

ELECTRONIC DESIGN

JULY 6, 1960

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SPECIAL TRANSISTOR ISSUE
including ELECTRONIC DESIGN's Eighth Annual
TRANSISTOR DATA CHART



ALSO IN THIS ISSUE:

• Seagoing Electronics — 2...p 34

• Digital Communications continued...p 98

HIGHEST ACCURACY IN PRODUCTION QUANTITIES

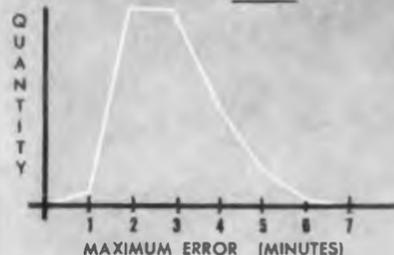
PRECISION COMPUTING RESOLVERS



PERPENDICULARITY OF AXES
87.7% showed 2' or less error



MAXIMUM ERROR
93.4% showed 4' or less error



MAXIMUM ERROR SPREAD
91.4% showed 6' or less error spread



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99.6% did not exceed 1 mv/v of output



TRANSFORMATION RATIO

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Occasionally we see advertised rotating components of fantastic accuracy. Sure, we make these *hand built* units too. But they are usually very expensive, of a large size, and you get delivery a few units at a time.

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Two modern rotary components facilities (Clifton Heights, Pa. and Colorado Springs, Colo.) assure deliveries in 45 days on quantity orders. Samples from the shelf immediately. Telephone Hilltop 9-1200 or our representatives.

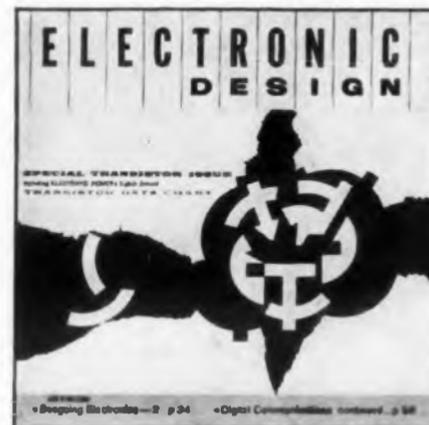
ENGINEERS—Pioneer with a leader in the field.
Write David D. Brown, Director of Personnel.

CLIFTON PRECISION PRODUCTS CO., INC.

CLIFTON HEIGHTS, PA.

CIRCLE 1 ON READER-SERVICE CARD

cppe



COVER: To present graphically *ELECTRONIC DESIGN's* complete breakdown of the transistor types in this issue, our Art Director cut apart a symbol of a transistor and arranged the pieces jigsaw-fashion, on a black field. For *ED's* report and the Eighth Annual Transistor Data Chart, turn to page 46.

Selected Topics In This Issue

Instrumentation

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- Pen Recorder Drives Slotted Line for Accurate VSWR Plots p 142

Materials

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Missiles and Rockets

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Systems

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Transistors

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- Airlines' Preferred Transistor List p 50
- Eighth Annual Transistor Data Chart p 54

Sidelights of This Issue

Transistors—1960

On page 46 of this issue begins *ELECTRONIC DESIGN's* annual transistor report, which this year runs to more than 50 pages. It includes the Eighth Annual Transistor Data Chart, with specifications for 1,088 transistors. Also in the report are articles and tables on the transistors most preferred by the military and the airlines, the latter being a \$50 million electronics customer. Convenient charts classify approved types into application categories. And be sure to see the article on selecting transistors for logic applications. Associate Editor Howard Bierman spent more than three months preparing this annual report and we think the report is the most complete coverage available.

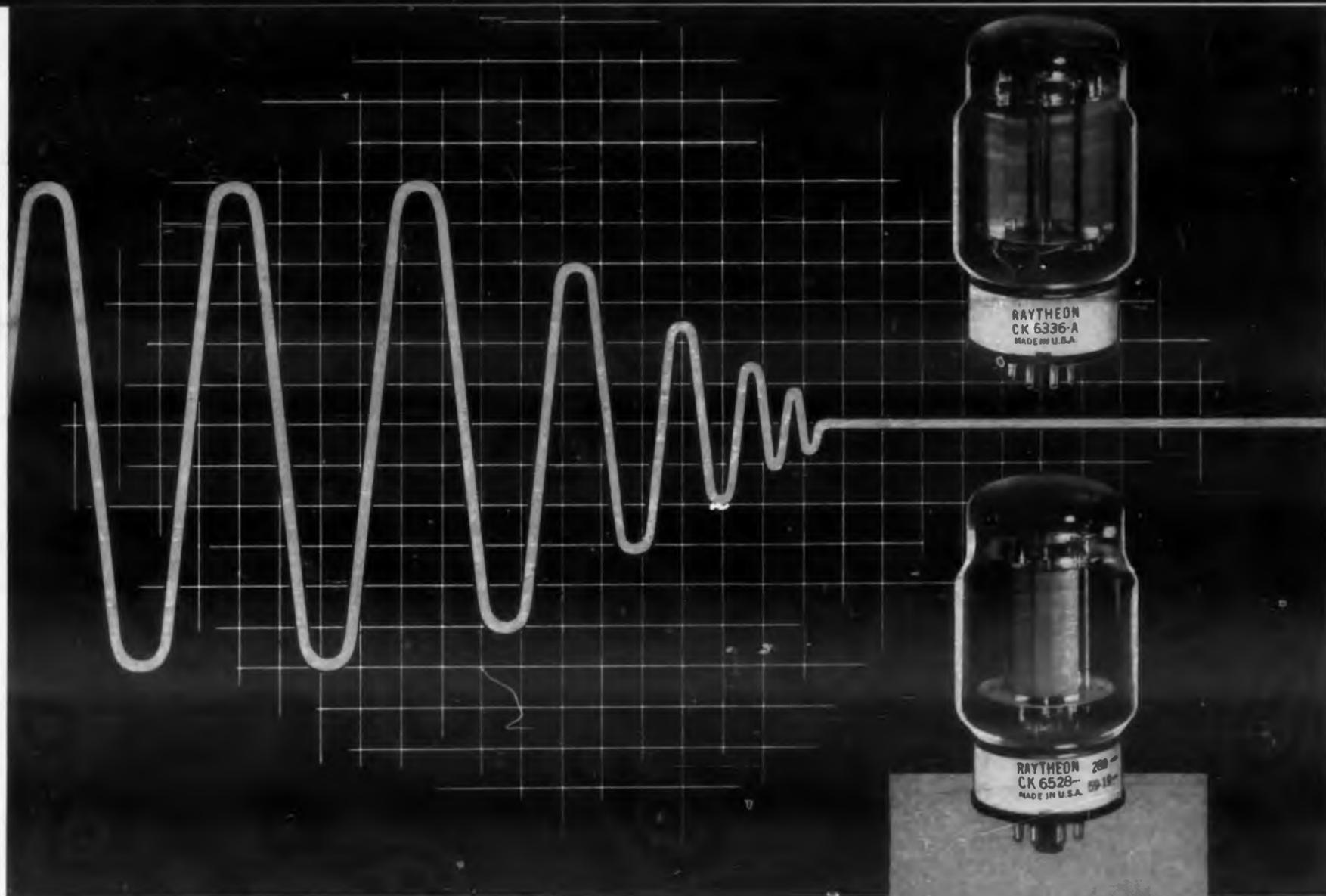
Twelve Years After

HISTORY AGAIN? In June of 1948, Bell Laboratories first announced the transistor. Last month, almost 12 years to the day from its announcement, Bell came forth with another announcement about transistors which has industry in a high state of excitement. This one told of the development of an epitaxial diffused transistor, which has reduced switching time by a factor of 10 and has also comparably lowered collector resistance. *ED's* editors, checking around the semiconductor industry, heard comments like "significant breakthrough," "great advance which appears to make the mesa the universal transistor," and "opens the way to tremendous flexibility." The designer can read about this Bell development and its significance in our story on page 4.

A Program for RFI

It's official now. Radio frequency interference is a major problem. At the RFI conference in Washington, plans were announced by government spokesmen for establishing a compatibility program for all major pieces of electronic equipment. Details are available in the news story on page 4. *ED* has long known how critical the RFI situation is. Readers will remember the Special Report in the Feb. 3 issue. And in the June 22 issue we printed for the first time anywhere the new three-service standard on radiation measurements.

CIRCLE 2 ON READER-SERVICE CARD ▶



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The Raytheon CK6336A and CK6528 are mechanically rugged, long-life twin power triodes. They are designed to handle large currents over a wide voltage range and at high temperatures in regulated power supplies. Zirconium coated graphite anodes, ceramic insulators, gold plated molybdenum grid wires, and hard glass envelopes are some of the advanced design features of both types.

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INDUSTRIAL COMPONENTS DIVISION

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FOR MISSILE SYSTEMS**



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An Editorial

Selecting Transistors And Diodes for Logic Applications 46
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Transistors 1960

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A breakdown by quantities used and by categories of applications

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A \$50 million electronics customer tells what it wants

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Combined with proper timing circuitry, a silicon controlled rectifier sets the initial multivibrator state and then allows the multi to function in a normal, balanced manner—R. A. Mammano

Point Plotter Provides Accuracy of 0.0015 In. 108
Uses numerical control techniques and digital position encoders

Large, Single Crystals Of Metals And Metallic Compounds Grown 110
Have variety of applications in high-temperature electronics

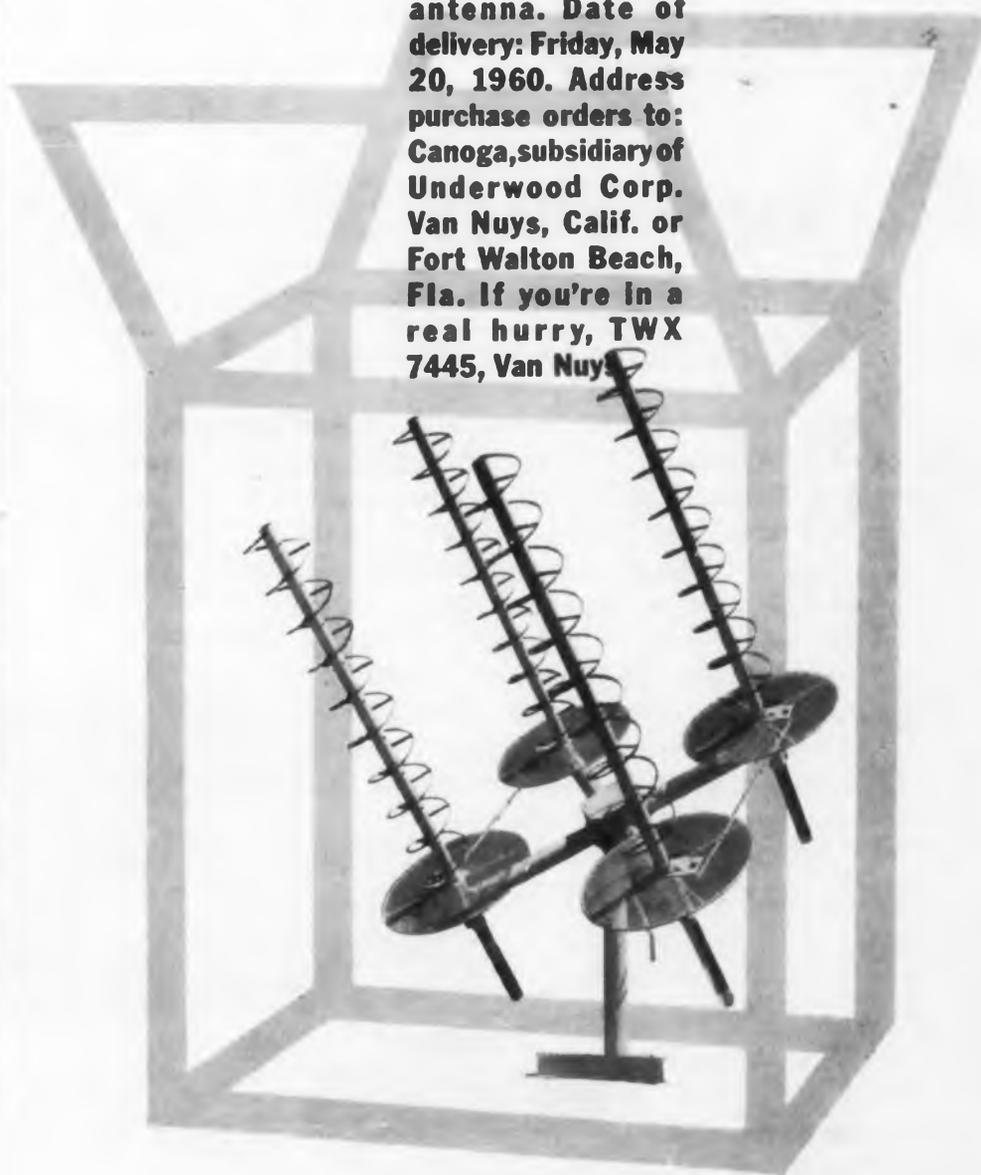
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7-**DELIVERED
IN 7 DAYS:**

The problem: Effective manual tracking of satellite on the 225 megacycle telemetry band. The customer: Lockheed Missiles and Space Division, Sunnyvale, California. Date of order: Friday the 13th, (they did everything they could to make us prove our point), May, 1960. The job: To design, manufacture and deliver within 10 days a quad helix antenna. Date of delivery: Friday, May 20, 1960. Address purchase orders to: Canoga, subsidiary of Underwood Corp. Van Nuys, Calif. or Fort Walton Beach, Fla. If you're in a real hurry, TWX 7445, Van Nuys.



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CIRCLE 4 ON READER-SERVICE CARD

DOD Sets Up RFI Compatibility Plan

*Military Electronic Equipment to Be Checked;
Analysis and Prediction Center Will Be Set Up*

A RADIO frequency interference compatibility program designed to reduce and control RFI between pieces of electronic equipment has been launched by the Department of Defense. Henry Randall of the Office of Defense Research and Engineering outlined the program to engineers attending the 2nd National Symposium of Radio Frequency Interference in Washington, D.C.

Heart of the new program will be an electromagnetic analysis and prediction center to be completed within the next year and a half. It will be operated by one of the military services and will collect and catalog the efforts of the individual services working in the interference field.

As part of the program, all types of military

electronics equipment will be examined to establish:

- Interference measurement and instrumentation techniques.
- Test equipment standards for measurement.
- Equipment specifications which will reduce the extent and effect of spurious emissions. This will also involve setting up receiver susceptibility limits.
- Compatibility requirements and spurious emission levels.
- A library of equipment spectrum signatures.
- An environmental file which will catalog the amount and types of equipment, their location, frequency, duty cycle, etc.

■ An electromagnetic analysis center to serve as a clearing house for interference research and study.

Initial emphasis of the program will be on radar. A series of new standards will be established which will set radar band-width limits and frequency allocations, spurious radiation levels, and antenna side lobe power levels.

The library of spectrum signatures and the environmental file will be stored at the analysis center. The spectrum library will be made up of frequency-response characteristics which will have to be furnished with each piece of equipment supplied for the military. These spectrum signatures together with the spectrum-like characteristics

Vapor-Phase Devices Made by Bell, IBM

*Many Other Semiconductor Makers Planning
Early Switch to New Fabrication Process*

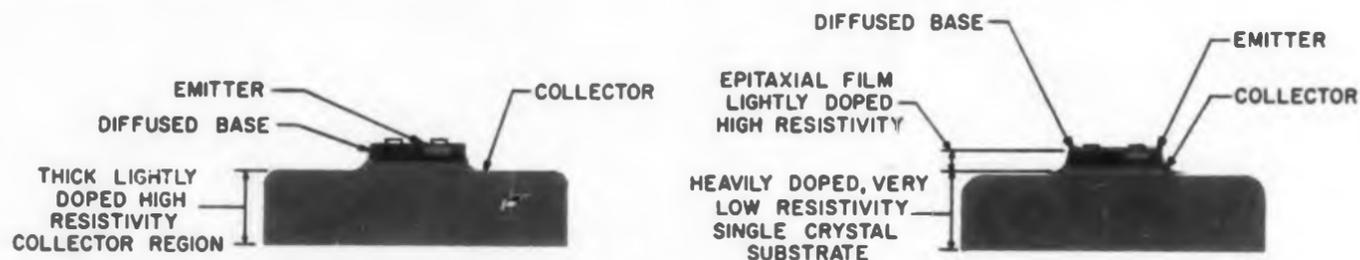
SUCCESSFUL fabrication of high-quality semiconductor devices using vapor-phase growth techniques has led to widespread excitement throughout the semiconductor industry.

Bell Telephone Laboratories has produced what it calls an "epitaxial diffused transistor," offering an order of magnitude decrease in both switching time and collector resistance when compared to conventional devices. The term epitaxial indicates that a film grown on a semiconductor wafer is a direct extension of the single-crystal structure of the substrate.

International Business Machines Corp. has fab-

ricated tunnel diodes, an improved variable capacitance diode, and other devices of good quality using vapor-phase processes. Some of the IBM work is being conducted under a one-year Army Signal Corps contract ending in July (*ED*, June 8, p 4), and other work is the result of a three-year internal research program.

Some of the work going on in this field was outlined at the recent Solid State Research Conference in Pittsburgh. Previous vapor-phase work at Merck & Co., Inc., Rahway, N. J., (*ED*, March 16, p 66) has been primarily in developing materials rather than fabricating devices.



Conventional diffused-base transistor, left, is compared to Bell Labs epitaxial-growth type, right. Collectors and emitters are n material, bases p material.

Transistor manufacturers told *ELECTRONIC DESIGN* that they are particularly enthusiastic about the Bell Labs development, because it can be easily adapted to present production lines. Devices produced by this method will soon be on the market, they said.

Dr. C. Lester Hogan, general manager of Motorola, Inc.'s Semiconductor Products Div., Phoenix, Ariz., said that his company planned to shift over to the new technique immediately on mesa transistor production lines.

Dr. Hogan feels that although the process adds one more step to production, the higher yields resulting from precise control of materials can lead to lower costs. The particular process being considered by Motorola involves the decomposition of germanium tetrachloride and the directing of the vapor formed over a seed crystal by means of a stream of hydrogen carrier gas.

Collector Resistance Problem Solved

The problem with diffused-base transistors

(continued on page 5)

for propagation path attenuation, plus information taken from the environmental file will be fed into a computer. The computer will then be able to calculate the electromagnetic radiation picture at a given geographic location.

RF Spectrum Standard Now Available

Made available for the first time at the Symposium were copies of MIL-STD-449, the military standard titled "Measurement of Radio Frequency Spectrum Characteristics." This standard previously reported in *ELECTRONIC DESIGN* (June 22, pp 4-5) is mandatory for use by all three services. It establishes uniform measurement techniques for determining the rf spectral characteristics of military electronic equipment.

Planned for issuance in the near future, is a modification of the Navy interference specification MIL-I-16910. To be assigned a "B" designation, this specification will deal with:

- Susceptibility requirements for receivers.
- Interference limits on high voltage power transmission lines.
- Line-impedance stabilization networks. Design information will be given for these networks which are to be flat to 100 mc.
- Radar design standards. This section will limit radar bandwidths, skirt values, spurious radiation levels, etc.
- Clamp-on devices. The measurement of conducted interference will be permitted with clamp-on devices.

The Navy also disclosed at the symposium that it is interested in frequencies up to 100 kmc and is already making measurements in that frequency area. A spectroscope which will operate from 10 kc up to 100 kmc is under development. It will be operable in seven or eight bands and the display will appear on a 17-in. tube.

Areas of Spec Improvement

Of great interest at the Symposium was a round table discussion on RFI and compatibility specifications. Each of the services as well as the Federal Communications Commission was represented on the panel. Albert R. Kall, president of the ARK Engineering Co., Philadelphia, outlined the industry position, noting that early military specifications and present FCC regulations, dealt mainly with outgoing interference sources and that only recently was emphasis placed on limiting receiver susceptibility. He also detailed areas where government RFI specifications could be improved. Some of his suggestions:

- Because the power of pure random noise varies directly with receiver bandwidth, and the voltage varies as the square-root of the bandwidth, the standard unit of random-noise inter-

(continued on page 6)

HOW YOU CAN PUT TELEVISION TO WORK

A brief report on how to use KIN TEL closed circuit TV systems to cut costs, reduce errors, up efficiency

Today, hundreds of companies are solving a wide variety of business and industrial problems with KIN TEL closed circuit TV systems.

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U.S. Steel uses a KIN TEL system to see inside open hearth furnaces. The Los Angeles Department of Water and Power uses one for remote viewing of water-level meters.

Convair, Douglas, Lockheed, and Northrop all watch rocket tests with KIN TEL systems.

Westinghouse watches nuclear power reactor tests with one.

American Potash and Chemical monitors conveyor line and warehousing operations with one.

The San Francisco Naval Shipyard uses one to guard against pilferage.

These, and many other KIN TEL customers — both large and small — have discovered a significant fact: *Closed circuit television is no longer a novelty.* It's a proven, practical piece of equipment that, in many instances, pays for itself within a year. It's a modern, money-making piece of equipment that you can use in your business, in your plant, in your operation.

What Is a Kin Tel Closed Circuit TV System?

The basic system manufactured by KIN TEL consists of a rugged yet sensitive camera that is small enough to hold in your hand; a receiver that displays pictures that are twice as sharp as you can get on your home TV set; and a camera control unit that is so automatic the only control you have to touch is the on-off switch.

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You can use one to watch events or operations that are tedious, difficult, dangerous, or even impossible for men to watch.



Dependable KIN TEL TV systems see where men cannot survive; withstand tremendous extremes in temperature and pressure; perform both critical and routine jobs inexpensively, faultlessly, safely, tirelessly.

You can use one for data transmission.



All types of visual information—from blueprints to fingerprints to graphs—are transmitted over great distances quickly, accurately. Such systems save money, reduce errors and confusion, speed operations.

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Null Sensitivity Ranges:	AC—100V, 10V, 1V, 0.1V, and 0.01V DC—10V, 1V, 0.1V, and 0.01V
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80A-3	6:1	3 KV	3 Megohms	\$ 80.00
80A-4	8:1	4 KV	4 Megohms	\$ 90.00
80A-5	10:1	5 KV	5 Megohms	\$100.00
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The JF 800 series differential voltmeters may be used to measure DC voltages in excess of 500 volts by utilizing an appropriate voltage divider (Volt Box). The division ratio of all models is accurate to 0.01% and long term stability is better than 0.01% per year. The approximate magnitude and the polarity of the unknown high voltage may be easily observed with the newly incorporated center zero panel meter.

Prices and technical data subject to change without notice.

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CIRCLE 6 ON READER-SERVICE CARD

NEWS

R F I

(continued from page 5)

ference should be microvolts-per-square-root-bandwidth. However, specification interference is divided into just two classes: narrow band (or cw) and broadband impulsive (or pulsed cw). The former does not involve bandwidth and the latter varies directly with bandwidth. FCC specifications restrict limits solely to microvolts or microvolts-per-meter, with no distinction based on whether the measured disturbance is narrow band or broadband. The FCC limits of Part 15 and 18, based on field intensity at various specified distances, should take into account, for broadband interference, the bandwidth of the measuring receiver.

■ More exact limits should be given when determining whether a piece of equipment complies with a given interference specification. To this end, he outlined three areas of compliance—absolute compliance, absolute non-compliance, and transitional compliance.

■ To decrease the time involved in making in-

Vapor-Phase

(continued from page 3)

has been the requirement for a relatively high resistivity collector region in order to attain low capacitance and high voltage breakdown. This region has been in general about 30 times thicker than required electrically, since ease in mechanical handling has been a prime requirement.

The excess thickness has increased collector resistance, and, through carrier storage, the switching time.

Bell overcame the problem by growing lightly doped epitaxial films onto a low-resistivity germanium and silicon wafers, thus attaining the desired combination of electrical properties and mechanical strength.

IBM researchers feel that the advantages of the vapor-growth processes they are developing include:

■ Closely controlled, arbitrary impurity distributions.

■ Heterogeneous junctions are possible—between germanium and gallium arsenide for example.

■ Resistivity layers can be deposited between junctions—as in the Bell Labs work.

■ Entire diode or transistor matrices might be made at once.

■ Multilayer microcircuit films seem feasible.

■ Large area junctions, useful in solar cells.

ELECTRONIC DESIGN • July 6, 1960

ference measurements, it may be wise to go to panoramic sweep techniques to augment present point-by-point methods. Also, the point-by-point method could be supplemented by a single reading on a vacuum tube voltmeter peak-type detector circuit.

■ In the area of susceptibility testing, there should be special rf radiated tests based on the practical situation which the piece of equipment will encounter. These tests would be in addition to the rf radiated, rf conducted, and audio-line conducted tests currently specified. Thus, for example, a computer to be installed near a radar would be irradiated by a radar transmitter having similar characteristics. This will help determine the threshold level at which malfunctioning occurs. The acceptable level should then be set on the basis of the actual rf environment to be encountered, with a reasonable safety factor included.

■ There should be a clearer definition of conditions which require RFI measurements in the field, instead of in a shielded enclosure. This definition should be tied in with consideration of equipment classification and area of use. ■ ■

can be produced.

Most of the IBM work has been done with compounds of iodine and semiconductors, with vapors formed passing over a seed crystal in a lower temperature region. A closed-tube process developed by IBM provides higher purity with less process tending.

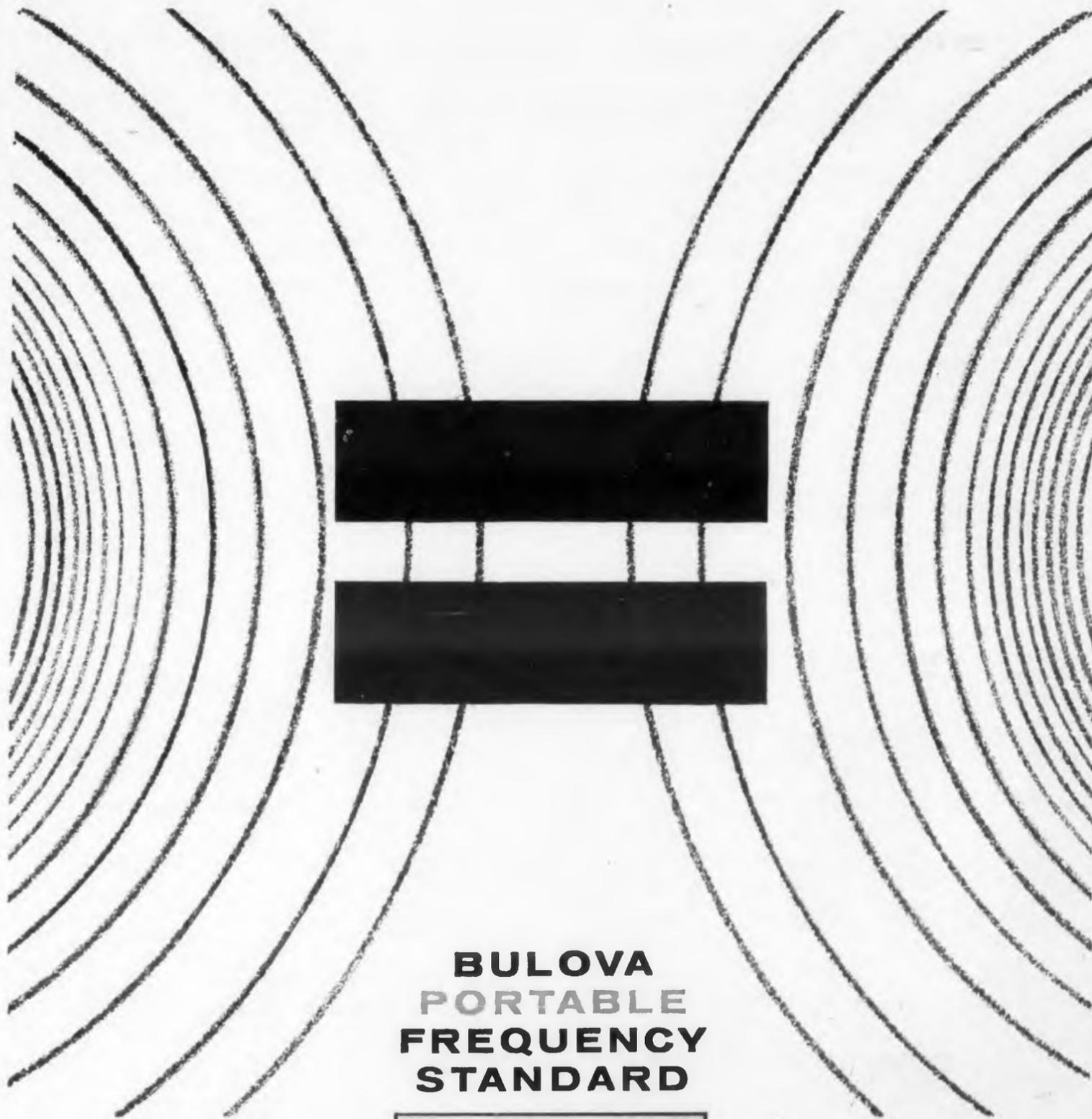
Open Tube Better for Quantity

A more conventional open tube process is more suitable for quantity production, however, according to IBM researchers.

IBM has found that hybrid transistors such as Bell Labs has produced are better than those made completely by vapor deposition. A primary problem has been to get enough doping in the emitter region. If doping levels are raised to necessity levels, poor injection efficiencies result.

In silicon work it has been difficult to clean substrate crystals before deposition because of extremely stable silicon oxide surface layers.

Work with germanium and intermetallic compounds has been much more successful, according to IBM. ■ ■



BULOVA PORTABLE FREQUENCY STANDARD



Whatever the beat you wish to "equal" or check out, you'll find the Bulova portable lab and field standard assures an uncompromised balance between stability and reliability.

For instance, the FS-100 will hold to $\pm 1 \text{pp}10'$ in the 10kc thru 20 mc range... or to $\pm 1 \text{pp}10'$ in the 50kc thru 10 mc group—for a full twenty-four hours. Its output is 1v P to P into 1K, sine or square wave, in either rating, with a 115v ac input

BULOVA
ELECTRONICS
DIVISION

or with its own self-contained, rechargeable power pack. Though it measures only a scant 6 x 8 x 8 inches—power supply and all—the advanced design and transistor construction of the FS-100 underwrites a life expectancy of over 25,000 hours.

For more information on how the Bulova FS-100's portability, reliability and stability

can assist you in pulling more accurate on-the-spot checks, write Department 1672, Bulova Electronics, Woodside 77, New York.

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TEN MEGACYCLE PULSE GENERATOR

FEATURING...HIGH REPETITION RATE WITH A LOWER
THAN 8 MILLIMICROSECONDS
RISE AND FALL TIME

Rutherford

MODEL B-5-A



This unit features an electronic pulse delay that can be set to zero or is continuously variable from .030 microseconds to 500 microseconds in five ranges. Pulse width is continuously variable from .02 to 12.5 microseconds in four ranges.

SPECIFICATIONS: **Amplitude:** 40 volts positive, 45 volts negative • **Attenuator:** 60 db in 1/2 steps • **Polarity:** Both positive and negative pulses simultaneously available • **Output Impedance:** 185 ohms • **Output Decay Constant:** 750 microseconds when terminated in 185 ohms • **Synchronizing Pulse Out:** 10 volts, positive • **Rise Time:** Less than .02 microsecond • **Width:** .03 microsecond • **External Trigger:** Pulse required: 10 volts minimum with rise time less than .05 microsecond • **Pulse Repetition Rate:** Continuously variable from 1 cycle/sec to 10 mc/sec in seven ranges • **Delay:** A fixed delay of .1 microsecond occurs between the synchronizing pulse out and the main pulse.

\$2,400.00 F.O.B. Culver City, Calif.

Also available in 10 MC double pulse version B5-2



MODEL A-2

TIME DELAY GENERATOR

EXTREME ACCURACY: After calibration: $\pm .1\%$ of full scale. Long term: $\pm 1\%$ of full scale.
FEATURES: .8 to 100,000 microseconds in 5 decimally related ranges.

Low jitter • Linear scales • Small repetition rate effects • External connector provided for delay voltage so that unit may be externally time modulated • Easily read dial controls.
\$750.00 F.O.B. Culver City, Calif.

ENGINEERS: If your field is Pulse Circuitry Design, a bright future awaits you at Rutherford Electronics Company. Send resume to Glen Stout, Industrial Relations Manager.

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pulse generators / pulse systems / accurate time delay generators

CIRCLE 8 ON READER-SERVICE CARD

NEWS

Static firing of all eight Saturn engines will provide data for processing by Marshall Space Flight Center's new IBM 7090.



Month Marked by Significant Firings

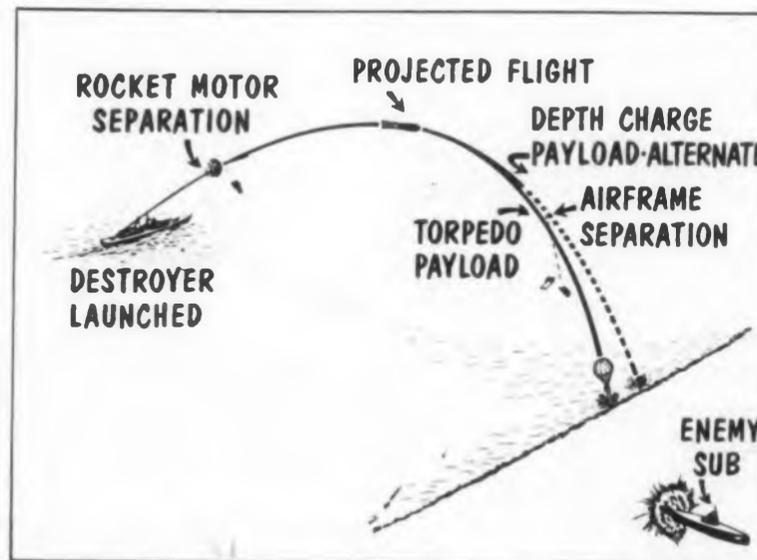
June Missiles Busted Out All Over; Saturn, Satellites, ASROC Successful

ELECTRONICS missile men—in fact, all missile men—were elated. In the space of a few days, a number of significant firings were achieved and the skies which sometimes had seemed grey now seemed almost black—with missiles.

At Huntsville, Ala., the Saturn heavy space vehicle underwent its

eighth completely successful test firing with an IBM 7090 computer processing all the data.

Aboard the U.S.S. Norfolk off Key West, Fla., the Navy's new anti-submarine rocket ASROC was successfully tested against a target nuclear submarine. Rear Adm. P. O. Stroop, chief of the Navy's Bureau



ASROC ballistic missile, new Sunday punch for the Navy's anti-submarine forces, is programed and launched from shipboard by digital computer.



Transit II-A and the radiation-measuring satellite above it orbited together.

ANOTHER QUALITY PRODUCT FROM **EFCON**

TANTALUM

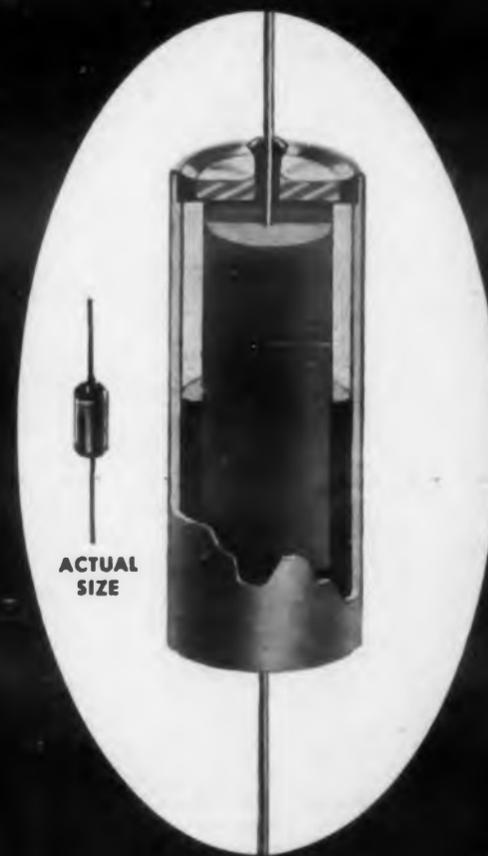
Solid Electrolyte Tantalum Electrolytic Capacitors - Type STP

Efcon Features -

- Same day quotations
- Delivery within 24 to 48 hours
- Complete product uniformity
- Extensive size range
- Positive hermetic seal

Type STP Features -

- -55°C to $+125^{\circ}\text{C}$ operation
- $\pm 10\%$, $\pm 20\%$ tolerance
- Polar operation
- Meets or exceed MIL-C-26655A electrically and mechanically
- 100% stabilized for 250 hours during production
- Low power loss, high insulation resistance
- Minimum size, long life and stable operation



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of Weapons, called it "a significant advance in the Navy's anti-submarine warfare program."

And most spectacular of all, an Air Force Thor-Able-Star rocket was launched from Cape Canaveral and successfully put into orbit two Navy-developed satellites.

Saturn: Tons into Space in '64

For two minutes, the Alabama hills reverberated with the roar of Saturn's eight rocket engines delivering a thrust of 1.3 million lb to bring closer the day when the huge space vehicle will put a multi-ton payload in orbit.

Speaking at the dedication of the 7090, Dr. Wernher von Braun, director of the Marshall Space Flight Center at Huntsville, said 11 flights are scheduled for Saturn. The first flight, next summer, will use only a single stage of the vehicle, as will the second and third flights. The fourth to the tenth flights will be R&D flights, using other stages. Then, in May, 1964, Saturn will blast off with its huge payload.

The 7090, IBM's most powerful commercially installed computer, will process information from nearly 1,000 instrument channels attached to the Saturn booster. Instrument readings, taken at rates up to 50 per second, will yield information on some 300 pressures, 200 temperatures, 24 flow rates and vibration and strain.

The solid-state 7090 will calibrate all measurements, change them into engineering units, and convert all parameters to equivalent vacuum conditions. It will compute thrust, pressure losses in different parts of the plumbing, loads on members where strain is not measured, and specific impulse (a measurement of rocket efficiency equal to flow rate/thrust).

ASROC: Tests Successful

ASROC, the Navy's newest, most effective anti-submarine weapons system, was tested in the waters off Key West in a blaze of glory. With ASROC, it is possible to deliver an

(continued on p 10)

CIRCLE 9 ON READER-SERVICE CARD ➤

Milgray Electronics, Inc.
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EDISON

**Servo Motor-Generators
are designed specifically
for your systems
applications**



Edison Servo Motor-Generators are available with any type or size gear head or gear train.

Unlike ordinary "off-the-shelf" components, Edison Servo Motor-Generators are designed specifically to operate as part of an electro-mechanical system.

For example, their motor sections are built to have minimum time constants and reversing times. To insure precise coupling with mating gear trains, output pinions are fabricated to *better than AGMA standards*. Damping constants, from unit to unit, are held to very close tolerances.

In addition to these special system features, Edison Servo Motor-Generators are made to the highest

quality standards. They outperform MIL-S-17087 (for motors) and MIL-S-17806 (for generators).

Edison engineers provide you with the exact servo motor-generator your system calls for—not a cataloged component that will only approximate your needs. For this reason, they will work closely with you in developing components that will assure you of the best system performance.

For additional information on Edison Servo Motors, Motor-Generators and other rotary components, write for Catalog 3044.

Thomas A. Edison Industries
INSTRUMENT DIVISION

55 LAKESIDE AVENUE, WEST ORANGE, N. J.



CIRCLE 10 ON READER-SERVICE CARD

NEWS

acoustic homing torpedo or depth charge to an enemy submarine thousands of yards beyond the range of present-day ship-launched torpedoes.

The new system uses sonar to detect and track targets, then programs the missile by means of a digital computer and launches it.

After the missile is accelerated, the rocket engine is dropped and the missile continues on its way. Just prior to entering the water in the vicinity of the target, the weapon drops its airframe and a torpedo is dropped by parachute for a soft landing on the surface. If a depth charge is the warhead, it is dropped without parachute.

ASROC is a ballistic missile whose trajectory and range is pre-set. Because of relatively simple plumbing and instrumentation, it is cheap, has a shelf life as long as the ship itself, and can be transferred at sea. The fact that setting is done by digital computer means that the missile itself need not be modified or scrapped as detection gear improves in quality.

The launcher is a pepper-box design, with each cell serving as an individual launcher. All eight cells turn together and each pair of over-under cells elevates individually. ASROC can be fired as rapidly as 10 seconds apart.

Prime contractor was Minneapolis-Honeywell, under direction of the Naval Ordnance Test Center at Pasadena, Calif. Librascope developed the computer and Universal Match Corp.'s Armament Div. the launcher.

Transit II-A: Two Up

Early performance of the Transit II-A navigational satellite launched late last month in tandem with a radiation-measuring package, is exceeding hopes of its designers, who attribute much of the success to a single design decision. The decision: to use a new type of solar-cell array in conjunction with nickel-cadmium batteries as the only power supply for the package.

This eliminated the silver-zinc battery pack that was used as an alternate power supply in Transit I-B, and saved enough space and weight to permit inclusion of a binary clock, an infrared scanner and a galactic-noise receiver in the package. The use of a single, nickel-cadmium supply may be the start of a trend toward this type of power source for many new satellites, reports the Applied Physics Laboratory of Johns Hopkins University, prime contractor for the Navy on the transit program.

Transit II-A, which is now orbiting between 400 and 490 mi above the earth, differs from the

still-circling Transit I-B in the following respects:

- The usual heavy quartz shielding protecting the solar cells has been replaced by thin glass covers over each cell shingle. This reduces weight of the array and provides optical filtering of solar radiation. Because of the weight saving, the number of cells in Transit II-A is about double that of Transit I-B.

- The telemetry system has been redesigned to provide an fm/pm channel independent of the Doppler transmissions. In Transit I-B, one of the Doppler links was used for telemetering the orbital and frequency data that are the heart of the navigational system. With an independent pm telemetry link, more bandwidth is available more of the time to transmit greatly increased quantities of data. In effect, the satellite's duty cycle has been lengthened.

- A more rugged crystal, developed by Bliley Electric Co., Erie, Pa., is operating in the ultra-stable oscillators used in the system.

- The de-spin equipment in Transit II-A uses shunted coils for greater efficiency. The coils enhance the electromagnetic effect of the high-permeability rods, which are mounted in the satellite to counter the earth's magnetic field.

- An infrared scanner was included to measure rotation of the earth, partly as a check on the effectiveness of the de-spinning system.

- The binary clock, developed by the Applied Physics Laboratory, counts down from the crystal-oscillator frequency in binary steps to an 11-sec interval, which is used to trigger the telemetry cycling system. By detecting leading edges of the pulse train, ground-based stations are able to calibrate time signals to an accuracy of 1 msec, about an order of magnitude better than present worldwide time standards. With special stations, a global time-standard service may eventually provide accuracies of about 1 microsec.

- The galactic-noise receiver riding in the Transit package was developed by the Defense Research Telecommunications Establishment, Ottawa, Canada. Its operation was part of a program jointly pursued by DRTE, APL and NASA to measure galactic noise at various frequencies. This data will be used later for making radiosonde measurements from above the ionosphere. The ultra-sensitive Canadian receiver operated at 3.8 mc until the set was turned off by plan last week.

The "piggy-back" satellite launched with Transit II-A was designed by the Naval Research Laboratory to measure solar-generated X-rays and Lyman-alpha ultraviolet radiation. This data is being transmitted on an 8-channel 108-mc telemetry link by a 2-transistor transmitter that delivers about 40 mw to the antenna system. ■ ■



LOGILINE offers designers the flexibility of encapsulated packages and the versatility of conventional wiring board construction for standard equipment assembly.

LOGIPAK* encapsulated packages

(see above photo)

- Epoxy encapsulated for protection against severe environmental conditions
- Smaller in size than standard wiring board assemblies, in keeping with the modern trend toward miniaturization
- Priced lower than standard assemblies, due to simplified production techniques
- Transistors are accessible for test or replacement
- Pins have standard grid module spacing of 0.1 inch
- Standardized configuration—ideal for prototype design, equally suitable in final production.

Logipak series includes:

1100Z1	Inverter	2100Z5	Delay
1100Z2	Diode	3100Z1	Clock
1100Z3	Complementary Trigger	3100Z2	Pulse Generator
2100Z1	Flip-Flop	3100Z3	Pulse Amplifier
2100Z2	Trigger Network	3100Z4	Indicator Driver
2100Z4	Shift Register Flip-Flop		

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For complete technical data on LOGILINE circuitry, or application assistance on your digital design problems, write to Special Products Division, Sprague Electric Company, 347 Marshall Street, North Adams, Massachusetts.

SPRAGUE COMPONENTS:

CAPACITORS • RESISTORS • MAGNETIC COMPONENTS • TRANSISTORS • INTERFERENCE FILTERS • PULSE NETWORKS
HIGH TEMPERATURE MAGNET WIRE • CERAMIC-BASE PRINTED NETWORKS • PACKAGED COMPONENT ASSEMBLIES

LOGILINE* CIRCUITRY

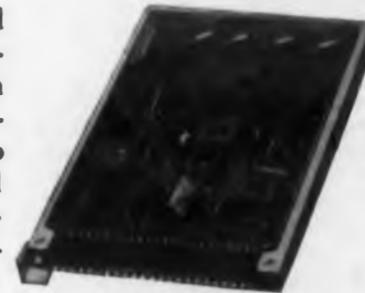
for digital system design

LOGILINE circuitry features a series of 5 mc/s transistor switching circuits in building block form. Basically a pulse-level system, LOGILINE circuitry performs all of the digital functions required by computer designers, including combinational logic, temporary storage, pulse source, and pulse amplification.

Because LOGILINE "building blocks" are pre-designed to incorporate standardized switching circuits, you can save many hours of valuable design time. The basic plug-in feature, which has gained wide acceptance throughout the digital industry, is another note-worthy time saver.

LOGICARD* wiring board cards

- Epoxy glass etched wiring board and twenty-two pin connector in aluminum frame
- Designed for insertion into pre-wired rack mounted panel
- Completely interchangeable with comparable units.



Logicard series includes:

1000Z1	Inverter	2000Z4	3-Digit Shift Register
1000Z2	Diode	3000Z1	Clock
2000Z1	Flip-Flop	3000Z2	Pulse Amplifier
2000Z2	Dual Flip-Flop	3000Z3	Pulse Generator
2000Z3	Delay	3000Z4	Indicator Driver

SPRAGUE®

THE MARK OF RELIABILITY

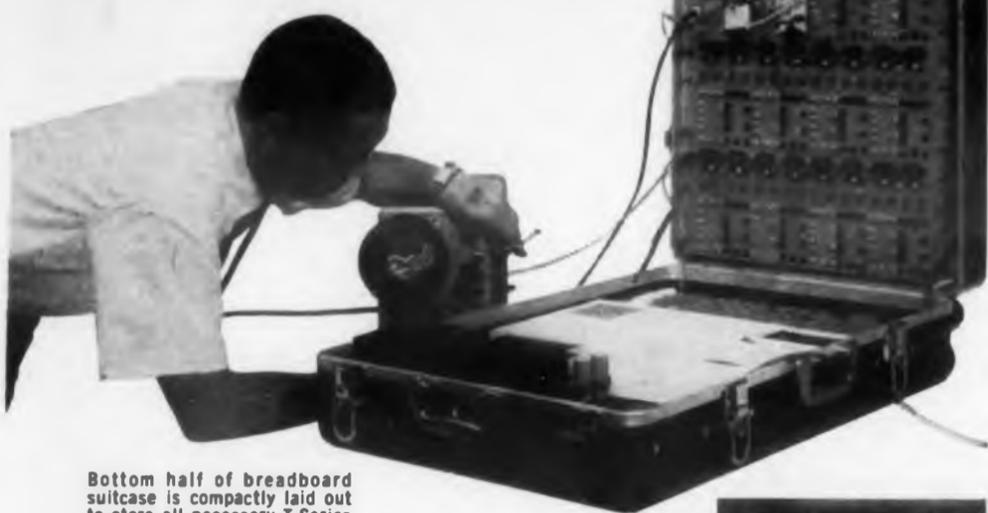
CIRCLE 11 ON READER-SERVICE CARD

SOMETHING NEW IN A SUITCASE...

...Complete transistorized EECO Digital System Breadboard

Designers who want to go places fast systemswise can be sure of getting there on time with an EECO suitcase. It's packed with a complete and integrated breadboarding system designed around mutually compatible EECO T-Series Germanium circuit modules, N-Series transistorized decades, and R-Series Minisig® sensitive indicators.

Standard 19" amateur-notched panels have the necessary permanent wiring to accommodate any standard EECO Germanium circuit module, and all other circuit interconnections are made by patch cords or plugs, with unique, prepunched circuit cards to guide you. No soldering is required, and experimental arrangements of T-Series circuits can be quickly patched up, changed, or taken down without waste of time or materials.



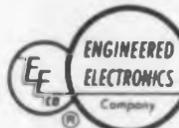
Bottom half of breadboard suitcase is compactly laid out to store all necessary T-Series circuit modules, circuit cards, patch cords, and compatible power supplies.

EECO T-Series breadboard equipment is available in both suitcase and rack-mounted types. Breadboard Kits of any degree of complexity can be built up in stages, according to the specific panels and number of circuits incorporated. Compatible interconnections between racks or suitcases further enable the designer to expand the equipment into a complete systems development console. Compatible solid-state, convection-cooled power supplies are also available in two different models: ZA-720 is a dual 12-volt, 5-amp supply; ZA-721 is a 12-volt, 1-amp plug-in power supply.

FEATURES

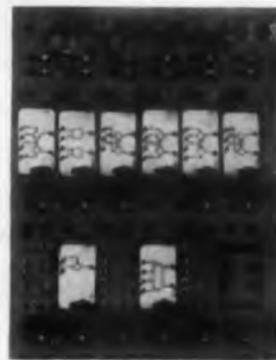
- Permits rapid formulation of digital electrical systems.
- System may be operated slowly to permit inspection of its mode of operation, or over-speed to indicate system derating.
- Operation may be analyzed with a minimum of test equipment.
- Provides a means for rapidly building and testing alternate ways of formulating a system.
- Minimizes wiring errors and the inclusion of defective parts.
- Circuit cards provide a means for rapidly visualizing the system, and facilitate drawing a circuit diagram.
- Circuit cards enable the designer to determine the elements involved, as well as the cost of the system.

A request, on your company letterhead, will bring detailed information on the flexibility of the EECO T-Series Breadboarding equipment, and a demonstration if desired.

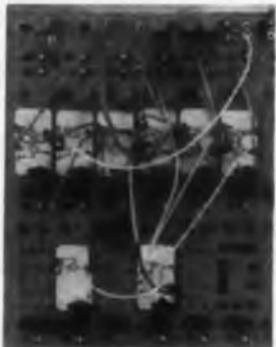


ENGINEERED ELECTRONICS COMPANY

1441 East Chestnut Avenue • Santa Ana, Calif.



Circuit cards are selected according to the system it is desired to breadboard and placed on the panel in alignment with the jack pattern. Corresponding T-Series circuit modules are plugged in above each card.



Circuit interconnections are made by patching through holes in the circuit cards. Resulting pattern of symbol cards and patch cords shows a schematic and bill of materials for the system, once it is checked out.

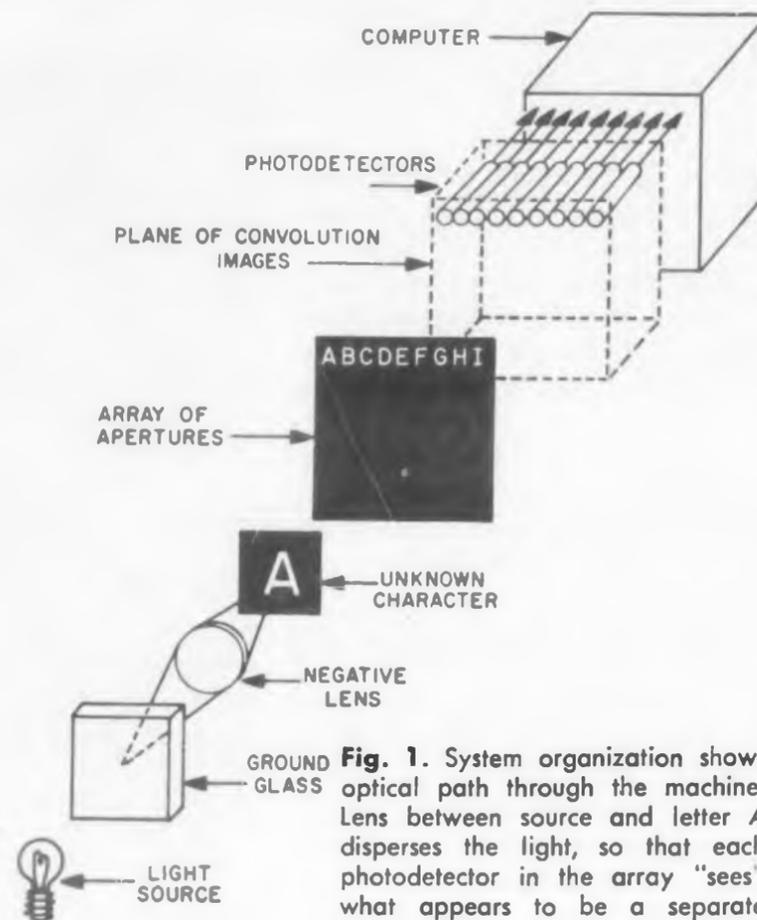


Fig. 1. System organization shows optical path through the machine. Lens between source and letter A disperses the light, so that each photodetector in the array "sees" what appears to be a separate source.

Russian Reader Uses Defocused Optics

*Will Read 1,000 Characters per Second;
Can Adapt to Any Language or Type Face*

AN OPTICAL system designed to read automatically Russian text at 1,000 characters per second is scheduled for delivery to the Rome Air Development Center, Rome, N. Y., this fall.

Russian text will be photographed on 70-mm film for input into the reading machine, now being developed by Baird-Atomic, Inc., Cambridge, Mass. The output of the machine, coded to represent the character being identified, will be stored on magnetic tape for subsequent input to a translating computer under development by International Business Machines Corp., New York. Currently input to the IBM translator is manual, by typewriter keyboard, at about 40 characters per minute.

Signal Subtraction Process

The reading machine uses defocussing optics and a novel signal subtraction

process. The ability to read punctuation marks easily, and to be adapted to any type font or language, are key features of the equipment. Character identification is accomplished by simultaneous correlation of the outputs of an array of photodetectors, each representing a character in a type font, with a decision made electronically. No time-consuming scanning is required unless the text includes more than one type font.

In operation, a beam from an arc source is directed through a dispersive lens, and then through the image of the character on the 70-mm negative.

The dispersed light then passes through a master negative containing images of all the characters in the type font being read. An array of photodetectors is located behind this master negative. Each of these detectors "looks" at the character being identified through a different character aperture in the master set.

Fig. 2.mitted l...
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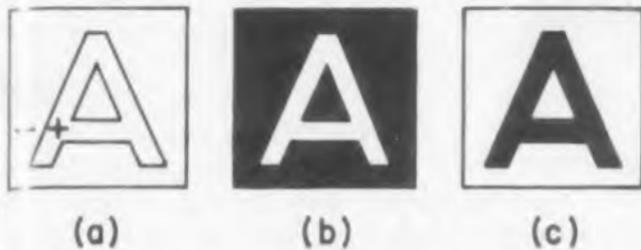


Fig. 2. A system in which the amount of light transmitted by each character in the master type font apertures is balanced by the amount of light not transmitted is represented by (a). A similar effect can be achieved in an optical system by using positive and negative masks, such as (b) and (c), with shaded areas blocking the light. Apertures (b) would transmit a maximum amount of light shining through the character "A" being identified, and aperture (c) would block a maximum amount of light.

Because of the optical properties of this dispersed light system, the largest signal is generated by the detector which looks at the character being read through the same character in the master set.

For example, if the letter being read is an A, most of the light coming through that letter would be transmitted through the A aperture in the master set. Much of the light would be blocked, however, by the B aperture, or any other aperture in the set, because of the difference in shape of the other letters and symbols.

Thus the A photodetector would provide a maximum output for this character, so that a set clipping point in the A photodetector amplifier is exceeded. This would cause a signal representing an A to be generated and recorded on magnetic tape.

Actually, the system under development is more complex than this, so that larger signal differences are provided. Distinguishing a comma from a period, or an O from a Q, for instance, would be difficult with the simple system because of the small differences in light reaching the photodetectors.

From a theoretical standpoint, a system which gave positive weight to the amount of light transmitted, and negative weight to the light not transmitted by each character in the master set, would provide more information for making an identification.

Such a system is illustrated by parts (b) and (c) of Fig. 2. In addition to a complete master aperture set, a set of blocking images and a second array of photodetectors would be required for this scheme.

One More Aperture

A more efficient technique has been developed, however, which requires only one additional aperture in the master set and one added photodetector.

If the positive transmittance for any particular

THE UNIVERSAL DIODE

Fairchild FD200, actual size

High Conductance, Ultra Fast Silicon Planar Diode

... satisfies all of today's diode requirements and forestalls obsolescence by fulfilling foreseeable future demands for logic, switching and general-purpose applications with these advanced specifications:

- Over 100 mA forward conductance at 1.0 V
- Less than 50 nsec reverse recovery time
- Capacitance under 5 μf at 0 V
- 200 V minimum breakdown voltage

RELIABILITY is significantly advanced by the introduction of Fairchild's latest semiconductor state-of-the-art development—the Planar Structure.

UNIFORM CHARACTERISTICS and minimal parameter spreads give unvarying results and consistent performance from every FD200 diode.

IMMEDIATE AVAILABILITY—Call your local distributor or sales office. Complete listing attached. Complete line of Fairchild 1N-types to current specifications complement the FD200.

MAXIMUM RATINGS (25°C)—(Note 1)

WIV	Working Inverse Voltage	150 V
I_D	Average Rectified Current	100 mA
I_F	Forward Current Steady State D.C.	150 mA
i_F	Recurrent Peak Forward Current	300 mA
i_F (surge)	Peak Forward Surge Current Pulse Width of 1 sec.	500 mA
i_F (surge)	Peak Forward Surge Current Pulse Width of 1 μsec .	2000 mA
P	Power Dissipation	250 mW
P	Power Dissipation	100 mW @ 125°C
T_A	Operating Temperature	-65° to +175°C
T_{stg}	Storage Temperature, ambient	-65° to +200°C

ELECTRICAL SPECIFICATIONS (25°C unless noted)

SYMBOL	CHARACTERISTICS	MIN.	TYPICAL	MAX.	TEST CONDITIONS
V_F	Forward Voltage			1.0 V	$I_F = 100 \text{ mA}$
I_R	Reverse Current			0.1 μA	$V_R = -150 \text{ V}$
$I_{R(150^\circ\text{C})}$	Reverse Current (150°C)			100 μA	$V_R = -150 \text{ V}$
BV	Breakdown Voltage	200 V			$I_R = 100 \mu\text{A}$
t_{rr} (Note 2)	Reverse Recovery Time			50 nsec	$I_F = 30 \text{ mA}$ $I_R = 30 \text{ mA}$ $R_L = 150 \text{ Ohms}$
C_0 (Note 3)	Capacitance			5.0 μf	$V_R = 0 \text{ V}$ $f = 1 \text{ mc}$
RE (Note 4)	Rectification Efficiency	35%			$f = 100 \text{ mc}$
	Forward Voltage Temperature Coefficient		-1.8 mV/°C		

NOTES:

- (1) Maximum ratings are limiting values above which life or satisfactory performance may be impaired.
- (2) Recovery to 1.0 mA.
- (3) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-58 Capacitance Bridge or equivalent.
- (4) Rectification Efficiency is defined as the ratio of D.C. load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V r.m.s. input to the circuit. Load resistance 5 k ohms, load capacitance 20 μf .

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CIRCLE 12 ON READER-SERVICE CARD

aperture in the master set is designated P_i , and the negative transmittance for the i th character N_i , then the function provided by such a system can be designated $P_i - N_i$.

The same result might be obtained by a system providing the function $2P_i - (P_i + N_i)$. The $2P_i$ term might be obtained by doubling the output of each character's photodetector.

The $(P_i - N_i)$ term is supplied for each character by adding an aperture to the master set which amalgamates the shapes of all characters. The photodetector behind this aperture receives all the light that would pass through any aperture, plus all of the light that would be blocked by that aperture—which is $P_i + N_i$.

Although it has not been proven theoretically, tests have indicated that a signal at least 15 per cent higher than any other signal is provided by the proper character in the master set. This permits positive identification of any character without too much difficulty.

Actual applications of the system bring several important problems. In some texts type fonts may

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good reasons for letting
KNAPIC grow your

Silicon Crystals

*KNAPIC specializes in Silicon and Germanium Crystals
for Semiconductor, Solar Cell and Infrared uses*

Major manufacturers of semiconductor devices have found that Knapic Electro-Physics, Inc. can provide production quantities of highest quality silicon and germanium monocrystals far quicker, more economically, and to much tighter specifications than they can produce themselves.

The reason? Knapic Electro-Physics are *specialists* with accelerated experience in growing new materials to specification.

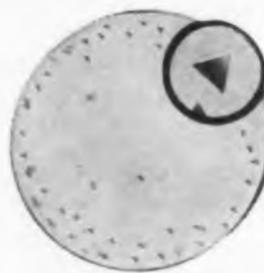
Why not let us grow your crystals too?

Check These Advantages

Extremely low dislocation densities.
Tight horizontal and vertical resistivity tolerances.
Diameters from 1/4" to 2". Wt. to 250 grams per crystal. Individual crystal lengths to 10".
Low Oxygen content 1×10^{17} per cc., 1×10^{16} for special Knapic small diameter material.
Doping subject to customer specification, usually boron for P type, phosphorous for N type.
Lifetimes: 1 to 15 ohm cm.—over 50 microseconds; 15 to 100 ohm cm.—over 100 microseconds; 100 to 1000 ohm cm.—over 300 microseconds. Special Knapic small diameter material over 1000 microseconds.

Write for SPECIFICATION SHEETS

... Also manufacturer of large diameter silicon and germanium lenses and cut domes for infrared use



Dislocation density, Knapic silicon monocrystals grown by a modified Czochralski technique: Crystal diameter to 3/8" — None; 3/8" to 1/2" — less than 10 per sq. cm.; 1/2" to 1 1/4" — less than 100 per sq. cm.; 1 1/4" to 2" — less than 1000 per sq. cm.



Knapic Electro-Physics, Inc.

936-40 Industrial Ave., Palo Alto, Calif. • Phone DAvenport 1-5544

SALES OFFICES:

Eastern—405 Lexington Avenue, New York, N. Y. • Phone YUkon 6-0360
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CIRCLE 13 ON READER-SERVICE CARD

GE Plans Multi-Function Compactrons

TUBES combining several functions into a single envelope are being developed for the entertainment market by General Electric Co.'s Tube Department, Owensboro, Ky.

GE expects its "compactrons" to lead to function-for-function price decreases of 20 per cent in comparison with conventional tubes. The extremely small size of the new units should make much tighter packaging of tube-type entertainment equipment possible.

Compactrons being readied for production are 12-pin types with base diameters of 0.075-in.

Six units are now under development, and GE expects to introduce nine others within the next year. An eventual line of 75 to 100 compactrons is planned.

To illustrate the compact designs possible, GE built a five-tube radio using two compactrons. The unit measures 2-1/2 x 2-1/2 x 10-1/2 in., with extra width required to accommodate the speaker.

A TV receiver can be built using 10 compactrons to replace the conventional 15 tubes and three diodes, or 24 transistors and 11 diodes, according to GE.

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be interspersed. In the machine being built for the Air Force 12 Russian type-font master aperture sets are being prepared. When the machine can not identify a character it will automatically search through the 12 sets in order of decreasing likelihood of occurrence.

Sizes of letters also differ, so that the machine may not be capable of reading larger size characters mixed with ordinary type sizes.

If the machine fails to identify a character, an image of the line being read will be presented on a cathode ray tube on the operator's panel. A trace underneath the line of text will have gaps in it wherever characters can not be identified. This will permit the operator to identify the character manually.

Currently, research is being directed toward a system similar to the one described, but with the ability to read original documents rather than filmed versions of them.

Since photography permits sharpening of character images and elimination of fingerprints or other spurious marks on a document, direct reading offers more problems.

Plans for the reading equipment after the Air Force development is completed are not yet firm, according to a company spokesman. ■ ■

Compactron Tubes

The compactrons under development for table radios are a combined oscillator, converter and if amplifier to replace the 12BA6 and 12BE6, and a combined second detector, audio amplifier, audio power output amplifier and rectifier to replace the 35W4, 50C5, and 12AV6.

Television receiver compactrons being developed, followed by the tube types they will replace in parentheses, are:

- Horizontal oscillator and afc (6CG7 and 6AL5).

- Horizontal damping diode (6AX4GTB).

- Vertical deflection amplifier and oscillator (6DN7).

- Horizontal deflection amplifier (6DQ6B).

Some compactrons are being designed to replace only a single tube because of power and voltage limitations.

The move to multi-function tubes was indicated at the IRE Convention in New York in March. Tung-Sol Electric Inc. and CBS-Electronics both showed 12-pin units (ED, Apr. 13, p 105).

Further engineering details on the compactrons will appear in a future issue. ■ ■

NEW CANNON PLANT

IN PHOENIX

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AND SPEEDS DELIVERIES

Plug/Harness Systems • Umbilical Plugs • Hermetic-seal Plugs

Yes...you now get faster deliveries—increased production—better service for all Cannon plug/harness systems, umbilical plugs, and hermetically sealed "Canseal" plugs! The manufacture of these specialized lines has been streamlined by combining in one location every phase of their engineering, manufacturing,

and testing. And the new 68,000-sq. ft. Phoenix facility has plenty of room to grow—is staffed with experienced Cannon personnel to give you complete service. This new plant reflects our continuing effort to anticipate expanding technology...is another of many reasons why you should consult the first name in plugs...why you should always consult Cannon for all your plug requirements.

CANNON ELECTRIC COMPANY 3208 Humboldt St., Los Angeles 31, California

CIRCLE 14 ON READER-SERVICE CARD

**CANNON
PLUGS**

Engineers Concentrate Efforts On 'Flat-Screen' Television

To achieve "picture-on-the-wall" TV, the ultimate in flat-screen picture-tube efforts, considerable development effort is being concentrated on increasing kinescope-deflection angle to decrease over-all tube length. Since deflection-power requirements are increased as tube length is shortened, more efficient sweep circuits and deflection yokes are being sought.

Another approach to reduce sweep power for conventional ac-operated TV as well as battery-powered transistor TV involves scan magnification techniques. Efforts to achieve these goals and advance the status of transistorized TV were described at the Chicago Spring Conference on Broadcast and TV Receivers.

In 1946, 10-in. "round" picture tubes possessed a deflection angle of 53 deg while 1959 17-in. and 21-in. rectangular tubes were 110 deg types, this represents a 2:1 improvement in length-to-diagonal ratio.

By departing from the conventional uniform 1-1/8 in. diameter common to 110-deg kinescopes and modifying the region in the yoke vicinity to a 3/4-in. diam, an 18-in., 122-deg tube has been developed.

Philco engineer R. A. Bloomsburgh revealed that the new tube structure, plus a toroidal yoke design coupled with circuit optimization, has resulted in full deflection with 20 per cent saving in horizontal deflection power and 30 per cent less vertical sweep energy than existing 110-deg receivers. The substantial over-all bulb decrease and power savings are decided contributions for the quest of more compact, cooler-operating TV portables.

Scan Magnification Success Still Distant

Another area for power saving, the heater supply, was discussed by H. E. Smithgall of Sylvania Electric Products, Inc. Under a Signal Corps sponsored contract, a 1.5-v, 150-ma cathode-heater arrangement has been developed for portable scopes and military equipment. This represents a 94 per cent saving over conventional 6.3-v, 600-ma kinescopes. However, Mr. Smithgall pointed to the need for automation in fabrication and test before high-quality, low-cost TV could be considered.

Post-acceleration schemes for scan magnification could decrease deflection-power requirements by as much as 50 per cent. Two- and three-ring internal aquadag coating techniques plus mesh-type screens in front of the kinescope faceplate are under consideration.

HERMACH-ENGELHARD multi-range transfer volt-ammeter with 0.05% accuracy through a frequency range d-c to 50,000 cps.

This multi-range instrument satisfies the exacting calibration requirements over a wide range of currents and voltages. High accuracy is attained without use of correction factors.

The functional design of this transfer standard, employing the null principle, provides operation sufficiently simple for non-technical operators. Results are read on the external d-c potentiometer in a conventional way and multiplied by convenient round numbers to give measured current or voltage to 0.05%, without correction, continuously over the frequency spectrum from d-c to 50,000 cps. To achieve the accuracy which the Hermach-Engelhard Transfer Volt-Ammeter provides across the whole audio frequency range, a whole battery of the usual measuring devices would be needed.

To provide efficient adaptability to various conditions of application, several models can be obtained. They are portable, simple and economical to maintain.

INSTRUMENTS AND SYSTEMS DIVISION • 850 PASSAIC AVENUE
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CIRCLE 230 ON READER-SERVICE CARD



Send for complete literature.

a complete range of brush materials for printed circuit applications.

Because the correct choice of contact materials for use on printed circuits is wholly dependent upon such factors as type of circuit, circuit function and mechanical design, the final selection of materials is generally obtained on an empirical basis.

Baker engineers and metallurgists are prepared to offer very broad, specialized experience, together with extensive records of performance data that can be extremely useful to you. They will be pleased to assist in resolving your particular problems in this field.

Baker-developed alloys and powdered metal products meet the full range of brush material requirements for printed circuit applications. Complete facilities are available here for reliable design and manufacture. Send for literature.

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PROMPT PRECIOUS METAL SCRAP RECOVERY SERVICE • ENGLHARD PROCEDURES RECOVER UP TO 95% OF

ELECTRONIC DESIGN • July 6, 1960

for detection and measurement of oxygen or hydrogen impurities in other gases

MINOXO INDICATOR... measures traces of molecular oxygen in other gases—from 1 to 10 parts per million, and from 1 to 100 PPM. High sensitivity and rapid speed of response enable it to be used for laboratory investigation and production quality control.

SUPER-SENSITIVE DEOXO INDICATOR... measures oxygen or hydrogen present as impurities in other gases—from 2 to 200 parts per million oxygen and 4 to 400 parts per million hydrogen. Dual range permits measurement up to .25% oxygen or .50% hydrogen. Send for literature.

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CIRCLE 232 ON READER-SERVICE CARD

SUPER-SENSITIVE
DEOXO INDICATOR

MINOXO
INDICATOR



corrosion-resistant rhodium plating

The properties of Rhodium are particularly well-suited to many electrical and electronic applications. In general, Rhodium improves efficiency whenever a low-resistance, long-wearing, oxide-free contact is required. Rhodium plate assures low noise level for moving contacts, no oxide rectification, low and stable contact resistance. Rhodium plated slip rings and commutators show negligible wear. The positive action of plated contacts subjected to long periods of inactivity emphasizes the efficiency of Rhodium for safety alarm contacts. Excellent protection against atmospheric corrosion is obtained for printed circuits by plating Rhodium over nickel to assure long wear and low noise, or Rhodium over Silver to protect against tarnish and corrosion.

In the realm of high and ultra-high frequency the high resistance of Rhodium to surface corrosion under all atmospheric conditions is specially useful. Oxide-free contacts eliminate partial rectification and unwanted signals.

Call for technical assistance or write for literature.

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CIRCLE 233 ON READER-SERVICE CARD

CRYSTAL STRUCTURE	FACE CENTERED CUBIC A° 3.7954
ATOMIC WEIGHT	102.91
DENSITY	12.44
MELTING POINT	1966°C
DEF. OF LIN. EXPANSION	8.19 X 10 ⁻⁶ 0°C, PER °C
THERMAL CONDUCTIVITY	(0°C) 213 C.G.S. UNITS
ELECTIVITY ELECTROPLATE	78% AT-620 MU
HARDNESS ELECTROPLATE	540-640 V.H.N. 20GRAM LOAD

Simplification With Flexibility Is Keynote of British IEA Show

Five hundred exhibitors from 15 countries displayed their wares at the Third International Instruments, Electronics, and Automation Exhibition at London's Olympia exhibition hall last month. The accent was on simplification with flexibility. Observers noted a tendency towards more complex instruments and systems packaged in smaller and more flexible subassemblies.

Mullard Equipment Ltd. showed four ranges of electronic subassembly "building bricks" and counters, described as "the shortest route from block diagram to complete equipment":

1. Preset counters for multiple programs in industrial control equipment.
2. Plug-in decade counting units.
3. Combi-element "building bricks" for electronic equipment—a comprehensive set of completely transistorized circuits, including flip-flops, multivibrators, pulse-shapers and inverters. These units can be used for nonsynchronous or synchronous logic.
4. Norbit "building bricks" for industrial control systems, using transistors as the basic switching unit. Applications include machine or lathe control and shape recognition and control.

Computer of Compact Versatility

Ferranti Ltd. played a variation on the same theme of compact simplicity without sacrifice of functional versatility. At Olympia the company displayed the prototype of a small, general-purpose, all-transistorized, digital computer called Sirius.

The basic store in Sirius is 1,000 words, each of 10 decimal digits. It can be extended to a maximum of 10,000 words by inserting plug-in packages. Basic digit frequency is 500 kc. Word-time is 80 μsec. The computer uses pulse techniques with transformers. Union transformer circuit is arranged to provide an output when a majority of the inputs are positive. Any of the four primary windings on the transformer can be reversed to provide an inhibit input.

Many potential users have distinctive needs which can be met neither by a "fixed" computer nor by a "fixed" data-processing system. For those firms the only answer is a flexible nucleus, around which *ad hoc* systems can be built.

Such are the new Stantec Computing Systems, exhibited by Standard Telephones and Cables Ltd. In each system the nucleus is a Stantec Computer.

The basic Stantec has a word-time of 312 μsec. Its main store is a magnetic drum (capacity 8,192 words; speed 6,000 rpm). For additional storage, various magnetic-tape equipment is available.

100% OF ASSAYED PRECIOUS METAL CONTENT • IRVINGTON-BAKER REFINING DIVISION

CIRCLE 230-231-232-233 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 1960

Another new Hydro-Aire product
for the aircraft, missile support,
missile and electronics industries



Ready Now! A Reliable Family of Transistorized Time Delay Devices —available on time from Hydro-Aire

These fully-transistorized time delay devices are but nine of a widely diversified family including relays, sequence timers, computer timing modules and time-programmed, system supervising units—all custom-designed, built and on-time delivered by Hydro-Aire. Perhaps one of these proven designs meets your specifications. If not, we will custom-design to your requirement. All of our time delay devices are compactly designed, available for AC or DC operation, and conform to applicable Mil Specs. These devices typify the many reliable electronic products being designed, developed, produced and on-time delivered by Hydro-Aire.

CHARACTERISTICS: TIME DELAY RELAY MODEL 50-085

Size— $2\frac{3}{8}$ " x $1\frac{1}{2}$ " x $1\frac{1}{2}$ "

Weight—4 oz.

Time delay range—adjustable over one decade; 6 to 60 seconds with $\pm 5\%$ accuracy

Life: 100,000 operations at rated contact load

Maximum power required: 50 ma at 24-31 VDC

Temperature range: -55°C to $+71^{\circ}\text{C}$ as standard; to $+125^{\circ}\text{C}$ available on special request

WRITE FOR ELECTRONICS CATALOG. A note on your letterhead brings a free copy, containing detailed facts and specifications. If you have a time delay device requirement, include your specifications for a prompt quote.



NEWS

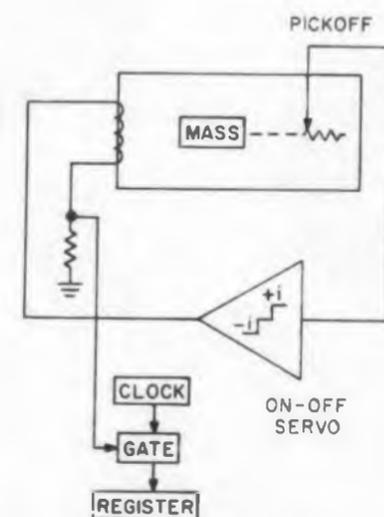
Guidance System Uses

Could Be Employed
In Aircraft, Missiles

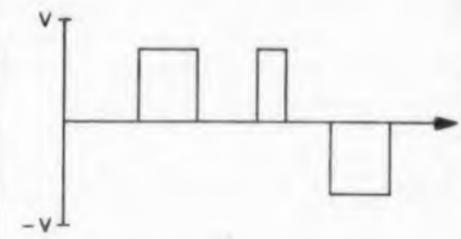
AN OPERATING inertial guidance system using micromodule electronics has been built by Radio Corp. of America's Missile Electronics and Controls Div., Burlington, Mass.

Performance of the system could typically navigate an aircraft within 1 to 3 mph, or control missile cut-off velocity within 0.05 per cent. Significant improvements over this performance are expected in planned micromodule inertial systems, according to RCA engineers.

A digital differential analyzer will include about 1,500 transistors and 600 diodes in 600 micromodules. Some of the modules will not be full

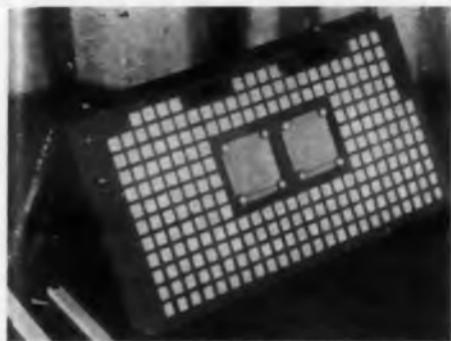


Basic operation of the digital velocity meter for use with the RCA micromodule inertial guidance system is shown. Positive and negative signals used to null an inertial mass are gated. These nulling voltages can be integrated by computer circuits to provide velocity measurements.



◀ CIRCLE 16 ON READER-SERVICE CARD

Uses Micromodules



Model of micromodule digital differential analyzer being built by RCA for use with the micromodule inertial guidance system.

sized so that circuit interconnection problems are simplified, RCA engineers explained.

Some Electronics on Inner Gimbal

Micromodularized preamplifiers are carried on the inner gimbal of the system, allowing the number of slip-rings to be cut by 30 per cent. This could have been reduced further, but it was felt that the use of alternate current paths to increase reliability was a more important consideration.

An "egg-crate" type package has been used for micromodules. Each module is held tightly in place by a frame spring insert, designed to carry heat from module wall to the crate wall.

The inertial system can provide as gimbal output angles either a resolver or synchro output with accuracy up to 1 min, or an unambiguous 14-bit digital serial output.

A digital velocity meter has been designed for use with the inertial system. If the inertial mass in this system moves in one direction, an on-off servo provides a nulling signal. The nulling signals are directed into a gating system which is also receiving clock pulses.

The gating logic combined with the clock pulses supplies an acceleration input to the navigation computer. This is integrated to provide a velocity measurement. ■ ■

CIRCLE 17 ON READER-SERVICE CARD >

SMALL APPETITE NOISE SOURCES

service-proved and available now



Until recently signal simulators for monitoring radar receivers or microwave relays were of two types. One was a big and heavy ampere eater with cumbersome auxiliary equipment; and the other was a sensitive though delicate instrument suitable only for the laboratory.

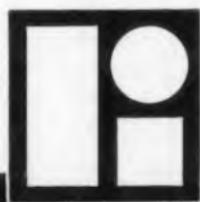
We call your attention now to the Litton 2000 series of miniature gas noise sources. The Litton 2000 for waveguide use is pictured above. It has a first cousin, the Litton 2007 designed for coaxial cable use. We call your attention because most tubes in this series are now in production and we suspect there are frustrated design engineers who will receive this announcement with keen interest.

Our gas noise sources may properly be called miniature. They require only inches of space, smaller, lighter auxiliary equipment, and small voltages and currents. Around 500 volts fires them; 100 milliamperes maintains them. These characteristics, plus others, have caused them to find numerous applications: for in-flight calibration and test of aircraft

microwave receivers; as *automatic* watchdogs on airborne radar systems; and in other systems which require various immunities to vibration, shock, humidity, and temperature cycling.

The Litton family of miniature gas noise sources, like all Electron Tube Division products, was designed to solve specific end item functions. We have found that this philosophy contributes to consistent reliability: tubes do their jobs more efficiently, for longer periods of time, and at lower overall cost to the buyer. Other advantages also result. For example, these noise sources require *no* ageing-in and the L-2000 is replaceable in the field without changing the mount.

Specific frequency ranges in L, S, C, X and K bands are covered. If you are concerned with radar transmission, or with microwave data links of any kind, we'll gladly send you more information. Write to Litton Industries Electron Tube Division, Office E42, 960 Industrial Road, San Carlos, Calif.



LITTON INDUSTRIES Electron Tube Division

BARRATRON® TRANSMITTING TUBES • MAGNETRONS • KLYSTRONS • TRAVELING WAVE TUBES • BACKWARD WAVE OSCILLATORS • GAS DISCHARGE TUBES • NOISE SOURCES • CROSSED-FIELD AMPLIFIERS • HIGH DEFINITION CRT DIRECT-WRITING CRT • COLOR CRT • STORAGE TUBES • MICROWAVE FILTERS • DUPLEXERS • TR TUBES

CAPABILITY THAT CAN CHANGE YOUR PLANNING

NEWS

Nuclear Weather Detector To Aid Nation's Forecasters

A nuclear weather detector, called Tracersonde, is under development by Tracerlab of Waltham, Mass., for the U.S. Weather Bureau.

The Tracersonde will be similar in size, weight, and appearance to a conventional Weather Bureau Weathersonde normally borne aloft by a balloon to radio back to earth information about temperature, barometric pressure, and humidity at various heights. In operation, the Tracersonde will differ from the Weathersonde in that it will use ultrasensitive radio-chemical detection techniques to determine ozone and radioactive chemical, "clathrate," in the apparatus.

This reaction produces an effluent radioactive gas which is detected by a Geiger tube. The amount of gas that is produced is proportional to the concentration of ozone at any given point.

Tracersonde has grown out of two recent scientific breakthroughs. First is the development by Tracerlab scientists of "clathrate," and the second is the meteorological theory that weather patterns could be more readily predicted if our weathermen had more information about the ozone clouds caused by solar radiation.

3-D Closed-Circuit System Employs Double Polarized Image

A three-dimensional closed-circuit television system has been developed by Kin Tel Div. of Cohu Electronics, Inc.

The system consists of two standard Kin Tel closed-circuit cameras, two camera-control units, and a polarized optical system. The optical system presents the overlapping images from each camera on a single viewing plane, with one image polarized vertically and the other horizontally.

Watching the image through special polarized glasses or a viewing hood gives a 3-D effect.

The system has automatic compensation for light levels up to 4,000 to 1 and maximum full-range adjustment time of 0.25 sec. One line, the 1988, uses equal horizontal and vertical resolution greater than 500 lines; the 1986 system has a vertical resolution of 650 lines and a horizontal resolution of 525 lines. Depth perception may be accentuated by camera separation and the unit may be switched from 3-D to normal two-dimensional viewing.

The standard unit employs 14 in. monitors, but the manufacturer can supply systems with monitors ranging in size from 8 in. to 27 in. Price on the standard model is \$9,500.



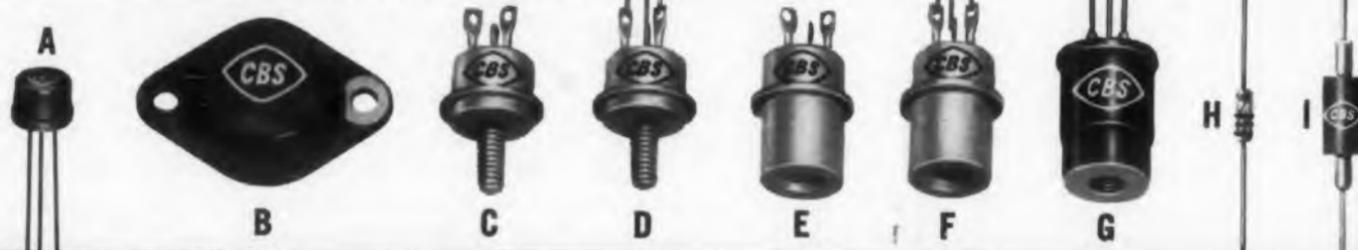
semiconductors

ACCENT RELIABILITY

FOR GOVERNMENT
• INDUSTRIAL
• ENTERTAINMENT USE

Reliability is the outstanding characteristic of CBS semiconductor products. The comprehensive line particularly emphasizes dependable diodes and transistors for data processing. Check the tables for types you need. Write or ask for complete technical bulletins listed for specific types. Order CBS semiconductors direct... from your local sales office... or your Manufacturer, Warehousing Distributor.

Male and female industrial types are also available with leads, as in case D and F



NPN SWITCHING TRANSISTORS

TYPE	Min. BV _{ceo} (Volts)	Typical f _{cb} Mc.	Case	Bulletin
2N306	20	1	A	E-354
2N312	15	2	A	E-346
2N356	20	3	A	E-297A
2N356A	30	3	A	E-372
2N357	20	6	A	E-297A
2N358	20	9	A	E-297A
2N377	25	5	A	E-335
2N385	25	6	A	E-335
2N388	25	8	A	E-335
2N438	30	4	A	E-336
2N438A	30	4	A	E-336
2N439	30	8	A	E-336
2N439A	30	8	A	E-336
2N440	30	12	A	E-336
2N440A	30	12	A	E-336
2N444	15	1	A	E-354
2N445	15	3	A	E-354
2N446	15	8	A	E-354
2N447	15	10	A	E-354
2N556	25	1	A	E-346
2N558	15	3	A	E-346
2N634	20	8	A	E-349
2N635	20	12	A	E-349
2N636	20	17	A	E-349
2N1000	40	9	A	E-346
2N1012	40	5	A	E-348

PNP POWER TRANSISTORS

TYPE	Max. W Diss.†	Max. V _{ceo}	Case	Bulletin
2N101	17	-30	E	2N101
2N143	17	-60	E	2N143

TYPE	Max. W Diss.*	Max. V _{ceo}	Case	Bulletin
2N155	20	-30	B	E-341
2N156	20	-30	G	E-259A
2N157	20	-60	B	E-288A
2N157A	20	-100	B	E-288A
2N158 JAN	20	-60	G	E-259A
2N158A	20	-80	G	E-259A
2N235A	25	-50	B	E-345
2N235B	25	-50	B	E-345
2N236A	25	-50	B	E-345
2N236B	25	-50	B	E-345
2N242	25	-45	B	E-345
2N257	25	-40	B	E-345
2N265A	25	-40	B	E-345
2N267A	35	-60	B	E-345
2N301	35	-40	B	E-345
2N301A	35	-60	B	E-345
2N390	25	-40	B	E-385
2N1070	20	-60	E	E-360
2N1291	20	-35	B	E-355
2N1293	20	-60	B	E-355
2N1295	20	-80	B	E-355
2N1297	20	-100	B	E-355
2N1320	20	-35	C	E-360
2N1322	20	-60	C	E-360
2N1324	20	-80	C	E-360
2N1326	20	-100	C	E-360
2N1328	20	-35	E	E-360
2N1331	20	-80	E	E-360
2N1333	20	-100	E	E-360
2N1433	35	-80	C	E-370
2N1434	35	-80	C	E-370
2N1435	35	-80	C	E-370
2N1437	20	-100	E	E-381
2N1438	20	-100	C	E-381
2N1453	40	-30	E	E-386
2N1455	40	-60	E	E-386
2N1457	40	-80	E	E-386
2N1461	40	-30	C	E-382
2N1463	40	-60	C	E-382

TYPE	Max. W Diss.†	Max. V _{CSO}	Case	Bulletin
2N1465	20	-120	C	E-383
2N1466	20	-120	E	E-383
2N1504	20	-80	G*	E-384
LT-5026	20	-30	E	E-288A
LT-5027	20	-30	C	E-288A
LT-5028	20	-30	B	E-288A
LT-5032	20	-60	E	E-288A
LT-5033	20	-60	C	E-288A
LT-5034	20	-60	B	E-288A
LT-5045	20	-120	B	E-288A
LT-5081	40	-30	E	E-288A
LT-5082	40	-30	C	E-288A
LT-5100	40	-60	E	E-288A
LT-5101	40	-60	C	E-288A
LT-5102	40	-80	B	E-288A
LT-5153	20	-60	E	E-288A

†Base mounting temperature.

*Special male version with 8-32 stud.

NPN POWER TRANSISTORS

TYPE	Max. W Diss.†	Max. V _{CSO}	Case	Bulletin
2N102	17	30	E	2N102
2N144	17	60	E	2N144
2N320	7	35	B	E-355
2N1292	25	35	B	E-355
2N1294	25	60	B	E-355
2N1296	25	80	B	E-355
2N1298	25	100	B	E-355
2N1321	25	35	C	E-360
2N1323	25	60	C	E-360
2N1325	25	80	C	E-360
2N1327	25	100	C	E-360
2N1329	25	35	E	E-360
2N1330	25	60	E	E-360
2N1332	25	80	E	E-360
2N1334	25	100	E	E-360

†Base mounting temperature.

DIFFUSED-SILICON DIODES

TYPE	Min. Reverse V @ 100μA	Min. Avg. Forward @ 1v mA @ 25°C	Case	Bulletin
1N482	-40	100	H	E-373
1N483	-80	100	H	E-373
1N484	-150	100	H	E-373
1N485	-200	100	H	E-373
1N625	-35	20	H	E-374
1N626	-50	20	H	E-374
1N627	-100	20	H	E-374
1N628	-150	20	H	E-374
1N629	-200	20	H	E-374

DIUM-BONDED DIODES

TYPE	Peak Reverse Volts	Min. Forward MA, +1V	Case	Bulletin
1N95	-75	10	H	E-314R
1N96	-75	20	H	E-314R
1N97	-100	10	H	E-314R
1N98	-100	20	H	E-314R
1N99	-100	10	H	E-314R
1N100	-100	20	H	E-314R
1N107	-15	150	H	E-314R
1N108	-60	50	H	E-314R

TYPE	Peak Reverse Volts	Min. Forward MA, +1V	Case	Bulletin
1N117	-75	10	H	E-314R
1N118	-75	20	H	E-314R
1N273	-30	100	H	E-314R
1N276 JAN	-75	40	H	E-314R
1N278	-60	20	H	E-314R
1N279	-35	100	H	E-314R
1N281	-75	100	H	E-314R
1N283	-20	200	H	E-314R
1N287	-60	20	H	E-314R
1N288	-85	40	H	E-314R
1N289	-85	20	H	E-314R
1N296	-85	30 @ 2V	H	E-314R
1N447	-50	25	H	E-314R
1N497	-30	100	H	E-314R
1N498	-50	100	H	E-314R
1N499	-65	100	H	E-314R
1N500	-75	100	H	E-314R
1N631	-70	100	H	E-314R
1N634	-115	50	H	E-314R
1N699	-105 @ 70°C	100	H	E-314R
1N770		15 @ 0.5V	H	E-314R
LD-70	-15	100	H	E-314R
LD-71	-15	2 @ 0.4V	H	E-314R
LD-123	-35	100	H	E-314R
LD-125	-75	10	H	E-314R
LD-141	-80	20	H	E-314R
LD-143	-75	40	H	E-314R

GENERAL-PURPOSE DIODES

TYPE	Peak Reverse Volts	Min. Forward MA, +1V	Case	Bulletin
1N34/A	-75	5	H, I	E-217A
1N35	-75	7.5	H	E-217A
1N38/A/B	-120	4 to 25	H, I	E-217A
1N39A	-225	5	I	E-217A
1N40	-85	4	H, I	E-217A
1N51	-50	2.5	H, I	E-217A
1N52	-85	4	H, I	E-217A
1N54/A	50/75	5	H, I	E-217A
1N55/A	-170	4	I	E-217A
1N58/A	-50	15	H, I	E-217A
1N59/A	-120	5	H, I	E-217A
1N60	-30	3	H	E-217A
1N63	-125	4	H, I	E-217A
1N64	-20	—	H, I	E-217A
1N65	-85	2.5	H, I	E-217A
1N67/A	-100	4	H, I	E-217A
1N68/A	-130	3	H	E-217A
1N69/A	-75	5-25	I	E-217A
1N70/A	-125	3-25	I	E-217A
1N75	-125	2.5	H, I	E-217A
1N81/A	-50	3-25	I	E-217A
1N82	-5	—	I	E-217A
1N82A	-5	—	H, I	E-217A
1N90	-75	5	H	E-217A
1N116	-75	5	H	E-217A
1N126/A JAN	-75	5-25	H	E-217A
1N127/A JAN	-125	3-25	H	E-217A
1N128 JAN	-50	3	H	E-217A
1N191	-105	5	H	E-217A
1N192	-80	5	H	E-217A
1N196 JAN	-100	4	H	E-217A
1N230	-120	5	H	E-217A
1N294	-70	5	H	E-217A
1N295	-50	—	H	E-217A
1N541	-30	1.5	H	E-217A
1N636	-60	2.5	H	E-217A
LD-47	Del.	FM, AM	H	E-217A
LD-145	-60	5	H	E-217A

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CIRCLE 18 ON READER-SERVICE CARD

Honeywell Ceramic Gyro Employs a Gas Bearing

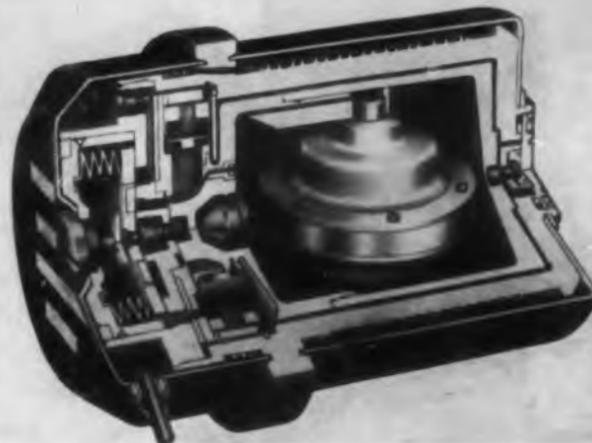
Using a new sapphire-hard ceramic and a self-generating gas bearing, Minneapolis-Honeywell has developed what it says is the aerospace industry's first ceramic gyroscope.

