ELECTRONIC DESIGN

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BPA

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Editorial

Something for Everyone

Among the 225 technical papers being read at WESCON, Aug. 20-23, there are many that will appeal to every professional group in IRE. Many papers are contributed by engineers from abroad, thus giving the engineers in this country an insight into the scope of electronics internationally. There are 765 exhibit booths. Over 200 new devices will be unveiled for the first time at the Show. Future engineers will be inspired to approach matriculation day with eagerness as they take in the displays and films planned for 12- to 18-year-olds. There will be something cultural and something entertaining for wives.

Not the least attraction is the location—San Francisco. Cable cars and Nob Hill, the Golden Gate Bridge, Fisherman's Wharf, a more-cosmopolitan-than-New York night life, and the surrounding distinctively Californian Bay area beckon all but the most blase. The locale is certainly a reason for the large number of prospective authors (552) submitting papers to the Program Committee!

Probably the hardest part for an engineer to take will be obeying the dictates of his conscience and forcing himself to take in all of the technical sessions that are relevant to his job. It is not a paradox that a subject can be extremely interesting in content, but agonizingly dull because of its construction into a convention paper. What makes both possible is the paper reader. His electronics may be perfect, but his elocution is too often abominable. What with the generous supply of authors wishing to read, one of the criteria of the papers committee might be an audition rather than the usual abstract. A brief record on tape could be required to prove that the paper reader can enunciate and pronounce well enough to assure that his message is not unintelligible "noise." It probably wouldn't be necessary for the auditionee to even send his record if he would but listen to one playback. This act alone surely would cause him to scurry to the library for a book on speech.

By next year, the new Professional Group on Engineering Writing and Speech may be able to aid convention authors materially. Part of their purpose is to disseminate knowledge on techniques of good oral communication.

Despite this to-be-expected weakness, WESCON figures to be unsurpassable in offering something of value for everyone. The number of electronics industries backing WESCON equals the support for the N.Y. Radio Engineering Show. WESCON has a block of industries, the West Coast Manufacturers' Association, trying to make it a huge success. Furthermore, the zeal of the San Francisco and Los Angeles IRE Sections, co-sponsors with WCEMA, to excel the Eastern attraction assure the visitor that many things for his benefit have been planned in detail. SEE YOU THERE.

Engineering Review

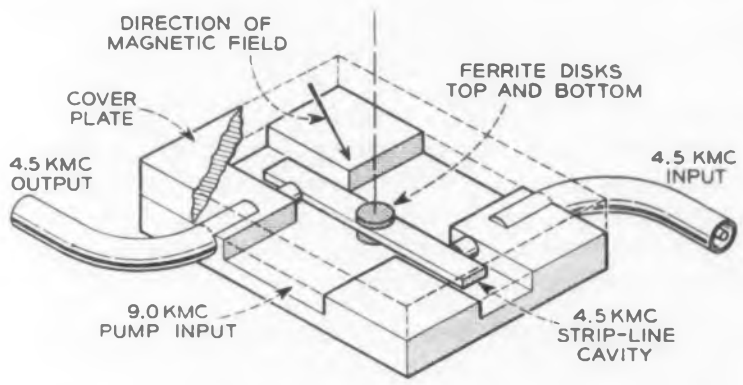
For more information on developments described in "Engineering Review," write directly to the address given in the individual item.

Ferromagnetic Amplifier

A new solid-state microwave amplifier has been successfully operated using a ferrite material as the active element. Although still in the laboratory stage, the amplifier has several promising qualities. It operates at room temperature, and is expected to have a much lower noise level than conventional microwave amplifiers. Thus it has excellent potential as a pre-amplifier for very weak microwave signals, such as encountered in the fields of radio astronomy, microwave relaying and radar. The ferromagnetic amplifier was predicted on theoretical grounds by Dr. H. Suhl, and the experimental program was carried out by Dr. M. T. Weiss, both of Bell Telephone Labs., N.Y.

The amplifier has certain superficial similarities to a solid-state spin oscillator announced in Jan., 1957. Both types must be supplied power from an oscillator operating at a higher frequency than the signal to be amplified, but the principles of operation of the two devices are quite different. In principle, the present device requires that a ferrite sample be placed in a microwave cavity which is simultaneously resonant at two signal frequencies. Microwave power at a frequency equal to the sum of the two signal frequencies is then pumped into the cavity. A dc magnetic field, properly oriented and of sufficient intensity to cause gyromagnetic resonance at this sum frequency, must also be applied. Through nonlinear coupling in the ferrite, amplification or oscillation will be exhibited at either of the lower frequencies, or frequency conversion of a microwave signal can take place between these two frequencies.

In the experimental setup, a dc magnetic field of about 2500 gauss was provided by an electro-magnet, but a permanent magnet could be employed if desired. The field is parallel to the plane of the strip-line cavity and oriented at an angle of about 45 deg with the cavity. Pumping power, equal to the sum of the two resonant frequencies, was fed into the cavity, and the signal power taken in and out by means of coaxial cable. With sufficient pumping power, oscillations took place at both the lower frequencies. When the pumping power was reduced somewhat, amplification was observed at either of the signal frequencies. Preliminary results indicated that the amplifiers would be designed for operation in practically any portion of the microwave spectrum.



One experiment done with the ferromagnetic amplifier is described in the above diagram. To simplify the circuitry, the two signal frequencies were each made approximately 4500 mc, although they do not necessarily have to be equal. When sufficient power of 9000 mc—equal to the sum of the signal frequencies—was fed into the resonant cavity, oscillation occured at 4500 mc and amplification was observed when the power was slightly reduced.

At the Vanguard Computing Center: As the satellite swings through its orbit, information of its position transmitted from Minitrack stations around the world will be fed into an IBM 704 in Washington, D.C. An output display, equipped with map overlays as shown above, will show the predicted course of the satellite above the various portions of the globe. The 704 was chosen for the complex task of prediction primarily because it is the most powerful computer existent that has a duplicate—a definite necessity should one computer be temporarily out for maintenance reasons.

The satellite's orbit wil be computed about 30 minutes after launching. The third stage release occurs after about 12 minutes, and it takes an additional 15 minutes for information from Minitrack stations to be relayed to the computing center. The first solution will be in terms of distance from the earth, period of revolution, and orbit path.

Schedules of the satellite's position, speed and angle of approach will be compiled and signaled to optical tracking stations around the world, allowing watchers to direct their instruments at the right place and at the right time for precise observation.

As more information of the satellite's behavior is observed, this information will be fed into the computer as additional data to enable increasingly precise predictions.

Engineering Review

Indicators for Refinery Use

An electronic level indicator is being used to measure levels in sulphur dichloride tanks at Esso Standard Oil Co., Linden, N.J. Sulphur dichloride, used in producing additives for motor oil, is a noxious toxic material that gives off chlorine gas at atmospheric temperature and pressure. Cleaning these 30 ft long sulphur dichloride tanks was a difficult and time consuming job and was done usually with gas masks. Conventional gage glass indicators used for measuring level in the chemical tanks prior to the installation of electronic devices became caked and coated with sulphur dichloride deposits after a few week's use. When the glass indicators needed cleaning, two or three men were required, and the job scheduled only at times the tanks were empty.

Solar Cells for Satellite

The possibility that solar batteries may provide the ideal power source for satellite instrumentation is under investigation by the Army Signal Engineering Labs., Fort Monmouth, N.J. To prove their theory, glass-protected clusters of solar cells were attached to the skin of an Aerobee-Hi rocket. When the rocket was fired to an altitude of 190 miles, the silicon cells functioned perfectly. Interpretation of telemetered data indicated that the cells provided continuous electrical output from the time of the firing until the rocket's radio ceased functioning on re-entering dense atmosphere.

The cells were not affected by skin friction as the rocket passed through the atmosphere. Some apprehension had been expressed that the heat might cause failure, but neither heat nor the rocket's rotation caused major voltage fluctuations. As visualized by the Army Signal Corps scientists, the solar cells attached to the skin of the satellite would theoretically supply instrument power during approximately 60 of each 100 min while the vehicle is in the sun during each circuit of the earth. They could be used to charge nickel-cadmium batteries during the 40 min that the satellite would be travelling in the earth's shadow.

Drilling Spacers Ultrasonically: Ceramic tube spacers are being drilled by an ultrasonic process employing an electro-mechanical transducer that converts alternating current into mechanical force to vibrate the impact tool at 25,000 cps. Particles of abrasive introduced as a slurry between work and tool face are driven with tremendous impact to reproduce an exact counterpart of the tool face in the workpiece. As a result, intricate orifices, multiple arrangements of holes and slots, and other complex configurations are cut into the workpiece in a single operation. Because the work is not chipped, spun, stressed or distorted, parts can be shaped to close tolerance with high piece-to-piece reproducibility.

The technique was developed by C-Mar Corp., Manasquan, N. J. in order to make feasible the use of alundum (aluminum oxide) in place of mica spacers since alundum has a much higher melting point (3750 to 1757 F). Accuracy of the holes and slots are within 0.001 and 0.0005 in.

Thirty-Four Manufacturers Fail

Thirty-four manufacturers of electronic equipment encountered financial difficulties during the eleven months ending March 31, according to T. B. Judge, International Resistance Co., Philadelphia.

The thirty-four failures compares with twenty-nine and twenty-five equipment manufacturers who experienced financial difficulty in the twelve months ending April 30, 1956 and April 30, 1955, respectively. The average age of the companies involved was thirteen years and their difficulties were attributed to unusually keen competition, inadequate capital, poor engineering, and lack of management.

The following is a breakdown of the types of manufacturers involved: component parts, 14; phonograph and high fidelity equipment, 6; radio and television receivers, 5; test equipment, 3; Geiger counters, 2; communications equipment, 2; cathode ray tubes, 1; recording equipment, 1.

CIRCLE 5 ON READER-SERVICE CARD FOR MORE INFORMATION

Engineering Review

Automatic Failure Predictor: The automatic failure predictor detects probable failures in a radar system before they occur and alerts the operator to take preventative action by replacing or repairing an assembly or components as indicated by the device. Use of the automatic failure predictor will not only eliminate radar failure at a critical moment, but also will reduce maintenance costs for America's far-flung radar picket lines. Rather than several skilled maintenance technicians at each radar location, a single operator at central locations now can monitor the performance of many radars at remote areas. Upon receipt of a failure warning, a maintenance crew can be dispatched to the offending radar and repairs made before actual breakdown occurs. Techniques for automatic prediction of radar failure were revealed by F. R. Scripture of AMF's Electroincs Division, Boston, Mass., at the RETMA Reliability Symposium in Syracuse.

State-Sponsored Educational TV System

The nation's first state-sponsored educational closed-circuit television system will be installed this summer in The Conley Hills Elementary School, Fulton County, Georgia, for classroom operation in September. It will serve primarily as a laboratory installation for educators who are studying the practicability of state-wide teaching-by-television. The project was authorized by the State Board of Education.

Installed by RCA, the Conley Hills TV system will be a multi-channel installation, embracing four TV camera chains linked by closed-circuit with twenty-six TV receivers installed in classrooms throughout the school. Film and live educa-

tional TV programs will be originated from a centralized TV studio now under construction within the school. Two TV Eye cameras will be used with individual 16mm sound-film projectors for school-wide transmission of educational motion picture films. Two ITV-6 TV camera chains also will be installed in the TV studio for direct pick-up of lectures, demonstrations, and other live programs. Signals from the four camera chains will be fed to miniature transmitter, for amplification and distribution throughout the school. The multi-channel installation will enable each classroom to tune in any one of the four school-originated film or studio programs, or any program broadcast by local or network TV stations in the area.

New Method for Detecting Corona Discharges

The electrometer method was announced at an AIEE meeting on June 28, as a new technique for the detection and estimation of magnitudes of corona discharges in electrical devices during high voltage testing. J. G. Anderson and J. S. Kresge of the General Electric Co., Pittsfield, Mass. stated that for impulse tests, the new method is equally effective for steep-front, chopped waves and full waves and is not restricted by voltage magnitudes.

The paper points out that a major objective of the engineer is to obtain a clear and reliable picture of the behavior of electrical apparatus during overvoltage testing. A factor of great importance which should be determined as accurately as possible is the onset level of corona in any particular device. An estimate of the relative corona magnitudes at various high voltage levels is also of value in predicting the ultimate failure of the apparatus, and in estimating the degree of insulation damage caused by the corona discharges. The new method is applicable in the testing of high voltage structures involving at least some solid insulation, and has been used with significant success in laboratory testing of high voltage coil stacks permitting the prediction of permanent damage and breakdown.

The method uses the memory principle, and is based on the measurement of residual charge left in a high voltage structure by previous corona discharges. From this residual charge the corona onset voltage can be determined, and measurements of order of magnitudes of the original corona discharges are possible in many cases.

It was cautioned that the new method requires considerable skill in application, and in elimination of stray charges and spurious effects. Therefore, in its present state of development, the method is not recommended for factory testing of commercial apparatus, but only for laboratory testing under carefully controlled conditions.

Correction: On page 5 of the July 15 issue, Intercontinental Electronics Corp. was referred to as "International" in the article on the French portable microwave system.

Engineering Review

Computer Studies English Syntax

With the aid of an automatic digital computer, a brief exploratory study to obtain information needed on the statistical frequencies with which different English sentence structures occur was recently completed.

The project was undertaken by the National Bureau of Standards upon the request of the U.S. Patent Office.

In an effort to keep the problem tractable, a scheme was devised which consisted of dividing the features of a sentence into six major categories, with code numbers from 1 to 6: (1) Subject (2) Object (3) Predicate Nominative (4) Adjectivial Modifier (5) Adverbial Modifier (6) Verb.

Only independent clauses were analyzed and coded in terms of their elements. Other structures were coded by one notation each to represent the function of the entire structure. Connectives, absolutes, and appositives not affecting the basic structures of the independent clause were not coded.

Coding of the sample sentences was done by hand. The sentences analyzed, totaling 550, were chosen with a rough attempt at randomization from scientific journals and books. The function of the computer was threefold: accurate high speed tabulation, precise comparison of data, and compression of coded data in terms of syntactical-equivalence relationships.

The computer program called for the first incoming sentence-code (containing letters and numbers) to be reduced to its numerical pattern, which was then stored. Since the computer could handle numbers up to 11 hexadecimal digits in length, a sentence with the primary pattern, 1665 for instance, would be stored in the form 16650000000. Each subsequent pattern was reduced in the same way and its pattern was compared with all the stored patterns. If a candidate pattern was identical with a stored pattern, a recurrence tally of 1 was added into the last place of the stored pattern

◀ CIRCLE 8 ON READER-SERVICE CARD

and the candidate pattern was rejected. In the example, the stored number becomes 16650000001. If the candidate pattern was new it was stored with the others.

Among the 550 sentences thus far studied, 335 unique patterns were found. The maximum recurrence of any primary pattern was 12 in two cases (41665 and 414665). The most common primary pattern represented only 2.2 per cent of the entire sample and the rest of the patterns showed a roughly even distribution of nonsignificant recurrence.

A study was also made of the effect of compressing the primary patterns, wherein the computer rejected all but one of any digit, that is continuously repeated within a pattern. Thus, for example, "The little hen clucks," represented by 44416, was considered syntactically equivalent to "The hen clucks," 416.

The compressed patterns showed the expected high degree of identity. There were 189 unique compressed patterns, the most common being 4165 (i.e. The man ran across the street) comprising 12.5 per cent of the sample. The first three most common compressed patterns made up thirty per cent of the sample.

Variable Speed Turntable Motor

A phonograph turntable has been developed which utilizes a variable-speed hysteresis motor. The turntable's four speeds are the result of a power source delivering the four frequencies necessary to drive the hysteresis motor. The advantages of a hysteresis motor are retained, yet moving parts have been reduced to a minimum since turntable speed no longer depends on rubber idler wheels or slippage. The unit will function on either 50 or 60 cps.

The unit, being produced by Fairchild Recording Equipment Co. of Long Island City, N.Y., can be purchased without the special drive for those who require one speed, 33-1/3 rpm, operation. The variable-speed model is constructed on a single chassis that slips into the same housing, and, therefore, no additional space is required when the four-speed conversion is made.

CIRCLE 9 ON READER-SERVICE CARD ➤

Engineering Review

Increased Computer Storage Capacity

A high speed memory storage unit which can contain up to 32,768 words of stored information and with access to the stored work in 12 μsec has been developed by IBM, Poughkeepsie, N.Y. Designated 738, the unit has four times the maximum storage of the IBM 704. It has been installed at RAND Corp., Santa Monica, Calif.

Facsimile Set Speeds Pictures

A new portable radio facsimile system can put a high-quality photo in the hands of a person miles away five minutes after the photographer clicks the shutter. The facsimile equipment fits easily into the back of a radio-equipped jeep or car and can send a picture to its companion receiver 40 miles away. The set can also send a photo thousands of miles, over telephone lines, or around the world, by long-range radio circuits.

The facsimile, claimed to be the fastest in the world by its innovator, U.S. Army Signal Engineering Labs., uses Polaroid film that produces a finished 3-1/4 x 4-1/4 in. print one minute after exposure. The print fits right into the transmitter in the jeep. The set automatically sends the picture in three minutes. The picture is received on another sheet of Polaroid film, and is ready for use one minute later.

Poisonous Vapor Detection

Medical detection of carbon-tetrachloride poisoning, potentially four times as dangerous as carbon-monoxide, is being accomplished through the use of the Halogen leak detector which can detect carbon-tetrachloride in the human system more than an hour after exposure to relatively small amounts of vapor. Both qualitative and quantitative measurements of the gas present may be made. Developed by General Electric, the detector can find a leak so small that only one ounce of gas would leak through the opening in 100 years.

Cryostat; A New Low in Temperature

A super-refrigerator, known as a cryostat, will be used to produce liquid helium and to study the effect of temperatures near absolute zero. The interest in liquid helium is due to its possible use as a low-temperature bath for electronic and other devices, as well as the unusual properties of liquid helium itself. The cryostat, which will have a monthly capacity of about 1000 liters, is scheduled for installation in mid-August at the Lockheed Missile Division's research center at Stanford University, Calif. The liquid helium will be used by Lockheed in the search for improved computing machine elements, rocket fuels, energy detectors, and several other similar objectives.

Of particular interest is the superconductivity of certain metals at very low temperatures. A low-temperature electric motor, with an efficiency of nearly 100 per cent, is one of the possible applications. Another would be the development of sensitized instruments to detect the heat of a candle at a theoretical distance of 25 miles.

Correction of Inertial Guidance Systems

Detection of angular displacements in the azimuth alignment of monitored inertial guidance equipment is made possible with Theodolite. The unit incorporates two modulated glow lamps which direct light to the mirror in the monitored unit. If the gyroscope of the guidance system is perfectly squared with the optical axis of the Theodolite, the reflected light from the mirror will re-enter the Theodolite and be lost back in the light source. But if the mirror on the monitored unit is rotated slightly in azimuth, the returning light beams will not be centered on the optical axis and some energy will enter a light responsive device through a slit. This energy is transduced to an electrical signal which indicates an error in alignment, and a corrective signal can then be applied manually or automatically to the drive elements of the monitored equipment. The unit was developed by Perkin-Elmer Corp., Norwalk, Conn.

CIRCLE 11 ON READER-SERVICE CARD ➤

ANACONDA WIRE & CABLE COMPANY
INTER-OFFICE CORRESPONDENCE

G 400A

COPIES TO:

TO: Fred Luna

DATE July 1, 1957

FROM: W. E. Sprackling

OFFICE Hastings

SUBJECT: ADVERTISING

REFERRING TO: Quality Control Inspection - ETL

FILE REFERENCE:

Fred, we've been telling our customers about our methods of Inspection, our Quality Control, and other manufacturing safeguards. But perhaps we're missing a bet. I think the BIG THING is what the Electrical Testing Laboratories, Inc. does for us -- not just the fact that they calibrate all of our testing equipment (that's quite common), but that they actually go through our test reports at all mills annually to see that our testing system is functioning the way management planned it.

I don't think any other outfit goes so far as to have such a complete independent audit. To me -- that's newsworthy -- our customers should know that we have an outside agency -- fully competent -- to watch after their interest.

Why not tell our story broadly -- after all, it's to the customers' interest -- they will appreciate, I'm sure, what is being done for them.

W. E. S.

P. S. And another important thing -- the inspection department is entirely separate and independent of production -- reporting only to the Vice President in Charge of Manufacturing.

JEF - What more could we say? Sin for running this as is. What do you think? Fred

OK - JER

57422

LIVE BETTER ELECTRICALLY

Engineering Review

Radar; New Headache for Burglars

A motion detection instrument capable of sensing any movement within a radius of 25 ft purports to be the most sophisticated anti-burglar device on the market. Called Radar-Eye, the instrument employs the basic principals of radar in sensing movement within its area of operation. Once triggered, it turns on floodlights and sets off sirens. Intruders cannot crawl over it, slide under it, cut through it or in any way tamper with either the unit or wiring system without setting off the alarm. A portable unit, the Radar-Eye may be installed anywhere desired even behind non-metallic walls. The instrument is being produced by Radar-Eye Corp., North St., Natick, Mass.

Cable Repairs for Damage From '29 Quake

A submarine earthquake in Nov. 1929 that did great damage to transatlantic cables is believed to be the culprit that forced extensive repairs on a Western Union Telegraph Co. cable between Long Island and Newfoundland last year. The cable was so badly damaged that 23 miles of cable, at a depth of 200 fathoms, had to be replaced with 30 miles of cable of a different type. The original cable laid in 1926 was loaded cable. The conductor was wound with magnetic tape or wire to increase its efficiency, but by 1956 a sufficient supply of this type did not exist because it had been used for previous repairs following the 1929 quake. The damaged cable, from Hammel near Rockaway on Long Island, to Bay Roberts, Newfoundland, was replaced with non-loaded cable, with loading coils inserted at five-mile intervals. The loading coils, complete with armour, cost about $2,000 each. The unloaded cable cost $1,000 less per mile than fully loaded cable.

The Cable System also includes a transoceanic link from Bay Roberts to Penzance, England, and one from Long Island to Horta in the Azores.

◀ CIRCLE 12 ON READER-SERVICE CARD

Parallel Paths for Reliability

Seven months of continuous operation without a single moment of lost time due to radio equipment failure is the record of a microwave radio system designed by Federal Telecommunication Labs., Nutley, N.J. The system, installed by an oil pipeline company, utilizes standard commercial PTM radio receivers and transmitters in a system orginally conceived for tactical communication between the Navy's shore bases. The system's reliability is the result of the parallel path technique, which allows two signals on the same frequency to be transmitted in synchronization from two separate transmitters to separate receivers.

More than duplication of equipment is involved, however. Although the frequencies of the two transmissions are made identical, the phase of the signals cannot conveniently be controlled. In order to avoid signal cancellation, which would occur if out-of-phase signals were received on a common antenna, one signal is transmitted and received on horizontal polarization, and the other on vertical polarization. The dual polarization was made possible by the development of a feed-horn that could handle the required radiation. The horn, in addition to its usefulness in signal diplexing, simplified the problem of space diversity in similar line-of-sight microwave systems, since only three instead of four horns are needed.

Doppler Navigation for Jets

A self-contained airborne Doppler Navigator System for jet fighter planes is under construction. The Doppler system sends out radio waves to the ground from various fixed positions in the plane. The waves after hitting the ground bounce back to the plane at varying frequencies depending on the motion of the plane. These changes in frequency are fed into a computer, which in turn translates this data into ground speed, drift, exact position according to longitude and latitude, course to destination, and distance to destination. The system was designed by Laboratory for Electronics, Inc., Boston, Mass.

Washington Report

Herbert H. Rosen

Aviation Expenditures Cut, Electronics Increased

Leaders from both the aviation and electronics industries were called to Air Secretary James Douglas' Pentagon office recently and told flatly that the Air Force is spending too much money on airplanes. As a result, there will be a shift to electronics-dominated weapons and more responsibility for electronic subsystem contractors.

Immediate reaction of those attending seemed to be a stunned silence. As far as the electronics industry is concerned, the move bodes both trouble and prosperity. Prosperity, because a $1.3 billion bill for electronics will fill plants to the bursting point. Trouble, because the airframe manufacturers will be looking for ways to make up their loss in defense dollars. And electronics looks like a healthy field in which to spread. As one observer put it: "I won't be surprised to see a Lockheed or North American TV set appear on the market one of these days."

At the meeting, Douglas said the Air Force is spending money it does not have in the bank. The reasons listed were: price increases; failure to adjust estimates when long lead time programs are compressed and a rapid, expensive, growth of the ballistics missile program during the Fiscal Year 1957. Payments so far for some programs this year are double original estimates. And it looks like 60 per cent to 70 per cent of all funds allotted to the overall ballistics missile program may be expended in the first year. The solution according to Mr. Douglas is that "we are going to have to be quite ingenious. . . ."

Scarce Defense Money—No Overtime

Now that the Government is well into its new Fiscal year, the effect of a recent Department of Defense directive is probably beginning to be felt. DOD Instruction 4105.48 specifically outlines what classes of overtime are allowable on all contracts. It clarifies some of the vagaries of ASPR 12-102 and a series of memoranda issued last May by the service Secretaries. The new instruction makes it extra difficult to authorize overtime, except under certain circumstances. These are: (1) when the military objective will not be met; (2) when a lower cost will accrue to the Government, and (3) when natural and technical causes make it mandatory. Under the third class are the following enlargements: (a) to

eliminate specific bottlenecks which cannot be eliminated in any other way; (b) to cope with emergencies resulting from accidents or natural disasters; (c) to make up for delays beyond the control and without the fault or negligence of the contractor, and (d) to perform tests, industrial processes, and laboratory procedures which are continuous in nature and cannot reasonably be interrupted or otherwise completed.

But the company manager who thinks he can meet any of these will have to write a thorough and detailed justification for the overtime he needs. He will have to prove that other sources cannot do the job as well and as cheaply. Also, "the use of overtime premium pay (is not) a regular part of employee compensation.

And no longer can the mere contracting officer give this authority to work overtime. It must come from "a designee of the Secretary (of a service) occupying a position comparable to or higher than a Head of a Procuring Activity." The Navy Chief of the Bureau of Ships would be an example. In some instances, the Assistant Chief may be allowed to give an authorization. In most cases, however, approval authority may be delegated to others as long as that authority is limited to "not more than 2 per cent of total anticipated labor-hours under contract."

What Impresses the Japanese Most?

A team of 12 Japanese visited U.S. electronics manufacturers recently. Three characteristics of the industry impressed them more than anything else: our high productivity, safety consciousness, and small business originality. The team came to the U.S. under the sponsorship of the International Cooperation Administration. Collectively, they represent most of the electronic trade associations in Japan. Individually, they are presidents or directors of small manufacturing companies averaging about 250 employees.

Although they learned much from our production techniques, few can be applied to their organizations. First and foremost, the buyer market could not support such production levels. Secondly, the labor market is not that well trained. Japanese industry has only just started to train its employees.

Safety consciousness has been largely a Government-sponsored effort, with industry lending token support. However, the team was so impressed, they plan to preach the philosophy to industrial leaders in the homeland when they return.

Electronics is now among the top ten of Japan's big industries—valued at nearly $200 million a year. As here, there are abundant signs of greater growth in a few years. The key is electrical power. Within a few years the number of kilowatt hours generated is expected to jump, and so will electronics, TV, radio, communications, and the rest.

Meetings

Aug. 20-23: Wescon (Western Electronic Show and Convention)

Cow Palace, San Francisco, Calif. Sponsored by the San Francisco and Los Angeles Sections representing the Seventh Region IRE and West Coast Electronic Manufacturers Association. There will be upwards of 700 exhibits and 48 technical sessions under the following titles:

Tuesday a.m., Aug. 20

1 Transistor Circuits; *2* Microwave Components; *3* Nonlinear Automatic Control Systems; *4* Component Part Design and Performance; *5* Electronics Research Abroad; *6* Information Theory.

Tuesday p.m., Aug. 20

7 Models for Systems—Symposium; *8* Microwave Ferrite Devices; *9* Computer Systems; *10* Component Part Design, Control, and Assembly; *11* Engineering Management; *12* Antennas and Propagation.

Wednesday a.m., Aug. 21

13 Semiconductor Devices—I; *14* Electronics in High Speed Flight; *15* Sampled Data Control Systems; *16* Communications Systems Engineering; *17* Military Research Requirements in Electronics; *18* Microwave Antennas.

Wednesday p.m., Aug. 21

19 Semiconductor Devices—II; *20* Microwave Instrumentation; *21* Statistical Methods in Feedback Control; *22* Crystal Filters Symposium; *23* TV and Radio Broadcasting; *24* Data Handling Devices.

Wednesday Eve, Aug. 21

25 Symposium on Controlled Nuclear Fusion.

Thursday a.m., Aug. 22

26 Computers in Network Synthesis; *27* Microwave Tubes—I; *28* Computer Circuit and Logical Design; *29* Automatic Instrumentation; *30* Reliability Programs; *31* Antennas.

Thursday p.m., Aug. 22

32 Passive and Active Circuits; *33* Microwave Tubes—II; *34* A Symposium on the Medical Applications of Super Voltage Radiation; *35* Instrumentation; *36* Vehicular Communications—I; *37* Production Techniques.

Friday a.m., Aug. 23

38 Audio; *39* Advances in Microwave Solid State Devices; *40* Analog and Digital Computer Devices; *41* Telemetry—I; *42* Vehicular Communications—II; *43* Symposium on New Electronic Techniques for Industry.

44 Ultrasonic Engineering; 45 Television Receivers and Televisual Devices; 46 Ionospheric Propagation; 47 Telemetry—II; 48 Nuclear Science Session.

Aug. 19: Symposium on Automatic Control

Mark Hopkins Hotel, San Francisco, Calif. Sponsored by the IRE Professional Group on Automatic Control, with participation by the ASME and AIEE. The program will consist of a morning technical session on "Practical Applications in Nonlinear Control," and an afternoon panel discussion on "Obstacles to Progress in Nonlinear Control." For information write to J. Melvin Jones, Hughes Aircraft Co., Bldg. 6, Mail Sta. 2344, Culver City, Calif.

Aug. 20-21: Third Biennial Electron Beam Symposium

General Electric Co. X-Ray Dept., Milwaukee, Wis. There will be reports on radiation equipment, applications of radiations, and economic evaluation of processes and methods. Chemical, plastic and petroleum applications are to be stressed. A conducted tour of GE facilities for fabricating electron beam generators and linear accelerators will be offered. More information may be obtained from J. J. Ludwig, General Electric Co., X-Ray Dept., 4855 Electric Ave., Milwaukee 1, Wis.

Aug. 29-30: Fourth Annual Symposium on Computers and Data Processing

Albany Hotel, Denver, Colo. Sponsored by the Denver Research Institute. Technical papers on components, devices, systems organization, analysis techniques, and design techniques will be presented. For further information write to J. Marshall Cavenah, Electronics Div., Denver Research Institute, University of Denver 10, Colo.

Sept. 4-6: Special Technical Conference on Magnetic Amplifiers

Penn Sheraton Hotel, Pittsburgh, Pa. Sponsored by the AIEE and the IRE. The program's four sessions will deal with New Circuits and Techniques, Analysis and Design, and Applications. For more information, write to D. Feldman, Bell Telephone Labs.

Sept. 17-18: RETMA Symposium on Numerical Control Systems for Machine Tools

Ambassador Hotel, Los Angeles, Calif. For details write to RETMA, Room 650, 11W. 42nd St., New York 36, N.Y.

Sept. 8-13: Second Annual Course on Investment Castings

MIT, Cambridge, Mass. Sponsored by the Investment Casting Institute. Lectures, laboratory exercises and demonstrations will be offered on investment materials; melting; gating, risering, solidification and heat transfer; metal and alloy systems; defects in castings; and consideration of new investment and allied processes. For further information, write Harry P. Dolan, Investment Casting Institute, 27 E. Monroe St., Chicago 3, Ill.

Sept. 9-13: Twelfth Annual Instrument-Automation Conference and Exhibit

Cleveland Auditorium, Cleveland, Ohio. Sponsored by the ISA. Organized under the unifying theme, "Instrumentation for Systems Control," the conference will open with formal sessions devoted to data handling and instrument terminology. Following these there will be individual workshop sessions in limited discussion groups covering such topics as aircraft and missiles (excluding propulsion), wind tunnels, flight propulsion systems, process industries, power generation and distribution, meteorological, nuclear, medical, geophysical exploration and general industrial laboratories. Some 100 papers will be presented at the technical sessions. There will be about 500 exhibits. For details of the technical program write to Herbert S. Kindler, Director of Technical Programs, ISA, 313 Sixth Ave., Pittsburgh, Pa.

Sept. 24-25: Sixth PGIE Symposium on Industrial Electronics

Morrison Hotel, Chicago, Ill. Sponsored by the IRE Professional Group on Industrial Electronics and AIEE. The main theme for the conference will be the characteristics, use and integration of transducers into complete systems to measure and control complete processes. For further details, write to J. N. Banky, 628 West 18th Street, Chicago, Ill.

Oct. 16-18: 1957 IRE Canadian Convention and Exposition

Automotive Building, Exhibition Park, Toronto, Canada. Sponsored by the Canadian Sections of the IRE. For information write to Grant Smedmor, IRE Canadian Convention, 745 Mt. Pleasant Rd., Toronto 7, Canada.

Oct. 31-Nov. 1: Third Annual Technical Conference of the Professional Group on Electron Devices, IRE.

Shoreham Hotel, Washington, D.C. For more information, write W. M. Webster, RCA Semiconductor Div., Somerville, N.J.

Nov. 6-8: Tenth Annual Conference on Electronic Techniques in Medicine and Biology

Boston, Mass. Sponsored by ISA and AIEE. Further details and advance programs may be obtained from H. S. Kindler, Director of Technical Programs, Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

Nov. 6-8: Third Aero-Com Symposium

Hotel Utica, Utica, N.Y. Sponsored by the IRE Professional Group on Communications Systems. The conference will deal with systems, equipment design, techniques, antennas, spectrum conservation, air traffic control, management and other topics. For the presentation of confidential material, there will be a classified session on Nov. 8. For more information, write to R. C. Benoit, 138 Riverview Pkwy., Rome, N.Y.

Nov. 11-13: Third Annual Instrumentation Conference

Biltmore Hotel, Atlanta, Ga. The theme of this conference will be "Instrumentation for Data Handling" with special symposiums on electronic instrumentation as applied to medicine and the sales and purchasing aspects of electronic instrumentation. Papers should be submitted to Lamar Whittle, Federal Telecommunications Lab., 1389 Peachtree St., N.E., Atlanta, Ga. For more information write B. J. Dasher, School of Electrical Engineering, Georgia Institute of Technology, Atlanta, Ga.

Nov. 13-14: Mid-America Electronics Convention

Municipal Auditorium and Hotel Muehlebach, Kansas City, Mo. Sponsored by the Kansas City Section of the IRE. There will be exhibits and twelve technical sessions. Approximately thirty papers will deal with medical electronics, airborne electronics, instrumentation, engineering management, electronics in nucleonics and a diversity of other subjects. Persons who want to submit papers should contact the Technical Papers Chairman, MAECON, 5109 Cherry St., Kansas City 10, Mo. The deadline for submissions is Aug. 15. For more information write Richard L. Clarke, 425 Volker Blvd., Kansas City 10, Mo.

Nov. 13-15: Eighth National Conference on Standards

St. Francis Hotel, San Francisco, Calif. Sponsored by the American Standards Association. Emphasis will be on standards as a key to progress and profits. Sessions will cover radiation exposure, electronics, industrial preparedness, motion pictures and television, purchasing, company standards, technical communications, government standards and safety. For more information, write to D. E. Denton, ASA, 70 E. 45th St., New York 17, N.Y.

Encapsulation of Electronic Circuits

Richard Calicchia
Rome Air Development Center
Griffiss Air Force Base
Rome, N. Y.

Comparison of a Vacuum Tube Remote Control Unit and a Transistorized Version Employing Encapsulation Techniques, Printed Circuitry, and Miniaturized Parts

EVALUATION of casting resins for electronic equipment at frequencies up to 240 mc is covered in this report. This frequency was selected as the upper limit because above this frequency encapsulation ceases to be practical. This upper limit of frequency will define Type A insulating compounds or encapsulents (per Military Specification MIL-I-16923) which are intended for high frequency application. A comprehensive investigation of encapsulating resins and their effects was sponsored by Rome Air Development Center at Battelle Memorial Institute and is being continued at RADC.

Epoxy Resins

Epoxy resins are presently accepted as the most suitable for encapsulation. These are generally favored because of the inherent properties possessed in them such as ease of handling, excellent chemical resistance, low moisture absorption, superior adhesive quality, low shrinkage during cure, exceptional mechanical properties and satisfactory electrical characteristics. It appears further that the epoxy resin is the only type that will best satisfy the requirements for an insulating materials as outlined in MIL-I-16923. However, only a select few epoxy resins possess the necessary physical and electrical properties for application to electronic equipment up to 30 mc (Type B) and none meet the ultimate in physical and electrical requirements for frequencies up to 240 mc.

Some attempts were made to modify and blend epoxy resins for the purpose of improving specific desirable properties. The results were found favorable in some instances. Attempts were also made to introduce foam materials which would be most applicable where an encapsulent possessing optimum dielectric properties is desired. It is noted that the initial efforts were encouraging and the results indicate that further development would contribute markedly to the progress in this field.

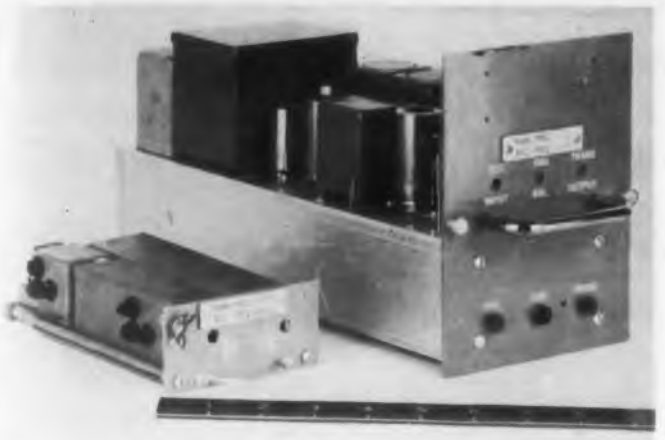
Epoxy Modifications

The modification of epoxies involved the compounding of inorganic or organic fillers, the use of anhydride hardeners, the addition of plasticizers, the blending with polyamide and the inclusion of plastic microballoons. The investigation was also extended to the foam materials which are most promising and merit further consideration because of their dielectric quality. Although the work and evaluation was directed towards producing an encapsulent with all-embracing properties, the behavior of some of these insulating materials was markedly improved. Greater emphasis was placed on the thermal shock requirements, the mechanical resistance and the dielectric quality. The results of this research reflected some very interesting information particularly applicable to this work.

- The anhydride-hardened epoxies possess better resiliency than the conventional amine-hardened epoxies. This is advantageous in as much as resiliency improves the thermal shock resistance.
- Moderate temperature cures are essential in developing optimum properties. Obviously a room temperature cure would be preferable.

Table I. Chemical and Physical Behavior of Some Epoxy Casting Resins

Resins	Hardeners	Curing Temp.(F)	Maximum Exotherm	Thermal Shock	Mechanical Shock	Dielectric Constant	Dissipation Factor
Scotchcast 2	amine	rm temp.	207				
Scotchcast 235	anhydride	200	252	10	9		
Scotchcast 241	anhydride+filler	200	222	10	9		
Epon 828	amine	150	272		9		
Epon 815	polyamide	150	310	10			
Epon 828	plasticizer	rm temp.	290	10			
Hysol 6040	amine	rm temp.	274				
Hysol 6800	anhydride	250	264	10	4		
Araldite 6010	polyamide	150	294	10			
ERL 2795	polyamide	150	300	10	9		
P-420	plasticizer	rm temp.	272	10	9		
Eccofoam FP		rm temp.				2.06 - 1.08	0.0035 - 0.0034
Epocast 3	anhydride	150	200	10	9	3.15 - 3.08	0.013 - 0.02
Castiplast 11	plasticizer	rm temp.	165	10	9	3.75 - 3.3	0.048 - 0.056



■ On account of their high-polarity, plasticizers and inorganic fillers tend to degrade the electrical properties. However, inorganic fillers are regarded useful because they improve the thermal shock resistance of the body by increasing the coefficient of thermal expansion of the embedding material.

■ Polyamide blend epoxies possess exceptionally good physical and electrical properties at room temperature, but are undesirable at elevated temperatures.

Foam Resins

The study of foam resins was initiated because their exceptional dielectric quality makes them the most likely to satisfy the requirements of Type A encapsulent (MIL-I-16923.) These may include either the fragile foam-in-place plastic or the microballoon loaded epoxy material. The foams are of particular interest because they exhibit low dielectric constant and low dissipation factor combined with light weight. On the other hand, caution should be taken against their poor dielectric strength, poor resistance to heat distortion and poor mechanical shock.

An encapsulent having all the properties intended for application to electronic circuits at all frequencies and under all conditions is not available. Therefore, it is necessary that specific encasing resins, exhibiting specific characteristics, be utilized for specific applications.

Chemical and Physical Behavior

Chemical and physical behaviors of some of the more commonly known epoxy casting resins are listed in Table I. The conventional amine-setting epoxies may be cured at room temperature dissipating the heat over an extended period. The resulting exothermic heat will be generally lowered. It is noticed that the resistance to thermal and mechanical shocks is extremely poor, making them unsatisfactory in this regard. The number tabulated under thermal shock indicates the number of cycles that the test specimens were subjected to without yielding to thermal fracture. Each cycle consists of exposing the sample to ten minutes at −65 F followed by thirty minutes at approximately 200 F. The mechanical resistance was measured as the weight in pounds, of a steel ball, dropped at a height of three feet, required before the sample breaks. However, there same resins are highly useful in the embedment of electronic parts which are delicate or sensitive to high temperatures. Among these will be transistors, diodes, and permalloy cores. Furthermore, in some applications, the inherent characteristics of the amine-setting epoxies could be improved markedly by compounding them with inorganic fillers such as alumina or silica.

The adhydride-hardened epoxy resins generally possess a superior combination of mechanical and electrical properties as compared with the conventional amine-hardened epoxies. The maximum exothermic temperature is reasonably low although it is necessary to cure at above room temperature. Some examples of encapsulents of this type which are classified as Type B per MIL-I-16923 are Hysol 6800, Epocast 3 and Scotchcast 235 and 241. These plastics satisfy the minimum electrical requirements, yet have excellent thermal and mechanical resistance.

The polyamide-epoxy blends possess some distinct advantages in exhibiting exceptionally good physical and electrical properties for encapsulation at moderate curing temperatures. However, they are regarded inferior to the anhydride-catalyzed resins because at elevated temperatures both the physical and electrical characteristics are degenerated. Further work with polyamides and epoxies with or without the inclusion of microballoons may result in a profitable development in achieving an encapsulent with all-embracing properties.

Also listed in Table I are three resins; namely Eccofoam FP, Epocast 3 and Castiplast 11 which are categorized in descending merits of dielectric constant and dissipation factor. Respectively, these materials satisfy the electrical requirements referenced for Type A, B and C encapsulents specified per MIL-I-16923 and were selected to represent encasing media suitably applicable for high frequency (up to 240 mc) for general electrical purpose (frequencies up to 30 mc) and for mechanical resistance. The encapsulation of various resistors, capacitors and inductors was tested and evaluated at various frequencies in order to note the relative effect of the several encapsulents on the electrical charactristics of these unit parts.

Effects of Encapsulation

Measurements were taken on 1/2 w boron-carbon resistors ranging in value from 4.7K to 100K before and after encapsulation and at frequencies from

3 mc to 240 mc. An approximate empirical relationship for predicting the effect of encapsulation on resistors at various frequencies involved a simple equivalent circuit; the direct current resistance, the alternating current resistance and the dielectric constant of the encasing medium. Reactance measurements were made with a Boonton "R-X" meter and a Boonton "Q" meter. By this method a close correlation was obtained between the calculated and measured values.

Fig. 1 shows a graph whereby the ratio of ac to dc resistance of 4.7K boron-carbon resistors is plotted as a function of frequency. With increasing frequencies an increasing drop in the ratio of Rac/Rdc is noted with encapsulents having increasing dielectric constants. Therefore, the effect of the embedment of a 4.7K resistor with a Type A encapsulent (Eccofoam FP) would be negligible at frequencies up to about 60 mc, whereas a Type C encapsulent (Castiplast 11) would satisfy the electrical requirements at frequencies up to approximately 10 mc. However, the same embedment of a 47K resistor with Eccofoam FP would give no variation in performance at frequencies up to 10 mc (Fig. 2) and Castiplast 11 shows a distinct deviation within the range of this investigation. The effect of Epocast 3 on 47K resistor is also shown.

Factors influencing the electrical performance of a resistor are the frequency, the value of the resistor and the dielectric constant of the encasing medium. Since there is an increase in the dielectric constant of an insulating material with temperature, consideration should be given to temperature as another important factor influencing the resistance.

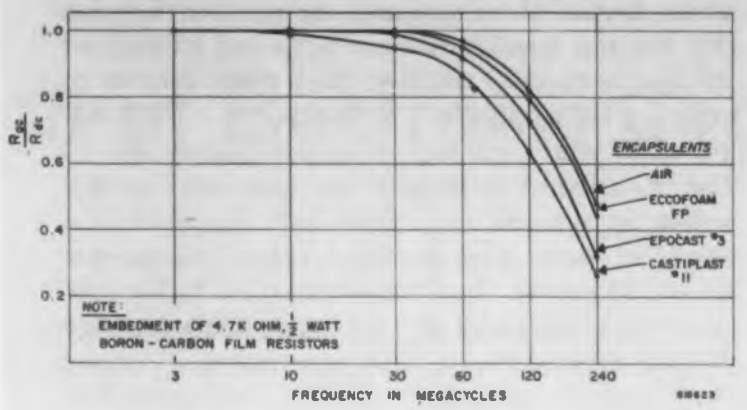


Fig. 1. Ratio of Ac to Dc Resistance of 4.7K Resistor

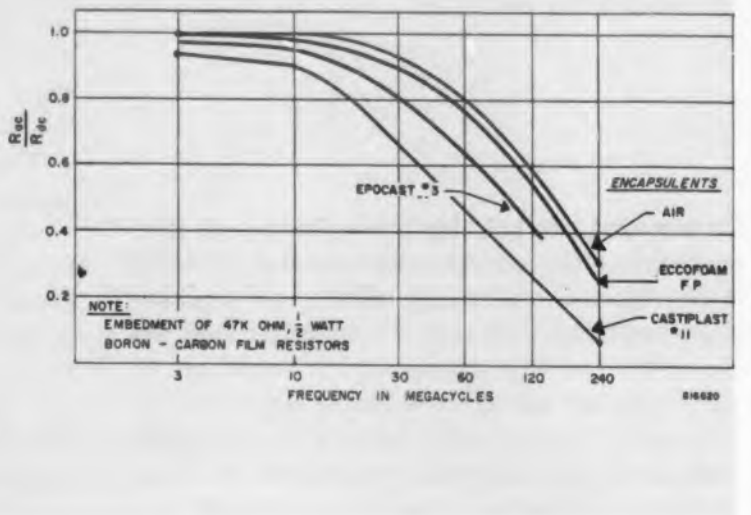


Fig. 2. Ratio of Ac to Dc Resistance of 47K Resistor

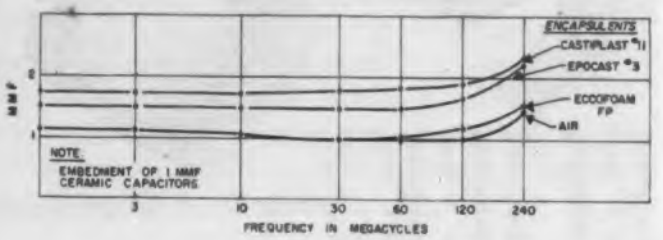


Fig. 3. Capacitive Effect of Encapsulation on 1 μμf Ceramic Capacitor

Reliability Investigation

Further investigation is continuing at RADC on the effect of temperature on the reliability of the encapsulated resistor. This work was prompted by the fact that since reliability is known to decrease with increasing temperature, the value of the embedded resistor will be depreciated. Experimental data involve tests on resistors having a power rating up to 2 w since it is established that resistors of greater power rating are not embedded. The method of approach for this work is based on the "de-rating" factor whereby the ratio of power is determined by the heat dissipation between resistors embedded with air and other dielectrics. For example, if the surface temperature of a 2 w resistor dissipating 2 w of electrical power is 190 F, and dissipating, after encapsulation, 1.5 w at this same temperature, the "de-rating" factor would be 1.5/2.0 or 0.75. This means that the resistor can safely use only 3/4 as much electrical power as it could in air for identical reliability. The investigation is not complete, but it is anticipated that the data will be helpful in determining the effect of temperature on reliability and may provide a method of verifying the "de-rating" factor without life testing. Another interesting observation is that encapsulents, particularly when filled with an inorganic material tends to provide a coolant effect upon the embedment thus indicating more stable operation.

