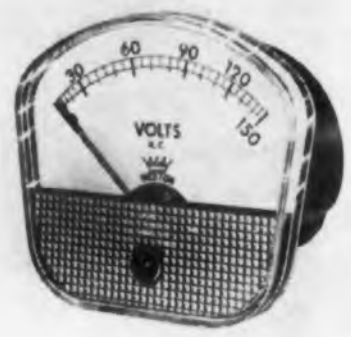
Operating from a 60-cps power line, this vibration exciter provides for spot checking of vibration and pressure transducers. The unit is equipped with a visual reading amplitude indicator for measurement of vibration displacement. Accuracy is within 5%.

Gulton Industries, Inc., Dept. ED, 212 Durham Ave., Metuchen, N.J.
Price: *$850.*

NEW PRODUCTS

AC Panel Meter 540

Accuracy is ±2% of full scale



Designated model 1724, this panel meter uses a movable iron-vane mechanism. It is available as a voltmeter, ammeter or milliammeter. It has a 2.25-in. scale, covering a 90-deg arc. The ac voltmeter can be used from 25 to 125 cps with adjustments for up to 2,500 cps. The voltmeter voltage ranges are 0 to 5 v up to 0 to 500 v. Ammeters and milliammeters are for use on 25 to 500 cps; ranges are 0 to 1 amp up to 0 to 10 amp and 0 to 15 ma up to 0 to 500 ma.

Daystrom, Inc., Weston Instruments Div., Dept. ED, 614 Frelinghuysen Ave., Newark 12, N.J.

Price: $21.

Availability: Immediate.

Magnetic Shield Enclosures 499

These shielded enclosures permit temporary or permanent shielding of separately manufactured sub-assemblies. Slip-over covers with lead holes and access plates can be supplied for high-gain transistor amplifiers, miniaturized servo mechanisms and other data storage devices. They are non-shock sensitive and non-retentive, additional holes may be drilled in the field without sacrificing shielding effectiveness.

Perfection Mica Co., Magnetic Shield Div., Dept. ED, 1322 N. Elston Ave., Chicago 22, Ill.

Frequency Meters 445

Accurate within 0.1% at 400 and 60 cps, these expanded-scale meters are also available in non-standard ranges as high as 100 kc. A 4-1/2-in. mirrored scale provides 0.5-cycle resolution in the 400-cps type. Type F-5908 linearly displays the 57-63 cps range; Type F-5907, the 375-425 cps range. Both types are parallel-connected to the source and require less than 5 w of power.

Airpax Electronics, Inc., Seminole Div., Dept. ED, Fort Lauderdale, Fla.

Price & Availability: *Deliverable in 3 to 4 weeks, the units are priced at $148.75 each in quantities of 1 to 3 and $118.95 for 4 to 6.*

Accelerometer 535

Dynamic error band is ±1%

Model 609 accelerometer has an error band, including linearity, hysteresis, resolution and repeatability, of as low as ±1%. Specifications include: resistance, 1 to 10 K; nominal resolution, 0.25%; power rating, 0.5 w at 165 F; damping, 0.5 to 0.8 of critical from —65 to +165 F; dimensions, 1.5 x 1 x 1 in. The unit stands environmental extremes.

Bourns, Inc., Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

Ferrite Core 408

For use in impulse-switching conditions

Type 400M1 toroidal ferrite core for impulse-switching operation in magnetic-memory systems, switches to 0.2 μsec. At a read driving current of 380 ma and a disturbed 0-output of 8 mv, the unit can deliver 50-mv undisturbed read-one output. Its dimensions are 0.03 in. OD, 0.018 in. ID and 0.01-in. thick. It stands a compressive force of 100 g.

Radio Corp. of America, Semiconductor & Materials Div., Dept. ED, Somerville, N.J.

Digital Voltmeter 594

For industrial applications

The V-45 voltmeter is for production-line testing, quality control, and inspection applications. It covers an extended dc range from 1 mv to 1,099.9 v. Sensitivity control is continuous from 1 to 10,000 digits. The unit measures 19 x 5-1/4 x 15-1/2 in. and is suitable for rack or bench mounting.

Cubic Corp., Dept. ED, San Diego 11, Calif.

NEW PRODUCTS

Subminiature Relay 600

Meets missile requirements

Series V relay meets the environmental requirements of prototype missiles. It is available with or without arc-inhibiting circuits and with ac or dc relay motors.

Filtors, Inc., Dept. ED, Port Washington, N.Y.
Availability: *60 days.*

Resistance Thermometers 607

Resistance is 676 ohms

Model S29 resistance thermometer produces a change of resistance of more than 3 ohms for a change in temperature of 1 deg C. Resistance is 676 ohms ±0.5%. Operating temperature range is −55 to +100 C. The units can be used as remote or proximate detectors in temperature-flashing signs and in industrial processing and control applications.

Minco Products, Inc., Dept. ED, 740 Washington Ave. N., Minneapolis 1, Minn.
Price: *$16.90 for one or two; $13 for 51 to 100.*
Availability: *Within 30 days.*

Induction Motor 696

Meets Mil specs

Type A-10-11 induction motor can be supplied to drive a vane-axial or propeller-type fan for applications such as cooling an electronic chassis. It meets MIL-M-7969, MIL-E-5272A and MIL-A-8625. Specifications include: 1/400 hp; 115 v at 400 cps, three phase, 10,500 rpm; torque, 0.24 oz-in. full load and 0.2 oz-in. starting; and efficiency, 35%.

Kearfott, Div. of General Precision, Hertner Electric Co., Dept. ED, 1150 McBride Ave., Little Falls, N.J.

Photoelectric Modulator 391

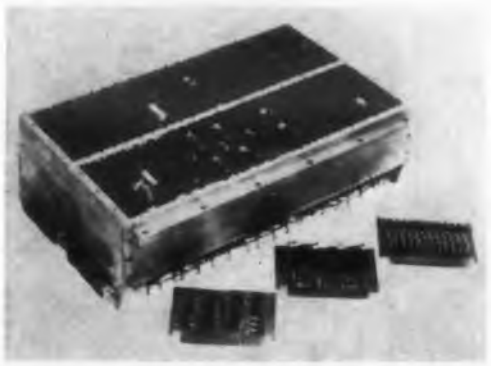
Life is over 2,000 hr

Model PG-4 photoelectric modulator alternately connects and disconnects a load from a signal source; it may also be used to convert ac to dc. It can be driven from dc to 1 kc by sine- or square-wave sources. Light-modulated photosensistors are used as the switching element. The unit has no moving parts, stands shock and vibration and is suitable for military and missile applications. It uses a 7-pin base.

Photochron Research, Inc., Dept. ED, 2 Howard St., New York 13, N.Y.
Price: *$14.70 in lots of 50 to 100.*
Availability: *From stock for up to 50 units.*

Digital Data System 603

For missile applications



Model ADS-1 converts system parametric voltage measurements to a digital equivalent for fm telemetry systems and magnetic or paper tape recorders. It has 12 channels, a sampling rate of 120 samples per sec, a conversion accuracy of ±0.2%, and a 10-mv resolution and repeatability. Full-scale inputs of −5 to +5 v at input impedances of greater than 10 meg dc and 1 meg at 60 cps.

Curtiss-Wright Corp., Electronics Div., Dept. ED, P. O. Box 8324, Albuquerque, N. Mex.
Price: *About $13,000.*
Availability: *Three to four months.*

Oscilloscope 387

Supplied in kit form

Model IO-30 5-in. oscilloscope is for audio and TV service work. The kit is supplied with capacitors providing preset frequencies of 30 and 7,875 cps. By changing capacitor values, any two preset frequencies within the sweep frequency range can be made available. The preset controls can be adjusted without removing the cabinet.

Heath Co., Daystrom, Inc., Dept. ED, Benton Harbor, Mich.
Price: *$76.95.*

NEW PRODUCTS

Miniature Rectifiers 395

Come in high-voltage and bridge types

The Micro-Assemblies are claimed to be the smallest units of this kind available. The bridge rectifiers, offered in nine types from 50 to 2,000 v, are contained in 1/4-in. epoxy cubes. The high-voltage rectifiers, offered in a range of 2,000 to 10,000 v, are of axial design with diameters of 0.313 and lengths of 0.5, 0.75 and 1 in. The assemblies are of all-welded construction, hermetically sealed. They are subjected to a 200-hr, 175 C burn in.

Pacific Semiconductors, Inc., Dept. ED, Hawthorne, Calif.

Price: *Types PS2411 through PS2419 bridge units, $18 to $58.50 in quantities of 100 to 999; types PS2422 through PS2430, $18 to $81.90.*

Pulse Generator 598

Delivers a 50-v pulse into 50 ohms

Model 121 high-current pulse generator delivers a 50-v pulse into 50 ohms; either polarity is possible. Rise and fall times are less than 5 nsec. Widths are variable from 10 to 200 nsec. Repetition rate is from 10 cps to 10 mc. The unit is suitable for ferrite and magnetic switching studies, applications in high-speed transistor and diode switching, and the design of logic and memory circuits.

E-H Laboratories, Inc., Dept. ED, 163 Adeline St., Oakland, Calif.

Price: *$1,675.*

Coaxial Band-Pass Filter 585

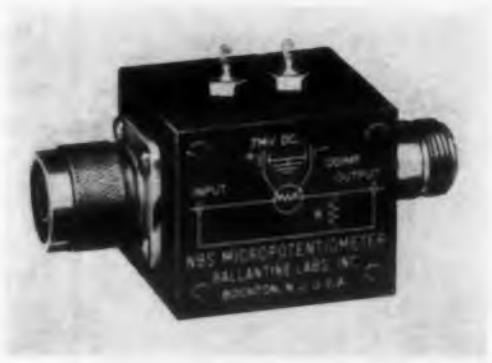
Frequency range is 5,200 to 5,700 mc

This two-section, gang-tuned coaxial filter has the following specifications: frequency range, 5,200 to 5,700 mc; insertion loss, 2.7 db max; bandwidth at 3 db, 10 mc min; rejection at 40 mc from center frequency, 32 db; input vswr, 1.5 max. Connectors are female type N. Units measure 3-3/4 x 2 x 1 in., excluding connectors and dial.

Waveline Inc., Dept. ED, Caldwell, N.J.

Voltage Standard 674

For dc to 900 mc



Model 440 Micropotentiometer can be used as a relative or an absolute voltage standard. Stable, passive circuit elements are used and the unit is based on designs of the National Bureau of Standards. It is suitable for laboratory use.

Ballantine Laboratories, Dept. ED, Boonton, N.J.
Price: *$250.*
Availability: *Immediate.*

Ultrasonic Cleaner 393

With solid-state generator

Model LG-75 cleaner is powered by a 75-w Sonogen generator driving a transducerized tank at a nominal frequency of 25 kc. The system is compact and is recommended for cleaning precision parts, electronic components, miniature bearings and intricate sub-assemblies.

Branson Instruments, Inc., Dept. ED, 40 Brown House Road, Stamford, Conn.
Availability: *Four-week delivery.*

Tube Tester 561

For multiple-socket and punch-card tests

Model 685 mutual-conductance tube tester combines multiple-socket and automatic punch-card testing. It accommodates over 125 tube types. Each section of multiple tubes is tested separately. The instrument is portable.

B & K Manufacturing Co., Dept. ED, 1801 W. Belle Plaine, Chicago 13, Ill.
Price: *$199.95.*

Vol. 1, No. 5

Nickelonic News

DEVELOPMENTS IN NICKEL AND NICKEL ALLOYS AND THEIR APPLICATIONS

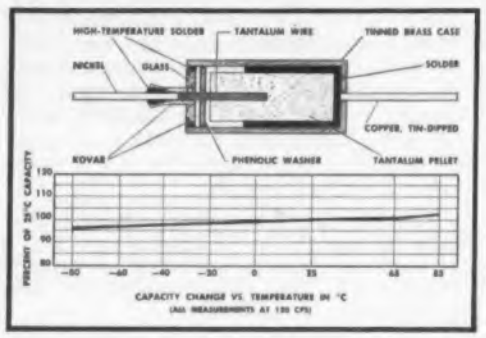
Nickel leads, welded directly to tantalum, boost capacitor ruggedness

DALLAS, TEX. – For maximum reliability, new Texas Instruments *tan*-TI-*cap*** capacitors depend on leads of Electronic Grade "A"* Nickel. This strong, tough nickel wire, welded soundly and easily to the tantalum stubs, helps provide the good connections needed to withstand mechanical and thermal shock.

Electronic Grade "A" Nickel is highly resistant to oxidation and corrosion. What's more, it provides tight hermetic seals (note figure below) and speeds unit installation.

**T. M. of Texas Instruments Incorporated

Pertinent Literature: Write for Technical Bulletin T-15.

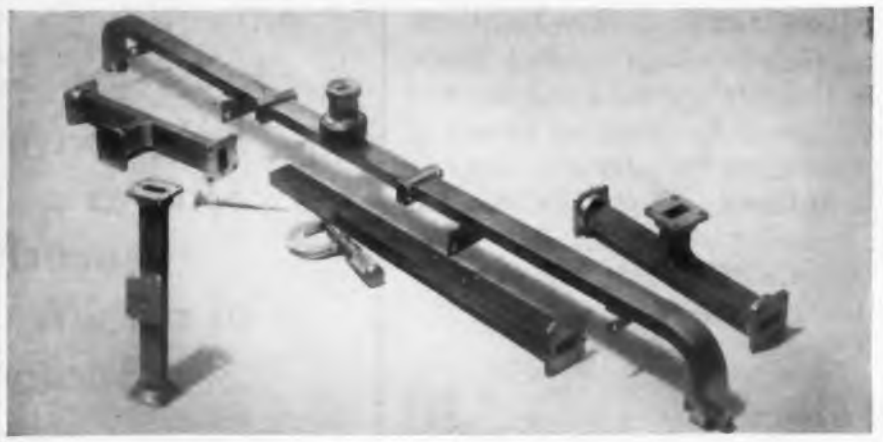


Lead wires of Electronic Grade "A" Nickel strengthen this new *tan*-TI-*cap* Solid Tantalum Electrolytic Capacitor.

Nickel materials keep electrons "in line" in new linear accelerator

WALNUT CREEK, CALIF. – Intense electron, neutron and X-ray beams are generated by this new ARCO linear electron accelerator. In order to operate at very high vacuums -10^{-7} to 10^{-8} mm Hg –its vacuum envelope must be de-gassed by baking out at 400°C. ARCO designers specify Electronic Grade "A" Nickel for the envelope because it provides the excellent vacuum properties required. This metal also resists oxidation, corrosion and retains its strength at operating temperatures well above 400°C.

FIRST COMMERCIAL ATOMIC CLOCK... WAVEGUIDES OF LOW PERMEABILITY MONEL "403" HOLD DOWN SIGNAL DISTORTION



No problem fabricating these waveguides of Monel "403" low permeability alloy, reports National. The intricate tubes carry microwaves in the Atomichron atom-regulated frequency standard.

Heart of the "clock" – a cesium beam tube–Monel "403" alloy provides the tube's pole assemblies with excellent mechanical properties plus low magnetic permeability. Manufactured by National Company, Inc., 61 Sherman Street, Malden 48, Mass.

Nickel improves seals

All metal surfaces of the envelope's metal-ceramic seals are nickel-covered. Nickel is easily brazed, protects parts from oxidation. Its purity facilitates the elimination of all organic products from the vacuum envelope, permitting excellent radio-frequency operation.