The gyro is also said to represent a 10-fold improvement in gyro accuracy. The combination of ceramics and gas bearings has purportedly reduced the prime causes of gyro drift inaccuracies.

A film of helium gas only 25 millionths of an inch thick flows between the bearing and the seat. The 8-oz gyro is 2.82 in. long and has a diameter of 2 in.



The tiny ceramic spin motor of the gyro is encased in its gimbal, also of ceramic. The ability of the ceramic material to withstand heat up to 1,500 F without losing its original dimensions represents a major improvement over ball bearings.



The bell-shaped part of the gyro is the new ceramic spin motor. Its interior spins at 24,000 rpm suspended on a film of helium gas only 25 millionths-in. thick.

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Basic material for the R Series is 440C stainless steel. A new type ribbon retainer, for low uniform torque, is available, as are duplexed mountings and preloaded pairs. ABEC Class 7 tolerances maintained in all types and sizes. Standard dimensions are

	Bore	O.D.	Width
R2	.125"	.375"	.156"
R3	.1875"	.500"	.156"
R4	.250"	.625"	.192"

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CIRCLE 19 ON READER-SERVICE CARD

WASHINGTON REPORT



Ephraim Kahn

VEGA-AGENA B HASSLE, which the General Accounting Office claims to have lost the government at least \$15 million, may spur officials to make sure that they have covered all bases when they check out proposed new programs. An extensive system of informational interchange already exists. In the case of the Vega and Agena-B, both upper stages for use with the Atlas as a booster, the Accounting Office's major objection seems to be that the two projects did not represent "the calculated pursuit of two alternative approaches to better insure success." The auditing agency asserts that "there was no evident communication by the Department of Defense of NASA of planning for the Atlas-B," despite that NASA (which has since cancelled the Vega) first spoke of it to representatives of the military in December 1959.

MULTIPLE SOURCES of supply for complex electronic guidance systems for missiles are being carefully examined at the Pentagon. As production needs grow, the military is getting more than a mite uncomfortable at the thought of being tied to a single producer—one that might be knocked out in a single attack, leaving a major arm of defense in the lurch. Steps have been taken to double-track supply of the Polaris guidance system in anticipation of a go-ahead this summer for stepped-up production.

SKYBOLT MISSILE'S COST is put at \$800 million by the Air Force. Through 1965, about \$200 million will go for research, development, test and evaluation of this air-launched ballistic missile while \$600 million will be spent on procurement. Costs have not been projected beyond 1965, but about \$60 million is in the 1961 budget.

INVENTIVE PROPOSALS PROCEDURE has been standardized by the Army. From now on, when unsolicited inventive proposals are received, they will be sent to the technical service thought to have primary interest. After a preliminary (and non-technical) analysis one of the following actions will be taken: (1) it will be re-referred to another technical service if this seems desirable; (2) it will be sent to the Commerce Department's National Inventors Council if the Army does not want to investigate further.

DESIGN PLAN for an advanced communications satellite system proposed by the Army is understood to have been approved by the Advanced Research Projects Agency. Known as "Project Decree," it is expected to use at least three satellites for world-wide coverage.

AIR FORCE BASIC RESEARCH will be raised over the years to just about double current levels. Target is annual expenditure of \$70 million for basic inquiry.

HEFTIER MILITARY BUDGETS are urged on the Senate by Gen. Maxwell Taylor. With more emphasis than has been permitted to military men on active duty, Taylor suggested that the Defense Department be allowed to program its needs over five years, with financing to be based on "an annual sum approximating 10 per cent of the gross national product." This would add about \$9 billion to the military's spending money.

USERS OF ELECTRONIC SYSTEMS in the Air Force will be represented when the systems are being planned by the Command and Control Systems Office, Hanscom Field, Bedford, Mass. Though the office does not yet represent all elements of the Air Force—SAC and TAC are not yet there—it expects eventually to be able to examine and criticize proposed design improvements and new systems from the viewpoints of all the men who will be working with them.

\$500 MILLION NATO AIR DEFENSE costs will be shared by the U.S., which expects to pony up about \$125 million. In fiscal 1960, about \$30 million was scheduled for buying both large and gap-filler radar equipment, and NATO is expected to get almost \$70 million more toward its air defense system in fiscal 1961. In addition, foreign allies of the U.S. will be supplied with missiles worth more than \$210 million (including almost \$22 million worth of spares and maintenance equipment). Total foreign military assistance is to cost about \$2 billion in fiscal 1961.

PATENT POLICY CHANGE is under serious study at the Defense Department. If changes are made, they will not necessarily conform to the proposals embodied in the House-passed NASA bill. If more restrictive patent policies (such as those observed before 1955) are recommended, the Pentagon will have to decide whether the contracting officer or a higher authority will be empowered to decide whether the government or the contractor should get title to patents developed in the course of work under federally financed contracts.

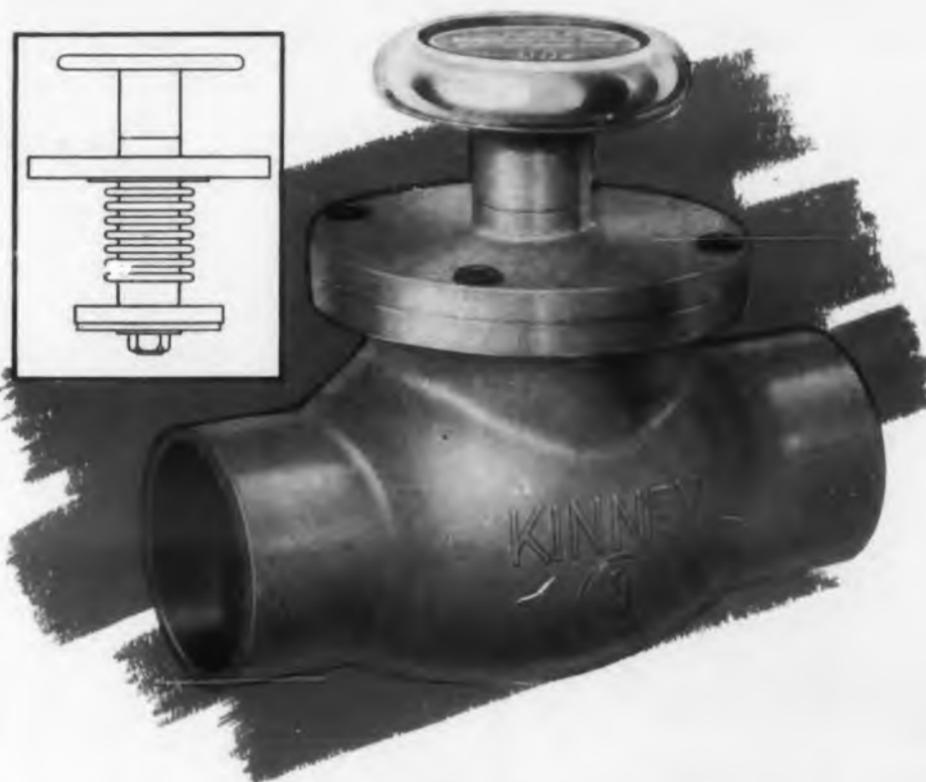
COMPETENCE AND EXPERIENCE are keys to Navy R&D contracts. Rear Adm. Charles D. Martell, Assistant Chief of Naval Operations (Development) suggests that seekers after such pacts weigh their abilities carefully and concentrate on fields in which they excel.

BETTER QUALITY CONTROL throughout the contract cycle is urged on industry by Col. J. G. Schneider, quality control chief for the Air Materiel Command. Stressing that success of a quality control program "depends as much on the industry partner of the team as on the Air Force," Col. Schneider predicts that the quality controls now being applied to ballistic missiles and space systems will in short order be expanded to other weapons systems.

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The new Series BBSM KINNEY Vacuum Valves form a reliable force of "Traffic Cops" for your Vacuum systems. In sizes 1", 1½", 2" and 3", these Bronze Bellows Sweat Fitted Valves are especially designed for Vacuum applications having soldered or brazed manifolding. They are of the globe type with non-rising stem, with positive isolation of rotating parts. The brass bellows is sealed to the seat disc and bonnet flange by static "O" rings of Buna N.

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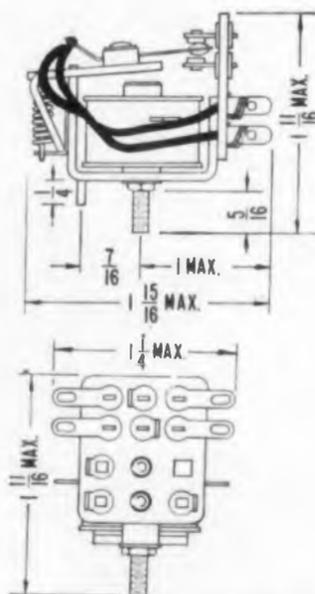
Here are only three of a large family of "K Series" relays by P&B. Blood brothers all, they are distinguished by fine craftsmanship and design maturity. Together they will handle a multitude of switching requirements.

Many design engineers find it saves time, saves money to integrate their circuits with *related* P&B relays. Makes sense, doesn't it?

KR—A small, lightweight relay used widely in communications and automation. Engineered for long life and dependability. 3PDT max. AC or DC. (See engineering data.)

KT—Designed for antenna switching. Capacitance: 0.5 mmfds between contacts. Terminal board is glass melamine and stack insulation is glass silicone for minimum RF losses to switch 300 ohm antenna line. 3 PDT max. AC or DC.

KC—Low cost plate circuit relay with sensitivity of 125 mw per pole. Factory adjusted to pull-in on specific current values. Available open, hermetically sealed or in clear plastic dust cover with standard octal-type plug. 3 PDT max. DC.



P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR

KR ENGINEERING DATA

GENERAL:
Breakdown Voltage: 500 volts rms minimum between all elements.

Temperature Range:
DC Coils—45°C to 85°C.
AC Coils—45°C to 70°C.

Terminals:
Pierced solder lugs standard. Octal 8 and 11 pin plug-in headers available.

Enclosures: Type K—Hermetically sealed.
Type P clear cellulose acetate dust cover.

CONTACTS:
Arrangements: 3 Form C (3PDT) max.
Material: 1/8" dia. fine silver (gold plated).
Other materials available to increase contact capacity.
Load: 5 amperes 115V 60 cycle resistive.

COILS:
Resistance: 16,500 ohms max. AC or DC.

Power: 1.1 watts minimum to 4 watts maximum for DC at 25°C ambient.

Duty: Continuous.
Insulation: Centrifugally impregnated with insulating varnish.

CHANGES IN PRICES AND AVAILABILITY

DIFFUSED-JUNCTION SILICON RECTIFIERS, having peak inverse voltage ratings from 100 to 600 v, have been reduced in price ranging up to 45 per cent by Radio Corp. of America of Somerville, N.J. Types affected are the following: 1N444B, 1N445B, 1N537B, 1N538, 1N539, 1N540, 1N547 and 1N1095.

MICRO-DIODES have been reduced in price by Pacific Semiconductors, Inc. of Los Angeles, Calif. The price was set at \$20 each a little less than a year ago. This announcement pegs the Micro-Diode price at the same level as several EIA counterpart types for an average price of \$3.29 each in 100 to 999 quantities. For example, Micro-Diode type 1N914 is priced at \$4.50; 1N663 at \$3.15; 1N643 at \$2.97; 1N658 at \$3.40; 1N547 at \$2.75; 1N458 at \$3.03 and 1N459 at \$3.23.

MOLDED CASE CIRCUIT BREAKERS, panel boards, safety switches, bus duct, and circuit breaker and fusible load centers have been increased 10 per cent in price by I-T-E Circuit Breaker Co. of Philadelphia, Pa.

CAPACITORS and other electronic products have been increased in price by Cornell-Dubilier Electric Corp. of Plainfield, N.J. The price changes include from 5 to 10 per cent on most dc electrolytic capacitors; 10 per cent on paper, metalized paper, oil and film types of tubular capacitors; 3 per cent on fluorescent ballast oil type capacitors and 10 per cent on most other oil type capacitors; 5 per cent on filters; 5 to 10 per cent on selected types of vibrators and power supplies.

Is your company making changes in prices or availability of its products? Send the details to **ELECTRONIC DESIGN**, 830 Third Ave., New York 22, N.Y.

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CIRCLE 22

British Show Design Ideas At New York Exhibition

An aircraft-control system using direction finders to track planes and a closed-circuit TV system to display the tracking data was introduced at the British Exhibition in New York by Standard Telephone and Cables, Ltd., England.

The system was part of a wide assortment of British electronic equipment on display from both industrial and commercial segments of the industry.

The STC system uses wide aperture direction finders at several locations operating on communications frequencies to locate aircraft by triangulation. The bearing is sent to a control center and displayed on a cathode-ray tube indicator in the form of a bearing line.

Mirrors over various crt's reflect bearing traces so that they can be superimposed onto a TV display map of the area.

Automated Cigarette Equipment Shown

A full-scale electronically automated cigarette production system was displayed in action by Molins Machine Co., Ltd., London. A machine which automatically produces 350 filter tip cigarettes a minute at about \$50,000, according to a company spokesman.

An atomic reactor simulator was shown by Vickers-Armstrongs (Aircraft) Ltd. This equipment was designed primarily for use in education and for research laboratories.



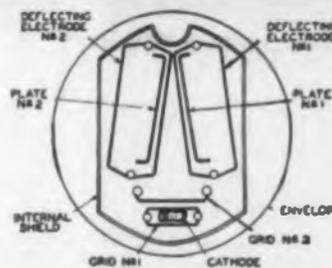
Bill Bruce and his latest torture machine...

To people, Bill Bruce may be the essence of gentleness, but to new industrial receiving tubes he's a demon!

As head of RCA Receiving-Tube Test Engineering, Bill delights in tormenting our tubes: seeing what they will deliver, how much they'll take. When existing torture methods aren't cruel enough, Bill gleefully designs new ones.

The object before him is a good example. It's a test set he designed to put our new RCA-7360 Beam-Deflection Tube through its paces. The 7360, which is rapidly revolutionizing SSB circuitry, utilizes such a radically new design concept that no existing equipment could prove its capabilities.

Bill's latest testing device, built for a single tube type, is an indication of how far we go at RCA to insure top quality in every tube. It's another reason why you know the tube will do the job when it's made by RCA.



Cross section, RCA-7360 Beam Deflection Tube

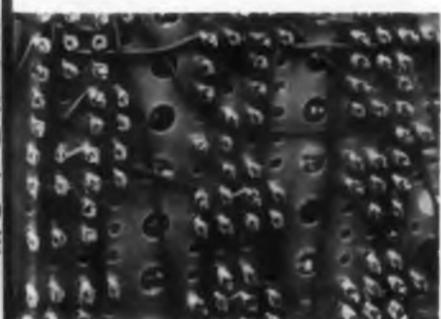
Special deflecting electrodes permit flow of electron beams to plates with minimum interception of current. This assures high sensitivity and μ_m plus excellent SSB carrier suppression.

FREE technical literature explains principles and capabilities of RCA-7360. Write Commercial Engineering, RCA Electron Tube Div., Harrison, N. J.

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Component leads are pushed through holes in punched plastic boards and connected by wires in the telegraph switching system displayed by Standard Telephone and Cables Ltd. at the British Exhibition.

Space Computer Designed at MIT

Use of "Core Rope" Linear Select Memory, Split Clock Cycles Used in Mars Computer

A COMPUTER for a three-year round trip to Mars has been accomplished by Massachusetts Institute of Technology's Instrumentation Laboratory.

The object of the program was to develop design approaches to the space-computer problem rather than a specific machine, Dr. R. L. Alonzo, Instrumentation Lab staff member, explained at the recent National Specialists Meeting on Guid-

ance of Aerospace Vehicles in Boston. A typical machine was designed, however, to illustrate the principles evolved.

The critical periods for a computer on such a flight would be at in-flight correction points and during the approach to Mars, according to Dr. Alonzo and his co-worker, Dr. J. Halcombe Laning Jr., deputy associate director of the Lab.

Because of the long, relatively inactive periods

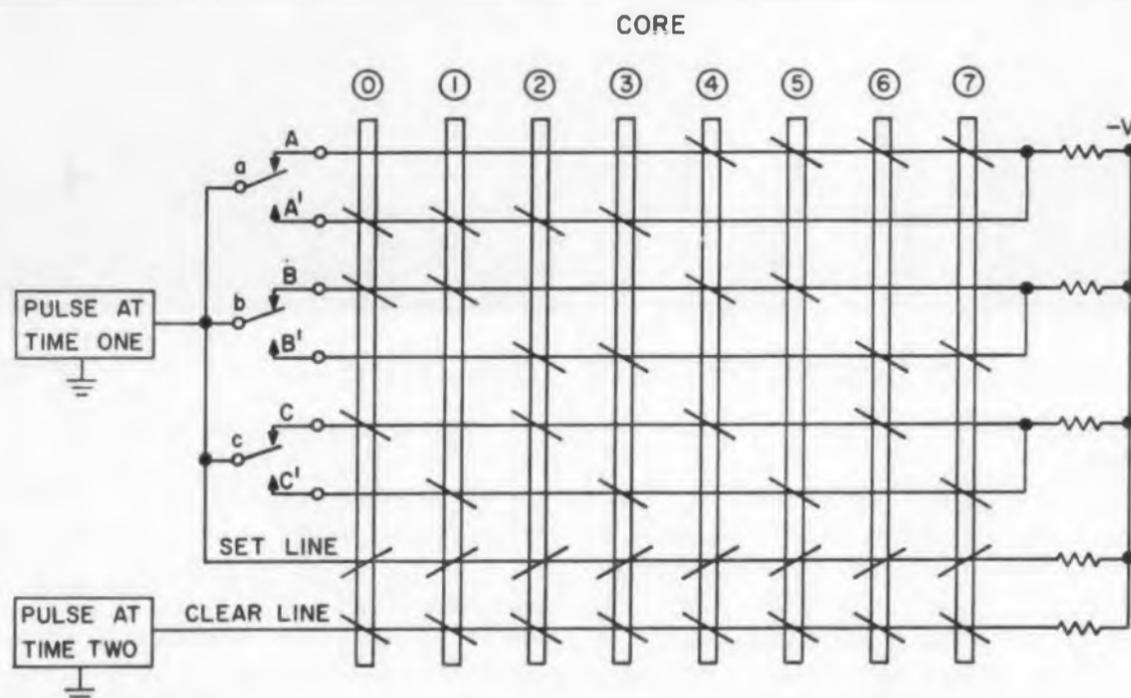
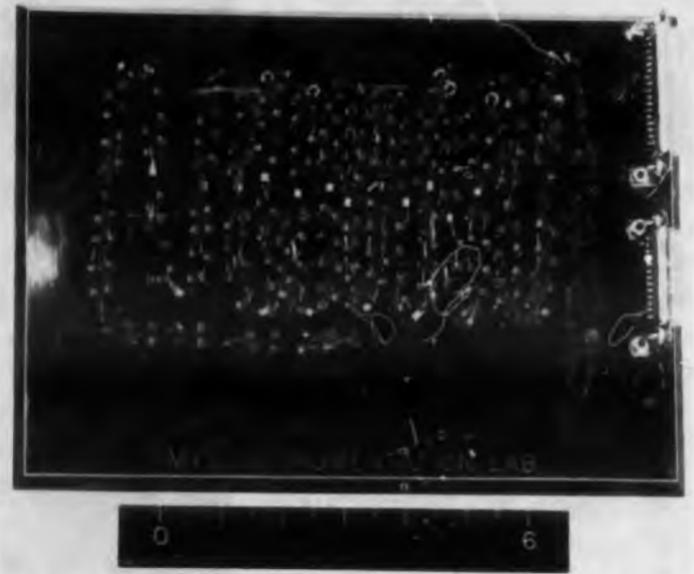


Fig. 1. Selection of a core in an eight-core rope is illustrated. Numbered vertical strips represent cores, and wires A, A', B, B', C, and C' are inhibit wires. Slashes represent the direction of wire threading through the core. All cores are initially at ZERO. At time one a pulse in the set line attempts to set all cores to ONE. With electronic switches a, b and c as shown, however, the pulse only passes through positions A, B and C. Where an inhibit wire is threaded through the core as indicated by slashes, the setting is prevented. Thus wire A inhibits cores 4, 5, 6 and 7; wire B inhibits cores 0 and 1; and wire C inhibits core 2. Thus core 3 is selected by this position of the switches a, b and c. Cores are selected by setting these switches.



Breadboarded 256 core rope is capable of holding 256 words of 8 bits each in fixed storage.

between these points in the flight it was decided to make power consumption proportional to speed of operation, so that low-powered, leisurely computation can be performed during these periods.

Need Flexibility for Emergencies

Flexibility is required because the problems of a Mars flight are not completely known and the computer must be programed for emergencies.

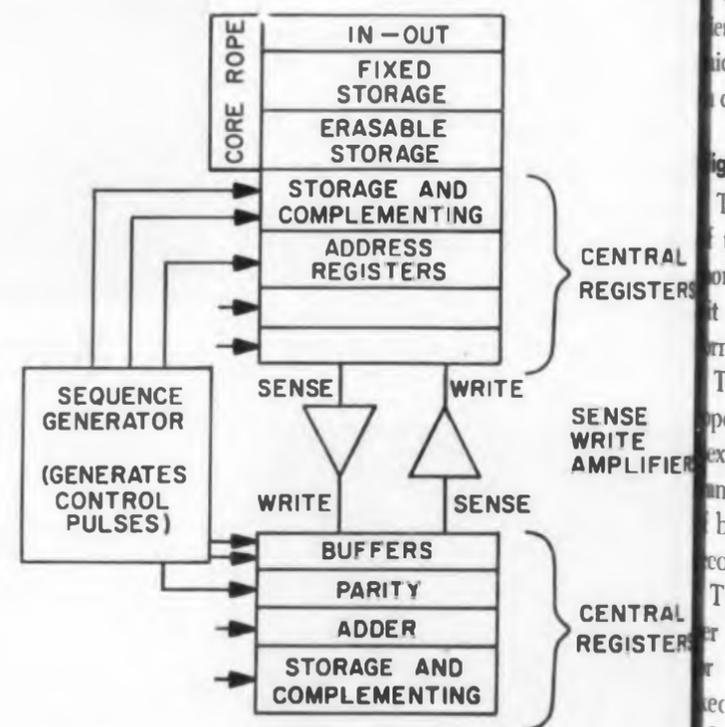
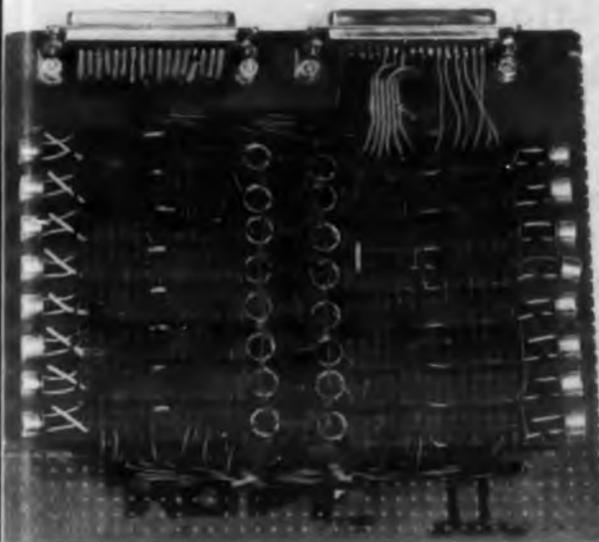


Fig. 2. Organization of the space computer designed by MIT's Instrumentation Lab shows how central registers are split into two groups. During the first, or α , portion of clock pulse information flows through the left sense-write amplifier toward the buffers. During the second, or β portion of the clock cycle the flow is in the reverse direction toward the erasable storage.



erasable-storage unit has 16 registers capable of holding 12 bits each. A core rope for selecting a register is at the center.

During the flight, a priority circuit continuously monitors some 100 input lines from various points in the vehicle. Activity in one of these lines presents an alarm, so that the computer immediately stops the task it is working on to deal with the input.

The speed of computation can be increased according to the input requirements, and then slowed again when the computer automatically returns to its previous task.

Continuous monitoring is felt to be more efficient than a sequential-type scan, Dr. Alonzo said, because scanning would require an increase in computer speed with added input channels.

High-Density Storage Cuts Size

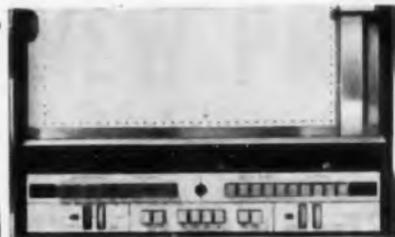
To minimize size and weight, various portions of the computer have been designed to handle more than one task. Addition is synthesized using bit by bit OR circuits, and multiplication is performed by use of a subroutine.

The computer memory is based on the "core rope" memory developed by Lincoln Laboratories, Lexington, Mass. Cores are used as ac-coupled transformers for fixed storage so that the number of bits stored per core depends on the number of secondary windings on the cores.

The erasable-storage section requires one core per bit. The major computer storage requirements for such a trip, however, is for constants and fixed program.

In the MIT design, about 4,000 words of fixed storage and 128 words of volatile storage are specified.

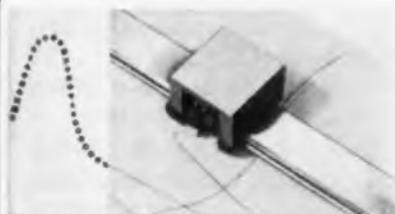
Fixed-memory storage density is about 1,000 bits per cu in.—about 100 times greater than present computer memories, according to Dr. Alonzo.



PUSH BUTTON PANEL controls operations rapidly, even at remote locations.

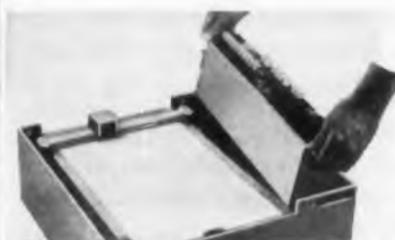


FLAT VACUUM PLATEN assures positive hold down of roll or sheet paper up to 12 1/4" width. Plot area, standard 10x15".

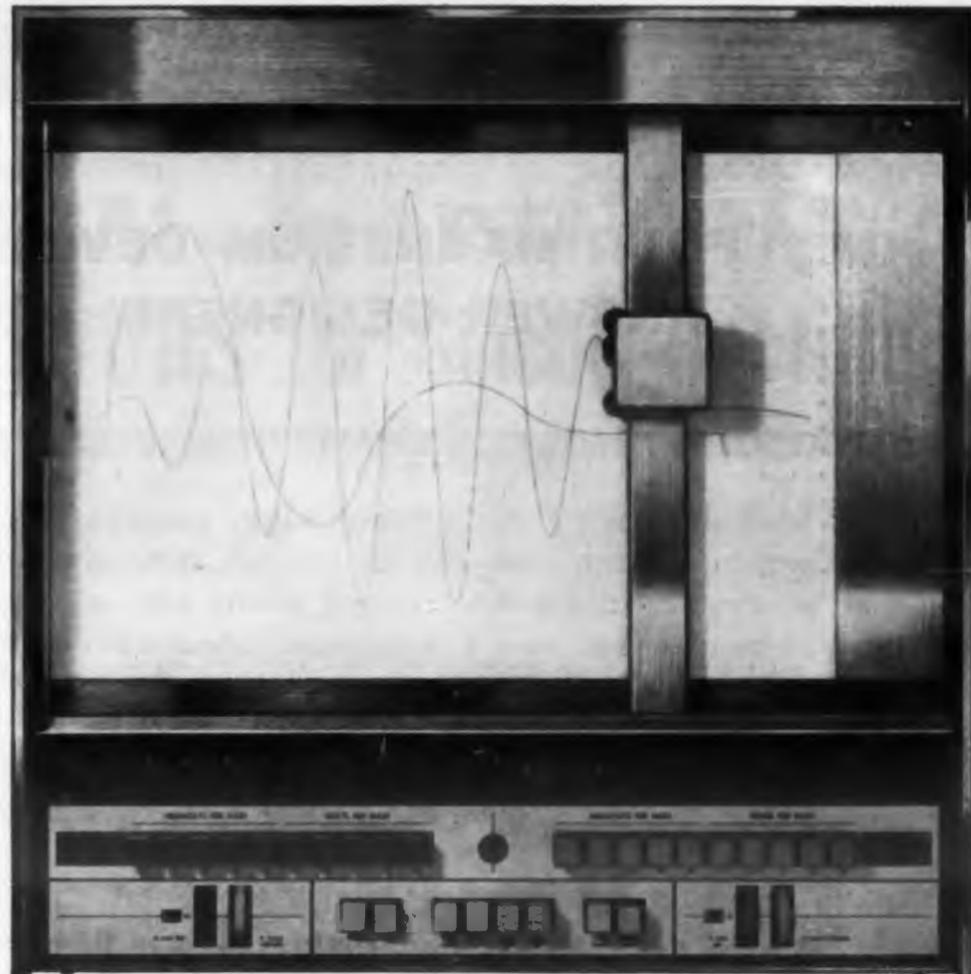
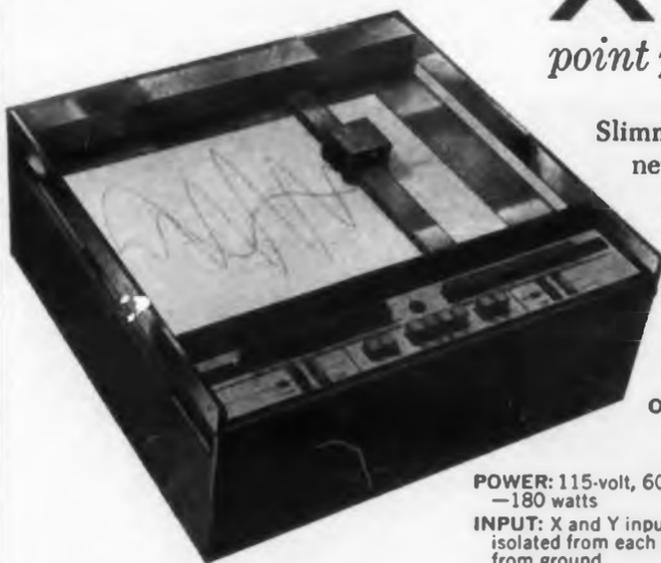


PRINTING FEATURES: Multiple symbol printing head—12 symbols...self contained ink supply.

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INTERCHANGEABLE MODULES add versatility...interchange with basic control section.



engineered for ease of operation...new

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Slimmer, flatter, push-button fast...Librascope's newest, most advanced plotter is the result of personally-conducted field research by Librascope engineers. Compact design permits rack mounting in groups, saves desk space. Many new conveniences have been added to answer *your* needs.

OPERATING INFORMATION

POWER: 115-volt, 60 cycle
—180 watts

INPUT: X and Y inputs isolated from each other and from ground.

INPUT RESISTANCE: 2 megohms nominal on most scales. 1 megohm per volt on .5 millivolts per inch to .1 volts per inch scales.

INPUT SENSITIVITY: .5 millivolts per inch to 50 volts per inch with calibrated push button scales at .5, .1, 5, 10 and 50 millivolts per inch and .1, .5, 1, 5 and 10 volts per inch. Vernier controls permit continuous sensitivity adjustment between fixed scales, permitting full scale plotting for any sensitivity.

ACCURACY: Static .1%, dynamic .2% at 10° per second.

PLOTTER CALIBRATION ACCURACY: .05% on all scales.

SLEWING SPEED: 20° per second.

For full details — dimensions, applications, list of accessory equipment, call our Sales Engineering Department or send for illustrated brochure on Model 210, XY Plotter.

For information on career opportunities at Librascope, write Glen Seltzer, Employment Manager.

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LI 9-20

FOUR MAGNESIUM DEVELOPMENTS ANSWER DESIGNERS' PROBLEMS

New Dow developments in magnesium provide solutions to critical problems for aircraft, missile and electronics designers. Among them are: a special bend sheet; new close sheet tolerances; precision extrusions; elevated temperature alloys.



Heated dies are not necessary with Special Bend sheet.

NEW SPECIAL BEND SHEET bends easily on standard bending equipment at room temperature. This AZ31B-O Special Bend sheet can be cold-bent

without cracking through an angle of 90 degrees around a mandrel radius equal to the bend factor times the nominal sheet thickness . . . bend factor for .040" to .100" sheet thickness is 2.0! And tensile yield strength meets the requirements of Federal Specification QQ-M-44.

NEW CLOSE SHEET TOLERANCES can now be obtained on standard gauges when required. For example, on .090" gauge, 48-inch-wide sheet, tolerances can now be held as close as plus or minus .002". Standard tolerances run plus or minus .004". These closer tolerances help to cut down on weight



Magnesium gives greater rigidity for equal weight than other metals.

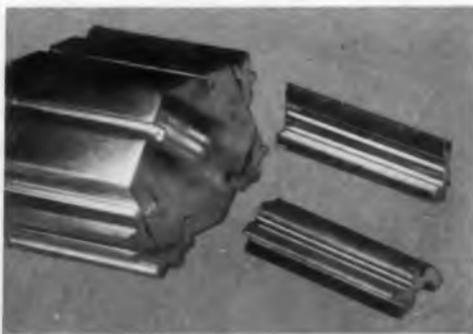
penalty, so important in missile and aircraft design.

PRECISION MAGNESIUM EXTRUSIONS from Dow give you exact-tolerance parts without costly multiple machining operations. Sharp V's, deep notches, thin slots, accurate serrations . . . all can be economically produced in Dow's Madison, Illinois, extrusion plant.

LARGE EXTRUSIONS. A huge 13,200-ton press easily handles large sections, stepped extrusions, combined extrusion forgings and single unit extrusions to replace fabrications. This giant can handle sections of up to a 30-inch circumscribed circle!

ELEVATED TEMPERATURE ALLOYS are available from Dow for extruded and rolled products. These alloys have excellent static and creep properties, some up to or above 700°F. Because of magnesium's high specific heat, it's an excellent heat sink for instruments and components!

Compared pound for pound with other metals, magnesium permits the use of heavier-gauge, more rigid sections for extra structural strength . . . and substantial weight savings!



Dow precision-extrudes magnesium in almost any cross-sectional shape.

For more information on these products, and on Dow's fabrication facilities for magnesium and aluminum, contact the nearest Dow sales office, or write THE DOW METAL PRODUCTS COMPANY, Midland, Michigan, Merchandising Department 1002BC7-6.



THE DOW METAL PRODUCTS COMPANY

Division of The Dow Chemical Company

CIRCLE 24 ON READER-SERVICE CARD

NEWS

A 16-word erasable-storage system has been built with bit density of about 100 per cu in.

All memory transfers are performed in parallel rather than serially, requiring less power. Transistors used in the memory only draw power when actually transferring data.

The complete memory system consists of fixed storage, erasable storage, and a group of erasable type central registers under direct control of the computer logic.

Because of the special electrical requirements of the erasable registers, it was decided to split the central registers into two separate sections. Each clock pulse is divided into two equal parts designated α and β .

During the α portion of the cycle, information flows from the upper registers toward the buffer through the sense amplifier at the left in Fig. 2. During the β portion, information flows toward the erasable storage through the sense amplifier.

These operations do not occur simultaneously because of the chance that a single core might be cleared and written into at the same time.

Address registers are used to address the fixed and erasable storage sections through energizing the proper inhibit and sense wires.

Other special central registers are designed to perform specific functions in the computer specified by particular instructions.

Sequence Generator Provides Logic

The sequence generator is the logic section of the computer. It provides control-pulse sequences associated with instructions stored in the fixed or erasable-storage sections.

Sequences are provided by threading or not threading a wire through cores in a row of a core

Space Computer Specifications

Power (proportional to speed)	0.1-20 w
Clock rate	0-100 kc
Size (estimated)	0.37 cu ft
Weight (estimated)	20 lb
Memory (parallel transfer)	
Program and constants	4,000 words
Volatile	128 words
Word length	24 bits
Life (estimated)	3 yr
Average speeds at 100 kc	
Multiplication	7.5 msec
Addition	0.27 msec
Transistors	1,500
Diodes	5,000

NEW PROTECTION AND COST SAVINGS

with **VICKERS**® **CAPTIVOLT**™

SURGE PROTECTORS for Silicon Rectifiers

Chart below shows the remarkable savings with just one of these low-cost devices.



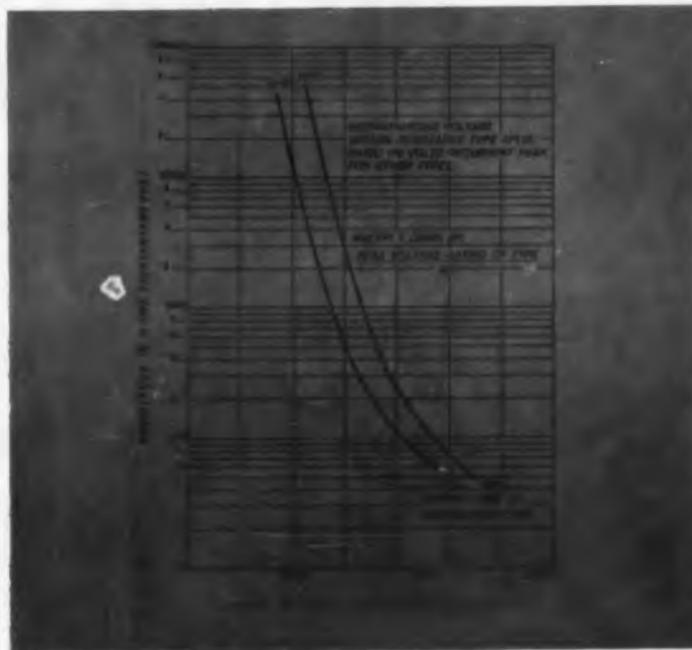
ACTUAL SIZE

GUARD SILICON RECTIFIERS AGAINST BREAKDOWN FROM TRANSIENT HIGH VOLTAGES

REDUCE INITIAL RECTIFIER COST

To protect silicon rectifiers against destructive voltage surges, design engineers are using rectifiers rated considerably higher than the normal operating level. This is a costly practice, and doesn't always guarantee reliable rectifier performance and freedom from breakdown.

The new Vickers CAPTIVOLT Surge Protector, with its non-linear resistance characteristics, eliminates the need for extreme derating of cells... assures greater reliability and longer rectifier life. Connected across the secondary of the transformer supplying AC to the rectifier circuit, the CAPTIVOLT absorbs excessive intermittent energy up to 3000 watts. Extreme decrease in CAPTIVOLT resistance with small increase in voltage shunts destructive voltages... protects the rectifier. Under normal operating voltages the high resistance of the surge protector consumes less than 5 watts.



AN EXAMPLE OF THE COST SAVINGS WITH THE NEW VICKERS SURGE PROTECTOR

Normal operating conditions (50 cycles/sec. 60 Hz. 240 volts)	Surge protector needed (240 V)	Cost
WITHOUT CAPTIVOLT Surge Protector	400	\$108.00
WITH CAPTIVOLT Surge Protector	400	\$1.95
Savings in rectifier		\$106.05
Cost of surge protector		1.95
NET SAVINGS		\$104.10

The CAPTIVOLT has been field tested for more than a year, laboratory surge tested for more than 20,000,000 cycles.

STANDARD TYPES AND RATINGS

Type No.	Rated Peak Volts, Recurrent Continuous Duty Across AC Line	Rated RMS Volts, Continuous Duty Across Sinusoidal AC Line	Maximum Dissipation, Average Watts	Maximum Recommended Surge Amperes, Instantaneous (Convection Cooling)	PRICE EACH (NET)
SP105	50	35	12	5	\$1.95
SP110	100	70	14	5	2.20
SP115	150	105	17	5	2.50
SP120	200	140	20	5	2.70
SP125	250	175	23	5	2.95
SP130	300	210	26	5	3.15
SP140	400	280	32	5	3.70
SP150	500	350	38	5	4.20
SP160	600	420	44	5	4.65

¹If fan cooling at velocity of 600 LFM is employed, multiply watts by two (2). EPA 3135-1

ORDER SAMPLES TODAY—One-Day Shipment
Bulletin 3135-1 Also Available

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matrix. Different sequences are provided by varying core threading combinations from row to row. Selection of sequences is provided by selecting row in the matrix. When the row is selected all cores in the row are set to ONE, and a ONE is also set on the first core of a controlling shift register row at the bottom of the matrix.

As the ONE is shifted across the shift register, sequential switching of the cores in the selected row from ONE to ZERO occurs. A wire across the row will carry a pulse whenever a core through which it is threaded shifts from ONE to ZERO.

If a wire is threaded through every core in the row a pulse is generated with each cycle of the controlling shift register, providing a continuous pulse sequence. If two or more wires are threaded through cores in the selected row, a sequence of pulses is generated in each wire corresponding to the threading pattern.

Various trick techniques permit optimal use of the sequence generator in providing control signals for the central registers. ■ ■

R & D Costs Hit \$8.2 Billion in 1958, Science Report Says

Research and development accounted for \$8.2 billion of American industry expenditures in 1958, according to a report by the National Science Foundation. This was a seven per cent increase over the figure for 1957, and more than double that of 1953.

The \$8.2 billion for industry represents about three-fourths of the national dollar volume of research and development, estimated at \$11 billion for 1958. The remaining fourth was performed by the federal government, colleges and universities, and other nonprofit institutions.

The report, based on a survey conducted for the foundation by the Bureau of the Census, cites a 10 per cent increase in research and development for the electrical equipment and communication industry.

NASA Sets Up New Office of Information and Education

The National Aeronautics and Space Administration has established a new Office of Technical Information and Educational Programs. Shelby Thompson, formerly with the Atomic Energy Commission's Div. of Information Services, has been appointed director.

The new office is expected to consolidate NASA's present public information services, such as the distribution of brochures.



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**SILICON POWER
RECTIFIERS
AND
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**YOU CAN OBTAIN
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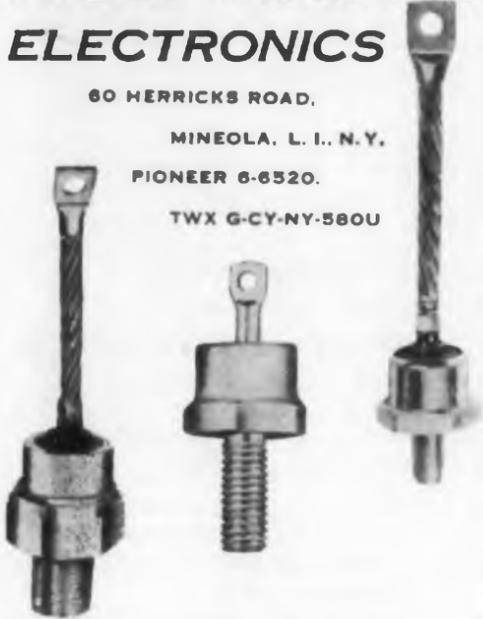
ELECTRONICS

60 HERRICKS ROAD,

MINEOLA, L. I., N. Y.

PIONEER 6-6520.

TWX G-CY-NY-580U



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UP TO 40%**

AVAILABLE NOW IN ANY QUANTITY! Now you can have the proven quality and reliability of Westinghouse Silicon Power Transistors at the lowest cost yet. Types 2N1015 and 2N1016 are available in 30, 60, 100, 150 and 200 volt ratings in production quantities to meet your requirements at all times. Because these transistors have **True Voltage Ratings**, they can be operated continuously at full published voltage ratings without risk of failure.

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Other Westinghouse Transistor advantages include:

- High Power... up to 150 watts
- Collector current to 7.5 amperes
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- Designed to meet or exceed MIL specifications
- Extremely low saturation resistance

Present industrial and military applications include: Inverters • Regulators • Amplifiers • High Power Switching • Telemetry • Guidance • Powersupplies. For additional information, and quotation of new low prices, call your nearest Westinghouse representative or semiconductor distributor. Or write: Westinghouse Electric Corporation, Semiconductor Department, Youngwood, Penna. SC-1001

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Each Westinghouse Silicon Power Transistor is guaranteed by 100% power testing before shipment.



True Voltage Ratings—you can operate Westinghouse Silicon Power Transistors at full rating without risking transistor failure.

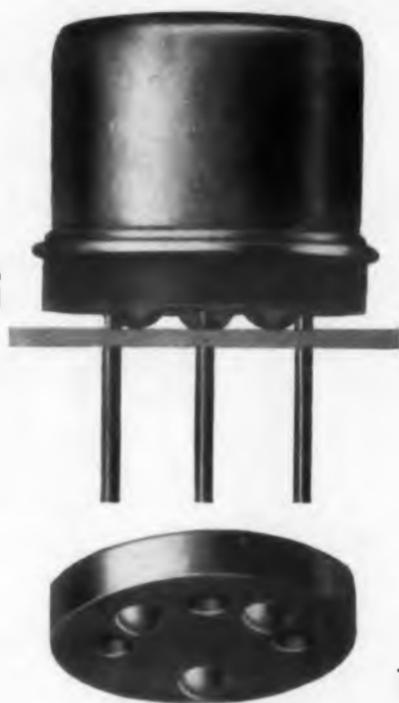
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FOR TRANSISTORS

Transipads put a little extra security into printed-circuit assemblies. For a cost you count in pennies. A Transipad mounting is rock solid. It eliminates strain on delicate leads, provides vibration-proof separation between them. It isolates the transistor case from contact with printed conductors. And, perhaps most important, it provides a built-in air space to dissipate the heat of soldering (how many transistors have you lost lately through heat shock?). Transipads come in sizes and styles to fit most transistor types; some will convert lead arrangements from in-line to pin-circle, or vice-versa; others will widen lead spacing. Samples and drawings are yours for the asking. A note or a phone call will bring them.



THE MILTON ROSS COMPANY

236 Jacksonville Road, Hatboro, Pa. Phone: OSborne 2-0551

CIRCLE 29 ON READER-SERVICE CARD



NEWS

Automatic Navigator Designed to Project Aircraft Position on Map Screen for Pilot



Engineer at International Business Machines laboratory at Owego, N.Y. inspects the glass hemisphere in a new navigation system. The 6-in. globe has a map of half the earth photographically reproduced on its inner surface.

AN EXPERIMENTAL navigation system may eventually enable pilots of supersonic planes to check their position by merely glancing at a screen on the instrument panel. The system, under development at International Business Machines Corp., Federal Systems Div., Owego, N.Y., uses a map projection technique.

It reportedly projects a highly accurate circular map of an area 400 miles in diameter (125,000 sq miles) on a 7-1/2 in. screen. An airborne computer performs all the calculations to position the map on the screen and to pinpoint the plane's position.

The key unit in the system is a glass hemisphere of about 6 in. diam. A detailed map of half the earth is reproduced photographically on the inside of the glass. A beam of light illuminates a small section of the map, which is then projected onto a flat, translucent screen in front of the pilot. As the plane moves, computer automatically adjusts map presentation.

IBM says a similar device could be used in space navigation.

To use the system in space, a technique known as stellar navigation

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Map projection technique used in the navigation system is illustrated during a laboratory test. The system, still under development, uses a computer to position a map of half the earth inside a glass hemisphere in such a way that the area over which a plane is flying is projected onto a display screen. Engineers Richard W. Kern (left) and John F. Creedon are presently working towards refinement of the system.

atching might be employed. A stellar map, or chart of the heavens, would replace the map of the earth inside the glass hemisphere and be projected onto the screen. Then a telescopic view from the space craft would also be projected onto the screen, superimposed on the space map projection. When the stellar map and the telescope view were lined up, the computer could automatically determine the position of the space craft.

The entire system is comparable to the ATRAN guidance system now used in the Air Force Mace missile. ATRAN is a map-matching system that compares the terrain over which the Mace is projected with a synthetic film strip of the programmed route produced from topographical maps. The system is said to be completely independent of human control at all times.

Uses of ATRAN are not restricted to missiles, according to the developer, Goodyear Aircraft Corp. of Akron, Ohio. The company has recently demonstrated the guidance capabilities of the system in a commercial aircraft.

Design details of ATRAN have been classified by the Air Force. ■ ■

The Breakthrough ...How It Was Accomplished!

This VHF transistor breakthrough was made possible by a new Post Alloy Diffusion Process, a manufacturing method that combines the best features of the currently used alloy and diffusion processes, without their drawbacks.

The limitation of the alloy process is encountered when attempting to manufacture transistors with an average cut-off above 20 Mc. In this process the collector and emitter elements are fused (or alloyed) to the base. For this to be successfully accomplished the base must be relatively thick and the thickness very accurately controlled in order that during the fusion process the collector and emitter elements do not flow through the base and short the transistor. This relatively thick base increases the transit time, precluding any usable response above 20 Mc.

In the diffusion process the base is formed on the collector by gaseous diffusion in a high temperature oven. Very thin bases can be manufactured by this method with low transit time and very high cut-off frequencies. In this process the problem lies in attaching the emitter junction and base lead.

In the AMPEREX Post Alloy Diffusion Process, alloying and diffusion take place simultaneously. The transistor is built up on a piece of P-type germanium. Two small pellets are placed on the germanium. Pellet B, the base pellet, contains only an N-type impurity. Pellet E, the emitter pellet, contains a P-type and an N-type impurity.

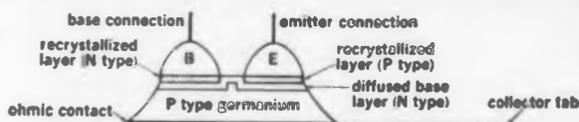
When this assembly is heated at a certain temperature, the germanium dissolves into the metal pellets until saturation is reached, and the pellet impurities diffuse into the solid germanium.

However, the P-type impurity in pellet E has such a low diffusion constant, that for practical purposes it does not penetrate into the germanium. The N-type impurity in pellets E and B has a much greater diffusion constant and readily penetrates into the solid germanium to form a diffused N-type layer underneath the pellets.

When the assembly is cooled down, a layer of germanium recrystallizes from the pellets as in the normal alloy technique. The recrystallized layer of pellet E contains many atoms of the P-type impurity and is, therefore, a P-type germanium layer. The germanium layer recrystallized from pellet B is, of course, the N-type because there are no other impurities in the pellet.

Connections are made to the germanium and the metal pellets and a "mesa-like" P-N-P transistor is obtained. The original P-type germanium is the collector, pellet B the base, and pellet E the emitter.

This process makes it possible to mass produce transistors with a base layer of a few ten-thousandths of an inch for very short transit time and high cut-off frequencies. The yield is also very high which enables AMPEREX to supply these transistors at low prices.



MAXIMUM RATINGS	2N1515	2N1516	2N1517
-V _{cb}	20 V	20 V	20 V
-I _c	10 mA	10 mA	10 mA
P _C at T _{amb} ≤ 25°C	83 mW	83 mW	83 mW
TYPICAL CHARACTERISTICS			
Gain-Bandwidth Product (f _t , I _E = 1 mA)	70 Mc	70 Mc	70 Mc
Gain-Bandwidth Product (f _t , I _E = 4 mA)	—	180 Mc	180 Mc
Power Gain			
G at 0.45 Mc (I _E = 1 mA) ...	35 db	35 db	—
G at 10.7 Mc (I _E = 1 mA) ...	22 db	24 db	—
G at 100 Mc (I _E = 1 mA) ...	—	—	12 db
Conversion Gain G _C at 26 Mc ...	—	18 db	—
Noise Figure NF at 0.45 Mc ...	3 db	3 db	—
NF at 10.7 Mc ...	5 db	4 db	—
NF at 100 Mc ...	—	—	9 db

If You Will Remember
ONE New Name —

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You Can Forget
FIVE Old Transistor Problems

Amperex[®]
High Gain VHF Transistors
manufactured by the
Post Alloy Diffusion Technique

are unrivalled for:

1. RELIABILITY
2. OPERATING STABILITY
3. UNIFORMITY
4. PRICE
5. AVAILABILITY

At last, you can realistically use high frequency transistors for RF and IF amplifiers in production FM receivers; as mixers, oscillators and RF and IF amplifiers in mobile radio equipment, car radios and short wave receivers; and as broadband amplifiers in instrumentation and industrial applications. Implemented and fully proven by Amperex, a unique manufacturing technique originating with Philips of the Netherlands now enables Amperex to provide you with production VHF Post Alloy Diffused Transistors* of unparalleled laboratory quality at truly reasonable prices.

The new Amperex "Post-Alloy-Diffusion" P-N-P Transistors combine the best qualities of both the alloy and the diffusion approaches to transistor construction. As a result of the special "self-jigging" techniques, a maximum degree of uniformity is achieved. Thus the necessity for "selection" is completely eliminated.

The 2N1516 is designed for use as a mixer oscillator in short wave receivers, as an IF amplifier in FM receivers, and as a broadband linear amplifier for instrumentation and industrial applications. The 2N1516 features a high cut-off frequency of 70 Mc and a low collector-to-base capacitance of 1.8 μf.

The 2N1515 is designed for high gain IF amplifier service in medium and short wave receivers.

The 2N1517 is designed for use as a local oscillator and preamplifier in FM receivers and has a power gain of 12 db at 100 Mc.

This is, of course, only the beginning of the Amperex PADT story. Availability is further assured by a new Amperex PADT plant in Slatersville, Rhode Island. A range of new PADT transistors, now in the final stages of development will provide UHF performance at VHF prices and give every promise of providing increased reliability and uniformity.



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transistors and diodes for industrial and
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This concluding section of ELECTRONIC DESIGN'S report on electronics in oceanography describes some of the systems for collecting, transmitting and processing the data obtained with the measuring instruments discussed in the first part of the report. Oceanographic systems afford the possibility for long-run production and may thus be of greater interest to industry than the measuring instruments, which although of sophisticated design, are generally less complex and required in only limited quantities.

Oceanography—Opportunities in Systems Design

Manfred W. Meisels

Assistant Editor

OCEANOGRAPHY, perhaps more than any other science, must resort to the design and construction of its own electronic instruments. Little else beyond basic components is available "off the shelf." Instruments are hand-tailored and the electronics section of an oceanographic laboratory typically resembles a prototype shop in land-based industry.

In the absence of commercially available systems or sub-systems, an inordinate amount of time is spent in assembling power supplies, modu-

lators, transmitters, sonar packages, etc. Though requirements may differ somewhat for each particular experiment, much of the electronic gear could be assembled from standard packages—if such packages were available.

With the anticipated growth of oceanography in the '60s, many areas of instrumentation may prove attractive for commercial exploitation. Some of the more promising opportunities for industry are described here. Ingenuity of design has been the keynote of oceanographic equipment

and will be a continuing requirement. The design problems are complex and the funds available are as yet limited; but the field is growing and oceanographers stress that now is the time for industry to get in on the ground floor.

Telemetry

The buoy is to oceanography what the satellite is to space exploration. Each vehicle carries instruments to regions where man cannot go in safety or convenience. In each, telemetry devices are necessary to recover the data collected by the instruments.

At sea, two modes of telemetry are possible—radio telemetry for a floating buoy, and acoustic telemetry from a submerged instrument package. Each method is presently limited by an almost total lack of equipment to do the job.

Sonar techniques have been used successfully to track and locate submersible and "Swallow" buoys. Passive, active, and transponding methods are employed. In addition, sonar is now being exploited as a means of underwater telemetry and communication. Pulse-coded and frequency modulation of the acoustic signal offer the most likely possibilities at present. Amplitude modulation is restricted by the variable attenuating properties of the scattering and thermal layers in the oceans. Sub-carrier and multiplexing also appear feasible, but further development is needed in applying these techniques to an acoustic carrier.

As in ASW devices, the trend is toward the use of lower frequencies. (The attenuation of a low-frequency acoustic signal is roughly 0.2 f (in kc) db per thousand yards.) Unlike most sonars, however, the telemetry device must operate at great depths, where pressures exceed 10,000 lb per sq in. Ordinary crystal transducers, when backed with oil or otherwise designed to with-

'Please Go Near the Water!'

Electronic engineers at the various oceanographic institutes have learned by repeated experience that it pays to go to sea.

"Once you've been seasick and had to work on a piece of equipment, you build it differently," is how Bernard Luskin, chief engineer at the Lamont Geological Observatory, put it. "You have to human engineer your devices for use by people who are not at their best."

This means leaving out knobs and switches which, in accordance with the principle of perverse probability, will inevitably be set to the wrong position. Printed circuits and miniaturization make sense in missiles, but to repair such packages on a vibrating, rolling ship is next to impossible—cold solder joints are all that can be produced.

Stable power supplies are taken for granted ashore, but the performance of a ship's electrical system cannot approach that of your local utility company. The result—equipment that checks out in the lab but is useless on shipboard.

Nothing on ship stays dry, so design your equipment accordingly. Don't wait for packaged prototypes—get your breadboard to sea and avoid unpleasant surprises later. Survey ships may be at sea for 10 months or more, so design for reliability. Are your computers and other equipment designed to operate in a clean, well lit, air conditioned environment? Go aboard an oceanographic vessel and face reality.

These rules, which apply in spades for the design of electronic gear for the Navy, are often ignored. The first Loran-C receivers delivered to the Navy were marvels of packaging and miniaturization but were soon replaced by less glamorous units designed for easier servicing. The leftovers have been offered gratis for oceanographic use but have found no takers. SINS equipment is another instance where designers found themselves at sea by not going to sea in the first place.

The rule to be followed in designing electronics for the sea is "Please go near the water."

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N. Y. Times photo

The Schooner "Vema," research ship of the Lamont Geological Observatory of Columbia University. "Vema," now circumnavigating the Antarctic, is typical of the vessels being used in oceanography. Modern ships, soon to be built, will certainly be more efficient, but hardly as glamorous.

stand these pressures, deteriorate markedly in efficiency. Magnetostrictive transducers, which are free-flooding and hence not pressure-sensitive, are inefficient to begin with. Clearly, a family of efficient, high-pressure transducers would greatly extend the range of practical applications for acoustic telemetry.

Wanted: Acoustic Telemetry Packages

Transducers should cover a frequency range from 1 kc to 30 kc at efficiencies of 30 per cent or more. Such orders of efficiency are needed to provide a reasonably long operating life with presently available power sources. Accompanying the transducers there should be a line of packaged acoustic equipment including generators, data samplers, modulators, transponders, repeating beepers, etc. Modular construction and matched components would permit the oceanographer to assemble an acoustic telemetry or beacon system with maximum ease.

Design problems are greatly simplified by the low data transmission rates involved. A capacity of 10 measurements per minute would be more than adequate for an acoustic telemetry system. On the other hand, design for high-pressure oper-

ation must be total. Oceanographers report instances where transducers and hydrophones claimed to be designed for use at 10,000 lb per sq in. came equipped with ordinary connectors and feedthroughs. Occasionally, equipment is delivered in which the instrument case is used for a chassis ground, a procedure totally unsuited for immersible equipment.

Oceanographers have ambitious plans for submersible buoys. Ocean-bottom seismographs, temperature and current monitors, and navigation beacons are in active development. All require acoustic equipment which no oceanographic laboratory is equipped to build in quantity.

Emphasis on Low-Frequency Radio Telemetry

Radio telemetry from a surfaced buoy is a more straightforward affair in that the design problems have long since been solved. The need here is for equipment designed to operate at suitably low frequencies. The emphasis in telemetry has been on missile and space applications where the high data-transmission rates involved have led to the use of vhf equipment. The resultant line-of-sight transmission range makes such gear of little use to oceanographers, who are thinking of transmission

ranges of up to 1,000 miles. Winter and rough weather generally curtail oceanography and a system of telemetering buoys could make it a year-round trade.

A complete line of telemetry equipment in the 2 to 4 mc range would satisfy the bulk of oceanographic requirements. In certain applications, such as weather buoys, frequencies might go to perhaps 15 mc, but no higher. Data rates are again comparatively low. Ten cps per channel with up to 8 channels would suffice for any buoys now in sight. Some of the modulation schemes developed for missile use, particularly fm/fm, are of interest to oceanographers, who would like to see them adapted for use at lower frequencies. Data conversion should present no difficulty. The greater part of oceanographic measurements involve temperature and pressure, the telemetry of which is routine in space and missile tests.

Buoys in Gulf Stream

Present activity in radio telemetry by oceanographers is rather limited. Woods Hole has a chain of temperature and current measuring buoys in the Gulf Stream, the Bureau of Standards and the Naval Research Laboratory have been ex-



This unlikely looking vehicle could be the answer to many an oceanographer's prayer. It is a Remote Underwater Manipulator (RUM) complete with 3-D television sonar obstacle locator and double-jointed handling arm. RUM will perform a variety of inspection, installation and servicing functions underwater and by remote control. The vehicle was designed for the Office of Naval Research with the Scripps Institution of Oceanography as the prime contractor. RUM can operate out to 5 miles from shore and at depths to 20,000 feet. It is driven by a pair of 7.5 hp series motors and cranks up a top speed of 3 mph. Power, communication, and control are via a coaxial cable to a control van on the beach.

The TV equipment, designed and built by Orbitran, Lakeside, Calif., consists of four cameras which can be switched for either stereo or two-dimensional viewing. In the 3-D mode, a 250-line picture is transmitted at 7.5 frames per second; for two dimensional viewing, a 530-line 15-frame picture can be transmitted. The cameras and a TV power and control unit are each housed in 1/2-in. steel casings and can operate at pressures to 18,000 psi.

The manipulator arm is a modification of the General Mills handlers for nuclear materials.



perimenting with weather buoys, and the Scripps Oceanographic Institution at La Jolla, Calif. obtains wave measurements from a remote measuring station.

The Woods Hole buoys are part of an order of 40 buoys being filled by Prodelin Inc. of Kearney, N.J. These units are interrogable and transmit ocean-temperature data from a 25-unit thermistor chain. Telemetry is in the 2 to 3 mc range at about 20 w giving a range of about 100 miles. A 20-w transistor operating in this frequency range, said to be in development, will increase operating life and improve reliability. The buoys are priced at about \$1,500 each.

The shortage of trained oceanographers will lead to the increased use of buoys for data collection as our oceanographic efforts accelerate, and every buoy launched will be equipped with a telemetering device. The implication to electronics designers is obvious.

Power Sources

New power sources are needed for the heavily instrumented, long-lived buoys being designed for oceanography. The carbon-zinc and lead-acid cells now in general use are adequate for small vehicles, but weather buoys, ocean-bottom instrument packages, and radar and sonar beacons call for more sophisticated power devices.

Emphasis in battery design has been on high output, short-lived cells for missile use whereas oceanographic requirements are for low drain, long-lived sources. Weight and volume, so critical in missiles, are of limited importance in the science of oceanography.

But even generous weight allowances preclude the continued use of ordinary cells. A constant drain of only 1 ma amounts to 9 amp hr per year. A good many milliamps, often at more than 2 v, are required in oceanographic systems. For example, one prototype weather buoy developed by the National Bureau of Standards draws an average current of 175 ma at 12 v. Transistorized circuitry and improved design would reduce current demand, but the power required by weather buoys and other complex systems is nevertheless quite considerable.

Every Possibility to Be Tried

Thus, oceanographers are willing to examine every reasonable possibility leading to new power sources. Among the methods now under study are: wind-powered generators, wave-powered generators, solar cells, fuel cells, nuclear batteries and sea water activated cells.

NBS, as a part of its work on weather buoys is considering a variety of power sources. Two

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ELECTRONIC DESIGN • July 6, 1960

wind-powered generators having a combined output of 30 w in a 10-knot wind will be tested on a weather buoy this summer. Wind powered generators are at first glance an ideal means of powering a surfaced buoy, but their reliability and uniformity of power output have yet to be determined. In arctic regions, the chance of icing rules out their use.

By next year, NBS will test a propane-gas-powered fuel cell using thermoelectric elements. A catalyst will be used to generate heat without an open flame and a single propane cylinder is expected to be sufficient for a year's operation. Such cells are, of course, usable only on surfaced buoys.

Solar Cells, Too

NBS has also investigated solar cells to power its buoy. A 1 sq ft array of solar cells can deliver up to 7 ma at 15 v. Salt spray and humidity do not affect performance and solar cells would appear ideally suited for use in tropical waters. The cost of solar cells, however, is considered excessive; the array tested ran to about \$500.

The Naval Research Laboratory, also working on weather buoys, is planning to test a nuclear-powered battery in about two years. Power requirements for large NRL weather buoys are equivalent to 1 w-hr continuous drain; the nuclear cell is expected to deliver about 5 w-hr. The cell will use heat from strontium-90 decay to power a thermopile.

The NRL buoys drift with the ocean currents and the possibility exists that someone could irradiate himself if a buoy with a nuclear battery drifted ashore. One buoy that landed recently in Nicaragua was opened with a machete before the Navy could recover it.

The Scripps Institution is developing a carbon-magnesium, sea-water activated cell. Results are not yet available, but this or perhaps other electrode combinations offer interesting possibilities.

Shipboard Equipment

Shipboard equipment will account for a significant share of oceanography's electronic budget. Up to \$1 million worth of instruments is to be installed on each of the new survey ships now being planned. U.S. oceanographers would like to have as many as 25 of these new ships and stand a reasonable chance of getting at least a large share of them in the next 10 years. Stepped-up oceanographic activity in other western countries will lead to the construction of still more survey ships. It has been estimated that a full-scale, world-wide program of oceanography would require the construction of more than 100 new vessels, each crammed to the gunwales with electronic equipment.

Until now shipboard electronics has been a crazy-quilt affair, growing in complexity and re-

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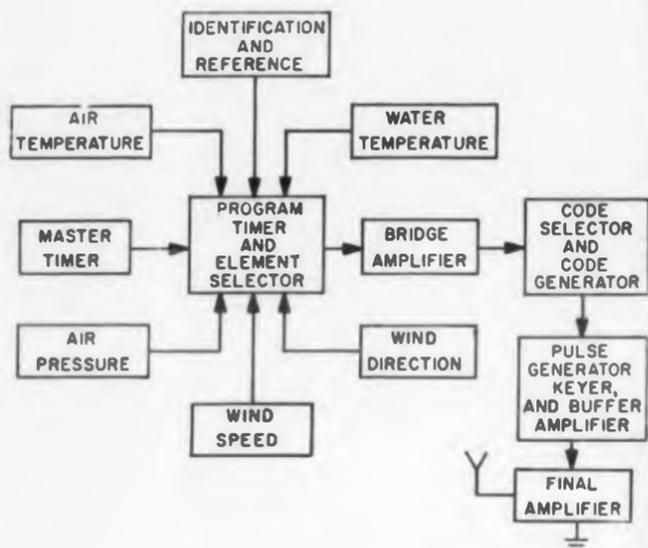
CIRCLE 32 ON READER-SERVICE CARD

SEAGOING ELECTRONICS—2

dundancy with each introduction of a new instrument. A systems approach in the design of ship-board electronics is urgently needed and equipment designs reflecting this attitude will certainly be selected.

Funds Available

Funds have been allocated for the first of the new survey ships and construction will begin



Large, seagoing weather buoy developed by National Bureau of Standards. The buoy collects and telemeters a wide variety of oceanographic and weather data and could readily accommodate other sensors. Transmission is programed for six-hour intervals, but cuts in more frequently during storms. As shown in block diagram, output of each sensor is fed, in turn, to self-balancing bridge amplifier. Transmission is by morse-coded cw system.



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Nominal Coupling: 10db
VSWR of Primary Line: 1.05
Coupling Variation Over Range: ± 0.5
Tracking Between Arms: ± 0.05db
Minimum Effective Directivity: 40db

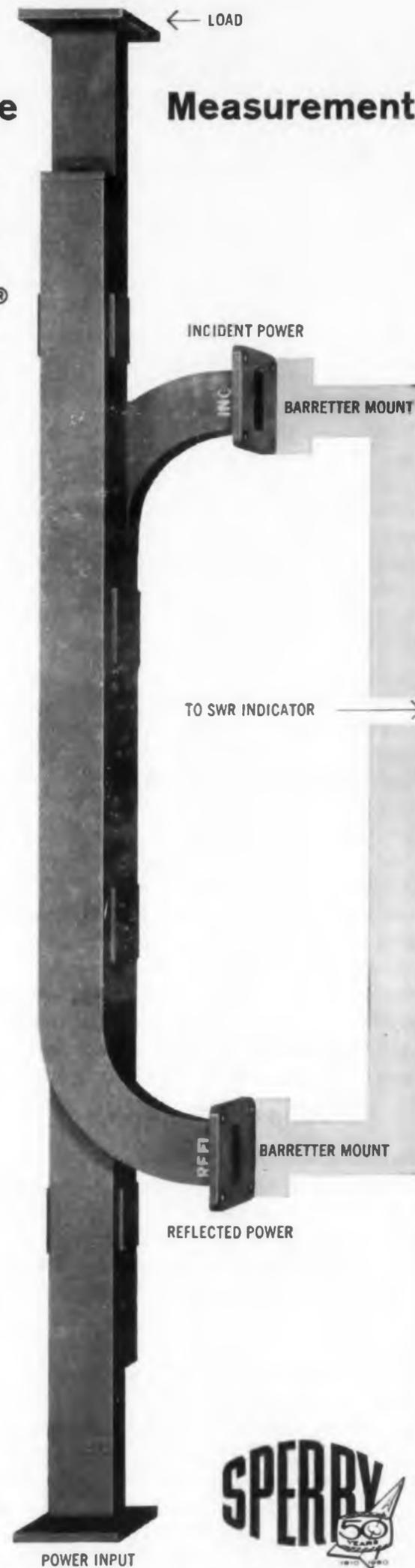
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The 29A1 incorporates an expanded scale and automatic compensation for increased accuracy in low VSWR measurement. A "Plus 5 db" gain step facilitates accurate upper-scale readout on the meter. Many other advantages, such as a push-button bolometer current reading . . . positive diode protection against bolometer burnout . . . "wide" position switching eliminating the tuned circuit . . . easy readability and operability . . . make the 29A1 the most desirable instrument of its kind. It is handsomely designed—a light blue case, brushed aluminum control panel, and contrasting gray sub-panel.

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\$200



SPECIFICATIONS:

Frequency:	1000 cps. \pm 1%
Sensitivity:	0.1 uv at 200 ohm level for full scale deflection.
Noise Level:	Less than 0.03 uv referred to input, narrow-band position.
Amplifier Bandwidth:	Wide band position, 300-5000 cps; Narrow band position, continuously adjustable, 30-150 cps.
Calibration:	Meter reads SWR, db, bolometer current.
Range:	70 db. Input attenuator provides 60 db in 10 db steps. Accuracy 0.1 db per step.
Meter Scales:	SWR 1-4, SWR 3-10, Expanded SWR 1-1.3, db 0-10, expanded db 0-2, bolometer current 0-10 ma.
Gain Control:	30 db.
Input:	BNC female.
Input Positions:	High Bolo—8.4 ma bolometer position, 200 ohms. Low Bolo—4.3 ma bolometer position, 200 ohms. 200—200 ohms for crystal rectifier. Hi-Z—high impedance for crystal rectifier.
Output:	Jack provided for 0-1 ma recorder, 1 side grounded, 1500 ohm resistance. Jack for audio output.
Power:	115 230 volts, 50-60 cps.
Size:	Approx. 8 x 11 x 12.
Weight:	14 lbs.
Price:	\$200.



shortly. The electronics aboard this vessel will include the following:

- Multichannel precision-depth recorders.
- Multiple sonar arrays with provisions to vary frequency, pulse rate, pulse duration, beam width, etc. Four or five depth sounders will be included in the array.
- Navigation and communication equipment.
- Magnetometers, both of the flux-gate and nuclear-precision types, together with associated electronics.
- Gravity meters mounted on a gyro-stabilized platform.
- Auxiliary acoustic generators such as spark gaps, gas burners, thumpers and explosives.
- Auxiliary power sources.
- Test equipment.
- Hydrophones both hull-mounted and variable-depth types for seismic work.

The standard depth sounder for oceanography is the Navy's UQN-1E sonar apparatus, thought to be the best of its type. English Kelvin Hughes and German Elac depth sounders have also been used but do not quite match the performance of the UQN-1E. Elac equipment is known to be in service aboard Russian oceanographic ships.

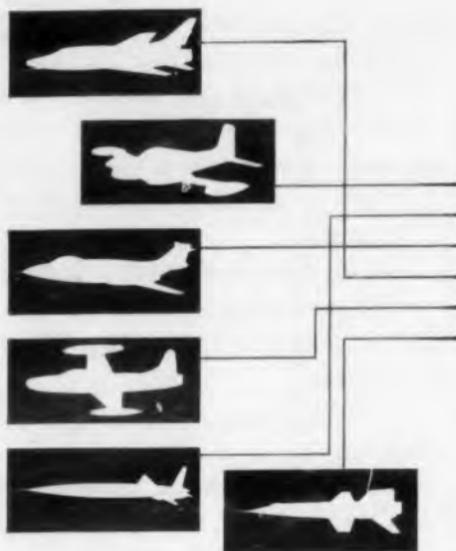
Aboard the Lamont Geological Observatory's "Vema" the UQN-1E is used together with a Westrex Mark 5 precision depth recorder. An accurate time standard, perhaps the major consideration in depth sounding, was developed by Westrex from the tuning-fork standards used in its facsimile machines. The Mark 5 is a versatile chart recorder equipped for automatic scale changing, variable gating and simultaneous recording on the chart of ship's heading, logged miles, magnetometer data, and all other pertinent information.

The next advance in depth sounding equipment will be the integration of recorders and sonars into a single system. Lamont, to which the first new survey ship has been assigned, plans to install a system of this type aboard the vessel.

Static Converters and Test Equipment Needed

Static power converters are another "must" for oceanographic ships. Many measurements are taken under "quiet ship" conditions in which not even ventilating fans are permitted to operate. Storage batteries are now used to power equipment at such times, but static dc-dc and dc-ac converters would be of major convenience and would permit the use of a greater variety of instruments not readily adaptable to battery operation. Converters should deliver several kilowatts at stable voltages and with great reliability.

Shipboard test equipment should, wherever possible, be designed for battery operation. This is desirable for portability in making "on the deck" repairs and adjustments and to assure stable



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Electronic and Mechanical Designers—engineers with background in transistor circuitry, inertial sensor development and evaluation, and precision mechanical equipment design are needed to perform component development and evaluation, and to design mounting and alignment equipment.

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CIRCLE 911 ON CAREER INQUIRY FORM, PAGE 159

SEAGOING ELECTRONICS—2

power for such instruments as oscilloscopes, frequency generators and counters.

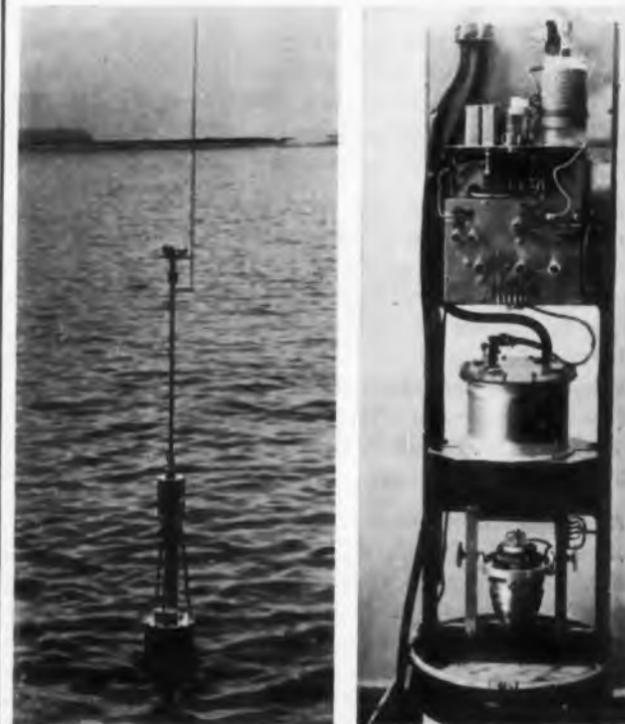
A complete line of battery-operated test equipment designed for use at sea would be welcomed by oceanographers who now have to fuss with power packs, adapters, and other jury-rigs.

Data Collection and Processing

Equipment for the storage, recovery, and processing of instrument data is a critical need in oceanography. "The first rule in this business," according to Bernard Luskin, chief engineer at the Lamont Geological Observatory, "is to look at your data right away—you may never be able to find the place again. If something interesting turns up, you've got to exploit it then and there." This rule is not always observed, with consequent loss of much valuable information. Data processing on shipboard can thus give oceanographers greater mileage from the information they collect.

The data input to a well-equipped survey ship is enormous and justifies the use of the most modern, high speed data-reduction and computing equipment. Typical input rates to a ship are:

- Depth soundings—1 per second.
- Gravity measurements—continuous.
- Magnetic measurements—1 per 6 seconds.
- Seismic measurements—up to 5,000 per day.
- Temperature, current and pressure readings.



Small weather buoy designed by National Bureau of Standards measures and telemeters wind direction and velocity, air temperature, and barometric pressure. Buoy's electronic package at right includes programmer and transmitter (top), barometer and magnetic compass.

telemetered from buoys or taken over the side—many thousands per day.

Chart recorders are a time-honored means of reducing data for immediate visual inspection. For depth soundings, they can hardly be improved upon. Nevertheless, ingenuity of design, such as demonstrated in the thermal contour plotter, can improve the utility of chart recorders and help to present data in a more significant form.

Combined Displays a Good Idea

Seismic measurements are charted as a series of pips along a time base and must be interpreted by trained observers. A major advance would be the development of an integrated graphic display of seismic, sonar, gravity and magnetic data to give a complete picture of the bottom and sub-bottom structure.

Similarly, temperature, current, density and other related measurements might be automatically combined into a graphic display of the ocean's fine structure. Here again, sonar readings could be presented together with data telemetered from buoys to illustrate the relation of bottom topography upon these measurements.

Conventional digital computers would form an important part of any such integrated data-reduction and display system. Even now, computers would prove useful in shipboard data reduction, but the design or modification of a business or scientific type of digital computer for operation at sea is a job that has yet to be tackled.

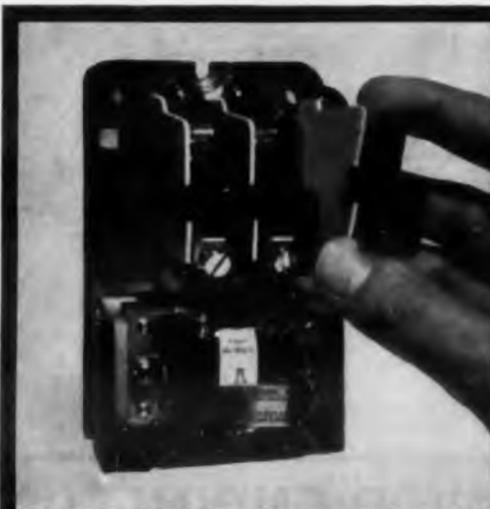
Data storage in buoys can be important in reducing power requirements since telemetry equipment represents the largest part of the energy expended. An obvious solution here would be the use of a tape recorder, but the models available are generally overdesigned—and hence overpriced—for oceanographic use.

Time compression would be a necessary feature of any buoy-storage system. Measurements taken continuously over several hours should be transmitted in a small fraction of that time. Ideally, a ratio of 100 to 1 is desired. So far, in work at the Scripps Institution, a ratio of 64 to 1 has been achieved.

Other storage means, including electrostatic tubes, magnetic cores, or film, might prove applicable, but no serious attempts have been made to adapt these techniques to oceanography. Pioneer V's telebit memory, though perhaps too limited in capacity for use in buoys is indicative of the type of equipment required here.

Weather Buoys

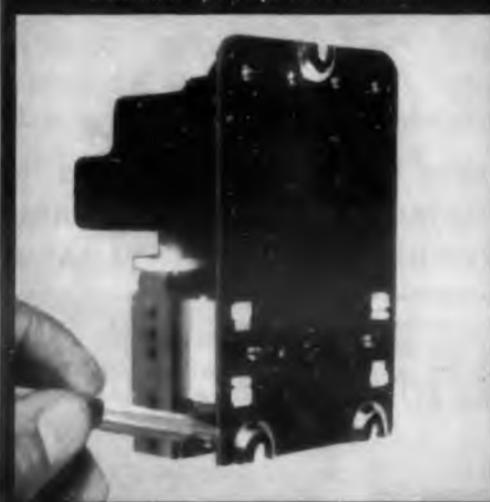
Weather is made over the oceans, which cover 70 per cent of the earth's surface. Yet, as Dr. Columbus O'D. Iselin, former head of the Woods



"Unitized" poles protect contacts



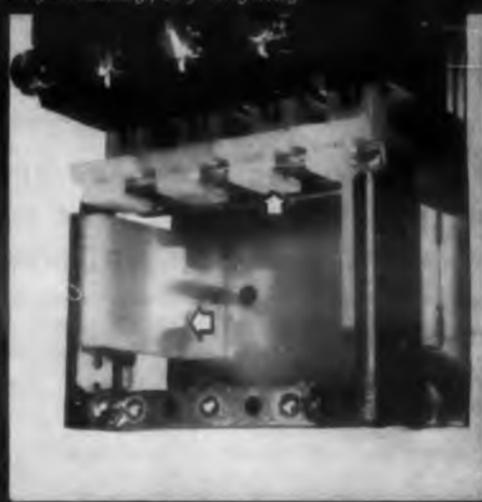
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SEAGOING ELECTRONICS—2

Hole Oceanographic Institution, points out, "We practically run out of weather information at the water's edge."

Some weather reports are received from ships and aircraft in transit and a very small number of weather ships are maintained on station by the U.S. and other countries. But operating costs for a single weather ship can run to \$1,000 a day without including the cost of other ships in dry-dock and in transit which are needed to support year-round operation.

\$10 Million Market Possible

Thus, unmanned weather buoys present an attractive alternative to weather ships from the standpoint of cost and area of coverage. According to Dr. Iselin, 1,000 weather buoys would be needed for world-wide coverage. Some 250 of these might be stationed in the Atlantic, where a program of this kind would probably be initiated. Projected costs for such buoys would be on the order of \$5,000-10,000 each, if manufactured in quantity.

A more likely proposal is one put forward by Texas A & M University for a chain of 10 weather buoys in the Gulf of Mexico to warn of incipient hurricanes. This proposal is based on a weather buoy under development by the National Bureau of Standards.

NBS has anchored a weather buoy 300 miles out in the Gulf of Mexico for the last two summers. The heavily instrumented device measures and telemeters the following data:

- Water temperatures down to 1,000 feet at 40 foot intervals
- Air temperature
- Barometric pressure
- Wind direction and speed

The buoy is programmed to telemeter at 6-hour intervals, but a wind-velocity switch cuts in for transmission every three hours during storms.

Instrument readings are encoded into a three-letter Morse code group. The sampling, encoding and transmitting operation requires approximately four minutes.

Telemetry frequency is 5.34 mc with data transmitted by rf pulse modulation. Peak pulse power is 4 kw. A pulse length of 250 μ sec at 180 pulses per second gives an average power of about 180 w. The output stage is a 3E29 dual triode and feeds a vertical, grounded antenna.

It was found necessary to increase peak power from 1 kw for adequate reception over the required 300 mile range.

A more ambitious weather-buoy program, encompassing ship-launched and air-dropped types, is being conducted by the Naval Research Laboratory. NRL is putting its money on drifting rather than on anchored buoys. Anchoring problems have never been adequately solved and a free buoy can "roll with the punch" in heavy seas, thus reducing wear and tear on the electronic devices it contains.

Improvements on the Way

The first version of the new free ship-launched buoy, tested last fall, carried the same types of measuring instruments as the NBS buoy. Temperature sensors, however, consisted of wire-wound resistance thermometers rather than the thermistors commonly used in oceanography. Although thermistors are accurate, they are not very uniform and must be individually calibrated. NRL, thinking in terms of larger systems prefers to avoid this nuisance.

The buoy broadcasts at a frequency of 15 mc by day and 9 mc by night at an average power of 75 w. Morse code cw modulation is employed and usable signals have been heard at a distance up to 4,000 miles.

This summer, four improved models of the buoy will be spotted in the Caribbean hurricane zone. Provisions have been made for the inclusion of "Splashnik" wave meters and other oceanographic gear. Command receivers will permit interrogation of the buoy in addition to the usual 6-hr telemetry program. Storage batteries will permit up to a year of operation.

Air-launched buoys, smaller than ship-launched but carrying similar instrumentation, are being readied for use during this year's hurricane season. NRL hopes to drop these buoys into actual hurricanes in order to obtain accurate on-the-spot weather data.

Sophisticated Telemetry and Shore Stations Envisioned

For large-scale systems composed of many elaborately instrumented buoys, present Morse code telemetry methods must give way to more sophisticated, higher-speed transmission techniques. Telemetry will have to be compatible with data storage devices aboard the buoys which will provide rapid playback of continuous readings accumulated over a long period.

Shore stations containing the receiving and data-processing equipment for a weather-buoy system have yet to be designed. Certainly, a shore station would have to include telemetry receivers, direction finders, command transmitters, computers for reduction and analysis of data and communications equipment to forward the data to weather forecasting centers. ■ ■

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Operating sensitivity: 400 milliwatts at pickup voltages; continuous duty.

Vibration: 55 to 2000 cps at 30G's with 0.195" max. excursion 10 to 55 cps.

Shock: 50G's for 11 ms operating.

Temperature range: 125 C to -65 C.

Operating time: 6 milliseconds max. including bounce.

Insulation resistance: 1000 megohms min.

Dielectric strength: 1000 volts rms except 600 volts across contact gap.

Contact resistance: 0.050 ohms maximum (0.1 ohms max. after life).

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EDITORIAL

Missing From the Transistor Data Chart

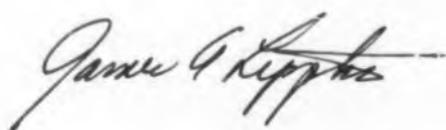
ELECTRONIC DESIGN has been justly proud of its annual Transistor Data Chart. Despite the increasing growth of the number of transistors—1,088 this year—we have tried to keep our charts to manageable size by eliminating less important data and improving the organization. Missing from this year's chart, as in previous years, is reliability data.

Semiconductor materials inherently have an indefinite life—if perfectly sealed off in an ideal environment of their own. Unfortunately, even 12 years after the appearance of the first transistor, engineers and scientists know little about surface phenomena. Transistor characteristics do change, largely as a result of surface changes, and what reliability has been achieved has been accomplished by empirical approaches.

The reliability that has been achieved is pretty vague. There is no standard definition of what constitutes a failure. Neither are there standards established for the conditions of tests. One company can get a million-dollar transistor-testing contract and boast about achieving a reliability failure rate that is not as good as that carried in other companies' ads!

Some organizations are reluctant to specify transistors for design in their equipment until performance over its intended operating life has been proven (See ARINC specifying practices, p. 54). Premature use of transistors has often caused serious trouble. However, it is encouraging to note that proven high reliability transistors are better than the most reliable tubes yet made.

Much must be done to get greater reliability in more types. At the Solid State Conference earlier this year, several spokesmen admitted that the industry had no standards for reliability but claimed that a reliable product must be produced before standards can be established. We agree that a reliable product is needed, but we disagree that a standard can't be set now. Reliability indexes would be a desirable addition to next year's Transistor Data Chart.



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CIRCLE 43 ON READER-SERVICE CARD



Selecting Transistors and Diodes for Logic Applications

Charles Askansas
Chief Automation Eng.

General Transistor Corp.
Jamaica, N. Y.

Carl Uretsky
Senior Applications Eng.

Logic arrangements such as direct-coupled transistor logic (DCTL), resistor-transistor logic (RTL), resistor capacitor transistor logic (RCTL), diode logic (DL) and current mode logic (CML) are discussed and pertinent factors affecting semiconductor requirements are evaluated for each.



A sizable portion of the \$200 million spent on transistors last year can be attributed to overspecification, insist co-authors Charles Askansas (right) and Carl Uretsky (left). They are convinced that, by carefully evaluating specs and designing around selection limits rather than typical characteristics, design engineers could produce more efficient circuitry at lower cost.

WITH MORE than 1100 different transistor types and over 1500 small signal diode types available to the design engineer, selection of one particular device for a specific logic function can be complicated. However, by careful evaluation of the semiconductor requirements involved for each logic mode, key parameters become apparent and final choice can rapidly be narrowed down.

Direct Coupled Transistor Logic (DCTL)

An important set of computer circuits to consider are those designed to use the transistor as both the logical gating and power amplifying element. Although it requires many transistors, it does not use interstage coupling elements between gates, or between gates and amplifiers. The same building block could be used as an AND gate, OR gate, inverter or flip-flop. A single low voltage supply (4 or 5 v) is the only one required for this logic mode.

With DCTL, circuit logic is performed by combinations of direct coupled transistors in series and in parallel. Since it is necessary for V_{CE} of an "on" transistor to be less than V_{BE} of the coupled transistor, saturated switching is required. V_{CE} and V_{BE} measured with the transistor in saturation define the two logic levels, illustrating the need for V_{CE} to be much lower than V_{BE} to insure stability and circuit flexibility.

Fig. 1a shows a DCTL flip-flop. When T_1 is "on", the V_{CE} voltage of T_1 is very low (0.1 v) and not sufficient to turn T_2 "on" while V_{CE} of T_2 is about 0.4 v holding T_1 "on." When T_1 is momentarily turned off by an external trigger, the V_{CE} of T_1 will increase causing T_2 to turn "on" which will then lower the V_{BE} applied to T_1 and cause T_1 to turn "off."

In Fig. 2 is shown a parallel and a series logic gate. The importance of extremely low V_{CE} when the transistors are "on" is particularly apparent in the series gate.

The output voltage V_o must be about 0.1 v when all transistors in the series chain have been turned "on." If this does not occur, the coupled logic will not recognize the negative AND signal. Important consideration must be given to tightly controlled saturated gain, charge storage and input voltage. Since these parameters must remain within close limits during the entire operating life of the transistor, a wide operating temperature range is not possible.

The charge storage of the transistor, as will be explained in greater detail later, is an indication of the time to turn a transistor off. Excessive charge storage in transistors used for DCTL could easily cause a malfunction by not turning "off" with a small trigger voltage excursion of the base.

With the realization of small voltage swings in the order of 0.5 v and the fact that only resistive components are used, it becomes obvious that the transistor is the only speed limiting

Basic Guide

1. Specify what the circuit *actually* requires.
2. Select compatible limits for all necessary parameters.
3. Whenever possible, select a registered specification type.
4. Allow for parameter change with operating point.
5. Design around selection limits, not typical characteristics.

device in the system. For high speed operation, transistors with high common emitter cut-off frequencies or high frequency gain specifications should be selected. This will help to insure fast rise and fall times when the transistors are switching. Maximum voltage ratings are of minimum importance since the supply voltage is usually less than 6 v. The small collector to emitter voltage keeps the power dissipation very low and helps to make this mode of operation well suited to miniaturization. The load resistors as seen in Figs. 1 and 2 are carrying essentially a constant current at all times and are alternately being supplied by either the base or collector of a transistor. It is for this reason, that DCTL is sometimes referred to as operating in the current mode.