Capacitive Effects

Representative types of capacitors commonly used in electronic equipment were selected for test and study of capacitance change with various encapsulating media. These included the ceramic and mica body units ranging in value from 1 to 10 μμf. Capacitors above 10 μμf would have no significance inasmuch as the added capacitance due to the distributed constant of the dielectric would be negligible relative to the value of the unit. This deduction was anticipated and conclusive evidence was shown by the experimental data recorded in Figs. 3 and 4. Note the variation in capacitance in a 1 μμf component embedded in different dielectrics. It is obvious that the per cent deviation is dependent primarily on the electrical value of the encasing dielectric, therefore the effects in the variation should be determined in the calculation, design and function of the circuit. The effect of encapsulation is again demonstrated with a 10 μμf mica capacitor. It is immediately noted that the per cent deviation (roughly 2 per cent to 10 per cent) is reduced such that the added capacitance would be either neglible or calculated in the design of the equipment in those cases where a close tolerance is critical.

Inductors of the type generally used for peaking and tuning purposes in wideband video amplifiers

were tested. The values selected for embedment ranged from 6.8 to 68 μh at test frequencies for each inductor in excess of the resonant frequency of the unit and normal stray capacitance combined. It was noted that within experimental errors encapsulation has no significant effect on inductors.

Conclusion

The data obtained on various resistors, capacitors and inductors give indication that reasonable predictions regarding the high frequency performance of these units comprising part of the circuit can be made after encapsulation. In addition certain fundamental principles can be established whereby the performance of an encapsulated circuit could be related to the behavior of the individually embedded parts. Of the information and conclusions deducted from the work outlined above, it is safe to assume that changes in the resonance of capacitive-inductive circuits would be a function only of the factors influencing the capacitor. Since the encasing medium has no significant effect on capacitance of values above 10 μμf and since the variation due to the distributed constant amounts to approximately 1 μμf most conventional resonant circuits could be embedded without giving serious consideration to the electrical performance. However, in the encapsulation of a highly critical, narrow band resonant circuit, wherein the capacitor is designed for low tolerance, discretion should be taken in the selection of a proper dielectric.

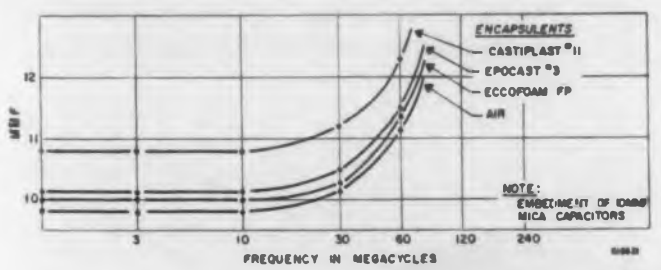


Fig. 4. Capacitive Effect of Encapsulation on 10 μμf Mica Capacitor

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CIRCLE 20 ON READER-SERVICE CARD FOR MORE INFORMATION

Easier Reading, More Reliable

Decade Counter

SHARP, bright, easily read numbers are displayed in a horizontal row by the decade counter. Most *visual* errors result from staggered vertical displays and hazy, poorly formed numerals. Lucid "in-line" numbers will decrease reading errors. Simplicity of the counting circuitry and the elimination of electro-mechanical components greatly increases the *electronic* reliability. Errors which occur in converting a binary count to a decimal count are effectively elminated.

The terms "accuracy" and "reliability" are almost synonymous when used in reference to the circuitry associated with counting. If a counter is in proper working order and used within its operating limits, it should be 100 per cent accurate. Counting errors can be caused either by actually operating the counter outside its limits, or by

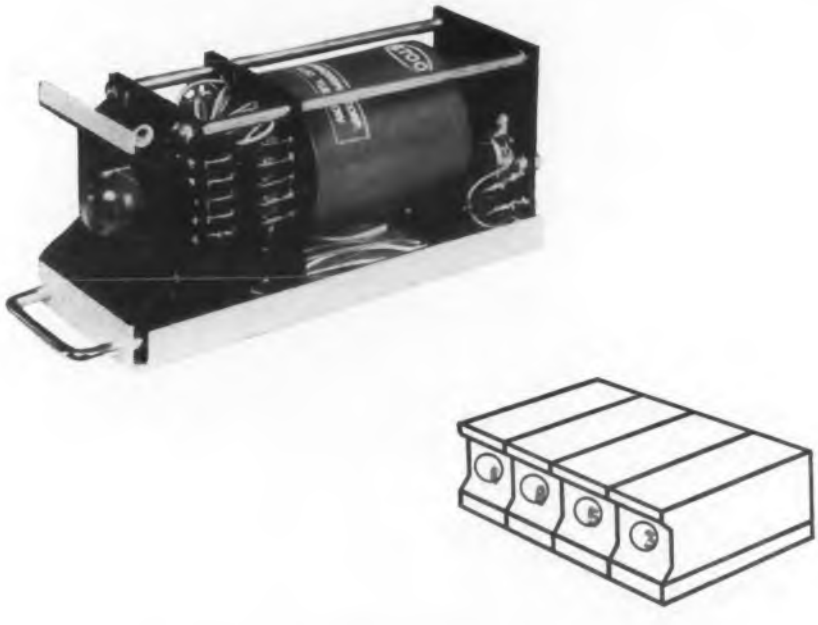

Fig. 1. Decade counter plug-in unit features high reliability and clear presentation.

component failure or "decay" below the manufacturer's specified limits.

A schematic of the counter, manufactured by Electronic Tube Div., Burroughs Corp., Plainfield, N.J., is shown in Fig. 1. Selection of the number to be illuminated is done with a beam switching tube. It channels the current directly to each number and isolates the other nine numbers in the unit. Components associated with the "isolated" numbers have no effect on the "count-reliability."

Only one resistor is used—for each position of the beam switching tube—to supply the voltage for each number. When the probability of component failure in this counter is compared with other electronic or electro-mechanical counters, the relatively few components used substantially reduces the possibility of error. An expected operating life of 50,000 hours is claimed by Burroughs for the beam switching tube.

Any desired count capacity can be had by cascading the individual plug-in units. Provisions are made for both manual and electronic zero setting. Two models are available—the DC-101 with a maximum frequency of 10 kc and DC-102 with 100 kc.

With the 100 kc and 1 mc units, a dual-triode (6201) flip-flop stage is added. Even with the addition of this tube, the probability of error-free operation is much better than other electronic counting methods which require a minimum of 4 dual triodes. Outside dimensions are 3-1/16 x 2-1/2 x 6-7/8 in. Power requirements are 300 v, 18 ma, dc and 6.3 v, 3 a, ac filament supply. Resolution of paired pulses is less than 10 μsec. For further information turn to the Reader's Service card and circle **21**.

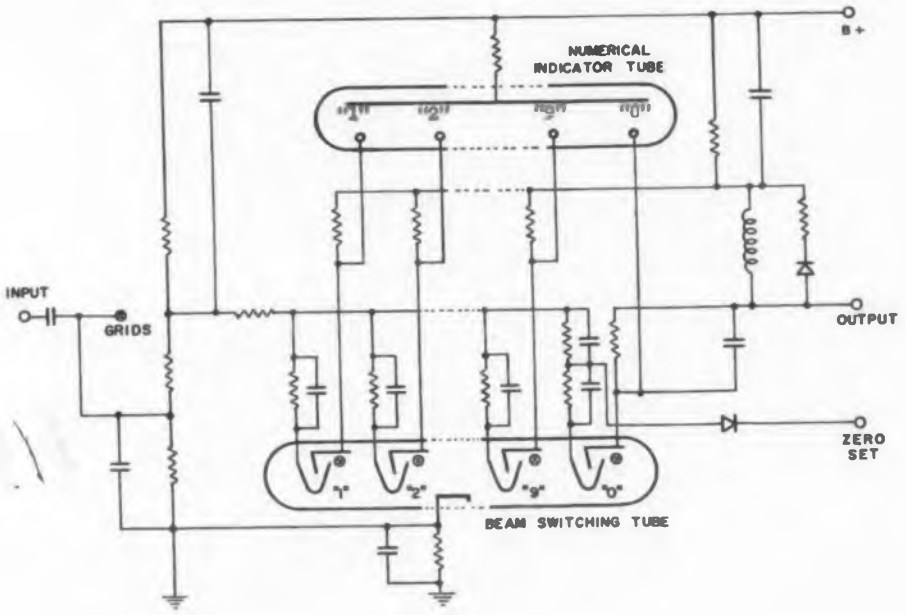

Fig. 2. A single resistor is used to supply the voltage for each number.

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- D – ¾" (up to 10 channels)
- E – 1" (up to 13 channels)
- F – 1¼" (up to 15 channels)

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- J – 30 and 7.5 inches per second
- K – 60 and 15 inches per second
- L – 75 and 18.75 inches per second
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Start time:	3 milliseconds
Stop time:	3 milliseconds
Reel sizes:	8" or 10½" standard NAB reels. Adaptors for other types can be provided.
Control:	Front panel pushbuttons or remote control contact closure and pulses.
Weight:	100 pounds
Dimensions:	Panel, width . . . 19"; height . . . 24½" Depth behind panel . . . 13½" Depth in front of panel . . . 3½"
Power Requirements:	110 to 120 volts, 60 cps, 400 watts.

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CIRCLE 22 ON READER-SERVICE CARD FOR MORE INFORMATION

RC-Transistor Network Design—I

Isaac M. Horowitz
Polytechnic Institute of Brooklyn

Background in Modern Network Synthesis

Network synthesis is the science of building networks to desired specifications. It can be extended to transducer design and has been extended to servo design.[1] The specifications may be in the form of a desired frequency response—filters and compensating networks—or a desired transient-response —delay lines and control systems. The classical methods of filter design[2, 3, 4] are based completely on the frequency characteristics of the amplitude response of the network and only three classes exist —low, high and band-pass filters. Developments in the field of network synthesis in the past 25 years have led to a much more general and sophisticated approach.

The fundamental relationships between the variables in a linear system are expressed in the form of integro-differential equations. Thus in Fig. 1, the fundamental relationship between e and i, is

$$e = Ri + L\frac{di}{dt} + \frac{1}{C}\int_{-\infty}^{t} idt \qquad (1)$$

It is extremely inconvenient to work with equations containing integrals and derivatives and so by a clever artifice such equations are transformed into algebraic equations. The artifice consists of examining the equations for the steady-state response only, for the very special case when the driving functions is of a sinusoidal nature (e^{ω}). Because of the unique property of exponentials that their derivatives and integrals are also exponentials, the awkward integro-differential equations are transformed into more convenient complex algebraic equations. One is thereafter led to the concepts of complex impedance, transfer ratio, which are all functions of $j\omega$. In effect, this amounts to describing the system by its steady state response to a special type of input. If a more general and universal description of the system is sought, one that contains within it both the transient and the steady state responses and which is amenable to almost any arbitrary input, the Laplace Transform technique is used. The exceedingly simple result is that this more general description of the system can be got very easily from the previous special sinusoidal response description. The rule is to replace the variable $j\omega$ in the first description by the complex variable s. $S = \sigma + j\omega$, has both real and imaginary parts. The input impedance of the circuit of Fig. 1,

$$Z(j\omega) = R + j\omega L + \frac{1}{j\omega C}$$

becomes $\quad Z(s) = R + sL + 1/sC.$

So long as we are dealing with lumped parameter systems (transmission lines, antennas etc. are being excluded), all system functions, such as impedances, transfer ratios, will consist of a finite numerator polynomial in s divided by a finite denominator polynomial in s, i.e.

$$F(s) = K\frac{s^m + a_1 s^{m-1} + a_2 s^{m-2} + \ldots a_m}{s^n + b_1 s^{n-1} + b_2 s^{n-2} + \ldots b_n} \qquad (2)$$

For example, in the circuit of Fig. 1,

$$Z(s) = L\,(s^2 + sR/L + 1/LC)/s$$

with $K = L$, $m = 2$, $n = 1$, $a_1 = R/L$, $a_2 = 1/LC$.

These polynomials may be factored, leading to

$$F(s) = K\frac{(s+0_1)(s+0_2)(s+0_3)\ldots(s+0_m)}{(s+p_1)(s+p_2)(s+p_3)\ldots(s+p_n)} \qquad (3)$$

The values of s at which $F(s) = 0$, are called the "zeros" of $F(s)$; those values of s at which $F(s)$ is infinite, are called the "poles" of $F(s)$. Thus -0_1, -0_2, ..., -0_m are the zeros of (3) and $-p_1$, $-p_2$, ..., $-p_n$ are the poles of (3). In Fig. 1, if $L = 1$, $R = 2$, $C = 0.2$, the zeros are at $s = -1 + j2$, $-1 - j2$; the poles are at $s = 0$ and at s infinite. There are as many zeros as poles if those at infinity are counted too. The zeros and poles of a function describe it completely except for the scale factor K. The zeros and poles of a function constitute therefore a very powerful and compact description of the function. There is direct correlation between the pole-zero pattern of a function and its other properties such as frequency response and transient response.[5] It is very convenient to make a map of the pole-zero pattern of a function. Thus the pole-zero pattern of $Z(s)$ of Fig. 1 for the values $L = 1$, $R = 2$, $C = 0.2$, is plotted in Fig. 2 with the circles indicating zeros, the crosses indicating poles. The transfer ratio, E_o/E_i in Fig. 1 has the pole-zero pattern plotted in Fig. 3.

There is a large body of information available on the pole-zero patterns that are permissible under various constraints. LC networks have their poles and zeros on the imaginary axis only, for example. Driving point impedances of RC—or RL—networks have their poles and zeros on the negative real axis only and they must alternate. Transfer functions of RC—or RL—networks have their poles on the negative real axis but the zeros may be anywhere. Transfer functions of RC—or RL—networks with a common ground between input and output (unbalanced networks) cannot have zeros on the positive real axis. Poles on the imaginary axis indicate networks oscillating at constant amplitude; poles in the right half plane indicate networks with exponentially increasing amplitudes of oscillation.

The Approximation Problem

Network synthesis is divided into two parts—the Approximation problem and the Realization problem.

The Approximation problem is concerned with the study of the specifications and their reduction to an equivalent standard form independent of the original form of the specifications. This standard form consists of the pole-zero pattern of the desired function plus a statement of tolerances on the pole-zero positions, such tolerances depending of course on the tolerances in the original specifications.

The function of the Approximation problem is to translate the specifications for any function into a pole-zero pattern that will meet the specs. Band-pass filters have pole-zero patterns of the form shown in Fig. 4(a); low-pass filters have pole-zero patterns of the form shown in Fig. 4(b), while the

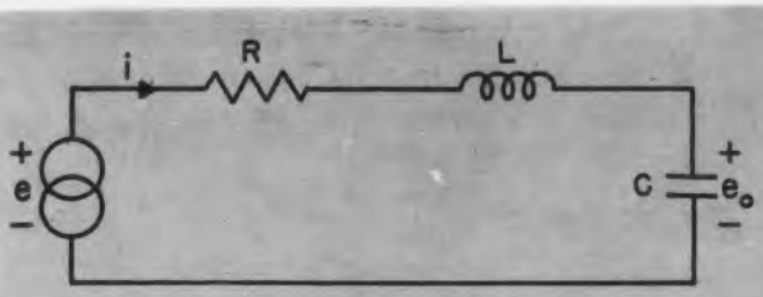


Fig. 1. RLC circuit.

Fig. 2. Pole-zero pattern of Fig. 1, for $L = 1$, $R = 2$, $C = 0.2$.

Fig. 3. Pole-zero pattern of the transfer ratio E_o/E_1 of Fig. 1.

form of the pole-zero patterns for high-pass filters is shown in 4 (c).

The Realization Problem

The second part of the synthesis is the Realization problem. It can be simply stated as follows: given a function with any pole-zero pattern, find a network whose appropriate function has this desired pole-zero pattern. The realization scheme must include a systematic, direct method for finding the network and its element values.

We are finally in a position to consider the primary purpose of this article and that is the description of realization schemes applicable to transfer functions of networks whose elements are restricted to resistors, capacitors and transistors. The elimination of inductors is justified in low-frequency applications where large values of inductance must involve bulky inductors if losses are not to be too large. This, in fact, is the classical application[6] of RC-vacuum-tube synthesis. However, because of the various unattractive features of tubes, such applications have been restricted pretty well to situations where vacuum tubes and their attendant nuisances were anyhow present. The transistor has revived interest in this field and has made it worthwhile to use RC-Transistor synthesis in higher frequency ranges than formerly used. The synthesis procedures described hereafter are valid only in those frequency ranges for which the low-frequency model of the transistor—3 resistors and one controlled source which are all independent of frequency—is accurate. Accordingly, the frequency range for which the synthesis procedures are accurate may be up to 1 kc for one transistor type and possibly up to 50 kc for others.

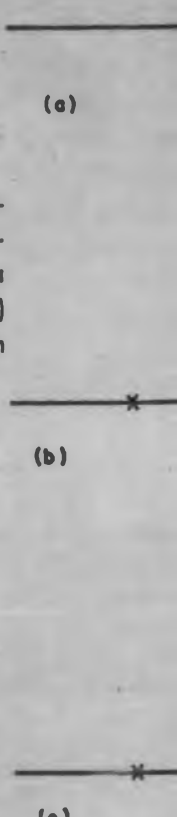
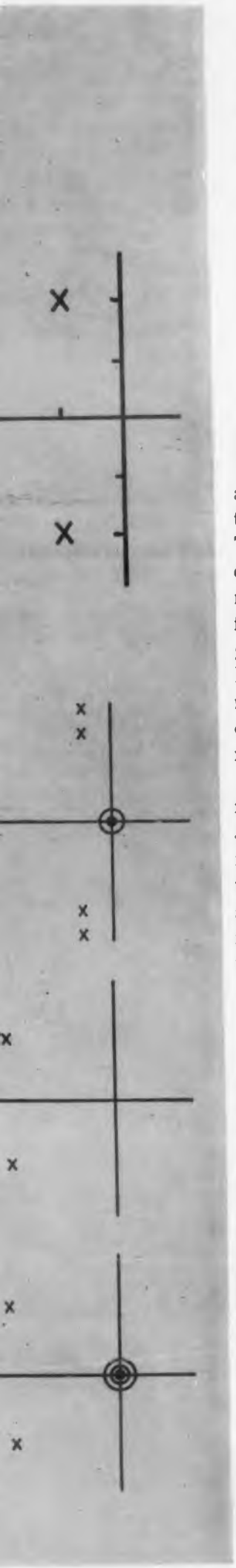


Fig. 4. Pole-zero patterns of filter methods: (a) represents a band-pass filter, (b) low-pass, (c) high pass.



Practical design methods for transistor-resistor-capacitor filter networks are presented in this series of two articles. These design procedures are particularly useful in low frequency applications—where high-Q inductors are bulky and expensive. To enable the reader to appreciate the scope and generality of the method a certain background in pole-zero concepts and in modern network synthesis is necessary. A review of elementary network theory is included in the appendix.

Part I of this series presents theory background and the Negative Impedance Converter method of design. Part II, in the next issue of ELECTRONIC DESIGN, will present the RL-RC Synthesis method, and will give a design example to show the immediate application of modern synthesis to transistor-restistor-capacitor network design. Enough detail is given to permit its immediate exploitation by the engineer.

FOR ALMOST every type of realization problem there is a variety of procedures and networks available to do the job. An important practical and theoretical problem is that of selecting the best. There is no unique answer to this question until one decides *what* he wants to optimize. If the minimum number of elements is the most important factor, method A may be the best. If the maximum gain is what is wanted, B or C may be the best. Nevertheless it is probably correct to say that in network synthesis in general, too little has been done in this matter of classification of optimum realization methods.

In active synthesis a reasonable figure of merit for comparing methods of realization is the *gain/sensitivity* ratio for a given number of active elements. In any method of realization one should try to obtain the maximum gain to sensitivity. The designer should also have the freedom to trade gain for sensitivity or vice versa, as in amplifier design, where gain may be traded for bandwidth.

Sensitivity

If any particular realization scheme requires very precise element values the technique is probably impractical. This matter of tolerances on element values and alignment difficulties comes under the heading of sensitivity, a quantitative measure of how sensitive the desired function is to variations in element values. In active network synthesis the sensitivity function is of even greater importance because of actual variations in the parameters of the active element with operating point, dynamic level and temperature. One sensitivity function that is popular is the inverse of the one defined by Bode[7],

$$S_k^F = \frac{dF/F}{dk/k} \quad (4),$$

i.e., the sensitivity of F to k is the percentage change in F divided by the percentage change in k, for small changes only. Equation (4) is itself a function of frequency and some care must be taken in

its interpretation. Another sensitivity function which is perhaps more easily interpreted and practical in realization problems is

$$S_k^{p_o} = dp_o \frac{dk}{k} \quad (5),$$

where dp_0 is the actual shift in the pole—or zero—at p_0 (due to the change in k) divided by the relative change in k. Equation (5) gives the sensitivity of the pole positions—or zero positions—to the element k. Thus in Fig. 5, if a pole originally at A shifts to B when k changes to $k + dk$, $S_k^{p_o} = \dfrac{\overline{AB}}{dk/k}$, where $\overline{AB}$ is a phasor (has magnitude and angle). The angles of $S_k^{p_o}$ may be more important than its magnitude. For example in a band-pass filter —Fig. 4(a)— with poles close to the ω axis, if $S_k^{p_o}$ has zero angle, a positive change in k drives the pole towards the imaginary axis and if sufficiently large, may cause instability.

Transfer Function Methods

Networks consisting of resistors and capacitors only have their transfer function poles restricted to the negative real axis. Most interesting transfer functions have complex poles (Fig. 4 in appendix). Therefore the basic problem in Transistor-R-C synthesis is that of realizing complex transmission poles that are unrealizeable with R's and C's alone.

Negative Impedance Method

A method involving realization of the negative of an RC impedance was first suggested by Linvill. In Fig. 6,

$$F(s) = \frac{I_o}{E_i} = \frac{y_{21a}\, y_{21b}}{y_{22a} + y_{11b}} \quad (6)$$

where y_{21a} is the short circuit transfer admittance of A defined in Fig. 7(a), y_{22a} is the short circuit output admittance of A defined in Fig. 7(b), y_{11b} is the short circuit input admittance of B defined in 7(c). Now the zeros of $F(s)$ in equation (6) are given by the zeros of $y_{21a}y_{21b}$ and the poles of $F(s)$ are given by those values of s for which $y_{22a} + y_{11b}$ is zero. Suppose the desired

$$F(s) = \frac{KN(s)}{s^2 + \xi\omega_n s + \omega_n{}^2} \quad (7a)$$

We write

$$F(s) = \frac{KN(s)/(s+\sigma)}{(s^2 + 2\xi\omega_n s + \omega_n{}^2)/(s+\sigma)} \quad (7b)$$

The number σ may be any positive number but for maximum efficiency $\sigma = \omega_n$, and this value is used in the following. The breakdown is now made:

$$y_{22a} + y_{11b} = \frac{s^2 + 2\xi\omega_n s + \omega_n{}^2}{s + \omega_n} \quad (8)$$

$$= s + \omega_n - \frac{2\omega_n s\,(1-\xi)}{s+\omega_n}.$$

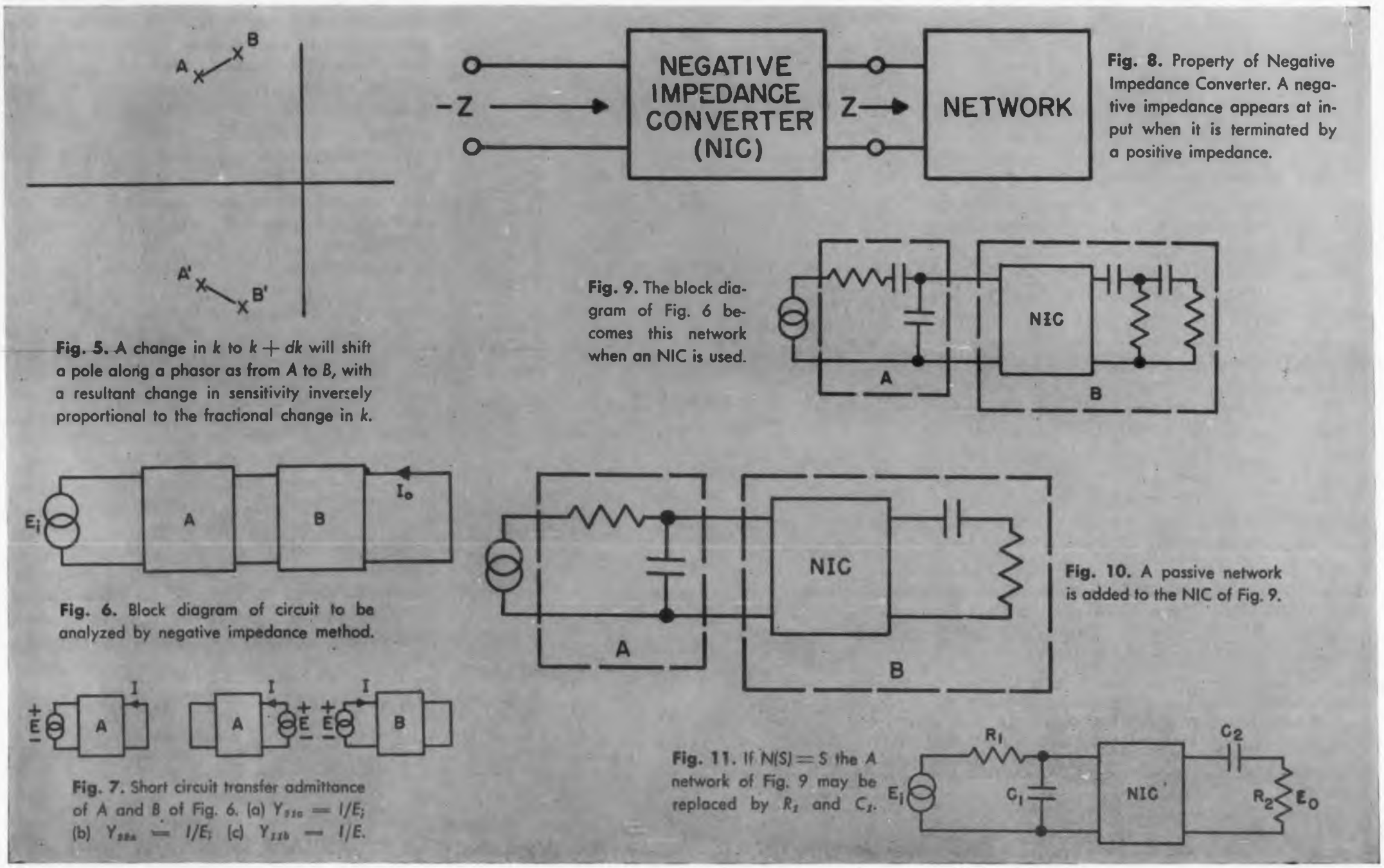


Fig. 5. A change in k to $k + dk$ will shift a pole along a phasor as from A to B, with a resultant change in sensitivity inversely proportional to the fractional change in k.

Fig. 8. Property of Negative Impedance Converter. A negative impedance appears at input when it is terminated by a positive impedance.

Fig. 9. The block diagram of Fig. 6 becomes this network when an NIC is used.

Fig. 6. Block diagram of circuit to be analyzed by negative impedance method.

Fig. 10. A passive network is added to the NIC of Fig. 9.

Fig. 7. Short circuit transfer admittance of A and B of Fig. 6. (a) $Y_{21a} = I/E_i$; (b) $Y_{22a} = I/E_i$; (c) $Y_{11b} = I/E$.

Fig. 11. If $N(S) = S$ the A network of Fig. 9 may be replaced by R_1 and C_1.

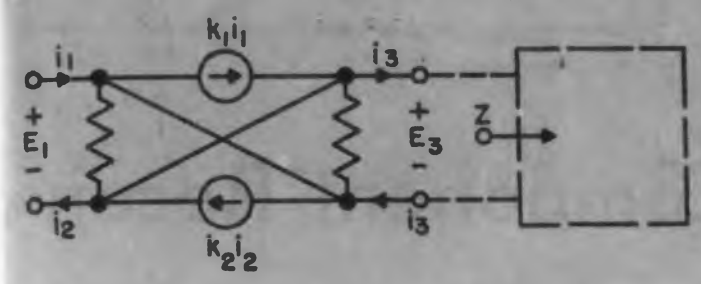


Fig. 12. An ideal Negative Impedance Converter. Ideal current sources are required.

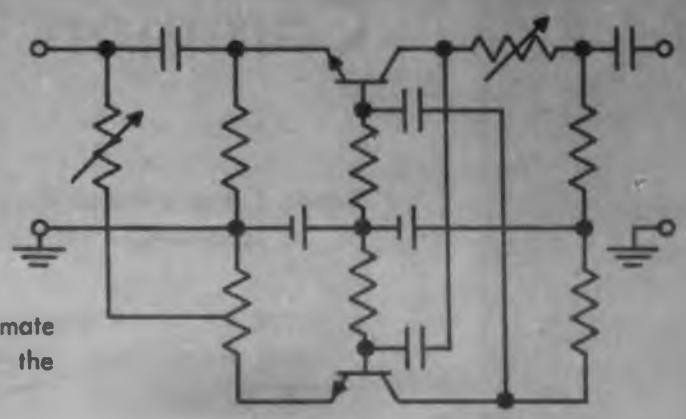
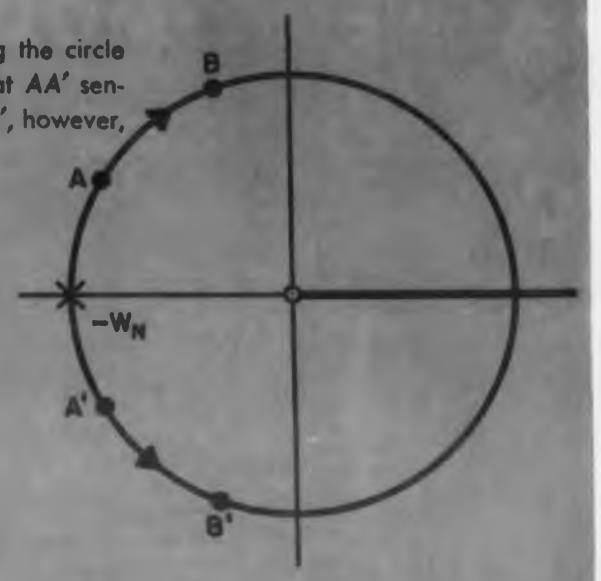


Fig. 13. The approximate transistor realization of the NIC.

Fig. 14. Passive poles at $-\omega_n$ are moved along the circle in the directions shown. If the action is stopped at *AA'* sensitivity is fair and stability reasonably good. At *BB'*, however, sensitivity and stability are poor.



We pick,

$$y_{22a} = s + \omega_n, \quad y_{11b} = \frac{-2\omega_n s\,(1-\xi)}{s+\omega_n}. \qquad (9)$$

If $\xi < 1$ (corresponding to $Q > 0.5$), y_{11b} represents the short circuit input admittance of the negative of an RC network. Linvill uses a negative impedance converter (NIC)[8, 9, 10, 11] to do this. The NIC has the property shown in Fig. 8. Its input impedance is $-Z$ when it is terminated by the impedance Z. Accordingly, the block diagram of Fig. 6 becomes the network of Fig. 9. The same method may be used for any number of poles. For example, if the denominator of the transfer function is $(s^2 + 2s + 2)\,(s^2 + 4s + 8)$, on may write

$$y_{22a} + y_{11b} = \frac{(s^2+2s+2)\,(s^2+4s+8)}{(s+1)\,(s+2)\,(s+3)} \qquad (10)$$

$$= s + \frac{4s}{s+2} - \left[\frac{2.5\,s}{s+1} + \frac{(25/6)s}{s+3}\right].$$

$$y_{22a} = s + \frac{4s}{s+2} \qquad (11)$$

(representing a passive RC admittance), and

$$y_{11b} = -\left[\frac{2.5\,s}{s+1} + \frac{(25/6)s}{s+3}\right] \qquad (12)$$

may be realized by means of an NIC followed by a passive network as shown in Fig. 10. In general, if the transfer function denominator is D(s) of degree n, one writes

$$y_{22a} + y_{11b} = \frac{D(s)}{(s+a_1)\,(s+a_2)\,\ldots\,(s+a_{n-1})} \qquad (13)$$

and makes a partial fraction expansion of eq (13) leading to

$$y_{22a} + y_{11b} = s + \sum^{i} \frac{A_i s}{s+a_i} - \sum^{j} \frac{B_j s}{s+a_j}\,(i \neq j) \qquad (14)$$

and apportions:

$$y_{22a} = s + \sum \frac{A_i s}{s+a_i},\quad y_{11b} = -\sum^{j} \frac{B_j s}{s+a_j} \qquad (15)$$

In order to realize the transmission zeros as demanded by $N(s)$ in eq (7), y_{22a} and y_{11b} must each be developed in such a manner as simultaneously to obtain the desired zeros. For example if $N(s) = s$, then in place of the *A* network of Fig. 9, the one shown in Fig. 11 may be used. More information may be found in the literature[12] on the art of realizing driving point admittances (or impedances) so as to simultaneously obtain desired transmission zeros. In concluding this section the design values for realizing equation (7) with $N(s) = s$, are given below. The appropriate network is drawn in Fig. 11.

$$C_1 = \frac{I}{m}\text{ farads},\ R_1 = \frac{m}{\omega_n}\text{ ohms},\ R_2 = \frac{m}{2\omega_n\,(1-\xi)}\text{ ohms},$$

$$C_2 = \frac{2\,(1-\xi)}{m}\text{ farads}.$$

In the above m may be any positive number and can be chosen for convenience. For example if $\omega_n = 5000$ radians per sec and $\xi = 0.25$, a convenient value for m might be 10^7, leading to $C_1 = 0.1\ \mu F$.

The Negative Impedance Converter

Various negative impedance converter circuits have been described. The reader who is interested in building an NIC may consult the references for details. The circuit of Fig. 12 represents an ideal NIC and requires ideal current sources. Fig. 13 represents the approximate transistor realization of Fig. 12. Various compensation schemes may be used to compensate for the non-ideal nature of the transistor. These are described in the references. Should there be any patent difficulties in connection with the transistor NIC circuits, one may use circuits[13, 14] other than the NIC method for the realization of negative RC impedances.

Whenever a negative impedance is realized, positive feedback must be used. The dangers of positive feedback are well known. When poles close to the imaginary axis are obtained by the above methods, large numbers are being subtracted from each other, with resultant poor sensitivity. The pole sensitivity, $S_k^{p_o}$ discussed previously, is convenient as a quantitative measure of the sensitivity. For the single complex pole-pair case, under the best of circumstances the pole sensitivity to the negative impedance conversion factor is approximately $\omega_n/0$. This means for example that if the design Q is 10, a 5 per cent drift in the conversion factor leads to an unstable system. In general, for small changes if the conversion factor changes by x per cent, the Q changes by $2Qx$ per cent. When two pole pairs are attempted by this method, a change in the conversion factor by x per cent changes the Q by $4Q^2x$ per cent. This poor sensitivity for poles close to the imaginary axis may also be seen by referring to Fig. 14. The passive poles at $-\omega_n$ are moved—by the negative impedance conversion factor—along the circle in the directions *AB*, *A'B'*. If poles far from the imaginary axis are being realized (e.g. low or high pass filters), the action is stopped in the neighborhood of *AA'* and the sensitivity is not bad—there is little risk that drift in the conversion factor will cause the network to become unstable. However if the action is stopped at *BB'*, corresponding to a band-pass filter, the sensitivity is poor, and there is much greater danger of instability. The conclusion therefore is that this particular method involving the realization of negative impedances is useful *providing no high Q poles are involved.* The NIC scheme is very attractive because it can be used for any number of complex poles without too much algebraic effort, and because the active and passive portions of the network are isolated.

References will be found in Part II of this series.

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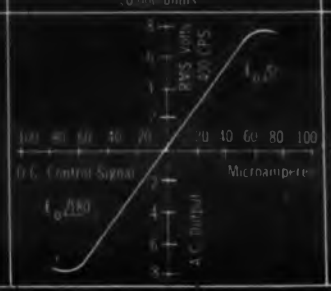
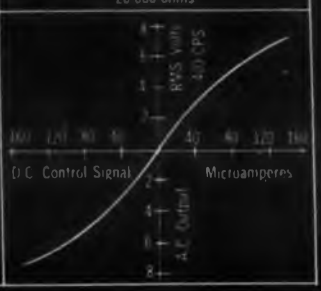
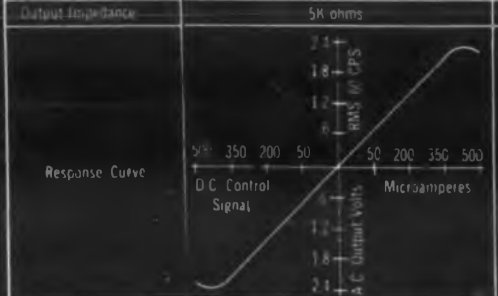
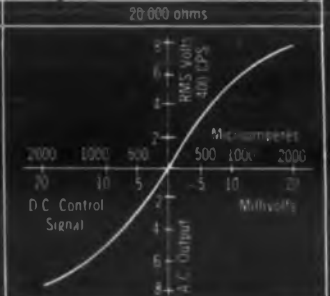
PARAMETER	INPUT MODULATORS	
Type No.	IMV— [illegible]	IMM 311 1000
Excitation Frequency	[illegible] CPS	360—440 CPS
Signal Winding DC Res.	[illegible]	1000 ohms
AC Excitation Volts	[illegible]	5.0 Volts RMS
Input Signal Range	—± [illegible] μA	— ± 200 μA
AC Output	—Vv RMS Phase Rev. [illegible]	—7V RMS 400 CPS Phase Rev.
Overall Dimensions	[illegible]	1" x 1 1/16" x 1 1/8"
Null Amplitude	2MV RMS Maximum	30Mv RMS Maximum
Output Impedance	20,000 ohms	20,000 ohms
Response Curve		

PARAMETER		THERMOCOUPLE CONVERTERS
Type No.	IMM 369 1	MTC-336-10
Excitation Frequency	60 CPS	360—440 CPS
Signal Winding DC Res.	800 ohms ± 10%	10 ohms ± 10%
AC Excitation Volts	3V RMS	6 volts RMS @ 400 CPS
Input Signal Range	—± 500 μA	0—± 20 Millivolts
AC Output	0—2.4V RMS Phase Rev.	—7.5V RMS Phase Rev.
Overall Dimensions	[illegible]	1" x 1 1/16" x 1 1/8"
Null Amplitude	2MV RMS Maximum	20 Millivolts
Output Impedance	5K ohms	20,000 ohms
Response Curve		

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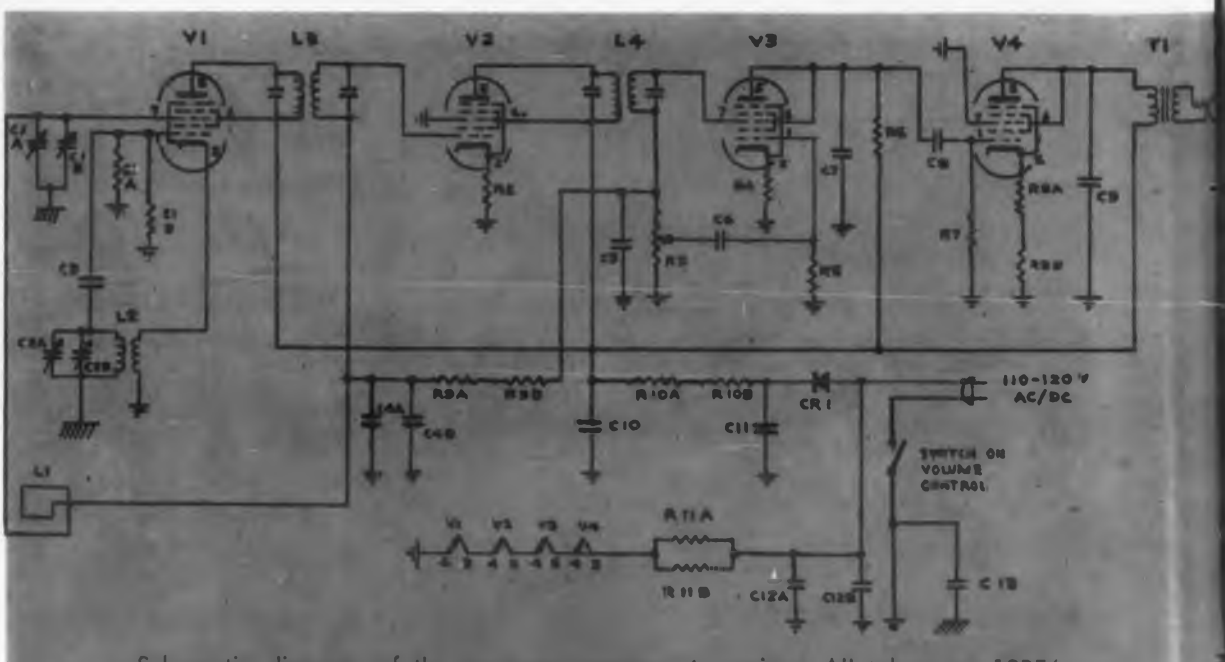
Common Component Receiver

Table 1. Parts list of the common component receiver

V1, V2, V3, V4	12BE6
R1A, R1B, R6	47K 1/2 watt
R2, R4, R8A, R9A, R10A, R10B	330 ohms 1/2 watt 10%
R5, R7, R9A, R9B	1 meg. 1/2 watt 10%
R11A, R11B	900Ω 10 watt 10%
R3	Volume control with switch .5 meg
C1A, C1B, C2A, C2B	Variable capacitor
C3, C5, C7, C9	220 μμf discap
C4A, C4B, C6, C8, C12A, C12B	0.02 μfd discap
C13	0.15 μfd 200v
C10, C11	20-40 μfd 150v electrolytic
L1	Loop antenna
L2	Oscillator coil
L3, L4	455 kc i-f transformer
T1	Output transformer
CR1	Selenium rectifier
	Speaker 4 in.

Table 2. Comparison of recommended spare parts for conventional and common component receiver

	Conventional (P-B5R1)	Common Component
Tubes	1—12BE6 1—12BA6 1—12AV6 1—50C5 1—35W4	1—12BE6
Resistors	1—22K 1—220 Ω 1—2.2 meg 1—4.7 meg 1—220K 1—.47 meg 1—150 Ω 1—68 Ω 1—1000 Ω	1—47K 1—330 Ω 1—1 meg
Capacitors	1—.047 μf 200V 1—220 μμf discap 1—5000 μμf discap 1—470 μμf discap 1—40-20-150 v	1—.02 μf discap 1—220 μμf discap 1—40-20-150v



Schematic diagram of the common component receiver. All tubes are 12BE6 pentagrid converters and only 3 values of resistance and capacitance are used.

IN LINE with the *common component* philosophy of design being advocated by the military, a conventional 5-tube ac-dc receiver was modified, reducing the spare parts inventory from 19 to six parts. The receiver originally contained nine values of resistors, five values of capacitors and five different tubes. It now contains three values each of resistance and capacitance and 1 tube-type.

The major design problem was the selection of a tube suitable for use in all stages. In this case a 12BE6 pentagrid converter was used. B+ requirements were met by utilizing a selenium rectifier since it was considered impractical to parallel several low-current tubes for this function. These rectifiers when operated at suitable ratings are reliable enough to be considered permanent parts, and are left out of the spare parts inventory.

The schematic shows the design of the Packard-Bell unit. Parts cost for production is somewhat greater than for the original 5-tube receiver, because of the increased amount of parts that were necessary to reduce the number of part-values. The parts list is shown in Table 1.

The audio output requirement of most military and similar equipment is small and can be met easily by many conventional tubes which were not designed for this function. Dual purpose tubes such as pentode-triode combinations offer great design flexibility for more complex pieces of equipment. Additional power, when necessary, can be had by push-pull operation.

Selection of the number and values of resistors and capacitors to be used is dependent on the space available and the extent to which spare parts reduction is required. Some optimum compromise must be made since it is normally undesirable to use more than two components in series or parallel to give a required value. The additional space requirement may not be warranted.

A comparison of spare parts inventory for the original 5R1 and the new receiver is made in Table 2, and it is here that the advantage of the Common Component Concept is manifest. The servicing of the equipment is substantially simplified, and in the event of tube failure non-skilled personnel can make tube replacements, since there is no chance of putting the wrong tube in a socket.

Designed by Packard-Bell Technical Products Division, 12333 W. Olympic Blvd., Los Angeles, as a demonstration of the CCC—Common Component Concept—the receiver was commended by Major Gen. Corderman, Deputy Chief Signal Officer.

This article is an investigation into the family of transistor building-block circuits using direct-coupled transistor logic. It is based on the development of complementing flip-flop circuits having no requirements on input pulse duration, and the design of a steering mechanism to complement the basic direct coupled saturation flip-flop. Part I of this article dealt with basic steering concepts and the principles of conditional steering circuits, culminating in a set of design rules (ELECTRONIC DESIGN, June 15, 1956).

Direct Coupled Transistor Logic Complementing Flip-Flop Circuits—II

E. G. Clark
Burroughs Corp. Research Center
Paoli, Pa.

Conditional Steering with Magnetic Cores

Of the wide variety of circuits which can be designed in accordance with the above rules, one of the most interesting is given in Fig. 1. This circuit illustrates the application of conditional steering to magnetic cores and has several unique characteristics. The method of utilization of cores makes is possible to achieve higher apparent squareness ratios or higher speeds than the core characteristics would indicate.