Pertinent Literature: Write for "Nickel Alloys for Electronic Uses."

For outstanding vacuum properties, key parts of the Mark 1-T4 accelerator are made of Electronic Grade "A" Nickel. Built by Applied Radiation Corp., Walnut Creek, Cal.

*Inco trademark

. . . clock generates frequencies accurate to 5 parts in 10 billion!

MALDEN, MASS. – You can now tell time accurately down to 100 millionths of a second with the Atomichron†, first commercial atom-regulated "clock."

How it works

Waveguides feed a tuned microwave signal through a stream of cesium atoms. As signal reaches the atoms' resonant frequency, it changes some atoms in internal structure. This change is sensed by a detector and signalled to a servo system, which regulates the frequency of a basic oscillator at precisely the atomic resonance value. By means of electronic multipliers and dividers, this oscillator produces standard output frequencies of 0.1, 1.0, 5, 10, and 100 megacycles – the required "clocking" action.

Designers chose Monel "403"* low permeability nickel-copper alloy for the waveguides, radio frequency sections and magnet pole assemblies, because it provides magnetic permeability so low that atomic resonance remains free from distortion. Monel "403" alloy offers excellent vacuum and mechanical properties, is readily machined and formed into intricate shapes.

Like all nickel alloys, Monel "403" alloy is freely available.

Pertinent Literature: Write for "Basic Data-Monel '403' Low Permeability Nickel-Copper Alloy."

†T. M. of The National Company, Inc.

HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
Huntington 17 West Virginia

INCO TRADE MARK **ALLOY PRODUCTS**

CIRCLE 163 ON READER-SERVICE CARD

NEW PRODUCTS

Thermistor Thermometer 392

Wide-span, transistorized unit

Model 42 thermometer, providing remote reading and continuous indication, covers –40 to +150 C in model 42SC and –40 to +300 F in model 42SF. It uses a transistor-controlled, constant-current Wheatstone Bridge to allow monitoring to an absolute accuracy of ±0.5 C or ±1 F. The multiple range provides readabilities of ±0.2 C or ±0.25 F.

Yellow Springs Instrument Co., Inc., Dept. ED, Yellow Springs, Ohio.
Price: $125.

Mylar Capacitors 718

Power factor is less than 0.5% at 25 C

Type MFA molded mylar capacitors operate from –55 to +105 C without derating, can be operated to +125 C with 50% derating, and have a power factor of less than 0.5% at 25 C. Insulation resistance is 50,000 meg μf at 25 C. They provide extreme resistance to moisture, exceeding MIL-C-25, MIL-C-91 and EIA spec RS-164. Non-inductive, extended foil winding provides for low rf impedance.

Hopkins Engineering Co., Dept. ED, 12900 Foothill Blvd., San Fernando, Calif.
Price: $0.04 to $0.20, in thousand-lot quantities.
Availability: Immediate.

Silicon Diodes 741

Leakage is 0.001 μa at 125 v

Type FD300 general-purpose silicon diodes offer the following characteristics: leakage, 0.001 μa max at 125 v; capacitance, 6 pf max at 0 v; and forward conductance, 200 ma min at 1 v. Working inverse voltage is 125 v, average rectified current is 150 ma and forward current (steady state) is 225 ma dc. Operating temperature range is –65 to +175 C. The units are general-purpose and are for applications where switching speed is not of prime importance.

Fairchild Semiconductor Corp., Dept. ED, 545 Whisman Road, Mountain View, Calif.
Availability: Immediate, in production quantities.

Silicon Diodes 406

Fast-switching types

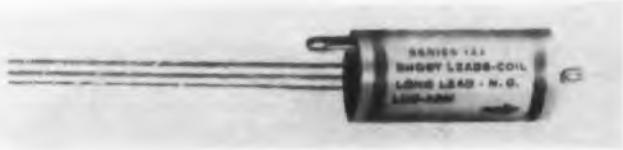
Made to meet Mil specs, these silicon Planar diodes can be used in fast-switching and rf applications. Type 1N643 has a working inverse voltage of 175 v, an average rectified current of 40 ma dc and a recurrent peak-forward current of 125 ma. Type 1N662 has a working inverse voltage of 80 v, an average rectified current of 40 ma dc and a recurrent peak-forward current of 125 ma. Type 1N663 has a working inverse voltage of 80 v, an average rectified current of 60 ma dc and a recurrent peak-forward current of 190 ma.

Fairchild Semiconductor Corp., Dept. ED, 4300 Redwood Highway, San Rafael, Calif.

Availability: *Immediate, in production quantities.*

Tubular Relay 543

For high shock and vibration use



Series 123 tubular relay, provides high vibration and shock resistance. It measures 1-1/8-in. long and 15/32 in. in diameter. Contact arrangement can be 1 Form A, 1 Form B or 1 Form C. Contact rating is: 2 amp at 115 v ac or 24 v dc for 30,000 operations, 1 amp at 115 v ac or 24 v dc for 1,500,000 operations, and 3 mils at 115 v ac or 24 v dc for 50,000,000 operations. Coil power is 350 mw at 20 C. Vibration rating is 10 g to 2,000 cps and shock, 30-g de-energized or 100-g energized. Operate time is 5 msec and release time is 7 msec.

Wheelock Signals Inc., Dept. ED, Long Branch, N.J.

Price: *$8.90 to $13.*

Availability: *60-day delivery.*

Connectors 573

For molded-cable assemblies

These connectors are offered in three types. The Y type, junction ST-90, is designed to eliminate maintenance problems on headphones and binaural and stereophonic headsets. The ST-26 is a four-contact microphone screw-type connector with 3, 5, or 6 contacts. The ST-25 is a single-contact microphone connector molded to a two-conductor shielded cable.

Switchcraft, Inc., Dept. ED, 5555 N. Elston Ave., Chicago 30, Ill.

Availability: *Made on order.*

NEW PRODUCTS

Connectors 394

Have interchangeable end fittings

These connectors with interchangeable end fittings come in three types: series E for electronic cooling systems, series A for aircraft and missile applications and series C for standard industrial and commercial applications. Special configurations can be furnished on order. The locking mechanism is actuated by a simple push-to-engage and pull-to-disengage motion.

Exeter Connectors, Inc., Dept. ED, 93 Court St., Exeter, N.H.

Precision Clock 567

With planetary gears

The PlanetGear model 6010 24-hr clock is for long, heavy-duty, split-second timing. Instantaneous snap-over of numbers is by means of a nylon cam and roller-compensating device which moves the planetary gear. Hours and minutes are manually preset. Numerals are 3/8 in. high; mounting dimensions are 2-7/8 x 2-3/8 in. and depth is 4 in.

Haydon Instrument Co., Dept. ED, 165 W. Liberty St., Waterbury 20, Conn.

Price: *Model 6010, $155; model 6011 12-hr type, $75.*

Availability: *Model 6010, six to eight weeks; model 6011, three weeks.*

X-Y Recorder 693

Weighs 20 lb

Model 135 transistorized X-Y recorder weighs 20 lb and measures 10-1/2 x 16-1/8 x 4-1/2 in. The unit has built-in calibrated X-axis time sweeps with 16 calibrated ranges on each axis. It is for use with ac-to-dc converters, log converters and other data-handling and recorder accessories.

F.L. Moseley Co., Dept. ED, 409 N. Fair Oaks Ave., Pasadena, Calif.

Price: *$1,375 ea.*

Hysteresis Synchronous Motor 706

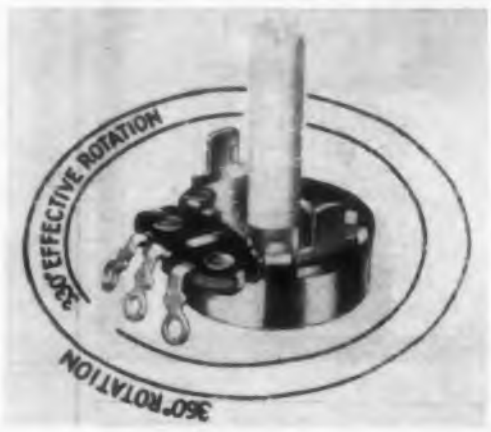
Size 8

Size-8 hysteresis synchronous motor, 0.960 in. long, meets MIL-E-5272 specs. Model A3361 400-cps unit provides constant speed drive for computers and navigational devices. Specifications include: torque: 0.025 oz-in.; synchronous speed, 8,000 rpm at 55 v; total power, 5.1 w; weight, 1.25 oz. Single-phase and two-phase units are available.

Kollsman Motor Corp., Dept. ED, Dublin, Pa.
Price: *$92.75 ea, 1 to 9; $85.65 ea, 10 to 49; $78.50 ea, 50 to 99; $71.35 ea, 100 up.*
Availability: *3 to 4 months.*

Variable Resistors 591

With 360-deg continuous rotation control



Series CR45 composition resistors measure 15/16 in. in diameter and 29/64-in. deep. The resistance range is 250 ohms to 10 meg with linear resistance gradient. Power rating is from 1/4 to 1/2 w, depending on resistance. Maximum operating voltage from terminals to bushing is 750 v dc. A variety of shafts and bushings can be supplied.

CTS Corp., Dept. ED, Elkhart, Ind.
Availability: *Four weeks.*

Coaxial Microwave Filters 601

Individually or gang tuned

These band-pass filters are for use as laboratory equipment with a calibrated micrometer- or counter-dial drive. Individually tuned units have frequency ranges of 2.1 to 2.5 kmc on up to 5.4 to 5.9 kmc and an input vswr of 1.25 max. The gang-tuned units are available in frequency ranges of 2.1 to 2.4 kmc on up to 5.4 to 5.9 kmc and have an input vswr of 1.5 max. Units have a bandwidth at 3 db of 12 mc, a rejection at 40 mc from center frequency of 28 db, and insertion loss of 1 to 2.5 db. Size is 3-1/2 x 2-1/2 x 1-1/4 in.

Waveline Inc., Dept. ED, Caldwell, N.J.

NEW PRODUCTS

Band-Pass Filter 582

Four-section type

This four-section, gang-tuned filter is designed for the frequency range of 2,700 to 3,000 mc. Other characteristics include: insertion loss, 1.5 db max; bandwidth at 3 db, 18 mc min; rejection at 30 mc from center frequency, 37 db; and input vswr, 1.5 max. The unit has female type TNC connectors and measures 3 x 2-1/2 x 2-1/2 in. without connectors and dial.

Waveline Inc., Dept. ED, Caldwell, N.J.

Signaling Terminals 610

Provide two-way signaling on any voice channel

Type 3817 signaling terminals are for station selection or remote control. Dial pulses are transformed to interrupted tone signals for transmission. Although designed primarily for wire-line applications, the unit works over carrier, microwave and radio in any combination. The unit is designed for rack mounting, measures 10.5-in. high and operates from 117 v at 60 cps.

Secode Corp., Dept. ED, 555 Minnesota St., San Francisco 7, Calif.
Price: *$480 to $555.*
Availability: *30-day delivery.*

Function Generator 399

Output frequency is 30 cps to 39 kc

Designed as a breadboard testing or trouble-shooting instrument, this function generator provides a sine-wave, square-wave or pulsed output. Output frequency range is 30 cps to 39 kc in six ranges. Sine-wave output is 0.8 v rms, square-wave and pulsed outputs are 3 v, peak-to-peak. Output amplitude is within ±1 db. The pulse width can be varied from 2 to 10 μsec; rise and fall time is less than 1 μsec. The frequency dial is accurate to within 10%.

Airborne Instruments Laboratory, Dept. ED. Deer Park, L.I., N.Y.
Price: *$299.*

Image Amplifier Tubes 697

For use in astronomy and nuclear physics

These image amplifier tubes are for experimental work in astronomy and nuclear physics. They increase the light sensitivity of any telescope system many times over and permit observation of tracks of cosmic rays and other high-energy particles.

Westinghouse Electric Corp., Electronic Tube Div., Dept. ED, Elmira, N.Y.
Price: *$7,500, approx.*
Availability: *Production begins September, 1960.*

TNC Receptacle Adapter 584

With 3/4-in. spaced banana plugs

Type 2B-1340 TNC receptacle adapter features the TNC receptacle on the upper portion of the unit. The receptacle is molded to the plug body containing double 3/4-in spaced banana plugs. Made of heat-treated beryllium copper, nickel-plated springs, the banana plugs are formed to fit the round receptacle hole.

Pomona Electronics Co., Inc., Dept. ED, 1500 East Ninth St., Pomona, Calif.
Price: *$5.85 in lots of one to six.*
Availability: *Through distributors.*

Traveling Wave Tube 575

Low-noise type

Model ZM-3103 low-noise, traveling-wave tube has the following characteristics: cathode voltage, 0; cathode current, 500 to 800 μa; anode voltage 30 to 50 v; anode current 0 to 10 μa; helix voltage 700 to 800 v; helix current, 0 to 20 μa. Uses are in radio receiving and transmitting, TV, and industrial applications.

General Electric Co., Dept. ED, 2155 S. First St., San Jose, Calif.

NEW PRODUCTS

Compressed-Gain Amplifier 599

Frequency range is 10 kc to 50 mc

Model 110 compressed-gain amplifier converts input voltage variations into decibel variations. It has a virtually linear transfer characteristic and can be used to measure the attenuation performance of crystal filters, tuned amplifiers and other frequency-selective devices. Compression ranges are: range A, 80 db and range B, 60 db with vtvm connected. The unit measures 7 x 19 in.

Hermes Electronic Co., Dept. ED, 75 Cambridge Parkway, Cambridge 42, Mass.
Price: *$595.*
Availability: *10 days.*

Metal Sheathed Thermocouples 475

This line of metal-sheathed thermocouples is designed for accurate temperature sensing applications; accuracy of calibration is within recommended ISA limits. Other features include resistance to thermal shock and severe pressures, small size and lightweight.

Harco Laboratories, Inc., Dept. ED, New Haven, Conn.

High-Temperature Ceramic Cements 476

Asteroceram type A cement is useful to 4,300 F and can be air-dried in joining ceramic, glass and metals. Asteroceram type B is useful up to 5,000 F and must be fired to develop a bond.

Instrumentation Associates, Dept. ED, 17 W. 60 St., New York, N.Y.

Test Probe Tips 477

These test probe tips can be used with all collet type, test lead handles. The design eliminates sparks and shorting and has a lock-on feature that holds the lead to the connector. Three sizes of tips are available for testing the following pin sizes: 0.040, 0.062 and 0.093 in.

Autotron, Inc., Dept. ED, P.O. Box 2278, Santa Monica, Calif.

Molding Compounds 404

For high-temperature operation

Type M-6-4156 mineral-filled silicone molding compound is for the manufacture of parts requiring long-term operation at 700 F. Parts made of this material have over 400 sec of arc resistance and dissipation factors as low as 0.002 at 10^6 cps. Typical applications are fuses and fuse holders, coil forms, tube bases, arc barriers and switch parts.

Dow Corning Corp., Dept. ED, Midland, Mich.

Availability: *Immediate, in production quantities.*

Low-Noise Chopper 583

Noise level is 0.6 mv rms

Model 33 electromechanical chopper achieves noise levels of 0.6 mv rms. Specifications include: drive, 6.3 v at 60 cps; dwell, 175 deg avg; phase, 25 ±10 deg; balance, within 15 deg; and contact action, spdt, BBM. Housing is a round metal can with pierced pin terminals. The unit is 3/4 in. in diameter, has a seated case height of 1/3/16 in. and weighs 22-1/2 g.

