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Use IRC® Deposited and Boron Carbon Resistors

Now you can save two ways whenever circuits call for high precision resistors with long term stability and built-in overload protection. IRC Molded Deposited and Boron Carbon Resistors can withstand substantial overloads for considerable periods without exceeding tolerances. This means savings in space, weight and cost! The conservative rating of these units assures you of reliability—no need to specify larger resistors.

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for an entirely new range of time delays

Delay Intervals: \(\frac{1}{10}\) to 5 seconds

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specify sturdy, dependable, application-tested

**G-V** Hot Wire Time Delay Relays

Designed for delay intervals which are longer than those produced by magnetic relays and shorter than can be produced by the usual types of thermal relays, these G-V Hot Wire Time Delay Relays make possible many simplified, lightened and improved designs.

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**ADJUSTABLE DELAY** even though hermetically sealed

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TELEMETERING FILTERS
UTC manufactures a wide variety of band pass filters for multi-channel telemetry. Illustrated are a group of filters supplied for 400 cycle to 40 KC service. Miniaturized units have been made for many applications. For example a group of 4 cubic inch units which provide 50 channels between 4 KC and 100 KC.

Dimensions:
(6174A) 1 1/16 x 1 1/4 x 2V
(2000, 1) 1 1/4 x 1 1/4 x 1/4".

CARRIER FILTERS
A wide variety of carrier filters are available for specific applications. This type of tone channel filter can be supplied in a varied range of bandwidths and attenuations. The curves shown are typical units.

Dimensions:
(6740A) 1/4 x 1/8 x 1/8", (6741A) 1/2 x 1/2 x 1/4".

DISCRIMINATORS
These high Q discriminators provide exceptional amplification and linearity. Typical characteristics available are illustrated by the low and higher frequency curves shown.

Dimensions:
(6174G) 1/4 x 1/8 x 3/4", (6174A) 1 1/4 x 1 1/4 x 1/4".

AIRCRAFT FILTERS
UTC has produced the bulk of filters used in aircraft equipment for over a decade. The curve at the left is that of a miniaturized (1020 cycles) range filter providing high attenuation between voice and range frequencies. Curves at the right are that of our miniaturized 90 and 150 cycle filters for glide path systems.

Dimensions:
(4682A) 1 1/2 x 2 x 4".

Editorial
Retirement of Engineers
Each year the electronic industries lose engineers for various reasons. Many of these reasons are sound or unavoidable.

What we can't understand is the case where a man of 30 or more years of experience, is forced to leave engineering because of the compulsory retirement policy of his company. We know that there are perfectly sound reasons for compulsory retirement.

None of these reasons, however, are sufficient justification for tossing years of engineering experience out the window, especially when the need for technical men is so urgent. Surely, ways could be found to make use of this experience.

For one thing, the retired engineer could be employed on a part-time basis or in some consulting capacity. He might come in later and leave earlier, and possibly work fewer days than he did before. As for consulting work, there are always dozens of problems around that no one seems to have time to work on.

Another suggestion is that retired engineers take on light teaching loads at nearby engineering schools. Students could benefit a lot by contact with really experienced engineers.

Writing books, articles, etc. represent another form of activity that requires the time and background which older engineers have. This is one way of passing on the knowledge gained through years of experience.

Many of these ideas are being carried out. More are needed. No engineer who is capable and willing should be denied the opportunity of contributing to the growth of his profession and his industry—even though he is 65 years old.

Article Index
In the center section of this issue we have included an index to the articles published in ELECTRONIC DESIGN for the first six months of this year.

We welcome readers' comments and suggestions on the arrangement, contents, appearance, etc. of the index. Additional copies may be obtained by using the Readers' Service Card and circling number 305.
Biggest Analog Computer West of the Mississippi

The biggest analog computer west of the Mississippi will be built for the Allison Div. of General Motors. When completed, it will stand 6 feet high and span a width of nearly 60 feet. The mass of electronic equipment, grouped in 29 metal cabinets, will weigh some 10 tons. Built by the Berkeley Div. of Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif., the computer will be used by Allison engineers to simulate jet engines electronically. With the instrument, designers can picture an engine in action under varying conditions even before it has been built.

Capable of solving with lightning swiftness the high order differential equations involved in design work, the computer will substantially speed the development of engines of the future. Outstanding feature of the computer is its 12 automatically set “map readers” to investigate function contours made up of two independent variables. Their basic components include 90 function generators—five times the number used in previous analog computers.

Technique Resembles Deliberative Human Judgment

Broad patents have been applied for on a small black box having man-like powers of deliberative judgment. The device follows precise rules of logic in reasoning whether to accept, reject, or demand confirmation of data fed into it.

Developed primarily for airborne applications, by Lear, Inc., Santa Monica, Calif., the system provides basic new methods of discriminating automatically between data from any two information sources. It does this through continuous electronic application of the laws of probability and error distribution, in order to deduce from two sets of data, each having known chances of error, intelligence more accurate than either conventional source could possibly provide.

The system is called SCAN, meaning Self-Correcting Automatic Navigator. It will enable an aircraft to fly straight to its target over enemy territory despite any attempts at electronic jamming, and without disclosing its presence by emitting any radiation. This technique will make use of reflected v-h-f signals far beyond the line of sight to which such signals are normally confined, and thus can penetrate through mountaneous terrain at low levels avoiding radar detection. Only those signals are accepted which fall within the error limits of the system.

Higher Electronic Manufacturers Failures This Year

Business failures of manufacturers of radio-TV-electronic equipments and components during the year ending April 30, 1956 rose slightly in number from the total reached in the corresponding 1955 period.

During the year ending in April, 29 manufacturers of electronic equipment or products failed compared with 26 in the previous period. The bulk of the troubled companies are continuing in business under the supervision of creditor’s committees, although nine of them have gone out of business completely with little or no recovery to creditors.

By type of product manufactured the companies were classified as follows: 17 were producers of components; 8 were manufacturers of electronic equipment, 2 manufactured phonographs; 1 produced recorders; and 1 manufactured electronic organs.

Plane Within Plane Tests Control System For Jet Interceptors

An advanced electronic control system is being tested for a jet all-weather interceptor plane by installing a cockpit and entire electronic control system in the main cabin of a T-29 military adaptation of the Convair 240 airliner.

Developed by Hughes Aircraft Co., Culver City, Calif., it operates in this manner. The regular pilot takes the T-28 aloft, then transfers control to a test pilot in the cabin cockpit. This “back-seat” pilot flies the plane as though it were a jet interceptor, operating its electronic “seek, find and kill” system while scientists and engineers check the performance of the system and a psychologist checks the performance of the pilot.
Diffused Base Germanium Transistors . . . Urgent military demands for diffused base germanium transistors have called for the Western Electric Co. to undertake immediate manufacture of these units for exploratory development work. Initial production facilities were set up in the Company's Laureldale plant and the manufacturing program will be stepped up to meet military requirements as they develop.

These new transistors have a high frequency performance surpassing that of any other transistor presently available. They are particularly suited to v-h-f oscillator, medium power i-f and broad band video amplifier applications. Representative units which were recently described at a symposium held by Bell Telephone Laboratories, have provided 50mw output as oscillators at 200Mc. Other units of this type as video amplifiers have given about 19db gain per stage with an 8Mc bandwidth.

Typical units produced at present have an alpha frequency-cutoff median value of approximately 400Mc with some units showing alpha frequency-cutoff in excess of 600Mc. Power dissipation is 150mw maximum at 25°C with an appropriate heat sink. Common emitter short circuit current gain at 50Mc is 12db minimum.

First Hi-Fi Tape Recorder With Transistors And Printed Circuitry . . . A compact, professional quality hi-fi magnetic tape recorder has been developed utilizing transistors and printed circuitry—the first of its kind.

The instrument, developed by Radio Corp. of America, is designed for plug-in use in home assembled hi-fi music systems and industrial sound systems.

Designated the SRT-2, the recorder covers the audible range from 30 to 15,000 cycles, utilizes all types of standard magnetic tapes, in 5" and 7" reels and can be installed in either vertical or horizontal position.

Scheduled for availability early this fall, the recorder will be retailed through distributors at a suggested consumer price of $495.

Research Reactor for German University . . . A contract was signed recently to install at a University the first reactor in free Europe for training engineering students in nuclear science.

The contract was signed by AMF Atomics, Inc., subsidiary of American Machine and Foundry Co., and the Federal Republic of Germany's State of Bavaria, calling for the construction of the reactor at Munich's Technische Hochschule.

The installation of the reactor and the development of the nuclear research center which it will serve will be a significant milestone in free Europe's peaceful atom program. The specialized training the reactor will make possible will create a new supply of nuclear scientists which German industries will have access to in implementing their own nuclear research program.

Machinability Computer . . . By applying old machining standards, it would have taken 244 minutes to machine a specific part in the Chicago plant of Scully-Jones and Co. Today, with new standards furnished by this machinability computer, developed by Carboly Department of General Electric Co., Detroit, Mich., the company is machining the same part in 166.20 minutes, or 77.80 minutes less time per part. This is a saving of roughly 17 hours on 13 parts.

Vapor Container Shell . . . Welders put finishing touches on a steel shell for the vapor container of the Army Package Power Reactor, one of the nation's first atomic generating plants. The container is 64' high and 36' in diameter with walls of 7/8" steel plate and that will be reinforced with 2' of concrete. It is designed to withstand maximum pressure which could be exerted should an incident occur. The APPR, which ALCO Products, Inc. Schenectady, N. Y., is building at Fort Belvoir, Va., for the AEC, is expected to be in operation early in 1957.
General Dynamics Builds Controls For Largest Super-Sonic Wind Tunnel . . . The U. S. Army Corps of Engineers has awarded General Dynamics Corp. a contract for more than $2,500,000 to provide the electronic equipment for controlling the flow of air in what will be the world's largest super-sonic wind tunnel. The tunnel is now under construction at the Air Force's Arnold Engineering Development Center at Tullahoma, Tenn.

Dynamics' Electric Boat Div., in Groton, Conn., has overall responsibility, and will execute the contract in partnership with Stromberg-Carlson. General Dynamics' part of the contract is to design and construct a control system for the nozzle of flexible ducting which will regulate the flow of high velocity air through the actual testing chamber. The portion of the contract which will be carried out by Stromberg-Carlson calls for creation of a digital computer system for automatically controlling the shape of the nozzle by electric means.

New 16" Sendzimir Cold Rolling Mill . . . A new 16" Sendzimir cold-rolling mill, the largest of its kind in the spring industry and the first designed especially to use a water-emulsifiable mineral oil as coolant and lubricant for the rolls, was recently placed in full scale operation.

Designed by the Armzen Co., Waterbury, Conn., and built by the Waterbury Farrel Foundry & Machine Co., also of Waterbury, the mill is in operation at the Forestville, Conn., plant of Associated Spring Corp.'s Wallace Barnes Steel Div. It is capable of rolling strip steel up to 13" wide, and will increase by up to 50% the steel-rolling capacity of the plant's facilities. The mill will make it possible to roll much thinner gages of steel than was possible before.

It also provides, by automatic controls, greater accuracy in the gage of the steel rolled, and much greater uniformity of thickness across the width of the strip as well as along its length.

The 16" mill is capable of rolling strip steel up to 13" wide.

80 MILLION SOLD!

TRU-OHM is Now the World's Largest Producer of Wire-Wound Resistors!

Chicago . . . From Tru-Ohm's general sales office. Since starting just a few short years ago, TRU-OHM PRODUCTS has grown phenomenally to ten times its original capacity. Having just produced its 80,000,000th wire-wound resistor, Tru-Ohm is now the world's largest growing and largest producers of wire-wound resistors.

Chicago . . . From Tru-Ohm's general sales office. Since starting just a few short years ago, TRU-OHM PRODUCTS has grown phenomenally to ten times its original capacity. Having just produced its 80,000,000th wire-wound resistor, Tru-Ohm is now the world's largest growing and largest producers of wire-wound resistors.

High Quality, Speedy Delivery Sets Record

Over 50,000 square feet of the most modern manufacturing facilities, including a brand new furnace, enable volume production . . . assure faster delivery, finer quality, better prices. And TRU-OHM EXPEDITES FOR YOU . . . ships on time.

Inquiries Invited. You can get the complete story of Tru-Ohm's tremendous growth and why, by writing to 2800 N. Milwaukee Ave., Chicago 18. Let Tru-Ohm's experts solve your resistor and rheostat needs.

Resistor No. 80,000,000. One of many wire-wound resistors which are turned out by the thousands daily.

For Original Equipment or Replacement Needs

A complete line of resistors as well as a complete line of power rheostats are now produced for the finest industrial manufacturers in the world . . . for replacement applications . . . sold through parts jobbers.

Complete line of power rheostats...of finest quality with UL approval; variety from 25 watts up.

Special size resistors: Tru-Ohm's highly skilled factory trained technicians turn out large varieties of special resistors. Complete data of these special size resistors is available.
New EIMAC Microwave Center Opens at Salt Lake City, Utah for Research and Production of Local Oscillator Klystrons

A new microwave facility for Eimac local oscillator reflex klystron research and production is opening this month at our Salt Lake City, Utah plant. For 13 of the 22 year history of Eitel-McCullough, Inc., the production excellence of the Salt Lake City installation has been instrumental in establishing Eimac as the world’s largest manufacturer of transmitting tubes.

And now this production skill and decentralized location 600 miles from the Pacific Coast combines with research specialization to offer ready made advantages to users of reflex klystrons. Investigate these Eimac advantages to fulfill your requirements for development or production of rugged local oscillator microwave klystrons.

EITEL-MCCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
The World’s Largest Manufacturer of Transmitting Tubes

Electronic Brain Supply Sargeant

The IBM Type 702 giant brain is installed at the Navy’s Aviation Supply Office in Philadelphia, where it is used to provide the thousands of Naval aircraft based around the globe with parts and equipment they need. This one reel of tape, shown here, contains over 5,000-000 digits and letters of inventory information and is read at the rate of 15,000 characters a second.

Women Will Double Engineers Supply in Next Century . . . The possibility of doubling the supply of engineers and scientists by including more women in the profession was underscored recently by Morris D. Hooven, president of the American Institute of Electrical Engineers.

Mr. Hooven has gone even a step further by envisioning a woman as president of the Institute a century hence. Present membership now consists of more than 49,000—most of them males.

These interesting prognostications are contained in a letter by Mr. Hooven to the president of the Institute in 2055, which has been placed in the “Vault for the Future” at the George Washington Univ., Washington, D.C.

Scale Model of SAGE System

Low-flying aircraft which come in under the beam of the long-range search radar of the SAGE system are detected by gap-filler installations. This model of an unattended low-altitude radar is complete, even to the wire fence around the installation. The scale model was made by Atkins & Merrill, Inc., South Sudbury, Mass.
Force Transducer
This specially built SR-4 load cell of 250,000 lb capacity, 22" high and 12" diameter will be used by a large aircraft company to measure rocket thrust. Developed by Baldwin-Lima-Hamilton Corp., Philadelphia, Pa., the transducer incorporates two independent load measuring resistance wire strain gage bridge circuits for instrumentation.

Storm-Detection Radar System . . . Radio Corp. of America recently exhibited a weather-detection radar system which enables pilots to see storms and cloud formations up to 150 miles ahead.

Shown at the opening of the U.S. Weather Bureau Show, it featured a model of the nose and cockpit of an aircraft, with the antenna of the weather radar system installed in the nose, and a radarscope, with storm picture, mounted in the cockpit. The exhibit enabled visitors to observe how the antenna picks up storm formations ahead to provide the pilot with early storm warnings.

The system has already been purchased for use in the air fleets of five U.S. and four foreign commercial airline companies, and in numerous business airplanes and other types of private aircraft.

Air Traffic Control System
Volscan, a new air traffic control system, is designed to convert a confusion of randomly arriving aircraft into an orderly, safe procession. It is a combination of radar and computers and can handle as many as 120 landings per hour. The first Volscan system, a development of Crosley Govt. Products Div., Avco Mfg. Corp., Evendale, Ohio, will be delivered to the Air Force for flight evaluation.

For all your TV designs, Sylvania offers a complete line of deflection amplifier tubes with proper plate knee characteristics to meet every deflection need.

And Sylvania offers you the Sylvania-originated type 25DN6 designed to deliver high peak currents for proper deflection in low B+TV designs.

All Sylvania deflection tube types are tested under an exhaustive dynamic testing program. Critical parameters are checked 100% in production and double checked in destructive life tests in universal equipment specially designed by Sylvania engineers to simulate circuit conditions existing in the modern television receiver.

Whatever your needs, 70°, 90° or 110°, Sylvania can fill your vertical and horizontal deflection socket—backed by exhaustive reliability tests under actual operating conditions.
NEW WESTINGHOUSE
HIGH-POWER
SILICON RECTIFIER

475 amperes d-c...
300 volts PIV

Highest power silicon rectifying cell commercially available... that's the Westinghouse WN-5082! Ambient temperatures present no heat problems for these silicon cells—units operate in temperatures up to 175° C. Curve below shows forced air-cooled, three-phase bridge ratings.

This diode is ideally suited for railway, elevator, arc welder, battery charger and other industrial high-power applications.

Production quantities are available immediately. For more information on the WN-5082, or any other silicon rectifier requirements, regardless of voltage and current, call your nearest Westinghouse apparatus sales office. Or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

WATCH WESTINGHOUSE!
WHERE BIG THINGS ARE HAPPENING TODAY!

Infrared Oven Paint Dryer

The fast-drying feature of infrared oven is used by Westinghouse Electric Corp. to temporarily set paint on washing machine spinners and roaster pans in their Columbus, Ohio, plant. The oven installation, by the Fostoria Pressed Steel Corp., Fostoria, Ohio, quickly sets the frit to prevent running into corners and joints of the pieces.

New Machine Prints 360 Radio or TV Units Per Hour... A new machine has been developed that ejects completely assembled and soldered printed circuit TV or radio units, consisting of 50 to 100 component parts each, at the rate of 360 units per hour, without the aid of a human hand.

The machine is equipped with multiple parts inserters (on which patents are pending) that automatically place all of each variety of part in single stations of the machine requiring no crimping and no flux application. Finished units are automatically ejected and bare panels injected from a multi-sided turret.

Magazines which feed parts to the inserters are of such capacity as to require infrequent reloading, the machine running hour after hour without attention. The machine was developed by Equip-a-matic Engineering Corp., Riverside, Ill.

ASTE Plans 5-Year Technical Book Expansion Program... More and better technical books for engineers in the tooling and manufacturing field are on the way as part of a new 5-year book publishing expansion program recently announced by the American Society of Tool Engineers.

The plans call for publication of at least two additional major handbooks in the production and manufacturing field, as well as the undertaking of a 3-year revision of the Tool Engineer handbook, which has sold in excess of 75,000 copies all over the world.

To accomplish the work, a field book editor is being organized in each of the Society's 392-chapters. Each group will assist in the authoring and reviewing of assigned book sections. Eventual plans call for more than 800 authors and reviews, each a recognized industry expert in some particular field.
Avionic Operational Equipment
This view of the outside of the three vans comprises the new MSQ-1A Close Support Control Set built by Reeves Instrument Corp., a subsidiary of Dynamics Corp. of America, at a cost of approximately $40,000,000. The system consists of radar, computer, and communications vans capable of being transported from place to place in support of tactical operations under combat conditions.

Electronics May Provide Guided Missile Defense
According to Dr. Allen B. Du Mont, a defense against nuclear missiles is developed, electronics will play a major role in such a system.

In discussing particular types of electronic devices at the Pacific General Meeting of the AIEE, Dr. Du Mont said that the cathode-ray oscillograph or scope is the key to the electronic age. He said, "there isn't any other device in existence that can accurately measure the kind of high-speed phenomena found in electronics. I feel safe in predicting that the writing speed of the beam of an oscillograph can be increased in the near future to a speed faster than the speed of light. This will make possible the measurement of such extremely high-speed phenomena as nuclear reaction and radioactive scintillation."

Air-to-Air Guided Missile
Close-up view of U.S. Navy's air-to-air guided missile, the supersonic Sparrow I, now combat-ready with the Fleet. The new air weapon, developed by Sperry Gyroscope Co., Great Neck, N. Y., is shown here on the wing of a Chance Vought F7V-3M "Cutlass", as presently deployed on carriers. Deadly accuracy has been shown by many practice launchings against drone targets, high speed jet aircraft, and against other missiles.
write for
DAVEN'S NEW ENCAPSULATED RESISTOR CATALOG
...a 12-page catalog on Daven's complete encapsulated wire wound line

Based on the results of an intensive research development program designed to improve encapsulated wire wound resistor performance, advance miniaturization, and reduce cost, the new DAVEN catalog places vitally important data at the command of the engineer and will prove to be an indispensable reference guide.

Newly developed products, new plastic formulations, new encapsulating techniques, in addition to many, many other design features, are embodied in DAVEN's new line of encapsulated resistors and are presented, in detail, in this new reference catalog.

Briefly, the catalog includes: temperature-sensitive resistors, new products: card-type resistors—miniature DC voltage dividers and DC networks—"toothpick" resistors, miniature resistors, sub-miniature resistors; axial lead types; lug types; MIL-TYPES—in short, all of DAVEN's new contributions to the field of encapsulated resistors.

Write, Today, For Your Copy of this 12-page supplement to Daven's Precision Wire Wound Resistor Catalog!

THE DAVEN CO.
530 West Mt. Pleasant Ave
Livingston, N. J.
Wind Tunnel Tests On TV

Three RCA industrial TV camera chains and four 24" TV monitors are enabling engineers at the Lewis Flight Propulsion Laboratory, Cleveland, Ohio, to remotely view the performance of aircraft models and engines in wind tunnel tests. Research personnel in the control room operate and observe the performance of a model undergoing tests in a wind tunnel 250 feet away.

Largest Aluminum Wound Transformer . . . The largest aluminum wound transformer ever made was recently installed at the Kitimat, British Columbia, smelter of the Aluminium Company of Canada, a subsidiary of Aluminium Ltd.

Made by the English Electric Co., at St. Catharines, Ont., the 70,000kva, 3-phase, 60cy oil-filled power transformer features high and low voltage coils wound with aluminum conductor (about 40 miles of it); a tubular and rectangular aluminum bus bar system; internal aluminum connections; and finned aluminum tubing cooling units.

In operation, the windings are cooled by circulating the oil through five heat exchangers distributed about the periphery of the tank. These exchangers incorporate an integrally mounted oil forcing pump, designed and built especially for this application. An extruded aluminum fin tube is used in a three pass combination and heat is carried away from the fins by air blown over the tubes by motor-driven fans.

A sixth cooler is also included which increases the transformer capacity to 76,000kva under emergency conditions. Each transformer will contain about 12,750 gallons of high dielectric strength transformer oil.

Huge Enclosure Shields Guided Missiles . . . The largest pre-fabricated shielded enclosure ever built has been erected at Bell Aircraft Corp., Buffalo, N.Y., for comprehensive electronic testing of guided missiles and small aircraft in their entirety. The shield measures 40 feet long, 35 feet wide,
and stands 18 feet high. It was installed primarily to check the electronic installations in the Air Force GAM-63 "Rascal" air-to-surface guided missile and its ground equipment prior to delivery to Holloman Air Force Base, N.Mex., for firing. Engineered and built by Ace Engineering and Machine Co., Philadelphia, Pa., it is made of pre-fabricated, interchangeable panels of galvanized sheet steel which permit the entire structure to be taken down, moved, and reassembled at another location if necessary, with a minimum of time and effort.

An unusual feature of the enclosure is its two electrically controlled sliding doors which can operate independently or together to give a maximum opening 16 feet high by 21 feet wide.

**Commutator Alloy Has High Electrical Conductivity**

... A copper-zirconium alloy has been developed possessing high electrical conductivity and good strength retention at elevated temperatures.

Developed at Battelle Institute, Columbus, Ohio, it is suitable for electric motor commutators serving at temperatures above 500°F and under conditions where strength is required. This alloy is the result of research for the Nippert Electric Products Co., Columbus, Ohio.

Electrical conductivity of the alloy is 95.8% of that of the copper standard. Rate of loss of strength under load is exceptionally low by commutator alloy standards.

Other properties of the alloy include good machinability, ability to develop and maintain a commutator film, and strength increase with notching.

**TV Inspects Lithography Blades**

The "TV-Eye" closed-circuit TV installation has improved product quality and production at the Cincinnati Machine Shop of the American Can Co. by 100%. It provides remote microscopic inspection of thin scraper blades used in the lithography coating presses. The camera peers at the blades through a microscope and projects the images, magnified 288 times, on a 21" TV receiver a few feet away.

---

**EPOXY COATED CERAMIC DISCS**

... at No Premium Cost!

**High Voltage Breakdown Strength**

Excellent Moisture Resistance - Durable - Attractive

Good-All's tough, durable EPOXY coated ceramic disc capacitors combine excellent dielectric strength and stability with high humidity resistance. Good-All's exclusive EPOXY coating process results in an intimate bond between the coating and the edge surface of the ceramic. This bond serves to block the voltage breakdown path across the ceramic edge. No wax coating is required on EPOXY coated discs.

**TEMPERATURE COMPENSATING EPOXY DISC CAPACITORS**

Good-All has designed a full line of TC discs in accordance with RETMA specification REC-107-A (class 1). These units are well suited for resonant circuits or other applications where HIGH Q and STABILITY of capacitance is essential. Small size gives an inherent advantage in VHF and UHF applications.

**SPECIFICATIONS** - Working Voltage: 600 VDC - Flash Test Voltage: 1500 VDC - Power Factor: Less than 1% at 1 MC - Leakage Resistance: Greater than 10,000 megohms - Leads: #22 gage tinned copper wire - Capacity Tolerance: ±5%, ±10%, ±20%

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Good-All's complete line of EPOXY coated ceramic disc capacitors are designed to fit both standard and specialized applications. Write or wire today for catalog containing more information on our TC discs and other EPOXY coated disc types listed below.

**BY-PASS** Good-All Type B STABLE Good-All Type E and EE (REMA CLASS 2) STEEL LINE BY-PASS Good-All Type D TRANSISTOR CIRCUIT Good-All Type H

**DUAL SHIELDED** Good-All Type C HIGH VOLTAGE Good-All Type G

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Through this policy, Designers acquire the technical background so necessary for successful missile design. Those able to contribute to a design effort of the utmost importance are invited to write. Address inquiries to the Research and Engineering Staff at Van Nuys.

Lamme Medal Presented To Dr. C. R. Hanna . . . The Lamme Gold Medal was presented recently to Dr. Clinton R. Hanna, associate director of research, Westinghouse Electric Corp., East Pittsburgh, Pa. Dr. Hanna received the medal for his fundamental calculations and developments in the field of electrodynamics, and particularly for his achievements in the design of generator voltage regulators, automatic rolling mill controls and tank gun stabilizers.

The medal was established in 1928 based on a bequest by the late Benjamin G. Lamme, chief engineer, Westinghouse Electric & Mfg. Co., to be awarded a member of AIEE "who has shown meritorious achievement in the development of electrical apparatus or machinery."

RCA To Offer Lowest Priced Color TV Set . . . RCA recently announced it is mass producing a color TV set with a 21" screen that will retail for $495 and be introduced to the public in July. This is the lowest price yet announced for a large screen color set.

The set has a viewable picture of 254 sq. in. with a 21" (over-all diameter) tri-color picture tube, and includes 23 tubes, 2 crystals, and 4 rectifiers.

Transistor Clock Lasts Five Years . . . An electric battery clock with a transistor has been introduced by the German firm of Kieninger & Obergfell, St. Georgen (Black Forest, Germany). A single battery gives the clock a running life of approximately five years.

Auto TV A Step Closer . . . American Television & Radio Corp., St. Paul, Minn., recently demonstrated a series of inverters for portable TV sets that will bring car TV a step closer. The device has a plug which fits a car's cigarette lighter and draws power from the battery.

One model, especially designed for RCA's 88" portable TV, lists for $42.50. Two other units, designed for Admiral's 10.375" set, and GE's 9" and 14" portables, list for $84.95.
Electronics Fiscal Budget For 1957 $1 Billion... Of the Defense Department's $35.6 billion budget for fiscal 1957, about $1 billion is slated for electronics and communications equipment. Ass't Defense Secretary W. J. McNell described the appropriation as about three times the amount provided in fiscal 1956, and reflects for the most part the high cost of improving our extensive system of radar defenses and related communication system.

Expenditures are expected to total $745 million during 1957, compared with $671 million in 1956 fiscal year. For its missile program, the Defense Dept. is asking for $1.776 billion, compared with $838 million in fiscal 1956. Expenditures for missiles are expected to total $1.276 billion, as against a total of $876 million in the current fiscal year. About $1.5 billion is being requested for all types of research and development, $112 million more than provided in fiscal 1956.

Radar Used For Making Maps... A new and rapid method of preparing maps by using radar has been developed to help provide a quick means for restoring communications in a disaster area.

Developed by the Army's Signal Corps Engineering Laboratories, Fort Monmouth, N.J., the radar-photographic technique requires little time and uses readily available military equipment. In the new system, a radar antenna scans the countryside around the proposed transmission point and a camera photographs the radar screen. Every part of the terrain that reflects on the screen is good reception territory. The photograph is then superimposed on the existing road or contour map, instantly showing the best relay points.

Admiral Producing 1,500 Portable TV Sets A Day... Admiral Corp., Chicago, Ill., is ahead of schedule in its production of 10,375" portable TV receivers and is assembling them at the rate of 1,500 a day. The sets will be introduced on a market-by-market basis.

How G.E.'s 20-year antenna background can help make your radar system more effective

6 examples show experience in all areas of land- and ship-based antenna work

To give you an outstanding source for reliable, precision radar antenna equipment, General Electric backs modern facilities with the know-how that comes from many years of research, engineering, and manufacturing experience.

For example, early research in electronic location equipment at G.E. began in 1935 and engineering and manufacturing experience includes these six major areas:

1. Stabilized bases to compensate for ship pitch and roll were built in large quantity with Navy antennas in World War II.
2. Small, portable systems for weather balloon tracking were developed and produced for the Army and Navy in 1948.
3. Powerful heightfinding antenna, FPS-6XW1, developed by G.E. for USAF in 1949, was an advancement in long-range detection.
4. Giant shipboard search antenna, largest in use today, was G.E. developed and produced for Navy early-warning ships.
5. Long-range search antennas (FPS-7) were designed and built by G.E. using advanced construction techniques.
AUTOMATIC ultrasonic soldering

...ELIMINATES CORROSIVE FLUX

Gulton Industries' Research-on-the-Production-Line makes possible instantly soldering of basic materials, instruments or complete systems to fill difficult or unusual requirements.

THE PROBLEM: It's one faced by many manufacturers who solder aluminum, magnesium and similar metals requiring corrosive flux. Light bulb producers must now wash their bulb's aluminum base immediately after soldering the leads... creating a costly production bottleneck. To further combat pitting action, each high-speed machine has to be constructed of expensive, resistant-type metals. The seriousness of this problem grows with expanding emphasis on lightweight metals.

THE SOLUTION: A GLENNITE Ultrasonic Soldering System which completely does away with flux of any kind! Manufacturing operations are simplified and "speeded up"... products never need special treating or cleaning baths. Versatile GLENNITE Soldering Irons are also available in compact, portable units... gas or electrically heated... for shop and field use.

Vibro-Ceramics' Systems and Tools can radically improve other production techniques... ultrasonics provides rapid, yet precise drilling of extra-hard or brittle materials to tolerances within .0005 inch... with ultrasound, positive cleaning of assorted products from aircraft pistons to medical syringes is a snap! All versatile, advance-design GLENNITE equipment delivers maximum useful energy with minimum power consumption.

Vibro-Ceramics pioneered commercial development of transducers; this leadership is backed by Gulton Industries' integrated talents, a group of unique facilities available for complete ultrasonic projects... from original research to final systems' production. Send for Booklet #306; it contains full information. Inquiries from manufacturers' representatives invited.

FM Carrier Communications System

A new Telecana FM carrier communications system supplied by Mine Safety Appliances Co., Pittsburgh, Pa. to Sheffield Steel Div. of Armco Steel Corp., Kansas City, Mo. permits direct conversation between control pulpit and crane station in the blooming mill. A microphone in the center is equipped with a footswitch to close a circuit.

Seminar Program For Du Mont Engineers... A program of seminars for research engineers has been instituted by Allen B. Du Mont Laboratories, Inc., Clifton, N.J., to keep its engineering specialists well informed of their specialties.

The program is carried on during the work week schedule. It entails weekly lectures by Du Mont engineering and research authorities in the wide variety of electronic fields. They range from "transistor applications in consumer products" to "inertialless data recording" and fields such as "new types of information display devices." The lectures are supplemented with on-the-spot visits to engineering projects throughout the company.