Resistor Transistor Logic (RTL)

RTL circuits are straightforward saturated switching circuits designed for medium speed, medium current logic operations; Fig. 3 shows an RTL NOR circuit.

All logic operations can be performed by this single logic circuit since any positive input produces an inverted output regardless of the other inputs. Conversely, all inputs must be negative to give a positive output. A large number of audio and medium speed transistors readily meet the requirements for this type of operation, but special attention should be given to voltage ratings, β , and charge storage Q_s .

When selecting a transistor, the first consideration should be given to the maximum voltage between collector and emitter, V_{CE} , when the transistor is in the "off" condition. In many instances this voltage can exceed the rated V_{CE0} of the transistor depending on the value of R_B and V_B in Fig. 3. As the reverse bias is increased, the V_{CE} breakdown will increase. Always specify the V_{CE} rating with the base reverse biased by V_B and R_B .

The required dc gain (h_{FE}) should be specified at the operating current of the circuit. If a minimum saturated gain is required at a specific col-

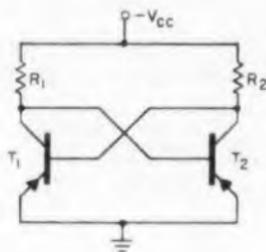


Fig. 1. Direct-coupled transistor logic (DCTL) flip-flop circuit. When T_1 is on, the V_{CE} voltage of T_1 is too low to turn on T_2 . When T_1 is triggered off, T_1 's V_{CE} increases, permitting T_2 to conduct; the V_{BE} applied to T_1 decreases causing T_1 to turn off.

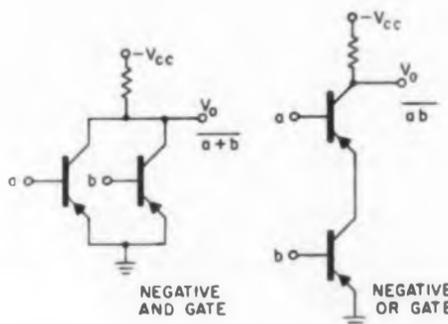


Fig. 2. A parallel DCTL logic gate (a) and a series gate (b). Only small voltage swings, in the order of 0.5 v, are handled and the switching speed is limited only by the transistor selected.

lector current, the transistor should be selected to just meet that condition.

Transistors with a very high gain will insure fast turn-on time ($t_d + t_r$), but must sacrifice turn-off time ($t_s + t_f$). This is due to the fact that operating the transistor in saturation produces charge storage effects which are proportional to the degree of saturation. Thus, as the charge storage (Q_s) and the storage time of the transistor increases, it will take a longer period of time for the stored charge to leave the base region of the transistor and permit it to turn off. Further, it should be noted that h_{FE} is a function of I_C ; although a transistor might meet a minimum h_{FE} requirement at say 5 ma, there is no guarantee that h_{FE} would be acceptable at $I_C = 50$ ma.

RTL circuits can also be operated in an unsaturated switching mode. This would eliminate the charge storage effects. Unfortunately though, it will require greater power dissipation in the transistor and more components. The logic levels will also be closer together than they would be in the saturated mode.

Resistor Capacitor Transistor Logic (RCTL)

Resistor-capacitor logic (RCTL) is basically the same as the RTL with the addition of speed up capacitors to minimize the storage time by supplying a charge equal to the stored base charge. The additional components, and a carefully selected charge storage (Q_s) specification will optimize the RTL circuits as illustrated in Fig. 4, where the value of the speed up capacitor is chosen so that

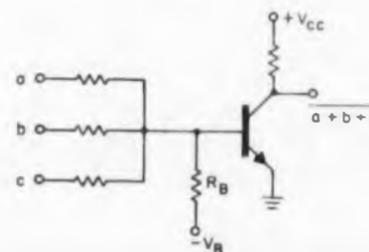


Fig. 3. Resistor-transistor logic (RTL) circuits are popular for medium speed, medium current applications since relatively cheap transistors can be used.

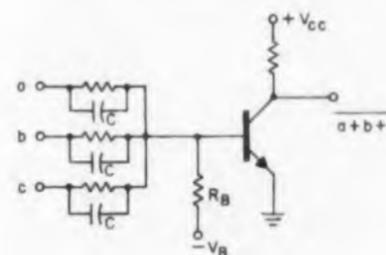


Fig. 4. By adding a capacitor to compensate for stored charge effects in the RTL arrangement, an RCTL circuit is created for faster speed applications. An RCTL NOR circuit is shown.

it will effectively compensate for the stored charge.

The value of C may be calculated by

$$\frac{Q_s}{V_{in}} = C$$

where Q_s is the maximum rated value of charge storage and V_{in} is the input voltage swing.

As expected, this transistor will be slightly more expensive since it is a well specified, highly efficient switching transistor. The maximum pulse repetition rate for most practical circuits will be limited by the RC time constant in the base.

Diode Logic (DL)

Diode logic has the advantages of high speed, low cost, and simplified circuitry. Diodes perform the logic, and transistors are used as amplifiers and inverters since there is no inversion in diode logic. A diode AND circuit is shown in Fig. 5a.

The output voltage of the AND circuit ap-

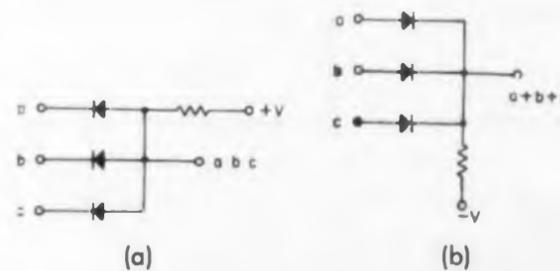


Fig. 5. A diode AND circuit for positive inputs (a). Diode logic (DL) permits high speed at low cost; transistors are used as amplifiers and inverters following the logic operation. In (b) is shown a diode OR circuit for positive inputs.

proximately equals the most negative input voltage. This is true regardless of the number of inputs. An OR circuit for positive inputs, where the output voltage approximately equals the most positive input voltage is shown in Fig. 5b.

The back resistance of diodes in AND/OR circuits acts as a load on the driving circuits. When this effective back resistance is too low, the driving source (another diode circuit or emitter follower) cannot supply enough current to maintain proper down levels, or maintain required rise and fall times. Diode AND/OR circuits with six or seven inputs are used and these circuits present the problem of lowered effective back resistance.

If cascaded inputs are used, back resistance can be greatly increased. Figs. 6a and 6b show how cascaded diode logic will improve the load impedance as seen by the driving source (-20 v). (The back resistance of each diode is approximately 400 K.)

The rise and fall times of diode logic circuits are primarily a function of the circuit capacitance including the diode capacitance and the limiting resistor. Usually, for circuit design, the rise or fall time and the stray capacitance are known, and by transient analysis the value of limiting resistance can be calculated. For an AND circuit the fall time usually follows the input, while for

an OR circuit the rise time usually follows the input.

Specification of the diodes should include peak inverse voltage, maximum reverse dc operating voltage, forward voltage and current and reverse recovery time. From the reverse dc condition, the value of back resistance can be calculated from which to select a minimum design value.

The maximum reverse voltage should be selected such that the diode will not break down under the worst bias conditions existing in the circuit. Recovery time should be specified relative to the clock rate of the computer to insure that the diodes will recover between operations. Always specify recovery time simulating actual circuit conditions as closely as possible.

Selection of transistors for inversion and amplification would be the same as for RTL circuits except that switching times should be selected to be compatible with the switching speed of the diodes. The use of transistors unsuitable for DCTL circuits, low impedances and low voltage swings, the lack of serious noise problems, as well as the small number of transistors required, make this mode of operation very desirable.

Current Mode Logic (CML)

Another important type of operation is current mode logic which makes use of the full potential speed of switching transistors. Biasing the circuit so that the transistor will not go into saturation will eliminate the problem of charge storage discussed earlier. Since it is known that the cutoff frequency and the collector capacitance vary with operating point, operating conditions can be selected to give a maximum cutoff frequency and at the same time, a minimum output capacitance. Collector capacitance is proportional to the square root of $1/V_{CB}$ and frequency cut-off is a function of I_E and V_{CB} . From this guide, it can be shown that an operating point of about 5 v V_{CB} and 1 ma for I_E will satisfy both conditions and give good frequency response.

Drift transistors are ideally suited for current mode switching. They are biased by constant current supplies to keep them out of saturation. Voltage excursions are small, but the circuitry is relatively unaffected by noise.

Fig. 7 shows a typical current mode NOR circuit. The transient response of the transistor is very nearly the same as for common-base operation. Because of the current source in the emitter, the entire common-base frequency response of the transistor can be realized.

When specifying drift transistors for computer circuits, certain parameters should be particularly selected. The collector emitter breakdown voltage should be specified so as not to be exceeded by the voltage of the constant current supply. Because of the high frequency cut-off of drift transistors,

Table 1. A Comparison of Five Semiconductor Logic Arrangements with Comments on the Criteria for Device Selection.

Logic Mode	Features	Limitations	Semiconductor Parameters to be Specified
DCTL	<ol style="list-style-type: none"> 1) Simple Circuitry. 2) Saturating logic. 3) Low power dissipation. 4) Small supply voltages. 5) High speed. 6) Transistors that have low breakdown voltages can be used. 	<ol style="list-style-type: none"> 1) Storage effect limits turn off time. 2) Small voltage swings. 3) Expensive, requires a large number of transistors. 	<ol style="list-style-type: none"> 1) Strict control of V_{CE}, V_{BE} $V_{CE} \ll V_{BE}$ 2) Low charge storage. 3) High common emitter frequency characteristics. 4) Gain at operating conditions.
RTL	<ol style="list-style-type: none"> 1) Economical use of transistors. 2) Large voltage swings can be handled. All logic functions can be performed. 	<ol style="list-style-type: none"> 1) Medium speed. 2) Serious charge storage limiting t_{off} speed. 3) Higher power dissipation than DCTL. 	<ol style="list-style-type: none"> 1) Collector-emitter avalanche voltage. 2) Gain at operating collector current. 3) Charge Storage. 4) V_{CBO} and V_{PI}
RCTL	Same as RTL except higher speed possible.	Additional components required (speed up capacitor).	Same as RTL except charge storage requirements are more critical.
DL (Diode Logic)	<ol style="list-style-type: none"> 1) Very economical. 2) Relatively simple design. 3) High speed easily obtained. 4) Low power dissipation. 5) Large number of inputs possible. 	<ol style="list-style-type: none"> 1) Logic does not perform inversions. 	<ol style="list-style-type: none"> 1) Peak inverse voltage. 2) Maximum reverse dc operating voltages. 3) Forward voltage and current characteristics. 4) Reverse recovery time. 5) Reverse impedance.
CML (Current Mode Logic)	<ol style="list-style-type: none"> 1) Uses full potential speed of the transistor. 2) No charge storage problems. 3) Relatively unaffected by noise. 4) Increased base drive for faster t_{on}, without sacrificing t_{off}. 	<ol style="list-style-type: none"> 1) Higher dissipation than other modes. 2) Small voltage swings. 3) Requires additional transistors. 4) Requires constant current supply. 	<ol style="list-style-type: none"> 1) f_{ab} or gain-bandwidth product. 2) Unsaturated low current gain.

Fig. 6. source diode 80 k w

Fig. with does stora

sistors, stituted Gain h emitter quency frequen mately ship di mesa t larger t sistors, other v could h

Other gain (h $1_{\beta} = 5$ 2N603 a very hig circuits.

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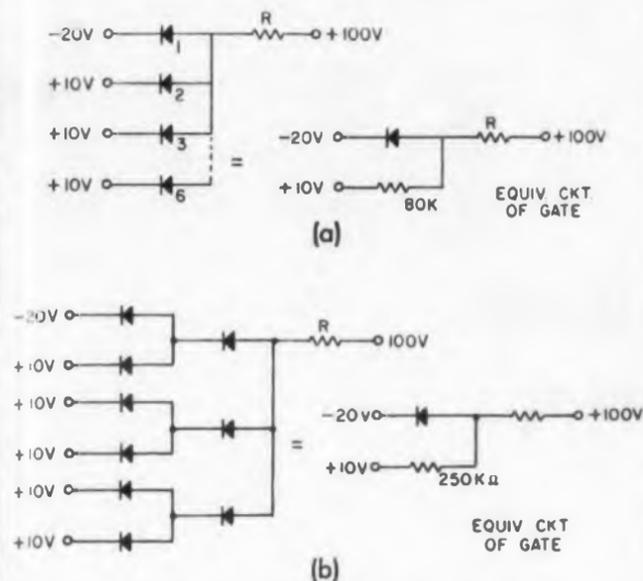


Fig. 6. By cascading diode logic inputs (b), the driving source impedance increases to 250 k (assuming each diode has a reverse resistance of 400 k) compared to 80 k when all inputs are in parallel (a).

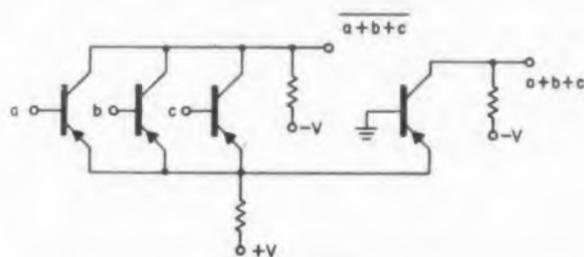


Fig. 7. Current mode logic (CML) NOR circuit with inverter. Biasing is such that the transistor does not saturate thereby eliminating the charge storage problem which limits speed.

sistors, a gain bandwidth measurement is substituted for the common base cut-off frequency. Gain bandwidth is measured in the common emitter configuration and defined as the gain frequency product when the gain fall off with frequency is 6 db per octave, and is approximately 0.7 of the frequency cut-off. This relationship differs for each type of transistor. In the mesa transistor, GBW is usually considerably larger than $f\alpha_b$, while for some types of drift transistors, the GBW can be only half of the $f\alpha_b$. In other words, a transistor with GBW of 30 mc could have a frequency cut-off of 50-60 mc.

Other important parameters to specify are dc gain (h_{FE}) in an unsaturated condition, usually $I_R = 500 \mu a$, and $V_{CE} = 1 v$. The 2N602 and 2N603 are specially designed drift transistors for very high speed and reliable current mode logic circuits. ■ ■

Bibliography

Design of Transistorized Circuits for Digital Computers—A. Pressman; Rider 1959.

Pulse and Digital Circuits—J. Millman—H. Taub; McGraw-Hill 1956.

Transistor Circuit Engineering—W. F. Chow et al; John Wiley & Sons 1957.

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Type	Capacity Range	WVDC	Temperature Range	Case Diameter Range	Case Length Range
TCW	2-750 mfd.	150-3v.	-40 to +85°C	3/8"-5/8"	5/8"-1 1/16"
KETA	1-1400 mfd.	50-3v.	-30 to +65°C	3/16"-5/8"	5/8"-2"

Type KETA available in dual ratings, in 1/2" and 5/8" diameter cases; and in non-polarized ratings of approximately one-half the above capacitance values.

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CIRCLE 45 ON READER-SERVICE CARD

◀ CIRCLE 44 ON READER-SERVICE CARD



Transistors Most Frequently Used In Signal Corps R&D Equipment

Irving J. Ross

U. S. Army Signal Research and Development Laboratory
Fort Monmouth, N. J.

THE MOST frequently used types of transistors used in Signal Corps research and development equipment are shown in Tables I and II. The tables show a breakdown by categories of transistor application and by quantities of transistors used. The information for this report was based primarily on submissions of transistor complement reports by contractors of Signal Corps research and development equipment. It must be realized that in the design of research and devel-

opment equipment, the transistor complements are not frozen and may change with subsequent circuit design modifications. The information given is, therefore, the status as of April 30, 1960.

The total number of development equipment models represented in this compilation is roughly 4,900 and encompasses the full range of military equipment being developed for the Signal Corps. Included are such categories as data processing (computers), radar, communications, countermeas-

ures, and instrumentation (test equipment).

The tables include only those transistor types for which military specifications have been prepared. This includes all silicon types shown in Table II. It should be noted that the majority of transistor types are germanium (24 types) as against silicon (17). It is expected that the trend for silicon transistors will be increased as high junction temperatures are required for compact, high performance military equipment. ■ ■

Table 1. Most frequently used germanium transistors covered by military specifications.

Category	500 -1,000	1,000 -2,000	2,000 -5,000	5,000 -10,000	> 10,000
NPN Low Power Low Freq.	*2N119	2N335 2N1247	2N332 2N333		
PNP Low Power Low Freq.		2N1026			
NPN Med Freq 3-30 Mc		2N495	2N338		
PNP Switch Low Speed < 5 μsec	2N328A				
NPN Med Speed Switch 1-5 μsec	2N545				
NPN High Speed > 1 μsec				2N706	
NPN Med Pwr 300 mw-3w	2N342	2N341	2N697		2N718
NPN 3w-30w	2N497				

*These types are not recommended for future Signal Corps R&D equipment.

Table 2. Most frequently used silicon transistors covered by military specifications.

Category	500 -1,000	1,000 -2,000	2,000 -5,000	5,000 10,000	10,000 -20,000	> 20,000
PNP Low Power Low Freq.	2N467 2N526		*2N43A 2N465		2N466	
PNP Med Freq. 3-30Mc		2N274 2N416				
PNP High Freq. 30 Mc	2N502A	2N499		2N384		
PNP Med Speed Switch 1-5 μsec				2N404	*2N123 *2N240 2N248	
NPN Med Speed Switch 1-5 μsec	2N1000			2N388	2N167	
PNP High Speed Switch > 1 μsec				2N501A		2N393 2N1411
PNP High Power > 30 w	2N575	2N297A	2N174			

For designs up to 50 V



TRANSISTORS-1960

Tung-Sol 2N381, 2N382, 2N383 Transistors

Service-proved reliability for:

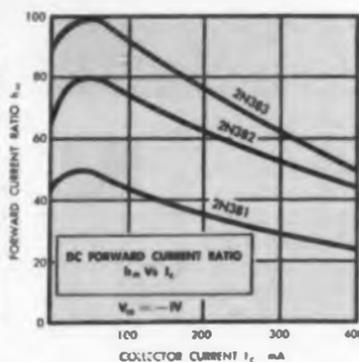
- Small signal and audio amplifiers
- Class B push-pull output stages
- Medium speed switching circuits



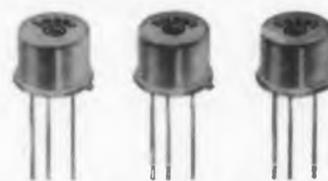
ELECTRICAL CHARACTERISTICS (25°C)

TEST AND CONDITIONS	SYM-BOL	2N381			2N382			2N383			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Collector Cut-off Current $V_{CB} = -25$ v	I_{CBO}	6	10		6	10		6	10		μ A
Emitter Cut-off Current $V_{EB} = -20$ v	I_{EBO}	5	10		5	10		5	10		μ A
Forward Current Ratio $I_C = 20$ mA, $V_{CE} = -1.0$ v	h_{FE}	35		65	60		90	75		120	
Forward Current Ratio $I_C = 100$ mA, $V_{CE} = -1.0$ v	h_{FE}	30	45		50			65			
Forward Current Ratio $I_C = 10$ mA, $V_{CE} = -5.0$ v, $f = 1$ kc	h_{FE}	35	60	85	70	90	135	90	115	155	
Frequency Cut-off $I_C = 1$ mA, $V_{CB} = -6.0$ v	f_{cb}	3			4			5			Mc

ABSOLUTE MAXIMUM RATINGS (25°C)		
Collector to Base Voltage	BV_{CBO}	-50V
Emitter to Base Voltage	BV_{EBO}	-20V
Collector to Emitter Voltage	$BV_{CER} (R_{BE} = 10K)$	-25V
Collector Dissipation (Free Air)	P_C	200mW
Collector Dissipation (infinite Heat Sink)	P_C	500mW
Collector Current	I_C	400mA
Junction Temperature	T_j	-65 to +100°C



The striking superiority of these service-proved germanium transistors is evidenced by their long and successful use in any number of exacting applications, where they have established outstanding performance records under the toughest environmental extremes. When long-life reliability and electrical stability are demanded, these versatile units are ideally suited.



Packaged in the standard JEDEC TO-5 outline with the base lead connected to the case, these units can be supplied in any quantity immediately from stock.

Like all Tung-Sol components, these transistors are the products of the highest manufacturing standards and severe quality assurance practices which have made Tung-Sol the name synonymous with the finest componentry.

Write for full technical details. Tung-Sol Electric Inc., Newark 4, N. J.

Guide to Military Transistor Specs

TO FACILITATE logistic support of transistorized military equipment a limited number of transistor types have been approved, by the Department of Defense, for engineers to consider during design and production. In MIL-STD-701A, see p 55, a list of preferred and guidance type transistors are given under joint approval of the Departments of the Army, Navy, and Air Force.

In MIL-STD-701A, preferred types are "the best available, those which have been in production, comply to particular military specifications and are listed on a Qualified Products List." Guidance types are "the best available, comply to a particular specification completed or in preparation, and possess a type designation acceptable to the military departments."

In addition, each service has its own particular list of approved types. A complete tabulation of all approved types that have been issued and their current status are presented on the facing page. ■ ■

Technical assistance is available through the following sales offices: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Texas; Denver, Colo.; Detroit, Mich.; Irvington, N. J.; Melrose Park, Ill.; Newark, N. J.; Philadelphia, Pa.; Seattle, Wash. Canada: Toronto, Ontario.

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CIRCLE 48 ON READER-SERVICE CARD

Military-Approved Transistor Types

Detail Specification	Date Of Issue	Transistor Type	Remarks	Detail Specification	Date Of Issue	Transistor Type	Remarks
MIL-T-19500/1	14 June 1957	JAN-2N220		MIL-T-19500/50A(SigC)	3 February 1959	2N465	
MIL-T-19500/2	12 December 1957	JAN-2N118		MIL-T-19500/51A(SigC)	3 February 1959	2N466	
MIL-T-19500/3(NAVY)	- - -	2N230	Dropped	MIL-T-19500/52B(SigC)	3 February 1959	2N467	
MIL-T-19500/4A	16 January 1958	JAN-2N331		MIL-T-19500/53(SigC)	- - -	2N325	Dropped—See MIL-T-19500/61 (SigC)
MIL-T-19500/5(USAF)	- - -	2N200	Dropped	MIL-T-19500/54A(SigC)	13 August 1959	2N495	
MIL-T-19500/6(USAF)	10 April 1958	2N44A	Amendment 1	MIL-T-19500/55(SigC)	21 July 1958	2N300	
MIL-T-19500/7(NAVY)	- - -	2N43A	Dropped—See MIL-T-19500/18(USAF)	MIL-T-19500/56A(SigC)	3 February 1959	2N416	
MIL-T-19500/8(SigC)	21 July 1958	2N129		MIL-T-19500/57A(SigC)	3 February 1959	2N417	
MIL-T-19500/9A	12 June 1959	JAN-2N128		MIL-T-19500/58A(SigC)	17 November 1958	2N665	
MIL-T-19500/10(USAF)	- - -	2N78	Dropped	MIL-T-19500/59(Pro JAN)	- - -	JAN-2N333	Work temporarily suspended
MIL-T-19500/11(USAF)	3 April 1958	2N167	Amendment 1	MIL-T-19500/60B(NAVY)	29 June 1959	JAN-2N335	
MIL-T-19500/12(NAVY)	- - -	2N117	Dropped—See MIL-T-19500/35(Navy)	MIL-T-19500/61(SigC)	23 October 1958	2N526	
MIL-T-19500/13A	8 January 1958	JAN-2N174		MIL-T-19500/62(SigC)	5 December 1958	2N325	
MIL-T-19500/14(USAF)	- - -	2N245	Dropped	MIL-T-19500/63A(NAVY)	26 June 1959	2N501A	
MIL-T-19500/15(USAF)	- - -	2N246	Dropped	MIL-S-19500/64A(NAVY)	14 September 1959	2N358A	
MIL-T-19500/16A	8 January 1958	JAN-2N342		MIL-T-19500/65(NAVY)	20 March 1959	2N396A	
MIL-T-19500/17(USAF)	- - -	JAN-2N343		MIL-T-19500/66A(NAVY)	26 June 1959	2N388	
MIL-T-19500/18(USAF)	10 November 1958	2N343	Dropped—See MIL-T-19500/16A	MIL-T-19500/67(SigC)	22 January 1959	2N422	
MIL-T-19500/19	- - -	- - -	Amendment 2	MIL-T-19500/68(SigC)	10 February 1959	2N1011	
MIL-T-19500/20(USAF)	25 March 1959	2N404	Never Used	MIL-T-19500/69A(NAVY)	26 June 1959	2N1120	
MIL-T-19500/21(USAF)	10 April 1958	2N404				2N337	
MIL-T-19500/22(USAF)	10 April 1958	2N431	Obsolete	MIL-T-19500/70(NAVY)	14 May 1959	2N338	
MIL-T-19500/23(USAF)	10 April 1958	2N432	Obsolete	MIL-T-19500/71A(NAVY)	29 June 1959	2N463	
MIL-T-19500/24(NAVY)	20 September 1957	2N433	Obsolete	MIL-T-19500/72(SigC)	5 March 1959	2N1195	
MIL-T-19500/25(NAVY)	20 November 1957	2N158		MIL-T-19500/73(NAVY)	26 June 1959	2N499	
MIL-T-19500/26(SigC)	3 October 1957	2N240		MIL-T-19500/74(NAVY)	30 June 1959	2N560	
MIL-T-19500/27(SigC)	14 October 1957	2N274				2N497	
MIL-T-19500/28(USAF)	- - -	2N384				2N498	
MIL-T-19500/29(USAF)	- - -	2N333	Dropped—See MIL-T-19500/37A(NAVY)	MIL-T-19500/75(USAF)	- - -	2N656	
MIL-T-19500/30(USAF)	4 February 1959	2N144	Dropped			2N657	
MIL-T-19500/31(USAF)	- - -	2N123				2N489	Undated
MIL-T-19500/32	- - -	2N339				2N490	
MIL-T-19500/33	- - -	2N340				2N491	
MIL-T-19500/34(USAF)	- - -	2N341				2N492	
MIL-T-19500/35(NAVY)	15 March 1958	2N341				2N493	
MIL-T-19500/36A(SigC)	17 November 1958	- - -	Never Used	MIL-T-19500/76(NAVY)	4 February 1960	2N494	
MIL-T-19500/37A(NAVY)	18 June 1959	- - -	Never Used	MIL-T-19500/77A(SigC)	30 October 1959	2N1100	Undated
MIL-T-19500/38(NAVY)	28 May 1958	2N243	Dropped	MIL-T-19500/78A(SigC)	7 December 1959	2N393	
MIL-T-19500/39(Pro JAN)	- - -	2N244				2N1025	
MIL-T-19500/40	- - -	2N117				2N1026	
MIL-T-19500/41A(SigC)	26 January 1959	2N118		MIL-T-19500/79(SigC)	22 June 1959	2N1026A	
MIL-T-19500/42A(SigC)	26 January 1959	2N119		MIL-T-19500/80(SigC)	22 June 1959	2N1000	
MIL-T-19500/43A(SigC)	26 January 1959	2N297A		MIL-T-19500/81(SigC)	17 July 1959	3N35	
MIL-T-19500/44A(SigC)	26 June 1959	2N332		MIL-T-19500/82	10 August 1959	2N1001	
MIL-T-19500/45(USAF)	7 July 1958	2N333		MIL-T-19500/83(SigC)	10 August 1959	2N624	Never Used
MIL-T-19500/46(SigC)	22 May 1958	2N334		MIL-T-19500/84(USN)		2N1002	
MIL-T-19500/47(SigC)	22 May 1958	2N335		MIL-T-19500/85	14 Oct 1959	2N545	
MIL-T-19500/48(USAF)	- - -	2N539		MIL-T-19500/89(USN)		2N496	
MIL-T-19500/49B(SigC)	3 February 1959	2N299	Dropped	MIL-T-19500/99A	1 April 1960	2N1039, 1041	
		JAN-2N325	Final Draft In Preparation	MIL-T-19500/100	30 Nov 1959	2N696, 697	
		JAN-2N326		MIL-T-19500/101	30 Nov 1959	2N537	
		2N425		MIL-T-19500/102(USAF)		2N1201	
		2N426		MIL-T-19500/103	18 Dec 1959	2N1016B	
		2N427		MIL-T-19500/105	28 Dec 1959	2N1082	
		2N428		MIL-T-19500/110	1 April 1960	2N1200	
		2N461		MIL-T-19500/111	1 April 1960	2N328A	
		2N574		MIL-T-19500/112	4 April 1960	2N329A	
		2N575		MIL-T-19500/113	4 April 1960	2N502A	
		2N247	Dropped			2N1158A	
		2N464					



Airline Industry Completes Transistor Preferred List

AN OUTSTANDING example of a concentrated and well organized effort to prepare a transistor "Preferred List" is that of the Airlines Electronic Engineering Committee (AEEC), a body within Aeronautical Radio, Inc. (ARINC).

Activities of ARINC, a corporation in which U.S. scheduled airlines are major stockholders, include the operation of an extensive system of domestic and overseas land stations, allocation and

assignment of operating frequencies, coordination of communication and electronic systems and the formulation of standards such as the ARINC Preferred Tube List and Preferred Transistor List.

Glamour vs Reliability

In 1947, an ARINC committee and the Military jointly prepared a listing of 10 tube types as a basis for the ARINC Preferred Tube List and the

Military Standard Preferred List of Electronic Tubes. In later years, 15 additional types were added to the ARINC list while the military (with a wider scope of applications) included 65 more types.

Tube and equipment manufacturers criticized the stubborn attitude of the ARINC body because of the failure to include latest high g_m , high power or "super-performance" tubes. However, stacks of carefully collected data on long-life operation and in-service reliability have helped convince many former opponents of ARINC that it is perhaps wiser to "stick with old standbys" until the "new, glittering" devices have proved their performance.

Based on the wide acceptance and success of the ARINC Preferred Tube List, the ARINC Transistor Preferred List project was started in the fall of 1959.

39 U.S. Types on ARINC Transistor List

A total of 21 germanium and 18 silicon U.S. types (plus eight British types awaiting European Airline Electronics Committee approval) were included in the ARINC Preferred Transistor List, completed April 1960, shown in Table I. Of the 39 types, 64 per cent appear on the MIL-STD-701 listing, shown in Table II; military representatives at the ARINC meetings indicated that the MIL-STD-701 revision will include several ARINC types presently off the MIL-STD chart. At the same time, at least 85 per cent of the ARINC types will be MIL-STD approved. The eight British types, indicated as non-U.S. devices on Table I, are included in recognition of the practical fact that non-U.S. equipment manufacturers need "local" availability sources for production and logistics purposes.

How Transistor Types Were Selected

Criteria for inclusion of a particular transistor type include:

- (1) The type must meet the requirements of a maximum number of future applications.
- (2) The type should be reliable and of sound design with sufficient production experience to prove its process and performance.
- (3) The type must be available, not a developmental device.

Table 1. Arinc Transistor Preferred List

		GERMANIUM		SILICON	
		PNP	NPN	PNP	NPN
Low Power	Audio < 300 mw	2N525 2N526 2N466 CV 7008* CV 7006*	2N388	2N327A 2N328A CV 7044*	2N333 2N335 2N336
	Med. Freq. 3 to 30 mc	2N1224 CV 7003*	2N388	2N1132	2N697 2N337 2N338
	High Freq. 30 mc to 100 mc	2N1225 (OC 171)***			3N35
	Higher Freq. 100 mc up	2N1195 2N700			2N716
Switching	Low Speed > 5 usec.	2N398 CV 7007*		2N327A 2N328A	
	Med. Speed 1 to 5 usec.	2N404 2N396A	2N167 2N388	2N491	2N337 2N338
	Fast < 1 usec.	** CV 7087*		2N1132	2N697
Power	300 mw to 3 w	2N1039 2N1041			2N697 2N341 2N343
	3 to 30 w	2N158A CV 7083*	2N326		2N498 2N657 2N1486
	> 30 w	2N174 2N1011 2N677C 2N1412 2N1120			1016B

* Non-U. S. proposed types.

** U. S. equipment manufacturers indicate no immediate requirements for this application; however, U. S. types will be added when the need arises.

***Non-U. S. proposed type which has not yet been assigned a "CV" number.

ment device. Multiple source supply is desirable with essentially continuous quantity production assured.

4) A MIL spec should exist which can be met in the event the airlines should wish to buy top-quality, high-yield devices.

5) The cost should be commensurate with performance and reliability.

Equipment manufacturers who wish to use a non-ARINC type are advised to contact ARINC, 700 K St. N.W., Washington 6, D.C. The reasons for not approving the type will be outlined and recommendations for future inclusion will be forwarded to the Airlines Electronic Engineering Committee.

Transistor Manufacturer, User and Military Pleas at Outcome

Although some transistor manufacturers were best-fallen during early standardization meetings when "pet" types were not endorsed, the final ARINC transistor draft appeared favorable to all. In addition, the air-borne equipment manufacturers active during the list preparation indicated that their needs could be well covered by the devices approved. Finally, military representatives active in their individual service standardization efforts were pleased with the close compatibility achieved.

Airline Customers Can Wait, Military Cannot

Equipment manufacturers are not forced to conform with the ARINC Preferred Transistor List. However, based on the emphasis which the airline customers have previously (and still) place on the ARINC tube types, it might be considered unwise for an airborne equipment maker to include unlisted transistor types. Sufficient justification for the need of a non-preferred type as well as extensive reliability and performance data would be needed before acceptance would be approved, in many cases.

While the practice of incorporating non-MIL components is certainly not uncommon in many tightly specified military contracts, waivers are often granted to the manufacturer to permit "to get the job out on time." No waivers, no delivery.

The military urgently needs small, lightweight devices requiring a minimum of battery power—therefore, they are often forced to grant waivers. The airline industry, representing an estimated 50 billion dollar annual electronic equipment customer is not in dire need of transistorized equipment. Planes are equipped with reliable, tube complemented equipment which have reached a point where preventive maintenance, parts inventory and repair are well under control.

For space economy, cooler operation and hopes

Table 2. List of Mil-STD-701A Transistors

		GERMANIUM		SILICON		
		PNP	PNP	PNP	NPN	
Low Power	Audio <300 mw.	Preferred	2N220 2N331 2N526		2N335	
		Guidance	2N43A 2N465 2N535B		2N1026 2N333	
	Med. Freq. 3 to 30 mc.	Preferred				
		Guidance			2N495 2N338	
		Preferred				
	High Freq. >30 mc.	Guidance	2N537 2N384 2N700		3N35	
Switching	Low speed >5 usec total time	Preferred				
		Guidance	2N398		2N328A 2N329A	
	Medium speed 1 to 15 μ sec.	Preferred	2N404 2N428			
		Guidance	2N599 2N396A	2N1310 2N358A 2N388	2N491 2N496 2N337	
	Fast Speed <1 usec.	Preferred	2N393		2N1132 2N697	
		Guidance	2N695 2N1195 2N501A		2N560	
	Bilateral Switch med. speed	Preferred				
		Guidance				
	Power	300 mw to 3 w	Preferred			
			Guidance	2N1039		2N343 2N341
3 to 30 w		Preferred				
		Guidance	2N539	2N326	2N498 2N657 2N1016E 2N497 2N656	
		Preferred	2N297A			
>30 w		Preferred	2N665 2N174 2N463 2N1120 2N1165		2N389 2N424 2N1050	

of longer life operation, the airlines are obviously interested in using transistors. However, they are adamant in their demands to sacrifice nothing in the way of reliability, maintenance, or operation.

This briefly means that the airline industry, as a group or as a single airline, will be extremely reluctant to buy a piece of equipment which includes non-ARINC preferred transistors. They

may be quite content to wait, say another year, for the equipment manufacturer to redesign his proposed gear using preferred types or for sufficient data and proof to indicate that the non-ARINC type is suitable. Meanwhile, of course, another manufacturer of similar equipment may submit prototypes using ARINC approved types and walk off with quantity orders. ■ ■

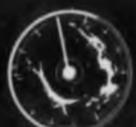
Communications



Instruments



Controls



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Mobile Electronics

New RCA Intermediate-Power Transistors feature JEDEC TO-8 case with removable heat sink mounting flange



6 NEW RCA INTERMEDIATE POWER TRANSISTORS

Now—in production quantities—six new RCA PNP germanium alloy junction transistors designed primarily for intermediate-power switching and audio-frequency industrial and military applications. Featuring 100°C maximum junction temperature and a unique case design, these new types can be used with or without the heat-sink mounting flange. With mounting flange in place, these types can dissipate 7.5 watts at 25°C case temperature; without flange, one watt at 25°C.

These new RCA intermediate-power transistors provide a choice of voltage ratings and beta ranges for design flexibility. They feature low saturation resistance and low leakage current.

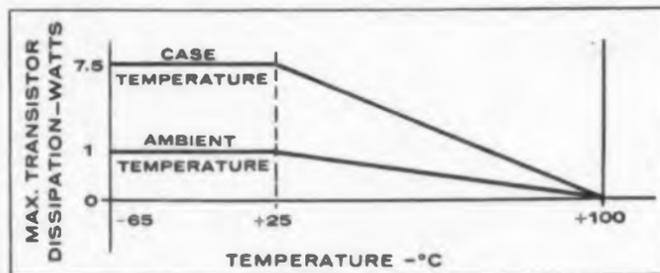
They are particularly useful in power switching circuits such as dc-to-dc converters, inverters, choppers, solenoid drivers, and relay controls; oscillator, regulator, and pulse-amplifier circuits, and as class A and class B push-pull amplifiers for servo and other audio-frequency applications.

RCA intermediate-power germanium transistors were developed in cooperation with the U. S. Army Signal Corps on an Industrial Preparedness Measure for military devices.

Call your nearest RCA field office today for full particulars. For further technical information write RCA Commercial Engineering Sec. G-18-NN-1, Somerville, N. J.

ELECTRICAL CHARACTERISTICS

Type	Min. V _{CE} (I _C = -50 ma)	Min. V _{CE0} (I _C = -50 ma)	Min. V _{CE0} (I _{CEO} = -250 μa)	Min. V _{EB} (I _E = -100 μa)	h _{FE} (I _C = -400 ma)
2N 1183	-35v	-20v	-45v	-20v	20-60
2N 1183A	-50v	-30v	-60v	-20v	20-60
2N 1183B	-60v	-40v	-80v	-20v	20-60
2N 1184	-35v	-20v	-45v	-20v	40-120
2N 1184A	-50v	-30v	-60v	-20v	40-120
2N 1184B	-60v	-40v	-80v	-20v	40-120



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ELECTRON

**ELECTRONIC
DESIGN's
Eighth Annual**

TRANSISTOR DATA CHART

ELECTRONIC DESIGN's Eighth Annual Transistor Data Chart, following last year's pattern, has been specially tailored to meet the specific needs of the design engineer.

Contrary to existing lists which group transistors by manufacturer or in numerical sequence (fine for salesmen, of limited use to engineers), the 1960 Data Chart has transistors organized into six application categories:

- *Audio*—mostly general purpose types, under 1-w power rating. Types are listed in order of increasing forward-current transfer ratio.
- *Power devices*—transistors rated at 1 w and above are listed in order of increasing collector power dissipation.
- *High frequency*—types ranging up to and above the vhf range and tabulated in order of increasing alpha-cutoff frequency.
- *High-level switching*—devices intended to handle high currents are listed in order of increasing alpha-cutoff frequency.
- *Low-level switching*—low power devices for switching signal circuits are tabulated in order of increasing alpha-cutoff frequency. For both high- and low-level switching devices, rise, storage and fall time are given when supplied by manufacturers.
- *Special types*—low noise, high power/high frequency and other miscellaneous types are included.

By this system of listing transistors, the design engineer is offered a rapid method of selecting a particular type based on a parameter value. In addition, close substitutes are apparent and multiple sources of supply are listed when applicable.

For example, if a 5-w power transistor is required, it is merely necessary to scan down the "W_c" columns in the "Power Transistor" group until "5w" is found. Various units, together with significant characteristics and manufacturers, will be tabulated. Immediately several types are shown and final selection is up to the design engineer. Similar arrangement of the other groups by a key parameter grouping offers rapid selection and sufficient information for initial guidance to proper types. Only U. S. manufactured types are tabulated.

One word of caution is included. Quite a few similar number types, made by several companies, were submitted with different characteristics due to the non-conformity in test methods among manufacturers. The manufacturer whose data is used for each particular type is listed under "Mfg." Other suppliers of the same types are found under "Remarks." There is no implication that the company listed under "Mfg." is a prime supplier, a cheaper source or the original EIA registrant. The final choice of supplier is obviously up to the design engineer. It is thus advisable to use this listing as a guide to selection and then follow up with a detailed evaluation of specific test methods and data as outlined in each manufacturer's specification sheet.

A cross index is included to identify a type number with its listed category. The JEDEC type numbers are tabulated in numerical order and the category group is indicated.

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Power ...	p 62
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High Level ...	p 82
Low Level ...	p 86
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TRANSISTORS - 1960

Audio

Type No.	Mfg.	Type	h_{fe} or h_{FE}	Max. Ratings				Characteristics				Remarks	Type No.	
				W_c (mw)	T_j (c)	m_w/c	V_c V	I_c ma	I_{co} μa	NF db	C_c μf			$f_{\alpha e}$ mc
2N461	MO	npn,AJ,ge	768.985	200	100	2.67	45	-	0.22	20	40	.5		2N461
2N160	RDR	npn,GJ,si	0.93	150	175	-	40	25	0.2	25	7	4		2N160
2N160A	RDR	npn,GJ,si	0.93	150	175	-	40	25	0.2	25	7	4		2N160A
2N349	RDR	npn,GJ,si	0.95	750	175	-	125	40	10	-	-	3		2N349
2N161	RDR	npn,GJ,si	0.96	150	175	-	40	25	0.2	25	7	5		2N161
2N161A	RDR	npn,GJ,si	0.96	150	175	-	40	25	0.2	25	7	5		2N161A
2N348	RDR	npn,GJ,si	0.96	750	175	-	90	50	10	-	-	3		2N348
2N1096	RDR	npn,GJ,si	0.96	500	175	-	90	30	6	-	-	3		2N1096
2N347	RDR	npn,GJ,si	0.98	750	175	-	60	60	10	-	-	3		2N347
2N1095	RDR	npn,GJ,si	0.98	500	175	-	60	40	5	-	-	3		2N1095
2N163	RDR	npn,GJ,si	0.99	150	175	-	40	25	0.2	25	7	6		2N163
2N163A	RDR	npn,GJ,si	0.99	150	175	-	40	25	0.2	25	7	6		2N163A
952	TI	npn,GJ,si	6	750	150	6	80	50	6	-	-	8	2N1155	952
951	TI	npn,GJ,si	9	750	150	6	50	60	5	-	-	8	2N1154	951
953	TI	npn,GJ,si	9	750	150	6	120	40	8	-	-	8	2N1156	953
2N117	TI	npn,GR,si	9-20	150	175	1	45	25	2	20	-	4	TR	2N117
2N332	TI	npn,GR,si	9-20	150	175	1	45	25	2	20	-	6	GE, RDR, TR	2N332
903	TI	npn,GJ,si	9-20	150	175	1	45	25	2	25	-	4	2N1149	903
2N243	TI	npn,GJ,si	9-32	750	150	6	60	60	1	-	-	7		2N243
2N45*	GT	npn,AJ,ge	12	150	100	2	45	-	10	22	40	-	*MIL	2N45*
2N1439	NA	npn,AJ,ge	12	400	200	2.28	50	100	0.01	12	25	1	audio-med. pow.	2N1439
GT327A	GT	npn,AJ,si	14	150	150	1.2	50	-	0.1	18	70	0.5	2N327A	GT327A
2N284	AMP	npn,AJ,ge	15	125	75	2.5	32	125	-	-	-	-		2N284
2N284A	AMP	npn,AJ,ge	15	125	75	2.5	60	125	-	-	-	-		2N284A
2N339A	TR	npn,DJ,si	15	1000	200	8	55	.1	1	-	-	-	beta specs at 3Ic levels	2N339A
2N340A	TR	npn,DJ,si	15	1000	200	8	85	.1	1	-	-	-	beta specs at 3 current levels	2N340A
2N341A	TR	npn,DJ,si	15	1000	200	8	125	.1	1	-	-	-	beta specs at 3 current levels	2N341A
2N1440	NA	npn,AJ,si	15	400	200	2.28	50	100	0.01	12	25	1	audio/med. pow.	2N1440
2N1623	RA	npn,AJ,si	15	250	160	0.54	20	50	.005	18	70	.1		2N1623
2N1655	RA	npn,AJ,si	15	250	160	0.54	125	50	.005	18	70	.2		2N1655
TR34	IND	npn,AJ,ge	15	120	85	3	40	150	10	15	15	1.6		TR34
2N472A	TR	npn,DG,si	16	200	200	1.1	45	-	.02	22	7	8	100% reliability assurance processed	2N472A
2N118	TI	npn,GR,si	18-40	150	175	1	45	25	2	20	-	5	TR	2N118
2N333	TI	npn,GR,si	18-40	150	175	1	45	25	2	20	-	8	GE, TR	2N333
904	TI	npn,GR,si	18-40	150	175	1	45	25	2	25	-	5	2N1150	904
2N334	TI	npn,GR,si	18-90	150	175	1	45	25	2	20	-	10	GE, TR	2N334
904A	TI	npn,GR,si	18-90	150	175	1	45	25	2	25	-	8	2N1151	904A
2N368	TI	npn,AJ,ge	19-49	150	85	2	30	50	7	-	33	1		2N368
2N129	PH	npn,AJ,ge	20	30	85	-	3.0	5.0	-	-	-	30	SPR	2N129
2N1051	WE	npn,DD,si	20	600	150	.25	40	-	-	-	8	60	US, MIL only	2N1051
OC200	AMP	npn,PADT,si	20	250	150	-	25	50	10	-	-	1		OC200
2N406	SY	npn,AJ,ge	20-80	150	75	3	20	35	14	-	-	250		2N406
TR722	IND	npn,AJ,ge	22	150	2.5	3	45	200	10	15	20	2.5		TR722
CK22A	RA	npn,AJ,ge	22.5	80	85	-	20	100	2	6.5	1.2	micromin		CK22A
CK64	RA	npn,FA,ge	23	80	85	-	29	100	2	22	-	0.8		CK64
CK64A	RA	npn,AJ,ge	22.5	80	85	-	29	100	2	22	-	0.8	micromin	CK64A
2N186A	GE	npn,AJ,ge	24	200	85	4	25	200	16	-	40	0.8		2N186A
2N189	GE	npn,AJ,ge	24	75	85	2	25	50	16	15	40	0.8		2N189
2N381	SY	npn,AJ,ge	24-45	200	85	3.3	25	200	20	-	-	10		2N381
2N44	GE	npn,AJ,ge	25	240	100	4	45	300	16	6	40	1	MIL, GT	2N44
2N229	SY	npn,AJ,ge	25 min	50	75	1	10	-	100	-	-	600		2N229
2N330A	SSC	npn,AJ,si	25	-	160	3	30	50	.1	8	-	0.5		2N330A
2N402	WH	npn,FJ,ge	25	180	85	3.3	25	200	15	12	40	0.6	AF driver	2N402
2N460	TS	npn,AJ,ge	25	200	100	.3	45	400	15	-	-	-		2N460
2N564	IND	npn,AJ,ge	25	150	85	2.5	30	300	3	12	20	0.8	US	2N564
2N592	GT	npn,AJ,ge	25	150	100	.2	20	-	5	16	35	0.4	Bilateral driver	2N592
2N612	WH	npn,FJ,ge	25	180	85	3.3	25	200	15	12	40	0.6		2N612
2N1265	SY	npn,AJ,ge	25	50	85	.9	10	100	100	-	-	0.6		2N1265
2N1441	NA	npn,AJ,si	25	400	200	2.28	50	100	0.01	12	25	1	audio/med. pow.	2N1441
GT328A	GT	npn,AJ,si	25	150	150	1.2	50	-	0.1	18	20	1	2N328A	GT328A
2N1101	SY	npn,AJ,ge	25-50	180	75	3.6	20	100	50	-	-	0.01	RCA	2N1101
2N1102	SY	npn,AJ,ge	25-50	180	75	3.6	40	100	50	-	-	0.01		2N1102
2N34	SY	npn,AJ,ge	25-125	150	75	3	40	100	50	-	-	0.01	Driver	2N34
2N35	SY	npn,AJ,ge	25-125	150	75	3	40	100	50	-	-	.01	Driver	2N35
2N306	SY	npn,AJ,ge	25-125	50	85	.83	20	100	100	-	-	.6		2N306
2N464	IND	npn,AJ,ge	26	150	85	2.5	45	200	6	15	20	0.7	Mo, Ro, US, GT	2N464
2N244	TI	npn,GJ,si	28-90	750	150	6	60	60	1	-	-	0.08		2N244
2N118	TI	npn,GR,si	29	150	175	1	45	25	2	20	-	5		2N118
2N279	AMP	npn,AJ,ge	30	25	75	2.5	20	10	110	10	-	0.15		2N279
2N475A	TR	npn,DG,si	30	200	200	1.1	45	-	.02	20	7	10	100% reliability assurance processed	2N475A

Index of Manufacturers

Abbrev.	Company	Location
AMP	Amperex Electronic Co.	Hicksville, N. Y.
BE	Bendix Aviation Corp.	Long Branch, N. J.
CBS	CBS-Hytron, Semicon. Operations	Lowell, Mass.
CL	Clevite Transistor Products	Waltham, Mass.
CR	C. P. Clare Transistor Corp.	Glen Head, L. I., N. Y.
DE	Delco, General Motors Corp.	Kokomo, Ind.
FA	Fairchild Semicond. Corp.	Palo Alto, Calif.
GE	General Electric Co.	Syracuse, N. Y.
GT	General Transistor Corp.	Jamaica, N. Y.
HO	Hoffman Semiconductor Div.	El Monte, Calif.
HU	Hughes Products, Semicon. Div.	Los Angeles, Calif.
IND	Industro Transistor Corp.	Long Island City, N. Y.
MH	Minneapolis-Honeywell	Minneapolis, Minn.
MO8	Motorola, Semiconductor Products Div.	Phoenix, Ariz.
NA	National Semiconductor Corp.	Danbury, Conn.
PH	Philco Corp.	Lansdale, Pa.
PSI	Pacific Semiconductors, Inc.	Culver City, Calif.
RCA	Radio Corp. of America	Somerville, N. J.
RA	Raytheon Mfg. Co.	Newton, Mass.
Rh	Rheem Mfg. Co.	Mountain View, Cal.
RRD	Radio Development and Research Corp.	Paterson, N. J.
STC	Silicon Transistor Corp.	Long Island City, N. Y.
SSD	Sperry Semiconductor Div.	South Norwalk, Conn.
SPR	Sprague Electric Co.	North Adams, Mass.
SY	Sylvania Semiconductor Div.	Woburn, Mass.

DATA CHART

Audio (continued)

Type No.	Mfg.	Type	h _{fe} or h _{FE}	Max. Ratings					Characteristics				Remarks	Type No.
				W _c (mw)	T _i (c)	mw/c	V _c V	I _c ma	I _{co} μa	NF db	C _c μμf	f _{ae} mc		
2N524	SY	npn,AJ,ge	30	225	100	3	45	500	10	-	-	2	GE	2N524
2N594	GT	npn,AJ,ge	30	100	85	1.67	20	-	2	16	15	2	Bilateral	2N594
2N1248	TR	npn,DG,si	30	30	150	0.24	6	-	2.0	1.1	9	5	Low noise	2N1248
2N1446	IND	npn,AJ,ge	30	200	85	3.33	45	400	5	6	20	2		2N1446
2N1654	RA	npn,AJ,si	30	250	160	0.54	80	50	.005	18	70	.2		2N1654
2N1656	RA	npn,AJ,si	30	250	160	0.54	125	50	5	18	70	.2		2N1656
CK25A	RA	npn,AJ,ge	30	80	85	-	20	400	2	-	14	4	micromin RF switch	CK25A
OC201	AMP	npn,PADT,si	30	250	150	-	25	50	10	-	-	4		OC201
2N331	MO	npn,AJ,ge	30-70	75	85	1.2	30	-	1	20	50	.4		2N331
2N650A	MO	npn,AJ,ge	30-70	200	100	2.67	45	500	.33	15	25	.75		2N650A
2N1372	SY	npn,AJ,ge	30-90	150	100	2	25	200	100	-	-	-		2N1372
2N1373	SY	npn,AJ,ge	30-90	150	100	2	45	200	100	-	-	-		2N1373
2N1432	SY	npn,DD,ge	30-120	80	85	1.3	35	10	15	-	-	250		2N1432
2N1380	SY	npn,AJ,ge	30-300	150	100	2	15	200	14	-	-	-		2N1380
2N1381	SY	npn,AJ,ge	30-300	150	100	2	25	200	100	-	-	-		2N1381
2N319	GE	npn,AJ,ge	34	225	85	4	20	200	16	-	25	2.20		2N319
2N403	WH	npn,FJ,ge	35	180	85	3.3	25	200	15	12	40	0.85	driver	2N403
2N405	RCA	npn,AJ,ge	35	150	85	2.5	20	70	14	-	-	0.25	SYL	2N405
2N406	RCA	npn,AJ,ge	35	150	85	-	20	70	14	-	-	-		2N406
2N593	GT	npn,AJ,ge	35	150	100	2	35	-	5	16	35	0.6	Bilateral	2N593
2N613	WH	npn,FJ,ge	35	180	85	3.3	25	200	15	12	40	0.85	driver	2N613
2N734	TI	npn,MS,si	35	1.0	175	-	80	50	1	20	5	50	TO-18	2N734
2N1010	RCA	npn,AJ,ge	35	20	55	-	10	2	10	5	-	2		2N1010
2N1564	TI	npn,MS,si	35	1.2	175	-	80	50	1	20	5	50	TO-5	2N1564
OC57	AMP	npn,PADT,ge	35	10	55	-	7	10	1.5	-	-	1.4		OC57
OC53	AMP	npn,AJ,ge	35	10	55	0.7	3	5	0.1	10	-	0.01	Hearing aid	OC53
2N383	SY	npn,AJ,ge	35-110	200	85	3.3	30	200	20	-	-	10		2N383
2N187A	GE	npn,AJ,ge	36	200	85	4	25	200	16	-	40	1		2N187A
2N190	GE	npn,AJ,ge	36	75	85	2	25	50	16	15	40	1		2N190
2N119	TI	npn,GR,si	36-90	150	175	1	45	25	2	20	-	6	TR	2N119
2N335	TI	npn,GR,si	36-90	150	175	1	45	25	2	20	-	13	TR, GE	2N335
905	TI	npn,GR,si	36-90	150	175	1	45	25	2	25	-	6	2N1152	905
2N650	MO	npn,AJ,ge	40	200	100	2.8	25	250	4	10	20	2	US	2N650
2N653	MO	npn,AJ,ge	40	200	100	2.8	15	250	4	10	20	2		2N653
2N742	NA	npn,MS,si	40	-	200	1.71	60	100	0.1	-	5	200	Switch	2N742
2N1009	SY	npn,AJ,ge	40	150	85	2.5	25	20	1	-	-	-		2N1009
2N1191	MO	npn,AJ,ge	40	175	85	2.8	25	200	4	10	20	1.5		2N1191
CK4	RA	npn,AJ,ge	40	80	85	-	24	100	2	-	14	6	Submin. RF switch	CK4
CK4A	RA	npn,AJ,ge	40	80	85	-	24	100	2	-	14	6	micromin RF switch	CK4A
CK26A	RA	npn,AJ,ge	40	80	85	-	18	400	2	-	14	6	micromin RF switch	CK26A
TR-650	IND	npn,AJ,ge	40	150	85	2.5	45	400	1.0	10	20	2	2N650	TR-650
TR-653	IND	npn,AJ,ge	40	150	85	2.5	30	400	1.0	10	20	2		TR-653
2N382	SY	npn,AJ,ge	40-76	200	85	3.3	25	200	20	-	-	10		2N382
2N43	GE	npn,AJ,ge	42	240	100	4	45	300	16	6	40	1.3		2N43
OC79	AMP	npn,PADT,ge	42	550	75	-	26	300	10	-	-	1.2		OC79
2N104	RCA	npn,AJ,ge	44	150	85	-	30	50	10	12	-	0.7		2N104
2N215	RCA	npn,AJ,ge	44	150	85	-	30	50	10	12	-	0.7		2N215
2N525	GE	npn,AJ,ge	44	225	100	4	45	500	10	6	25	2.5	Sy	2N525
2N238	TI	npn,AJ,ge	45	150	85	2.5	25	150	6	7.5	-	1.5		2N238
2N291	TI	npn,AJ,ge	45	180	85	3	25	200	6	7.5	-	1.5		2N291
2N322	GE	npn,AJ,ge	45	140	85	4	16	100	16	-	25	2.0	Driver	2N322
2N465	IND	npn,AJ,ge	45	150	85	2.5	45	200	6	15	20	0.8	Mu, Ra, US, GT	2N465
2N595	GT	npn,AJ,ge	45	100	85	1.65	20	-	2	16	15	4	Bilateral	2N595
2N1098	GE	npn,AJ,ge	45	140	85	4	16	100	16	-	25	-	Driver	2N1098
2N1442	NA	npn,AJ,si	45	400	200	2.28	50	100	0.01	12	25	1	audio/med. power	2N1442
2N1145	GE	npn,AJ,ge	45	140	85	4	16	100	16	-	40	-	Driver	2N1145
2N1372	TI	npn,AJ,ge	45	250	100	3.3	25	200	3	7	-	1.5		2N1372
2N1373	TI	npn,AJ,ge	45	250	100	3.3	45	200	3	7	-	1.5		2N1373
2N1447	IND	npn,AJ,ge	45	200	85	3.3	45	400	5	6	20	3		2N1447
2N1451	IND	npn,AJ,ge	45	200	85	3.3	45	400	7.5	9	20	1.5		2N1451
CK65	RA	npn,FA,ge	45	80	85	-	24	100	2	22	-	1		CK65
CK65A	RA	npn,AJ,ge	45	80	85	-	24	100	2	22	-	1.0	micromin	CK65A
TR721	IND	npn,AJ,ge	45	150	2.5	3	30	200	10	15	20	3		TR721
2N280	AMP	npn,AJ,ge	47	25	75	2.5	20	10	150	10	-	0.1		2N280
2N43A*	GT	npn,AJ,ge	48	155	100	-	45	-	8	10	40	2	PML-GE	2N43A
2N61	WH	npn,FI,ge	48	180	85	3.3	25	200	15	12	40	1		2N61
2N611	WH	npn,FJ,ge	48	180	85	3.3	25	200	15	12	40	1		2N611
TR320	IND	npn,AJ,ge	48	150	85	3	25	100	10	-	25	2.5	2N320	TR320
2N369	TI	npn,AJ,ge	49-142	150	85	2	30	50	7	-	33	1.3		2N369
2N320	GE	npn,AJ,ge	50	225	85	4	20	200	16	-	25	2.5		2N320

Abbreviation of Terms

- Alloyed Junction
- Diffused Base
- Double Diffused
- Grown Diffused
- Diffused Junction
- Diffused Mesa
- Drift
- Fused Alloy
- Fused Junction
- Grown Diffused
- Germanium
- Grown Junction
- Grown Rate
- Meltback
- MADT
- Micro Alloy
- Mesa
- Rate Grown
- Silicon
- Surface Barrier
- = Collector to emitter capacitance measured across the output terminals with the input ac open-circuited.
- = Frequency at which the magnitude of the forward-current transfer ratio (small-signal) is 0.707 of its low frequency value.
- = Common Emitter-Small signal forward current transfer ratio
- = Common Emitter-Static value of short-circuited forward current ratio
- = Collector current when collector junction is reverse biased and emitter is dc open-circuited.



TRANSISTORS - 1960

Audio (continued)

Type No.	Mfg.	Type	h _{fe} or h _{FE}	Max. Ratings			Characteristics					Remarks	Type No.	
				W _c (mw)	T _j (c)	mw/c	V _c V	I _c ma	I _{co} ua	NF db	C _c uuf			f _{ae} mc
2N331	RCA	pn _p ,A _J ,ge	50	200	85	-	30	200	16	9	-	1.16	GT, BE, IND	2N331
2N363	IND	pn _p ,A _J ,ge	50	150	85	2.5	30	200	10	-	-	1	Re, US	2N363
2N422	RA	pn _p ,F _A ,ge	50	150	85	-	20	100	6	6.5	-	0.8		2N422
2N1251	SY	np _n ,A _J ,ge	50	150	85	2.5	20	100	50	-	-	7.5		2N1251
2N1273	TI	pn _p ,A _J ,ge	50	150	85	2.5	15	150	3	6.5	-	-		2N1273
2N1274	TI	pn _p ,A _J ,ge	50	150	85	2.5	25	150	3	6.5	-	-		2N1274
2N1383	TI	pn _p ,A _J ,ge	50	200	85	3.3	25	200	3	7	-	1.5		2N1383
TR-320	IND	pn _p ,A _J ,ge	50	150	85	2.5	30	200	7.5	-	20	2.5	2N320	TR-320
2N214	SY	np _n ,A _J ,ge	50-100	180	85	3	40	100	50	-	-	0.01	Matched	2N214
2N228	SY	np _n ,A _J ,ge	50-100	50	75	1	40	100	100	-	-	0.01		2N228
2N241A	SY	pn _p ,A _J ,ge	50-100	200	85	3.3	30	200	16	-	-	10		2N241A
2N270	SY	pn _p ,A _J ,ge	50-100	150	85	2.5	25	75	12	-	-	.01		2N270
2N321	SY	pn _p ,A _J ,ge	50-100	200	85	3.3	25	200	16	-	-	10		2N321
2N1059	SY	np _n ,A _J ,ge	50-100	180	75	3.6	20	100	50	-	-	0.01		2N1059
2N651A	MO	pn _p ,A _J ,ge	50-120	200	100	2.67	45	500	.33	15	25	1.0		2N651A
2N408	SY	pn _p ,A _J ,ge	50-135	150	85	2.5	20	70	14	-	-	-		2N408
2N109	SY	pn _p ,A _J ,ge	50-150	50	85	.9	25	75	12	-	-	-		2N109
2N217	SY	pn _p ,A _J ,ge	50-150	-	85	-	25	75	12	-	-	10		2N217
2N323	SY	pn _p ,A _J ,ge	50-150	140	85	2.3	16	100	16	-	-	800		2N323
2N1374	SY	pn _p ,A _J ,ge	50-150	150	100	2	25	200	100	-	-	-		2N1374
2N1375	SY	pn _p ,A _J ,ge	50-150	150	100	2	45	200	100	-	-	-		2N1375
2N188A	GE	pn _p ,A _J ,ge	54	200	85	4	25	200	16	-	40	1.2		2N188A
2N191	GE	pn _p ,A _J ,ge	54	75	85	2	25	50	16	15	40	1.2	Driver	2N191
2N105	RCA	pn _p ,A _J ,ge	55	60	85	-	25	15	7	16.5	-	0.75		2N105
2N566	IND	pn _p ,A _J ,ge	55	150	85	2.5	30	300	3	12	20	1	US	2N566
2N1097	GE	pn _p ,A _J ,ge	55	140	85	4	16	100	16	-	25	-	Driver	2N1097
2N1144	GE	pn _p ,A _J ,ge	55	140	85	4	16	100	16	-	40	-	Driver	2N1144
CK27A	RA	pn _p ,A _J ,ge	55	80	85	-	15	400	2	-	14	11	micromin RF switch hearing aid	CK27A
OC54	AMP	pn _p ,A _J ,ge	55	10	55	0.7	3	5	0.1	10	-	0.01		OC54
OC58	AMP	pn _p ,PADT,ge	55	10	55	-	7	10	1.5	-	-	1.6		OC58
2N226	PH	pn _p ,A _J ,ge	60	250	75	5.0	30	150	8	-	140	0.4		2N226
2N480A	TR	np _n ,D _G ,si	60	200	200	1.1	45	-	.02	20	7	11	100% reliability assurance processed.	2N480A
2N596	GT	np _n ,A _J ,ge	60	100	85	1.67	20	-	2	16	15	6	Bilateral	2N596
2N633	IND	pn _p ,A _J ,ge	60	150	85	2.5	35	200	10	-	-	0.8	Re, US	2N633
OC60	AMP	pn _p ,PADT,ge	60	10	55	-	7	10	1.5	-	-	1.6		OC60
2N526	SY	pn _p ,A _J ,ge	64	225	85	3.7	45	500	10	-	-	3	GE	2N526
2N175	RCA	pn _p ,A _J ,ge	65	50	85	-	10	2	12	6	-	0.85		2N175
2N220	RCA	pn _p ,A _J ,ge	65	50	85	-	10	2	12	6	-	0.85		2N220
2N407	RCA	pn _p ,A _J ,ge	65	150	85	-	20	70	14	-	-	-	SY	2N407
2N408	RCA	pn _p ,A _J ,ge	65	150	85	-	20	70	14	-	-	-		2N408
2N649	RCA	np _n ,A _J ,ge	65	100	85	-	20	100	14	-	-	-		2N649
2N1448	IND	pn _p ,A _J ,ge	65	200	85	3.33	45	400	5	6	20	4		2N1448
2N1452	IND	pn _p ,A _J ,ge	65	200	85	3.33	45	400	7.5	9	20	2.2		2N1452
OC56	AMP	pn _p ,A _J ,ge	65	10	55	0.7	3	5	120	15	-	-	hearing aid	OC56
OC74	AMP	pn _p ,PADT,ge	65	550	75	-	20	300	10	-	-	1.5		OC74
2N323	GE	pn _p ,A _J ,ge	68	140	85	4	16	100	16	-	25	2.5	Driver	2N323
2N281	AMP	pn _p ,PADT,ge	70	165	75	-	32	250	4.5	-	-	0.9		2N281
2N361	IND	pn _p ,A _J ,ge	70	150	85	2.5	45	200	10	-	-	-	Re, US	2N361
2N591	RCA	pn _p ,A _J ,ge	70	100	85	-	32	40	7	-	-	-	SY	2N591
2N647	RCA	np _n ,A _J ,ge	70	100	85	-	25	100	14	-	-	-		2N647
2N735	TI	np _n ,MS,si	70	1000	175	-	80	50	1	20	5	50	TO-18	2N735
2N1247	TR	np _n ,D _G ,si	70	30	150	0.24	6	-	0.8	-	9	5	Low drift dc amp.	2N1247
2N1352	IND	pn _p ,A _J ,ge	70	150	85	2.5	30	200	2.5	-	18	2.5		2N1352
2N1565	TI	np _n ,MS,si	70	1200	175	-	80	50	1	20	40	50	TO-5	2N1565
2N213	SY	np _n ,A _J ,ge	70-250	150	85	2.3	40	100	50	-	-	0.01		2N213
TR-383	IND	pn _p ,A _J ,ge	72	200	85	3.33	25	200	7.5	-	20	1.8	2N383	TR-383
2N241	GE	pn _p ,A _J ,ge	73	100	85	3	25	200	16	-	40	1.3		2N241
2N241A	GE	pn _p ,A _J ,ge	73	200	85	4	25	200	16	-	40	1.3		2N241A
2N60	WH	pn _p ,F _J ,ge	75	180	85	3.3	25	200	15	12	40	1.5		2N60
2N109	RCA	pn _p ,A _J ,ge	75	150	85	-	25	70	14	-	-	-		2N109
2N192	GE	pn _p ,A _J ,ge	75	75	85	2	25	50	16	15	40	1.5		2N192
2N217	RCA	pn _p ,A _J ,ge	75	150	85	-	25	70	14	-	-	-		2N217
2N610	WH	pn _p ,F _J ,ge	75	180	85	3.3	25	200	15	12	40	1.1		2N610
2N651	MO	pn _p ,A _J ,ge	75	200	100	2.8	25	250	4	10	20	2.5	US	2N651
2N654	MO	pn _p ,A _J ,ge	75	200	100	2.8	15	250	4	10	20	2.5	US	2N654
2N1192	MO	pn _p ,A _J ,ge	75	175	85	2.8	25	200	4	10	20	2		2N1192
2N1443	NA	pn _p ,A _J ,si	75	400	200	2.28	50	100	0.01	12	25	1	audio/med. power	2N1443
GT74	GT	pn _p ,A _J ,ge	75	150	100	2	25	-	5	6	35	-		GT74
GT81	GT	pn _p ,A _J ,ge	75	150	100	2	25	-	5	16	35	-		GT81
TR-323	IND	pn _p ,A _J ,ge	75	150	85	2.5	16	200	7.5	-	20	2.5	2N323	TR-323
2N1376	SY	pn _p ,A _J ,ge	75-150	150	100	2	25	200	100	-	-	-		2N1376
2N1431	SY	np _n ,A _J ,ge	75-150	180	75	3.6	25	100	50	-	-	10		2N1431

Audio (continued)

Type No.	Mfg.	Type	h _{fe} or h _{FE}	Max. Ratings			Characteristics	
				W _c (mw)	T _j (c)	mw/c	NF db	C _c uuf
2N120	TI	np _n ,GR,si	76-333	150	175	1	-	-
2N336	TI	np _n ,GR,si	76-333	150	175	1	-	-
910	TI	np _n ,GR,si	76-333	150	175	1	-	-
2N185	TI	pn _p ,A _J ,ge	80	150	85	2.5	-	-
2N321	GE	pn _p ,A _J ,ge	80	225	85	4	-	-
2N527	SY	pn _p ,A _J ,ge	80	225	85	3.7	-	-
2N1370	TI	pn _p ,A _J ,ge	80	150	85	2.5	-	-
2N1371	TI	pn _p ,A _J ,ge	80	150	85	2.5	-	-
2N1374	TI	pn _p ,A _J ,ge	80	250	100	3.3	-	-
2N1375	TI	pn _p ,A _J ,ge	80	250	100	3.3	-	-
2N1382	TI	pn _p ,A _J ,ge	80	200	85	3.3	-	-
2N1449	IND	pn _p ,A _J ,ge	80	200	85	3.3	-	-
CK28A	RA	pn _p ,A _J ,ge	80	80	85	-	-	-
OC55	AMP	pn _p ,A _J ,ge	80	19	55	0.7	-	-
OC59	AMP	pn _p ,A _J ,ge	80	10	55	-	-	-
TR-321	IND	pn _p ,A _J ,ge	80	150	85	2.5	-	-
2N527	GE	pn _p ,A _J ,ge	81	225	100	4	-	-
2N324	GE	pn _p ,A _J ,ge	85	140	85	4	-	-
2N224	PH	pn _p ,A _J ,ge	90	250	75	5.0	-	-
2N466	MO	pn _p ,A _J ,ge	90	150	85	2.5	-	-
CK22	RA	pn _p ,F _A ,ge	90	85	85	-	-	-
CK66	RA	pn _p ,F _A ,ge	90	80	85	-	-	-
CK66A	RA	pn _p ,A _J ,ge	90	80	85	-	-	-
OC75	AMP	pn _p ,PADT,ge	90	115	75	-	-	-
2N1376	TI	pn _p ,A _J ,ge	95	250	100	3.3	-	-
2N1377	TI	pn _p ,A _J ,ge	95	250	100	3.3	-	-
2N59	WH	pn _p ,F _J ,ge	100	180	85	3.3	-	-
2N207	PH	pn _p ,A _J ,ge	100	50	65	1.25	-	-
2N207A	PH	pn _p ,A _J ,ge	100	60	65	1.25	-	-
2N207B	PH	pn _p ,A _J ,ge	100	50	65	1.25	-	-
2N360	RA	pn _p ,A _J ,ge	100	150	85	2.5	-	-
2N362	IND	pn _p ,A _J ,ge	100	150	85	2.5	-	-
2N535	PH	pn _p ,A _J ,ge	100	50	85			

DATA CHART

(continued)

Rating V _c %	Characteristics			Remarks	Type No.
	NF db	C _c uuf	f _{co} mc		
20	-	-	7		2N120
20	-	-	13	TR, GE	2N336
20	-	-	7	2N1153	910
6.5	-	-	2		2N185
-	25	-	3		2N321
-	-	-	3.3		2N527
6.5	-	-	2.0		2N1370
6.5	-	-	2.0		2N1371
6.5	-	-	2		2N1374
6.5	-	-	2		2N1375
6.5	-	-	2		2N1382
6	20	-	5		2N1449
-	14	-	17	Micromin RF switch	CK28A
10	-	-	0.01	hearing aid on	OC55
-	-	-	2.2		OC59
-	20	-	3.1	2N321	TR-321
4	6	-	3.3		2N527
4	-	-	3	Driver	2N324
1.0	-	-	125		2N224
1.5	15	-	1	RA, US, GT	2N466
-	-	-	1.2		CK22
-	22	-	1.2		CK66
-	22	-	1.2	micromin	CK66A
-	-	-	0.75		OC75
3.3	5.5	-	2		2N1376
1.3	5.5	-	2		2N1377
3.3	12	40	1.2		2N59
1.25	5	-	2		2N207
1.25	2	-	2		2N207A
1.25	2	-	2		2N207B
2.5	-	-	1.2	IND, US	2N360
2.5	-	-	-	Ra, US	2N362
0.83	5	-	2		2N535
1.43	-	-	-		2N534
0.83	2	-	2		2N535A
0.83	2	-	2		2N535B
2.5	12	20	1.5	US	2N568
3.3	12	40	1.2		2N609
2.5	-	-	1	Ra, US	2N632
-	20	5	50	TO-18	2N736
5.0	-	-	1.0		2N1124
2.5	-	-	90		2N1128
3.3	5	-	2		2N1380
3.3	5	-	2		2N1381
3	-	-	1.8	2N383	TR383
2.67	5	25	1.25		2N652A
2.5	-	-	10		2N213A
5.0	-	-	90		2N223
2	5	40	1.5	Driver	2N265
2	5	35	-		GT109
4	-	-	25	Driver	2N508
-	-	-	14	micromin RF switch	2N101B
2.5	-	-	20		TR508
1.1	-	-	7	100% reliability assurance processed.	2N543A
2.5	-	-	1	IND, US	2N359
2.5	20	-	2		2N570
2.5	-	-	1.2	RA	2N631
6.6	-	-	25		2N1008A
3.3	-	-	18		2N1471
2.8	-	-	20		2N652
2.8	-	-	20	US	2N655
2.5	125	0.75	-		2N1130
2.8	-	-	20		2N1193
2.5	5	20	1.2	Mo, Ra, US, GT	2N467
-	-	-	1.5		CK67
2.5	-	-	-	micromin	CK67A
2.5	125	0.75	-		2N1129
2.5	20	-	3		2N572
3.3	-	-	3		2N1378
3.3	-	-	3		2N1379
2.5	-	-	-	relay photo	OCP70

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SILICON CONTROLLED RECTIFIERS



actual size

For control circuit application in the
10 to 1250 ma output current range

■ HIGH SENSITIVITY

only 2 mA input to control one ampere
(continuous) at 100°C.

■ HIGH TEMPERATURE

stable operation to 150°C.

■ LOW LEAKAGE

10 uA cutoff current at full voltage.

■ SIMPLIFIED MOUNTING

no need for insulating hardware —
stud is electrically isolated.

Type	Maximum Anode Voltage (DC or Peak AC) + Volts	Maximum Average Forward Current 100°C Case Amps	Maximum Gate Current to "Fire" mA	Gate Voltage to Fire + Volts	
				Min.	Max.
3B30S	30	1.0	2	.40	2.5
3B60S	60	1.0	2	.40	2.5
3B100S	100	1.0	2	.40	2.5
3B150S	150	1.0	2	.40	2.5
3B200S	200	1.0	2	.40	2.5

FROM SOLID STATE

These devices offer significant circuit advantages in that they are specifically designed for operation in the 10 to 1250 mA current range. It is no longer necessary to derate higher power units, with attendant losses in efficiency.

The miniature SCR combines a current rating of 1 ampere at 100°C with extremely small size. It features high peak recurrent and surge current ratings. Switching efficiency up to 98% is practical. High gain, low loss control of loads up to 300 watts can now be achieved along with significant miniaturization. The internally insulated junction eliminates the need for external mica washers. Assembly is therefore simplified and reliability improved.

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CIRCLE 50 ON READER-SERVICE CARD



TRANSISTORS - 196

Type No.	Mfg.	Type	W C W	Max. Ratings			Power Gain dB
				w/c	T _i °C	V _{ce} V	
2N339	TI	npn, GR, si	1.0	0.008	150	35	30
2N340	TI	npn, GR, si	1.0	0.008	150	35	30
2N341	TI	npn, GR, si	1.0	0.008	150	125	30
2N342	TI	npn, GR, si	1.0	0.008	150	60	30
2N342A	TI	npn, GR, si	1.0	0.008	150	85	30
2N343	TI	npn, GR, si	1.0	0.008	150	60	30
2N1206	TR	npn, GR, si	1.2	0.01	200	60	-
2N1566	TI	npn, MS, si	1.2	-	175	80	-
2N1207	TR	npn, GR, si	1.2	-	200	60	-
2N1335	PS1	npn, MS, si	2.8	.024	150	120	mc
2N1336	PS1	npn, MS, si	2.8	.024	150	120	mc
2N1339	PS1	npn, MS, si	2.8	.024	150	120	mc
2N1340	PS1	npn, MS, si	2.8	.024	150	120	mc
2N1341	PS1	npn, MS, si	2.8	.024	150	120	mc
2N1561	MO	pnP, MS, ge	3	.04	100	25	mc
2N1562	MO	pnP, MS, ge	3	.04	100	25	mc
OC30	AMP	pnP, PADT, ge	3.6	-	75	32	-
2N497	TI	npn, DJ, si	4.0	.023	200	60	mc
2N498	TI	npn, DJ, si	4.0	.023	200	100	mc
2N656	TI	npn, DJ, si	4.0	.023	200	60	mc
2N657	TI	npn, DJ, si	4.0	.023	200	100	mc
2N1172	DE	pnP, AJ, ge	4	0.07	95	40	34
2N1479	RCA	npn, DJ, si	4	-	175	60	mc
2N1480	RCA	npn, DJ, si	4	-	175	100	mc
2N1481	RCA	npn, DJ, si	4	-	175	60	mc
2N1482	RCA	npn, DJ, si	4	-	175	100	mc
2N1067	STC	npn, DJ, si	5	0.067	175	60	-
H3A	MH	pnP, AJ, ge	5	0.07	95	60	-
H4A	MH	pnP, AJ, ge	5	0.07	95	60	-
2N326	SY	npn, AJ, ge	7	0.11	85	35	-
2N1183	RCA	pnP, AJ, ge	7.5	-	100	45	-
2N1183A	RCA	pnP, AJ, ge	7.5	-	100	60	-
2N1183B	RCA	pnP, AJ, ge	7.5	-	100	80	-
2N1184	RCA	pnP, AJ, ge	7.5	-	100	45	-
2N1184A	RCA	pnP, AJ, ge	7.5	-	100	-60	-
2N1184B	RCA	pnP, AJ, ge	7.5	-	100	-80	-
2N255	BE	pnP, AJ, ge	8.5	0.3	85	15	23
2N256	BE	pnP, AJ, ge	8.5	0.3	85	30	26
2N122	TI	npn, GR, si	8.75	0.07	150	120	28
2N176	SY	pnP, AJ, ge	10	0.15	90	30	35.5
2N350	SY	pnP, AJ, ge	10	0.13	100	40	32
2N351	RCA	pnP, AJ, ge	10	1.0	90	40	34
2N376	RCA	pnP, AJ, ge	10	1.0	90	40	35
2N669	MO	pnP, AJ, ge	10	1.5	90	30	40
2N1068	IND	npn, DJ, si	10	0.13	175	60	-
CDT1310	CL	pnP, AJ, ge	10	1.5	95	40	40-120
CDT1311	CL	pnP, AJ, ge	10	1.5	95	60	40-120
CDT1312	CL	pnP, AJ, ge	10	1.5	95	80	40-120
CDT1313	CL	pnP, AJ, ge	10	1.5	95	100	40-120
CST1740	CL	pnP, AJ, ge	10	2.5	95	40	28-33
CST1741	CL	pnP, AJ, ge	10	2.5	95	40	32-35
CST1742	CL	pnP, AJ, ge	10	2.5	95	40	34-37
CST1743	CL	pnP, AJ, ge	10	2.5	95	40	36-39
CST1744	CL	pnP, AJ, ge	10	2.5	95	40	28-37
CST1745	CL	pnP, AJ, ge	10	2.5	95	40	28-33
CST1746	CL	pnP, AJ, ge	10	2.5	95	40	32-37
CTP1104	CL	pnP, AJ, ge	10	2.0	85	40	28
CTP1105	CL	pnP, AJ, ge	10	2.0	85	40	30
CTP1106	CL	pnP, AJ, ge	10	2.0	85	40	27

DATA CHART

Max. V _{cb}	Characteristics		Remarks	Type No.
	Pow. Gain db	Pow. Out. w		
55	30	-	TR	2N339
85	30	-	TR	2N340
125	30	-	TR	2N341
60	30	-	TR	2N342
85	30	-	TR	2N342A
60	30	-	TR	2N343
60	-	-		2N1206
80	-	-	TO-5	2N1566
60	-	-		2N1207
120			high frequency,	2N1335
			high power	
120			high frequency,	2N1336
			high power	
120			high frequency,	2N1339
			high power	
120			high frequency,	2N1340
			high power	
120			high frequency,	2N1341
			high power	
25			high frequency,	2N1561
			high power	
25			high frequency,	2N1562
			high power	
32				OC30
60			TR	2N497
100			TR	2N498
60			TR	2N656
100			TR	2N657
40	34	-	driver	2N1172
60				2N1479
100				2N1480
60				2N1481
100				2N1482
60				2N1067
60				H3A
60				H4A
35				2N326
45				2N1183
60				2N1183A
80				2N1183B
45				2N1184
-60				2N1184A
-80				2N1184B
15	23	-	2N234A, CL	2N255
5	26	2	2N234A, CL	2N256
120	28	-		2N122
30	35.5		Rca, Mo, Be	2N176
40	32		Mo	2N350
40	34	4	Mo, SY	2N351
40	35	4	Mo	2N376
40	40	2		2N669
75			STC	2N1068
95	40-120			CDT1310
95	40-120			CDT1311
95	40-120			CDT1312
95	40-120			CDT1313
95	28-33			CST1740
95	32-35			CST1741
95	34-37			CST1742
95	36-39			CST1743
95	28-37			CST1744
95	28-33			CST1745
95	32-37			CST1746
85	28	1.2		CTP1104
85	30	1.2		CTP1105
85	27	0.6		CTP1108



3N49, 3N50, 3N51, 3N52



2N1658



2N1261, 2N1262, 2N1263



2N538, 2N538A



2N1501, 2N1502

Important New Developments From Honeywell!

New Power Transistors

3N49, 3N50, 3N51, 3N52: Power tetrodes in a new, single ended, cold weld package mechanically interchangeable with TO-6 case. 12 ampere, 75 watt at 25°C, 60 and 80 volts VCB. Tetrode design provides exceptional gain linearity. Circuit stability achieved through control of leakage current. Electrically identical with 3N45, 3N46, 3N47 and 3N48.

2N1658: New medium power general purpose unit in stud mounted, cold weld package. Gain specified at 1 ampere, 15 watt at 25°C, 80 volt VCB. Suitable for pulse amplifiers, switching servo and audio amplifiers. Frequency response, low leakage characteristics and small package are unique in this power class.

Higher Voltage at no increase in price!

2N1261, 2N1262, 2N1263: VCB now 80 volts (previously 60). 3.5 amperes, 32 watt at 25°C. Typical applications include power conversion, voltage regulation switching and servo amplifiers.

Special Price Reductions

2N538, 2N538A: High quality power transistors at a 20% price decrease. 3.5 amperes, 32 watt at 25°C, rated at 80 volts VCB. Designed for high power amplifiers (servo and audio), power converters, voltage regulators and switching circuits.

2N1501, 2N1502: Standard units now in the lower price range. 3.5 amperes, 32 watt at 25°C, VCB of 40 and 60. Ideal for servo amplifiers, power conversion and switching.

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TRANSISTORS - 1960

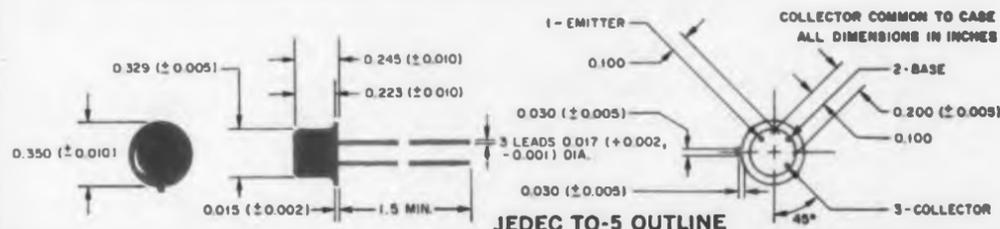
Type No.	Mfg.	Type	WC W	Max. Ratings		
				w/c	T _j °C	V _c V
CTP1109	CL	pn-p, A, ge	10	2.0	90	20
CTP1111	CL	pn-p, A, ge	10	2.0	90	10
CTP1728	CL	pn-p, A, ge	10	2.5	95	40
CTP1729	CL	pn-p, A, ge	10	2.5	95	40
CTP1730	CL	pn-p, A, ge	10	2.5	95	100
CTP1731	CL	pn-p, A, ge	10	2.5	95	40
CTP1732	CL	pn-p, A, ge	10	2.5	95	100
CTP1733	CL	pn-p, A, ge	10	2.5	95	100
CTP1735	CL	pn-p, A, ge	10	2.5	95	60
CTP1736	CL	pn-p, A, ge	10	2.5	95	60
CST1739	CL	pn-p, A, ge	10	2.5	95	40
2N1314/OC26	AMP	pn-p, PADT, ge	11	-	90	32
2N301A	SY	pn-p, A, ge	12	0.2	85	60
2N1315/OC27	AMP	pn-p, PADT, ge	12.5	-	90	32
CTP1112	CL	pn-p, A, ge	14	1.5	90	100
CTP1117	CL	pn-p, A, ge	14	1.5	90	40
CTP1133	CL	pn-p, A, ge	14	1.5	90	40
CTP1137	CL	pn-p, A, ge	14	1.5	90	40
2N307	BE	pn-p, A, ge	15	0.2	75	35
2N307A	SY	pn-p, A, ge	17	0.34	75	35
2N1483	RCA	npn, DJ, si	15	-	175	60
2N1484	RCA	npn, DJ, si	15	-	175	100
2N1485	RCA	npn, DJ, si	15	-	175	60
2N1486	RCA	npn, DJ, si	15	-	175	100
2N155	CBS	pn-p, A, ge	20	.33	85	30
2N156	CBS	pn-p, A, ge	20	0.33	85	30
2N157	CBS	pn-p, A, ge	20	0.33	85	60
2N157A	CBS	pn-p, A, ge	20	0.33	85	100
2N158	CBS	pn-p, A, ge	20	0.33	85	60
2N158A	CBS	pn-p, A, ge	20	0.33	85	80
2N255A	CBS	pn-p, A, ge	20	0.5	85	15
2N256A	CBS	pn-p, A, ge	20	0.5	85	25
2N401	BE	pn-p, A, ge	20	0.5	90	40
2N1042	TI	pn-p, A, ge	20	.28	95	40
2N1043	TI	pn-p, A, ge	20	.28	95	6
2N1044	TI	pn-p, A, ge	20	.28	95	80
2N1045	TI	pn-p, A, ge	20	.28	95	100
2N1078	CBS	pn-p, A, ge	20	0.33	85	60
2N1291	CBS	pn-p, A, ge	20	0.33	85	30
2N1292	CBS	npn, A, ge	20	0.33	85	30
2N1293	CBS	pn-p, A, ge	20	0.33	85	60
2N1294	CBS	npn, A, ge	20	0.33	85	60
2N1295	CBS	pn-p, A, ge	20	0.33	85	80
2N1296	CBS	npn, A, ge	20	0.33	85	80
2N1297	CBS	pn-p, A, ge	20	0.33	85	100
2N1298	CBS	npn, A, ge	20	0.33	85	100
2N1320	CBS	pn-p, A, ge	20	0.33	85	30
2N1321	CBS	npn, A, ge	20	0.33	85	30
2N1322	CBS	pn-p, A, ge	20	0.33	85	60
2N1323	CBS	npn, A, ge	20	0.33	85	60
2N1324	CBS	pn-p, A, ge	20	0.33	85	80
2N1325	CBS	npn, A, ge	20	0.33	85	80
2N1326	CBS	pn-p, A, ge	20	0.33	85	100
2N1327	CBS	npn, A, ge	20	0.33	85	100
2N1328	CBS	pn-p, A, ge	20	0.33	85	30
2N1329	CBS	npn, A, ge	20	0.33	85	30
2N1330	CBS	npn, A, ge	20	0.33	85	60
2N1331	CBS	pn-p, A, ge	20	0.33	85	80
2N1332	CBS	npn, A, ge	20	0.33	85	80
2N1333	CBS	pn-p, A, ge	20	0.33	85	100
2N1334	CBS	npn, A, ge	20	0.33	85	100
2N1437	CBS	pn-p, A, ge	20	0.33	85	100
2N1438	CBS	pn-p, A, ge	20	0.33	85	100
2N1465	CBS	pn-p, A, ge	20	0.33	85	120
2N1466	CBS	pn-p, A, ge	20	0.33	85	120
2N1504	CBS	pn-p, A, ge	20	0.33	85	80
CDT1319	CL	pn-p, A, ge	20	1.5	100	40
CDT1320	CL	pn-p, A, ge	20	1.5	100	60
CDT1321	CL	pn-p, A, ge	20	1.5	100	80
CDT1322	CL	pn-p, A, ge	20	1.5	100	100

DATA CHART



SILICON MESA TRANSISTORS

Rheem transistors are tested to exceed the requirements of MIL-S-19500B. All are stabilized by storage at 300°C and by three temperature cycles from -65°C to 200°C.