The following description of the complementing flip-flop action will serve to illustrate the mechanism by which these properties are achieved. Referring to Fig. 1, assume the initial condition to be TR-2 "off" and TR-3 "on". By virtue of the direct coupling, TR-1 must be "on" and TR-4 "off". TR-1 collector current will flow in windings $N1_b$ and $N2_d$ on the two cores. These windings are of sufficient turns and of such polirity to hold the left core in the "1" state and right core in the "0" state. (the magnetomotive force contributed by base current to TR-3 through $N1_c$ is negligible in comparison). Trigger current in $N1_a$ and $N2_a$ applies mmf's to switch both cores to the "1" state, thereby producing output only from the switched core. The induced voltage pulse in $N2_c$ will be negative at the dot (base) end, turning on TR-2 and reversing the state of the flip-flop.

Because the triggering mmf is by necessity of sufficient magnitude to overcome the opposite mmf produced by the flip-flop, the triggering current pulse holds the cores unconditionally in the "0" state for the duration of the pulse. Upon conclusion of the trigger, the cores are released to the control of the flip-flop. The half cycle is completed when the mmf applied as the result of the new flip-flop state switches the right core to the "0" state. As before, the spurious pulse generated by this core switching is in the direction to maintain the new state of the flip-flop and has no effect on the circuit.

A number of features result from this simple mode of operation. To appreciate these, it must be recognized that:

- The internal saturation flip-flop has a definite trigger threshold.
- At rest, the state of both cores is controlled by the flip-flop.
- The dc mmf applied to the core controls its operation, giving, in effect, a biased core whose natural remanence point is relatively unimportant.
- The steering action of the cores does not require them to switch completely.

The performance of the complete circuit is related to the above characteristics as follows:

Core Squareness Not Critical. The trigger threshold gives the internal flip-flop sufficient noise immunity to permit reliable operation on relatively low signal to noise ratios. The application of a dc mmf makes it possible to accurately establish a pseudo-remanence, or dc operation point, by choice of turns and steady-state transistor collector current. Since the core-controlling transistors are either cut-off or bottomed, collector current will be determined only by the collector supply voltage and series resistance, R_{L1}. This pseudo-remanence can be exploited to provide either large signal-to-noise ratio or to make possible operation with non-square cores such as the ferrites. The degree of nonlinearity required of the core is determined by the available mmf and the minimum signal-to-noise ratio required for reliable flip-flop triggering.

High Speed Operation. The same factors which make core squareness noncritical make it possible to operate the flip-flop with pulse repetition frequencies considerably in excess of those predicted on the basis of complete core switching. Once the

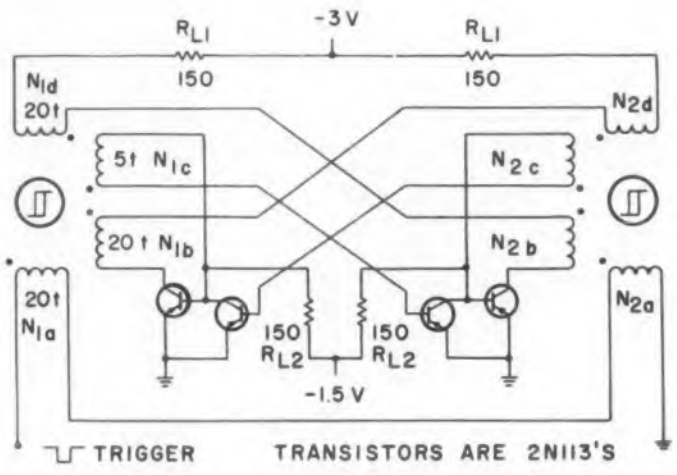


Fig. 1. Circuit illustrating the application of conditional steering to magnetic cores. Higher speeds can be achieved than core characteristics would indicate.

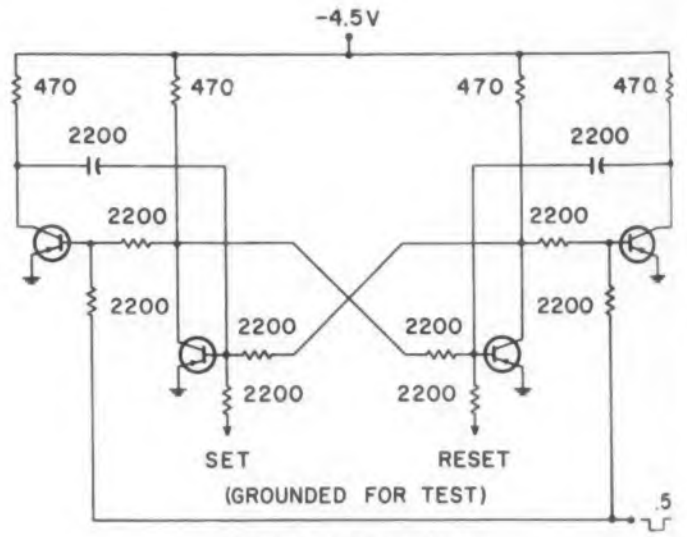


Fig. 2. RC coupled circuit with NOR circuit substituted for the DCTL gates.

change of flux in the core is sufficient to trigger the flip-flop, completion of core switching is not essential to flip-flop action, provided that by the time of the next pulse the core is sufficiently close to its opposite remanence (or "pseudo-remanence") state to initiate the next cycle. Accordingly, a high pulse repetition frequency can coerce the cores into alternate states in a much shorter period than required for complete switching without prejudicing reliable flip-flop triggering. Operation of the cores will then be around a family of minor loops determined by operating speed.

Increasing the frequency will require higher switching mmf's and reduce the signal-to-noise ratio. Results with a typical square tape core indicate that operation is possible at a signal-to-noise ratio of 2:1 at a frequency up to 10:1 higher than that corresponding to a complete core switching period. In addition to the above-mentioned features, this circuit also provides dc level indication of the core state and could be employed for nondestructive read-out. The amplifying transistors on the outside of the figure serve to isolate the switching waveform appearing across the R_{L1}'s from the internal flip-flops and can be probably eliminated for many applications.

Still another permutation is illustrated in Fig. 2. This differs from the previous RC coupled circuit by departing from DCTL gates. In their place is substituted the logically equivalent resistive OR with transistor inverter, or as it is sometimes called, the NOR circuit.

The circuit of Fig. 3 is one of many possible variations on the basic RC coupled theme. It evolved as a configurational modification of the basic circuit (Part I, Fig. 4, ED, June 15, 1956) and has unique properties.

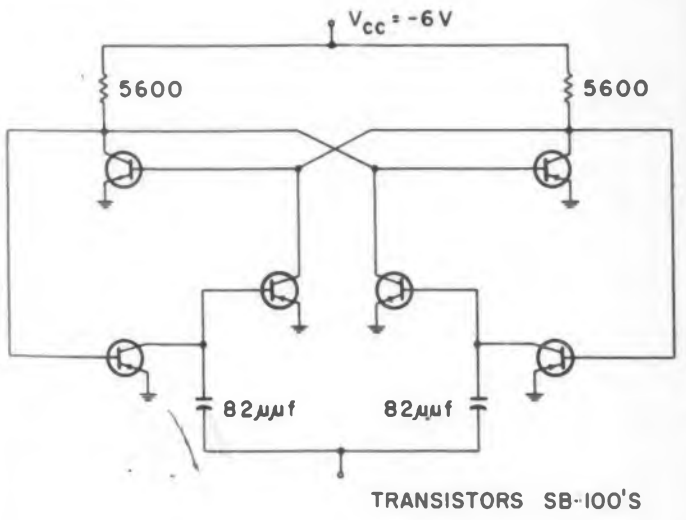


Fig. 3. Variation on the basic RC coupled circuit. The coupling capacitor has been moved to the input in order to follow it with current gain.

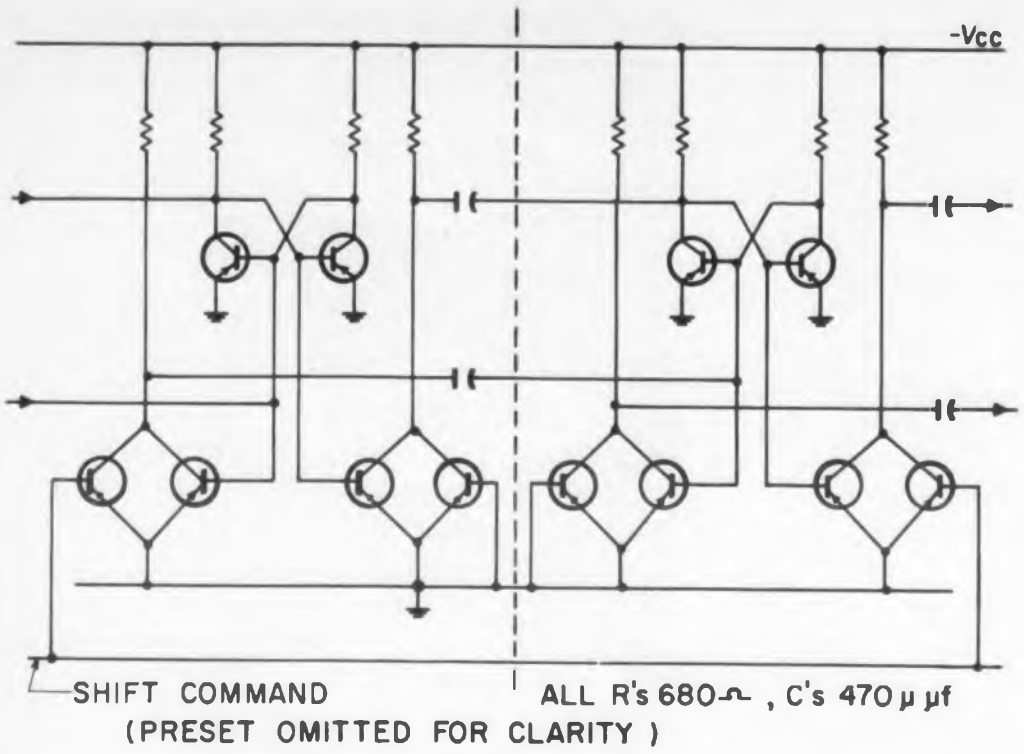


Fig. 4. Two stages of conditional steering shift register, utilizing the parallel OR, RC coupled gate.

Note that the coupling capacitor has been moved to the input in order to follow it with current gain. This makes it possible to reduce the stored charge and hence the size of capacitor and the recovery time constant. In addition, a new form of gate is employed.

The gate transistors steer by inhibiting base current in the set and reset transistors. The gate is enabled when the steering transistor is off, making it possible for a negative-going input to be differentiated into the base resistance. Base conduction in the disabled gate is prevented by the collector clamping action of the ON steering transistor.

An important speed-up action occurs in the disabled gate once the flip-flop is triggered. As soon as the flip-flop changes state, the enabled gate is disabled by conduction in the steering transistor. Conduction in this transistor serves the two important speed-up functions of pulling a reverse base current in the triggering transistor and discharging the input capacitor. In other words, as soon as the flip-flop has accepted enough charge to trigger, the excess charge on the input capacitor is quickly removed by collector clamping.

The previously disabled gate is likewise enabled and time race is theoretically possible if the input trigger continues to fall at the initial rate. In practice, the margins are sufficient to permit quite conservative design. This is due in part to the fact that a slower trigger fall time which might be expected to cause time race will also delay the initial trigger. As a result, the volts per micro-second remaining after trigger to produce time race is negligible, especially with an exponential fall time. In practice,

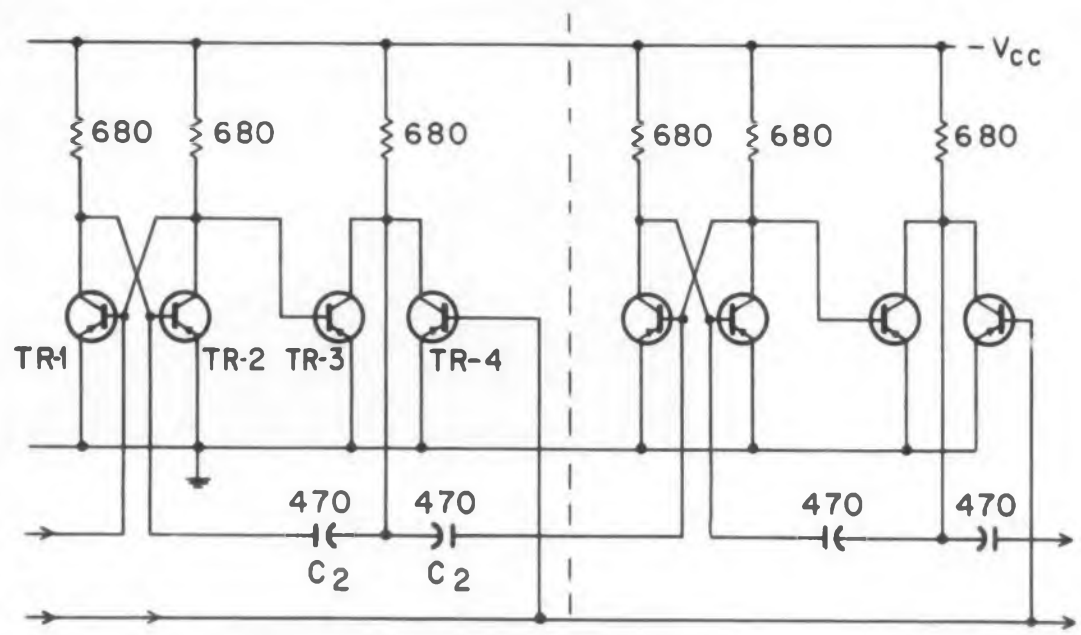


Fig. 5. Two stages of conditional steering ring counter. The circuit uses an end-around carry and a preset which sets all stages except one in the zero state.

this circuit has been demonstrated to operate satisfactorily with more than a ten to one difference input fall time.

This circuit operates in excess of 10 mc with surface barrier transistors, with a maximum frequency of oscillation of 30 mc. It is even simpler than the parallel OR circuit but is slightly more susceptible to thermal effects due to the cascaded direct-coupled stages. For high-speed counter work, the steering-transistor collector provides a convenient fast-propagate output since it is not necessary to wait for the basic flip-flop to trigger.

Shift Register Application

So far this article has covered only the application of conditional steering to complementing flip-flops and binary counters. Perhaps an even more important application is in the design of shift registers. The circuit of Fig. 4 utilizes the parallel OR, RC coupled gate (from the complementing flip-flop of Fig. 4, Part I, ED, June 15, 1956). The only difference from the counter application is that the gate outputs are connected to the stage adjacent instead of back on itself. This is possible since connected to the stage adjacent instead of back on itself. This is possible since the steering required for unconditional transfer is basically the same as that required to complement a flip-flop. Because unconditional transfer is an important logical operation, a means for accomplishing it without time race is of general value. Parallel read-out, for example, can be performed with identical circuitry.

The performance of this register is essentially the same as that already given for the equivalent complementing flip-flop. In this particular circuit, recharging of the capacitor generates a negative noise pulse following the turn-off pulse.

The effect is negligible, however, since the noise pulse is driving against a bottomed collector junction condition.

Shift Register Circuits

An interesting application of conditional steering to a special-purpose shift register is the counter circuit illustrated in Fig. 5. This circuit employs an end-around carry and a preset which set all stages except one in the zero state. The single one is advanced around the ring, one stage per input pulse. This is the form of counter sometimes employed as a cycle distributor. It is interesting here because conditional steering provides a convenient gating system to provide counting from near-static to multi-megacycle rates. Only one-half the normal register gate is required. The output of this gate simultaneously resets the stage carrying the ONE as it advances the ONE to the adjacent stage. *(Based on a paper presented at the joint IRE-AIEE-U. of Pa. 1957 Transistor and Solid State Circuits Conference, Philadelphia, Feb. 1957).*

△ *See at WESCON*

4 MILLIMETER KL

ANY klystron that can produce 4 mm electromagnetic energy is newsworthy. This 65.5 to 77.5 kmc tunable waveguide output reflex klystron is further distinguished by being commercially available. Although designers will probably need a DX priority to get a tube for themselves, operating characteristics are available and not classified. A demonstration unit will be on display at Wescon, booth 3206.

The 4mm generator, developed by P.H.J.A. Kleinjnen of the Philips Co., Holland is available from Amperex Electronic Corp., Hicksville, N.Y. The unit, designated the DX151, has a power output of 40 mw at the center of the band and 10 mw minimum across the band. The focusing is electrostatic.

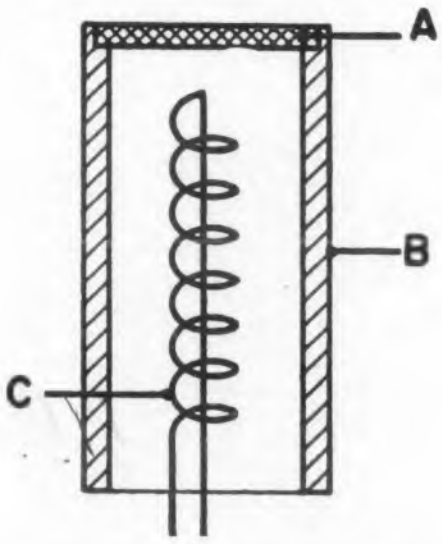
The "dispenser-type" cathode in the DX151 makes possible continuous thermionic emission at a high-current density in the order of 2 to 4 amp per sq cm. This results not only in high power output, but in long life as well. A barium aluminate mixture is "dispersed" or impregnated into the pores of a machinable tungsten body. This construction maintains a homogeneous temperature distribution across the emitting area, improves thermal efficiency, and permits space for a larger heater. The dispenser-type cathode can operate at a temperature about 500 C lower than bombardment-type cathodes. Hence the low input power of 0.4 amp at 10 v ac and dc.

The unit is of rugged construction. Tuning is accomplished by a single knob. A matching

R KLYSTRON

plunger adjustment optimizes tube performance. Resonator voltage is 2200 to 2400 v. The focus voltage is −30 to −60 v. Repeller voltage is −100 to −400 v. Great care is necessary in manufacturing this tube to obtain extremely precise tolerances and desirable electrical characteristics.

An adapter will connect the output to an RG-99/v waveguide. Maximum dimensions are 5-5/8 x 4-9/16 x 4-1/8 in. For more data turn to the Reader's Service card and circle 30.



Planar-type impregnated cathode used in 4 mm reflex klystron. Tungsten body *a* is impregnated. Molybdenum body *b* encircles heater *c*.

Voltage Stress Effects on Ca

Charles H. Bridenbaker
Capacitor Dept.,
General Electric Co.

IN THE design of many electronic circuits, the insulation resistance of capacitors is an important consideration. It is therefore important that the design engineer know the factors which affect insulation resistance, particularly in paper dielectric capacitors, the most common type.

It is generally understood how insulation resistance varies with temperature; resistance limits at room temperature and a maximum rated temperature have been established in MIL-C-25A specifications. But very little has been published about how insulation resistance changes with voltage stress. Since the variation between 100 and 500 v dc is far greater than might be expected, a series of tests to demonstrate this variation with voltage were made in our laboratories at five different voltages on paper dielectric capacitors. Three different impregnants were used—mineral oil, G. E. permafil 2860 and polyisobutylene. Since the electronic designer is primarily interested in insulation resistance at the maximum operating temperature, an ambient of 125 C was selected for this investigation.

The test units were placed in a preheated, forced circulation oven set at 125 C. The insulation resistance readings were started after units had been in the oven for one hour. Electrification time was one minute and readings were first made at the low potential. The applied voltages were 100, 200, 300, 400, and 500 vdc. All units were read at one potential before going to the next higher, and the units were shorted after each reading.

For subminiature metal-clad tubular capacitors the typical minimum thicknesses of the dielectric are as follows:

Rating	Total Dielectric Thickness	Stress in Rated Volts per Mil	Stress in Volts per Mil at 100 Vdc
100	0.4 mil	250	250
200	0.5 mil	400	200
300	0.6 mil	500	167
400	0.7 mil	571	143
600	0.9 mil	667	111

From these statistics it is evident that insulation resistance readings should be made at rated voltage.

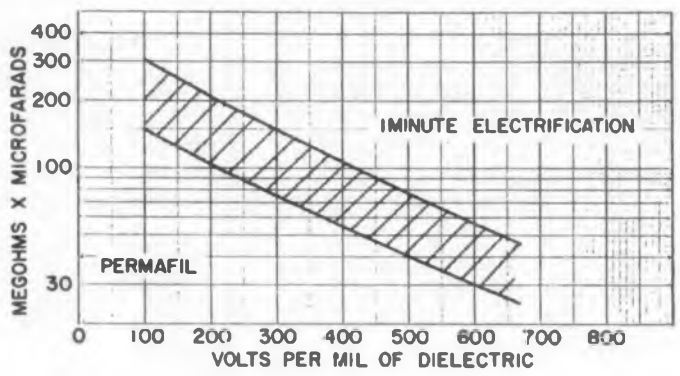


Fig. 1. Megohms x microfarads vs. voltage stress on permafil-impregnated paper dielectric capacitors. Ambient temperature was 125 C.

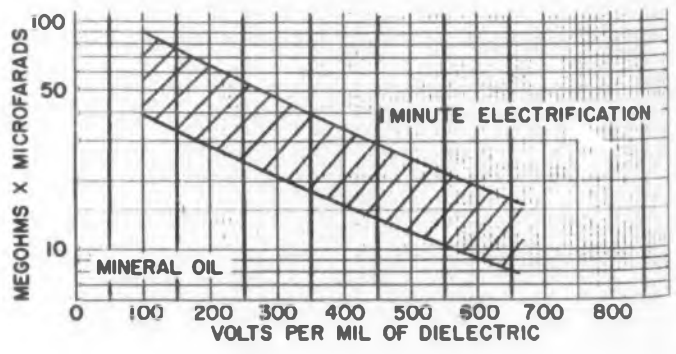


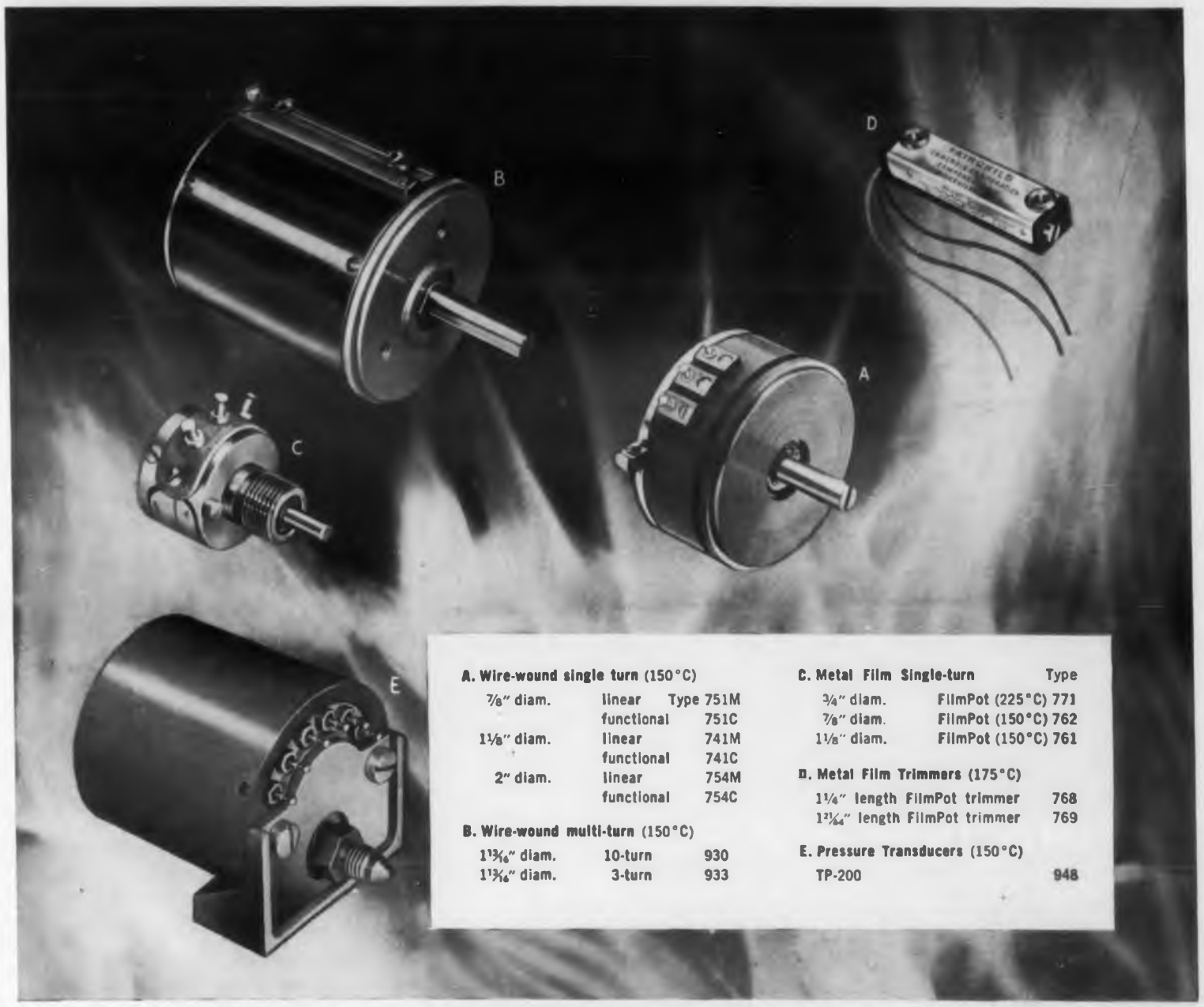
Fig. 2. Megohms x microfarads vs. voltage stress on mineral oil impregnated paper dielectric capacitors. Temperature 125 C.

Capacitors

MIL-C-25A specifications permit voltages to be between 100 and 500 v dc but no greater than rated voltage of the unit. They *do not* specify that each unit must be tested at rated voltage. This means that a 500 v dc unit could be tested at 100 v dc and still meet MIL-C-25A specifications.

Consider a paper dielectric capacitor with a 600 v dc rating, treated with permafil. Typical thickness of the dielectric is 0.9 mils, as in the Table. Insulation resistance at 100 v dc, 125 C, is 140 meg-μf, minimum (Fig. 1). The insulation resistance at 500 v dc, 125 C, is 34 meg-μf, minimum. There is approximately a 410 per cent difference between the 100 v dc and 500 v dc values.

In the case of another 600 v dc rated capacitor, this time treated with polyisobutylene, the typical thickness of the dielectric is again 0.9 mil. Insulation resistance at 100 v dc, 125 C, is 33 meg-μf, minimum (Fig. 3). The insulation resistance at 500 v dc is 10 meg-μf minimum. Here there is approximately a 330 per cent difference between 100 and 500 v dc insulation resistance values.



A. Wire-wound single turn (150°C)			
⅞" diam.	linear	Type	751M
	functional		751C
1⅛" diam.	linear		741M
	functional		741C
2" diam.	linear		754M
	functional		754C
B. Wire-wound multi-turn (150°C)			
1 13/16" diam.	10-turn		930
1 13/16" diam.	3-turn		933

C. Metal Film Single-turn		**Type**
¾" diam.	FilmPot (225°C)	771
⅞" diam.	FilmPot (150°C)	762
1⅛" diam.	FilmPot (150°C)	761
D. Metal Film Trimmers (175°C)		
1¼" length FilmPot trimmer		768
1 23/64" length FilmPot trimmer		769
E. Pressure Transducers (150°C)		
TP-200		948

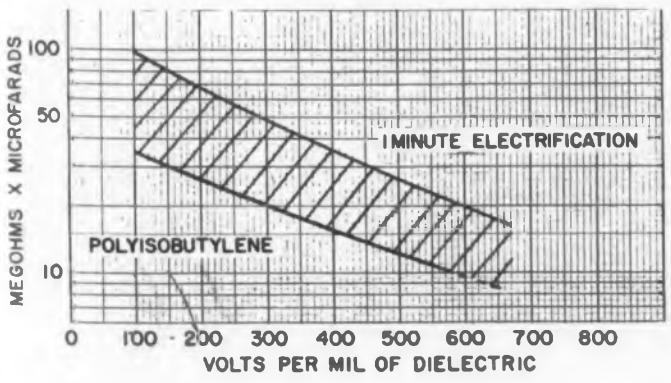


Fig. 3. Megohms x microfarads vs. voltage stress on polyisobutylene-impregnated paper dielectric capacitors. Temperature 125 C.

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CIRCLE 34 ON READER-SERVICE CARD FOR MORE INFORMATION

Nuclear Powered Timer

TIME delays from milliseconds to forty hours with an accuracy of ±3 per cent from −65 to 165 F are obtained by combining a nuclear battery (25 year shelf and use life) with gas diode circuitry in one miniature unit. The timer weighs about six oz and is able to withstand extremes in pressure, vibration, jolt, jumble and brutal acceleration.

A nice thing about the Betachron, manufactured by Patterson, Moos Research Div. of Universal Winding Co., 90-28 Van Wyck Expressway, Jamaica 18, N.Y., is that it can be tested virtually *ad infinitum* to assure its reliability and timing accuracy. Even continuous short circuiting of the battery will not affect its life. The Betachron is used in pilot ejection systems, missile arming and safety systems, missile self-destructors, missile parachute recovery, warheads, satellite timers and remote shut-off actuators. There is no radiation hazard: the AEC declares the nuclear battery may be treated as a conventional sealed source.

Settable Betachron units can be purchased with a 10 position selector switch to cover the time range from msec to 10 min. The standard Betachrons with time ranges from 1 msec to 60 sec, 1 min to 60 min, and 1 hr to 40 hr will give an output energy of 10,000 ergs; non-standard units with energy outputs up to 200,000 ergs can be furnished.

The Betachron consists of a nuclear battery (Fig. 1) and two cold-cathode gas diode-resistor circuits shown in Fig. 2. The battery is simply

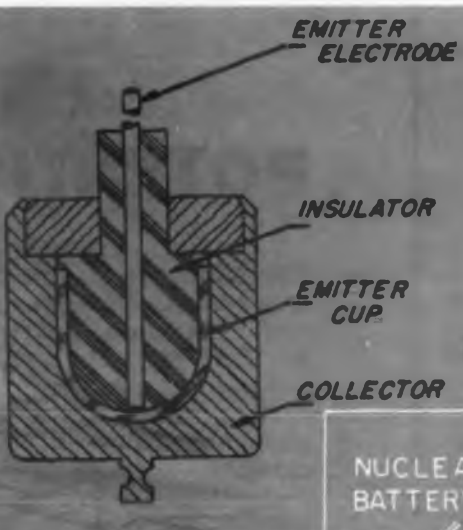


Fig. 1. Nuclear battery construction. Unit pictured measures 9/16 in. long x 1/2 in. diam, and can be supplied in current ratings from 10 to 200 μμa, having a linear charging rate to 500v.

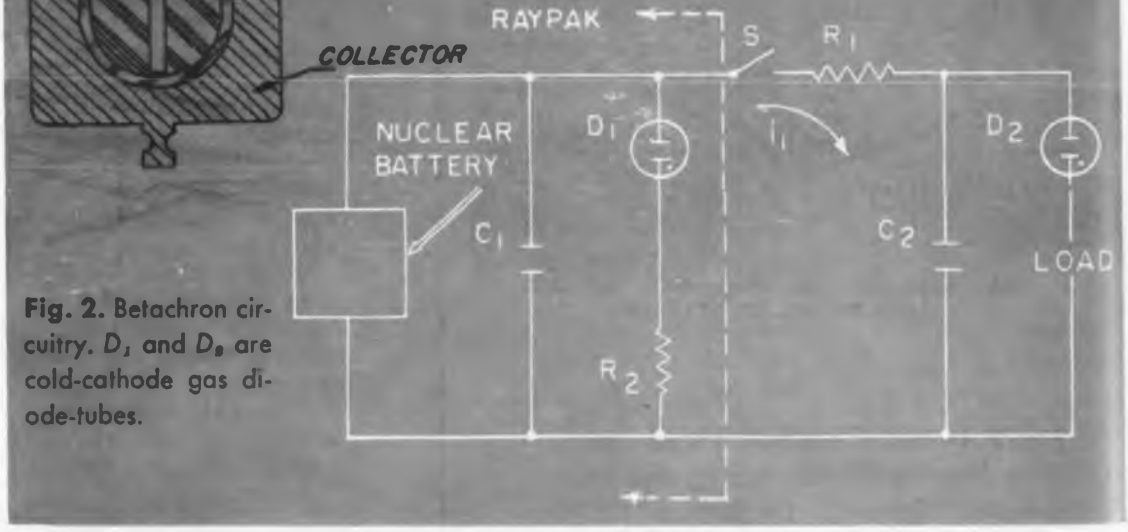


Fig. 2. Betachron circuitry. D_1 and D_2 are cold-cathode gas diode-tubes.

an electrically insulated electrode in contact with a β-emitting radioisotope which comprises one plate of a capacitor. A brass case acts as the collector and the other plate of the capacitor. β particles emitted by the radioisotope are collected, causing a potential difference to exist across the capacitor.

When the battery is connected to C_1, D_1 and R_2 of Fig. 2, a pulse source of energy with essentially zero impedance is obtained. Patterson, Moos calls this the Raypak and markets it separately as well as part of the Betachron. The battery maintains C_1 under charge at a voltage close to and determined by the breakdown voltage of the cold-cathode gas diode. If the Raypak is connected to the circuit consisting of R_1, C_2 and D_2 as shown, a time delay can be achieved when S closes. Capacitor C_1, which is charged to a regulated voltage close to the breakdown voltage of D_1, discharges through resistor R_1 into capacitor C_2. When the voltage on C_2 reaches the breakdown voltage of cold-cathode diode D_2, the diode conducts and discharges the energy available on C_2 into the load. The time delay of such a circuit is dependent, of course, on the rating of C_1, R_1 and C_2 and the breakdown voltages of diodes D_1 and D_2. The mathematical analysis of this circuit is as follows:

Initially:

$$Q_1 = C_1 V_1$$

$$Q_2 = 0$$

$$\frac{1}{C_1}\int i_1 dt + \frac{1}{C_2}\int i_1 dt + i_1 R_1 = 0$$

Since

$$i_1 = Ae^{kt}, \text{ at } t = 0$$

$$A\left(\frac{1}{C_1 k} + \frac{1}{C_2 k} + R_1\right) = 0,$$

and

$$V_2 = V_1 \frac{C_1}{C_1 + C_2}\left[1 - exp\left(-\frac{C_1 + C_2}{C_1 C_2 R_1} t\right)\right]$$

From this expression and working from the energy content desired in the output pulse (C_2V_2), it is possible to calculate values for the components necessary to provide a given time delay. The Betachron is small–2-1/2 in. diam x 1-1/4 in. long–rugged, light weight, encapsulated and hermetically sealed in a brass case. The switch for initiating the time delay is included in the timer and can be of the snap action, pull wire, or electrical signal type. The timer can be repeatedly tested before use to assure proper time delay and energy transfer.

For further information on this battery, turn to the Reader's Service Card and circle 35.

Meeting Report

Reliability

2nd RETMA Symposium on Applied Reliability
Syracuse, N. Y., June 10-11

THE TENOR of the RETMA symposium was a quiet unanimous determination to realize future high *numerical* reliabilities in components and equipment. The problem in the past has been *1.* to develop adequate techniques, *2.* to create departments whose responsibility is reliability, and *3.* to make engineers aware of the importance and necessity for being reliability-conscious. The latter two are principally the concern of management.

But they are expensive. A reliability department requires manpower, scheduling, departmental shifting and the establishing of standards for production. Management has needed to be convinced that the inevitably higher priced end-product would be paid for.

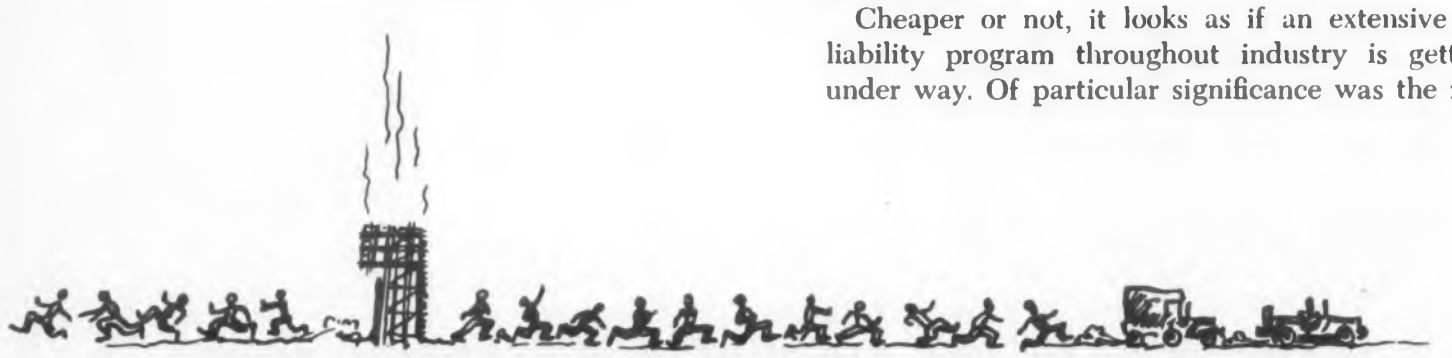
At this last RETMA symposium it looked very much as if management *was* being convinced. The attendance was pretty well split between members of the "management team" of companies and the design engineers. In papers presented engineers talked about the technical side of reliability, methods, procedures, and gave empirical data and statistics. Management talked about the need for reliability and expressed a determination to have it. It is not desirable, they said, it is vital. All realized that a product with a high reliability coefficient—or a manufacturing setup designed to produce reliable components and equipment, which is practically the same thing—will cost more initially . . . but they also realized that in the long run it will be cheaper. Reduced maintenance and less waste and less "shrinkage" at the end of a production run were given as the reasons for this long-term reduction in cost.

Cheaper or not, it looks as if an extensive reliability program throughout industry is getting under way. Of particular significance was the fact that when Julian Sprague said, "Military contracts must be taken off the auction block," nobody disagreed, nobody objected. Mr. Sprague, of Sprague Electric Co., was speaking at a panel meeting at the symposium and was reminding his audience that the manufacturer who maintains a full reliability program cannot enter a competitive bid against a company that has no such profit restrictions. Military representatives on the panel, Captain Bull, USN, Col. Sladek, Army, and Col. Reiser, USAF, listened impassively, nodding agreement now and then as Sprague elaborated on this point.

Sprague went on to say that committees set up to investigate just what changes in regulations would be required to make it legal discovered that *no* changes are necessary. The contracting officers technically have the power to select bidders without being subject to regulations regarding price or bids. Of course, he added, contracting officers are pretty much subject to pressure and when a higher bid is accepted, must explain it. It is sometimes easier to accept the lower bid than go through the virtually inevitable investigations and questions.

For once we heard no one define reliability, which we take as a healthy sign that work is going ahead reasonably smoothly. In the past every time somebody started to talk about reliability, he gave a definition. We recall one meeting where three hours were spent on trying to agree on what the word meant, with nobody aware of Hayakawa's principle of reducing an idea to its least abstract state. Nobody said, "When a piece of equipment works satisfactorily for as long as it is needed—that's reliability."

But this time the monkey wrench was not thrown in the works and information was communicated steadily. We were impressed with R. B. Bonney's



exposition of standard plug-in units as an aid to reliability, more for the aid to reliable maintenance it suggested than for a high reliability coefficient. Engineering design and mechanical layout is simplified; drafting time is shortened by the use of standard symbols denoting the units; model shop assembly is made easier; and debugging can be done more quickly.

This is nothing new or radical. But we think it represents the kind of thinking that is going into maintainability today. It is apparent that the soldiers, sailors and Air Force technicians who will be operating the equipment may be relatively untrained. Extensive programs of training won't be necessary if operation and maintenance of the equipment is simplified.

Col. Sladek, Head of the Communications and Electronics Division, USAF, complained about the bill the Air Force was getting annually for contractor services. It costs them $6 million a year to hire industry's servicemen to maintain equipment that Air Force technicians should be able to handle themselves. The Rand Corporation says the *annual* cost of electronic maintenance is *twice* the original cost of the equipment. Sladek cautioned later, however, that care must be taken in designing "throw-away" units. Be sure the module is small enough so it costs less to dispose of it than to repair it.

It should be pretty clear that the military is prepared to spend more money on the original cost of equipment . . . if it means that maintenance costs will be cut substantially.

We talked with R. E. Clark, of Britain's Admiralty. He said the most pressing problem at present was the *mechanical* design of electronic equipment. Later in his paper, Mr. Clark described procedures for achieving mature design. These are mainly matters of philosophy. Engineers, he maintains, must be educated carefully in reliable design procedures, and ought to have substantial experience with field equipment. He gives an example of a mature design: the soldered connection is always found high on the list of causes of equipment failure. Solderless joints proved out very well in extremely severe environmental tests. Much work has gone into making wire-wrapping tools. Mr. Clark concludes that as the process stands it is fairly mature.

We might cite Sprague Electric again to give an idea of the extent to which industry is planning to go. Sprague has spent four years and $1.5 million in establishing a reliability department and a line of high reliability components. Six million component hours were spent in life testing. Later in the week at New York and Washington, Sprague revealed that it was producing a line of capacitors of such high numerical reliability that one would have to have 6,000 computers, each containing 60,000 capacitors and run them steadily for six months before *one* capacitor failure would be noted.—TM

New Products

△ Products marked with a triangle (△) are being exhibited this month at the WESCON Show. The company's booth number is included at the bottom of each product.

△ Compact Selenium Rectifiers

36 V Per Plate

Individual rectifier plates are capable of handling twice the current of conventional plates of the same dimensions, and feature input voltages up to 36 v per plate. The low forward drop and high voltage capacity resulting from the Dualtron process reduces the number of plates required to provide the same output as other selenium rectifiers. Rectifiers of all circuit types will be available in plate sizes ranging from 1 in. to 6-1/4 x 7-1/4 in.

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

Wescon Booth No. 1501-02.

CIRCLE 38 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Kilovoltmeter

100,000 V Range

This high voltage vacuum tube voltmeter, model J-1003, with a maximum range of 100,000 v can measure voltages of various waveforms including pulses at frequencies from 10 cps to 20 mc with an accuracy of ± 3 per cent. Higher frequencies can be measured with slight loss in accuracy. The linear meter scale provides full scale readings of 2.5, 5, 10, 25, 50, and 100 kv. Two inputs are provided, each equipped with a vacuum capacitor divider, arranged to permit measurement of balanced or unbalanced circuits with either or neither side grounded. The range can be doubled by installation of accessory vacuum capacitors on the high voltage probes. Ordinarily the probe assembly is attached to the main instrument. The probe assembly may be removed to permit installation of the probes in close proximity to the high voltage circuits to be measured but with the meter at a safe distance. A jack is provided on the front panel to permit use of an oscilloscope for visual observation of wave forms being measured.

Jennings Radio Mfg. Corp., Dept. ED, P.O. Box 1278, San Jose, Calif.

Wescon Booth No. 1516-1517.

CIRCLE 39 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Silicon Rectifiers

Mounted on Tube Base

Tube base mounted silicon replacements for vacuum tube rectifiers provide savings on filament power supply, cooler operation, and longer life and resistance to vibration and shock. The S6X4, a direct replacement for the 6X4 full-wave high vacuum rectifier tube, features an output of 85 ma dc max, an input voltage of 400 v rms, and a maximum peak current of 225 ma. Maximum piv is 1250 v; the voltage drop, 6 v at 70 ma. The physical dimensions approximate the same over-all dimensions as those of the standard 6X4 tube, and will plug directly into the same tube socket. Testing over a range of temperature and environmental conditions indicates extreme reliability for the design characteristics, and maximum stability is realized under all mounting positions.

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

Wescon Booth No. 1501-02.

CIRCLE 40 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Rotary Joints

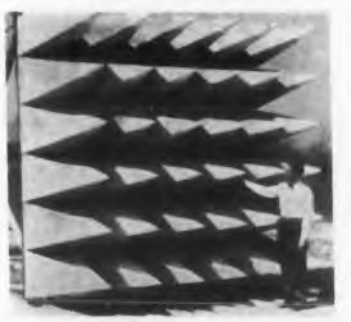
Operate at High Speeds

The high power rotary joints are capable of pressurization and operate at high speeds. The coupling is normally choke type, but in cases of large bandwidth or smaller sizes, contact finger type couplings can be incorporated for slower speeds. Coaxial joints can be furnished in 7/8, 1-5/8, 3-1/8, 6-1/8 and other line sizes and can be either 50 ohms, 75 ohms or other characteristics impedances. Wave-guide rotary joints are of the in-line type and feature broad band operation at high speeds. These cover complete frequency bands from 2.6 to 40 kmc and are capable of pressurization.

Diamond Antenna & Microwave Corp., Dept. ED, 7 North Ave., Wakefield, Mass.

Wescon Booth No. 1814.

CIRCLE 41 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Absorbers

VHF, UHF and Microwave

Eccosorb CHW is a series of absorbers which reflect less than 2 per cent of incident energy at all frequencies above 50 mc. Eccosorb CHW is used in free space rooms where extremely broad frequency coverage is required. It is easily installed and has a smooth white surface for good light reflection. Outdoor exposure is also possible.

Emerson & Cuming, Inc., Dept. ED, 869 Washington St., Canton, Mass.

Wescon Booth 1518-19.

CIRCLE 42 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Display Storage Tube

High Writing and Erasure Speed

The 3 in. VTP 6992 is a storage type cathode-ray tube designed to present bright visual displays of television, radar or other types of electronically written information. Features of this tube are its ability to display tones and to write, hold and erase at the operator's option. Brightness is sufficiently high for easy viewing in bright daylight, and writing and erasure speeds are fast enough to present excellent displays of high speed data with good contrast. The VTP 6992 contains a storage structure mounted internally near the panel, and both a flood gun and an electrostatically deflected and focused writing gun supported in a single neck axially aligned at the rear of the tube. All gun connections are terminated in a diheptal base attached to the tube neck.

Vacuum Tube Products Co., Inc., Dept. ED, 2020 Short St., Oceanside, Calif.

Wescon Booths No. 2403, 2404.

CIRCLE 43 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Teflon-Insulated

Taper-Pin

Solderless Press-Fit stand-offs are available for taper-pin connections. A turret lug may be provided if extra and soldered connections are required in addition to the taper-pin. Feed-thrus are available with taper-pin or soldered connections at either or both ends. Completely-insulated types, with metal insert entirely imbedded except for the flush end that takes the taper-pin connection, provide exceptionally long leakage path for elevated voltages. Since Press-Fit Terminals are Teflon-insulated, they mount directly on metal, thereby eliminating usual phenolic board with its troublesome and costly breakage. Patch-cord boards, utilizing taper pin connections, can be made with metal panels at considerable saving.

Sealectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, New York.

Wescon Booth No. 2619.

CIRCLE 44 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ *See at WESCON*

△ Equipment Blower

Minimum Space

This blower's recess in the base of the company's modular frames provides the maximum delivery of filtered air while utilizing a minimum of panel height. Two models available are the B350 and B800, delivering 350 and 800 cu ft of air per min respectively. Each blower is adequately filtered and fused. An example of the space saving feature of the blower is shown. The Model B350 blower absorbs 3-1/2 in. of vertical panel space in a standard modular frame.