Noise-Cancelling Device

This microphone and headset, developed by Radio Corp. of America for the U.S. Air Force, provides clear communication at high levels of noise. The equipment operates over the full frequency range of 200 to 6100 cps and is capable of a constant level of operations under unpressurized conditions up to 40,000 feet.
Washington Report
Albert Warren

Washington Trends & Briefs . . . Trade secrets would be jeopardized, Radio-Electronics-TV Mfrs. Assn. and 5 other industry associations told Defense Dept. recently in their protest to new proposed procurement regulation (ASPR IX, Part 2). Defense Dept. had proposed to require contractors to supply govt with technical data and to give govt unlimited use of such data. The 6 groups warned that this provision would remove incentive for research and development because manufacturers would be unable to protect their secrets from competitors. Counter-proposal by associations was that technical data be supplied to govt only if there's clear need for it, if it will definitely foster research and development and if protection of manufacturers' techniques is assured . . . Air Coordinating Committee continues meetings in efforts to resolve conflicts between TACAN and VOR/DME civil air navigation facilities. After recent meeting, ACC stated: "It was apparent during the discussion which evolved around costs, time schedule for implementation, international considerations, and operational requirements, that the existing VOR azimuth aid to navigation would be required for the balance of its previously planned useful life" . . . Greater simplicity and reliability in military equipment was again urged on industry by Maj. Gen. T. P. Gerrity, asst. to Air Force Deputy Chief of Staff (Material), who stated in speech before Armed Forces Communications & Electronics Assn. that complexity of electronic equipment has "increased the maintenance workload tremendously by virtue of our failure to achieve the necessary reliability." Seriousness of situation is aggravated, he said, by fact that about 42% of Air Force's top electronic technicians would leave service within 2 years, attracted by private industry. On another front, Gen. Gerrity reported that delays in equipment development have been such that only 72% of funds previously scheduled for fiscal 1955 were obligated . . . Air Force has disclosed development, by General Precision Laboratory, of new air navigation system, AN/APN-66, a fully automatic self-contained combination of Doppler radar and automatic dead reckoning. It comprises the AN-APN-81 Doppler radar and AN/APN-95 navigational computer. GPL claims that new system can bring plane within sight of destination after flight covering several thousand miles. Device is free of dependence on ground-based radio aids. Equipment weighs 1200 lb, and GPL reports production at rate of $1,500,000 monthly.
In Electronic Fan Design

Only JOY AXIVANE FANS Offer All These Advantages

PRECISION CONSTRUCTION

Precision construction insures performance that gives you great power in so compact a unit.

COMPACT DESIGN

Joy's axivane design permits installation of Axivane fans as part of the duct... requires no extra space.

LIGHT WEIGHT

Axivane fans are light in weight as well as compact because they are built from precision aluminum or magnesium castings produced in our own foundry under JOY engineering supervision.

AERODYNAMIC ENGINEERING

The airfoil blades and stationary vanes of JOY fans are made with power-saving, efficient airfoil cross-section. AXIVANE design provides equal pressure and velocity distribution across the fan outlet... eliminates turbulence... and produces the greatest cooling effect with the least expenditure of power.

MAXIMUM STRENGTH

Joy AXIVANE fans are durable because the outer casing, stationary vanes, and inner casing are precision-cast as a single unit, giving extra strength and maximum resistance to shock.

Meetings

Aug. 20-21: National Telemetering Conference, Biltmore Hotel, Los Angeles, Calif. Sponsored by the IRE, AIEE, Institute of the Aeronautical Sciences, and the Instrument Society of America. Papers will be presented on novel industrial or military applications of telemetering in remote measurement systems, flight test data, remote guidance systems, remote monitoring, and air traffic control. New component developments such as transducers, multiplexers, data recorders, transmitters and receivers, pickoffs, and telemetering filters will be discussed. For information, write to IRE, 1 E. 79th St., New York, N.Y.

Aug. 20-24: Conference on Scientific and Technical Writing, Philadelphia, Pa. Sponsored by the University of Pennsylvania Institute for Cooperative Research. The conference, open to scientists, engineers, editors, writers, and administrators, will provide advanced study and experience-sharing in the art of making technical literature readable. The fundamental problems involved in the communication of technical information will be analyzed, and current systems for handling these problems will be evaluated. For information and applications, write to Dr. Harry F. Arader, 3400 Walnut St., Philadelphia 4, Pa.


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Meetings


Sept. 24-25: Industrial Electronics Conference, Cleveland, Ohio. Sponsored by the Professional Group on Industrial Electronics, IRE. For information, write to G. F. Bosomworth, Firestone Tire & Rubber Co., Engineering Laboratory, Akron 17, Ohio.

ELECTRONIC DESIGN • July 15, 1956
Sept. 26-30: New York High Fidelity Show, Trade Show Building, New York, N. Y. Sponsored by the Institute of High Fidelity Manufacturers. The Audio Engineering Society will hold its annual meeting at the show. For information, write to Jack Gilbert Associates, 1186 Broadway, New York 1, N. Y.


Oct. 1-3: Canadian Institute of Radio Engineers Convention, Automotive Building, Exhibition Park, Toronto, Canada. Technical papers are planned on medical electronics, scatter propagation, application of electronics to atomic energy projects, use of computers in automation and engineering problems, and transistors. An exposition will include many of the latest improvements in radio, radar, TV, control mechanisms, computers, and other electronic items.

For information, write to Grant Smedmor, Convention Manager, 745 Mount Pleasant Road, Toronto 12, Canada.

Oct. 1-5: AIEEE Fall General Meeting, Chicago, Ill. For information, write to AIEEE, 33 W. 39th St., New York 18, N. Y.

Oct. 3-5: Fifth Annual Meeting of the Standards Engineers Society, Hotel Willard, Washington, D. C. Theme of the meeting is “Standards—Guides for Tomorrow.” Sessions are scheduled on standardization in the chemical industry, standards and the atomic energy field, the future trend of standards in the metals field, and creative engineering and standards. For information, contact the Standards Engineers Society, P.O. Box 281, Camden, N. J.

Oct. 8-9: Second Annual Symposium on Aeronautical Communications, Hotel Utica, Utica, N. Y. Sponsored by the IRE Professional Group on Communications Systems. The symposium will stress communication requirements in support of present and future aeronautical activities. The submission of papers on associated topics is invited. Titles, authors, and a brief abstract of 200 words should be submitted to Fred Moskowitz, 1014 N. Madison St., Rome, N. Y., before July 1. For information, write to R. C. Benoit, Jr., 158 Riverview Parkway N., Rome, N. Y.
**AUTOMATIC PLOTTING OF RECORDER REFERENCE DATA**

... the NEW REAC® Six-Channel Pen Recorder

Reeves... pioneer in invention and development of electronic analog computers... again adds to a growing list of important FIRSTS in this field.

The new REAC Six-Channel Recorder, designed especially for use with analog computers, is FIRST to embody all of the following requirements for efficient, accurate and reliable recording of computer data:

- **NEW AUTOMATIC CALIBRATION**, whereby, for the FIRST time, pen zero set, attenuation setting and offset for each channel are automatically registered, along with a record of the paper speed, at the start of each run.
- **ZERO TIME MARKER**, where a pip marks the point at which recording of each run begins.
- **COMPLETE OPERATIONAL CONTROL** of one or more analog computers from a single recorder station.
- **ALL CONTROLS** directly in line with channels for easy identification.
- **NEW PAPER DRIVE** mechanism with unique electrical speed change and dependable accuracy.
- **NEW REEVE S A-400 SERIES** dual DC chopper-stabilized amplifier units identical with those used in REAC 400 Series Computers for stable, balanced performance and simplified maintenance.
- **SELF-CONTAINED** independent plug-in power supply.
- Provision for slaving one recorder to another where required, and for control of any number of computer units from one recorder.
- A range of special optional accessories, such as electric writing pens, event markers for random phenomena, and Arabic-numeral-coded run designations.
- Write for detailed specifications and additional information.

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**Oct. 16-18:** Conference on Magnetism and Magnetic Materials, Hotel Statler, Boston, Mass. Sponsored by the AIEE, IRE, American Physical Society, American Institute of Mining and Metallurgical Engineers. Authors should submit titles of proposed papers by June 15 and abstracts by August 1. For further information, write to T. O. Payne, Measurements Laboratory, General Electric Co., W. Lynn, Mass.

**Oct. 18-19:** Third Annual International Meeting of the Institute of Management Sciences, Statler Hotel, Los Angeles, Calif. Theme of the conference is "Management Sciences—A Progress Report." Program plans include the presentation of technical papers on the latest developments in the application of advanced sciences to business and industrial management. For further information, please contact Al N. Sears, Vice President Remington Rand, Sperry Rand Corp., 315 Fourth Ave., New York 10, N.Y.

**Oct. 22-24:** AIEE Machine Tool Conference, Sheraton Gibson Hotel, Cincinnati, Ohio. For information, write to AIEE, 33 W. 39th St., New York 18, N.Y.

**Oct. 25-26:** Second Annual Technical Meeting of the IRE Professional Group on Electron Devices, Shoreham Hotel, Washington, D.C. Titles and abstracts of 100-200 words on papers to be offered for presentation should be submitted to R. L. Pritchard, Research Laboratory, General Electric Co., Schenectady, N.Y., before August 1. For other information, contact Prall Culviner, Sylvania Electric Products, Inc., 1740 Broadway, New York, N.Y.

**Oct. 29-30:** Third Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md. Sponsored by the Baltimore Section and Professional Group on Aeronautical and Navigational Electronics of the IRE. Theme of the conference is "Electronics in the Jet Age." For information, write to W. D. Crawford, Publicity Chairman, Westinghouse Electric Corp., Air Arm Div., Friendship International Airport, Baltimore 27, Md.

**Nov. 7-9:** Conference on Electronic Technology in Medicine and Biology, Governor Clinton Hotel, New York, N. Y. Sponsored by the AIEE, IRE, Instrument Society of America. For information, write to AIEE, 33 W. 39th St., New York, N. Y.


Dec. 5-7: Second IRE Instrumentation Conference, Biltmore Hotel, Atlanta, Ga. Sponsored by the Professional Group on Instrumentation and the Atlanta Section of the IRE. Sessions will be devoted to industrial applications, missile range instrumentation, and the application of solid state devices. Prospective authors are invited to submit abstracts of 200 words or less not later than Sept. 1 to the program chairman, M. D. Prince, Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Ga. For further information, contact the IRE, 1 E. 79th St., New York, N. Y.

Dec. 10-12: Eastern Joint Computer Conference, Hotel New Yorker, New York, N. Y. Sponsored by the IRE, AIEE, Association for Computing Machinery. "New Developments in Computers" is the theme of the meeting. In addition to an extensive program of technical papers, the meeting will feature exhibits by many manufacturers in the computing field. For information, contact Al Forman, Room 639, 480 Lexington Ave., New York 17, N. Y.

Jan. 14-15, 1957: Third National Symposium on Reliability and Quality Control in Electronics, Hotel Statler, Washington, D. C. Sponsored jointly by the IRE Professional Group on Reliability and Quality Control, the American Society for Quality Control, and RETMA. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

Can be supplied with single or double governors, gear train, brake or clutch, radio noise filters, thermostats, double commutators, blowers, fans, or any practical combination of these with stated or other voltages.

-55°C to +150°C temperature range.
Design Considerations for Semiconductor Regulated Power Supplies

S. Sherr and P. M. Levy
General Precision Laboratory Inc.
Pleasantville, N. Y.

Increasing use of transistors makes it desirable and feasible to develop compact low voltage power supplies to meet the requirements of this device, and also if possible to eliminate the vacuum tubes completely from the circuit. Vacuum tube low voltage supplies, if they are not to become too bulky and inefficient, are limited generally by the minimum voltage at which the tubes will operate and by the minimum voltage for good voltage reference tubes. The introduction of the reference silicon diode,1 power rectifiers and power transistors have put the engineer in a position where he can consider the possibility of all semiconductor power supplies. This article describes the combinations which have been discovered to result in the simplest effective circuits.

There are a number of possible combinations which result in regulated power supplies. These combinations include series regulators and shunt regulators. Circuits have been designed to provide either a constant voltage or a constant current. In each case the silicon diode is used as the reference element but it may be replaced by a battery if the current and life requirements are compatible with the available battery.

Series Voltage Regulator (Complementary Transistors)

The circuit of Fig. 1 is usable as a constant voltage source. It will regulate against changes in both input voltage and load as well as act as a ripple filter. This circuit will also work in the complementary configuration, with a p-n-p transistor replacing the n-p-n and vice versa. Using Kirchhoff’s laws

\[
\frac{E_v}{E_0} = \frac{1}{R_L + \beta_1 \beta_2 \frac{R_L}{R_s}}
\]

where \( r_e = \frac{\delta E_c}{\delta I_e} \), \( I_e = k \). Assume \( \beta = \alpha/1-\alpha \), \( \beta' s >> 1 \), \( r_e >> R_t \), and \( >> R_s \).

In order to find the regulation expression we differentiate with respect to the appropriate variable and divide by \( E_s \) to provide the following results.

\[
\frac{dE_0}{E_0} = \frac{1}{1 + \beta_1 \frac{R_L}{R_s}} \frac{dE_i}{E_i}
\]

These two equations express the regulation of this circuit against changes in input voltage and output loads.

Eq. 2 also expresses the percent ripple reduction of this circuit from input to output. The complete analysis of this and other circuits is available in an Appendix which may be requested from ELECTRONIC DESIGN. Regulation of better than 1% and ripple reductions of 100 to 1 have been achieved utilizing this design. A 6v 2amp supply, which was intended as a d-c filament supply was designed using this circuit and gave excellent results. The complete circuit diagram is shown in Fig. 2. As previously stated, it is possible...
to design this circuit with either the n-p-n or p-n-p as the series element. In the configuration shown, it is preferable to use a germanium transistor as the shunt element in order to keep the drop across it and the series transistor low. A silicon transistor has been used as the shunt element in this circuit but due to its higher saturation resistance, the total dissipation in the regulation circuit was doubled over that required for the all germanium type. The dissipation in the all germanium circuit was 10.5w for an output of 12w or a total efficiency of 53%. However, in the germanium silicon circuit this dropped to about 33%. The rectifier filter circuit shown was not designed for maximum efficiency, and could be greatly improved by using a choke instead of resistors. Clearly the all germanium circuit is preferable for most applications. This circuit was operated successfully to 60°C with a heat sink.

**Series Voltage Regulator (Similar Transistors)**

The circuit of Fig. 3 is of interest because it permits the use of only one type of transistor and only adds one resistor to the circuit. This permits all silicon supplies to be built. When p-n-p silicon transistors become available this circuit may not have as much utility. The regulation equation is

\[
dE_0 \over E_0 = \frac{1}{1 + \frac{E_r}{E_i}} \left( \frac{dE_i}{E_i} \right) \quad (4)
\]

\[
e_\epsilon \frac{dE_0}{E_0} = \frac{1}{1 + \frac{E_r}{E_i} \frac{R_L}{R_b}} \frac{dR_L}{R_L} \quad (5)
\]

It is generally possible to have \( R_b \) reduce to \( r_b \) and \( \beta_i E_r / E_i > 1 \). Under these conditions the regulation term in 4 can take on values as high as 500 using commonly available transistors. However, for high current supplies this circuit will not work as successfully, since for \( R_L / R_b < 1, \) usually \( R_L / R_b < < 1 \) and the circuit will not regulate too well against load changes. However it does exhibit improvement in regulation against load changes over the complementary circuit of Fig. 1 for medium and low current supplies, though by the same token its regulation against input voltage will be worse by a factor depending on the ratio of \( r_e (1 - \alpha_i) / R_i \). A 45v 30ma version of this supply has been built and tested. The regulation against 20% change in \( E_i \) and a 50% change in \( R_L \) was better than 1%, and the supply operated up to 100°C with a 5% change in output voltage. Most of this change was due to the temperature characteristic of the reference diode and could be corrected down to 1% if a temperature compensated reference diode were used. The efficiency of the supply was better than 75%, and the entire supply, exclusive of transformer and choke was built on a 2" x 2" printed circuit card.

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**Fig. 1. Series Voltage Regulator Circuit, Complementary Transistors.**

**Fig. 3. Circuit With Similar Transistors.**

---

Editor's Note: This article is based on a paper delivered to the Transistor Circuit Conference, Feb. 1956, Philadelphia, Pa. Because of the immense interest expressed in the paper we are reproducing parts here. The original paper covered, in addition, development of equations. At the National Conference of Aeronautical Electronics, May 1956, Dayton, Ohio, the authors delivered a sequel paper which went into, in detail, typical design procedure of the circuits illustrated here. The following three factors were given as describing the operation of the supplies.

**Fractional change in output voltage to the fractional change in input voltage**

\[ K_i = \frac{1}{1 + \frac{E_r}{E_i} \frac{1 - \alpha_i}{R_b}} \]

**Fractional change in output voltage to a fractional change in output level**

\[ K_L = \frac{1}{1 + \beta_i \frac{R_b}{R_L}} \]

**Ripple Reduction factor**

\[ K_r = \frac{\beta_i}{\frac{1}{R_L} + \frac{\beta_i R_b}{R_L}} \]

The completed Dayton paper is published in the Proceedings of the National Conference on Aeronautical Electronics, §4. Order from National Conference on Aeronautical Electronics, 621 Far Hills Branch, Dayton 9, Ohio.
Shunt Voltage Regulator

A third circuit which is useful in that it requires only one transistor is the shunt regulator shown in Fig. 4. The circuit equation is

\[ E_o = \frac{E_i + \beta E_i R_s}{1 + \frac{R_s}{R_L} + \beta \frac{R_s}{R_b}} \]  

(6)

and the regulation equations are

\[ \frac{dE_o}{E_o} = \left[ \frac{1}{1 + \beta \frac{R_s}{R_L}} \right] \frac{dE_i}{E_i} \]  

(7)

\[ \frac{dE_o}{E_o} = \left[ \frac{1}{1 + \beta \frac{R_s}{R_b}} \right] \frac{dR_L}{R_L} \]  

(8)

This circuit will give effective regulation against both input voltage and output load variation. Its major drawback is that it requires considerable dissipation in the series resistor and may often be uneconomical of power, though it does save one transistor. However it is readily possible to calculate the efficiency of this circuit as opposed to one of the others for some fixed regulation factor, and then determine which is engineering wise more feasible. An important advantage of the shunt regulator is that the transistor does not carry the load current. Therefore a relatively small transistor can control appreciable load current.

Constant Current Supply

A fourth basic circuit which might be mentioned is the current regulator shown in Fig. 5. This circuit utilizes the current amplification of the grounded emitter stage in conjunction with a reference current to produce a constant output current. The circuit equation is

\[ I_L = \frac{E_i + \beta E_r r_e (1 - \alpha)}{r_e (1 - \alpha) + R_L} \]  

(9)

and the regulation equations are

\[ \frac{dI_L}{I_L} = \left[ \frac{1}{1 + \frac{r_e}{R_L} (1 - \alpha)} \right] \frac{dE_i}{E_i} \]  

(10)

\[ \frac{dI_L}{I_L} = \left[ \frac{-1}{1 + \frac{r_e}{R_L} (1 - \alpha)} \right] \frac{dR_L}{R_L} \]  

(11)

This circuit is then independent of input voltage and load changes to a very good approximation. Unfortunately the load current will be directly affected by changes in \( \beta \). However \( \beta \) effects can be stabilized by d-c feedback methods described elsewhere and reproducible constant current supplies can be built in this fashion. Cascading transistors will provide higher load currents with a given reference current.

Variations of Basic Supplies

There are certain variations of the above supplies which offer some improvement in performance and should be discussed before the subject is closed. The first of these is shown in Fig. 6. It is easily recognized as a version of the complementary series regulator circuit with the addition of a cascaded transistor stage in the amplifier circuit. The circuit equation is

\[ E_o = \frac{E_i \left[ \frac{\beta_3 \beta_2}{\beta_e (1 - \alpha)} + \frac{\beta_1 \beta_3 \beta_2}{R_b} \right]}{1 + \frac{\beta_1 \beta_2 \beta_3}{R_s}} \]  

(12)

and the regulation equations are

\[ \frac{dE_o}{E_o} = \left[ \frac{1}{1 + \frac{\beta_1 \beta_2 \beta_3}{R_s}} \right] \frac{dE_i}{E_i} \]  

(13)

\[ \frac{dE_o}{E_o} = \left[ \frac{1}{1 + \frac{\beta_1 \beta_2 \beta_3}{R_s}} \right] \frac{dR_s}{R_s} \]  

(14)
From these equations we see that the additional transistor improves the regulation against load variations, but has no effect on input voltage variation.

As a final variation, there is the circuit similar to Fig. 4 except that a second transistor is paralleled across the original one. This version of the shunt regulator type supply has as the general circuit equation

\[ E_0 = \frac{E_i + \beta_1 \beta_2 R_e E_r}{1 + \beta_1 \beta_2 \frac{R_e}{R_b} + \frac{R_e}{R_L}} \]  

(15)

The regulation equations are

\[ \frac{dE_0}{E_0} = \frac{1}{1 + \beta_1 \beta_2 \frac{E_r}{E_i} \frac{R_e}{R_b}} \frac{dE_i}{E_i} \]  

(16)

\[ \frac{dE_0}{E_0} = \frac{1}{1 + \beta_1 \beta_2 \frac{R_L}{R_b} + \frac{R_L}{R_e}} \frac{dR_L}{R_L} \]  

(17)

Here the additional transistor improves load regulation and input voltage regulation.

Other variations are possible, using additional cascaded stages.

**Heat Sink Design**

An additional requirement which is incidental to the circuit design is the necessity for a heat sink for both the rectifier diodes and the series transistor when high currents are desired.

The conduction of heat through a multiple media transmission path is analogous to the conduction of current through a resistive network. The analogy is complete where temperature corresponds to e-m-f, power corresponds to current, and thermal resistance corresponds to ohmic resistance. The equivalent circuit for a transistor operating at a junction temperature \( T_j \) and dissipating a power \( P \) into an ambient temperature \( T_a \) is shown and the corresponding analytical expression is (Fig. 7)

\[ T_j = T_a + P \sum_{i=1}^{n} R_{ei} \]

Knowledge of \( T_a, T_j, \text{ and } \sum_{i=1}^{n} R_{ei} \) enables one to solve for \( \Delta t \).

The surface area of the dissipator required is now found from the graph shown. For forced air cooling, smaller dissipating areas are required.

**References**

LOW TIME JITTER
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Principal Electrical-Mechanical Data and Ratings:

<table>
<thead>
<tr>
<th>6587</th>
<th>5957/E-37B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater voltage</td>
<td>6.3 volts ±7.5%</td>
</tr>
<tr>
<td>Heater current</td>
<td>11 amperes</td>
</tr>
<tr>
<td>Reservoir</td>
<td>Conn. across Htr.</td>
</tr>
<tr>
<td>Minimum heating time</td>
<td>3 minutes</td>
</tr>
<tr>
<td>Over-all length</td>
<td>7.25” max.</td>
</tr>
<tr>
<td>Greatest diameter</td>
<td>2.36” max.</td>
</tr>
<tr>
<td>Peak anode v. forward</td>
<td>16 kV max.</td>
</tr>
<tr>
<td>Peak anode current</td>
<td>325amps. max.</td>
</tr>
<tr>
<td>Average anode current</td>
<td>225 max. max.</td>
</tr>
<tr>
<td>Operation factor</td>
<td>3.9 x 10⁴</td>
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<tr>
<td>Maximum rad</td>
<td>0.60 µs</td>
</tr>
<tr>
<td>Maximum t rad</td>
<td>0.10 µs</td>
</tr>
<tr>
<td>Maximum ti</td>
<td>0.005 µs</td>
</tr>
</tbody>
</table>

"World's Largest Manufacturer of Hydrogen Thyatrons"
Self-Calibrating D-C Voltmeter

Fig. B. Schematic of the self-calibrating d-c voltmeter.
BUILT-IN accuracy is assured with the internal calibration circuit of this d-c voltmeter. Using the potentiometer null-balanced method of measurement, the instrument contains a standard cell as an integral part of the calibration circuit. An ordinary 1-1/2v dry cell in conjunction with a 10-turn potentiometer provides balancing voltage to match the unknown voltage.

To calibrate the meter, the "Calibrate" switch is closed. Then $R_s$ is adjusted until the voltage of the dry cell is exactly equal to the standard cell voltage. This balanced condition is indicated by a zero reading on the meter. At this point, the voltage drop across the 10-turn potentiometer $R_s$ is exactly 1v.

Releasing the "Calibrate" switch and pressing the "Measure" switch impresses a calibrated fraction of the input voltage into the meter circuit. Potentiometer $R_s$ is adjusted until the meter reads zero. Value of the unknown voltage is read directly from the potentiometer dial.

Intended for high-accuracy d-c measurements, the instrument has an accuracy of $\pm 0.3$ per cent of full scale on the 1 volt range and about $\pm 0.4$ per cent on the other ranges. Ten overlapping ranges are provided from 1v to 1000v full scale. Made by Nuclonics Engineering Laboratories, Inc., 32 Monadnock Rd., Wellesley, Mass., the meter is more rugged than precision, moving-coil type devices. It weighs about 5 lbs, making it suitable for field use.

Among the applications recommended for the d-c voltmeter is the calibration of d-c meters. Measuring computer voltages and laboratory testing are other possible uses for the instrument. Absence of vacuum tubes decreases maintenance, increases reliability and eliminates warm-up time. For further data on the d-c voltmeter, turn to Reader's Service Card and circle No. 21.

Where specifications read "ruggedized", it means instruments that can really take punishment, and come through! That's why WESTON is industry's major supply source, and the exclusive source for ruggedized panel instruments in all sizes in A-C, D-C, RF, and THERMO types. For the complete story on WESTON ruggedized meters, as well as on the full line of conventional and core-magnet type panel meters, consult the Weston representative near you, or write WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J. A subsidiary of Daystrom, Incorporated.
WHEN YOU BUILD MicroMatch Directional Couplers into your transmitters, you add an invaluable feature at extremely low cost — positive confirmation of transmitter performance. Your customers stay sold by the coupler’s continuous RF Power indication.

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Now incorporated in most modern Government and commercial transmitters, MicroMatch Directional Couplers produce an output essentially independent of frequency over the range of 20 to 2000 megacycles. Couplers are adjusted to produce full scale meter deflection at power levels of 1.2 watts to 120 KW. Accuracy of power measurements is plus or minus 5% of full scale. For complete details on the MicroMatch line of monitoring equipment, write for our 50-page catalog.
High Sensitivity

SEVERAL design features built into this relay contribute to its high sensitivity and long operating life. An essentially friction-free armature movement, wiping contacts, and elimination of residual magnetic effects permit a sensitivity as low as 5 mw.

Mounted at the end of a slightly flexible arm, the moving contacts touch the stationary contacts slightly before the armature comes to rest. During the last few mils of armature travel, the moving contacts are pulled in a wiping motion about 0.006" across the stationary contacts.

This wiping action serves two purposes: first, to clean impurities from the contacts, and second, to assure a good electrical connection. Long operating life without bounce or chatter are other benefits derived from this operation.

One of the factors contributing to high sensitivity is a "floating" armature design. Instead of the usual hinge pins, a relatively friction-free
fulcrum mounting arrangement is thus used.

Residual magnetic effects tending to decrease sensitivity are minimized by using hydrogen annealed magnetic parts of high-permeability, nickel alloy steel.

Optimum magnetic flux is achieved by using a large number of ampere-turns for each coil resistance. An iron core as large as reasonably possible also creates an efficient magnetic field.

According to the manufacturer, Hedin Technical Corp., 640 W. Mt. Pleasant Ave., Livingston, N.J., the relay is designed for a-c or d-c applications. Contact rating is 1 amp inductive or 5 amp resistive. Contact material may be either silver, palladium, gold alloy, or various alloy variations. Plug-in, solder lug, or fixed mounting types are available. Dust covers may be hermetically sealed. For further information on this high-sensitivity long-operative relay, turn to Reader’s Service Card and circle No. 24.

Let’s look at it this way—What features should an instrument incorporate to make your job easier, help prevent costly mistakes? Take the case of the new PRD Klystron Power Supply. Should we incorporate a sawtooth rather than a sine wave modulation? It’s easier to put in a sine wave. However, a sawtooth has the definite advantage of eliminating phasing and blanking problems when the frequency response of a transmission device is to be studied. So, in goes the sawtooth. It’s easy enough to get hold of some sine wave modulation which can be applied through the external modulation input.

As for preventing mistakes—consider switching from cw to square wave modulation. Suppose you forget to readjust the reflector voltage ... Sure, you’ll catch the mistake later, but time is lost. The new PRD Klystron Power Supply has an electronic clamping circuit which locks the top of the square wave to the previously chosen reflector voltage. No readjustments to think about, no mistakes.

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CIRCLE 25 ON READER-SERVICE CARD FOR MORE INFORMATION
HIGH speed, reliable computer operation has been achieved using transistors in direct coupled circuits. In Part I of this article describing the Transac, basic circuits and arithmetic units for basic operations were discussed. This part discusses control, memory circuits, and communications with the computer. These circuits are representative of many possible configurations and are, at present, necessarily limited by the state of the transistor art.

Control of the Computer
The arithmetic section can perform simple arithmetic operations. But it must be told what to do and when to act. This requires communication both with the permanent memory for the instructions, and with the data memory and the input. Communication from memory is in the form of an array of digits. When decoded the digits might mean "multiply the number in the data section indicated by this following address by the number in the multiplier-quotient register."

To signify multiply, or to indicate the position of the multiplier, a pyramid of AND gates actuated by a group of flip flops might be used. The pyramid is such that there is one unique path through it to some output line for each series of digits. In the example, Fig. 1, four inputs are required. If these inputs energize transistors $1_s, 2_s, 3_s$, and $4_s$, a conducting path at the

A. L. Cavalieri, Jr.
Philco Corp., Government and Industrial Div.

Fig. 1. A pyramid of AND gates. Large units designate the flip flop to which the base in question is connected. Subscript defines the state of that flip flop which will cause the base to conduct.

Fig. 2. Dual AND-OR gates. Circuit $a$ is the inverse of $b$.

Fig. 3. Typical data memory circuit.

Fig. 4. Memory driver circuit. Original stored information is retained.
extreme right side of the diagram is formed, and that output terminal rises to a potential close to the ground.

These transistors are energized by four flip-flops which have been set in some pattern, possibly by the instruction from the memory.

Depending upon the nature of the stage to be driven, a potential near ground may or may not be suitable. However, it is possible to follow each output with an inverter or make use of parallel rather than series AND gates, Fig. 2. In the circuit of Fig. 2a, a negative OR pulse can be created by dropping the potential of either input 1 or 2 provided that both 1 and 2 were originally in a conducting state, both 1 and 2 would have to be energized to produce a positive AND pulse. The circuit of Fig. 2b is just the inverse of Fig. 2a in that it produces negative AND pulses and positive OR pulses. Height of an AND pyramid of this type is limited by the finite drive capabilities of transistors in current production. To handle more precise or detailed instruction, it is necessary to insert buffer stages between flip-flops and the pyramid so that no more than four transistors are driven from one.

Memory Circuit

The program or schedule of operation for Transac may be stored on a drum from which it is read off in a parallel fashion. Certain fixed information may also be wired into a transistor memory section, with provision for replacing this section with another when it becomes necessary to the stored data.

Transac circuits are also applied to the data storage or "scratch pad" memory. In fact, circuits can be designed to retain the information in this memory as long as the computer remains energized. A simple circuit for data storage with parallel input and output is shown in Fig. 3.

To read-in, the digit flip-flops are set to the desired condition and the address wires are energized. The cores will be set to a position corresponding to that of the flip-flops. Because the transistors are really two-way gates, they will conduct almost equally well in either direction provided an appropriate change in the polarity of collector to emitter voltage is made.

To read out, all flip-flops are set to a zero condition, then the address lines are energized. In the sensing windings associated with those cores where a change in magnetic state occurs, a voltage pulse is instantaneously generated. The parallel presentation of stored information is achieved but only at the expense of losing the original stored information.

It is possible to return the cores to their original state through circuitry such as in Fig. 4. In that circuit, the flip-flops and address lines must be in their proper condition before the demand line is energized. The polarity of the voltage pulse in the transformer secondary will be determined by the side of the primary windings that carries current.

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- Less Distortion, Less Noise—FM distortion and inherent noise are negligible—60 db below a 1-megacycle deviation.
- Lower Cost—VA-220 klystrons cost far less than any other relay klystron with comparable performance characteristics.

For complete specifications... and technical data on the VA-220 and other Varian klystrons, write to the Varian Application Engineering Department today.

ELECTRONIC DESIGN • July 15, 1956
Fig. 5. Translation matrix used with a coded disc input.
INDICATORS (FOR CHECKING)

2.0 VOLT
0.06 AMP
PILOT LIGHT

L-5017
or
L-5112

Fig. 6. Monostable circuit, a, may be converted into a free-running multivibrator, b, by replacing the resistor R with an inductance.

Fig. 7. One variety of a transistorized decade ring counter.
If an output pulse is generated with a read-out signal present, it will be gated back to the flip flop, setting the flip flop state corresponding to the original state of the core. The core will then be returned to its original state.

Communicating with the Computer

Electro-mechanical inputs of the Teletype, Flexowriter, or Kleinschmidt variety provide suitable digitized inputs. Similar output devices may also be used but it might be necessary to feed the computer output into some storage medium for processing on some other occasion.

Particularly well suited to the Transac computer is the Gray code disc. Because of the brush arrangement in this device, a translation matrix, Fig. 5, is necessary to provide non-ambiguous outputs from the 2n-1 terminals available to the converter. Any signal at output 4 can reach transistor 4 causing it to conduct and cut off 5. A negative pulse at the collector of transistor 5 is, then, the output. Transistor 1 is energized and no matter what happens at terminal 3, transistor 3 is held off and at that signal cannot propagate.

Setting time of this matrix is about 4μsec while gating out requires about 0.25μsec. Thus, a given shaft position can be read into the computer in about 4.25μsec.

Other Direct-Coupled Circuits

The family of Transac circuits includes many members which, although they have not found extensive use in computers, are nevertheless interesting and potentially useful. The simplest of these is the monostable circuit of Fig. 6a. The circuit is stable with the transistor 2 conducting. Flipping the device to its alternate state requires temporarily grounding the base of that transistor. This alternate state is maintained until the voltage at that base of transistor 2 rises to a value allowing conduction. Replacing the resistor in the monostable circuit with an inductor, Fig. 6b, the multivibrator will free-run at a frequency depending upon the values of the inductances.