SILICON MESA TRANSISTORS (selected list)

TYPE	DISSIPATION AT 25°C CASE watts	COLLECTOR VOLTAGE MAX.—volts	COLLECTOR CURRENT MAX.—mA	DC CURRENT GAIN h_{FE} TYPICAL	TYPICAL COLLECTOR-BASE REVERSE CURRENT $\mu A @ V_{CB}$	f_{β} @ 20 mc TYPICAL	SATURATION VOLTAGE @ $I_C = 10 I_B$ TYPICAL $V_{CE} (volts) I_C (mA)$	RISE TIME @ $I_C = 10 I_B$ TYPICAL $\mu sec I_C (mA)$	
VERY HIGH CURRENT FAST SWITCHING									
RT5001	3	60	1000	40	.01 30 V	4	1.3 500	100 350	
RT5002	3	60	1000	75	.01 30 V	5	1.3 500	80 350	
RT5003	3	100	1000	40	.01 30 V	4	1.5 500	100 350	
RT5004	3	100	1000	75	.01 30 V	5	1.5 500	80 350	
HIGH CURRENT FAST SWITCHING									
★2N696	2	60	500	40	.003 30 V	4	.7 150	70 150	
★2N697	2	60	500	70	.003 30 V	5	.7 150	85 150	
★2N698	2	120	500	40	.01 60 V	4	2.0 150	70 150	
2N699	2	120	500	65	.01 60 V	5	2.0 150	85 150	
2N1409	2.8	30	500	30	.01 20 V	6.5	.3 100	120 100	
2N1410	2.8	30	500	60	.01 20 V	6.5	.3 100	85 100	
2N1420	2	60	500	175	.003 30 V	6.5	.7 150	80 150	
2N1507	2	60	500	175	.003 30 V	6.5	.7 150	80 150	
2N1613	3	75	500	45	.001 60 V	5	.7 150	80 150	
MEDIUM POWER GENERAL PURPOSE									
★2N497	4	60	500	20	.1 30 V	2.5	2.0 200	100 150	
★2N498	4	100	500	20	.1 30 V	2.5	2.0 200	100 150	
★2N656	4	60	500	60	.1 30 V	3	2.0 200	60 150	
★2N657	4	100	500	60	.1 30 V	3	2.0 200	60 150	
MEDIUM POWER LOW STORAGE									
2N1252	2	30	500	35	.1 20 V	4	.6 150	100 150	
2N1253	2	30	500	60	.1 20 V	5.5	.6 150	100 150	
VERY FAST SWITCHING									
2N706	1	25	100	30	.01 15 V	4 @ 100mc	.3 10	20 10	

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CIRCLE 54 ON READER-SERVICE CARD



TRANSISTORS - 1960

Type No.	Mfg.	Type	Wc W	Max Ratings			Character
				w/c	T _c	V _c	
LT-11	CBS	pnp,AJ,ge	20	0.33	85	80	5
LT-12	CBS	pnp,AJ,ge	20	0.33	85	100	5
LT-13	CBS	pnp,AJ,ge	20	0.33	85	120	5
LT-14	CBS	pnp,AJ,ge	20	0.33	85	150	5
LT-15	CBS	pnp,AJ,ge	20	0.33	85	200	5
2N234A	BE	pnp,AJ,ge	25	0.5	90	30	-
2N235A	BE	pnp,AJ,ge	25	0.5	90	40	6
2N235B	BE	pnp,AJ,ge	25	0.5	90	40	-
2N236A	BE	pnp,AJ,ge	25	0.5	95	40	-
2N250	TI	pnp,AJ,ge	25	0.36	85	30	-
2N251	TI	pnp,AJ,ge	25	0.36	85	60	-
2N285A	BE	pnp,AJ,ge	25	0.5	95	40	-
2N296	SY	pnp,AJ,ge	25	0.33	100	60	4
2N350A	MO	pnp,AJ,ge	25	1.5	100	40	7
2N351A	MO	pnp,AJ,ge	25	1.5	100	40	7
2N376A	MO	pnp,AJ,ge	25	1.5	100	40	7
2N399	BE	pnp,AJ,ge	25	0.5	90	40	-
2N400	BE	pnp,AJ,ge	25	0.5	95	40	-
2N419	BE	pnp,AJ,ge	25	0.5	95	45	-
2N639	BE	pnp,AJ,ge	25	0.5	100	40	-
2N639A	BE	pnp,AJ,ge	25	0.5	100	80	-
2N639B	BE	pnp,AJ,ge	25	0.5	100	70	-
2N1146	CL	pnp,AJ,ge	25	0.7	95	40	4
2N1146A	CL	pnp,AJ,ge	25	0.7	95	60	4
2N1146B	CL	pnp,AJ,ge	25	0.7	95	80	4
2N1146C	CL	pnp,AJ,ge	25	0.7	95	100	4
2N1147	CL	pnp,AJ,ge	25	0.7	95	40	4
2N1147A	CL	pnp,AJ,ge	25	-	95	60	4
2N1147B	CL	pnp,AJ,ge	25	-	95	80	4
2N1147C	CL	pnp,AJ,ge	25	-	95	100	4
2N1245	CBS	pnp,AJ,ge	25	0.5	85	25	5
2N1246	CBS	pnp,AJ,ge	25	0.5	85	25	5
B-177	BE	pnp,AJ,ge	25	0.5	90	30	-
B-178	BE	pnp,AJ,ge	25	0.5	90	30	40
B-179	BE	pnp,AJ,ge	25	0.5	90	40	25
CTP1500	CL	pnp,AJ,ge	25	1.0	95	100	-
CTP1503	CL	pnp,AJ,ge	25	1.0	95	80	-
CTP1504	CL	pnp,AJ,ge	25	1.0	95	60	-
CTP1508	CL	pnp,AJ,ge	25	1.0	95	40	3
CTP1544	CL	pnp,AJ,ge	25	1.0	95	60	-
CTP1545	CL	pnp,AJ,ge	25	1.0	95	80	3
CTP1552	CL	pnp,AJ,ge	25	1.0	95	40	3
CTP1553	CL	pnp,AJ,ge	25	1.0	95	100	3
2N236B	CBS	pnp,AJ,ge	30	-	85	40	5
2N242	SY	pnp,AJ,ge	30	0.33	100	45	3
2N257	BE	pnp,AJ,ge	30	0.5	90	40	3
2N268	BE	pnp,AJ,ge	30	0.5	90	80	6.0
2N1505	PSI	npn,MS,si	30	-	175	50	150 mc
2N1506	PSI	npn,MS,si	30	-	175	60	150 mc
2N538	MH	pnp,AJ,ge	32	0.45	95	80	200
2N539	MH	pnp,AJ,ge	32	0.45	95	80	200
2N540	MH	pnp,AJ,ge	32	0.45	95	80	200
2N1202	MH	pnp,AJ,ge	32	0.45	95	80	200
2N1203	MH	pnp,AJ,ge	32	0.45	95	120	200
2N1261	MH	pnp,AJ,ge	32	0.45	95	80	200
2N1262	MH	pnp,AJ,ge	32	0.45	95	80	200
2N1263	MH	pnp,AJ,ge	32	0.45	95	80	200
2N1501	MH	pnp,AJ,ge	32	0.45	95	60	200
2N1502	MH	pnp,AJ,ge	32	0.45	95	40	200
H45	MH	pnp,AJ,ge	32	0.45	95	80	-
2N297A	MO	pnp,AJ,ge	35	0.5	95	80	5
2N392	DE	pnp,AJ,ge	35	0.7	95	60	6
2N463	WE	pnp,AJ,ge	35	2	100	60	.5
2N553	DE	pnp,AJ,ge	35	0.5	95	80	25
2N665	DE	pnp,AJ,ge	35	0.5	95	80	25
2N1011	BE	pnp,AJ,ge	35	1.2	95	-	-
2N1073	BE	pnp,AJ,ge	35	1.2	100	40	-
2N1073A	BE	pnp,AJ,ge	35	1.2	100	80	-
2N1073B	BE	pnp,AJ,ge	35	1.2	100	120	-
2N1168	DE	pnp,AJ,ge	35	0.7	95	50	10
2N1047	TI	npn,DJ,si	40	0.25	200	80	-

DATA CHART

(continued)

Type No.	Characteristics			Remarks	Type No.
	f_{osc} kc	Powr. Gain db	Powr. Out. w		
LT-11	5	-	-		LT-11
LT-12	5	-	-		LT-12
LT-13	5	-	-		LT-13
LT-14	5	-	-		LT-14
LT-15	5	-	-		LT-15
2N234A	25	2	2	CBS	2N234A
2N235A	6	36	2	CBS, CL	2N235A
2N235B	-	38	-		2N235B
2N236A	-	35	4		2N236A
2N250	-	30	-	CL	2N250
2N251	-	30	-		2N251
2N285A	-	39	-		2N285A
2N296	4	-	-		2N296
2N350A	7	31	4		2N350A
2N351A	7	33	4		2N351A
2N376A	7	35	4		2N376A
2N399	-	33	8		2N399
2N400	-	35	6		2N400
2N419	-	-	5		2N419
2N639	-	-	-		2N639
2N639A	-	-	-		2N639A
2N639B	-	-	-		2N639B
2N1146	4	-	-		2N1146
2N1146A	4	-	-		2N1146A
2N1146B	4	-	-		2N1146B
2N1146C	4	-	-		2N1146C
2N1147	4	-	-	solder lugs	2N1147
2N1147A	4	-	-	solder lugs	2N1147A
2N1147B	4	-	-	solder lugs	2N1147B
2N1147C	4	-	-	solder lugs	2N1147C
2N1245	5	-	-		2N1245
2N1246	5	-	-		2N1246
B-177	-	36	-		B-177
B-178	40	33	-		B-178
B-179	25	28	-		B-179
CTP1500	-	-	-		CTP1500
CTP1503	-	-	-		CTP1503
CTP1504	-	-	-		CTP1504
CTP1508	-	-	-		CTP1508
CTP1544	3	-	-		CTP1544
CTP1545	3	-	-		CTP1545
CTP1552	3	-	-		CTP1552
CTP1553	3	-	-		CTP1553
2N236B	5	37	4	BE	2N236B
2N242	45	36	-	CL, BE	2N242
2N257	40	33	-	CL	2N257
2N268	80	6.0	35	SY, CL	2N268
2N1505	50 mc	-	-	High frequency, high power	2N1505
2N1506	50 mc	-	-	High frequency, high power	2N1506
2N538	80	200	-		2N538
2N539	80	200	-		2N539
2N540	80	200	-		2N540
2N1202	80	200	-		2N1202
2N1203	80	200	-		2N1203
2N1261	120	200	-		2N1261
2N1262	80	200	-		2N1262
2N1263	80	200	-		2N1263
2N1501	60	200	-		2N1501
2N1502	40	200	-	Sat. volt = 0.15v	2N1502
H45	80	200	-		H45
2N297A	80	5	-		2N297A
2N392	60	6	-		2N392
2N463	60	.5	-	US, MIL only.	2N463
2N553	80	25	-		2N553
2N665	80	25	-	2N665 SIG. MO	2N665
2N1011	-	-	-		2N1011
2N1073	40	-	-		2N1073
2N1073A	80	-	-		2N1073A
2N1073B	120	-	-		2N1073B
2N1168	50	-	-		2N1168
2N1047	80	-	-	STC	2N1047

electrical tests

mechanical tests

shock tests

centrifuge tests

vibration tests

humidity tests

storage life tests

Approved

"MEG-A-LIFE"

units



MOTOROLA "MEG-A-LIFE" INDUSTRIAL POWER TRANSISTORS

Only Motorola power transistors offer 30 watts power dissipation, 0.3°C/W maximum thermal resistance and 100°C junction operating temperature.

8 AMP

$V_{CE} = 2V$ $I_C = 3A$	V_{CE}			
	40V	60V	80V	100V
75 - 150	2N1844A	2N1845A	2N1846A	2N1847A
50 - 100	2N1838A	2N1839A	2N1841A	2N1842A
35 - 70	2N1834A	2N1835A	2N1836A	2N1837A
20 - 40	2N1828A	2N1829A	2N1831A	2N1832A

15 AMP

$V_{CE} = 2V$ $I_C = 10A$	V_{CE}			
	40V	60V	80V	100V
50 - 100	2N1887A	2N1888A	2N1889A	2N1890A
30 - 60	2N1883A	2N1884A	2N1885A	2N1886A
10 - 30	2N1848A	2N1849A	2N1851A	2N1852A

28 AMP

$V_{CE} = 1V$ $I_C = 25A$	V_{CE}		
	50V	80V	100V
15 - 65	2N1182A	2N1184A	2N1186A
15 - 65	2N1183A	2N1185A	2N1187A

Motorola "MEG-A-LIFE" program extended

NOW CERTIFIED RELIABILITY FOR INDUSTRIAL POWER TRANSISTORS

46 types in 3 current ranges provide military reliability for industrial applications

Now you can have the same assurance of reliability for your critical industrial power transistor applications as you do when using military-approved types for military applications. Motorola, in its "Meg-A-Life" quality assurance program (with written certification) now offers 46 "military-quality" industrial power transistors in three current ratings with voltages of 40 to 100 and betas to 150.

When you use Motorola "Meg-A-Life" industrial power transistors, you can be sure they have successfully passed electrical, mechanical and environmental tests (including shock, centrifuge, vibration, humidity and temperature tests) and 1000-hour storage life tests at 100°C in accordance with MIL-S-19500. You can be sure because written certification of compliance to "Meg-A-Life" reliability requirements is available to you. Only Motorola offers such documentation of quality. Approved "Meg-A-Life" units are stored and shipped to you from a bonded area.

Since all tests represent the most adverse conditions for which these devices are designed, Motorola's "Meg-A-Life" program provides you with an assurance of reliability not previously available in industrial units.

FOR COMPLETE "MEG-A-LIFE" BROCHURE and specification sheets on new Motorola "Meg-A-Life" power transistors, contact your Motorola district office:

BOSTON 385 Concord Ave., Belmont 78, Mass. IVanhee 4-3070
 CHICAGO 39, 5234 West Diversay Avenue AVenue 2-4300
 DETROIT 27, 13131 Lynden Avenue BRoadway 3-7171
 LOS ANGELES 1741 Iver Avenue, Hollywood 28, Calif. HOLlywood 2-0821
 MINNEAPOLIS 27, 7731 6th Avenue North LIBerty 5-2198
 NEW YORK 1051 Bloomfield Ave., Clifton, N.J. GRegory 2-5300
 from New York WIsconsin 7-2980
 SAN FRANCISCO 1299 Bayshore Highway, Burlingame, Calif. DIamond 2-3228
 SYRACUSE 101 South Saline GRanite 4-3321
 WASHINGTON 8405 Cameron St., Silver Spring, Md. JUniper 5-4483



MOTOROLA
Semiconductor Products Inc.

A SUBSIDIARY OF MOTOROLA, INC.

CIRCLE 55 ON READER-SERVICE CARD



NEW WOUND FIELD MOTORS / VERSATILE

Precision miniature wound field d.c. motors in five basic frame sizes (to 2 1/4" OD and to 1/10 hp) and in countless variations are now available from Globe Industries. You can design them into many military and other high quality products because they meet such an enormous variety of power and duty requirements. Examples:

Split-series units reverse rapidly and simply with a SPDT switch. Series units start with relatively high torque, low current drain. Shunt wound varieties offer means for low current control. Universal motors operate on a.c. or d.c. Globe-designed gear reducers, brakes and clutches can be built into the unit, and Globe can efficiently design and build the motor and accessories into a special motorized device.

If you'd like to look into miniature wound field motors of any description, or combine them with other components, ask the largest manufacturer of precision miniature motors first. Request technical Bulletin WF-1. GLOBE INDUSTRIES, INC., 1784 Stanley Avenue, Dayton 4, Ohio.

GLOBE INDUSTRIES, INC. **GLOBE**

CIRCLE 56 ON READER-SERVICE CARD

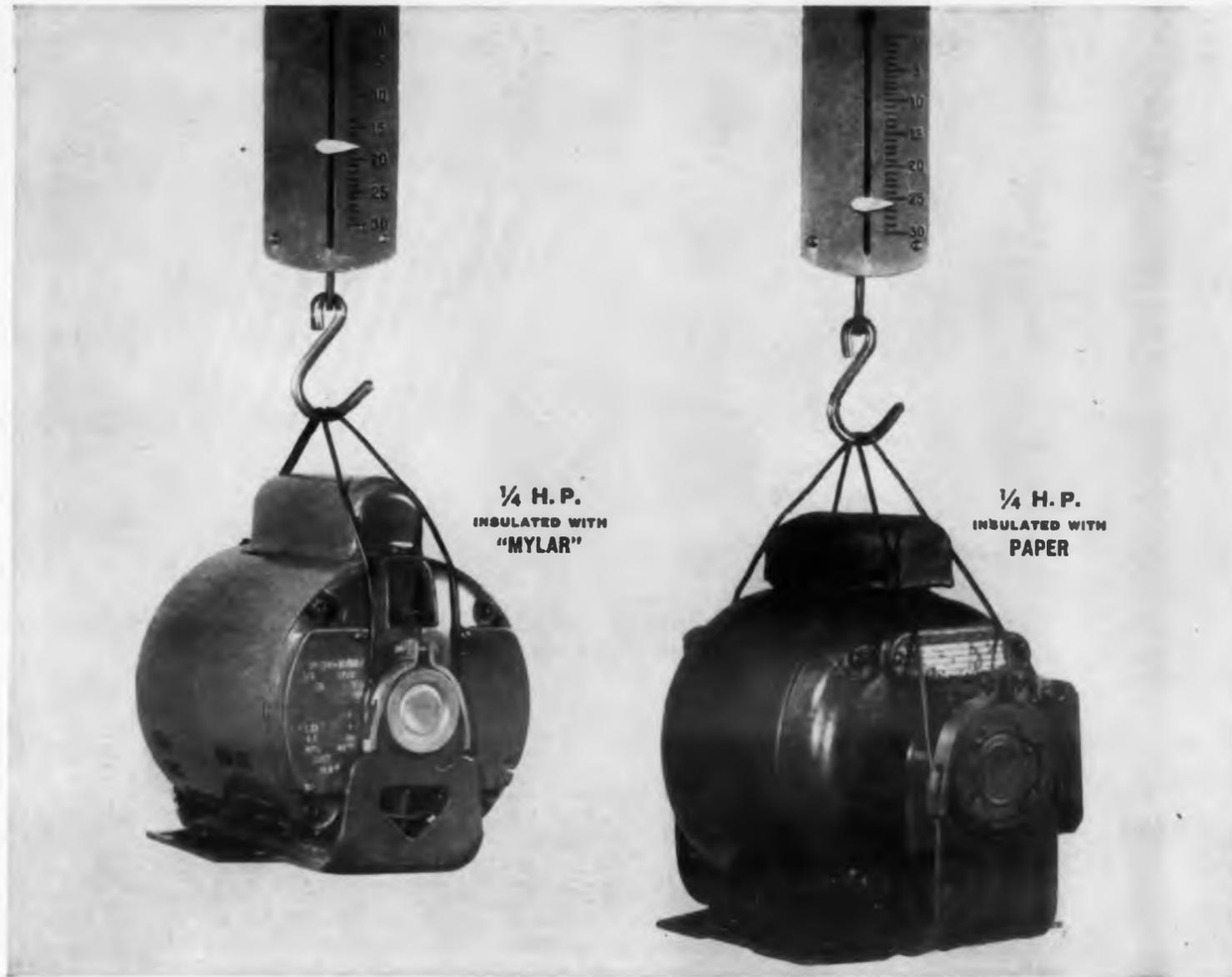


TRANSISTORS - 1960

Type No.	Mfg.	Type	W C W	Max. Ratings			Characteristics
				w/c	T _j c	V _c V	
2N1048	TI	npn,DJ,si	40	0.25	200	120	-
2N1049	TI	npn,DJ,si	40	0.25	200	80	-
2N1050	TI	npn,DJ,si	40	0.25	200	120	-
2N1453	CBS	npn,AJ,ge	40	0.66	85	80	5
2N1454	CBS	npn,AJ,ge	40	0.66	85	80	5
2N1455	CBS	npn,AJ,ge	40	0.66	85	60	5
2N1456	CBS	npn,AJ,ge	40	0.66	85	60	5
2N1457	CBS	npn,AJ,ge	40	0.66	85	80	5
2N1458	CBS	npn,AJ,ge	40	0.66	85	80	5
2N1461	CBS	npn,AJ,ge	40	0.66	85	80	5
2N1462	CBS	npn,AJ,ge	40	0.66	85	30	5
2N1463	CBS	npn,AJ,ge	40	0.66	85	60	5
2N1464	CBS	npn,AJ,ge	40	0.66	85	60	5
2N1120	BE	npn,AJ,ge	45	1.0	95	-	-
2N1173	DE	npn,AJ,ge	50	1.0	95	60	10
2N277	DE	npn,AJ,ge	50	1.0	95	40	10
2N278	DE	npn,AJ,ge	50	1.0	95	50	10
2N441	DE	npn,AJ,ge	50	1.0	95	40	10
2N442	DE	npn,AJ,ge	50	1.0	95	50	10
2N443	DE	npn,AJ,ge	50	1.0	95	60	10
2N561	RCA	npn,AJ,ge	50	1.0	100	80	-
2N627	MO	npn,AJ,ge	50	0.8	90	30	8
2N628	MO	npn,AJ,ge	50	0.8	90	45	8
2N629	MO	npn,AJ,ge	50	0.8	90	60	8
2N630	MO	npn,AJ,ge	50	0.8	90	80	8
2N1014	RCA	npn,AJ,ge	50	1.0	100	100	-
2N1021	TI	npn,AJ,ge	50	0.667	95	100	430
2N1022	TI	npn,AJ,ge	50	0.667	95	120	430
2N1031	BE	npn,AJ,ge	50	1.0	100	30	-
2N1031A	BE	npn,AJ,ge	50	1.0	100	40	-
2N1031B	BE	npn,AJ,ge	50	1.0	100	70	-
2N1031C	BE	npn,AJ,ge	50	1.0	100	80	-
2N1032	BE	npn,AJ,ge	50	1.0	100	30	-
2N1032A	BE	npn,AJ,ge	50	1.0	100	40	-
2N1032B	BE	npn,AJ,ge	50	1.0	100	70	-
2N1032C	BE	npn,AJ,ge	50	1.0	100	80	-
2N1069	STC	npn,DJ,si	50	1.0	175	60	-
2N1070	STC	npn,DJ,si	50	1.0	175	60	-
2N1159	DE	npn,AJ,ge	50	0.8	95	80	10
2N1160	DE	npn,AJ,ge	50	0.8	95	80	10
2N1470	RA	npn,DJ,si	55	3.0	200	60	1mc
2N1136	BE	npn,AJ,ge	60	1.2	100	40	-
2N1136A	BE	npn,AJ,ge	60	1.2	100	70	-
2N1136B	BE	npn,AJ,ge	60	1.2	100	80	-
2N1137	BE	npn,AJ,ge	60	1.2	100	40	-
2N1137A	BE	npn,AJ,ge	60	1.2	100	70	-
2N1137B	BE	npn,AJ,ge	60	1.2	100	80	-
2N1138	BE	npn,AJ,ge	60	1.2	100	40	-
2N1138A	BE	npn,AJ,ge	60	1.2	100	70	-
2N1138B	BE	npn,AJ,ge	60	1.2	100	80	-
2N1487	RCA	npn,DJ,si	60	-	175	60	1mc
2N1488	RCA	npn,DJ,si	60	-	175	100	1mc
2N1489	RCA	npn,DJ,si	60	-	175	60	1mc
2N1490	RCA	npn,DJ,si	60	-	175	100	25mc
2N174	DE	npn,AJ,ge	70	0.8	95	80	10
2N1099	DE	npn,AJ,ge	70	1.2	95	80	10
2N1100	DE	npn,AJ,ge	70	1.2	95	100	10
2N174A	TS	npn,AJ,ge	75	-	95	80	10
3N45	MH	npn,AJ,ge	75	1.0	100	60	700
3N46	MH	npn,AJ,ge	75	1.0	100	80	700
3N47	MH	npn,AJ,ge	75	1.0	100	40	700
3N48	MH	npn,AJ,ge	75	1.0	100	60	750
2N511A	TI	npn,AJ,ge	80	1.07	100	60	160
2N511B	TI	npn,AJ,ge	80	1.07	100	80	160
2N512	TI	npn,AJ,ge	80	1.07	100	40	180
2N512A	TI	npn,AJ,ge	80	1.07	100	60	180
2N512B	TI	npn,AJ,ge	80	1.07	100	80	180
2N389	TI	npn,DJ,si	85	.48	200	60	1mc
2N424	TI	npn,DJ,si	85	.48	200	80	1mc
2N1210	TR	npn,DJ,si	85	.27	200	60	1mc

DATA CHART

V _{rms} V	Characteristics			Remarks	Type No.
	f _{oe} kc	Powr. Gain db	Powr. Out. w		
1:0	-	-	-	STC	2N1048
80	-	-	-	STC	2N1049
1:0	-	-	-	STC	2N1050
30	5	-	4	TO-13	2N1453
30	5	-	4	TO-13	2N1454
60	5	-	4	TO-13	2N1455
60	5	-	4	TO-13	2N1456
80	5	-	4	TO-13	2N1457
80	5	-	2	TO-13	2N1458
30	5	-	4	TO-10	2N1461
30	5	-	4	TO-10	2N1462
60	5	-	4	TO-10	2N1463
60	5	-	4	TO-10	2N1464
-	-	-	-	MO	2N1120
60	10	-	20		2N173
40	10	-	20		2N277
50	10	-	20		2N278
40	10	-	20		2N441
50	10	-	20		2N442
60	10	-	20		2N443
80	-	26	30		2N561
30	8	38	-		2N627
45	8	38	-		2N628
60	8	38	-		2N629
80	8	38	-		2N630
100	-	26	30		2N1014
100	430	-	-	TR	2N1021
120	430	-	-	TR	2N1022
30	-	-	-		2N1031
40	-	-	-		2N1031A
70	-	-	-		2N1031B
80	-	-	-		2N1031C
30	-	-	-		2N1032
40	-	-	-		2N1032A
70	-	-	-		2N1032B
80	-	-	-		2N1032C
60	-	-	-		2N1069
60	-	-	-		2N1070
80	10	-	-		2N1159
80	10	-	-		2N1160
60	1mc	-	-		2N1470
40	-	-	-		2N1136
70	-	-	-		2N1136A
80	-	-	-		2N1136B
40	-	-	-		2N1137
70	-	-	-		2N1137A
80	-	-	-		2N1137B
40	-	-	-		2N1138
70	-	-	-		2N1138A
80	-	-	-		2N1138B
60	1mc	-	-	STC	2N1487
100	1mc	-	-	STC	2N1488
60	1mc	-	-	STC	2N1489
100	1.25mc	-	-	STC	2N1490
80	10	-	40	JAN, 2N174A	2N174
80	10	-	40		2N1099
100	10	-	40		2N1100
80	10	-	-		2N174A
60	700	-	-	Sat. volt = 0.15v	3N45
80	400	-	-	Sat. volt = 0.15v	3N46
40	700	-	-	Sat. volt = 0.15v	3N47
60	450	-	-	Sat. volt = 0.15v	3N48
60	360	-	-		2N511A
80	360	-	-		2N511B
40	380	-	-		2N512
60	380	-	-		2N512A
80	380	-	-		2N512B
60	1mc	-	-	STC, TR, RA	2N389
80	1mc	-	-	STC, TR, RA	2N424
60	1mc	-	-		2N1210



Motors insulated with Mylar® are smaller... lighter

Motors above have the same rating, but the smaller, lighter one takes advantage of "Mylar"* polyester film for slot and phase insulation.

Because of its excellent electrical and physical properties, "Mylar" can be used in thin gauges to help reduce motor size up to 40% and weight up to 33%. The thermal stability of "Mylar" allows motors to run hotter and develop more horsepower from a given frame size.

Insulation of "Mylar" contributes built-in reliability and longer life to appliance motors because its properties do not change over long periods of continuous operation at high temperatures or when exposed to chemicals, solvents and lubricants. And because "Mylar" is unaffected by moisture, current leakage and shock hazard are cut to a minimum. And yet, motors insulated with "Mylar" frequently cost no more than those

using other common types of insulation.

Whether you manufacture or buy electrical products, you can get improved performance with Du Pont "Mylar". And, figured on a square-foot basis, "Mylar" will often cost you less than your present material. For full facts on "Mylar", write for free booklet. E. I. du Pont de Nemours & Co. (Inc.), Rm. #14, Film Department, Wilmington 98, Delaware

Tough, thin "Mylar" has this unique combination of properties for superior insulating performance.

- Average 4,000 volts per mil dielectric strength (ASTM D-149). Average power factor of 0.002 at 60 cycles.
- Thermal stability from -60°C. to Class B range.
- Chemical and moisture resistance.
- Resistance to aging, abrasion, tearing and rotting.



IN CAPACITORS—Units insulated with "Mylar" have superior moisture resistance and longer life... meet highest reliability standards.

*"Mylar" is Du Pont's registered trademark for its brand of polyester film.



Better Things for Better Living... through Chemistry

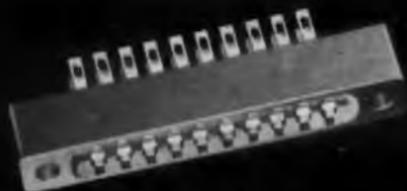
DU PONT
MYLAR
POLYESTER FILM

CIRCLE 57 ON READER-SERVICE CARD

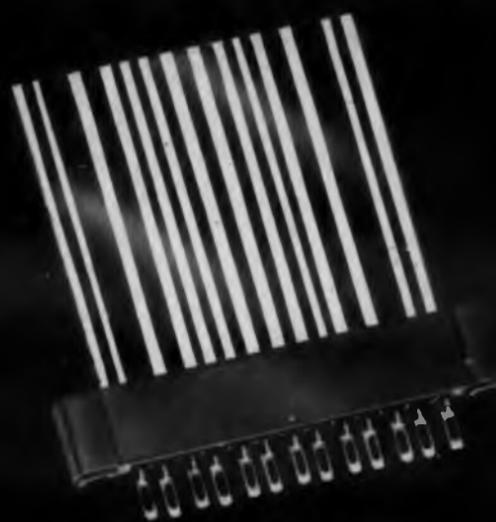
ACTUAL SIZE



Series 600 7-1 18 contacts
for 3/64" PC board or cable



Series 600 4PC10 10 dual contacts
for 1/32" PC board or cable



Series 600 4PCSC13 13 contacts
for 1/32" PC board or cable

Continental Connector MINIATURE PRINTED CIRCUIT CONNECTORS

Continental printed circuit connectors and "Bellowform" contacts are covered by patent number 2,875,425

WHERE RELIABILITY IS A MUST

and space limitations are critical...
specify Continental Miniature PC Connectors

Series 600 precision miniature printed circuit connectors provide a positive, space-saving connection between printed circuitry and conventional wiring, through printed circuit boards, tape cables or plug-mounted sub-assemblies.

SERIES 600-7-1. For 3/64" printed circuit board or tape cable. 18 contacts for #24 AWG wire. Solder lug terminations are staggered to simplify soldering operations.

SERIES 600-4PCSC13. For 1/32" printed circuit board or tape cable. 13 staggered contacts accommodate #22 AWG wire. Module design permits stacking of any reasonable number of single units. Contacts have minimum spacing with maximum contact wiping surface.

SERIES 600-4PC10. Accepts 1/32" printed circuit board or tape cable. Double row of 10 contacts with solder lug terminations provides a total of 20 connections. For #22 AWG wire. Overall length only 1 1/8".

Continental Connector's "Bellowform" contacts are used in this series and provide coil spring action grip that clasps the printed circuit board firmly over the entire contact area regardless of board tolerance variations.

Contact material is spring temper phosphor bronze with gold plate over silver plate. Body molding compound is glass reinforced Diallyl Phthalate (MIL-M-19833, Type GDI-30, green color).

Technical literature on Continental Connector Series 600 Miniature PC Connectors is available on request. Write to Electronics Division, DeJUR-AMSCO CORPORATION, 45-01 Northern Boulevard, Long Island City 1, N. Y. (Exclusive Sales Agent)



MANUFACTURED BY
CONTINENTAL CONNECTOR CORPORATION,
AMERICA'S FASTEST GROWING LINE OF
PRECISION CONNECTORS

CIRCLE 58 ON READER-SERVICE CARD



TRANSISTORS - 1960

Type No.	Mfg.	Type	W C W	Max. Ratings			C k c
				w/c	T _i c	V _c V	
2N1211	TR	npn,DJ,si	85	.27	200	80	15m
2N1616	TR	npn,DJ,si	85	.27	200	60	15m
2N1617	TR	npn,DJ,si	85	.27	200	100	15m
2N1618	TR	npn,DJ,si	85	.27	200	100	15m
2N1619	TR	npn,DJ,si	85	.27	200	80	15m
ST440	TR	npn,DJ,si	85	.27	200	60	6m
ST450	TR	npn,DJ,si	85	.27	200	60	6m
STC1101	STC	npn,DJ,si	85	-	200	60	1m
STC1102	STC	npn,DJ,si	85	-	200	100	1m
STC1103	STC	npn,DJ,si	85	-	200	60	1m
STC1104	STC	npn,DJ,si	85	-	200	100	1m
2N1162	MO	pnnp,AJ,ge	90	1.2	100	35	4
2N1163	MO	pnnp,AJ,ge	90	1.2	100	35	4
2N1164	MO	pnnp,AJ,ge	90	1.2	100	60	4
2N1165	MO	pnnp,AJ,ge	90	1.2	100	60	4
2N1166	MO	pnnp,AJ,ge	90	1.2	100	80	4
2N1167	MO	pnnp,AJ,ge	90	1.2	100	80	4
2N1359	MO	pnnp,AJ,ge	90	1.2	-	50	7
2N1360	MO	pnnp,AJ,ge	90	1.2	-	50	5
2N1362	MO	pnnp,AJ,ge	90	1.2	-	100	7
2N1363	MO	pnnp,AJ,ge	90	1.2	-	100	5
2N1364	MO	pnnp,AJ,ge	90	1.2	-	120	7
2N1365	MO	pnnp,AJ,ge	90	1.2	100	120	5
2N1529	MO	pnnp,AJ,ge	90	1.2	100	40	10
2N1530	MO	pnnp,AJ,ge	90	1.2	100	40	10
2N1531	MO	pnnp,AJ,ge	90	1.2	100	80	10
2N1532	MO	pnnp,AJ,ge	90	1.2	100	100	10
2N1533	MO	pnnp,AJ,ge	90	1.2	100	120	10
2N1534	MO	pnnp,AJ,ge	90	1.2	100	40	8.5
2N1535	MO	pnnp,AJ,ge	90	1.2	100	60	8.5
2N1536	MO	pnnp,AJ,ge	90	1.2	100	80	8.5
2N1537	MO	pnnp,AJ,ge	90	1.2	100	100	8.5
2N1538	MO	pnnp,AJ,ge	90	1.2	100	120	8.5
2N1539	MO	pnnp,AJ,ge	90	1.2	100	40	4
2N1540	MO	pnnp,AJ,ge	90	1.2	100	60	4
2N1541	MO	pnnp,AJ,ge	90	1.2	100	80	4
2N1542	MO	pnnp,AJ,ge	90	1.2	100	100	4
2N1543	MO	pnnp,AJ,ge	90	1.2	100	120	4
2N1544	MO	pnnp,AJ,ge	90	1.2	100	40	4
2N1545	MO	pnnp,AJ,ge	90	1.2	100	60	4
2N1546	MO	pnnp,AJ,ge	90	1.2	100	80	4
2N1547	MO	pnnp,AJ,ge	90	1.2	100	100	4
2N1548	MO	pnnp,AJ,ge	90	1.2	100	120	4
2N1549	MO	pnnp,AJ,ge	90	1.2	100	40	4
2N1550	MO	pnnp,AJ,ge	90	1.2	100	60	10
2N1551	MO	pnnp,AJ,ge	90	1.2	100	80	10
2N1552	MO	pnnp,AJ,ge	90	1.2	100	100	10
2N1553	MO	pnnp,AJ,ge	90	1.2	100	40	6
2N1554	MO	pnnp,AJ,ge	90	1.2	100	60	6
2N1555	MO	pnnp,AJ,ge	90	1.2	100	80	6
2N1556	MO	pnnp,AJ,ge	90	1.2	100	100	6
2N1557	MO	pnnp,AJ,ge	90	1.2	100	40	5
2N1558	MO	pnnp,AJ,ge	90	1.2	100	60	5
2N1559	MO	pnnp,AJ,ge	90	1.2	100	80	5
2N1560	MO	pnnp,AJ,ge	90	1.2	100	100	5
3N49	MH	pnnp,AJ,ge	94	1.25	100	60	700
3N50	MH	pnnp,AJ,ge	94	1.25	100	80	450
3N51	MH	pnnp,AJ,ge	94	1.25	100	40	700
3N52	MH	pnnp,AJ,ge	94	1.25	100	60	450
2N574	MH	pnnp,AJ,ge	100	1.43	95	60	75
2N574A	MH	pnnp,AJ,ge	100	1.43	95	80	75
2N575	MH	pnnp,AJ,ge	100	1.43	95	60	75
2N575A	MH	pnnp,AJ,ge	100	1.43	95	80	75
2N1157	MH	pnnp,AJ,ge	100	1.43	95	60	75
2N1157A	MH	pnnp,AJ,ge	100	1.43	95	80	75
PT900	PSI	npn,MS,si	125	1	150	80	0m
PT901	PSI	npn,MS,si	125	1	150	140	0m

DATA CHART

POWER

(continued)

V _c V	Characteristics			Remarks	Type No.
	f _{oe} kc	Powr. Gain db	Powr. Out. w		
80	15mc	-	-		2N1211
60	15mc	-	-		2N1616
100	15mc	-	-		2N1617
100	15mc	-	-		2N1618
80	15mc	-	-		2N1619
60	6mc	-	-		ST440
60	6mc	-	-		ST450
60	1mc	-	-		STC1101
100	1mc	-	-		STC1102
60	1mc	-	-		STC1103
100	1mc	-	-		STC1104
35	4	-	-		2N1162
35	4	-	-		2N1163
60	4	-	-		2N1164
60	4	-	-		2N1165
80	4	-	-		2N1166
80	4	-	-		2N1167
50	7	-	-		2N1359
50	5	-	-		2N1360
100	7	-	-		2N1362
100	5	-	-		2N1363
120	7	-	-		2N1364
120	5	-	-		2N1365
40	10	-	-		2N1529
40	10	-	-		2N1530
80	10	-	-		2N1531
100	10	-	-		2N1532
120	10	-	-		2N1533
40	8.5	-	-		2N1534
60	8.5	-	-		2N1535
80	8.5	-	-		2N1536
100	8.5	-	-		2N1537
120	8.5	-	-		2N1538
40	4	-	-		2N1539
60	4	-	-		2N1540
80	4	-	-		2N1541
100	4	-	-		2N1542
120	4	-	-		2N1543
40	4	-	-		2N1544
60	4	-	-		2N1545
80	4	-	-		2N1546
100	4	-	-		2N1547
120	4	-	-		2N1548
40	10	-	-		2N1549
60	10	-	-		2N1550
80	10	-	-		2N1551
100	10	-	-		2N1552
40	6	-	-		2N1553
60	6	-	-		2N1554
80	6	-	-		2N1555
100	6	-	-		2N1556
40	5	-	-		2N1557
60	5	-	-		2N1558
80	5	-	-		2N1559
100	5	-	-		2N1560
60	700	-	-	Sat. volt = 0.15v	3N49
80	450	-	-	Sat. volt = 0.15v	3N50
40	700	-	-	Sat. volt = 0.15v	3N51
60	450	-	-	Sat. volt = 0.15v	3N52
60	75	-	-		2N574
80	75	-	-		2N574A
60	75	-	-		2N575
80	75	-	-		2N575A
60	75	-	-		2N1157
80	75	-	-		2N1157A
80	10mc	-	-	High frequency, high power	PT900
140	10mc	-	-	High frequency, high power	PT901



There's a Better Way . . . Although ice cubes *can* be used to keep transistors cool enough to operate at full rated load, there are those who maintain that ice cubes serve a better purpose in a long cool drink. This is the school of thought that leans toward Birtcher Heat Radiators for preventing thermal runaway and for getting maximum performance from semiconductor devices. If you would like to investigate before choosing sides in this debate, write for the Birtcher Transistor Radiator Catalog . . . it comes complete with all sorts of test reports and other technical looking papers. Address your inquiry to: Charles F. Booher, Secretary, *There's a Better Way Society of America, Inc.* **The Birtcher Corporation**/Industrial Division, 4371 Valley Boulevard, Los Angeles 32, Calif.



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Radiator Catalog.



B

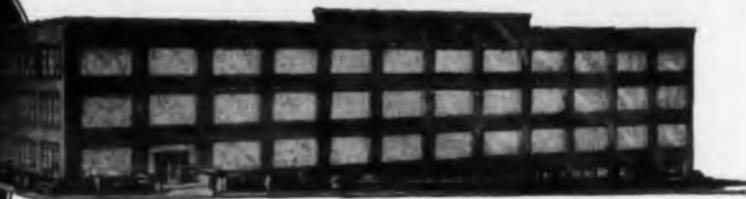
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PRECISION FORK OSCILLATOR UNITS

TYPE 2003



Size 1½" dia. x 4½" H. Wght. 8 oz.
Frequencies: 200 to 4000 cycles
Accuracies:—
Type 2003 (±.02% at -65° to 85°C)
Type R2003 (±.002% at 15° to 35°C)
Type W2003 (±.005% at -65° to 85°C)
Double triode and 5 pigtail parts required.
Input, Tube heater voltage and B voltage
Output, approx. 5V into 200,000 ohms

TYPE 2007-6



TRANSISTORIZED, Silicon Type
Size 1½" dia. x 3½" H. Wght. 7 ozs.
Frequencies: 360 to 1000 cycles
Accuracies:
2007-6 (±.02% at -50° to + 85°C)
R2007-6 (±.002% at +15° to + 35°C)
W2007-6 (±.005% at -65° to + 85°C)
Input: 10 to 30 Volts, D. C., at 6 ma.
Output: Multitap, 75 to 100,000 ohms

TYPE 2001-2



Size 3¾" x 4½" x 6" H., Wght. 26 oz.
Frequencies: 200 to 3000 cycles
Accuracy: ±.001% at 20° to 30°C
Output: 5V. at 250,000 ohms
Input: Heater voltage, 6.3-12-28
B voltage, 100 to 300 V., at 5 to 10 ma.

ACCESSORY UNITS FOR 2001-2



L—For low frequencies multi-vibrator type, 40-200 cy.
D—For low frequencies counter type, 40-200 cy.
H—For high freqs, up to 30 KC.
M—Power Amplifier, 2W output.
P—Power supply.

PRECISION FREQUENCY STANDARDS

TYPE 2005A

Size 8" x 8" x 7¼" High
Weight, 14 lbs.



Frequencies:
50 to 400 cycles (Specify)
Accuracy:
±.001% from 20° to 30°C
Output, 10 Watts at 115V
Input, 115V. (50 to 400 cy.)

TYPE 2121A

Size
8¾" x 19" panel
Weight, 25 lbs.



Output: 115V
60 cycles, 10 Watt
Accuracy:
±.001% 20° to 30°C
Input,
115V (50 to 400 cy.)

TYPE 2111C

Size, with cover
10" x 17" x 9" H.
Panel model
10" x 19" x 8¾" H.
Weight, 25 lbs.



Frequencies: 50 to 1000 cy.
Accuracy:
(±.002% at 15° to 35°C)
Output: 115V, 75W.
Input: 115V, 50 to 75 cy.

WHEN REQUESTING INFORMATION, PLEASE SPECIFY TYPE NUMBER

ATP
**American Time Products
Inc.**
61-20 Woodside Avenue
Woodside 77, N. Y.



TRANSISTORS - 1960

High Frequency

Type No.	Mfg	Type	f _{ce} MC	Max. Ratings			V _{ce}	I _{co}
				W _c (mw)	T _j (c)	mw/c		
2N444A	GT	npn,AJ,ge	1	150	100	2		2
2N1024	SSD	pnp,AJ,si	1	150	150	1.2		25
2N1025	SSD	pnp,AJ,si	1	150	150	1.2		25
2N94	SY	npn,AJ,ge	2	50	75	1		50
2N139	SY	pnp,AJ,ge	2(min)	.080	85	.75		50
2N169A	SY	npn,AJ,ge	2	65	75	.8		5
2N193	SY	npn,AJ,ge	2	50	75	1		50
2N194	SY	npn,AJ,ge	2	50	75	1		50
2N194A	SY	npn,AJ,ge	2	50	75	1		50
2N211	SY	npn,AJ,ge	2	50	70	1.1		20
2N233A	SY	npn,AJ,ge	2	50	75	1		50
2N413A	SY	pnp,AJ,ge	2	150	85	2.5		10
2N445	CBS	npn,AJ,ge	2	100	85	1.67		6
2N515	SY	npn,AJ,ge	2	50	75	1		50
2N516	SY	npn,AJ,ge	2	50	75	1		50
2N517	SY	npn,AJ,ge	2	50	75	1		50
2N519A	GT	pnp,AJ,ge	2	150	100	2		1
2N1026	SSD	pnp,AJ,si	2	150	150	1.2		25
2N1469	SSD	pnp,AJ,si	2	150	150	1.2		25
2N413	RA	pnp,FA,ge	2.5	150	85	-		2.0
CK13	RA	pnp,FA,ge	2.5	80	85	-		2.0
GK13A	RA	pnp,AJ,ge	2.5	80	85	-		2.0
2N356	CBS	npn,AJ,ge	3	100	85	1.67		5
2N438	CBS	npn,AJ,ge	3	100	85	1.67		10
2N438A	CBS	npn,AJ,ge	3	150	85	2.5		10
2N445A	GT	npn,AJ,ge	3	150	100	2		2
2N481	RA	pnp,AJ,ge	3	200	85	3		3
2N614	WH	pnp,FJ,ge	3	125	85	2.1		6
2N1222	GT	pnp,AJ,si	3	150	150	1.2		0.05
2N482	IND	pnp,AJ,ge	3.5	150	85	2.5		3
TR-482	IND	pnp,AJ,ge	3.5	150	85	2.5		3
2N212	SY	npn,AJ,ge	4	50	75	1		50
2N385	CBS	npn,AJ,ge	4	150	100	2.0		35
2N414A	SY	pnp,AJ,ge	4	150	85	2.5		20
2N1027	SSD	pnp,AJ,si	4	150	150	1.2		25
2N1058	SY	npn,AJ,ge	4	50	75	1		50
2N94A	SY	npn,AJ,ge	5	50	85	.8		50
2N168A	SY	npn,AJ,ge	5	65	85	1.1		5
2N292	SY	npn,AJ,ge	5	65	85	.9		5
2N395	RA	pnp,AJ,ge	5	150	85	-		2.0
2N438	RA	npn,AJ,ge	5	100	85	-		3
2N439	CBS	npn,AJ,ge	5	100	85	1.67		10
2N439A	CBS	npn,AJ,ge	5	150	85	2.5		10
2N446	CBS	npn,AJ,ge	5	100	85	1.67		6
2N448	GE	npn,RG,ge	5	65	85	1.1		5
2N520A	GT	pnp,AJ,ge	5	150	100	2		11
2N615	WH	pnp,FJ,ge	5	125	85	2.1		6
2N634	CBS	npn,AJ,ge	5	150	85	2.5		5
2N1090	CBS	npn,AJ,ge	5	120	85	2		8
2N483	RA	pnp,FA,ge	5.5	150	85	-		3.0
2N357	CBS	npn,AJ,ge	6	100	85	1.67		5
2N377	CBS	npn,AJ,ge	150	6	150	2.0		5
2N446A	GT	npn,AJ,ge	6	150	100	2		2
2N1221	GT	pnp,AJ,si	6	150	150	1.2		0.05
OC-65	AMP	pnp,PADT,ge	6	83	75	-		0.5
ST4150	TR	npn,DJ,si	6	5W	200	45		15
2N139	RCA	pnp,AJ,ge	6.8	80	85	1		6
2N218	RCA	pnp,AJ,ge	6.8	80	85	-		6
2N409	RCA	pnp,AJ,ge	6.8	80	85	-		10
2N410	RCA	pnp,AJ,ge	6.8	80	85	-		10
2N412	SY	pnp,AJ,ge	7	50	75	1		5
2N414	RA	pnp,FA,ge	7	150	85	-		2.0
2N414B	IND	pnp,AJ,ge	7	200	85	3.33		2
2N439	RA	npn,AJ,ge	7	100	85	-		3
2N417	WH	pnp,FJ,ge	7	125	85	2.1		6

DATA CHART

Ratings	Characteristics			Remarks	Type No.
	I _{co}	NF	C _{coo}		
2	12	14	CR		2N444A
25	-	7			2N1024
25	-	7			2N1025
50	-	-			2N94
50	-	-			2N139
5	-	-			2N169A
50	-	-			2N193
50	-	-	Mixer		2N194
50	-	-	Converter		2N194A
20	-	-			2N211
50	-	-			2N233A
10	-	-	CR		2N413A
6	-	12	CR		2N445
50	-	-			2N515
50	-	-			2N516
50	-	-			2N517
1	12	14	Ind, CR		2N519A
25	-	7			2N1026
25	-	7			2N1469
2.0	7	-	Ind., US, CR		2N413
2.0	7	-			CK13
2.0	7	-	micromin		GK13A
5	-	12	RCA, GT, SY, CR		2N356
10	-	12	GT, CR		2N438
10	-	12	CR		2N438A
2	12	14	CR		2N445A
3	-	14			2N481
6	10	8			2N614
0.05	16	9			2N1222
3	-	12	RA, US		2N482
3	-	12			TR-482
50	-	-	Converter		2N212
35	-	4	SY, CR		2N385
20	-	-	CR		2N414A
25	-	7			2N1027
50	-	-	Converter		2N1058
50	-	-			2N94A
5	-	-			2N168A
5	-	-	GE		2N292
2.0	12	-	TO-5 RF switch		2N395
3	-	9	TO-5 RF switch		2N438
10	-	12	GT, SY, CR		2N439
10	-	12	CR		2N439A
6	-	12	CR		2N446
5	-	2.4			2N448
11	12	14	Ind, CR		2N520A
6	10	8			2N615
5	-	12	GE, CR		2N634
8	-	12			2N1090
3.0	-	-	Ind, US		2N483
5	-	12	RCA, GT, SY, CR		2N357
5	-	12	SY, CR		2N377
2	12	14			2N446A
0.05	16	7			2N1221
0.5	-	-			OC45
15	-	80			ST4150
6	8	-	SY		2N139
6	-	-			2N218
10	-	-	SY		2N409
10	-	-			2N410
5	-	-			2N412
0.0	6	-	IND, US, CR		2N414
2	6	12			2N414B
3	-	9	TO-5 RF switch		2N439
6	10	8	Converter		2N617

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CIRCLE 910 ON CAREER INQUIRY FORM, PAGE 159



TRANSISTORS-1960

High Frequency

Type No.	Mfg	Type	f _{ce} MC	W _c (mw)	Max. Rating		I _{co}
					T _i (c)	mW/c	
2N1090	RA	npn,AJ,ge	7	150	85	-	3
2N1119	GT	npn,AJ,si	7	150	140	1.3	50
CK14	RA	npn,FA,ge	7	80	85	-	2.0
ST903	TR	npn,GR,si	7	150	150	1.0	0.1
2N485	IND	npn,AJ,ge	7.5	200	85	3	3
2N168A	GE	npn,RG,ge	8	65	85	1.1	5
2N169	GE	npn,RG,ge	8	65	85	1.1	5
2N293	GE	npn,RG,ge	8	65	85	1.1	5
2N388	CBS	npn,AJ,ge	8	150	100	2.0	2.0
2N396	RA	npn,AJ,ge	8	150	85	-	-
2N449	GE	npn,RG,ge	8	65	85	1.1	72
2N581	RA	npn,AJ,ge	8	100	85	-	3
2N1086	GE	npn,RG,ge	8	65	85	1.1	3
2N1086A	GE	npn,RG,ge	8	65	85	1.1	3
2N1087	GE	npn,RG,ge	8	65	85	1.1	5
2N1121	GE	npn,RG,ge	8	65	85	1.1	25
SS00	SSD	npn,AJ,si	8	150	150	1.2	5
2N358	CBS	npn,AJ,ge	9	100	85	1.67	6
2N447	CBS	npn,AJ,ge	9	100	85	1.67	1
2N521A	GT	npn,AJ,ge	9	150	100	2	6
2N616	WH	npn,FJ,ge	9	125	85	2.1	0.1
ST904	TR	npn,GR,si	9	150	150	1.0	3
2N140	RCA	npn,AJ,ge	10	80	85	-	6
2N219	RCA	npn,AJ,ge	10	80	85	-	6
2N411	RCA	npn,AJ,ge	10	80	85	-	10
2N412	RCA	npn,AJ,ge	10	80	85	-	10
2N414B	IND	npn,AJ,ge	10	200	85	2.5	3
2N416	RA	npn,FA,ge	10	150	85	-	2.0
2N440	CBS	npn,AJ,ge	10	100	85	1.67	10
2N440A	CBS	npn,AJ,ge	10	150	85	2.5	10
2N447A	GT	npn,AJ,ge	10	150	100	2	2
2N473	TR	npn,GR,ge	10	200	200	1.1	0.01
2N474	TR	npn,GR,si	10	200	200	1.1	0.01
2N475	TR	npn,GR,si	10	200	200	1.1	0.01
2N484	RA	npn,FA,ge	10	150	85	-	3.0
2N635	CBS	npn,AJ,ge	10	150	85	2.5	5
2N1091	CBS	npn,AJ,ge	10	120	85	2	8
CK16	RA	npn,FA,ge	10	80	85	-	2.0
GK16A	RA	npn,AJ,ge	10	80	85	-	2.0
ST905	TR	npn,GR,si	10	150	150	1.0	0.1
2N118A	TI	npn,GR,si	11	150	175	0.8	0.1
2N478	TR	npn,GR,si	11	200	200	1.1	0.01
2N479	TR	npn,GR,si	11	200	200	1.1	0.01
2N480	TR	npn,GR,si	11	200	200	1.1	0.01
2N1417	TR	npn,GR,si	11	150	150	1.2	0.01
2N1418	TR	npn,GR,si	11	150	150	1.2	0.02
ST15	TR	npn,GR,si	11	200	200	1.1	2
ST35	TR	npn,GR,si	11	200	200	1.1	0.02
ST45	TR	npn,GR,si	11	200	200	1.1	0.02
ST904A	TR	npn,GR,si	11	150	150	1.0	0.1
ST910	TR	npn,GR,si	11	150	150	1.0	0.1
2N397	RA	npn,AJ,ge	12	150	85	-	2.0
2N486	IND	npn,AJ,ge	12	-	85	3	3
2N751	RA	npn,DJ,si	12	150	175	0.75	0.01
2N1390	RA	npn,DJ,si	12	300	175	0.5	0.01
2N440	RA	npn,AJ,ge	15	100	85	-	3
2N541	TR	npn,GR,si	15	200	200	1.1	0.01
2N542	TR	npn,GR,si	15	200	200	1.1	0.01
2N543	TR	npn,GR,si	15	200	200	1.1	0.01
2N636	CBS	npn,AJ,ge	15	150	85	2.5	5
2N1091	RA	npn,AJ,ge	15	150	85	-	3
OC44	AMP	npn,PADT,ge	15	83	75	-	0.5
2N522A	GT	npn,AJ,ge	17	150	100	2	1
2N582	RA	npn,AJ,ge	18	100	85	-	3
2N1428	PH	npn,SAT,si	19.5	100	140	0.87	0.1
2N1429	PH	npn,SAT,si	19.5	100	140	0.87	0.1

DATA CHART

Characteristics			Remarks	Type No.
I_{CO}	NF	C_{COO}		
3		9	TO-5 RF switch	2N1090
50	-	6		2N1119
2.0	6	-		CK14
0.1	25	7		ST903
3	-	12	RA, US	2N485
5	-	2.4		2N168A
5	-	2.4		2N169
5	-	2.4		2N293
5	-	12	GT, SY, CR	2N388
2.0	-	12	TO-5 RF switch	2N396
72	-	2.4		2N449
3	-	12	TO-5 RF switch	2N581
3	-	2.4		2N1086
3	-	2.4		2N1086A
3	-	2.4		2N1087
5	-	2.4		2N1121
25	-	7		S500
5	-	12	GT, SY, CR	2N358
6	-	12	CR	2N447
1	12	14	CR	2N521A
6	10	8	Reflex	2N616
0.1	25	7		ST904
6	8	-	SY	2N140
6	-	-		2N219
10	-	-	SY	2N411
10	-	-		2N412
3	-	12		2N414B
2.0	4	-	Ind., US, GT, CR	2N416
10	-	12	GT, SY, CR	2N440
10	-	12	CR	2N440A
2	12	14	CR	2N447A
0.01	20	7		2N473
0.01	20	7		2N474
0.01	20	7		2N475
3.0	-	-	US	2N484
5	-	12	GE CR	2N635
8	-	12		2N1091
2.0	4	-		CK16
2.0	4	-	micromin	GK16A
0.1	25	7		ST905
0.1	25	7	JAN, TR	2N118A
0.01	19	7		2N478
0.01	19	7		2N479
0.01	19	7		2N480
-	19	7		2N1417
0.01	19	7		2N1418
0.02	22	7		ST15
0.02	22	7	2N332	ST35
0.02	22	7	2N332	ST45
0.1	25	7		ST904A
0.1	20	7		ST910
2.0	-	12	TO-5 RF switch	2N397
3	-	12	TO-5 RF switch	2N486
0.01	-	6	RA, US	2N751
0.01	-	6		2N1390
3	-	9	TO-5 RF switch	2N440
0.01	19	7		2N541
0.01	19	7		2N542
0.01	19	7		2N543
5	-	12	GE, CR	2N636
3	-	9	TO-5 RF switch	2N1091
0.5	-	-		OC44
1	12	14	CR	2N522A
3	-	12	TO-5 RF switch	2N582
0.1	-	14		2N1428
0.1	-	14		2N1429

SPECIFY SPERRY SEMICONDUCTORS

GERMANIUM TUNNEL DIODES

Standard types T101-T105 are available with typical peak current ratings of 0.8 to 15 milliamperes and typical peak-to-valley current ratios of 8. In addition, numerous other Sperry tunnel diodes are available on a do-it-yourself specification basis to meet your design requirements. Send for your own tunnel diode spec and price nomogram #1201.

SUBMINIATURE SILICON DIODES

HIGH CURRENT SWITCHING DIODES. Unique types developed by Sperry for your special high-current applications.

Type	Min. Sat. Vol. (Volts) (@ 100 μ A, 25°C)	Min. Fwd. Current (mA) (at 1.0V)	Max. Reverse Recovery Time (μ sec)	Application
1N658	120	100	0.3	High-current pulse circuits, MIL approved type.
1N663	100	100	0.3	
1N690	40	400	0.8	Gating, Clamping, Switching, Magnetic Core-Switching Circuits, High-frequency rectifier, demodulator, MIL guidance types.
1N691	80	400	0.8	
1N692	120	400	0.8	
1N693	150	400	0.8	
1N920	40	500	0.3	
1N921	80	500	0.3	
1N922	120	500	0.3	
1N923	150	500	0.3	

*Measured at 500mA in high current diode reverse recovery test set. See Sperry Technical Information Bulletin #2103.

LOW CURRENT SWITCHING DIODES. Popular MIL types for all logic and low-current applications.

Type	Min. Sat. Vol. (Volts) (@ 100 μ A, 25°C)	Min. Fwd. Current (mA) (at 1.0V)	Max. Reverse Recovery Time (μ sec)	Application
1N643	200	10	0.3	High speed computer logic and switching applications. High-frequency rectifier, demodulator, MIL approved type.
1N659	60 @ 100°C	6	0.3	
1N660	120 @ 100°C	6	0.3	
1N662	100	10	0.5	

Many other low-current switching types available such as 1N625 series, 1N789 series, and 1N837 series.

HIGH-CONDUCTANCE GENERAL-PURPOSE DIODES

Extremely low reverse leakage. Applications include low-level magnetic amplifier, power supplies, modulator and demodulator circuitry. A partial list:

1N456	1N462	1N482A	1N483B	1N485
JAN 1N457	1N463	1N482B	1N484	1N485A
JAN 1N458	1N464	1N483	1N484A	1N485B
JAN 1N459	1N482	1N483A	1N484B	1N486
1N461				1N486A

SILICON NPN MESA TRANSISTORS

Diverse application in all areas of high-speed switching, broadband video amplification and RF oscillation. Improved construction means greater reliability. More rugged short-post design.

Type	BV_{CE} (Volts)	h_{FE}	f_t (mcs.)	Application
FOR SWITCHING APPLICATIONS —				
2N696	40	20 - 60	80	Medium and high gain, high frequency, high power switch and amplifier.
2N697	40	40 - 120	100	
2N702	25	20 - 60	150	Medium and high gain, very high frequency switch and amplifier.
2N703	25	40 - 100	150	
2N706	20	15	400	Ultra fast switch.
FOR LINEAR AMPLIFIER APPLICATIONS —				
2N698	80	20 min.	100	Medium and high gain, high-voltage and power linear amplifier.
2N699	80	40 - 120	100	

SILICON ALLOY PNP TRANSISTORS

All production units are baked at 200°C for 200 hours to insure stability and high performance under extreme environmental conditions.

Type	BV_{CE}	h_{FE}	f_t (kc)	Application
GENERAL PURPOSE (AUDIO AND SWITCHING) TYPES —				
2N327A	40	14 avg.	200	Medium and high gain transistors for high temperature, audio and d.c. amplifiers. MIL guidance types.
2N328A	35	28 avg.	300	
2N329A	35	60 avg.	500	
2N330A	30	25 avg.	500	Low noise amplifier.
2N1024	15	9 min.	1 mc.	Low, medium and high gain, high efficiency switch. Low I_{CO} for D.C. control, servo amplifiers, MIL preferred types.
2N1025	35	9 - 22	1 mc.	
2N1026	35	18 - 44	2 mc.	
2N1469	35	36 - 88	2 mc.	Low, medium and high gain. Specified A.C. parameters, small signal specs.
2N1034	40	9 - 22	200	
2N1035	35	18 - 40	300	
2N1036	30	36 - 88	500	Low noise amplifier.
2N1037	35	25 avg.	300	

HIGH VOLTAGE AUDIO AND SWITCHING TYPES —

2N1275	80	14 avg.	100	High voltage, high temp. audio switching and d.c. amplifiers for servo, control applications.
2N1474	60	9 - 44	1 mc.	High voltage for switching circuits and audio, servo applications.
2N1475	60	36 - 88	1 mc.	
2N1476	100	12 - 36	1 mc.	
2N1477	100	30 - 66	1 mc.	

HIGH FREQUENCY TYPES —

2N1118	25	9 min.	15 mc.	Amplifier, and oscillator to 20 mc.
2N1119	10	16 (dc)	18 mc. (f_{max})	High speed switching circuits, low saturation. Excellent DCTL type.
2N1027	15	18 min.	4 mc.	General purpose switching.
2N1028	10	9 min.	10 mc.	

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SPERRY

SPERRY SEMICONDUCTOR DIVISION
SPERRY RAND CORPORATION • SOUTH NORWALK, CONN.

CIRCLE 62 ON READER-SERVICE CARD

Manufacturer makes unique guarantee for new "EVEREADY" Energizers with cathodic envelope construction

*New Battery Design Makes These Energizers So Reliable They
Can Be Guaranteed Leakproof Up to Value of Device Which Houses Them*

Union Carbide Consumer Products Company, in answer to the growing need, now offers "Eveready" brand Energizers designed especially to meet the requirements of modern transistorized devices.

MORE POWER, LOWER COST

These "Eveready" Energizers (now available in many different sizes) are guaranteed leakproof and provide more power, longer life and lower operating cost than conventional battery construction. They also offer the radio set manufacturer many cost savings such as the elimination of the contacts needed when round cell batteries are used.

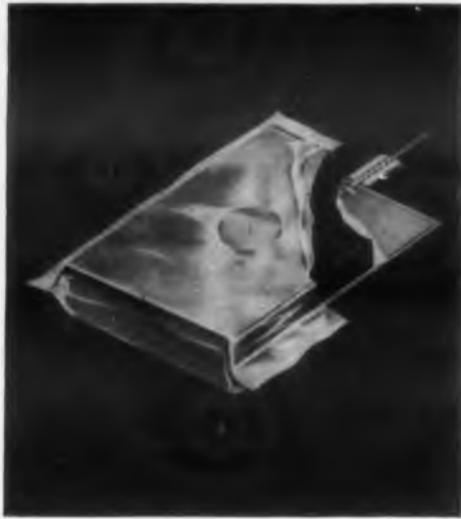
ENERGIZERS NOW GUARANTEED LEAKPROOF

Proof of the complete reliability of these sensational new cathodic envelope batteries can be read in the unprecedented leakproof guarantee which reads: "If this battery is defective through fault of the manufacturer, satisfactory adjustment will be made within the limits of the value of the electronic device!"

Energizers now available in many different sizes →

*Write for complete technical
information on "Eveready" Energizers.*

NEW ADVANCE IN BATTERY DESIGN GIVES NO. 2762 OVER 3 TIMES LIFE OF 6 D-CELLS



Cathodic Envelope design doubles anode and cathode areas to give high current, low impedance required for transistor circuits, provides volume efficiency unknown to other carbon zinc cells with no side penalties for peak performance!

COMPLETE PORTABILITY

New "Eveready" Energizers ideal for radios, marine depth finders, telephone amplifiers, barricade flashers and similar devices. Make countless additional electronic devices truly portable.

DESIGNERS CITE SEVEN MAJOR ADVANTAGES!

1. No instrument damage from leakage.
2. Reduction of tooling and manufacturing cost for mounting batteries.
3. Elimination of corrosion of contacts.
4. Ease of battery replacement — no reversed polarities to damage circuit.
5. More compact design because Energizers give more energy per cubic inch.
6. Easy availability of batteries through any "Eveready" distributor.
7. Outstanding service life.



TRANSISTORS - 1960

High Frequency

Type No.	Mfg	Type	f _{oe}	Max. Ratings				I _{co}	M
				W _c (mw)	T _j (c)	mw/c	V _c		
2N417	RA	pn _p ,FA,ge	20	150	85	-	10	2.0	
2N602	GT	pn _p ,DR,ge	20	120	85	2	20	3	
CK17	RA	pn _p ,FA,ge	20	80	85	-	10	2.0	
CK17A	RA	pn _p ,AJ,ge	20	80	85	-	10	2.0	
2N495	PH	pn _p ,SA,ge	21	150	140	1.3	25	1.0	
2N523A	GT	pn _p ,AJ,ge	23	150	100	2	20	1	
2N1065	GT	pn _p ,DR,ge	25	120	85	2	40	4	
2N1118	PH	pn _p ,SA T,si	25	150	140	1.3	25	1.0	
2N1118A	PH	pn _p ,SAT,si	25	150	140	1.3	25	1.0	
2N247	RCA	pn _p ,DR,ge	30	80	85	-	35	16	
2N274	RCA	pn _p ,DR,ge	30	80	85	-	35	16	
2N370	RCA	pn _p ,DR,ge	30	80	85	-	20	20	
2N371	RCA	pn _p ,DR,ge	30	80	85	-	20	20	
2N372	RCA	pn _p ,DR,ge	30	80	85	-	20	20	
2N373	RCA	pn _p ,DR,ge	30	80	85	-	25	8	
2N374	RCA	pn _p ,DR,ge	30	80	85	-	25	8	
2N544	RCA	pn _p ,DR,ge	30	80	85	-	18	8	
2N1109	TI	pn _p ,GD,ge	30	30	85	-	16	5	
2N1224	SY	pn _p ,DD,ge	30	120	100	1.6	40	12	
2N1224	RCA	pn _p ,DR,ge	30	120	85	-	40	12	
2N1226	RCA	pn _p ,DR,ge	30	120	85	-	60	16	
2N1395	RCA	pn _p ,DR,ge	30	120	85	-	40	16	
2N1425	RCA	pn _p ,DR,ge	33	120	85	-	24	16	
2N1426	RCA	pn _p ,DR,ge	33	120	85	-	24	16	
2N1108	TI	pn _p ,D,ge	35	30	85	-	16	5	
2N1110	TI	pn _p ,GD,ge	35	30	85	-	16	5	
2N1111	TI	pn _p ,GD,ge	35	30	85	-	20	5	
2N1111A	TI	pn _p ,GD,ge	35	30	85	-	20	5	
2N1111B	TI	pn _p ,GD,ge	36	30	85	-	27	5	
2N603	GT	pn _p ,DR,ge	40	120	85	-	30	3	14
2N750	RA	npn,DJ,si	40	150	175	0.75	50	10	
2N1107	TI	pn _p ,GD,ge	40	30	85	-	16	5	
2N1389	RA	npn,DJ,si	40	300	175	0.5	50	10	
2N640	RCA	pn _p ,DR,ge	42	80	85	-	34	5	
2N641	RCA	pn _p ,DR,ge	42	80	85	-	34	7	
2N642	RCA	pn _p ,DR,ge	42	80	85	-	34	7	
2N1196	HU	pn _p ,MS,si	45	350	200	2	70	2	6
2N248	TI	pn _p ,GD,ge	50	30	75	0.6	25	5	
2N344	PH	pn _p ,SB,ge	50	20	55	1.33	5	0.7	
2N345	PH	pn _p ,SA,ge	50	20	55	1.33	5	0.7	
2N604	GT	pn _p ,DR,ge	50	120	85	2	30	4	14
3N36	GE	npn,MB,ge	50	30	85	0.5	10	3	
PT900	PSI	npn,MS,si	50	125	150	1000	100	30	
PT901	PSI	npn,MS,si	50	125	150	1000	100	30	
2N1197	HU	pn _p ,MS,si	55	350	200	2	70	.006	6
2N393	PH	pn _p ,MAD,ge	60	25	85	0.63	8	1.5	
2N749	RA	npn,DJ,si	60	150	175	0.75	45	10	
2N1388	RA	npn,DJ,si	60	300	175	0.5	45	10	
OC170	AMP	pn _p ,DJ,ge	70	60	75	2	30	2	
2N346	PH	pn _p ,SB,ge	75	20	55	1.3	5	0.7	
2N696	TR	npn,DJ,si	80	2W	175	13.35	60	0.1	
RT5002	RH	npn,MS,si	120	3W	175	20	60	.1	
2N128	PH	pn _p ,SB,ge	85	25	85	0.4	4.5	0.6	10
3N37	GE	npn,MB,ge	90	30	85	0.5	10	3	
2N384	RCA	pn _p ,DR,ge	100	80	85	-	30	16	
2N697	TR	npn,DJ,si	100	2W	175	13.3	60	0.1	
2N1180	RCA	pn _p ,DR,ge	100	80	85	-	30	12	
2N1225	RCA	pn _p ,DR,ge	100	120	85	-	40	12	
2N1396	RCA	pn _p ,DR,ge	100	120	85	-	40	16	
3N34	TI	npn,GD,si	100	125	150	1	30	0.4	20
OC171	AMP	pn _p ,DJ,ge	100	60	75	2	30	2	
2N497	RH	npn,MS,si	120	4W	175	26.5	100	.1	
2N498	RH	npn,MS,si	120	4W	175	26.5	100	.1	
2N656	RH	npn,MS,si	120	4W	175	26.5	100	.1	
2N657	RH	npn,MS,si	120	4W	175	26.5	100	.1	
2N698	RH	npn,MS,si	120	2W	175	13.2	120	.1	



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CIRCLE 63 ON READER-SERVICE CARD

DATA CHART

A GOOD RUN FOR YOUR MONEY—
New "SCOTCH" BRAND Heavy Duty Tapes offer exceptional life, low rub-off, good resolution



HAVE PROBLEMS OF TAPE-LIFE, rub-off and resolution? To cure your headaches in applications that subject magnetic tape to high speeds, pressures, temperatures and low humidity, "SCOTCH" BRAND now prescribes two new tapes—Heavy Duty Tapes 198 and 199. They offer plus-performance in a wide variety of temperature and humidity conditions.

Take the matter of wear, for instance. Field tests show that "SCOTCH" BRAND Heavy Duty Tapes wear five times longer than standard tapes—yet they maintain good resolution and freedom from drop-outs over this long haul. Two factors are decisive in this performance—resistance to rub-off and resistance to high temperatures.

Ordinary tapes age fast if the temperature climbs or the relative humidity drops sharply. The binder softens, allowing the oxides to rub off on those costly and sensitive heads. Further, as an electrostatic charge builds with each pass, stray contaminants are attracted to the tape—and the tape starts to cling to the equipment. In each case—your drop-out count mounts.

Not so with "SCOTCH" BRAND Heavy Duty Tapes. They boast an extra tough binder system similar to that used in "SCOTCH" BRAND Video Tape, which after two years is still the only video tape in commercial use. The heavy duty binder system anchors the oxides firmly to the polyester base in a way that resists very high temperatures—minimizing rub-off. Moreover, Heavy Duty Tapes have a conductivity nearly 1000 times greater than conventional tapes, allowing static charge to drain off. Result? Clean, smooth runs with good resolution—a good run for your money.

Performance of this kind is easy to promise—much harder to deliver. And only experienced "SCOTCH" BRAND technology has such a record of delivering the right tape for every application in data acquisition, reduction or control programming.

Check all the tapes in the "SCOTCH" BRAND line. High Resolution Tapes 158 and 159 pack more bits per inch, offer extra play time. High Output Tape 128 gives top output in low frequencies, even in temperature extremes. Sandwich Tapes 188 and 189 drastically cut head-wear, eliminate oxide rub-off, and wear 10 times longer than ordinary tapes. Standard Tapes 108 and 109 remain the standard of instrumentation.

Your 3M Representative is close at hand in all major cities—a convenient source of supply and information. For details consult him or write Magnetic Products Div., 3M Co., St. Paul 6, Minn.

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SCOTCH BRAND MAGNETIC TAPE
 FOR INSTRUMENTATION

MINNESOTA MINING AND MANUFACTURING COMPANY
 ... WHERE RESEARCH IS THE KEY TO TOMORROW



CIRCLE 64 ON READER-SERVICE CARD



WESTON FAN SHAPES OFFER EXTENDED SCALE LENGTH, MULTIPLE RANGES

*Designed for accuracy...
engineered for long life*

Weston's fan shaped switchboard instruments are well known throughout the industry as standards of long-term dependability. The number of uses for these quality DC meters is legion. They are frequently specified for temperature measurement, speed indication and other applications where their long scale length and accuracy of $\pm 1\%$ are important.

Exceptional scale length is achieved through classic Weston design. Model 273, for example, provides a 7.32" scale in less than 9.5 x 7.5" of panel space. For extremely precise measurement, these meters can be supplied with knife-edge pointers and mirror scales.

Shielded cases are of pressed steel for maximum strength and immunity to stray fields. Cases are surface type, back connected.

Ranges depend on intended use. Weston fan shaped meters are supplied from 100 microamperes full scale, and 10 millivolts full scale.

Call your Weston representative for details, or write for Catalog 01-200 which contains full technical data. Daystrom, Incorporated, Weston Instruments Division, Newark 12, N. J. International Sales Division, 100 Empire St., Newark 12, N. J. In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 19, Ontario.

Permanent magnet moving coil type. Supplied with dull black finish. DC ranges as specified. Maximum required panel space and scale length: Model 267-4-3/32 x 3-3/8", 2.6" scale. Model 269-5-5/8 x 4-7/16", 4" scale. Model 271-7-7/8 x 6-1/4", 5.8" scale. Model 273-9-5/16 x 7-13/32", 7.32" scale.

DAYSTROM, INCORPORATED
WESTON INSTRUMENTS DIVISION
Reliability by Design

CIRCLE 65 ON READER-SERVICE CARD



TRANSISTORS - 1960

High Frequency *Continued*

Type No.	Mfg.	Type	W _C W	Max. Ratings			f _{max} Mc	P _o G
				w/c	T _j c	V _c V		
2N699	RH	npn,MS,si	120	2W	175	13.2	12	.1
2N1023	RCA	pnnp,DR,ge	120	120	85	-	12	.1
2N1066	RCA	pnnp,DR,ge	120	120	85	-	12	.1
2N1252	RH	npn,MS,si	120	2W	175	13.2	12	.1
2N1253	RH	npn,MS,si	120	2W	175	13.2	12	.1
2N1397	RCA	pnnp,DR,ge	120	120	85	-	16	.1
2N1409	RH	npn,MS,si	120	2.8W	150	22.5	16	.1
2N1410	RH	npn,MS,si	120	2.8W	150	22.5	16	.1
2N1420	RH	npn,MS,si	120	2W	175	13.2	16	.1
2N1507	RH	npn,MS,si	120	2W	175	13.2	16	.1
2N1613	RH	npn,MS,si	120	3W	200	17.2	16	.025
RT5001	RH	npn,MS,si	120	3W	175	20	16	.1
RT5003	RH	npn,MS,si	120	3W	175	20	16	.1
RT5004	RH	npn,MS,si	120	3W	175	20	16	.1
2N715	TI	npn,MS,si	125	1.2W	175	8	16	1
2N716	TI	npn,MS,si	125	1.2W	175	8	16	1
2N1177	RCA	pnnp,DR,ge	140	80	85	-	12	.1
2N1178	RCA	pnnp,DR,ge	140	80	85	-	12	.1
2N1179	RCA	pnnp,DR,ge	140	80	85	-	12	.1
2N728	TR	npn,DJ,si	150	300	175	-	0.5	-
2N729	TR	npn,DJ,si	150	300	175	-	0.5	-
2N1267	PH	npn,SADT,si	150	100	150	0.8	10	-
2N1268	PH	npn,SADT,si	150	100	150	0.8	10	-
2N1269	PH	npn,SADT,si	150	100	150	0.8	10	-
3N35	TI	npn,GD,si	150	125	150	1	10	0.4
2N1335	PSI	npn,MS,si	170	2.8 W	150	24	10	8
2N1336	PSI	npn,MS,si	170	2.8 W	150	24	10	8
2N1337	PSI	npn,MS,si	170	2.8 W	150	24	10	8
2N1270	PH	npn,SADT,si	200	100	150	0.8	10	-
2N1271	PH	npn,SADT,si	200	100	150	0.8	10	-
2N1272	PH	npn,SADT,si	200	100	150	0.8	10	.01
2N1339	PSI	npn,MS,si	220	2.8 W	150	24	10	8
2N1340	PSI	npn,MS,si	250	2.8 W	150	24	10	8
2N588	PH	pnnp,MAD,ge	250	30	85	0.75	10	3
2N695	MO	pnnp,DM,ge	250	75	100	1	10	2
2N1491	RCA	npn,MS,si	250	3	175	-	10	10
2N1492	RCA	npn,MS,si	275	3	175	-	10	10
2N1341	PSI	npn,MS,si	280	2.8 W	150	24	10	8
2N710	MO	pnnp,MS,ge	300	150	100	4	10	2
2N1493	RCA	npn,MS,si	300	3	175	-	10	10
2N503	PH	pnnp,MAD,ge	320	25	85	0.63	10	3
2N499	PH	pnnp,MAD,ge	340	30	85	0.75	10	3
2N1505	PSI	pnnp,MS,si	350	30 W	175	-	10	3
2N1506	PSI	npn,MS,si	350	30 W	175	-	10	3
2N741	MO	pnnp,MS,ge	360	150	100	4	10	2
2N706	RH	pnnp,MS,si	400	1W	175	6.6	10	1
2N502	PH	pnnp,MAD,ge	440	25	85	0.63	10	3
2N502A	PH	pnnp,MAD,ge	440	25	100	0.45	10	3
2N1143	TI	pnnp,DB,ge	480	750	100	10	10	7
2N700	MO	pnnp,DM,ge	500	75	100	1	10	3
2N1562	MO	pnnp,MS,ge	500	3W	100	40	10	3
2N1561	MO	pnnp,MS,ge	500	3W	100	40	10	3
2N1142	TI	pnnp,DB,ge	600	750	100	10	10	7
2N528	WE	pnnp,DG,ge	750	100	100	.5	10	3
2N537	WE	pnnp,DG,ge	750	250	100	.3	10	3

DATA CHART

ency (continued)

Settings	Characteristics			Remarks	Type No.
	Cap. (pF)	Powr. Gain (db)	Powr. Out. (w)		
3.2	12	.1	15		2N699
	12	.1	15		2N1023
	12	.1	15		2N1066
3.2	30	.1	30		2N1252
3.2	30	.1	30		2N1253
	16	.1	20		2N1397
2.5	30	.1	20	PSI	2N1409
2.5	30	.1	20	PSI	2N1410
3.2	30	.1	20		2N1420
3.2	30	.1	20		2N1507
7.2	75	.025	20		2N1613
20	100	.1	30		RT5001
20	100	.1	30		RT5003
20	100	.1	30		RT5004
8	50	1	3	h _{FE} 10-50	2N715
8	70	1	3	h _{FE} 10-50	2N716
	12				2N1177
	12				2N1178
	12				2N1179
	0.5		8		2N728
	0.5		8		2N729
0.8	20	10	1.5		2N1267
0.8	20	10	1.5		2N1268
0.8	20	10	1.5		2N1269
1	30	0.4	14	Tetrode	3N35
24	100	8	4	High freq., high power	2N1335
24	100	8	4	High freq., high power	2N1336
24	100	8	4	High freq., high power	2N1337
0.8	20	10	1.5		2N1270
0.8	20	10	1.5		2N1271
0.8	20	.01	1.5		2N1272
24	100	8	4	High freq., high power	2N1339
24	100	8	4	High freq., high power	2N1340
0.75	3	5		SPR	2N588
1	2		3.5		2N695
	10				2N1491
	10				2N1492
24	100	8	4	High freq., high power	2N1341
4	2			Switch	2N710
	10				2N1493
0.63	3		1.0		2N503
0.75	10		1.3		2N499
	30		15	High freq., high power	2N1505
	10		8	High frequency, high power	2N1506
4	2		6	Amp VHF	2N741
6.6	1		5		2N706
0.63	3		1.0		2N502
0.45	3		1.0		2N502A
10	7		1.5	PG = 22 db at 200 mc	2N1143
1	4		1.1	UHF amp	2N700
40	5		7	High freq., high power	2N1562
40	5		7	High freq., high power	2N1561
10	7		1.5	PG = 26db at 200 mc	2N1142
.5				U.S., MIL only	2N528
.3			2.8	U.S. MIL only	2N537

SUBMINIATURE CAPACITORS

Good-All
CAPACITORS

FOR Transistor CIRCUITRY

...packaged to
fit where others won't!



601PE 602

UPRIGHT MOUNTING

ENCAPSULATED IN EPOXY

Slim, trim and compact. The specially shaped winding is of extended foil construction—equal in all regards to high quality Good-All tubular designs. These two types differ in that the 602 incorporates a base of epoxy-glass laminate for flush mounting on circuit boards.

SPECIFICATIONS

Dielectric Mylar Film
Case Epoxy Dip
IR at 25°C 75,000 megohms
Voltage Rating 50VDC
Temp. Range -55°C to +125°C
Capacity Tolerance To ±5%

TYPICAL 50 VOLT SIZES TYPE 601 PE

CAP.	T	W	L
.01	.187	.310	.562
.047	.203	.531	.453
.1	.225	.650	.525
.22	.296	.718	.687
.33	.312	.812	.950



663F 663FR

EDGE MOUNTING

AXIAL OR RADIAL LEADS

These special-purpose versions of popular Good-All Type 663UW use precious space efficiently. Their ratings are conservative, and are equally suited for military and instrument grade applications.

SPECIFICATIONS

Dielectric Mylar Film
Case Plastic Wrap
End Fill Thermo-setting epoxy
Voltage Range 100, 200, 400 & 600VDC
Temperature Range -55°C to +125°C
IR at 25°C 100,000 meg. x mfd.
Humidity Resistance Superior

TYPICAL 100 VOLT SIZES TYPES 663F and 663FR

CAP.	T	W	L
.01	.125	1/4	3/4
.047	.140	1/4	3/4
.1	.171	3/8	3/4
.47	.281	3/8	1 1/4
1.0	.375	3/4	1 1/2



627G

617G

Hermetically Sealed

50 VOLT RATING

Ideal transistor "companions" where hermetic sealing is required. Both types are smaller than comparable MIL-C-25A designs yet exceed all requirements of this specification.

SPECIFICATIONS

Dielectric Mylar Film
Case Hermetically Sealed
Winding Extended Foil
IR at 25°C 40,000 meg. x mfd.

Type 627G

Temperature Range Full rating to 85°C, 50% derating at 125°C
DC Voltage Rating 50 volts only

Type 617G

Temperature Range Full rating to 125°C, 50% derating at 150°C
DC Voltage Rating 50, 150, 400 & 600

TYPICAL 50 VOLT SIZES TYPE 627G

CAP.	DIA.	L
.01	.173	3 1/2
.047	.313	3 1/2
.1	.313	3 1/2
.47	.500	1 3/4
1.0	.560	1 1/2

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SAVE SPACE, WEIGHT AND MAINTENANCE with Versatile Compact MIL Spec Modules

For your electronic/electromechanical packaging problems, consult Oster specialists. Compact, transistorized, MIL spec, hermetically sealed, plug-in modules are available for numerous applications.

Typical building block basic units are illustrated. Temperature range is -55°C to $+105^{\circ}\text{C}$. Basic units can be modified

easily or completely redesigned to your specific requirement.

Oster engineers are specialists in creating densely packaged black boxes. These boxes can help you design more compactness and less weight into your systems. Phone or write your nearest John Oster office today.

GENERAL ENVIRONMENTAL CONDITIONS

- A. Temperature— -55°C to $+75^{\circ}\text{C}$
- B. Altitude— -1000 Feet to $+80,000$ feet
- C. Humidity— Section 4.4.3 of MIL-E-5272
- D. Vibration— 0.30 inch double excursion from 3 to 18 cycles per second and ± 2 g. acceleration from 18 to 500 cycles. (Without vibration isolators)
- E. Crash Safety— Repeated shocks of 30 g. with durations of 11 milliseconds
- F. Salt Atmosphere— Section 4.6.1 of MIL-E-5272
- G. Fungus Growth— Section 4.8.1 of MIL-E-5272
- H. Sand and Dust— Section 4.11.1 of MIL-E-5272

GENERAL PERFORMANCE SPECIFICATIONS

- A. Gain Variation— Less than 10% due to any given parameter extreme variation.
- B. Linearity— Better than 10% through the range of 3% to 80% of full output.
- C. Noise— Less than 5% of maximum output.
- D. Phase Shift— Less than 8 degrees.

TYPE 9805-20— SYNCHRONIZER

Same as 9805-19 except Control Transformer Speed is 10 degrees/second—Min.

TYPE 9805-19—SYNCHRONIZER



Synchronizer

Motor Control Phase— 40/20 volts, 1.7 watts, 400 cycles
Motor Reference Phase— 57.5 volts, 2.2 watts, 400 cycles
Generator Excitation— 57.5 volts, 3.0 watts, 400 cycles
Generator Output— 0.3 volts/1000 R.N.M. Min. Control Transformer Speed— 100 degrees/second—Min.
Control Transformer— John Oster Mfg. Co. 4053-19
Motor Generator— John Oster Mfg. Co. 6232-17

TYPE 9816-08—DEMODULATOR AMPLIFIER



Input Impedance— Greater than 25,000 ohms
Output Impedance— 2830 ohms (Dual)
Voltage Gain— Greater than 115
Supply Voltage— 28.0 D.C.

Demodulator Amplifier

TYPE 9816-07—SYNCHRONIZER AMPLIFIER



Input Impedance— Greater than 50,000 ohms
Voltage Gain— Greater than 250
Load— Control Phase of Motor Generator of 9805-19 or 9805-20

Synchronizer Amplifier

TYPE 9816-16—4-CHANNEL ISOLATION AMPLIFIER



Input Impedance— 1200 ohms per channel
Voltage Gain— $.98 \pm .01$ per channel
Load Impedance— 1200 ohms per channel
Supply Voltage— 48VDC

4-Channel Isolation Amplifier

TYPE 9816-09—SERVO ACTUATOR AMPLIFIER



Input Impedance— Greater than 50,000 ohms
Output Impedance— 400 ohms
Voltage Gain— Greater than 900
Supply Voltages— 100.0 volts D.C. 28.0 volts D.C.

Servo Actuator Amplifier

TYPE 9816-15—RELAY AMPLIFIER



Input Impedance— Greater than 15,000 ohms
Relay Closing Voltage— 150-175 Millivolts, 400 cycles
Relay Opening Voltage— 125-150 Millivolts, 400 cycles
Relay Contacts— 4 Pole, Double Throw—Dry Circuit
Supply Voltage— 28.0 V. D.C.

Relay Amplifier

TYPE 9816-06—SUMMING AMPLIFIER (DUAL)



Summing Inputs— 10 (per channel)
Gain— Nominal 1.0; variable from 0.1 to 10.0
Input Impedance— Dependent on Summing Channel. (50,000 ohms—500,000 ohms)
Load Impedance— Greater than 10,000 ohms
Supply Voltage— 28 V. D.C.

Summing Amplifier

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Engineers For Advanced Projects: Interesting varied work on designing transistor circuits and servo mechanisms.

Contact Mr. Dallas Nielsen, Personnel Manager, in confidence.

CIRCLE 67 ON READER-SERVICE CARD



TRANSISTORS—1960

High Frequency

Type No.	Mfg	Type	f _{oe}	Max. Ratings			V _{co}	NF
				W _c (mw)	T _i (c)	mw/c		
2N1094	WE	pn _p ,DM,ge	750	250	100	0.3	1.2	
2N1141	TI	pn _p ,DB,ge	750	750	100	10	1.7	
2N1195	WE	pn _p ,DM,ge	750	250	100	0.3	1.2	
2N218	SY	pn _p ,AJ,ge	—	80	85	1.3	50	
2N231	PH	pn _p ,SBT,ge	—	9	55	0.9	3	
2N232	PH	pn _p ,SBT,ge	—	9	55	0.9	6	
2N233	SY	npn,AJ,ge	—	50	75	1	50	
2N312	CBS	npn,AJ,ge	—	75	85	—	60	
2N410	SY	pn _p ,AJ,ge	—	50	75	1	5	
2N544	SY	pn _p ,DJ,ge	—	80	85	1.3	4	
2N544	SY	pn _p ,DD,ge	—	80	100	1.1	16	
2N624	SY	pn _p ,DJ,ge	—	100	100	1.3	30	
2N1264	SY	pn _p ,DD,ge	—	50	75	1	50	
2N1266	SY	pn _p ,AJ,ge	—	80	85	1.3	100	
2N1515/OC169	AMP	pn _p ,PADT,ge	—	83	75	—	—	
GT1665	GT	pn _p ,AJ,ge	—	150	100	2	4	
ST3031	TR	npn,DJ,si	—	150	175	—	—	

Abbreviation Terms

AJ	Alloyed Junction
DB	Diffused Base
DD	Double Diffused
DG	Grown Diffused
DJ	Diffused Junction
DM	Diffused Mesa
Dr	Drift
FA	Fused Alloy
FJ	Fused Junction
GD	Grown Diffused
GE	Germanium
GJ	Grown Junction
GR	Grown Rate
MB	Melback
MD	MADT
MA	Micro Alloy

Special Types

Type No.	Mfg	Type	I _{ao}	Max. Ratings			V _{co}	NF
				W _c (mw)	T _c (c)	mw/c		
2N469A	GT	pn _p ,AJ,ge	1.8 mc	50	85	0.83	16	
2N1311	GT	npn,AJ,ge	1.5 mc	120	100	1.5	10	
2N1312	GT	npn,AJ,ge	2 mc	120	100	1.5	10	
2N1392	GT	pn _p ,AJ,ge	1 mc	50	85	0.83	16	
2N1310	GT	npn,AJ,ge	1.0 mc	120	100	1.5	10	
2N1393	GT	pn _p ,AJ,ge	3.4 mc	50	85	0.83	16	
2N1394	GT	pn _p ,AJ,ge	1 mc	50	85	0.83	16	
2N1408	GT	pn _p ,AJ,ge	—	150	100	2	10	
GT1624	GT	npn,AJ,ge	—	150	100	2	—	

DATA CHART

(continued)

Ratings	Characteristics			Remarks	Type No.
	f_{co}	NF	C_{coe}		
1.3	1.2	-	4	U.S., MIL only	2N1094
10	.7	-	1.5	PG = 30 db at 200 mc	2N1141
1.3	1.2	-	4	Mo	2N1195
1.3	50	-	-		2N218
1.9	3	-	-	SPR	2N231
1.9	6	-	-	SPR	2N232
1	50	-	-		2N233
1	60	-	12	SY	2N312
1.3	5	-	-		2N410
1.3	4	-	-		2N544
1.1	16	-	-		2N544
1.3	30	-	-		2N624
1	50	-	-		2N1264
1.3	100	-	-		2N1266
-	-	-	-	OC169	2N1515/ OC169
2	4	-	-	Drift	GT1665
-	-	-	-		ST3031

Abbreviation Terms

Mesa	Mesa
Rate Grown	Rate Grown
Silicon	Silicon
Surface Barrier	Surface Barrier
Collector to emitter capacitance measured across the output terminals with the input ac open-circuited.	
Frequency at which the magnitude of the forward-current transfer ratio (small-signal) is 0.707 of its low frequency value.	
Common Emitter-Small signal forward current transfer ratio.	
Common Emitter-Static value of short-circuited forward current ratio.	
Collector current when collector junction is reverse biased and emitter is dc open-circuited.	

Special Types

Ratings	Characteristics			Remarks	Type No.
	f_{co}	NF	C_{coe}		
0.83	16	30		Photo	2N469A
1.5	10	11		High Voltage	2N1311
1.5	10	11		High Voltage	2N1312
0.83	16	30		Photo	2N1392
1.5	10	11		High Voltage	2N1310
0.83	16	30		Photo	2N1393
0.83	16	30		Photo	2N1394
2	10	35		High Voltage	2N1408
2	-	-		High Voltage	GT1624



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2N332A	2N756	2N335A	2N759
2N333	2N757	2N336	2N760
2N333A	2N757	2N336A	2N760
2N334	2N758	2N337	2N761
2N334A	2N758	2N338	2N762

The only 2N332-A and 2N337 series silicon transistors made by mesa technique to offer mesa quality. Also available: a complete line of NPN mesa high-frequency amplifier and switching transistors — plus PNP alloy small-signal amplifier types.