Airpax Electronics Inc., Cambridge Div., Dept. ED, Cambridge, Md.

Availability: *One to three weeks delivery.*

Preflight Checkout Systems 572

Have automatic operation

These checkout systems test the performance of missile tracking, guidance, radio and safety equipment. The system simulates an actual flight sequence, from initial missile launching through flight and recovery. Operation of all electronic and electrical sub-systems can be verified. Visual and graphic records are provided.

R S Electronics Corp., Dept. ED, 435 Portage Ave., Palo Alto, Calif.

Availability: *Made on order.*

NEW PRODUCTS

Accelerometer Transducer 563

Sensitivity is 20 mv per g

Model 101 accelerometer, having a sensitivity of 20 mv per g, also has a low-cross sensitivity of 3% nominal. Linearity is 2% from 1 to 15 kc. The unit stands temperatures from —65 to +365 F and is capable of measuring up to 10^4 g. Models 101-15, 101-30 and 101-50 have maximum cross sensitivities of 1.5%, 3% and 5%, respectively.

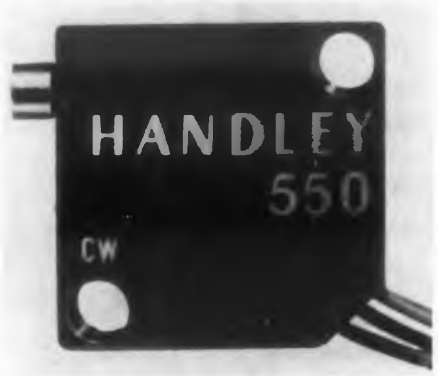
United Aerotronics Corp., Dept. ED, Burlington, N.J.

Price: *$219.50.*

Availability: 10 days.

Trimmer Potentiometers 589

Operate to 200 C



The Weetrim 550 trimmer potentiometers, rated at 1 w, are protected against humidity and corrosion by sealed isolation of electrical parts and withstand temperatures up to 200 C. They have 6-in. Teflon-covered wire leads. Other features include high resolution, good dielectric strength and noise-free operational life.

Handley, Inc., Dept. ED, 12960 Panama St., Los Angeles 66, Calif.

Price: *$4.50 down to $3.08.*

Availability: *Immediate.*

Erasable Intermediate Paper 678

For corrections of variable information

Type 402-IZE erasable intermediate paper is for use where the addition or deletion of variable information has to be made. Pencil, ink and typewritten entries can be removed by rubbing with an ordinary eraser. The base paper is transparent for fast reprint speed and has show-through for drawing purposes. Both sides of the sheet are coated with a plastic surface, making it water and grease resistant. The paper is compatible for filing with silver halide materials.

General Aniline & Film Corp., Ozalid Div., Dept. ED, 63 Corliss Lane, Johnson City, N.Y.

Speed Monitor 569

Provides constant rpm

In spite of varying accessory loads, the Speed monitor provides an rpm that is constant to ±5%. The governed speed can be from 1,000 to 6,000 rpm. Ratio of drive to driven is as high as 4:1. The unit is self cooling.

Knechts Inc., Dept. ED, Box 1037, Springfield, Ore.

Price: $50 for most models.

Epoxy Powders 472

Maraset 135E, an unfilled epoxy, and Maraset 136E, a filled epoxy, are semi-flexible powders for impregnating and encapsulating electronic parts. They are low exotherm materials which have a 4-hr pot life, negligible shrinkage, and a 60% elongation rate.

Marblette Corp., Dept. ED, 37-31 30 St., Long Island City 1, N.Y.

Price: Working samples of either resin are available at $4 a qt; further price data upon request.

Soldering Hold-Down Fixture 473

Model 500 Connex is a hold-down fixture with a non-slip base and quick-locking, rubber-covered spring attachment designed to hold any standard size connector rigidly in place during soldering operation. Weighing 3 lb and 13 oz, it does not have to be bench-mounted and may be easily moved.

Hudson Pacific, Inc., Dept. ED, 12964 Panama St., Los Angeles 66, Calif.

Price: $8 fob Santa Monica.

Potting Compound 479

This potting compound, known as Pro-Seal 729 is a one-part, high-temperature resistant polysulfide. Its physical and electrical properties are said, by the manufacturer, to equal MIL-S-8516B specifications. It can be used at prolonged exposure of 275 F. It is packaged in containers ranging from 2.5-oz to one-gallon sizes.

Coast Pro-Seal and Manufacturing Co., Dept. ED, 2835 Beverly Blvd., Los Angeles 57, Calif.

NEW PRODUCTS

Punched-Tape Reader 578

Tape capacity is 550 ft

This punched-tape reader can stop on character at a tape-reading rate of more than 200 eight-bit characters per sec. It reads from 1-in. Mylar or paper tape. Normal reading rate is 20 ips in both directions. Fast reading rate in both directions is up to 1,400 characters per sec. The complete unit weighs about 50 lb and measures 17 x 11 x 9 in.

Litton Industries, Westrex Recording Equipment Dept., Dept. ED, 6601 Romaine St., Hollywood 38, Calif.

Availability: *90 days.*

Germanium and Silicon Transistors 625

Available in NPN an PNP units

The Beta-Max transistor line is available in npn and pnp units. These germanium and silicon units measure 3/4 x 1 x 1-5/8 in. Minimum current gain is 26,000. The units are for switching applications.

Electromation Co., Dept. ED, 4254 Glencoe Ave., Venice, Calif.

Price: *$46 ea.*

Availability: *Sample quantities, from stock.*

Multi-Channel Potentiometer 616

For computer use

Having a rotary input, model 802 potentiometer is designed for direct servo motor drive in computer applications. It incorporates straight resistive elements in place of the conventional ganged rotary potentiometers. Over 1,000 separate channels can be contained in 1 cu ft. Resistances are 500 ohms to 140 K, resolution is 0.02% to 0.13%, linearity is 0.1% to 0.3%, and power rating for each channel is 7.5 w at 40 C.

Bourns, Inc., Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

Magnetic Storage Drums 593

Stores 100,000 binary bits

This magnetic storage drum, designed to meet rigid requirements for buffer storage to magnetic tape, is capable of storing 100,000 binary bits of computer information. The pulley and belt drive provides speeds up to 25,000 rpm. The unit can be provided with read-write circuitry.

Farrington Manufacturing Co., Dept. ED, Needham Heights 94, Mass.

Magnesium Cases 641

Magnesium military cases, combination cases and instrument cases are available in size ranges from 3-3/4 x 7-13/16 x 2-1/4 in. to 18-15/16 in. square and 18 in. deep.

Zero Manufacturing Co., Dept. ED, 1121 Chestnut St., Burbank, Calif.

Epoxy Adhesive 657

Type 4322 adhesive has a tensile shear of 2,200 psi at 300 F on aluminum to aluminum. It will not flow during cure, has a slight resiliency which gives thermal shock. Can also be used for bonding metal, plastics, ceramics, glass and wood.

Hysol Corp., Adhesives and Sealants Dept., Dept. ED, Olean, N. Y.

Metalized Paper Capacitors 449

These plastic-molded, metalized paper capacitors are fully insulated and have a high resistance to heat and moisture. Standard units can be had from 0.005 to 4 μf; higher capacities are available. A 4-μf unit measures 37/64 × 3/4 × 1-3/4 in.

Hopkins Engineering Co., Dept. ED, 12900 Foothill Blvd., San Fernando, Calif.

Metalized Ceramic Terminals 708

The L-series metalized ceramic terminals have ratings as high as 15,000 v and meet JAN 1-8 and JAN 1-10 specs. The line consists of four basic type terminals in 26 different sizes.

Metalizing Industres, Inc., Dept. ED, 338 Hudson St., Hackensack, N.J.

NEW PRODUCTS

Temporary Connections 679

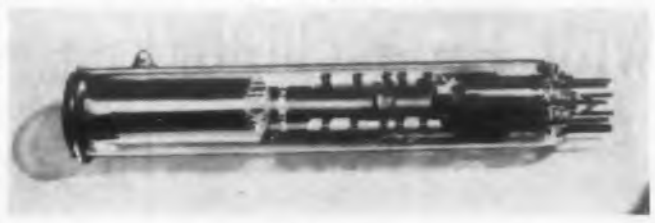
Consist of 20 junction cells

The Inter-Connek units consist of 20 rubber-core junction cells arranged in two parallel rows, with copper foil connecting each pair of cells. Wires are inserted by pulling up the flexible rubber core at the end of each cell. When the core is released, the rubber expands, gripping the wire. Capacitors, resistors or other circuit elements can be inserted between cell units.

Plastic Associates, Dept. ED, 2900 S. Coast Blvd., Laguna Beach, Calif.

Rate Gyro 606

Accuracy is 1%



Measuring 1-1/8 in. in diameter and 3-3/4-in. long, this dc rate gyro with potentiometer output has an accuracy of 1%. The steel flexure pivot-gimbol suspension and the heavy metal rotor provide a hysteresis of about 0.5%, max. Hermetically sealed in a steel case the 28-v unit operates under severe environmental conditions. Service life of the motor is more than 300 hr; the pot has a life exceeding 10^6 cycles.

Humphrey, Inc., Dept. ED, 2805 Canon St., San Diego 6, Calif.

Availability: *Units are made on order.*

Waveguide Harmonic Filter 609

Passband range is 400 to 450 mc

This uhf filter, having a frequency range in the passband of 400 to 450 mc, is claimed to be the largest unit of this type; it weighs 1,400 lb and measures 16 x 4 x 3 ft. It is typically used with WR-2100 waveguide equipment to suppress harmonic and spurious signals from microwave tubes and is applied between the tube and the antenna. Passband characteristics are: insertion loss, less than 0.2 db; vswr, 12:1 and power-handling capacity, 5 mw peak, 300 kw avg. Stopband characteristics are: range, 700 to 1,800 mc; insertion loss, greater than 20 db; vswr, less than 2 for each propagating mode and power-handling capacity, 5 kw avg.

General Electric Co., Dept. ED, 2155 S. First St., San Jose, Calif.

Lumped-Constant Delay Lines 666

Are totally encapsulated

Totally encapsulated in epoxy resin, these delay lines do not need the terminal boards which are commonly used to trap moisture. Model F-577A has a total delay of 10 μsec and a rise time of 0.5 μsec max; it has multi-taps every 0.2 μsec. Model F-578A has a total delay of 15 μsec and a rise time of 0.4 μsec max. This unit has multi-taps every 0.125 μsec. Both models have an impedance of 400 ohms and an operating temperature to 125 C.

Control Electronics Co., Inc., Delay Line Div., Dept. ED, 10 Stepar Place, Huntington Station, L.I., N.Y.

Availability: *Two to three weeks.*

Low Temperature Solder 716

This high-strength, low-temperature solder preform material, designated alloy D-800 is a lead base "N" type ohmic-junction alloy material, containing neither boron nor free iron. Its melting range is 240 to 268 C, and the material will operate at 200 C with no deformity under load. Available only as preforms in the form of washers, discs, spheres and pellets.

Accurate Specialties Co., Inc., Dept. ED, 340 Hudson St., Hackensack, N.J.

Vaneaxial Blower 707

Model VAX-3-BD dc vaneaxial blower produces an optimum output of 90 cfm at 1 in. H_2O back pressure. At 28 v dc maximum current is 1.7 amp at free air delivery. Motor windings can be provided for 4 to 115 v dc operation. Life exceeds 500 hr. The unit weighs 16 oz.

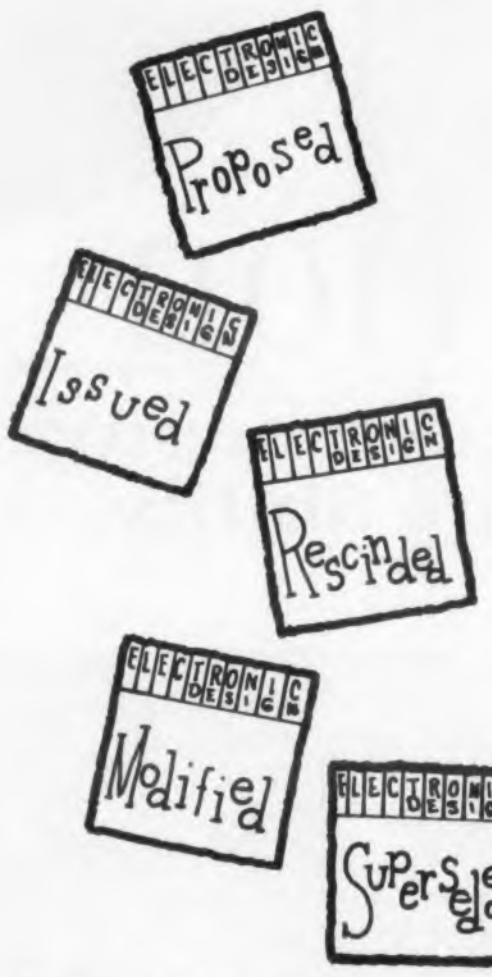
Globe Industries, Inc., Dept. ED, 1784 Stanley Ave., Dayton 4, Ohio.

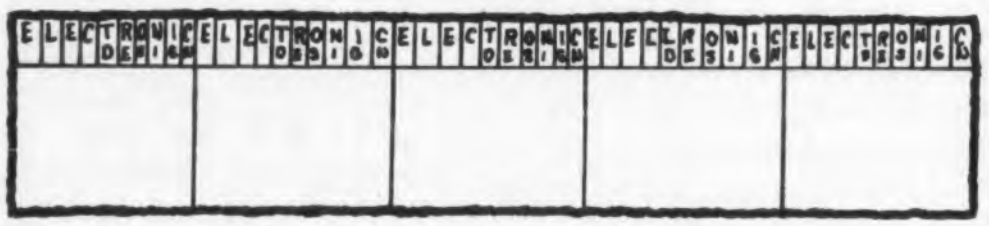
Miniature Trimmer Capacitors 709

Miniature trimmer capacitors having nylon-insulated bushings and lugs for ungrounded operation are available. The "F" mount series has capacitance-to-ground as low as 0.50 pf. The "FL" mount is used where lower capacitance is needed. Both types meet MIL-C-14409A.

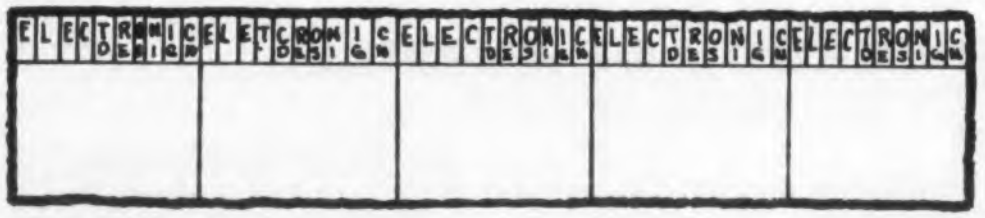
JFD Electronics Corp., Dept. ED, 6101 16th Ave., Brooklyn 4, N.Y.

standards are





We select military and commercial standards of interest to the electronic design engineer and brief them in the Standards & Specs Section. Another service that saves you time and keeps you up to date on the latest design developments.



ELECTRONIC DESIGN . . . communicates ideas for *ACTION*.