Transac circuits need not be limited to simple two-state devices. A wide variety of coded and uncoded counters have been developed. The transitorized decade ring counter, Fig. 7, requires two inputs such as obtained from a scale of two counter. A positive input at either terminal energizes the associated line. Those transistors with their emitters tied to that line conduct if the base voltages are suitable.

Acknowledgements

The author wishes to acknowledge the aid of Ralph H. Beter and Ralph B. Brown of the Philco Corporation.

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Contains essential data on processing, control methods, applications, types, sizes, suggested use frequencies, etc. of Arnold iron powder cores.

ADDRESS DEPT. ED-67

ELECTRONIC DESIGN • July 15, 1956
Long ago, when knighthood was in full flower, the heraldic arms of a family were a proud mark of dignity and distinction. No brave knight would think of venturing forth to battle without a coat of arms! Even today, official arms are proudly displayed by states, corporations and others as a badge or trademark.

As in days of yore, trademarks are important today, too! The modern label or trademark serves as a badge of pride and distinction on any product. So...

TO IDENTIFY...SPECIFY Metal-Cal

Cannon Electric Company specifies Metal-Cals for identifying most of their well-known electrical and electronic components—Cannon knows Metal-Cals are more permanent and colorful than decals or name plates. Use this coupon for FREE Samples and an Explanatory Brochure that show how Metal-Cal, the colorful, original, anodized and dyed, etched .003" aluminum foil sticks to the job of trademarking or providing clear, sharp diagramming or serial numbering for your products.
Acoustic Damped Rectilinear Recorder

True recordings of a 60cy signal and a repetitive step function as actually reproduced on the new Massa Recorder employing the exclusive electrodynamic movement. (Note complete absence of distortion.)

Distorted recordings of the same signals as actually reproduced on a conventional Recorder employing the usual D'Arsonval movement. (Note curvilinear distortion, overshoot and ringing.)
ACOUSTICAL damping of the pen, elimination of curvilinear distortion, and elimination of massive magnets are features of the high-speed direct inking chart recorder illustrated here. The frequency range is from d-c to 200cps. Highest chart speed is 200mm/sec.

Critical acoustic damping in the new recorder made by Massa Laboratories, Inc., 5 Fottler Rd., Hingham, Mass., completely eliminates any resonance peak in the response. This results in excellent transient response, which makes the pen motor independent of the amplifier compensation so that it may be used as a true recording millimeter. Pen design includes a built-in mechanical filter that permits smooth, splatter-free writing at all frequencies up to 200cps. A cross section of a portion of the pen is shown in the attached sketch. A novel linkage assembly produces true rectilinear motion of the pen tip and eliminates the familiar curvilinear distortion present in the conventional D'Arsonval type instruments.

The Massa Electrodynamic Recorder uses a typical cylindrical driving coil mounted in a coaxial magnetic field, which means that all of the air gap flux is effectively used in the operation of the instrument. Because of the greatly increased air gap efficiency that results from this new design, a rugged, high sensitivity pen motor has been made possible which weighs only 1-1/2 lbs. Sensitivity is 20ma rms full scale deflection. The decrease in size resulting from the new design has made it possible to include a fixed mounting base as an integral part of the pen motor assembly, which permits multiple channels to be spaced only 1-1/4" on centers. The complete two channel system weighs 10 lbs.

The recorder includes a paper chart drive with decimal speed changes of 0.01sec, 0.1sec and 1sec which permits the direct reading of time scales on the chart at any selected speed. The time resolution is approximately 1 millisecond. The chart strips reproduced here compare actual recordings of a 60cps sine wave and a repetitive step function as made on the new recorder and on a D'Arsonval type instrument. The complete absence of curvilinear distortion as well as the complete absence of ringing and overshoot is noted in the Massa recordings as compared to the distorted records made on the D'Arsonval type instrument. For more information on the item, turn to the Reader's Service Card and circle No. 29.

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CIRCLE 30 ON READER-SERVICE CARD FOR MORE INFORMATION
ALMOST any quantity that can be measured with an ordinary D'Arsonval meter movement may be converted into digital units with this relatively simple device. Basically, the device uses the meter pointer to complete an electrical circuit between contacts on the scale of the meter assembly. Digital output depends upon the position of the pointer and may be read out at predetermined intervals. Because the converter is inherently low-current consuming, it was named LIAD (Low I, Analog-to-Digital).

Heart of the device is a D'Arsonval meter movement. Sensitivity can be that of most available meter movements. Thus, LIAD may be driven directly from thermocouples, ion gages, differential transformers, strain gages, bridges, photocells, and various other types of transducers. Vacuum tubes are not essential to the operation of the converter.

In place of the standard meter scale, designers at Assembly Products, Inc., Chesterland, Ohio, have incorporated a printed-circuit board over which the indicating pointer moves. This printed-circuit dial plate may be divided into several bands; each band is divided into segments. For each value being measured by the meter signal coil, the pointer is positioned over a particular combination of contacts. Arrangement of these bands and segments determines code output.

In operation, the indicating pointer moves freely over the printed-circuit scale. A readout coil, energized either automatically or manually, pulls a "clamper" or pusher bar against the pointer and pushes it against the printed scale. Individual segments or bands are energized only if a contact is under the pointer at the time the readout coil is energized. Feeding these outputs to proper indicators produces a binary code indicative of pointer position. At present a maximum of six bands on the printed scale is feasible; up to 64 positions can be indicated. Possible resolution is about 1-1/2 percent.

Fig. A. Meter-type analog-to-digital converter with cover removed.

Fig. B. Cutaway view of LIAD showing how the indicator pointer is placed between the pusher bar and the coded printed-circuit dial plate.
Standard coil sensitivities are 1 ma at 100 ohms or 100 µa at 3000 ohms. Response time ranges from 1/4 to 3/4 seconds. Contacts are rated at 100 ma at 100 v d-e or 0.5 amp at 110 v a-c. A clockwork mechanism is available to energize the readout coil at rates ranging from two per second to one per hour.

Some of the suggested applications include telemetering, automatic production testing or grading, maximum value reading, or simple quantitative readout. Values of pressure, flow, liquid level, temperature, voltage, or current may be converted into a series of pulses and transmitted without inaccuracies due to line losses. Resistors, vacuum tubes and similar components may be tested to determine quality level. Coded output of the LIAD may be used to activate suitable relays or gates.

A system using four 10-segment LIAD's has been developed to provide readout of information stored in decade counters. Readings up to 9999 are provided. Readout is accomplished by actuating proper circuits to electrodes of Inditron tubes to give direct readings of rpm, pressure, etc. Nixie tubes or digital in-line readout devices may also be used. LIAD may also work directly into printers. For further information, turn to Reader's Service Card and circle No. 31.

Fig. D. Schematic of an application of LIAD for direct digital readout.

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TYPE J—2 watts—in single, dual, or triple construction. With or without line switch. Dual units can be supplied with concentric shafts for individual resistor control.

TYPE G & GP—1/8 watt—1/8 inch in diameter. Type GP units have long terminals for printed circuit applications.

TYPE T—1/2 watt—compact units for hearing aids and similar applications.

A-B variable resistors are available in standard RETMA values up to 5 megohms.
EUROPEAN designers are challenging U.S. superiority in the field of instrumentation. Designers abroad have been remarkably successful in developing precise and versatile instruments; those which are simple to read by semi-technical personnel and which save time for engineers and production people alike. Presented here are unusual and interesting design features of some of the foreign equipment.

The following examples are selected rather arbitrarily from certain countries and fields of application in accordance with the author's own activities. One should not conclude, therefore, that interesting work is limited to specific countries such as Western Germany or to specific fields such as instrumentation.

**Mechanical Design**

Much attention is paid by foreign designers to the mechanical aspects of electronic equipment. One gains the impression that the design job is generally done by engineers who are as much at home in mechanical as in electronic design. Attention to styling or aesthetic beauty is relatively high in importance. The concept that a well designed machine is a good looking machine is very much encouraged and is fostered by prizes given for the best combination of good styling and functional design. Fig. 1 shows a prize winning design in the form of a set of standard capacitors. This design makes possible an unlimited combination of fixed and variable capacitors with a minimum of series resistance and inductance and no lead capacitance. This results in a rather unusual looking but harmonious design.

**Space Economy**

The European designer, like his American counterpart, finds his work space at a premium. An ever increasing number of instruments are needed for his work. Instruments are usually piled on top of one another or put on racks. Rack mounting, however, is only practical for specialized equipment because it ties up the equipment permanently. Piling up instruments on work benches is messy and often dangerous. By standardizing on cabinet sizes and by providing cups for the upper corners into which the feet of the instruments fit (Fig. 2), it is possible to mount 2, 3, or 4 instruments securely on top of each other conveniently and safely. It is interesting to note that while this design was started by one manufacturer, German industry seems to have adopted this method quite generally.

Because of limited local markets, European manufacturers must export much of their production. This entails marking of panels and preparation of instruction books in various languages, with corresponding manufacturing and inventory problems. The use of symbols on panels, understood in all languages, enabled designers to specify one panel for all markets. Such panels also often replace lengthy instructions. It is apparent that simplicity in panel lettering is an advantage that is appreciated by every user.

**Simplicity of Operation**

Lack of engineers and technically trained personnel is as bad in Europe as in the U.S. Yet, requirements
for precision instruments are constantly increasing. Tests performed heretofore in a relatively few laboratories are today routine in incoming inspection, quality control or even on the manufacturing line. There is a need for production-line instruments with laboratory accuracy which are simple enough in design so that they can be readily used by unskilled personnel. Such an instrument is shown in Fig. 3. It is Maxwell Bridge for the measurement of inductance, series resistance, capacitance, and parallel conductance. The decimal point automatically shows as a white dot, and the unit of measurement (henrys, ohms, microfarads, megohms, etc.) is read directly through the window at the right of the numerical value. Calculations, with their inherent possibilities for errors, are thus completely eliminated.

The Wheatstone Bridge shown in Fig. 4 has similar features. In this instrument, the decimal points and units window are illuminated. The bridge covers an unusually wide range (0.01 ohms to 100 megohms) and has an accuracy of 0.1%. It is thus an instrument which combines laboratory accuracy with industrial design. The diagram shown in Fig. 5 directly plots impedance vs frequency on a Smith Chart, Carter Chart, Polar Diagram or other standard form. Since no calculating is required, what would normally be hours of engineering work is reduced to minutes of work by a technician.

**Human Engineered**

Another example of an interesting foreign design is the Audio Frequency Spectrograph, shown in Fig. 6.
When reading. smallest position of the meter for a given scale size, the meters can be made smaller this way. The arc is the smallest one that can be fitted inside a square.

It automatically plots line spectra of such phenomena as noise, vibration, etc., with utmost accuracy and convenience. At the touch of a button, paper is inserted under the ink stylus and removed as easily by touching another button.

In Europe there are some very interesting and radical departures from established meter design practices. One example is shown in Fig. 7. Two advantages are claimed for this design; the longest possible scale obtains for a square meter; and zero and full scale readings are easier to spot, particularly on large panels containing many meters.

Laboratory precision meters also feature interesting design; most are now being built as shown in Fig. 8 with a “light pointer” instead of a needle, and with curved scales to minimize errors. Advantages claimed for the “light pointer” are: greater resistance to damage, no parallax error, and no need for illuminated scale. A meter built in accordance with this same principle has recently been announced by an American manufacturer.

**Economy of Operation**

Since electric power is considerably more expensive in Europe than in the U.S., much attention is paid to economical design from an operational standpoint. It is not unusual to find equipment which requires less than half the power drawn by comparable equipment of U.S. manufacture. Apparently, this is not done at the expense of good regulation.

As much attention is commonly paid to what is behind the panel or in the cabinet as to external appearance and operating features. Every effort is made to reduce the “down time” for maintenance. High quality conservatively rated parts are used. In Fig. 9 is an example of a mechanical chassis design that aids in maintenance. What is behind the panel is as neat and business-like in appearance as the panel itself. The entire equipment is designed to last almost indefinitely, to require a minimum of maintenance and above all, to save the valuable time of the designer or technician who might use it.

For many design applications it is necessary to have the very best test equipment available in accuracy, versatility, readability, and reliability. Many times a design is limited by the available instruments (tools) for checking it out. Certainly, valuable engineering time is often wasted using make-shift methods and in checking test equipment for proper operation. Where “only the best” is good enough, designers should have the best possible tools with which to do their best work. In seeking such tools, all sources should be checked; and European or other foreign instruments should not be overlooked.
Fig. 8. Light Spot Watt Meter. This Hartmann and Braun design eliminates the needle pointer common to galvanometer type instruments. Several interesting advantages result. By focusing a light spot onto a mirror affixed to the moving coil, scale illumination follows coil movement. No external illumination is necessary to read the meter. An important feature is that there is no parallax since the cross-hair in the light beam appears directly on the scale. Meter sensitivity can be greater because less force is necessary to move the coil than when a needle pointer is attached. Also, there is no mechanical damage to the instrument on overload. The light beam will move off scale but there is no needle to “wrap around the pin.”

Fig. 9. Frequency Synthesizer. Essentially all information necessary for using this instrument is incorporated on the panel; yet, it appears uncluttered. The pointers on the frequency scales move horizontally as the drum dials are rotated to indicate at all times which scales are to be read. The markings above the Selector Switch indicate which frequencies are “locked in” with the crystal and which are continuously variable. The half moon above the voltage dial indicates the direction of “crescendo” or increased amplitude. The rear view shows how carefully the instrument is constructed. The mechanical layout and design facilitates ease of testing and maintenance.
Kearfott Servo Motor-Generators are characterized by low rotor inertia, low time constants and high stall torque. Motor-Generator combinations provide 0.3 to 3.1 volts per 1000 R.P.M. with an extremely linear output over a speed range of 0—3600 R.P.M. and useful output up to 10,000 R.P.M.

*New Size 11 low cost, Servo Motor-Damping Generator Type R 809.

**CHARACTERISTICS**

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CIRCLE 33 ON READER-SERVICE CARD FOR MORE INFORMATION
The Westinghouse XP-5052 fused-junction silicon diode can handle 500 ma continuous d-c current at peak inverse voltages from 50 to 600 volts.

Leakage at rated voltage is extremely low... result is increased efficiency and temperature ranges never before attainable.

This diode is suitable for use in radio and TV, radar, aircraft, magnetic amplifiers, voltage regulators, computers, precipitators, and other industrial applications. Two case designs are immediately available... pigtail (XP-5052) and threaded stud (XP-5053).

For more information on the XP-5052, or any other silicon rectifier requirements, regardless of voltage and current, call your nearest Westinghouse apparatus sales office, or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

CALIBRATION and testing of many pulse systems require a series of pulse trains of variable amplitude and width. Coincidence equipment found in computers and nuclear counters are two of the possible applications of multipulse test equipment.

Four square-wave pulses of less than 1 millisecond rise time are generated by this newly developed pulse generator. Pulse width may be varied from 0.001 to 0.1 microsecond. Additional plug-in delay lines may be used with the instrument to attain pulse widths up to several microseconds.

Separate panel jacks are provided for each of the four outputs. Amplitude of each may be varied from 0 to 75 volts into 500 ohms, with a half-wave output of 10 volts into 500 ohms.

The Westinghouse XP-5052 fused-junction silicon diode is suitable for use in radio and TV, radar, aircraft, magnetic amplifiers, voltage regulators, computers, precipitators, and other industrial applications. Two case designs are immediately available... pigtail (XP-5052) and threaded stud (XP-5053).

For more information on the XP-5052, or any other silicon rectifier requirements, regardless of voltage and current, call your nearest Westinghouse apparatus sales office, or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.
Typical pulse train at a sweep speed of 50 milli-usec per cm and a vertical amplifier rise time of 7 milli-usec. Pulse widths are 50 milli-usec. Spacing is 30 milli-usec between the first and second, 35 milli-usec between the second and third, and 50 milli-usec between the third and fourth pulses.

Pulses can be varied in 1 db steps from 0.006 to 100 v by means of toggle switches. Nominal output impedance is 75 ohms. Amplitude range is from 0.004 to 60 v into 50 ohm cable. A continuously variable attenuator permits finer control if desired. A polarity switch is also provided.

At all outputs are simultaneous in time to within 0.1 milli-usec. Pulses can be used separately or individually delayed, then mixed into a common pulse train.

Among the applications for this unit, made by Electrical & Physical Instrument Corp., 25 W. 43rd St., New York 36, N. Y., is the calibration of oscilloscope horizontal sweep deflection as a function of time. This calibration depends upon accurate measurement of length and velocity of propagation of the coaxial cable delay line.

Vertical deflection as a function of pulse amplitude as well as rise time and distortion of vertical amplifiers may also be measured.

Multipulse resolution and behavior of fast counting devices, such as scalers and beam switching tubes can be determined using multiple pulse trains of various amplitudes and widths. Another application involves observation of transient response of diodes and transistors. For more information on this multiple generator, turn to Reader's Service Card and circle No. 35.
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MOTOR DIVISION
WRIGHT MACHINERY COMPANY
Durham, North Carolina
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OCCASIONALLY the need arises for an impedance transformer which will match a given generator to an unusual value of load impedance. If commercial transformers with appropriately rated impedance taps are not available, advantage can often be taken of the unrated odd impedances between various secondary taps of multiple winding transformers when the impedance values between the different taps and common are known.

The nomograph for finding these odd impedances can be used to save time in determining these values and is based on the following calculations:

Referring to the figure, it is assumed that impedances \( Z_1 \) and \( Z_2 \) are known, but that impedance \( Z_{(2-1)} \) is unknown.

Basic transformer theory tells us that:

\[
\frac{Z_1}{N_1^2} = \frac{Z_2}{N_2^2} 
\]

from (1)

\[
N_2^2 = N_1^2 \frac{Z_2}{Z_1} 
\]

\[
N_2 = N_1 \sqrt{\frac{Z_2}{Z_1}} 
\]

Similarly:

\[
\frac{Z_1}{N_1^2} = \frac{Z_{(2-1)}}{(N_2-N_1)^2} 
\]

Substitute (2) in (3) and solve for \( Z_{(2-1)} \):

\[
Z_{(2-1)} = Z_1 \left[ N_1 \sqrt{\frac{Z_2}{Z_1}} - N_1 \right] 
\]

\[
= Z_1 \left[ \sqrt{\frac{Z_2}{Z_1}} - 1 \right] 
\]

Algebraically, this may be written as:

\[
Z_{(2-1)} = (\sqrt{Z_2} - \sqrt{Z_1})^2 
\]
If the primary winding is improperly matched, each secondary impedance must be multiplied by the mismatch factor of the primary impedance. It should be noted, however, that a transformer operated at impedances distinctly different from those for which it is rated may have undesirable performance characteristics even though the turns ratio is correct for the application.

Example

As an example of nomograph use, assume a transformer with 500-ohm primary is available having secondary taps of 4 and 50 ohms. The impedance between these taps is unknown. By laying a straight-edge across the nomograph, a line is drawn between the 4-ohm point on the Z₁ scale and 50-ohm point on the Z₂ scale. The line crosses the Z(2-1) scale at 25 ohms. Thus, the unknown impedance is 25 ohms. The impedance step-down is 500:25 or 20:1.
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CIRCLE 39 ON READER-SERVICE CARD FOR MORE INFORMATION
Epoxy-Resin Tape Insulation

Electronic capacitors may be insulated with a cigarette wrap of epoxy-resin tape. The tape forms a cylinder around the body of the capacitor and is cured to form a waterproof sheath. Ends of the capacitor are then sealed by pouring them full of liquid resin.

Shown here is epoxy-resin tape X-1045—a non-woven polyester mat impregnated with epoxy resin—being applied to a motor coil. The fully wrapped coil is cured and pressed to provide a smooth hard surface which is shaped to fit snugly in its slots.

ELECTRONIC DESIGN • July 15, 1956
EPOXY-RESIN impregnated glass cloth and non-woven polyester mat insulation tapes are now commercially available for the first time. Such tapes have the advantages associated with epoxy resins, including high dielectric strength, high resistivity, mechanical strength, chemical resistance, excellent adhesion to glass, metals and other materials, resistance to thermal degradation, and no voids or fissures.

The two types of epoxy resin tapes, manufactured under the brand name "Scotchcast," are type X-1035, a 4-mil glass cloth coated with 14 mils of epoxy resin, and type X-1045, a polyester mat also coated to a nominal thickness of 14 mils. The manufacturer is Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul 6, Minn. The tapes meet class B electrical insulation requirements and can be used for such purposes as: insulation of coils and conductors, insulating motor or generator field windings, wrapping toroidal windings, forming L and V shaped channels, anchoring transformer leads, as transformer outer covers, and as inter-layer and inter-winding transformer insulation.

Both epoxy resin tapes have a dielectric strength of 1000v per mil and a volume resistivity of $10^{12}$ ohms at 96% RH. A paper liner strips off the tape before use. The tapes feel smooth and plastic at room temperature but leave no residue or pigment on the hands of the workers.

On application, the tape can be elongated up to 45%, allowing for shrinkage on cure to permit a tight bond for the wire or material to which it is applied. Some specific electronic applications include a "cigarette wrap" sleeve of epoxy resin tape around capacitors. The ends are sealed with an epoxy resin. When cured, a moisture resistant covering with good electrical properties results. Another application is the use of Tape X-1045 to wrap transformer coils. When cured, two holes are punched in the tape; resin is squirted through one hole using a pressure gun to impregnate the coil, with the other hole providing an outlet for trapped air.

Necessary electrical insulation on a small heat-sensitive bi-metallic relay is satisfactorily provided with epoxy-resin tape because of its ability to withstand the high operating temperatures. For another application, several layers of X-1035 tape have been laid flat and cured to make a base for printed circuits; these can then be molded to conform to irregular contours. The tapes have also been cured in layers, shaped to make coil forms. Such forms will not absorb moisture, a common fault with the paper often used for this purpose.

For additional information on this product, fill out the Reader's Service Card and circle No. 40.

putting IDEAS to work—research at IBM

- **Multi-Stable Work Horse:** By employing a non-linear load, new circuit permits two transistors to do the work of ten. IBM Bulletin No. 200.
- **Self-Complementary:** New Gas Tube Counter subtracts by adding. IBM Bulletin No. 201.
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Multi-Stable Work Horse

As the size and complexity of IBM products increase, we are faced with growing numbers of components—which means increased cost. As part of our continuous search for improvement and ways to reduce the number of components, Robert Henle, one of our Transistor Circuit Research people, undertook to get more work out of a given number of transistors. The result is a two-transistor, multi-stable circuit employing feedback controlled by a non-linear load. Junction transistors are naturally suited to this new kind of circuit.

Self-Complementary

Accounting machines these days must be able to do everything—even make decisions. In order to get a machine to do more in a day's time with little or no increase in operating cost, IBM Component Research people studied the idea of using a multi-cathode gas tube. It's good news that they came up with an attractive approach, which Robert Koehler, of our Device Development Group, then reduced to practice; it operates faster than its electro-mechanical predecessor and, furthermore, with simple circuitry, can subtract by adding. It can read out in true number form both positive and negative balances. This is possible because a number stored in the tube may be transposed to its 9's complement (i.e., value subtracted from nine) by a single electrical pulse.

If you'd like more information on the basic principle, physical arrangement of parts, and typical problems solved, write for IBM Bulletin No. 201. If you are fascinated by the theory of numbers, we recommend this Bulletin.

To learn more about career opportunities available at IBM, write, describing your background, to: W. M. Hoyt, IBM, Room 907, 590 Madison Avenue, New York 22, N. Y.
New models are being released daily—just recently a 4-transistor handle-carried set by Olympic has been announced. The table includes only those models for which information was received in time for publication.

Current Trends in Transistor Radios

Sol D. Prensky

This year's growth in the use of transistors has produced a fine crop of all-transistor portable radio sets that cannot fail to impress observers—from the design engineer right down to the ultimate consumer. Practically everyone has become conscious of the great variety of portables in all sorts of sizes: wrist-radios, pocket-size sets, and the larger handle-carried sets. To these are added, the recently announced transistorized automobile radios and portable phono players.

We have tabulated here a description of the receivers not only to show the type number and function of the transistors being used, but also to emphasize the outstanding advantages that these new sets have to offer in the way of their compact size and their increased practicality obtained from the use of lower-voltage and longer life batteries. The use of mercury batteries in many cases has not only increased operating life to the point where battery replacement is no longer necessary during the entire summer season, but it has also broken through the "shelf-life" deterioration barrier, that previously made it impractical to keep a set of reserve batteries on hand. A mercury battery pack has the unique property that after a full year of non-use, it can still be depended upon to be as much as 97% fresh. Additionally, for the highly important civil-defense use, it is now possible for everyone owning a model to keep an extra mercury battery in reserve, and thus have a truly practical "Alert-ready" receiver that will be ready, whenever needed, (within any given year), to work on either its operating battery or on its entirely-dependable reserve supply.

From the standpoint of transistor receiver-circuit design, much development has taken place in the availability of the special items, such as antenna, oscillator, and i-f transformers and other components that adapt the widely used superhet circuit to transistor operation. Various new transistor types have come into use. The schematic diagrams of Figs. 1, 2, and 3 show representative circuits where use has been made of special

Fig. 1. Schematic diagram of 7-transistor chassis by Raytheon (T-2500) uses all p-n-p transistors.

Fig. 2. Five transistor circuit uses n-p-n detector (G.E. models 675 & 6).
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<td>9 dry</td>
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Includes if stage LS113.

100mw output, 30 ohm v.c. (see schematic).

High min vol level used as reminder to turn set off.

Dual-pot vol control; (see schematic) (15x120).

Home-portable type.

Ferrite loop antenna.

Details not yet announced.

All three chassis produced as model 500.
The RWT is now in full production. This latest addition to TIC’s precision trimmer potentiometer line — most complete in the industry — provides a high-power, low-cost, stable, and compact unit for fixed-gain adjustments... padding ... critical bias ... and balancing adjustments.

The wire-wound RWT incorporates the advanced mechanical design of the popular TIC RFT Metfilm Trimmer. Permits precise trimming with a unit less than 1/10 of cubic inch in volume. Advanced mechanical design provides: Complete environmental protection with one-piece anodized aluminum base and sealed stainless-steel cover ... less than 4/10 ounce in weight ... and precise stable adjustment with a 25-turn, stainless-steel lead screw.

RWT provides standard temperature range from \(-55^\circ C\) to \(+95^\circ C\) ... wide resistance range from 50 to 20K ohms ... and a power rating of 2 watts at 25°C derated to 1/4 watt at 95°C. Special units are also available for operation up to \(+145^\circ C\) and power ratings up to 1/4 watt at 125°C.

For complete specifications on the RWT request Bulletin TP-200.
Fig. 3. This pocket radio schematic uses 3 n-p-n and 3 p-n-p transistors (RCA 7-BT-9J). Compactness of set is illustrated in photograph below.

Wrist model (somewhat king-sized) of LEL, Copiague, N. Y. uses regenerative circuit.

Compact small portable is illustrated well by Roland’s all-transistor 66. Four-in. speaker is larger than most.
Most.

The Raytheon circuit model (model 72500, chassis 7RT4) Fig. 1, uses 7 transistors (all p-n-p) and is representative of the larger (handle-carried) sets using separate transistor as an oscillator, one mixer, one i-f amplifier, a crystal diode detector, two audio amplifier stages, and a push-pull audio output stage. Fig. 2 shows the circuit used in the RCA "transistor-six" pocket-sized set (model 7-BT-9J, chassis RC-1159), which illustrates the use of three n-p-n type transistors for the r-f--i-f section and a crystal diode detector followed by an audio driver and a push pull output stage, accounting for the other three (of the p-n-p type) transistors; the provision for plugging-in a low-impedance earphone is also shown. A five-transistor complement is shown in Fig. 3 by the General Electric pocket-size set (model 675-6), which employs four p-n-p transistors for the oscillator-mixer. 1st i-f, 2nd i-f and single-ended audio output stages, while the fifth transistor for detector stage is of the n-p-n type.

A typical rectangular shaped portable is Raytheon 500 model.

This larger CBS 260 chassis is used in a transistor "home" radio which features 6"x9" oval speaker. The model 260 becomes a chair-side unit when set on its metal stand—no a-c cord, of course.

Solving logical problems with Burroughs pulse control systems

Converting Gray code to binary equivalents

Here is a simple method for converting Gray code to true binary equivalents. It was put into operation in minutes just by interconnecting Burroughs Pulse Control Units in accordance with the engineer's block diagram, without detailed specifications or complicated circuit designs. With pulse control equipment at his disposal, the engineer was able to turn immediately to other important problems awaiting his attention.

The majority of engineers solving logical problems are badly in need of such tools. Most are bogged down by equipment of limited use that must be redesigned and rebuilt for every new project... that clutters the path to a working solution instead of clearing and shortening it.

The smallest discrete units with which such a man can work are logical concepts... the basic logical operations. The ideal tools for him are these same operations, packaged for convenient and immediate use by simple interconnections—like the blocks in his block diagram. Such tools are Burroughs Pulse Control Units, which bring block diagrams to life in a matter of hours rather than weeks. Wherever logical problems are being solved with pulses they have earned the title "Tools For Engineers" by eliminating intermediate steps to a proof, obsoleting the frustrations and complexities of breadboarding.

Why not lift the burden of proof from your shoulders by passing pulse problems on to us? We'll gladly show you how Burroughs Pulse Control Units can bring your logical problems closer to a neat working solution... at no cost. Or, write for Bulletin 236.
D-C Power Supply
Dual Magnetically Regulated

Designated the Stablvolt Model MR 532-15, the unit is short circuit-proof, has excellent static and dynamic regulation and provides line transient-free d-c power.

Offering an output range of 3-36v at 15amp, the instrument features static regulation of ±0.25%, ripple less than 50mv for the entire voltage range, dynamic regulation of less than 1% for a 10% line transient and less than 1.5v for a 10% load transient. Response time is less than 25millisecc for line transients and 150millisecc max for load transients.

Voltage adjustment is accomplished by means of a pot. No tubes or variacs are incorporated in the unit. When short circuited, line current is automatically limited, protecting power supply from internal damage.

Magnetic Research Corp., Dept. ED, El Segundo, Calif.

CIRCLE 44 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Divider
Has Zero Insertion Loss

The new power divider, Model PD-90, splits microwave power without losses. It has zero insertion loss; the division of power is accomplished by means of matched transformers rather than by dissipative networks. The power at each output is exactly half of that at the input (i.e. 3db) with a balance between outputs of 40db or better. Model PD-90 has type "N" female connectors at each arm. Five models cover the entire frequency range from 800Mc to 10,000Mc.

Empire Devices Products Corp., Dept. ED, 55-15 Bell Blvd., Bayside, N. Y.

CIRCLE 45 ON READER-SERVICE CARD FOR MORE INFORMATION

Medium Power Transistors
Up to 300mw Audio Output

Types 2N223, 2N226, 2N224, are specifically designed for the audio stages of transistorized radios. In driver and Class B push-pull operation, these new, hermetically sealed, p-n-p transistors provide up to 300mw audio output at battery supply voltages of 3 to 12v. Extremely linear d-c current amplification up to 100ma of collector current assures minimum distortion. Output transistors 2N226 and 2N224 can be made available in matched pairs.


CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION

High Voltage Leakage Tester
Audibly Signals Defects

Used for the high voltage a-c breakdown testing of equipment when a maximum leakage current is specified. The Model 103 cancels current due to the electrostatic capacity of the tested article and checks insulation leakage only.

Adjustable, the unit will cancel up to 0.005ufd capacity and has external binding posts for adding greater correction on the job. The leakage limit can be set between 0 and 5ma.

High leakage and grounds are signalled by a buzzer, and arcing above 20amp by a speaker. Test voltages from 400 to 2100v a-c are provided by the unit, which has a momentary contact on-off switch, pilot light, voltmeter, and milliammeter.

Slaughter Co., Dept. ED, Young & College Sts., Piqua, Ohio.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

Ohmmeter

Measures Up To 5000 Million Megohms

This new Tera-Ohmmeter is designed for making resistance measurements up to 5000 million megohms (5000 tera-ohms). Designated Type FT-H4, it is similar in most respects to the well-known Type FT-H except that it has 10 times the sensitivity. The FT-H4 includes a test voltage which is continuously variable from 100 to 1000v.

The instrument is of particular value in such applications as the development of special insulating materials or wherever it is desired to measure extremely wide ranges (20 meegohms to 5000 million megohms) of resistance.

Specifications are: range—20 meegohms to 5000 million megohms in 6 ranges; test voltage—continuously adjustable from 100 to 1000v d-c; accuracy±3% in scale center; test samples—grounded, ungrounded, or with guard ring electrodes.

Instrument Div., Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Bd., Clifton, N.J.

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

Delay Line
Taps Every 1.45usec

This is a new lump constant delay line specifically developed for tele-metering, digital or analog computers, pulse circuits, coders and decoders.

Characteristics include: 20.30usec with end delays; taps every 1.45usec; tap accuracy ± 0.1usec; rise time better than 0.7usec; low attenuation, less than 4db overall; operating temperature range from -55° to 155°F; characteristic impedance 180 ohms for standard unit.


CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION
Electrical Connectors
In 5 Assembly Styles

This is a new series of waterproof, shock-resistant electrical connectors with five assembly styles. The series, designated QWL, is being used with multi-conductor cable on ground-launching equipment for missiles and ground radar units. A complete line of accessories, including cable assembly with Kellem's grip, and protection cap rings, provides adaptability of the series to any heavy-duty applications.