Amco Engineering Co., Dept. ED, 7333 W. Ainslie St., Chicago 31, Ill.

Wescon Booth No. 3217-18.

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Trimming Potentiometers

Printed Circuit Miniature Type

Trimming potentiometers called Acetrims, have been designed especially for printed circuit applications, and have round or flat tabs in place of terminals to facilitate and speed up assembly with other circuit elements. Assembly is simple: plug into printed circuit board, secure, and dip solder. Standard specifications of printed circuit Acetrims include: 1/2 in. size; wt 1/4 oz; 10 ohms to 150 K resistance; power 2 w at 60 C max; temp —55 to 125 C; sealed moisture-proofed, anti-fungus treated; withstands severe shock, vibration, acceleration, and meets applicable military specifications.

Ace Electronics Associates, Inc., Dept. ED, Somerville, Mass.

Wescon Booth No. 2720.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Taper Pins

Quick-Disconnect

The A-MP miniature taper pin receptacle eliminates tedious operations of soldering leads to miniature connectors. This quick-disconnect terminal is applied to the lead by means of A-MP automachine and A-MP certi-crimp tooling, and then capped over other type connectors, modified to receive the A-MP 37 series miniature taper pin receptacle. Other A-MP taper pins are available, series 53 and 88, for wire sizes 2-12 AWG and a wide range of insulation sizes. Insulation piercing taper pins are available for small stranded wires and popular size tinsel cords.

Amphenol, Inc., Dept. ED, 1030 S. 54 St., Chicago 50, Ill.

Wescon Booth No. 2319-20.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Function Programmer

Sixteen Circuit Functions

The Function Programmer provides switching as well as potentiometer control of electrical and electronic circuitry in relation to time. Up to 16 separate circuit functions can be accommodated with 8 detachable function switch strips. In addition, a pulsing switch is provided for deriving pulses in one-half sec increments or any multiple or one-half sec. A speed-regulated dc motor with reduction gears causes the moving contracts to travel along the switch or potentiometer strips at constant speed. The travel time is 50 sec ± one-tenth sec. The direction of travel is reversed by inversion of the dc input to the motor. The motor normally requires 350 ma. Input voltage may vary between 22 to 36 v. The timer may be stopped or reversed at any point. Individual circuit function strips or potentiometer strips already in place. The Function Programmer has been approved for a missile application.

Hubbard Scientific Labs. Inc., Dept. ED, 1292 E. Third St., Pomona, Calif.

Wescon Booth No. 2130.

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION

(Advertisement)

Unique Sales Promotion Planned

A unique sales campaign, coupled with demonstration, is being planned for this year's WESCON Show. In order to impress electronic engineers and purchasing agents with the practical economy of using *general purpose* oscilloscopes, "Kit" Kittleson, LFE's West Coast representative and Joe Worth, Special Products Division Sales Manager of Laboratory For Electronics, have announced that LFE's new 411A oscilloscope will be sold *from San Francisco* at WESCON. According to the company, this is probably the first time from-the-convention sales have been conducted at an electronics show. Using this method, LFE will offer immediate delivery either for final sales or trial and evaluation by users.

Automatic Triggering Beyond 10mc

Model 411A, a wide-band oscilloscope featuring diversification of the horizontal deflection system through plug-in units, now also offers positive triggering beyond 10mc on any signal above 20mv. No touchy control manipulation is required; triggering is unaffected by positioning or amplitude changes. The 411A is a general purpose scope with direct-reading, calibrated delay in microseconds, functionally grouped controls, bandwidth from D-C to 10mc and 20mv/cm sensitivity without using additional plug-ins. The scope features reliability and accuracy plus time measurements within 1% accuracy with amplitude, blanking or intensity markers. Laboratory For Electronics has competitively priced the instrument, offers immediate delivery and on-the-spot servicing. At the WESCON Show, LFE will deliver 411As from San Francisco and guarantee 24 hour delivery from the convention to the buyer's factory.

CIRCLE

Attention: knob twirlers, CRT scanners, hard-working R and D engineers, money-saving buyers, project schedulers . . .

For a more detailed view of an easterner's view of a westerner's view of the U.S.A., get your own full-color, full-size map at Wescon, booths 2806-7. FREE!!!

Straight from WESCON- Scope Delivery

in 24 Hours Guaranteed!

WHO EVER HEARD of scopes being delivered from San Francisco at the convention — delivered anywhere in the country — within 24 hours! Nobody! But you can get them — *now, for the first time* — at WESCON! "Kit" Kittleson and Joe (LFE) Worth are the boys to see. They'll have a scope in your lab or plant for trial by "users" or final sale within 24 hours *or else*. What's the scope? New 411A — with quick, clean, positive, automatic triggering beyond 10mc at any signal level above 20mv, 1% time measurements through amplitude, intensity or blanking markers, 20mv/cm sensitivity without additional plug-ins and many more features. Get a reliable, competitively-priced, wide-band scope . . . get on-the-spot servicing . . . get immediate delivery NOW! AT WESCON, BOOTHS 2806, 2807.

Laboratory For Electronics, Inc.

51 ON READER-SERVICE CARD FOR MORE INFORMATION

In our first presentation, October 1952, *Electronic Design* stated this publishing policy:

"To promote the progress of the electronic manufacturing industry by serving the key technical function—design.

"To make the electronic designers' task easier, more efficient, and more productive.

"To provide a central source of electrical information preselected and concisely presented for convenient readership and use.

"To encourage two-way communication between electronic designer and manufacturer."

Now, almost five years later, *Electronic Design*, alone among all other electronic publications, remains unchanged in policy, in concept, and in its pledge to both reader and advertiser.

T. Richard Gascoigne

James S. Mulholland, Jr.

—co-publishers

ELECTRONIC DESIGN

a HAYDEN publication

New York • Chicago • Los Angeles

New Products

△ *See at WESCON*

△ Modular Oscilloscope

Miniature

The Model 200 modular oscilloscope features interchangeable amplifier and sweep generator units. The design is available in standard rack mount or a portable case measuring 9-1/2 wide x 11-1/2 high x 12-1/16 in. deep. It is furnished completely assembled as a standard low or high freq unit, or in other combinations to fit specific applications.

Advanced Electronics Mfg. Corp., Dept. ED, 2025 Pontius Ave., Los Angeles, Calif.

Wescon Booths No. 1001, 1002.

CIRCLE 52 ON READER-SERVICE CARD

△ Vibration Shaker

1500 lb Force

The Model 174 Shaker is designed for high frequency operations and low input requirements and is featured in a system for random vibration testing of components and assemblies up to approximately 30 lb in wt. The armature behaves as a simple single-degree-of-freedom system over an extended frequency range. The inherent rigidity of the armature maintains a high first resonance under loaded conditions. The Model 174 Shaker features an armature having its longitudinal resonance at approximately 4000 cps, bare table. Additional features of this new Model 174 1500 lb force output shaker include: collinear table motion, table diam of 9 in., 130 lb load for 10 g vector and 55 lb load for 20 g vector, maximum stroke of ±0.5 in. with recommended stroke of ±0.25 in. for continuous duty. Field supply requirements are 3 kw at 125 v dc. When used with amplifiers, a separate rotary m-g set is supplied. Weight of this new shaker is 2000 lb.

The Calidyne Co., Dept. ED, 120 Cross St., Winchester, Mass.

Wescon Booth No. 710-711.

CIRCLE 53 ON READER-SERVICE CARD

△ Isomica and Samica Sheets

For Rolled and Stacked Capacitors

Capacitor Grade Isomica and Samica are two grades of continuous mica sheet designed for use in stacked and rolled capacitors, especially those intended for operation at elevated temperatures or under high corona bombardment. Samica sheet is made in continuous form from either domestic or foreign mica especially refined to eliminate all impurities. Size and thickness of the mica particles are controlled to insure uniformity of physical and electrical properties. The Samica sheet contains no resin impregnant. It is supplied as pure mica sheet which can be impregnated by the user. In pressed units, the temperature limitation of Samica sheet is determined by the impregnant used. In rolled units, the pure sheet will maintain its characteristic in excess of 550 C. The Isomica sheet is impregnated with a high temperature, silicone resin. This provides optimum dielectric characteristics at continuous operating temperatures as high as 550 F. It also provides intermittent operation up to 750 F.

Mica Insulator Co., Dept. ED, Schenectady 1, N.Y.

Wescon Booth No. 921-22.

CIRCLE 56 ON READER-SERVICE CARD

△ Expandable Cabinet System

For Small Instruments

A line of cabinets is available with either a bolt-on or hinged top. Through the utilization of louvered or plain side spacers, a basic 7 in. panel height cabinet may be expanded up to 21 in. in panel height. Nine different panel heights ranging from 7 to 21 in. are available. Some of the features are the minimization of stacking and stocking problems, the ease of access for servicing equipment, and the variety of assemblies that can be achieved from standard stock parts. The cabinets are 18-1/2 in. deep overall and they conform to RETMA mounting specifications.

Amco Engineering Co., Dept. ED, 7333 W. Ainslie St., Chicago 31, Ill.

Wescon Booth No. 3217-18.

CIRCLE 57 ON READER-SERVICE CARD

CIRCLE 58 ON READER-SERVICE CARD ➤

New Products

△ *See at WESCON*

△ Automatic Marine Converter

For Refrigerators and Appliances

This refrigerator-appliance automatic marine converter runs house freezers, refrigerators, tools and appliances from dc or battery power. It measures 6-3/4 x 14 x 11 in. high and weighs 65 lb. The converter output is 750 w. Seven models are available. They are able to operate on 24, 28, 32, 46, 64, 115 or 230 v dc input.

Carter Motor Co., Dept. ED, 2764 W. George St., Chicago, Ill.

Wescon Booth No. 2616.

CIRCLE 61 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Tab Mounted Clips

For Printed Circuits

A line of component clips for mounting on printed circuit boards use mounting tabs spaced for 0.1 in. grids instead of riveting. The tabs, capable of taking five 90 deg bends without fracturing, are inserted either manually or by automatic machine into 3/64 in. diam. holes in a printed board and bent over underneath clinching the clip in place. Clips and tabs are of one-piece construction made of beryllium copper and finished by electro-tinning over copper flash. Clips maintain a tight grip on components over a wide vibration range loaded from 5 to 50 g. Available in following component diam: 0.17, 0.235, 0.312, 0.408, 0.508, 0.625, 0.758, 0.875 and 1 in.

Atlas E-E Corp., Dept. ED, 47 Prospect St., Woburn, Mass.

Wescon Booth No. 404.

CIRCLE 62 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Recording Oscillograph

Eliminates Dark Room Processing

The 24-channel Electrograph embodies all the features necessary to produce continuous permanent recordings on a light-sensitive emulsion. The direct writing feature eliminates the need for a dark room processing of the record as required with standard photographic recording oscillographs. Intelligence is transferred to the recording medium through the use of pencil type light beam galvanometers. Input connection to each of the 24 galvanometers is accomplished through the use of individual mating electrical connectors. The photographic process is completely dry and employs the techniques of electrophotography. The recording emulsion becomes photoconductive once it is electrostatically charged within the machine. Exposure of the emulsion to a focused beam of light reflected from the galvanometers reduces the charge level in the areas exposed. The image becomes visible as a result of attracting a finely ground thermoplastic black powder to the discharged portions of the emulsion. The record thus produced is made permanent by passing it over a heated surface which fuses the powder to the surface of the emulsion. The record may be reproduced by Ozalid or other similar processes without loss of definition.

Century Electronics & Instruments, Inc., Dept. ED, Tulsa, Oklahoma.

Wescon Booth No. 614-15.

CIRCLE 63 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Plug-in Modules

29 Positions

Each of the T line series of universal, transistorized, 1 mc logical plug-in modules for digital control and data handling systems has twenty-nine plug-in positions to accommodate a fully transistorized power supply, gating modules, unit delays and clock packages.

Computer Control Co., Inc., Dept. ED, 92 Broad St., Wellesley 57, Mass.

Wescon Booths Nos. 117, 118.

CIRCLE 64 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ *See at WESCON*

△ Cycling Oscillator

One Cycle every 30 Sec to 1 Hr

A new concept in automatic frequency scanning has been introduced by Ling Electronics, Inc. (formerly L. M. Electronics), that provides limitless variations due to its time cycling range and scanning selectivity.

The CO-10 cycling oscillator permits scanning an entire range or any portion thereof at a rate of once every 30 sec to 1 hr. Upper and lower frequency limits can be pre-set for cycling any portion of the frequency range or, if desired, manual tuning may be employed. The pre-set rate covers any requirement from 2.3 to 600 dial per min. Calibrated frequency range of 20 to 20,000 cps is also available on special order. The CO-10 has an accuracy factor of ±4 per cent overall and a frequency response of ±1 db. Hum and noise are at a minimum—at least 60 db below rated output. Stability of at least ±1 per cent and amplitude stability of ±0.25 db after warmup are some of the other salient features.

Ling Electronics, Inc., Dept. ED, 5120 W. Jefferson Blvd., Los Angeles, Calif.

Wescon Booth No. 2208-09.

CIRCLE 66 ON READER-SERVICE CARD

△ Molded Insulated Terminals

Standoff and Feedthrough

An expanded line of molded insulated standoff and feedthrough terminals will be featured in addition to the standard line of Snap-Lock Teflon-insulated terminals. The 14 standoffs, insulated with molded melamine or alkyd, give a broad line to cover every terminal need.

Lerco Electronics Inc., Dept. ED, 501 Varney St., Burbank, Calif.

Wescon Booth No. 1507.

CIRCLE 67 ON READER-SERVICE CARD

◀ CIRCLE 68 ON READER-SERVICE CARD
CIRCLE 551 ON READER-SERVICE CARD ▶

WESCON SHOW

SAN FRANCISCO

August 20-23

Here G. D. Schott (right), Flight Controls Department head, discusses computer solutions of control and guidance problems with E. V. Stearns (center), Inertial Guidance Department head, and J. E. Sherman, Analog Computer Section head.

MISSILE FLIGHT CONTROLS — *the creative field for engineers*

Few fields equal missile systems flight controls in the need for original thinking. The ever-increasing performance of missiles presents problems that grow constantly in complexity. At Lockheed, weapon systems programs demand important advances in flight controls. Emphasis is on new ideas, new techniques.

Positions are open on the Sunnyvale, Palo Alto and Van Nuys staffs for engineers possessing strong ability and interest in: Research and development of advanced flight control systems for controlling missiles and rockets; system synthesis by application of control system feedback techniques; analysis and design of nonlinear servo systems; development of transistor and magnetic amplifier techniques in the design of advanced flight control systems; analysis and simulation of the dynamic performance of the guidance – autopilot – airframe combination; development of systems utilizing advanced types of inertial and gyroscopic instruments; analysis and design of hydraulic servo systems for controlling missiles at high Mach numbers; environmental and functional testing of prototype flight control systems.

Inquiries are invited from engineers possessing a high order of ability. Address the Research and Development Staff at Sunnyvale 22, or Van Nuys 14, California.

Lockheed

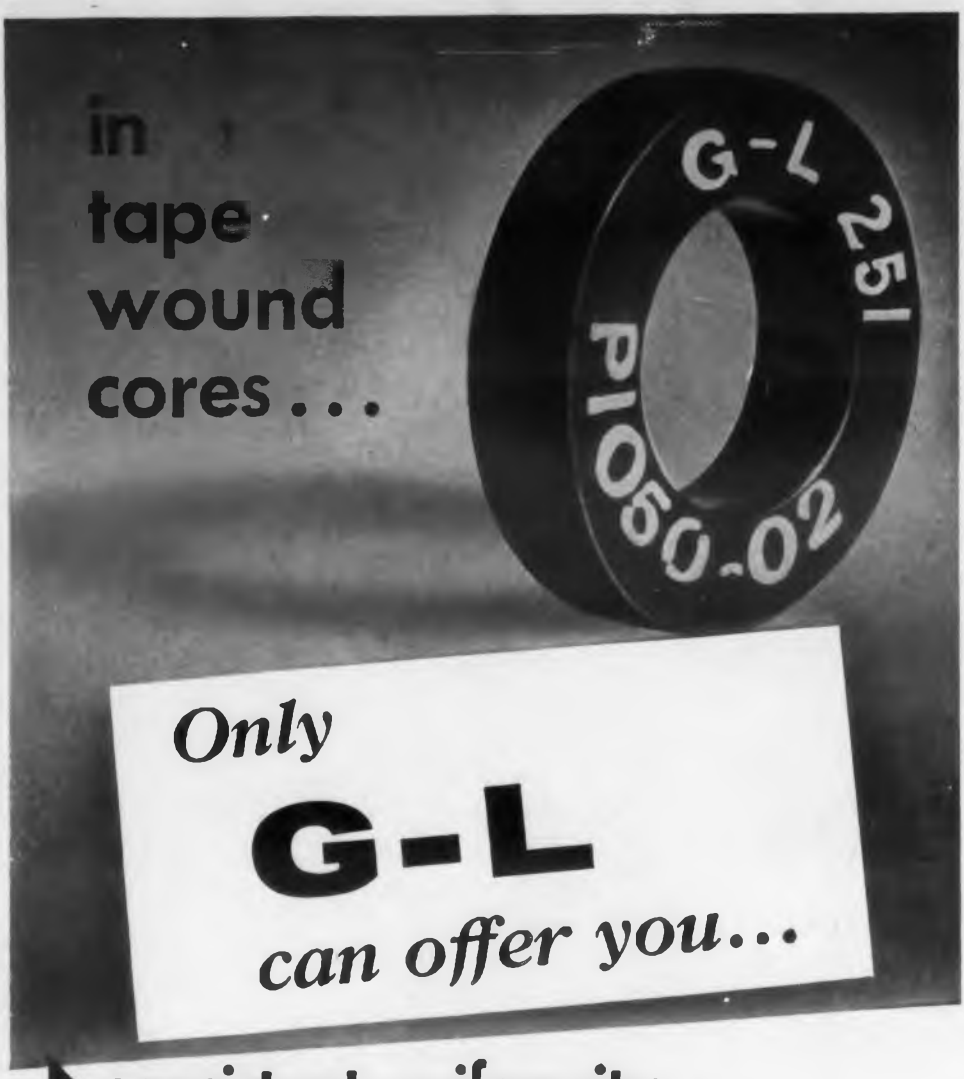
MISSILE SYSTEMS DIVISION • LOCKHEED AIRCRAFT CORPORATION

PALO ALTO • SUNNYVALE • VAN NUYS • CALIFORNIA

Engineers and scientists attending the convention will be interested in new positions on Lockheed's Palo Alto, Sunnyvale, Van Nuys and Santa Cruz Test Base staffs in fields of:

- Alalog Computers
- Antennas
- Circuit Design
- Circuit Development
- Communications Theory
- Electromagnetic Radiation
- Electromechanical Design
- Electronic Packaging Design
- Electronic Product Engineering
- Electronic Systems
- Flight Controls
- Inertial Guidance
- Infrared Detection Systems
- Microwave Systems
- Radar Systems
- Reliability
- Specifications Engineering
- Test Engineering
- Transducer Development
- Video Systems

M. H. Hodge and senior members of the technical staff will be available for consultation during the convention. For interview in San Francisco, phone YUkon 2-3460. Phone day or night.



consistent uniformity . . .

The engineering staff of G-L Electronics completely re-engineered the tape wound core and its manufacturing process to assure the production of consistently uniform, high quality cores. Now, through new, exclusive, G-L production and advanced test procedures, you can be sure of getting "Precision Made" tape wound cores with the greatest uniformity ever achieved in commercial quantities. Proof comes not only from our own exhaustive tests but also from customers who report unbelievable uniformity with every core.

prompt deliveries . . .

Production line techniques have been worked out to make sure that every order is completed in time to meet delivery dates. You can depend upon a delivery date quoted by G-L Electronics so that you can schedule your own operations with confidence.

Proof of our claims will come when your order for G-L cores is filled. Write, wire, call or teletype us about your requirements.

G-L ELECTRONICS

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CAMDEN 5, NEW JERSEY
WOodlawn 6-2780 TWX-761 Camden, N.J.

CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ *See at WESCON*

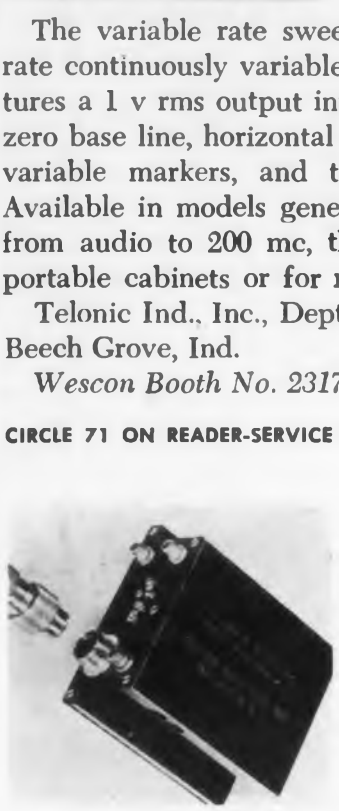
△ Sweep Generators
Variable Rate

The variable rate sweep generator, with sweep rate continuously variable from 0.01 to 60 cps, features a 1 v rms output into 50 ohms (or 75 ohms), zero base line, horizontal drive voltage, crystal and variable markers, and toggle switch attenuator. Available in models generating output frequencies from audio to 200 mc, the units are furnished in portable cabinets or for rack mounting.

Telonic Ind., Inc., Dept. ED, 73 N. Second Ave., Beech Grove, Ind.

Wescon Booth No. 2317.

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Miniature Airborne Amplifier
Model F-418

Glennite miniature airborne low microphonic voltage amplifier, Model F-418, is designed specifically for use in missiles, aircraft and other structures where size, weight, power consumption and vibration are prime considerations. Employed in the units are ruggedized subminiature tubes, individually selected for low microphonics. Ungrounded filaments also assist in minimizing noise. The Glennite miniature amplifier has provision for both fixed and variable gains from 10.2 to 99.5 for variable and 10 to 100 for fixed gains. The gain is constant over a wide range of plate voltage. The amplifier is designed to permit adjustment of system gain of accelerometer, amplifier and filter so that full scale gain of the system can be adjusted within the necessary tolerances. For special applications, where extreme environmental conditions warrant, the amplifier can be potted.

Gulton Industries, Inc., Dept. ED, 212 Durham Ave., Metuchen, N.J.

Wescon Booth No. 1412-13.

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Miniature Waveguide Switch

8500 to 9600 mc

This miniature waveguide switch provides rapid switching of signals from any one of three positions to either of the remaining two and will not change to another position upon failure of its power supply. Characteristics of the 1.00 x 0.500 in. OD size switch include: a frequency range of 8500 to 9600 mc with a maximum VSWR of 1.10, and a minimum isolation of 40 db. The maximum switching time is 0.25 sec. for 240 deg operation and 0.15 sec for 120 deg operation. The switch operates at 3.0 amp maximum at 28 vdc nominal and employs rf and pressurized fittings built into the switch, giving up to 20 lb of pressurization throughout. Available in Xs and X_L band series, the switches, are of the rotary channel type using a circular bend in the rotor and a broadband internal choke design. Precision casting insures a low VSWR and top electrical performance.

Airtron, Inc. Dept. ED, Linden, N.J.
Wescon Booth No. 2822.

CIRCLE 74 ON READER-SERVICE CARD

△ Broadband 10 DB Antenna

Omidirectional

The fiberglass radome high gain antennas, type 212, for the 450-470 band have gains of 10 db across this entire band and can be used at any frequency in the band with no troublesome tuning adjustments. A suppressor-type feed incorporates the desirable feature of a single-point feed, while maintaining high aperture efficiency, eliminating wasted radiation and producing superior mast isolation. To facilitate handling and installation, the antenna is supplied in three sections, the longest of which is 12 ft. Over-all length is 23 ft., with the lower 3 ft. for mounting. This lightweight antenna is enclosed in a fiberglass radome which assures dependable systems performance under unfavorable weather conditions. Windload rating is 30 psi, with 1/2 in. of radial ice.

Andrew Corp., Dept. ED, 363 E. 75th St., Chicago 19, Ill.
Wescon Booth No. 1609.

CIRCLE 75 ON READER-SERVICE CARD
CIRCLE 76 ON READER-SERVICE CARD ➤

New Products

△ *See at WESCON*

△ Dynasert
For Component Assembly

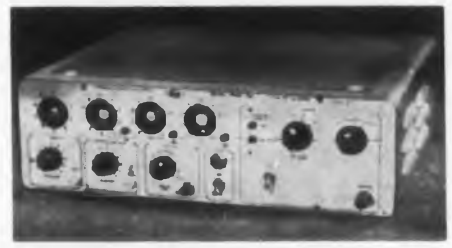
The Number 3 Component Inserting Machine is capable of inserting many different types of components into printed wiring boards. The machine is similar to those being used in fully automatic conveyorized installations.

United Shoe Machinery Corp., Dept. ED, 140 Federal St., Boston, Mass.

Wescon Booth No. 1219-20.

CIRCLE 79 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Frequency Indicator & Counter
Model 7340C



The Model 7340C frequency indicator and counter features printed wiring and modular construction, with snap-off top and bottom plates allowing full access for ease of maintenance. The unit occupies a minimum of bench space and may be adapted to a relay rack with standard mounting brackets. The input signal (photocell, tachometer generator, flowmeter, etc.) is counted during a known time base (0.1 sec, 1 sec, 10 sec) and displayed, with automatic decimal point location, in cycles, kilocycles, or in rpm (with proper transducer). Time bases are established by electronic countdown from the line frequency. Indication may be held manually or the instrument may be set to automatically recycle, after a controllable display time. A self-test switch position, for check of time bases and counters, is provided and the instrument may be used with an external time base.

Electro-Pulse, Inc., Dept. ED, 11861 Teale St., Culver City, Calif.

Wescon Booth No. 2613-14.

CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Time Interval Meter

3 μSec to 1 Sec

The Model 251-A time interval meter is designed for precise measurement of elapsed time between two events occurring in the range of 3 μsec to 1 sec. Optional features permit extension to 10 or 100,000 sec. The accuracy is ±1 μsec. The measurement interval may be started and stopped by independent or common voltages representing optical, mechanical or electrical events. Typical applications are: ballistics measurements, relay timing, photographic timing, testing of mechanical and electro-mechanical timing devices, etc. Among the features of this instrument are: two independent, continuously adjustable trigger level controls permitting full rated sensitivity, 0.2 v rms, at any voltage level between −300 and +300 v. Small increments of voltage ordinarily masked by attenuators are easily selected even though high voltage bias levels, voltage steps, sq waves, etc., are present.

Computer-Measurements Corp., Dept. ED, 5528 Vineland Ave., N. Hollywood, Calif.

Wescon Booth No. 910-11.

CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Delay Line

Improves Pulse Shape Fidelity

The Signal Enhanced Delay Line, consists of several sections, each composed of a delay line, an amplifier, a video transformer, a clipping diode and a cathode follower. Improvement in the fidelity of pulse shape resulting from use of Signal Enhanced Delay Lines indicates, among many potentialities, an application in a demodulator for pulse code trains such as are used in air traffic control systems. Use of a more faithfully reproduced delayed pulse will result in the possibility of greater interleaving of replies and operational improvement. Another possible application is the use of the delay line in computer operation where narrow pulses will permit an increase in the rapidity of calculation.

Packard Bell Electronics, Dept. Ed, 12333 W Olympic Blvd., Los Angeles 64, Calif.

Wescon Booth No. 609-610.

CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ See at WESCON

△ Subminiature Switch

Licon Type 16

This switch is 1/4 in. thick and 25/32 in. long and gives a life cycle consistently over 5 million. It is rated 10 amps, 30 v dc inductive at a time constant of 0.026 sec which is four times greater than other switches can handle. Movement differential is 0.010 to 0.020 in. A wide range of forces is available, with a nominal of 6 oz.

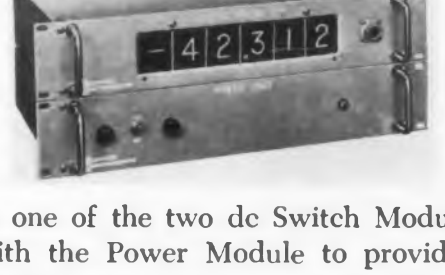
Illinois Tool Works, Dept. ED, 2501 North Keeler Ave., Chicago 39, Ill.

Wescon Booth No. 716.

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION

△ DC Voltmeters

0.01 Per Cent Accuracy



Either one of the two dc Switch Modules combines with the Power Module to provide a precision, digital voltmeter for automatically digitizing input data to 0.01 per cent accuracy. Measurements on both models are displayed digitally with easy-to-read 1 in. high, edge-lighted numerals. Contact closures are also provided for operating machine output equipment. The Switch Modules (4 digits: Model DVX-400 and 5 digits: Model DVX-500) incorporate a new logic which speeds balance time, preventing the loss of significant digits on down ranging under all conditions; and a controlled stepper drive which increases switch life by a factor of three. With the appropriate Power Module, a 0.1 mv to 1000 v range is possible with the use of a single instrument.

Electro Instruments, Inc., Dept. ED, 3794 Rosecrans Ave., San Diego, Calif.

Wescon Booth No. 1001-02.

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Magnetic Amplifier
For Temperature Control

The type PA3C-1 magnetic amplifier is designed specifically to provide proportional temperature control of a heating element in response to a change in resistance of a temperature sensor. Power output is proportional from 0 to 100 w, 400 cps, as the temperature sensing element resistance changes by approximately 1 ohm. Nominal output load is 130 ohms.

The two-stage amplifier combines a high degree of sensitivity and reliability. It is designed to operate in ambient temperatures of −55 to 100 C and to exceed all other environmental conditions of MIL-E-5272. Internal circuitry design is such that open or short circuit sensing elements will cause the output voltage to automatically reduce to zero. The amplifier may be mounted directly to the airframe in any position.

Magnetic Controls Co., ED, 6325 Cambridge St., Minneapolis 16, Minn.

Wescon Booth No. 707.

CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Transistorized Power Converter
150 v, 400 ma, or 300 v, 200 ma, Output

This transistorized power converter, TPC-2, is designed for 12 v input and 150 v 400 ma or 300 v 200 ma output. The unit has an efficiency of better than 75 per cent and is expected to be invaluable in replacing dynamotors and vibrator type power supplies. It will operate at ambient temperatures up to 150 deg F under continuous full load conditions. The TPC-2 is housed in a black-aluminum heat dissipating case with an anodized aluminum cover.

Southwestern Ind. Elect. Co., Dept. ED, 2831 Post Oak Rd, P.O. Box 13508, Houston 19, Texas.

Wescon Booth No. 1812-13.

CIRCLE 88 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW SERVO-RATIO MULTIMETER

Combines all the functions of an AC-DC voltmeter, ohmmeter and AC-DC ratiometer in one compact portable unit

Here is a new, highly accurate test instrument designed to make life easier for those who work with computers and other electronic and electrical devices. It measures AC-DC ratios, absolute AC-DC voltages and resistance. You can also measure the gain of operational amplifiers using the 0° phase output provided.

The Servo-Ratio Multimeter computes voltage ratios by dividing the voltage to be measured by the reference voltage obtained from the computer. It is a high-impedance instrument and utilizes a motor-driven, position-type servo mechanism. Average time to obtain a reading is three seconds. Simplification and reliability are obtained through the use of printed circuits.

The front panel contains a four-digit illuminated drum counter for readout, phase or polarity indicating lights, function switch, ON-OFF switch, range switch, 0° phase ratio selector, input terminals and 0° phase output terminals.

The Servo-Ratio Multimeter is compact and easy to handle. It has an aluminum case and weighs only 10 pounds. The instrument can be operated in a horizontal or vertical position and has a unique carrying handle that serves as a tilt-stand when the unit is used horizontally. Write for Product Description 2005.

SPECIFICATIONS

Power Consumption: 50 Watts, 110 Volts, 60 cps. Reference Voltage: DC or 60 cps AC; ± 10 Volts to ± 100 Volts across 8.7K Ohms Load.

Functions	Range
Ratio, AC	0.001 to 1.000 ± 0.1% in 1 range
Ratio, DC	0.001 to 1.000 ± 0.1% in 1 range
60 cps AC Voltage	1 Volt to 1000 Volts full scale ± 1.0% in 4 ranges
DC Voltage	1 Volt to 1000 Volts full scale ± 1.0% in 4 ranges
Ohms	10K Ohms to 10 Megohms full scale ± 1.0% in 4 ranges
Gain	0.01 to 1000 in 4 ranges

PORTABLE AND COMPACT—Weighs only 10 pounds. Size: 7⅞" x 5½" x 11-13/16".

SIMPLIFIES TESTING—Eliminates need for many other instruments. Has digital readout counter.

See our exhibit at the Wescon Show, Booths 810-811.

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

New Products

△ See at WESCON

△ Waveguide Pressure Window

For 35 Kmc Range

A high power flange-mounted waveguide pressure window for use in radars operating in the 35 kmc freq range requires pressure seals to prevent waveguide or magnetron rf breakdown. Designated MA-1334, the window is claimed to handle peak powers of 40 kw at atmospheric pressure. Higher power levels can be used with this window by increasing the pressure within the RG-96/U waveguide. The window is mounted directly between UG-600/U choke flanges in RG-96/U waveguide. The MA-1334, now available in production quantities, is resonant at 34.86 kmc. Maximum vswr at the band extremes of 33.25 and 36.5 kmc is 1.1; the vswr gradually increases outside this range. Maximum pressure rating is 45/30 lb per sq in. Higher pressure can be sustained on the side of the window to which the glass is bonded. Construction is of kovar and glass. The metal surfaces are silver plated.

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

Wescon Booth No. 1307.

CIRCLE 90 ON READER-SERVICE CARD

Outer Race Bearings

Non-Metallic

Stud, bore, flange and special bearings can be supplied with nylon, rubber or laminated phenolic tires, each of which serve to considerably reduce noise factors during operation. Outer race materials can be molded or pressed fit to the basic steel outer race and the resultant combination affords the wear-ability of steel plus the silent operation of rubber, nylon or phenolic. The manufacturer slates that the application of non-metallic outer races to ball bearings will appreciably lessen the wear on contacted surfaces.

General Bearing Co., Inc., Dept. ED, 47 Roselle St., Mineola, N.Y.

CIRCLE 91 ON READER-SERVICE CARD

◀ CIRCLE 92 ON READER-SERVICE CARD

Cleaning Compound

For Glass and Plastic

GTC-59 is a liquid preparation which contains no caustics or abrasives and therefore can be used on the most delicate equipment. This product is approved and used on electron-optical systems by the Air Force where the combination of glass, plastic and static fields present complex cleaning problems. GTC-59 provides the following: cleaning and removal of oil film, cancellation of static fields which attract dust, deposit of a smooth hard coating which repels dirt and dust formations and has smear resistant and water repellent properties.

Beaver Labs., Dept. ED, 187-61 Hollis Ave., Hollis 23, N.Y.

CIRCLE 93 ON READER-SERVICE CARD

Striped Teflon Tubing

Easy Identification

The Teflon tubing with axial stripes of any color, including combinations is available. There is no danger of wearing away the stripes since they penetrate the full depth of the tubing. The material has dielectric strength of 500 to 1,000 v per mil., dielectric constant of 2.0 and dissipation factor of 0.0002. The striped tubing is unaffected by moisture.

Pennsylvania Fluorocarbon Co. Inc., Dept. ED, 1115 N. 38th St., Philadelphia 4, Pa.

CIRCLE 94 ON READER-SERVICE CARD

Multiple Glass Windows

Withstand + 500 F

A multiple dry-air insulating glass observation window assembly is capable of withstanding temperature cycles from −100 F to +500 F. Sealing techniques and added light thickness have increased the endurance and utility of the units. Multiple glass units are available in sizes ranging from 12 x 12 in. to 40 x 40 in., and are constructed in thickness of 3 to 10 lights with 1/4 and 1/2 in. air spaces. Individual lights have sizes of 1/4, 5/16, 3/8, 1/2, 3/4, 1, and 1-1/4 in.

Duo-Pane Corp., Dept. ED, 21-23 Grattan St., Brooklyn 6, N.Y.

CIRCLE 95 ON READER-SERVICE CARD
CIRCLE 96 ON READER-SERVICE CARD ➤

New Products

△ See at WESCON

△ Panel Meters

Four Sizes

A new series of high-visibility panel meters is available in all standard ac and dc scales. These meters feature regular or custom matched colors on the lower frosted panel. The full assortment of sizes includes 2-1/2, 3-1/2, 4, and 4-1/2 in. models, all with greatly increased dial areas for multi-band scales and individual imprinting.

Burton-Rogers Co., Dept. ED, 42 Carleton St., Cambridge 42, Mass.

Wescon Booth No. 2219.

CIRCLE 97 ON READER-SERVICE CARD FOR MORE INFORMATION

△ High Power Transformer

100 KVA Units

These high power transformers permit high fidelity performance plus savings in size and wt. The unit has application in radio broadcast modulation transformers, output transformers for vibration testing and other equipment utilizing Class B amplifiers over 250 w. One hundred kva units operating down to 15 cps have been designed.

A division of the transformer functions into two transformations, allowing interprimary coupling and primary-to-secondary coupling to be accomplished completely independently of each other. Thus, each may be designed to its optimum value. Conventional designs have a conflicting interdependence of these factors which does not permit optimum values to be used. The units are now available to equipment manufacturers custom-designed to each application.

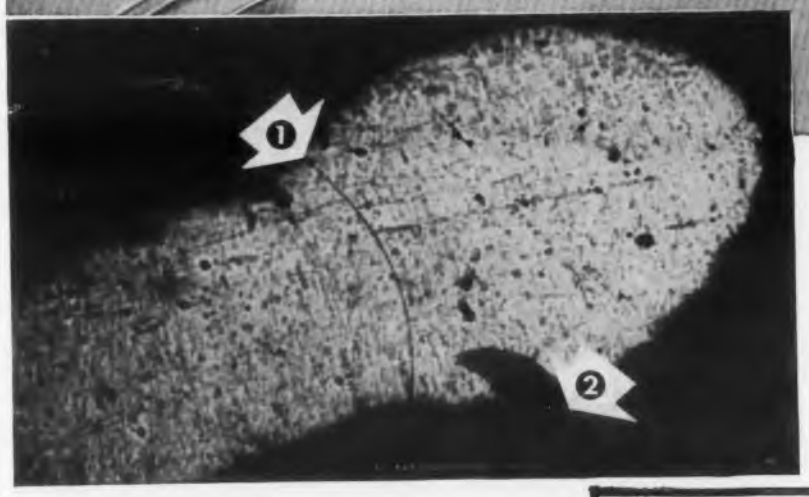
Electro Engineering Works, Inc., Dept. ED, 401 Preda St., San Leandro, Calif.

Wescon Booth No. 1717.

CIRCLE 98 ON READER-SERVICE CARD FOR MORE INFORMATION

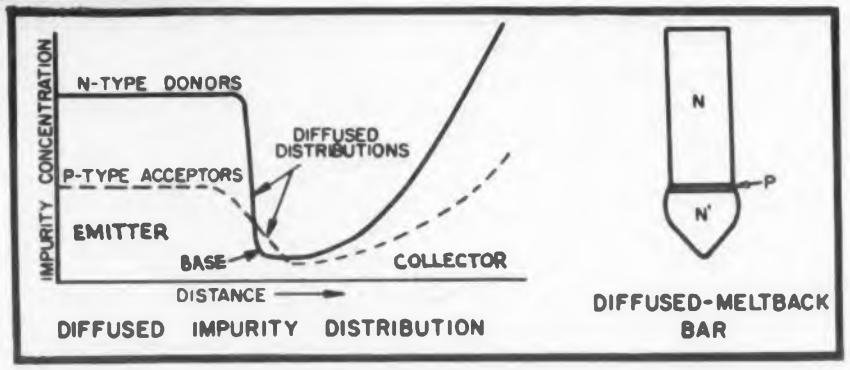
Using the diffused-meltback process

G.E. gets the most from silicon...



Before going through the diffused-meltback operation, a crystal of silicon is sawed into wafer-form: wafers are then diced to produce 4000 to 5000 individual silicon bars. Photomicrograph at left shows size-comparison of a silicon NPN bar, or pellet, with human hair (Arrow 2). "Tear drop" at end of bar is formed during meltback process. Micro-thin base, or "P", region (Arrow 1) is created through G-E diffusion technique. Base regions of 2-micron size are made with relative ease.

Curves illustrating impurity distribution after diffusion. P-type impurities in the high concentration side of the meltback junction diffuse, within solid semiconductor, into "plateau" region of low impurity concentration. High resistivity "plateau" contributes to elimination of punch-thru effects.



CIRCLE 99 ON READER-SERVICE CARD FOR MORE INFORMATION

to put the most into transistors

High degree of uniformity and control in junction formation. General Electric's diffused-meltback process was developed by Dr. I. A. Lesk of the G-E Advanced Semiconductor Laboratory. The development came about as the result of Dr. Lesk's efforts to create a transistor manufacturing process that would yield high-quality results at reasonable cost.

Not only does the G-E diffused-meltback process result in a maximum number of transistors from a single crystal (4000 to 5000 NPN transistors), *but it offers an extremely high degree of uniformity and control in transistor junction formation.*

Opens the door to high frequency performance. Diffusion of a melted-back silicon bar, or pellet, is the final step in the diffused-meltback process. It's the stage in which the micro-thin base, or "P" region is formed, establishing the final NPN transistor structure. Because the actual diffusion is accomplished over a high temperature heating cycle lasting several hours, the need for split-second accuracy is eliminated. The result is a high degree of process control.

By proper choice of the initial impurity concentrations and the time and temperature of the diffusion cycle, heavily-doped base regions as thin as 2 microns are easily obtained. *These micro-thin, uniform base regions are the "open-sesame" to extremely reliable high frequency transistor performance.*

High current gain. Silicon NPN transistors feature inherent high current gains and high frequency cut-offs. The diffused meltback process permits mass production, since it combines the principles of impurity segregation and solid-state diffusion.

G-E silicon NPN transistors are nominally rated for 25 megacycles, but with useful gain to 50 megacycles—the highest frequencies offered by any mass-produced silicon NPN triode on the market today. All production units are aged at extremely high temperatures for over 150 hours. This is to provide maximum stability of I_{co} and current gain (beta).

The header assemblies of G-E silicon NPN transistors are constructed of high-purity materials. A gold-silicon alloy is used for end connections: the base lead is pure aluminum. There are no solders or fluxes, eliminating any danger of transistor "sleeping sickness" caused by corrosion at soldered junction points.

Outstanding For Switching Applications and Linear Amplifier Use. The gold-alloy mountings, with a melting temperature of over 350°C represent the lowest melting point of the entire transistor assembly structure. The G-E Series 4JD4A silicon transistors provide reliable operation to 150°C, with storage temperatures to 200°C.

With well-controlled high frequency characteristics and a low saturation resistance of 20 ohms, G-E silicon NPN transistors are "naturals" for switching applications and linear amplifier use.

Would you like complete specification information? Please contact your nearest G-E Semiconductor Products district office, or write to General Electric Company, Semiconductor Products, Section S2387, Electronics Park, Syracuse, N. Y.

Ordering Data—G-E Silicon NPN Transistors

High Frequency Amplifier Type
ask for: **2N429** (formerly 4JD4A2)

Computer DCTL Type
ask for: **2N430** (formerly 4JD4A3)

General-Purpose Amplifier Types

ask for:		Beta
2N431	(formerly 4JD4A4)	9 to 30
2N432	(formerly 4JD4A5)	20 to 55
2N433	(formerly 4JD4A6)	45 to 100

View of uncapped G-E silicon NPN diffused-meltback transistor, showing mounted silicon bar with aluminum base lead connected. Bar ends attached using a gold-alloy mounting technique. No solders or fluxes are used.

Diffusion furnace. Operator places quartz vials, with large quantity of silicon bars, in furnace. Diffusion occurs through high-temperature heating cycle lasting several hours.

An aging oven in which G-E silicon NPN transistors are aged at extremely high temperatures for over 150 hours. Provides maximum stability of I_{co} and current gain (beta).

Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 99 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Rate Gyro

Constant Damping

Designated the Type JRT, this rate gyro is a precision instrument for measurement of absolute rates of rotation in inertial space. Damping is electro-mechanically controlled to maintain a constant damping ratio over the entire operating temp range of −65 to +175 F. The JRT is designed expressly for flight control of long range missiles and for flight instrumentation in missiles and aircraft where ambient temperatures are not controlled. Ratings include: linearity of 0.25 per cent of full scale; hysteresis of less than 0.1 per cent of full scale; threshold of less than 0.01 deg per sec; microsyn pickoff-variable reluctance type providing infinite resolution and high signal-to-noise ratio; full scale rate of up to 1000 deg per sec; full scale output of up to 12 v; withstands 100 g shock, and 15 g to 2000 cps; measures 2-7/64 in. diam, 4-5/16 in. long, and weighs 2 lb.

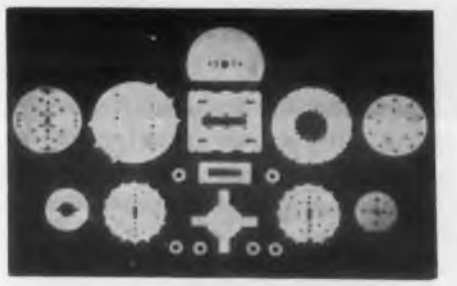
Minneapolis-Honeywell, Dept. ED, Boston Div, 1400 Soldiers Field Rd, Boston 35, Mass.

Wescon Booth No. 202.

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Alumina Shapes

Supports Electron Tube



AlSiMag Alumina shapes for use as supports in electron tube applications are available. Parts as thin as .0007 in. can be efficiently produced from these materials. Their use often extends the operating temperature range of the finished tube. Additional advantages include the ability to de-gas at higher temperatures, excellent strength characteristics, and resistance to heat deterioration and fatigue failure.

American Lava Corp., Dept. ED, Cherokee Blvd. & Mfgrs. Rd., Chattanooga 5, Tenn.

Wescon Booths Nos. 921, 922.

CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ *See at WESCON*

△ Inverters and Converters

Semiconductor Line

These units will convert low voltage dc to ac or higher voltage dc. These models feature improved circuitry, which provides extended operating characteristics. Additions to the line include six inverter models, which convert 6, 12, or 24 v dc battery input to 115 v ac, 60 or 400 cps. These new inverters are available in power ratings up to 150 va. Additional models include units for providing outputs of 150 and 300 v dc at current ratings of 100 or 200 ma. These types are available in either regulated or unregulated designs. All models are potted in transformer housings, but transistors are located on an inner header, which makes them accessible for servicing or replacement purposes. A choice of octal plug-in type or solder loop terminal is available.

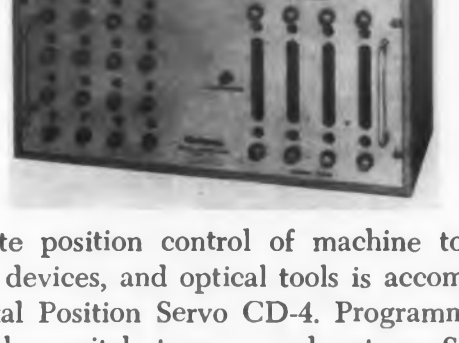
Electronic Research Associates, Inc., Dept. ED, 67 East Centre St., Nutley 10, N.J.