National Semiconductor

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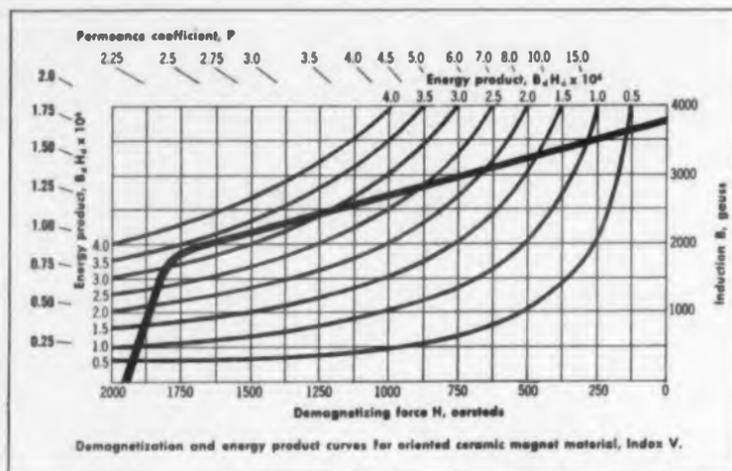
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CIRCLE 68 ON READER-SERVICE CARD

INDOX V opens NEW design avenues in permanent magnet applications

Use of Indiana Steel's INDOX V by design engineers continues to grow by leaps and bounds. So much so that the company has just completed a new plant solely for the production of this remarkable ceramic magnet material. Designers find it the answer where other materials didn't measure up. Today it's in big volume demand by major users of permanent magnets.

Here's a summary of basic data on INDOX V. Investigate this material. It has helped others outstrip competition—both in product design and cost reduction. It could do the same for you. Whatever you're working on, keep this information close at hand—or write for the complete story on INDOX V, and ask about design help on any project that involves permanent magnets.



What Is Indox V?

INDOX V is a highly oriented barium ferrite permanent magnet material—the first to be produced in this country on a commercial scale. Like other ceramics, it is a non-conductor, hard, brittle and lightweight—much lighter than metallic alloy magnets. It has an energy product $3\frac{1}{2}$ times that of non-oriented ceramic magnets.

Typical Characteristics of Indox V

Coercive Force (H_c), oersteds	2,000
Residual Induction (B_r), gauss	3,840
Peak Energy Product ($B_d H_d$)	3.5×10^4
Reversible Permeability	1.05
Temperature Coefficient of Reversible Flux Change	$-0.19\% / ^\circ C$
Magnetization Field for Saturation, oersteds	10,000
Chemical Composition	$BaFe_{12}O_{19}$
Specific Gravity	5.0 or .181 lb/cu in

INDOX V is made of readily available, non-critical materials—an important design consideration for long-range production plans. In the precisely controlled manufacturing process, magnet shapes are die-formed from powdered material under high pressure, then sintered in a special high-temperature furnace. Standard shapes of INDOX V mag-

nets available from stock include wafers, rings and cylinders in most practical sizes. Special shapes and sizes can be produced for unusual applications.

Special Properties

The unique characteristics of INDOX V often have indicated its use in areas of design where the application of permanent magnets formerly was considered impossible.

High resistance to demagnetization. The high coercive force of INDOX V permits much shorter magnet lengths than is possible with other materials, but larger magnet area is necessary because of lower flux density.

High resistivity. As a non-conductor, INDOX V can be used where other materials would create unwanted current paths. In the presence of high-frequency alternating fields,

eddy current losses and associated heating effects are extremely low.

Low incremental permeability. The change in flux that results from a change in demagnetizing influence is lower in INDOX V than in any other magnetic material. Thus, INDOX V maintains a more constant field in the presence of external fields because variations in its flux are small.

High energy per unit volume. On an equivalent weight basis, the energy product of INDOX V is comparable to that of Alnico V—the strongest permanent magnet material available—and $3\frac{1}{2}$ times that of non-oriented ceramic magnets. Optimum area is $5\frac{1}{3}$ times the area of an equal Alnico V magnet, about half the area of a non-oriented ceramic. Optimum length is 28 percent that of Alnico V. Since INDOX V requires less magnetic material and less space, the cost per unit of usable energy is extremely low.

Resistance to radiation environments. Recent comprehensive studies of the effects of nuclear radiation on permanent magnet materials indicate that INDOX V meets or exceeds environmental requirements for equipment likely to be used in nuclear-powered aircraft and ballistic missiles.

APPLICATIONS

Electronic	Loudspeakers Ion pumps
Holding	Door closers: refrigerators Conveyors and automation Magnetic switches Magnetic chucks
Electro-Mechanical	Synchronous drives: Motors DC fields AC rotors Generators
Miscellaneous	Temperature control Magnetic separation

INDOX V has proved successful on the above applications. If you want to know more about this outstanding material in relation to your product write. M-7

INDIANA STEEL PRODUCTS

Division of

Indiana General Corporation

VALPARAISO, INDIANA

**INDIANA
PERMANENT
MAGNETS**

IN CANADA: The Indiana Steel Products Company of Canada Limited, Kitchener, Ontario

CIRCLE 69 ON READER-SERVICE CARD



TRANSISTORS-1960

High Level

Type No.	Mfg.	Type	f_{os} KC	Max. Ratings			Characteristics
				W_c W	T_i °C	W/C	
2N1238	HU	pnp,FJ,si	0.8	1.0	200	-	
2N1239	HU	pnp,FJ,si	0.8	1.0	200	-	
2N1240	AU	pnnp,FJ,si	1.0	1.0	200	-	
2N1241	HU	pnnp,FJ,si	1.0	1.0	200	-	
2N1242	HU	pnnp,FJ,si	1.0	1.0	200	-	
2N1243	HU	pnnp,FJ,si	1.0	1.0	200	-	
2N1244	HU	pnnp,FJ,si	1.2	1.0	200	-	
2N1073	BE	pnnp,DJ,ge	1.5	35	100	1.5	
2N1073A	BE	pnnp,DJ,ge	1.5	35	100	1.5	
2N1073B	BE	pnnp,DJ,ge	1.5	35	100	1.5	
B-1085	BE	pnnp,DJ,ge	1.5	35	100	1.5	
2N1651	BE	pnnp,DJ,ge	3.0	-	110	1.3	
2N1652	BE	pnnp,DJ,ge	3.0	-	110	1.3	
2N1653	BE	pnnp,DJ,ge	3.0	-	110	1.3	
2N1518	DE	pnnp,AJ,ge	4	70	95	1.2	
2N1519	DE	pnnp,AJ,ge	4	70	95	1.2	
2N1520	DE	pnnp,AJ,ge	4	70	95	1.2	
2N1521	DE	pnnp,AJ,ge	4	70	95	1.2	
2N1522	DE	pnnp,AJ,ge	4	70	95	1.2	
2N1523	DE	pnnp,AJ,ge	4	70	95	1.2	
2N297	CL	pnnp,AJ,ge	5	4	85	.4	
2N297A	CL	pnnp,AJ,ge	5	12	95	2.0	
2N618	CL	pnnp,AJ,ge	5	14	90	1.5	
2N375	CL	pnnp,AJ,ge	7	-	95	-	
2N378	TS	pnnp,AJ,ge	7	50	100	1.2	
2N379	CL	pnnp,AJ,ge	7	5	85	.3	
2N380	TS	pnnp,AJ,ge	7	50	100	0.8	
2N458	TI	pnnp,AJ,ge	7	50	95	0.72	
2N459	TS	pnnp,AJ,ge	7	50	100	0.8	
2N511	TI	pnnp,AJ,ge	7	80	95	1.4	
2N511A	TI	pnnp,AJ,ge	7	80	95	1.4	
2N511B	TI	pnnp,AJ,ge	7	80	95	1.4	
2N512	TI	pnnp,AJ,ge	7	80	95	1.4	
2N512A	TI	pnnp,AJ,ge	7	80	95	1.4	
2N512B	TI	pnnp,AJ,ge	7	80	95	1.4	
2N513	TI	pnnp,AJ,ge	7	80	95	1.4	
2N513A	TI	pnnp,AJ,ge	7	80	95	1.4	
2N513B	TI	pnnp,AJ,ge	7	80	95	1.4	
2N514	TI	pnnp,AJ,ge	7	80	95	1.4	
2N514A	TI	pnnp,AJ,ge	7	80	95	1.4	
2N514B	TI	pnnp,AJ,ge	7	80	95	1.4	
2N1011	DE	pnnp,AJ,ge	7	35	95	0.8	
2N387	PH	pnnp,AJ,ge	9	12.5	75	0.5	
2N386	PH	pnnp,AJ,ge	10	12.5	75	0.5	
2N1038	TI	pnnp,AJ,ge	10	20	100	.27	
2N1039	TI	pnnp,AJ,ge	10	20	100	.27	
2N1040	TI	pnnp,AJ,ge	10	20	100	.27	
2N1358	DE	pnnp,AJ,ge	10	70	95	1.2	
2N1412	DE	pnnp,AJ,ge	10	70	95	1.2	
2N1046	TI	pnnp,AJ,ge	12	15	65	0.37	
2N1609	DE	pnnp,AJ,ge	17	4	95	0.7	
2N1610	DE	pnnp,AJ,ge	17	4	95	0.7	
2N1611	DE	pnnp,AJ,ge	17	4	95	0.7	
2N1612	DE	pnnp,AJ,ge	17	4	95	0.7	
OC22	AMP	pnnp,PADT,ge	25	10	75	-	
OC23	AMP	pnnp,PADT,ge	25	10	75	-	
OC24	AMP	pnnp,PADT,ge	25	10	75	-	
WX1015	WH	npn,FJ,si	25	150	150	1.4	
WX1015A	WH	npn,FJ,si	25	150	150	1.4	
WX1015B	WH	npn,FJ,si	25	150	150	1.4	
WX1015C	WH	npn,FJ,si	25	150	150	1.4	
WX1015D	WH	npn,FJ,si	25	150	150	1.4	
WX1015E	WH	npn,FJ,si	25	150	150	1.4	
WX1015F	WH	npn,FJ,si	25	150	150	1.4	
WX1016	WH	npn,FJ,si	25	150	150	1.4	
WX1016A	WH	npn,FJ,si	25	150	150	1.4	
WX1016B	WH	npn,FJ,si	25	150	150	1.4	
WX1016C	WH	npn,FJ,si	25	150	158	1.4	
WX1016D	WH	npn,FJ,si	25	150	150	1.4	
WX1016E	WH	npn,FJ,si	25	150	150	1.4	

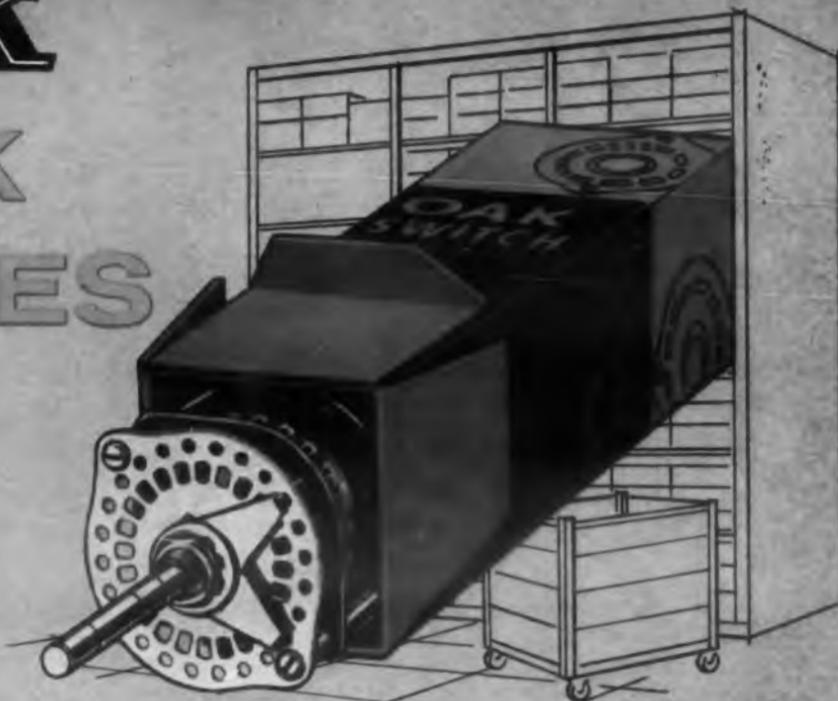
DATA CHART

Frequency kHz	Characteristics		Switching		Remarks	Type No.	
	Gain db	Powr. Out W	Rise Time μsec	Stor. Time μsec			
.1	-	-	-	-		2N1238	
.1	-	-	-	-		2N1239	
.1	-	-	-	-		2N1240	
.1	-	-	-	-		2N1241	
.1	-	-	-	-		2N1242	
.1	-	-	-	-		2N1243	
.1	-	-	-	-		2N1244	
2.0	-	-	-	-		2N1073	
1.5	2.0	-	-	-		2N1073A	
1.5	2.0	-	-	-		2N1073B	
1.5	2.0	-	-	-		B-1085	
1.5	-	-	-	-		2N1651	
1.3	-	-	-	-		2N1652	
1.3	-	-	-	-		2N1653	
1.3	100	40	20	7	min. gain of	2N1518	
1.2	100	40	20	7	12 at 25A		
1.2	100	40	20	7	min. gain of	2N1519	
1.2	100	40	20	7	12 at 25A		
1.2	100	40	20	7	min. gain of	2N1520	
1.2	100	40	20	7	12 at 35A		
1.2	100	40	20	7	min. gain of	2N1521	
1.2	100	40	20	7	12 at 35A		
1.2	100	40	20	7	min. gain of	2N1522	
1.2	100	40	20	7	12 at 50A		
1.2	100	40	20	7	min. gain of	2N1523	
1.2	3	-	-	-	12 at 50A		
.4	3	-	-	-	BE	2N297	
2.0	3	-	-	-	BE, DE	2N297A	
1.5	-	-	-	-	MO	2N618	
1.2	0.5	-	-	-	MO	2N375	
1.2	5	-	-	-		2N378	
.3	0.5	-	-	-		2N379	
0.8	1	-	-	12	12.5	CL	2N380
0.72	0.5	-	-	-	-		2N458
0.8	0.2	-	-	11.2	2.5		2N459
1.4	0.2	-	-	11.2	2.5		2N511
1.4	0.2	-	-	11.2	2.5		2N511A
1.4	0.2	-	-	11.2	2.5		2N511B
1.4	0.2	-	-	11.2	2.5		2N512
1.4	0.2	-	-	11.2	2.5		2N512A
1.4	0.2	-	-	11.2	2.5		2N512B
1.4	0.2	-	-	10.8	2.0		2N513
1.4	0.2	-	-	10.8	2.0		2N513A
1.4	0.2	-	-	10.8	2.0		2N513B
1.4	0.2	-	-	10.3	2.0		2N514
1.4	0.2	-	-	10.3	2.0		2N514A
1.4	0.2	-	-	10.3	2.0		2N514B
1.4	100	-	-	5	2	2N1011 Sig C	2N1011
0.8	1.0	33	5	-	-		2N387
0.5	0.8	33	5	-	-		2N386
0.5	50	-	-	-	-		2N1038
.27	50	-	-	-	-		2N1039
.27	50	-	-	-	-		2N1040
.27	100	-	-	-	-		2N1358
1.2	100	40	15	5			2N1412
1.2	100	40	15	5			2N1046
0.37	0.2	-	-	0.7	1.2		2N1046
0.7	10	-	400 mw	3	1		2N1609
0.7	10	-	400 mw	3	1		2N1610
0.7	10	-	400 mw	3	1		2N1611
0.7	10	-	400 mw	3	1		2N1612
0.7	30	-	-	-	-		OC22
-	30	-	-	-	-		OC23
-	30	-	-	-	-		OC24
1.4	10	-	-	5	1		WX1015
1.4	10	-	-	5	1		WX1015A
1.4	10	-	-	5	1		WX1015B
1.4	10	-	-	5	1		WX1015C
1.4	10	-	-	5	1		WX1015D
1.4	10	-	-	5	1		WX1015E
1.4	10	-	-	5	1		WX1015F
1.4	10	-	-	5	1		WX1016
1.4	10	-	-	5	1		WX1016A
1.4	10	-	-	5	1		WX1016B
1.4	10	-	-	5	1		WX1016C
1.4	10	-	-	5	1		WX1016D
1.4	10	-	-	5	1		WX1016E

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- Subassemblies: Sections, Shafts with Index, Strut Screws, Spacers, Miscellaneous Hardware
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- Shorting and Nonshorting

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West Coast: Oak Electronics Corp., 11252 Playa Court
Culver City, Calif. Phone: 2Xmont 1-6367

CIRCLE 70 ON READER-SERVICE CARD



MOISTURE ABSORPTION IS NAUGHT, NIL, ZERO IN CORNING NF RESISTORS

Glass-enclosed, fusion-sealed Corning NF resistors have boiled merrily in salt water for days without showing a jot of change in their electrical characteristics.

These are resistors that are rugged, completely moisture resistant, highly vibration resistant... in short, resistors that exceed the requirements of MIL-R-10509C, Char. B, better than any we've seen or heard of.

The key to such fortitude is our NF structure. We start with glass rods with metal oxide applied under heat. This in it-

self makes a moisture-resistant, almost abnormally stable resistor, as you well know if you have ever used our regular N-style resistors.

We encapsulate this basic unit in a glass envelope and apply glass-to-metal seals at the leads... comparable to those in a vacuum tube.

IMMEDIATE DELIVERY • There are two models of this gem in production, ready for *quick shipment*: the 1/8-watt NF-60

and the 1/4-watt NF-65. Resistance ranges from 100 ohms to 360K ohms. Voltage ratings are 250v and 300v. Full rating at 70°C. with derating to 150°C. More data:

- Load life 0.3%
- Voltage coefficient 0.001%/v
- Temp. coefficient 0.03%/°C.
- Insulation resist. . 100,000 megohms

To get this and other data for your file, just write and ask for Data Sheet CE-2.02. Address: Corning Glass Works, 540 High Street, Bradford, Pennsylvania.



CORNING ELECTRONIC COMPONENTS

CORNING GLASS WORKS, BRADFORD, PA.



1/8-WATT NF-60

ACTUAL SIZE

1/4-WATT NF-65

CIRCLE 71 ON READER-SERVICE CARD

High Level (continued)

Type No.	Mfg	Type	f _{oe} KC	Max. Ratings			I _{co} ma	P _G
				W _o W	T _j °C	V _e V		
WX1016F	WH	npn,FJ,si	25	150	150	1.4	300	10
2N1041	TI	npn,AJ,ge	33	20	100	.27	100	50
OC28	AMP	pnnp,PADT,ge	200	13	90	-	80	100
OC29	AMP	pnnp,PADT,ge	200	13	90	-	60	100
OC35	AMP	pnnp,PADT,ge	200	13	90	-	60	100
OC36	AMP	pnnp,PADT,ge	200	13	90	-	80	100
2N418	BE	pnnp,AJ,ge	400	25	100	0.5	80	1.5
2N420	BE	pnnp,AJ,ge	400	25	100	0.5	45	0.5
2N420A	BE	pnnp,AJ,ge	400	25	100	0.5	70	1.5
2N637	BE	pnnp,AJ,ge	400	25	100	0.5	40	0.5
2N637A	BE	pnnp,AJ,ge	400	25	100	0.5	70	2
2N637B	BE	pnnp,AJ,ge	400	25	100	0.5	80	2
2N638	BE	pnnp,AJ,ge	400	25	100	0.5	40	0.5
2N638A	BE	pnnp,AJ,ge	400	25	100	0.5	70	2
2N638B	BE	pnnp,AJ,ge	400	25	100	0.5	80	2
2N456	TI	pnnp,AJ,ge	430	50	100	0.67	40	0.2
2N457	TI	pnnp,AJ,ge	430	50	100	0.67	60	0.6
2N671	PH	pnnp,AJ,ge	700	1	85	.017	40	25
2N673	PH	pnnp,AJ,ge	700	1	85	.017	25	75
2N675	PH	pnnp,AJ,ge	700	1	85	.017	75	100
GA52830	WE	pnnp,AJ,ge	4 mc	500	85	60	40	10
GA53242	WE	pnnp,AJ,ge	4 mc	500	85	60	40	10
GF45017	WE	pnnp,AJ,ge	4 mc	500	85	60	40	10
2N547	TR	npn,DJ,si	6 mc	5	200	0.045	60	.001
2N548	TR	npn,DS,si	6 mc	5	200	0.045	30	.001
2N549	TR	npn,DJ,si	6 mc	5	200	0.045	60	.0004
2N550	TR	npn,DJ,si	6 mc	5	200	0.045	30	.0004
2N551	TR	npn,DJ,si	6 mc	5	200	0.045	60	.001
2N552	TR	npn,DJ,si	6 mc	5	200	0.045	30	.001
2N1116	TR	npn,DJ,si	6 mc	5	200	0.045	60	.001
2N1117	TR	npn,DJ,si	6 mc	5	200	0.045	60	.0004
2N1250	TR	npn,DJ,si	6 mc	85	200	0.267	60	20
ST401	TR	npn,DJ,si	6 mc	85	200	0.27	45	20
ST402	TR	npn,DJ,si	6 mc	50	200	0.33	60	20
ST403	TR	npn,DJ,si	6 mc	50	200	0.33	45	20
2N545	TR	npn,DJ,si	8 mc	5	200	0.045	60	0.07
2N546	TR	npn,DJ,si	8 mc	5	200	0.045	30	0.05
2N1212	TR	npn,DJ,si	10 mc	45	200	0.267	60	10
2N1208	TR	npn,DJ,si	12 mc	85	200	0.267	60	10
2N1209	TR	npn,DJ,si	12 mc	85	200	0.267	45	20
2N1046A	TI	pnnp,DJ,ge	20 mc	30	100	0.4	130	3
2N1046B	TI	pnnp,DJ,ge	20 mc	30	100	0.4	130	3
2N1072	WE	pnnp,DD,si	60 mc	12	150	65	60	.01
2N696	FA	npn,DM,si	100mc	2	175	-	40	0.01
2N697	FA	npn,DM,si	100mc	2	175	-	40	0.01
2N730	TI	npn,MS,si	100mc	1.5	175	0.01	60	0.01
2N731	TI	npn,MS,si	100mc	1.5	175	0.01	60	0.01
2N1131	FA	pnnp,DM,si	100mc	2	175	.0133	30	0.01
2N1132	FA	pnnp,DM,si	100mc	2	175	.0133	30	0.01
RT5001	Rh	npn,Mesa,si	120mc	3	175	20	60	0.01
RT5002	Rh	npn,Mesa,si	120mc	3	175	20	60	0.01
RT5003	Rh	npn,Mesa,si	120mc	3	175	20	100	0.01
RT5004	Rh	npn,Mesa,si	120mc	3	175	20	100	0.01
2N696	FA	npn,DM,si	150mc	2	175	.0133	40	0.01
2N697	FA	npn,DM,si	150mc	2	175	.0133	40	0.01
2N717	FA	npn,DM,si	150mc	1.5	175	.010	40	0.01
2N718	FA	npn,DM,si	150mc	1.5	175	.010	40	0.01
2N1613	FA	npn,DP,si	150mc	3	200	.0172	40	0.008
2N1409	PSI	npn,MS,si	175mc	2.8	150	0.024	30	10
2N1410	PSI	npn,MS,si	175mc	2.8	150	0.024	45	10
2N698	FA	npn,DM,si	180mc	2	175	.0133	80	0.01
2N699	FA	npn,DM,si	180mc	2	175	.0133	80	0.01
2N719	FA	npn,DM,si	180mc	1.5	175	.010	80	0.01
2N720	FA	npn,DM,si	180mc	1.5	175	.010	80	0.01
2N268A	CL	pnnp,AJ,ge	-	14	90	1.5	80	2
2N252	FA	npn,DM,si	-	2	175	.0133	20	0.01
2N1253	FA	npn,DM,si	-	2	175	.0133	20	0.01

DATA CHART

V _c	I _{co}	Characteristics		Switching		Remarks	Type No.
		Powr Gain db	Powr Out W	Rise Time μsec	Stor. Time μsec		
300	10	-	-	5	1		WX1016F
100	50	-	-	-	-		2N1041
80	100	-	-	-	-		OC28
60	100	-	-	-	-		OC29
60	100	-	-	-	-		OC35
80	100	-	-	-	-		
80	1.5	-	-	15	-		2N418
80	0.5	-	-	15	-		2N420
45	1.5	-	-	15	-		2N420A
70	0.5	-	-	15	-		2N437
40	2	-	-	15	-		2N437A
70	2	-	-	15	-	CL	2N437B
80	0.5	-	-	15	-		2N438
40	2	-	-	15	-		2N438A
70	2	-	-	15	-		2N438B
80	2	-	-	15	-		
40	0.2	-	-	12	12.5	RCA	2N456
60	0.6	-	-	12	12.5	RCA	2N457
7	40	25	-	-	-	Infinite Heat Sink	2N471
7	25	75	-	0.5	0.4	Infinite Heat Sink	2N473
17	75	100	-	-	-	Infinite Heat Sink	2N475
40	10	-	-	0.5	1	US, MIL only	GA52830
40	10	-	-	0.5	1	US, MIL only	GA53242
40	10	-	-	0.5	1	US, MIL only	GF45017
15	60	.001	-	0.7	0.2		2N547
15	30	.001	-	0.7	0.2		2N548
15	60	.0004	-	0.7	0.2		2N549
15	30	.0004	-	0.7	0.2		2N550
15	60	.001	-	1.2	0.3		2N551
15	30	.001	-	1.2	0.3		2N552
15	60	.001	-	0.7	0.2		2N1116
15	60	.0004	-	0.7	0.2		2N1117
15	60	20	-	0.25	0.5		2N1250
7	45	20	-	0.25	0.5		ST401
3	60	20	-	0.25	0.5		ST402
3	45	20	-	0.25	0.5		ST403
15	60	0.07	-	0.3	0.1		2N545
15	30	0.05	-	0.3	0.1		2N546
15	60	10	-	0.25	0.5		2N1212
15	60	10	-	0.25	0.5		2N1208
15	45	20	-	0.25	0.5		2N1209
130	.3	-	-	-	-		2N1046A
130	.3	-	-	-	-		2N1046B
60	.1	-	-	0.05	0.05	US, MIL	2N1072
40	0.01	-	-	0.08	0.03	T1, IND	2N696
40	0.01	-	-	0.08	0.03	T1, IND	2N697
01	60	0.01	-	0.11	0.14		2N730
01	60	0.01	-	0.11	0.14		2N731
33	30	0.01	-	.08	-		2N1131
33	30	0.01	-	0.08	-		2N1132
60	0.01	-	-	0.1	0.15		RT5001
60	0.01	-	-	0.1	0.2		RT5002
100	0.01	-	-	0.1	0.15		RT5003
100	.1	-	-	0.1	0.2		RT5004
33	40	0.01	-	.08	-	PSI, HO	2N496
33	40	0.01	-	.08	-	PSI, HO	2N497
0	40	0.01	-	.08	-	TO-18	2N717
0	40	0.01	-	.08	-	TO-18	2N718
72	40	.0008	-	-	-	TO-5	2N1613
24	30	10	7	1	.06	Power gain F=70mc	2N1409
24	45	10	7	1	.042	IND	2N1410
33	80	0.01	-	.08	-		2N498
33	80	0.01	-	.08	-		2N699
0	80	0.01	-	.08	-		2N719
0	80	0.01	-	.08	-		2N720
80	2	-	-	-	-	BE	2N268A
33	20	.1	-	.08	.05	IND	2N252
13	20	.1	-	.08	.05	IND	2N1253

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Today more than 60% of all transistor elements are being cut on Microtom-atic machines. This industry-wide preference was won through sheer performance — dependable accuracy, high production rates, and trouble-free, continuous-duty operation.

Now the new Microtom-atic MTA-7 brings even greater accuracy and increased production at lower cost. Unique cross-feed mechanism co-ordinates mechanical and hydraulic movements to achieve ultra-precision indexing. Fracture-free cutting of extremely thin wafers with excellent parallelism is no problem on the MTA-7. Simple, accurate controls expedite setup with minimum waste and then the MTA-7 automatically repeats the indexing and cutting cycle until the crystal is completely sliced.

The new MTA-7 is extremely rigid throughout with heavy base, saddle, table and column construction. Long life and continued accuracy are assured through generous bearing areas, hand-scraped ways and positive, automatic lubrication of all contact areas and lead screws.

If your work involves slicing of hard, brittle and shock-sensitive materials, DoALL can help you. Call your local DoALL Sales-Service Store and discuss your problem. A corps of specialists and the DoALL Demonstration Test-Center are at your disposal.



Large silicon crystal being wafered on an MTA-7. Wafers .030" thick are being cut at 1 sq. in. per min. with parallelism between .001" and .002".



Model MTA-7 provides index stroke from 0 to .100" per index with positive table rates as low as 1/16" per minute. Other models available.

DoALL diamond slicing wheels are produced by an exclusive process that insures positive rim bond to the core. These wheels deliver extreme accuracy... save time and materials.

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CIRCLE 72 ON READER-SERVICE CARD



Above—Sola plate-filament transformer is built-in component of B & W Associates lie detector. It supplies plate and filament voltage regulated within $\pm 3\%$ even when line voltage varies from 100 to 130 volts . . . helps assure accurate operation in field.

Below—Railway Communications Inc. uses Sola line voltage regulator to improve performance and reliability of this Rycom combination transmitter-receiver. Regulator delivers 118 volts stabilized within $\pm 1\%$ under line voltage variations as great as $\pm 15\%$.



Build it in or add it on . . . Sola voltage regulation helps your equipment give full-rated performance

Whether you build it in as a component or add it on as an accessory, a Sola static-magnetic voltage regulator soon pays for itself by keeping your equipment operating at its designed capability.

These units provide a stabilized output voltage even when input voltage varies over a considerable range, and give you eight important advantages over electronic or motor-driven regulators:

1. Ultra-fast response time of 1.5 cycles or less reduces effects of transients.
2. No moving or renewable parts or routine maintenance.
3. Automatic, continuous regulation; no manual adjustments.
4. Protection against accidental short circuits and excessive overloads for unit and its load.
5. Versatility: Step-up, step-down, plate, plate-filament, transistor-voltage ratios are available to permit substitution in place of non-regulating transformers.
6. Simple, compact design; light weight.
7. High degree of isolation between input and output circuits.
8. Negligible external magnetic field.



This is the Sola Standard Sinusoidal Constant Voltage Transformer, shown in its usual accessory-type structure. It continuously regulates output voltage within $\pm 1\%$ under line voltage variations of $\pm 15\%$. Because its output is essentially a commercial sine wave (less than 3% total rms harmonic content at any load above 25% of rating), it is ideal for exacting laboratory applications and instrument calibration, and with equipment sensitive to wave shape . . . designed d-c voltage levels in the load are not affected.

The entire line of sinusoidal regulators is now available at prices formerly charged for static-magnetic regulators without the patented Sola harmonic-free circuit.



This is the Sola Normal-Harmonic Constant Voltage Transformer, shown in component-type structure, with end bells and separate capacitor. It offers the same reliability and $\pm 1\%$ regulation as Type CVS (above), and is suitable for the many applications where a commercial sine wave voltage supply is not required. It is widely used for voltage regulation on filaments, solenoids and relays.

Because prices of these normal-harmonic units have been substantially reduced, voltage regulation may now be possible in many of your applications.

Sola static-magnetic voltage regulators are available in a wide selection of mechanical structures and ratings in over 40 stock models, and your custom designs can be delivered in production quantities.

SOLA

Write for Bulletin 31G CV



SOLA ELECTRIC CO. A Division of
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4633 West 16th Street Chicago 50, Illinois

CIRCLE 73 ON READER-SERVICE CARD



TRANSISTORS - 1960

LOW

Type No.	Mfg.	Type	f _{max} MC	Max. Rating				I _{co} mA	C _{co} μF
				W _c (mw)	T _i C	mw/o _c	V _c V		
2N327A	RA	npn, FA, si	0.2	385	160	-	40	5	70
2N619	RA	npn, FA, si	0.2	385	160	-	40	5	35
2N1034	RA	npn, FA, si	0.2	250	160	-	40	5	70
2N1074	RA	npn, FA, si	0.2	250	160	-	40	5	35
2N1037	RA	npn, FA, ge	0.25	250	160	-	35	5	70
2N328A	RA	npn, FA, si	0.3	385	160	-	35	5	35
2N620	RA	npn, FA, si	0.3	385	160	-	35	5	70
2N1035	RA	npn, FA, si	0.3	250	160	-	35	5	35
2N1075	RA	npn, FA, si	0.3	250	160	-	35	5	35
2N1077	RA	npn, FA, si	0.3	385	160	-	30	5	70
2N1036	RA	npn, FA, si	0.4	250	160	-	30	5	70
2N329A	RA	npn, FA, si	0.5	385	160	-	30	5	35
2N621	RA	npn, FA, si	0.5	385	160	-	30	16	40
2N1057	GE	npn, AJ, ge	0.5	240	100	4	45	5	35
2N1076	RA	npn, FA, si	0.5	250	160	-	30	25	-
2N670	PH	npn, AJ, ge	0.7	300	85	5.0	40	10	100
2N674	PH	npn, AJ, ge	0.7	300	85	5.0	75	50	100
2N1228	HU	npn, FJ, si	0.8	250	200	-	15	50	100
2N1229	HU	npn, FJ, si	0.8	250	200	-	15	10	95
1234	HU	npn, AJ, si	0.8	400	160	3	110	10	95
1244	HU	npn, AJ, si	0.8	1000	160	7.4	110	10	95
2N327A	HU	npn, AJ, si	1.0	385	160	3	50	10	95
2N328A	HU	npn, AJ, si	1.0	385	160	3	50	10	-
2N329A	HU	npn, AJ, si	1.0	385	160	3	50	16	-
2N331	RCA	npn, AJ, ge	1.0	200	85	3	30	5	-
2N1008	BE	npn, AJ, ge	1.0	400	85	.15	20	5	-
2N1008A	BE	npn, AJ, ge	1.0	400	85	.15	40	7	-
2N1008B	BE	npn, AJ, ge	1.0	400	85	.15	60	25	40
2N1056	GE	npn, AJ, ge	1.0	240	100	4	50	10	-
2N1176	BE	npn, AJ, ge	1.0	300	85	0.4	15	12	-
2N1176A	BE	npn, AJ, ge	1.0	300	85	0.4	40	15	-
2N1176B	BE	npn, AJ, ge	1.0	300	85	0.4	60	50	100
2N1230	HU	npn, FJ, si	1.0	250	200	-	35	50	100
2N1231	HU	npn, FJ, si	1.0	250	200	-	35	50	100
2N1232	HU	npn, FJ, si	1.0	250	200	-	65	50	100
2N1233	HU	npn, FJ, si	1.0	250	200	-	65	10	95
1232	HU	npn, AJ, si	1.0	400	160	3	65	10	95
1233	HU	npn, AJ, si	1.0	400	160	3	65	10	95
1242	HU	npn, AJ, si	1.0	1000	160	7.4	65	10	95
1243	HU	npn, AJ, si	1.0	1000	160	7.4	65	50	100
2N1234	HU	npn, FJ, si	1.2	250	200	-	110	10	95
1228	HU	npn, AJ, si	1.2	400	160	3	15	10	95
1229	HU	npn, AJ, si	1.2	400	160	3	15	10	95
1230	HU	npn, AJ, si	1.2	400	160	3	35	10	95
1231	HU	npn, AJ, si	1.2	400	160	3	35	10	95
1238	HU	npn, AJ, si	1.2	1000	160	7.4	15	10	95
1239	HU	npn, AJ, si	1.2	1000	160	7.4	15	10	95
1240	HU	npn, AJ, si	1.2	1000	160	7.4	35	10	95
1241	HU	npn, AJ, si	1.2	1000	160	7.4	35	15	-
2N312	SY	npn, AJ, ge	1.5	100	85	1.66	15	2	14
2N519	IND	npn, AJ, ge	1.5	150	85	2.5	15	1	14
2N519A	IND	npn, AJ, ge	1.5	150	85	2.5	25	15	20
B-1154A	BE	npn, AJ, ge	1.5	400	100	.15	60	10	20
B-1154	BE	npn, AJ, ge	1.5	400	100	.15	40	20	-
2N1125	PH	npn, AJ, ge	1.6	300	85	5	40	4	-
2N536	PH	npn, AJ, ge	2.0	50	85	0.83	20	25	-
2N679	SY	npn, AJ, ge	2.0	150	85	2.5	20	30	15
2N1223	GT	npn, AJ, si	2.0	150	150	1.2	40	10	-
OC80	AMP	npn, PADT, ge	2.0	550	75	-	30	10	-
2N438	SY	npn, AJ, ge	2.5	100	85	1.6	30	5	-
2N356	RCA	npn, AJ, ge	3	100	85	-	20	3	14
2N356A	GT	npn, AJ, ge	3	150	100	2	40	50	9
2N1220	GT	npn, AJ, si	3	150	150	1.2	30	25	12
2N1353	IND	npn, AJ, ge	3.5	200	85	3.33	15	40	-
2N385A	SY	npn, AJ, ge	4	150	100	2	40	40	-

DATA CHART

OHMITE RESISTORS



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Fixed . . . adjustable . . . tapped . . . noninductive . . . precision metal film and encapsulated wire-wound . . . thin type . . . high-current—practically any resistor you need, you can find in the Ohmite line.

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YOUR CUSTOMERS KNOW THE VALUE OF OHMITE QUALITY—When a purchaser sees Ohmite resistors in a piece of equipment, he knows that equipment is designed and built for dependability.

OHMITE ENGINEERING ASSISTANCE ASSURES THE RIGHT UNIT—Selecting the right resistor for the job is sometimes a tough problem. Why not call on Ohmite application engineers to help out. Take advantage of their specialized skills and background.

Write on Company Letterhead for Catalog and Engineering Manual 58



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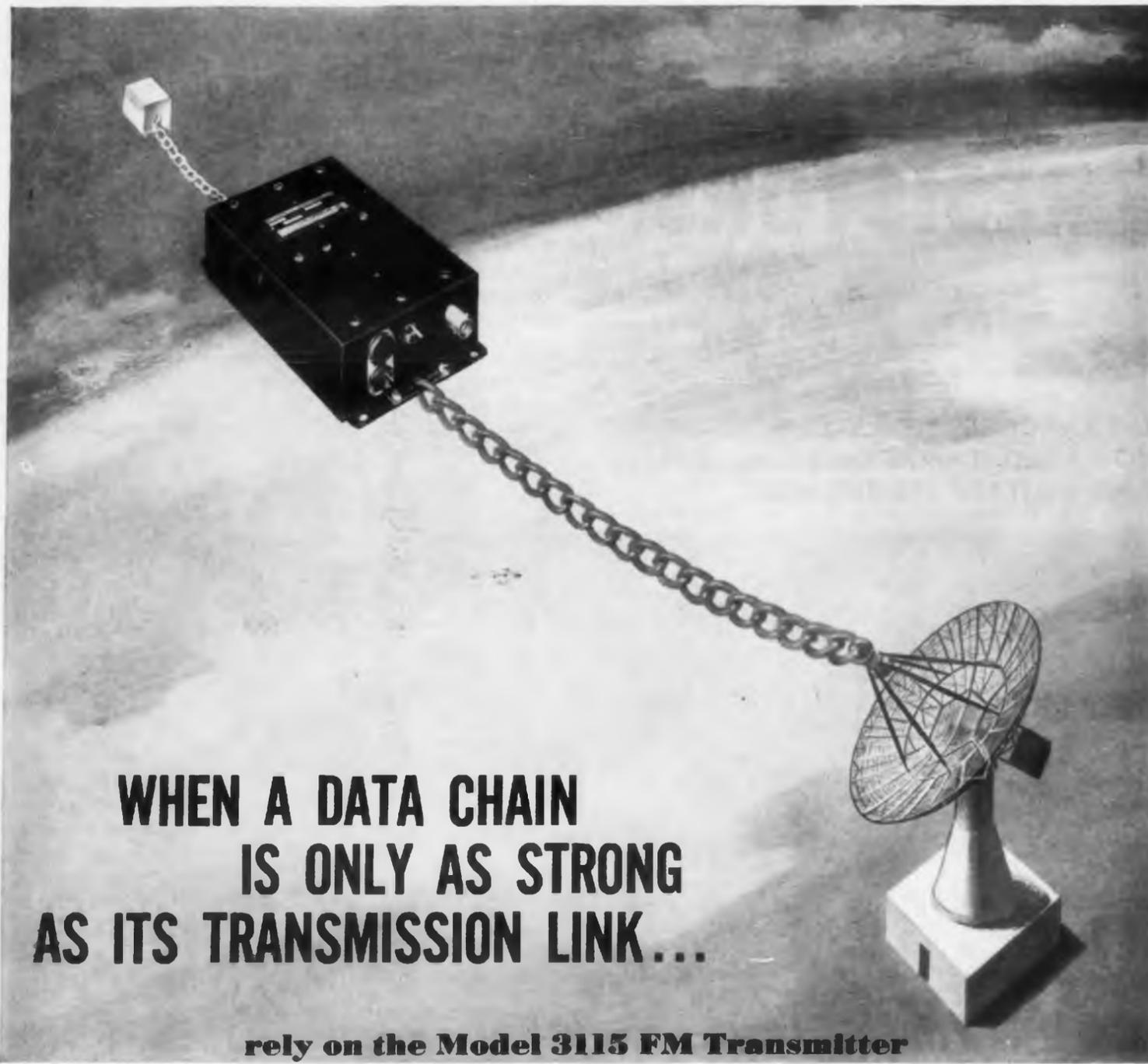
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CIRCLE 74 ON READER-SERVICE CARD

V _c V	I _{co} A	Switching		Remarks	Type No.
		Rise Time μsec	Stor. Time μsec		
5	70	-	-	GT	2N327A
5	35	-	-		2N619
40	70	-	-		2N1034
40	35	-	-		2N1074
40	70	-	-		2N1037
35	70	-	-	GT	2N328A
35	35	-	-		2N620
35	70	-	-		2N1035
35	35	-	-		2N1075
35	35	-	-		2N1077
30	70	-	-		2N1036
30	70	-	-		2N329A
30	35	-	-		2N621
30	40	-	-		2N1057
45	35	-	-		2N1076
30	-	-	-	Pulse Amp	2N670
40	100	-	-		2N674
75	100	-	-		2N1228
15	100	-	-		2N1229
15	95	-	-	TO-5 Package	1234
110	95	-	-	coaxial package	1244
110	95	-	-	TO-5 package	2N327A
50	95	-	-	TO-5 package	2N328A
50	-	95	-		2N329A
50	16	-	-	BE, US	2N331
30	-	-	-		2N1008
20	-	-	-		2N1008A
40	7	-	-		2N1008B
60	25	40	-	neon indicator	2N1056
50	10	-	-		2N1176
15	12	-	-		2N1176A
40	15	-	-		2N1176B
60	30	100	-		2N1230
35	50	100	-		2N1231
35	30	100	-		2N1232
65	30	100	-		2N1233
65	10	95	-	TO-5 package	1232
65	10	95	-	coaxial package	1233
65	10	95	-	coaxial package	1242
65	10	95	-	coaxial package	1243
50	100	-	-		2N1234
110	95	-	-	TO-5 package	1228
15	95	-	-	TO-5 package	1229
15	95	-	-	TO-5 package	1230
35	95	-	-	TO-5 package	1231
35	95	-	-	coaxial package	1238
15	95	-	-	coaxial package	1239
15	95	-	-	coaxial package	1240
35	95	-	-	coaxial package	1241
35	-	1.5	2		2N312
15	14	-	-	US, CR	2N519
15	14	1.3	0.7	US, CR	2N519A
25	20	1.5	-		B-1154A
60	20	1.5	-		B-1154
40	20	-	-		2N1125
40	-	-	-		2N536
20	25	5	5		2N679
5	20	15	-		2N1223
2	10	-	-		OC80
30	10	0.7	-		2N438
30	5	1.0	0.3	GT, SY, CR	2N356
20	3	1.5	0.3	CR	2N356A
40	9	-	-		2N1220
30	12	.6	.4		2N1353
15	40	-	-		2N385A



Low continued



WHEN A DATA CHAIN IS ONLY AS STRONG AS ITS TRANSMISSION LINK...

rely on the Model 3115 FM Transmitter

When radio telemetry transmission is the link between airborne data gathering and ground data acquisition, rely on Radiation's Model 3115 FM Transmitter. This ruggedized unit has proved its reliability and dependability again and again in missile projects and on test sleds.

Model 3115 provides true linear FM output. Modulation frequency response is within 0.5 db from 100 to 100,000 cps, and carrier frequency stability is within $\pm 0.01\%$. RF power output is 2 watts. The unit is available in two crystal-controlled models, which cover the 215 to 260 mc telemetry band.

For more complete technical data on the Model 3115, write for a new bulletin, RAD B-102, to Radiation Incorporated, Dept. ED-7, Melbourne, Fla.

THE ELECTRONICS FIELD ALSO RELIES ON RADIATION FOR...

RADIPLEX—50-channel low-level multiplexer with broad data processing applications. Features rugged solid-state circuitry, almost unlimited programming flexibility, unique modular construction for compactness and exceptional ease of operation and maintenance.

RADICORDER—Multistylus recorder provides high-speed instantaneous readout for wide range of data acquisition or processing systems. Eliminates necessity of electronically translating complete data, thereby reduces computer work loads.

TDMS—Telegraph Distortion Monitoring System pinpoints type and source of trouble on teletype, data processing and similar communications links without interrupting traffic. Ultra-compact TDMS can replace most test equipment now required for teletype maintenance and monitoring.



RADIATION
INCORPORATED

CIRCLE 75 ON READER-SERVICE CARD

Type No.	Mfg.	Type	f _{ce} MC	W _c (mw)	T _i C	Max. Ratings		Characteristics	
						mw/°C	V _{ce}	I _{co} μa	C μ
2N425	MO	pnp,AJ,ge	4	150	85	2.5		2.0	
2N1027	SSD	pnnp,AJ,si	4	150	150	1.2		25	
2N1028	SSD	pnnp,AJ,si	4	150	150	1.1		25	
2N1605	SY	npn,AJ,ge	4	150	100	2		20	
CK25	RA	pnnp,FA,ge	4	80	85	-		2	
2N395	GE	pnnp,AJ,ge	4.5	200	100	3.3		6	
2N520	IND	pnnp,AJ,ge	4.5	150	85	2.5		1	
2N520A	IND	pnnp,AJ,ge	4.5	150	85	2.5		1	
2N1302	TI	npn,AJ,ge	4.5	150	100	2.5		6	
2N1303	TI	pnnp,AJ,ge	4.5	150	100	2.5		6	
2N1354	IND	pnnp,AJ,ge	4.5	200	85	3.33		2.5	1
2N123	SY	pnnp,AJ,ge	5	100	85	1.66		.6	
2N315	GT	pnnp,AJ,ge	5	100	85	2		1	1
2N315A	GT	pnnp,AJ,ge	5	150	100	2		1	1
2N396A	SY	pnnp,AJ,ge	5	150	100	2		6	
2N414	SY	pnnp,AJ,ge	5	150	85	2.5		5	
2N439	SY	npn,AJ,ge	5	100	85	1.66		10	
2N450	GE	pnnp,AJ,ge	5	150	85	2.5		6	2
2N576	SY	npn,AJ,ge	5	200	100	2.6		20	
2N578	RCA	pnnp,AJ,ge	5	120	85	-		6	
2N585	RCA	npn,AJ,ge	5	120	85	-		8	
2N658	RA	pnnp,FA,ge	5	150	85	-		2.5	12
2N1012	GT	npn,AJ,ge	5	150	100	2		5	10
2N1123	PH	pnnp,AJ,ge	5	750	100	10		10	15
2N1348	IND	pnnp,AJ,ge	5	200	85	3.33		5	12
GT1658	GT	npn,AJ,ge	5	150	100	2		3	10
2N377	SY	npn,AJ,ge	6	150	100	2		10	
2N357	RCA	npn,AJ,ge	6	100	85	2		5	
2N357A	GT	npn,AJ,ge	6	150	100	2		3	14
2N426	MO	pnnp,AJ,ge	6	150	85	2.5		2	14
2N1343	IND	pnnp,AJ,ge	6	150	85	2.5		3	12
CK26	RA	pnnp,FA,ge	6	80	85	-		2	14
2N100	SY	npn,AJ,ge	7	150	100	2		15	
2N1090	RCA	npn,AJ,ge	7	120	85	-		8	
2N1114	SY	npn,AJ,ge	7	150	100	2		30	
2N1219	GT	pnnp,AJ,si	7	150	150	1.2		50	7
GT123	GT	pnnp,AJ,ge	7	150	150	2		3	15
2N123	GE	pnnp,AJ,ge	8	150	85	2.5		6	15
2N388	GT	pnnp,AJ,ge	8	150	100	2		5	10
2N396	GE	pnnp,AJ,ge	8	200	100	3.3		6	12
2N576A	SY	npn,AJ,ge	8	200	100	2.6		40	
2N579	RCA	pnnp,AJ,ge	8	120	85	-		6	
2N581	RCA	pnnp,AJ,ge	8	80	85	-		6	
2N358	GT	npn,AJ,ge	9	100	85	2		3	14
2N583	RCA	pnnp,AJ,ge	8	80	85	-		6	
2N597	PH	pnnp,AJ,ge	8	250	100	3.3		5	15
2N662	RA	pnnp,FA,ge	8	150	85	-		2.5	12
2N1280	IND	pnnp,AJ,ge	8	200	85	3.33		5	10
2N1284	IND	pnnp,AJ,ge	8	150	85	2.5		2	15
2N1304	TI	npn,AJ,ge	8	150	100	2.5		6	20
2N1305	TI	pnnp,AJ,ge	8	150	100	2.5		6	20
2N1347	IND	pnnp,AJ,ge	8	150	85	2.5		2.5	12
2N1350	IND	pnnp,AJ,ge	8	200	85	3.33		10	12
2N1351	IND	pnnp,AJ,ge	8	200	85	3.33		5	12
2N1355	IND	pnnp,AJ,ge	8	200	85	3.33		5	12
2N1356	IND	pnnp,AJ,ge	8	200	100	2.66		5	12
2N1478	PH	pnnp,AJ,ge	8	250	100	3.3		5	15
2N167	GE	pnnp,GJ,ge	9	65	85	1.1		5	2.5
2N358A	GT	npn,AJ,ge	9	150	100	2		3	14
2N394	GE	pnnp,AJ,ge	9	150	85	2.5		6	12

DATA CHART

(continued)

Type No.	Characteristics		Switching		Remarks	Type No.
	t_{co} μs	C_{coe} μmf	Rise Time μsec	Stor. Time μsec		
2N425	2.0	14	1.0	0.3	US,SY,RA,IND,CR	2N425
2N1027	25	-	-	-		2N1027
2N1028	25	7	-	-		2N1028
2N1605	20	-	-	-		2N1605
CK25	2	14	0.5	0.3		CK25
2N395	6	12	0.55	0.5	CR	2N395
2N520	1	14	-	-	US,CR,SY	2N520
2N520A	1	14	0.9	0.7	US,CR	2N520A
2N1302	6	20	.70	.50	TO-5,US,CR	2N1302
2N1303	6	20	.40	.90	CR	2N1303
2N1354	2.5	12	.55	.5		2N1354
2N123	.6	-	-	-		2N123
2N315	1	14	1.0	0.2	IND,US,CR	2N315
2N315A	1	14	0.9	0.4	IND,US,CR	2N315A
2N396A	6	-	-	-		2N396A
2N414	5	-	-	-		2N414
2N439	10	-	0.5	0.7	CR	2N439
2N450	6	20	-	-		2N450
2N576	20	-	2	1		2N576
2N578	6	-	0.85	0.33	IND,US,CR	2N578
2N585	8	-	0.35	0.25	SY,CR	2N585
2N658	2.5	12	-	-	CR	2N658
2N1012	5	10	0.1	0.1	CR	2N1012
2N1123	10	15	-	-		2N1123
2N1348	5	12	-	-		2N1348
GT1658	3	10	-	-		GT1658
2N377	10	-	2.5	0.7	CR	2N377
2N357	5	-	0.6	0.3	GT,SY,CR	2N357
2N357A	3	14	0.5	0.5	CR	2N357A
2N426	2	14	1.0	0.3	US,RA,SY,TR,CR	2N426
2N1343	3	12	1.0	-		2N1343
CK26	2	14	0.5	0.3		CK26
2N100	15	-	-	-		2N100
2N1090	8	-	0.25	0.20	CR	2N1090
2N1114	30	-	-	-		2N1114
2N1219	50	7	-	-		2N1219
GT123	3	15	0.9	0.5		GT123
2N123	6	15	0.45	0.90	SY	2N123
2N388	5	10	0.6	0.4	SY,CR	2N388
2N396	6	12	0.4	0.6	TI,GT,SY,CR	2N396
2N576A	40	-	2	1		2N576A
2N579	6	-	0.36	0.33	IND,US,CR	2N579
2N581	6	-	0.20	0.20	US,IND,CR	2N581
2N358	3	14	0.4	0.5	SY,CR	2N358
2N583	6	-	0.20	0.20		2N583
2N597	5	15	-	-	CR	2N597
2N662	2.5	12	-	-		2N662
2N1280	5	10	1.0	-		2N1280
2N1284	2	15	.45	.9		2N1284
2N1304	6	20	.45	.50	TO-5,SY,CR	2N1304
2N1305	6	20	.28	.80	TO-5,CR	2N1305
2N1347	2.5	12	-	-		2N1347
2N1350	10	12	-	-		2N1350
2N1351	5	12	-	-		2N1351
2N1355	12	12	.4	.6		2N1355
2N1356	2.5	12	.4	.6		2N1356
2N1478	5	15	-	-		2N1478
2N167*	1.1	2.5	0.4	0.7	USAF 2N167-MIL	2N167*
2N358A	2	14	0.4	0.4	CR	2N358A
2N394	2.5	12	-	-	CR	2N394

Judging from the literature, most discussion of analog computers turns on form rather than function.

Every computer manufacturer, including Donner, is ready to tell you all about their designs, right down to the last microvolt. Few spend their literary effort in telling you how to use them and what kind of problems are amenable to analog computer solution. Not too strangely, this is what you, the prospective user, wanted to find out in the first place.

HOW AN ELECTRONIC ANALOG COMPUTER SOLVES PROBLEMS

A mathematical expression which defines the dynamic behavior of a particular physical system also describes the behavior of all other analogous systems. A general purpose analog computer can be programmed to behave as one of these analogous systems. So programmed, it can be used to explore the characteristics of the system or to "solve" the describing equations. Typical problems range all the way from explaining the laws of classical and modern physics to the physiological relations of life itself. Here are some of the fields where analog computers are in use: antenna design, medical research, cybernetics, electron trajectories, nuclear reactor design, fluid me-



Assembly of Donner 3100 series high accuracy medium size analog computers in quantity lots provides the user with more value at lower cost. Complete Donner 3100 Computer Consoles start at just under \$11,000.



The Donner 3400 Desk-top Computer functions as a compact, versatile electrical model of a dynamic system.

chanics, heat transfer analysis, aerodynamics, meteorology, classical and nuclear physics, chemical kinetics, petroleum, engineering, servo system analysis, auto- and cross-correlation, and economic forecasting.

Basic computing elements in an electronic analog computer are dc amplifiers, precision components (resistors, capacitors, and potentiometers), and non-linear accessories (multipliers, function generators, and transport delay simulators).

By interconnecting the computing elements at a patchboard, varying voltage amplitudes can be integrated, summed, differentiated, multiplied, divided, altered in non-linear fashion, and otherwise operated on as directed by a mathematical equation. The answer, which appears as a varying voltage, can be visually observed on a voltmeter or an oscilloscope and permanently recorded by any one of several plotting devices.

The analog computer user can take an equation, change the coefficients at will, and get whole sets of solutions with amazing ease and speed. He can get these results to accuracies of 0.1% or better for a very modest investment. Small Donner computers begin at just over \$1,000.

ANALOG OR DIGITAL

The chief advantages of the analog technique are speed, economy, and flexibility. With the analog computer, you get a genuine insight into the response of the system to both internal and external stimuli. No other ap-

proach can bring the investigator into such intimate contact with the system.

Digital computers sometimes provide more accurate results, but they seldom give the user the same knowledge because they are at best only machines that compound arithmetic information. Unlike digital computers, analog computers actually behave just like the simulated systems.

TWO NEW PUBLICATIONS PROVIDE MORE INFORMATION

If you are interested in learning more about the application of analog computers, copies of Donner Tech Notes #1 and #2 are available from your nearby Donner engineering representative or directly from the factory. Tech Note #1 is titled "How to Simulate a Non-Linear Control System with an Analog Computer;" Tech Note #2, "How to Use and Program Analog Computers."

Donner Scientific specializes in the manufacture of accurate fixed and general purpose analog systems designed to analyze, measure, and control dynamic inputs. Complete technical information and informed applications assistance can be obtained from your nearby Donner engineering representative or writing Dept. 36.

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CIRCLE 76 ON READER-SERVICE CARD

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Guarantee



The CMC 700 Series is the only major breakthrough in counting, timing and frequency measuring equipment in the past 10 years. Here is the first successful application of transistors to high frequency counting and timing. Transistors perform all the functions in CMC's 700 series that required 63 tubes in old style counting equipment. These are the most reliable counters ever made.

TRUE DIGITAL LOGIC CIRCUITRY

By answering an obvious need for a completely new, up-to-date approach to counting and timing instrumentation, CMC has produced solid state instruments with greatly simplified circuitry, using logic "and" and "or" gates.

LIGHT AND SMALL, LOWER POWER DRAIN

Each 700 series instrument weighs only 27 pounds, measures 7 inches high, 17 inches wide, and 14 inches deep. Power consumption is a meager 46 watts, 1/10 the amount for vacuum tube models.

DO ALL THESE JOBS

Measure frequency from dc to 10 mc, time interval from 0.1 μ sec. ratio 1 cps to 1 mc and unlimited multiple period selection. Frequency converters available for higher frequencies. The counter also generates time interval marker pulses from 1 μ sec to 1 second. Data can be presented on standard decades or inline Nixie tubes. The 700 series will operate digital recording equipment, punches, inline read-outs, and other data handling gear.

These Features, Too—Decade count-down time base—frequency divider circuits never need adjustment. Accuracy, ± 1 count \pm oscillator stability. Sensitivity, 0.25 v rms; input impedance, 25 k ohms/volt.

And The Price—Higher than vacuum tube models. But you can save the difference on down time in the first year. Model 727A Universal Counter-Timer, \$2,750; Model 707A Frequency-Period Meter, \$2,575; Model 757A Time Interval Meter, \$1,975. Rack mount optional at no extra cost. All prices f.o.b. Sylmar, California.

More Information Available—Your nearby CMC engineering representative will be happy to arrange a demonstration and provide you with complete technical information. Or you may write Department

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TRANSISTORS-1960

Low Level

Type No.	Mfg.	Type	f ₂₀ MC	Max. Ratings				V _{ce} V	I _{co} μ A
				W _c (mw)	T _i C	mw/o _C	V _c V		
2N1198	GE	npn,RG,ge	9	65	85	1.1	25		
OC141	AMP	npn,PADT,ge	9	100	75	-	20	1.5	
2N440	SY	npn,AJ,ge	10	100	85	1.66	15	0.8	
2N518	GE	npn,AJ,ge	10	150	85	2.5	12	10	
2N521	IND	npn,AJ,ge	10	150	85	2.5	15	6	
2N521A	IND	npn,AJ,ge	10	150	85	2.5	25	1	
2N598	PH	npn,AJ,ge	10	250	100	3.3	35	1	
2N600	PH	npn,AJ,ge	10	750	100	10	35	10	
2N659	RA	npn,FA,ge	10	150	85	-	14	10	
2N745	RA	npn,MS,si	10	150	175	0.75	45	2.5	
2N1281	IND	npn,AJ,ge	10	200	85	3.33	16	10	
2N1349	IND	npn,AJ,ge	10	200	85	3.33	40	5	
2N427	GT	npn,AJ,ge	11	150	100	2	30	15	
CK27	RA	npn,FA,ge	11	80	85	-	15	2	
2N269	RCA	npn,AJ,ge	12	120	85	-	25	2	
2N316	GT	npn,AJ,ge	12	100	85	2	30	5	
2N316A	GT	npn,AJ,ge	12	150	100	2	30	1	
2N397	GE	npn,AJ,ge	12	200	100	3.3	15	1	
2N404	RCA	npn,AJ,ge	12	120	85	-	25	6	
2N635	GE	npn,AJ,ge	12	150	85	2.5	20	5	
2N1306	TI	npn,AJ,ge	12	150	100	2.5	25	5	
2N1307	TI	npn,AJ,ge	12	150	100	2.5	30	6	
2N1313	IND	npn,AJ,ge	12	175	85	-	30	6	
2N1344	IND	npn,AJ,ge	12	150	85	2.5	15	14	
2N1345	IND	npn,AJ,ge	12	150	85	2.5	15	5	
2N1346	IND	npn,AJ,ge	12	150	85	2.5	12	3	
2N1357	IND	npn,AJ,ge	12	200	85	3.33	30	2.5	
2N1091	RCA	npn,AJ,ge	13	120	85	-	25	2.5	
2N580	RCA	npn,AJ,ge	15	120	85	-	20	8	
2N660	RA	npn,FA,ge	15	150	85	-	15	5	
2N1282	IND	npn,AJ,ge	15	200	85	3.33	16	10	
2N1316	IND	npn,AJ,ge	15	200	85	3.33	30	5	
2N1317	IND	npn,AJ,ge	15	200	85	3.33	20	2	
2N1318	IND	npn,AJ,ge	15	200	85	3.33	30	3	
2N428	GT	npn,AJ,ge	17	150	100	2	30	4	
2N636	GE	npn,AJ,ge	17	150	85	2.5	25	2	
CK28	RA	npn,FA,ge	17	80	85	-	5	-	
2N522	IND	npn,AJ,ge	18	150	85	2.5	10	14	
2N522A	IND	npn,AJ,ge	18	150	85	2.5	20	1	
2N582	RCA	npn,AJ,ge	18	120	85	-	20	1	
2N584	RCA	npn,AJ,ge	18	120	85	-	20	5	
2N599	PH	npn,AJ,ge	18	250	100	3.3	5	-	
2N601	PH	npn,AJ,ge	18	750	100	10.0	30	15	
2N317	GT	npn,AJ,ge	20	100	85	2	30	15	
2N317A	GT	npn,AJ,ge	20	150	100	2	30	1	
2N337	TI	npn,GD,si	20	125	200	1.0	1	1.4	
2N417	IND	npn,AJ,ge	20	200	85	3	1	1.4	
2N661	RA	npn,FA,ge	20	150	85	-	2	12	
2N746	RA	npn,MS,si	20	150	175	0.75	5	12	
2N1017	RA	npn,FA,ge	20	150	85	-	10	3	
2N1308	TI	npn,AJ,ge	20	150	100	2.5	6	20	
2N1309	TI	npn,AJ,ge	20	150	100	2.5	6	20	
2N523	IND	npn,AJ,ge	24	150	85	2.5	10	14	
2N523A	IND	npn,AJ,ge	24	150	85	2.5	10	14	
2N496	PH	npn,SB,si	25	150	140	1.3	10	6	
2N747	RA	npn,MS,si	25	150	175	0.75	5	5	
2N748	RA	npn,MS,si	25	150	175	0.75	5	5	
2N1386	RA	npn,MS,si	25	300	175	0.5	5	5	
2N1387	RA	npn,MS,si	25	300	175	0.5	5	5	
2N1205	TR	npn,GR,si	27	150	150	-	5	5	
2N338	TI	npn,GD,si	30	125	200	1.0	3	3	
2N643	RCA	npn,DR,ge	*30	120	85	-	1.4	0.	

DATA CHART

(continued)

Type No.	Switching		Remarks	Type No.
	Rise Time μsec	Stor. Time μsec		
2N1198	0.4	0.7		2N1198
OC141				OC141
2N440	0.3	0.7	GT	2N440
2N518	0.8	0.9		2N518
2N521	14	-	US, CR	2N521
2N521A	0.2	0.5	US, CR	2N521A
2N598	15	-	CR	2N598
2N600	15	-		2N600
2N659	12	-	CR	2N659
2N745	3	-		2N745
2N1281	10	.9		2N1281
2N1349	12	-		2N1349
2N427	14	0.43	MO, IND, RA, US	2N427
CK27	14	0.4		CK27
2N269	-	0.17		2N269
2N316	14	0.4	IND, US, CR	2N316
2N316A	14	0.4	IND, US, CR	2N316A
2N397	12	0.3	TI, CR	2N397
2N404	5	0.17	GE, RA, GT, SY, US	2N404
2N635	-	-	CR	2N635
2N1306	20	.22	TO-5, SY, CR	2N1306
2N1307	20	.20	TO-5, CR	2N1307
2N1313	14	-		2N1313
2N1344	12	.7		2N1344
2N1345	14	.3		2N1345
2N1346	14	.3		2N1346
2N1357	12	.3		2N1357
2N1091	-	0.20		2N1091
2N580	5	0.16	IND, US	2N580
2N660	12	-		2N660
2N1282	10	.8		2N1282
2N1316	2	14		2N1316
2N1317	3	14		2N1317
2N1318	4	14		2N1318
2N428	2	14	SY, MO, RA, IND, US	2N428
2N636	5	-	CR	2N636
CK28	14	0.4		CK28
2N522	14	-	US	2N522
2N522A	14	0.2	US, CR	2N522A
2N582	5	0.15	IND, CR, SY	2N582
2N584	5	0.15	US	2N584
2N599	15	-		2N599
2N601	15	-		2N601
2N317	14	0.3	US, IND, CR	2N317
2N317A	14	0.3	IND, US, CR	2N317A
2N337	1.4	0.02	TR, GE, RA	2N337
2N417	12	-	CR	2N417
2N661	12	-	CR	2N661
2N746	3	-		2N746
2N1017	12	-	US	2N1017
2N1308	20	.22	TO-5, SY, CR	2N1308
2N1309	20	.15	TO-5, CR	2N1309
2N523	14	-	US, CR	2N523
2N523A	14	0.1	US, CR	2N523A
2N496	6	-		2N496
2N747	5	-		2N747
2N748	5	-		2N748
2N1386	5	-		2N1386
2N1387	5	-		2N1387
2N1205	3.1	-		2N1205
2N338	1.4	0.06	GE, TR, RA	2N338
2N643	-	0.03	gain bandwidth product*	2N643

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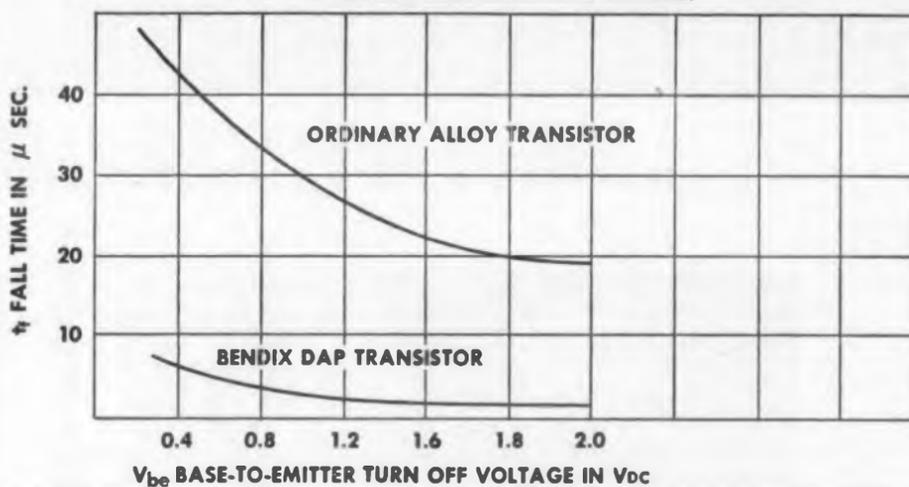
Bendix Bulletin



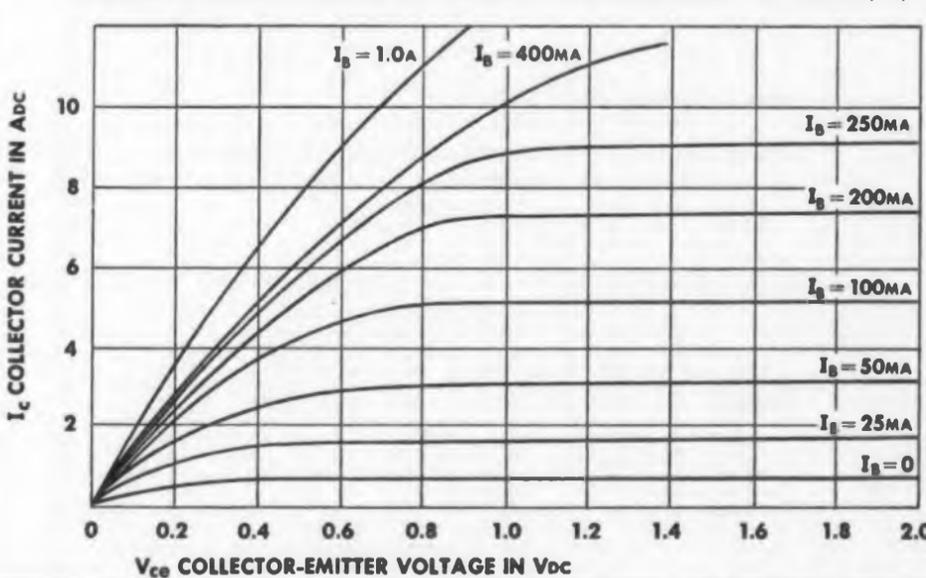
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2N1073	-40	-40	10	10	35	-60 to +100	100
2N1073A	-80	-80					
2N1073B	-120	-120					

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INTERMEDIATE POWER TRANSISTORS



- Now in stud-mounted package

For regulated power supplies and amplifier output stages —
replaces 2N1047-50 and 2N1483-86—offering low R_{cs} , good Beta
linearity and voltage ratings to 120V.

Type	Maximum Power Dissipation @ 100°C (watts)	Typical DC Current Gain @ $I_c = 1$ amp	Maximum Collector Voltage (Volts)	Typical Saturation Resistance (ohms)	Typical DC Input Voltage (Volts)
2N1647	20	25	80V.	1.7 @ 1A.	2 @ 1A.
2N1648	20	25	120V.	1.7 @ 1A.	2 @ 1A.
2N1649	20	45	80V.	1.7 @ 1A.	2 @ 1A.
2N1650	20	45	120V.	1.7 @ 1A.	2 @ 1A.

WRITE FOR BULLETIN /TE-1355S

With these new transistors, Transitron offers improved performance and outstanding features in all power ratings from 100 microamps to 5 amps. Each functions in a wide operating range — permitting use of fewer types, simplifying equipment manufacture. All provide the ruggedness and reliability of mesa silicon construction. All are available now, at prices competitive with lower-performance devices.

HIGH POWER TRANSISTORS



- Available in two package styles — 11/16" hex stud mount and square flange

For regulated power supplies and amplifier output stages —
replaces 2N1015-16, 2N424, 2N389, 2N1487-90 — with low R_{cs}
(typical .8 ohms), good Beta linearity, high cut-off frequen-
cies, and high voltage.

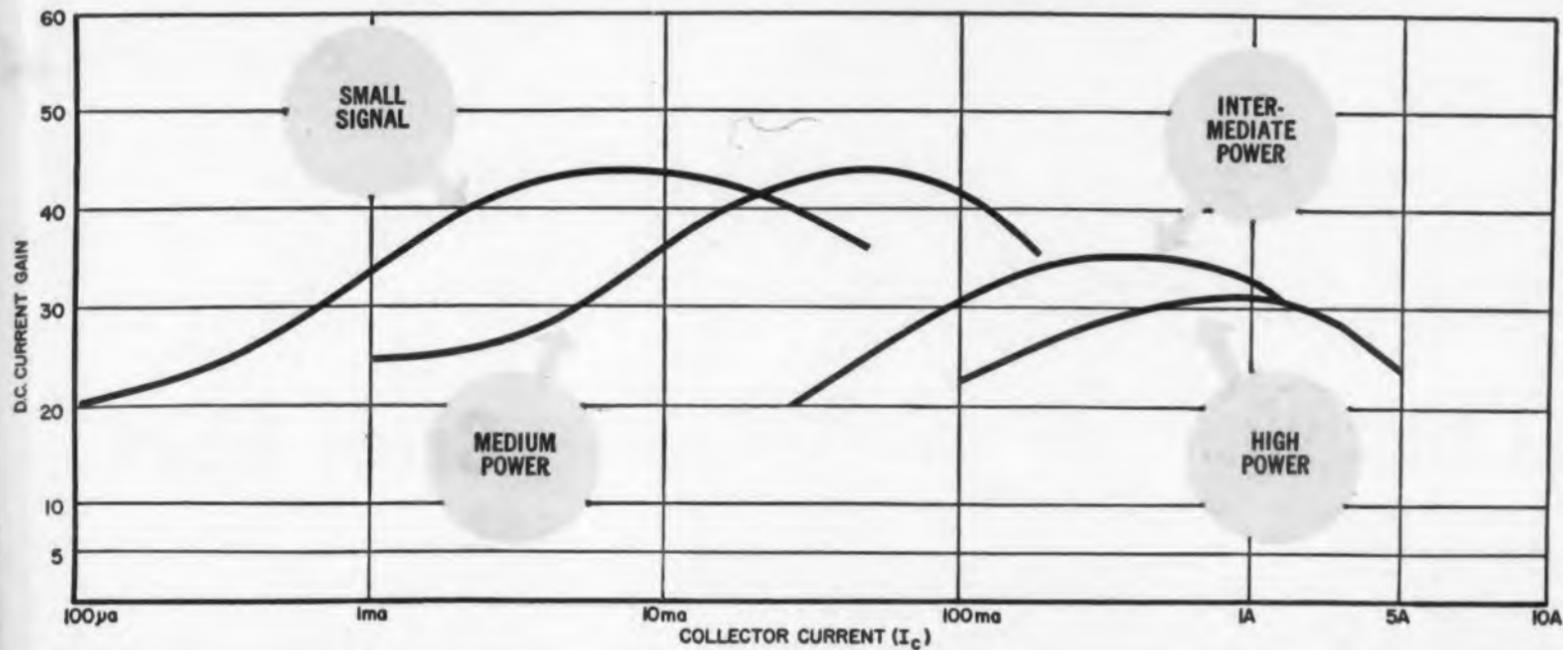
Type	Maximum Power Dissipation @ 100°C (Watts)	Maximum Collector Current (amps)	Maximum Collector Voltage (Volts)	Maximum Saturation Resistance (ohms)	Maximum DC Input Voltage (Volts)	DC Beta @ 2 amps	
						Min.	Max.
2N1616 2N1210	30	5	60	1 @ 2A.	3 @ 2A.	15	75
2N1617 2N1211	30	5	80	1 @ 2A.	3 @ 2A.	15	75
2N1618 2N1620	30	5	100	1 @ 2A.	3 @ 2A.	15	75

WRITE FOR BULLETIN /TE-1355R

COMPUTER DESIGNERS ATTENTION

Watch for announcement of
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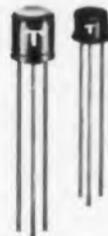
HIGH CUT-OFF FREQUENCIES, LOW R_{CS} AND BETA LINEARITY

SMALL SIGNAL TRANSISTORS



For low level high voltage switching and amplification. Replaces 2N332-2N343 with higher cut-off frequencies (30mc), lower R_{cs} , smaller sized TO-18 package, and higher voltages.

MEDIUM POWER TRANSISTORS



- Collector lead isolated from case — greatly simplifying heat dissipation measures and increasing reliability
 - Include highest standard voltage ratings available (to 125V) — for extra safety margin against overloads.
- To replace 2N332-343, with improved high frequency characteristics, good Beta linearity, and low R_{cs} .

SMALL SIGNAL TO-18

Type	Maximum Collector Voltage	Minimum DC Beta			Maximum Power Dissipation @ 25°C Ambient (mw)	Typical Saturation Resistance (ohms)
		I_c 500µa	I_c 5ma	I_c 50ma		
ST1504	60	15	20	20	300	40
ST1505	100	15	20	20	300	50

WRITE FOR BULLETIN /TE-1353T

Type	Maximum Collector Voltage (volts)	Minimum Beta			Maximum Power Dissipation (Watts) @ 25°C Case	Maximum Saturation Resistance (ohms)
		I_c 1ma AC	I_c 5ma AC	I_c 50ma DC		
*2N339A †	60	15	25	20	1	50
*2N340A	85	15	25	20	1	70
*2N341A †	125	15	25	20	1	70
**2N1054	125	20(DC) @ 200ma			5	20
***2N696	60	20(DC) @ 150ma			2	10
****2N697	60	40(DC) @ 150ma			2	10

† Electrical equivalents available in TO-5 package as 2N1206 and 2N1207

* WRITE FOR BULLETIN /TE-1355J1 ** WRITE FOR BULLETIN /TE-1346E-2

*** WRITE FOR BULLETIN /TE-1355B-3 **** WRITE FOR BULLETIN /TE-1306B-4

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2N362	A	2N456	HL	2N553	P
2N363	A	2N457	HL	2N556	LL
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2N388	LL, HF	2N496	HF	2N586	LL
2N389	P	2N497	P, HF	2N587	LL
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2N394	LL	2N501	LL	2N592	A
2N395	LL, HF	2N501A	LL	2N593	A
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2N411	HF	2N515	HF	2N614	HF
2N412	HF	2N516	HF	2N615	HF
2N413	HF	2N517	HF	2N616	HF
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2N442	P	2N540	P	2N639B	P
2N443	P	2N541	HF	2N640	HF
2N444	HF	2N542	HF	2N641	HF
2N444A	HF	2N543	HF	2N642	HF
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2N650	A	2N1032	P	2N1136A	P	2N1238	HL	2N1350	LL	2N1471	A	2N1623	A	CST1739	P
2N650A	A	2N1032A	P	2N1136B	P	2N1250	HL	2N1351	LL	2N1472	LL	2N1651	HL	CST1740	P
2N651	A	2N1032B	P	2N1137	P	2N1251	A	2N1352	A	2N1473	LL	2N1652	HL	CST1741	P
2N651A	A	2N1032C	P	2N1137A	P	2N1252	HF,HL	2N1353	LL	2N1478	LL	2N1653	HL	CST1742	P
2N652A	A	2N1034	LL	2N1137B	P	2N1253	HF,HL	2N1354	LL	2N1479	P	2N1654	A	CST1743	P
2N653	A	2N1035	LL	2N1138	P	2N1254	LL	2N1355	LL	2N1480	P	2N1655	A	CST1744	P
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2N658	LL	2N1040	HL	2N1142	HF	2N1259	LL	2N1360	P	2N1485	P	3N36	HF	CTP1108	P
2N659	LL	2N1041	HL	2N1143	HF	2N1261	P	2N1362	P	2N1486	P	3N37	HF	CTP1109	P
2N660	LL	2N1042	P	2N1144	A	2N1262	P	2N1363	P	2N1487	P	3N45	P	CTP1111	P
2N661	LL	2N1043	P	2N1145	A	2N1263	P	2N1364	P	2N1488	P	3N46	P	CTP1112	P
2N662	LL	2N1044	P	2N1146	A	2N1264	P	2N1365	P	2N1489	P	3N47	P	CTP1117	P
2N665	P	2N1045	P	2N1146A	P	2N1265	HF	2N1370	A	2N1490	P	3N48	P	CTP1133	P
2N669	P	2N1046	HL	2N1146B	P	2N1266	A	2N1371	A	2N1491	HF	3N49	P	CTP1137	P
2N670	LL	2N1046A	HL	2N1146C	P	2N1267	HF	2N1372	A	2N1492	HF	3N50	P	CTP1500	P
2N671	HL	2N1046B	P	2N1147	P	2N1268	HF	2N1373	A	2N1493	HF	3N51	P	CTP1503	P
2N673	HL	2N1047	P	2N1147A	P	2N1269	HF	2N1374	A	2N1499	LL	3N52	P	CTP1504	P
2N674	LL	2N1048	P	2N1147B	P	2N1270	HF	2N1375	A	2N1500	LL	3N54	P	CTP1508	P
2N675	HL	2N1049	P	2N1147C	P	2N1271	HF	2N1376	A	2N1501	P	903	A	CTP1544	P
2N679	LL	2N1050	P	2N1157	P	2N1272	HF	2N1377	A	2N1502	P	904	A	CTP1552	P
2N695	HF	2N1051	A	2N1157A	P	2N1273	A	2N1378	A	2N1504	P	904A	A	CTP1553	P
2N696	HF, HL	2N1056	LL	2N1159	P	2N1274	A	2N1379	A	2N1505	P, HF	905	A	CTP1728	P
2N697	HF, HL	2N1057	LL	2N1160	P	2N1280	LL	2N1380	A	2N1506	P, HF	910	A	CTP1729	P
2N698	HF, HL	2N1058	HF	2N1162	P	2N1281	LL	2N1381	A	2N1507	HF	952	A	CTP1730	P
2N699	HF, HL	2N1059	A	2N1163	P	2N1282	LL	2N1382	A	2N1515	HF	953	A	CTP1731	P
2N702	LL	2N1065	HF	2N1164	P	2N1284	LL	2N1383	A	2N1517	LL	957	A	CTP1732	P
2N705	LL	2N1066	HF	2N1165	P	2N1291	P	2N1385	LL	2N1518	HL	1228	LL	CTP1733	P
2N706	LL, HF	2N1067	P	2N1166	P	2N1292	P	2N1386	LL	2N1519	HL	1229	LL	CTP1735	P
2N707	LL	2N1068	P	2N1167	P	2N1293	P	2N1387	LL	2N1520	HL	1230	LL	CTP1736	P
2N710	LL, HF	2N1069	P	2N1168	P	2N1294	P	2N1388	HF	2N1521	HL	1231	LL	GA52830	HL
2N711	LL	2N1070	P	2N1172	P	2N1295	P	2N1389	HF	2N1522	HL	1232	LL	GA53242	HL
2N715	HF	2N1072	HL	2N1176	LL	2N1296	P	2N1390	HF	2N1523	HL	1233	LL	GK13A	HF
2N716	HF	2N1073	HL	2N1176A	LL	2N1297	P	2N1392	Sp	2N1529	P	1234	LL	GK16A	HF
2N717	HL	2N1073A	P	2N1176B	LL	2N1298	P	2N1393	Sp	2N1530	P	1238	LL	GT74	A
2N718	HL	2N1073B	P	2N1177	HF	2N1299	LL	2N1394	Sp	2N1531	P	1239	LL	GT81	A
2N719	HL	2N1074	LL	2N1178	HF	2N1302	LL	2N1395	HF	2N1532	P	1240	LL	GT109	A
2N720	HL	2N1075	LL	2N1179	HF	2N1303	LL	2N1396	HF	2N1533	P	1241	LL	GT123	LL
2N725	LL	2N1076	LL	2N1180	HF	2N1304	LL	2N1397	HF	2N1534	P	1242	LL	GT327A	A
2N728	HF	2N1077	LL	2N1183	P	2N1305	LL	2N1408	Sp	2N1535	P	1243	LL	GT328A	A
2N729	HF	2N1078	P	2N1183A	P	2N1306	LL	2N1409	HF, HL	2N1536	P	1244	LL	GT1624	Sp
2N730	HL	2N1086	HF	2N1183B	P	2N1307	LL	2N1410	HF, HL	2N1537	P	B177	P	H3A	P
2N731	HL	2N1086A	HF	2N1184	P	2N1308	LL	2N1411	LL	2N1538	P	B178	P	H4A	P
2N733	A	2N1087	HF	2N1184A	P	2N1309	LL	2N1412	HL	2N1539	P	B179	P	H45	P
2N735	A	2N1087A	HF	2N1184B	P	2N1310	A	2N1417	HF	2N1540	P	B1085	HL	LT11	P
2N736	A	2N1090	LL, HF	2N1191	A	2N1311	A	2N1418	HF	2N1541	P	B1154	LL	LT12	P
2N741	HF	2N1091	LL, HF	2N1192	A	2N1312	A	2N1420	LL, HF	2N1542	P	B1154A	LL	LT13	P
2N742	A	2N1095	A	2N1193	A	2N1313	A	2N1425	HF	2N1543	P	CF45017	HL	LT14	P
2N745	LL	2N1096	A	2N1194	HF	2N1314	A	2N1426	HF	2N1544	P	CK4	A	LT15	P
2N746	LL	2N1097	A	2N1195	HF	2N1315	A	2N1427	LL	2N1545	P	CK4A	A	OC22	HL
2N747	LL	2N1098	A	2N1196	HF	2N1316	LL	2N1428	HF	2N1546	P	CK13	HF	OC23	HL
2N748	LL	2N1099	P	2N1197	HF	2N1317	LL	2N1429	HF	2N1547	P	CK14	HF	OC24	HL
2N749	HF	2N1100	P	2N1198	LL	2N1318	LL	2N1431	A	2N1548	P	CK16	HF	OC29	HL
2N750	HF	2N1101	A	2N1198	LL	2N1318	LL	2N1432	A	2N1549	P	CK17	HF	OC30	P
2N751	HF	2N1102	A	2N1199	LL	2N1320	P	2N1437	P	2N1550	P	CK17A	A	OC35	HL
2N751A	A, LL	2N1107	HF	2N1202	P	2N1321	P	2N1438	P	2N1551	P	CK22	A	OC36	HL
2N751B	LL	2N1108	HF	2N1203	P	2N1322	P	2N1439	P	2N1552	P	CK22A	A	OC44	HF
2N751C	LL	2N1109	HF	2N1205	LL	2N1323	P	2N1440	A	2N1553	P	CK25	LL	OC45	LL
2N751D	LL	2N1110	HF	2N1208	HL	2N1324	P	2N1441	A	2N1554	P	CK25A	A	OC46	LL
2N751E	LL	2N1111	HF	2N1209	HL	2N1325	P	2N1442	A	2N1555	P	CK26	LL	OC47	LL
2N751F	LL	2N1111A	HF	2N1210	P	2N1326	P	2N1446	A	2N1556	P	CK26A	A	OC53	A
2N751G	LL	2N1111B	HF	2N1211	P	2N1327	P	2N1447	A	2N1557	P	CK27	LL	OC54	A
2N751H	LL	2N1114	LL	2N1212	HL	2N1328	P	2N1448	A	2N1558	P	CK27A	A	OC55	A
2N751I	LL	2N1116	HL	2N1213	LL	2N1329	P	2N1449	A	2N1559	P	CK28	LL	OC56	A
2N751J	LL	2N1117	HL	2N1214	LL	2N1330	P	2N1451	A	2N1560	P	CK28A	A	OC59	A
2N751K	LL	2N1118	HF	2N1215	LL	2N1331	P	2N1452	A	2N1561	P, HF	CK64	A	OC60	A
2N751L	LL	2N1118A	HF	2N1216	LL	2N1332	P	2N1453	P	2N1562	P, HF	CK64A	A	OC74	A
2N751M	LL	2N1119	LL, HF	2N1220	LL	2N1333	P	2N1454	P	2N1564	A	CK65A	A	OC75	A
2N751N	LL	2N1120	P	2N1221	LL	2N1334	P, LL	2N1455	P	2N1565	A	CK66	A	OC79	LL
2N751O	P	2N1121	HF	2N1222	LL	2N1335	P, HF	2N1456	P	2N1566	P	CK67	A	OC80	LL
2N751P	P	2N1122	LL	2N1223	HL	2N1336	P, HF	2N1457	P	2N1605	LL	CK67A	A	OC139	LL
2N751Q	HF	2N1122A	LL	2N1224	HF	2N1337	HF	2N1458	P	2N1609	HL	CDT1310	A	OC140	LL
2N751R	HF	2N1123	LL	2N1225	HF	2N1339	P, HF	2N1461	P	2N1610	HL	CDT1311	P	OC141	LL
2N751S	HF	2N1124	A	2N1226	HF	2N1340	P, HF	2N1462	P	2N1611	HL	CDT1312	P	OC170	LL
2N751T	HF	2N1125	LL	2N1228	LL	2N1341	P, HF	2N1463	P	2N1612	HL	CDT1313	P	OC171	HL
2N751U	LL	2N1128	A	2N1229	LL	2N1344	LL	2N1464	P	2N1613	HL	CDT1319	P	OC200	A
2N751V	LL	2N1129	A	2N1230	LL	2N1345	LL	2N1465	P	2N1616	HF, HL	CDT1320	P	OC201	A
2N751W	P	2N1130	A	2N1231	LL	2N1346	LL	2N1466	P	2N1617	P			OCP70	A
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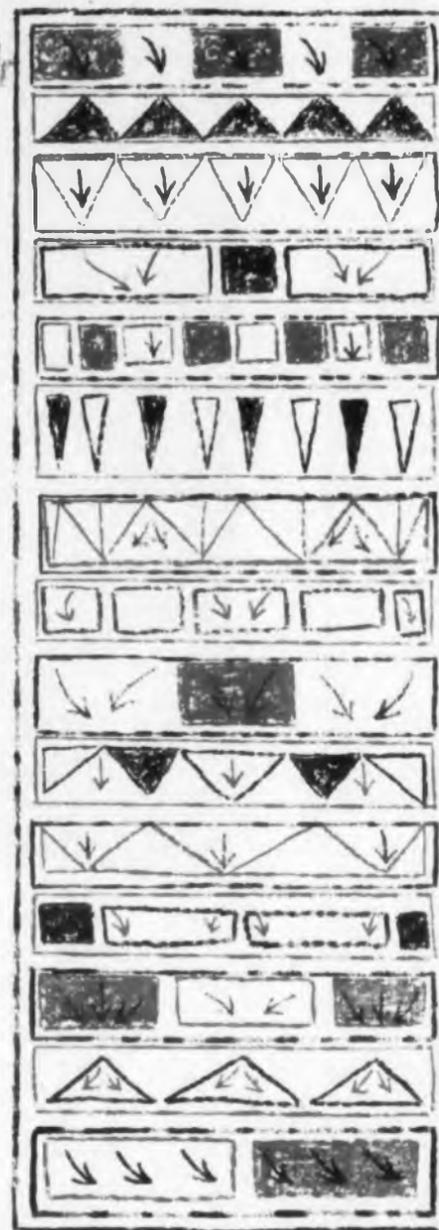
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Part 3

Pulse Code Modulation Terminal And Repeater Methods

Because coded pulses can be regenerated, the design of repeaters for PCM systems is an important part of the system design. In this third and concluding part of this series Bob Carbrey details regenerative repeater operation and design. Part 1 of the series appeared in ED, June 8, p 52 and Part 2 in ED, June 22, p 66.



R. L. Carbrey
Bell Telephone Laboratories
Murray Hill, N.J.

ONE OF THE most important advantages of pulse code transmission is that the pulses can be recreated at the receiving end. Thus, all noise and distortion can be eliminated, resulting in a signal generally as clean as the original.

In the process of transmitting coded signals over long lines, the repeaters can be designed to amplify and recreate, or regenerate, these pulses.

Regenerative repeaters have been successfully operated with bit rates ranging from ordinary telegraph to several hundred megabits per second. Ordinary exchange area telephone pairs, coaxial cable, microwave radio, and waveguides have been used as transmission media.

Normal repeater functions are shown in block form in Fig. 13. When pulses are sent over a transmission medium that does not have a flat

pass band, the pulses are "smeared out in time" so that some frequency components of a given pulse appear in the following time slots. A particularly severe example is shown in Fig. 14 which shows what happens to a code group sent over 3000 feet of exchange area telephone cable at a 10-megabit rate. After appropriate low-frequency loss has been inserted by a simple equalizer, the combination appears as shown at 14c. If flat band loss were the only consideration, the equalizer could just as well be located at the output. The equalizer would be used at the output if crosstalk into other systems from the pulse system were controlling. When it is located at the input, however, any noise picked up in the link is also attenuated.

Fig. 15a shows a 2-mc interfering sine wave

added to the binary signal as it appears before the equalizer. The interference is about 8 dB greater than the signal transition due to a change from pulse to space or space to pulse. The resulting output after the amplifier and equalizer is shown in Fig. 15b. The signal is about 1 dB greater than the 2-mc interference.

With simple sine wave timing added as shown in 15c, some variation in the regenerated signal is apparent as shown in 15d. This is adequate unless the following noise is severe. Usually very little equalization is needed for microwave and coaxial transmission circuits.