The various assembly styles provide either pin or socket contacts in receptacle or plug. Provisions also have been made for alternate positions, thermocouple contacts, and coaxial circuit contacts. Among the assembly styles are: wall-mounting receptacle (QWL3100); cable-connecting receptacle (QWL3101); box-mounting receptacle (QWL3102); straight plug (QWL3106); a flange-mounting plug (FLMTPLUG); and two types of jam nut receptacles.

Three styles of cable accessory clamps are available to accommodate various cable sizes. A straight style is designed for a cable with diameter near the size of the connector; step-down style is for conduit that is smaller than the diameter of the connector; and step-up style is for a large cable with smaller connectors.

Scintilla Div., Bendix Aviation Corp., Dept. ED, Sidney, N. Y.

CIRCLE 50 ON READER-SERVICE CARD

Subminiature Teflon Lead Wire
For Slip-Ring Assemblies

This miniature Teflon insulated solid wire designated "DQT," is available in sizes from 34 AWG to 20 AWG, in eight solid colors. Because of its reduced diameter, "DQT" is an excellent lead for slip-ring assemblies. The Teflon insulation is not affected by the high molding temperatures encountered during the fabrication of the slip-ring assembly.

Hitemp Wires, Inc., Dept. ED, Mineola, N. Y.

CIRCLE 51 ON READER-SERVICE CARD

A Giant in Performance...Sub-Miniature in Size

JFD PISTON CAPACITORS
FOR AUTOMATION AND PRINTED CIRCUIT APPLICATIONS

Over 1 year in development, it's here at last! The new precision sub-miniature JFD Variable Trimmer Piston Capacitor, designed expressly for use in automation and printed circuitry.

Features: Stability, approximately Zero temperature coefficient...End stops at either end of adjustment...working temperature — 55° to +125°C....Anti-backlash and thread wear compensation.

These new JFD Capacitors are available in 2 models to meet your most exacting network applications:

<table>
<thead>
<tr>
<th>MODEL</th>
<th>OVERALL LENGTH</th>
<th>CAPACITANCE</th>
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<tbody>
<tr>
<td>VC9G</td>
<td>9/16&quot;</td>
<td>0.5 MMF. TO 8.5 MMF.</td>
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<tr>
<td>VC10G</td>
<td>5/16&quot;</td>
<td>1 MMF. TO 4.5 MMF.</td>
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Both units feature glass dielectric and invar silver-plated rotors. Write today for Bulletin No. 106 which gives you complete electrical characteristics.

Whether you specify these new Piston Capacitors or any of the many other JFD units for your critical tuning requirements, you upgrade efficiency and stability of performance. A letter will bring you complete details. Write today.
HIGH CAPACITY
in very small size!

NEW Acro Subminiature Snap-Switch

• HIGH ELECTRICAL RATING—10 Amps at 115 volts or 230 volts A.C. or 28 volts D.C.
• EXTREME TEMPERATURE RANGE—from $+350^\circ\text{F}$ to $-100^\circ\text{F}$
• LONG MECHANICAL LIFE—many millions of cycles, continuous duty
• DOUBLE CIRCUIT TERMINAL ARRANGEMENT

The big feature about this little switch is its high rating. It has *four times* the capacity of most switches in this size. And temperature extremes pose no problem. The Acro subminiature switch will operate within a range of from $+350^\circ\text{F}$ to $-100^\circ\text{F}$. Long life is assured through use of the rugged Acro rolling spring principle, up to 10 million cycles continuous duty.

High rated Acro subminiature switches are your answer to the problem of controlling big loads in confined areas. And on lesser loads their excess current-carrying capacity is a good safety factor. Four terminal construction permits wiring double circuits where required. The entire unit is housed in a plastic case and can be adapted to any present type actuator. Write for literature.

ACRO
MANUFACTURING COMPANY

SWITCH DIVISION
Columbus 16, Ohio
Plants at Columbus and Hillsboro
REPRESENTATIVES IN PRINCIPAL CITIES
CIRCLE 54 ON READER-SERVICE CARD FOR MORE INFORMATION
Batteries
Use New Grid Alloys

New grid alloys and other product improvements have been introduced in this line of batteries for stationary power applications. They are expected to extend service life up to 10% and reduce maintenance requirements.

The improvements have been made in the flat-plate battery line intended specifically for uses in the electric utility field, signaling, telephone service, emergency lighting and other industrial operations. The line for the first time includes Silvium positive grids. Silvium, an alloy of lead, silver and other metals, has superior ability to resist corrosion and withstand overcharging.

In addition to the wide application in float services, the improved Exide-Tytex battery also is well adapted to cycle services. The enlarged reservoir at the bottom of the jar provides ample sediment space for even the most severe cycle applications.

Exide Industrial Div., The Electric Storage Battery Co., Dept. ED, Box 8109, Philadelphia 1, Pa.

CIRCLE 55 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Waveguide Horns
From 8.2 Through 75.0kMc

This is a complete series of precision standard horns for use in antenna design and measurement in the range from 8.2 through 75.0kMc.

Nominal gain of the RG-52/U X-band model MA-647 is 15db. In the 50.0-75.0 kMc millimeter range, gain of standard horn model MA-627 is 25db.

The horns are fabricated from brass sheet stock which is silver-plated. External finish is blue-gray baked enamel. Maximum VSWR over a specified waveguide size is 1.10.


CIRCLE 56 ON READER-SERVICE CARD FOR MORE INFORMATION
**New, useful data**

This new, 8-page, Barry Product Bulletin tells you all about the mounts whose outstanding performance has won their acceptance as a standard for U. S. Navy applications.

**In Combat Service**

Barry Cup-Mounts protect sensitive electronic and electrical equipment and machinery from the high-impact shocks of naval combat service. Vehicular equipment on Barry Cup-Mounts is protected from the impact of gunfire recoil, projectile shock and impact, and travel over rough terrain. These mounts are particularly designed for equipment that must meet MIL-T-17113.

**In Industrial Service**

Barry Cup-Mounts are widely used to protect vehicular and railway electronic and electrical equipment. As shipping-and-service isolators built into the equipment, they give the advantages of simplicity and economy.

**Free Bulletin**

Barry Product Bulletin #56-02 gives you detailed data on the characteristics and use of Cup-Mounts. Write today for your free copy.

Barry's New Western Division in Burbank, California will offer engineering, prototype, and short-run "specials" production.

---

**Delay Lines**

**In Matched Multiple Units**

This is a new series of very long delay lines in matched multiple units. The assembly shown comprises three 20Mc, 2780µsec lines matched within 0.25µsec of one another. Spurious responses are 45db or more below the main delayed signal.

These lines can be supplied in dual or triple assembly, with or without temperature control. At the present time, matching of delays can be specified as close as 0.25µsec.

Andersen Laboratories, Dept. ED, W. Hartford, Conn.

**Electronic Switch**

**Samples Up To 10 Signal Sources**

The Beamplexer, a fast electronic switch used to sample up to 10 separate signal sources and put them out in sequence on a single line, has been thoroughly re-designed to meet testing requirements found in the field.

One of the most important applications of the new Beamplexer is as an accessory to the conventional single channel oscilloscope. It provides the user with the advantages of multi-channel oscillography at a fraction of the cost of a multi-channel scope.

Individual position and amplitude controls for each of the 10 input channels allow vertical positioning of all the signals on the face of the oscilloscope so that they may be superimposed or placed in any desired relationship.

Each of the Beamplexer's input channels is a-c coupled to an individual triode amplifier which has gain control and a pedestal level control in its grid circuit. The cathode of each of the triode amplifiers is connected to a corresponding target of a beam switching tube. As the beam steps through its 10 positions, at adjustable speeds ranging from push-button to 100kc, current is supplied to the tube connected to the particular target on which the beam is formed. In this way only one tube at a time is allowed to conduct through the output circuit.

Burroughs Corp., Dept. ED, Detroit, Mich.
Are You an Engineer
Who is lost in the Mob?

Has a year or two of your present job made it obvious that you're just one of the mob and the odds on your being seen—let alone given some challenging assignment—are pretty sad?

We're offering challenging careers—not jobs—that can be just as exciting and rewarding as your initiative makes them . . . Career opportunities in circuitry, applications, development, equipment design, electron tube and transistor development and production.

Submit resume or address request for personal interview to D. Bellat, Personnel Director, Tung-Sol Electric Inc., 200 Bloomfield Avenue, Bloomfield, N. J.
TEFLON-INSULATED WIRE

PERMACODE is a Teflon-insulated hook-up wire with striping that goes right down to the conductor... with colors that won't rub off... that heat won't change... that are good for the life of the wire. Coding is available in a wide variety of combinations of twin, triple or quadruple stripes selected from fifteen basic solid colors. Insulation quality unaffected by striping process.

Revere PERMACODE — with tough extruded Teflon insulation — offers excellent abrasion resistance and high dielectric characteristics for continuous operation from —90°C to +210°C. Strips clean. Doesn’t shrink when soldered. Isn’t hurt by the slip of a hot soldering iron.

PERMACODE hook-up wire is available with either solid or stranded silverplated copper conductors. Shielding and jacketing can be furnished. Sizes 28 to 16 gauge in 0.010" wall (600 volt) and 0.015" wall (1,000 volt) thicknesses. Conforms to MIL-W-16878, Types E and EE.

TYPICAL SPECIFICATIONS — 22 Gauge Permacode Wire

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Spark Test Voltage</td>
<td>3000 volts</td>
<td></td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>Greater than 10⁴ megohms/1000 ft.</td>
<td></td>
</tr>
<tr>
<td>Continuous Operating Range</td>
<td>—90°C to +210°C</td>
<td></td>
</tr>
<tr>
<td>Flammability</td>
<td>Does not support combustion</td>
<td></td>
</tr>
<tr>
<td>Operating Voltage</td>
<td></td>
<td>600 or 1000 volts</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td></td>
<td>2000-3000 PSI</td>
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<tr>
<td>Shrinkage</td>
<td></td>
<td>Less than 1/4&quot; in 18&quot; at 250°C</td>
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<tr>
<td>Abrasion (Per MIL-T-5438)</td>
<td></td>
<td>Passes 30&quot; of 400 grit, aluminum</td>
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<td></td>
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<tr>
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<td>0.0%</td>
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<tr>
<td>Specific Gravity</td>
<td></td>
<td>2.2 average</td>
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<tr>
<td>Chemical and Solvent Resistance</td>
<td></td>
<td>Excellent</td>
</tr>
</tbody>
</table>

Write today for Engineering Bulletin No. 1901 describing Revere PERMACODE wires.
Channel Termination Unit
Carried From Station to Station

The new Model SC-1 service channel termination unit is designed to provide full talking and signaling facilities on the baseband of the company's CLR-6 or CLR-7 microwave terminal and repeater equipments.

The 2 lb unit may be carried from station to station by service personnel, thus assuring continuous contact with the system control point. The unit plugs directly into the front panel jacks of the CLR equipment and provides a means of monitoring and inserting voice frequencies into the baseband of the system at a response of 200 to 2000cy. It may also be operated over a standard derived telephone channel.

The unit includes an a-c power cord which connects directly to the utility outlet on the CLR-6 or CLR-7 rack. Three type L-5021 transistors and a miniature loudspeaker are used for transmission and reception. Front panel switches are provided for "transmit-receive" selection and for outbound signaling, accomplished by a built-in audio tone oscillator.

Philco Corp., Dept. ED, Govt. & Industrial Div.
CIRCLE 63 ON READER-SERVICE CARD FOR MORE INFORMATION

Test Jack Eyelets
For Fast Assembly

This is a new, insulated miniature test jack with an integral molded eyelet for fast, secure mounting. Known as the "Stak-in" Mini-Test Jack No. 110BCI, it was designed specifically to provide points of check for circuitry on equipment front panel, chassis, or other accessible check points.

To insure positive contact and long life over thousands of insertions, the jack incorporates a 360° wrap-around beryllium copper clip, silver plated for 60 hours salt spray. To speed soldering, the terminal end is hot-tin dipped, and a large wire hole is provided. Contact insulation is nylon rated for 3.5kV d-c with the jack mounted on metal panel, test prod inserted. Ambient temperature range is from -30°C to 105°C. The integrally molded eyelet is cadmium plated, brass.

Alden Products Co., Dept. ED, Brockton, Mass.
CIRCLE 64 ON READER-SERVICE CARD FOR MORE INFORMATION
Solder
Activated Rosin-Flux

A highly activated rosin-flux that will remove tough surface oxides from most common metals, and is both non-corrosive and non-conductive, is contained in the new purified metal solder.

Designed for soldering applications where chemical surface cleaning is normally difficult, the flux spreads fast to remove oxides and inhibit re-oxidation prior to solder flow. These qualities assure production line soldering of copper, brass, nickel-plate, cadmium-plate, German silver and other metals that previously required a corrosive acid flux.

The activated flux does not throw off objectionable odors or fumes, nor will it boil away or char under excessive heat. Residues can be left on the joints without damage, but can also be easily removed if desired.

The bright, porous-free joints have withstood prolonged humidity-temperature tests at 98°F and 95% relative humidity for 72 consecutive hours under rigid test conditions without any sign of joint breakdown, corrosion or changes in original solder properties.

Anchor Metal Co., Dept. ED, 244 Boerum St., Brooklyn 6, N. Y.
CIRCLE 66 ON READER-SERVICE CARD

Aluminum Foil Wire Markers Are Self-Sticking

This new self-sticking aluminum foil metal wire marker features high resistance to oils and solvents. It is only 3 mils thin, conforms to wires without bulking, and withstands constant operating temperatures up to 375°F.

The legend is imbedded in full soft aluminum for lasting, positive wire identification. The markers can't curl or slip off oily wires and temperature does not discolor it.

Furnished on handy Blue Streak dispenser cards for quick application, the markers are coated with a silicone plastic overcoating to protect against abrasion—shed grease, water, dirt.

W. H. Brady Co., Dept. ED, 727 W. Glendale Ave., Milwaukee 9, Wis.
CIRCLE 67 ON READER-SERVICE CARD

CIRCLE 68 ON READER-SERVICE CARD

Mechanical properties and high dielectric strength of TEFLO® unaffected by extremes of temperature

Electrical properties of TEFLO® constant over tested range of 60 cycles to 10⁸ cycles

The unique combination of properties of TEFLO offer many advantages to the electronics industry, permitting improved design and providing unexcelled performance. TEFLO is capable of continuous service at 260°C, exceeding the requirements of Class H materials.

The power factor of TEFLO is less than 0.0003 over the measured spectrum (60 cycles to 10⁸ cycles), and its dielectric constant is 2.0 over the same range. Following prolonged soaking in water, the volume resistivity of TEFLO is greater than 10¹⁵ ohm-cm., and water absorption (ASTM D570-42) is only 0.005%. TEFLO has good arc resistance and its short-time dielectric strengths are high, ranging from 1,000 to 2,000 volts per mil depending upon thickness.

SEND FOR MORE INFORMATION

For complete details that will help you further evaluate Du Pont TEFLO for use in your product-development programs, mail the coupon at the right.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department Room 417 Du Pont Building, Wilmington 98, Delaware.
In Canada: Du Pont Company of Canada Limited, P.O. Box 660, Montreal, Quebec

Please send me complete property and application data on DuPont TEFLO. I am interested in evaluating this material for

Name

Firm Name

Position

Type of Business

Street Address

City State
HOW THE VARIABLE DENSITY FILTER WORKS—New Polaroid variable density filter enables radarscope operator to control brightness without re-focusing. When control knob is at "9 o'clock" (upper left), image is at full brightness. At "6 o'clock" (lower right), image is virtually blacked out.

NEW POLAROID® radar filter...

MECHANICALLY CONTROLS BRIGHTNESS . . . KILLS REFLECTIONS

The new Polaroid CP* Variable Density Filter for radar (and all instruments using cathode ray tubes) improves readability two important ways. First, it enables the operator to control brightness mechanically — without re-focusing. Second, it swallows up reflections and provides a glare-free, easy-to-read image regardless of surrounding light.

Polaroid has developed a whole new family of polarizing filters like this one, designed to solve many of the engineer's most stubborn visibility problems. Wherever your scope design calls for filters . . . to eliminate reflections, increase contrast, even change the color of the image . . . or for any combination of these effects, we'd like to show you how Polaroid Filters can help.

Write or phone John Mulhall, Cambridge (UNiversity 4-6000) for more information.

*Ask for this new folder describing Polaroid CP (Circularly Polarizing) variable density and variable color filters.

POLAROID CORPORATION
Cambridge 39, Massachusetts

CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION
Tachometer
Features a Plug-In Assembly

Model ETC features a package type plug-in assembly that permits the replacement of any or all of 9 separate electronic components in only a few minutes. Since the tachometer's circuitry permits self-checking for correct operation and accuracy, it is merely necessary to replace individual packaged components until the unit is again in operation.

This feature alone makes Model ETC valuable for two reasons. First, when the equipment is in daily use, its down time due to failure is held to a minimum. And, second, the services of a skilled electronics engineer are not necessary to service the unit.

In operation, Model ETC counts rpm, rate, or frequency by counting electrical pulses for an accurately timed interval. The count is displayed directly on glow counter tubes and is accurate to ±1 count. To count rpm, a 60 tooth gear on the transducer or generator is used. Model ETC reports pulses from 10 to 50,000/sec.

The unit can be operated from any photoelectric, magnetic, electrical or electromechanical means that produces pulses of from 0.2v to 115v.


CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

Distortion Meter
Measures From 1 To 100 Mc

The Model 85B has been modified to permit its use either as a distortion meter or as a sensitive broadband r-f voltmeter. The unit is capable of measuring total distortion of an r-f source from 1 to 100 Mc.

Used with a 50-ohm or a high-impedance probe, the voltmeter section has a range of 0.001 to 3v from 0.2 to 400 Mc. As an ultrasensitive wattmeter, the device gives readings down to 0.02µw.

Boonton Electronics Corp., Dept. ED, 738 Speedwell Ave., Morris Plains, N. J.

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

SOUND ADVICE!
New Isophon ELECTROSTATIC TWEETERS

Easily included in your present circuits!
★ Better performance in higher frequencies (7000-20000 cycles)
★ Compact, space-saving
★ Substantially lower cost
★ Remarkable brilliancy of sound

Write for details and spec. sheet D-7

Arnhold ARNOLD CERAMICS, INC.

CIRCLE 73 ON READER-SERVICE CARD
Rotary Actuators
Ultimate Static Load 600 Lb

This is a new 1 lb linear actuator designated R-5140 series. The unit includes radio noise filter, limit switches externally adjustable throughout entire stroke range, positive stops, optional thermal protection, and anti-rotation device.

Speed at max oper load of 150 lb is 12 in/min. Ultimate static load is 600 lb. The unit measures 2-5/8” x 1-3/16” x 4.0” (plus stroke length up to 8” and overtravel).

Airborne Accessories Corp., Dept. ED, 1414 Chestnut Ave., Hillside 5, N. J.

PORTABLE TRANSPORTS

Two new transports have been developed for accurate magnetic tape data recording under adverse environmental conditions. Each serves as a complete mobile tape recording system with provisions for up to 26 or more data channels, depending on system characteristics.

The Model 541 transport is particularly useful where large quantities of data are to be recorded at one time. Its 10-1/2” reels carry 2400 feet of 1-1/2-mil base tape, 3600 feet of 1-mil base tape. For moderate recording times, the Model 581 is the more desirable. Equipped with 7-1/4” reels, it carries 1200 feet of 1-1/2-mil base tape, 1800 feet of 1-mil base tape.

While standard models of the two transports require only d-c power for operation, a 400cy capstan motor can be supplied. Any single capstan speed from 30 to 1/2ips is available, and interchangeable capstan assemblies permit operation at more than one speed.

The new transport can be successfully operated at temperatures from -55 to +55 C, up to 95% humidity, and under conditions of extreme vibration and shock.

Davies Labs., Inc., Dept. ED, 4705 Queensbury Rd., Riverdale, Md.
variable "L" by BURNELL

ADJUSTOROIDS®

The Adjustoroid, a low cost adjustable toroid, exclusively developed by Burnell & Company, Inc., contains an actual complete toroid with all the excellent characteristics of the non-adjustable types. Adjustment is obtained by a completely stepless function with magnetic biasing.

The nominal inductance value for an Adjustoroid is the maximum value, and the inductance range is the nominal value minus approximately 10%.

Hermetically sealed to meet Government MIL specifications, many types of networks in tuned circuits are being produced which employ the Adjustoroid in completely hermetically sealed packages.

Intermediate inductance values as well as special taps and extra windings available on special order with minimum delay.

For additional technical data on Adjustoroids, refer to equivalent toroid in catalog.

Airborne Power Supply
Efficient Up to 60,000 Ft

This new dual-magnetic-regulated airborne power source features efficient performance at altitudes up to 60,000 feet, improved output adjustment and versatile mounting.

The unit, designated the Stabvolt MRP-5-15, provides a transient-free 5v d-c source for missile and aircraft instrumentation. High-altitude efficiency is accomplished through use of a 2906-55 Cannon connector, which permits the MRP-5-15 to carry 115v a-c at 60,000 feet. A 25-turn Burns Trimpot provides 0.5v output adjustment. Spot-welded mounting flanges permit mounting in any position, and allow for the severe shock and vibration encountered in missile applications.

Magnetic flux oscillator circuitry effectively isolates line voltage transients from the output and regulates d-c to 0.1% accuracy. Current capacity is 1 amp. The unit is short-circuit proof, has no tubes and requires no batteries or fusing. It is hermetically sealed with all components cast in thermostat plastic, and meets MIL-T-27 and MIL-E-5272-A specifications. High-temperature silicon diodes assure stable operation at 100°C.

Magnetic Research Corp., Dept. ED, El Segundo, Calif.

CIRCLE 79 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Counter
Measures Frequency, Period and Time

This is a new multipurpose electronic counter measuring frequency 10cy to 1.1 Mc, period 0.00001cy to 10kc, and time interval 3μsec to 27.8 hours.

The counter, Model 522B, presents direct reading results in seconds, milliseconds, microseconds, or kiloseconds. Accuracy of frequency measurement is ±1 count ± crystal stability of 2ppm/week.

A special pulse output permits Z-axis modulation of an oscilloscope to visually observe time interval start and stop on an input waveform, shown in the figure as bright spots on the input signal.


CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION
Optical Filters
For Radarscopes

This new light-filter kills reflections on a radarscope, or any cathode-ray tube instrument. The filter traps between 98 and 99% of all reflections from surrounding windows and lights. By removing these reflections, which tend to wash out the display, it makes the image sharp and easy to read. It eliminates the need for bulky hoods or other light-shielding.

The filter gets its “one-way” properties through circular-polarization of the light striking it from outside sources. Lightweight and sturdy, it can be laminated in either glass or plastic, for easy mounting on any size scope.


CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION

Communications Antenna
Withstands Adverse Weather Conditions

This new series of communications-type antennas is designed to withstand the most adverse weather conditions while providing maximum gain.

Series SY-41 antennas are yagis with screen reflectors designed to operate in the region of 132 to 174Mc and 160 to 174Mc.

The antenna is a 4-element yagi with a folded-dipole driven element. With the addition of the screen reflector, the antenna shows a gain of 15.7db over an isotropic source. VSWR is under 1.25 for a single bay. Models are available with either a single or double antenna mounted on the single screen reflector.

An unusual mounting technique is employed whereby the antenna may be mounted on the side of the supporting tower, permitting orientation in any direction. The Series SY-41 may be polarized either vertically or horizontally thus permitting greater isolation between two antennas mounted adjacent to each other.

The all-aluminum antenna is completely welded in a single, rugged assembly. The completed assembly, including the screen reflector, is designed to withstand wind loads up to 250mph, and 175mph with an ice load of 1/2”.

Technical Appliance Corp., Dept. ED., Sherburne, N. Y.

CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION

El-Menco DUR-MICA Capacitors will match your equipment’s life expectancy to at least 15 years!

A recent series of the toughest trials has proved El-Menco DM15, DM20 and DM30 Dur-Mica Capacitors outlast all others. Accelerated conditions of 1 1/2 times rated voltage at ambient temperature of 125° centigrade found El-Menco capacitors still going strong after 10,000 hours. Similar conditions obtaining under normal usage would equal a lifetime of over 15 years.

Tougher phenolic casing means longer life, greater stability, over wide temperature range.

Meet all humidity, temperature, and electrical requirements of both civilian and MIL-C-5 specs.

Parallel leads simplify use in television, electronic brains, miniature printed circuits, computers, guided missiles, and other civilian and military applications.

El-Menco Dur-Mica DM15, DM20, and DM30 Capacitors Assure:

1. LONGER LIFE
2. POTENT POWER
3. SMALLER SIZE
4. EXCELLENT STABILITY-SILVERED MICA
5. PEAK PERFORMANCE

Tell us your specific needs. Write for FREE samples and catalog on your firm’s letterhead.

El-Menco

THE ELECTRO-MOTIVE MFG. CO., INC.
WILLIMANTIC, CONNECTICUT

• molded mica • mica trimmer • tubular paper • ceramic
ARCO ELECTRONICS, INC. 64 WHITE ST., NEW YORK, N. Y.

Exclusive Supplier to Jobbers and Distributors in United States and Canada.

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION
MILLIAMPERES

colors

Now!...Phaoston custom panel meters are available in colors at no additional cost

Time-tested and proven movements, anti-magnetic shielding, insulated zero adjustments and fine accuracy are familiar features of Phaoston Custom Panel Meters...now, something new has been added...

COLOR-CUSTOMIZED PANELS
Handsome harmonizing colors that will give a touch of distinction to your equipment. Send us a color swatch and we will make Phaoston color-customized panels to match...and at no extra cost!

Phaoston Custom Panel Meters, nine types in 77 Standard Ranges are available at your Parts Distributor. For special requirements, write to the Product Development Department for practical recommendations.

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION
Shaft Position Encoder
Has Low Inertia

This is a new low inertia shaft position encoder designed specifically for use in high speed servo systems. The encoder utilizes a method of construction that results in lowering the inertia reflected into the servo driving system from 423 gm. \( \cdot \text{cm}^2 \) to 235 gm. \( \cdot \text{cm}^2 \).

These encoders are especially suitable for servo system applications, in that they provide an angular resolution of 0.3° or better (1000 counts in 360° or less), and can be mounted directly on the servo shaft. Thus, the encoder operates at relatively low speeds, and provides long life with reliable operation.

Since no gearing is required, a relatively low inertia load is reflected into the driving system (inertia is reflected as the square of the gear ratio). Thus, inertia effects are reduced permitting higher servo operating speeds.

Datex Div., G. M. Giannini & Co., Inc., Dept. ED, 919 E. Green St., Pasadena 1, Calif.

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION

Shield Insert Liners
Provide Excellent Cooling

A berillium copper spring finger liner material is available in sizes to fit all miniature JAN type shields. The individual finger liner insert, through spring properties in the closely-spaced finger points, overcomes the shortcomings of the corrugated types of liners. The fingers of this insert liner can be depressed 0.100" without deforming, which is equal to three times the amount of spring movement required when in use on the tube.

The new liner affords substantial bulb temperature reductions of up to 30% as compared to the regular JAN shield when tested on a heat slug as described in MIL-S-9372C.


CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

CHICAGO MAGNETIC
solves problems in

creative engineering

such as this*

Paired Filters

Matched
to tolerances of 0.1% through a temperature cycle of \(-67^\circ \text{F.}\) to \(+190^\circ \text{F.}\).

*designed and manufactured for a specific application in aircraft glidepath equipment.

CHICAGO MAGNETIC
CONTROL
1616 NORTH DAMEN AVENUE
CHICAGO 47, ILLINOIS

CIRCLE 87 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 15, 1956
Rate Gyro
Output Independent of Line Voltage

The motor of this unit is d-c powered and governor controlled so that the output is independent of line voltage. The size is 2-3/8" diam by 4-7/16" long and the weight is 1.7 lb. The case is designed to provide hermetic sealing.

Standard units incorporate a potentiometer pickoff and adjustable switches which can be set to close at any desired rate within the range of the unit. The standard unit also incorporates a dashpot for damping, and the natural frequency of the gyro is in the range of 5-10cy. The gyro is well suited for rate stabilization, position control, telemetery, and rate switching.


CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors
Have Low Inductance

This is a new line of low inductance capacitors designed for applications requiring high peak energy within a short time constant. They can be used for such applications as a precision light source for nuclear research, energy sources for linear accelerators, or as pulsed r-f tank circuit capacitors.

The very low inductance of these capacitors is achieved through a design which reduces magnetic flux to a minimum. The result is a unit of not only high voltage and high capacitance but also high ringing frequency.

They are hermetically-sealed in a heavy-gauge welded steel case. Insulating creepage distance is provided by an insulating cover, which provides terminal access and keeps size to a minimum.

Electrodes are made of dead-soft, dry annealed aluminum foil, held to the closest tolerances. Stock ratings are available from 500 joules @ 25v with 0.025 μh inductance to 8000 joules @ 125kv with 0.065 μh inductance.

Axel Electronics Div., Axel Bros., Dept ED, 134-20 Jamaica Ave., Jamaica 18, N.Y.

CIRCLE 91 ON READER-SERVICE CARD FOR MORE INFORMATION

BULLETIN MFT-1 contains complete specifications on the foregoing pressure transducer models. All matters pertaining to sale or use of instruments of our manufacture are handled by engineering personnel directly from our Los Angeles plant.

Please feel free to wire or telephone us collect whenever we may be of service.

Statham LABORATORIES
12461 W. Olympic Blvd., Los Angeles 64, Cali

CIRCLE 89 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 15, 1956
Eimac preformed finger stock is the inexpensive, efficient answer to many circuit and equipment design problems.

Used for efficient electrical contact in high-frequency tuning devices, in coaxial tube sockets, for electronic weather stripping around access doors in equipment, and for dozens of other purposes, resilient silver-plated EIMAC finger-stock is outstanding.

EIMAC finger stock is accurately heat-treated to maintain uniform mechanical properties, can be fitted around a ½-inch radius, and may be fastened by screws, rivets, clamps or soft soldering.

A size for every need —

<table>
<thead>
<tr>
<th>Single Edge Width</th>
<th>Double Edge Width</th>
<th>Klystron Types</th>
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<td>CF-100 1 1/2</td>
<td>CF-200 1 3/4</td>
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<tr>
<td>CF-300 1 1/2</td>
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</tr>
<tr>
<td>CF-500 1 1/2</td>
<td>CF-600 2 1/4</td>
<td></td>
</tr>
</tbody>
</table>

For further information write our Application Engineering Department.
S-T-A 100 Series rated 35 volts, 1 mfd to 2 volts; 17 mfd
S-T-A 200 Series rated 35 volts, 5 mfd to 2 volts; 45 mfd
S-T-A 300 Series rated 35 volts, 20 mfd to 2 volts; 250 mfd

For further information, write for Bulletin 614D or contact the Fansteel office nearest you.
80kw Power Supply
Up to 20kv D-C Output

Designed for powering the pulse modulator section of high voltage pulse test stations, this mobile, completely self-contained power supply delivers up to 20kv d-c output at 4amp, with less than 1% ripple. The equipment operates from a 208v, 3-phase, 60cy input source and provides a continuously variable output from zero to maximum rating that is regulated to within 1.5% from no load to full load conditions.

Some advanced features of this equipment include: overload and overvoltage circuits which remove the output power when either the current or voltage exceeds pre-selected values; an automatic shorting circuit to discharge HV to ground after the set is de-energized; and automatic re-cycling of output voltage to zero on overload. In addition, remote control operation of all switch functions is possible.

Manson Laboratories, Dept. ED, 207 Greenwich Ave., Stamford, Conn.

CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION

Insulation Block
Has Improved Strength

This is a new high heat-resistant, lightweight, bonded Fiberfrax ceramic fiber block designed for high temperature insulation. Resistant to temperatures up to 2300°F and chemically inert, the F-20 Fiberfrax blocks withstand flame impingement and are unaffected by furnace atmospheres.

The block has an approximate density of 20 lb/cu ft, which is about 7 lb more than the original F-13 block. Thermal conductivity is 1.27 BTU/hr, sq ft and °F/in of thickness at a mean temperature of 1000°F; at 2000°F it is 2.24.

Standard size are 12" x 12", 18" x 12", 18" x 6", 36" x 6" and 36" x 12", in thicknesses ranging from 1-1/2" to 4" in 1/2" increments.

The Carborundum Co., Dept. ED, Niagara Falls, N. Y.

CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION
Low-Frequency Oscilloscope
Has 2 Identical Amplifiers

The new 1-t oscilloscope Model 130A has nearly identical horizontal and vertical amplifiers. The amplifiers provide a max sensitivity of 1mv/cm or 10mv full scale deflection with pass hands from d-c to 300kc, and can accept balanced inputs on the five most sensitive ranges.

The Model 130A sweep circuit employs a linear Miller-integrator triggered sweep producing an accurate calibrated sweep, from 1usec/cm to 15sec/cm.

Etched circuitry is used extensively to stabilize capacities, sectionalize circuitry, and increase operating dependability. The mono-accelerator cathode ray tube replaces through the front panel by removing a twist-off bezel which also locks in place to support conventional camera equipment.


CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Attenuators
Parallel Vane Type

Seven new calibrated variable attenuators, Models 701, 702, 749, 751, 752, 753, and 754 comprise an uninterrupted series for the frequency range of 2600 to 18,000Mc. These attenuators are all of the parallel vane type with dissipative element of pyrex glass vane and an evaporated nichrome film. The precise lead screw is driven by duo-dial to provide convenient, accurate measurement of the displacement of the dissipative element. Calibration is accurate to 0.3db, precise, permanent, and not affected by humidity or temperature variations. A large calibration chart is supplied with each attenuator.