NEW PRODUCTS

Power Tube 699

For zero-drive power-amplifier service

Type WL-7540 power tube is for zero-drive power-amplifier service in shaker table and sonar equipment. It has 35-kw dissipation during continuous service at audio frequencies. Characteristics include: filament voltage, 5 v; filament current, 250 amp; amplification factor, 5. Maximum ratings are: dc plate voltage, 15 kv; dc plate current, 10 amp; plate-power-input at audio frequencies, 70 kw. At 35-kw dissipation the flow of cooling water is 30 gal per min at a pressure drop of 8 psid.

Westinghouse Electric Corp., Electronic Tube Div., Dept. ED, P.O. Box 284, Elmira, N.Y.
Price: *$560 ea.*
Availability: *30 days.*

Magnetic Shift-Register Elements 592

Postage-stamp size

These magnetic shift-register elements are postage-stamp size. Up to 10 elements can be contained in 1 cu in. The serial-driven, gated transfer element permits operation at an information rate of 100 kc per sec and a peak shift pulse of 0.1 w.

General Electric Co., Heavy Military Electronics Dept., Dept. ED, Court Street Plant, Syracuse, N.Y.

Drilling Machine 576

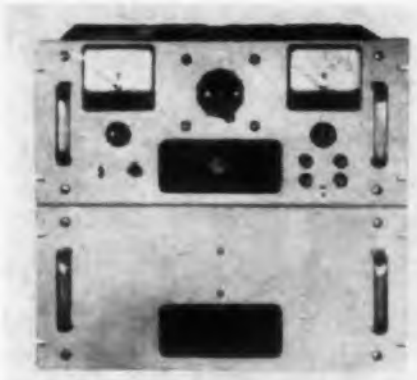
For drilling printed circuitry

Model 151 drills more than 64,000 holes per shift. Holes are from 0.02 to 0.25 in. in diameter; each hole can be within 0.001 in. of true position and minimum wall thickness between holes is 0.004 in. Foot controls are used. The unit occupies 2 x 3 ft of floor area.

Nationwide Engineering Service, Inc., Nawide Machine Tools Div., Dept. ED, 6138 Washington Blvd., Culver City, Calif.
Availability: *35 to 40 days.*

DC Power Supply 571

Ratings are 0 to 18 v dc and 0 to 35 amp



Model ST18-35 supply has ratings of 0 to 18 v dc and 0 to 35 amp, both continuously variable over the full range. Line regulation is 0.005% and load regulation is 0.05%. Recovery time for half-current step changes to full-current load is 100 μsec. Ripple is less than 500 mv. The unit is transistorized and has automatic protection against short circuits.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.

Price: $1,595 fob Springfield.

Availability: Three weeks delivery.

Sealing Grommet 361

This sealing grommet can be molded to suit any required situation, in any size, shape or dimension. Membrane expansion is between 300% and 400%.

Automotive Rubber Co., Dept. ED, 12550 Beech Rd., Detroit 39, Mich.

Tubing And Monofilament 451

Penntube III is a transparent spaghetti tubing and monofilament made of modified trifluorochloroethylene polymer which is available in monofilament down to 0.008 in. and spaghetti tubing in AMS 3648 sizes. Zero moisture absorption, low dielectric constant, and good power factor at high temperature and high frequency are claimed.

Pennsylvania Fluorocarbon Co., Inc., Dept. ED, 1115 North 38 St., Philadelphia, Pa.

Absolute Pressure Transducer 447

Model 226 is designed for accurate absolute pressure measurements over a wide temperature range. It features pressure cavity cleanout, infinite resolution, and standard built-in pressure overload protection. Stainless steel construction permits contact with corrosive acids. Repeatability is 0.1% linearity, 0.25%; hysteresis, 0.25%; ambient temperature, −100 to +275 F; pressure ranges, 0 to 300 to 0 to 2,000 psi.

Taber Instrument Corp., Dept. ED, North Tonawanda, N.Y.

NEW PRODUCTS

Induction Motor 580

Has sealed housing

Type C-20-20 motor is a continuous duty, totally enclosed permanent split-capacitor unit designed to function as a high-starting-torque, fuel pump drive for aircraft. It delivers up to 345% starting torque and is sealed to stand an internal pressure of 400 psi when mounted on the driven shaft. It can be modified to operate as a self-contained sealed drive motor. Requirements of MIL-E-5272A and MIL-E-7894 are met.

Kearfott Div. of General Precision, Inc., Dept. ED, 1150 McBride Ave., Little Falls, N.J.

Brakes and Clutches 359

These fhp electric brakes and clutches are produced in two sizes: 0.875-in. in diameter with 2 lb-in. torque, and 1.725-in. in diameter with 10 lb-in. torque. They are supplied as 28 or 90 v, standard.

General Time Corp., Haydon Div., Dept. ED, 245 E. Elm St., Torrington, Conn.

Sockets For Small Lamps 362

This series of sockets, pilot lights and lamp holders provides a variety of plug-button arrangements. A choice of materials and finishes is offered. Units are available for mounting in holes from 9/16 in. in diameter. Head diameters of plug buttons range from 13/16 in.

Leecraft Manufacturing Co., Inc., Dept. ED, 60 Greene St., New York 12, N.Y.

Ratio Computer 352

Model 597-2B computes the ratios of two independent low-level variables and has an accuracy of ±1%. The computer can measure ratios as low as 1 mv full scale.

Magnetic Instruments Co., Inc., Dept. ED, 546 Commerce St., Thornwoood, N.Y.

Constant-Power Tube 694

Dc plate voltage is 6,000 v

For use to 30 mc, these constant power tubes have the following specs: dc plate current (loaded), 3.3 amp; dc plate current (unloaded), 0.51 amp; plate dissipation 5,500 w; plate power output, 14,300 w; and efficiency, 72%. Type 7804 is forced-air cooled and type 7805 is water-cooled.

Amperex Electronic Corp., Power Tube Div., Dept. ED, 230 Duffy Ave., Hicksville, L.I., N.Y.
Price: *Type 7804, $440; type 7805, $402.*
Availability: *From stock.*

Multiform Glass Beads 446

This line of multiform glass beads is for header applications with both Kovar and compression type hermetic seals. The parts come in all the RMA colors, range in size from 0.050 to 0.075 in. OD with thicknesses between 0.020 and 0.250 in. max.

Electronic-Ceramics Co., Dept. ED, 188 Belmont Ave., Belleville, N.J.
Availability: *Delivery runs one to two weeks from receipt of order and approval of pre-production parts.*

Shelf-Threading Coil Forms 470

These self-threading, epoxy-glass coil forms are available in 4 diameters for use with core sizes of 6, 8, 10 and 1/4 in. They are fungus-proof and non-hygroscopic with dielectric strength of 420 v per mil and volume resistivity of 10^{14} ohms. Excellent torque and moisture resistance characteristics are claimed.

Wells Electronics Co., Dept. ED, 1701 S. Main St., South Bend, Ind.
Availability: *Sample quantities available in 7 days.*

All-Vinyl Cable Markers 496

These self-sticking, vinyl-plastic cable markers simplify identification of large cables, power-supply lines and heavy-duty wiring harnesses. They are made of 6-mil thick, non-conductive vinyl and printed continuously with a bold, black-on-white numeral or letter for full, round-the-cable indentification. The markers are self-adhesive and ready for instant use.

W. H. Brady Co., Dept. ED, 727 W. Glendale Ave., Milwaukee 9, Wis.

Cable-Harness Analyzer 541

Is tape-programed

Model 230 analyzer has programed continuity, complete random selection, 100% branch-testing capabilities, search scan and fault print-out. The programable continuity range is 1 to 15 ohms in 1-ohm steps, and 10 to 150 ohms in 10-ohm steps. The leakage range is 10 to 100 meg in 20-meg steps and 100 to 500 meg in 100-meg steps.

California Technical Industries, Dept. ED, 1421 Old Country Road, Belmont, Calif.

Price: $28,000.

Availability: 30-day delivery.

Loop-Type Polypropylene Clamps 357

These cable clamps are available in seven sizes: 1/8, 3/16, 1/4, 5/16, 3/8, 7/16, and 1/2 in. in diameter. They are for use as wire and cable clamps, transformer lead clips, strain reliefs, and tube and pipe hangers.

Holub Industries, Inc., Dept. ED, 430 Elm St., Sycamore, Ill.

Servo Motor 455

Type 5104-01 servo motor is 1.37-in long, weighs 4.2 oz, and meets ARP 497. Housing is stainless steel. The unit is designed for 400-cps airborne and ground control applications.

John Oster Manufacturing Co., Avionic Div., Dept. ED, Racine, Wis.

***Availability:** Immediate delivery from stock on prototype and production quantities.*

Relay Rack Cabinet 715

This relay-rack cabinet is a reinforced version of the manufacturers standard MC series. It has been designed for high shock and vibration conditions. It is available with: welded heavy-duty steel or aluminum construction; built-in panel mounting blowers or refrigerated cooling systems; thermal and acoustic insulation; standard 19, 24 or 30-in. panels; heights in mutiples of 1-¾ in.; cabinet depths 18 to 36 in. in 2 in. increments.

Western Devices, Inc., Dept. ED, 600 W Florence Ave., Inglewood 1, Calif.

NEW PRODUCTS

De-reeling Machine 596

Provides constant tension

This Swiss-made calibrated-tension takeoff for coil winding and wire spooling machines permits small wires to be de-reeled and made up into virtually perfect coils. Called the Meteor, the device is claimed to be the only one of its kind. Model 483 can be used for wires from 0.0004 to 0.003 in. in diameter with tensions as small as 1 g; model 484 is for wire from 0.0015 to 0.014 in.

Associated American Winding Machinery, Inc., Dept. ED, 750 St. Ann's Ave., New York 56, N.Y. *Availability: From stock.*

Electrical Power Load Bank 468

This electrical-power load bank uses a thin-plate conductor of woven-wire mesh. It weighs less than 15 lb, measures 16 x 16 x 22 in., and is portable. It has a low retained-heat capacity and low surface temperatures. Total wattages are available up to 15 kw with 110 v or 28 v.

Electrofilm, Inc., Dept. ED, 7116 Laurel Canyon Blvd., North Hollywood, Calif.

Scatter Antenna 480

This 60-ft scatter antenna is fabricated of galvanized steel. The overall design stresses maximum interchangeability and standardization of the various members. Of all-bolted construction, it meets the applicable MIL specifications. It will withstand winds up to 158 mph with 6 in. of ice.

Antenna Systems, Inc., Dept. ED, Hingham Industrial Center, Hingham, Mass.

Miniature Toroid 478

This miniature, epoxy-encapsulated toroid is available in a frequency range of 2 kc to 25 kc, with a maximum inductance of 2 henries. It is designed in a linear version for maximum stability when used with polystyrene capacitors. Available in a variety of styles and sizes, it meets the requirements of MIL-T-27A.

Aerovox Corp., Cinema Engineering Div., Dept. ED, 1100 Chestnut St., Burbank, Calif.

Square Potentiometer 534

Wirewound type

Model 3250P square potentiometer uses the Silverweld multi-wire termination. Specifications of the unit include: resistance range, 100 ohms to 50 K; power rating, 1 w at 70 C; temperature range, −65 to +175 C; and weight, 0.05 oz. Dimensions are 1/2 x 1/2 x 3/16 in.

Bourns, Inc., Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

Availability: From stock.

Vector-Force Vibration Exciter 360

Designated model EL250, this 2,500-lb exciter is for both sine-wave and random-motion testing. A magnetic circuit is employed to increase flux density. The moving-element weight is 22 lb. Acceleration capability is over 100 g; frequency range is 5 to 5,000 cps. The unit is for use in environmental chambers where vibration is combined with high altitudes and high temperatures.

MB Electronics, Dept. ED, 781 Whalley Ave., New Haven, Conn.

Phase-Sequence Tester 490

This portable tester is completely self-contained. It determines phase rotation by connecting it to the three lines of the circuit under test. No neutral connection is required. Models are available for 50, 60, 400 or 1,000 cps and voltages including 28, 115 and 220 v.

Space Electronic Laboratories Co., Dept. ED, P.O. Box 447, Lynbrook, N.Y.

Price: $15.95

Availability: From stock

High-Temperature Permeable Dielectric 353

CMA-415 high-temperature permeable dielectric operates continuously in a temperature environment exceeding 400 F. The material is for microwave applications.

Custom Components, Inc., Dept. ED, Caldwell, N.J.

NEW LITERATURE

Recorder/Reproducer 261

All-transistorized modular construction is just one of the features of an instrumentation recorder/reproducer that appears in this six-page brochure. Detailed specifications for both analog and PDM recording are included. Minnesota Mining and Manufacturing Co., Mincom Div., 2049 S. Barrington Ave., Los Angeles 25, Calif.

Test Tables 262

Featured in this four-page, illustrated catalog are test tables and training devices for ground-support applications. Position, rate and centrifuge-type test equipment; Scorsby, spin, sinusoidal oscillating rate and vibration tables; and visual-audio personnel training devices are described. Lear Inc., P.O. Box 688, Grand Rapids, Mich.

Digital Transducers 263

Two-page bulletin No. 150 provides a general description of the firm's series of digital transducers; the deviation alarm, upset alarm, and the storage of data are discussed. Also included are photos of the transducer and the digital position encoder, a dimensional diagram, and a block diagram showing operation. Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif.

Hermetic Sealing Processes 264

A manual detailing the steps and applications for electro-sealing not only single electrical, electronic and mechanical components, but also entire assemblies is available. Illustrations of such applications as complete timer mechanisms, electronic amplifiers, and centralized remote control gear for power stations that have been hermetically sealed by the electro-seal process appear in the manual. Electro-Seal Corp., 946A North Ave., Des Plaines, Ill.

High-Voltage Testing 265

Methods and equipment for high-voltage breakdown and insulation-resistance tests to meet high reliability and extended environmental conditions are discussed in manual No. C-61. Equipment is shown for measuring to five million megohms and for high-voltage leakage tests at 150 kv and higher on electronic components, cables, wiring harnesses, completed assemblies, and control circuits of all types. Associated Research, Inc., 3777 W. Belmont Ave., Chicago 18, Ill.

Work-Holding Fixtures 317

This eight-page catalog, No. HF-560, describes and illustrates a line of work-holding fixtures for use in electronic assembly. Vises, card holders, harness board holders, work positioners, bench and floor model chassis holders, and a modular production assembly system are included. Flotron Industries, Inc., 1608 Centinela Ave., Inglewood 3, Calif.

Choppers for 60-Cps Drive 318

This two-page bulletin, No. C-70, describes the firm's series 175 electromechanical choppers suitable for use as industry standards for 60-cps operation. Typical applications are discussed. Electrical, environmental and mechanical characteristics and mounting diagrams are provided. Airpax Electronics Inc., Cambridge, Md.

Power Disturbances in Digital Equipment 319

This five-page bulletin discusses digital computer errors resulting from power disturbances. Tolerance of digital equipment and the design of regulated power sources are considered. Advantages and disadvantages of various solutions are presented. Dynamic Controls Co., 2225 Massachusetts Ave., Cambridge, Mass.

Low-Noise Choppers 320

The firm's series 2300 low-noise choppers are described and illustrated in this two-page data sheet, No. C-79. Construction and application information, electrical, environmental and mechanical characteristics, and test information are included. Airpax Electronics, Inc., Cambridge, Md.

Microwave System 321

The firm's model RT-3A heterodyne-repeater microwave communications system suitable for inter-city relays, tv-stl, remote pickups and off-the-air pickups in the 2-kmc range is described in this eight-page brochure. Descriptions, with specifications and block diagrams of the transmitter and receiver units, and general discussions of the other units of the relay system, are provided. Adler Electronics, Inc., 1 LeFevre Lane, New Rochelle, N.Y.