The ideal regenerative repeater would be one in which no linear amplification is used. However, linear amplification is used in repeaters because most decision circuits do not have sufficient

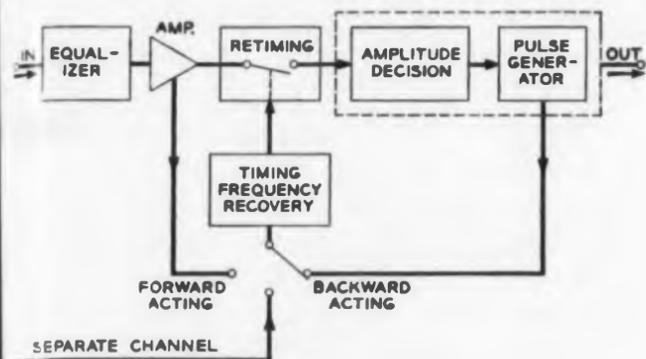


Fig. 13. PCM repeater functions.

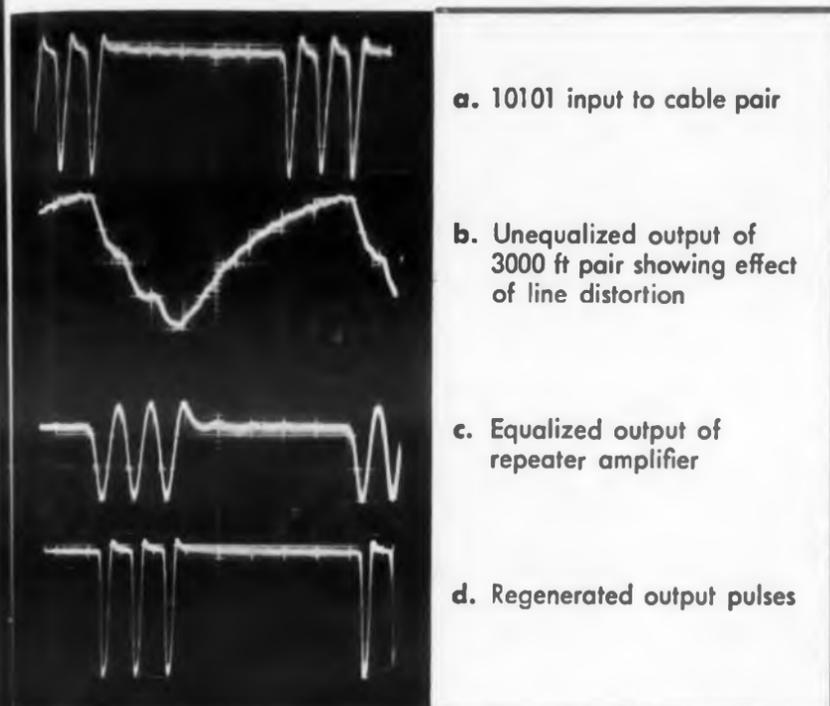


Fig. 14. Example of how severe noise can cause a "time shift" in a pulse train.

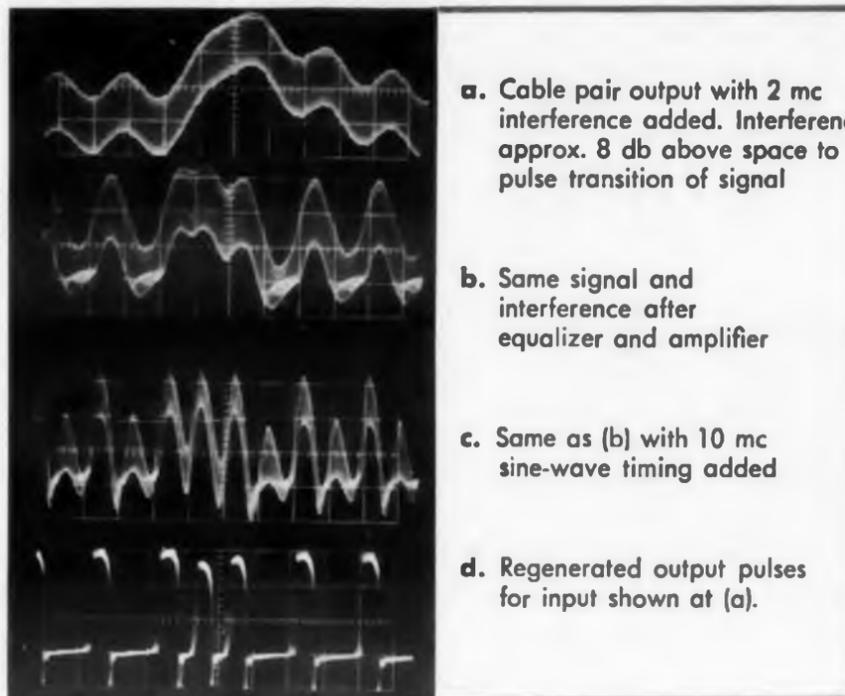
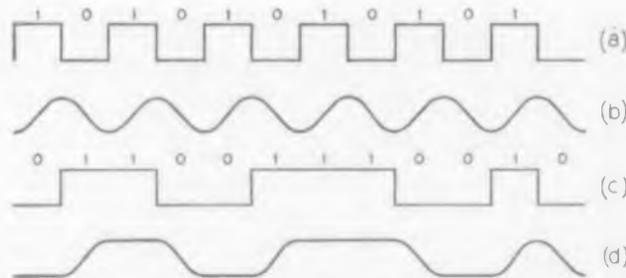


Fig. 15. Effect of 2 mc interference added to a pulse train and the way the pulses are regenerated.



WAVEFORMS SHOWING MAXIMUM TRANSITION RATE EQUIVALENT TO HALF BIT FREQUENCY

Fig. 16. Putting two or more bits through a system in sequence (c) does not require additional bandwidth over single bit sequence (a). Cosine wave (d) resulting from passing (c) through an appropriate filter results in fewer transitions per second than cosine wave (b), the resultant of (a) passing through an appropriate filter.

sensitivity and stability to be triggered correctly from signals which are still far enough above the noise to be easily distinguished. Amplifiers provide a part or all of the gain necessary to make up for the loss of the preceding transmission link and permit repeaters to be spaced further apart. The amplifier band should be kept only wide enough to prevent excessive intersymbol interference due to cutoff at the high end, and excessive low frequency "droop" due to cutoff at the low end. Wider bands than this just permit more noise to get through to the decision circuit. The overall combination of transmission line amplifier and equalizer for the 10-megabit signals of Figs. 14 and 15, for example was already down 6 db at 10 mc. At 10 mc it was down 18 db.

Nyquist showed that $2B$ bits per second could

theoretically be transmitted over a system of bandwidth B even in the presence of noise. Although a discussion of Nyquist's theorem,²⁰ is beyond the scope of this article, some insight into how this can be done may be gained from a study of Fig. 16.

A sequence of alternate pulses and spaces, 16a, passing through an appropriate filter band appears as a raised cosine wave of half the bit frequency, 16b. This represents the maximum possible number of transitions from one level to the other. If two or more like bits are put in sequence as shown at 16c, then there are actually fewer transitions per second; so no more high-frequency bandwidth is necessary.

A transmission bandwidth of at least 28,000 cps per channel would be required to transmit the

56,000 bits per second resulting from coding a 4000-cps speech band as seven digit PCM. If this seems wasteful of bandwidth, it should be recalled that regeneration makes possible use of bandwidth which could not be used for analog signals because of excess distortion and noise.

Timing Methods

The next function shown in Fig. 13 is that of retiming. Ideally the switch should gate a very narrow sample of the input signal through to the decision circuit at the center of each bit interval. This provides the maximum protection against excursion of the bits either forward or backward in time. Fig. 17c shows the result of gating both a noise-free pulse and one with the limiting time perturbation as shown at 17a. The timing pulses

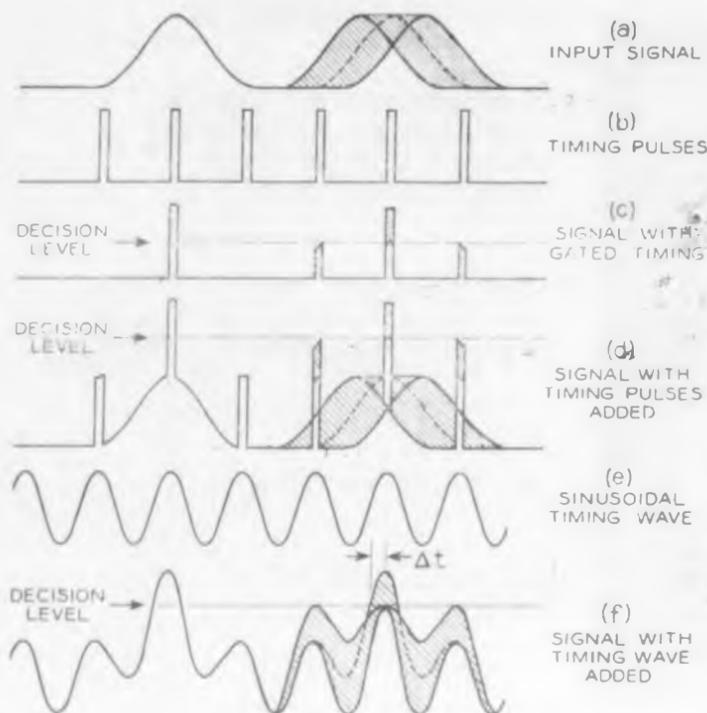
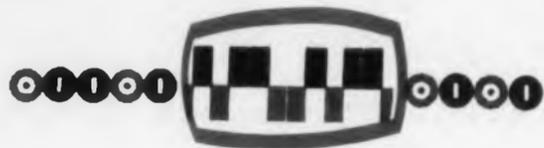


Fig. 17. Result of gating both a noise-free pulse and one with limiting time perturbation (a). Effect of adding timing pulses (d) is shown (f).

are shown at 17b. This is a very desirable type of signal to apply to a regenerative trigger circuit.

Two other retiming techniques are frequently used in order to keep the complexity of a repeater to a minimum. These are negative pedestal timing and additive timing. In these, the timing pulses are essentially added to the signal wave as in Fig. 17d. This eliminates both the gate circuit components and the loss through the gate. With negative pedestal timing,²¹ the peaks of the pulses are held at zero. The space interval between pulses holds the signal down below the trigger level thus preventing operation except during the pulse.

If the timing pulse magnitude changes or even drops to zero, the amplitude threshold will still be at the center of the binary signal. As a result,

the timing pulses need not be controlled precisely, and backward acting timing recovery circuits can start without difficulty. The negative pedestal must be added in after the last ac coupling and its power must be comparable to that of the signal.

When the timing wave is added before the last ac coupling, the dc reference is lost, and simple additive timing results. The amplitude threshold will vary as the timing signal varies. With this method, the timing signal can be added at the input of the signal amplifier; so that very little timing signal is required. This is particularly useful where a number of repeaters are driven in parallel at each repeater point. Isolation can be provided between repeaters by attenuation in the timing input circuits.

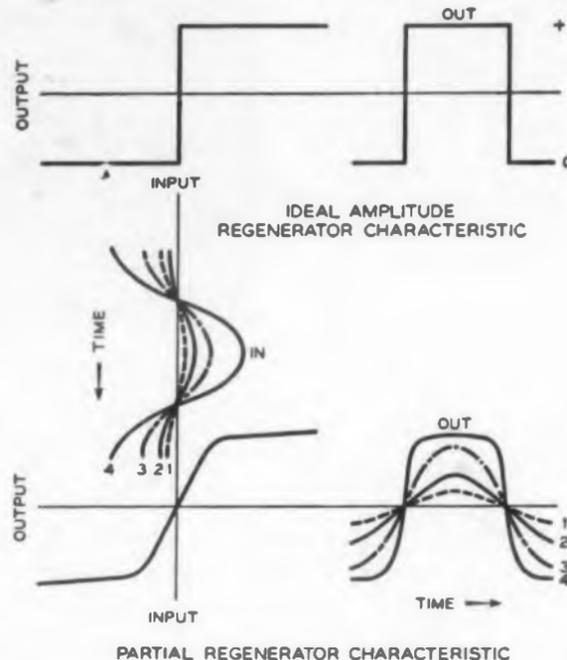


Fig. 18. Ideal regenerator characteristic (top) compared to the close approximation (bottom) that can be obtained by cascading enough clipping-tape amplifier stages.

Generating the idealized pulses of Fig. 17b is not easy to do. Even simple sine wave timing can be used, however, as shown in 17e and 17f. The timing and signal waves are shown at equal magnitudes with a resulting timing variation, Δt , remaining. This is a form of partial timing regeneration, and the following repeater should clean the timing up almost entirely.

Amplitude Decision

The input-output characteristic of an ideal amplitude regenerator is shown in Fig. 18a. For all input amplitudes below threshold, the output is zero, and for all amplitudes above this the output is a unit height pulse such as that shown to the right. As with most ideal characteristics this one, too, is difficult to obtain. It can be approximated as closely as the designer wishes (subject to de stability and bandwidth limitations) by cascading enough clipping type amplifier stages which successively amplify the center region and limit the upper and lower extremes.

This is really a process of cascading partial regenerator characteristics such as that shown at 18b. Fig. 19a is a functional diagram of a partial regenerator stage. Diode A limits the positive swing as soon as the forward breakdown voltage is exceeded. Diode B limits when the negative swing exceeds its forward breakdown. Four such circuits in cascade are shown in Fig. 19b.

When high-level interference is not likely to occur between repeater sections, considerable economy will result by simply using a single section at each repeater thus spreading the regeneration out along the transmission medium. The effect of either the local or spread out cascaded regeneration is indicated by the waveforms in Fig. 18. A low level signal such as Curve 1 shown on the input axis between the two characteristics would simply be amplified as it passed through the first repeater stage. The output is shown to the right of partial regenerator characteristic.

At the next repeater this amplified signal appears as input Curve 2 which is further amplified. At the input to the third repeater in the string it would appear as Curve 3 which is already large enough to show some upper and lower level limiting action. The resulting input to the fourth repeater produces a full height pulse.

Pulse amplification and stretching will be required after the clipping operation unless the clipping is done at high level and unless a long signal sample is taken. Repeaters using diode limiting in a hybrid T waveguide section have been used at the Bell Laboratories Holmdel Laboratory to directly regenerate microwave pulses

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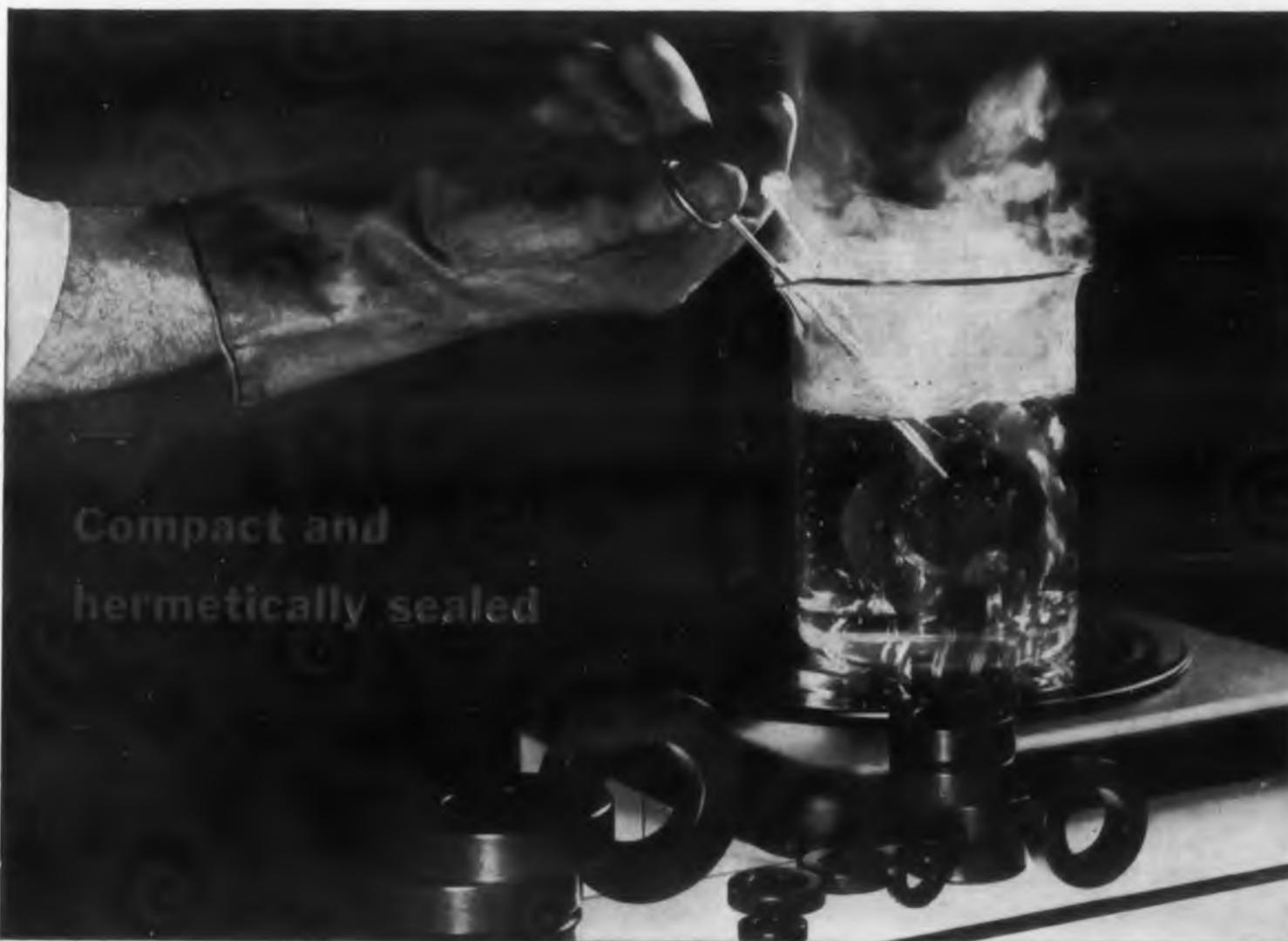
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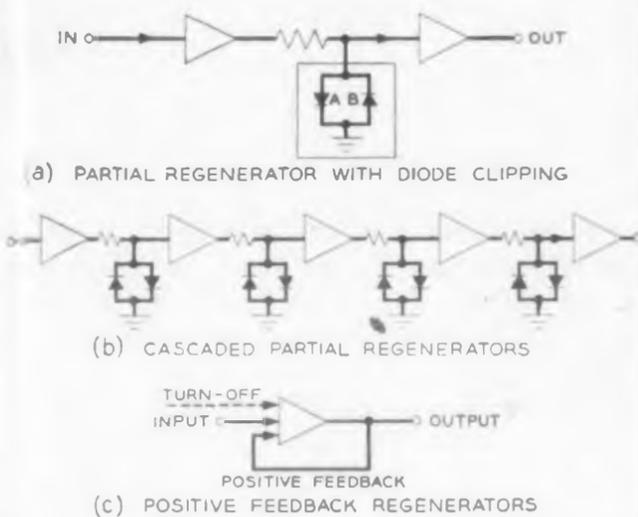


Fig. 19. Partial regenerator (a) shown cascaded (b). Positive feedback can be used as at (c).

a rate of more than 320 megabits per second.²²

Positive Feedback Regenerators

Positive feedback trigger circuits such as blocking oscillators and the various types of multivibrators accomplish the effect of cascading a large number of stages in a much more economical manner. The output is simply fed back to the input as indicated in 19c where it is amplified again. The process continues until self-limiting occurs. These circuits provide amplification as well as pulse stretching and can be triggered from a short input sample. Unlike the simple clipping amplifiers, however, some form of "turnoff" must be provided in order to bring the circuit back out of the limiting condition.

When control pulses are used to do this, they have to be relatively high power. This is particularly true of transistor circuits which are driven into saturation. The pulse length can be controlled relatively precisely because both turn-on and turn-off are specified.

When internal time constants are used to terminate the pulse, as in a blocking oscillator, no turn-off power is required. The pulse usually must be shorter than the full digit interval in order to allow time for recovery to a stable decision threshold. The duration is subject to somewhat greater variation. Monostable blocking oscillators or negative resistance circuits are probably the most economical of components since they can be built with one active element.

Timing Recovery Control

The regenerative repeater timing frequency must be slave in both frequency and phase to the signals which are sent out from the transmitter. The frequency can be taken from a separate channel or recovered from the pulse signals themselves

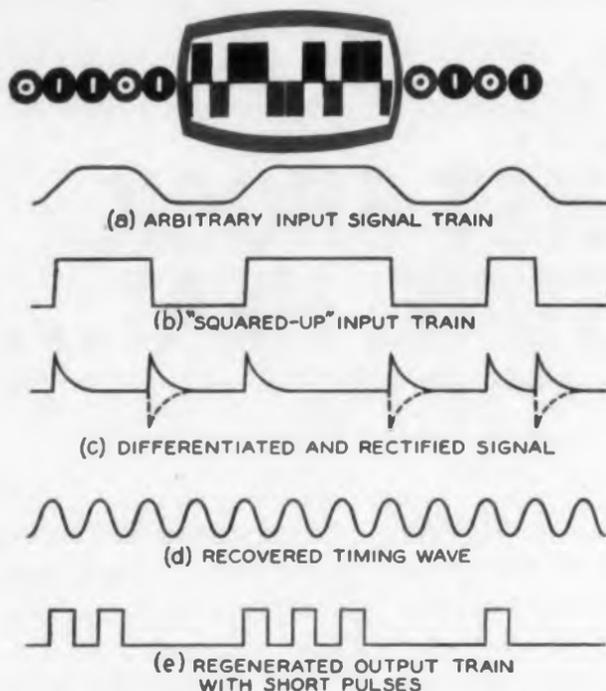


Fig. 20. Squaring up of input signal (b) is followed by differentiation (c), adding timing wave (d) resulting in regenerated output.

as indicated by the switch of Fig. 13.

When separate channel timing is used, a frequency which is either the fundamental bit frequency or a submultiple of it is sent over the same route as the signals. It is subject to the same delay variations as the signal; so it presumably will remain in the correct phase relationship to cause the retiming operation to occur at the midpoint of the binary signals. Noise should be small because a narrow band repeater can be used. It is, however, subject to crosstalk from the system itself which is right in the band. Regenerative type timing repeaters will help minimize the timing signal variations.

The major advantage of a separate channel timing circuit is that the timing information is always the same and the problem is simply one of separating it from the noise. A disadvantage is that a separate transmission path and repeater circuit must be used which, with very little addition, could be used to transmit a full channel of data. Failure can occur as a result of loss of either the timing or the signal path.

A narrow band filter can be used to extract timing information directly from the binary signal train. The filter "averages out" the frequency and phase. Although the timing wave will follow the slow or permanent changes, the broadband of noise will not perturb it.

If the bandwidth of the input amplifier and transmission circuit is kept to a minimum, such as indicated in Fig. 16, there is very little fundamental bit frequency in the input signal train. The most common practice in forward acting timing is to "square-up" the input signal, differentiate the result, and then rectify it as shown in Fig. 20. After rectification all transitions will add in phase with the bit rate timing frequency. The timing

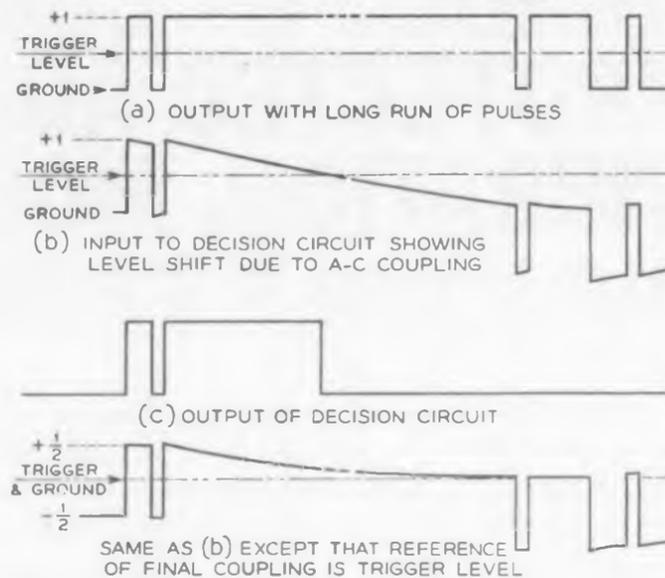


Fig. 21. Loss of regenerators margin due to duty factor variation.

frequency recovery circuit must have a sufficiently high Q to bridge any gaps due to long runs of all pulses or all spaces. A local slave oscillator can be used to provide a source of fixed magnitude signal.

The variation of input signal sequences may cause shifts in either magnitude or phase of the recovered timing wave. This is the principal problem for timing circuits which depend on the pulse train for timing information. Although the pattern effect is small in a single repeater, it may accumulate in a large number of repeaters because the same pattern appears at each one.^{23,24,25}

It is important to note that accumulated low-frequency timing variation will not reduce the signal-to-noise margin due to pulse-to-pulse jitter and distortion. Even though the timing wave variation accumulates through a long chain of repeaters to the point where it is slowly wandering forth and back through many cycles of phase shift with respect to absolute reference, the pulses from which the timing wave is derived are also accumulating a corresponding slow wander.

The penalty, if any, occurs in the demodulation process. If the effective filter bandwidth is sufficiently small, any disturbance for a time separation multiplex signal should be inaudible.

"Squaring-up" the input signals is really a form of partial regeneration with the retiming omitted. With backward acting timing the actual regenerated signal is used as a source of timing frequency. If the pulses occupy the full time interval as shown in Fig. 16a, the same differentiation process would have to be used as with the forward acting case. When the pulses are shorter than a full bit interval, as with a monostable type regenerator, every pulse will contribute to the recovered timing wave. See Fig. 20e.

Backward acting timing depends for control on the slight changes in firing time which occur when either the signal or timing is not in the proper position. A perfect timing control pulse would always cause the regenerator to fire at the same time. Therefore, a timing pulse with a finite rise time should be used. Because the regenerated pulses are used as a source of timing frequency, it is always necessary to design backward acting circuits so that pulses will be produced even though the timing wave disappears.

With either forward or backward acting timing, very long runs of pulses and very long runs of spaces should be avoided, if possible, in any type of repeater. In almost any ac coupled repeater, the duty factor variations cause shifts of the effective decision threshold which reduce the signal-to-noise margin to the point where errors are likely to occur long before the timing goes out. Even with dc coupling, the operating points and decision levels tend to shift with severe change in duty factor. For example, fixed and stray capacity charge, heating, I_{co} , base or grid currents, etc. may shift.

Duty Factor Variation

Fig. 21 illustrates the effect of using ac coupled circuits in regenerative repeaters with baseband signals. Ac coupling is usually desirable both for stability and gain where impedance transformation can be used and for coupling between balanced transmission lines and unbalanced circuits.

A long run of pulses, Fig. 21a, is equivalent to a step function. If the run is long compared with the low frequency cut-off, the pulse train will decay back to the coupling reference potential as indicated in 21b. Single time constant is shown. The result will be spaces where pulses should be as in 21c. Even if the run does not last long enough to cause an error directly, the decay will reduce the signal to noise margin. If the circuit is arranged so that the final ac coupling reference is the decision threshold as indicated in 21d, the pulses will at least decay no further than the decision level. In this case a long run of spaces is put in equal jeopardy.

The effective decision level for a pulse train will shift around due to simple variations of duty factor. The long run of all pulses or all spaces is simply the limiting case. The most obvious solution to this problem is to use dc restoration, but there are two limitations. Spaces must be pro-

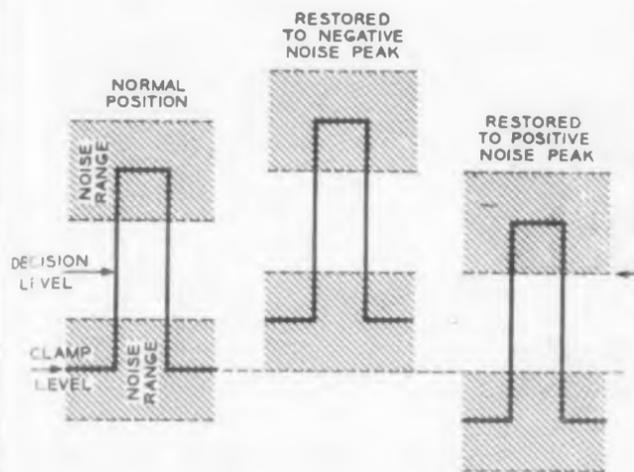


Fig. 22. Reduction of signal-to-noise margin due to dc restoration.

duced frequently enough to insure adequate restoration, and the signal-to-noise margin is cut in half because restoration is to the sum of signal and noise as indicated in Fig. 22a.

L. R. Wrathall²¹ showed that quantized feedback could be used to correct for the duty factor variation. Because the pulses have a fixed shape, they will cause a known low frequency "tail" to appear in going through one or more ac coupled circuits. The decay is really the summation of the tails from a large number of pulses.

With quantized feedback, an equal and opposite set of tails is generated to cancel the original ones by feeding back a part of the short regenerated pulse energy through the same or equivalent time constants. Quantized feedback is very effective, but the balance is subject to variation with general magnitude. In high speed circuits delay variations from the input to the output create problems.

Proposals for eliminating or reducing the dc or converting the ordinary binary pulse train to a more favorable one have been made by a number of workers in the field. ■ ■

References

20. H. Nyquist, "Certain Topics in Telegraph Transmission Theory", *Trans AIEE*, April 1928, pp. 617-644.
21. L. R. Wrathall, "Transistorized Binary Pulse Regenerator", *B. S. T. J.*, Sept. 1956, pp. 1059-1084.
22. S. E. Miller, "Waveguide as a Communication Medium", *B. S. T. J.*, Nov. 1954, pp. 1209-1266.
23. C. E. DeLange and M. Pustelnyk, "Experiments on the Timing of Regenerative Repeaters", *B. S. T. J.*, Nov. 1958, pp. 1456-1500.
24. H. E. Rowe, "Timing in a Long Chain of Regenerative Binary Repeaters", *B. S. T. J.*, Nov. 1958, pp. 1543-1598.
25. W. R. Bennett, "Statistics of Regenerative Digital Transmission", *B. S. T. J.*, Nov. 1958, pp. 1501-1542.



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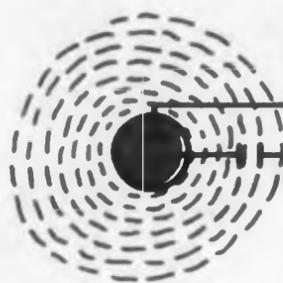
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Silicon Controlled Rectifier Automatically Sets Initial Multivibrator State



A naval officer as well as an engineer, Robert Mammano has been working on semi-conductor applications in missile programing systems. The module he's holding contains the circuit he describes in this article.

A SIMPLE, silicon controlled rectifier (SCR) circuit can be used to automatically fix, or set, the initial turn-on state of a bistable multivibrator.

When power is applied to a bistable multi, it is entirely arbitrary which side of the flip-flop will conduct initially. There will usually be enough unbalance in a flip-flop stage so that it will turn on in the same state. However, this turn-on characteristic is hard to predict and is also unreliable. The SCR circuit described here, sets the initial turn-on state and then allows the multi to be triggered in a balanced, normal manner.

Positive Base Voltage Can Be Used to Set Bistable Multi

A bistable multivibrator, which uses base turn-off triggering with negative input pulses, is shown in Fig. 1. This multi can be set by putting a positive voltage on one base and saturating the

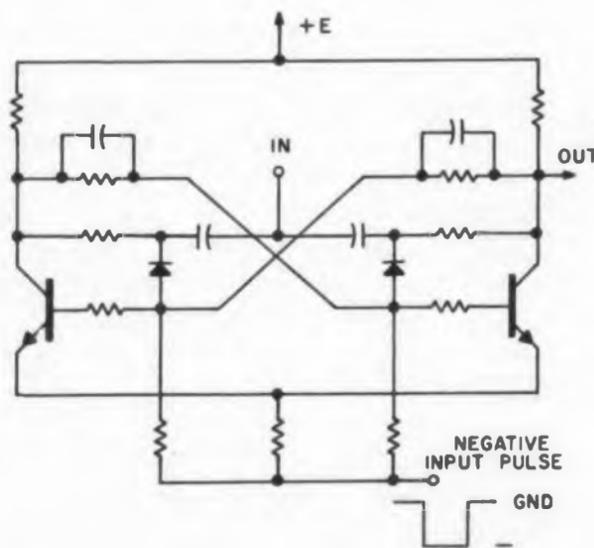


Fig. 1. Initial turn-on state of a bi-stable multivibrator is hard to predict.

transistor. This voltage can be introduced with the manually operated switch shown in Fig. 2. The positive voltage is applied to the transistor base when the switch is in the SET position. When moved to the OPERATE position, the set flip-flop can operate normally. The value of R is determined from the number of flip-flops to be controlled. An approximate value of R is found from the equation

$$R = \frac{E - I_b R_b}{n I_b}$$

where n is the number of multi stages and I_b is the base current which is required to saturate the transistor.

This system works quite well. It reliably sets the flip-flops and when switched to allow them to count, no triggering transients are developed. If, at a later time, it is desired to reset the stages, the switch is returned to the SET position. The obvious disadvantage of this system, however, is the need for a manually operated switch.

Pulse-Gated SCR Automatically Sets Initial Multi State

For remote or automatic operation, the manual switch is replaced by a silicon controlled rectifier, Fig. 3. The rectifier's open and closed states correspond to the SET and OPERATE positions of the manual switch. A 3A31 controlled switch made by Solid State Products, Inc. is highly suited for this application. It requires very little firing current (20 μ a), has a low maximum holding current (less than 2 ma), and is packaged in a standard TO-9 transistor case.

Initially the SCR is open. When the circuit is energized, current flows into the base of the tran-

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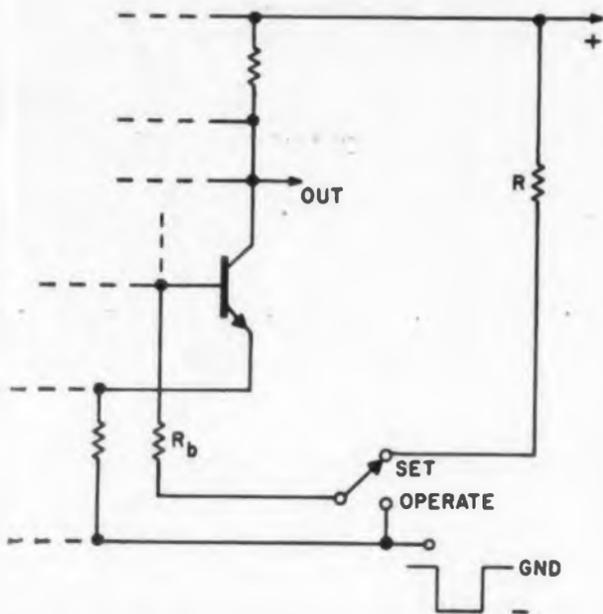


Fig. 2. Multi can be set by applying a positive voltage, through the manually operated switch, to the base of one transistor. The voltage is removed by moving the switch to the *OPERATE* position.

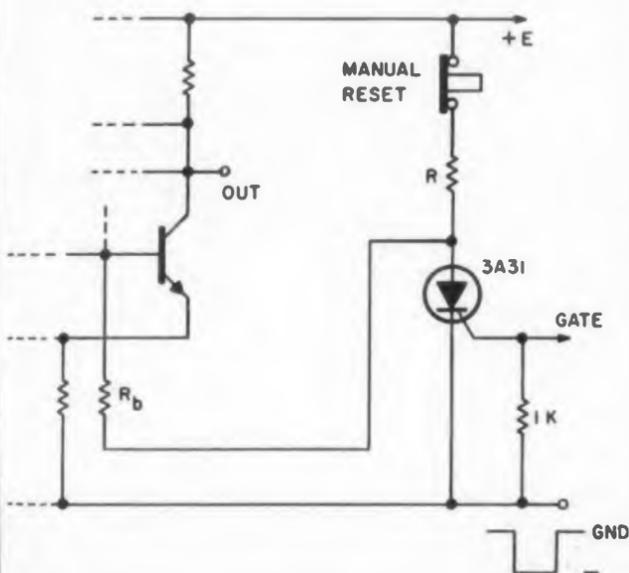
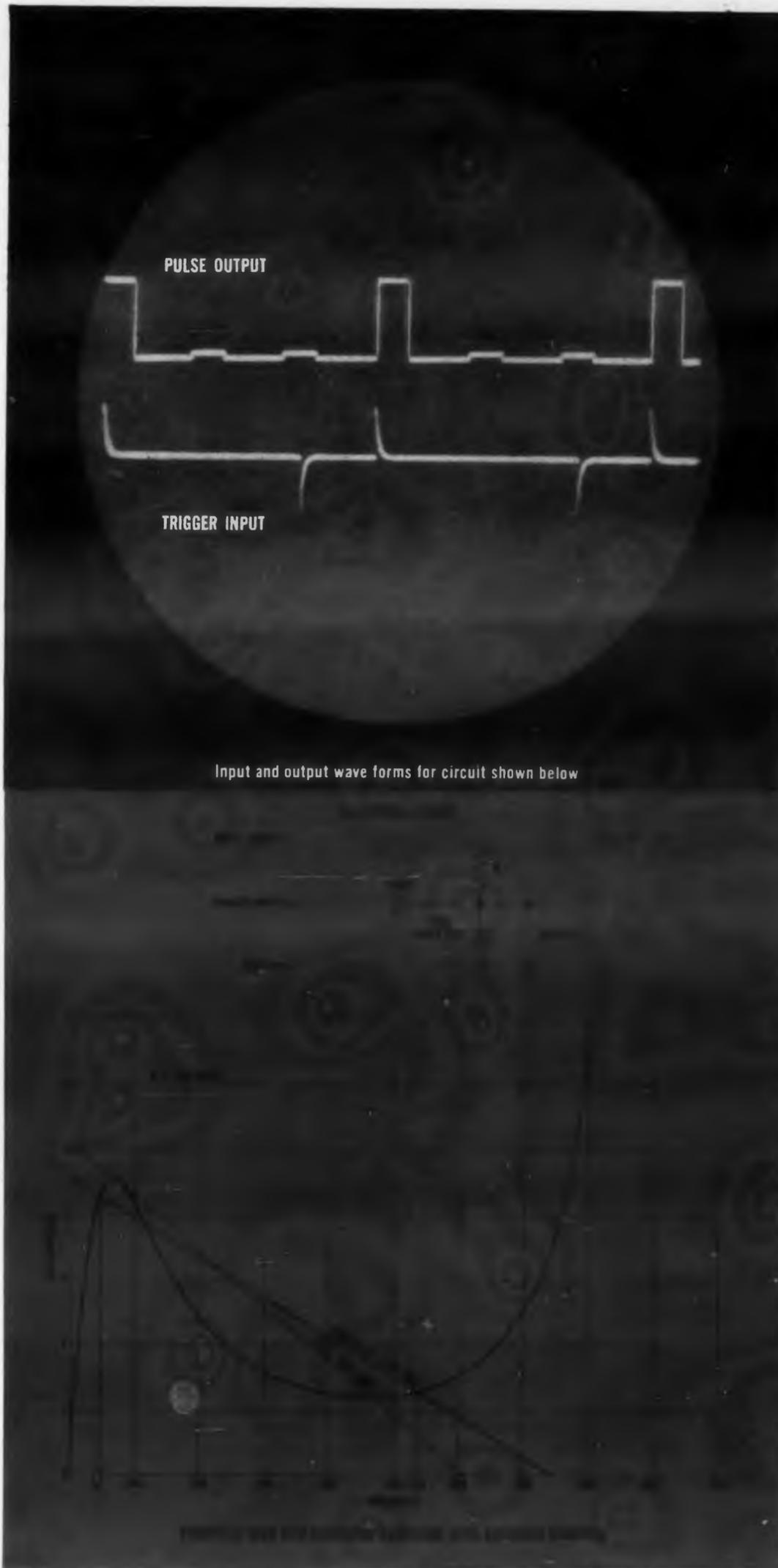


Fig. 3. The manually operated switch is replaced by a silicon controlled rectifier. Multivibrator can now be set electrically.

istor as in the manually operated case. However, when a positive signal is applied to the rectifier gate, it switches closed and the anode voltage is equal to the saturation voltage of the SCR. For the 3A31 unit this voltage is less than 1 v. This is close enough to ground potential to allow the flip-flops to operate in their normal manner. Thus, by applying a position gating pulse to the SCR, we have effectively moved the manually operated switch of Fig. 2 to the *OPERATE* position.

If it is desired to reset the flip-flop, the SCR may be turned off by either manually or electrically reducing the anode current below the holding value.

There are a few points to be considered if the circuit of Fig. 3 is to be used effectively. First,



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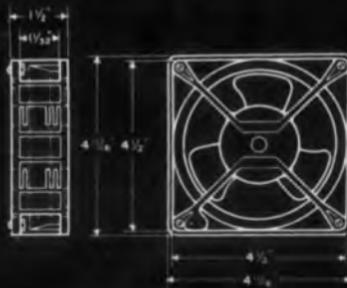
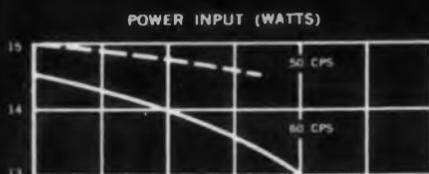
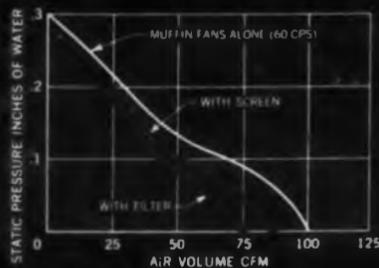
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An original aerodynamic design that provides a high air performance of 100 CFM free delivery and is capable of developing sufficient pressure for operation through a washable dust filter and tightly packed electronic equipment. Its high air performance, extremely compact size (only 4 1/8" square by 1 1/2" deep) and its moderate cost, provides for the first time efficient forced air cooling for equipments where cooling has been previously prohibitive.

As a design innovation, Rotron now offers the MUFFIN FAN in combination with a FILTER BOX which is perfectly matched to the pressure building capacity of the fan. The FILTER BOX locks in place between the Grille Frame and the Venturi Fan adding slightly less than 3/4" to the overall depth. The filter material is Air-Maze Media P96A, a high velocity, high efficiency, viscous impingement type that is permanent and is washable in hot water.

Power requirement is 105 to 120 VAC, 60 cycles, single phase. Electrical connection is made to convenient terminal lugs accepting standard 18 gauge lamp cord.

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"MUFFIN SKELETON FAN" "MUFFIN VENTURI FAN" "MUFFIN GRILLE FAN" "MUFFIN FILTER FAN"

MUFFIN FAN SELLING PRICES

	1-9	10-24	25-49	50-99	100-499	500-999	1000 up
Skeleton Fan	\$12.80	\$11.50	\$10.20	\$8.95	\$8.30	\$7.35	\$6.40
Venturi Fan	13.70	12.30	10.95	9.60	8.90	7.90	6.85
Grille Fan	14.50	13.05	11.60	10.15	9.45	8.35	7.25
Filter Fan	15.85	14.40	12.95	11.50	10.80	9.70	8.60



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ROTRON

mfg. co., inc. WOODSTOCK, NEW YORK — ORiole 9-2401
In Canada: The Hoover Co., Ltd., Hamilton, Ont.

CIRCLE 87 ON READER-SERVICE CARD

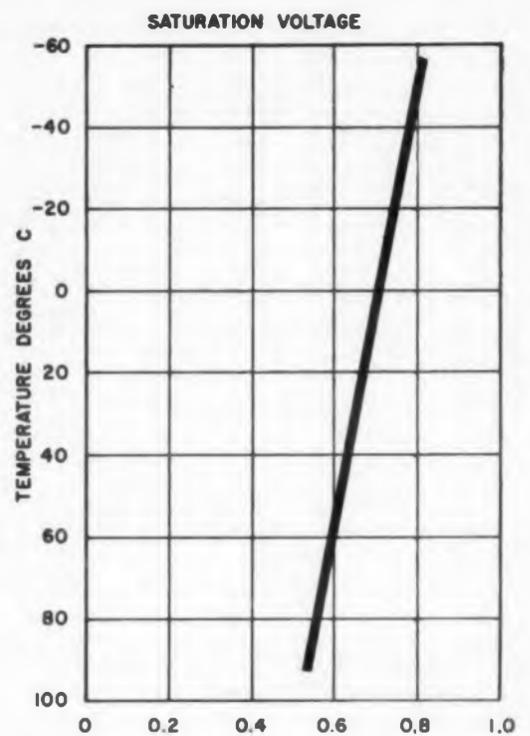


Fig. 4. Saturation voltage of switched controlled rectifier varies with temperature.

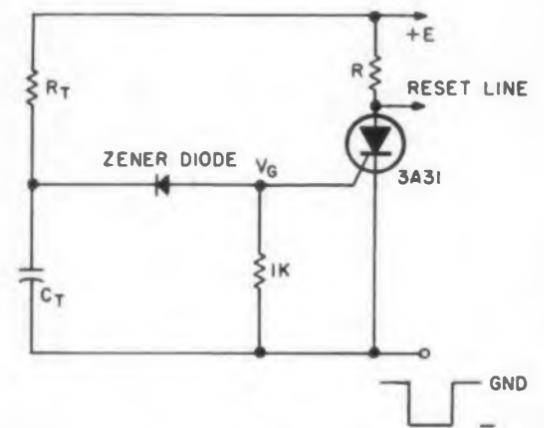


Fig. 5. With an RC charging circuit, the gating (switching) voltage for the SCR is obtained from the B+ supply.

the value of R has a maximum value determined by the holding current of the SCR. With a maximum holding current of about 2 ma, R would be limited to about 7 or 8 K. For most transistors this would normally not offer much restriction.

Second, instead of going directly to ground, the base resistor now goes to the saturation voltage of the rectifiers. In normal saturated flip-flop design, the off npn transistor has a negative V_{BE} . This negative voltage should be large enough so that when it is increased by the saturation voltage of the SCR, it is still negative.

Another problem is that the saturation voltage of the SCR varies with both temperature and current. A plot of the variation of this voltage with temperature is given in Fig. 4. Because of this

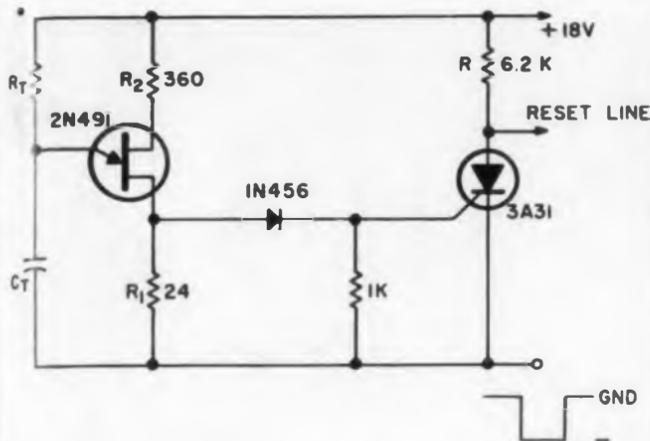


Fig. 6. For greater time delays in gating the SCR, a unijunction transistor is added.

variation it may be necessary to check the operation of the circuit at low operating temperatures.

RC Delay Switches SCR Without Separate Gating Pulse

The SCR can also be triggered, after an adjustable time delay, directly from the power source. There are two techniques for this. With each, the separate gating pulse for switching the rectifier is no longer required.

For short delays, an RC charging circuit and a Zener diode are used as shown in Fig. 5. In this circuit, V_G must be about 1 v to fire the SCR, R_T must be selected so that when the capacitor is charged, the voltage divider of R_T , the Zener voltage, and the 1 K biasing resistor allow V_G to equal 1 v. For times longer than a few seconds, C will have to be quite large. For delays of less than 1 sec, the Zener diode could be omitted.

The other method uses a unijunction transistor to provide the time delay as shown in Fig. 6. Here the delay can be made as much as a minute, and is fairly stable over changing environmental conditions. The time delay is given approximately by the equation:

$$T = R_T C_T \ln \frac{1}{1-k}$$

where k is the stand-off ratio of the unijunction transistor. To keep the steady state voltage well below the gate firing voltage of the SCR, R_1 is limited to about 24 ohms. The diode is included to avoid, after the switch has fired, the paralleling effect of the 24-ohm resistor. If the gate-to-cathode resistance is lowered, the value of holding current will increase.

This circuit was experimentally built for a 10-sec delay. It performed satisfactorily with a timing tolerance of 5 per cent over the temperature range of -50 C to $+100$ C. Higher temperatures could be obtained with a sacrifice in holding current by changing the biasing of the controlled rectifier. ■ ■

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Our design thinking is not limited to cold plates: we use ultra-thin pin-type plates, corrugated foil, corrugated plates, spiral tubes, or combinations of elements to achieve optimum heat transfer while meeting electronic, mechanical, and other design requirements.

For example, mounting shown above was made to the specifications of a major electronic manufacturer. We solicit your inquiries. Janitrol Aircraft Division, 4200 Surface Road, Columbus 4, Ohio.

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CIRCLE 89 ON READER-SERVICE CARD

Automated coordinatograph extracts cartographic data from aerial photograph. Flexowriter at left prints out coordinates of objects observed through viewing microscope. Operation is controlled from panel atop the electronics cabinet. Robert Conroy (left) and C. W. Hargens, both of the Franklin Institute Laboratories, Philadelphia, demonstrate the machine.



Point Plotter Gives a 0.0015-In. Accuracy

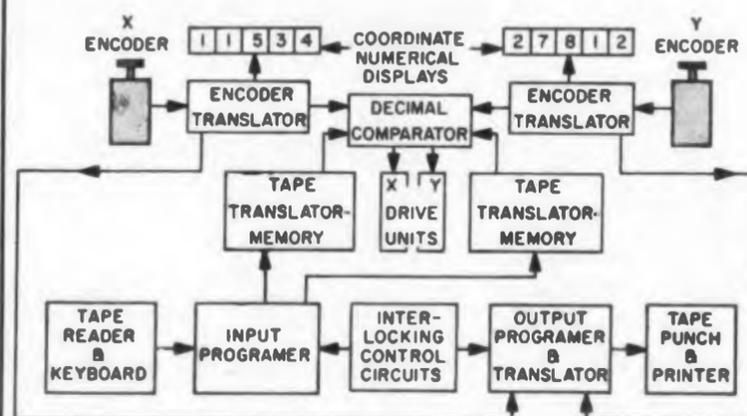
NUMERICAL control techniques and digital position encoders are employed in a newly developed, automated point plotter that has a claimed accuracy of 0.0015 in. The instrument is being manufactured by the Aero Service Co., 210 E. Courtland St., Philadelphia, Pa., and is an automated version of the Swiss-made Haag-Streit coordinatograph—a manual plotter widely used in printed circuit layouts, data plotting and other precision drafting applications.

The automated instrument employs two servo-driven carriages mounted on the X and Y rails of the basic Haag-Streit machine. Carriage positions are measured by two Datex double-disc, contact-type digital encoders having a resolution of 0.001 in. Their accuracy permits carriage position determination to five significant figures over the entire 47-1/4 in.-square working area. This information can be printed out directly by a Flexowriter or used as an error signal in driving the carriages to a desired location on the work table. A solenoid-operated marking pin and a viewing microscope can be interchanged, depending on

whether a point is to be marked on or read off the work table.

When driving the carriages to a desired position by a manual or punched tape input, each decimal digit of the input is examined sequentially and compared against carriage location as derived from the encoders. The most significant decimal digit is compared first and an "increase" or "decrease" circuit is closed to the servo drives. When coincidence is reached, the next significant digit is examined and nulled. This process continues automatically until complete coincidence of all X and Y digits is reached. The marking solenoid is then energized.

A separate carriage speed is used in zeroing each decimal position. These speeds range from a maximum of 3 ips for the first significant digit to a minimum of 0.003 ips for the thousandths decimal position. Speed changing is performed automatically, a decade at a time, as each successive digit reaches coincidence with the numerical command. The four highest speeds are implemented by various driving combinations of two servo motors working through a differential and



Logic and control system of the automated coordinatograph. Input Programmer directs Flexowriter input to appropriate X and Y channels. Tape Translator converts 8-digit binary code to decimal code for use in Comparator. Encoder Translator receives binary-coded cyclic decimal information from position encoders and converts it into decimal code. Both decimal codes are then fed to the Decimal Comparator which drives the carriages accordingly.



Millimeter devices now available in six product lines



**SMALLER, LIGHTER
BACKWARD-WAVE OSCILLATOR**

Type BW-1757 delivers up to 15 mw from 26.5-41 kmc in a streamlined new package. Also available are types from 18 to 26.5 and 40 to 75 kmc. BWO's above 75-100 kmc are in development.

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**



coupled to the carriage by a steel tape. A gear-head motor and lead screw at the encoder provide the 0.003 ips drive.

Connections to the encoder heads and servo motors are through Mylar-insulated printed circuit cables. Two 30-conductor cables are required for each carriage.

Semiconductor And Relay Logic Used

The logic and control circuits, housed in a separate cabinet, employ relay and semiconducting computing elements throughout. All-digital logic and the absence of tubes eliminate drift. Pulse counting is avoided; the logic circuit is static and directly coupled at all times. Binary-to-decimal conversion is through transistor-buffered relay trees and odd-even complementing circuits. Numerical comparisons and decisions are made by diode matrices.

The coordinate origin can be shifted at will; carriage position with respect to the origin is indicated on the control panel by projection-type numbers.

A series of points can be marked one at a time or programmed automatically by a punched tape input to the Flexowriter. The coordinatograph can mark or locate successive points at 0.001-in. intervals. When operated in this manner, the instrument serves as a highly accurate but slow curve tracer.

Closed Circuit TV Available

The reverse of this operation (such as locating objects in an aerial photograph or determining values from a data curve) can be performed to the same close tolerances as the plotting function. This operation generally requires two men—one at the control console and an observer at the work table. An optional closed-circuit TV system will be made available to expedite viewing and control. Full benefit of the coordinatograph's 0.0015-in. accuracy of course requires that reading or plotting be done on glass, metal and other dimensionally stable materials.

The automated coordinatograph was designed by C. W. Hargens of the Franklin Institute Laboratories, Philadelphia. The instrument, including Flexowriter and control console, is priced at \$34,750. The closed circuit TV system, specially designed for mounting on the carriages, is approximately \$6,500 additional. Delivery is from 90 to 120 days.

For more data, turn to the Reader Service card and circle number 250.

FERRITE CIRCULATORS AND ISOLATORS

In production at Sylvania are Tee circulators and waveguide isolators in the 18 to 26 kilomegacycle range. Development programs are under way for devices above 26 kmc.

MAGNETRONS DELIVERING UP TO 100 KILOWATTS

Sylvania's line of rugged Ka-band magnetrons have output powers from 20 to 100 kw. K-band type M-4154 delivers 55 kw. Samples are available of new, rugged Ka-band type M-4218, weighing only 4 1/2 pounds. Techniques are available for development of types to 100 kilomegacycles.

NEW WAVEGUIDE WINDOWS AVAILABLE

Sylvania is now producing two new waveguide windows in K and Ka bands, with flanged mica windows:

Type WG-4224	18 to 26 KMC
Type WG-4223	26 to 40 KMC

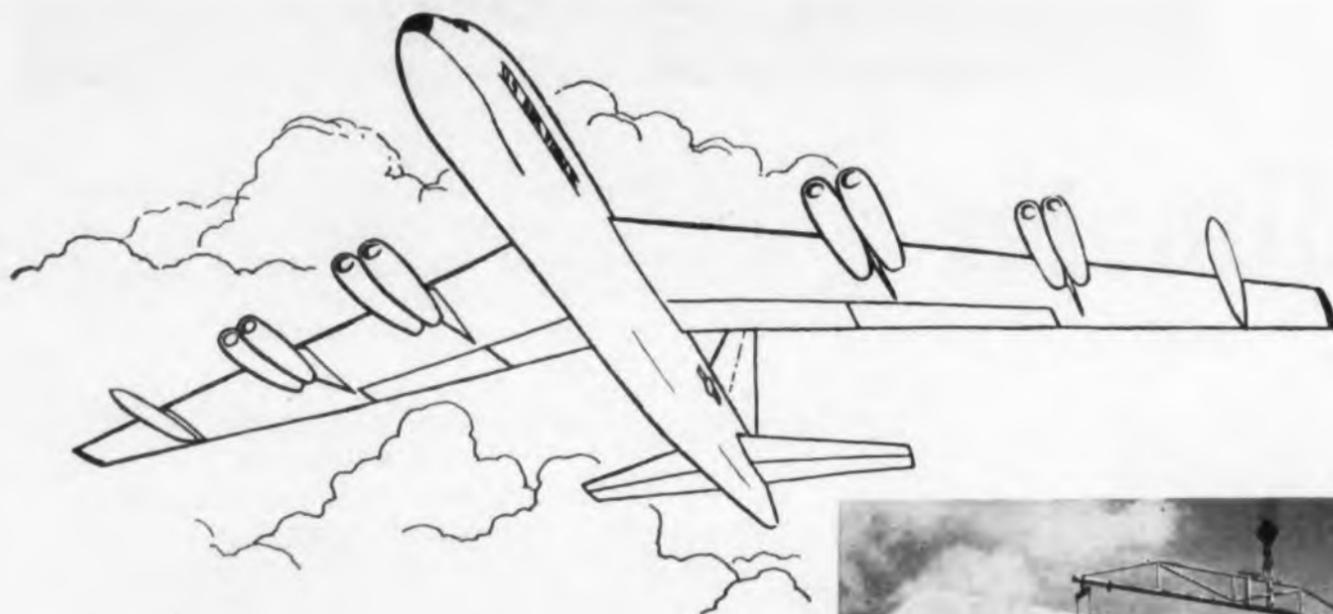
SYLVANIA TR AND ATR TUBES

Sylvania-developed TR and ATR tubes for Ka-band operation are available with power handling capability up to 100 kw.

IN THE DEVELOPMENTAL STAGE:

Sylvania has proved research and development capability for O and M type devices. One of the important projects now programmed at Sylvania's Bayside Physics Laboratory is a harmonic generator in the 200 to 400 kmc range which takes advantage of the non-linear conductivity characteristics of Germanium. And the Bayside labs are at work on the Tornadotron, with which 0.1 MM will be reached; millimeter amplifiers are also in development.

For further information write Sylvania Special Tube Operations, 500 Evelyn Ave., Mountain View, California, indicating the product lines in which you are interested.



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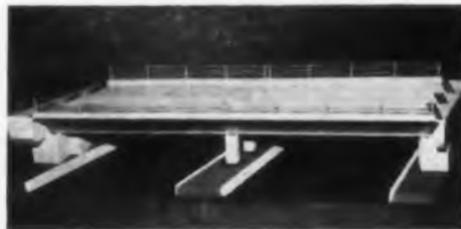
The Fairchild Aircraft & Missiles Division's design and construction capabilities were acquired through long experience in successfully completing varied projects for industry. Just one of the many areas where Fairchild's proved abilities are at work is the production of major assemblies for the Boeing B-52 intercontinental jet bomber. Fairchild utilizes its diverse experience in bonding, plastics and metals to con-



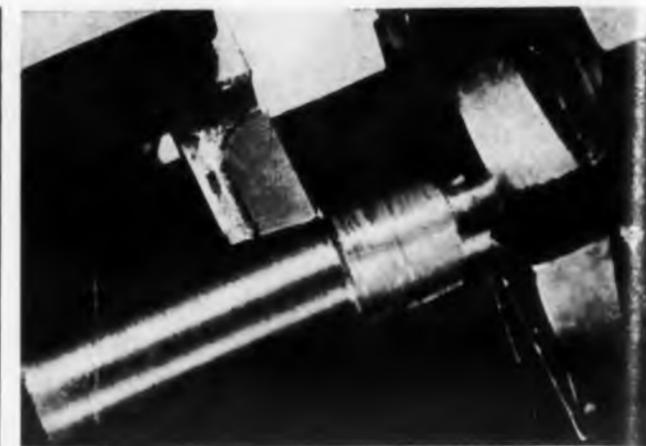
struct honeycomb sandwich wing panels, magnesium laminated wing skins, tapered honeycomb trailing edges and honeycomb wheel and strut doors—many to critical tolerances.

Fairchild's broad facilities, its modern equipment and personnel experienced in the on-time design

and fabrication of systems, sub-assemblies and products, are available to you. Write today for detailed information.



Representative of Fairchild's diverse production capabilities are: VTOL/STOL projects • High flotation gear • Boeing B-52 assemblies • SD-5 surveillance system • Antenna and installation housing for Project Defender Pincushion radar • F-27 propjet • Aluminum boats, lampposts and bridges.



Machining of tungsten and other refractory materials is now possible at significantly lower temperatures as a result of the development of large crystals of these metals and compounds.

Large, Single Crystals of And Metallic Compounds

Type Available "As Grown" Single Crystals

NEW MATERIALS that lend themselves to the solution of a variety of problems encountered in high-temperature electronics are now available. The materials take the shape of large single crystals and are grown from metals and metallic compounds by an arc fusion process.

Made by the Linde Co., a division of Union Carbide Corp., 270 Park Ave., New York 17, N.Y., the crystals have the following claimed advantages:

- Purity.
- Homogeneity.
- Absence of grain boundaries and porosity.
- Controlled crystallographic orientation.

	Material	Largest Diameter (In.)	Maximum Length (In.)
METALS	Tungsten	5/8	12
	Molybdenum	3/4	12
	Vanadium	3/4	12
	Columbium	3/8	12
	Tantalum	5/8	12
COMPOUNDS	Titanium Monoxide	3/8	2
	Titanium Sesquioxide	1/4	1/2
	Titanium Carbide	3/8	3/4
	Molybdenum Disilicide	1/4	1/2

FAIRCHILD AIRCRAFT & MISSILES DIVISION
Fairchild Engine & Airplane Corp. • Hagerstown, Maryland

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The new large single crystals are produced by the arc fusion process in individual furnaces like the one pictured here.

Metals

Compounds Grown

Single Crystals of Refractory Materials

The high purity and non-porosity of tungsten crystal suggests applications as electrical contact points in vacuum switches, lead-ins to vacuum equipment, and other places where outgassing is a problem, according to Dr. C. R. Castor of the Linde Company's Crystal Products Dept. He adds, "the high purity of these crystals also results in low, cold emission, making them of value in several electronic applications."

Some of the non-metal crystals hold promise as semiconductors. Titanium diboride, for instance, is a high-temperature semiconductor.

At present, the company has available in stock nine refractory materials as grown in single crystal form. These are: (metals) tungsten, molybdenum, vanadium, columbium, tantalum; (compounds) titanium carbide, titanium monoxide, titanium sesquioxide, molybdenum disilicide. Other crystals will be available shortly.

These single crystals can be formed and worked at temperatures significantly lower than those normally associated with the refractory group, says Linde. Threads, for example, can be tapped into bolts made from single crystal tungsten without cracking.

The crystals come either in "as grown" cylindrical form, as swaged or in fabricated shapes. Special sample packages for laboratory investigation of properties have been prepared for both the metal and non-metal crystals. These packages are priced at \$90 each. The cost of large single crystals depends on a number of variables.

For more information on these crystals, turn to the Reader Service Card and circle 251.



CUBIC Digital systems speak for themselves

An uncluttered, human-engineered front panel and internal engineering and construction demonstrate to the eye that Cubic's is the *superior* digital instrument. Proof of this superiority is in the *operation* . . . and side by side in independent evaluations of many instruments, Cubic again and again provides the instrumentation that is *specified*.

Any phenomenon of science which can be converted to a usable DC Voltage can be measured with the Cubic 4 or 5-digit Voltmeter (Models V-41, V-51) powered by the Model C-1 Control Unit. Addition of an AC Converter (Model AC-1, manual ranging; Model AC-2, automatic ranging) or a Model PA-1 Preamplifier extends the systems capabilities to the measurements of AC voltages or lower level DC voltages.

Precise resistance measurement is possible using O-41 and O-51 four- and five-digit Ohmmeters, powered by C-1 or C-2 Control Units.

Multiple input channels may be sampled rapidly and accurately with the Model MS-2, a single unit for scanning up to 100 points, or the MS-1, AS-1 Master-Auxiliary combination for scanning up to 1000 points with multiples of one, two, four or five-wire inputs.

Voltage ratio measurements are made with the R-41 and R-51 4 and 5-digit models operating only as Ratiometers or with the VR-41 and VR-51 models, which operate both as Ratiometers and Voltmeters. Measurements can be permanently recorded with the addition of a PC-Series Printer Control Unit, providing input for any quality printer on the market.

AND NEW FROM CUBIC . . . the Talking Meter, instrumentation that really *does* speak for itself, instrumentation that provides a new dimension in "readout," measurements or other parameters reported to the ear by a clear human voice.



Years-ahead engineering, factory production techniques inspired by pride in the end result, careful quality control and reliability testing . . . all these factors make Cubic's the truly fine instrumentation . . . Digital Systems that speak for themselves.



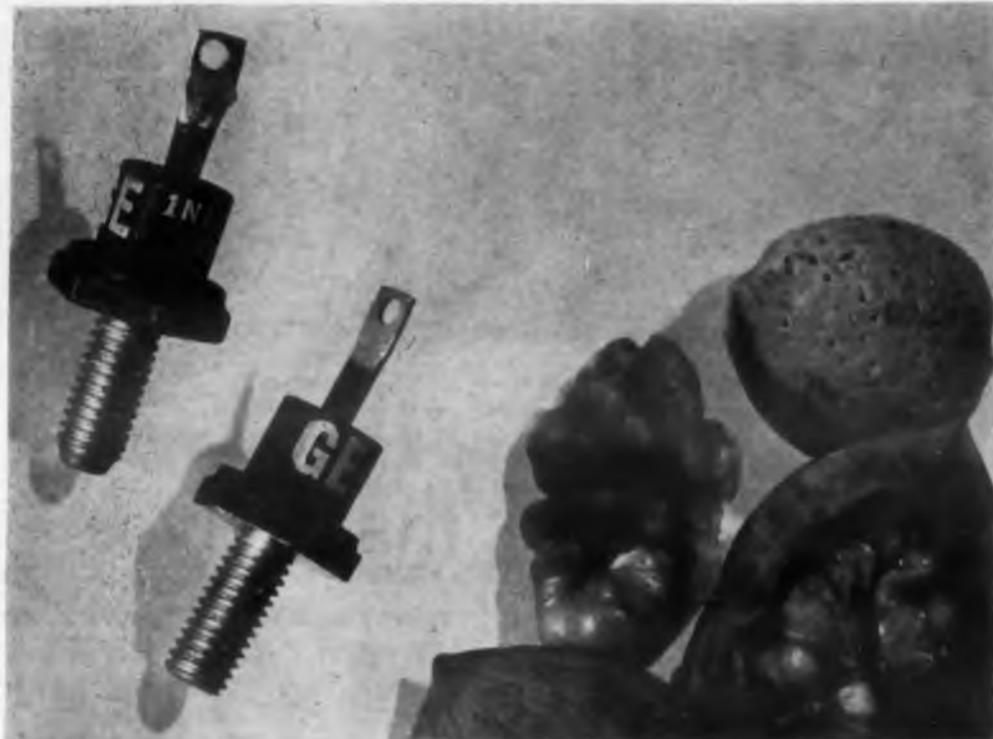
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NEW PRODUCTS

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



Silicon Rectifiers Designed For 2 to 8 Amp Range

257

Designed for rectifier applications in the 2- to 8-amp range, these 16 silicon units have piv ratings between 50 to 600 v. Both positive and negative polarity rectifiers are available. All the units, JEDEC numbers 1N1341A through 1N1348A and 1N134RA through 1N1348RA, feature all hard-solder design for maximum thermal fatigue free operation. They have a junction operating and storage temperature range from -65 to $+200$ C.

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

Price & Availability: In medium size quantities, the units are priced from \$2.40 each to \$15.15 each. No extra charge for reverse polarity units.

Diode Combines Feature Of General And Computer Types

256

The type 1N661A, all-purpose silicon diode combines the low leakage specifications of the best general purpose types with the switching speed of the best computer types. At 200 v, the unit has a maximum reverse leakage of $0.025 \mu\text{a}$ at 25 C, $1 \mu\text{a}$ at 100 C, and $5 \mu\text{a}$ at 150 C. Recovery time is 0.3 μsec to 400 K under the switching conditions of $+30$ ma to -35 v in the JAN 256 circuit. Sealed in a standard glass package, the unit is certified to MIL-S-19500B.

Rheem Semiconductor Corp., Dept. ED, 350 Ellis St., Mountain View, Calif.

Price & Availability: \$2.74 at 100 quantity level; immediately available from stock in production quantities.



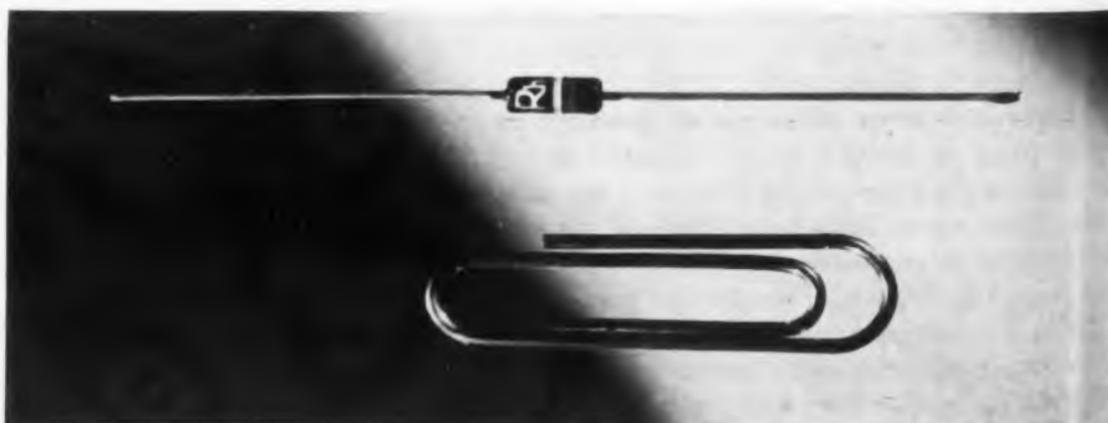
Laboratory Kit Fabricates Micromodules And Circuits

255

This do-it-yourself laboratory kit enables engineers to design and fabricate micromodules and electronic circuits with packing densities of several hundred thousand parts per cubic foot. Ten feet of workbench and a tank of nitrogen are all the additional equipment required. The micromodule is a series of tiny ceramic wafers with microminiature components applied to them. The kits start with the completed wafers and include all equipment to build and test up to 10 modules.

Radio Corporation of America, Semiconductor and Materials Div., Dept. ED, Somerville, N.J.

Price: \$800 per unit.



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Miniature Power Supply Delivers 20,000 V

258

These plug-in power supplies, actuated by sources as small as a 1.5-v penlight cell or a 1.3-v mercury cell, deliver voltages as high as 20,000 v. They can stand the shock and acceleration found in missiles. Designated Varia-Volt, three models are available. Inputs range from 1.5 to 6 v at 4 to 65 ma; outputs from 800 to 20,000 v dc.

Victory Electronics, Inc., Dept. ED, 50 Bond St., Westbury, L.I., N.Y.

Price: Prices start at \$93.80 each.



Coaxial Cable Operates At 1,500 F

259

Model 323 coaxial cable operates at temperatures as high as 1,500 F. It uses a specially processed silica dielectric, copper conductors, and a protective stainless steel sheath. It can only be supplied with type C, N, TNC or BNC rf connectors capable of operating at 500 F or with special connectors that operate at 1,000 F. It is normally supplied with a 50 ± 2 ohm characteristic impedance; other impedances are available.

Thomas A. Edison Industries, McGraw-Edison Co., Dept. ED, West Orange, N.J.

Availability: Samples available in 8 to 10 weeks.

From JFD the Miniature Trimmer America Knows Best!



6 X actual size



actual size
model VC20G
0.8 - 8.5 pf

U. S. Patent No. 2,922,093

FEATURES

1. Compactness—(More capacitance per cubic inch).
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11. High Q.—low dissipation factor.
12. Positive mechanical stops at both ends of adjustment.
13. Available in either glass or quartz dielectric.
14. Sealed interior construction locks out all atmospheric effects in Sealcap series.

Whether your circuit requirements call for performance in or out of this world, you can rely on JFD miniature trimmers. Tens of thousands in daily use under severe operating conditions on land, under sea and in space best tell their story of outstanding reliability.

The reasons why JFD precision piston trimmers are preferred make sense. They deliver maximum capacitance range in a minimum size...offer exceptional stability... High Q... — even under conditions of severe shock, vibration and acceleration. The adjusting shaft of the miniature capacitors is self-contained within the capacitor permitting tuning without changing the size of the unit. In short, the design meets the most demanding requirements of the missile age electronics.

The popular model VC20G above is only one of the complete family of JFD miniature and subminiature trimmers. More than 200 models are available from stock. JFD also manufactures trimmers in quantities to meet special needs — plus a wide variety of fixed metalized inductors, LC tuners, fixed and variable, distributed and lumped constant delay lines, pulse forming networks and diplexers.

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15 Moore Street, New York, N. Y.

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Gives you accurate, continuously variable voltage outputs

0 to 10 v RMS, 1000 cps
0 to 10 v PEAK to PEAK, 1000 cps
0 to 10 v DC

Especially useful for checking accuracy

of laboratory voltmeters and oscillographs

Ballantine's Model 420 Calibrator has proven to be an extremely useful instrument for quickly checking the calibration accuracy of voltmeters and oscillographs.

Its long term stability is such that you can rely on it for better than 1/4% when using it with a calibration chart, and 1/2% without the chart. Accuracy checks can be made with it in less than a minute. This will help you to reduce materially the out-of-service time for voltmeters that otherwise might have to be sent to a central calibration department.



Price: \$365

BALLANTINE MODEL 420-AC-DC CALIBRATOR

SPECIFICATIONS

Internal Impedance of Outputs: 2 to 20 ohms over range 0 to 10 v, 1000 cps output; less than 5000 ohms on dc output.

Distortion and Hum: Less than 0.25%.

Setting Resolution: Approaches 0.01% above 10 mv.

Power Supply: 115 v, 50-60 cps, 35 watts; 230 v, 50-60 cps on request.

Dimensions: 6" h, 6 3/4" w, 10 7/8" d.

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Boonton, New Jersey

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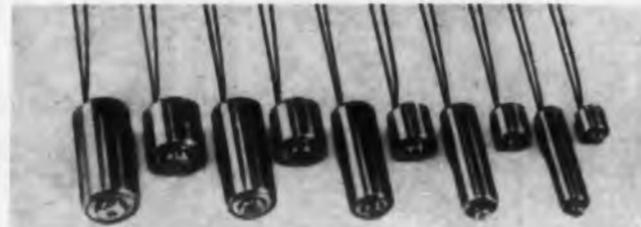
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NEW PRODUCTS

Miniature Solenoids

509

Come in five types



Series ME solenoids are offered in five standard types ranging from 1/2 to 1 in. in diameter, have high-temperature insulation, and can be push or pull types. Various mounting arrangements can be furnished. The units are for dc applications and are made with ratings to 125 v.

Anderson Controls, Inc., Dept. ED, 9959 Pacific Ave., Franklin Park, Ill.

Silicon Rectifier Stacks

510

Current ratings are 2 to 35 amp



For all basic circuit configurations, these pre-assembled silicon rectifier stacks have piv ratings from 50 to 600 v and current ratings from 2 to 35 amp. Sizes are 2 x 2 in., 2 x 3 in., and 5 x 5 in., all 0.064 in. thick.

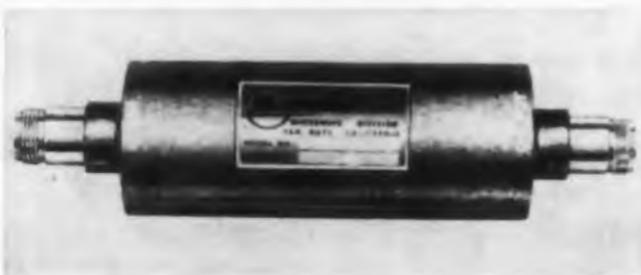
Vickers, Inc., Dept. ED, 1815 Locust St., St. Louis 3, Mo.

Availability: Delivery time is two weeks on all standard units.

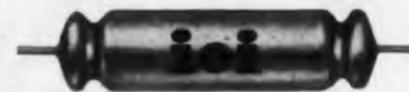
Ferrite Isolators

507

Five units cover 2 to 11 kmc



These ferrite isolators consist of coaxial con-



tantalum foil, silver encased, non-polar



tantalum foil, silver encased, polar



aluminum foil, ceramic and plastic encased



aluminum foil, aluminum and plastic encased, single end

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Here's why **iei** is your best source for virtually any type of miniature or sub-miniature electrolytic capacitor:

- Tantalum foil capacitors in ten different case sizes—less weight—save space.
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Write for bulletins 81558 and 2625. International Electronic Industries, Inc. Box 9036-P, Nashville, Tennessee.

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CIRCLE 95 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 1960

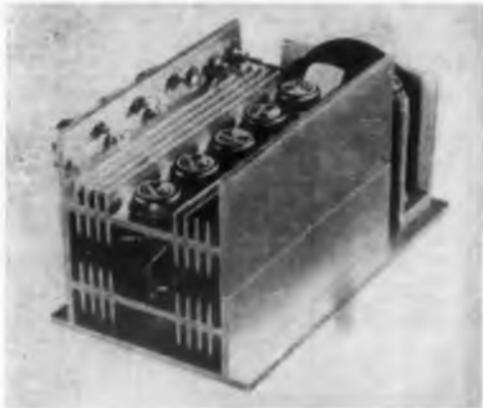
struction with permanent magnet transverse field and ferrite sections built in. Five models are offered. Model C992100-402 covers 2 to 3 kmc; model C992100-404, 2 to 4 kmc; model C992100-403, 3 to 4 kmc; model C993100-401, 4 to 8 kmc; and model C994100-402, 7 to 11 kmc. The vswr is 10 w for all units. Type N female terminations are used.

Kearfott Div., Dept. ED, 14844 Oxnard St., Van Nuys, Calif.

Heat Sink

512

Dissipates 200 w with a rise of 12 C



This heat sink dissipates hundreds of watts with temperature rises of a few degrees, using forced convection or a few watts of power with natural convection. With a 6.75-in. stacked structure and 120 cfm of blower-supplied air at 0 pressure, 200 w are dissipated with a temperature rise of 12 C. Thermal resistance is 0.06 C per w.

The Delbert Blinn Co., Dept. ED, P.O. Box 757, Pomona, Calif.

Price: The extrusion is offered in 5-ft lengths at the price of \$10 per ft for up to 25 ft. For 25 to 100 ft, price is \$9 per ft.

Torque Tester

436

Static and dynamic characteristics measured

Model 67-M2 torque tester can measure the static and dynamic characteristics of such devices as ball bearings, gyro motors, meter measurements, torsion wires and dampers. The tester has an air bearing that offers low friction and stiff support in both radial and axial directions for the device under test. Measurements are made by summing torque about the air supported shaft. The maximum axial load is 1 lb and the readout accuracy is 0.1%. The adjustment resolution of the alignment fixture is 20 millionths of an inch. Maximum calibration torque is 5000 dyne cm.

Dynamics Research Corp., Dept. ED, 38 Montvale Ave., Stoneham, Mass.

Price & Availability: Made on order only; \$19,958 per unit.



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THE DELAY TIME

with the New ESC Direct Readout Variable Decade Delay Line

Now you can make your own rapid selection of desired delay with the new Direct Readout Variable Decade Delay Line — the newest product developed and manufactured by ESC, America's leading manufacturer of custom-built and stock delay lines! Increments of 1/1,000 of the total delay may be selected by the turn of a dial. And there are three models:

Model 101 — a total delay of 9.99 usec.

Model 102 — a total delay of 99.9 usec.

Model 103 — a total delay of 999 usec.

There is a constant impedance of 1,000 ohms between input and output terminals for any delay increment.

Delay/rise time ratio at maximum delay is 33:1. The ESC Direct Readout Variable Decade Delay Line is a passive delay network and will not introduce noise or jitter. Mechanical and electrical modifications available on special order.



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Distributed constant delay lines • Lumped-constant delay lines • Variable delay networks • Continuously variable delay lines • Step variable delay lines • Shift registers • Video transformers • Filters of all types • Pulse-forming networks • Miniature plug-in encapsulated circuit assemblies

CIRCLE 96 ON READER-SERVICE CARD

NEW PRODUCTS

Tantalum Capacitors 515

Operate from -80 to +125 C

These capacitors are offered in type ST-12 with an un-insulated case and type ST-13 with an insulated case. Temperature range is -80 to +125 C. Voltage ratings are 6, 10, 15, 20, and 35 v dc for operation at +85 C and 4, 7, 10, 13, and 23 v dc for operation at +125 C. A semiconductor electrolyte is used. Designated Aerotan, the units meet the requirements of the proposed specification MIL-C-26655A.

Aerovox Corp., Dept. ED, New Bedford, Mass.

General Purpose Relay 505

Has built-in neon lamp



Type KRP-N general-purpose relay, equipped with a built-in indicator lamp, can be furnished for 6 to 110 v dc or 6 to 230 v ac operation. Silver contacts rated at 5 amp and silver-cadmium contacts rated at 10 amp are used for both units. Contact arrangements are up to 3 pdt. Overall dimensions are 2 x 1-13/32 x 1-13/32 in.

Potter & Brumfield, Dept. ED, Princeton, Ind.

Micromodule Socket 514

For printed-circuit boards

Designed to mount on a printed-circuit board, this socket makes it possible to remove and replace the RCA micromodule with the same ease as replacing a tube. Micromodules may be mounted on 0.4-in. centers. The insulating material is

SELECT FROM INDUSTRY'S BROADEST LINE OF SILICON DIODES AND RECTIFIERS

HIGH CONDUCTANCE GENERAL PURPOSE SILICON DIODES

Type	Case Type	PIV	V _Z	Min. DC Fwd I @ 25°C ma @ 1v	Maximum I _b		P @ 25°C mw
					25°C μA	100°C μA	
1N645	N	225	275	400	0.2	15	600
1N645A	N	225	275	400	0.2	15	600
					0.05 @ 60v	10 @ 125°C @ 60v	
AF1N645	N	225	275	400	0.2	15	600
1N646	N	300	360	400	0.2	15	600
AF1N646	N	300	360	400	0.2	15	600
1N647	N	400	480	400	0.2	20	600
AF1N647	N	400	480	400	0.2	20	600
1N648	N	500	600	400	0.2	20	600
AF1N648	N	500	600	400	0.2	20	600
1N649	N	600	720	400	0.2	25	600
AF1N649	N	600	720	400	0.2	25	600

GENERAL PURPOSE SILICON DIODES

Type	Case Type	PIV	V _Z	Min. DC Fwd I @ 25°C ma @ 1v	Maximum I _b		P @ 25°C mw
					25°C μA	150°C μA	
1N456	N	25	30	40	0.025	5	500
1N456A	N	25	30	100	0.025	5	500
1N457	N	60	70	20	0.025	5	500
1N457A	N	60	70	100	0.025	5	500
JAN 1N457	N	60	70	20	0.025	5	500
1N458	N	125	150	7	0.025	5	500
1N458A	N	125	150	100	0.025	5	500
JAN 1N458	N	125	150	7	0.025	5	500
1N459	N	175	200	3	0.025	5	500
1N459A	N	175	200	100	0.025	5	500
JAN 1N459	N	175	200	3	0.025	5	500
1N461	N	25	30	15	0.5	30	200
1N462	N	60	70	5	0.5	30	200
1N463	N	175	200	1	0.5	30	200
1N464	N	125	150	3	0.5	30	200
1N482	N	30	40	100*	0.25	30	500
1N482A	N	30	40	100	0.025	15	500
1N482B	N	30	40	100	0.025	5	500
1N483	N	60	80	100*	0.25	30	500
1N483A	N	60	80	100	0.025	15	500
1N483B	N	60	80	100	0.025	5	500
1N484	N	125	150	100*	0.25	30	500
1N484A	N	125	150	100	0.025	15	500
1N484B	N	125	150	100	0.025	5	500
1N485	N	175	200	100*	0.25	30	500
1N485A	N	175	200	100	0.025	15	500
1N485B	N	175	200	100	0.025	5	500
1N486	N	225	250	100*	0.25	50	500
1N486A	N	225	250	100	0.025	25	500
1N486B	N	225	250	100	0.05	10	500
1N487	N	300	330	100*	0.25	50	500
1N487A	N	300	330	100	0.025	25	500
1N488	N	380	420	100*	0.25	50	500
1N488A	N	380	420	100	0.025	25	500
600C	M	27	30	3	1 @ -10v	20 @ -10v**	150
					0.025 @ -10v	40 @ -10v**	
601C	M	45	50	10			150
604C	M	4.7	5.5	60	0.1	40	150
606C	M	6.8	7.5	35	0.1	40	150
608C	M	10	11	25	0.1	40	150
610C	M	15	17	20	0.1	40	150
612C	M	22	25	20	0.1	40	150
614C	M	33	37	20	0.1	40	150
616C	M	47	52	10	0.2	40	150
618C	M	68	75	10	0.2	40	150
620C	M	100	110	10	0.2	40	150
622C	M	150	170	7	0.2	20**	150
624C	M	220	250	3	0.2	20**	150

* Measured at 1.1V
** At 100°C

GALLIUM ARSENIDE TUNNEL DIODES

Type	Case Type	I _p @ 25°C ma	I _p /I _v @ 25°C	Capacitance @ V _b @ 25°C μμf	V _f @ 25°C volts
1N650	U	10 (±10%)	> 15:1	30 (typ)	1.10 (±10%)
1N651	U	10 (±2%)	> 10:1	30 (typ)	1.10 (±5%)
1N652	U	5 (±10%)	> 5:1	40 (typ)	0.98 (±10%)
1N653	U	5 (±10%)	> 5:1	60 (typ)	0.98 (typ)

SILICON COMPUTER DIODES

Type	Case Type	PIV	V _Z	Max. T _r @ 25°C μsec	Maximum I _b @ PIV		Min Fwd Current @ 1 volt ma dc
					25°C μA	100°C μA	
1N625	N	20	30	1 †	1	30	4*
1N626	N	35	50	1 †	1	30	4*
1N627	N	75	100	1 †	1	30	4*
1N628	N	125	150	1 †	1	30	4*
1N629	N	175	200	1 †	1	30	4*
1N643	N	175	200	0.3**	0.025 @ 10v 1 @ 100v	10 @ 10v 15 @ 100v	10
1N658	N	50	120	0.3 ‡	0.05	25 @ 150°C	100
1N659	N	50	55	0.3 †	5	25	6
1N660	N	100	110	0.3 †	5	50	6
1N661	N	200	220	0.3 †	10	100	6
1N662	N	80	100	0.5 †	1 @ 10v 20 @ 50v	20 @ 10v 100 @ 50v	10
1N663	N	80	100	0.5**	5 @ 75v	50 @ 75v	100
1N914	N	75	100	0.0004 †	5 @ 75 v 0.025 @ 20 v	50 @ 150°C @ 20v	10
1N916	N	75	100	0.0004 †	5 @ 75v 0.025 @ 20v	50 @ 150°C @ 20v	10

* E_b equals 1.5v

† JAN 256 (30 ma forward, switched to -35 v reverse, recovery to 400 K ohms)

** JAN 256 (5 ma forward, switched to -40 v reverse, recovery to 200 K ohms)

‡ JAN 256 (5 ma forward, switched to -40 v reverse, recovery to 80 K ohms)

§ JAN 256 (5 ma forward, switched to -40 v reverse, recovery to 100 K ohms)

¶ EGG Type 2236A (10 ma forward, switched to -6 volts reverse, recovery to 1 ma reverse)

HIGH VOLTAGE DIODE STACKS

(48 Standard Units)

Type	Case Type	PIV	V _f Max @ 250 ma @ +25°C	Max Operating Freq. @ PIV (Sinusoidal)	Zener Min	Zener Max	No. of Diodes
1N2878 through 1N2925	GG	700	2	10 KC	800	1400	2
		6500	13	4.0 KC	7150	9100	13

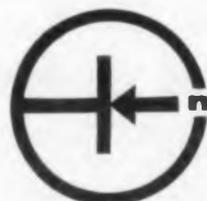
VOLTAGE REGULATOR DIODES

Type	Case Type	Zener Voltage @ 25°C		Power Diss @ 25°C		Max. Z _z @ I _Z Ohms	Typ Temp Coef %/°C
		5 ma I _Z	20 ma I _Z	25°C mw	150°C		
1N746†	N	3.3		400	100	28	-0.062
1N747†	N	3.6		400	100	24	-0.055
1N748†	N	3.9		400	100	23	-0.049
1N749†	N	4.3		400	100	22	-0.036
1N750†	N	4.7		400	100	19	-0.018
1N751†	N	5.1		400	100	17	-0.008
1N752†	N	5.6		400	100	11	+0.006
1N753†	N	6.2		400	100	7	+0.022
1N754†	N	6.8		400	100	5	+0.035
1N755†	N	7.5		400	100	6	+0.045
1N756†	N	8.2		400	100	8	+0.052
1N757†	N	9.1		400	100	10	+0.056
1N758†	N	10.0		400	100	17	+0.060
1N759†	N	12.0		400	100	30	+0.060
650C*	M	3.7 -4.5		150	40		
651C*	M	4.3 -5.4		150	40		
652C*	M	5.2 -6.4		150	40		
653C*	M	6.2 -8.0		150	40		
654C9*	M	8.5 -9.5		150	40		
655C9*	M	9.5 -10.5		150	40		

† Suffix A (±5% tolerance)

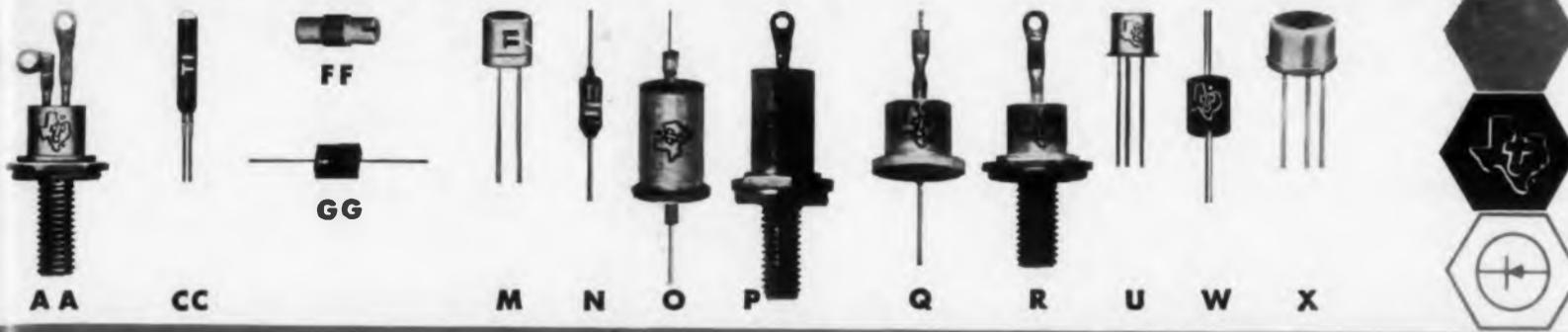
* (±5% or ±10% tolerance available)

Units 1N748 through 1N748 (A) meet Mil specification MIL-E-1/1268 (Navy) and are available with UGM profile.