The attenuators range from frequencies of 2.60-3.95kMc in Model 754 to 8.20-12.4kMc for Models 701 and 702. The general attenuation range is 0.5 to 40db except in model 702 where the range is 0.5 to 10db with a calibration accuracy of 0.2db. Maximum VSWR is 1.15.

The Narda Corp, Dept. ED, Mineola, N. Y.

CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION
of men, missions and missiles...

The ancients' bow and arrow, today's guided missile, and tomorrow's space ship have one thing in common. They are all guided missiles. The problems of aerodynamics, guidance and propulsion remain basic. Early man solved his problem with raw materials and native ingenuity. Now the problems are much more complex, requiring the best our civilization can produce. Today, such problems are best solved by highly organized and creative engineering teams. These teams are even now supplying the building blocks for tomorrow's achievements.

At Bell there are no limits to engineering advances. Our engineering teams are engaged in advanced missile projects in the supersonic and hypersonic range. These projects offer unlimited opportunity for individual ability in professional and financial advancement for those possessing a B.S. or advanced degree in:

- AERONAUTICAL ENGINEERING
- ELECTRONIC ENGINEERING
- MECHANICAL ENGINEERING
- MATH OR PHYSICS

Arrange to see our representative on campus, or write for your copy of our brochure "ENGINEERING OPPORTUNITIES".

Manager, Engineering Personnel; Dept. 4B

POST OFFICE BOX 1
BUFFALO 5, NEW YORK
Digital Flow Indicator
Compact, Packaged System

Model 5692 digital flow indicator is designed to fill the need for a testing instrument compact enough to move from test bench to test bench for calibrating flow meters and making actual flow measurements.

Its unusual front panel features a 4-digit presentation reading directly in either lb/hr or gallons. Direct flow rate indication runs from zero to 9999 lb/hr. The time base may be selected from 1 millisecond to 10 seconds, in increments of 1 millisecond.

Model 5692 includes complete test and flow totaling qualities, and is engineered to operate with any impeller type transducers. A complete test feature checks the entire operation and indicates on the four banks of decimal counting units the actual time base chosen. Accuracy is ±1 count, and time base stability is one part in 10⁶ short term. Sensitivity is 5 mV at 5 sec.

Berkeley Div. Beckman Instruments, Dept. ED, 2200 Wright Ave., Richmond 3, Calif.

CIRCLE 105 ON READER-SERVICE CARD FOR MORE INFORMATION

Right Angle Drives
Feature Dual Output Shafts

Featuring dual output shafts, two basic types are available with a variety of input-output ratios, a bevel gear assembly, and a worm gear assembly. Both are assembled in anodized aluminum dust-proof housings, measuring 1" x 1-1/2" x 1-1/2", with gears permanently pinned to stainless steel shafts mounted in bronze bearings with constant pressure thrust washers.

The BG series employs precision bevel gears and is available with input-output ratios of 1:1, 2:1, and 3:1. The WG series, worm gear assemblies, are especially suited to handling spring or gravity loaded controls, as the output shaft automatically locks in position with the input shaft remaining free for smooth drive in either direction. The WG series is available with the following input-output ratios: 5:1, 10:1, and 20:1.

Jan Hardware Mfg. Co., Inc., Dept. ED, 75 N. 11th St., Brooklyn 11, N.Y.

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION
new automatic sweep generator eliminates manual oscilloscope adjustments

This instrument frees you from the tedious, time-consuming job of manipulating controls. Hooked up to your cathode-ray oscilloscope, it adjusts automatically every time you change signal frequency. Change it 10...50...500 times an hour—the display comes up unaltered, and with the preset number of cycles. You never lose the display. Hence all the time you now spend setting and resetting dials is put to productive use. You get more work done, with less distraction.

Trigger input—any waveshape 5 cps to 100,000 cps. Output is sawtooth, approximately 10 V.P.P. The SWEEP-SYNC saves time in circuit development, production testing, and waveshape monitoring...makes many visual techniques practical. Occupies only 4" of front panel width. Write for literature.

CHADWICK HELMUTH COMPANY
472 East Duarte Road
Monrovia, California

CIRCLE 109 ON READER-SERVICE CARD

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Force Transducer
Has 20,000 lb Capacity

This transducer is an SR-4 load cell of 20,000 lb capacity with max deflection of only 0.005" under full load. This provides a natural mechanical frequency response of about 1900cy, more than twice that of previous cells. Full capacity thrust on this cell was measured in 3µsec during a rocket test.

SR-4 resistance wire strain gages used in these cells have almost instantaneous electrical response to strain. Another feature of these Type 9236 cells is the use of two independent strain gage bridge circuits to permit producing two independent records of thrust with associated instrumentation systems. One circuit is used with an oscillograph to measure the peak transient thrust that occurs during the first few milliseconds of firing. The other bridge circuit is wired to permit higher input voltages and consequent higher output voltage.


CIRCLE 110 ON READER-SERVICE CARD FOR MORE INFORMATION

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Utility Ovens
Ranges From 100°C to 1000°C

This is a new line of 4 junior sized utility ovens for small batch drying, curing, baking, processing, heat treating, product control and sample testing. The 4 models have approx 2' x 2' x 2' oven interior dimensions, but vary in temperature ranges from from 100°C to 1000°C.

A true forced air recirculating system is maintained within the oven chamber through use of a fan and controlled intake and exhaust vents. A shielded heating element prevents radiant over-heating and aids in a more even temperature control throughout the chamber.

The interior of the oven is lined with Armco aluminized sheet steel allowing quick, easy cleaning of the entire chamber. A drip pan collects and disperses any accumulated moisture and aids in keeping a non-contaminating interior.

Ovens operate at 110 and 220v, but can be modified to conform to any non-standard power supply.

New England Oven and Furnace, Dept. ED, Orange, Conn.

CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION

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CIRCLE 112 ON READER-SERVICE CARD
NOW—G.E. adds 2PDT sub-miniature to small sealed relay line

Now—to give you still more flexibility in applying General Electric hermetically sealed relays to your electronic systems—G-E engineers have developed the new 2PDT sub-miniature. Like other ratings in the G-E sealed-relay line, this new unit combines small size with unusual reliability under severe temperature, shock, and vibration conditions—making it ideal for air, sea, as well as ground applications.

**Description:**
- .651 in. in diameter, 1.6 in. long; weighs one ounce. Unaffected by vibrations of 10 to 55 cps at .12 in. maximum excursion or 55 to 500 cps at 15Gs acceleration. Withstands shock tests in excess of 50Gs. Operates in ambient of 125 C. Available in a wide variety of coil ratings.

**Description:**
- Micro-miniature relay: Weighs only .35 oz, measures .34 in. by .78 in. by .34 in. Rated 2 amp resistive at 28 v DC or 115 v AC. Also available in current-sensitive models. Standard relays withstand ambient temperatures of 125 C, and 20Gs acceleration at 50 to 500 cps.
- Sub-miniature SPDT relay: This rugged relay weighs only .9 oz and occupies less than .8 cu. in. of space. Available for d-c or 400-cycle a-c operation. Contacts are rated 2 amp at 28 volts DC or 115 volts AC.
- High-speed 4PDT relay: Is especially designed for use where operation as fast as 500 microseconds is required. Weighing only 5 oz and measuring 1 1/8 in. by 1 3/8 in. by 2 1/4 in., it is ideal for such applications as ground-based radar, multiplexing of electronic signals, and computer circuits.

**Description:**
- Miniature relay: Over 300,100,000 operations without a miss is the record of a typical model of this relay. After the 200 millionth operation there was less than 3 mils wear between the armature tail piece and the contact lifter. Available in 2-, 3-, or 4-pole double throw and 6-pole normally open forms. Rated 5 amp at 28 volts DC at 85 C.
exceptionally stable by-pass capacitors

— Solar ceramic bodies DA, WA & WG

Constantly advancing Solar research brings you small-size discs in unusually stable bodies. Solar's technically proven ceramic formulations provide flat temperature coefficient and low power factor throughout a broad capacity range. These discs are available not only in GMV, but due to their stability can be produced to 10% and 20% tolerances.

A ceramic formulation can be furnished to yield optimum performance under conditions of your particular application. Capacities for typical ranges are shown below. Note the unusual stability of the new "WG" Body for radio and television temperature range.

### DA Medium "K"

<table>
<thead>
<tr>
<th>Solar Style</th>
<th>CD 8</th>
<th>CD 12</th>
<th>CD 16</th>
<th>CD 20</th>
<th>CD 24</th>
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<tr>
<td>Max. Dia.</td>
<td>5/16</td>
<td>7/16</td>
<td>9/16</td>
<td>11/16</td>
<td>13/16</td>
</tr>
<tr>
<td>Max. Cap. mfd</td>
<td>150</td>
<td>400</td>
<td>740</td>
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### WA High "K"

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<td>11/16</td>
<td>13/16</td>
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<tr>
<td>Max. Cap. mfd</td>
<td>390</td>
<td>1000</td>
<td>1850</td>
<td>3000</td>
<td>4500</td>
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### WG High "K"

<table>
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<tr>
<td>Max. Dia.</td>
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<td>7/16</td>
<td>9/16</td>
<td>11/16</td>
<td>13/16</td>
</tr>
<tr>
<td>Max. Cap. mfd</td>
<td>700</td>
<td>1800</td>
<td>3300</td>
<td>5400</td>
<td>8000</td>
</tr>
</tbody>
</table>

Normal Ratings: 500 V, 1/2% max. PF; min. IR; 7500 Meg.

Write for literature, or the complete Solar catalog.
Power Transistor Thermometer
With High Thermal Impedance

The Model 1 thermometer is a battery powered instrument for measuring temperature in the 35 to 85°C range. The high thermal impedance of the sensing element gives this unit, as a thermometer, the same freedom from loading the thermal path that a VTVM has in an electrical circuit. In addition to this performance feature, a mounting convenience is also included.

The sensing element is enclosed in insulating material and shaped like a washer so that it may be used as the insulating washer normally used for mounting the transistor. This point is the closest available point to the heat source that does not require breaking the thermal flow or modifying the transistor.

The penlite battery which is readily removable from the bottom of the instrument, yields about 250 hours of service. The measuring unit is 4" wide by 6" long and 2-5/8" high. The 36" cord from the sensing element attaches to the measuring unit with a miniature plug.

B & B Engineering Associates, Dept. ED, RFD #1, Concord, N.H.

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION

Phase Indicator
No Tubes, Batteries, or External Power

Model 400 P Phasemeter requires no tubes, no batteries or external power. It is designed to measure any phase shift network between input and output, analog computer circuits, electronic and mechanical choppers, production comparison of capacitors, inductances, etc.

The Model 400 P has direct reading indicator digital readout to 0.1° with no chart conversion. No special equipment is required for calibration. Frequency range is 350cy to 15kc, usable to as low as 40cy. Accuracy at 400cy is ±0.25° or better.

Winco Electronics, Dept. ED, 644 No. Hawthorne Blvd., Hawthorne, Calif.

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION
The Beckman Leak Detector finds leaks with production-line speed in vacuum, pressure and hermetically-sealed systems and units of any size. It is useful in the manufacture of instrument and electronic components, testing glass-to-metal seals and welded or soldered joints, maintenance of pressure and vacuum processing systems-wherever operating and shelf life and system efficiency are sharply reduced if even normally insignificant leaks are present.

A unique radio-frequency principle makes the Beckman Leak Detector a simpler, more reliable and less expensive mass spectrometer leak detector. It is sensitive to leakage rates down to $10^{-9}$ standard cc/sec., it is easy to use and completely safe for operator and system under test because inert helium is the leak tracing agent, and it is portable and dependable. Write for Data File N20-57 to Beckman Instruments, Inc., Process Instruments Dept., Fullerton, California.

---

**Parabolic Antenna**

New Parabolic Grid Structure

This is a new series of parabolic antennas for the 890-960 Mc and 450-470 Mc regions. Units are now available in sizes up to 10 ft diam employing a newly-developed parabolic grid structure which materially reduces weight and wind loading while retaining all of the electrical properties of a solid spun dish at frequencies up to 1000 Mc.

At 960 Mc three models are available: Model P-942, Model P-972, and Model P-9120 are 42", 6 ft and 10 ft in diameter and produce gains of 15, 20, and 25 db over a dipole. At 460 Mc two units are available: Models P-472, and P-4120, are 6 ft and 10 ft in diameter and produce gains of 15 and 20 db over a dipole.

Mark Products Co., Dept. ED, 6412 W. Lincoln Ave., Morton Grove, Ill.

CIRCLE 120 ON READER-SERVICE CARD FOR MORE INFORMATION

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**Shielded Container**

For Magnetic Tape

This is an entirely new type of protective carrying and storage container which completely shields tape recordings from high and low intensity fields which might cause double sound, echo, or partial or full erasure. It also shields delicate instruments in government and other laboratories. The container is available in a variety of sizes and shapes to fit any desired application.

Double metal construction consists of two layers of specially prepared magnetic shielding steel, known as Ferneotic, which attenuates high intensities and Co-Netic, which attenuates low intensities. The layers are rendered non-shock sensitive by coating both sides of each layer with specially developed ferrous and ferrite powders which raise the metal's saturation point considerably. The high saturation point and non-shock sensitive features insure lasting safety to tape recordings and delicate instruments.

Magnetic Shield Div., Perfection Mica Co., Dept. ED, 20 N. Wacker Dr., Chicago 6, Ill.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION
For High Strength and High Endurance—specify microprocessed I-S springs of beryllium copper. These unique springs are particularly suited for applications requiring non-magnetic, corrosion-resistant properties, with excellent electrical conductivity, and stability. The inherent advantages of this ideal spring material—combined with I-S specialized engineering techniques in manufacture—assure absolute conformity to your critical spring requirements.

I-S Design Service saves you time and money! For recommendations on specific spring problems, check with I-S. Samples and short runs can be supplied quickly and economically!

For Additional Information consult Sweet’s Product Design File or write for our latest Catalog.
True sine and square waves for servo, geophysical, and computer work. 0.01 to 1000 cps in 5 decades. High stability, low distortion. Accurate frequency calibration and precisely metered output.

DONNER MODEL 15
LOW FREQUENCY GENERATOR
$365, F.O. B. Berkeley

ADVANCED INSTRUMENTATION

Versatile engineering tool solves both differential equations and transfer functions. Detachable problem boards, plug-in components. Function generator, multiplier, other accessories available. High accuracy with operating simplicity.

DONNER MODEL 30
ANALOG COMPUTER
$995, F.O. B. Berkeley

DONNER SCIENTIFIC COMPANY

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION
**Furnace Has Six Zones**

This furnace is designed for many critical temperature heat treating operations such as annealing large intricate assemblies of laboratory glass, production heat-treating metal, etc., where furnace gradients must be controlled closely.

The interior dimensions of this furnace are 24" wide x 24" high from hearth to roof and 72" long. Not only is temperature evenness easily attained but different temperatures in different parts of the furnace are easily controlled and indicated by means of the thermocouple selector switch.

There are six zones in the furnace, the input to each controlled by an input controller which may be set from 7% to 100% of input in increments of 1%, giving precise control over the rate of heating in that zone. Any rate of heating up time may be selected enabling control over product uniformity.


CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION

**Miniature Connectors In 20 and 27 Contacts**

This new Series 18 precision Continental Connector is available in 20 and 27 contacts. They provide a larger, more rugged contact with the same efficient spacing used on the Series 20. The 0.053" diam solder cup can accommodate two #20 wires, if necessary.

Outstanding features include non-rotating, floating contacts that assure self-alignment of each individual contact. This reduces the engagement and disengagement force normally encountered when using connectors with fixed contact.

Clear anodized, aluminum hoods provide positive cable support and strain relief. Positive polarization is achieved through the use of a reverse type guide pin and guide socket arrangement. A polarizing screwlock guide pin and guide socket are also available in this series connector.

DeJUR-Amisco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N.Y.

CIRCLE 126 ON READER-SERVICE CARD FOR MORE INFORMATION

**BART LABS**

*a prime source for precious metal plating and precision electro-forming*

**BART PRECIOUS METAL PLATING SERVICE**

"ARMOR-CLADDING" propeller blades with nickel for commutator and government air-craft, AEC development work, these typify our many patented processes and vast facilities.

**BART PRECISION ELECTRO-FORMING PROCESS**

We can reproduce any intricate shape to precision dimensions...no secondary operations to alter tolerances.

BART Laboratories has been serving government and industry for 44 years. Now, with greatly expanded facilities, BART invites new accounts. BART ELECTROFORMING provides product design engineers with unlimited flexibility and, combined with our exclusive Precious Metals Plating Techniques, offers excellent opportunities for creative engineering.

Write for copy of BART SERVICES and FACILITIES

BART LABORATORIES
Division of BART MANUFACTURING CORPORATION
Dept. ED-7, 227 Main Street, Belleville 9, N. J.
Pioneers in Rhodium Plating and Electroforming of Reflectors, Electronic and other Precision Parts.

CIRCLE 127 ON READER-SERVICE CARD
A high quality, reliable mylar capacitor designed for standard and sub-miniature packaging of military or commercial equipment.

FEATURES
- Sealed in Kel-F** for moisture resistance
- Convenient form factor
- High insulation resistance
- Excellent temperature characteristics
- Two sets of parallel leads
- Lightweight

The Sanders Reliacap® Mylar® Capacitor is a flat, thin, compact capacitor which may be stacked or mounted in any convenient manner in sub-miniature packaging. Two pairs of parallel leads facilitate mounting and securing the Reliacap. Reliability is achieved by sealing in a tough Kel-F jacket (which is impervious to moisture) with a resultant high insulation resistance, and by using at least 2 layers of Mylar film dielectric. Most sizes are made with 3 layers of mylar film. The Kel-F jacket is also chemically inert, thereby permitting use of the Reliacap in applications where oils, chemical agents or gases may affect components.

GENERAL SPECIFICATIONS
- Temperature Range: -55°C to +125°C
- Tolerance: ±5%, ±10%, ±20%
- Insulation Resistance (Megohm x MFD): 500 at 125°C
- Power Factor: 1% Max. at 1,000 cps
- Moisture Resistance: Will meet requirements of MIL-C-91

Write for complete information:
Sanders Associates, Inc.
95 Canal Street
Nashua, New Hampshire

Visit the Sanders Exhibit at the Wescon Show—Booth 1608

*Mylar® is a trademark of E. I. Du Pont de Nemours & Company
**Kel-F® is a trademark of The Fenton Co., Inc.

Magnetic Cartridge
Made in Two Series

This cartridge is available only in single stylus and is designed to fit into all professional arms with 1/2" center-spaced mounting holes or stand-offs.

In order that the B&O Special may be used with high level magnetic input professional amplifiers and also with amplifiers having only low level magnetic input, it is made in two series: B&O 350 A+ Special with 350 ohm d-c resistance having 30mv output at 4.4cm/sec (black body and red lettering); B&O 72 A+ Special with 72 ohm impedance having 15mv output at 4.4cm/sec (black body and gold lettering).

The B&O Special has the same 8-pole construction as the standard series. This permits high output and excellent signal-to-noise ratio on low impedances.

Fenton Co., Dept. ED, 15 Moore St., New York 4, N. Y.

CIRCLE 130 ON READER-SERVICE CARD FOR MORE INFORMATION

Attenuator Plates
Metalized Glass


The metalized resistance elements, manufactured by evaporating pure metals in high vacuum to a glass base, are highly stable, unaffected by humidity, controllable as to resistance, and are reproducible. The films are negligibly thin compared to the highest microwave frequencies; they are non-inductive, and their noise level is barely measurable.

By precise measurement during evaporation, the resistance films are held to an accuracy of 1% and they offer an extremely low temperature coefficient of resistance of approx 75ppm/°C.

Metavac, Inc., Dept. ED, 45-68 162nd St., flushing 58, N. Y.

CIRCLE 131 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 129 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 15, 1956
ENGINEERED CABLE SYSTEMS
BY PACIFIC AUTOMATION
ARE RELIABLE SYSTEMS

SYSTEM DESIGN
In your own plant and
works you can specify and
design cable and cable
components to meet your
exact SYSTEM requirements.

SYSTEM FABRICATION
At our modern cable plants we
build custom-made cable with
facilities for fabricating and
molding multi-break-con
connections and plating and
"gilding" components so that a
complete SYSTEM is provided.

SYSTEM INSTALLATION
On-site installation of circuitry
and block houses of our automated
componentry and components
are approved by our field
engineers to provide complete
SYSTEM integration.

SYSTEM CHECK-OUT
Testing of on-site installations
for circuitry by Pacific
Automation Products engineers
assures functional reliability
of the electrical SYSTEM.

Write for Bulletin 156

Pacific Automation Products, Inc.
1000 AIR WAY, GLENDALE 1, CALIF.

Engineers and technicians will find a challenging and fas-
cinating career with us. Your qualifications are welcomed.
Power Supply
225-325v d-c at 175ma

Model RS-317 is a compact power supply designed to provide excellent regulation characteristics over the extensively used voltage range of 225-325v.

The supply is complete, ready to operate, has a line cord and plug. Barrier-type terminal strip on the rear face of the chassis provides convenient connections for regulated d-c as well as a heavy duty, 6.3v filament winding.

Specifications of the unit are: line regulation: less than 5mv/v a-c; internal impedance: less than 0.5 ohms in series with an inductance of less than 1 µh; recovery time: less than 25usec; ripple and noise: no load—less than 500µv, rms; full load—1500µv, rms; current range: 0-175ma, continuous duty.

Trans Electronics Co., Dept. ED, Canoga Park, Calif.

CIRCLE 135 ON READER-SERVICE CARD FOR MORE INFORMATION

Multi-Circuit Timers
In Various Switch Combinations

This unit is made only to individual specifications and utilizes a standard Bristol “Circle B” synchronous timing motor and snap-action enclosed switches rated at 15 amp, 125v a-c.

It is available in various switch combinations and is normally made with pre-set factory-adjusted cams and cam settings.

Cam speeds are available in ranges from 1 rev/see down to 1 rev/month, and the entirely enclosed construction provides a high degree of dependability and accuracy.

The unit pictured is approx 3” high, by 2” wide, and with 4 switches, is approx 4” long. It is intended for applications such as appliance timers, industrial controls, control applications, etc.

The Bristol Motor Div., Vocaline Co. of America, Inc., Dept. ED, Old Saybrook, Conn.

CIRCLE 136 ON READER-SERVICE CARD FOR MORE INFORMATION
Superior Tube offers widest selection of glass sealing alloys

Available for virtually any application, Superior Tube glass sealing alloys are used today to conduct electricity into sealed vacuum or gas-filled chambers. Have same expansion coefficient as glass. Cold drawn to close tolerances in seamless or Weldrawn form. Sizes from .012 in. to .625 in. Supplied in quantities as small as 50 ft. in any size and analysis. Write for free copy of Catalog 50, Superior Tube Company, 2050 Germantown Ave., Norristown, Pa.

* T.M. Supplied

ELECTRONIC CIRCLE GLASS

SRON

GLASS

Good

SUPERIOR

Weld

THEER

GLASS

ALLOY

Superior Tube

The big name in small tubing

NORRISTOWN, PA.


CIRCLE 140 ON READER-SERVICE CARD FOR MORE INFORMATION

First with true all-solder construction, Johnson Type "L" capacitors are an ideal choice for applications requiring extreme stability and strength. Rotor bearings and stator support rods are actually soldered directly to the heavy .030" thick steatite ceramic and frames. Impervious to shock and vibration, parts can't break loose — capacity can't fluctuate. Plate spacing is .030" rated at 1500 volts peak at sea level; over 300 volts at 30,000 feet altitude. Plating is heavy nickel — other platings available on special order. Requires 1 1/2" x 1 1/2" panel mounting area.

+ For complete information on Johnson Type "L" Air Variables or other quality Johnson components write for your copy of Components Catalog 976A.

RUGGED! RELIABLE BUILT TO TAKE IT!

JOHNSON "L" CAPACITORS

E. F. Johnson Company

3413 Second Avenue Southwest • Waseca, Minnesota

CAPACITORS • INDUCTORS • DREMELS • DIALS • SOCKETS • RELAYS • PLUGS • JACKS • PLOT LIGHTS

CIRCLE 141 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Valve

Uses Dry Coil Construction

This compact servo valve is designed for stabilization and flight control that permits coil and all magnetic circuitry to operate in air rather than fluid media. The valve utilizes an isolation diaphragm that functions as a positive fluid barrier. The dry coil torque motor is not immersed in fluid, hence build-up of magnetic particles is prevented.

Five internal micron filters of corrosion resistant steel furnish thorough filtration of oil within the valve. All oil that passes through the hydraulic amplifier section of the valve must first go through three separate filtering stages.

Integral construction of stainless steel power sleeve, spool, centering springs and null adjustments assure identical coefficient of expansion for excellent null stability under all conditions.

Hydraulic Research and Mfg Co., Dept. ED, 2835 N. Naomi St., Burbank, Calif.

CIRCLE 142 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrical Error Analyzer

For Calibration of Synchros

The Type 226A synchro error test stand is a new and improved precision electrical error analyzer for all sizes of torque or control transmitters, receivers and transformers, 60 or 400cy. Designed for incoming material testing, manufacturing, quality control or laboratory calibration of synchros, the 226A is accurate to ±.10sec of angle in 10° steps and is in accordance with MIL-S-2335 and MIL-S-16892.

The equipment provides stable indications of the fundamental null and total harmonic null signals in millivolts. A phase shift zero indicator is a function of the fundamental frequency with a resolution of 2sec. Third and higher harmonic signals are attenuated 40db on both 60 and 400cy setups.


CIRCLE 143 ON READER-SERVICE CARD FOR MORE INFORMATION

OHMITE AMRECON RELAYS

65 types in four stock models

Dependable Ohmite Amrecon general-purpose relays have proven their exceptional ruggedness and long life in years of service. Some models are particularly adapted to applications where severe shock and vibration are present. Others are of the sensitive type. Ohmite can assure you immediate shipment of 65 stock units and good delivery on the many made-to-order relays. Available in current ratings up to 25 amp, AC or DC, with varied contact arrangements; hermetically sealed or dust-protective enclosures.

HIGH QUALITY, ALL-PURPOSE RELAYS... RUGGED, DEPENDABLE FOR LONG LIFE

Current ratings up to 25 amp, AC or DC

Also made-to-order models in a wide variety of contact combinations, coil voltages, and contact ratings.

Write on Company Letterhead for Catalog No. R 11.

OHMITE Manufacturing Company

3643 Howard Street, Skokie, Illinois (Suburb of Chicago)

Be Right with OHMITE

RHEOSTATS • RESISTORS • RELAYS • TAP SWITCHES

CIRCLE 144 ON READER-SERVICE CARD FOR MORE INFORMATION
Energy Storage Capacitors
Have Low Inductance

Type XN-249 (the unit shown on the photograph) is approx 17" diam x 40" high. The high voltage terminal insulator shown is efficiently utilized to house a portion of the capacitor section. The unit weighs approx 500 lb.

Design of the unit is based on coaxial line principles so as to enable the discharge at rated voltage in an extremely short time. In the case of Type XN-249, the result is a peak current in excess of 200,000 amp upon discharge. The unit is completely hermetically sealed.

Applications involve high temperature gas discharge studies and similar applications where extremely high energy bursts are required in an extremely short time. In addition, there are requirements for low inductance capacitors as oscillator tank capacitors in high power r-f generators.

Specifications are: capacitance 0.9 μfd; voltage 100 kv with 20% reversal; internal inductance 0.12 μh max; average Q 200.

Tohe Deutschmann Corp., Dept. ED, Norwood, Mass.

1Mc Signal Source
Stable to 1 Part in 10°

This instrument offers exceptional frequency stability at a standard frequency of 1Mc. Typical applications include use as a secondary frequency standard, reinsertion of carrier in suppressed carrier systems, telemetry, navigation systems, geophysics, astronomical and other critical measurements.

Performance characteristics are: frequency: 1Mc tunable over a range of ±0.5cy; frequency stability: drift less than 1 part in 10° per day after one month's operation; crystal oven: temperature stabilized to better than 0.01°C by temperature sensitive resistance bridge; outputs: sine wave—4v rms; pulse—1v; output impedance; approx. 250 ohms.


AC Performance and Phase Compensation of Copper-Mandrel Potentiometers
BY BENJAMIN F. LOGAN
Research Engineer
Dynamic Analysis & Control Laboratory
Massachusetts Institute of Technology

Hellop Corporation
South Pasadena, California
a division of Beckman Instruments, Inc.

CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION

Got a LOAD on your mind?
Burdened down with a problem in design
diminution, weight reduction, power capsulation?
lighten the load on your mind; send for the
amazing story of how MPB's such as these
make designing a breeze.

MINIATURE PRECISION BEARINGS, INC.
7 Precision Park, Keene, N. H.
CIRCLE 150 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCUIT 74 ON READER-SERVICE CARD FOR MORE INFORMATION
Threshold Indicator
For Actuating a Signal Device

The 91296-1 threshold indicator may be used with any of the company's radio interference-field intensity measuring equipments, covering the frequency range of 30cy to 1000Mc.

The instrument is primarily intended to actuate a signalling device, such as a light, bell, or horn, when radio interference exceeds a pre-determined level. This adapts the radio interference measuring equipment for use as a "Go-No-Go" device, for rapid indication wherever interference must not exceed certain levels.

A latching relay and a momentary relay are included in the unit. Operation of the relays may be adjusted to any desired signal level at which the warning device is to be actuated. An impulse counter may also be used with the system for gathering statistical information concerning the number of interference sources checked.

Stoddart Aircraft Radio Co., Inc., Dept. ED, 6644 Santa Monica Blvd., Hollywood 38, Calif.

CIRCLE 152 ON READER-SERVICE CARD FOR MORE INFORMATION

Germanium Rectifiers
100kw Liquid Cooled

This is a 100kw liquid cooled germanium power rectifier capable of delivering 80v d-c at 1350amp with a max input of 66v d-c and approx 1150amp a-c, and with rectifier efficiencies to 98.4%.

This 3-phase full wave bridge rectifier is recommended for a-c to d-c power conversion where high current at moderate voltage output and small unit size is required. The rectifier design provides for superior cooling using a liquid coolant (water, oil, etc.) at a max inlet temperature of 30°C and a flow rate of 4 gals/min (for water).

Unlimited operation life can be expected over a temperature range of -20°C to +50°C max, where equipment is designed to operate within specified voltage, current and temperature rise ratings.

International Rectifier Corp., Dept. ED, El Segundo, Calif.

CIRCLE 153 ON READER-SERVICE CARD FOR MORE INFORMATION

Memo
FROM: THE ENGINEERING STAFF AT NJE
TO: COMPUTER DESIGNERS
SUBJECT: THE SYMPATHETIC EAR

If you are building an electronic computer—digital or analogue—it will pay you to talk to NJE about the power supplies.

Why? Four good reasons:
1. NJE has built computer power supplies for almost every major computer facility during the past two years.
2. NJE offers modern techniques not available elsewhere—ZERO-LAG, ELG SEMI-REGULATED, Transistor-forced Mag-emp, high-speed ET Thyratron, etc.
3. NJE knows computers. We offer the services of engineers with computer design experience. They know all about marginal checking, turn-on sequencing, long-term stability, voltage-failure alarms, fail-safe design, turn-down procedures, heater-cycling, interaction prevention, reliability prediction, and all the rest of modern computer practice.
4. NJE offers the advantages of the world's largest custom power supply volume and the industry's largest, most diversified engineering staff—lower costs, quicker delivery, consistently high quality.

Got computer supply problems?
Tell us.
Ours is a sympathetic—and experienced—ear.
Midget Mica Capacitors

High Temperature Molded Units

Two new series of high-temperature molded midget mica-dielectric capacitors have been developed for operation up to 130°C and 160°C without voltage derating.

These capacitors were developed to meet applications in a constantly-increasing variety of high-heat industrial and military equipment. Maximum capacitance is 15,000μfd in the 130°C types and 7500μfd in the 160°C types. Voltage ratings are 300v and 500v d-c working (depending on capacitance). Temperature ranges are −55°C to 130°C and −55°C to 160°C.

Cornell-Dubilier Electric Corp., Dept. ED, So. Plainfield, N. J.

CIRCLE 157 ON READER-SERVICE CARD FOR MORE INFORMATION

Switches

High Contact Pressure

Design features of the series 750 switches are: positive make and break action; high pressure; non-sensitive to vibration and shock; stable against momentary high overload capacity; rugged construction insures long life; oversize fine silver contacts provide stability against momentary high overload capacity; high current capacity enables direct control of circuit.

Controls Corp. of America, Dept. ED, 9555 Soreng Ave., Schiller Park, Ill.

CIRCLE 158 ON READER-SERVICE CARD FOR MORE INFORMATION

Film-Type Heater

Continuous Operation At 600°F

This new electrical resistive film type heater will heat uniformly to a desired temperature over the area covered. The heating element is lightweight, inorganic, stable, unaffected by environmental conditions or moisture and capable of continuous operation at 600°F. Operation to wattage densities 40w in² may be thermostatically controlled.

Thermatic Co., Dept. ED, Box 365, Great Neck, N.Y.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C Transistor Voltmeter

Has 2uv Sensitivity

Unusual sensitivity of 2uv and battery operation make the Model MV-45A a-c voltmeter a new tool for laboratory use. Minimum battery life is 200 hours, made possible by 9 transistors incorporated in the unit.

Full scale ranges run from 10uV to 1kv in 10db steps, making a total of 17 ranges.