Wescon Booth No. 3308.

CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Digital Position Servo

Switch, Tape, or Card Programming



Discrete position control of machine tools, inspection devices, and optical tools is accomplished by Digital Position Servo CD-4. Programming input is either switch, tape or card systems. Standard CD-4 single axis control systems are in production.

Century Engineers, Inc., Dept. ED, Burbank, Calif.

Wescon Booth No. 2717-18.

CIRCLE 104 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Counters

May Operate Above 500 RPM

Compact internal pinion type counters, capable of operating at speeds above 500 rpm, are available in two, three, four, five and more digit versions. The numeral size is 1/4 in., available with numerals of white on black and black on white, designed with precision machined parts for high performance instrument applications.

Bowmar Instrument Corp., Dept. ED, 2415 Pennsylvania St., Fort Wayne, Ind.

Wescon Booth No. 709.

CIRCLE 105 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Differential Data Amplifier

Zero Drift, 0.01 Per Cent Accuracy

Infinite common mode rejection, zero drift, 0.01 per cent accuracy and 0.05 per cent linearity are features of the Type 190 Data Amplifier. Designed for dc amplification of thermocouple, strain gauge and similar signals, the Type 190 has a maximum voltage gain of 1200, adjustable if required. Employing a new chopper circuit, the amplifier provides true differential amplification with complete rejection of dc common mode signals, and a rejection ratio of the order of a million for ac signals. Stability of the Type 190 is excellent, with no zero-point drift and gain remaining constant within 0.01 per cent over 1000 hours of operation.

For strain gage use, the differential input of the Type 190 allows a single battery to be used to excite a number of bridges, thus simplifying installation. With thermoeouples, differential input eliminates errors due to multiple grounds, particularly where the same thermocouple is used simultaneously in several circuits.

Offner Electronics, Inc., Dept. ED, 5320 N. Kedzie Ave., Chicago, Ill.

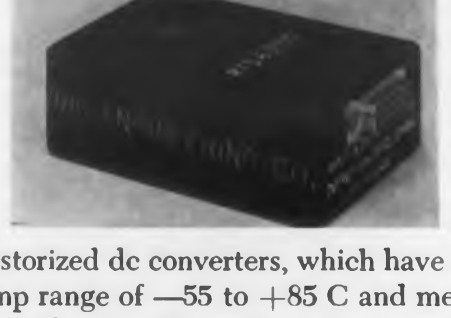
Wescon Booth No. 510-11.

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ See at WESCON

△ Subminiature Power Supplies
Encapsulated



Transistorized dc converters, which have an operating temp range of —55 to +85 C and meet MIL-E5400 specifications, have been developed. Available in units up to 300 w output, a 75 w unit measures 4-1/4 x 1-1/4 x 2-3/4 in. and weighs approximately 11 oz, with slight increases for larger outputs. Designed to withstand heavy shock, vibration, and atmospheric pressures, the units feature high temp transistors, and incorporate parts made of epoxy resin. Metal construction is confined to the base plate, which is cadmium plated to resist corrosion. The design is also available in commercial versions for mobile radios and other battery-operated equipment, which offer an operating temp range of —30 to +71 C.

Rho Engineering Co., Dept. ED, 2242 Sepulveda Blvd., Los Angeles 64, Calif.

Wescon Booth No. 2407.

CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Volume Unit Meter
For Sound Equipment

The VU Meter is designed expressly for sound equipment and tape recorder applications to measure volume levels of sound or noise. A target pointer, sharply outlined against a contrasting face, deflects almost instantaneously over a two color scale. It features a clear polystyrene, anti-static treated case.

Burton-Rogers Co., Dept. ED, 42 Carleton St., Cambridge 42, Mass.

Wescon Booth No. 2219.

CIRCLE 109 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Ammeter Adapter

Permits Rapid Checking

The Model 10 clamp-on ammeter adapter is designed primarily for use with the Model 310 volt-ohm-milliammeter. In addition to retaining the wide range V-O-M functions of the Model 310, the clamp-on ammeter permits checking all line loads quickly and safely without breaking the circuit or interrupting work. It is especially valuable in rapid checking or wiring circuits, motor loads, appliance loads, etc.

There are six adapter ac ammeter ranges: 0-6-12-30-60-120-300. With Model 101 line separator, ammeter sensitivity is increased by factors of 10 and 20. This separator quickly divides two-conductor cords. The Model 310 with selector switch has 20,000 ohms per v dc sensitivity; 5000 ohms per v ac.

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

Wescon Booth No. 2608.

CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Voltage Doubler

Silicon Cartridge

Each of these cartridge rectifiers, capable of —55 to 150 C operation, is a voltage doubler having a maximum rating per leg of 3200 piv. Therefore, two units can be connected as a single-phase, full-wave bridge, capable of delivering 1900 v dc at 90 ma for an input voltage of 2240 v rms at 75 C. Measuring 37/64 in. diam, these rectifiers are available in two standard lengths: 2-1/2 and 4-5/16 in. The cartridge design permits mounting in standard 30 amp fuse clips. This series is suited to applications such as: mounting in dc relay housings to eliminate the need for separate power supplies; replacing ac relay units where hum is objectionable; providing dc power for solenoids, counters, variable speed controls, and for the supply of power to the fields of small dc motors.

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

Wescon Booth No. 1501-02.

CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Transistorized Relay

Sensitive to 12 μa

Model 30 relay is said to have switched a 4.5 a load on and off some 5 million times without signs of wear. Input of 12 μa will actuate the relay. The Model 30 can be used with any combination of normally-open or normally-closed input circuits and normally-off or normally-on outputs. It will handle resistive loads of up to 10 a for short periods. The relay can always be set to fail safe. Switch prevents chatter; pilot light shows when the relay is energized, and the control circuit is completely isolated from the power line.

Fisher Scientific Co., Dept. ED, 717 Forbes St., Pittsburgh 19, Pa.

CIRCLE 113 ON READER-SERVICE CARD

90 Deg TV Tube

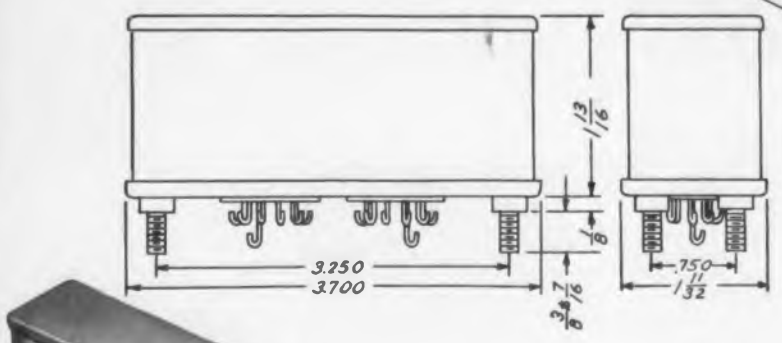
For Series Heater Operation

The 14ATP4 is a rectangular glass picture tube of the 14 in. type, designed especially for use in television receivers employing a single, series-connected heater string. It utilizes a 450 ma/8.4 v heater having a controlled warm-up time to insure dependable performance. A feature of the 14ATP4 is its electron gun of the straight type designed to minimize deflection distortion. This gun permits a 5-1/2 in. long neck and eliminates the need for an ion-trap magnet. The overall length of the 14ATP4 is 13-3/16 in. and its weight is 8-1/2 lb. The 14ATP4 is of the low-voltage electrostatic-focus and it is of the magnetic-deflection type.

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

CIRCLE 472 ON READER-SERVICE CARD

CIRCLE 115 ON READER-SERVICE CARD ➤



STAR SERIES
KG RELAY

DESIGNATION: KG23DBH

GENERAL: Insulating Materials: Teflon, glass and ceramic.
Insulation Resistance: 100 megohms min.
Breakdown Voltage: 500 V. RMS.
Shock: 100g where contact openings less than 80 microseconds may be permitted.
Vibration: 30g 5 to 2000 cycles.
Ambient Temperature: −65°C to +125°C.
Weight: 13 ozs.
Pull-in-Speed: 12 MS using 310 ohm coil at 24 V. DC. (25°C).
Terminals: Two 11 pin multiple solder headers with hook ends for 3 #20/AWG wires.
Enclosures: Hermetically sealed only.
Dimensions: 1-11/32 x 3.700 x 1-13/16 (See drawing for width, etc.)

CONTACTS: Arrangements: 6 pole double throw.
Load: Dry circuit to 3 amps, 115 V. AC, resistive. 5 amps, 28 V. DC, resistive.

COIL: Power: 2.0 watts at Nominal Voltage.
Duty: Either coil may be left energized without damage to the relay.
Insulation: Teflon tape.

MOUNTINGS: Four ⅜ inch #8-32 studs on 3¼ x ¾ inch centers.

COIL DATA: (EACH COIL)

Voltage:	6 V. DC	12 V. DC	24 V. DC	48 V. DC	110 V. DC
Resistance: ±10% @ 25°C	14 ohms	55 ohms	310 ohms	835 ohms	5500 ohms

See What's New in P&B Progress at Booth 603, 604 WESCON, San Francisco, August 20-23

Potter & Brumfield, inc.
PRINCETON, INDIANA

Subsidiary of **AMERICAN MACHINE & FOUNDRY COMPANY Manufacturing Divisions also in Franklin, Ky. and Lacenia, N. H.**

Mail the coupon below for further engineering data on P&B's new Star Series relays *plus* new compact catalog of standard type relays. If you need answers to a specific application problem, write in detail.

Potter & Brumfield, Inc., Princeton, Indiana
Attn: T. B. White, Brig. Gen. M.C. (Ret.)
Special Projects Engineer

Please send me complete data on the new Star Series relays, plus the new compact catalog of P&B standard relays.

*Name*_____
*Company*_____
*Address*_____
*City*_____ *Zone*_____ *State*_____

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Peak Voltage Comparator
0.1 Per Cent Accuracy

The peak voltage comparator, Model 950, performs precision voltage ratio measurements of two signals, and is suitable for laboratory, or production test use. Its unique feature is the ability to perform ratio comparison of the peak magnitudes of any two signals up to 100 cycles, regardless of their phase, frequency, or polarity relationship, with any accuracy of 0.1 per cent. Typical measurement applications include amplifier gain, transformation ratio, power supply regulation, resistance ratio, and scale factor. Circuit features permit the accomplishment of these measurements with equal ease and accuracy under static or dynamic signal conditions. The comparator is available from stock in both rack-mounted and portable models.

Cal-Tronics Corp., Dept. ED, 11307 Hindry Ave., Los Angeles 45, Calif.

Wescon Booth No. 2105.

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Eput Meter
Variable Time Base

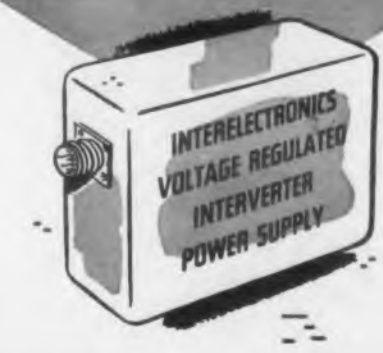
Model 7351 Eput Meter with a variable time base for direct digital indications without conversion uses preset decimal counting units as the last four time base dividers to obtain highly flexible E/UT and period measurements. In addition, the instrument can be operated as a preset counter and time interval generator. Regardless of transducer conversion factors, indications of flow, speed, and pressure can be read directly by simply selecting the proper time base. It may be used as a totalizer for indicating the sum of groups which are preselected and counted by the instrument. Time intervals of any number of periods from 1 to 10,000 over the frequency range 0 to 10 kc may be measured.

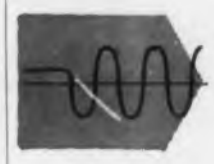
Beckman/Berkeley Instruments, Dept. ED, 2200 Wright Ave., Richmond, Calif.

Wescon Booth No. 1406-07, 906-07.

CIRCLE 117 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW!
DC to DC and DC to AC solid-state power converters voltage regulated, frequency controlled, for missiles, telemetering, gyros, servos





Interelectronics Interverter solid-state thyratron-like elements and magnetic components convert DC to any number of voltage regulated or controlled frequency AC or filtered DC outputs from 1 to 1800 watts. Light weight, compact, 90% or better conversion efficiency.

Ultra-reliable in operation, no moving parts, unharmed by shorting output or reversing input polarity. Complies with MIL specs for shock, acceleration, vibration, temperature, RF noise.

Now in use in major missiles, powering telemetering transmitters, radar beacons, electronic equipment. Single and polyphase AC output units now power airborne and marine missile gyros, synchros, servos, magnetic amplifiers.

Interelectronics — first and most experienced in the DC input solid-state power supply field, produces its own solid-state gating elements, all magnetic components, has the most complete facilities and know-how—has designed and delivered more working KVA than any other firm!

For complete engineering data write Interelectronics today, or call LUdlow 4-6200 in N. Y.

INTERELECTRONICS CORPORATION
2432 GR. CONCOURSE, N. Y. 58, N. Y.

CIRCLE 118 ON READER-SERVICE CARD

New Products

△ *See at WESCON*

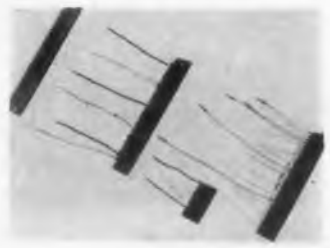
△ Frequency Analyzer
TP-625

The TP-625 frequency analyzer determines the frequency and amplitude of the individual components of a complex wave within the frequency range of 2 to 25,000 cycles. When equipped with its auxiliary equipment, the TP-629 control panel and the TP-628 servo drive, the analyzer will automatically track to a frequency established by the speed of the equipment under analysis. Odd, even, or fractional ratios can be established by the control panel. The auxiliary equipment requires only one external signal, a function of the fundamental frequency of the equipment being analyzed.

Technical Products Co., Dept. ED, 6670 Lexington Ave., Los Angeles 38, Calif.

Wescon Booth No. 209.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Strip Package
For Component Packaging

The 3976 strip package for packaging all types of completed electronic components, consists of two parallel rows of continuous metal terminals mounted on a phenolic base. The terminals are cut to produce the correct circuit, after which components are laid parallel to each other between these two rows of terminals. All joints are then automatically soldered. This concept in package design is produced at a quality level of one defective joint per 100,000 solder connections. Any standard component can be incorporated in the circuit design and in the one package.

Erie Resistor Corp., Dept. ED, Erie 6, Pa.

Wescon Booth No. 1510.

CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Capacitor

Polystyrene

This dual adjustment hermetically sealed polystyrene capacitor is encased in a heavy gage metal container to insure maximum rigidity. The dual adjustment feature permits a tolerance range of ±2 per cent and can be set to ±0.005 per cent. It will operate without voltage derating from −55 to +85 C. The insulation resistance will average 2 x 10^6 meg/μfd when measured at 25 C. The dual adjustment capacitors possess all the characteristics of polystyrene capacitors and are adaptable to matching circuit standards, servo-mechanisms, and other extremely precise instrumentation.

Hopkins Engineering Co., Dept. ED, 12900 Foothill Blvd., San Fernando, Calif.

Wescon Booth No. 311.

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Toroidal Core Grader

Iron and Mo-Permalloy Cores

Model BPA Permeameter grades powdered iron and Mo-permalloy toroidal cores in percentage-of-nominal-turns deviation, plus or minus, from a standard coil. For example, a standard coil of correct inductance requires 1000 turns of wire on a core selected as nominal. A typical reading for another core might be plus 1.5 per cent. Therefore, this core requires 1015 turns to have the same inductance as the standard coil. Use of Model BPA, consequently, eliminates nearly all costly labor used in trimming coils to inductance, assures product uniformity, and simplifies engineering design. Two meter ranges provide reading plus or minus 10 per cent or plus or minus 5 per cent. In operation, the core under test becomes part of a tuned circuit and any deviation from the standard center frequency is detected by a linear frequency discriminator. This deviation is then read on the meter in percentage of nominal turns as compared with a core selected as the standard. This new instrument handles cores ranging in permeability from 14 to 125 and sizes from 0.3 in ID to 5.28 in OD. Overall accuracy is 0.25 per cent. The large meter reads to 0.1 per cent.

Boesch Mfg. Co., Inc., Dept. ED, 233 Harvard St., Brookline, Mass.

Wescon Booth No. 418.

CIRCLE 125 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

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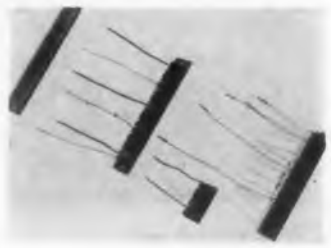
Technical Products Co., Dept. ED, 6670 Lexington Ave., Los Angeles 38, Calif.

Wescon Booth No. 209.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION



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Boesch Mfg. Co., Inc., Dept. ED, 233 Harvard St., Brookline, Mass.

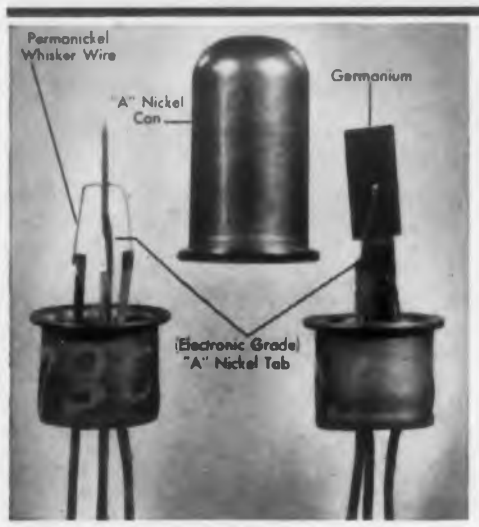
Wescon Booth No. 418.

CIRCLE 125 ON READER-SERVICE CARD FOR MORE INFORMATION

Nickelonic News

VOL. 1 — Developments in Nickel and Nickel Alloys and their applications — No 1

Sled trains snowhaul 34,000 tons of supplies to speed new Nickel mines into production



3 Nickels help Philco step up life of new HF transistors

These new Philco Surface Barrier Transistors demonstrate top-notch stability, life and performance to 50mc and above.

One reason is low power consumption . . . under one milliwatt. Another is Philco's use of three Inco Nickels.

To insure a strong, contamination-free support for the germanium, Philco makes the tabs of Electronic Grade "A" Nickel. Ductile "A" Nickel is used for the can, too . . . makes it rugged, corrosion-resistant. And for tolerance stability, the whisker wires are made from spring-temper Permanickel* age-hardenable, electrically conductive nickel.

New Name for Old Alloy

Recently a wrought alloy, widely used in cable shielding and in CR and other special tubes, was renamed. Formerly "326" Monel alloy, it is now "403" Monel* nickel-copper alloy. Above room temperature, this highly workable alloy stays practically non-magnetic. Permeability is 1.2 max. at 27°F. max. (H=0.5 oersteds.)

"403" Monel alloy... Nominal Composition %					
Ni (+Co)	58.65	Cu	38.75	Mn	1.80
Fe	0.40	Si	0.30	C	0.12
S	0.005				

POWER KLYSTRON FOR SCATTER TRANSMISSION

Nickel in gun components steadies tube operating characteristics

This is a typical Eimac Klystron, employing an oxide coated Nickel cathode. A similar Klystron has shown no drop in cathode emission or efficiency after more than a year of operation at 8000 volts and 550 milliamperes.

To help achieve this, Eimac uses Inco Electronic Grade "A" Nickel... in cathode button, as the oxide base; in shields, cylinders, supports. The Nickel boosts life, aids conductivity, retains dimensions despite bombardment at high temperatures.

Last winter Inco-Canada shuttled 24 diesel sled trains over a 35-mile snow trail in northern Manitoba southwest of Hudson Bay. Object was to get a flying start on the construction of two new Nickel mines . . . part of an Inco program for adding over 100 million pounds a year to Nickel output.

1000 trips

In this gigantic snowhaul, sled trains made 1000 trips laden with equipment to start work on the mines and the new townsite while a railroad spur line was being built.

In addition to new mines, the project includes new concentrating, smelting and refining facilities. The expected boost in Nickel availability is good news for many now working on designs calling for the special properties of Nickel and Nickel alloys.

*Registered trademark

INCO TRADE MARK — **THE INTERNATIONAL NICKEL COMPANY, INC. • 67 Wall Street • New York 5, N. Y.** — INCO TRADE MARK

For more information on Inco products mentioned above, use reader service number or write.

CIRCLE 128 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ *See at WESCON*

△ Power Supply

300 v, 150 ma

Model 7P13 is a 300 v 150 ma voltage regulated laboratory-type power supply. Input voltage is 105 to 125 v at 50 to 60 cps. Three output voltages are available: continuously variable 0 to 300 v dc at 150 ma; continuously variable 0 to negative 150 v dc at 5 ma; and 6.3 v ac at 8 amp. High voltage regulation is plus or minus 5 per cent from 20 to 300 v at 0 to 150 ma, and line variations from 105 to 125 v oc. Metering is accomplished with separate voltmeter and milliameter. The power supply is available in either cabinet or rack type mounting. Cabinet mounting measures 12 1/2 wide x 8 high x 8 1/4 in. deep. All adjustments and controls are brought to the front panel.

Western Gear Corp., Dept. ED, P.O. Box 182, Lynwood, Calif.

Wescon Booth No. 2401-2402.

CIRCLE 129 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Mechanical Filters

Collins Markets Miniaturized

Hermetically sealed in a metal tube 2-3/16 in. long and 7/16 in. in diam, this filter represents a substantial size reduction from older model mechanical filters. Termed the Y series, the new model offers identical response characteristics as older models and is ideally suited for transistorized printed circuit applications. Models are available from stock in center frequencies of 455 kc with 6 db bandwidths of 2.1, 3.1, 4, 6, 8, 12, 16, and 35 kc. Other bandwidths will be made available in the immediate future.

Communication Accessories Co., Dept. ED, Lee's Summit, Mo.

Wescon Booth No. 1707-08.

CIRCLE 130 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 132 ON READER-SERVICE CARD ➤

Electron Tube News
—from SYLVANIA

Meeting Industry's New Challenges—Everywhere in Electronics

IN COMPUTER TUBES . . .

Sylvania releases another new computer tube, the 7044, featuring high perveance

Advanced duo triode computer tube released by Sylvania, type 7044, features high perveance and dissipation capabilities and for many applications is a replacement for type 5687. Optimized design featuring leakage slots and the best alloys to preclude interface resistance contribute to a long and stable life.

Type 7044 supplements Sylvania's extensive line of tubes for computer applications which includes types 5844, 5963, 5964, 5965, 6211, 6350, 6814, 7AK7, 6145, 6888 and 5915A.

CHARACTERISTICS

RATINGS:

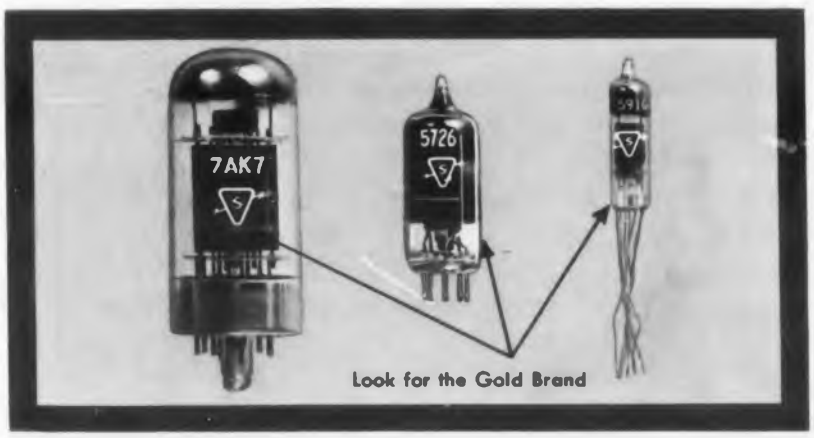
Heater Voltage	(Series)	12.6 Volts
	Parallel	6.3 Volts
Heater Current	(Series)	450 Ma
	Parallel	900 Ma
Plate dissipation per section		4.5 Watts
Total plate dissipation		8.0 Watts

TYPICAL CHARACTERISTICS:

Plate Voltage	120 Volts
Grid Voltage	−2 Volts
Plate Current	36 Ma
Transconductance	10,000 umhos
Amplification Factor	19
Plate Resistance	1,900 Ohms
Grid Voltage for Ib = 200 ua (Eb = 150V)	−12 Volts
Plate Current (Eb = 90 V Ec adjusted for Ic = +250 ua)	50 Ma

IN RELIABLE TUBES . . .

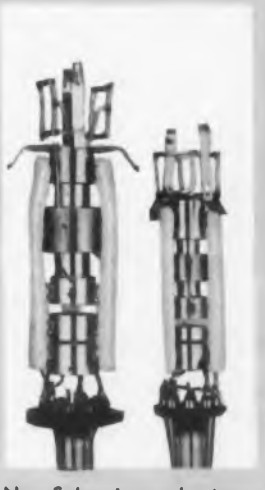
Sylvania's Gold Brand means extra dependability and reliability



Now all Sylvania reliable receiving tubes are distinguished by the famous Gold Brand that already identifies the premium dependability of Sylvania subminiatures. The Gold Brand assures you of airborne and computer tubes with extra accuracy and dependability.

Sylvania Gold Brand tubes meet extra critical specifications throughout the entire tube-making operation. This extensive quality control is possible because Sylvania itself furnishes nearly every tube part. As a result, extra-critical specifications can be applied to the production of components throughout the manufacturing of tubes.

IN TV PICTURE TUBES . . .



New Sylvania non-ion trap electron guns for 90° and 110° deflection with electrostatic focus.

New non-ion trap electron guns reduce tube length, eliminate external ion trap magnet

Sylvania, trendsetter in electron tube design, offers two new improvements for television picture tubes:

- **For 110° deflection—a small neck, non-ion trap gun with electrostatic focus**
- **For 90° deflection—a standard neck non-ion trap gun with electrostatic focus.**

Both new guns permit reductions in overall tube length of up to a full inch. They also make possible important cost savings by eliminating the need for external ion trap magnets.

The small neck gun for 110° deflection is available in the conventional base design with flexible stem leads or in the rigid pin base design with nylon cap.

Meeting Industry's New Challenges—

IN DYNAMIC TESTING . . .

Sylvania expands its Dynamic Testing Program to include every key TV type

Sylvania's expanded dynamic testing program now covers every important family of tube types used in today's critical TV receiver circuits. Individual Sylvania receiving tube types are evaluated in actual circuit environments that simulate current TV set designs. This extra quality check substantially reduces line rejects for receiver manufacturers and gives greater reliability and improved TV set performance at lower cost.

Sylvania's Joint Engineering and Manufacturing Committee, JEMC, meets weekly to keep testing specs current. The group, made up of key engineering and manufacturing management personnel, establishes specifications that assure better performance levels under actual operating conditions.

JEMC group, comprised of top engineering and production personnel in Sylvania's receiving tube operations, sets standards for the Dynamic Testing Program.

Sylvania tubes undergo arc tests in TV receiver circuits as part of its extensive Dynamic Testing Program.

IN ADVANCED DESIGN . . . new filament designed for 1B3GT and its new short version, type 1G3GT

New heater design shown at right

Sylvania introduces a new coil filament design that improves the performance and extends the life of the standard 1B3GT. This new development replaces the conventional filament shield with a hooked coil design that reduces shorts and arcing and increases emission.

Sylvania's new 1G3GT, a miniaturized version of the 1B3GT, incorporates the new filament coil design, is a full ½ inch shorter in overall length, and exhibits the same characteristics as the 1B3GT.

IN 110° DEFLECTION TUBES . . .

New TV Deflection Pentode

Sylvania offers a new tube development, type 12DW5, to meet the requirements for large-screen 110° vertical deflection. It also has application in 110° off-the-line circuits.

This new beam power amplifier with a T 6½ bulb size, is an original Sylvania design. It is already creating interest in the TV industry for many 1958 receiver designs by leading television manufacturers.

For series-string circuits, the new 12DW5 features high peak-positive plate voltage, high zero bias current and adequate plate and screen dissipation. To supplement the 12DW5, Sylvania offers the 6DW5 with a 6.3-volt, 1.2-ampere heater characteristic.

Vertical Deflection Ratings (Pentode Connected)	
Plate Voltage	330 Volts Max.
Grid No. 2 Voltage	220 Volts Max.
Peak-Positive Pulse Plate Voltage (absolute max.)	2200 Volts
Plate Dissipation	11 Watts Max.
Screen Dissipation	2.5 Watts Max.
Zero Bias Characteristics (Instantaneous Values)	
Plate Voltage	60 Volts
Grid No. 2 Voltage	150 Volts
Grid Voltage	0 Volt
Plate Current	260 Ma
Grid No. 2 Current	20 Ma

Everywhere in Electronics

—IN GUIDED MISSILE TYPES

. . . Structural advantages earmark Sylvania tubes expressly designed for guided missile use

Possibly the biggest single factor behind the wide acceptance of Sylvania's Guided Missile subminiature tubes is the fact that each type was designed from start to finish under a new philosophy born of thorough investigation of Guided Missile requirements.

From closer control of raw materials to tighter parts tolerances and new manufacturing techniques, nothing was spared to design and produce the most missile-worthy tubes available.

Wider grid-to-cathode spacing

Consistent with tube functioning requirements optimum grid-to-cathode spacing provides greater protection against flicker shorts and minimizes vibrational noise.

Adequate mica bearing surfaces

Tight, solid fitting is achieved between mica and cathode and mica and grid side rods through close parts tolerances and optimized bearing surface between the parts and mica.

Shortest mica-to-mica spacing

Shortened mount adds structural rigidity and relocates natural resonances beyond the frequency range encountered in missile operations.

Plate tabs and bent stems

Whenever possible, plate tabs are used and stem leads are bent, eliminating extra connectors and welds. A more rigid mount and improved reliability are achieved.

Lowest mica-to-header spacing

This structural advantage is inherent in the button-header design which makes possible shorter spacings without interfering with tube assembly.

Special bulb glass

Special new glass is employed in the guided missile tubes. The new hard glass makes possible bulb temperatures of 250° C. at a plate voltage of 250 volts.

"NEW CONCEPT" BULB

. . . a Sylvania refinement contributing to greater tube reliability

The new concept bulb is a typical Sylvania refinement which places greater controls over raw materials and physical tolerances.

From header to top seal, the new concept bulb is controlled for uniform wall thickness. The combination of more uniform bulb and closer mica spacing tolerances provides a tighter fitting, more rugged mount.

Uniform wall thickness is maintained through "new concept" bulb fabricating techniques.

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
(First Class Permit No. 46687, New York 19, N. Y.)

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway
New York 19, N. Y.

Meeting Industry's New Challenges —Everywhere in Electronics

IN 12-VOLT HYBRID TYPES . . .

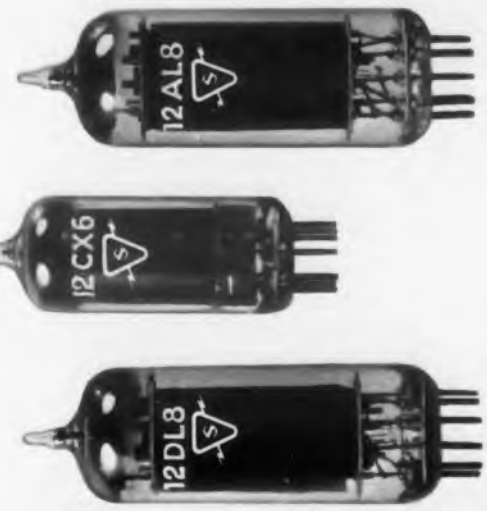
Sylvania's three new tubes, 12CX6, 12AL8 and 12DL8, meet needs of 1958 auto radio designs

Three new 12-volt hybrid receiving tubes from Sylvania are becoming the mainstays in 1958 auto radio designs. They are types 12CX6, 12AL8 and 12DL8.

Type 12CX6, a new rf-if pentode, is a Sylvania original design that is becoming one of the most popular auto tubes in 1958 lines. It has high transconductance of 3,100 micromhos and high plate resistance which is relatively unaffected by variation in the automobile supply voltage.

The 12AL8 is a medium mu triode and space-charged tetrode. It can be used as an audio amplifier and a transistor driver, or a trigger tube in remote control sets.

The 12DL8 is a new duo diode and space charge tetrode for transistor driver service and other applications.



Three new 12-volt hybrid tubes from Sylvania for 1958 auto radio designs.

IN SPECIAL CRT'S

Expanding CRT program produces Type 5UP1— more to come as development continues

Sylvania announces the availability of the Type 5UP1 general-purpose cathode-ray oscilloscope tube. It's among the first in Sylvania's plans to enter the special CRT program on a full-scale basis. Already in various stages of development and planned for early production are such cathode-ray types as the 3JP7, 3RP1, 5AHP7A, 7ABP7A and 12ABP7A.

To meet its projected goals, completely separate development and production facilities have been established to meet industry's special needs.

SYLVANIA

Please send additional information on the items checked below.

- ☐ Computer type 7044
- ☐ Type 1G3GT
- ☐ Hybrid auto radio types 12CX6, 12AL8, 12DL8
- ☐ Special purpose cathode-ray tubes
- ☐ Non-ion trap TV picture tubes
- ☐ Type 12DW5—6DW5
- ☐ Guided Missile types

Name_____

Address_____

Company_____

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

△ **Klystron**

69.5-77.5 Kmc/sec

The DX151 is a tunable, waveguide-output, reflex klystron oscillator operating in the 69.5-77.5 kmc/sec freq range, which features high power output and low heater power. The high power output and long life of these klystrons are due to the use of a Philips dispenser type cathode, which is able to supply high current density thermionic emission continuously at emission levels in the order of 2 to 4 amps/cm^2.

Amperex Electronic Corp., Dept. ED, 230 Duffy Ave., Kicksville, L.I., N.Y.

Wescon Booth No. 3206.

CIRCLE 133 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Quadrature Rejector**

Attenuates 100 to 1

Designed as an interstage element in 400 cps ac servo amplifiers, the QR-400 attenuates undesired quadrature signals by 100 to 1. Quadrature rejection finds application wherever undesired quadrature voltage tends to cause saturation or excessive power dissipation, or when quadrature obscures desired in-phase servo error signals. The QR-400 is a small hermetically-sealed unit composed of high-temperature solid-state components.

The rejector is simply a sampling device. It may be represented schematically by a switch and capacitor. Keyed by a 400 cps reference signal, the switch, in effect, closes momentarily at the peak of each half-cycle of the reference signal. The QR-400 thus samples its input at the peak of each half-cycle of the in-phase component, and holds that value until the next sample is taken. Since sampling occurs at the peak of the in-phase component, which corresponds to zero-crossing of the quadrature component, the output is insenstive to quadraturs.

Feedback Controls, Inc., Dept. ED, 899 Main St., Waltham 54, Mass.

Wescon Booth No. 1305.

CIRCLE 134 ON READER-SERVICE CARD FOR MORE INFORMATION

◄ CIRCLE 132 ON READER-SERVICE CARD

Norden-Ketay presents a superior new synchro . . .

3SYN

THE 3 FUNCTION, 3 MINUTE QUADRATURE BAR SYNCHRO

3-IN-1 VERSATILITY: TORQUE TRANSMITTER TORQUE RECEIVER • CONTROL TRANSMITTER

FUNCTION	UNITS	3SYN	STANDARD MIL SYNCHROS
NKC TYPE DESIGNATION		113CF2A	113F2B/113C2A
Number of Phases STATOR / ROTOR		3 / 1	3 / 1
EXCITATION PHASE		Rotor	Rotor
FREQUENCY	cps	400*	400
VOLTAGE RATING	volts	115/90	115/90
Maximum Input CURRENT / POWER	amps / watts	0.92 / 7.5	1.21 / 9.4
INPUT IMPEDANCE	ohms	138/86.4°	105/86.6°
Maximum Null Volts TOTAL / FUND.	mv / mv	100 / 50	100 / 75
DC Resistance at 20°C STATOR / ROTOR	ohms / ohms	3.93 / 3.04	5.86 / 2.59
MOMENT OF INERTIA	oz-in^2	0.45	0.43
FRICTION TORQUE AT 20°C MAXIMUM	oz-in	0.1	0.1
ELECTRICAL ERROR, MAXIMUM	minutes	±3′	±8′
RECEIVER ERROR, MAXIMUM	degrees	0.5	1
TORQUE GRADIENT, MINIMUM	oz-in/deg	0.25	0.13
DAMPING TIME, MAXIMUM	sec.	1	2
OPERATING TEMP. RANGE	°C	−55 to +55 †	−55 to +55
WEIGHT	oz.	21	21
MILITARY DESIGNATION			23TR4a/23TX4a

* Although this synchro is rated at 400 cps, 3SYNs are available to your order to operate at any frequency from 400 cycles to 10,000 cycles.

† *The normal temperature range of −55°C to +55°C can be extended to 140°C on special order.*

3SYN as a TORQUE TRANSMITTER

- Twice the torque gradient (0.25 oz-in) of standard mil synchros (0.13) drives a bigger load, or the same load more accurately.
- More than twice the electrical accuracy (3′) of mil synchros (8′).

3SYN as a CONTROL TRANSMITTER

- Better regulation with less input current improves efficiency, drives more transformers.
- 3-minute accuracy surpasses mil synchro performance (8′).

3SYN as a TORQUE RECEIVER

- Twice the receiver accuracy (±½° error) compared with standard mil synchro (±1° error).
- One-half the damping time (1 sec) compared with mil synchro (2 secs).

PLUS

3SYN minimizes problem of 'spares', since it is interchangeable with mil torque transmitters, control transmitters, and torque receivers. Moreover, 3SYN does not merely equal, but *excels* the critical ratings of standard mil synchros in each of those three functions.

extending man's capabilities

NK NORDEN KETAY

For full data and application engineering on the 3SYN synchro, write to Norden-Ketay Corporation, Western Division, 13210 Crenshaw Blvd., Gardena, Calif.

Sales Offices: Stamford Conn. | Chicago | Washington, D.C. | Dayton, Ohio | Los Angeles

CIRCLE 135 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ *See at WESCON*

△ Transistorized Switch

Starts and Stops Clock Pulses

This Switch Unit provides a means of starting and stopping clock pulses with manual or electrical impulses. Pulse standardization is accomplished and partial pulses are eliminated by a regenerative circuit. Amplified —20 v dc levels are available at the outputs, and will supply 1 ma to other transistor loads. In addition, positive and negative 1.5 μsec standardized pulses are produced by the gating circuit output. These pulses are suitable for driving binary counters, shift registers, delays, and all other units in the integrated 100 series.

Navigation Computer Corp., Dept. ED, 1621 Snyder Ave., Philadelphia 45, Pa.

Wescon Booth 906-907.

CIRCLE 138 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Linear Accelerometer

Damping without Warm-up

Designated the Type LA-500 Series, these accelerometers are true linear, non-pendulous type instruments, inherently insensitive to cross-coupling accelerations. These instruments are available in a variation of ranges from ±1 to ±60 g and can be provided with two potentiometer pickoffs. Essentially constant damping is maintained automatically throughout the entire operating range of —65 to +175 F. No warm-up time is required. Features include: damping ratio, 0.6 ±0.2 (from —65 to +175 F); linearity, 1 per cent of full scale; size 1-7/16 in. diam, 3-1/4 in. long; weight, 1 lb.

Minneapolis-Honeywell, Dept. ED, Boston Div., 1400 Soldiers Field Rd, Boston 35, Mass.

Wescon Booth No. 202.

CIRCLE 139 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Absorber Material

Broadbanded, Permanent

A vhf-uhf microwave absorber material, for production and laboratory antenna, testing, TV antenna test rooms or aircraft ramp testing of high-power, low-frequency radar, is announced. Type BL-48 absorber is made of an inert plastic foam material and can be used for both indoor and outdoor applications. These absorbers maintain permanent attenuation characteristics with a frequency range from 40 mc to 35,000 mc. Supplied in wedge form, in blocks with a base of 1 x 2 ft and a ht of 4 ft, the individual wedge block weighs 5 lb per sq ft and has an average power reflection coefficient of 2-1/2 per cent at normal incidence. Each piece of vhf-uhf microwave absorber is tested in a parallel plate line to insure quality performance.

McMillan Industrial Corp., Dept. ED, Brownville Ave., Ipswich, Mass.

Wescon Booth No. 518.

CIRCLE 143 ON READER-SERVICE CARD FOR MORE INFORMATION

△ RFM Cooling Panel

4000 w Heat Dissipation

This packaged cooling panel may be installed in the bottom of a standard 19 in. relay rack. It will handle 4000 w heat dissipation with a 40 deg temp rise and moves within the neighborhood of 300 cfm. It includes the fan filter box and a 2 in. thick metallic, oil-wetted, washable filter. Mounted on the front of the grill is a filter pilot which indicates when the filter should be cleaned. Models are available which will operate on 50-60 or 400 cps, 1 or 3 phase, 110/220 vac. This unit will meet existing military environmental and shock and vibration specifications for this type of equipment.

Rotron Mfg. Co., Dept. ED, Schoonmaker Lane, Woodstock, N.Y.

Wescon Booths No. 2813, 2814.

CIRCLE 144 ON READER-SERVICE CARD FOR MORE INFORMATION

CANOGA

New, Improved WOBBULATOR

Model 7200

Features New Technique In Electronic Swept Frequency Signal Generators!

One of the objectives in the design of the Canoga Wobbulator 7200 is to obtain high sensitivity without the "hum" problems normally experienced with other swept frequency generators. The swept frequency output voltage of the Wobbulator 7200 is modulated at approximately 50 Kc; the probes, with their internal diodes, detect this modulation which is then amplified in the vertical CRT band-pass amplifier. This new principle allows the use of swept generator techniques for evaluation of low gain or lossy circuits where point by point frequency measurements were previously necessary.

Frequency Range:	2.0 to 1000 mc
Swept Frequency Band:	2.0 to 55 mc, continuously variable
Output:	More than 0.03 volts, 50 ohms
Sweep Circuit:	All electronic
Swept Output:	1) Constant within ±1 db over 40 mc 2) Constant within fractions of db over 30 mc
Attenuator Dial:	Calibrated in 1 db increments
Probe Detectors:	1) Low impedance 50 ohms 2) High impedance
High Sensitivity Vertical Amplifier:	50 microvolts input gives at least 2" deflection
Cathode Ray Tube:	5UP1, with camera mounting bezel
Calibrated Panel Controls:	Center frequency Output Attenuator
Panel Controls:	Deviation Vertical Amplifier Gain Control Vertical Amplifier Gain Switch, high-low CRT intensity, focus CRT Vertical & Horizontal Centering On-off switch
Power:	115V, 60 cps, 175 Watts
Output Impedance:	50 ohms, BNC connector

WRITE TODAY FOR COMPLETE DETAILED INFORMATION

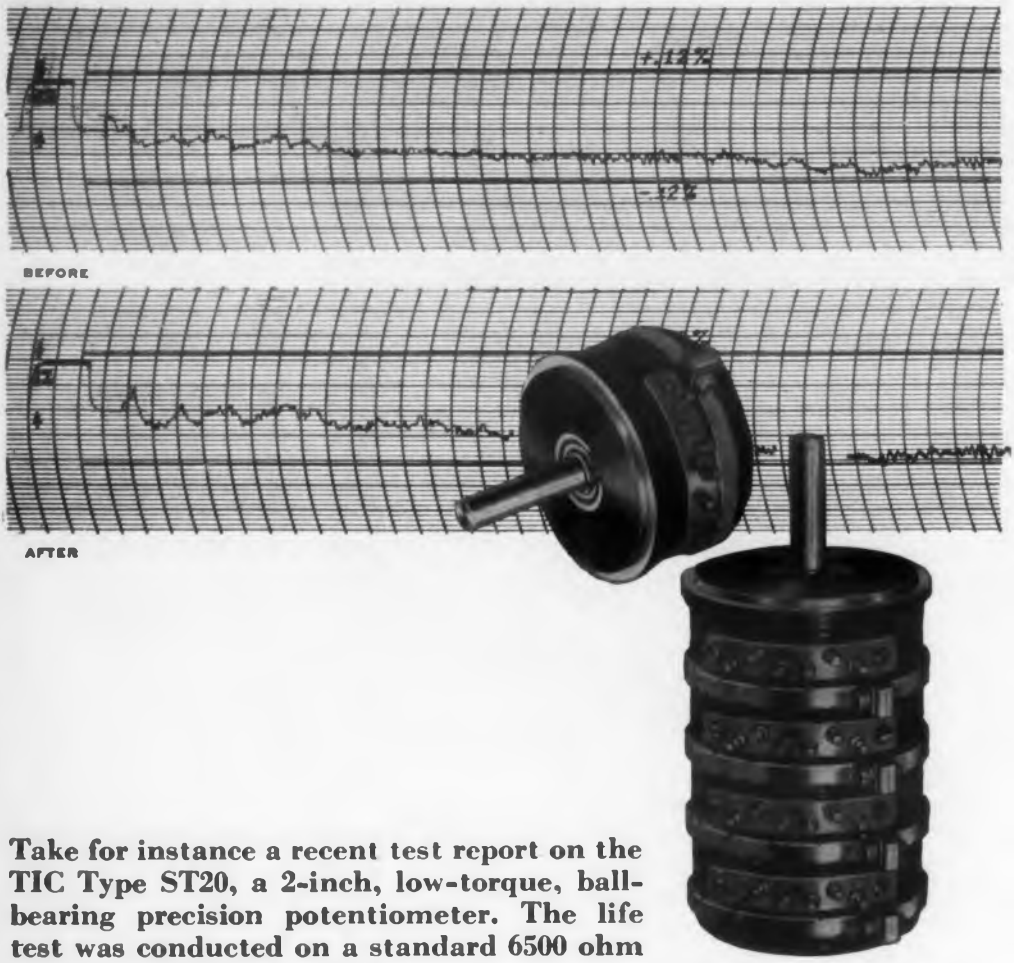
Radar Systems
Antennas
Receivers
Test Equipment
Microwave Components

CANOGA
CORPORATION
5955 Sepulveda Boulevard
Van Nuys, California

CIRCLE 145 ON READER-SERVICE CARD FOR MORE INFORMATION

LIFE IS NO PROBLEM

WITH TIC® PRECISION POTENTIOMETERS



Take for instance a recent test report on the TIC Type ST20, a 2-inch, low-torque, ball-bearing precision potentiometer. The life test was conducted on a standard 6500 ohm unit. At 30RPM the ST20 was subjected to 700,000 cycles, reversing direction every 30 minutes. The linearity graphs shown above show the before and after of the ST20's independent linearity. *As can be seen, the linearity change is imperceptible.*

Some of the change in linearity after the life cycling can be attributed to change in effective resolution due to contact wear. Other results from the life test indicate less than 100 ohm equivalent noise resistance except for one spot, where it was less than 1000 ohms. The 1000 ohm spot was of such short duration that the linearity recording did not pick it up. **Test Summary: The ST20 will perform with only infinitesimal degradation for over 700,000 cycles.** If it's long life *at full precision performance*, that you want, specify precision potentiometers by TIC.

TECHNOLOGY INSTRUMENT CORP.