Stepping Synchronous Motors 322

Data Sheet No. 1, four pages, explains the use of Slo-Syn synchronous motors as dc stepping motors. Diagrams show stepping principles of permanent-magnet type motors. Curves give speed and torque characteristics. Bifilar motors are also described. Superior Electric Co., 83 Laurel St., Bristol, Conn.

Welding Equipment 323

Equipment for precision welding of electronic components is described in this 24-page catalog. Stored-energy, capacitor-discharge power supplies, precision welding heads, handpieces, and accessories are included. Photographs and specifications of the equipment are given. Weldmatic Div., Unitek Corp., 950 Royal Oaks Drive, Monrovia, Calif.

Rotary Switch 324

This 13-page bulletin, D-460, describes the recently standardized, series 150,000 hermetically sealed, rotary switch. Three sections illustrate 3,072 designs, including dimensions, drawings, mountings, receptacles and wiring. Also included are complete control and performance data, environmental conditions, duty cycles, voltage codes, and approximate "hold-in" resistor values. Ledex Inc., 123 Webster St., Dayton 2, Ohio.

Electronic Connectors 325

Catalog No. CC-860 describes in eight pages precision electronic connectors. Features and specifications of the firm's line of printed-circuit, microminiature, subminiature, miniature and power connectors for missile, aircraft, computer and communication applications are included. DeJur-Amsco Corp., Electronics Div., 45-01 Northern Boulevard, L.I. City 1, N.Y.

Digital Building Blocks 326

Bulletin No. C-1000, eight pages, describes the 1,000 series system building blocks. Logic diagrams and descriptions of such units as flip-flops, inverters, delay lines, generators, amplifiers, decoders and diodes are given.

Digital Equipment Corp., Maynard, Mass.

NEW LITERATURE

Heat Radiator Tests 266

A line of transistor heat radiators has been tested in accordance with MIL-STD-202A specifications. The results of these tests appear in this four-page data sheet. Temperature-time curves are said to show an efficiency increase of 25% when the devices are used. The Birtcher Corp., 4371 Valley Blvd., Los Angeles 32, Calif.

Gears 267

Booklet No. 5, 18 pages, is concerned with low-inertia, custom-made, military-type gears. Specifications of and methods of testing fine-pitch spur gears, and stock-numbering systems for pin-hub, split-hub, and hubless gears are included. PIC Design Corp., 477 Atlantic Ave., East Rockaway, N.Y.

Plastics 268

This six-page folder, "Facts About Plastics," outlines properties and applications of 13 different types of plastics. Nylon, Teflon, Mylar, polyethylene, polystyrene, fibrous glass, and resins are among those covered. Cadillac Plastic and Chemical Co., 15111 Second Ave., Detroit 3, Mich.

Aerodynamic Instrumentation 269

Specifications, illustrations, and prices of aerodynamic and random signal instruments are given in this four-page short-form catalog, Bulletin No. 50. Included are hot-wire anemometer systems and probes, a micromanometer, a static-pressure probe, and a random-signal voltmeter and correlator. Flow Corp., 85 Mystic St., Arlington, Mass.

Graphite Cloth 270

Applications and properties of graphite cloth are outlined in this four-page bulletin, No. 101. Thermal, plastic reinforcement, electrical, mechanical, and chemical applications, including uses as high-voltage conductor, tube grid, thermocouple, and antenna materials, are listed. Thermal, physical, chemical, and electrical properties of the material are tabulated. National Carbon Co., 270 Park Ave., New York 17, N.Y.

Airborne Telemetry Systems 271

Pulse-code-modulation airborne telemetry systems and associated ground stations are described in this brochure. The systems measure both analog and digital signals, convert them to a digital code, and record them on magnetic tape or telemeter them to ground receivers. Epsco, Inc., 275 Massachusetts Ave., Cambridge, Mass.

Toroids 272

The firm's series CTL toroids are described in this six-page bulletin, No. 57B. Electrical and physical specifications, frequency-response curves, dimensional drawings, and illustrations are given. The line is said to cover most toroidal inductor applications. Cinema Engineering, 1100 Chestnut St., Burbank, Calif.

Strip-Chart Papers 273

This 14-page catalog of replacement strip-chart papers lists replacement charts for different makes and models of recorders manufacturers' model numbers. Techni-Rite Electronics, Inc., P.O. Box 3575-F, Providence 10, R.I.

Compressor-Limiter Amplifier 274

A compressor-limiter amplifier for general af use, comprised of the firm's models RA-1593-A amplifier and RA-1594-A control unit, is described in this illustrated four-page brochure. Charts and specifications are included. Westrex Corp., Recording Engineering Dept., 6601 Romaine St., Hollywood 38, Calif.

Inductor Stability Design 275

Increductor Notes Nos. 6 and 7 comprise a two-part technical article entitled "Designing for Stability." It describes the application of electrically controllable inductors in minimizing the effects of temperature and hysteresis in coils. Open and closed loop and bellweather stabilization methods are considered, and specific circuits are offered. The firm's models No. 61BT1 and 81AM1 Increductors are described, with typical characteristics tabulated, control and temperature characteristics curved, and dimensional diagrams drawn. Trak Electronics Co., 49 Danbury Road, Wilton, Conn.

Circuit-Breaker Operators 276

Applications of electrical operators for remote control of types E, EH, and HF circuit-breakers are described in this four-page bulletin, No. B-7534. Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

Computer Logic 277

NOR and NAND computer logic is explained in this two-page bulletin, No. 16. Diagrams and a truth table are included. Applications in flip-flop circuits are described. The firm's models 318 and 346 transistorized logic circuits with NOR and NAND functions are described and illustrated. Navigation Computer Corp., 1621 Snyder Ave., Philadelphia 45, Pa.

Precision Potentiometers 278

Bulletins No. 1200, 1300, and 3200, two pages, describes precision potentiometers, giving mechanical, electrical, environmental, physical, and general specifications, outline drawings, and design considerations of the units. Duncan Electronics, 1305 Wakeham Ave., P. O. Box 1953, Santa Ana, Calif.

Receiving Tube Manual

This 432-page reference manual, No. RC-20, contains technical data for over 760 receiving tubes, including types for black-and-white and color television, series-string applications, ac/dc equipment, 12-v car radio receivers, and high-fidelity audio applications. Data are also provided for 173 picture tubes, including color types. Basic tube theory and application information is included in separate sections. Circuits for high-fidelity audio equipment and radio receivers are given. *Send $1.00 to Radio Corp. of America, Electron Tube Div., Harrison, N.J.*

Temperature Controls 280

The firm's series 9000 relay and proportioning type temperature controls utilizing bridge-connected thermistor probes are described and illustrated in this two-page bulletin. United States Testing Co., Inc., 1415 Park Ave., Hoboken N.J.

Indicator Lights 281

This four-page bulletin, No. 47-7-1-60, illustrates and describes the firm's Tec-Lite series MCL miniature cartridge lights for control-panel indicator systems and individual signals. Diagrams show mounting arrangements and dimensions for six different models. Specifications and ordering information are listed for the several variations available in lamp types, lenses, lens colors, legends, and terminals. Other lights, push-button switches, indicators, and transistorized digital-readout units are illustrated and briefly described. Transistor Electronics Corp., 3357 Republic Ave., Minneapolis 26, Minn.

Language Translators 282

This four-page bulletin describes various types and techniques of code conversion and the relative merits of different numerical codes. A discussion of the theory of numerical codes is included. Units which can convert digital input data into usable output form are described. Hermes Electronics Co., 75 Cambridge Parkway, Cambridge 42, Mass.

High-Temperature Inconel 283

A grain coarsened inconel alloy with high resistance to relaxation at high temperatures is described in this bulletin. Tables and specifications are included. Techalloy Co., Inc., Rahns, Pa.

Pressure Monitor 284

The firm's model 304 long-term gas pressure transducer and monitor, which measures long-term pressures in a nuclear field and at high temperatures, is described in this two-page technical manual. An outline drawing is included. Physical Sciences Corp., 389 N. Fair Oaks Ave., Pasadena, Calif.

Power Resistors

The firm's type high-power resistors with low inductance at high frequencies are described in this two-page data sheet, No. CE-2.04. A temperature derating curve, electrical characteristics, and tabulated physical and electrical ratings are included. *Write on company letterhead to Corning Electronic Components, Corning Glass Works, Bradford, Pa.*

NEW LITERATURE

Microwave Test Instruments 286

Bulletin No. 400, four pages, lists and prices a line of microwave test instruments and coaxial test equipment. PRD Electronics, Inc., 202 Tillary St., Brooklyn 1, N.Y.

Vibration Isolators 287

The firm's series 6300 and 6550 isolators, designed to protect equipment from vibration and shock, are described in this two-page data sheet. Outline drawings showing mounting configurations, application information, and load curves are included. Barry Controls, Inc., 700 Pleasant St., Watertown 72, Mass.

Magnetic Core Data Folders 288

A series of data folders provide specifications for a series of storage cores with a wide range of characteristics. These data sheets describe both physical and magnetic characteristics and give information concerning applications. Telemeter Magnetics Inc., Components Div., P. O. Box 329, Culver City, Calif.

Temperature Monitor System 289

The firm's model 204B precision digital temperature measurement and control system, which continuously measures temperature using Chromel-Alumel thermocouples and a null-balancing servo readout system, is described in this nine-page technical manual. Included are several block diagrams, schematics, and an illustration of the digital readout unit. Physical Sciences Corp., 389 N. Fair Oaks Ave., Pasadena, Calif.

High-Frequency Bus Duct 290

Application data for high-frequency bus duct is contained in this 12-page booklet, No. 30-663. The description, drawings, dimensions, specifications, and engineering and test data in the publication give information needed to lay out, specify and install the duct. Applications include induction heating systems, missile launching sites, and air-frame and electronics manufacturing facilities. Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30, Pa.

In-Reactor Profileometer 291

The firm's Model 303 profileometer which operates in a nuclear environment, under water, and up to 1,000 F, is described in a three-page manual. An illustration of the unit showing the various sensor tips available is included. Physical Sciences Corp., 389 N. Fair Oaks Ave., Pasadena, Calif.

Plastic Cabling and Circuitry 292

Polystrip multiconductor flat wire cable and Lamoflex etched cables, circuits, and laminates are described and illustrated in this eight-page booklet, No. S-9. Properties of the materials are listed; physical and electrical specifications are tabulated. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Phosphor-Bronze 293

This 18-page handbook on phosphor-bronze includes information on wire, bars, rods, strip, sheets, circles, and special shapes of the alloy. The continuous casting process is explained. Specifications on six phosphor-bronze alloys are tabulated. H. K. Porter Co., Inc., Riverside-Alloy Metal Div., Riverside, N.J.

Shipping Containers 294

Reusable shipping containers and cushioning materials are described in this eight-page brochure. Containers suitable for packaging delicate electronic equipment in accordance with Mil specs are included. Capacitances are tabulated for each style. Nash-Hammond, Inc., 10141 E. Rush St., El Monte, Calif.

Electric Power Control System 295

This brochure describes methods for supervising, starting, and shutting down an electric power generating plant with the firm's model RW-300 digital control computer. Thompson-Ramo-Wooldridge Products Co., 202 N. Canon Drive, Beverly Hills, Calif.

Broadband RF Filter 296

This 16-page brochure contains performance data, attenuation charts, specifications, and application information on the firm's L-Cap broadband rf filter. Devco, Inc., East Longmeadow, Mass.

Solar Energy Convertors 297

This four-page bulletin, No. 60A, discusses solar energy converters. Construction and operating principles of silicon devices are described. Design data and curves of output characteristics, spectral response, and temperature variations are given. Physical and electrical characteristics of a line of converters are tabulated, and application information is included. Solar Systems, Inc., 8241 N. Kimball Ave., Skokie, Ill.

Magnetic Core Memories 298

Operation and applications of random-access magnetic core memories are described in this eight-page brochure. Memory systems and systems components are described, with specifications of the firm's instrumentation included. A block diagram of operations and a description of the insertion and extraction cycles are given. Computer Control Co., Inc., 983 Concord St., Framingham, Mass.

Expanded Teflon Tubing 299

Expanded Teflon tubing which tends to recover its original dimensions when heated is described and illustrated in two-page Bulletin No. 3E. Applications for protecting electronic components are described. Available sizes and recovered dimensions are tabulated. Pennsylvania Fluorocarbon Co., Inc., 1115 N. 38th St., Philadelphia 4, Pa.

Tantalum Capacitors 300

Bulletin No. 6.100-5, 14 pages, contains specifications, performance characteristics, ratings, curves, and application data on tantalum capacitors. The seal used on the firm's type PP capacitors is described. Curves include capacitance-frequency and capacitance-temperature functions. Cut-away and dimensional drawings are included. Fansteel Metallurgical Corp., Rectifier-Capacitor Div., North Chicago, Ill.

Electric Melting Pots 301

This eight-page catalog No. VG-201-P, contains specifications and prices on electric melting pots for solder, lead, glues and compounds. Vulcan Electric Co. Danvers, Mass.

Automation Components 302

Index tables, dial assembly presses, rivet spinners, special assembly machines, tooling, and automatic feeds are described in this 46-page Catalog No. 60. Outline drawings, specifications, and application information are included. Precision Detroit Co., 20100 Sherwood, Detroit 34, Mich.

Capacitors 303

This spiral-bound 20-page booklet includes engineering bulletins, test information, application notes, dimensional drawings and ratings for miniature Mylar, high-temperature Teflon, miniature Polystyrene, high-voltage Glasscon acetate, and solid tantalum electrolytic capacitors. Efcon, Inc., Garden City, L.I., N.Y.

Tachometry Applications 304

This four-page bulletin describes various methods of monitoring or controlling rotating shafts, gears, and similar units. Applications of electromagnetic coils, tachometer generators and photocells, in conjunction with frequency-to-dc converters and read-out and control equipment are described. Waugh Engineering Co., 7842 Burnet Ave., Van Nuys, Calif.

Cable and Wire 305

Properties and applications of various conductors, strandings, shieldings, insulators, and cable assembles are described in this 18-page brochure. Several lines of cable and hook-up wire with Teflon TFE, Teflon FEP 100, and PVC insulation are tabulated with physical and electrical ratings. Times Wire and Cable Co., Inc., Wallingford, Conn.

Single-Sideband Receiver 306

The firm's model 605A single-sideband strip receiver, providing one or more fixed frequency ssb channels for use in usb, lsb, dsb, am, mcw, and fsk, is described in this four-page bulletin. Construction and operation of separate rf and if/audio units are outlined, and block diagrams are included. Specifications and ratings are given. Wilcox Electric Co., Inc., 1400 Chestnut St., Kansas City 27, Mo.

NEW LITERATURE

Precision Wirewound Resistors 307

This 14-page brochure, Catalog No. 160, describes six series of precision wirewound resistors. Alloy-characteristic and resistor-specification tables, photographs and cut-away illustrations, and dimensional drawings accompany the description. Plant facilities are also described. Precision, Inc., 4748 France Ave. N., Minneapolis, Minn.

Servos, Generators, Synchros 308

This 55-page brochure describes construction, operation, and application of servo motors, tachometer generators, and synchros. Illustrations and tabulated specifications of the firm's units are included. Diagrams, charts, outlines, tables, schematics, definitions, and formulas appear throughout the brochure. Kearfott Div., General Precision, Inc., 1150 McBride Ave., Little Falls, N.J.