Frequency range is 10cy to 150kc. Accuracy is 2% of full scale on all except the lowest range. Noise level in the MV-45A is well below 500 milli-microvolts over a 100kc pass band. All ranges from 3mv to 1kv have individual calibration controls.

MILLIVAC INSTRUMENT CORP.
444 SECOND STREET
SCHENECTADY 6, N. Y.

CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

KNOTS WON'T SLIP
...TIE EASIER AND FASTER
WHEN YOU USE...

HEMINWAY & BARTLETT

NEW!

TEFLON COATED
FIBERGLASS TAPES

Newest scientific tapes...coated with DuPont Teflon...withstand temperatures up to 600°F...fireproof!

NYLON or DACRON Flat Braided Tapes


FREE! Write today for free samples.

Sampling Switches
5 Minute Brush Replacement

These switches provide constant force brushes, precision phasing 1 to 3 poles, up to 60 shorting or 30 non-shorting channels per pole, complete with 6, 12, or 28 v d-c motor, shielded r-f filter, and special precision spur gear reduction.

Plugs are recessed and mounted into housing.
Approximate dimensions as shown are 3.625" sq by 2.687" high. They are also available hermetically sealed or with 400c c-c motor with slightly changed dimensions.

General Devices Inc., Dept. ED, Princeton, N. J.
CIRCLE 164 ON READER-SERVICE CARD FOR MORE INFORMATION

Miter Gear Boxes
For Right Angle Drives

Type BA precision miter gear boxes are available from stock and have been designed where right angle precision drives are required. All material is certified under Military applications and is constructed of aluminum (chromic acid anodized) housing and cover and stainless steel ball bearing, shafts and collars. Three size units are available, 1/8", 3/16", and 1/4" shaft size.

PIC Design Corp., Dept. ED, 160 Atlantic Ave., Lynbrook, L. I., N. Y.
CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

Solid Tantalum Capacitors
Contain No Liquid Electrolyte

The type STA capacitor contains no liquid electrolyte. Made with a true hermetic seal, the capacitor eliminates altitude and humidity problems. It is intended primarily for low voltage transistor circuits for which it is ideally suited.

Available are 24 standard ratings from 1ufd at 35v d-c working to 350ufd at 2v working. Three standard case sizes are used.

Fansteel Metallurgical Corp., Dept. ED, N. Chicago, III.
CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION
Sweep Generator

FM Deviation ±1% to ±30%

Model SG132-2
v-h-f/u-h-f sweep generator offers the following features: center frequency range—15 to 400Mc; c-w, a-m, and f-m output; f-m deviation — ±1% to ±20% at any frequency setting; crystal calibration markers—every 200kc, 1Mc, 5Mc, or 20Mc, at an accuracy of ±0.01%; low residual f-m—at 50% amplitude modulation; tuning dial accuracy—±0.05%, without crystal correction; calibrated output—accurate to ±1dB; r-f output—0.1 to 150,000µv, when operated into rated load of 50 ohms; power output variation—±0.25db, independent of band or dial setting, type of operation, input power line frequency or voltage variation; harmonic output—less than 40db below desired signal.

A power-stabilizing circuit maintains constant power output from the r-f oscillator by controlling the oscillator plate voltage as the detected output from the oscillator varies.

Transiton, Inc., Dept. ED, 186 Granite St., Manchester, N. H.

CIRCLE 170 ON READER-SERVICE CARD FOR MORE INFORMATION

ARNO LD TORDAL CO WINDLE

sets up quickly... easy to operate... takes wide range of wire sizes

SPECIFICATIONS:
- Min. finished hole size: .18 in.
- Max. finished toroid O.D.: 4.0 in.
- Winding speed: 1500 turns/min.
- Wire range: AWG 44 to AWG 26
- Dual, self-checking turns counting system
- Loading (wire length) control
- Core range: 3/8" I.D. to 4 1/4" O.D. to 1 1/2" high

LABORATORY USE
- Change wire and core size in 45 sec.

PRODUCTION USE
- 1500 turns per minute
- Insert core and load in 20 sec.

write for literature

ARNOLD MAGNETICS CO.
1615 SALBY DRIVE, CULVER CITY, CALIFORNIA

CIRCLE 172 ON READER-SERVICE CARD FOR MORE INFORMATION

CORNING
FIXED GLASS CAPACITORS
available through
erie distributors

The instrument consists of a shielded, low capacitance (1.52µf) and an associated video amplifier with a gain of 40 to compensate for the probe attenuation.

The overall bandwidth is within 3db from 150 to 12Mc. The amplifier may be used separately to provide a gain of 40, or with the probe to provide attenuations of X1, X1.5 and X0.5.

Used with an oscilloscope, the HF-3A oscilloprobe permits observation of signals in a circuit with negligible loading or detuning, or otherwise affecting the normal performance of the circuit.

Linear Equipment Laboratories, Inc., Dept. ED, Boonton, N. J.

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION
stainless steel locknuts for temperatures to 800°F.

Fasteners for aircraft electronic applications are being upgraded to meet the special requirements imposed by higher temperatures and unusual climatic conditions. ESNA's solution is a new line of Type 305 stainless steel nuts designed to perform efficiently at temperatures up to 800°F. Silver plating is used to assure a constant locking torque, freedom from galling action and a high degree of re-usability.

This new series is significantly lighter than corrosion resistant fasteners previously available (16% lighter in some sizes ... in others as much as 65%). Configurations include one and two lug, fixed and floating type anchor nuts and corner mounting type. Thread sizes are 6-32, 8-32, 10-32 and 1/4-28. For design information, address Dept. N15-757.

ESNA
ELASTIC STOP NUT CORPORATION OF AMERICA
2330 Vauxhall Road, Union, N. J.
CIRCLE 174 ON READER-SERVICE CARD FOR MORE INFORMATION

Wide Band Amplifier
Has High Amplification

The Model 380 combines a wide pass band with high amplification, having 70db gain over the frequency range from 2kc to 60Mc. Input and output impedances are 90 ohms, and the unit is supplied with self-contained power supply in an instrument case 8-1/2" x 10-1/2" x 12-3/4". A front panel gain control is provided.

Applications include pulse amplification, pre-amplification for counters to increase their sensitivity, and use as a general laboratory amplifier within its frequency range.

Instruments for Industry, Inc., Dept. ED, 150 Glen Cove Rd., Mineola, N. Y.
CIRCLE 176 ON READER-SERVICE CARD FOR MORE INFORMATION

In-Circuit Tester
Cuts Capacitor Service Time 75%

This new in-circuit tester cuts capacitor servicing time as much as 75%. The unit is capable of locating 7 out of 10 faulty capacitors without removing them from circuit.

Capable of testing both shunted and coupling capacitors, the 380-A Capacohmeter has an efficiency rating 10 times greater than conventional in-circuit shunt testers. In the case of faulty coupling capacitors, over 90% of faulty capacitors can be detected. The unit is equally efficient on color and on black and white TV.

Weighing only 9 lb, the Capacohmeter can be used with paper, mica, and ceramic capacitors. Capacitance is indicated directly on the meter scale over a range of 10μfd to 10μfd. A considerable number of capacitance values can be measured in-circuit. All can be measured out-of-circuit.

Simpson Electric Co., Dept. ED, 5200 W. Kinzie St., Chicago, Ill.
CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION
Here is a new guide to strong, wear-resistant tapped threads in non-ferrous metals, plastics and other structural materials... through the use of TAP-LOK INSERTS.

You'll find detailed information, illustrations, typical applications, specifications, on these internally and externally threaded bushings of steel or brass which increase shear area in one self-tapping operation.

Write for your free copy today.

GROOV-PIN CORPORATION

1125 Hendricks Causeway
Ridgefield, New Jersey

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION
New Literature

Frequency Meters 180

Short form catalog C-702 has been released describing the company's 7000 series of time interval meters and frequency meters. Included are descriptions, applications, illustrations of the several units, and brief specifications.
Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond 3, Calif.

Counter Tubes 182

A new 4-page brochure has been issued describing ratemeters for measurement of radioactivity. Illustrations of the major types of halogen quenched, stainless steel counter tubes are listed. Prices of this product are also included.
Anton Electronics Labs., Inc., 1226 Flushing Ave., Brooklyn 37, N.Y.

Ultrasonic Delay Lines 181

A new bulletin, No. 48, has been offered covering a complete line of solid ultrasonic delay lines. Included are general information, construction and operation, performance graphs, line illustrations, and typical measurement diagrams.
Bliley Electric Co., Union Station Bldg., Erie, Pa.

Rivets 183

A 14-page data book has been offered describing Rivnuts, a one-piece blind rivet with internal threads. Included are a description of how they work, preparation procedures, illustrations, tables showing the various types with sizes and type numbers, test data, and torque strength data.
The B. F. Goodrich Co., Akron, Ohio.
A booklet has been published describing chemicals for industry. Included in the booklet are salts, acids, and oxides of molybdenum, uranium, vanadium, and tungsten.

The S. W. Shattuck Chemical Co., 1805 S. Bannock St., Denver 23, Colo.

A new catalog, No. 257, has been issued describing more than 40 standard accessory items used in electronic and TV installations and service practice. The catalog includes photographs, diagrams, and features single as well as multi-installations.

Javex, P.O. Box 646, Redlands, Calif.

A new bulletin has been issued describing airborne high voltage radar power supplies and more specifically, a 6000v model. Specifications of the 6kv unit are outlined, and advantages of the use of these power supplies is discussed.

Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

A technical bulletin has been made available on the Model 204 low frequency VTVM. Included are features of the instrument, a general description, and complete specifications.

Shasta Div., Beckman Instruments, Inc., Richmond, Calif.

A brochure has been made available describing a line of reflecting galvanometers. Included in the brochure are descriptions, applications, features, and specifications of the various types illustrated.

Pimex Inc., 2 E. 82nd St., New York 28, N. Y.
Engineers
choose your climate...choose your job

AiResearch jet pump "shoots air bullets" to increase efficiency of refrigeration units

THE GARRETT CORPORATION
AiResearch Manufacturing Co., Los Angeles, California
Aero Engineering Division, Mineola, Long Island, New York
AiResearch Manufacturing Co. of Arizona, Phoenix, Arizona
AiResearch Industrial Division, Los Angeles, California
Airsupply Division, Beverly Hills, California
Air Cruisers Division, Belmar, New Jersey
Rex Division, Los Angeles, California

NEEDS ENGINEERS FOR

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For information regarding these openings and for follow-up interview write giving resume of experience and qualifications to: W. E. Clifford

9851 S. Sepulveda Blvd., Los Angeles 45, California
for your waveguides • transitions • couplers

look into GAR-FORMING
from a microwave point of view

You'll see this unique part-forming process gives you the fine surface finish and absolute accuracy that keeps transition losses low and gives identical characteristics, part for part.

Gar-forming is an advanced electroforming process. It produces intricate internal shapes with an inside precision and finish unobtainable with any other method. For the first time, it makes it possible to produce a wide variety of solid and thin-wall parts in configuration and materials that are particularly suitable for microwave components. The price of Gar-forming is equally low for experimental, prototype, or production runs. Send us your specifications — we'll be glad to demonstrate the advantages of Gar-forming in your particular application.

Send today for full information

PRECISION PARTS, INC.
5 LUDLOW STREET, STAMFORD, CONNECTICUT

CIRCLE 199 ON READER-SERVICE CARD FOR MORE INFORMATION
Power Supplies

Six-page bulletin S-56 has been offered on power supplies. The new bulletin has complete specification listings on all the company’s standard tubeless magnetic amplifier regulated 6, 12, 28, and 115v d-c power supplies, as well as airborne radar power supplies, a-c line voltage regulators and heavy duty germanium rectifier units. Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

Subminiature Rotary Switch 201

An engineering data sheet describes completely the new series 7000 12-position subminiature rotary switch. Providing 12 stator positions per deck exclusive of poles, the series 7000 is only 1.160” diam including contacts. These switches provide unusual versatility and variability; standard contact arrangements from 1 pole/12 positions to 4 poles/3 positions per deck are offered. All electrical characteristics, details of construction, listings of available models, specifications, and mounting dimensions are covered in the data sheets.

International Instruments Inc., P.O. Box 2954, New Haven, Conn.

Limiters and Fuses 202

A new 10-page catalog has been offered presenting detailed data on this company’s line of small dimension limiters and fuses for use in aircraft, instrumentation, electrical, electronic and automotive industries. The range of fuses covers physical sizes from 1/4” x 5/8” to 13/16” x 10”, in ratings up to 10,000v.

Sightmaster Corp., 111 Cedar St., New Rochelle, N. Y.

Silicone Impregnating Varnish 203

An 8-page data sheet has been issued describing the uses, properties, and application procedures of R-620 silicone impregnating varnish for high-temperature electrical insulation systems. It is outstanding for its ease of application, bubble-free curing, and hard, tack-free cured surface, which remains free from dust accumulation and chemical attack. R-620 meets or exceeds the high-temperature requirements established by the U.S. Navy, the AIEE (Class H) and the NEMA Group III standards.

Union Carbide & Carbon Corp., Silicones Div., 30 E. 42nd St., N.Y. 17, N.Y.

Century MODEL 20 VISUAL MONITOR

For TEMPERATURE PRESSURE VIBRATION FLOW RADIATION COLORIMETRY CURRENT VOLTAGE

Does your data problem include any of the above? Or anything similar?

The Model 20 Visual Monitor is a completely new concept in multiple data-point indication.

Now you can observe and measure 24 separate data points, simultaneously. No Switching, no commutating, no time lag.

Wherever a graphic display of several quantities will facilitate measurement and control, the Model 20 should be considered.

Utilizing light-beam D’Arsonval galvanometers as the indicating elements, the Visual Monitor permits display of transducer output in an easy-to-interpret, graphic form.

Let us hear from you. We would like to discuss your instrumentation problems with you.

Century Electronics & Instruments, Inc.
1333 No. Utica, Tulsa, Oklahoma

CIRCLE 204 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • July 15, 1956
Beryllium Copper Springs 209
A new 4-page technical bulletin has been made available describing the uses and advantages of beryllium copper as the heart of a new vibration damping device for mounting electronic components in aircraft. Included are complete data on metal requirements for the Berylco alloy wire mesh springs, as well as design and fabrication considerations.
The Beryllium Corp., Reading, Pa.

Vibration Case Histories 210
Eighteen case histories which are typical of installation problems that prevent full utilization of machine tools for increase production are described in a new folder now available. The selected cases are taken from experiences of 42 machine tool builders who used the company's mounts. Case histories reported include mounting of several types of milling machines, a turret punch press, a precision gear grinder, a power shear, several types of surface grinders, and diversified punch presses.
Barry Controls Inc., 700 Pleasant St., Watertown, Mass.

X-Ray Spectrograph 211
A new 2-page bulletin has been issued telling how Shell Oil utilizes the X-ray Spectrograph for production control at its Martinez Refinery. The text deals with additives and tetra ethyl lead determinations and describes how the new method provides required accuracy and is much faster and less costly than wet methods.
Instruments Div., North American Philips Co., Inc. 750 So. Fulton Ave., Mount Vernon, N.Y.

Stainless Steel Tubing 212
A reissued 12-page catalog has been made available describing cold drawn mechanical, capillary, hypodermic, nickel and nickel alloy tubing, to replace the 8-page catalog, #11, published in 1955. The catalog describes the line ranging in size from 0.008" to 1.000" OD with 0.003" to 0.083" wall, as well as the tubular fabricated parts. Data is included on comparative analysis of alloy types, specifications, standard tolerances, physical properties and relative workability.
CRL The most complete line of Ceramic Trimmer Capacitors

Eight standard types. Special designs engineered to specifications.

Rotors and stators ground optically flat, to insure dependability and accurate retrace.

Lightweight rotors always in balance and under heavy spring pressure. Provide excellent stability under vibration without special locking device.

All units easily adjusted. Full capacity range is obtained with 180° rotation. Equal stability is maintained at any position from minimum to maximum.


Centralab®
A DIVISION OF GLOBE-UNION INC.
960G East Keefe Avenue • Milwaukee 1, Wisconsin
In Canada: 804 Mt. Pleasant Road, Toronto, Ontario

CIRCLE 214 ON READER-SERVICE CARD FOR MORE INFORMATION
$20,000 IN SALES SAVED by a CHICAGO STANDARD STOCK TRANSFORMER For Reeve Electronics, Inc., of Chicago, Illinois

Reeve manufactures custom-made, high frequency heating equipment, including a device to eliminate hand retwisting and retinning of cut standard wire. It applies a high frequency pulse to the point at which the wire is to be cut, forming a solid bundle of the wire strands that resists the strain of cutting and stripping.

Normally sold individually, Reeve received orders for fourteen of these units—all with firm delivery dates within a five week period. All parts could be obtained in time, except for one special choke. This stumbling block was removed, however... when they found that Chicago Standard Transformer C-1414 met the required specifications... and was immediately available from stock.

RESULT:
Reeve was able to meet their customers' delivery deadlines. This would have been impossible if they had to wait for the production of a "special" transformer.

LET CHICAGO STANDARD STOCK TRANSFORMERS SOLVE YOUR TRANSFORMER BOTTLENECKS

FREE The latest Chicago Standard catalogs listing over 1100 stock transformers

CHICAGO STANDARD TRANSFORMER CORPORATION
3501 Addison Street • Chicago 18, Illinois
Export Sales: Fabera Agencies, Inc.
431 Greenwich St., New York 13, N. Y.

CIRCLE 219 ON READER-SERVICE CARD FOR MORE INFORMATION
Phase Comparator 220

A new 6-page illustrated folder has been made available describing the Model 201 phase comparator. It covers the operation and applications of this model, which has been specifically designed for computer, control and servomechanisms testing where phase relationship must be accurately determined. Specifications and advantages of the equipment are listed in the folder. Link Aviation, Inc., Binghamton, N.Y.

Alloys 221

Four bulletins have been published describing four new product developments of interest to electrical, electronic, and instrument manufacturers. Each of these pamphlets include information on (1) 0.0005" diameter enameled Karma wire with specifications; (2) D-H alloy #531, describing temperature resistance characteristics; (3) heating element alloy #245, designed to make possible a longer life heating element; (4) D-H thermocouple alloys #242 and #33. Included in this pamphlet is a temperature curve showing the EMF temperature relationships and tables illustrating thermocouple stability in reducing temperature. Driver-Harris Co., Harrison, N.J.

Titrometer 222

Bulletin 640B has been published describing the company's dual recordomatic titrometer. In addition to the applications of the unit, the bulletin discusses such features as wide range, automatic plotting of titration curves and control of titrant feed rate, simplified operation, and sturdy construction.

Precision Scientific Co., 3737 W. Cortland St., Chicago, Ill.

Automatic Transfer Switch 223

A 4-page illustrated bulletin has been released covering circuitry and mechanical features of the Trans-O-Matic automatic transfer switch. The bulletin describes the use of two circuit breakers with a motor-driven mechanical linkage to provide positive transfer of service for power and light to an emergency source in event of failure of the normal source. Schematic drawings show four optional transfer circuits. Also covered are available accessories including special enclosures, adjustable time delay on restoration, engine starting contacts, pilot lights and several others.

Lake Shore Electric Corp., 205 Willis St., Bedford, Ohio.

For ambient temperature tests in the LABORATORY or on the PRODUCTION LINE, the Model TC-2 Temperature Test Chamber is ideal. Interchangeable extra test trays may be ordered to eliminate loading delays in continuous production tests, or for convenience in special test work.

Range: 0 to +250° F.
Heater: Electric strip heater
Coolant: Dry ice, 15 lbs. capacity
Control: Adjustable thermostat & selectable heat inputs
Load Capacity: 600 cubic inches of test materials
Power: 115V, 5 amp; 50-60 cycle
Overall Size: 48" x 18½" x 12½"
Weight: 62½ lbs.

CIRCLE 224 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • July 15, 1956
Microwave Components 229
A new 12-page catalog, C-536, has been issued describing in detail the complete line of E and H plane bends and top wall and side wall hybrid junctions now available from this company. Included are illustrations, specifications, dimensional drawings. Microwave Development Laboratories, 92 Broad St., Wellesley, Mass.

Metal Marking Machines 230
A 50th Anniversary catalog has been published containing the complete line with hundreds of illustrations of marking applications. The 3-color printed catalog includes basic technical information on metal marking, rapid production marking machines, series 50 general purpose marking machines, precision graduating equipment, mechanical and pneumatic marking presses, bench marking machines and several others. Also included are new marking machines capable of production speeds up to 15,000 pieces per hour with full automation, and the cyclical control for cycling and sequencing marking machine operations. Noble & Westbrook Mfg. Co., Westbrook St., E., Hartford 8, Conn.

Wound Cores 231
A new and comprehensive 32-page bulletin has been issued covering an extensive line of wound cores. The booklet, titled Orthosil Wound Cores, provides a complete parts list of standard 4 mil and 12 mil “C” cores and toroidal cores. Included are mechanical dimensions, tolerances and weights. Thomas & Skinner, Inc., 1157 E. 23rd St., Indianapolis, Ind.

Aluminum Nameplates 232
A 3-color, 4-page brochure has been issued describing Therma-Cal all-purpose aluminum nameplates for use on irregular surfaces and crinkle finishes. In addition, this illustrated booklet shows typical applications: dials, scales, insignia and trade schematic drawings, insignia and trademarks which can be permanently color-anodized and etched into the surface of thin-sheet aluminum. One page of the booklet is a catalog sheet describing accessories which can be obtained by Therma-Cal users—including photos, descriptions, and prices. North Shore Nameplate Co., 214 Northern Blvd., Bayside, L.I., N.Y.
mechanical connect and disconnect
SCREWLOCK* CONNECTORS

subminiature and miniature Series 20
Available in various contacts (7 thru 104 for Series 20; 7 thru 50 for Series SM20). With or without aluminum hoods. For #20 AWG wire. Current rating: 5 amps. Voltage breakdown: 2100V, RMS.

Polarizing Screwlocks*
Screwlocks provide a secure contact even under severe vibration conditions. They also eliminate the need for prying, "rocking" or forcing the connector when disconnecting the plug from the receptacle.

Connectors with polarizing screwlocks

Easy Release—Series E-Z 16
Individually spring loaded pin contacts assure quick release with low insertion force and practically no disengagement force. 12, 18, 24 or 34 contacts for #16 or #12 AWG wire, or solderless wiring taper pin.

Hermetic Seal—Series H-20

High Voltage—Series 14
Available in 7, 9, 10, 15 and 18 contacts. High barriers around pins prevent arcing up to 4500 volts. Contacts are gold plated over silver. Current rating: 10 amps.

Technical data on these connectors, and special designs requiring the use of sub-miniature, printed circuit, hermetic seal, pressurized, high voltage or power connectors are available on request. Write today for complete catalog.
NEW
HI-PERFORMANCE!

in a new hi-quality miniature potentiometer

Diameter \( \frac{3}{4} \)" 
Weight 1 oz.
Standard Linearity \( \pm 0.3\% \)
Standard Resistance Tolerance \( \pm 3\% \)
Standard Resistance Range 250 to 120 K\( \Omega \)

*Special Resistance and Linearity Tolerances available on request.

price — $15.00 (bushing Mount. Single Lot) Quantity Discounts.

SPECTROLO

HI-PRECISION 10-TURN MODEL 500

Spectrol's highly specialized experience in potentiometer design has produced a sturdy and dependable 10-turn precision miniature potentiometer with outstanding new performance advantages.

Lower starting torque, lower running torque, higher resolution and closer linearity are achieved with new and improved construction, inside and out. Superior design guarantees low-noise performance and consistently reliable operation. Machined aluminum lids, dimensionally stable laminated phenolic housings, precision-ground shafts with ball bearings at both ends are typical Spectrol hi-quality features.

The new Spectrol Model "500" can be tailored to fit your exact needs over a wide range of variations.

Write or call for full details about the new Model 500 — and other Spectrol potentiometers — today.

SPECTROL Electronics Division of Carrier Corporation
1704 South Del Mar Avenue, San Gabriel, California

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HOUSTON  FT. WORTH  SYRACUSE
Fred B. Hill Co.  Thomson Eng. Service  Wally B. Swank
FT. WORTH  FT. WORTH  WASHINGTON, D. C.
HOLLYWOOD  HOLLAND  PITTSBURGH
Hollywood  Hamilton  Samuel K. MacDonald, Inc.
PITTSBURGH  PITTSBURGH  WALLACE
Samuel K. MacDonald, Inc.  Macdonald, Inc.  Wally B. Swank
ST. LOUIS  SYRACUSE
SAN DIEGO  BOSTON  WASHINGTON, D. C.
Gerard B. Miller Co.  Samuel K. MacDonald, Inc.

Sawtooth generators as a rule do not provide an exactly linear wave in that the wave does not start at zero volts and variations in temperatures affect the linearity of the wave. With the generator described in this patent these undesired characteristics are eliminated or minimized and, in addition, the sawtooth wave is generated at zero time upon application of the starting pulse.

The circuit includes an oscillator consisting of tubes 2 and 4 and their circuit elements for generating a gating pulse for discontinuing the generation of the sawtooth wave. The gating pulse from the oscillator is amplified by tube 10 and applied to the cathodes of diodes 20 and 26. The cathodes of these diodes are connected. Normally, the two diodes are conducting.

Upon application of the initiating zero time pulse to the oscillator and to the cathodes of diodes 20 and 26, current through diode 20 is cut off. So long as diode 20 is passing current, capacitors 40, 42 and 44 are not charged. With diode 20 cut off, the charging current passes through diode 36 and charging resistors 32. Charging of the capacitors causes the bias on grid 45 of amplifier tube 46 to rise, so that the cathode potential of this tube increases as charging progresses. The potential of cathode 48 is applied to the cathode of diode 36. As the potential on the lower end of resistors 32 increases, the potential at cathode 34 or the upper end of the charging resistors...
also increases. A substantially constant potential is maintained then across the charging resistors 32 and linearity of the sawtooth wave is maintained for about 70% of its potential increase. By connecting resistor 60 between the cathode of the tube 46 to the connected plates of capacitors 42 and 44, compensation is provided for the circuit, so that the linearity of the sawtooth wave is maintained for 90% of its potential increase. The oscillator gating pulse restores diode 20 to its conducting state and charging of the capacitors ceases. The output of the circuit is taken from cathode connection 58 of tube 46.

Charging capacitors 40, 42 and 44 are temperature compensated by capacitor 40 having a negative temperature coefficient and capacitors 42 and 44 having a positive temperature coefficient. In this way any change in the temperature which may affect the capacitors is compensated for. Preferably, too, the charging resistors are wire wound so that they maintain their resistance substantially constant over the operating range of the circuit. The circuit generates a sawtooth wave of good linearity which begins at zero time and at zero potential and is temperature compensated.

Frequency Control . . . Patent No. 2,738,422. Leslie L. Koros. (Assigned to Radio Corp. of America.)

A frequency control system for a magnetron operating in the microwave frequency spectrum. A stable electronic oscillator operating at a submultiple of the magnetron frequency is appropriately coupled to the output of the magnetron. The coupling is such as to synchronize the magnetron frequency to the frequency of the stable oscillator.


An electron tube with two beams and appropriate deflection plates for controlling the position of the beams. By utilizing two collector plates for each beam and applying feedback from a collector of each beam to a deflection plate for the other beam, it is possible to build a bistable device with two stable beam positions. To change the state of the device it is only necessary to apply an external voltage to another deflection plate, thereby moving the beams to the other stable state.
ALTO Subminiature Transistorized Voltmeter

Two models—10 cps to 1 MC and 5 cps to 500 KC
1 mv to 300 v full scale; reads to 50 microvolts

±3% accuracy, 20 cps to 500 KC or 10 cps to 200 KC
High input impedance, low stray pickup, no noise
Battery powered, wt. 30 oz., portable or rack mounting

The revolutionary new Alto subminiature D-21A/B provides highest accuracy, 1 mv full scale sensitivity, complete temperature stability 0 to 120° F, and hum-free operation. No ac power supply; operates anywhere. 12 decade ranges, meter reads direct in db (−20 to +2 db) or volts (0-1 or 0-3). Battery powered, 130 hours continuous duty. Output terminals for monitoring with 1,000 ohm and higher impedance devices. 10 megohm input impedance. Ideal as null detector, for unbalanced voltages measurements, general use in laboratory and field.

Two models: D-21A — 10 cps to 1 MC — $250.00
D-21B — 5 cps to 500 KC — $250.00

(Rack mount $5 extra per instrument; request details.)

Prices f.o.b. factory. Data subject to change without notice.

ALTO SCIENTIFIC COMPANY
855 Commercial Street • Palo Alto, California
DAvenport 4-4733

CIRCLE 242 ON READER-SERVICE CARD FOR MORE INFORMATION
Texas Instruments expanding research and development programs have opened outstanding opportunities for physicists (solid state) and electronics engineers. TI offers you real chances for advancement in a rapidly-growing industry. Positions are now available in the following fields of engineering:

- Transistor device development
- Transistor circuit applications
- Automation and test equipment design
- Microwave component development
- Infrared radiation development
- Transformer design
- Resistor engineering
- Electrical meter design
- Production planning and control

At Texas Instruments you will have the long-range stability of a 25-year-old firm with many notable “firsts” in the fields of semiconductors, geophysics, radar, infrared radiation, and others. You will enjoy the many living, cultural, and recreational rewards of the sunny Southwest. We would be glad to discuss these career opportunities with you . . . our profit-sharing plan and other personnel advantages at Texas Instruments.

Contact Personnel Director.

Texas Instruments
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

The cold cathode tubes used in flip-flop circuits have limitations in the speed of operation which is determined by the de-ionization time of the gas content of the tube. If this time is reduced, the counting rate of a flip-flop circuit can be increased with accuracy in the count. In addition, a tube with higher sensitivity and having a voltage swing which is greater has its advantages.

This patent describes a tube with these improvements by providing an anode symmetrically located between a pair of cathodes and a tube filling. The tube is of a gas such as helium containing from one to five per cent of water vapor or hydrogen or mixtures of both.


A variable inductor for high power applications which utilizes a coil form mounted on bearings. The coil is wound around this form and makes electrical contact through roller brushes which move along the coil as the form is rotated. By rotating the coil form it is possible to vary the effective number of turns and thus the inductance of the coil.


This patent describes a triode-heptode mixer circuit in which a substantial increase in the conversion gain is secured.

The input signal is applied to grid 17 of the heptode section. Local oscillator 1 applies its frequency to the first grid of the heptode section, which is continuous with the control grid of the triode section. Plate 35 of the triode is connected with screen grid 16, 18 of the heptode; thus it is connected with the same source of d-c potential that is applied to these screen grids. Bypass capacitor 22 keeps the screen grids and plate 35 at ground potential so far as radio frequencies are concerned. Plate 20 of the heptode receives its potential through inductance 31, which has a capacitor 32 in parallel with it, so that the plate circuit

---

P.S.* save space, time and money-

with EDCOR * Packaged Selectivity DECADES!

Newest in the line of EDCOR adjustable and fixed Polystyrene Decades is the 1 to 10 mfd PS model. The EDCOR PS Decades maintain high insulation of 10^5 meg/mfd, precision up to 1%, long-time stability and the space-saving benefits of precision capacitors combined into a single package. EDCOR PS Decades are widely used in Analog Computers, Filter Designs, Laboratory Standards.

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Filters • Networks • Comparison Bridges • Decade Boxes • Servo-circuits.

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CIRCLE 244 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • July 15, 1956
can be tuned to the i-f output of the circuit.

The heptode section of the tube need not be a 5-grid section but may have as many grids as desired. The only requirement is that input grid 17 be well shielded from the grid of the triode section. Since a common grid for both tube sections has the local oscillations applied to it, the electron stream in the heptode is modulated by both the local oscillation and the input frequency, resulting in an i-f output. By maintaining plate 35 of the triode section of the mixer circuit positive with respect to its cathode, the circuit secures a substantially increased gain in frequency conversion.
Giannini has created a completely new potentiometer to work hand in hand with today's rapid advancements in electro-mechanical systems. The Giannini 875T high temperature potentiometer, recommended for applications requiring high power accommodation at elevated temperatures, is capable of continuous operation at temperatures to 200°C and is constructed to dissipate two watts at 150°C. In addition to its outstanding thermal characteristics, this precision potentiometer offers the precise linearity and fine resolution usually associated with much larger instruments.

875T — the most significant milestone in potentiometer achievement since the introduction of Giannini's infinite resolution "Spiralpot" — rounds out the definitive line of Giannini electro-mechanical products which also includes the well known ultra-low torque "Microtorque." Just as these instruments are unique in their respective categories, it is anticipated that the 875T will similarly become the standard for high power, high temperature applications.
setting new standards for dependability in sub-miniaturization

Let the facts speak for themselves! ACE Sub-Miniature Precision Wire-Wound Potentiometers and Potentiometer Trimmers are the result of 4 years development and over a year of successful use by leading electronic equipment manufacturers. Users have conclusively proved that ACEPOTS and ACETRIMS meet requirements for space and weight saving compactness, while at the same time meeting MIL specs’ most stringent qualifications for performance and dependability. Why invite trouble with untested components when you can protect your reputation with ACEPOT and ACETRIM... the subminiature potentiometers and trimmers proved in actual use.