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GALLIUM ARSENIDE VARACTOR

Type	Case Type	Min Breakdown Voltage -v	Junction Capacitance @ 0 volts bias $\mu\mu\text{f}$	Min Q @ 3 Kmc	Min Cut-off Frequency Kmc
XD-500	FF	-6	0.1 min 1.0 max	20 @ -2 volts 30 @ -6 volts	60 @ -2v

POWER REGULATORS AND DOUBLE ANODE CLIPPERS

Available with either anode or cathode to stud

Type	Case Type	Zener Voltage @ 25°C	I _z ma	Power Diss @ 50°C w	Reverse Current L _b @ 25°C μa	Max Z _z @ I _z Ohms	Typ Temp Coef %/°C
1N2798†	R	10	500	10	40	—	2
1N2499†	R	11	500	10	30	—	2
1N2500†	R	12	500	10	25	—	2
1N1816†	R	13	500	10	25	—	2
1N1817†	R	15	500	10	15	—	2
1N1818†	R	16	500	10	10	—	3
1N1819†	R	18	500	10	10	—	3
1N1820†	R	20	250	10	—	10	3
1N1821†	R	22	250	10	—	10	3
1N1822†	R	24	250	10	—	10	3
1N1823†	R	27	250	10	—	10	3
1N1824†	R	30	250	10	—	10	4
1N1825†	R	33	150	10	—	10	4
1N1826†	R	36	150	10	—	10	5
1N1827†	R	39	150	10	—	10	5
1N1828†	II	43	150	10	—	10	6
1N1829†	R	47	150	10	—	10	7
1N1830†	R	51	150	10	—	10	8
1N1831†	R	56	150	10	—	10	9
1N1832†	R	62	50	10	—	10	12
1N1833†	R	68	50	10	—	10	14
1N1834†	R	75	50	10	—	10	20
1N1835†	R	82	50	10	—	10	22
1N1836†	R	91	50	10	—	10	35
1N2008†	R	100	50	10	—	10	40
1N2009†	R	110	50	10	—	10	47
1N2010†	R	120	50	10	—	10	56
1N2011†	R	130	50	10	—	10	65
1N2012†	R	150	50	10	—	10	82

† Suffix A ($\pm 5\%$ Tolerance)

Units 1N1816 through 1N1836 (A & RA) meet Mil specification MIL-E-1/1259 (Navy) and are available with USN prefix.

PHOTO DEVICE

Type	Case Type	Bias Voltage v max	Dark Current @ 25°C $\pm 50\text{v max}$ μa	Dark Current @ 100°C $\pm 50\text{v max}$ μa	*Typ Light Current @ 25°C $\pm 10\text{v}$ μa	*Typ Sensitivity @ 10v $\mu\text{a}/\text{mw}/\text{cm}^2$
1N2175	CC	50	0.5	100	200	22.3

* Light current measured in terms of radiation. Radiation = 9 mw/cm² in a frequency bandwidth of 0.7 to 1 micron.

SILICON CONTROLLED RECTIFIERS

Type	Case Type	At 80°C Case Temp		Non-Recurrent Surge Current 1 Cycle at 60 cps Amps	Min Fwd (IH) Voltage* v	PIV	Min Breakdown Voltage v	Max Case Temp °C	Max Fwd Gate Current ma	Gate to Cathode PIV v	Max Fwd Voltage Drop @ Avg Rect. Fwd. Current @ 25°C Stud Temp v @ a	Gate Current Req to Fire ma	
		Av Rect Fwd Current Amps	Recurrent Peak Current Amps									Typ	Max
2N1600	AA	3	10	25	50	50	60	150	100	5	2 @ 3 amps	1	10
2N1601	AA	3	10	25	100	100	120	150	100	5	2 @ 3 amps	1	10
2N1602	AA	3	10	25	200	200	240	150	100	5	2 @ 3 amps	1	10
2N1603	AA	3	10	25	300	300	360	150	100	5	2 @ 3 amps	1	10
2N1604	AA	3	10	25	400	400	480	150	100	5	2 @ 3 amps	1	10
2N1595	X	1	3	15	50	50	60	150	100	5	2 @ 1 amp	1	10
2N1596	X	1	3	15	100	100	120	150	100	5	2 @ 1 amp	1	10
2N1597	X	1	3	15	200	200	240	150	100	5	2 @ 1 amp	1	10
2N1598	X	1	3	15	300	300	360	150	100	5	2 @ 1 amp	1	10
2N1599	K	1	3	15	400	400	480	150	100	5	2 @ 1 amp	1	10
T1-010	X	1	3	15	50	50	60	150	100	5	See data sheet for switching information		
T1-025	X	1	3	15	50	50	60	150	100	5			
T1-050	X	1	3	15	50	50	60	150	100	5			

* Measured with 1K resistor gate to cathode

STABISTORS

Type	Case Type	I _f ma	PIV Volts	V _f Volts at 1 ma	V _f Volts at 100 ma	L _b μa at -2v at 25°C
G 129	N	250	10	0.56 $\pm 10\%$	I	0.1
G 130	N	150	6	0.64 $\pm 10\%$	I	0.1

SILICON RECTIFIERS—ECONOMY PACKAGE

Type	Case Type	PIV	I _o ma 25°C	I _o ma 100°C	Recurrent Peak Current @ 25°C a	DC Forward Voltage Drop @ 25°C v @ ma	Max Reverse Current @ 25°C μa @ v
1N2069	w	200	750	500	6	1.2 @ 500	10 @ 200
1N2070	w	400	750	500	6	1.2 @ 500	10 @ 400
1N2071	w	600	750	500	6	1.2 @ 500	10 @ 600

SILICON RECTIFIERS

Type	Case Type	Mounting	PIV v 25°C	PIV v 150°C	I _o ma 25°C	I _o ma 150°C	Recurrent Peak Current -65°C to +150°C ma	E _b @ 25°C v @ a	L _b @ PIV @ 25°C μa
1N588	Q	Axial	1500	1000	25	10	150	10 @ 10ma	50
1N589	Q	Axial	1500	1000	50	25	250	8 @ 50ma	50
1N1130	P	Cathode Stud	1500	1000	300	150	1 a	15 @ 0.3	50
1N1131	P	Anode Stud	1500	1000	300	150	1 a	15 @ 0.3	50
1N570	BB	plug in	1500	1000	37.5*	25*	1.2a @ 25°C*	10a @ 50ma*	50
1N538	Q	Axial	200	200	750	250	2.5a @ 25°C	1 @ 0.5	10
JAN 1N538	Q	Axial	200	200	750	250	2.5a @ 25°C	1 @ 0.5	10
1N539	Q	Axial	300	300	750	250	2.5a @ 25°C	1 @ 0.5	10
1N540	Q	Axial	400	400	750	250	2.5a @ 25°C	1 @ 0.5	10
JAN 1N540	Q	Axial	400	400	750	250	2.5a @ 25°C	1 @ 0.5	10
1N547	Q	Axial	600	600	750	250	2.5a @ 25°C	1 @ 0.5	10
JAN 1N547	Q	Axial	600	600	750	250	2.5a @ 25°C	1 @ 0.5	10
1N1095	Q	Axial	500	500	750	250	6a @ 25°C	1 @ 0.5	10
1N1096	Q	Axial	600	600	750	250	6a @ 25°C	1 @ 0.5	10
1N253†	R	Cathode Stud	100	100	3 a	1a @ 135°C	10a @ 50°C	1.1 @ 1	10
JAN 1N253†	R	Cathode Stud	100	100	3 a	1a @ 135°C	10a @ 50°C	1.1 @ 1	10
1N254†	R	Cathode Stud	200	200	3 a	0.4a @ 135°C	10a @ 50°C	1.1 @ 1	10
JAN 1N254†	R	Cathode Stud	200	200	3 a	0.4a @ 135°C	10a @ 50°C	1.1 @ 1	10
1N255†	R	Cathode Stud	400	200	3 a	0.4a @ 135°C	10a @ 50°C	1.1 @ 1	10
JAN 1N255†	R	Cathode Stud	400	200	3 a	0.4a @ 135°C	10a @ 50°C	1.1 @ 1	10
1N256†	R	Cathode Stud	600	200	3 a	0.2a @ 135°C	10a @ 50°C	1.1 @ 1	10
JAN 1N256†	R	Cathode Stud	600	200	3 a	0.2a @ 135°C	10a @ 50°C	1.1 @ 1	10
1N1124†	R	Cathode Stud	200	200	3 a	1 a	10a @ 50°C	1.1 @ 1	10
1N1125†	R	Cathode Stud	300	300	3 a	1 a	10a @ 50°C	1.1 @ 1	10
1N1126†	R	Cathode Stud	400	400	3 a	1 a	10a @ 50°C	1.1 @ 1	10
1N1127†	R	Cathode Stud	500	500	3 a	1 a	10a @ 50°C	1.1 @ 1	10
1N1128†	R	Cathode Stud	600	600	3 a	1 a	10a @ 50°C	1.1 @ 1	10
1N1614†	R	Cathode Stud	200	200	15 a	5 a	50a @ 50°C	1.5 @ 10	10
1N1615†	R	Cathode Stud	400	400	15 a	5 a	50a @ 50°C	1.5 @ 10	10
1N1616†	R	Cathode Stud	600	600	15 a	5 a	50a @ 50°C	1.5 @ 10	10

* For each half-wave section
† R Suffix denotes anode to stud configuration, i. e. 1N1124R

DIAL FS-5 and the contacts are heat-treated, beryllium copper, heavily silver plated.

Jettron Products, Inc., Dept. ED, 56 Route 10, Hanover, N.J.

Pulse Receivers

508

Range is 45 to 10,750 mc



Models 301, 302, and 303 pulse receivers cover the range of 45 to 10,750 mc with sensitivities approaching those of superheterodyne equipment. For the range of 45 to 550 mc, stagger-tuned amplifiers are used. Above 550 mc, permanent magnet-focused traveling wave tubes are used. The receivers are offered in relay rack of aircraft packaging. Power requirements are 109 to 121 v at 50 to 800 or 360 to 800 cps.

Granger Associates, Dept. ED, 974 Commercial St., Palo Alto, Calif.

Parabolic Antenna

447

Surface tolerance is ± 0.065 to ± 0.125

Model 103 30-ft, parabolic antenna, for use in radio astronomy, radar tracking, and experimental test installations, has a surface tolerance of ± 0.065 to ± 0.125 . A tolerance of ± 0.08 can be furnished on special order. The f/d ratio is 0.417. Use above 10,000 mc is possible. The antenna can be mounted on the top or the side of a tower with azimuth and elevation adjustments, on el-az or equatorial pedestals, self-contained trailer mounts, or other types of mounts.

Antenna Systems, Inc., Dept. ED, Hingham, Mass.

◀ CIRCLE 97 ON READER-SERVICE CARD

TEXAS INSTRUMENTS
INCORPORATED
SEMICONDUCTOR COMPONENTS DIVISION
13500 N. CENTRAL EXPRESSWAY
POST OFFICE BOX 313
DALLAS, TEXAS

NEW PRODUCTS

Power Supplies 513

For missile and airborne use

This line of dc power supplies is designed for missile and other airborne applications. Made to step up dc power, the units have precise regulation against line and load variation, even under severe changes in environmental conditions. Requirements of MIL-E-5272C are met. The units are solid state and are offered in 34 standard models, having outputs of 5 to 250 v.

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

Constant Voltage Transformer 516

Comes in 60- and 400-cps units

This sine-wave constant-voltage transformer is offered in both 60- and 400-cps units. With a line variation of 95 to 130 v, output remains constant to within $\pm 1.5\%$. The unit can replace non-regulating transformers in step-up or step-down service. It is hermetically sealed for military application at high temperatures and has a current-limiting feature.

Freed Transformer Co., Inc., Dept. ED, 1718 Weirfield St., Brooklyn 27, N.Y.

DC Power Supply 451

For missile ground support use

Model M-1348 dc power supply with an output of 24 to 32 v at 100 amp is for missile ground support use. The unit has magnetic amplifier regulation with no vacuum tubes or moving or delicate parts. Silicon rectifiers provide resistance to high temperatures and adverse environmental conditions. Regulation is $\pm 0.5\%$ for line and load. Ripple is 0.5% rms based on an ac input of 208, 230, or 460 v $\pm 5\%$, three-phase, 60 cps.

Perkin Engineering Corp., Dept. ED, El Segundo, Calif.

What do these 38 products



Representing only a few of the many items produced by VTP, these 38 products (and others like them now in research, development and manufacturing stages) offer you "built-in" reliability and highest quality—at competitive prices. These products break down into five broad categories:

Storage Tubes: World's most complete line of 21 different types. Screen diameters: 3" to 21". Electrostatic focusing. Electrostatic or magnetic deflection. *Tonotron** Half-tone Display Tubes. *Typotron** Character Display Tubes. *Memotron** Image-retention Tubes.

Special Purpose CRTs: Special configurations, phosphors, electrical characteristics—or for *special* environmental conditions. Screen diameters: 1" to 18". Electrostatic or magnetic deflection and focusing. Packaged, shielded versions are available. A choice of 28 different phosphors to meet your exact needs.

Vacuum Gauge Tubes & Equipment: Most complete line of high vacuum gauge tubes and controls (including: ionization, cold discharge and thermocouple gauge tubes; electronic ultra-high-vacuum pumps.) Single source supply for all of your high-vacuum requirements.

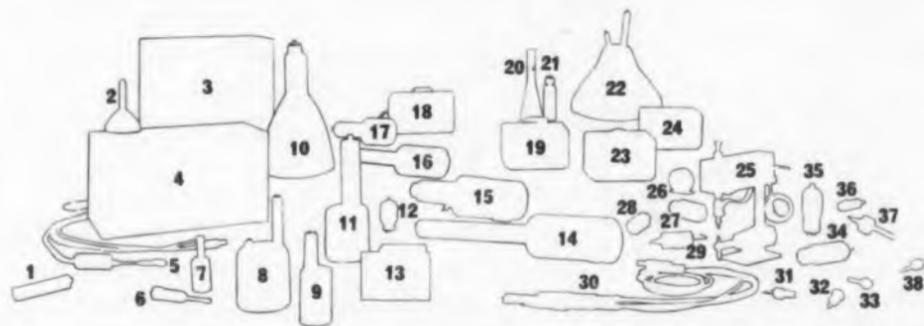
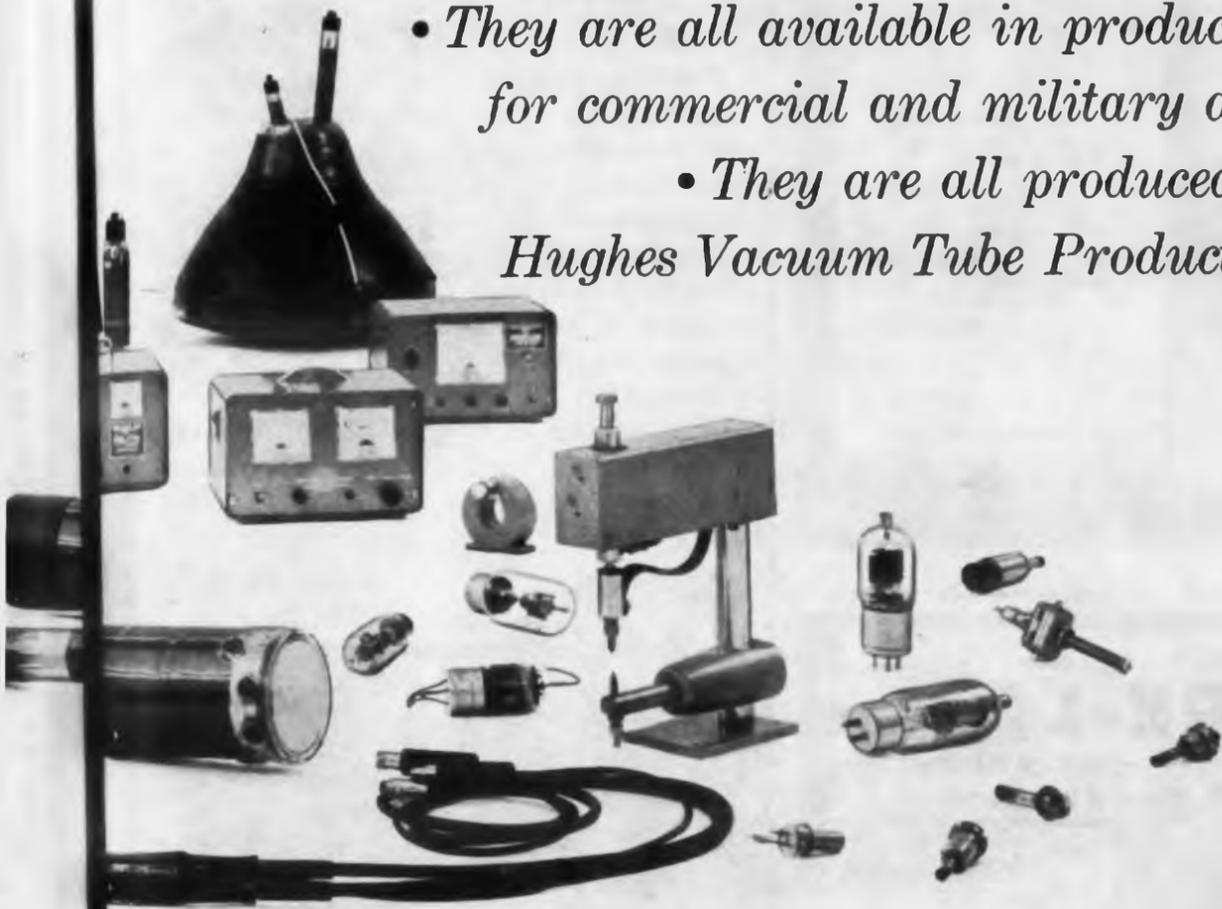
Welders, Controls & Accessories: Complete line of precision electronic welding equipment for joining thin metal parts (.0001" to .08"). Half and full-cycle AC power supplies, stored energy power supplies, inert-gas shielded-arc welder controls—plus welding heads and accessories.

Rectifiers & Transmitting Tubes: Heavy-duty rectifiers, xenon thyratrons, clipper diodes and triode transmitting tubes are now available in production quantities to fill all of your requirements. **See the complete Vacuum Tube Products lines on display at WESCON, Booths 2826-2827.**

Products have in common?

Basically, 3 things—

- They are all electronic in nature.
- They are all available in production quantities for commercial and military applications.
- They are all produced by Hughes Vacuum Tube Products Division.



(1) Monoscope (2) 5" CRT (3) Capacitor Welding Power Supply (4) Thermocouple/Ionization Vacuum Gauge Control (5) Seam Welding Handpiece (6) Thermocouple Vacuum Gauge Tube (7) Ionization Gauge Tube (8) (9) 5" & 3" Tonotron Tubes (10) 17" CRT (11) 5" Tonotron Tube (12) High Vacuum Diode (13) Thermocouple Vacuum Gauge Control (14) 5" Typotron Tube (15) 5" Shielded CRT (16) 5" Memotron Tube (17) 5" Tonotron Tube (18) (19) Electrolytic Welding Power Supply (20) (21) 5" & 3" CRTs (22) 21" Tonotron Tube (23) Thermocouple Vacuum Gauge Control (24) Philips Vacuum Gauge Control (25) Precision Welding Head (26) Ion Pump (27) Power Triode (28) High Vacuum Diode (29) Xenon Thyatron (30) Welding Handpiece (31) High Vacuum Diode (32) Thermocouple Vacuum Gauge Tube (33) High-Voltage Vacuum Switch (34) High Vacuum Diode (35) Clipper Diode/Rectifier (36) Halogen Vacuum Leak Detector (37) Philips Vacuum Gauge Tube (38) Thermocouple Vacuum Gauge Tube.

For full information on reliable, high-quality products in any of these fields, write or wire today: HUGHES, Vacuum Tube Products Division, 2020 Short Street, Oceanside, Calif. For export information, write Hughes International, Culver City, Calif.

Creating a new world with ELECTRONICS

HUGHES

VACUUM TUBE PRODUCTS DIVISION
HUGHES AIRCRAFT COMPANY

*Trade-mark of Hughes Aircraft Company

Polycrystalline Silicon Rods 572

For floating zone crystal growing

For floating zone crystal growing, these polycrystalline silicon rods are uniform in diameter, have a boron content of 1 ppb, and have a very high density. Standard diameters of the rods are 3/4 to 7/8 in. with tolerances of ± 0.005 in. Nominal length is 10 in. Diameters of 3/8 to 1 in. are available on special order.

Trancoa Chemical Corp., Dept. ED, Reading, Mass.

Price: \$1 per gram.

High-Q Coating 697

For tuned circuits

Type 338-D high-temperature, high-Q coating is particularly suited for use with tuned circuits. One application is in the fabrication of miniature, in-line rf filters. The coating is supplied as a solvent solution that can be brushed, dipped, or sprayed. After a brief drying period, the coating is cured in an oven at 275 to 300 F for 2 hr. Besides having only a negligible effect on the frequency response of assembled units, this coating resists water, oils and solvents.

Plastic Associates, Dept. ED, 185 Mountain Road, Laguna Beach, Calif.

Price & Availability: Available for immediate delivery, the product is priced at \$4.90 per lb.

Polarized DC Motor 446

Operates without commutation

Operating without commutation, this polarized dc motor has a starting torque of 4 lb-in., a running torque of 8 lb-in., and a starting and running current of 85 ma at 28 v dc. The motor is useful in areas where there is a limited source of power. Free-arc-operating, the motor is activated by synchronized impulses and a sealed circuit that may be remotely located.

Diaphlex Div., Cook Electric Co., Dept. ED, 2700 N. Southport Ave., Chicago 14, Ill.

CIRCLE 98 ON READER-SERVICE CARD

There are all kinds of coils



. . . . but for network applications

TOROIDAL COILS EXCEL!

C&C is a premier manufacturer of standard and custom coils in Open Core Molded Plastic and Hermetically Sealed cases. C&C coils are designed to meet all special inductance and mutual inductance requirements and are supplied in stock. C&C toroidal coils are known for superior quality and performance in standard products.

COMMUNICATION ACCESSORIES COMPANY 1475 SUNNYSIDE BLVD. NEW YORK 17, N.Y. 10019

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DENVER 7, COLORADO
Fred A. Pease Company
4921 East 38th Ave.

SYRACUSE 8, NEW YORK
Leonard D. Allen, Inc.
Box 32 Salina Station

CLEVELAND 13, OHIO
Electro Com
1231 Main Avenue

TENELFY, NEW JERSEY
Harold Gray Associates
8-10 Highwood Ave.

NORTH HOLLYWOOD, CALIF.
Samuel O. Jewett Co.
13111 Ventura Blvd.

SCOTTSDALE, ARIZONA
Samuel O. Jewett Co.
P. O. Box 172

HADDENFIELD, NEW JERSEY
G. W. Moler Co.
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Northport Engineering, Inc.
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KANSAS CITY, MISSOURI
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Testco
Boeing Field—Room 105



CIRCLE 99 ON READER-SERVICE CARD



actual size
Model HCM 7/16

MINIATURE 7/16" INDICATOR

Micro-miniature moving coil, core magnet indicator; 7/16" diameter, 31/32" length. Weight 10 grams; sealed. Available with a pointer or flag display in a wide variety of electrical sensitivities and functions. Data on request. Marion Instrument Division, Minneapolis-Honeywell Regulator Co., Manchester, New Hampshire, U.S.A. In Canada, Honeywell Controls Limited, Toronto 17, Ontario.

Honeywell

75th YEAR PIONEERING THE FUTURE SINCE 1899 First in Control

At Wescon, Booth 2722

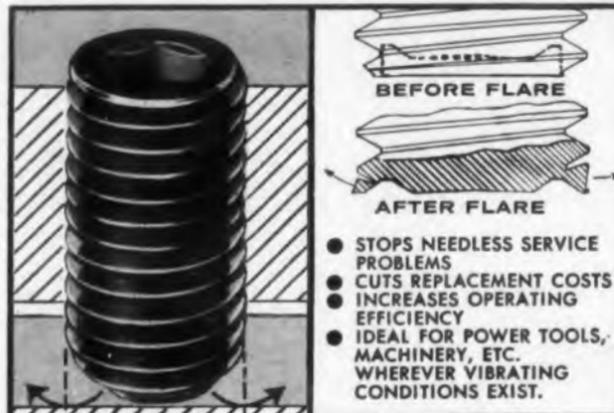
CIRCLE 100 ON READER-SERVICE CARD

new setko

FLARE-LOK

SET SCREW

WILL NOT SHAKE LOOSE!



HERE'S HOW IT WORKS: The point of the FLARE-LOK set screw is specially formed to flare out when it is tightened against a bearing surface. The thread gap is closed just enough to prevent loosening or shaking free due to vibration, etc. Yet, the screw may be removed without damaging the mating threads. You can get them in hex socket, slotted or slotted heads.

WRITE FOR FREE "FLARE-LOK" TEST SAMPLES and full information TODAY.



265 Main Street, Bartlett, Illinois

CIRCLE 101 ON READER-SERVICE CARD

NEW PRODUCTS

Digital Demonstration Unit

395

For use to 100 kc



Providing continuously adjustable frequencies to 100 kc, this digital demonstration unit can be used as an aid to training personnel in the digital field. Patch cords on the control panel permit inter-connection of circuits to form an adder-subtractor, shift registers, binary counters, and binary-coded-decimal counters. Switches allow selection of continuous operation, single-pulse operation, or single cycles of addition or subtraction. The unit has a power supply and eight plug-in modules providing a total of 12 flip-flops.

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

Cavity Filters

416

Center frequencies are 200 to 2400 mc



Having center frequencies ranging from 200 to 2400 mc, the ACF cavity filters allow for bandwidth adjustment, by means of a hex-screw, from 1.5% to 10% of center frequency. They have 2 to 9 cavities. Insertion losses are 0.5 to 3 db. The input and output impedances are normally 50 ohms; units with 75- or 93-ohm impedances can also be furnished. The units can be used as fixed-tuned pre-selectors or for harmonic suppression or selection on the output of fixed-frequency oscillators. Power rating is 100 w.

Telonic Engineering Corp., Dept. ED, Laguna Beach, Calif.

Price & Availability: Price ranges from \$200 to \$1000 ea; units are made on order and have a 30- to 45-day delivery time.

CIRCLE 102 ON READER-SERVICE CARD



**HOT
TIN**

PLATED

THIN STRIP

**for precision
electronic
manufacturing**



**SMOOTH,
UNCONTAMINATED
SURFACE**



**READILY
SOLDERABLE,
HIGH ADHERENCE**



**GUARANTEED FREE
OF BURRS, SLAG, PITS**

Somers special process provides pure tin, 80-20 tin-lead and 60-40 coatings of .00002 to .00008 and .0002 to .0003 on Thinstrip® copper, brass, bronze, and other alloys from .012" to .002" thin, 1/8" to 12 1/2" wide.

Write for confidential data blank or field engineer for analysis of your special problem — no obligation, of course.

FOR EXACTING STANDARDS ONLY



Somers Brass Company, Inc.
116 BALDWIN AVE., WATERBURY, CONN.
CIRCLE 103 ON READER-SERVICE CARD
CIRCLE 102 ON READER-SERVICE CARD

Cable Tester

361

Checks 150 simple circuits



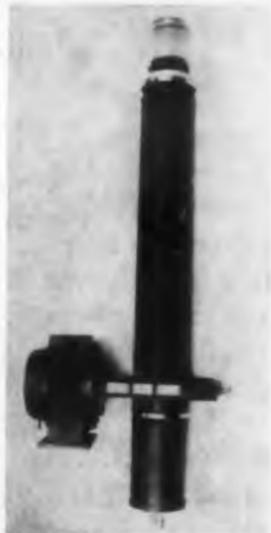
Model 196 military cable tester checks 150 simple circuits, 75 main circuits with up to 75 branch circuits, and any intermediate combination of main and branch. It performs leakage and continuity tests simultaneously. Measurements are made on precision bridges. Continuity testing can be made from 0.3 to 10 ohms at 0.5 to 3 amp; high-pot testing can be made to 1000 v dc. An ohmmeter measures leakage resistance from 0 to 1000 meg. The equipment meets MIL-T-945A.

California Technical Industries, Div. of Textron, Inc., Dept. ED, 1421 Old Colony Road, Belmont, Calif.

Price & Availability: \$7000 ea; 60-day maximum delivery time.

Klystron

351



Produces 2 megawatts

Type L-3270 klystron produces 2 megawatts peak rf power with a 100-mc bandwidth at the L-band. It has flat bandpass and linear phase shift characteristics over the bandwidth centered at 1300 mc. Minimum gain is 30 db. The klystron is suited for use as the output stage of radar systems where frequency diversity or precisely shaped pulses are required.

Litton Industries, Electron Tube Div., Dept. ED, 960 Industrial Road, San Carlos, Calif.

Availability: Made to order, units can be furnished in 90 to 120 days.



Complexities to Simplivities

**with HRB-SINGER's Multicoupler,
one antenna feeds FOUR receivers**

A military requirement for a multicoupler to meet a restricted space antenna installation problem was solved by HRB-SINGER's Model 330-M4 amplifier-multicoupler.

HRB's distributed bandpass amplifier techniques provided a 30 to 300 mc response with low noise characteristics and a high degree of reliability. A multiple position requirement was fulfilled by a single antenna and four output multicoupler incorporated with the low noise amplifier, thus eliminating the need for multiple antenna installations.

This is only one of many instances where HRB-SINGER research has been applied in the development of a custom amplifier line. The Company has a complete capability to meet customer special performance and environmental specification or design requirement problems for specific UHF and VHF application. Direct your inquiries to Dept. G-10. A comprehensive series of data sheets describing this capability is yours for the asking.

ELECTRONIC RESEARCH AND DEVELOPMENT in the areas of: Communications • Countermeasures • Reconnaissance • Operations Research • Human Factors • Intelligence • Weapons Systems Studies and Analysis • Nuclear Physics • Astrophysics • Antenna Systems

HRB

HRB-SINGER, INC.
A SUBSIDIARY OF THE SINGER MANUFACTURING COMPANY
Science Park, State College, Pa.



CIRCLE 104 ON READER-SERVICE CARD



actual size

BRISTOL
chopper
helps put

Navy
TARTAR on
target

... Every component in the U.S. Navy's TARTAR, newest supersonic surface-to-air guided missile must meet the highest standards for statistical reliability.

No exception is the Bristol Syncroverter* chopper used in the TARTAR's guidance system. The TARTAR, produced for the Bureau of Naval Weapons by Convair (Pomona) Division of General Dynamics Corporation, is slated to form the primary anti-aircraft weapon aboard destroyers and secondary anti-aircraft batteries aboard cruisers.

The Bristol Syncroverter chopper has a long history as a component in U.S. guided missiles. It's the ideal miniature electromechanical chopper for use in d-c analog computers or wherever utmost reliability is required.

BILLIONS OF OPERATIONS have been completed without a failure on Bristol's continuing life tests—aimed at improving the Syncroverter's already superlative characteristics. Just one sample: A group of five choppers, with 400 cps drive and 12v, 1 ma resistive contact load have been going for more than 26,000 hours without failure. That's more than 2.96 years continuous operation or more than 37 billion complete cycles!

No matter what your chopper requirements, we're sure you can find the model you need among the wide selection of Syncroverter choppers and high-speed relays available... including low-noise, external coil types. For complete data, write: The Bristol Company, Aircraft Equipment Division, 150 Bristol Road, Waterbury 20, Conn. O. 15

*T.M. Reg. U.S. Pat. Off.

BRISTOL FINE PRECISION
INSTRUMENTS FOR OVER SEVENTY YEARS

CIRCLE 105 ON READER-SERVICE CARD

NEW PRODUCTS

Power Supply

354

Provides 35 kv dc



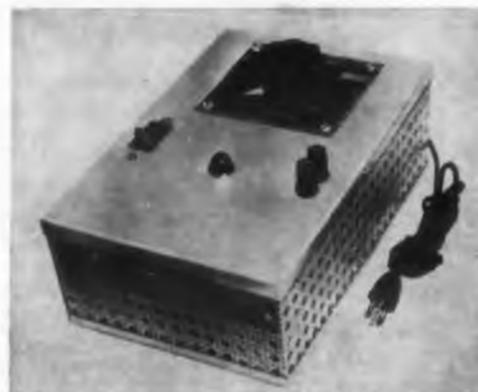
Model PSC 30-5-1 power supply provides an output of 35 kv at 1 ma and 30 kv at 5 ma. Input is 115 v at 60 cps. Ripple is less than 0.5% per ma rms. The unit is portable, measuring 12 x 14 x 12 in. and weighing 60 lb.

Del Electronics Corp., Dept. ED, 521 Homestead Ave., Mt. Vernon, N.Y.

DC Power Supply

359

For laboratory applications



Designed for laboratory work such as circuit testing or transistor testing, this supply delivers 0 to 45 v at 0 to 2.5 amp. It plugs into a 60-cps, 95 to 130 v line. The output is stabilized to $\pm 1\%$ of setting. The unit can be supplied as a portable type or a rack mounting type.

Acme Electric Corp., Dept. ED, Cuba, N.Y.
Price & Availability: \$131 for portable type; \$152 for rack type. Delivery from stock.

Precision Switch

483



Total resistance is 0.7 milliohms

This precision instrument switch has a total resistance of 0.7 milliohms and remains constant

JERROLD

R. F. Test Equipment

Quantitative Measurements Using Sweep Frequency Techniques



Model 900A—THE MOST VERSATILE SWEEP GENERATOR \$1,260.00

CENTER FREQUENCY—VHF 0.5 to 400 MC
UHF 275 to 1000 MCS—SWEEP WIDTH—up to 400 MCS—FLATNESS— ± 0.5 db over widest sweep!



Model 707—ULTRA FLAT SWEEP GENERATOR \$795.00

Featuring $\pm 5/100$ db flatness—Plug-in osc. heads*; variable sweep rates from 1/min. to 60/sec.; all electronic sweep fundamental frequencies; sweep width min. of 1% to 120% of C.F.

*Heads available within the spectrum 2 to 265 MCS

Models 601/602—PORTABLE GENERAL PURPOSE \$295.00

COVERAGE—Model 601—12 to 220 MCS. Model 602—4 to 112 MCS—FLATNESS— ± 0.5 db
OUTPUT—up to 2.5 V RMS
WIDTH—1% to 120% of C.F.



Model FD-30 \$250.00

High speed DPDT coaxial switch permitting oscilloscope measurements without calibration—all measurements referenced continuously against standard attenuators.

Model AV-50
Variable Precision Attenuator \$150.00

Long life rotary switches; dual wiping silver contacts on "Kel-F" dielectric. 0-62.5 db in $\frac{1}{2}$ db steps; DC to 500 MCS.

Write for catalog and technical Newsletter series on measurements using sweep frequency techniques. Prices and data subject to change without notice.

JERROLD ELECTRONICS CORPORATION

Industrial Products Division Dept. ITE-60
The Jerrold Building, Philadelphia 32, Pa.
Jerrold Electronics (Canada) Ltd., Toronto
Export Representative: Roche International, N.Y. 16, N.Y.

CIRCLE 106 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 196

to ± 20 micro-ohms. It is for use on instruments that measure electrical potential and resistance.

The Ealing Corp., Dept. ED, 33 University Road, Cambridge 38, Mass.

Price & Availability: Price is \$29 per unit when ordered in quantities of 1 to 11, and \$25 per unit in quantities of 12 or more. Available from stock.

Static Inverter

403

Meets missile requirements



Built to meet missile requirements, this 90-w, single-phase static inverter performs over the temperature range of -65 to $+180$ F. Efficiency is 70%. It is suitable for any application requiring a 400-cps output in a small, lightweight package, and is able to provide power to mechanical teletyping commutators or to gyros.

Kinetics Corp., Dept. ED, 410 S. Cedros Ave., Solana Beach, Calif.

Code Generator

353

Produces 43 characters



The Codamite transistorized code generator, measuring 6.25 x 5.25 x 2.25 in., produces 43 different code characters. Circuitry includes a ten-bit magnetic core memory to retain each character until transmitted. A speed control provides for rates of transmission from 5 to 40 words per min. R. W. Johnson Co., Dept. ED, 9372 Hillview Road, Anaheim, Calif.

Price & Availability: \$1275 ea; 60-day delivery time.



COOL is the word for General Electric NPN silicon transistors, Series 2N332 through 2N338. At 150 mw the junction temperature is 70°C at an ambient of 25°C . Compare this with the registered derating factor which calls for a junction temperature of 175°C .

The "A" versions of these transistors dissipate 500 mw at 25°C , 83 mw at 150°C — all without a heat sink.

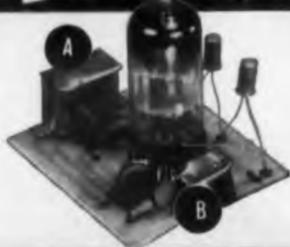
When junction temperatures go down, reliability goes up. The wide safety factor you enjoy with General Electric silicon transistors means better performance and longer life than you may ever have seen achieved before in a similar device. See your G-E Semiconductor Sales Representative for complete details.

On the shelf at your General Electric Distributor.

GENERAL  **ELECTRIC**

CIRCLE 107 ON READER-SERVICE CARD

MINIATURIZATION PLUS LOWER COST



Thin Versatile Co-Netic and Netic Magnetic Shielding Foils

Permit positioning foil-wrapped components A & B closely, minimizing interaction due to magnetic fields... making possible compact and less costly systems.

How thin Co-Netic and Netic foils lower your magnetic shielding costs:

- 1) Weight reduction. Less shielding material is used because foils (a) are only .004" thick and (b) cut and contour easily.
- 2) Odd shaped and hard-to-get-at components are readily shielded, saving valuable time, minimizing tooling costs.

These foils are non-shock sensitive, non-retentive, require no periodic annealing. When grounded, they effectively shield electrostatic and magnetic fields over a wide range of intensities. Both foils available from stock in any desired length in various widths.

Co-Netic and Netic foils are successfully solving many types of electronic circuitry magnetic shielding problems for commercial, military and laboratory applications. These foils can be your short cut in solving magnetic problems.



Cuts readily to any shape with ordinary scissors.



Wraps easily.



Inserts readily to convert existing non-shielding enclosures.



Shielding cables reduces magnetic radiation or pickup.



Wrapping tubes prevents outside magnetic interference.

PROTECT VITAL MAGNETIC TAPES

When accidentally exposed to unpredictable magnetic fields, presto!—your valuable data is combined with confusing signals or even erased.



For complete, distortion-free protection of valuable magnetic tapes during transportation or storage. Single or multiple reel Rigid Netic Enclosures available in many convenient sizes and shapes.



Thin pliable foil wraps easily around magnetic tape, maintaining original recorded fidelity.



Rigid Netic (.014" and up in thickness) Shielded Rooms and Enclosures for safe, distortion-free storage of large quantities of recorded magnetic tapes.

Composite photo demonstrating that magnetic shielding qualities of Rigid Netic Alloy Material are not significantly affected by vibration, shock (including dropping or bumping) etc. Netic is non-retentive, requires no periodic annealing.



Write for further details today.

MAGNETIC SHIELD DIVISION PERFECTION MICA CO.
1322 No. Elston Avenue, Chicago 22, Illinois
ORIGINATORS OF PERMANENTLY EFFECTIVE NETIC CO-NETIC MAGNETIC SHIELDING

CIRCLE 108 ON READER-SERVICE CARD

NEW PRODUCTS

Waveguide Gages

417

For go/no-go operation



A go/no-go means of checking critical dimensions of standard waveguide transmission lines used in uhf, shf, and ehf instruments, the ID series gages cover from WR 975 (0.75 to 1.12 kmc) to WR 10 (75 to 110 kmc). Each gage is ground to a tolerance of 0.0002 in. The gages are offered in 24 sizes.

Somerset Radiation Laboratory, Inc., Dept. ED, 192 Central Ave., Stirling, N.J.

Price & Availability: \$90 to \$545 ea; stock delivery.

Wideband Amplifier

397

Bandwidth is 10 to 90 mc

Model 1004 wideband amplifier, capable of amplifying sine waves, symmetrical signals, or fast pulses, has a bandwidth of 10 to 90 mc. Gain is 40 db and noise figure is better than 8.5 db at 85 mc. Amplifier delay is about 0.03 μ sec. Input and output impedance is 300 ohms. A power supply is self-contained within the unit.

Community Engineering Corp., Dept. ED, P.O. Box 824, State College, Pa.

Price & Availability: \$195 ea; 45-day delivery.

Dual-Channel Amplifier

414

For compensated-resolver applications



For compensated-resolver applications, this transistorized amplifier has a parallel summation input circuit that accepts up to five inputs per channel. Amplifiers and resistors are packaged separately; the dual amplifier plugs into the re-

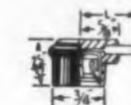
SILICONE INSULATED TUBE CAP CONNECTORS



HI ALTITUDE
TEMPERATURE
VOLTAGE

This is a new series of Tube Cap Connectors using special silicone components for high reliability applications. They provide the highest degree of resistance to temperature extremes and are virtually unaffected by ozone and corona. The excellent dielectric characteristics make them ideal for high voltage. Skirts and sealed-in leads guard against flashover at high altitudes. Additional features include anti-corona cup and long-life spring contacts.

Clip this out — keep handy for part numbers and specs on connectors below for either 1/4" or 3/8" top caps. Prefix 90 for 1/4"; 91 for 3/8". Lead wire 18" long from center of cap or length to your specs.



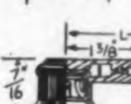
#90 or 91SCCSL beryllium copper contact, cadmium plated nests in anti-corona cup. Silicone rubber insulation throughout.



#90 or 91SCCRSL beryllium copper contact, cadmium plated nests in anti-corona cup. Silicone rubber insulation throughout. Takes up to one watt resistor — specify value and tolerance.



#90 or 91SCCDSL beryllium copper contact, cadmium plated nests in anti-corona cup. Skirt clings to tube — guards against flash-over. Silicone rubber insulation throughout.



#90 or 91SCCDRL beryllium copper contact, cadmium plated enclosed in anti-corona cup. Skirt clings to tube — helps suppress corona—guards against arc-over. Takes up to one watt resistor. Specify value and tolerance.



#90 or 91CCSTLRL beryllium copper contact, cadmium plated nests in anti-corona cup. Glass-filled silicone insulation on cap; silicone rubber on lead. Long skirt for arc-over. Takes up to 2 watt resistor. Specify value and tolerance.

Besides new silicone types — Alden provides a complete series of connectors for 1/4", 3/8" and 1/2" cap in your choice of phenolic, mica, polyethylene, nylon and Kel-F. Complete hi-voltage cable assemblies are available using Alden hi-voltage disconnects and tube cap connectors.

TELL US ABOUT YOUR CONNECTING PROBLEM. FOR PROMPT RECOMMENDATIONS — WRITE OR PHONE JACK POLLARD NOW.

ALDEN PRODUCTS CO.

7139 North Main St., Brockton, Mass.

CIRCLE 109 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 1960

istor package and is retained by captive screws. Voltage transfer accuracies can be maintained to an accuracy of 0.1% from -55 to +105 C. Ratios in the range of 0.1 to 10 can be obtained. The amplifier operates at 400 cps, signal frequency, and provides a 26-v rms output. Total power requirement is 45 v dc at 16 ma.

Reeves Instrument Corp., Dept. ED, Roosevelt Field, Garden City, N.Y.

Availability: Sample quantities are available from stock.

Pressure Transducers 415

Ranges extend to 100 psi



The 800 series pressure transducers use a free-edged, circular diaphragm of Ni-Span-C in the sensor to increase system accuracy. Full scale ranges are 1 to 100 psi; differential or absolute measurements can be made. Units are sensitive to less than 0.01% of full scale for a 0 to 1 atmosphere pressure range. Hysteresis effects are less than 0.03%. Temperature range is -55 to +100 C. The sensor stands 100% overpressure.

Rosemount Engineering Co., Dept. ED, 4900 W. 78th St., Minneapolis 24, Minn.

Price & Availability: Delivery time is 30 to 60 days. One of the units, for example, is priced at \$290 ea.

Impulse Counter 477

Has decade cascade system

The Minichron 10 impulse counter counts timed pulses with a decade cascade system like that of an abacus. A cascade of six ring counter decades counts each pulse of a 400-cps time base signal and pinpoint 16 different operations within a millisecond count-time period of about 45 min. Programming can be changed in a few minutes and without disturbing associated wiring or connections. Operating on 22 to 35 v dc, the unit has a current drain of 0.2 amp. Designed for programming missiles in flight, the unit can program a sequence of events such as automated operations in testing, process control, or production.

The Victoreen Instrument Co., Dept. ED, 55 W. Mission Road, Alhambra, Calif.

ELECTRONIC DESIGN • July 6, 1960



solid



General Electric silicon transistors are manufactured by the Fixed Bed Mounting process. All parts are firmly fastened to a ceramic disk, with no suspended parts. The transistor reacts as a solid block in resisting shock and vibration.

G-E type 2N332 through 2N338 transistors (including "A" versions and USN versions) have been struck with a golf club, rattled 700 miles in a hub-cap, fired from a shotgun and shot from an artillery piece (40,000 G's) — and still survived to operate! Call your G-E Semiconductor Sales Representative for full details.

Absolute Maximum Ratings	2N332-6*	2N337-8†	2N332A-6A
Collector to base voltage	45 V _{CSO}	45 V _{CSO}	45 V _{CS}
Emitter to base voltage	1 V _{ES0}	1 V _{ES0}	4 V _{ES}
Collector current (I _C)	25 ma	20 ma	25 ma
Collector dissipation @ 25°C (P _C)	150 mw	125 mw	500 mw
Operating temperature (T _J)	-65 to 175°C	-65 to 150°C	-65 to 175°C

*USN versions of all units except 2N332 have QA per MIL-T-19500/37A.
†USN versions have QA per MIL-T-19500/69B.

Immediate delivery from your General Electric Distributor

GENERAL ELECTRIC

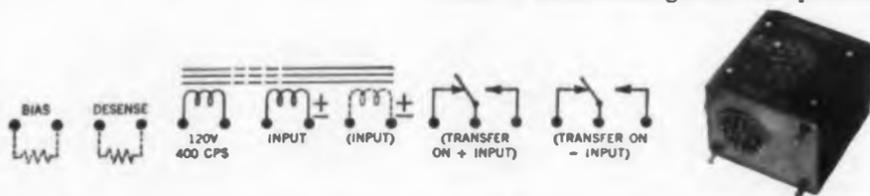
CIRCLE 110 ON READER-SERVICE CARD



unusual potting, push-pull design increase stability of new 400-cycle magnetic amplifier relay

If you pried the base off the can of this new magnetic amplifier relay (which you probably wouldn't after paying good money for a hermetically sealed device) you might be surprised. Sitting there in quiet intimacy would be an isolation transformer, reactor, one or two relays and sundry other items — all immersed in a transparent, slightly wiggly material, just like grapes in a gelatin salad. The compound is selected for its ability to soak up shock, vibration and thermal expansion. In that order, the specs for this device are 100 g's, 10 g to 55 cps, -55° to $+100^{\circ}$ C.

What you can do with the Series 8300 is the same thing you can almost do with any good transistor- or meter-relay — except this one will work on DC inputs as low as 0.2μ w. and remain stable (circuit is push-pull) under $\pm 10\%$ variations in line voltage, frequency, and the 155° spread mentioned earlier. Standard models also have single or dual coils, a contact rating of 1 amp. at 28 VDC/120 VAC, resistive, for at least 100,000 operations, and terminals for connecting bias and desensing resistors. The connection schematic looks like this, but has the circular floral arrangement as pictured:



If you have an application that demands an even fancier version with such features as DPDT output contacts, higher vibration and load ratings (and less sensitivity), built-in DC power supplies, reference sources, etc., we may be able to do something for you on a special order basis. First, however, it would probably be a good idea to see our $5 \pm 20\%$ -page Series 8300 Preliminary Bulletin — collated, stapled, 3-hole punched and unpotted.

$10^6 = \mu$ H

SIGMA

SIGMA INSTRUMENTS, INC.
91 Pearl St., So. Braintree 85, Mass.

AN AFFILIATE OF THE FISHER-PIERCE CO. (Incorporated)

CIRCLE 111 ON READER-SERVICE CARD

NEW PRODUCTS

Wirewound Resistors

Exceed MIL-R-26c

394



The TO-RW series of wirewound resistors are made to exceed the requirements of MIL-R-26c with "V" characteristics. They use alloy terminals which match the thermal expansion of tube and enamel. Minimum wire size is 0.00175 in.

Tru-Ohm Products, Dept. ED, 2800 N. Milwaukee Ave., Chicago, Ill.

Availability: Delivery time is 10 days to two weeks.

Pushbutton Switches

479

For pulse and digital systems

Designed for pulse and digital electronic systems, these one-shot, switch-circuit, pushbutton assemblies generate a single square-wave pulse, synchronized with a clock pulse at each operation. Pulse frequencies are 4 to 500 kc. The assemblies can be used for manually loading magnetic drums, checking ring counters, resetting flip-flops, radar, telemetering, data reduction, industrial process control and other applications.

Micro Switch, Dept. ED, Chicago & Spring Streets, Freeport, Ill.

Price & Availability: \$46 ea; about six weeks for delivery.

Ceramic Coil Forms

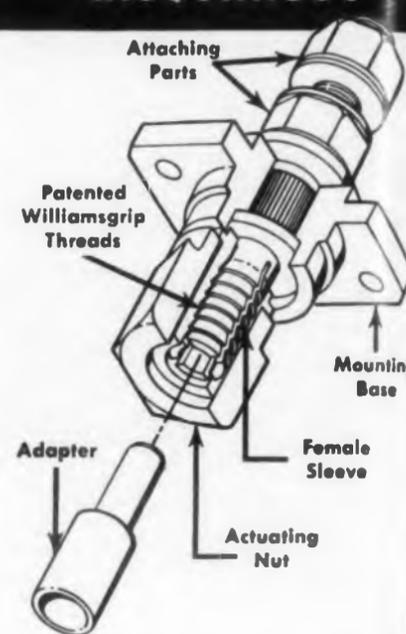
413

Have V-type thread



For use where high stability and uniformity of electrical properties are required, these V-threaded, ceramic coil forms are available in the

WILLIAMSGRIP single circuit quick disconnect



Williamsgrip electrical connectors provide quick connect and disconnect with a flick of the wrist... plus full positive connection insuring maximum conductivity without the use of springs, slip joints or friction methods.

The patented Williamsgrip construction and special thread design prevents slippage and corrosion, resulting in cooler operation, greater reliability and longer life.

The self-wiping action of the connector eliminates arcing and excessive heating, and allows the connector to operate from 5° to 25° F cooler than the cable, even under conditions of 100 percent overload. Both connectors and adapters are constructed to withstand severe environmental conditions, and have successfully withstood temperatures over 2000° F.

These high current, single circuit connectors covering a wide range of wire and cable sizes have proved their reliability over more than a decade of versatile, rugged service for a wide variety of requirements in the military, industrial and commercial fields.

Write today for AiResearch Product Catalog on "Electrical Connectors."



AiResearch Manufacturing Division
Los Angeles 45, California

CIRCLE 112 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 1964

Following sizes: 12-pitch, three-thread; 16-pitch, five-thread; and 18-pitch, seven-thread. They are made to stand shock and vibration. Silicone fibre-glass collars with silver-plated solder lugs are assembled at both ends of the form's threaded section.

United Products Co., Dept. ED, 165 Franklin Ave., Nutley, N.J.

Price & Availability: Price is \$0.34 ea in quantities of 1000. Delivery is from stock for limited quantities.

Disk Cathodes

485

Miniature



These miniature disk cathodes with triangular ceramic insulators provide a minimum heat sink by reducing the area of contact between the tank and the ceramic. The temperature of the cathode can be as high as 850 C. Shank diameter is about 0.09 in. and length, 0.22 to 0.28 in. The disk cathodes can be furnished with a 0.365- or 0.40-in. OD ceramic.

Superior Tube Co., Dept. ED, 1521 Germantown Ave., Norristown, Pa.

Encoder

401

Position-to-digital type



Model 773 13-bit, position-to-digital encoder with a resolution of 128 counts per input-shaft revolution. Full scale capacity is 8192 counts; accuracy is never less than the least significant digit. Starting torque is less than 0.2 oz-in. and moment of inertia is 0.048 oz-in.² The unit weighs 7.6 oz. Librascope Div. of General Precision, Inc., Dept. ED, 808 Western Ave., Glendale 1, Calif.

proved

Before any lot of G-E silicon transistors may be delivered, a representative number of units are selected for each of the four restrictive life tests. These tests include operation at maximum power at 25°C ambient, operation at high temperatures and peak ratings, storage at 200°C, and shelf life at 25°C—all tests for 1000 hours. If the sample fails any one of these tests, the lot cannot be shipped.



Only General Electric silicon transistors (Series 2N332-2N338, including "A" and USN versions) are subjected to such rigorous restrictive testing. And we keep them pure inside — no grease or surface contaminants that degrade performance are permitted to enter. Write for a full report on the restrictive tests which G-E silicon transistors must pass before they're shipped to you. Section S2370, General Electric Co., Semiconductor Products Dept., Electronics Park, Syracuse, N. Y.

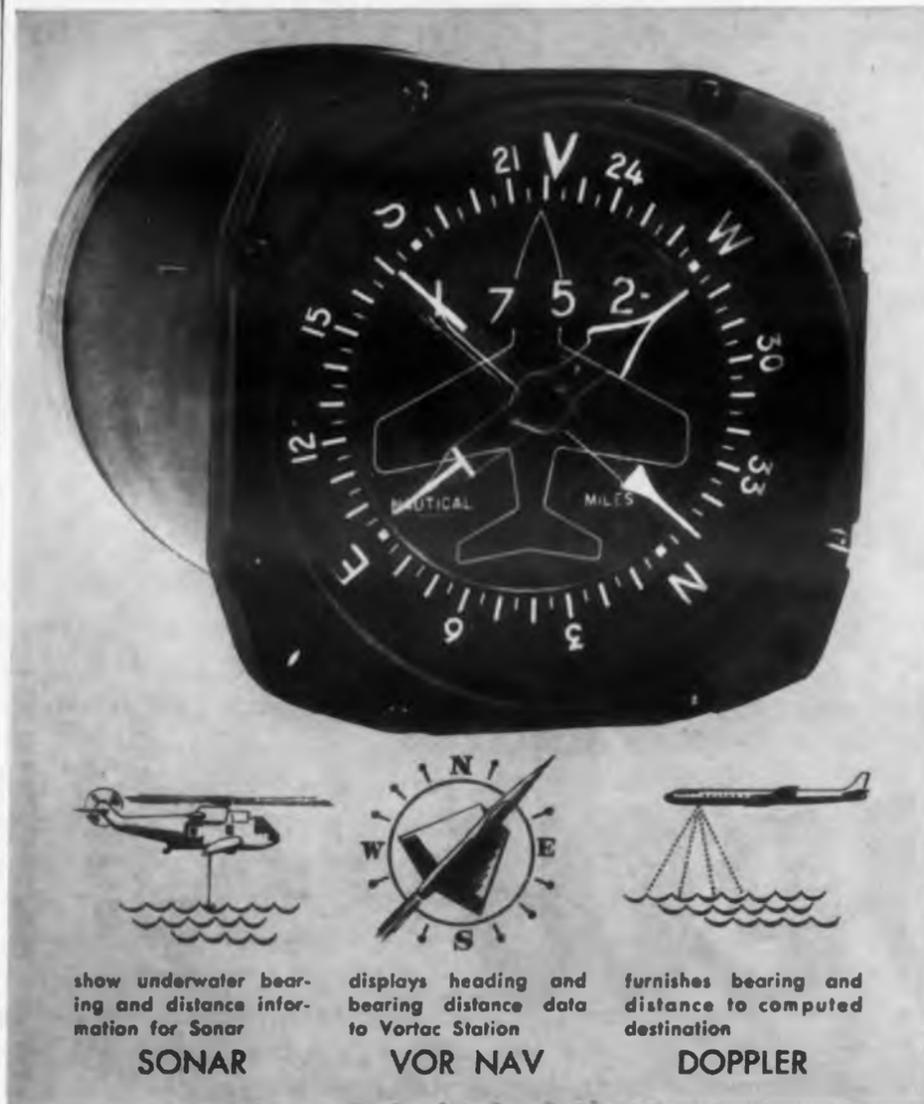
At factory-low prices from your General Electric Distributor.

GENERAL  **ELECTRIC**

CIRCLE 113 ON READER-SERVICE CARD



ENGINEERING
REPORT
ON BENDIX COMPONENTS



show underwater bearing and distance information for Sonar

SONAR

displays heading and bearing distance data to Vortac Station

VOR NAV

furnishes bearing and distance to computed destination

DOPPLER

NAVIGATIONAL INSTRUMENTATION

Compact Bendix Indicators with wide application range

Eclipse-Pioneer is long-experienced in the design, engineering, and production of lightweight, compact, versatile navigation instrumentation to meet both today's and tomorrow's needs.

Some examples are Bearing Distance Heading Indicators (illustrated), Radio Bearing Indicators,

Omni Magnetic Indicators, Radio Magnetic Indicators, Distance Indicators, and Remote Couplers for use in TACAN, ILS, VOR, SONAR, and DOPPLER systems.

If you have a navigation instrumentation problem, benefit by our precise skills in this specialized area. Call or write today.

Eclipse-Pioneer Division

Teterboro, N. J.



District Offices: Burbank and San Francisco, Calif.; Seattle, Wash.; Dayton, Ohio; and Washington, D. C.
Export Sales & Service: Bendix International, 205 E. 42nd St., New York 17, N. Y.

CIRCLE 114 ON READER-SERVICE CARD

NEW PRODUCTS

Monitor Receiver

368

Operates from 225 to 399.9 mc



Model 36 monitor receiver is offered in fm and am models. The fm unit is capable of receiving fm voice, frequency shift keying messages, telemetry, and digital transmissions. The unit is for various missile uses. The am model is designed for uhf aircraft traffic control, airport tower operations, am voice, am frequency division, and am-fm telemetry. The units are self-contained, integrating the power supply and the basic receiver. Input is 115 v at 60 cps.

Electronic Communications, Inc., Dept. ED, 1501-72nd St. N., St. Petersburg, Fla.

Availability: Units are built to customer specs.

Leak Detector

478

Spectrometer-type

Model 24-210B leak detector, a spectrometer-type unit, has a sensitivity such that it can detect one part of helium in 10,000,000 parts of air. A liquid-nitrogen cold trap removes condensable vapors before they can enter the analyzer section. Response time is less than 1 sec for 50% full-scale deflection of the leak-rate meter on the x1 scale. Attenuations are x1, x5, x10, x100, and x1000. Residual fluctuation and noise level are less than 2%, full-scale peak-to-peak. Input is 105 to 125 v ac.

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

Subcarrier Oscillator

398

For airborne applications



Model TS-56 voltage-controlled subcarrier oscillator converts information in the form of

ENGINEERING
REPORT
ON OTHER BENDIX
COMPONENT PACKAGES



GEAR HEADS

Compact units that provide output motor speed reductions.



These easily detachable heads are available in various frame sizes, and supply reductions in ratios ranging from 7.22:1 to 42,471.90:1. Ball bearings are Class A. B. E. C. 5, or better, and gears are cut to AGMA Precision II tolerances, or better, with backlash held to 30 minutes, or better. Adaptable to variety of motors and motor generators. Write for details.

1/2-INCH LOW INERTIA MOTOR

Designed for instant response in servo systems.



The CK-1066-40-A1 Bendix low inertia motor is a two-phase, four-pole, 400-cycle induction type and is one of the smallest motors available for servo systems. Measured only 0.50" in diameter and 1 1/4" in length. Unit consists of a squirrel-cage rotor that rotates on precision ball bearings, a two-phase stator, and a stainless steel housing. Standard motor has tapered shaft but units can be obtained with other type shafts and with center-tapped control windings.

Manufacturers of
GYROS • ROTATING COMPONENTS
RADAR DEVICES • INSTRUMENTATION
PACKAGED COMPONENTS

Eclipse-Pioneer Division



Teterboro, N. J.

CIRCLE 115 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 1964

varying dc voltage amplitude into a frequency-modulated subcarrier signal suitable for transmission by wire or radio to distant receiver stations. Available in all standard RDB channels, the unit is for use in airborne applications. Input requirement is 6 v dc $\pm 0.1\%$ at about 12 ma. Input impedance is 1 meg and output impedance is 47 K. The output voltage is 2 v rms min.

Vector Manufacturing Co., Inc., Dept. ED, Keystone Road, Southampton, Pa.

DC Differential Amplifier 393

Input resistance is 500 meg



Model 2900 dc differential amplifier has over 500-meg input resistance, voltage gains of 2 to 50, and over-all linearity of 0.05%. A missile-grade mechanical chopper and a silicon-transistor carrier amplifier are used. Output voltage is ± 5 v. Power consumption is 140 ma from an unregulated 28-v source. Construction is of cast magnesium alloy.

Dynamics Instrumentation Co., Dept. ED, 583 Monterey Pass Road, Monterey, Calif.

Price & Availability: Units will be in stock by Sept. 30, 1960. Price is \$2700 ea for quantities of 10 to 99.

Trimmer Potentiometer 441

Value range is 10 to 100,000 ohms

Designated W-51, this subminiature trimmer potentiometer comes in resistance values from 10 to 100,000 ohms. It operates from -55 to $+55$ C, and withstands 20 g vibration, 30 g acceleration, and a shock of 100 g for 10 msec. It can be furnished with standard soldering lugs, printed circuit leads, flexible insulated wire leads, or side mounted solid leads. The component weighs about 0.5 g, and has case dimensions of 0.89 x 0.312 x 0.21 in.

Atom Electronics, Dept. ED, 7648 San Fernando Road, Sun Valley, Calif.

Price & Availability: Delivery is from stock. Prices range from \$5.10 to \$7.50 for 1 to 24 units, depending on resistance value. All prices fob Sun Valley.



sensational

The performance of General Electric's silicon transistors is sensational:

Fixed Bed Mounting provides the most rugged construction yet developed for transistors.

By operating at a low junction temperature, reliability and stability are inherently increased.

Beta hold-up at low current is superior.

The "A" versions offer a 4V emitter-to-base breakdown and a 45V collector-to-emitter breakdown.

Every lot of transistors is subjected to four types of restrictive life tests.

USN versions are available in the Series 2N333 through 2N338.

Units tested to 5000 hours have shown an overall performance rate greater than 99 per cent.

Send for the complete specifications and test data and prove to yourself how G.E.'s silicon transistors will do a sensational job in your design. Section S2370, General Electric Company, Semiconductor Products Dept., Electronics Park, Syracuse, N. Y.

GENERAL  ELECTRIC

CIRCLE 116 ON READER-SERVICE CARD

Whether it's regulating critical line voltages aboard ship or making industrial test equipment work better, there's a Sorensen line-voltage regulator to do the job.

Sorensen a-c line regulators come in 26 standard catalog models for every requirement including both the tried and true standard Sorensen electronic circuit and the latest refinements in tubeless line regulators. And there are militarized models, high-precision ($\pm 0.01\%$) models, 400-cycle models, a fast-response low-distortion model and a precision a-c meter calibrator covering the range from zero to 799.9 vac in 0.1V steps.



SORENSEN

A-C line regulators for every job...

26 models... up to 15 kva output...

high

precision models

... completely

tubeless models



New Catalog. You'll find extensive technical data on Sorensen a-c line voltage regulators in the comprehensive new Sorensen Catalog—just off the press. Plus complete data on Sorensen d-c power supplies, frequency changers, high-voltage supplies and testers (to 600 kv)—plus extensive power-supply and regulator application data and a glossary of controlled power terms. Write for your copy of the new Sorensen catalog, today. Sorensen & Company, Richards Avenue, South Norwalk, Connecticut.



A SUBSIDIARY OF RAYTHEON COMPANY

CONTROLLED
POWER
PRODUCTS

...THE WIDEST LINE MEANS THE WISEST CHOICE

CIRCLE 117 ON READER-SERVICE CARD

NEW PRODUCTS

Spring Motors

491

Provide constant torque



These constant-torque spring motors, using a wide band of spring material, have a long, tubular shape. The units are suitable for applications such as internal mounting in drums and instrument chart drives. The spring material shown is a flat strip of stainless steel, 0.0033 in. thick and 7-7/8 in. wide. It has been given a curvature by continuous heavy forming so that in the relaxed condition, it is a tightly wound roll of flat material. A constant torque of 6 lb-in. is developed through 50 revolutions of the output pulley at all positions of cable extensions.

Hunter Spring Co., Dept. ED, 1 Spring Ave., Lansdale, Pa.

Attenuators

434

Have range of 0 to 61.5 db

Four separate attenuators cover a range of 0 to 61.5 db in 0.5 db steps to an accuracy of 0.1 db. Insertion loss is less than 0.05 db with a power rating of 1 w. The frequency range is dc to 70 mc with characteristic impedances of 50, 75, 92, and 600 ohms.

Wayne Kerr Corp., Dept. ED, 1633 Race St., Philadelphia 3, Pa.

Price & Availability: Prices from \$110 to \$130. Available from stock to 4 weeks.

Synchronous Motor

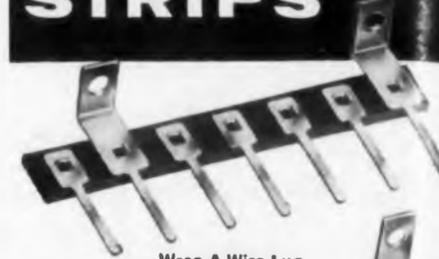
482



Permanent magnet type

Type SS50 synchronous motor is a permanent magnet type ac motor for a wide range of applications requiring constant, 72 rpm synchronous, speed and dc stepping with instant starting, stopping, or reversing. Input is 120 v, 40 to 70 cycles, single-phase; 0.3 amp is maximum current at 60 cycles. Output speed at 60 cycles is 72 rpm,

MANDEX OFFERS YOU THE MOST COMPLETE LINE OF TERMINAL STRIPS



Wrap-A-Wire Lug



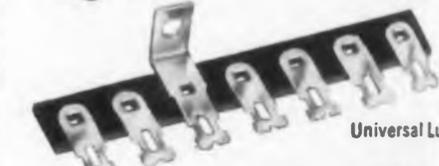
Tear-Drop Lug



External "T" Lug



Subminiatures (1/4" Spacing)



Universal Lug



Wire-Grip Lug

High Speed Automated Assemblies Bring You:

- Consistent Quality
- Quick Delivery
- Low Cost

Send prints-specs for prompt quotation... For complete information request

NEW MANDEX GUIDE BOOK TO TERMINAL STRIPS



2624 West 48th St., Chicago 32, Ill.

CIRCLE 118 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 1964

CICOID
ideal
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NEW...

compact...

small...

light...



CICOIL Super-Flex STRANDED-WIRE FLAT CABLE

for the ultimate in

FLEXIBILITY

CICOIL Super-Flex multi-conductor cable is ideal for use where extremes of temperature, movement and vibration preclude the use of other materials in missile packages, computers, gyro and radar systems. They provide light, reliable and compact harnessing of even the most complex electronic circuitry.

Super-Flex cables are made of stranded conductors, precisely spaced in CICOIL's specially processed silicone rubber base compound. Cables are made in lengths up to 8 feet, and widths determined by the size and number of conductors. Cable termination can be supplied bare or with commercial or military grade connectors. Special connectors can be molded by CICOIL to meet your requirements.

Write for new brochure
and complete technical data

CICOIL CORPORATION

13833 SATICOY STREET
VAN NUYS, CALIFORNIA
STATE 1-3440

CIRCLE 119 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 1960

and torque is 50 oz-in. The unit uses class B insulation and is rated for 75 C temperature rise from 40 C maximum ambient under continuous duty. It provides speeds of approximately 16.6, 3.3, 0.67, 0.133, or 0.027 rpm, and weighs 3 lb.

The Superior Electric Co., Dept. ED, 83 Laurel St., Bristol, Conn.

Price & Availability: Price is \$36 ea. Available from stock.

Power Supplies

365

Regulation is 0.1% or 0.5%



This line of ac to dc power supplies provides 0.1% regulation for line and load variations on units rated at 5 v and up, and a 0.5% regulation on units rated below 5 v. Response time is less than 100 μ sec for 10% line transient or 50% load transient. Ripple is 0.02% or 5 mv rms. Temperature coefficient is 0.01% per deg C. Outputs are 2 to 305 v dc from 100 ma to 1 amp. The units are plug-in type and are built on heat-sink chassis.

Consolidated Avionics Corp., Dept. ED, 800 Shames Drive, Westbury, N.Y.

Price & Availability: \$175 ea; from stock.

Laminate

432

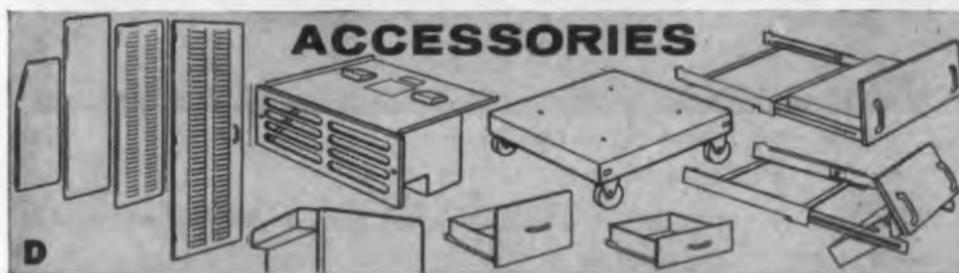
Has 1,000,000 meg resistance

Textolite 11577, a self-extinguishing, epoxy, paper-base laminate has 1,000,000 meg resistance at 35 C and twice the impact and flexural strengths of XXXP standards. It stands cyanide plating solutions and provides good bonding strength between copper and laminate for increased circuit reliability. Peel strength after UL aging test, 1544 hr at 128 C, is 4 to 6 lb. Standard sheet sizes are 36 x 36 in. and 36 x 72 in. from 0.031 to 0.250 in. thick.

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

Price & Availability: Price is between \$1.09 per sq ft and \$5.76 per sq ft when ordered in quantities of 500 sq ft or more, depending on thickness of core material, thickness of copper and whether copper is on one or both sides.

THE AMCO MODULAR INSTRUMENT ENCLOSURE SYSTEM



TWO COMPLETELY NEW LINES ADDED IN STEEL AND ALUMINUM TO GIVE 3 COMPLETE MODULAR FRAME LINES IN ONE OVER-ALL SYSTEM

- A Amco Custom Line.** Removable multi-panels and cowlings based on 19" increments of width. Custom, single-unit appearance for frames mounted in series—ideally suited for complex console arrangements. The 19 $\frac{1}{16}$ " width of frame saves space in series mounting of frames. Constructed of double-channel 16 gauge cold-rolled steel. Conforms to EIA mounting standards.
- B Amco Semi-Custom Line.** Removable multi-width cowlings provide a semi-custom, single-unit appearance for frames mounted in series. Extra rugged, wide box-type channel frames provide greater internal mounting area. 19" wide panels of any thickness can be recessed—from a flush-mounted position to any desired depth. Box type channel construction of 14 gauge cold-rolled steel. Conforms to EIA mounting standards.
- C Amco Aluminum Line.** This system of aluminum box extrusions and cast corners allows easy assembly of cabinets in any size from 7" to 20' in height, width or depth. Corners and extrusions

lock together by hand with built-in locking device. All sizes are standard. Ideal for stocking and odd-ball sizes. Cast and hardened corners of 356-T6 aluminum as described in Federal Spec. QQ-A-596a. Extrusions of 6061-T6 aluminum as described in Federal Spec. QQ-A-270a.

- D Amco Accessories.** A full line of Amco integrated accessories such as blowers, chassis slides and mounts, lighting, doors, drawers, dollies and many more available for A, B and C shown.

Cost savings. All the above—or any part thereof—may be ordered under one combined discount schedule base determined by order dollar value. Orders received at one time with one delivery date may also be combined. Free pre-assembly by Amco provides additional savings in time and installation.

3 week delivery on all standard parts. We welcome inspection of our plant and facilities. Send for your free literature now.

Factory-trained representatives in all principal U. S. cities and in Canada



AMCO ENGINEERING CO.

7333 W. Ainslie Street, Chicago 31, Illinois

CIRCLE 120 ON READER-SERVICE CARD

PINPOINT HEAT CONTROL

**SIMPLYTROL'S
ANTICIPATING ACTION
KEEPS TEMPERATURES
WITHIN $\pm 1^\circ\text{F}$.
OF SET-POINT**

Temperature controlled by the Simplytrol behaves the way you want it to. It doesn't soar or sag. It can't. Simplytrol's special time-proportioning anticipating circuit senses temperature build-ups, and modifies the heat cycle well before over-shoots can occur. Control consistently follows the straight-and-narrow . . . within $\pm 1^\circ\text{F}$. of set-point.

For all its precise performance, Simplytrol is a surprisingly uncomplicated device. The A.P.I. meter-relay (good for at least ten-million decisive "make-break" operations) is its primary component. Actuated directly from the thermocouple input signal, the meter-relay needs no amplifying circuits or vacuum tubes. Consequently, Simplytrol's operation is exceptionally stable; there is no drift or signal distortion.

There are three basic Simplytrol models available in thirty ranges from -400°F . to 3000°F ., and packaged in a variety of mounting cases. One could be just the temperature controller you've been looking for. All are fully described in new Bulletin 108 . . . yours for the asking.



ASSEMBLY PRODUCTS, INC.
Chesterland 17, Ohio

CIRCLE 121 ON READER-SERVICE CARD

NEW PRODUCTS

Cathode-Ray Tube

481

Has 7.5-in. diameter screen



Type 7BCP- magnetic focus and deflection cathode-ray tube is designed for flying spot scanner applications. It has a minimum useful screen diameter of 6-3/4 in., an over-all length of 18-3/8 ± 4 in., and a spot size of 0.0035 in. average. Accelerator voltage is 37,000 v dc and screen current is 300 μa .

Allen B. Du Mont Labs., Inc., Electronics Tube Div., Dept. ED, 750 Bloomfield Ave., Clifton, N. J.

Price & Availability: Price is \$300 ea. Delivery is 4 to 6 weeks.

Subcarrier Oscillator

396

Handles low-level signals

This solid-state subcarrier oscillator incorporates electronic commutation and a multi-input amplifier. Input signals vary from 50 mv full scale to 5 v full scale. Over-all system drift is $\pm 0.5\%$ over a 24-hr period. Signal linearity is $\pm 0.5\%$. The basic input module has a volume of 8 cu in. and weighs about 8 oz; each additive plug-in has a volume of about 5 in. A 22-input unit occupies less than 30 cu in.

Solidtronics Div. of Electrosolids Corp., Dept. ED, 14751 Keswick St., Van Nuys, Calif.

Price & Availability: \$200 to \$650 ea; delivery is in six to 41 weeks.

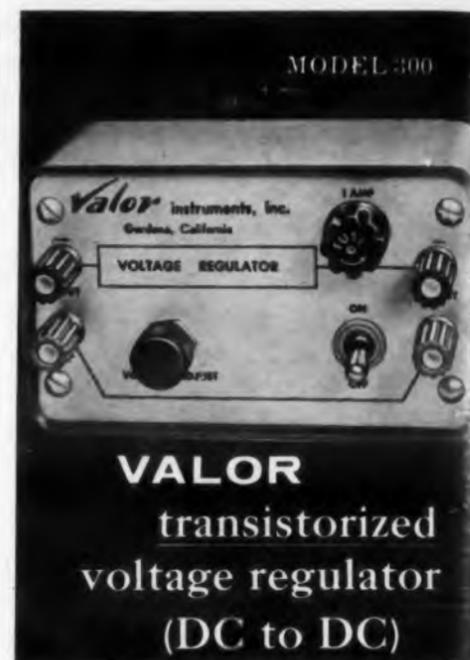
Servo Amplifier

418

Temperature range is -55 to $+150$ C



Model A419 servo amplifier operates servo motors up to size 15 at 6 w output over the tem-



— delivers highly regulated, variable voltage from an unregulated source

Upgrades power supplies. The Valor makes your low-voltage, unregulated power supply a regulated unit, at low cost. You can vary the voltage output, or use more than one Valor to get multiple voltages—positive or negative.

Regulates DC sources. In the laboratory or in missiles, for example, you can use it to regulate a master 28-volt supply.

Increases computer efficiency. You can locate these regulators directly at points of use, thus eliminating wire impedance.

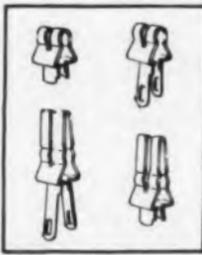
Eight models cover a range from 6 to 35 volts. Line regulation: 0.1%. Load: 0.2% at 25 volts. Size is only 3"x3"x5" . . . weight only 16 ounces. Models available with fixed outputs, and to Mil. specs. Off-the-shelf deliveries. Bulletin VR 1059 on request. Price: \$95.00.

Valor INSTRUMENTS, INC.
13216 Crenshaw Blvd., Gardena, Calif.

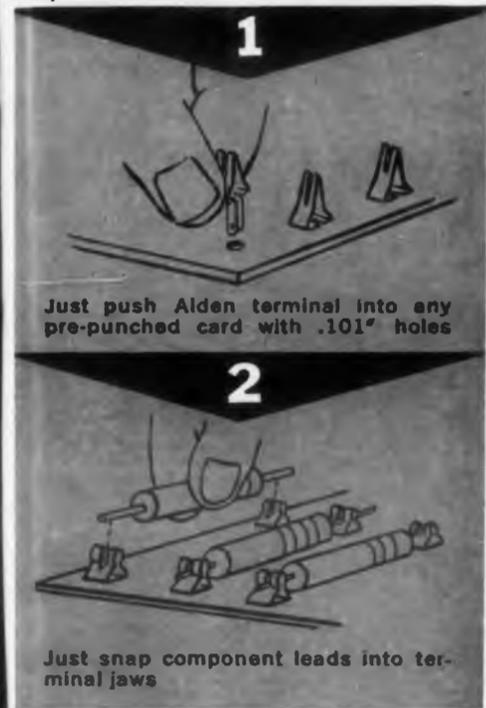
Transistorized Power Supplies and Pulse Generators • Voltage Regulators • Transistor Checkers • Delay Lines • Pulse Transformers.

CIRCLE 122 ON READER-SERVICE CARD
ELECTRONIC DESIGN • July 6, 1960

miniature ratchet terminals

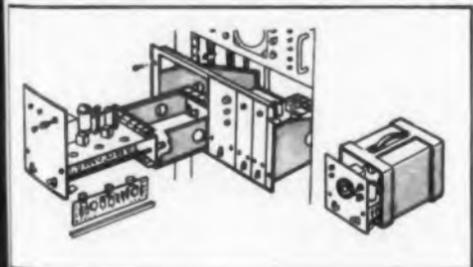


For mounting circuitry, they're neater
-- quicker -- and cost a lot less



What could be neater? Or quicker? Leads are locked firmly. There's no pre-forming. No feeding through holes. No wrapping around a post. In experimental circuitry, components can be snapped out, re-used. In production equipment, terminals can be staked quickly, automatically or by hand. Components can be mounted in place and soldered on production line basis. Heat is dissipated faster — in the terminal, not in the component.

Best news: the cost ... far lower than conventional terminals. Average price: about 3/4¢ apiece.



Alden miniaturized ratchet terminals are part of an integrated building block system that lets you lay out and package a single unit or a complete electronics system with "off-the-shelf" Alden components for plug-in, modular construction.

For complete information, write:

ALDEN

PRODUCTS COMPANY
139 North Main Street, Brockton, Mass.

CIRCLE 123 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 1960

perature range of -55 to $+150$ C. The self-contained power supply operates from 115 v at 400 cps. Input impedance is 10,000 ohms, nominal. Input signal is 25 v max and voltage gain is up to 2500.

Westamp, Inc., Dept. ED, 11277 Massachusetts Ave., Los Angeles 25, Calif.

Price & Availability: \$450 to \$550 ea in quantities of one to four. Made on order, units are delivered in eight weeks.

Synchronous Motor

412

For low speed operation



The Hypersyn motor drives a spindle in an automated machine tool. Two identical counter-rotating motors are contained in the housing; one is connected to the 60-cps line and the other to a variable-frequency power supply. If the variable frequency is 60 cps, the output shaft is stationary and opposes rotation with the full motor torque. An increase or decrease of the variable frequency begins to turn the shaft forward or reverse. With 60.6 cps applied the shaft speed is 18 rpm at 66 cps and the shaft speed is 180 rpm. Motors can be built with 1/50 to 1 hp.

Genisco, Inc., Dept. ED, Bekey Electric Div., Dept. ED, 2233 Federal Ave., Los Angeles 64, Calif.

Availability: Made on order.

Glass Laminates

438

Thicknesses up to 2 in.

Glass silicone laminated plastic, Grade G-7, is available in sheets up to 2 in. thick. Made with a glass fabric reinforced with silicone binder, the laminate is claimed to have good dielectric loss factor and insulation resistance properties under humid conditions, and excellent heat and arc resistance. Thicknesses of not less than 1/4 in. and up to 2 in. are available in sheets measuring 24 x 36 in.

Synthane Corp., Dept. ED, Oaks, Pa.

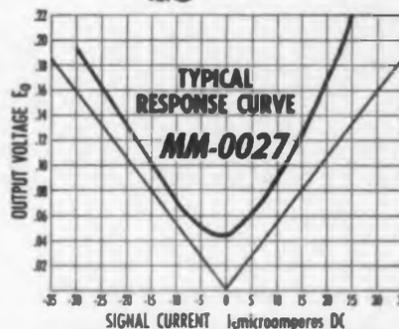
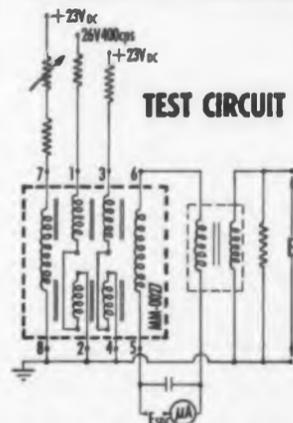
Price & Availability: Made on order usually; delivery 5 to 6 days after order received. Prices range from \$6.82 per lb when under 50 lb ordered to \$6.50 per lb when over 300 lb and over ordered.



HST MAGNETIC MODULATOR

furnishes stable signal amplification

THEORY & APPLICATION: Since certain control and instrumentation systems require amplification of DC signals, it is desirable to employ a static signal converter. Magnitude of these available DC signals is so small that instability of DC amplifying systems results when signal is brought to usable level. Therefore a stable AC amplifier is required to convert low level DC to AC. A magnetic modulator serves this function with the added advantage that a "polarity reversible" DC input is converted to a "phase reversible" output. The output can be rectified to a "polarity reversible" pulsating DC or can be applied to a phase sensitive indicating device. Input impedance is relatively high while the output impedance is inherently low.



SPECIFICATIONS: Model MM-0027

ELECTRICAL CHARACTERISTICS:

Maximum Output	>.4 V_{RMS} @ I_s 100 μa
Minimum Output	<.05 V_{RMS} @ I_s 0 μa
Voltage Unbalance	< 35%
DC Resistance	1-2 7.3 Ω \pm 20%
	3-4 500 Ω \pm 20%
	5-6 1200 Ω \pm 20%
	7-8 60 Ω \pm 20%

Frequency 400 cycles

MECHANICAL CHARACTERISTICS:

Diameter	1.13" maximum
Height	.68" maximum
Lead Length	2.00" minimum
Mounting	.125" clearance hole

ENVIRONMENT CONDITIONS:

Storage Temperature	-65° to $+100^\circ C$
Operating Temperature	-40° to $+70^\circ C$
Vibration	.060" total excursion 10-5cps
Shock	15 g's
Altitude	50,000 feet
Humidity	95% relative

Prices on request. Quotations without obligation on your other special components.

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Here's what they've done with this remarkable READALL® instrument

Several weeks ago, we used the ad you see in the picture to ask a question and give some facts. We said that the READALL readout instrument was about the size of a candy bar, and that it could display, store or transfer up to 64 different numbers, letters or symbols *without* using complicated conversion equipment and "black boxes."

We explained that the READALL instrument was originally developed for data display in flight control equipment. We described the READALL instrument as an electro-mechanical, D.C. operated, readout device for displaying characters in accordance with a pre-determined binary code . . . a compact self-contained device . . . which can be applied to the output of digital computers, teletype receiving equipment, telemetering systems, or wherever data must be displayed. And we wound up by asking about new applications for our READALL instrument. Here are some of the answers to our question:

1. A leading aircraft corporation is using READALL instruments in a visual intercom system in patrol aircraft that's connected with anti-submarine warfare.
2. Another company uses READALL instruments in ground checkout equipment for a new Air Force bomber.

We would be happy to tell you more about the READALL and its applications.

We would be happy to hear from you about possible applications. Please write to us at the address below.

"Pioneers in Push-Button Science"

UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY —

PITTSBURGH 18, PENNSYLVANIA

CIRCLE 125 ON READER-SERVICE CARD

NEW PRODUCTS

Sensitive Relays

502



Multiple-arm type

These multiple-arm, sensitive relays can be furnished with spst and spdt circuit arrangements and in several combinations. Series 50 ac coil windings are rated at 2.5 to 5 va. Series 60 dc coil windings are rated at 2 and 0.1 w. Standard contact material is silver or palladium. The magnetic circuit is substantially square.

F. A. Scherma Manufacturing Co., Inc., Dept. ED, 424 Broome St., New York 13, N.Y.

Gold-Finished Rivets

498

Are as small as 1/32 in. in diameter



Designed for electronic and instrument uses, these rivets have 24-carat gold shot-burnished finish and are offered in range of lengths varying in fractional increments of 1/32 in. and in a range of diameters down to 1/32 in. The head form is a modified brazier with low contour and minimum functional diameter for the stresses imposed. Non-magnetic brass is used with the alloy controlled for ease in setting and uniformity of the swaged or upset clinch.

Circon Component Corp., Dept. ED, Santa Barbara Municipal Airport, Goleta, Calif.

Price & Availability: \$2.23 to \$8.68 per 100; from stock.

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IDEAL FOR SEMI-CONDUCTOR METALS

Our unique process enables us to supply semi-conductor quality VITREOSIL to close tolerances in crucibles and special fabricated shapes. Write us about your requirements. See our ad in Chemical Engineering Catalog.

SPECTROSIL® FOR HYPER-PURITY IN SEMI-CONDUCTOR WORK

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TRANSPARENCY—unique optical properties
HOMOGENEITY—completely homogeneous and free from granularity
AVAILABILITY—block material for lenses, prisms, etc; rod, fiber, wool; hollow ware as tubing, crucibles, and special apparatus.

Write for complete, illustrated catalog.



THERMAL AMERICAN
FUSED QUARTZ CO., INC.
18-20 Salem St., Dover, N. J.

CIRCLE 126 ON READER-SERVICE CARD
ELECTRONIC DESIGN • July 6, 1966

Insulating Materials 610

Have high dimensional stability

These insulating materials, designated 800 Rod, have high dimensional stability under high moisture conditions. The paper base type has a flexural strength of 28,000 psi and a tensile strength of 16,700 psi. The linen base type has a flexural strength of 26,000 psi and a tensile strength of 21,000 psi. The materials can be supplied in bulk form or fabricated to precise dimensions as specified by the user.

Spaulding Fibre Co., Inc., Dept. ED, 310 Wheeler St., Tonawanda, N.Y.

Availability: From stock.

Wirewound Potentiometers 389

Case length is 3/8 in.

Type APS 1/2 wirewound potentiometers have a case length of 3/8 in. and a diameter of 1/2 in. Capable of dissipating 2 w continuously, they are for use in industrial and military equipment where reliability is an important consideration. The units are made for bushing-type mounting and are furnished with terminals, wire leads, or printed-circuit pins. They have a sealed construction.

Waters Manufacturing, Inc., Dept. ED, Boston Post Road, Wayland, Mass.

Microwave Oscillators 591

Come in three models

Three high-power sources have been added to the company's line of microwave oscillators. Model 814-S-31 covers a range from 3700 to 4300 mc and delivers 1 w. Models 814-C-31 and 814-C-32 are tunable over a range of 5900 to 6400 mc and 5400 to 5900 mc respectively, and deliver an output power of 1 and 1.5 w. All units have an incidental fm of less than 5 parts in 10^8 , and stabilities of better than 1 part in 10^6 over a one-hour period.

Laboratory For Electronics, Inc., Dept. ED, 1079 Commonwealth Ave., Boston 15, Mass.

SILICON TRANSISTOR CORPORATION



THE COMPLETE LINE OF INTERMEDIATE AND HIGH POWER SILICON TRANSISTORS



Silicon Transistor Corporation manufactures the broadest line of intermediate and high power silicon transistors in the industry. "Built-in" reliability of all STC semiconductors is assured by in-process and quality controls which are unsurpassed in the field. In addition, STC manufactures a complete line of silicon glass diodes including all of the popular military types.

FOR IMMEDIATE DELIVERY, CONTACT THESE STC AUTHORIZED DISTRIBUTORS: Ala: MG Electrical Equipment Co., Birmingham. Calif: Brill Semiconductor Corp., Oakland; Hollywood Radio Supply, Inc., Hollywood; Peninsula Electronic Supply, San Jose; Shelley Radio Co., Inc., Los Angeles; Wesco Electronics, Pasadena; Shanks & Wright, Inc., San Diego. Conn: Bond Radio Supply, Inc., Waterbury. Fla: Hammond Electronics, Inc., Orlando; Leader Distributors, Inc., Tampa. Mass: Durrell Distributors, Inc., Waltham. Md: Valley Electronics, Inc., Towson. New York: Arrow Electronics, Inc., Mineola, L. I. Penna: Philadelphia Electronics, Inc., Phila. Texas: Lenert Company, Houston; Central Electronics, Dallas.



SILICON TRANSISTOR CORPORATION

CIRCLE 127 ON READER-SERVICE CARD >

Max
Schweizer
is a
Specialist



...at "RACKING UP" RELIABILITY

That incredibly short (3½") rack-mounting counter-timer tucked under Max Schweizer's forearm is a tribute to the many years of specialized experience he brings to the position of Chief Mechanical Engineer at TSI. Every one of the 2162 components in the Model 361-R APTI®-METER* is logically located, thermally protected and instantly accessible. No "sardine packing" here!

Incidentally, Max found his job about 800 components easier, because our circuits group has achieved what we call "reliability through sophisticated simplicity" in the 360 Series. His superb packaging job further enhanced that reliability — and the Model 361-R bears a 5-year guarantee.

If you like sharp contrasts, compare this cool, compact, all-solid-state beauty with the hot-as-a-pistol vacuum-tube monsters five times its height and weight, not nearly as versatile or convenient.

Why plod along with old-fashioned counters? Let us send you literature on the newest — Model 361-R APTI®-METER, the only 1 MC solid-state counter!

*APTI®-METER is our registered trade-mark for an ACTIONS-PER-TIME-INTERVAL meter. Model 361-R counts from 0-1MC, has crystal-plus-oven stability of 0.3 ppm/week, IN-LINE NIXIE READ-OUT, and identical-twin, high-impedance, high-sensitivity amplifiers. Features galore, unlimited flexibility, yet the sensible-compromise price is only \$1680.



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Sophisticated Digital Instrumentation

TERMINAL DRIVE, PLAINVIEW, NEW YORK • WELLS 5-8700

CIRCLE 128 ON READER-SERVICE CARD

NEW PRODUCTS

Coaxial Latching Switch

499



Needs no holding power

This solenoid-actuated, coaxial, latching switch requires no holding power. The solenoids operate from 28 v dc, drawing 3.2 μ a per hr and have a switching time of 10 msec. The 50-ohm switch is a make-before-break type, weighing 8.7 oz. Frequency range extends to 11 kmc. The device has the following characteristics at 7 kmc; vswr, 1.4; insertion loss, 0.4 db; and crosstalk, 30 db.

Transco Products, Inc., Dept. ED, 12210 Nebraska Ave., Los Angeles 25, Calif.

Availability: Delivery time is 45 to 60 days.

Environmental Test Chambers 429

Altitude up to 150,000 ft

This environmental test chamber has a temperature range of from -100 F to +1000 \pm 5 F. It produces high and low temperatures by convection, and by radiation from all six sides, thus reproducing high altitude conditions around the test specimen. The free test space measures 4 x 4 x 4 ft. Mechanical refrigeration capable of dissipating a heat load at the rate of 7500 w at -70 F is provided.

The American Research Corp., Dept. ED, Farmington, Conn.

Silver-Zinc Battery 475

Fits curved missile skin

Model P13A silver-zinc primary battery, shaped to fit curved missile skin, is a main power supply for missile equipment and instruments, guidance and control systems, telemetry equipment, and warhead arming. The 40 dry-charged cells are activated by an electrically ignited solid propellant gas generator. Output is 11 kw; current rating is 180 to 3,700 amp. The capacity of the 56-v battery is 7.5 amp-hr with a shorting time of 2.5 min. The activation signal is 115 v at 4 amp.