Selenium Rectifiers 309

This eight-page catalog, No. 4002, tabulates cell ratings, electrical and mechanical specifications for high-voltage stacks, power stacks, and ac and dc surge suppressors. Construction methods are described, and dimensional drawings are included. Sarkes Tarzian, Inc., Semiconductor Div., 415 College St., Bloomington, Ind.

Rotary Cutting Tools 310

A line of solid carbide drills, mills, reamers, and other close-tolerance rotary cutting tools is described and illustrated in this 20-page catalog. Dimensions and tolerances are tabulated. Suggestions concerning type and speed of equipment desirable for various cutting operations are offered. Elgin National Watch Co., Abrasives Div., Elgin, Ill.

Thin-Film Microwave Resistors 311

Bulletins No. 10A and 10A-1 describe thin-film microwave resistors. Tabulated electrical and mechanical specifications, dimensional diagrams, and characteristics curves are included. Film Resistors, Inc., 242 Ridgedale Ave., P. O. Box 49, Morristown, N.J.

Parts and Equipment 312

Products of 80 manufacturers are included in this 250-page catalog, No. 61. Electronic parts and equipment for industrial applications are emphasized. Ferguson Electronics, Inc., 2306 Puritan Ave., Detroit, Mich.

Sintered Nylon Parts 313

Nylasint, a material suitable for electronics components formed by cold-pressing and sintering nylon powders, is the subject of this four-page bulletin, No. BR-1111. Expansion and compressive-strength curves are included. Typical applications are discussed. The Polymer Corp., 2120 Fairmont Ave., Reading, Pa.

Current Toroids 314

This four-page bulletin, No. 3-1.2, on Donut toroidal current transformers for metering and allied applications lists 200 types rated from 2.5 to 12.5 kv, and having turn ratios from 10:5 to 5,000:5. Associated Research, Inc., 3777 W. Belmont Ave., Chicago 18, Ill.

Molded Cable Assemblies 315

This four-page catalog covers straight and right-angle phono plugs, phone plugs, microphone connectors, Y junctions, and miniature phone plugs, molded to various types of cable. Physical and electrical specifications, dimensional drawings, and photographs are included. Switchcraft, Inc., 5555 N. Elston Ave., Chicago 30, Ill.

Digital Data Handling 316

This brochure, entitled "Electronic Digital Handling for Communications," describes available equipment as well as techniques and devices still in development for fast and accurate information flow between computers and remote stations. Equipment for information conversion between punched-paper and magnetic tape in either direction, and for both conversion and transmission of data, are described. Speeds, expenses, and equipment for different types of transmission media are compared. Digitronics Corp., Albertson Ave., Albertson, L.I., N.Y.

DESIGN

Wavelength-Frequency Conversion Chart For Coherent Light Applications

James R. McDermott
Electronics Consultant

RECENT strides in amplified light technology and optical masers combine techniques and concepts used in both the radio and the optical frequency regions of the electromagnetic spectrum. The current problem is: available data and basic references, in the regions of interest are defined in terms of optical wavelengths—not in wavelengths and frequencies familiar to electronic engineers.

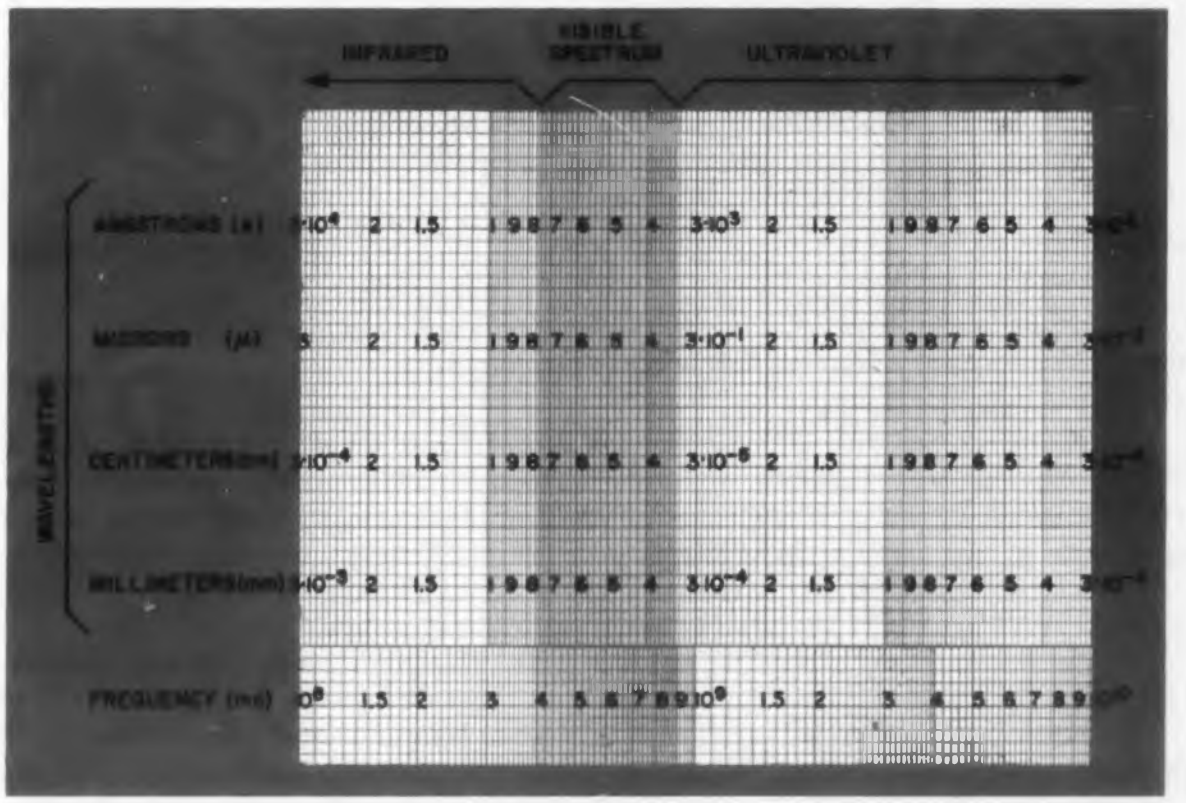
Here is a table that compares and converts all of these quantities. The scale start in the infrared region, include the visible spectrum, and end in the ultraviolet region. There is actually no sharp demarcation of the lower and upper edges of the visible region, since this is a matter of individual interpretation of the problem on hand.

The quantities presented are based on these relationships:

$$\begin{aligned} 1 \text{ Angstrom unit (Å)} &= 1 \times 10^{-10} \\ &= 1 \times 10^{-4} \text{ micron.} \\ 1 \text{ micron } (\mu) &= 1 \times 10^{-6} \text{ m} \\ &= 1 \times 10^{4} \text{ Angstrom units} \\ &= 1 \times 10^{-4} \text{ cm} \\ &= 1 \times 10^{-3} \text{ mm} \end{aligned}$$

Note: the wavelength scales read right to left; the frequency scale reads left to right. ■ ■

Conversion Table for Coherent Light



IDEAS FOR DESIGN

Get $10.00 plus a by-line for the time it takes you to jot down your clever design idea. Payment is made when the idea is accepted for publication.

Quotient Circuit Substitutes for Difference Variable

Quite often in instrumentation systems the variable to be measured is obtained by the subtraction of two other quantities (a function of the variable). However, the system variable may also be obtained by considering, not the difference, but the quotient of the two quantities.

An example of such a system would be a flow-meter using two receiver channels. The magnitude and direction of the flow may be determined by the difference between the two receiver outputs. If the received signals are in any way altered, the difference signal will reflect the changes. Assuming identical changes in each receiver channel, the quotient of the two receiver-outputs will also yield the magnitude and sense of the flow.

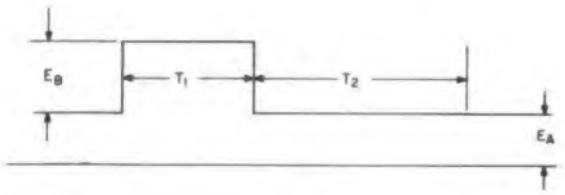


Fig. 1. Circuit uses time as an intermediate variable to obtain quotient expression.

The principle of the quotient circuit is illustrated by Fig. 1. Time, T, is used as an intermediate variable. If $T_1=K_1E_1$ and $T_2=K_1(E_2-E_1)$, then the dc output is:

$$V_{dc}= E_A + \frac{E_B K_1 E_1}{K_1E_1 + K_1(E_2 - E_1)} = E_A + E_B\frac{E_1}{E_2}$$

By subtracting E_A we have the desired ratio multiplied by a constant, E_B.

Fig. 2 shows the block diagram of the quotient circuit. No restriction is placed on the circuit for obtaining the individual blocks.

The system is essentially free-running with a frequency stability of the order of 0.1 per cent at frequencies of 200 to 1,000 cps. The bistable multivibrator will have one side "on" and one side "off." The "off" side permits the sawtooth generator to run up until the reference voltage is reached. At this point the blocking oscillator fires and resets the bistable, producing the same action in the other half of the circuit.

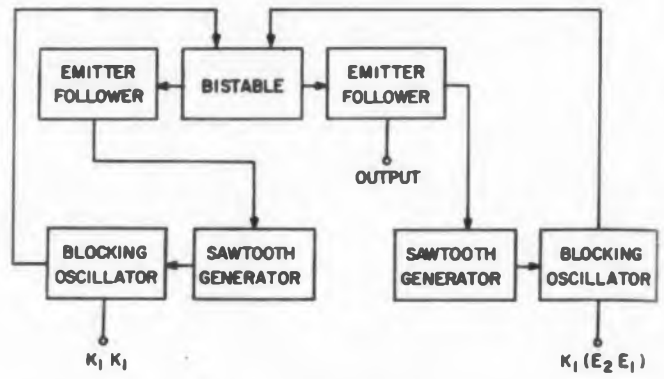


Fig. 2. Block diagram of quotient circuit.

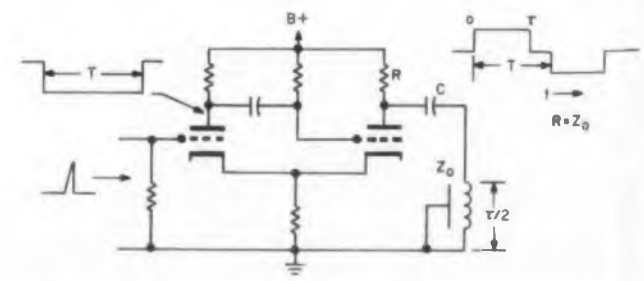
The alignment of the circuit consists of adjusting the two levels of the sawtooth generator —the maximum positive voltage that the capacitors can charge to and the holding voltage. Once this is accomplished, the slopes are adjusted until they are equal. This can be done by scope and eye.

All voltages were measured with a differential voltmeter. The output voltage was measured and, on the basis of the two reference voltages, a comparison was made. The deviations were between 0 and 0.3 per cent. The accuracy of the readings made it unwise to look for greater accuracies. As an example of the system's capabilities, the unattenuated filtered output voltage read 10.82 when E_1 and E_2 were 6.00 and 10.83, when E_1 and E_2 were 8.00.

Leonard L. Kleinberg, Information Technology Div., Lockheed Electronics Co., Plainfield, New Jersey.

Delay Line Added for Constant-Width Pulse

To make the pulse width of a monostable multivibrator independent of its circuit components and supply voltages, we placed a delay line in the output, as shown in the figure.



Shorted delay line forms constant-width output pulse.

Since the pulse width T of the one-shot multi is wider than the line delay τ, the waveform of width T is shaped by the shorted delay line. The width τ is now dependent only on the delay time of the delay line. This delay is essentially constant.

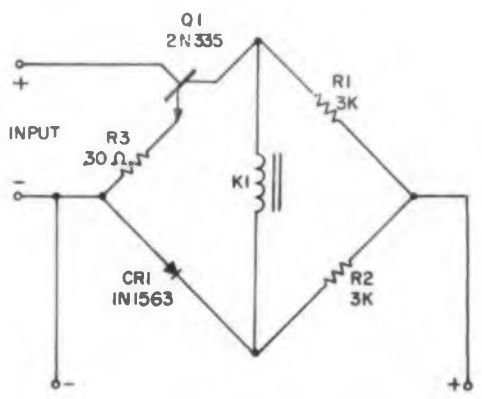
This scheme can also be applied to a transistorized one-shot multi. However, to prevent mismatch, it may be necessary to insert a matching resistor R_M in series with the delay line so that $R_M + Z_{out} = Z_o$ *where* Z_{out} is the transsistor output impedance.

Alfred W. Zinn, Project Engineer, Farrand Optical Co., New York, N. Y.

Bridge Circuit Temperature Stabilizes Relay Operation

The operation of a relay from the collector current of a transistor is a popular circuit configuration. However, this arrangement is not completely stable as the ambient temperature is varied.

While fancy and expensive circuits can be designed to provide an accurate relay trip-point over a wide temperature range, the circuit shown has been found to perform well over a temperature range of −55 C to +85 C.



Silicon rectifier *CR1* by compensating for the temperature sensitivity of *Q1*, stabilizes the relay operation.

The circuit is a bridge, with the silicon rectifier *CR1* compensating for the temperature sensitivity of silicon transistor *Q1*. A positive temperature coefficient resistor (Balco) may be inserted at *R3* to provide gain stabilization with temperature. For a 28-v dc supply and a 8-K relay, the approximate component values are shown in the figure. Input voltage to trip is approximately 1 v.

Thomas F. Bright, Assistant Chief Engineer, Bergen Laboratories Inc., Paterson, N.J.

RUSSIAN TRANSLATIONS

J. George Adashko

Calculating the Emitter Capacitance Of A Tuned Amplifier

AN ACTIVE resistance R, shunted by a capacitor C, is often used in the emitter circuit of a transistor to improve its temperature stability, Fig. 1. The recommended formula for the value of this capacitor is

$$C > \frac{5 \text{ to } 10}{2\pi f_1 R}, \qquad (1)$$

where f_1 is the lowest working frequency.

Experiments have shown, however, that when a capacitor of this size is used in a tuned amplifier, instability and self-oscillation may occur. Considered here is the influence of the RC network in the emitter circuit on the stability of the tuned amplifier.

The input and output admittances of a transistor in a tuned amplifier are determined from the following relations

$$Y_{in} = Y_{11} - \frac{Y_{12}Y_{21}}{Y_{22} + Y_1} = \frac{1}{R_{in}} + jB_{in} \qquad (2)$$

$$Y_{out} = Y_{22} - \frac{Y_{12}Y_{21}}{Y_{11} + Y_g} = \frac{1}{R_{out}} + jB_{out}$$

where Y_1 and Y_g are the load admittances in the collector and base circuits, respectively.

Y_{11} . . . Y_{22} are the characteristic admittances of the transistor.

The admittances Y_{in} and Y_{out} can each be represented by the sum of two components—the characteristic admittances Y_{11} and Y_{22}, and supplementary admittances, which result from the internal feedback produced by the admittance component Y_{12}.

The tuned amplifier becomes unstable because at certain values Y_1 and Y_g, the input and output impedances, become negative.

If y-neutralization is used in the tuned amplifier, Y_{12} vanishes. This eliminates the added admittance components, so that

$$Y_{in} = Y_{11} \quad Y_{out} = Y_{22} \qquad (3)$$

In tuned amplifiers without neutralization, as shown by Eq. 3, the internal feedback does not change the values of R_{in} or R_{out} by more than 10 or 15 per cent. Thus, Eq. 3 can be used in this case, too.