Condensed Engineering Data

<table>
<thead>
<tr>
<th></th>
<th>ACEPOT (potentiometer)</th>
<th>ACETRIM (trimmer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance Range</td>
<td>200 to 250K ± 2%</td>
<td>10 to 150K ± 3%</td>
</tr>
<tr>
<td>Linearity</td>
<td>±3%</td>
<td>±3%</td>
</tr>
<tr>
<td>Resolution</td>
<td>extremely high</td>
<td>excellent</td>
</tr>
<tr>
<td>Ambient Temperature</td>
<td>-55° C to 125° C*</td>
<td>-55° C to 125° C</td>
</tr>
<tr>
<td>Torque</td>
<td>low or high</td>
<td>low or high</td>
</tr>
</tbody>
</table>

The above specifications are standard — other values on special order.
Available in threaded bushing, servo, flush tapped hole or flange mounting, and ganged units. All units sealed, moistureproofed, and anti-fungus treated. Meet applicable portions of JAN specs and MIL-E-5272A standards.

*New X-500 ACEPOT operates to a new high of 150° C.

Expedited delivery on prototypes; prompt servicing of production orders. Send for Fact File and application data sheets.

ACEPOT* ACETRIM*

ACE ELECTRONICS ASSOCIATES

Dept. ED 101 Dover St. • Somerville 44, Massachusetts

CIRCLE 247 ON READER-SERVICE CARD FOR MORE INFORMATION
Means for Changing Coupling Impedance

... Patent No. 2,735,902. Aubrey W. Vose. (Assigned to The Houston Corp., Los Angeles, Calif.)

A means for changing the loading on a tuned circuit and thereby changing the Q of the circuit. By applying a bias to a crystal diode it is possible to alter the coupling circuit in a tuned amplifier such as to change the bandwidth of the amplifier.

System of Depth Measurement in the Acoustic Fathometer or the Like


A method of measuring the depth of a body of fluid. The system operates like an ordinary fathometer except that a double reflection is used. The transmitted signal is reflected first off the bottom and again at the surface so that the elapsed time measures twice the depth of the fluid. It is possible to measure the depth without knowing the distance between the transducer and the surface of the fluid.

Coarse and Fine Measuring System


An electrical system for measuring distance on both a fine and coarse scale. The current through a coarse control potentiometer is read on one meter which is calibrated in a coarse scale, for example, feet. A fine adjustment potentiometer supplies a current to a second meter (which is calibrated in inches) as well as to a second coil on the first meter. Thus, the first meter reads total distance while the second meter can be used to measure small changes in distance.

Process of Electrostatic Printing

... Patent No. 2,735,784. Harold G. Grieg and Charles J. Young. (Assigned to Radio Corp. of America) Process of Electrostatic Printing

... Patent No. 2,735,785. Harold G. Grieg. (Assigned to Radio Corp. of America)

A printing process in which an electrostatic field forms a dry powder image. This image is then converted into a black color on heating.
Multielement Semiconductor Devices . . .
(Assigned to Radio Corp. of America.)

An electrical device comprising a semiconductor body having four alternating regions of P-type and N-type material. A simplified diagram is shown below. The biases are so arranged that in operation the device is effectively a three stage grounded emitter amplifier. The first and third stages utilize a n-p-n type structure while the second stage uses a p-n-p type.

The Curtiss-Wright
"SNAPPER"

NEW CONCEPT...ADVANCED DESIGN IN THERMAL TIME DELAY RELAYS

Designed for high performance and long life, the Curtiss-Wright "SNAPPER" Thermal Time Delay Relay is proving itself in countless applications involving time delay in electrical circuits. Such applications include circuits to provide definite on-off time intervals to delay the application of high voltage until after warm-up period and for over and under voltage protection with simultaneous fault indication.

These relays have single-pole double-throw contact action, high ambient temperature range, freedom from chatter and arcing, and are small in size. The "SNAPPER" thermal time delay relays are factory pre-set from 3 to 120 seconds. They are available in metal envelope, miniature (7 and 9 pin) or octal (8 pin) and in a glass envelope in 9 pin only.

Curtiss-Wright manufactures the High-Low "SNAPPER" Differential Thermostat with high precision characteristics. Write to Thermal Devices for complete information.

CIRCLE 249 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN  •  July 15, 1956
Where requirements call for an insulation that can take constant abuse...flexing, creasing, pounding and twisting, without cracking, crazing or loss of dielectric strength...specify Resinite Vinyl Glass. This superior vinyl impregnated Fiberglas* sleeving surpasses all NEMA standards and offers these many advantages:

- 8,000 volt minimum dielectric breakdown rating (Grade 8000).
- Excellent chemical and oil resistance.
- Outstanding abrasion and cut-through resistance.
- For operation from —50° to 395°F (20 hours).
- No wicking.
- Grades B-A-1, B-B-1, B-C-1 and B-C-2.
- Sizes #24 to ¾". To 2" on special order.
- Eleven colors.
- Priced comparably to ordinary cotton or rayon base insulations.

Call your Resinite representative or write for samples and performance data. Test Resinite Vinyl Glass in your own lab and prove its vast superiority.

*Reg. TM-Owens-Corning Fiberglas Corp.
**NOW! .0005” TEFALON TAPE!**

- Easier to handle and wrap
- Provides greater Teflon coverage at less cost
- Ideal for capacitors, transformers, wrapped or sintered cables or wires, and similar items
- Supplied in continuous rolls on a 1½” I.D., wound to approx. 6” O.D. in widths from ½” to 12”.
- .001” and .0015” tapes as well as conventional thicknesses to .060” also available.

Price $24.00 to $28.00 per pound.
Conventional tape at competitive prices.

**Enflo TEFALON**

STOCK AND CUSTOM-MACHINED MATERIALS

**ENFLO CORPORATION**

Route 38 at Airport Circle, Pennsauken, N.J.
CIRCLE 251 ON READER-SERVICE CARD FOR MORE INFORMATION

**PREFERRED FOR PRINTED CIRCUITRY**

U. S. Components double-row Printed Card Receptacles are engineered to meet the critical demands of printed circuit applications. Series UPCR-DTP Receptacles are available with from 6 to 22 contacts per row, for 1/16” or 3/32” printed cards.

Beryllium copper “snap-in” contacts with taper-pin terminals are completely embodied within a high-compression glass-filled Alkyd molding. These low resistance contacts have high channel strength, retaining tension without stress or distortion. Available with or without polarizing pins, Series UPCR-DTP Receptacles are designed to accommodate AMP Series 53 taper pins.

For specifications and application information on the entire line of U. S. Components printed card and signal circuit connectors, write TODAY to:

**U.S. COMPONENTS, INC.**

454 East 148th Street, New York 55, New York

“Pioneers in Connectability”

Pat. Pending

CIRCLE 252 ON READER-SERVICE CARD FOR MORE INFORMATION
Books


Based on work of the Naval Reactors Branch of the Atomic Energy Commission in the design, construction and testing of shielding for reactor plants, this volume has wide application to many other projects. The design methods described include detailed illustrations of the use of general formulas in actual shield design, as well as brief derivations of many of them.

The section on materials deals with the basic components of shields, such as concrete, iron, stainless steel, lead, polyethylene, and various borated compounds. These are treated in detail and the economic comparison of various concretes should be of particular interest and value to the shield designer.

There are also useful tabulations and figures on flux to dose conversion, build-up factors, gamma rays resulting from neutron capture, and various formulas for different shield geometries. Additional features include a discussion based on actual experience of placement of coolant machinery and structure inside the secondary shield. Hints and graphs for determining source points in a numerical procedure for finding attenuation through shields are helpfully given.


Now, for the first time, the sustained accuracy of all-metal case construction is available in 10-turn and 3-turn potentiometers. These multi-turn units are capable of withstanding the severe environmental conditions required by military specifications and provide the user with high accuracy, reliability and long life.

ALL-METAL CASE CONSTRUCTION IN 10-TURN AND 3-TURN POTENTIOMETERS

The Types 930 and 933 are 1.812 in. diameter. In the Type 930 a linearity tolerance of ±0.05% is standard with linearity to ±0.025% for resistance of 2K ohms and greater. In the Type 933 the standard linearity tolerance is ±0.10%, with ±0.05% available in resistances of 10K ohms and above. Mechanical and electrical rotations are 360° for Type 930, with standard tolerance of ±0°, ±4° or in special cases, ±0°, +1°. For Type 933, rotations are 1080°, with standard tolerance of ±0°, ±4° and special tolerance of ±0°, +1°. Furnished with all standard mountings. Flexibility of design makes it possible to supply many types of special mechanical and electrical features.

SAMPLES AVAILABLE ON ORDER

Fairchild’s complete line can help solve all your precision potentiometer problems. For more information write Fairchild Controls Corporation, Components Division, 225 Park Avenue, Hicksville, L. I., N. Y., Dept. 140-65N3.

CIRCLE 253 ON READER-SERVICE CARD FOR MORE INFORMATION
This book presents the basic fundamentals of electronic devices as needed by men in industry, and explains how these devices are used in practical circuits. The author stresses the use of vapor or gas tubes. Several laboratory electronic instruments are discussed, as well as the many non-electronic devices often used in electronic equipment.

In this second edition, recent designs of industrial controls have been substituted. Those for resistance welding are covered more completely. A chapter has been added on simple closed-loop systems, giving a basic introduction to servos and the new field that includes automation.

The material is arranged and supplemented so that it may be used for a general or survey course by university students of mechanical, chemical, civil or aeronautical engineering; it can also be used as a supplementary text in electrical engineering.

The book supplements the material found in more specialized texts; its objective is to awaken interest in various phases of industrial electronics so that the reader is encouraged to use other texts for a complete coverage of the desired subjects.


This book has been organized to help the reader to understand the important ideas pertaining to the basic types of r-f transmission lines. A minimum of mathematical treatment has been employed, but the analyses are sufficiently extensive to permit the practicing engineer to develop these fundamental concepts and basic applications to best advantage.

Specific attention has been given to the various types of line in common use; the problem of lumped and distributed constants; variations of constants; characteristic impedance; line termination; standing waves; standing wave ratio; input impedance; line losses; the half and quarter-wavelength line; resonant lines; the Lecher wire line; supporting stubs; delay lines; and artificial transmission lines.

A number of sample problems are given in sufficient detail, wherever applicable and pertinent, to permit the reader to apply the demonstrated procedures to situations that may confront them.

---

**ENGINEERS**

**INERTIAL NAVIGATION**

**development program for an advanced Air Force missile**

Inertial Navigation offers the most advanced concept in guidance, requiring no terrestrial source of energy or information, no earth-bound direction once the ultimate destination is selected. It offers the most promising solution of the guidance problem for the long-range missile.

While the principles are simple, the realization involves advanced creative engineering. ARMA's many successes in the creation of precision instruments and systems for navigation and fire control, especially precision gyroscopic reference systems for all applications, fit it uniquely for a major role in this advanced area.

The height of imaginative resourcefulness and engineering skill are required to create the degree of precision—hitherto unattained—in the components essential to the guidance of advanced missile systems—the gyros, accelerometers, and computer elements. Miniaturization must be coupled with extraordinary ability to provide utmost accuracy under conditions of extreme velocities, temperatures, and accelerations.

There's significant scientific progress to be achieved at this leadership company and individual renown to be won, by engineers associated with ARMA's Inertial Navigation Program. Many supplementary benefits make a career here doubly attractive. ARMA engineers are currently working a 48 hour week at premium rates to meet a critical demand in the Defense Dept's missile program. Moving allowances arranged.

Salary—up to $15,000

Immediate openings for Supervisory and Staff positions as well as for Senior Engineers, Engineers, and Associate Engineers, experienced in:

- Systems Evaluation
- Gyroscopes
- Digital Computers
- Accelerometers
- Telemetry
- Guidance Systems
- Reliability
- Stabilizing Devices
- Servomechanisms
- Automatic Controls
- Thermodynamics
- Environmental Research
- Weight Control
- Transformers
- Production
- Test Equipment
- Standards

Division of American Bosch Arma Corporation
Roosevelt Field, Garden City, Long Island, N. Y.
Regulation in less than 1/50th cycle...

Output of typical electromechanical regulator in response to step change in input voltage. Average correction rate of 6v. per sec.

Output of Curtiss-Wright Distortion Eliminating Voltage Regulator from same input. Full recovery in 330 microseconds.

Simultaneous two-pen recording of 60 c.p.s. voltage

**PLUS** Pure Sine Wave Power

**CURTISS-WRIGHT LINE REGULATOR**

- Electronically regulates r.m.s. and peak voltage simultaneously to ±1%.
- Reduces typical power line distortion to less than 0.3%.
- Furnishes 1.4 KVA of distortion-free power.
- Introduces no phase shift between input and output.
- Simultaneously provides additional 4 KVA of ±1% electromechanically regulated power.

Faster recovery time (less than 1/50th cycle, or 330 microseconds) plus the unique ability to eliminate line distortion — these are the reasons why the Curtiss-Wright Distortion Eliminating Voltage Regulator has been chosen by more and more laboratories and production test departments. Besides general laboratory use, this line regulator provides simpler, more accurate calibration of meters... better design of transformers, synchros, motors... easier testing of such components, with fewer rejects... easier, more accurate measurement of magnetic properties and receiver sensitivity... better a.c. computer performance... elimination of fast line transient effects. Write for details.

Electronic Component 
& Instrument Sales Department

CIRCLE 255 ON READER-SERVICE CARD FOR MORE INFORMATION
Specify *BIRTCHER N.E.L. CORRUGATED INSERTS

**MATERIAL**
- 0.03 spring brass

**FINISH**
- Matte black to N.E.L. specification

**SIZES**
- 6 sizes available to fit all T-5V2 (7-pin) and T-6V2 (9-pin) miniature tubes

N.E.L. reports that 85% of all electronic equipment failures are caused by tube failures and the major cause of tube failure is excessive heat. The use of a Birtcher corrugated insert between miniature tube and JAN shield reduces tube temperatures well below bare bulb temperatures.

**THE BIRTCHER CORPORATION**
INDUSTRIAL DIVISION
4371 Valley Blvd.,
Los Angeles 32, Calif.

CIRCLE 256 ON READER-SERVICE CARD FOR MORE INFORMATION

---

**PRECISION PHASEMETER**

- **0.1° ABSOLUTE ACCURACY**
- **0.01° incremental accuracy**
- **30 to 20,000 cycles per second**
- **0 to 360° phase range**
- **10-megohm input impedance** (shunted by 25 μμ)

Output connection for strip-chart recorder.
Self-contained power supply for 105-125 volts, 50-60 cycles.
Adaptable to standard relay-rack mounting.

The New Maxson Model 901 Precision Phasemeter is a direct-reading electronic instrument adaptable to a wide variety of demanding measurement applications in computers, synchros, and amplifiers. The instrument measures phase difference between two sinusoidal voltages; phase angles are read from a two-degree, step control with vernier indicator having a precision of 0.01°. Built-in sensing provides direct reading of proper quadrant. Accuracy is independent of even harmonics and of third harmonics up to 1%. Input-level range is from 0.5 to 10 volts rms. Write or phone us for further information.

**MAXSON INSTRUMENTS**
DIVISION OF THE W.L. MAXSON CORPORATION
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Long Island City 1
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CIRCLE 257 ON READER-SERVICE CARD FOR MORE INFORMATION
Reliability Factors For Ground Equipment

This book discusses the numerous reasons why military electronic equipment does not have the necessary reliability. Statistics pinpoint the most likely and most prevalent malfunctions and finally, ways by which greater reliability in future equipment can be accomplished are pointed out.

Although primarily aimed at the designers of ground equipment, the problems and most of their solutions are general and the techniques are applicable to industrial as well as military equipment designers.

The book covers useful fundamentals of statistical methods, electrical and mechanical engineering principles, the human engineering side of the problem, some broad principles governing the selection and use of component parts and tubes, and some comments and data on training and service manuals and maintenance. All are dealt with for their effect on reliability and interest to the equipment designer.


This directory contains approximately 9000 names of manufacturers who distribute their products through manufacturers’ agents. The guide provides a comprehensive, alphabetical listing of the manufacturers and their addresses, and includes information on their principal products, estimated financial strength and the name and title of the sales executive.

The guide details the appropriate steps to follow in communicating with manufacturers, suggests commission scales for various products, and provides data on operations as an agent.


This book covers almost every legal subject bearing on engineering, with a view to helping avoid legal action in the first place, and permitting effective collaboration with lawyers should difficulties eventually arise.
The author first explains legal principles in text style and then presents actual cases to exemplify each topic covered. These examples conclude with a succinct summary of the court decision. Problems are also included for the purpose of putting the principles in factual context, but here, the author refers the reader to the specific case rather than providing its solution.

Specific points covered in the book are: contracts, sales, negotiable instruments, insurance, personal property, real property, torts, workmen's compensation, agency, business organizations, municipal corporations, labor law, ethical responsibilities of engineers, professional registration of engineers, construction contracts and specifications, governmental regulations of business, patents, copyrights, trademarks, and air and stream pollution.


Information handling is the central theme of this book. The author views the office as a kind of "information factory," turning raw information into processed information that serves a management objective. Integrated data processing facilitates the initial handling of information, electronic computers aid in the processing of information, and operations research contributes to the use of information.

The author primarily directs the book to the management profession, and he presupposes little direct association with office machines or office methods. Greater emphasis is given to specific techniques. It defines and explains basic concepts and provides a stimulating view of potentialities. Included are useful illustrations, charts, and tables.

The book provides a basic understanding that will be helpful to the manager in organizing programs to obtain more effective information. It will aid in setting goals for such programs and in directing the work of staff specialists.

Accountants, systems and methods men, operations researchers, computer specialists, and statisticians will find the book of interest because management will expect them to understand and apply these new techniques.

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Soviet Analog Computer

This analog computer, called the EMU-5, was developed in 1954. The design objectives were small size and low current consumption. It consists essentially of a linear computer intended for solution of linear differential equations up to the sixth order inclusive, a non-linear attachment to solve non-linear differential equations, oscillograph, power supply, and auxiliary control unit, Fig. 1.

The non-linear portion comes also in a different variant using a multiplication-division block and a functional converter designed to reproduce prescribed fixed functions. The linear portion measures 690 x 600 x 500mm, the non-linear portion measures 690 x 500 x 350mm, the power supply measures 360 x 485 x 287mm. (One individual multiplier and one functional converter unit fits between the handles of the linear unit if this scheme is used.)

The power drain of the linear portion is approximately 254w, and that of the non-linear portion is approximately 500w.

Additional auxiliary equipment consists of a functional converter employing a delay circuit, an electro-hydraulic converting device, and a coefficient-varying device for solving equations with time-variable coefficients.

The linear section of the equipment consists of 12 computing amplifiers with automatic zero-level stabilization, 30 resistance boxes permitting variation of a transfer coefficient over a range of 100 to 1 (for amplifiers) or 10 to 1 (for integrators), and bridge-type voltage dividers which permit continuous adjustment of the transfer coefficient from 1 to 0.001, Fig. 2.

Fig. 4 shows the method of switching the input resistance, feedback resistance, and voltage dividers together with the computing amplifiers, to vary and establish the required transfer coefficient. Fig. 5 shows an alternate circuit for adjusting the transfer coefficient of the computing amplifier.

The non-linear section contains also 6 dual computing amplifiers for sign reversal, Fig. 3, and 12 computing amplifiers with automatic zero-level stabilization. The non-linearities of elementary functions are reproduced with the aid of diode circuits, using the piecewise linear approximation. Different non-linear functions are obtained by various combinations of...
These actual production figures were recently compiled by a prominent semiconductor manufacturer... and all indications are that Constantin rejection rates are becoming even more infinitesimal! Constantin's six separate check points maintain rigid, meticulous inspection — from start to finished mount... 100% final inspection insures perfect units.

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This is a high voltage power supply for electrostatic dust collecting and air conditioning equipment. Operating on 230 volt single phase, 60 cycle, it supplies 12 KV direct current up to 30 ma. D.C. voltage is adjustable to load.

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How to select a Thermistor

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tions: a) Varies the period of the process from 2 to 50 seconds and automatically stops the process at a definite instant; b) Switches on or off the input signal at a definite prescribed instant of time; c) Reconnects the circuit at a definite time; d) Produces time markers for a cathode ray indicator tube with long-persistence screen; e) Switches the vertical plates of the cathode ray tube of the oscillograph to permit simultaneous observation of two processes.

The Fig. 10 illustrates the principles of the control method employed, and Fig. 11 shows an overload indicator for the computing amplifiers. Condensed from an article "New Electronic Analogue Apparatus of the Institute of Automation and Remote Control of the USSR Academy of Science, V. V. Gurov, B. Ja. Kogan, A. D. Talanisev, and V. A. Trapeznokov. Automatika I Telemekhanika, No 1, Jan. 1956.

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Russian Translation

New Russian Electronic Monthly

WE just received the first issue of Radiotekhnika i Elektronika (Radio Engineering and Electronics), a new monthly published by USSR Academy of Sciences, devoted to original reports and survey articles on theoretical and experimental advances in electronics and electron physics. The editor-in-chief is V. A. Kotel'nikov, and he is assisted by D. V. Zernov and Iu. B. Kozharev. The editorial board numbers some of the most prominent Russian scientists in the field and consists of A. G. Averbakh, A. I. Berg, V. A. Vvedenskii, N. D. Deviatkov, L. I. Dobretsov, A. F. Ioffe, S. G. Kalashnikov, P. L. Kapitsa, M. S. Kozodoiev, A. L. Mints, A. A. Pishkov, A. M. Prokhorov, S. M. Rykov, S. E. Khaikin, and B. M. Tsarev. Many of these names are by now familiar to readers of “What the Russians are Writing,” and the inclusion of Peter L. Kapitsa is an indication that electron physics will be prominently featured.

The last page of the magazine carries an announcement by the editorial board that the periodical will be devoted to the following topics:

U.H.F. electronics and instruments.
Electron emission.
Semiconductor electronics and instrumentation.
Discharges in gases and ionic instruments.
Electronic instruments (theory, design methods, new principles, and new types).
Electron optics and electron-optical instruments.
Vacuum techniques.
Antennas, feeders, waveguides, and cavity resonators.
Propagation of radio waves (in troposphere and ionosphere).
Communication theory.
Statistical radio-physics (noise, thermal radiation, propagation of radio waves in statistically inhomogeneous media).
Frequency stabilization (parametric, piezoelectric, molecular).
Theory or radio circuits.

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Radio-circuitry elements.
Radio astronomy.
Radio spectroscopy.
Radio-engineering and electronic applications in science and industry.
Radio-engineering and electro-vacuum materials.

The magazine will also publish proceedings of conferences and conventions held by the USSR Academy of Sciences organizations, and will report on foreign conferences in which its members participate.

Like all other Russian publications of interest to its readers, ELECTRONIC DESIGN will abstract this magazine regularly. The contents of the first issue is given below, and a summary will be published as soon as possible.

Radio tekhnika i Elektronika, Vol 1 No 1, January 1956.

Cold Cathode Emission and Emitters, D. V. Zernov, M. I. Elinson.

Time-Duration Distribution of Normal-Fluctuation Deviations, V. I. Tikhonov.

Effect of Semi-conducting Film on Attenuation of Electromagnetic Waves in Waveguides of Circumferential Cross Section, V. V. Malin.


Possibility of Extending the Similarity Concept to Multiple-Cavity Magnetrons with Different Numbers of Cavities, I. I. Rogovin.

Coherent Electron Beams in Synchrotrons at Centimeter Frequencies, E. S. Voronin, R. V. Khokhlov.

Mutual Synchronization of Reflex Klystrons, R. V. Khokhlov.


Photocells and Photo Multipliers with Magnesium Cathodes for Recording Ultraviolet Rays, O. P. Dorf, N. G. Kokina, T. M. Lifshits, D. A. Shklover.

Discussions and brief notices.

Russian Atomic Energy Publications

The 87 scientific and technical papers on atomic energy presented at a conference sponsored by the USSR Academy of Sciences in Moscow, July 1955, have been translated into English and are being published in four volumes.

Volume 1, physico-mathematical sciences covers properties of heavy elements, work on uranium-graphite reactors, and lattices, radiation effects etc., 23 papers, $1.25. Volume 3, treats application of nuclear technology to industrial processes and prospecting, 18 papers, $1.00. Volumes 2 & 4 cover chemical and biological sciences, respectively.

These volumes will be available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C.
Naval Research Laboratory Reports

The Office of Technical Service, U.S. Department of Commerce recently undertook to distribute the monthly "Report of NRL Progress." This is another endeavor on the part of OTS to bring to the attention of industry engineers results of work either being done by the government or under government sponsorship. The Editors of ELECTRONIC DESIGN are very happy to help OTS "pass the word." We are particularly impressed with the style of the report of the NRL Progress. It gives the reader understandable information efficiently. We are reproducing excerpts of interest to electronic designers here to give you an idea of the report's organization.

You can subscribe to this monthly by applying to OTS, Washington 25, D.C., price $1.50 per year. (Each issue contains reports on the following subjects: astronomy and astrophysics; chemistry; electricity; mathematics; mechanics; metallurgy and ceramics; nuclear and atomic physics; optics; radio; solid-state physics. Each issue also contains several feature articles on some of these subjects. A typical issue is about 60 pages in length.)

January 1956

L-Band Amplifier

Background: The characteristic most generally sought in the design of receivers for radar systems is a low noise figure. In the present state of the art the lowest noise figures for conventional receivers are obtained with crystal mixer front ends above 2000 Mc and with r-f amplifiers using coplanar triodes below 1000 Mc. This is due to the fact that the internal noise of triodes increases with the radio frequency while that of crystals remains essentially constant. Between 1000 Mc and 2000 Mc, and particularly in the 1250-1350 Mc band used for many search radar systems, the two types of front end are competitive. Although crystal mixers under optimum conditions have a slight edge of about 1 db in noise figure, and are, in general, simpler and less expensive, they are much more subject to burnout and hence require greater protection from the duplexer. It may be advantageous, therefore, to use an r-f amplifier front end in some cases, particularly in modifying existing radars where crystal burnout is known to be severe.

Progress: Radio-frequency amplifiers for L-band radar receivers afford considerably greater reliability than do crystal mixers, which are subject to burnout. Thus, they may prove desirable for many radar systems in spite of the fact that crystals provide slightly better noise figures under optimum conditions.

A simple and compact coaxial cavity amplifier for the 1250-1350 Mc range has been designed using a GL-6299 (Z-3011) triode. The input is taken from a tunable TR cavity by means of an adjustable loop, and the output is fed to a Point-type mixer. Tuning is accomplished by a simple susceptance screw parallel to the cavity axis.

Noise figures ranging from 8.0 db to 8.5 db were measured. Available as a separate report PB111907, "A Low-Noise L-Band Amplifier" by L. Hoffinan and H. Montague, III, Feb. 1956, 8 pages, $0.50. Order from OTS.

Circularly Polarized Antenna

Background: A type of antenna which has been under study consists of crossed slots cut in the wall of a rectangular waveguide in such a way as to radiate circular polarization.

Progress: A pair of narrow slots crossed at right angles and located at the proper point in the broad wall of a rectangular waveguide will radiate a circularly polarized wave. Some of the results of a study of the properties of such slots is presented. The study was undertaken with the aim of obtaining information useful in design of a circularly-polarized linear array.

Some of the properties of the slot pair are as follows: 1. They are inherently matched, independent of the slot length. 2. When the slot arms are made resonant, approximately 75% of the incident power is radiated, with a VSWR of 1.12-3. 3. When fed from one end of the waveguide, the slots radiate right hand circular polarization; from the other end, left hand.

In using these slots in linear arrays the power radiated is varied by changing slot length since position and orientation are fixed by the requirements of circular polarization. The slots must be separated by a guide wavelength, so waveguide loading or other complicated schemes must be used to reduce the slot spacing. Available as a separate report PB111904, 14 pages, $0.50. Order from OTS.

The January issue also included a brief feature article, describing "Chopper for 8.7-Millimeter Wavelength." The unit is lighter in weight and more com-
February 1956

Receiver Antenna Filters

Background: A general problem associated with the use of receiving equipment in an area of strong transmitted signals is that of reducing the strength of undesired signals to a level which can be accepted by the receivers, or, where used, by the receiver multcouplers. The use of trap filters inserted in the antenna system transmission line offers an obvious solution. The filters must exhibit a high attenuation at the frequency of the unwanted signal, and low insertion loss at all other frequencies.

Progress: Measurements performed on commercially developed filters (70-ohm impedance and for use from 2Mc to 32Mc) and a subsequent analysis to determine what maximum performance might be achieved, led to a design goal of a minimum attenuation of 40db at a skirt width of ±10kc relative to the rejected frequency, and a maximum insertion loss of 3db at a skirt width of ±5% of the rejected frequency. In addition, the loss should drop gradually to 1db or less over the remainder of the band.

A series of five filters covering the band from 2Mc to 30Mc has been designed and constructed. The attenuation at the ±10kc points rises from a value of 45db at 2Mc to 70db at 30Mc. Attenuation values at ±5% of the unwanted frequency are all less than 2db.

With all five filters in the circuit, which would be the case for rejection of five strong signals from an antenna circuit, the maximum attenuation for areas of desired signal frequencies is 1db. D. B. Keever and M. L. Leppert, Radio Division, Communications Branch.

Research on Millimeter-Wave Components

Background: The millimeter-wave research program was initiated at NRL to investigate the properties and possible military applications of the frequency range above 20,000Mc. Since there were no components or test equipment for the millimeter-wavelength region available at the time, a development and evaluation program was undertaken which covers the millimeter-wavelength range from 4mm to about 1cm.

Progress: The development and characteristics of a series of waveguide components and test equipment, covering the portion of the millimeter-wavelength range 4mm to about 1cm, have been investigated. Included are connectors, standing-wave indicators, waveguides, attenuators, directional couplers, switches, hybrid junctions, adjustable short circuits, crystal mounts, power meters, power supplies, terminations, bends, horns, tees, and tapers.


Rapid Scan Microwave Antenna

Background: Required is the development of rapid scanning antenna designs not unreasonably difficult to build or too heavy to install. A solution depends on designing a focusing objective with good off-axis performance, and on finding a means of obtaining a specified feed motion.

Progress: In the parabolic torus (see NRL Report 4141), rapid scanning of the beam is obtained with an organ-pipe feed system. This antenna has good radiation patterns in the two principal planes but has an objectionably high sidelobe in an intermediate plane owing to inherent phase errors in the parabolic torus. Therefore, attention has been directed toward improving the reflector surface to accomplish a reduction in phase errors.

A new reflector was derived by assuming a toroidal surface, thus utilizing the rotational symmetry of the parabolic torus as before, but determining the generating curve to provide a more optimum balance of phase errors over the illuminated area. The generating curve was derived to be a portion of an ellipse. Phase errors from this new reflector, an elliptical torus, are approximately one-half the magnitude of those from the parabolic torus. Therefore, this elliptical torus can produce better beam characteristics than the parabolic torus. This has been verified by measurements on experimental models of the elliptical torus. For the same f/D (ratio of focal length to diameter) the elliptical torus shows sides lobes down about 4db from those of the parabolic torus. Also beamwidths are smaller indicating increased aperture efficiency. D. H. Archer, Electronics Division, Microwave Antennas and Components Branch.

Klystron Power Supply

Background: In klystron power supplies a need has been felt for a relatively simple d-c voltage regulator which would operate over a wide range of d-c output voltages and currents with a minimum of switching.

Although there are commercial voltage regulators available that will provide low ripple and stable d-c output voltages, these are expensive, complicated, bulky, and hard to incorporate into existing equipment.

Progress: A circuit, which compared to conventional power supplies is simple to construct and has relatively few parts, has been built to give low ripple over a wide range of voltages and currents (schematic given in Report). The following results were obtained: 1. Regulated d-c from -400v to -1000v with no switching. (A 400v 4000v range is possible by switching two resistors.) 2. Low ripple voltage of

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under 10mv was easily obtained over the above voltage range. Under optimum conditions the ripple was as low as 1.5mv at -4000v. 3. A wide range of output currents, depending on the series tube chosen. With an 810 series tube, load currents from 0ma to 100ma were obtained. 4. All tube sockets, filament supplies, and VR tubes are at small potentials with respect to ground. This reduces the hazard to personnel as well as the possibility of failure due to voltage breakdown.

The reduction of hum is good enough to permit the use of the regulator with a supply of poor ripple factor. The regulator was used with a supply where the only filtering was provided by a 2µfd condenser. With 3500v out and series tube current 30ma, the ripple was 0.005v. With 2500v and 100ma, the ripple was 0.02v. D. H. Phillips, Electronics Division, Microwave Antennas and Components Branch.

March 1956
Magnetic Amplifiers

Background: In control applications an analog dividing circuit containing no moving parts has been needed. Magnetic cores offer possibilities.

Progress: The fact that a magnetic core requires a given number of volt-seconds to be driven from saturation in one direction to saturation in the other direction has been utilized to build a dividing circuit. This circuit, employing switching transistors and a single high-remanance magnetic core, provides an output voltage whose average value is the quotient, with the correct sign, of two input voltages. A preliminary model of the divider gives accuracies of ±2.5% of full-scale readings for a quotient range of one hundred to one and input variation of both numerator and denominator of better than ten to one. By varying the waveforms of the inputs, a much more general computing element whose output is proportional to various functions containing quotients can be obtained. An interim report on this problem will be published in the near future as NRL Report 4702, "Analog Computation of Quotients and Functions Containing Quotients Using Magnetic Cores" by D. H. Schaefer, Solid State Division, Applications Branch.

April 1956
The Microwave Turnstile Circulator

Magnetically biased ferrites are being used to impart nonreciprocal properties to new types of microwave components. One of the most important of these new components is the microwave circulator. The turnstile circulator, a simple nonreciprocal four-part network, is perhaps the simplest form of circulator yet described since it requires but a single junction and a 45 Ferraday rotator. Although a "narrow band" device, the turnstile circulator can provide high isolations over usable bandwidths, with very low insertion loss. Theoretical curves permit prediction of isolation bandwidths. Applications include electronic lobe switch-
Propagation in Ferrites

Background: A basic study of the propagation characteristics of ferrite materials at microwave frequencies is being pursued. The phase-shifting, attenuating, and non-reciprocal properties of various materials in waveguides and coaxial lines as functions of an applied dc magnetizing field are of particular interest. Information derived from this study is applied to the design of new type microwave components and antennas.