555 Main Street, Acton, Mass. COlonial 3-7711
West Coast Mail Address, Box 3941, No. Hollywood, Calif. POplar 5-8620

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ See at WESCON

△ Portable Radiotelephone

For Geophysical Application

The TR-247 portable radiotelephone for geophysical applications may be used on any single frequency between 2000 and 8000 kc. Power output of the transmitter is from 25 to 30 w. The unit may be operated directly from a 6 or 12 v battery. Current drain is kept low by employing quick heating tubes. The entire unit including carrying case weighs 52 lb. less battery. A stripped chassis is provided on which users may add special equipment for time break circuits as employed in geophysical operations. Facilities for auxiliary inputs have also been provided.

Kaar Eng. Corp., Dept. ED, P.O. Box 1320, Palo Alto, Calif.

Wescon Booth No. 1915.

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Metal Film Resistors

Low Noise Level

The Davohm Series 850 hermetically sealed metal film resistors are now available. The resistors offer low noise level; resistance values of 2 ohms in 1/2 w size, 3 ohms in 1 w size, 4 ohms in 2 w size; very low reactive impedance component; no semiconductor effect; a temp range of from —65 to 150 C; the same positive temperature coefficient for all resistors from 2 ohms to 4 megohms. In addition, the resistors are hermetically sealed in three sizes in ohmic ranges from 2 ohms to 4 megohms in accuracies of ±1/2, ±1, ±2 and ±5 per cent. They will never short out or burn up since there are no organic compounds which might carbonize.

The Daven Co., Dept. ED, Livingston, N.J.

Wescon Booth No. 721.

CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Automatic Wire Marker

1000 Wires Per Hr

The automatic wire marking machine, Mark-Matic, permits the use of self-sticking, Perma-Code wire markers; one operator can mark as many as 1000 wires per hr. Markers are stripped from a dispenser card and applied automatically. Complete around the wire identification may be obtained in 2 sec. Seven different wire marker materials can be used in the Mark-Matic. Wires may be coded by number, letter, or symbol—consecutively, or in series of consecutive groups—without changing the speed or feed of the machine. Three stock lengths, 1-1/2, 3/4 and 1/2 in. long wire markers are handled interchangeably. Mark-Matic dimensions are 19 in. long, 18 in. wide, and 15 in. high and it weighs 100 lb. It operates on 115 v ac, 60 cyc.

W. H. Brady Co., Dept. ED, 727 W. Glendale Ave., Milwaukee 9, Wis.

Wescon Booth No 1113.

CIRCLE 153 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Multi-contact Relay

Type 9

This miniature telephone-type multi-contact type 9 relay, especially suited for aircraft, guided missiles, data processing equipment, and two-way mobile radio unit, is available with a wide choice of contact materials, and with a maximum of 18 springs (9 per pile-up). The unit has a maximum 3 w dissipation and a resistance up to 14,000 ohms with two 4-40 tapped holes on 3/8 in. centers. It measures 1-5/32 in. long x 23/32 in. wide. Height depends on the number of springs. It is also available as a hermetically sealed unit, measuring 2-1/8 x 1-5/8 x 1 in. overall. Springs are phosphor bronze for long life .

Phillips Control Corp., Dept. ED, 59 W. Washington St., Joliet, Ill.

Wescon Booth No. 419.

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

Build into your transmitter

this handful of assurance

MicroMatch Directional Couplers* measure RF Power and VSWR—giving you, the designer, positive confirmation of your transmitter's performance and providing your customer with a monitor that constantly watches his transmission line and antenna.

Built into major military communications and ballistic missile programs, these compact, rugged—and low cost—couplers produce an output essentially independent of frequency over the range of 3 to 4000 megacycles. They are adjusted for full scale meter deflection at power levels of 1.2 watts to 120 KW. Accuracy of power measurement is plus or minus 5% of full scale.

WRITE FOR OUR 50-PAGE CATALOG ...OR SEE PAGE 323 OF ELECTRONICS BUYERS GUIDE FOR MORE INFORMATION

WHEN MICROMATCH® IS BUILT IN— YOU KNOW WHAT'S GOING OUT

**U. S. Letters Patent No. 2,588,390*

M.C. JONES ELECTRONICS CO., Inc.
BRISTOL, CONNECTICUT

CIRCLE 155 ON READER-SERVICE CARD FOR MORE INFORMATION

here is a partial list of...

RHEEM miniature/sub-miniature ELECTRONIC PRODUCTS

REL-09 R-F POWER AMPLIFIER... provides power amplification over the 215-235 mc telemetering band. With 1.4 watts input drive, will deliver an 11 watt output to a 52-ohm load.

REL-11 VOLTAGE REGULATOR...a ruggedized unit for use in airborne systems. When used with an unregulated dc power supply, it will deliver an output voltage regulated to within plus or minus .1%.

REL-16 AIRBORNE POWER SUPPLY... used where a compact, rugged and completely reliable regulated power supply is mandatory. Operates at altitudes up to 65,000 feet and will withstand shock up to 30 g's.

REL-102 INSTRUMENTATION AMPLIFIER... embodies a vacuum tube-transistor configuration... is capable of accepting low level signals from various transducers; i.e.: strain gage, potentiometer and bridge types, and accelerometers.

REL-103 GALVANOMETER AMPLIFIER...performs the functions of amplifying and impedance transforming low level signals from Barium Titanate transducers to a level and impedance suitable to drive fluid damped optical galvanometers and similar devices.

REL-104 ACCELEROMETER AMPLIFIER...used for amplifying piezo-electric accelerometer signals to modulate a sub-carrier oscillator in telemetering systems.

REL-106 TRANSISTORIZED SERVO AMPLIFIER... Amplifier Input: 100 MV RMS @ 400 cycles and 20,000 ohms input impedance. Amplifier Output: approximately 9/10 watt; Output impedance can be matched to customer requirements over applicable range. Phase shift and distortion a minimum.

REL-203 TRANSISTORIZED STATIC INVERTER POWER SUPPLY... used in aircraft and missile guidance systems and other applications where portability is a prime requirement.

REL-251 TELEMETERING POWER SUPPLY... for missile, aircraft, laboratory and ground support applications. It provides one regulated and one unregulated high voltage output and a 6.3 volt heater supply.

REL-10 120 WATT R-F AMPLIFIER... available September 1st.

REL-120 TRANSISTORIZED DC AMPLIFIER... available September 1st.

SEE RHEEM BOOTH NO. 3010 AT THE WESCON SHOW

For further information contact:

ELECTRONICS DIVISION
RHEEM MANUFACTURING COMPANY
7777 Industry Avenue, Rivera, California

10-57

CIRCLE 157 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ See at WESCON

△ Production Test System

Modular

The Hi-Pot Impedance and Continuity Test System verifies wiring and workmanship of all types of electrical and electronic assemblies. Five modules are available: master unit, hi-pot and continuity tester, impedance tester and two types of slaves (scanning units). A minimum system consists of a master unit, tester and slave. Additional testers and slaves can be added as needed, determined by the type and number of circuits and tests to be performed. The system can be quickly changed to a different test set-up by disconnecting one adapter harness and plugging in another. It is designed for mounting in a standard 19 in. cabinet.

Cal-Tronics Corp., Dept. ED, 11307 Hindry Ave., Los Angeles 45, Calif.

Wescon Booth No. 2105.

CIRCLE 158 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Dual Frequency Fan

Cools Electronic Equipment

This fan, which must operate from either a ground 50-60 cps power supply or the 320 to 1000 cps supplies encountered on aircraft, will cool instrument cabinets and electronic test equipment. It will operate on either single phase or 3 phase power, and specified voltage, and in accordance with military specifications for this type of equipment. Fans 4 in. and 4-1/2 in. in diam are presently contemplated, which will deliver from 75 to 115 cfm at 60 cps.

Rotron Mfg. Co., Dept. ED, Schoonmaker Lane, Woodstock, N.Y.

Wescon Booths No. 2813, 2814.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Sub-Miniature Relay

Type 506

This sub-miniature relay, Type 506, is operated from a standard dc voltage of 26.5 v dc with dc coil resistance of 400 ohms ±10 per cent at 25 C. Contract arrangement is DPDT. Standard contacts are suitable for low level circuits or general purpose use. Normal rating is 2 amp non-inductive at 26.5 v dc. It has a mechanical life in excess of 20,000,000 cycles, and exceeds 750,000 cycles at 2 amp non-inductive. It is especially designed for critical application in low level circuits and meets the requirements of MIL-R-25018 for a general-purpose relay for aircraft and missile use.

Price Electric Corp., Dept. ED, E. Church & Second St., Frederick, Md.

Wescon Booth No. 3310.

CIRCLE 163 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Noise Figure Meter

5 to 60 db

The Model NFT-2 eliminates the time consuming manual procedure for determining transistor noise characteristics. The model measures transistor noise figure automatically and provides a continuous direct reading on the basis of a simplified meter reading. The unit, in addition, checks noise figures of transistor amplifiers and similar devices. Applications include selection of transistors for low noise circuits, determination of noise figure as a function of environmental and circuit conditions, reliability and life expectancy evaluation, and general production testing and quality control. The Model NFT-2 operates from a 115 v ac, 60 cycle source. Noise figure range is 5 to 60 db with a 1 db accuracy. Noise figure reading is on the basis of 1 cycle equivalent band width at 1000 cps center freq. This model also includes provision for supplying emitter bias and collector voltage.

Electronic Research Associates, Inc., Dept. ED, 67 East Centre St., Nutley 10, N.J.

Wescon Booth No. 3308.

CIRCLE 164 ON READER-SERVICE CARD FOR MORE INFORMATION

Unparalleled savings for parallel resistor-capacitor applications

Centralab TUBE-R-Cap*

ACTUAL SIZE

Saves Space!—

Combines a high-quality ceramic capacitor and a built-in fixed resistor in the space of a tubular capacitor alone.

Saves Initial Cost!

Costs you less than an equivalent combination of individual resistor and capacitor.

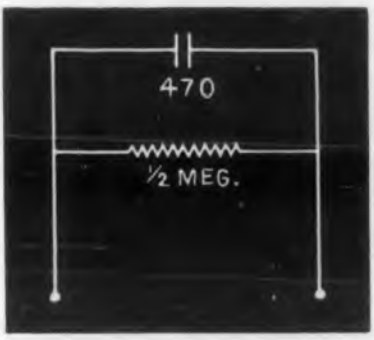
Saves Handling Costs!—

Only one piece to insert, instead of two; only one piece to carry on inventory.

Provides any normal capacitor specification through 4700 mmf. and any resistance value from 100 ohms through 3 megohms (with ±20% tolerance up through 1 megohm . . . ±30% or wider above 1 megohm).

6,000,000 Tube-R-Caps are now in use, in antenna-line and many other applications. Lead spacings provided for any printed-circuit board. (See illustration below.)

Write us for further information. Or have the nearby Centralab representative tell you more. If you don't know who he is, ask us for his name.



TYPICAL EXAMPLES

DA620
Max. length, .530" — max. diam.,.260"
470 mmf., ± 20%, 500V
470 K ohms, ± 20%

DA625
Max. length, .810" — max. diam.,.260"
1000 mmf., ± 20%, 500V
330 K ohms, ± 20%

DA632
Max. length, .900" — max. diam.,.280"
470 mmf., GMV, 1500 VAC (UL rated)
.3 to 1 megohm

Available with crimped leads, for printed wiring board insertion

*Trademark

Centralab

A DIVISION OF GLOBE-UNION INC.
960-H Keefe Ave.
Milwaukee 1, Wis.

In Canada:
804 Mt. Pleasant Road
Toronto, Ontario

SEE US AT THE WESCON SHOW
August 20-23
San Francisco
BOOTH 2701

D-2558

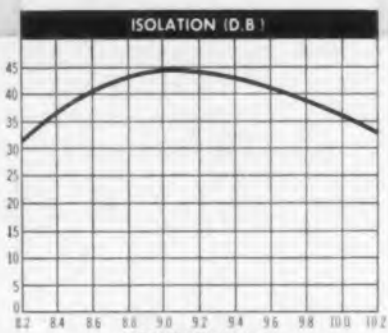
CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

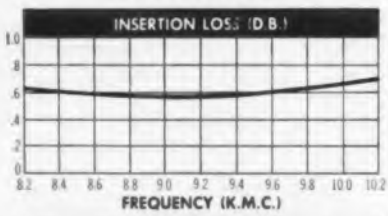
A New Broad Band Kearfott FERRITE ISOLATOR for Laboratory Test Bench Use

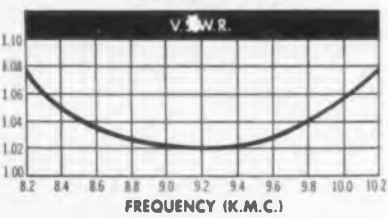
Model
W177-2C-1

Use this Ferrite Isolator in your microwave setup for maximum frequency stability.

Typical Performance Curves







CHECK THESE FEATURES:

Broad Band—Usable from 8.2 to 10.2 KMC

High Isolation—A minimum of 25 db over the band

Insertion Loss—Less than 1 db

Small & Compact—Only 2½ inches long—weighs only 1½ lbs.

Flanges—Cover type. Mates with UG39/U flanges. Will absorb up to 10 watts reflected power

Price—$135.00 each f.o.b., Van Nuys, Calif.

Delivery—From stock

Order—Model W177-2C-1

For custom-made isolators for specific radar & microwave application, you can depend on the skill of the Kearfott organization.

Kearfott, Western Division, has complete facilities for waveguide production, with qualified experts to assist in solving your problems. Let us help you.

For detailed information, ask for bulletins on new Ferrite Isolators and Radar Test sets.

Kearfott COMPANY, INC.
LITTLE FALLS, NEW JERSEY
A SUBSIDIARY OF GT&E

WESTERN DIVISION
MICROWAVE DEPARTMENT
14844 OXNARD ST. • VAN NUYS, CALIF.

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Midwest Office: 188 W. Randolph St. Chicago, Ill.

South Central Office: 6115 Denton Drive Dallas, Texas

Western Area Office: 253 Vinedo Ave. Pasadena, Calif.

CIRCLE 167 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ See at WESCON

△ Power Resistors

Strip-Type

Vitrohm stack mounting type resistors in characteristic V for styles RW20 to 24 are recommended for electronic and other applications where space for components is limited. Stack mounting power resistors feature strong oval-shaped ceramic cores, low mounting brackets and Vitrohm (R) construction. Power ratings in Characteristic V range is from 21 to 91 w, while resistance values are available from 0.8 to 71,000 ohms.

Ward Leonard Electric Co., Dept. ED, Mount Vernon, N.Y.

Wescon Booth No. 2609.

CIRCLE 168 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Precision Potentiometer

Unlimited Phasing

Designated the RL-270B, this line of unlimited phasing potentiometers includes these specifications: a 3/8 in. depth per section; continuous service up to 150 C; stainless steel clamps with unlimited phasing range; large number of taps, limited only by physical spacing; reliable performance under high g or vibration conditions; three styles of mounting-servo, bushing and 3-hole bushing, available in ball or sleeve bearings, shafts as specified. High unit pressure contacts give low resistance tap connections and eliminate linearity distortion.

The Gamewell Co., Dept. ED, Precision Potentiometer Div., Newton Upper Falls 64, Mass.

Wescon Booth No. 1304.

CIRCLE 169 ON READER-SERVICE CARD FOR MORE INFORMATION

Stromberg-Carlson's new type "E" relay combines the time-proven characteristics of the type "A" relay with a mounting arrangement common to many other makes.

As the sketch above shows, our new frame mounting holes and coil terminal spacing allow you to specify these relays—*of "telephone quality"*—interchangeably with brands you have been using. Costs are competitive and expanded production means *prompt delivery.*

Welcome engineering features of the new "E" relay are—

★ **Contact spring assembly:** maximum of 20 Form A, 18 B, 10 C per relay.

★ **Coil:** single or double wound, with taper tab or solder type terminals at back of relay.

★ **Operating voltage:** 200 volts DC maximum.

You may order individual can covers in a choice of 3 sizes for the new relay, as well as for our type "A" and "C" relays.

For complete details and specifications on the "E" relay and other Stromberg-Carlson relays, send for your free copy of Catalog T-5000R.

STROMBERG-CARLSON

A DIVISION OF GENERAL DYNAMICS CORPORATION
TELECOMMUNICATION INDUSTRIAL SALES
116 CARLSON ROAD, ROCHESTER 3, N. Y.

CIRCLE 172 ON READER-SERVICE CARD

△ Magnet Charger

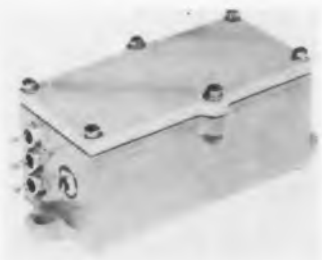
10,000 Ampere-Turns

The Model 1221 magnet charger is a condenser discharge unit developed to saturate two-pole permanent magnets up to 1-1/2 in. in length, depending upon the magnetic material. This portable charger employs plug-in, wire-wound type charging fixtures and is rated at capacity of 10,000 ampere-turns operating from a line source of 115 v, 60 cps. Charging of a magnet is accomplished by placing it within the fixture and pushing the charge button, or a conveyor belt can be run through the fixture to charge one or more magnets every 4 sec. The unit measures 7 x 8 x 10 in. and weighs 14 lb.

Radio Freq. Lab., Dept. ED, Powerville Rd., Boonton, N.J.

Wescon Booth No. 3321.

CIRCLE 173 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Accelerometers

1.5 Per Cent Accuracy

Accelerometers for a toss bombing control are designed to cover a wide range of static or uniformly varying type of accelerations. A potentiometer pick off is used for the electrical output of this unit. Inductive types can be supplied with modifications. Variations of conformation, G-ranges, natural frequency and damping will be developed to meet special customer requirements. The natural frequency of the unit varies from 5 to 30 cps for the measurement of accelerations in the range from 0 to 1 g to 0 to 30 g. Damping is accomplished by the viscous shear action of the mass moving in an oil medium. The seismic mass system provides a linearity of 1 per cent, while hysteresis is 1 per cent. Overall accuracy including linearity, hysteresis and repeatability is better than 1.5 per cent. The Type 940 will operate under ambient temperature of —55 to 100 C and will withstand vibrations of 10-55 cps 0.030 in. double amplitude and 55-500 cps 5 g in each of the three perpendicular axes.

Fairchild Controls Corp., Dept. ED, Components Div., 6111 E. Washington Blvd., Los Angeles, Calif.

Wescon Booth No. 3021-22.

CIRCLE 174 ON READER-SERVICE CARD FOR MORE INFORMATION

RECOGNIZED ii LEADERSHIP

SIDE INDICATOR PANEL METERS

MODEL 1145

APPROX. ½ ACTUAL SIZE

- **THREE SIZES—Models 1145, 1135, 1120**
- **Horizontal or Vertical Mounting**
- **Maximum Accuracy and Readability**

Save space on crowded, complex electronic controls and other panels without sacrificing accuracy or readability. These instruments provide same scale length as comparable conventional round meters, but occupy only 1/3 the panel area and are ideal for the redesigning and streamlining of panels. The wide range of standard and special ranges includes Expanded Scale Voltmeters, VU and DB meters.

Our Complete Line of Miniature Components Will Be On Display at the

WESCON Show, August 20, 21, 22, 23

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MINIATURIZATION HEADQUARTERS

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sub-miniature ROTARY SWITCH

- **Up to 12 Positions per Deck**
- **Up to 3 Decks**

A low-contact-resistance switch ideal for use in all electronic and test equipment applications where small size plus peak performance are essential. Available with 1, 2, 3 or 4 poles on each deck and with either shorting or non-shorting contacts; or rotor contacts shorting out any variations from 2 to 11 positions. Features include: specially impregnated glass melamine wafer, solder type lugs, and positive indexing.

1" ROUND and 1½" ROUND and SQUARE METERS

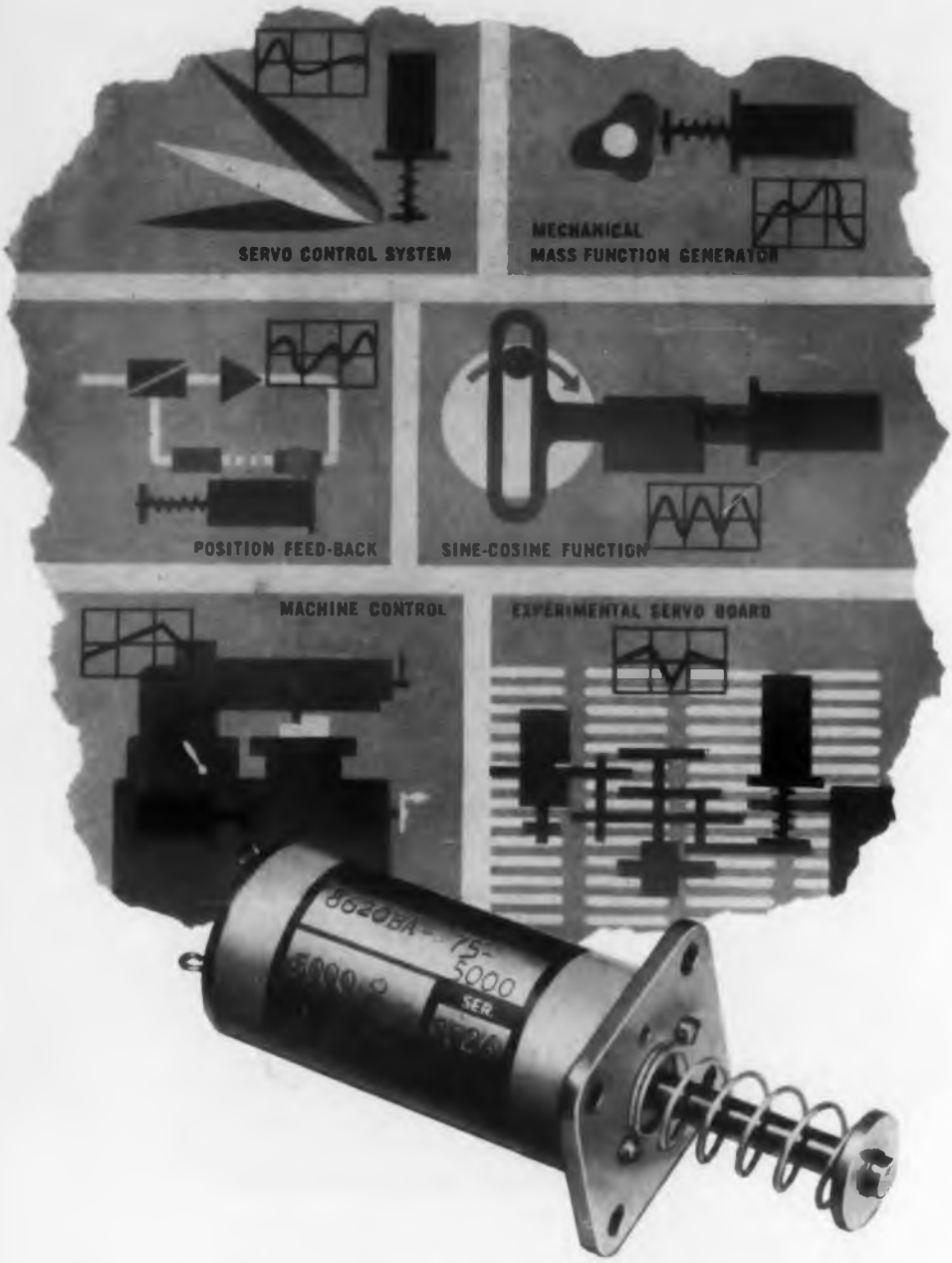
1" Meters have full 90° scale arc, scale length .760"
1½" meters to Military Specifications MIL-M-3823 and MIL-M-10304 (Sig. C.)
Also self-contained VU and DB meters, and illuminated models with lamp housing attached.

WRITE FOR ENGINEERING DATA SHEETS COMPLETELY DESCRIBING THESE MINIATURE COMPONENTS

1½" Ruggedized Meters • 1" and 1½" Panel Meters • 1½" VU, DB and Illuminated Meters • Miniature Multitesters • Side Indicators

P.O. BOX 2954, NEW HAVEN 15, CONNECTICUT

CIRCLE 175 ON READER-SERVICE CARD FOR MORE INFORMATION



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GIANNINI RECTIPOT

Reliable enough for the most severe airborne environments, sensitive enough for precision laboratory work! There is a RECTIPOT rectilinear potentiometer for any application where control or measurement of linear motion is required.

Standard RECTIPOTS are available with shaft displacements from 0.1" to 5.0". Resolution ranges from 0.001" to 0.003", and linearity of better than ±0.5% is typical for all models. The stainless steel shafts can be straight, threaded, keyed, or spring-loaded for automatic return to zero position.

specifications

SHAFT DISPLACEMENT: 0.1" to 5.0"
RESISTANCE: 80Ω/in. to 75,000Ω/in.
RESOLUTION: 0.001" to 0.003"
LINEARITY: ±0.5%
POWER RATING: 1.5 to 2 watts/inch
DIAMETER: 1.0 inch

See you at
WESCON
Booth 3204-3205

Giannini NEW JERSEY DIVISION
"Where reliability counts"

G. M. GIANNINI & CO. INC. • 918 E. GREEN STREET • PASADENA, CALIFORNIA

CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ *See at WESCON*

△ DC Power Supplies
Adjustable

These Transpac units are designed for either 60 or 400 cps operation, 105-125 v ac input and are available for output ranges of 5-10, 10-20, 20-30, 30-40, 40-50, 50-55 v dc in current ratings up to 200 ma. These adjustable models are also available for 100, 150, 200, and 300 v outputs at 100 ma ratings. Line regulation is better than 0.5 per cent; load regulation is better than 0.5 per cent. Ripple is less than 0.05 per cent. Units are potted in transformer type housing but transistors are available for servicing and replacement. Voltage variation is made via screwdriver adjustment. Size of a typical 60 cps unit is 2-1/2 x 3 x 4 in. and the 400 cps equivalent is correspondingly smaller.

Electronic Research Associates, Inc., Dept. ED, 67 East Centre St., Nutley 10, N.J.

Wescon Booth No. 3308.

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Storage Tube
Offers Tone Display

The VTP 6992 is a storage type cathode ray tube designed to present bright visual displays of television, radar or other types of electronically written information. The tube features an ability to display tones and to write, hold and erase at the operator's option. Brightness is sufficiently high for easy viewing in bright daylight and writing and erasure speeds are fast enough to present displays of high speed data with good contrast. The VTP 6992 contains a storage structure mounted internally near the panel, and both a flood gun and an electrostatically deflected and focused writing gun supported in a single neck axially aligned at the rear of the tube. All gun connections are terminated in a diheptal base attached to the tube neck.

Vacuum Tube Products Co., Inc., Dept. ED, 2020 Short St., Oceanside, Calif.

Wescon Booth No. 2403-2404.

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION

See You at the Show

Booth 2811

WESCON

An all time high, both in papers presented, and in number of exhibits, has been reported by the management of this year's WESCON.

If you would like an opportunity to publish your own practical design ideas, achievements, etc. not to a few, but to all of your 26,000 fellow engineer subscribers, be sure to look for us at the show. Editorial, advertising, and circulation representatives will be on hand at Hayden Booth No. 2811 to meet and talk to you.

ELECTRONIC DESIGN

a HAYDEN publication

NEW YORK • CHICAGO • LOS ANGELES

△ CRAM

Combines Four Test Functions

The Model 1051 C-R-A-M Unit combines four separate test functions in one unit for laboratory, communications or production line use. This unit is designed for use as: a secondary frequency standard of 0.0005 per cent accuracy; a receiver of standard time and frequency broadcasts from WWV; a moderate gain audio amplifier for general use; and a mixer to compare two external signals to each other or to compare one external signal to one of the harmonics or sub-harmonics of its 10 mc crystal oscillator. The unit has a self-contained, regulated power supply. Over-all size of cabinet is 11-1/4 x 21-9/16 x 14-7/8 in. Weight of unit is 49 lb. Chassis is mounted on standard 8-3/4 x 19 in. relay rack panel and may be removed from cabinet for relay rack mounting. Depth of chassis behind panel is 11 in. Chassis, less cabinet, weighs approximately 25 lb.

Radio Frequency Lab., Inc., Dept. ED, Powerville Rd., Boonton, N.J.

Wescon Booth No. 3321.

CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Strain Relief Breakout

For Multiconductor Cable

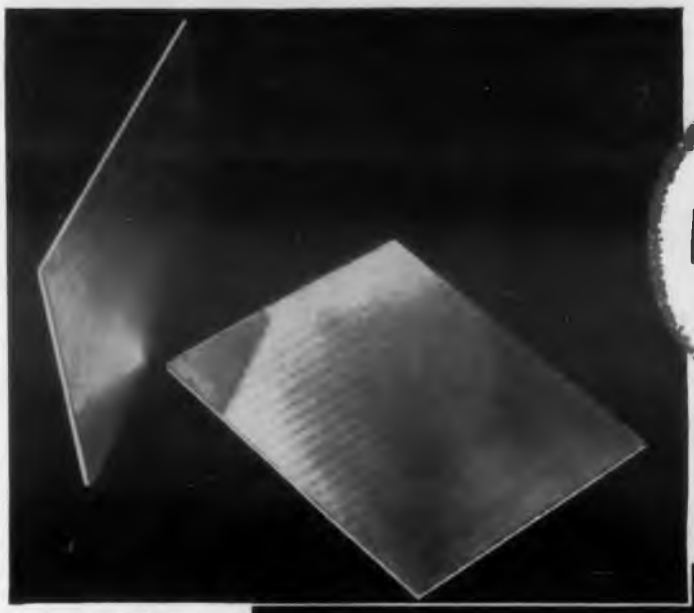
The design of this breakout for cables having multiple branch construction permits the cable entering and leaving the junction point to be mechanically clamped preventing the tearing of the breakout and rupture of conductors. This is accomplished by utilizing split and bored metal plates, which will accommodate the branch cables such that when the plates are secured together, a clamping action takes place on the cable jacket. Tension members between the clamping plates transmit any strain around the breakout junction so as to prevent undue stress on the wires within the junction. The entire mechanical structure is potted, preventing moisture and dirt from reaching the enclosed wires. The characteristics of this construction are strength, light weight, and maximum economy of space.

Pacific Automation Products, Inc., Dept. ED, 1000 Air Way, Glendale 1, Calif.

Wescon Booth No. 2412.

CIRCLE 184 ON READER-SERVICE CARD FOR MORE INFORMATION

Now
COPPER CLAD TEFLON



for PRINTED CIRCUITS

for CABLE STRIPS

Chemelec Copper Clad TEFLON* inherits all of the fine qualities and characteristics of TEFLON among which are a low Dielectric Constant (2.05), Dissipation Factor (.002 max. at 1 Mc under condition D/48/50), and Water Absorption (.02% per MIL-E-5272-A). Under duress, a uniform dielectric constant over a given area is assured and no delamination of insulating material is possible. In addition, this material has a bond strength of greater than 7 lbs./in. peel back and is unaffected by 500°F. solder.

SIZES AVAILABLE: Copper Clad Sheet is available 18" wide by 36" long, in TEFLON thicknesses of 1/16", 1/8", and 3/16", with 1 or 2 oz. copper on both sides.

Copper Clad Tape 12" wide by 36" long, is available in thicknesses of .005", .010", .015", .020", .030", .045", and .060", with 1, 2, or 3 oz. copper on 1 or 2 sides (or with copper on one side and cementable surface on reverse side, upon request). The above Copper Clad Tapes are also offered 12" wide by 150" long. Heavier copper available upon request.

Write for Catalog EC-757 which describes this and other new Chemelec developments. FLUOROCARBON PRODUCTS, INC., Division of United States Gasket Company, Camden 1, N. J.

*du Pont Trademark

Sold through leading electronic parts distributors by Erie Resistor Corp.

Fluorocarbon Products Inc.

CIRCLE 185 ON READER-SERVICE CARD FOR MORE INFORMATION

new model DFE

4 inch propeller fans with screen and venturi

Made with 22 different motor types,
1 ø, 3 ø, • 50-60-400 CPS,
variable frequency,
also with "ALTIVAR" high altitude motors.

Request copies of new catalog sheets
#s 50102-5, 50102-6 and 50102-7

ROTRON

MANUFACTURING CO., Inc.

WOODSTOCK • NEW YORK

New Products

△ *See at WESCON*

△ Panelscope

For Phase Measurements

The model P1A5X5 Panelscope has been designed for oscilloscope type phase measurements and the observation of other Lissajous patterns. The vertical and horizontal amplifiers are identical. They differ only in their basic sensitivity which is due to the difference in deflection sensitivity within the cathode-ray tube itself. The vertical amplifier maximum sensitivity is 7 mv rms per in., while the horizontal amplifier maximum sensitivity is 10 mv rms per in. In all other respects the amplifiers are identical. Each amplifier has a 7 position attenuator switch with attenuation ratios of 1-1, 3-1, 10-1, 30-1, 100-1, 300-1, 1000-1. Thus, the minimum sensitivies are 7 and 10 v rms per in., respectively. The phase shift is 0 for any attenuator position between 40 cycles and 2 kc. The frequency response of the amplifiers is held within −1/2 db from 20 cps to 8 kc. The static controls such as beam, focus, vertical positioning, horizontal positioning and graph screen illumination are all mounted within the cathode-ray tube escutcheon.

Waterman Prod. Co., Dept. ED, 2445-63 Emerald St., Philadelphia 25, Pa.

Wescon Booth No. 911.

CIRCLE 188 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Delay Line

Attenuation of 0.5 Db

The entire delay range of the Model 501, from zero to maximum delay, is covered by a single control shaft in ten turns. The unit may be locked at the desired delay by a locking device. Attenuation in the unit is 0.5 db. Resolution is better than 1/1000 of maximum delay. Termination is external. Maximum delay is 0.9 μsec. Maximum rise time is 0.18 μsec. Impedance is 1000 ohms. Outside dimensions are 7-1/4 x 1 x 1-5/8 in.

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

CIRCLE 189 ON READER-SERVICE CARD FOR MORE INFORMATION

Using Thermistors

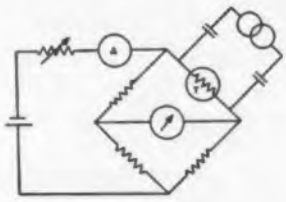
Edited by

FENWAL ELECTRONICS

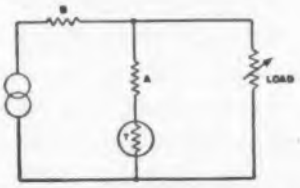
This is the third in a series of news columns devoted to thermistors — a device that is super-sensitive to temperature change.

The example in point: power measurement and voltage control.

A bead thermistor can be used to balance a bridge circuit, allowing the thermistor current to be measured and its DC power calculated. This is done with a 2000 Ω bead thermistor in a 200 Ω bridge circuit with a variable resistor in series with the bridge. This will heat the thermistor enough to lower the resistance to 200 Ω and balance the circuit to determine the H.F. power. By applying a source of high frequency power to the thermistor through capacitors this will further heat the thermistor and the bridge will be unbalanced. Then reduce the DC power until the bridge balances again. Calculate the new DC power, and the difference between the two calculations is the H.F. power.



To maintain constant voltage a thermistor with a suitable series resistor "A" can be placed in parallel with a load in a circuit. As the load resistance increases there is a reduced drop across resistor "B." This tends to raise the voltage across the load. The thermistor heats up, reduces its resistance, and more current passes through it and through resistor "B." This brings the voltage across the load back to its original state. Controls like this can maintain as close as 1% voltage regulation over a broad range of load resistance, or any voltage from ½ volt to 100 volts can be regulated in this way with suitable circuitry.



Engineers: these and other thermistor applications are discussed in 12-page catalog EMC-1. Write for your copy to FENWAL ELECTRONICS, INC., 37 Mellen St., Framingham, Massachusetts.

Fenwal Electronics

Makers of Precision Thermistors

CIRCLE 192 ON READER-SERVICE CARD

△ Servoscope

Low End Coverage

The Model 1100 F Servoscope is a sweep generator, a multiple signal generator and phase angle indicator. It accurately measures frequencies as high as 100 cps, and still affords low end coverage at 0.005 cps. The Model F provides a direct method for measuring gain and phase shifts of any component or system in the subsonic freq ranges. By turning the big phase dial, phase lead or lag is shown within an accuracy of 1 deg. The Model F provides sine, modulated sine and square wave signals as well as the linear sweep on four ranges from 0.005 to 100 cps.

Servo Corp. of America, Dept. ED, New Hyde Park, N.Y.

Wescon Booths No. 2819, 2820.

CIRCLE 193 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Mutliple Tape Handler

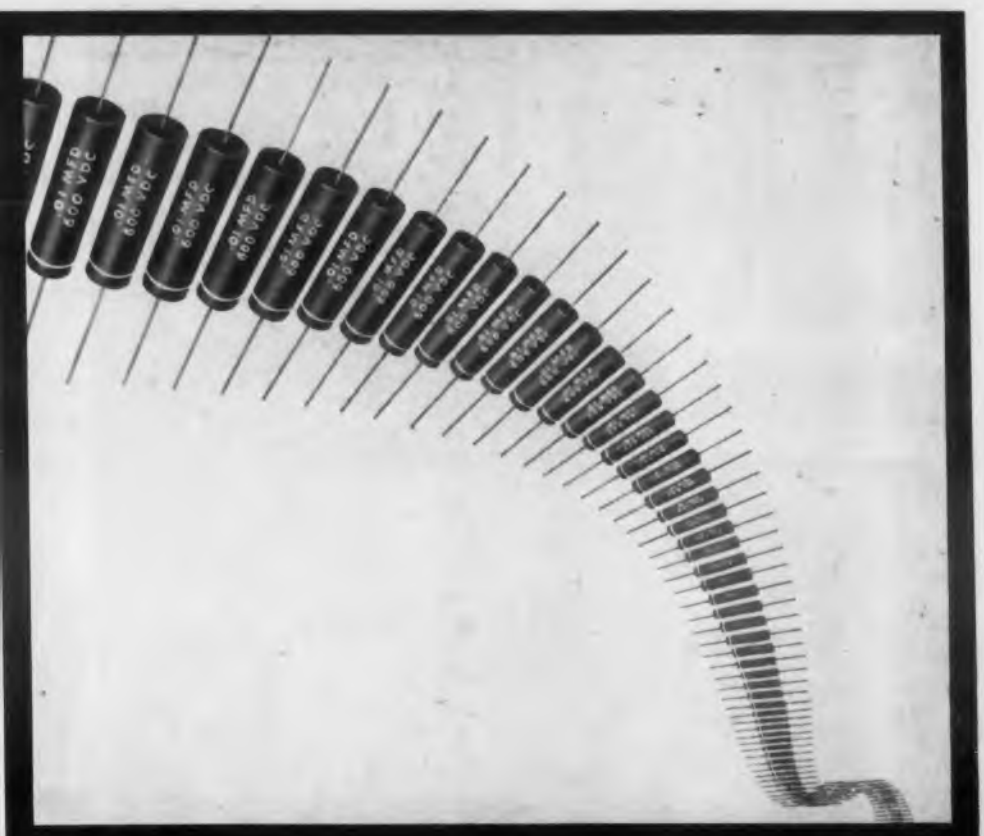
Stores 160 Million Bits

Digital magnetic tape multiple bin handler, Model 3219, stores over 160 million bits and can be employed for sequential sorting or as a random access memory of high capacity. The tape handler consists of ten separate identical units or bins each with a storage capacity of over 8 million bits, a bin normally containing 500 ft of 1 in. wide magnetic recording tape for 14 channel recording with 200 ppi density. Each bin is equipped with its own record-playback head, which may be relay switched to a common output. Employing the digit-by-digit method with a simple counter and matrix, decimal sorting rates up to 100 information blocks per sec are achieved.

Potter Instrument Co., Inc., Dept. ED, 115 Cutter Mill Rd., Great Neck, N.Y.

Wescon Booth No. 1003.

CIRCLE 194 ON READER-SERVICE CARD FOR MORE INFORMATION



If it's capacitors for automation...

C-D *makes them...*

makes them better

and packs them better, too!

A perfect parade of many styles of automation capacitors (paper, mica, electrolytic and ceramic) packaged to match your automation equipment. C-D's automation packaging keeps leads straight, lead tolerances close, and your handling time to a minimum. While you have your eye on budget and time-and-motion studies, we keep *our* eye on your automation capacitor problems. C-D engineers will be happy to show you how you can save time *and* money by C-D's specialized pre-packaging. Let us help you with your automatic feeding problems. Write to Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

ONSISTENT HI- EPENDABILITY

CORNELL-DUBILIER CAPACITORS

SOUTH PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER & CAMBRIDGE, MASS.; PROVIDENCE & HOPE VALLEY, R. I.; INDIANAPOLIS, IND.; SANFORD, FUQUAY SPRINGS & VARINA, N. C.; VENICE, CALIF.; & SUBSIDIARY, THE RADIART CORPORATION, CLEVELAND, OHIO; CORNELL-DUBILIER ELECTRIC INTERNATIONAL, N. Y.

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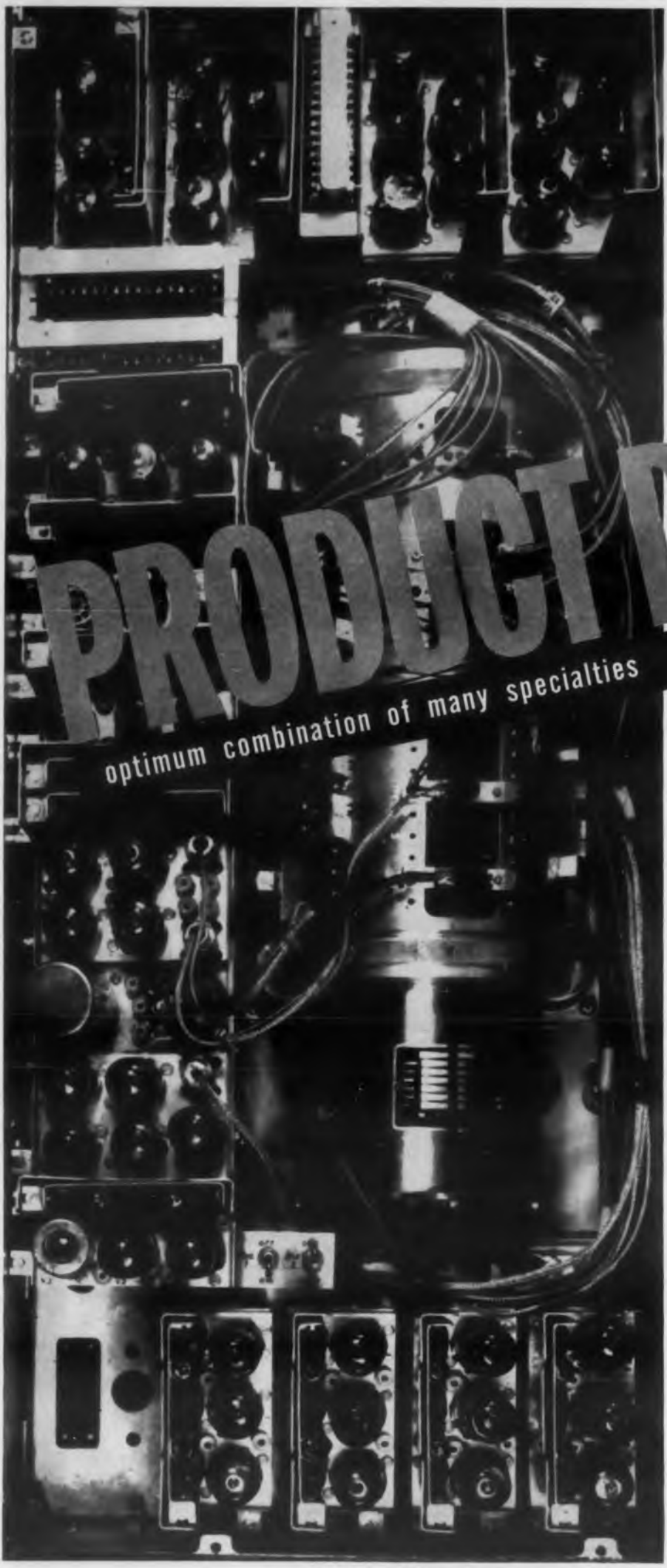
CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION



New Products

△ *See at WESCON*

△ High Current Power Supplies

Transistorized

With ratings up to 12 amp, these units have fast transient response, small size and light weight, close regulation, low ripple content, and independence from line response change. Units are shock and vibration proof. Stock models include units with a voltage range of 6 to 32 v dc and in current ranges of 4, 8, and 12 amp. High voltage models are also available for outputs up to 150 v dc at 1 amp and 300 v dc at 1 amp. Models are designed for 105 to 125 v ac input, 60 to 400 cps. Line and load regulation is within 0.5 per cent, ripple, less than 1 mv. Size of a typical unit is 5-1/4 x 19 x 7 in.

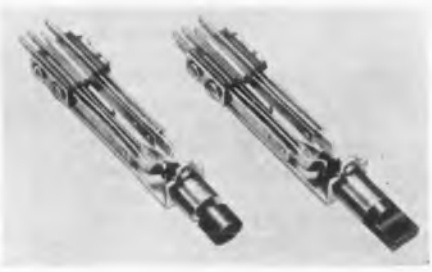
Electronic Research Associates, Inc., Dept. ED, 67 East Centre St., Nutley 10, N.J.

Wescon Booth No. 3308.

CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

△ T-Switch

Two Frame Designs



Series 11000 push button switch is available in momentary action and in push-to-lock, pull-to-release action or locking type. Series 11200 two position turn button switch is available in non-locking and locking action. Design features include relatively long springs without any forms at point of flexing for longer spring life; required minimum of panel space; welded cross-bar palladium contacts standard, rated at 3 amp ac non-inductive load, 300 w max. Fine silver contacts accommodate heavier current circuits on special order.

Switchcraft, Inc., Dept. ED, 1328 Halstead St., Chicago 22, Ill.

Wescon Booth No. 1508.

CIRCLE 198 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Capacitors

1 to 110 μF Range

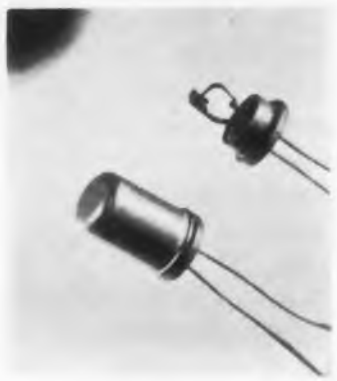
Known as the TT line, these aluminum cased electrolytic capacitors are available in 30 capacity and voltage ratings from 1 to 110 μf, and from 1 to 50 v working. The smallest unit is 3/16 in. diam x 1/2 in. long. The aluminum case uses silicone rubber hermetic seals. The No. 22 wire leads are 1-3/4 in. long, and can be had with insulating sleeves if desired. The TT line has an operating temperature range of from −20 to +65 C.

P. R. Mallory & Co., Inc., Dept. ED, 3029 E. Washington St., Indianapolis 6, Ind.

CIRCLE 200 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Four-Layer Diode

Bistable



The low power four-layer switching diode is a two-terminal silicon device which can exist in either of two states: an open or high-impedance state (1 to 100 megohms) and a closed or low-impedance state (1 to 10 ohms). It is switched from one state to the other through control of the voltage and current values. It is driven to its closed state by application of a voltage greater than the critical breakdown point, and it will continue to be conductive as long as a current greater than a critical holding current is maintained. When the current is reduced below the holding value, the device regains its open state. While the parameters are controllable over some breadth in manufacture, typical ranges of values are as folows: firing voltages range from 20 to 60 v; holding currents are 25 ma or somewhat less at about one v; the switched-current capacity is in the order of 100 ma; and maximum power dissipation is on the order of 100 mw. Switching rates are on the order of 1 mc though theory indicates that rates to 10 mc can be reached.