Cook Batteries, Dept. ED, 3850 Olive St., Denver, Colo.

for **CONTINUOUS
RELIABILITY...**

**INSTALL Hoyt
PANEL METERS**



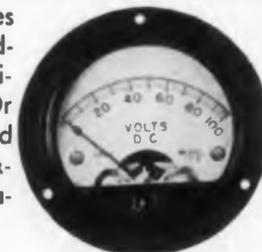
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Model 1060
Transparent
Polystyrene

Quality meters on the panel indicate quality throughout—and HOYT Panel Meters are quality in appearance and function... the complete line of matching AC and DC Meters for original equipment and replacement applications. Get accuracy, readability, and reliability; plus economy. Specify HOYT Electrical Instruments—compatible components for production, research, and test requirements.



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Moving coil, rectifier, and repulsion types available promptly in a wide assortment of sizes, ranges, cases, shapes, and colors; some with parallax-free mirror scales—all with standard mounting dimensions. Or custom designed to the most exacting specifications.



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BURTON-ROGERS COMPANY

Sales Division—Dept. ED

42 Carleton Street, Cambridge 42, Mass.

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ELECTRONIC DESIGN • July 6, 1960

Rotary Solenoid 399

For airborne and computer applications

This rotary solenoid is designed for computer, aircraft, and missile applications. It is offered in sizes as small as 3/4 in. in diameter. Linear force is translated into torque by means of roller bearings moving over precision cams. The output shaft has no linear motion. Units have a high accuracy, operate under environmental extremes, and will function for millions of cycles.

PSP Engineering Co., Dept. ED, 6058 Walker Ave., Maywood, Calif. Booth 2229.

Silicon Transistors 409

For industrial applications

This complete line of silicon transistors is for industrial applications. The 2N1586/J-503 and J-623 general-purpose units are for operation to 100 C, have 15, 30, and 60 v BV_{cbo} and BV_{ceo} , and guarantees beta spreads of 9:27, 25:75, and 70:210. The J-581 grown-junction, medium-power amplifier series has the same ratings with beta spreads of 10:30, 20:60, and 40:150. The J-460 series, for NOR logic circuitry, available in kits, have a 30-v BV_{cbo} at 50 μ a, operate from -40 to +100 C, and have minimum dc betas of 3 to 50.

Texas Instruments, Inc., Dept. ED, P. O. Box 312, Dallas Tex.

Availability: Production quantities are immediately available.

Servo Amplifiers 448

For open- or closed-loop systems

The Trans-mag line of servo amplifiers, using ac or dc inputs for 60 and 400 cps systems, are designed for open- or closed-loop servo systems. Semiconductors are used in the low power preamplifier stage. The units meet Mil specs. Applications are in military and industrial control such as in radar antenna positioning, inertial platforms, computers, and optical tracking.

Magnetic Amplifiers, Inc., Dept. ED, 632 Tinton Ave., New York 55, N.Y.

CIRCLE 130 ON READER-SERVICE CARD ➤

NEW Electronic Chemicals Brochure for manufacturers of

semi-conductors electronic tubes thermistors ferrites



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Aluminum Sulfate	Ether, Anhydrous	Petroleum Ether
Ammonium Carbonate	Hydrochloric Acid	Potassium Dichromate
Ammonium Chloride	Hydrofluoric Acid	Potassium Hydroxide
Ammonium Hydroxide	Hydrogen Peroxide, 30% and 3% Solution	iso-Propyl Alcohol
Ammonium Phosphate	Lithium Carbonate	Radio Mixture No. 3
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Barium Carbonate	Lithium Sulfate	Sodium Chloride
Barium Fluoride	Magnesium Carbonate	Sodium Hydroxide
Barium Nitrate	Magnesium Chloride	Sodium Phosphate Dibasic
Benzene	Magnesium Oxide	Strontium Carbonate
Boric Acid	Manganese Dioxide	Strontium Nitrate
Cadmium Chloride	Manganese Nitrate	Sulfuric Acid
Cadmium Nitrate	Manganese Sesquioxide	Toluene
Cadmium Sulfate	Manganous Carbonate	Trichloroethylene
Calcium Carbonate	Methanol	Triple Carbonate
Calcium Chloride	Nickel Carbonate	Xylene
Calcium Fluoride	Nickel Oxide, Black	Zinc Chloride
Calcium Nitrate	Nickel Oxide, Green	Zinc Nitrate
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Carbon Tetrachloride		

This new brochure . . . just off the press . . . tells you how Baker Electronic Chemicals can help you achieve operating economies.

The Electronic Chemicals listed on the left bring you these benefits:

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ELECTRONIC CHEMICALS
OF
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'Baker Analyzed' Reagents



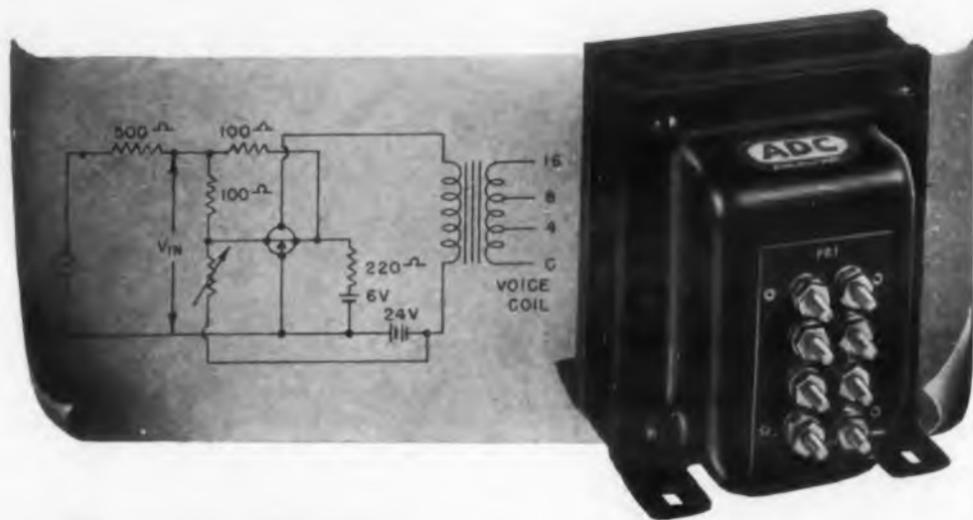
J. T. Baker Chemical Co.
Phillipsburg, New Jersey

Capable Transistor Transformer design is simple as



Capable transistor transformer design is simple at ADC. The problems are no different than those for vacuum tube circuits. And ADC has been solving these design problems for 25 years.

The transformer shown below at right, was ADC designed as an experimental output transformer for use by Minneapolis Honeywell with their H200E Power Tetrode. This transformer is capable of delivering up to 20 watts with low distortion through the frequency range of 20 to 20,000 cycles. A typical application is pictured below in the class A amplifier circuit.



The tiny transistor transformers such as those illustrated at the right are for low power applications. Introduction of new, low distortion, power transistors has required larger transformers, especially for operation at low frequency. While these may be new to transistor circuits, the design problems and solutions are identical with those of vacuum tube circuitry.

Whether you are interested in transformers for use with transistors or vacuum tubes, it will be to your advantage to come to a firm with the design experience of a pioneer like ADC.

Write for Bulletin on Miniature Transformers for Transistor and Printed Circuit Applications

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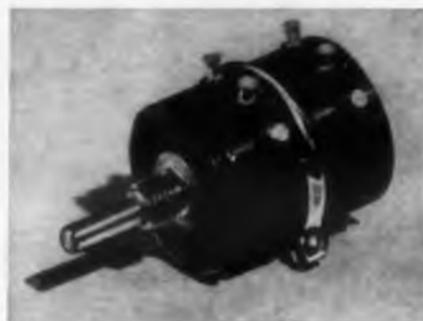
TRANSFORMERS • REACTORS • FILTERS • JACKS AND PLUGS • JACK PANELS
CIRCLE 131 ON READER-SERVICE CARD

NEW PRODUCTS

Trimmer Potentiometers

362

Have 100 to 25,000 ohms resistance



Type 118 7/8-in. trimmer potentiometers are offered in eight resistance values ranging from 100 to 25,000 ohms. The units are manufactured with 20 ppm resistance wire and can dissipate 1 w at 125 C for 2000 hr. Units meet MIL-STD-202A and NAS710.

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

Price & Availability: \$15 to \$25 ea; stock to four weeks.

Ultrasonic Cleaner

619

For large missile parts

Model BC-2500 ultrasonic cleaner, designed for cleaning large missile parts, is for use with automatic or semi-automatic washers and degreasers, manual washers, or for automatic plating. The frequency is adjustable from 36 to 40 kc. Input is 6 kw at 220 v or 440 v, 60 cps, single phase. Frequency output averages 3 kw. The unit measures 22 x 54 x 18 in. and weighs 350 lb. The fluid capacity of the tank is 75 gal.

Circo Ultrasonic Corp., Dept. ED, 51 Terminal Ave., Clark, N.J.

Power Meter

419

Reads from 30 μ w to mw



Model B832T temperature-compensated power meter measures cw or pulsed rf power in five full scale direct-reading ranges from 30 μ w to 3 mw. Values can be read in mw or dbm. Readings are

MINIATURE CIRCUITS TRANSISTORIZED



ACTUAL SIZE

1.125" x 1.225" x .413"

DID YOU KNOW . . . That Walkirt has achieved package densities of over ONE MILLION PARTS PER CUBIC FOOT? The popular "cartridge" style module pictured above has "flown" with many Missiles and Satellites where small size and high reliability are mandatory. Nothing etched or deposited here . . . only standard components of proved reliability. We have hundreds of digital and logic circuits that are available in this popular package style which is a logical compromise between Micro-Miniaturization and cost. May we send you a price list and technical data? You'll be surprised at the performance, economy and the huge selection of Walkirt Circuit Modules.

Write for technical information on DIGITAL and LOGIC circuitry.



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ELECTRONIC DESIGN • July 6, 1960

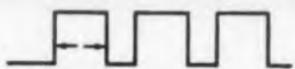
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REGISTER PULSES



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DO BINARY LOGIC



DRIVE TRANSISTOR CIRCUITS

New NAVCOR Series 300—completely transistorized 5" x 6" card modules available from stock to efficiently perform all major pulse generating and programming functions.

Write for
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NAVIGATION COMPUTER CORP.
1621 SNYDER AVE., PHILADELPHIA 45, PA.
PHONE: HOward 5-7700

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virtually drift free. The unit is transistorized and is energized by a self-contained, rechargeable nickel-cadmium battery. The charging circuit operates from 105 to 125 v ac at 50 to 400 cps. Use-to-charge ratio is 2:1.

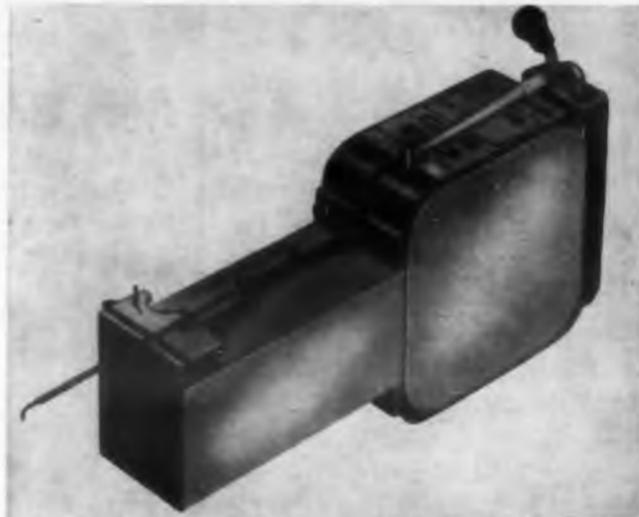
FXR, Inc., Dept. ED, 26-12 Borough Place, Woodside 77, N.Y.

Price & Availability: Price is \$450 ea. A limited number of units can be furnished from stock.

Pen Motor

366

For rectilinear ink or electric writing



Model OS-600 40-mm pen motor records signals from dc to 100 cycles and over. An interchangeable electric stylus is available for electric writing. Specifications of the unit with the firm's DA-101 compensated driver-amplifier are: current sensitivity, 28 ma per mm; linearity, dc to 120 cps, 3 db down; hysteresis, less than 1/4 mm. The motor weighs 1-1/2 lb and measures 1-3/16 x 2-1/2 x 5-1/8 in.

Cohu Electronics, Inc., MASSA Div., Dept. ED, 5 Fottler Road, Hingham, Mass.

Price & Availability: Price is \$175 in single quantities; immediate delivery available from stock.

Power Supplies

433

Outputs are up to 150 kv at 50 ma

These dc power supplies provide output voltages up to 150 kv at 50 ma. Output voltage and current are indicated on separate 4.5-in., wide-view rectangular meters. The bench type cabinet may be supplied in units with outputs up to 45 kv; mobile cabinets are used in models up to 120 kv; the caster-mounted console houses the larger supplies.

Associated Research, Inc., Dept. ED, 3777 W. Belmont Ave., Chicago 18, Ill.

Price & Availability: Prices range from \$497.50 to \$5480. Some available from stock, others require 6-8 weeks after receipt of order.

The future . . . from your point of view

A good day's growth for a hard day's work.

A position to suit your talents, experience and ambition.

Opportunity to exercise full initiative in Research, Radar, Doppler Navigational Systems, Magnetic Memory Systems, Microwave and Computers.



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Management awareness encouraging exploration beyond the range of present knowledge.

APPOINTMENTS NOW AVAILABLE:

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Experience and state-of-the-art knowledge in one or more of these: oscillators, cw or pulse modulators, video, IF or microwave amplifiers, differentiators, integrators, power supplies, pulse coders and decoders, phase detectors, MTI cancellers. Projects include: R&D of advanced techniques; ground, airborne, space equipment.

PHYSICIST

Applied Research

Advanced degree in physics or engineering physics, plus an appreciation of theory. To design a series of experiments in plasma physics, taking responsibility for equipment specification and installation plus all other experimental considerations.

For confidential discussion, please write:

Eugene Rust
Laboratory for Electronics
75 Pitts Street, Boston 14, Massachusetts



Laboratory for Electronics

CIRCLE 902 ON CAREER INQUIRY FORM, PAGE 159



Regulated, multiple voltage output +250 volts, +150 volts, +70 volts, +70 volts, +250 volts, -35 volts, -50 volts, -60 volts, -70 volts, -250 volts D.C. 6.3 volts, 115 volts, A.C. Total power capacity approx. 15 KW

EXPERIENCE and SKILL
are an inherent component
of every ACME ELECTRIC built
POWER SUPPLY

"Know your supplier" is pertinent advice as it applies to the design, engineering and construction of power supplies. Acme Electric not only knows the state of the art but is a recommended supply source. That's why you can expect specific advantages based on engineering experience, and backed-up by manufacturing facilities and trained manpower. If power supplies are an important part of your products, it will pay you to investigate the part Acme Electric can play in your procurement program.



Series regulated
Output 120, $\pm 1\%$ dc
@ 0-6 amps.

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SAA 3420/1072

Acme ACME Electric
TRANSFORMERS

CIRCLE 134 ON READER-SERVICE CARD

NEW PRODUCTS

Telephone Type Relay

501

Coil resistance is 10 K



Series TW medium power telephone type relay is available with contact arrangements up to 4 pdt. In voltages from 6 to 220 v ac and dc, 3/16-in. diam contacts made of fine silver and gold flashed are rated at 5 amp at 115 v, and 60 cps, noninductive. Coil resistance is 10 K as standard, higher on request. Applications include: communications equipment, computers, industrial programming devices, and other applications requiring a small, fast-acting multi-contact relay.

Line Electric Co., Dept. ED, 229 River St., Orange, N.J.

Price & Availability: Price is \$5.50 to \$8.05. Delivered in 8 weeks.

Schering Bridge

400

Available as a cable-tester

This Schering bridge is offered as a general purpose bridge and as a cable test bridge. Units measure the power factor and capacitance of insulating materials. The general purpose bridge has a range of 0.0000025 to 1 μ f; the cable test bridge, from 0.0000025 to 2 μ f. Capacitance accuracy is $\pm 0.2\%$.

Industrial Instruments, Inc., Dept. ED, 89 Commercial Road, Cedar Grove, N.J.

Price & Availability: \$6950 ea; 70-day delivery time.

Shield-Bezel Assemblies

355

For CRT use



This series of CRT bezel assemblies includes complete assemblies for 3, 5, and 7-in. curved and flat-faced tubes. Assemblies consist of cast alu-

Gurley Photoelectric Pulse Generator



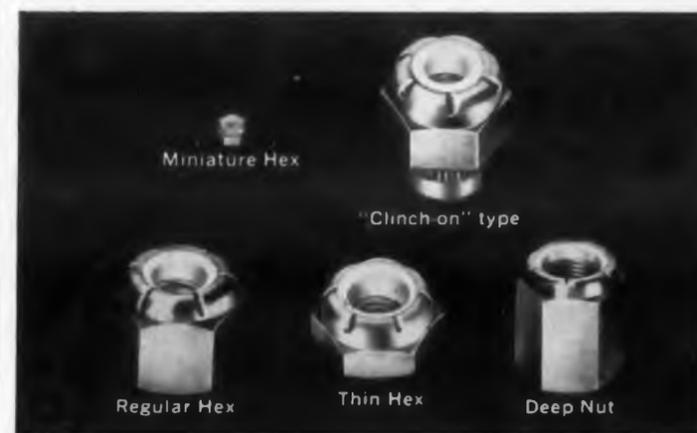
Rate Generator or Angle Reader

Gurley Photoelectric Pulse Generator is a shaft-driven device delivering electrical pulses at output terminals ... Pulse frequency is directly proportional to shaft rpm ... *Two basic uses:* as a rate generator (output frequency may be read in terms of shaft rpm) or as an angle-measuring device ("total angle" is determined by "totalizing" individual pulses). Write for brochure.

W. & L. E. Gurley

525 Fulton Street, Troy, New York

CIRCLE 135 ON READER-SERVICE CARD



THERE'S A STANDARD ELASTIC STOP NUT FOR EVERY BOLTED ASSEMBLY

Whether you need a self-locking fastener that measures 1/10 inch across the flat—or a husky hex nut that can stand up under the heaviest vibration—look to ESNA.

No amount of vibration, shock, or impact can make an Elastic Stop® nut break loose. Exclusive nylon locking insert grips like a vise—yet never deforms bolt threads and may be re-used again and again. Try it for prestressed or positioned settings—it stays put anywhere on the bolt you set it. For details write Dept. S49-435, Elastic Stop Nut Corporation, 2330 Vauxhall Road, Union, New Jersey.



ELASTIC STOP NUT CORPORATION OF AMERICA

CIRCLE 136 ON READER-SERVICE CARD
ELECTRONIC DESIGN • July 6, 1960

* Package with Confidence



New Mystik Brand Super Flextron® Tape No. 6497 Has Bi-Directional Strength

An unique packaging tape. Super strength bi-directional filaments are an integral part of the product—providing equal strength in both directions. The tape is water and moisture proof. Excellent quick stick properties and it stays stuck.

TYPICAL APPLICATIONS: Strapping and holding heavy machinery parts—sealing heavy-content packages for shipment—holding loose parts in place for assembly of refrigerators and stoves—heavy banding on corrugated, fiberboard and wooden cartons—strapping tubes, rods and lumber—banding groups of cartons on pallets. Frequently replaces steel strapping.

(Conforms to Government Specifications PPP-T-97-Type 11)

Write for full information on Mystik Super Flextron No. 6497 and other Mystik brand packaging tapes.

Mystik Adhesive Products, Inc.
2635 N. Kildare Ave.,
Chicago 39, Illinois

MYSTIK
BRAND
TAPES
SELF-STIK

PROTECTIVE COVERING MATERIALS—TAPES THAT TALK

CIRCLE 137 ON READER-SERVICE CARD

write for

Shaft Retention

FASTENERS

CATALOG TODAY!

Featuring **Fastex® Springrip Fasteners**
Springrip Fasteners simply slip on shaft or stud. Biting teeth resist dislodging movement. Full story told in new catalog containing data on Springrip Fasteners, **Plasti-Rings®**, **Push-On Fasteners** and **"C"-Rings**.

FASTEX 195 Algonquin Road,
Des Plaines, Illinois

Division of **Illinois Tool Works** **itw**

CIRCLE 138 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 1960

minum and/or molded plastic bezel, scale-calibrated reticule, colored light filter, molded rubber shock cushion, and mounting hardware. Bezels are non-reflecting, black baked enamel throughout.

Jan Hardware Manufacturing Co., Inc., Dept. ED, 38-01 Queens Blvd., Long Island City 1, N.Y.

Waveguide Switches 420

Range is 3.95 to 40 kmc



Series 641 waveguide switches cover the range of 3.95 to 40 kmc. Each switch operates over the full waveguide bandwidth. They can be operated manually or driven by a 28 v dc solenoid actuator. Maximum vswr is 1.1; minimum isolation is 60 db for 3.95 to 26.5 kmc and 50 db for 26.5 to 40 kmc.

FXR, Inc., Dept. ED, 26-12 Borough Place, Woodside 77, N.Y.

Price & Availability: Manually-operated units are from \$225 for X-band type to \$350 for H-band type. Electrically-operated units are from \$250 for X-band to \$400 for H-band. Delivery is in 30 to 90 days.

Digital Readout System 439

For quality control, statistical testing

Having applications in high-volume, high-speed testing operations for quality control and statistical testing, this digital readout system consists of the firm's universal testing instrument equipped with encoders, memory storage units and associated assemblies. Through binary decimal code, the system converts information normally presented in graphic form directly into automatic printing digital form. Specific characteristics of materials to be evaluated are preselected and their values are sorted in magnetic memory units during the test. The values are automatically printed out after the test.

Instron Engineering Corp., Dept. ED, 2500 Washington St., Canton, Mass.

Price & Availability: Made on order only; delivered 120 days order received. Price depends on the number and kind of parameters to be printed in digital form.

THERMOSTATS

BY *Therm-O-Disc*

TYPE A—Adjustable



- Slow make or break contacts
- For operating temperatures up to 550°F.
- Resistive load—1500 watts at 120 VAC

TYPE HL



- Single pole, single throw or double pole, single throw
- Manual or automatic reset
- Preset, snap action, non-adjustable
- For operating temperatures up to 300°F.
- Resistive load—40 amperes at 125 VAC 25 amperes at 250 VAC

TYPE 11T-11

Best suited for controlling temperatures in air streams same ratings as TYPE 11T-21



Designed for surface mounting also available for watertight mounting

- High ratings with minimum size
- Single pole, single throw or single pole, double throw
- Preset, snap action, non-adjustable
- For operating temperatures up to 350°F.
- Blade or screw terminals, exposed or enclosed disc
- Resistive load—6000 watts at 240 VAC 3000 watts at 120 VAC
- Inductive load—10 amps, full load at 120 VAC 5 amps, full load at 240 VAC



TYPE 11T-21

TYPE AF & AL

- For fan motor or limit control
- 3" or 7" sensing element
 - Snap action—adjustable
 - For operating temperatures up to 300°F.
 - Fan or limit rating—½ h.p. at 120/240 VAC and 125 volt amperes at 120/240 VAC



TYPE WA

Best suited for controlling temperatures in air streams same ratings as TYPE WC



TYPE WC

Designed for surface mounting (with or without mounting bracket)



- Preset, snap action, non-adjustable
- Single pole, single throw
- For operating temperatures up to 350°F.
- Blade or screw terminals, exposed or enclosed disc
- Resistive load—2500 watts at 240 VAC 1650 watts at 120 VAC
- Inductive load—4.4 amps, full load at 120 VAC 2.2 amps, full load at 240 VAC

TYPE 20T

- Refrigeration and air conditioning control
- Hermetically sealed in all-metal case
- Single pole, single throw
- For operating temperatures up to 200°F.
- Resistive load—1000 watts at 120/240 VAC



Detailed information on request Minimum production order quantity accepted—25



THERM-O-DISC, Incorporated Mansfield, Ohio

CIRCLE 139 ON READER-SERVICE CARD



DRESSEN-BARNES STOCKS MIL-SPEC COMPONENT MODULAR DC POWER SUPPLIES



D/B CAN PROVIDE MANY MODULAR DC POWER SUPPLIES WITH COMPONENTS DESIGNED TO MEET MIL-SPECS AND WITH MIL-SPEC WIRING AND WORKMANSHIP; SOME OF THESE MODELS ARE DESCRIBED BELOW:

RANGE (volts)	DC OUTPUT		REGULATION		RIPPLE MV RMS MAX. (115V AC)	MODEL NUMBER
	NOMINAL (volts)	CURRENT (MA)	% LINE	% LOAD		
130-170	150	250	.2	.1	2	22-121
145-170	150	70	.4	.3	5	30425
180-220	200	240	.15	.1	2	30305
235-265	250	70	.24	.18	5	30423
225-425	300	150	.05	.05	2	22-107
275-325	300	300	.05	.05	2	22-123
285-315	300	70	.2	.15	5	30424
375-425	400	240	.05	.05	2	22-122

6.3 VAC UNREGULATED OUTPUT ALSO PROVIDED
INPUT: 105-125 V, 60-400 CPS

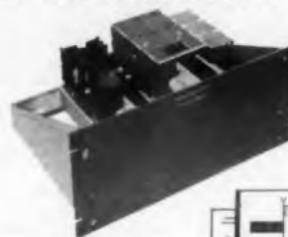
DRESSEN-BARNES CORPORATION
250 NORTH VINEDO AVENUE PASADENA, CALIFORNIA
MURRAY 1-0643 TWX: PASACAL 8499



MODEL 22-107

TYPICAL KIT INSTALLATION

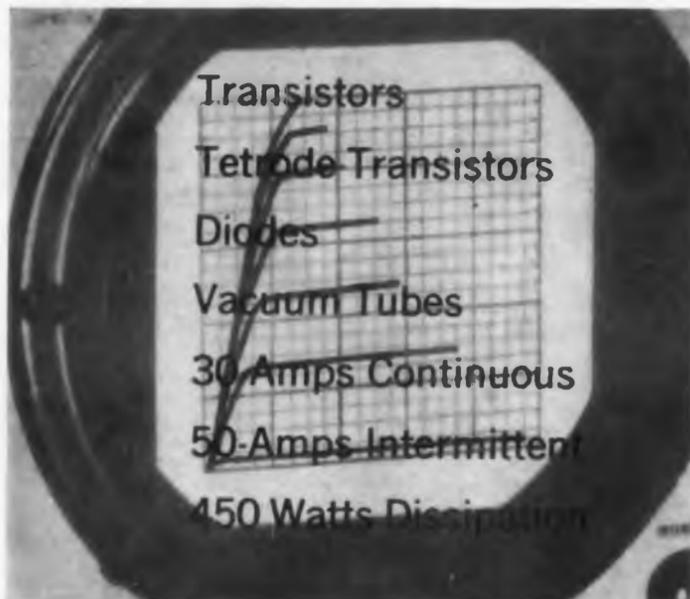
BACK MOUNTING KIT
MODEL 70-101
WILL ACCOMMODATE
UP TO FOUR MODULES.
IDEAL FOR MULTIPLE
OUTPUT COMBINATIONS
FROM D/B MODULES.
KIT IS ALSO AVAILABLE
SEPARATELY.



SEND FOR MIL-SPEC
COMPONENT MODULES
DATA SHEET AND NEW CATALOG

CIRCLE 140 ON READER-SERVICE CARD

NEW CURVE TRACER with Tube Adapter



Transistors
Tetrode Transistors
Diodes
Vacuum Tubes
30 Amps Continuous
50 Amps Intermittent
450 Watts Dissipation

For complete information
write for bulletin #TT108.



Beird-Atomic, Inc.
33 UNIVERSITY RD.
CAMBRIDGE 38, MASS.



CIRCLE 141 ON READER-SERVICE CARD

NEW non-corrosive HYDRAZINE FLUX* ends residue problems on soldered joints, saves production time

HYDRAZINE FLUX leaves no rosin residue. New flux in water and water-alcohol solutions vaporizes completely at soldering temperature. Leaves no residue which would support growth of fungus. Will not corrode. Conforms to strict military requirements.

HYDRAZINE FLUX permits prefluxing. This means you can hold prefluxed parts before soldering—an efficiency measure

that can increase manhour output substantially.

Ideal for soft-soldering a wide range of copper and copper-based alloys in electronic applications.

Test Hydrazine Flux in your own plant. Write for a sample of Hydrazine Flux and technical literature . . . for name of your nearest distributor.

*U.S. Patent No. 2,612,459

Available only from Fairmount and its sales agents.

Fairmount
CHEMICAL COMPANY, INC.

Dept. ED, 136 Liberty St., N.Y. 6, N.Y. • Plant: Newark, N. J.
CIRCLE 142 ON READER-SERVICE CARD

DESIGN DECISIONS

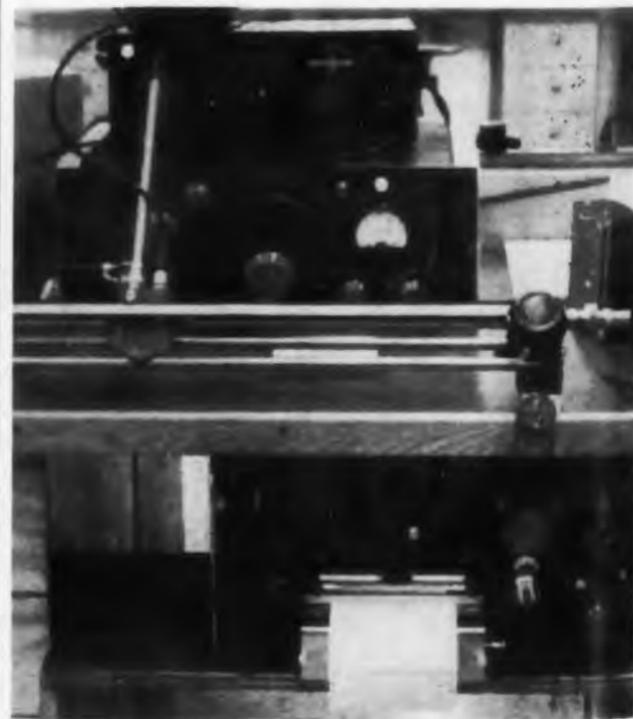
Featuring the clever and unusual in packaging, appearance design and circuitry in electronic equipment.

Pen Recorder Drives Slotted Line For Accurate VSWR Plots

THE USUAL way to measure the vswr of coaxial microwave components involves connecting them to a slotted line, then carefully reading vswr for many discrete positions of the slotted-line probe. With luck, these readings can be closely duplicated on a second run.

A simpler and faster technique, and one which makes for more accurate measurements is one devised by engineers at General Radio Co. in West Concord, Mass. They chain-drive the probe carriage on a slotted line directly from a G-R Graphic Level Recorder.

They can thus plot vswr directly on paper and can repeat measurements to within 0.1 per cent. By making separate runs for the line alone and for the line with a component to be tested, they can cancel the vswr introduced by the line.



Graphic recorder plots vswr of components connected to chain-driven slotted line.

ELECTRONIC DESIGN • July 6, 1960



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.



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

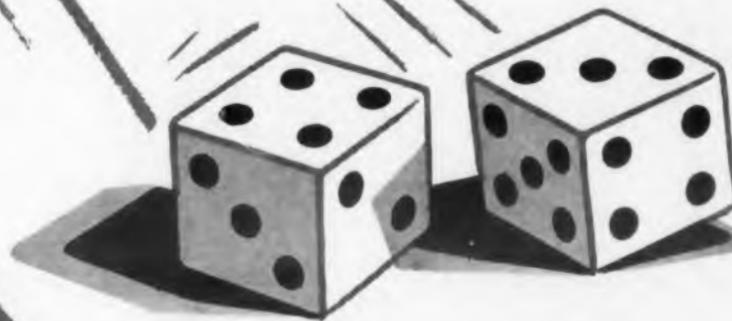
CIRCLE 143 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 1960

WHY GAMBLE?

RELIABILITY

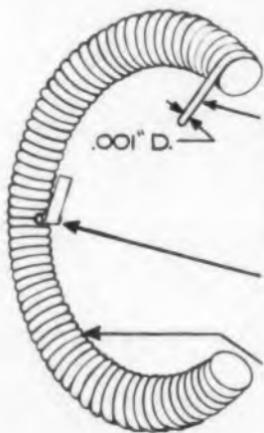
is a NATURAL...



WITH CIC PRECISION FILM POTS!

HERE'S WHY!

WIRE-WOUND... THE HARD WAY

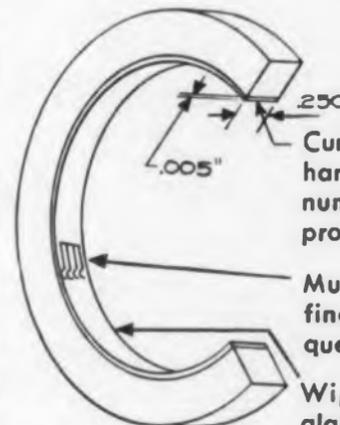


All current carried by a single fragile hair-like wire. Cutting any one turn causes no-warning, catastrophic failure—for 2,000 turns, 2,000 chances for element failure!

Single bar contact wiper — one microscopic dust particle can cause an open — 1:1 odds on failure!

In one traverse wiper must make switch-like contact to each turn for continuity — for 2,000 turns, 2,000 chances for opens!

FILM POT... THE EASY WAY



Current carried by broad band of hard carbon film with an infinite number of current paths — ZERO probability of element failure!

Multiple fingered wiper — each finger with different natural frequency — odds on opens 1:16!

Wiper rides on continuous film, glass smooth, self-lubricating carbon — ZERO probability of opens!

Precision film potentiometers are inherently four million times more reliable than wire-wound types! Write for our Tech Note "Reliability Factors in Precision Potentiometers" for the whole story.

FIRST IN FILM POTS



92 MADISON AVENUE, HEMPSTEAD, L. I., N. Y.

CIRCLE 144 ON READER-SERVICE CARD

SAVE 50% to 90% ON DC POWER SYSTEMS



The modern way to boost electronic power-system reliability is also the best way to cut cost, size, heat-loss, and complexity... by interposing a precisely-regulated motor-alternator set as a buffer-regulator between your DC power supplies and the power line. Typical Savings: 50-90%.

This technique often eliminates the need for regulated supplies... simple brute-force rectifiers suffice. If regulation is still necessary, the stress on the regulator is greatly reduced, hence remarkable savings in cost, etc.

Everybody's doing it... in Computers, Automation, Telemetry, Ground Support. Incidentally, ignore old-fashioned prejudices about rotary equipment... this is "turn-it-on-and-forget-it" gear... we even build them brushless, if you object to routine once-a-year maintenance.

Skeptical? Write today for this complete, authoritative, 32-page illustrated technical manual describing ESCO-RI PRECISE POWER SYSTEMS.



Partners
in Power

**ELECTRIC
SPECIALTY CO.**

202 SOUTH STREET, STAMFORD, CONNECTICUT
Fireside 8-6203



REGULATORS, INC.



CIRCLE 145 ON READER-SERVICE CARD

NEW LITERATURE

Slip Ring Assemblies 260

This 28-page catalog describes the company's line of seven standard slip ring assemblies with ring envelope diameters from 1 through 10-1/2 in. Custom assemblies are also described and illustrated. Breeze Corp., Inc., 700 Liberty Ave., Union, N.J.

Converting to Solid State 261

State-of-the-art advancements on new systems and components are graphically presented in this 42-page brochure, "Solid State Conversions." Among the categories discussed are: Voltage Level Sensing Systems—Ac; Voltage Level Sensing Systems—DC; Static Inverters; Power Supplies; Ice Detection Systems, and Solid State Components. The booklet intends to show how size reduction and environmental range extension are possible by using solid state techniques. Cook Electric Co., Diaphlex Div., 2700 Southport Ave., Chicago 14, Ill.

Metal Tubing 262

Bulletin No. 42, 12 pages, is a selection guide to metal tubing. It briefly summarizes the important properties of 84 tubing analyses in seven groups: carbon steels, stainless steels, alloy steels, nickel and nickel alloys, copper base alloys, glass sealing alloys and reactive metals. Alloys are described in tabular style which provides AISI type number, available form, characteristics and applications. Superior Tube Co., 1521 Germantown Ave., Norristown, Pa.

Carbon Film Resistors 263

This 12-page catalog describes the company's line of carbon film resistors. In addition to specifications, the catalog contains three histograms on the four basic types of resistors. In graph form, these show the results of continuing temperature cycling, load life and moisture tests. Electra Manufacturing Co., 4051 Broadway, Kansas City, Mo.

ADEL LINE SUPPORTS

designed for every application

CLAMPS · BLOCKS · HARNESS STRAPS

for military & industrial systems & equipments

They cut maintenance and replacement costs... performance and reliability far beyond specifications of any other Line Support.



CLAMPS provide cushioned, vibration absorbing support for cables, tubing and piping.



BLOCKS provide resilient support for multiple grouping of lines to eliminate failures.



HARNESS STRAPS embody heat and cold resistant material for temperatures far above +550°F to well below -55°F.

For safety, flexibility, durability and economy SPECIFY ADEL and be certain of getting the best possible service from products that are the result of advanced engineering design and the most modern production techniques.

A COMPLETE LINE... SERVICE-FITTED, TESTED AND APPROVED. SPECIFICATIONS ARE AVAILABLE TO AIRCRAFT, MISSILE AND ORIGINAL EQUIPMENT MANUFACTURERS... WHAT ARE YOUR REQUIREMENTS?



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ADEL PRECISION
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Huntington 4,
West Virginia

CIRCLE 146 ON READER-SERVICE CARD

CIRCLE 147 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 1960

Elastometers

264

Bulletin No. 902, six pages, contains a chart that covers physical and chemical properties, processing properties, and environmental resistance of ten general elastometer types. Some of the types covered are: silicone rubbers, styrene butadiene rubber and fluorinated elastomers. Lord Manufacturing Co., Erie, Pa.

Heating Element

265

The Electro-Mesh heating element is described in this 16-page catalog. Complete technical data includes physical properties and thermal characteristics, as well as a visual description of the varied components now being used in the aircraft, missile and space age fields. Electrofilm, Inc., 7116 Laurel Canyon Blvd., N. Hollywood, Calif.

Fractional Horsepower Motors

266

Characteristics of the full line of fractional horsepower Form G general purpose motors appear in this 12-page brochure. Capacitor-start, split-phase, permanent-split capacitor, shaded-pole and

polyphase motors are included. Sixteen different kinds of motors are shown in NEMA frame sizes 48 through 56. General Electric Co., Schenectady 5, N.Y.

Industrial Alloy Transistors

267

Industrial alloy transistors types 2N650A, 2N651A and 2N652A are described in this six-page technical data sheet. Results of acceptance tests are given in table form; performance curves are included for collector characteristics, current versus base drive voltage and current gain versus collector current. Motorola Semiconductor, 5005 E. McDowell Road, Phoenix, Ariz.

Servometer-Amplifier

268

Type R1040-6 servometer-amplifier is described in this four-page bulletin, No. 910-4B. Specifications include resistance and capacitance balance, temperature characteristics, frequency response, and output indication. Associated equipment described in the bulletin includes a stick force, a rudder force and a wheel force dynamometer. Radiation, Inc., Melbourne, Fla.



NEW TRANSISTORIZED



MODEL PS-3 \$69⁵⁰ net
0-25v. DC variable output voltage

REGULATED DC POWER SUPPLY

NOW service technicians and industrial users can afford the performance of a regulated variable-voltage power supply.

Set It and Forget It—Voltage remains essentially constant at any output voltage setting regardless of load (within ratings) and AC supply voltage fluctuations.

Extremely Low Ripple—Less than 1 MV (.001 V) RMS for all conditions of rated operation . . . less than 1/2 MV (.0005 V) for AC line voltage between 115 and 120 volts.

Output—0-200 MA, 0-15 volts. 0-100 MA, 0-25 volts.

Input Voltage—110 to 130 volts, 60 cycles.

Regulation—500 MV maximum, for above mentioned ratings.

Sold by Leading Electronic Distributors. Send for Catalog Sheet PS-3

ELECTRO PRODUCTS LABORATORIES

4501-U Ravenswood, Chicago 40 / Canada: Atlas Radio Corp., Ltd., Toronto, Ont.

AT ONE-HALF THE COST!

CIRCLE 148 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 6, 1960

HELITRIM® 1/2" SQUARE TRIMMING POTS... Now available from Helipot at the lowest price in history! Model 70 with Teflon leads, \$4.95 and down; Model 71 with pins, \$5.45 and down.

Take your pick: Model 70 with leads... Model 71 with pins. They'll solve your trimming and space problems and see you through adverse environmental conditions, too!

They should. They're the best pair of square trims on today's market... at this or any price!

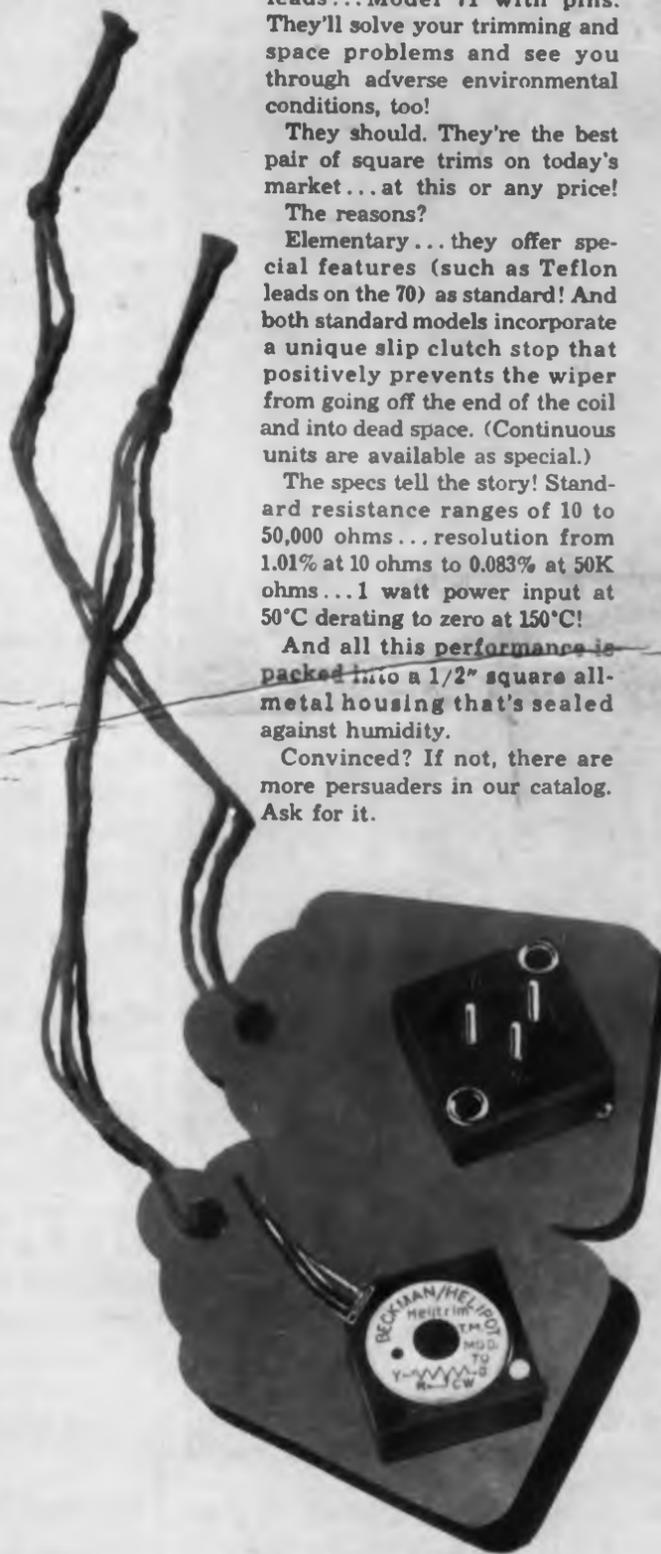
The reasons?

Elementary... they offer special features (such as Teflon leads on the 70) as standard! And both standard models incorporate a unique slip clutch stop that positively prevents the wiper from going off the end of the coil and into dead space. (Continuous units are available as special.)

The specs tell the story! Standard resistance ranges of 10 to 50,000 ohms... resolution from 1.01% at 10 ohms to 0.083% at 50K ohms... 1 watt power input at 50°C derating to zero at 150°C!

And all this performance is packed into a 1/2" square all-metal housing that's sealed against humidity.

Convinced? If not, there are more persuaders in our catalog. Ask for it.



Beckman/Helipot®

POTS : MOTORS : METERS

Helipot Division of
Beckman Instruments, Inc.
Fullerton, California



© 1960 B.I.I. 61004

CIRCLE 149 ON READER-SERVICE CARD

WHEN YOU START USING GRANT * SELF-ALIGNING SLIDES...



Time and labor saving Self-Aligning slides compensate for cabinet or chassis construction inaccuracies by an exclusive "built-in" design feature which results in slide action of the same efficient degree as within ordinary, wholly square chassis. All Grant Self-Aligning slides meet military specifications for material and finish. Load ratings on Grant Self-Aligning slides are the same as those for regular Grant Slides.

* Grant Self-Aligning slides are manufactured under U.S. Pat. No. 2,370,861.

We'll be pleased to send you additional data on request.

GRANT INDUSTRIAL SLIDES GRANT PULLEY & HARDWARE CORPORATION



Eastern Division / 21 High Street, West Nyack, N. Y.
Western Division / 944 Long Beach Ave., Los Angeles 21, Calif.

CIRCLE 150 ON READER-SERVICE CARD

NEW LITERATURE

Memory Core Tester 269

Type 2101 automatic memory core tester is described in this four-page folder. The folder contains block diagrams of sensing and decision circuitry, four different programs of current driving pulses, and examples of test accept and reject criteria. Digital Equipment Corp., Maynard, Mass.

Filters and Toroids 270

This four-page illustrated catalog lists various toroid types and shows typical performance curves. A new standard line of encapsulated toroids is described and illustrated, and information is given on how to specify size, style, types of leads and mountings by a system of designators. The catalog has a section on the ordering of filters, with a listing of requirements under eight general groups which cover the information necessary to develop suitable characteristics. Barker & Williamson, Inc., Canal St. & Beaver Dam Road, Bristol, Pa.

Time Delay Relays 271

This 1960 catalog on thermal time delay relays contains separate sheets describing different models. Dimension drawings are given for each model in addition to complete specifications. Schematics also show delay, ignition timer, sequence operation, and rapid reset-no operation typical circuit applications. Thermal Controls, Inc., 43 River Road, N. Arlington, N.J.

Ceramic Insulated Wire 272

Entitled "Secon Ceramic Insulated Wire For Use in High Temperature and Nuclear Environments," this brochure outlines many of the pitfalls which must be avoided if components are to operate successfully at temperatures in the 800 to 1200 F range. Part I covers the physical and electrical properties of the insulation. The next section contains data on conductors for use under various conditions. The last section is concerned with potting, sealing and termination. Secon Metals Corp., 7 Intervale St., White Plains, N.Y.

Decimal Scalars 273

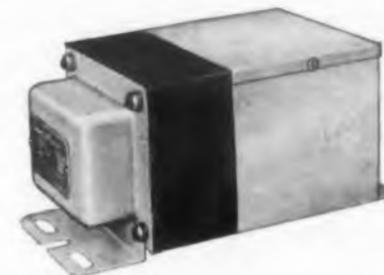
Series SC-750 transistorized decimal scalars are described in this data sheet, No. D-750, two pages. A photograph and block diagram of the equipment are included. Specifications cover resolution, count storage, input pulse requirements, gating modes and threshold control. Eldorado Electronics, 2821 Tenth St., Berkeley 10, Calif.

WHICH CONSTANT VOLTAGE STABILIZER MEETS YOUR NEED?



This compact stabilizer design occupies a minimum of space and is especially adaptable as a component in electronic devices where output voltages must be maintained $\pm 1\%$ of normal. Available in ratings of 15, 25, 50 VA.

Input voltage: 95/130
Output voltage: 120; 6.3



For applications requiring steady-state voltage for laboratory use or electronic circuitry this heavy duty design is available in the following stock ratings and voltage ranges.

Capacities: 100; 200; 300; 500 VA
Input voltage: 95/130; 190/260; 190/260
Output voltage: 120 120 240

This unit has been designed to provide instantaneous response to voltage fluctuation in large loads. Voltage output regulation between no load and full load is constant regardless of input voltage. Current limiting protection under overload conditions.

Available in ratings of
1000 and 2000 VA
Input voltage:
95/130; 190/260; 190/260
Output voltage:
120; 120; 240



ACME ELECTRIC CORPORATION

907 Water St. • Cuba, N. Y.

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Patent Preparation

274

Entitled "Preparing for Patent-Hood," this 19-page booklet tells you what to do with your invention idea; when to talk with a patent attorney; importance of dates and a verifier; about the patent office; applications handling; revising claims; claims and patents; economic importance of patents; and foreign patents. CGS Laboratories, Inc., Trak Electronics Co., Wilton, Conn.

Transistor Servo Amplifiers

275

One of these two four-page bulletins describes standard and stock lines of transistor servo amplifiers of miniature size and a stock line of magnetic control amplifiers for controlling silicon control rectifiers. The other bulletin describes the toroidal winding, inductor and magnetic amplifier facilities of the company. Magnetico Inc., 6 Richter Court, E. Northport, Long Island, N.Y.

Rare Earth Elements

276

Complete technical information about various chemicals, metals and alloys of the rare earth group of elements, thorium, scandium and yttrium, appears in this eight-page bulletin. In addition to potential uses, it describes manufacture and lists detailed properties and chemical analyses of more than 50 products. Vitro Chemical Co., 342 Madison Ave., New York 17, N.Y.

Digital Readout System

277

Brochure No. 7 describes the company's dynamic digital readout system. The six-page brochure contains a block diagram of the system. Included in the summary of specifications are data on the digital equipment, slope and maximum load detectors, power requirements, and accessories. Instron Engineering Corp., 2500 Washington St., Canton, Mass.

Speed Detecting Governors

278

Three types of housed speed detecting governors, as well as smaller components for original equipment, are described in this one-page bulletin, No. 264. In addition, operating principles of the detectors are covered. Torq Engineered Products, Inc., 32 W. Monroe St., Bedford, Ohio.

Transistor Adaptors

279

Five transistor adaptors, type Q-601, are described in two-page illustrated bulletin No. WK-Q-601. Brief specifications, purpose, and design features are included in the bulletin. Wayne Kerr Corp., 1633 Race St., Philadelphia 3, Pa.



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FOR INFORMATION, CONTACT Dept. 2207

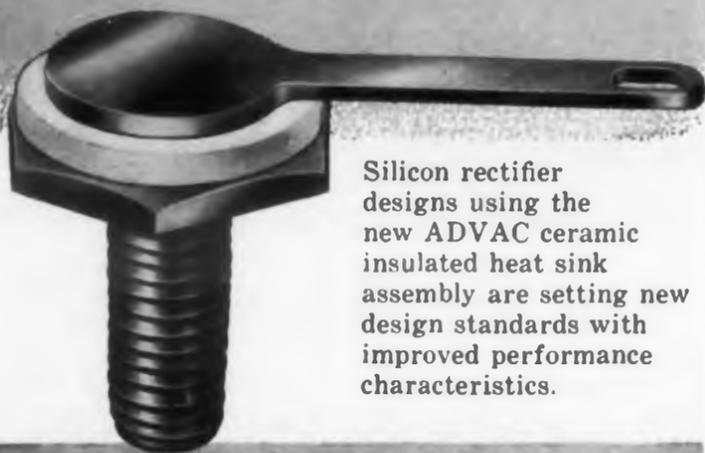
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Special Potting Method Provides Waterproof Seal Around Teflon Wire

Potting around Teflon-covered wire and cables can be made permanently watertight and highly resistant to shock impact by pre-treating the wire with an etching compound called Tetra-Etch. Introduced recently by W. L. Gore & Associates, Inc., Tetra-Etch reacts with fluorocarbon resin to produce a carbonaceous film on the treated surface. This film then serves as a medium for tightly bonding the potting compound to the Teflon.

The accompanying photos illustrate the steps involved in attaching and potting plug assemblies to flat, multiple-conductor ribbon cable.

After the cable ends have been slit between conductors and stripped of insulation, they are dipped in the etchant, Fig. 1, for approximately 2 min. After the wires are removed from the etchant, they're wiped off with a damp cloth or flushed with water. The etched area will show a definite change of color to light brown. As a final preparatory step, all surfaces are wiped with acetone.

Next, the wire ends are tinned and all leads are soldered into the plug. After soldering, all surfaces are wiped clean with MEK solvent (methyl ethyl ketone) to make certain they're



Fig. 1. After the cable is slit, it is immersed in the etchant for about 2 min; then residue is removed with water and all surfaces are wiped with acetone. Carbonaceous film formed on the Teflon is the key to tight bonding.

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Fig. 2. Primer is brushed on sparingly, then allowed to dry for several minutes. Duct seal is applied to all areas where uncured resin might leak out.

completely free of possible contaminants such as grease, oils and sealants.

Now the assembly is ready for priming as in Fig. 2. A thin coat of 3-M Scotchcast resin No. XR-5001 is brushed sparingly on all surfaces to be potted, then allowed to dry for several minutes. In preparation for potting, the unit is placed in a mechanical fixture to assure rigid clamping during the resin cure. At the same time, duct seal is applied to all areas where uncured resin might possibly leak out.

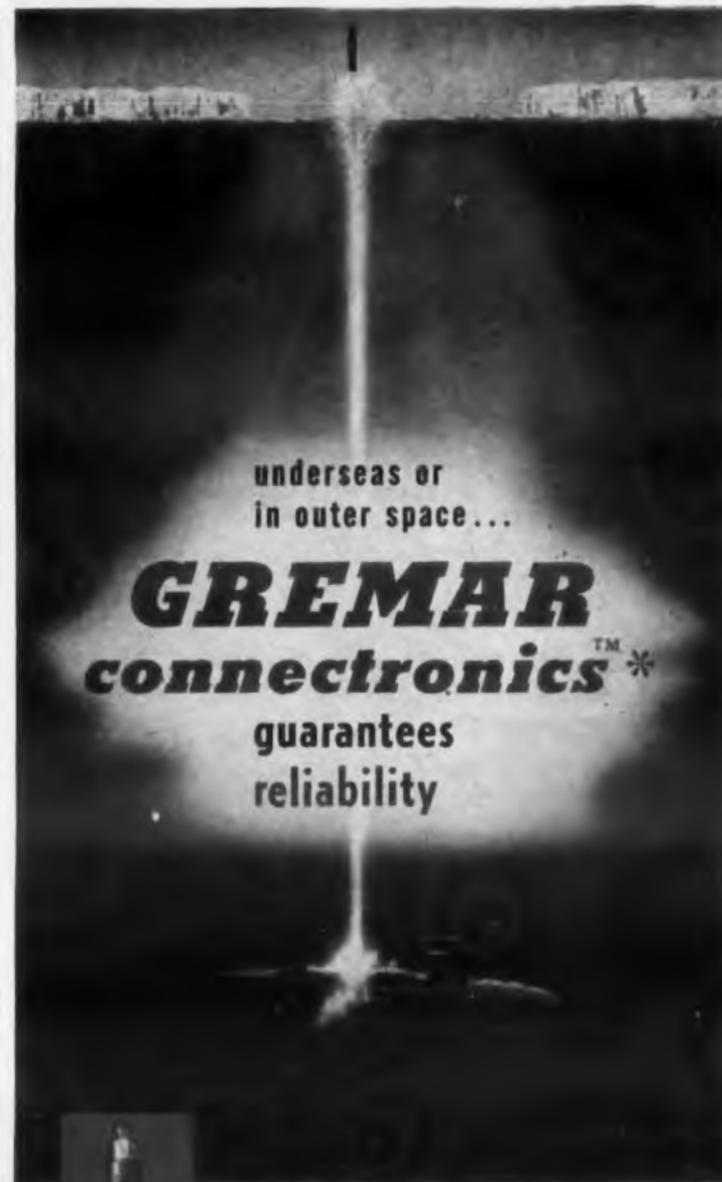
Finally, the unit is potted as in Fig. 3. Depending upon specific requirements, Scotchcast No. 212 or No. 1120 can be used.

Potted Unit Withstands Wear and Tear

That the resulting assembly will stand up to surprisingly rough treatment was demonstrated in tests run on the first plug-and-cable unit potted in this manner.

After potting and curing was completed on the back of the plug, the front was closed off tightly with duct seal. Then the entire assembly was submerged in 2 ft of water, with only the extreme opposite end of the cable extending above the surface. After the unit had soaked for an entire week, all adjacent wires were tested with a 500-v dc megger; no measurable leakage could be detected from wire to wire, or from any wire to the water.

Next, the potted assembly was subjected to severe manhandling. Each wire was pulled and wiggled many times by several people. The entire



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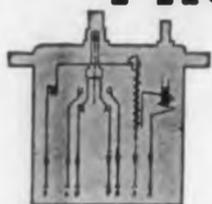
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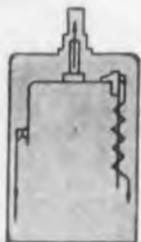
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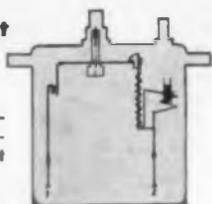
Two auxiliary circuits N.C., N.O., Shunt-Thermal Magnetic Circuit Breaker



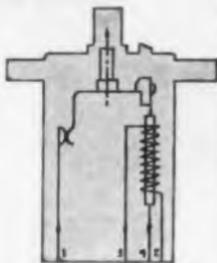
Series Trip — Overcurrent Circuit Breaker



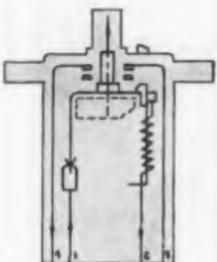
Series Trip — Overload Relay



Series Trip — Thermal Magnetic Circuit Breaker



Control of two circuits — Overcurrent Circuit Breaker



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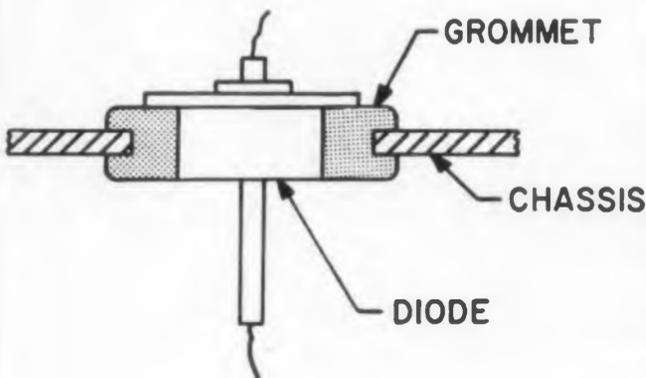
Fig. 3. Finally, the unit is potted. Mechanical fixture assures rigid clamping during subsequent resin cure under heat lamps.

cable was bent, twisted and pulled. Following this mechanical abuse, the plug was again soaked for a full week—this time in a solution of borax and water to decrease surface tension and increase conductivity. And once again, results of the 500-v megger test were completely negative, with no measurable leakage.

Harry D. Wintle, Manager Electrical Engineering Dept., Kollmorgen Optical Corp., Northampton, Mass.

Hold Onto Your Hat With a Rubber Grommet

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shown in the figure. The amount of holding force can be changed by varying the diameter of the hole in which the grommet is fixed. Using the grommet, mounting gear is held to an absolute minimum.

J. C. Mueller, Mechanical Design Engineer,
Crosley-Avco, Cincinnati, Ohio.

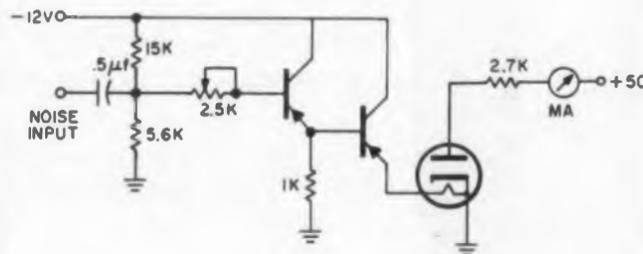
**Heat-Sensitive Diode
Calibrates RMS Meter For Noise
Voltage Readings**

A temperature-limited diode can be used to recalibrate a standard rms meter to give correct readings of noise. This recalibration is necessary because an rms meter is designed to measure pure sinusoids only. The waveform of a noise signal is decidedly nonsinusoidal.

The calibrating device works on the principle that the current through a temperature-limited diode is a function of the heat generated in its filament. Since the heat generated is proportional to the rms voltage applied, the current through the diode is also a function of its rms filament voltage. Thus, if a noise voltage is applied to the diode filament, its plate current will be a measure of the rms value of the voltage.

Known Sine Wave Signal Calibrates Meter

The calibrating circuit shown in the figure uses a low impedance amplifier to drive the diode's



filament. The rms voltmeter can be calibrated by the following procedure.

A known sine wave signal is applied to the input of the amplifier. The current through the diode and the deflection of the rms meter is noted. A sample of the noise to be measured is next applied and adjusted to give the same current reading as recorded for the sine wave. The noise voltage is then measured on the meter. The ratio of the sine wave voltage reading to the noise voltage reading is the calibrating factor. That is, the quantity the rms meter readings must be multiplied by this factor to give the correct rms noise voltage value.

Gwynn M. Reel, Design Specialist, Airborne Electronics, Martin-Orlando, Orlando, Fla.

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TR24R	24	0.2	5 x 4 1/4 x 6 3/4	160.
TR32R	32	0.2	5 x 4 1/4 x 6 3/4	160.
TR6-32R	6-32**	0.2	5 x 4 1/4 x 6 3/4	185.

* Prices FOB Cedar Grove, subject to change without notice

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In addition to models listed, units can be supplied to meet special military or commercial requirements. Write for quotations on special types.

For further details send for catalogue #118.

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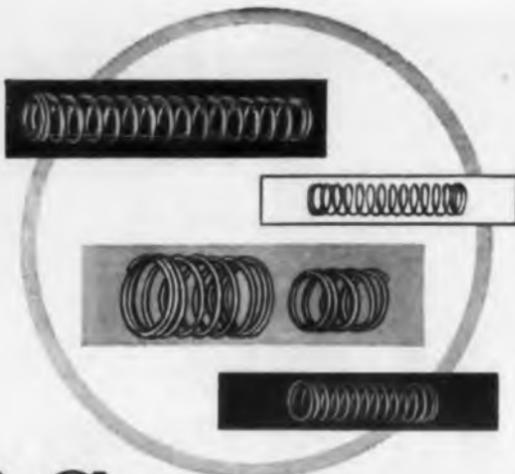
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PATENTS

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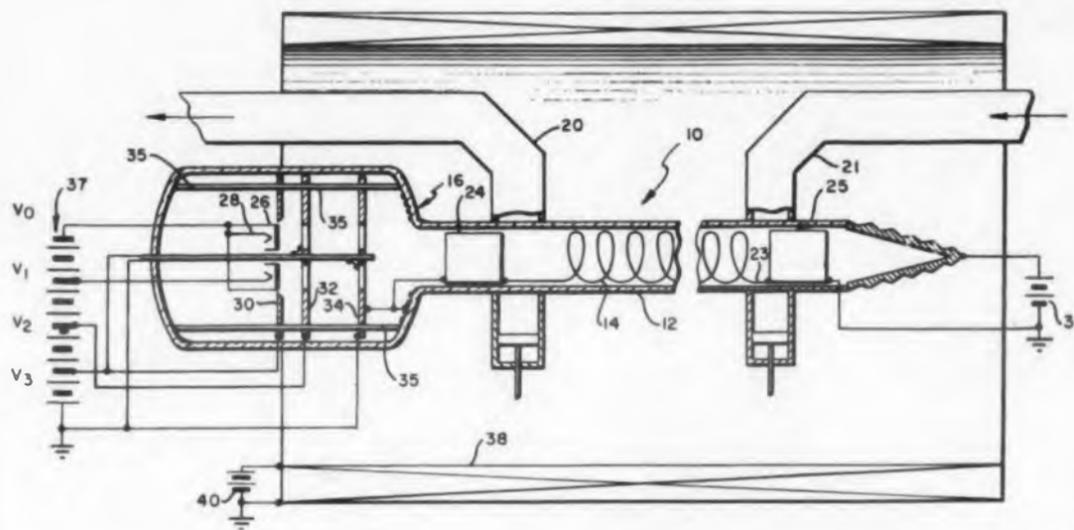
Low Noise TWT

Patent No. 2,936,393. M. R. Currie and D. C. Forster (Assigned to Hughes Aircraft Co).

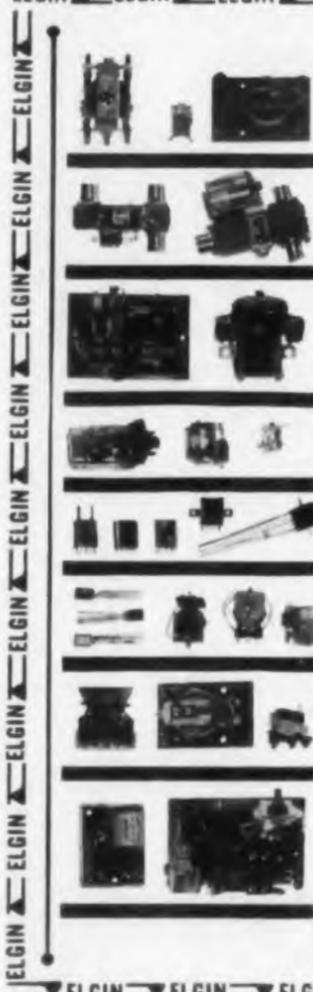
A low-noise electron gun is achieved by accelerating and decelerating the electron beam in the immediate vicinity of the emissive cathode. A beam-forming electrode at a higher potential than the anode is inserted next to the cathode.

This causes a saddle point to develop there. The potential profile along the tube axis is initially accelerating. However, this condition is then followed by a long drift region. It is believed that the crossover at the cathode increases the emission from the edges of the cathode. This factor ultimately contributes to the low noise figure.

A TWT having an electron gun



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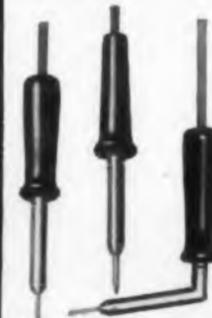
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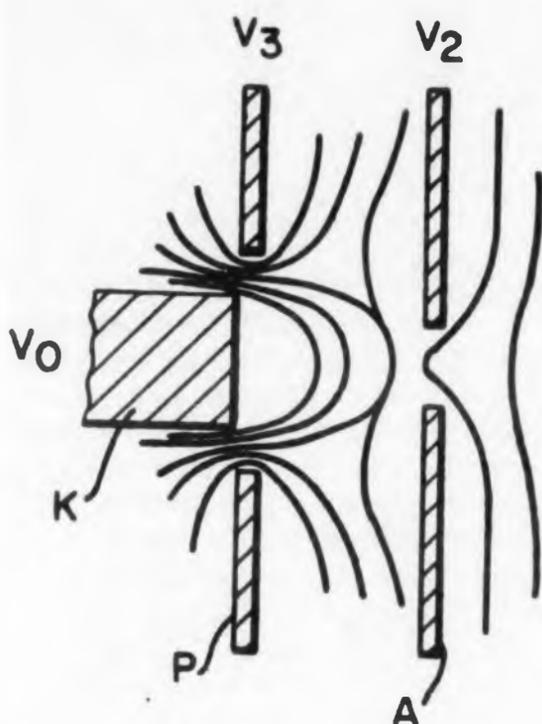
204-B

AMERICAN ELECTRICAL HEATER COMPANY

DETROIT 2, MICHIGAN

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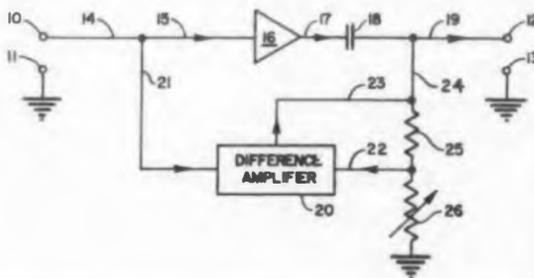
mounted in a strong solenoid focusing coil 38 is shown. The field shaping ring 30 (*p*) is at potential V_3 which is higher than the potential on the first accelerator 32 (*A*). The resultant potential profile includes the desired cross-over in the cathode region.

Wide-Band Amplifiers

Patent No. 2,935,696. C. F. Ault (Assigned to A. B. DuMont Labs).

A wide-band amplifier is obtained by placing a dc amplifier in shunt with the load of an ac amplifier. To operate correctly in the low frequency range a dc difference amplifier is used.

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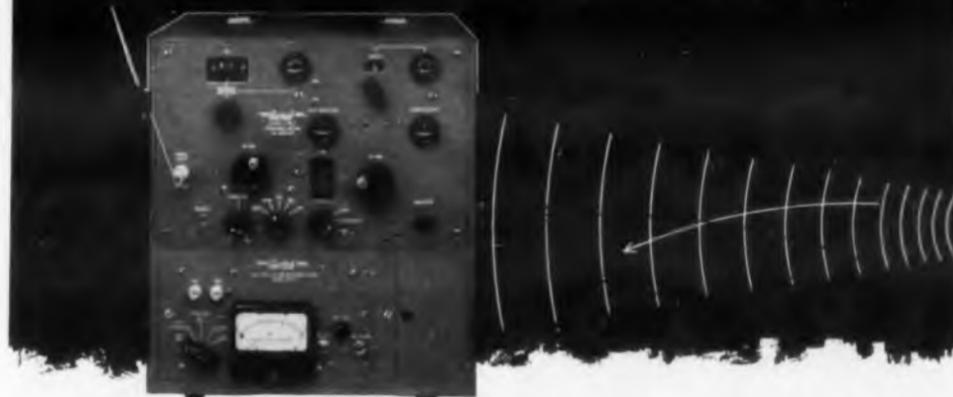


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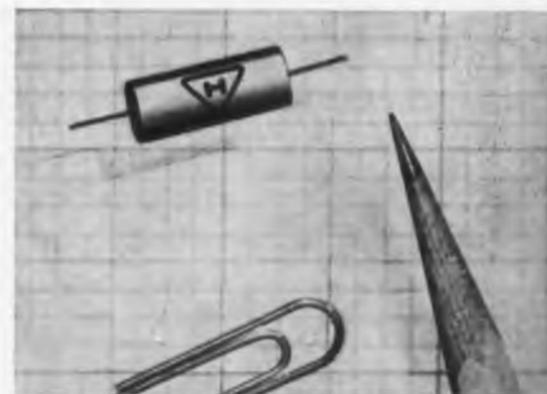
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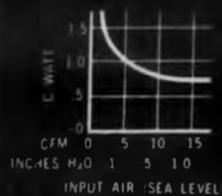
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BOOKS

Direct Conversion of Heat to Electricity

Joseph Kaye and John A. Welsh, John Wiley & Sons, Inc., 440 Park Ave. S., New York 16, N. Y., 220 p, \$8.75.

An edited collection of papers issued at an MIT seminar, this volume is one of the first published sources of reference material in the field of direct conversion of heat to electricity. The papers were presented at a special summer program titled "Direct Conversion of Heat to Electricity," that took place July 6 to 17, 1959. At the time they represented the latest advances in research.

The book has been divided into five general sections. These include fundamental discussions in thermoelectric energy conversion (the thermocouple), thermionic energy conversion (the vacuum tube and the gaseous tube), magneto-hydrodynamic conversion (separating the positive and

negative charges in a gas), and fuel cells (the separation of positive and negative charges during a chemical reaction). Also presented are examples of practical applications and problems associated with each type of conversion scheme.

Transistor Projects

Compiled by the staff of Gernsback Library, Gernsback Library, Inc., 154 W. 14th St., New York 11, N.Y., 160 pp, \$2.90.

Strictly a practical book, this volume passes very lightly over transistor theory and gets right down to detailing a large variety of transistor construction projects. Outlined are projects on radios, instruments and accessories, and miscellaneous devices such as a remote transistor ear, an electronic compass, and an electronic counter.

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An Introduction To Statistical Communication Theory

David Middleton, McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y., 1140 pp, \$25.00.

Broadly speaking, statistical communication theory may be described as a theory which applies probability concepts and statistical methods to the random phenomena (messages, signals, and noise) that influence and control the design, operation and evaluation of communication systems. Although the specific treatment in this book is directed toward electronic and electrical systems, such as radio, radar, etc., the general methods and philosophy described are applicable in other areas of communication science, as well.

According to the author, this is the first text to appear on the subject of statistical communication theory as distinct from special works on information theory, noise, and stochastic processes. It offers a systematic approach to the functional design of optimal communication systems, including evaluation and comparison with suboptimum systems. Sufficient development of the mathematical techniques re-

quired for the solution of advanced problems is included.

The book is divided into four main parts. Part I introduces and describes some of the statistical techniques required in the analysis of communication systems and concludes with an introductory chapter on information theory. Part 2 considers the random noise processes and some of the processes derived from it, and gives a short account of the physical models of shot and thermal noise. Part 3 is concerned mainly with various nonlinear operations that are common in transmission and reception, such as modulation and demodulation, and the calculation of signal-to-noise ratios. Linear measurement, filtering, and prediction and more general distribution problems, the results of which are needed in the general analysis of Part 4, are also examined here. Finally, Part 4 gives a detailed development of a statistical communication theory for the basic single-link communication system consisting of message or signal source, transmitter, medium of propagation (or channel), and receiver and decision-making elements.



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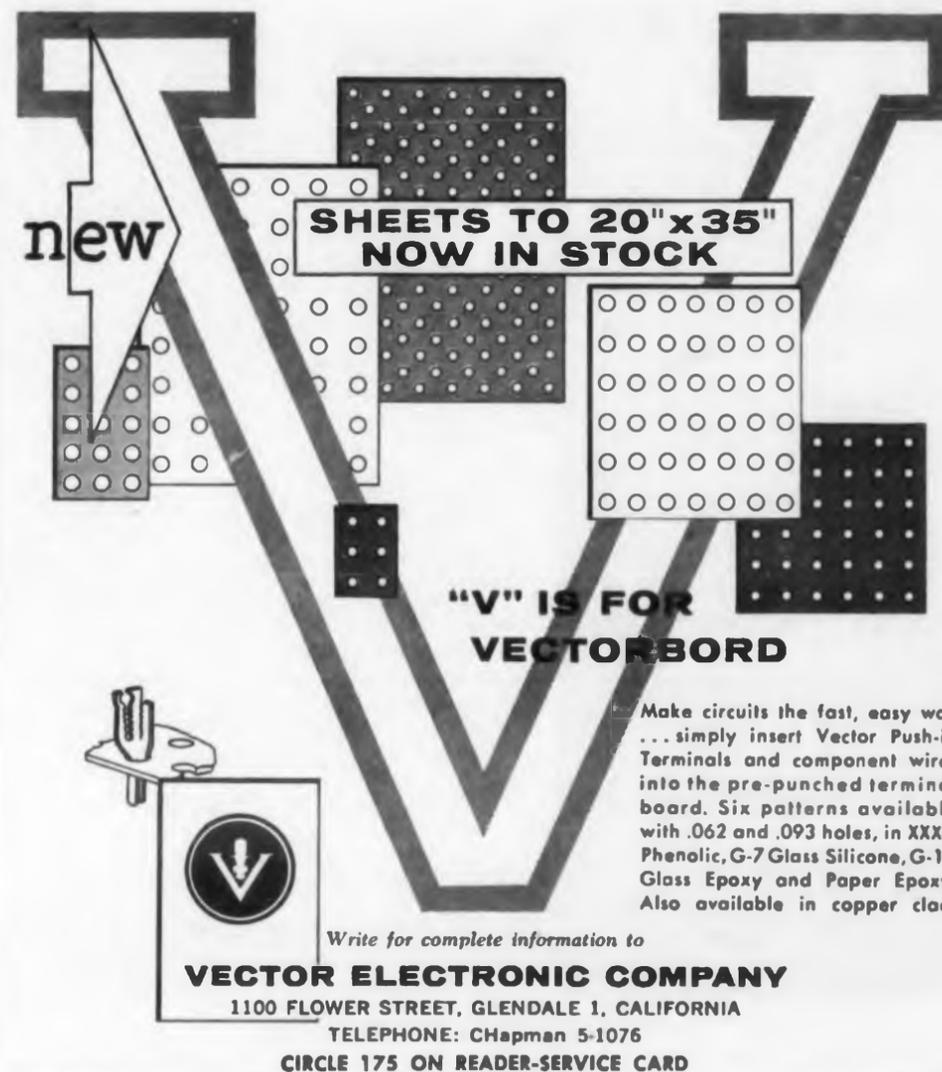
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REPORT BRIEFS

Asynchronous Logic Networks

The systems considered are asynchronous, dc-level sequential switching circuits. They do not have clock pulses, and the signals are represented, not by pulses, but by variables that can assume values in either of two non-overlapping ranges. The analysis of these circuits is discussed, with emphasis on the problem of choosing state variables. A relationship is established between the number of rows of a reduced flow matrix and the feedback index of the associated circuit. The major portion of the research is devoted to a study of the effects of stray delays on the operation of sequential switching circuits. *A Study Of Asynchronous Logical Feed Back Networks, Stephen H. Unger, Research Laboratory of Electronics, MIT, Cambridge, Mass., 26 April 1957, 47 pp, Microfilm \$3.30, Photostat \$7.80. Order PB 145436 from Library of Congress, Washington 25, D.C.*

Voice Data Processing

The system programing, the results of a feasibility study, and the design and development of transistorized plug-in modules for a digital Voice Data Processing System are presented. This system, being fabricated to support the development of a speech bandwidth compression technique, is a special purpose computer operating from a 400-kc clock. Several operational modes are provided to enable use of the Voice Data Processing System as a data accumulating and sorting device and then as a complete communication system simulator. The mathematical design analysis and the description of the operational evaluation tests for one of the circuit modules are included as appendices. *Voice Data Processing System, L. P. Schoene, Melpar, Inc., Falls Church, Va., 15 Oct. 1959, 121 pp, Microfilm \$6.30, Photocopy \$19.80. Order PB 144797 from Library of Congress, Washington 25, D.C.*

Supersonic Delay Lines

Structural features of supersonic delay lines, together with some investigations bearing on their acoustic and electrical properties, are described. The lines were designed specifically for laboratory use as signal storage devices for an MTI (Moving Target Indication) system and have delays of the order of 0.5 to 1.6 ms. *Supersonic Delay Lines, Herbert Shapiro, Office of Scientific Research and Development, Washington, D.C. 15 March 1946, 46 pp, Microfilm \$3.30, Photostat \$7.80. Order PB 137822 from Library of Congress, Washington 25, D.C.*

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LETTERS

Patent Law Point Clarified

Dear Sir:

In the ELECTRONIC DESIGN issue of April 27, 1960, there is an article entitled "Delayed Patent Application . . . What You Can Lose." The article's second paragraph contains an erroneous statement, which reads:

"Under the patent law an inventor is not entitled to a patent if his invention was known or used by others in this or a foreign country before the invention by the patent applicant."

The patent law under 35 U.S.C. 102 states that: "A person shall be entitled to a patent unless the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent."

As you can readily see, the author of the quoted article leads one to believe that foreign knowledge or use is an anticipation. However, only domestic knowledge or use, or a foreign patent or printed publication, is an anticipation.

Sincerely,
R. R. Skolnick
Patent Administrator
Ford Instrument Co.
Long Island City, N. Y.

Load Lines Simplify but Equations Don't

In your otherwise well written article "Load Lines Simplify Transistor Amplifier Analysis," a few errors have sneaked in: On page 22 of your March 2nd issue, the equation

$$i_1 = \frac{v_1 - i_1 r_{in} + (B + 1) R_e}{R_b}$$

should read

$$i_1 = \frac{v_1 - i_1 r_{in} - (B + 1) R_e i_1}{R_b}$$

The next equation

$$i_1 = \frac{v_1 - i_1 [r_m + (B + 1) R_e]}{R_b}$$

should read

$$i_1 = \frac{v_1 - i_1 [r_{in} + (B + 1) R_e]}{R_b}$$

Adam A. Jorgensen
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National Courses

Modulation Theory and Systems, Aug. 1-12, Massachusetts Institute of Technology

This program on "Modulation Theory and Systems" is planned particularly for practicing communications engineers with an active interest in communication systems and techniques. Emphasis will be on theory and methodology, rather than current practice. Familiarity with Fourier techniques and an understanding of the basic concepts of probability and noise theory will be assumed. The program, which will run from August 1-12, requires a \$300 tuition payable upon notification of admission. Academic credit is not offered. For information, contact Professor Elie J. Baghdady of the Department of Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

PAPER DEADLINES

Convention Program Chairmen have issued the following deadlines to authors wishing to have their papers considered for presentation.

July 30: Deadline for 50-200 word abstracts of papers for the **Conference on Reliability of Semiconductor Devices** to be held Jan. 12-13, 1961, at the Western Union Auditorium, 60 Hudson St., New York, N.Y. Papers are requested to cover the following: transistors, diodes and rectifiers made of germanium, silicon and other semiconductor material. The papers should be basically empirical in nature, covering observation of the devices alone, or the devices in circuitry and systems, under various conditions of operation and/or storage. A concise description of device structure and fabrication should be included. All material included in the papers must be unclassified. Send titles, abstracts and papers to: *Mr. John E. Shwop, Chairman, Program Committee, U. S. Army Signal Supply Agency, 225 S. 18th St., Philadelphia 3, Pa., ATTN: Production Development Div., 15th Floor.*

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In the Physics Div., the Electronics Dept. has a broad program which includes navigation, communications, computers, traffic control, and radar. Scientific activities in the Applied Physics Dept. center in the fields of atmospheric and radio-physics, nucleonics, solid state and surface physics, and instrumentation.

Theoretical and experimental research into fundamental and applied aerodynamics, gas-dynamics, and propulsion is the prime responsibility of the Aerodynamics Div. The Materials Dept. of this division is involved in a search for new materials to withstand the high temperature and stresses imposed by supersonic and hypersonic flight.

Under the Full Scale Div., the Flight Research Dept. serves primarily as an independent research group on flight projects requiring full-scale aircraft operations; the Vehicle Dynamics Dept. studies the problems of the design of many vehicle types, including submarines, seaplanes, and track-layers.

The brochure also includes career profiles of four men, representative of C.A.L.'s technical staff, opportunities available in the education program, salary and benefits and a description of the Buffalo community in which the laboratory is located. For further information write: Personnel Manager, Cornell Aeronautical Laboratory, Inc., 4455 Genesee St., Buffalo 21, N.Y.



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New combination protractor-triangle speeds up drafting

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Versatility with accuracy

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The second set of graduations, labeled *Slope*, shows directly the *Secant* trigonometric ratio of the angle indicated on the degree scale. The third scale, labeled *Rise*, indicates directly the *Tangent* trigonometric ratio shown on the degree scale.

Examples

This new tool has a host of drafting and engineering applications. Highway designers find the Trig-Matk very useful when making cross sections of roadways at ground level or below. By



An indicated angle of 40 degrees on the Trig-Matk (1589) shows directly that the Rise is 8.4 to the base of 10.

setting the *Slope* scale to the degree desired, road-curve grades are automatically determined. The protractor can be used to determine the angle of highway ingress and egress lanes.

Structural Engineers will find the Trig-Matk Adjustable Triangle a simple tool, eliminating the use of both a scale and individual triangles. In addition to the time saved, many of the errors usually associated with the older method are avoided. The Trig-Matk design eliminates the need of frequent reference to handbooks for information on various bevels.

Two Bases

The Trig-Matk No. 1589-12 has a 12" base for handy calculations in feet and inches. Number 1589-10 has a base of 10 for decimal calculations.

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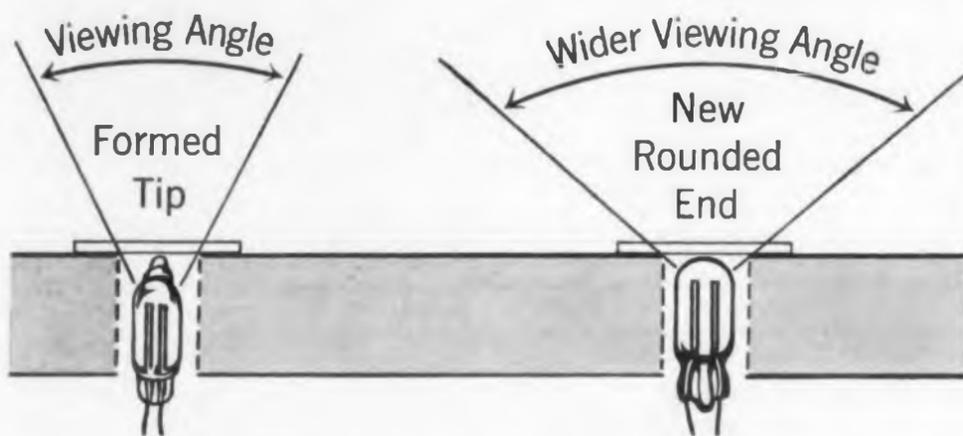
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New General Electric NE-2M and NE-2P Glow Lamps are more thoroughly described in the engineering data sheet, #3-9289. For your free copy, write: General Electric Co., Miniature Lamp Department M-023, Nela Park, Cleveland 12, Ohio.

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MA797	23/U	1.30 — 1.43	L	100	23/U	5.22 — 5.72	C	15db	3
MA798A	39/U	9.0 ± 150Mc	X	500	596/U	18.0 ± 300Mc	K	17db	10
MA798B	39/U	10.0 ± 150Mc	X	500	596/U	20.0 ± 300Mc	K	17db	10
MA798C	39/U	11.0 ± 150Mc	X	500	596/U	22.0 ± 300Mc	K	17db	10
MA798D	39/U	12.0 ± 150Mc	X	500	596/U	24.0 ± 300Mc	K	17db	10
MA799A	39/U	9.0 ± 100Mc	X	500	600/U	27.0 ± 300Mc	Ka	20db	5
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PIONEERS IN INSTRUMENTATION CABLE ENGINEERING

NOW HEAR THIS. Japanese hearing aids now coming into the U.S. market could mean real competition, since some units are priced as low as \$29.95. This compares with \$100 average price for U.S.-made aids. Recently published figures indicate that between 300 and 360 thousand hearing aids were sold here last year. Yet the Japanese, in planning their market strategy, estimate that some 15,000,000 Americans have some hearing difficulty. Despite the difference between current sales and this figure, it definitely looks like an expanding market. Manufacturers of electronic components are particularly interested in the trend toward the binaural eyeglass-type aid, since it uses separate microphones, amplifiers and earphones for each ear and, therefore, requires twice as many components as used by conventional-type aids.

UP 30 PER CENT. Shipments of electronic components jumped more than 30 per cent from 1958 to 1959 to reach a new all-time record. A Commerce Department report spells out all the details, gives quantities and values by major category, and breaks totals down into military and non-military use. If you'd like a copy, write to the Commerce Department and ask for BD-60-64.

ELECTRONIC VOLLEYBALL. Ways of knocking out unfriendly ICBM's without shooting them down are being looked into with great interest by the Pentagon. Among the more dramatic is a plan to supply missiles with extra energy at the height of their flight in space and, thus, cause them to overshoot their intended target by a very comfortable margin. Only a small amount of energy would be needed. But the big problem is how to apply it. The whole problem of anti-missile killing mechanisms of all kinds is coming in for more attention these days. The Advanced Research Projects Agency is increasing funds for this purpose to \$9 million for 1961. It's a wide-open field and it looks like anybody and everybody is invited to participate.

NEW WAY TO SPARK. A major electronics firm in this country is developing a revolutionary automobile system that would use microwave energy as the igniting agent. In this system, a microwave pulser, wave guides and timing pickup would replace the traditional ignition coil and condenser, distributor and timing drive, high-voltage wires and spark plugs.

CABLEMAN'S CORNER. The old adage "Don't put the cart before the horse" was never so true as it is in these days of automation and instrumentation. With all the intricate pieces of equipment being designed these days, it is important that careful consideration be given to the wire and cable that may be employed in any system. Often forgotten is the unromantic aspect of the connecting links of the system. Cables are the arteries through which must flow the power and informational pulses necessary for reliable performance.

Don't take a chance on being able to obtain a cable that will fit into what is left. Many times, important characteristics such as conductor size, insulating walls, protective sheaths, flexibility and flex-life have to be sacrificed. Don't sacrifice reliability in your cables for an existing space or connector fittings.

For 100% reliability in multi-conductor cables, call on a cable specialist—and call on him as soon as possible. Phone Rome 3000, or write: Rome Cable Division of Alcoa, Dept. 1170, Rome, New York.

These news items represent a digest of information found in many of the publications and periodicals of the electronics industry or related industries. They appear in brief here for easy and concentrated reading. Further information on each can be found in the original source material. Sources will be forwarded on request.

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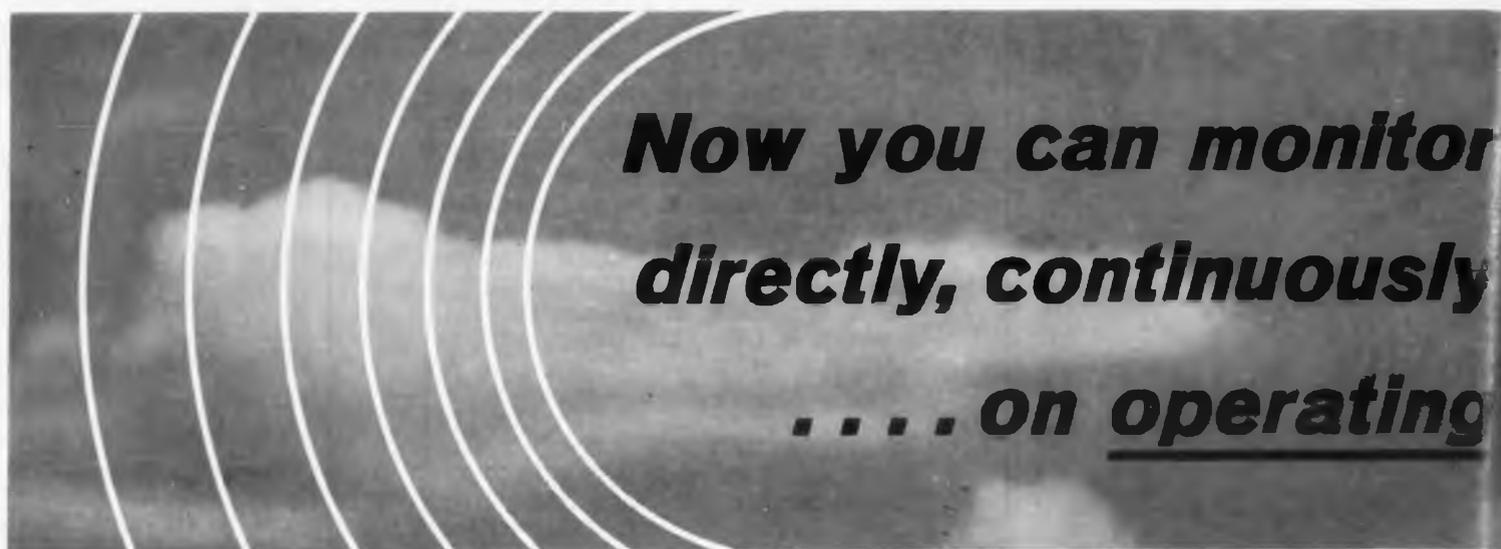
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All-New, Transistorized  344AR Noise Figure Meter



The new  344AR Noise Figure Meter assures you that your radar is continuously operating at peak performance, and you are enjoying maximum range. The instrument's fast meter response lets you optimize or adjust the system during operation or maintenance. Model 344AR is designed for the utmost in dependability—it is militarized, transistorized, very compact and very rugged.

With this new 5¼" high instrument system noise figure is measured on a time-shared basis with the radar scan. The unit has high sensitivity to minimize signal and transmitter losses; the noise source may be decoupled 20 db from the main transmitter line. Two alarm func-

tions give visible and electrical indication when an allowable noise figure is exceeded, or a noise source malfunctions.

High voltage on antenna slip rings is eliminated with a remote noise source modulator operated with low voltage triggers. Other features include quick, easy front panel calibration, and remote metering and alarms if desired.



**FREE APPLICATION NOTES INCLUDE
CONSIDERATIONS FOR AUTOMATIC
MEASUREMENT OF NOISE FIGURE
ON A CONTINUOUS BASIS**

Write  direct for Application Note 43—"Continuous Monitoring of Radar Noise Frequency". Discussion includes description of  344AR and its application to radar systems.

**PAGES
MISSING
ARE NOT
AVAILABLE**