Progress: The power absorbed by a ferrite-loaded rectangular waveguide increases with power level. As an example, differential phase shift sections having less than 0.25db loss at klystron power levels were found to have from 5db to 10db of loss at peak powers of 100kw. Two methods of obtaining good ratios of differential phase shift to power loss have been found:

1. The first method involves the use of ferrite slabs of small height and large width (40% of the guide). With such a design it is possible to build a 90° differential phase shift section with less than 1db of loss at 100kw.

2. It was felt that some of the increase in loss was due to the incidence of high-order modes which depend on the height of the ferrite slab and the waveguide. Therefore, a septum was placed perpendicular to the narrow walls of the guide, in the thought that this would suppress those modes which have an E-component parallel to the broad face of the waveguide. While hardly affecting the phase shift, the high power loss was reduced in db to about 40% of its previous value. Further work will be carried out to determine if one or more septa can be used to reduce the high power losses of other geometrical configurations. (See also earlier mention in January 1956 issue above.) H. N. Chait, Electronics Division, Microwave Antennas and Components Branch.

The April issue contained a feature article, Some Recent Advances in Radio Astronomy at NRL. The abstract of the article is as follows: The first decade of radio astronomical research at NRL has been unusually active and fruitful. Some of the more recent results include the discovery, development, and application of spectral absorption-line techniques for studying interstellar hydrogen gas. The development of the theory for the hydrogen case suggests that absorption methods enhance the possibility of detecting microwave spectral radiations from other interstellar atoms, molecules, and radicals. There has also resulted from these studies the first radio measurement of a cosmic red shift, using the radio source Cygnus A. The recently obtained radio data provide strong new support for the Doppler interpretation of the cosmic red shifts, upon which is based the concept of the expanding universe. 7 pages; A. E. Lilley, Radio Astronomy Branch, Atmosphere and Astrophysics Division.
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Abstracts

Soldering

Miniature
Connectors

MINIATURIZATION of electronic equipment has required the use of special soldering irons or other soldering equipment to successfully solder the small components into the circuit. Standard soldering iron tips are sometimes larger than the entire component. Small-size soldering irons usually do not provide sufficient heat to prevent cold joints. The use of a large iron with the tip cut down is discouraging as the large voltage heating element overheats the small tip and it soon oxidizes and burns up.

Resistance soldering pencils offer some improvement over the soldering iron, but they too are sometimes too large for miniature components. The high current may burn the contact or even melt the contact.

COLD CATHODE TRIODE NOW STABLE, RUGGED SUBMINIATURE

The KP-96 is a high gain, grid controlled cold cathode tube for time delay, trigger, counter and energy transfer circuits. New design features include small size (T-2) subminiature envelope, only 0.3" in diameter, rugged construction and stable anode hold-off and grid-firing voltages. Within the anode supply voltage range of 100-300v, the firing of the tube is controlled by application of voltage to the grid (95v). The transfer current is far lower than previously available, equaling less than 1.0 microampere. The KP-96 offers a higher ratio of anode hold-off voltage to grid-firing voltage than available before, smaller size, rugged structure, operation in both light and total darkness, high efficiency energy transfer. Since it requires no filament power supply, the KP-96 stands by at full sensitivity consuming no power.

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Excessive current flow through the miniature contact must be avoided if the contact is to remain undamaged. If this current is permitted to flow for a long period of time, the heat generated within the contact will be sufficient to anneal this contact. This annealing will remove the spring qualities from the metal and a "dead" contact results. Also, the contacts may weld together which will damage the connector when an attempt is made to disconnect one from the other.

One method of soldering to the miniature connector is to use a two-prong electric soldering device. This outfit consists of a two-prong soldering gun and a transformer with timer. The two-prong gun is applied to the contact only where the heat is needed—on the solder pocket of the contact. Then the amount of heat is carefully controlled by the timer built into the transformer unit. The length of time is adjusted so that current flows through the connector solder pocket and wire just a sufficient time to permit an adequate solder joint. Proper adjustment of the timer permits just the right amount of heat to be applied to the miniature contact. Even the most inexperienced operator can be expected to get a good clean solder joint.

A second soldering method may be used in soldering leads to the miniature types of ribbon connectors. One lead of the soldering unit is connected to a block which is laid under and touches all contact tails on one side of the connector. The wire is laid into the contact solder pocket and the solder and the other contact of the solder unit applied to the contact. Thus, current flows through the wire and the contact tail only and a good solder joint will result.

The two methods described apply the heat to solder only where it is needed—on the solder pocket of the contact and the wire. The heat time can be controlled, and just the right amount of heat applied to assure a good solder joint. No heat is applied to the contacting surfaces or the spring portions of the contact, therefore there is no chance of damaging the miniature contact.

The use of a small-size two-prong soldering tip makes it easy to remove wires or add wires to the miniature connector even when the wire is in the center of the connector. The timer unit prevents overheating of the contact and is an aid in preventing excessive solder from flowing over the contact. Abstracted from "Soldering Miniature Connectors," Harry M. Neben, Amphenol Engineering News, March 1956, p. 344.
Standards and Specs
Sherman H. Hubelbank

This department surveys new issues, revisions, and amendments, covering military and industry standards and specifications. Our sources of information include the Armed Services Electro-standards Agency (ASESA), the cumulative indexes to Military Specifications, Vols. II, IV, American Standards Association (ASA) and other standards societies.

Mica
NEMA ME1-1956, Manufactured Electrical Mica...Information concerning tolerances, bond content, nominal thickness and dielectric strength is given for mica splitting plates, sheets, and tapes; mica paper plates, sheets, and tapes; and round tubes. Muscovite and phlogopite (amber) mica splits are classified, and the methods of measuring thickness, dimensions of tubes, dielectric strength, binder content, and moldability are described. Copies of this standard are available from NEMA for $1.75 per copy.

Investment Castings
Designed to aid design engineers and other persons specifying investment cast parts, seven new material specs have been released by the Investment Casting Institute. These specs cover general iron-base carbon steels, low alloy steels, cobalt and nickel base super alloys, magnesium base, aluminum-zinc alloy, silicon-magnesium and silicon-copper, and silicon-brass. These new specs are identified by a code number in line with the new code number system developed under the Standardization Plan of the Secretary of Defense, as described in the publication entitled "Cross-Index of Chemically Equivalent Specifications and Identification Code", available from the Government Printing Office. Copies of the seven specs may be obtained for 70 cents from the Investment Casting Institute, 27 Monroe St., Chicago 3, Ill.

AIEE Standards
AIEE has announced the release of the following newly issued standards:
59, Proposed Test Code for Metallic Rectifiers
C39.1, Electric Indicating Instruments (Panel, Switchboard and Portable Instruments)
C50.1, Synchronous Generators, Motors, and Machines in General
C50.2, A-C Induction Motors, Machines in General, and Universal Motors
C50.4, D-C Generators, Motors, and Commutating Machines in General
C50.5, Rotating Exciters for Synchronous Machines
C50.6, Motor-Generator Sets
Copies of these standards are available from the American Institute of Electrical Engineers, 33 West Thirty-Ninth St., New York 18, N.Y. for a nominal cost.

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**ASA Standards**

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**Part Numbering System**

MIL-STD-208A, PART NUMBERING FOR MILITARY STANDARDS, 9 DECEMBER 1955 . Effective June 1, 1956, this standard is mandatory for use by the Departments of the Army, the Navy, and the Air Force. This standard provides a part numbering system for use in the preparation of Military MS (sheet form) standards. It defines an MS Part Number as a designation used to identify a standard part or item. It is composed of the number of the Military (MS) Standard Sheet on which the item is described and a serial (or dash) number assigned to each separate physical item listed on the sheet. It also defines a Military (MS) Standard. This standard is of a graphical form combined with tabular presentation if necessary. These MS Standards are limited to those dimensional and functional details necessary to insure interchangeability of the item.

**Application Design Notes**

The following Application Design Notes have been either revised or newly issued by ASEA:

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<tr>
<td>Resistors, Fixed Film</td>
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<td>10 Feb 56</td>
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<td>Connectors, Electrical, Power</td>
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Specifications listed on these pages are for information only and government contractors should be guided by their contracts. Copies of military specs should be obtained from sources recommended by procuring officers. ASEA bulletins may be obtained from Fort Monmouth, N. J. ASA standards may be obtained from American Standards Agency, 70 E. 43rd St., New York 17, N. Y., unless otherwise noted.

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**Design 56** (p 16) Comments by technical heads of 30 electronic companies on some of the major problems facing them in the immediate future.

**Plug-In Electronic Relay** (p 38) Ultra-sensitive relay circuit such that an input power less than 0.11 mw will control an output up to 115w. (Industrial Electronics Co. Inc.)

**High Compliance Transducer** (p 40) Describing a variable reluctance moving-iron transducer (Present models are phono pick-ups). Its differing characteristic is its extremely small and uniform loading of an input for wide range of frequencies. (Pickering and Co. Inc.)

**Gas-Filled Cavity WaveMeter** (p 42) A highly accurate temperature-compensated wave meter such that it can be used as a secondary standard to calibrate other laboratory wavemeters. (De Morney-Bornardi)

**Visual Frequency Response Indicator** (p 44) A visual frequency response indicator mechanically operated by bass and treble control knobs of a hi-fi audio amplifier. It provides a visual frequency response over the audio range of the amplifier. (Bell and Howell Co.)

**Fast Magnetic Amplifier** (p 46) Small low-power, light weight magnetic amplifier that can operate up to frequencies of 10 M.c. (Beckman Instruments Inc.)

**Electro Static Loud-Speakers** (p 88) A discussion of design considerations, acoustical factors and power output. (Abstract)

**Low Frequency Tape Recording** (p 90) Problems in recording low frequencies on magnetic tape. (Abstract)

**Pulse Amplifier With Two Feed Back Loops** (p 92) A d-c amplifier employing a second positive feedback loop to obtain sufficient gain with low response time and low overshoot. (Russian Translation)

**What the Russians Are Writing** (p 94) Annotated Table of Contents of Radiotekhnikha, July 1955. (Russian Translation)

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**Evaluation of Electronic Test Equipment**, by B. S. Browning (p 20) Discussing the advantages of evaluating test equipment to eliminate duplication of overlap in available equipment and avoid duplications in developing new equipment.

**Loaded-Cores Sandwich for Radomes** (p 22) Metal loaded to substantially the same dielectric constant of its skin, this core behaves as much heavier solid half-wave radome materials. (McMillan Industrial Corp.)

**Designing Cathode Coupled Amplifiers with Conductive Curves** by K. A. Pullen, Jr. (p 24) Design of highly non-linear amplifier stages, as well as the design of linear stages is simplified in many ways by the use of conductance curve techniques described herein.

**Cored Forging Parts for Electronic Devices** (p 28) How cored forging enables high-strength parts to be forged closer to their finished form than is possible in any other forging method. (National Cored Forging Co.)

**Thumb-Tuned Grid Dip Oscillator** (p 30) Wire is paid off the tuner coil onto a storage drum to change the inductance in this unique grid dip meter. (Alto Scientific Corp.)

**Multi-Trace Oscilloscope** (p 32) Twenty-four inputs are displayed simultaneously on this oscilloscope which uses a television-type raster. (Southwestern Industrial Electronics Co.)

**Accurate Oscilloscope Phase Shift Measurements**, by H. D. Webb (p 34) More accurate determination of phase shift with a cathode-ray tube made by measuring the axes of the ellipse rather than a and b intercepts.

**How to Evaluate Shielded Rooms**, by E. A. Lindgren (p 36) A discussion of the evaluation of attenuation rating, mechanical construction, cost, and the environmental conditions under which a shielded room will be used.

**Desk Size Digital Computer** (p 38) A digital differential analyzer about the size of a desk calculator containing 20 integrators, each with an accuracy of 1 part in 250,000. (Litton Industries, Inc.)

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February 1

**Comments on the New Stereophonic Coaxial Loudspeaker** (p 40) A review of the new coaxial loudspeaker system for home use. (Abstract)

**Filtering Techniques for Various Industrial Applications** (p 42) A discussion of the use of filters in industrial applications. (Abstract)

**A New Phono Preamplifier** (p 44) A description of a new phono preamplifier developed for hi-fi systems. (Abstract)
Bridged-T Circuits for Combining Transmitters (p. 88) Methods of using bridged-T networks and combining transmitter circuits. (Russian Translation)

Strain Gages (p. 90) Types of resistor strain gages and their uses. (Abstract)

Milliwattmeter for Microwaves (p. 92) Direct measurement of power from 10 to 100 milliwatts at centimeter wave lengths using the differential air thermometer principle. (Abstract)

What the Russians are Writing (p. 94) Annotated table of contents of Radiotekhnika, August 1955. (Russian Translation)

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Preferred Circuits (p. 20) A description of a few of the NBS preferred circuits including regulated power supplies, video circuits, p-r-f generators, pulse frequency dividers, delay circuits, and audio circuits.

Mechanical Microwave Phase Indicator (p. 24) Describing a mechanical device to be attached to a traveling probe permitting direct readings of relative phase in terms of guide wavelengths. (Sage Laboratories, Inc.)

FCC Rules Against Spurious Radiation, by Albert Warren (p. 26) A series of FCC regulations going into effect on radiation interference in television, FM receivers, and so called incidental devices.

Electronic Oven (p. 28) A home version of microwave cooking equipment described in this "Design Forum." (Tappan Stove Co.)

Corrugated JAN Shield Insert (p. 30) This corrugated insert for JAN shields increases reliability by reducing bulb temperature of miniature tubes over 100°C. (Atlas E.E. Corp.)

Miniature Connectors, by L. Baird (p. 32) A survey of miniature and sub-miniature connectors including connectors having up to 208 contacts.

Cold Cathode Decade Counter (p. 36) Counting at speeds to 30ke or switching at relatively high currents can be performed with this single ended cold cathode unidirectional gas tube. (International Standard Trading Corp.)

Tuners Join "Bookshelf" Amplifiers (p. 38) A survey of recent tuner preamplifier-amplifier combinations designed for book shelf type mounting. This article describes a representative group of these units. A comparison table of tube uses demonstrates their different approaches in circuit design.

Sweep Generator Applications (p. 80) Several little known important applications of sweep generators. (Abstract)

Dielectric Amplifiers (p. 82) An experimental audio frequency amplifier operating at a bias frequency on the order of 5Me. (Russian Translation)

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Designing Capacity Coupled Transformers, by G. Wilner (p. 26) How to design capacity-coupled transformers in which transfer characteristics can be closely predicted. Several nomographs are included.

Low-Cost Mercury Batteries (p. 30) New mercury cells designed to be stacked and low in cost because automatic fabrication and assembly methods are used. (P. R. Mallory and Co.)


Human Engineered Comparison Bridge (p. 34) Instrument styling which considered the human operator in every aspect. (Electro Measurement, Inc.)

Miniature High-Voltage Regulator (36) Miniaturization of regulated voltage supplies using a new pentode regulator tube. (National Union Electric Co.)
Transistorized Regulated Power Supplies, by H. R. Lowry (p 28) A Background for Designers article discussing the three basic types of voltage regulator circuits that can be built using transistors.

Precision Pot With Spring Contact Taps (p 42) A new precision metal spring contact assures dependable contacts without objectionable linearity distortion at the tap. (Gamewell Co.)

Miniature-Tube Tuning Eye (p 44) A German imported electronic-ray tuning indicator that saves space, requires no special mounting hardware, has high sensitivity, side of tube viewing, and low cost. (International Standard Trading Corp.)

Liquid Filament Transformer (p 46) Corona problems are minimized with this high voltage filament transformer using Askarel insulating liquids and a wet process porcelain high voltage bushing. (Magnatron Inc.)

Subminiature Variable Capacitor (p 48) A two section subminiature variable capacitor featuring high capacity in a small package. It is ideally suited for applications involving transistorized superhetrodyne receivers. (Lafayette Radio)

Temperature-Aging Nomographs, by S. A. Davis (p 50) Estimates of the life of motors as a function of the temperatures at which they will be operated can be obtained from the two nomographs presented in this article.

Sources of Standards, by S. H. Hubelbank (p 52) This article tells who publishes specs and standards, the organization, its address, and its activities in standardization are briefly described.

Reading Russian Schematics (p 116) A few basic symbols and tube designations from which an American reader can extract a considerable amount of information from Russian electronic periodicals without actually knowing the language. (Russian Translation)

What the Russians are Writing (p 118) Annotated tables of contents of recent Soviet journals that publish papers on electronics circuit design and behavior. (Russian Translation)
What the Russians are Writing (p 72) A review of a Russian book concerned with mathematical analog computing machines. A review of several technical articles from Russian periodicals. (Russian Translation)

Measuring Loudspeaker Distortion (p 74) A method of measuring nonlinear distortion in loud speakers employing modulation of an audio frequency with an infrasonic signal. (Russian Translation)

Diffused Based Transistors (p 76) Both germanium junction type and silicon N-P-N transistors have been produced by the diffusing impurities. (Abstract)

Designing Equipment to Fit the User (p 78) Objectives in designing equipment are to maximize performance of the user and to optimize the return on the investment. (Abstract)

March 15

Designing a UHF TV Sweep Frequency Generator, by H. F. Hanthorn (p 24) Some of the problems experienced in the development of an oscillator and tuning unit and a system for frequency-modulating the generated UHF voltage described in detail.

Toggle-Switch Programmed Computer (p 28) Toggle switches and calibrated dials on the problem board eliminate the use of connecting cables and patch cords in setting up problems on this general purpose analog computer. (Weber Aircraft Corp.)

Electron Tube Information Service (p 30) Questions pertaining to information about any particular tube type, with electrical characteristics, bulb sizes or base configurations that fall within particular ranges, and domestic tubes that can be substituted for unavailable foreign tubes can be answered by the Electronic Tube Section, National Bureau of Standards.

Miniature Wire-Wound Precision Resistors (p 33) Primarily designed for printed circuit applications, these wire-wound units are extremely small for their wattage ratings and the range of resistance values obtainable. (Reon Resistor Corp.)

Temperature Effects on V-R Tube Operation, by Earl J. Handley (p 34) How to determine the temperature which will yield the best performance from any given V-R tube type. Charts and a table illustrate temperature characteristics of V-R tubes.

Sensitive Heat Flow Transducer (p 38) More accurate measurement of temperature distribution of heat flow through a surface is achieved by using a small thermocouple disc transducer which has a low thermal resistance. (National Instrument Laboratories Inc.)

Applying Tape Resistors in Design, by H. F. Hanson (p 40) Tape resistors have good resistance to shock and vibration, withstand high operating temperatures and are highly reliable. To achieve these benefits it is necessary for the designer to know when and how to use them to advantage.

Ultra-Vernier Capacitor, (p 44) Designed principally for computer applications, these vernier capacitors exhibit extremely high order stability coupled with ease and accuracy of capacity adjustment. (Balco Research Laboratories Inc.)

Angle Analyzer (p 46) Exact angle setting of shafts potentiometers, resolvers and switches can be quickly measured with this device known as the "Anglyzer." (Waters Mfg. Co. Inc.)

Rectilinear Recording Milliammeter (p 48) Direct rectilinear ink recording is accomplished with a galvanometer-actuated instrument. (Texas Instruments Inc.)

Electro-Mechanical Cam, by D. Shaw and O. F. Shaper (p 50) Combining mechanical and electrical principles, the electrical cam described supplies angular shaft displacement as a function of time. By using a rotating eccentric contact, proportional control is achieved with basically an on-off system.

Sensitive Electrometer VTVM (p 52) Ultra-high input impedance and sensitivity of 800 microvolts are features of this battery operated d-c VTVM. (Keithley Instruments Inc.)

Printed Wiring Amplifier (p 54) These compact audio amplifiers are desirable for use in phonographs, intercoms, tape recorders, and other units requiring low power audio amplification. (Photocircuits Corp.)

What the Russians are Writing, by J. G. Adashko (p 168) Reviews of several technical articles from recent Russian periodicals. (Russian Translation)

Electronic Acoustic Transducer (p 172) Sound energy modulates secondary electrons emitted from the target in this cathode-ray electronic acoustic converter. (Russian Translation)
Applying Electron Tubes (p. 174) Electronic equipment designers may determine the adequacy of a specific tube for a given circuit by considering separate tube property categories. (Abstract)

High Voltage from Dry Batteries (p. 178) Transistors can be used in the circuit shown to provide high voltage from low voltage dry batteries for oscilloscope tubes and other low current high voltage requirements. (Abstract)

Atomic Energy Instrumentation (p. 180) Seven broad classifications of operations in production of atomic power are reactors, feed material, chemical separations, gaseous diffusion, waste disposal, health physics and industrial use of isotopes. (Abstract)

April 1

Die Casting Parts for Electronic Devices, by E. F. Hannon (p. 20) To the designer of electronic and electrical parts, die casting may offer advantages of low unit cost, assembly ease, freedom of design detail, weight reduction, and finishing flexibility.

Square Wave Generator (p. 24) Signals from the 75-ohm output of this square wave generator have a maximum rise time of 0.02usec from 10y to 1Mc and are sufficiently fast to test video amplifier response to about 20Mc or for high-speed triggering. (Hewlett Packard Co.)

High Power from Miniature Tubes, by J. T. Ravis (p. 26) Because required power could be obtained from miniature tubes, this power amplifier circuit increased power efficiency 47% thus reducing circuit heat produced for a given power output.

X-Band Torque Wattmeter (p. 28) Torque operated, this feed through microwave wattmeter is an absolute standard intended to replace cumbersome water calorimeters. (Marconi Instruments)

Hybrid Parameters for Grounded Emitter Amplifiers with Feedback, by R. L. Riddle (p. 30) This article presents the equations necessary to compute the performance of a grounded emitter stage with shunt or series feedback.

Circular Polarizer Improves Viewing, by W. A. Shurcliff (p. 32) Reflections from radar screens, cathode ray oscilloscope tubes, and from instrument dials are eliminated by using a circular polarizer.

Autotransformers for Power Supply (p. 34) A low-priced power supply using an autotransformer instead of a conventional transformer with a high voltage secondary, for use in the power supply of a television receiver. (United Scientific Labs. Inc.)

Accessible Modular Construction, by A. T. Steinkamp (p. 36) Accessible Modular Construction is a packaging method for electronic equipment which expedites servicing and maintenance. Its test points are conveniently accessible for localizing troubles and subassemblies are readily replaceable for quick repairs.

What the Russians are Writing (p. 76) A review of several technical articles from recent Russian periodicals. (Russian Translations)

Shunt Antenna Radiators (p. 78) Shunt radiators used for meter and decimeter waves as well as for short and medium waves are described. (Russian Translation)

Automatic Factory Components (p. 80) A discussion of steps in standardizing on building blocks that will make up automatic assemblies in automatic factories. (Abstract)

Computer Operational Equations (p. 82) Computing circuits of analog computers can be replaced by symbolic equations provided appropriate notation is used. (Abstract)

April 15

Construction and Use of Cathode Follower Design Charts, by N. Sokal (p. 26) Typical uses of universal cathode follower design charts and how to construct them.

Ultra-Sensitive A-C Transistor Voltmeter (p. 30) Providing the advantage of battery operation, this VTVM has a sensitivity of 2μV. Because of the low current drain of transistors, minimum battery life is 200hrs. (Millivac Instrument Co.)

Corona Testing, by T. F. Verbon (p. 32) A corona test set giving an accurate measurement of the corona being generated at any test voltage, and accurately measuring the voltage breakdown point of a component. It also determines the frequency at which the maximum corona noise is generated to aid in designing noise filters.
Miniature Indicators (p 34) Indicator lamps described here occupy half to 2/3 less volume than other assemblies heretofore available. (Circon Component Co.)

Testing Selenium Rectifier, by E. L. Pagano (p 36) Described here are some effective test procedures that can be performed to determine the quality of the selenium rectifier.

Miniature Servo Motor (p 40) This servo motor is only 1/2" x 1" in diam and is believed to be the shortest made. (John Oster Mfg. Co.)

Probe Tip Design (p 42) This newly developed probe tip includes a nylon body which has toughness, with added steel wall to aid in reaching otherwise inaccessible test points. (Tektron Inc.)

Seven Design Tips for Printed Circuit Layout, by A. E. Linden (p 44) Seven basic design tips are given for laying out a printed circuit board to facilitate low cost, automatic assembly, functional operation, neat appearance, and easier maintenance.

Up and Down Decade Counter (p 48) Using a novel internal gating system, this decade counter can either add or subtract electrical pulses. (Controller Instrument Co.)

Miniature Terminal Strip for P-C Work (p 50) Solderless taper tabs can be connected into one side of these miniature terminal strips designed for printed-circuit computer applications. (DeJur-Amsco)

Printed Circuit Fastener (p 52) Especially developed to hold printed circuit boards in place in assembly, the fastener described will hold against approximately 10 lbs pull or force. (Camlock Fastener Corp.)

Signal Generating Probes (p 54) Making use of a neon-tube relaxation oscillator, this variable-frequency audio generator as described in a "Design Forum" article is self contained in a standard 3/8" diameter test probe. (Talley Electronic Development Corp.)

What the Russians Are Writing (p 128) A review of several technical articles from recent Russian periodicals including a comparison of theories of vacuum tube and transistor amplifiers and the possibilities of generalizing these theories. (Russian Translation)

Ferrite Isolators (p 130) Commercial ferrite rotation-type isolators are available for frequencies from 5.4 to 17kmc with power handling capacities up to 250w. A table included lists models and characteristics of commercial ferrite isolators. (Abstract)

May 15

Decade Tube Counter Circuitry, by John Adams (p 26) Design information and circuit suggestions for getting the most effective performance from decade counter tubes.

Transistorized Volt-Ohmmeter (p 30) A general purpose transistorized volt-ohmmeter will nullpoint within 200,000 ohms/v d-c. Battery life from 300 to 400 hours. (New London Instrument Co.)

What Good Are Patents? by R. C. Miles (p 32) A guide to the engineer's understanding of patent protection, what to patent, when to patent, and infringement considerations.

Modularized Portable (p 36) Modular construction in a portable radio permits six tubes to be placed inside a cabinet designed for five. (Motorola)
Miniature Clutch Brakes (p 40) Used in the design of servo systems, these clutch brakes feature small size and light weight. (A. J. Thompson Co.)

Build a Volt Box, by O. M. Solati (p 42) Describing the construction of a portable variable-potential source for checking operations on an analog computer.

Interchangeability List of MIL Preferred Tubes (p 46) A list of military type numbers of rugged versions of well known commercial tubes. (New London Instrument Co.)


Electronic Circuit Synthesizer (p 50) Quick, easy, solderless circuit changes are possible using this device. It can also serve as a problem board for computers and for testing relay systems.

Radar Doppler Frequency Nomograph, by G. T. Baker (p 52) A nomograph for finding either transmitted wavelength, radial velocity or Doppler frequency when the other two are known.

Transistor Circuit Developments (p 56) Recent developments and trends in the transmitter field noted from the 1956 Transistor Circuits Conference.

What The Russians Are Writing, by G. Adashko (p 132) A review of some recent technical articles that appeared in recent Russian periodicals. (Russian Translation)

Soviet "K" Stabilizer (p 134) Several methods the Russians have been using to stabilize supply voltage. (Russian Translation)

Constant Temperature Oven (p 136) Description of a compact oven for stabilizing operation of a quartz crystal. (Abstract)

Stable RF Voltmeters (p 138) An r-f voltmeter, known as an attenuator-thermoelement maintains its calibration for over a year. (Abstract)

Kelvin-Varley Potentiometer (p 34) Precise voltages may be picked off at points of integral Kelvin-Varley voltage dividers and potentiometers. (Servonics, Inc.)

Factors Affecting Resistor Tolerances, by Floyd A. Paul (p 36) Handling, storage, installation and operating considerations in the selection of resistors.

What the Russians are Writing, by J. George Adashko (p 82) A review of some recent technical articles that have appeared in recent Russian periodicals. (Russian Translation)

Operations Research (p 86) Discussion of the scope of operations research. (Abstract)

June 15

What Type of Degenerative Feedback for Transistors, by R. B. Hurley (p 22) A discussion of negative feedback as applied to transistor amplifiers.

Multi-Oscilloscope (p 26) Grouping of two or more oscilloscope tubes in one relay-rack unit. (Tinker & Rasor)

Cathode-Ray Tube Phosphors, by R. G. Millatt (p 28) A design analysis to aid in the selection of tubescene phosphors.

Charge Storage Tube (p 30) Storage tube that may be used in a number of technical-data and business-information processing systems. (Radio Corp. of America)

Specifying Toroidal Reactors, by R. E. Edgar (p 22) How to correctly specify toroidal reactors based on the core material.

T.V. Tuner Design, by R.C.A. Eland (p 34) Circuitry and design features contributing to the lower cost and improved performance of this tuner.

Coaxial Impedance Matcher (p 38) An impedance matching coaxial E-H Tuner used for effecting impedance transformation in coaxial line circuits. (Jasik Laboratories)

New Program Board (p 40) Shielded patch and program board made of nylon blocks. (Aircraft-Marine Products, Inc.)


Automatic Functional Tester (p 46) A robot tester for circuit testing in a predetermined sequence. (Dit-McO, Inc.)

What the Russians are Writing (p 122) A review of recent technical articles that have appeared in recent Russian periodicals. (Russian Translation)

Centimeter Waves by Means of Sparks (p 124) How microwaves may be generated using a spark discharge. (Russian Translation)

Analog to Digital Converters (p 126) A discussion of various analog-to-digital converter systems and the advantages and disadvantages of each. (Abstract)

June 1

Effective Capacitance in Modulated Power Amplifiers, by R. Lee (p 22) Influence of incidental capacitance upon the performance of high-level-amplitude-modulated amplifiers.

Automatic Sweep Synchronizer (p 26) A device that maintains a predetermined number of cycles of a test wave on an oscilloscope screen over a wide frequency range. (Chadwick-Helmuth Co.)

Decade Counter Tube Circuity—II, by J. Adams (p 28) A complete counter circuit for applications involving high-speed counting.

Etched Board Test Points, by Neal Hass (p 20) Using printed eyelets as test points on printed circuit boards.

Dual Directional Couplers
for reflectometer measurements on coaxial systems

4 all-new couplers!

Complete coverage,
216 to 4,000 MC

Ideal for power measurements

Flat response, high directivity

Low SWR, wide band performance

These new -hp- couplers save your time by making possible, for the first time, convenient reflectometer measurements on coaxial antennas, transceivers, counter-measures and TV equipment, etc. Each unit centers on a major band but offers 2:1 frequency coverage. Directivity is high, units handle powers to 50 watts cw, and insertion loss is low for permanent installation. The couplers can be used to measure forward or reverse power or to adjust system flatness.

-hp- 760 series couplers are compact, sturdy, and precision built of highly heat stable materials for long-term accuracy.

SPECIFICATIONS

-**hp**- 764D  
-**hp**- 765D  
-**hp**- 766D  
-**hp**- 767D

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>-<strong>hp</strong>- 764D</th>
<th>-<strong>hp</strong>- 765D</th>
<th>-<strong>hp</strong>- 766D</th>
<th>-<strong>hp</strong>- 767D</th>
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<tbody>
<tr>
<td>Coupling Accuracy</td>
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<td>±1 dB</td>
<td>±1 dB</td>
<td>±1 dB</td>
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<tr>
<td>Max. Second. Line SWR</td>
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<td>1.30</td>
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<tr>
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<td>Prim. Line Insert. Loss</td>
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<td>Approx. 0.20 db</td>
<td>Approx. 0.25 db</td>
<td>Approx. 0.35 db</td>
</tr>
</tbody>
</table>

All models: Power handling capacity 50 watts CW or 10 Kw peak. Primary Line Connectors: Type H, Male & Female. Secondary Line Connectors: Type H, Female. Reflectometer Detecters: 7640/7650 take -**hp**- 476A, 7640/7670 take -**hp**- 426B. Size all units: 9" long, weight 2 lbs. Prices f.a.b. factory. Date subject to change without notice.

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Now in production, RCA-6861 is a major advance in electron-tube design for microwave receivers. It enables—for the first time—the practical application of low-level rf-amplifier stages in radar, scatter-propagation, and other microwave receivers, and if-amplifier stages for millimeter-wave receivers.

The unusually low noise figure of 6.5 db is obtained by the use of an RCA-designed special type of electron gun which deamplifies noise generated in the electron beam.

Patterns show signal-to-noise ratio at input to S-band receiver's crystal detector with and without a stage of rf amplification. Utilizing RCA-designed-and-developed type 6861 Traveling-Wave Tube, high signal-to-noise ratio and extended range are obtained. In addition, crystal "burnouts" caused by TR-tube leakage are eliminated by the isolation afforded by the rf stage.

Glass portion of RCA-6861 is enclosed with rf-input and rf-output transducers in tubular metal capsule. Transducers are factory-set for optimum tube performance; require no adjustment in the field. Capsule has terminals which fit the standard octal socket.

RCA-6861 DATA

- Collector Voltage: 400 volts
- Collector Current: 150 uA max.
- Magnetic Field*: 525 gauss
- Noise Figure: 6.5 db
- Gain: 25 db
- Frequency Range: 2700 to 3500 Mc

* Field supplied by RCA solenoid No. 1-7066 or equivalent.