Beckman Instruments, Inc., Dept. ED, Shockley Semiconductor Lab., Mountain View, Calif.

Wescon Booth No. 1406.

CIRCLE 201 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ *See at WESCON*

△ Servo-Ratio Multimeter

Measures AC-DC Ratios

The Servo-Ratio Multimeter is designed to measure ac-dc ratios, absolute ac-dc voltages and resistance. The gain of operational amplifiers can also be measured using the 0 deg phase output provided. The SRM computes voltage ratios by dividing the voltage to be measured by the reference voltage obtained from the computer. It utilizes a motor driven position-type servo mechanism. Simplification and reliability are incorporated through the use of printed circuits. SRM equipment is light, compact and designed for easy handling and maintenance. The chassis and front panel of the multimeter slide into a compact aluminum case to form a unit which can be operated in a horizontal or vertical position. A carrying handle serves as a convenient tilt-stand when the unit is used in a horizontal position. The front panel provides a 4-digit drum counter for readout. Phase or polarity of measured voltages is indicated by phase lights above the counter.

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

Wescon Booth No. 810-811.

CIRCLE 205 ON READER-SERVICE CARD FOR MORE INFORMATION

Hot Wire Anemometer

Constant Temperature Operation

This hot wire anemometer offers constant temperature operation making it available for industrial use. It has a frequency response of dc to 100 cps and a noise level of less than 1 per cent of the mean flow level. By constant temperature operation, the maximum sensitivity can be realized with minimum wire burnout. Operation is completely automatic in that no time constant testing or gain settings are required. This affords self-regulation over a wide range of flow. It requires no batteries and three can fit in a 19 in. panel rack. A larger wire is used to increase life. Output impedances are 10 K and 100 K ohms. Other systems for use to 60,000 cps are also available.

Aero Research Instrument Co., Dept. ED, 315 N. Aberdeen St. Chicago 7, Ill.

CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Rack-Mounted Oscilloscope

DC-to-10 Mc

The Type RM16 is a 3 in. rack-mounted oscilloscope measuring 7 in. high, 19 wide, 16-3/4 in. rack depth, 19-1/4 in. overall depth. Vertical deflection is calibrated in 9 steps from 0.1 to 50 v/div with dc-to-10 mc passband, 0.035 μsec risetime, with 3 additional ac-coupled steps from 0.01 to 0.1 v/div with 2 cycles-to-9 mc passband, 0.04 μsec risetime. Signal delay is 0.25 μsec, input capacitance is 38 μμf direct, 13 μμf with probe furnished. A single knob is used to select any of 22 calibrated sweep rates from 0.2 μsec/div to 2 sec/div. 5 x magnifier is accurate at all sweep rates. Full sweep range is 0.04 μsec/div to 6 sec/div. The unblanking waveform is dc-coupled to the CRT grid. Four-way triggering provides for amplitude-level selection with either preset or manual stability control, fully automatic triggering, and high-frequency sync. A 1 kc square-wave voltage calibrator has 11 fixed peak-to-peak outputs from 0.05 to 100 v.

Tektronix, Inc., Dept. ED, P.O. Box 831, Portland, Ore.

Wescon Booth No. 1701.

CIRCLE 207 ON READER-SERVICE CARD FOR MORE INFORMATION

High Volume Capacitors

Rated to 30 V at 1000 μF

These Tantalytic capacitors are for low voltage dc application where high μf values are required in a small space. The three styles all have the same base dimensions of 1.316 x 0.75 in. The heights are 1.375 in., 2 in., and 2.5 in.

Voltage ratings for the 1.375 in. high case is 30 v at 1000 μf, polar construction, etched foil; for the 2 in. case, 50 v, 200 μf, nonpolar, etched foil; and for the 25 in. case, 20 v, 100 μf, nonpolar, etched foil. Capacitors are rated for a minimum of 1000 hr operation at 125 C, with not more than 20 per cent loss of initial 25 C capacitance after 1000 hrs.

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

CIRCLE 208 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

△ See at WESCON

△ Tape Reader

Reads 10 Transverse Rows

The Tape-ard Reader features the ability to simultaneously read 10 transverse rows of 8 holes each in a perforated tape. Providing the convenience in handling data in a fixed sequence afforded by tape, the unit can supply 80 bits of information for each event without the use of memory circuits required by single-line readers. The reader accommodates standard 1 in. tapes with holes on 1/10 in. centers. A verifier panel of neon lamps duplicates the 8 x 10 hole pattern of an entire frame and is used to rapidly check newly punched tapes. Thirty-five msec is required to advance the tape to a new frame. Stepping can be controlled both automatically by a simple circuit closure in the accompanying equipment and manually with the step button on the front panel. The reader will operate in excess of fifteen 80 hole frames per sec; however, for continuous, high-speed operation a maximum rate of 6 frames per sec is recommended.

Calif. Technical Ind., Dept. ED, 1433 Old County Rd., Belmont, Calif.

Wescon Booth No. 412-13.

CIRCLE 220 ON READER-SERVICE CARD FOR MORE INFORMATION

High Purity Gallium

For Semiconductor Use

Gallium in two degrees of purity, 99.999 and 99.95 per cent, is being produced by Aluminum-Industrie A. G. of Switzerland. The purer of the two can be used for such stringent applications as crystals of intermetallic compounds, such as those having semiconductive, photoconductive and luminescent properties. 99.95 per cent gallium is also commercially available for other similar applications.

United Mineral & Chemical Corp., Dept. ED, 16 Hudson St., New York 13, N.Y.

CIRCLE 221 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Coaxial Connectors**

Plug In

A series of 4, 6 and 8 contact plug in coaxial connectors are available for rack and panel application or hand engagement, with locking provided by a threaded sleeve. The coaxial contacts may be obtained with clamping parts for cables from 1/16 to 1/4 in. OD, including the new miniature Teflon cables, or open solder type terminals. Full floating contacts insure low engagement force.

Danbury-Knudsen, Inc., Dept. ED, 15-25 Thorpe St., Danbury, Conn.

Wescon Booth No. 2312.

CIRCLE 224 ON READER-SERVICE CARD FOR MORE INFORMATION

△ **Magnetic Tape Transport**

Ten-Speed Operation

The Model 546-53368 digital magnetic tape transport selects any one of the 10 closely regulated tape speeds by remote or local control. Tape speeds, in inches per sec, are 1.5, 2.25, 3, 4.5, 9, 15, 22.5, 30, 45, and 90. It has a speed ratio of 60:1. The unit contains vacuum column tape feed control for handling of magnetic tape. Three-quarter in. tape is used, on two 10-1/2 in. reels. Start-stop time is 6 msec. The oxide surface of the tape touches only three stationary members, one of which is the magnetic head. During the rewind operation, the tape is automatically removed from the magnetic head.

Burroughs Corp., Dept. ED, ElectroData Div., 460 Sierra Madre Villa, Pasadena, Calif.

Wescon Booths No. 3107-08.

CIRCLE 225 ON READER-SERVICE CARD FOR MORE INFORMATION

drift zero

One of the remarkable achievements of the revolutionary GPL Doppler air navigation systems is that they reduce drift to zero. We believe that GPL can reduce your personal "career drift" to zero, too.

GPL was formed in 1945 with a nucleus of 25 engineers from MIT's famed wartime Radiation Laboratory. Today GPL employs 2,000 people, most of whom work at our beautiful 69-acre estate at Pleasantville, just 35 miles north of New York City.

With two new engineering buildings under construction, a hefty backlog of orders, recognized leadership in several fields of electronics and research going on into many new ones, the future of GPL is extremely bright.

Besides the top pay and beautiful suburban environment, GPL engineers enjoy many other benefits: a professional atmosphere, small working groups that ensure individual recognition, and the finest facilities that money can buy. They benefit, too, from GPL membership in the nationwide GPE Group.

If you are interested in a "drift-free" career – a career that keeps moving ahead along a straight line of accomplishment–why not call or write to us today?

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63 Bedford Road, Pleasantville, New York

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New Products

△ *See at WESCON*

△ Automatic Iris and Target Control

For Television System

This Automatic Iris and Target Control Unit for industrial and institutional television systems automatically compensates for wide variations in light up to 16,000 to 1 and assures the lowest possible aperture to provide maximum resolution, depth of field and contrast. The use of automatic iris and target control eliminates the need for a variable density filter and resulting shading. Instead of being held at its maximum aperture, the iris moves freely within its stops. In addition, the coordination of iris change and target voltage results in optimum signal to noise ratio. Excessive wear on the lens aperture mechanism is eliminated by the adjustment of the video signal by the target voltage control. As long as this voltage is within optimum range, the iris does not change. However, the iris drive motor automatically corects the aperture setting to bring the target back within its optimum range if the target voltage moves to one of its limits. Only large changes in brightness conditions, therefore, affect the iris setting. To avoid forcing, the motor cuts off if extreme light conditions stop the iris.

General Precision Lab., Inc., Dept. ED, 63 Bedford Rd., Pleasantville, N.Y.

Wescon Booth No. 2810.

CIRCLE 211 ON READER-SERVICE CARD FOR MORE INFORMATION

Instrument Shunts

50 Mv Range

Light weight instrument shunts are available in the 50 mv operating range. The MS-91586 shunts are furnished in current ratings ranging from 30 to 150 amp and are designated as the MSA type. MS-19587 units have current ratings ranging from 170 to 600 amp and are identified as MSB while the MSC type shunts are made to MS-19588 and are provided in ampere ranges from 800 to 1200 amperes.

Janco Corp., Dept. ED, Burbank, Calif.

CIRCLE 212 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Heat-Dissipating Shields

For Bendix 6094 Size Tubes

The NW type shield, NW6-6528, is designed especially for the Bendix 6094 tube and tubes of the same bulb size. These tubes are larger in diameter and length than the usual 9 pin Noval tube. The NW shield assembly consists of an aluminum shell, a phosphor bronze compression spring and an inner beryllium copper spring finger liner. The spring finger liner grasps the glass bulb and dissipates the heat by conduction, radiation, and convection. This shield will lower the bare bulb temperature of a 6094 tube operating at 16 w filament and plate dissipation by more than 60 C. The assembly and base retain the tube under extreme shock and vibration conditions. This type shield is also available to fit all standard sizes of 7 and 9 pin miniature tubes.

For retrofitting equipment having old style JAN bases, a TR shield is available to fit the 6094 tube. This shield asembly, TR6-6027-1, consists of an aluminum shell and an inner beryllium copper spring finger liner. Attachment to the base is accomplished by a snap-on type lock.

International Electronic Research Corp., Dept. ED, 145 West Magnolia Blvd., Burbank, Calif.

Wescon Booth No. 602.

CIRCLE 216 ON READER-SERVICE CARD FOR MORE INFORMATION

DC Transformer Package

Delivers 900 V

This transformer operates on 24 to 32 v input and delivers 900 v at 30 μa, regulated within 3 per cent. It operates over an ambient temperature range of −55 to +71 C, and is unaffected by extremes of shock and vibration. Output ripple is regulated within 3 v peak to peak. The unit—transistorized switching circuit, transformer, rectifier and regulator—is integrated in a 2 x 2-1/4 x 2-3/4 in. package. Other transistorized power supplies are available within ranges of input of 5 to 50 v and output of 3 to 10,000 v with output power up to several hundred watts.

George W. Fenimore, Director, Dept. ED, Electronic Instruments Div., The Ramo-Wooldridge Corporation, P.O. Box 8405, Denver 10, Colo.

CIRCLE 217 ON READER-SERVICE CARD FOR MORE INFORMATION

LAPP
GAS-FILLED CONDENSERS

for duty at

High Voltage

High Current

High Frequency

Lapp's experience of 18 years of design and manufacture of gas-filled condensers is back of this precision-made unit and its promise of years of trouble-free duty. It is small in size and low in loss, offers high voltage and current ratings, high frequency limits, safety, puncture-proof operation and constant capacitance under temperature variation.

The entire electrical and mechanical assembly of the Lapp gas-filled condenser is supported by a top aluminum ring, the steel tank serving only as a support for this ring and as a leak-proof gas container. High-potential plates are carried on a rigid center stud which is supported by a top ceramic bowl. Grounded rotor plates are carried on ball bearings nearly the full tank diameter. This construction provides a grounded tuning shaft on variable models and makes possible efficient and complete water cooling for high current operation.

Models in four tank diameters, 7″ to 18″, are available, in variable or fixed capacitances, for duty up to 30,000mmf; in current ratings to 400 amps at 1mc; operating voltages to 80Kv peak. Write for Bulletin 302, with complete description and characteristics data. Lapp Insulator Co., Inc., Radio Specialties Division, 101 Sumner Street, Le Roy, N. Y.

Lapp

CIRCLE 218 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

Printed Circuit Welder

Uses Stored Energy

This new welding accessory enables stored-energy welding of components to printed and etched circuits, metal-coated ceramics and other extremely thin metal surfaces. Described as the Duo-Weld Electrode Accessory, the new unit employs two welding electrodes mounted adjacently over the work, which make two series type welds simultaneously. Electrode pressure is variable so that a variety of materials in a range of thicknesses may be joined. Weldmatic circuitry eliminates discoloration problems with low-voltage, high-current operation and extremely short discharge times. There is no metallurgical change in resulting joints, which are strong and uniform, and resistant to vibration and a wide range of temperatures.

The Duo-Weld accessory consists of a fixed and a movable electrode mounted on a 1/4 in. shank, which fits any Weldmatic head in place of the standard upper electrode. A flexible cable shunts power from the standard lower electrode to the movable electrode, making it easy to adapt Model 1015, 1020, or 1023 bench welders to the new component-printed circuit assembly technique.

Unitek Corp., Dept. ED, Weldmatic Div., 275 N. Halstead Ave., Pasadena, Calif.

CIRCLE 230 ON READER-SERVICE CARD FOR MORE INFORMATION

Microtomatic Slicing Machine

For Germanium, Ceramics

The Microtomatic, a precision production slicing and dicing machine, is an automatic machine designed specifically for the machining of brittle, shock-sensitive materials such as germanium, silicon, quartz, ceramics and carbides.

Specifications are given to the three Microtomatic machine sizes now available. The MTA-6, having a work area of 6-1/2 x 19 in., is for slicing and dicing of semiconductor materials and quartz. The 8-1/2 x 24 in. work area of the MTA-8 is widely used for abrasive and diamond wheel cutting of ceramics, carbides, etc. The largest model, the MTA-10 has a work area of 10 x 30 in. and the power needed for heavy duty work.

The DoALL Co., Dept. ED, Des Plaines, Ill.

CIRCLE 233 ON READER-SERVICE CARD FOR MORE INFORMATION

Dip Soldering Machine

For Printed Assemblies

This EPC dip soldering machine, is a production and laboratory tool to facilitate semi-automatic production of electrical and electronic assemblies and circuit boards utilizing printed and etched circuit techniques. The machine has a capacity of 120 units per hr. and requires only one operator.

Angle and depth of immersion of the work in the molten solder are adjustable. Dwell time may be set at any value from 0 to 57 sec in 0.5 sec increments. Solder temperature, after the adjustment has been made, is automatically maintained at the desired temperature.

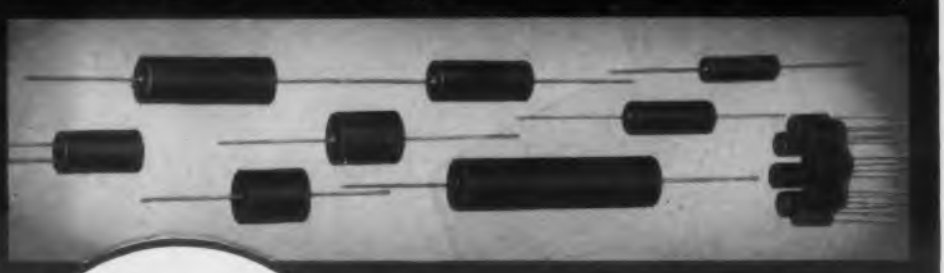
The machine is equipped with an automatic dross skimmer and a vibrator unit which removes excess solder from the work. The progressive rolling action with which the work engages the solder ensures proper soldering action.

The machine is only 24 in. wide and 32-1/2 in. deep. The cabinet surface is 39 in. above the floor while overall height of the machine is 61 in. The machine which is mounted on sturdy casters, weighs 350 lb. Single phase electrical power at 220-240 v, 60 cps is required. Power consumption depends upon the size of solder pot used. A typical load is 2400 w.

Electronic Products Corp., Dept. ED, 322 State St., Santa Barbara, Calif.

CIRCLE 234 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW! another epoxy exclusive!



EPOXY E-CASE SHELLS ...*for encapsulating electronic components*

Now your resistor, coil, capacitor, etc., can be encapsulated without the expense of temporary molds, release agents, and patching. The component is inserted into the new E-Case shell and epoxy compound added. A chemical reaction between the compound and epoxy shell assures a completely encased component resistant to humidity, temperature variations, and corrosive influences. The E-Case shells make mass production techniques possible in the encapsulation of components. Labor savings as high as 50% have been effected.

E-CASE SHELLS *completely eliminate:*

• mold problems • clean-up of mold and application of release agent • patching • removal of component from mold

Electrical Properties	Dielectric Strength Volts/Mil	380
	Surface Resistivity Ohm-cm	10^{14}
	Volume Resistivity Ohm-cm	10^{14}
	Dielectric Constant 60 CPS	6.7
	10^{6} CPS	5.4
	Power Factor 60 CPS	.027
	10^{6} CPS	.038
Physical Properties	Tensile Strength PSI	6,000
	Compressive Strength PSI	17,000
	Flexural Strength PSI	8,500
	Excellent Chemical and Solvent Resistance	

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CIRCLE 237 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Solenoids 238

"Solenoids for Industry" is a 4-page catalog of five basic solenoid types for industrial use. Tables provide ready references to the forces developed by the solenoids alone. Ac and dc readings for both continuous and intermittent duty are provided. These tables, the detailed dimensional drawings provided, and the designer's preliminary calculations or models will give an accurate approximation of the force required for a particular application, and also the installation requirements. Complete specifications covering frame construction, materials, plating and coil construction are listed for each solenoid. Examples of specially designed solenoids for specific applications are also presented. W. L. McMichael, Inc., 1428 W. Hillgrove Ave., Western Springs, Ill.

Epoxy Adhesives Chart 239

The properties of Epibond adhesives and Epocast pastes are listed in an 11 x 15 in. chart. The chart also cites typical applications for each type, and gives code numbers of bulletins containing more complete information. Covered are seven Epibonds, three Epocasts, and two resins. Furane Plastics Inc., 4516 Brazil St., Los Angeles 39, Calif.

Relays 240

All-purpose relays are listed according to type in 32-page catalog now available. Among the relays described are motor-control, coaxial and mercury wetted. Complete information is included on these and many others in the catalog. Relay Sales Inc., Box 186, W. Chicago, Ill.

Mica Bulletin 247

The unusual properties of natural mica, tips on part design for optimum utilization of properties, and a chart presenting the properties of mica (here reprinted) are presented in a new "Mica Bulletin." In addition to highlighting the 1000 deg F thermal resistance and extremely high dielectric strength of natural Muscovite, the pocket-size six-pager gives practical thicknesses of mica to use, tolerances possible on fabricated parts and other technical guides to the design engineer. Ford Radio and Mica Corp., 536 63rd St., Brooklyn 20, N.Y.

Properties of Mica

Specific Gravity	2.65-3.2
Specific Heat, 68°-212°F	0.208
Hardness, Mohs Shore	2.8-3.2 70-150
Compressive Strength, psi	32,000
Maximum Service Temperature	1000°F (1832°F for Phlogopite)
Heat Conductivity	0.00014-0.0008
Thermal Expansion Coeff., Linear	a=0.000003
Elasticity Modulus, psi	25×10^6
Dielectric Strength, 68°F, v/mil	3250-6250
Dielectric Constant	5-9.3
Power Factor	0.01-0.02
Specific Resistivity, 68°	$1\text{-}200 \times 10^{16}$
Volume Resistivity	$1\text{-}2 \times 10^{17}$
Puncture Voltage, 50mm electrodes	320,000 v/mil
Chemical Resistance	Resistant to chemical attack. Muscovite affected by hydrofluoric acid. Phlogopite affected by hydrofluoric and sulfuric acids
Optical	Optically negative and doubly refractive

RYCOM INSTRUMENTS

12 Channel Multi-Trace Large Screen Oscilloscope

MODEL 2400

Engineering techniques heretofore used only in large expensive test equipment have been incorporated into this new Model 2400 large screen oscilloscope which displays 12 complex wave-forms simultaneously. This instrument is currently being used in the following applications: Telemetering, Stress and Strain, Vibration, Analog Computors, Medical Wave-forms and Production Testing of Multiple Circuits of Complex Studies.

SENSITIVITY: 10 mv/inch deflection.

INPUT: Push-Pull direct coupled circuits for each channel.

FREQUENCY RESPONSE: dc to *2500 cps.

*This is displayed as 10 dot resolution, higher frequency is attained with less dot resolution, i.e. 10 kc is 2 dots, to form a sine wave.

SWEEP: 3 millimeter/second to 30 millimeters/millisecond.

PARTIAL LIST OF USERS: General Motors Corp. • General Electric Co. • Glenn L. Martin Co. • Lockheed Aircraft • Weltronics Company • Baylor University • University of California • University of Washington.

MODEL 2400 RM

(Basically same as Model 2400 except with Modified Time Base)

Rycom Model 2170 Selective Voltmeter

FREQUENCY: 1 kc to 200 kc

LEVEL: −70 dbm to +32 dbm (full scale)

ACCURACY: ±.5 db from −80 dbm to +32 dbm; 1 kc to 200 kc

SELECTIVITY: 6 db down at 75 cps off; 60 db down at 355 cps off

SPURIOUS RESPONSES: below 60 db

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RYCOM* INSTRUMENTS

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CIRCLE 249 ON READER-SERVICE CARD FOR MORE INFORMATION

You get the WHOLE story in one high-resolution display

WITH *Federal* LARGE-SCREEN

Oscilloscopes

Excellent resolution for accurate visual reading of large quantities of data or complex signals is provided by Federal's 17" and 21" oscilloscopes. Guesswork, reading errors and eye strain are reduced to a minimum.

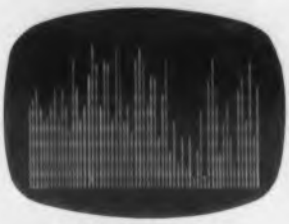
Almost perfect linearity and close control of orthogonality result from the magnetic deflection system used. Pin-point examination is permitted without sacrificing the total display.

Federal's 21" rectangular tube cabinet model is illustrated above. Standard 19" rack-mounting models are also available with 17" rectangular tube.

OUTSTANDING FEATURES:

- **High Resolution.** • **1% Linearity.**
- **Calibrated Time Base—10 microsec/in to 1 sec/in.**
- **Calibrated Gain Controls—1 millivolt peak-to-peak/in to 100 volts/in.**
- **Frequency Response—±0.1 db from DC to 50 kc; down 1 db at 100 kc.**
- **Long-term stability, accurate voltage calibration, linearity and constant deflection sensitivity eliminate the need for an internal voltage calibrator.**

Typical Applications



Telemetering

Illustrated is display of telemetered pulse width modulated signals, which appear clearly separated, permitting accurate observation.

Production Testing

Speeds up tests and reduces errors and eye strain. Production tolerances can be marked on the tube face.

Waveform Analysis

Permits observation of minute details, as in this display of relay contact chatter. Valuable for study of transient phenomena.

Computer "Read-out"

Displays computer output signals with such true fidelity that full use may be made of inherent accuracy of computer.

•

For complete technical information, write to Dept. S-535

Federal INSTRUMENTS
Industrial Products Division

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
100 Kingsland Road • Clifton, N. J.

CIRCLE 257 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Miniature Self-Locking Nuts 258

Information on miniaturized self-locking nuts for electronic units and avionic equipment has been prepared in a 36-page illustrated bulletin 5711 now available. Major sections of catalog cover size and weight reduction and fastener configuration and relative importance of each factor in choosing right fastener for particular job. Elastic Stop Nut Corp. of Amer., 2330 Vauxhall Rd., Union, N.J.

Magnetic Shield Designs 259

For convenience in specifying, data sheet 125 illustrates 14 basic designs and shapes for Fernetic Co-netic magnetic shields for cathode-ray tubes and photomultiplier tubes. These fit 99 per cent of the cathode ray and photomuliplier tubes available today. The shields are non-shock sensitive, non-retentive and effective indefinitely without periodic annealing. Perfection Mica Co., Magnetic Shield Div., 1322 No. Elston Ave., Chicago 22, Ill.

Linear Accelerometers 260

In Bulletin LF-MF-6-57, a 2-page illustrated sheet, a redesigned line of linear accelerometers is covered. The instruments are suitable for direct recording of maneuvering or low frequency accelerations of aircraft, missiles and other moving vehicles. G ranges, natural frequency, resistance, and current and voltage sensitivities are provided along with general specifications covering the nine low frequency and seven medium frequency models. An over-all dimension chart accompanies the bulletin. B & F Instruments, Inc., 4732 N. Broad St., Philadelphia 41, Pa.

Delay-Line Flats 261

Bulletin 9-56 is devoted to delay-line flats with an elliptical shape. The illustrated 2-page text cites advantages, salient features, and applications. It also offers pertinent technical data. Columbia Technical Corp., 61-02 31st Ave., Woodside, N.Y.

Transistor Types 267

Wall chart showing, at a glance, applications and maximum ratings and typical characteristics at 25 deg C of 56 types of germanium junction alloyed transistors is now available. The chart contains a handy interchangeability table, outlines five different transistor cases, diagrams of various circuits and standard IRE symbols and definitions. General Transistor Corp., 91-27 138 Pl., Jamaica 35, N.Y.

Pulse Calibrator 268

A 4-page technical brochure has been issued to describe the Type 1810 pulse calibrator, an instrument designed for measuring current and voltage pulse amplitudes, pulse durations and rise time. The pamphlet shows how the calibrator operates, illustrating and explaining actual waveforms obtained from different applications of the unit. Specifications and a complete analysis of the operation theory of both calibrator and chopper sections of the instrument are offered. Burroughs Corp., Electronic Instruments Div., 1209 Vine St., Philadelphia, Pa.

Electron Tubes 269

"What's new with the electron . . . 1957," a 20-page 2-color brochure on recently developed products is now available. Basic electrical data is supplied on many tube types, with emphasis on developments in ceramic tube design. Information is included on klystrons, power tetrodes, triodes, ceramic receiving tubes, beam switch tubes and beam rectifiers. Eitel-McCullough Inc., San Bruno, Calif.

Soldering Booklet 270

Handy booklet written especially for production personnel involved in soft and hard soldering is now available. The 6-page manual provides summary of origin and uses of soldering process; describes various types of solder and fluxes; basic characteristics of certain metals which give them "solderability" and "conductability" and three functions of fluxes. There is a section devoted to soldering aluminum including tips on most effective method. Anchor Metal Co. Inc., 966 Meeker Ave., Brooklyn 22,N.Y.

PERSPICUOUS SWITCH

Is it enough that a relay works? Not since we discovered the omission of a singularly vital instituent. To be a first-rate success today, a relay must *reveal* what it is doing every minute. With this in mind Sigma has developed a Radically New type of fully enclosed relay (see above) in which all moving parts can be seen moving while it is in operation. Although unsuitable for military use, this relay has already attracted considerable interest in certain quarters.* Technical features include: spark gap reference scale for quick visual juice estimations; fail-safe alarm; Manuel reset; contact unwelding mechanism and pit remover; double-pole, doubtful-throw contacts; ampere turn-signals. Continued observation of the operation of this new Sigma relay will pave the way for even greater discoveries and developments in the field, and permit other things. Basically, that is why none are presently for sale; all are in use by NASAW members who work at Sigma.

In their off moments (coffee break, luncheon bridge game, etc.) sensible members of this group* worked on another relay which is not as spectacular, but is available. A close watch of the Series 42 has shown that this DPDT relay: operates on less than 0.2 watt (DC), less than 0.5 volt-ampere (AC); doesn't chatter, buzz or snore; uses less power (AC version) than — and is interchangeable with — most competitive types; and is rated to switch 5 amperes. The DC version could be used as the output relay in such things as machinery control panels, automatic scales, circuits driven by Sigma Magnetic Amplifiers, and other domestic devices not requiring switching of the saludos amigos variety. It has no spark gap scale, but in normal use this relay will operate many millions of times. More information is contained in a bulletin, available on request.

Sigma Type 42RO Relay; transparent plastic dust cover.

*NORTH AMERICAN SOCIETY OF ARMATURE WATCHERS

SIGMA

SIGMA INSTRUMENTS, INC.
91 Pearl Street, So. Braintree 85, Mass.

CIRCLE 272 ON READER-SERVICE CARD FOR MORE INFORMATION

military test equipment

TS-505 B/U
MULTIMETER

AC volts 0-150
DC volts 0-1000
DC res. 0-1000 megs
RF up to 500 mc

AN/USM-26
FREQUENCY
COUNTER
10 cps to 220 mc

AN/UPM-33
SPECTRUM
ANALYZER
8470 to 9836 mc

northeastern engineering

Manchester New Hampshire

CIRCLE 277 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Analyzers 278

Five models of analyzers including the Model F are described in data sheet No. TDS 1100 now available. It states the Model F was developed in response to requests for a model that would accurately measure frequencies as high as 100.0 cps, yet still afford low end coverage at .005 cps. Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Pk., N.Y.

Assembly Kits Instruction Book 279

Tables of common gear ratios and moments of inertia are contained in an instruction book, SBI-1 Rev. 1, prepared for use with electro-mechanical assembly kits. The kits are used to test, correct, and prove systems and assemblies. The 8-page booklet spells out instructions for installing components in hangers, installing hangers and gears, gear alignment and gear selection. Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, N.Y.

Magslips 280

A 60-page catalog No. E1000 entitled "Magslips—Applications and Methods of Use" has been released. It tells the designer all he needs to know and is illustrated throughout with photographs, graphs and circuit diagrams. Among varied aspects of Magslip usage are: systems and circuits; remote control and remote indication; tests and fault location. Muirhead Instruments Inc., 677 Fifth Ave., New York 22, N.Y.

Electric Clips 281

An eight-page catalog provides complete descriptions and illustrations for an entire line of clips. Emphasis is on alligator-type and miniature test clips. An easy to find, faster reading format provides a quick visual and factual index. Free sample 70 Series clips accompany the catalog. Mueller Electric Co., 1580H E. 31st St., Cleveland 14, Ohio.

Phototubes 287

Phototubes and semiconductor lead sulfide photoconductive cells are catalogued in an 8-page illustrated booklet. Designated 257, the brochure provides full information, including charts and mechanical specifications, on the Cetron-Taylor line. Continental Electric Co., 6 N. Michigan Ave., Chicago 2, Ill.

Synchros 288

Equipment for testing synchros to MIL specifications are discussed in 4-page illustrated booklet now available. The various models described are provided with three clamps for securing the instrument to a panel. Muirhead Instruments Inc., 677 Fifth Ave., New York 22, N.Y.

Acetate Film Tape 289

Colored and transparent acetate film tapes are featured in a 4-page illustrated folder. The physical characteristics of the tape are given, and available colors and widths are listed with prices. A sample strip accompanies the folder. Labelon Tape Co., Inc., 450 Atlantic Ave., Rochester, N.Y.

Breadboard Parts 290

Catalog 575, "Standard Electromechanical Breadboard Parts," offers complete descriptions of all parts necessary for the assembly of complicated gear trains and servomechanisms. The 24-page booklet also contains typical schematics which are representative of basic synchro transmitter and receiver systems, potentiometer transmitter and receiver systems, and a mechanical resolver system. All parts are indexed for quick reference, and components are described in the approximate order in which they would be used in setting up a typical system. Pictures, specifications, outline drawings and complete ordering instructions accompany all listings. Beckman/Helipot Corp., Newport Beach, Calif.

Waveguide Components 291

Prices for waveguide components and test equipment are given in a 4-page illustrated list. For convenience, items are tabulated in two ways: by function and waveguide size, and numerically by model designation. Microwave Associates, Inc., Burlington, Mass.

Ace can meet your requirements in quality and delivery of NONLINEAR POTENTIOMETERS

Nonlinear precision wire-wound potentiometers in standard and subminiature sizes are now available in prototype or production quantities from Ace Electronics Associates . . *and you can be sure of delivery.*

These new Ace nonlinear units incorporate the same advanced engineering, precision craftsmanship, and controlled quality which have made ACEPOT linear potentiometers standards of excellence.

A new Division directed by highly qualified engineers, special prototype section, and mass production facilities are at your service to meet your requirements for quality and delivery of nonlinear precision potentiometers.

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Call or write William Lyon or Abraham Osborn, Nonlinear Division, outlining your requirements. Your inquiry will receive prompt attention . . . and you will get delivery as specified.

Featuring!

Highly developed design techniques achieve high resolution and close conformity for your unique nonlinear requirements.

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CIRCLE 293 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Hermetic Seals 299

Catalog 657A offers comprehensive information on compression multi-headers and plugs selected to provide a condensation of 10,000 available types. In the 16-page booklet, parts are grouped to offer essential information, part numbers are simplified, and dimensioning is standardized for quick, easy reference. Drawings and illustrations are included. Hermetic Seal Corp., 29 S. 6th St., Newark 7, N.J.

Crystal Filter Technical Memo 300

"Reduction of Interference in the HF Range Through Use of Bandpass Crystal Filter" is a recent Rome Air Development Center technical memorandum which describes the results of improved rf selectivity. Of particular interest is the improvement in sensitivity from 100 μv to 7 μv by the insertion of a crystal filter between the antenna and the first rf amplifier. Hycon Eastern, Inc., 75 Cambridge Pkwy., Cambridge 42, Mass.

Corona Type Voltage Regulators 301

"Corona Type Voltage Regulators," by Donald O. Ward, is an 8-page engineering paper which describes how corona regulators can solve voltage regulation problems without the use of multi-tube circuits, etc. It is illustrated with performance curves, a graphic analysis of corona regulator operation, and typical schematic diagrams for use in cascade regulators, circuits for increasing current rating, cathode follower regulator circuit and other applications. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Hybrid Duplexers. Flanges 302

Twelve-page catalog C457 illustrates and gives simplified ordering information on a full line of Hybrid junctions, flanges and adapters which, with appropriate TR tubes, will form microwave duplexers to meet a wide variety of requirements. Microwave Development Labs., Inc., 92 Broad St., Babson Pk., Wellesley 57, Mass.

Pulse Generators 307

Time delay generators, pulse generators, and a time measuring system are covered in a recent short form catalog of four pages. Each model is illustrated, and each is described as to principal features and specifications. The catalog also contains a price list. Rutherford Electronics Co., 8944 Lindblade St., Culver City, Calif.

Microvolt ammeter 308

Meter capable of measuring and amplifying minute dc voltages and currents is described in Technical bulletin 16-3 just released. Fifteen voltage ranges cover from 100 mv to 1000 v full scale and nineteen current ranges from 1 mμa to 1 a full scale. Kin Tel, 5725 Kearny Villa Rd., San Diego 11, Calif.

Pip Pin Engineering Data 309

Brochure on complete line of the 5440 series of single-acting self-locking quick-release pins has been released. This bulletin ADI 1268-257 is well illustrated and contains complete information on materials and finishes. Diagrams included provide for positive callout procedures. Aviation Developments Inc., PO Box 391, Burbank, Calif.

Electronic Galvanometer 310

The electronic galvanometer which is a combination dc null detector, linear deflection indicator microvoltmeter, micro-microammeter, and low level dc amplifier is described in bulletin 14-3 now available. This instrument is insensitive to vibration, shock, and stray pickup. Kin Tel, 5727 Kearny Villa Rd., San Diego, Calif.

Aluminum Electrolytic Capacitors 311

GEZ 1912 is a 4-page folder covering dc aluminum electrolytic capacitors for radio, television, and other communications equipment. The publication contains tables which enable the reader to calculate a capacitor's size from voltage and microfarad ratings. It also lists performance characteristics. General Electric Co., Irmo, S.C.

Wire Wound Resistors 312

A 2-page sheet on axial-lead wire wound resistors is offered. Illustrated with a photograph and a dimensional diagram, the bulletin gives details on construction, coating, power ratings, tolerances, and stock sizes. Stock items and prices are listed in a table. Hardwick, Hindle, Inc., 40 Hermon St., Newark 5, N.J.

SEALECTRO

PRESS-FIT®

TEFLON† TERMINALS

America's first supersonic bomber, the B-58 "Hustler", flies above 50,000 feet, with a crew of only three!

Hence a maze of electronic equipment for the many automatic functions. On such equipment rests the success of our defense program and the maintenance of peace.

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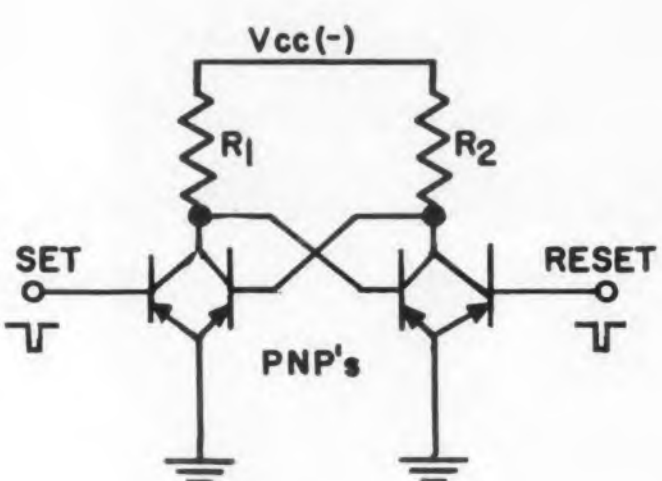
Wrong Pulse Polarity

THE PROBLEM tackled was one of how to introduce pulses of wrong polarity into transistor circuits or systems without increasing size, cost or number of components. This problem arises when external devices not under one's control must drive transistor circuits using a particular type of transistor for its response time, economy, availability or other reasons.

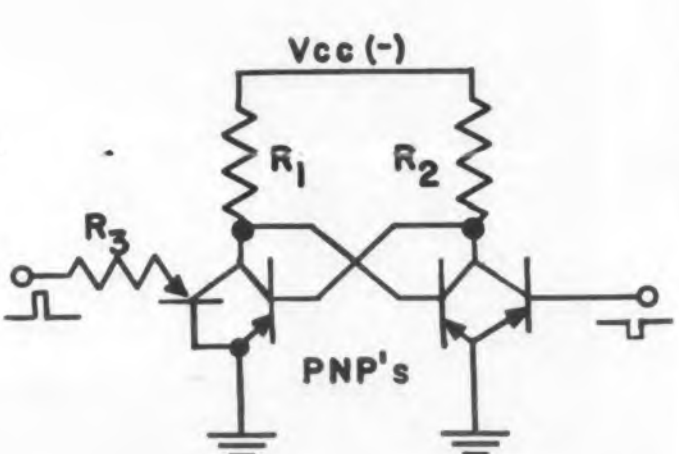
Solution

A typical transistor circuit (flip-flop) is shown at A. This particular circuit uses direct coupling and requires negative input pulses to the isolation transistors on the output side.

In order to accept a foreign (i.e. positive) pulse



Typical transistorized "flip-flop." A positive pulse is unacceptable.



A revised circuit for accepting "foreign" pulse. This circuit unfortunately has a low input impedance to R_3 since the emitter current must be great enough to saturate the collector.

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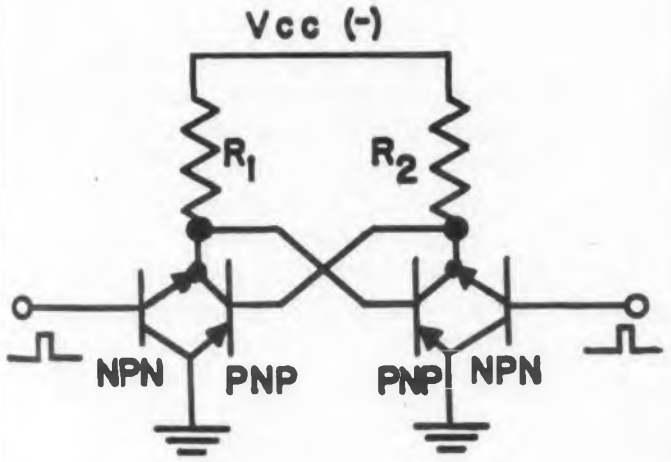
Acceptance Circuit

from an external source, the isolation stage with grounded base might be used (B). This has the disadvantage of lowering the input impedance or requiring a series resistance to limit emitter curent to whatever is required for proper triggering. A better solution is to use an emitter follower (common collector) connection with an n-p-n transistor. The input impedance will then be β times as large as the collector load. If the external driver is capacitively coupled, no further components are required. Care, however, must be taken not to bias the n-p-n transistor on through an external path.

D. P. Anderson, 1612 Wisconsin St., N.E., Albuquerque, N. Mex.



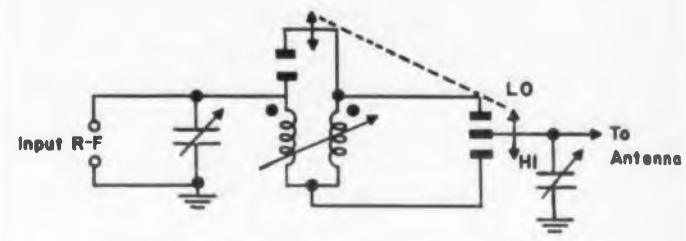
Better revised circuit for accepting "foreign" pulse. The input impedance is β times the collector load impedance.

Ideas for Design

Variometer Pi-Network

Shown here is a circuit using an infinitely variable inductor suitable for a Pi output rf amplifier. Variometers have been used heretofore but in order to get a large ratio of L_{max} to L_{min} coupling, the coefficient must be high, making circuit "Q" low.

The turning range is extended with a coupling coefficient (K) of 0.6, by switching from a series to a parallel coil arrangement. A ratio of 25:1 is practical with Q never lower than 125. Further, the rotation from Q to 180 deg from series aiding to series opposing, then switching to parallel aiding and continuing from 180-360 deg of rotation, enables the transit of L_{max} to L_{min} in 360 deg. *George B. Cottrell, Project Engineer, Robertshaw Fulton Controls, Anaheim, Calif.*

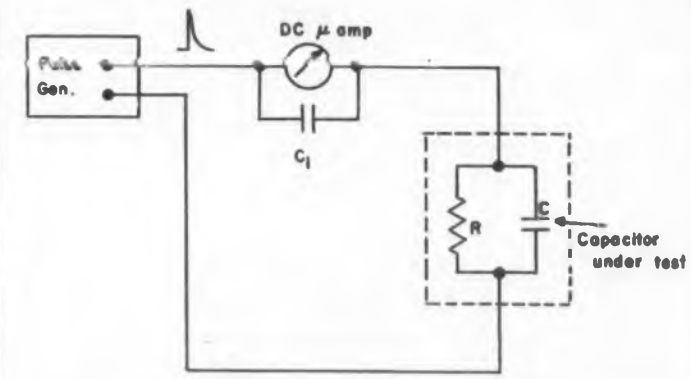


Extended tuning range variometer circuit

Capacitor Testing in the Circuit

Consider the case of a capacitor shunted by a resistor. The resistor may have any value from 100 ohms to 10 megohms. The capacitor may have any value from 10 μμ to 0.25 μf. The problem is to determine whether substantial leakage or possibility of breakdown exists in the capacitor, without disconnection of the capacitor from across the resistor.

A suitable pulse test will often detect a faulty capacitor in the foregoing situation. A pulse generator G applies its output through a bypassed microammeter to the shunted capacitor under test. The pulse has a peak voltage equal to or 50 per cent greater in some cases, than the rated working voltage of the capacitor. The pulses have a very fast



Test circuit for checking capacitor without disconnecting it from its circuit.

rise time, are narrow, and have a high repetition rate. Pulse width and repetition rate are not critical factors, but rise time should be a fraction of a microsecond, unless the generator has good regulation. A high repetition rate provides steady meter indication when H is small. Too great a pulse width provides excessive sensitivity, which will tend to cause R to produce some response on the meter. Small composition resistors impose the greatest limitation. Pulse generator G applies an ac voltage across RC, and the meter responds to a dc component which is usually developed by substantial pulse current through C, other than displacement current. C_1 must be quite large, in the order of 500 or 1000 μf. Meter sensitivity may be in the order of 50 microamps. The Simpson 383A utilizing this circuit provides this pulse test.

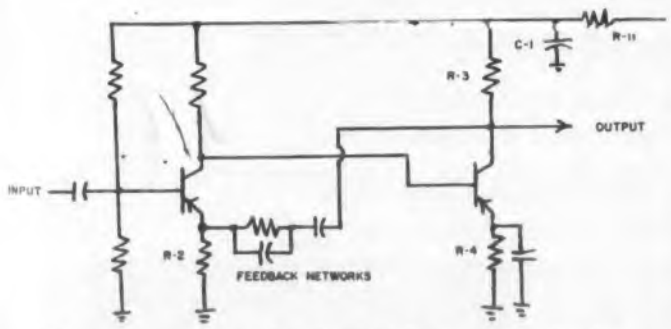
R. G. Middleton, Chief Field Engineer, Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

Economizing the Hybrid

The May 1st issue contained a description of a hybrid hi-fi amplifier and was concerned primarily with a feedback transistor equalizer. The equalizer described used voltage feedback from the second transistor collector to the emitter of the first transistor which is an excellent method when the second transistor is coupled to a high impedance load. With a slight rearrangement of the circuit, it is possible to eliminate two resistors and two expensive electrolytic capacitors. This modification is shown in the schematic.

The collector of the first transistor is directly connected to the base of the second transistor, and the bias current of the second transistor is determined by R4. Since resistor R2 is now connected directly to ground, it is no longer necessary to use capacitor C2 to effectively ground this point as in the proposed circuit. The feedback network remains unchanged.

The circuit described above is not suitable when used with supply voltage of 3 to 6 v, but is ideal for use with tube amplifiers where a high voltage is obtained. It would, of course, be necessary to adjust the value of R11 in the proposed circuit to provide a voltage compatible with the voltage ratings of the transistors. *Hugh R. Lowry, Mgr., Application Engineering, Semiconductor Products Dept., General Electric Co., Schenectady, N.Y.*



Economy version of hybrid hi-fi amplifier circuit.

Patents

Arrangement for Producing Full-Wave Output From Half-Wave Magnetic Amplifiers

Patent No. 2,754,474. P. W. Barnhart. (Assigned to the United States of America)

The usual form of magnetic amplifier provides a half wave output. There are many applications of magnetic amplifiers where a full wave output could be used advantageously. Full wave magnetic amplifiers have been designed; however, they lack the speed of response and the inherent demodulation characteristic of the half wave amplifier. The circuit of the patent delivers a full wave output and yet has the speed of operation of the half wave amplifier and also has the inherent demodulation characteristic of the half wave type of amplifier. It has value in servo motor mechanisms.