Eqs. 2 and 3 hold for the circuit of Fig. 1, if the equivalent admittances of the transistor are replaced by the characteristic admittances of the equivalent two-port network (transistor plus RC network.)

$$Y_{11} = \frac{YY_{11} + \Delta y}{Y_s} \qquad Y_{21} = \frac{YY_{21} - \Delta y}{Y_s} \qquad (4)$$

$$Y_{12} = \frac{YY_{12} - \Delta y}{Y_s} \qquad Y_{22} = \frac{YY_{22} + \Delta y}{Y_s}$$

where $\Delta y = Y_{11}Y_{22} - Y_{12}Y_{21}$, $Y_s \cong Y + Y_{11} + Y_{21}$, $Y = 1/R + j\omega C$.

On the basis of Eqs. 3 and 4, we can write, for the circuit of Fig. 1,

$$Y_{in} = Y_{11} = Y_{11}\frac{Y + Y_{22}}{Y_s} \qquad (5)$$

$$Y_{out} = Y_{22} = Y_{22}\frac{Y + Y_{11}}{Y_s}$$

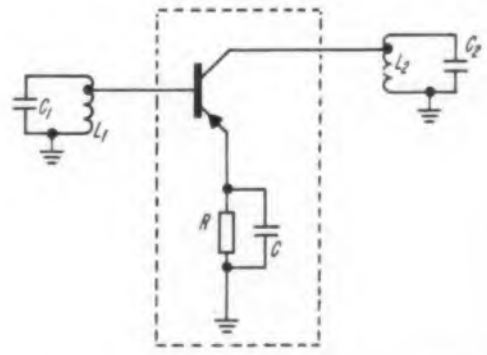


Fig. 1. An *RC* combination is often added in the emitter circuit to increase temperature stability. This can cause a tuned amplifier to oscillate.

Inserting the values of the characteristic admittances, as given in Eq. 5

$$Y_{11} = \frac{1}{r_{11}} + j\omega C_{11},\ Y_{21} = \frac{1}{r_{21} + j\omega L_{21}}, \tag{5a}$$

$$Y_{22} = \frac{1}{r_{22}} + j\omega C_{22}$$

and separating the real and imaginary parts, we obtain

$$R_{in} = r_{11}\frac{R}{r_{21}} \cdot \frac{\left[1 + \frac{r_{21}}{R}(1 - \omega^2 \tau\, \tau_{21})\right] + \left[\frac{r_{21}}{R}\omega(\tau + \tau_{21})\right]^2}{\omega^2 r_{21} RC^2 (1 + \omega^2\tau^2_{21}) - \omega^2 RC(\tau_{11} + \tau_{21}) + \frac{r_{21}}{R}(1 + \omega^2\tau^2_{21}) + 1 - \omega^2\tau_{11}\tau_{21}} \tag{6}$$

$$R_{out} = r_{22}\frac{r}{r_{21}} \cdot \frac{\left[1 + \frac{r_{21}}{r}(1 - \omega^2 \tau_1\, \tau_{21})\right]^2 + \left[\frac{r_{21}}{r}\omega(\tau_1 + \tau_{21})\right]^2}{\omega^2 r r_{21} C_1^2 (1 + \omega^2\tau^2_{21}) - \omega^2 r C_1(\tau_{21} + \tau_{22}) + \frac{r_{21}}{r}(1 + \omega^2\tau^2_{21}) + 1 - \omega^2\tau_{21}\tau_{22}} \tag{7}$$

where

$$\tau = RC,\ \tau_1 = rC_1,\ \tau_{11} = r_{11}C_{11},\ \tau_{21} = \frac{L_{21}}{r_{21}}$$

$$\tau_{22} = r_{22}C_{22},\ r = \frac{r_{11}R}{r_{11} + R},\ C_1 = C + C_{11}$$

Eq. 6 is derived on the assumption that $Y \gg Y_{22}$ which, in practice, always holds.

An investigation of Eqs. 6 and 7 shows that $R_{in} < 0$ and $R_{out} < 0$ when the following conditions are satisfied:

For R_{in}

$$R > \frac{4r_{21}}{\omega^2(\tau_{11} + \tau_{21})^2} = r',\ C_a < C < C_b, \tag{8}$$

where

$$C_{a,b} = \frac{\tau_{11} + \tau_{21}}{2r_{21}} \pm \sqrt{\frac{(\tau_{11} + \tau_{21})^2}{4r^2_{21}} - \frac{1}{\omega^2 r_{21} R}} \tag{9}$$

For R_{out}

$$R > \frac{4r_{21}}{\omega^2(\tau_{21} + \tau_{22})^2 - 4\frac{r_{21}}{r_{11}}} = r'',\ C_c < C < C_d, \tag{10}$$

(continued on p 198)

RUSSIAN TRANSLATIONS

where

$$C_{c,d} = \frac{r_{21} + r_{22}}{2r_{21}} \pm \sqrt{\frac{(r_{21} + r_{22})^2}{4r_{21}^2} - \frac{1}{\omega^2 r r_{21}}} \quad (11)$$

The values of r' and r'', calculated for transistors of various types, do not exceed 20 to 50 ohms. The values of R, obtained from the condition that the circuit has temperature stability, are usually on the order of several hundred ohms or several kilohms. Consequently, inequalities (8) and (10) are satisfied in all practical tuned amplifiers.

Plots of the typical dependence of R_{in} and R_{out} on C are shown in Fig. 2. The most dangerous values of capacitance, from the point of view of stability, are at C'_m and C''_m. At these values, the input and output impedances are a minimum.

Calculations of C_b and C_d for various transistors have shown that C_b is greater than C_d in all cases. To satisfy the conditions $R_{in} > 0$ and $R_{out} > 0$ it is only necessary that the capacitance C satisfy the equation

$$C \geqslant C_b = \gamma + \sqrt{\gamma^2 - \lambda}, \quad (12)$$

where

$$\gamma = \frac{r_{11} + r_{21}}{2r_{21}}, \quad \lambda = \frac{1}{\omega^2 r_{21} R}$$

In calculating C, we can use a simpler but more stringent condition, which is derived from Eq. 12, by neglecting the quantity λ under the radical, since usually $\gamma^2 \gg \lambda$ when $R \geqslant 100$ to 500 ohms and $f \geqslant 100$ kc. Then

$$C > \frac{r_{11} + r_{21}}{r_{21}}. \quad (13)$$

Example: Let us consider a numerical example. The parameters of the P403 transistor at 5 mc are:

$$r_{11} = 220 \text{ ohms}$$
$$C_{11} = 112\ \mu\mu\text{f}$$
$$r_{21} = 29 \text{ ohms}$$
$$L_{21} = 0.03\ \mu\text{h}$$

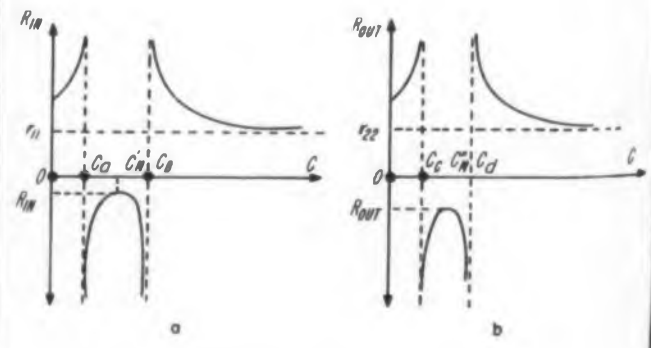


Fig. 2. Variation of (a) R_{in} and (b) R_{out} with C.

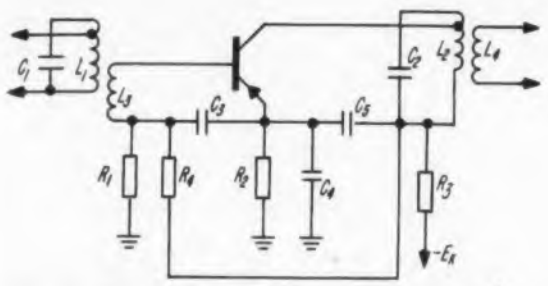


Fig. 3. Effect of the *RC* network in the emitter is eliminated in this more complicated arrangement.

The temperature stabilization condition gives R a value of 500 ohms.

Using the formulas above, we obtain the auxiliary quantities:

$$\lambda = 265\ \mu\mu f$$
$$\tau_{11} = 0.025\ \mu sec$$
$$\tau_{21} = 0.001\ \mu sec$$
$$\gamma = 450\ \mu\mu f$$

Using Eq. 9, we determine the values of C corresponding to the characteristic points on the abscissa axis of the plot, Fig. 2. That is,

$$C_a = 90\ \mu\mu f$$
$$C'_m = 380\ \mu\mu f$$
$$C_b = 810\ \mu\mu f$$

For the sake of comparison, we point out that the value of C as computed from Eq. 1 ranges from 320 to 650 μμf. This value of C lies in the region where the input resistance of the transistor is negative, and instability is therefore possible. Thus, to ensure the condition $R_{in} > 0$, we must choose $C \geqslant C_b = 810$ μμf.

In conclusion we note that the effect of the RC network in the emitter circuit can be eliminated by somewhat complicating the circuit of the tuned amplifier, Fig. 3. Here, there is no danger of self excitation, for there is a direct ac connection between the input or output circuits and the emitter, through the large capacitors C_2 and C_3. Capacitor C_4, which shunts resistor R_2, can be omitted if desired.

Yu. L. Simonov and V. I. Shilov, Calculation of The Emitter-Circuit Capacitor In A Tuned Amplifier, News of the Colleges, Radio Engineering, *No. 2, Mar.-Apr., 1960, pp 287-289.*

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STANDARDS
AND
SPECS

Diodes and Transistors:

—How They're Numbered

—What Military Specifications and Standards Are Applicable

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THIS ARTICLE on military specifications and standards primarily explains the semiconductor sale and procurement functions and focuses on aspects that concern both. By no means inclusive, the article also covers, for general knowledge purposes, an explanation of the origin of semiconductor device numbers.

Origin Is Spelled Out For Semiconductor Device Numbers

Two basic sources control the identity of semiconductor devices: the manufacturing company that makes the device and the Electronic Industries Association.

In the first instance, the manufacturer establishes a set of parameters and applies a "house" number to them, such as RD2121 and RT5001 (Rheem diode and transistor).

A device is given a house number when one or more of the following conditions apply:

1. The device is superior to anything on the market. Application of a house number gains the manufacturer promotional, psychological and other advantages.
2. The characteristics of the device have not been firmly set. The manufacturer desires relative flexibility in modifying the device as the need arises.
3. A requirement exists for a "custom" device having specifications not covering an existing EIA number and the device has such low volume usage that registration with EIA is impractical.

When a house type finds a substantial application in industry, users seek to insure a greater control over the permanence of the publicized characteristics of that type. Thus, pressure is brought on the manufacturer to register the device with EIA. This is accomplished by reserving an EIA number (1N series for diodes, 2N series for transistors) and then registering the specific parameters of the device with EIA. Reserving an EIA number does not guarantee permanence of the submitted specifications. Final registration, only, accomplishes this.

Registering a device with EIA accomplishes several things:

1. Primarily, it implies policing action over the permanence of the device's characteristics, thus assuring users the stability they desire.
2. It makes public to EIA members the device's specific parameters, presenting all semiconductor manufacturers with the opportunity of making and selling it.
3. It imparts a degree of uniformity by establishing a single identifying number per given set of specifications, regardless of the manufacturing source.
4. Acceptance by the military is usually enhanced by application of an EIA number. In fact, before becoming a Preferred or Guidance Type, a device "shall be one assigned a type designation acceptable to the military department." (MIL-STD-701A, Paragraph 4,2,2 Section C). In most cases this refers to an EIA designation.

Military Specifications Are Designed to Standardize

MIL-E-ID and MIL-S-19500B are general specifications whose main purpose is to define and standardize. They are reference documents from which definitions, prescribed methods, and established formats may be derived. They are the most recent issues of a series of standard, basic specifications.

The contents of these specs are broadly descriptive, insufficient in themselves to denote specific attributes for any individual type. They are the basic documents from which the individual type military specifications are derived. At this time, MIL-E-1D governs most individual diode specifications (e.g., MIL-E-1/1171-1N643), and MIL-T-19500A governs most individual transistor specifications (e.g., MIL-T-19500/74-2N497). However, current and future military specifications for both diodes and transistors will be derived from the most modern basic specification, MIL-S-19500B.

While the substance of MIL-E-1D parallels that of MIL-S-19500B, there are significant differences. The dissimilarity arises from the age difference between the two: MIL-E-1D is older and primarily designed for electron tube usage; MIL-S-19500B is more modern and more directly oriented to semiconductor devices, particularly transistors. Only MIL-E-1D contains certain fundamental information that pertains equally to tubes and semiconductor devices, such as the procedure for obtaining military qualification approval.

Major differences and similarities between the two specifications will be seen from the following comparative outlines. The sections presented are in specification sequence; they are ultra-condensed and selected sections only.

MI1-E-1D, 31 March 1958, Electron Tubes And Crystal Rectifiers

Part 1: This includes: listings of all specifications, standards and drawings supplementing the MIL-E-1D; definitions of terms used by the

electronic and electrical industries (primarily relating to tubes); graphic illustrations of tube configurations; abbreviations and symbols in common usage.

Part 2: Quality assurance provision. Presented are: further definitions, these relating to testing terminology; general outline of test procedures to be followed, methods to be applied (finite test conditions are not given, these would depend on the unit being tested and would be given the individual specification for that unit); test circuits illustrated, where applicable. Environmental, mechanical and electrical tests are all covered.

Part 3: Appendix A, Qualification Inspection and Correlation. The procedure to be followed to obtain military qualification approval is presented in detail. This includes the mode of application, the documents to be submitted, the number of samples required and the marketing and shipping of the samples. Causes of removal from qualification approval are also given.

Part 4: Appendix B, Visual and Mechanical Inspection. Definitions of physical defects and cause for failure are given in considerable detail.

Part 5: Appendix C, Special Acceptance Inspection Provisions. These are instructions designed to cover special procedure and criteria not included in MIL-STD-105B. MIL-STD-105B covers "Sampling Procedures and Tables for Inspection by Attributes" and includes the definition of AQL, a condensed version of which is: The Acceptable Quality Levels as a nominal value specified for a given group of defects of a product. The value specified (0.65 AQL, for instance) is insufficient in itself to enable determination of the number of failures allowable. Other knowledge required is the quantity of units to be tested and the inspection level (there are three: No. 1, least stringent; No. 3, most stringent). With knowledge of the AQL, the quantity of units involved and the inspection level, reference to the tables in MIL-STD-105B provides the applicable defects-allowed level.

MIL-S-19500B, 30 June 1959, Semiconductor Devices, General Specification For

Part 1: This includes: listings of all specifications, standards and drawings supplementing MIL-S-19500B, instructions for color-code marking; a color-code chart relating colors to numbers.

Part 2: Quality Assurance Provisions. Presented in this part are: definitions relating to Qualification Inspection and to Acceptance Inspection; a table of Group B Inspection Tests; frequency of testing for Group A (100 per cent), Group B (per production lot) and Group C (periodically

STANDARDS AND SPECS

as may be required) Inspection Tests.

Part 3: Appendix A, Definitions. Terms used with semiconductor devices are defined at length, such as: absolute maximum ratings; breakdown voltage; noise figure; pulse full time; punch-through voltage, etc. (Of note is a definition of a semiconductor device: "A semiconductor device is a device in which the characteristic distinguishing electronic conduction takes place within a semiconductor material".)

Part 4: Appendix B, Abbreviations and Symbols. Those abbreviations and symbols used in relation to semiconductor devices are listed.

Part 5: Appendix C, Inspection Conditions and Methods of Test. This is a general depiction of how to perform environmental and electrical tests without reference to absolute conditions or end points.

As stated earlier, MIL-E-1D and MIL-S-19500B are supplemented by other documents. Included among these documents are the individual-type specifications, and the standards, MIL-STD-202A, MIL-STD-200E and MIL-STD-701A. Because of the nature of the latter two and the direct knowledge they convey concerning approved device types, they are dealt with separately in another section.

MIL-STD-202A, 24 October 1956, Test Methods For Electronic Component Parts

This standard establishes, in complete detail, uniform methods for testing electronic and electrical component parts, including physical tests, electrical tests and basic environmental tests to determine resistance to deleterious effects of natural elements and conditions surrounding military operations. The methods are standardized for the industry by virtue of the MIL-STD-202A ironclad presentation.

The tests are categorized as follows:

Environmental: Salt Spray; Temperature Cycling; Humidity; Immersion; Barometric Pressure; Moisture Resistance; Thermal Shock.

Physical: Vibration; Mechanical Shock; Random Drop; Vibration, High Frequency.

Electrical Characteristics: Dielectric Withstanding Voltage, Insulation Resistance; DC Resistance, Temperature Characteristics; Capacitance; Quality Factor (Q), Contact Resistance.

Individual Military Specification Sheets Are Deviators from General Requirements

Primarily, at time of writing, the individual type specifications are generic derivations from MIL-E-1D, in the case of diodes, and MIL-T-

19500A, in the case of transistors. They are designated by the appropriate "slash" number, as in MIL-E-1/1171=1N643 and MIL-T-19500/74=2N497. (However, as outlined earlier, current and future military specifications for both diodes and transistors will be derived from MIL-S-19500B, e.g., MIL-S-19500/99A (Sig. C.)=2N697; MIL-S-19500/118 (Navy)=1N486B.) These specifications are additions to the master specification and are based on particular military requirements. To this end, the limits set within the specifications are finite, the readings are explicit.

For matters of procedure, methods, or definition, reference must be made to the master specifications, leaving only finite electrical characteristics to be denoted in the individual specification itself.

Military Standards Are Lists of Tubes, Semiconductors

The military standards, MIL-STD-200E and MIL-STD-701A, are lists of electron tubes and semiconductor devices chosen by the department of the Army, Navy and the Air Force for use in the design and manufacture of military electronic equipment.

MIL-STD-200E governs electron tubes and diodes, while MIL-STD-701A governs transistors.

The intent of the standards is:

1. To provide the equipment designer with a list of devices considered by the military departments to be the best available for the military.
2. To restrict and minimize the variety of devices used in military equipment to facilitate effective logistic support of equipment in the field.
3. To maximize support of, and to concentrate improvement on, the types listed.
4. To outline criteria pertaining to the choice, use, and application of electron tubes and semiconductor devices in military equipment.

Both standards list Preferred Types and Guidance Types but the MIL-STD-200E also has a supplement listing Navy Guidance Types. The difference between the Type categories is very significant from the procurement and usage viewpoint. For the sake of positive clarification the categories and the JAN designation will be dealt with separately.

Preferred Types. These types are selected by the military as being the best representatives of the generic group from which they come. They are first-choice devices for use in the design and manufacture of military equipment. Before a device can become a Preferred Type it must satisfy the following conditions:

(Continued on p 204)

STANDARDS AND SPECS

Diodes, per MIL-STD-200E Section 4.2.1:
1. It must be the best available.
2. Coordinated specification sheets must be made available.
3. There must be at least one qualified source.
4. It must have been in production.
5. It should remain on the list for a minimum of two years.

Transistors, per MIL-STD-701A Section 4.2.1:
1. It must be the best available.
2. It must have a military specification, coordinated (tri-service specification) or limited (single- or dual-service specification) coordination.
3. It must have been in production.
4. It must have been listed, or approved for listing, on a Qualified Products List associated with either coordinated or limited coordination specifications.
5. It must remain on the list for a minimum of one year.

Many Preferred Types are so designated by the Department of Defense because of extensive application to military equipment. However, they are not necessarily the elite of the semiconductor industry. On the contrary, advancing technology has made available today devices that are superior to some of the current Preferred Types.

Certain of these more advanced devices are favored by the military for current usage during the oft-times lengthy period required to advance newer devices to Preferred Type status. As a result, they are given official recognition by being categorized as Guidance Types.

Guidance Types, as outlined above, these types are also selected by the military as being of outstanding merit, though they do not as yet have the status of the Preferred Types. In many cases, a designer who cannot find a Preferred Type to suit his purpose and who must use a Guidance Type instead, is compelled to fill out and submit the same documentation required when seeking to make use of a non-approved, commerical device. However, the validation requirements are considerably less stringent for the Guidance Type.

Even so, submission of such information can be an onerous task. This in itself emphasizes the desire of the military to have Preferred Types used where possible in military equipment. To become a Guidance Type, a device must satisfy the following conditions:

Diodes, per MIL-STD-200E Section 4.2.2:
1. It shall be covered by a coordinated or limited coordination specification.

2. It shall be one of the following categories: (a) it should be intended for inclusion in the Prefered list, but does not meet criteria; (b) it meets criteria for Preferred list but is limited in use to one or two military departments; (c) it is a special purpose type recommended by a military department for use in a specific function; (d) it is a NATO Priority type but which is not included in the Preferred list.

Transistors, per MIL-STD-701A Section 4.2.2:

1. It must be the best type available.
2. A military specification, coordinated or limited coordination, must be available or in preparation.
3. It must have been assigned a type designation acceptable to the military departments.

Guidance Types are prime candidates for Preferred Type status. Often, it is their recent development only which has prevented them from being added to the Preferred list. Sufficient time has not elapsed for completion of the administrative procedures required to include them in the Preferred list.

JAN Types. JAN (Joint-Army-Navy) status is acquired following successful completion of the qualification program established by ASESA—Armed Services Electro-Standards Agency. They are types selected by the military in the same manner as were the Preferred Types. Progress within the industry has relegated some of the earlier JAN units to the role of being obsolete, so that irrespective of their continued JAN designation they are no longer included in the list of Preferred Types. Except for these, all JAN types are Preferred Types.

Qualified Products List. This is a list of electronic components selected by the Department of Defense as being preferential for use in military equipment. Each component listed must have a military specification and at least one qualified source. Those manufacturers who are qualified to supply the listed electronic components, are also designated.

In the case of semiconductors, the devices listed are those presented as Preferred or Guidance Types in the MIL-STD-701A and MIL-STD-200E.

The QPL is not widely distributed. Its rapidly changing list of contents makes it impossible to keep up to date on a large scale. Therefore, it is mainly maintained in centralized military offices where it is a source of reference and a procurement guide to manufacturers of military equipment. Large government contractors can receive copies of the QPL only after making specific requests to be added to the mailing list. ■ ■

YOUR CAREER

NEWS AND NOTES

Polarad Electronics Corp., New York, unable to fill personnel needs, has imported twelve engineers and technicians from England.

To date, four engineers and two technicians have arrived here with their families. Last November, the company advertised in London newspapers for electronics personnel with extensive microwave experience. And more recently, the company's chief test engineer went to London to interview the applicants.

• • •

Brooklyn Polytechnic Institute will establish an honors program in engineering and science under a $700,000 grant from the Ford Foundation. Under this program an exceptional student will be able to receive a doctorate degree in six years of full-time study.

About 6 per cent of the Institute's freshman class for September will be enrolled in the program, according to the school. Although there will not be a strict dividing line between graduate and undergraduate work, students will be awarded bachelor degrees after completing the undergraduate part of the curriculum.

• • •

About 3,000 engineering educators recently heard scientists, engineers, government officials and industrial administrators tell them what has to be done in the future. The occasion was the 68th annual meeting of the American Society for Engineering Education, at Purdue University.

G. Ross Henninger, president of the Ohio College of Applied Science, said the much-publicized shortage of engineers and scientists was really "an acute shortage of qualified technicians in engineering and science." Mr. Henninger also said, "an appalling proportion of graduates in engineering and science continue to be occupied with work which has evolved out of engineering science into engineering technology."

• • •

A vice-president of American Bosch Arma Corp., recently urged his engineers to write more technical articles. Clifton T. Foss, the vice-president, reportedly emphasized the sales value of such papers when the company seeks defense business.

He said that the company's research and development programs are of interest to other defense contractors as well as to the armed services. The results of such programs should be made public if they are not trade secrets or do not breach military security. He added: "We don't want to hide our potential in any area unless there's a good reason."

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ENGINEER-IMPROVEMENT COURSES AND SEMINARS

Below are courses and seminars intended to provide the engineer with a better knowledge of various specialties. Our grouping includes several different types of meetings: National Courses — those held on consecutive days and intended to draw attendees from all geographical areas; One-Day Seminars—one-day intensive seminars which move from city to city; and Regional Lectures —regional symposia or lecture series which generally run one night a week for several weeks.

National Courses

Industrial Education Institute, Dec. 12, 13, 14 and 15

Organizing for Better Materials Management, a two-day seminar presented by the Industrial Education Institute, will be held in Cleveland on Dec. 12 and Dec. 13 (Hotel Sheraton) and in Chicago on Dec. 14 and Dec. 15 (Hotel Sheraton-Blackstone).

The four major topics are: The Concept and Meaning of Materials Management, Organizing for Better Materials Management, Factors That Influence Materials Management Effectiveness, and Measuring the Effectiveness of Materials Management. Louis J. De Rose, Executive Director, Materials Management Institute, will conduct the seminar. Registration fee is $100 per man less 10% Team Discount for three or more men. For further information and reservations write Industrial Education Institute, 221 Columbus Ave., Boston 16, Mass.

Regional Courses

Norelco X-Ray School Set For February in New York

The 38th Norelco X-ray School will be held at the Henry Hudson Hotel, 353 W. 57th St., New York, during the week of Feb. 6 to Feb. 10, 1961. Registration for the course is open to chemists, metallurgists, physicists, production supervisors, quality control engineers and others interested in the application of these techniques: X-ray diffraction, diffractometry and spectography. There is no registration fee.

One-Day Seminars

Industrial Education Institute, Dec. 5, 7 and 9

The Industrial Education Institute of Boston, Mass. is presenting a one-day seminar on Increas-

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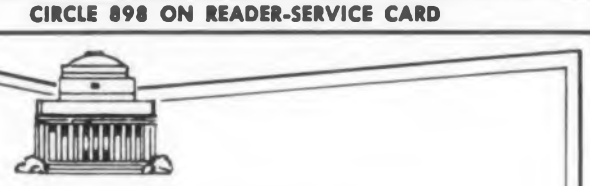

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The seminar schedule is: Philadelphia (Hotel Sheraton)—Dec. 5; New York (Hotel Park-Sheraton)—Dec. 7; Boston (Hotel Sheraton-Plaza)—Dec. 9. Ray F. Boedecker, Manager, Materials Planning & Control Data Systems Div., IBM Corporation, will conduct the course. Registration fee is $50 per man less 10% Team Discount for three or four men. For further information and reservations write Industrial Education Institute, 221 Columbus Ave., Boston 16, Mass.

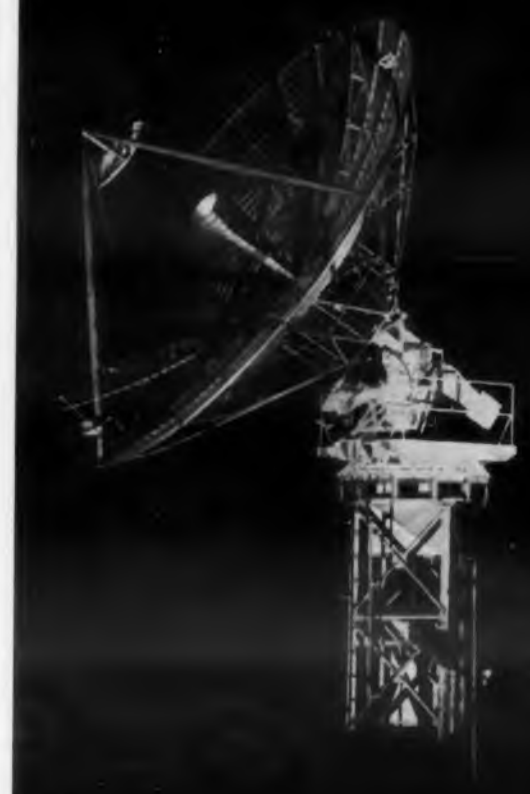
PAPER DEADLINES

Convention Program Chairmen have issued the following deadlines to authors wishing to have their papers considered for presentation.

Dec. 15: Deadline for detailed summaries of papers for the **1961 Western Joint Computer Conference** to be held **May 9-11, 1961** at the Ambassador Hotel in Los Angeles, Calif. Send summaries to: *C. T. Leondes, Associate Professor of Engineering, Dept. of Engineering, University of California, Los Angeles 24, Calif.*

Dec. 15: Deadline for four copies of full papers for the **1961 Joint Automatic Control Conference** to be held at the **University of Colorado, June 28 to June 30, 1961.** The conference will be sponsored by AIChE, AIEE, ASME, IRE and ISA. Submit papers to Robert Kramer, IRE Representative, 1961 JACC Program Committee, Building 32, Massachusetts Institute of Technology, Cambridge 39, Mass.

Jan. 1: Deadline for 500-word abstracts for the **IRE 7th Regional 1961 Technical Conference and Electronics Exhibits to be held April 26 to April 28, 1961** at the **Westward Ho Hotel in Phoenix, Ariz.** The two themes to be emphasized are: 1) Problems Associated with Increased Use of the Electromagnetic Spectrum by Military and Civilian Agencies, and 2) Problems Associated with Electronic Industrial Process Control and Instrumentation. An original and four copies of the abstract should be sent to: H. W. Welch, Jr., Technical Program Chairman, IRE 7th Regional 1961 Technical Conference and Electronics exhibits, Motorola, Inc., 8201 E. McDowell Road, Scottsdale, Ariz.



Collins men are working late tonight...

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One of the most difficult obstacles for Collins to overcome was that of accurately tracking the Echo I satellite. 800 miles, roughly speaking, separate Collins Radio Company in Cedar Rapids, Iowa, and its subsidiary, Alpha Corporation in Dallas, Texas. Both locations were prepared to send and receive radio signals bounced off Echo. Because Echo I was speeding through space at approximately 15,000 miles per hour some 900 miles above the Earth, its time above the horizon of both Collins locations was brief. However, Collins engineers perfected an automatic tracking device which permitted both the sending and receiving units to maintain constant contact from the time Echo I appeared on the horizon until it disappeared some 15 minutes later.

The radio signals actually traveled a minimum of about 2000 miles. Power loss was of staggering proportions . . . with received signal strength approximately 10^{-16} watts.

These contributions to the new world of space communications were completely company sponsored — and represent an investment in the future by Collins Radio Company and its subsidiary, Alpha Corporation. It was worth it . . . in the warm feeling of accomplishment alone.

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The Echo project is being coordinated with the National Aeronautics and Space Administration. Data collected by Collins is being submitted to NASA to be used in the evaluation of this communications technique.

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