The figure shows a magnetic amplifier circuit with the power supplied to the load through a half wave magnetic amplifier *20* consisting of a reactor core *21* having a winding *22* in series with a rectifier *23*. The reactance of the reactor core *21* is controlled by the current in a coil *11*. A second half wave magnetic amplifier *30* is in parallel with the first amplifier and includes a rectifier *33* and winding *32* around a core *31*. The rectifier *33*, however, is poled oppositely with respect to rectifier *23*. This second amplifier provides an output during the negative half cycle resulting in alternating current through the load *40*. The flux reset windings have not been shown in order to simplify the illustration.

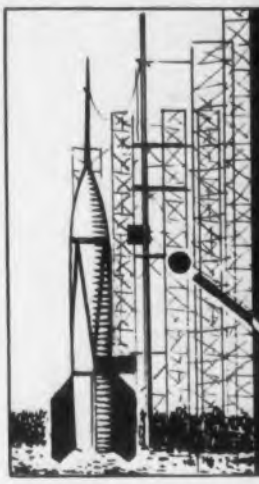
In the circuit illustrated, the second magnetic amplifier *30* delivers an output which is dependent upon the back impedance of the rectifier *33*. If the back impedance is high, upon the positive half waves little potential appears across the winding *32*. If on the other hand the back impedance of rectifier *33* is low, the voltage is divided be-

tween the rectifier and the winding 32. During the next half cycle therefore the output will be high and of opposite polarity to that of core 21 thereby producing the alternating current across the load. Should the output be small the difference between the line voltage and the output voltage approaches line voltage with the result that the flux of the core 31 is well down on the hysteresis curve with the result that the next half cycle is nearly cut off. The rectifier of the amplifier 22 must have a high back impedance so that the output of the second amplifier will have no effect on the control of the first amplifier. This avoids a positive feedback which would affect the speed of respondance. Several other forms of circuits using the basic principle of the illustrated circuit are also shown.

Compression Amplifier

Patent No. 2,784,263 A. A. Curry & P. S. Castro (Assigned to Motorola, Inc.)

The compression amplifier uses a signal translating circuit to which an attenuating network is coupled. The attenuating network includes a first discharge tube having a reference potential applied to its anode. The attenuating network also includes a second discharge tube, the anode of which is connected to the cathode of the first tube. The junction of the cathode of the first tube and the anode of the second tube are connected to the signal translating circuit. The first and second discharge tubes have a relatively low alternating-current resistance when their respective anodes are biased positively with respect to their cathodes. In addition these tubes have an ac resistance that varies from a relatively low value to a relatively high value when each cathode is biased increasingly positively with respect to its anode. A third tube uses the same cathode connection with a second tube. An impedance connects the latter with the point of reference potential for the anode of the first tube. Finally a bias control network impresses a control signal on the control electrode of the third tube to establish across the impedance, a positive bias potential with respect to the reference potential. The bias potential varies between zero and a predetermined value. This bias potential controls the ac resistance of the first and second discharge tubes and the attenuation of the attenuating network.



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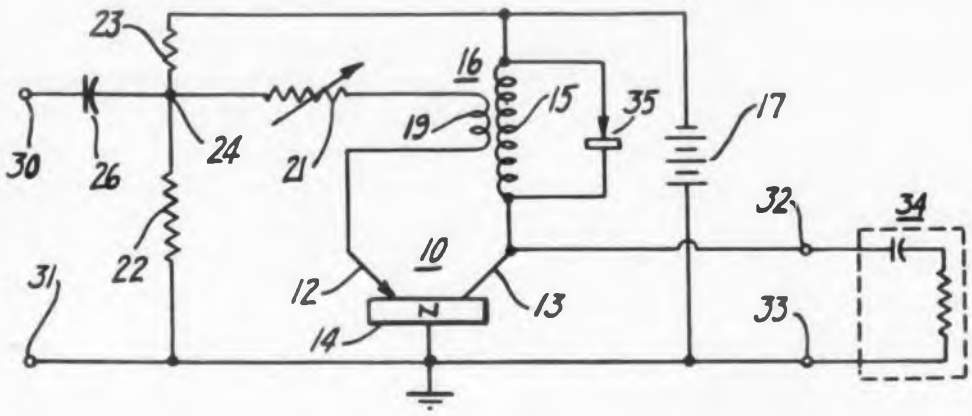
Patents

Pulse System

Patent No. 2,776,375. F. P. Keiper, Jr. (Assigned to Philco Corporation)

Transistors or semiconductive devices can be used for the generation of pulses either in the form of a free-running multivibrator or one which is triggered by an input pulse. The duration of the pulse generated will vary considerably due to varying temperatures. These variations in the pulse can be as much as twice the desired pulse duration for a relatively small temperature increase of eight degrees. It is desirable, therefore, that such devices have a higher degree of accuracy in the duration of the pulse irrespective of temperature changes.

The device shown in the figure uses a transistor or crystal *N* of any suitable type, however, the junction type has its advantages. The emitter *13* has an inductor *15* provided in series therewith and is supplied a proper potential from a suitable source of potential *17*. The collector *12* has in its circuit an inductor *19* coupled with the inductor *15*, a variable resistor *21* and resistor *22*. The input pulse is applied across the resistor *22* at the input terminals *30, 31*. The proper potentials are applied to the emitter



through the resistors *23* and *24*.

Upon the application of an input trigger pulse to the emitter, current flows in the collector circuit and a potential is generated in the secondary inductor *19* to increase the potential upon the emitter. Through regenerative action, the collector current constantly increases to a saturation point at which time regeneration ceases and the emitter potential returns to its low value thereby terminating the pulse. With an adjustable resistor *21* of substantial value in series with the emitter and base of the transistor, the current through the emitter is substantially independent of the internal resistance between the emitter and base electrodes, which changes with changes in temperature of the transistor. A substantial variation in the internal resistance of the emitter, therefore, has but little effect on the emitter current. With a total resistance which is about 50 times the internal resistance of the emitter, the current change due to temperature change is reduced to approximately 2%.

With the resistor *21* having a maximum value of about 5000 ohms, the duration of the output pulse will be about 6000 msec with a high degree of temperature stability. Upon decreasing the value of the resistance a pulse duration of 250 msec may be achieved but with some loss of temperature stability. The patent also shows a modification of the circuit illustrated.

Raster Centering Control

Patent No. 2,780,749. L. Dietch (Assigned to Radio Corporation of America)

A television deflection system uses a deflection winding connected to a winding of an output transformer. The raster centering circuit of the patent uses a potential dividing resistor having two terminals and an adjustable contact. An inductive choke connects one terminal of this resistor with the connection between the output transformer winding and one terminal of the deflection winding. The other terminal of the resistor connects with a second winding of the output transformer. The adjustable contact of the resistor is connected with the other terminal of the deflection winding. The potentiometer provided by the adjustable contact enable the direct current flow in the deflection yoke winding to be adjusted without affecting the flow of alternating current in this winding.

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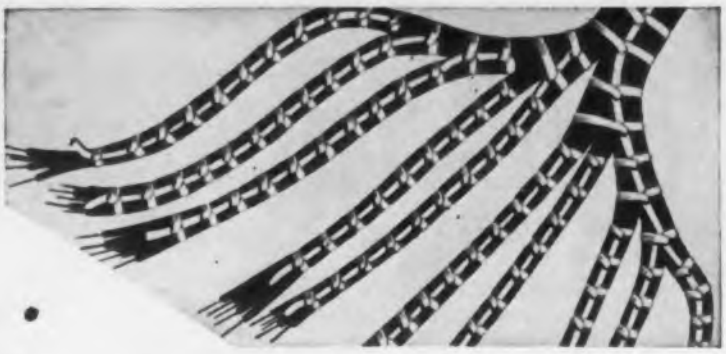

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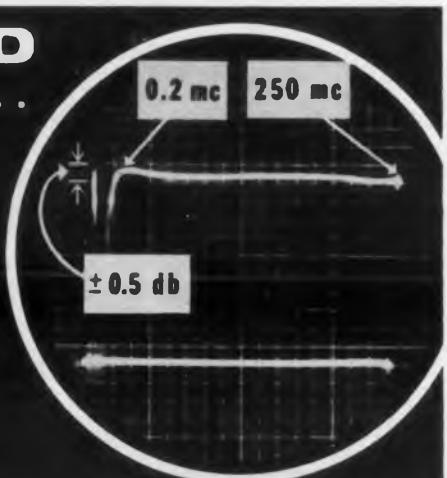

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Patents

One Shot Multivibrator

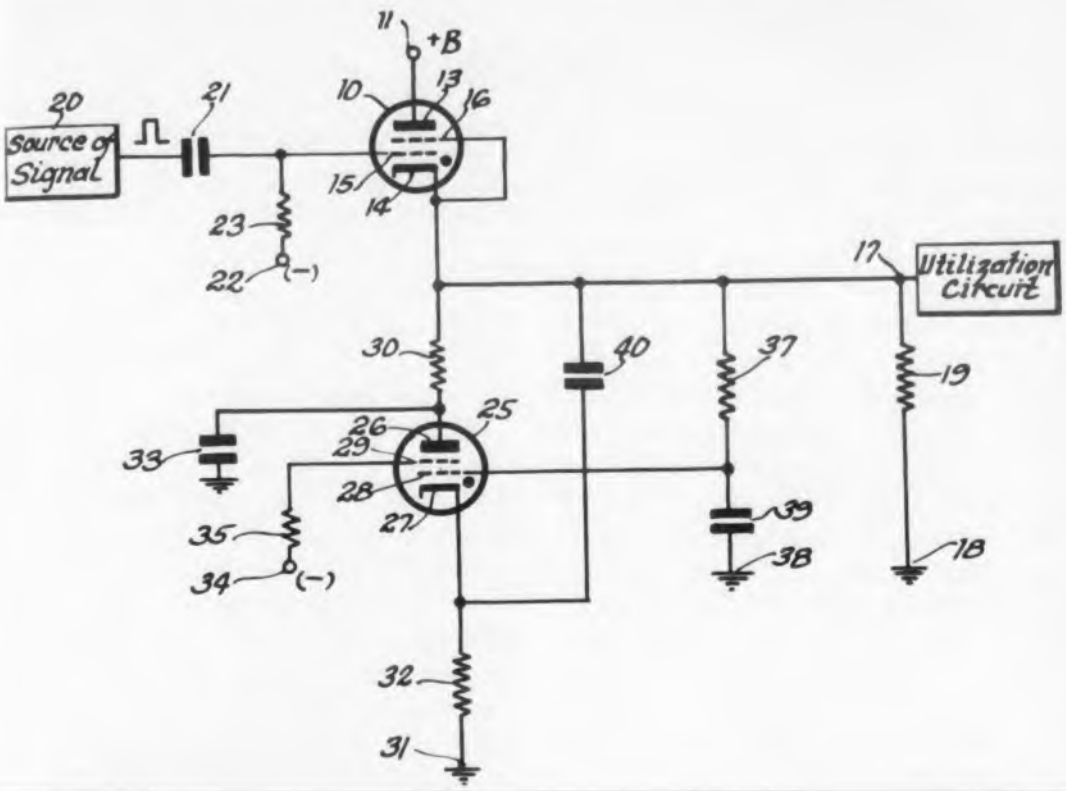
Patent No. 2,778,936. R. B. Trousdale. (Assigned to General Dynamics Corp.)

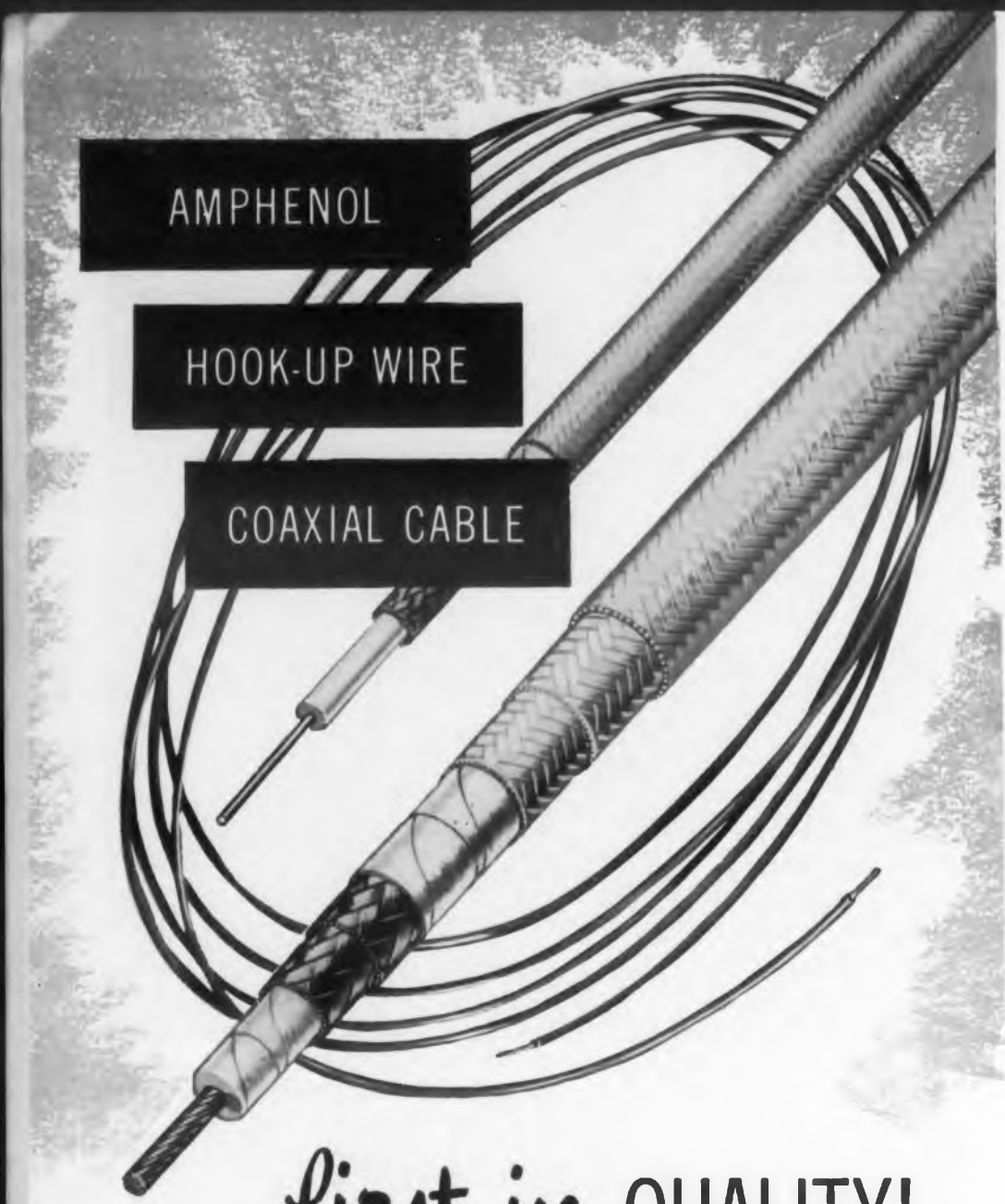
There are electronic devices which have need for a multivibrator of the type which generates a potential pulse for a utilization circuit only upon the application of an input signal to the multivibrator. If there is no input signal supplied, the multivibrator remains inactive. Such multivibrators have applicability also in gating circuits. The multivibrator described uses gas tubes so that a very high power output is obtained.

The circuit components are clear from the figure so that the operation of the multivibrator only need be described. Normally the gas tube *10* is biased non-conducting by virtue of the application of a negative potential from a source *22* on the control grid *15* of the tube *10*. The tube *25* is also rendered non-conducting by a negative biasing potential applied from the source *34* to the screen grid *29* of the gas tube *25*. Any charge on the capacitor *39* is discharged through resistors *37* and *19*. Any charge on the capacitor *40* is discharged through the resistor *19* and any charge on the capacitor *33* is discharged through resistor *30* and *19*.

If now a positive input trigger pulse from the source *20* is applied to the control grid *15* of the gas tube *10*, it becomes conducting and current flows through this tube and the resistor *19*. Since the potential drop across the tube is low, practically the entire potential of the power source is applied to the utilization circuit. Current flow through the tube *10* and resistor *19* establishes a potential across this resistor or at terminal *17*. This potential is also applied across the capacitor *40* which is charged as well as the capacitor *33* which becomes charged. This same potential is applied to the capacitor 39 so that the potential on the capacitor builds up and hence raises the potential on the control grid *28* of the second gas tube *25*. When this potential has built up enough so that the potential on the control grid overcomes the negative potential on the screen grid *39*, the tube *25* fires. The time interval between firing of the first tube *10* and the second tube *25*, and the duration of the pulse, is dependent primarily upon the time constant of resistor *37* and capacitor *39*.

Upon the firing of the second tube 25, the potential of the cathode *14* of the first gas tube *10* is boosted to a value with respect to the anode *13* such that tube *10* becomes non-conducting. Upon tube *10* becoming non-conducting, the potential on the plate of the tube *25* is removed with the result that this tube also becomes extinguished and the multivibrator is restored to its non-conducting condition. The multivibrator can be operated by a second input trigger signal from the source *20*.





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Books

Electronic Components Handbook

Keith Henney and Craig Walsh, McGraw-Hill Book Co., 327 W. 41st St., New York 36, N.Y. 244 pages, $9.00.

Resistors, capacitors, relays and switches —four principal components in all electronic circuitry—are analyzed with the intent of providing maximum reliability of the end product. All types of these four classes of components, for which a coordinated tri-service military specification has been written, are covered. In general the pattern for each component part is the same—first a general treatment of the facts that apply to all components in the class; then highly specific information that applies to several individual types—facts, figures, concepts of usage, safety factors, and general know-how on each.

The Electronic Musical Instrument Manual

Alan Douglas. Pitman Publishing Corp., 2 West 45 St., New York 36, N.Y., 250 pages, $7.50.

The relationship between electrical tone colors and their acoustic counterparts is treated from a theory and design point of view by Mr. Douglas.

Electronic circuits used in the reproduction of musical tone are described in detail. The coverage is extensive and includes all circuits commonly employed in musical instruments.

Mr. Douglas fills a void left in previous books on this subject by including British, French and German as well as American musical instruments. With wise discretion, he avoids entering into discussion on the merits or demerits of electrical tone values

as compared with "conventional" instruments. He leaves the artistic appraisal of musical sound to the individual. Treatment of the subject should prove valuable to both electronic engineers and musicians.

Principles of Engineering Heat Transfer

Warren H. Giedt. D. Van Nostrand Co., Inc., 120 Alexander Street, Princeton, N.J., 388 pages, $8.25.

The approach that Dr. Giedt uses in his new text emphasizes the basic fundamental principles of physics and thermodynamics which effect heat transfer. This treatment of the subject is by its nature rigorous but can be easily followed by the interested engineer. It gives a representative picture of the problem not often found in less detailed treatments. Special effort is made to provide a physical interpretation of the many quantities and processes involved. The three modes of heat transfer—conduction, convection and radiation—are studied separately. The treatment given to fluid flow should prove of special interest to the electrical engineer who would like to acquire a basic background in the field of fluid mechanics. Throughout the book, important historical developments and the individuals associated with them are noted.

Frequency Modulation Receivers

J. D. Jones. Philosophical Library, 15 East 40 St., New York 16, N.Y., 114 pages, $6.00.

Concentrating entirely on reception, this volume gives a stage-by-stage description of the principles and operations fm receivers. The calculation of various circuit elements is performed with basic mathematics. Only a general knowledge of the working of an ordinary broadcast receiver is assumed.

The first chapter outlines the reasons for using FM for high-quality broadcasting, together with the basic methods of frequency modulation. The second chapter gives the differences between fm and am receivers, a summary of the requirements of an FM receiver, and the considerations necessary for fm antenna. This is followed by a detailed discussion of the various sections of an fm receiver. In the final chapter the separate sections are assembled together into the complete receiver.

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What the Russians Are Writing

J. George Adashko

ELECTRICAL COMMUNICATIONS

(Contents of Elektrosvyaz' No. 12, 1956)

COUPLING NETWORKS

Coupling Devices for the Distribution and Combination of High and Low Frequency Power, A. A. L'vovich, (12 pp, 9 figs).

Coupling and decoupling (hybrid) networks must usually satisfy two requirements—minimum interaction between coupled circuits, and minimum power loss in the devices themselves. Coupling (or decoupling) is effected either by attenuator or by balanced networks; the latter are either of the resonant type and operate in a narrow frequency band, or of the transformer type, with broadband characteristics. Resonant decoupling networks were discussed by the author in the April issue of Radiotekhnika (See *ED* November 15, 1956). This article deals extensively with both common-core and separate-transformer circuits, and derives equations for the input impedances in terms of the transformer

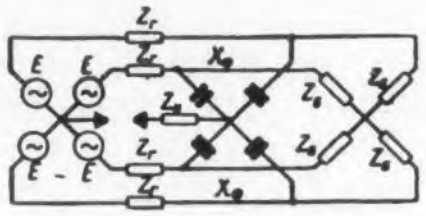


Fig. 1. Balanced narrow-band coupling network

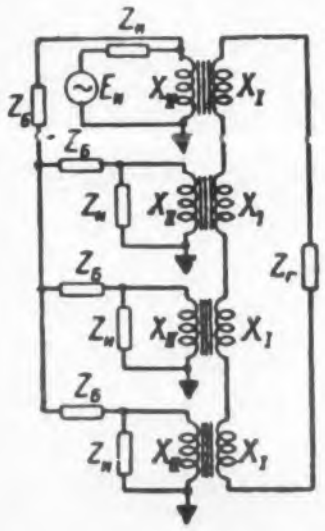


Fig. 2. Broadband coupling network with unbalance in one branch

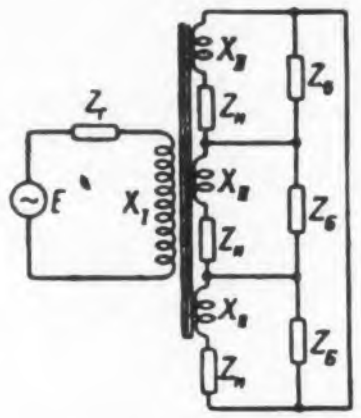


Fig. 3. Common-core coupling network

and generator parameters. Equations are given for the ballast impedances needed to compensate for variations in the parameters or in the internal voltage of one of the coupled circuits, as well as equations for the attenuation in the various branches. The effect of non-linearities and the performance of combined hybrid devices are also discussed. See Figs. 1, 2 and 3.

FREQUENCY CONTROL

Stabilization of UHF Oscillator Frequency using Crystal Harmonics, M. M. Pruzhanski; (13 pp, 14 figs).

Frequency-stabilizing crystals for uhf oscillators must be so thin that their manufacture involves considerable difficulties. These difficulties can be overcome by using thicker crystals and operating them at harmonic frequencies. However, the static capacitance of the crystal, as well as the capacitance of the circuit elements, impose substantial limitations on the use of this method. The author tells how these capacitances can be compensated for, and how to design simple yet stable bridge circuits in which the crystal can be excited with harmonics of high order. In addition, the article contains a discussion of harmonic quartz oscillators without compensation for the stray capacitances. A classification and comparative evaluation of various oscillators is also given.

Lock-In Band in Phase-Controlled AFC, V. M. Kapranov (14 pp, 18 figs).

Extensive theoretical analysis of the operation of a phase-controlled AFC system with two filter networks past the phase detector, and also with tuned circuits in the h-f portion. The lock-in band is derived analytically by piecewise linearization of the characteristic of the phase detector. Expressions are derived to relate the lock-in band with the filter parameter and with the time constant of the tuned networks. Refers to Preston-Tullier, "The Lock-In Performance of an AFC Circuit" (*Proc. IRE*, Feb. 1953), Jelonek-Celinski-Syski, "Pulling Effect in Synchronizing Systems," (*Proc. IEE*, No. 6, Part IV, 1954), and Gruen, "Theory of AFC Synchronization" (*Proc. IRE*, Aug. 1953).

MODULATION

Effect of Electron Inertia on the Form of the Modulation Characteristics of AM Transmitters, L. N. Kolesov, (9 pp, 6 figs).

This is claimed to be the first published analysis of this problem. By "modulation characteristic" is meant the plate-current vs. grid voltage or vs. plate voltage curves (for the case of grid or anode modulation, respectively). The analysis is based on the power relationships in uhf vacuum-tube oscillators, discussed by the author in Radiotekhnika No. 6, 1956 (*ED* January 1, 1957). The analysis discloses that the non-linearity of the modulation characteristics can be rectified by using combined anode and grid modulation, the latter not to exceed 20%.

RADIO ENGINEERING AND ELECTRONICS

(Contents of Radiotekhnika i Electronika No. 12, 1956)

TRANSISTOR MULTI

Point-Contact Transistor Multivibrator. K. S. Rzehvkin, M. A. Abdiukhanov, (7 pp, 6 figs, 1 table).

A steady-state analysis of the multivibrator shown in Fig. 4 was given by McDuffie (*Proc. IRE*, 1952, 40, 1487), and other modifications of the circuit are given by Anderson (*Proc. IRE*, 1952, 40, 1541) and Kramer (*Teletech*, May 1954). This article deals with the transient behavior of the circuit and gives a design procedure based on the equivalent circuit of Fig. 5.

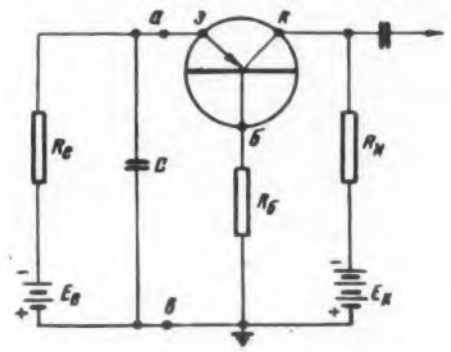


Fig. 4. Transistor multivibrator

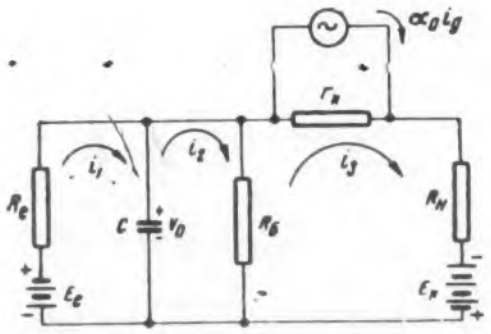


Fig. 5. Equivalent circuit of transistor multivibrator

Russian Translations

LINEAR PULSE SYSTEMS

Time and Frequency Behavior of Linear Pulse Systems with Variable Parameters, G. P. Tartakovski, (11 pp, 3 figs).

The concept of a time-dependent transfer function for pulse systems with variable parameters was introduced by the author in the November, 1956 issue of *Elektrosvyaz'* (See *ED* July 15, 1956). The time behavior is characterized by this transfer function and by another function, the pulse response of the system to a unit pulse. The time-dependent frequency characteristic is also introduced. Relationships between the various functions are derived and their use to obtain the response to an arbitrary pulse sequent is illustrated in an example.

MEASUREMENT

Setup to Measure Attenuation of H_{01} Wave in Short Waveguide Sections, Using the "Resonant-Cavity" Method. V. M. Vakhnin, T. F. Kolodina, (7 pp, 6 figs).

In the "resonant-cavity" method one determines the Q of the cavity formed by the waveguide section. The method for determining Q is based on the same compensation principle as described by Le Caine (*Proc. IRE*, 1952, 40, 155), but the engineering formulation of the principle and the test installation are different. The setup described can measure the attenuation of H_{01} waves in specimens 50 mm in diameter at 3.2 cm wavelengths. The systematic error does not exceed 3.3%, and the random error is less than 1%. The Q of the cavities measured ranged from 500 to 50,000. The method can be used for other ranges, for other modes, and for other specimen dimensions.

INSTRUMENTATION

Instrument Measuring Group Delay Time in Radio-Relay Line Apparatus, I. S. Pecherski, (7 pp, 3 figs).

The group delay time is an important factor determining the non-linear distortion in the hf channel of a long-distance radio-relay line. The article described a patented system.

OTHER ARTICLES IN THIS ISSUE

Non-Linear Properties of Bimetallic Communication Conductors Containing Ferromagnetic Materials, I. E. Efimov, (10 pp, 6 figs).

Copper-clad iron conductors are extensively used in the Soviet Union. The author derives equations for the attenuation of various harmonic components and for the current distribution over the wire cross section. The calculated values are checked against experimental data.

"Comparison of Transmission Stability of Tonal-Telegraphy Channels with Frequency and Amplitude Modulation," M. B. Rabinovich (4 pp, 2 figs). "Multilayer and Combined Shields in Communication Cables," I. I. Grodnev, K. A. Liubimov, E. F. Ukstin (9 pp, 4 figs.)

"Radio Static in the Eastern Hemisphere on February 23, 1956," K. M. Kosikov, (5 pp, 2 figs). "Present Status of the Techniques of Generating Millimeter Waves," G. I. Zhileiko, (11 pp, 8 figs, 1 table). "New Investigation of Magnetic Disturbances in the Ionosphere," V. A. Baranul'ko (4 pp, 1 table). "Comparison of Certain Noise-Rejecting Codes," E. S. Gorbunov (6 pp, 2 figs). (Deals with applications to telegraph codes.)

RADIO ENGINEERING

(Contents of Radiotekhnika No. 12, 1956)

ANTENNAS

Radiation Patterns of Surface-Wave Antennas, K. I. Grineva, (12 pp, 10 figs).

An approximate method, based on Huygens' principle, is used to calculate the radiation patterns of surface-wave antennas. The effect of attenuation on the directivity pattern of the antenna is analyzed. Theoretical data are compared with the test results. A procedure is proposed for the computation of the principal elements of surface wave antennas.

Received-to-Scattered Power Ratio in a Receiving Antenna, B. E. Kinber, (2 pp).

A brief analysis of antennas having dimensions considerably larger than a wavelength. Derives the approximate equation

$$\frac{P_{scat}}{P_{rec}} = \frac{2-\mu}{\mu}$$

where $\mu = \dfrac{\lambda^2 G f^2}{4\pi S}$ is the coefficient of utilization of the aperture surface, G the power gain, f the directivity factor, and S the aperture area of the antenna, and λ the wavelength.

CIRCUIT ANALYSIS

Calculation of the Duration of the Quasi-Equilibrium State in the Phantastron Circuit, G. I. Perov, (14 pp, 13 figs).

A straightforward procedure, beginning with plotting the characteristics for the optimum cathode resistance, formulating the initial system of equations, plotting the phase curves to obtain the circuit parameters, and finally deriving the time curves. Refers to "The Miller Integrator" by Briggs (*Electronic Engineering*, 1948, vol. XX, Nos. 246, 247, 248), and to "The Phantastron" by Roberts (*Radio-Electronic Engineering*, Nov. 1954, p. 12).

Analysis of Transients in "On-Off" Circuits, V. K. Levin, (6 pp, 3 figs, 1 table).

Circuits of this type employ as a rule a large number of tubes, and for high reliability it is essential that all stages operate without interruption for long periods of time regardless of possible changes in the parameters of the tubes, parts, or supply voltages. The customarily-employed transient analysis, based on piecewise-linear approximation of the characteristics of the non-linear elements, is too cumbersome. Since the reliability requirements thus call for a sharp emphasis on the shaping properties of the individual stages employed, it is simpler to compute the response of the individual stage to an ideal input, and to extend the analysis to a combination of such stages.

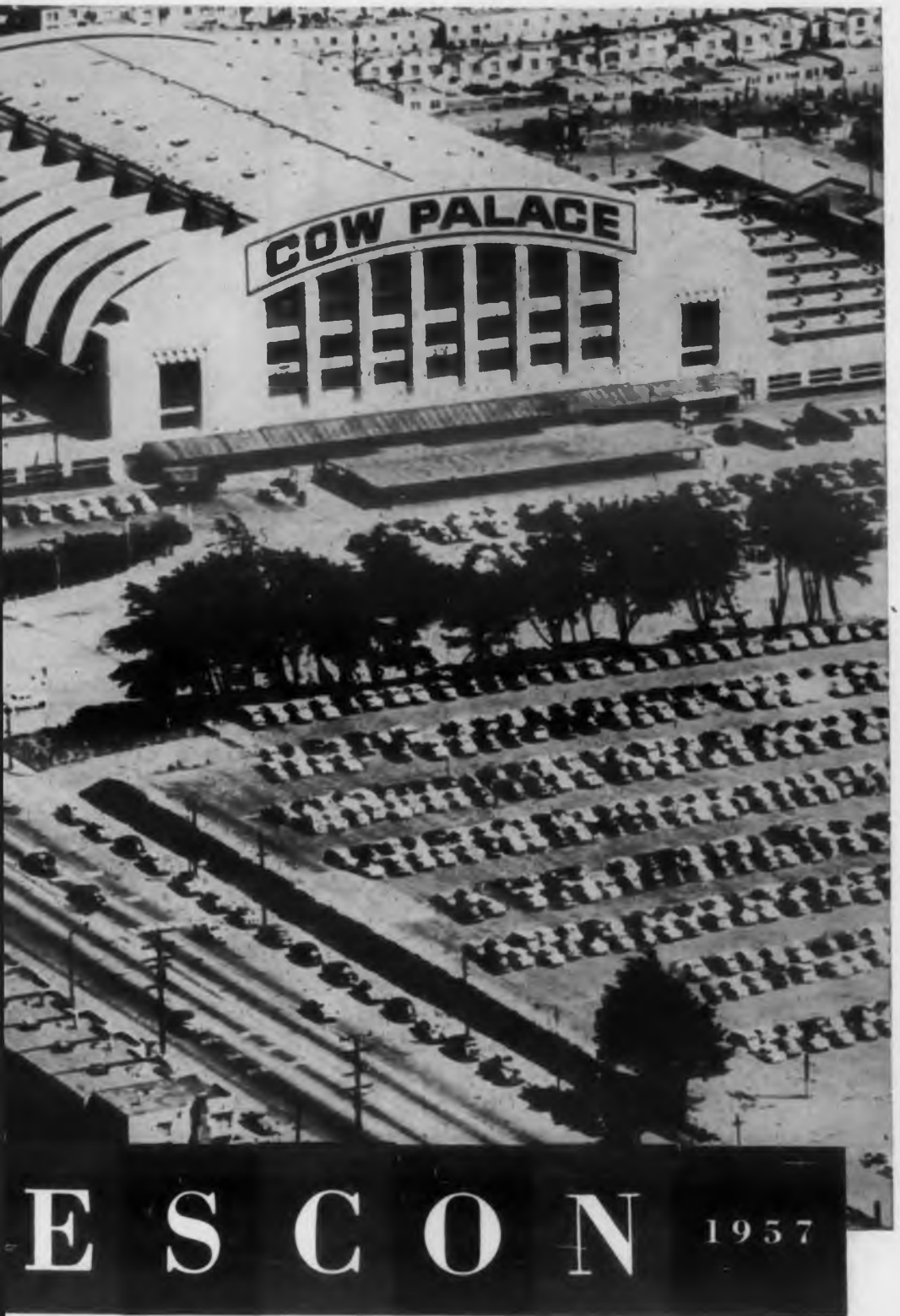
OTHER ARTICLES IN THIS ISSUE

"Concerning Excitation of Oscillations in Self-Excited Generator with a High-Q Cavity," A. P. Fedotov, B. K. Shembel' (4 pp, 2 figs). (Calculation of anti-parasitic resistance for the line connecting the generator to the cavity.) "On the Diffusion of Chemical Admixtures in Cuprous Oxide and their Influence on its Rectifying Properties," A. V. Sandulova, A. I. Andreevski, (11 pp, 9 figs, 3 tables). "Investigation of Noise of Lead-Sulfide Photoresistances," A. I. Goriachev, K. A. Iutanov, (12 pp, 14 figs, 2 tables). "Instrument for Relative Measurements of Constant Magnetic Fields," I. S. Shpigel', M. D. Raizer, E. A. Miae (5 pp, 5 figs). (Nuclear magnetic resonance is used in an instrument to measure field-intensity deviations up to 5%, at values of H on the order of 150 oersted. The accuracy of the instrument is 3-4%.)

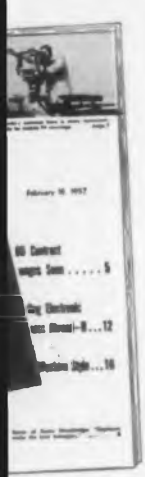
ACOUSTIC JOURNAL

(Contents of No. 4, Oct.-Dec. 1956)

None of the articles in this issue contain material normally of interest to our readers. We wish to mention, however, that a complete translation of the Acoustic Journal is now being published by the American Institute of Physics, 57 East 55th Street, New York 22, N.Y.



E S C O N 1957



An all time high in papers presented, number of exhibits, and attendance is anticipated for this year's WESCON-San Francisco August 20-23rd. If you are among the 30,000 who will be on hand – be sure to get your copy of *Electronic Daily* – this year combined with *Electronic Week*. All the last minute developments, program changes, events, meetings, as usual – PLUS – the added value of Electronic Week's regular news section. Look for your Daily, bigger and better than ever before, free at Hayden's booth at WESCON.

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German Abstract

Temperature Compensation of Oscillators

E. Brenner

SINCE inductors and capacitors have values which are temperature dependent, the frequency of tuned oscillators is also temperature dependent. The use of a reactance tube circuit together with a temperature sensitive resistive element makes it possible to compensate this effect or to synthesize oscillators which have a desired relationship between temperature and frequency.

If the ratio of the relative variation of a quantity to the temperature change is called the temperature coefficient, denoted by K, then

$K_L = (\Delta L/L)\ (1/\Delta T)$ = temp. coeff. of the inductance

$K_C = (\Delta C/C)\ (1/\Delta T)$ = temp. coeff. of the capacitance

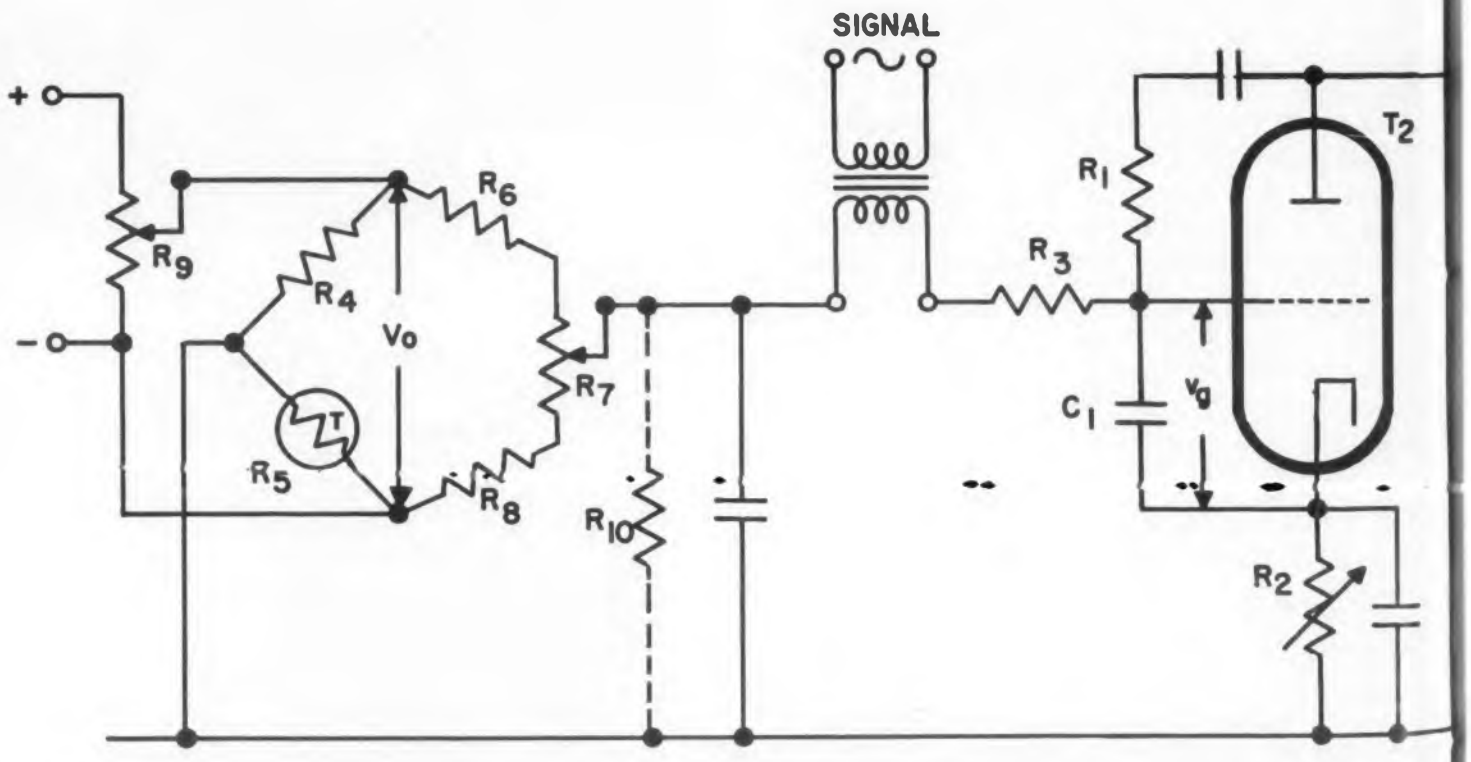
$K_f = (\Delta f/f)\ (1/\Delta T)$ = temp. coeff. of the frequency

then the temperature coefficient of the frequency is, to a very good approximation given by

$$K_f = -\frac{K_L + K_C}{2} \qquad (1)$$

In order to compensate for the effect of temperature on the frequency it is therefore necessary to set $K_L = -K_C$. The use of several condensers to form the tank capacitance to accomplish this purpose limits this compensation to particular points. With a reactance tube great flexibility is possible. The basic circuit is shown in the figure.

The tube T_1 together with the tank circuit consisting of C and L forms the oscillator. Tube T_2 together with the phase shifting circuit R_1, C_1 is the reactance tube circuit (whose inductance is approximately R_1C_1/g_m) so that the grid voltage of tube 2 controls the frequency of the oscillator.

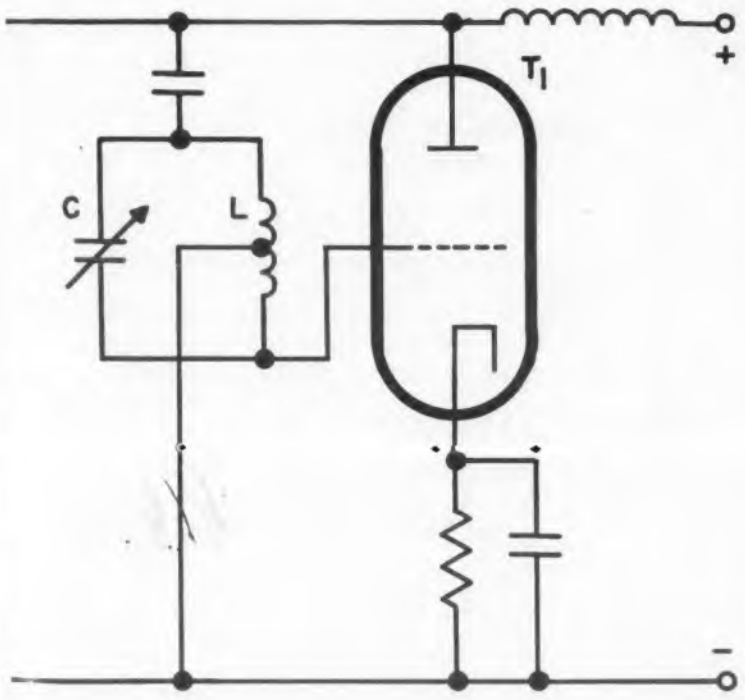


Basic temperature compensated circuit using a reactance tube.

The dc component of the grid voltage v_g is derived in part from the bridge arrangement consisting of R_4 through R_8. In this bridge one of the arms is a temperature dependent resistors (e.g. thermistor). This element is placed in the environment of the tank circuit LC so that it undergoes the same temperature changes as the tank. If the element R_5 has a negative value of temperature coefficient then the compensation results from the following sequence. If the temperature increases then R_5 decreases. Hence the grid of the reactance tube becomes more positive, its transconductance increases and the effective tank circuit inductance increases. The frequency therefore increases and this compensates for a negative value of K_t. If K_t is positive then the compensation can be achieved by reversing the bridge polarity V_o or by placing the temperature sensitive element in the R_4 arm of the bridge. Note that in the case of an FM transmitter as pictured, the reactance tube serves the dual purpose of compensation for carrier drift and frequency modulation according to signal strength.

The choice of components in the bridge depends on the value of K_t and on the curvature of the frequency-temperature curve which most oscillators exhibit. The value of R_{10} controls the curvature of the compensation scheme. In addition R_{10} must be large enough and V_o must be small enough so that the working current of the thermistor does not produce appreciable heating within it.

Various modifications of the basic circuit are also possible and are discussed in the original paper. *(Abstracted from an article by F. Mueller,* Electronische Rundschau, *Vol. 11, No. 3, March 1957, pp68-73).*

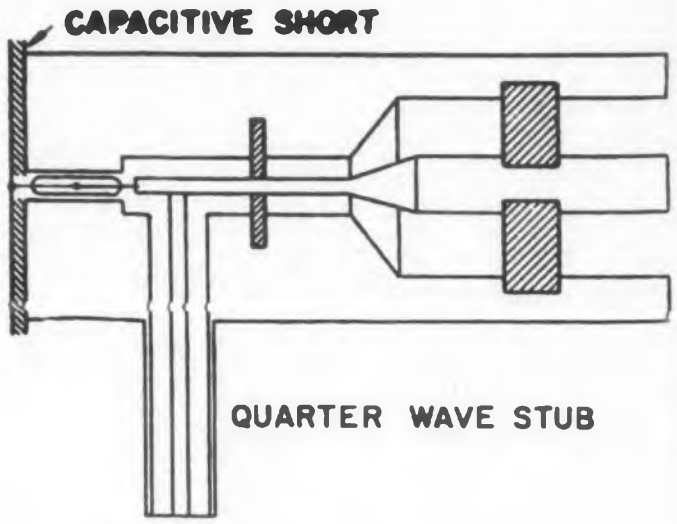


Thermistor Termination

A termination which consists of a single thermistor and an adjustable transformer can be used for power measurements in the range of wavelength of 9-16 cm or 12-20 cm, with a standing wave ratio (VSWR) of less than 1.1. The assembly contains an impedance transformer which needs little or no adjustment.

The termination is shown in the figure. The thermistor is placed in a capacitive short circuit. To avoid unnecessary series inductance the thermistor is placed in a narrow cavity whose length corresponds to the length of the thermistor, immediately before the short circuit. Using the Philips NTC Resistor type 83900 this cavity is about 12 mm long and has a diameter of about 2.5 mm. At the entrance of the cavity there is a 'jump' transition to a 70 ohm characteristic impedance (outside diameter 6.4 mm) and the transition to the conventional system (outside diameter 16mm) is accomplished with a short bevel. To obtain a second dc path a simple, adjustable quarter wave stub is used. In order to achieve simple construction, the 'jump' is overcompensated (capacitively) and the stub is placed close to it so that adjustment of the stub accomplishes simple adjustment of the compensating capacitance.

With selected thermistors a match giving VSWR values lower than 1.1 are reached in the region of wavelengths between 10 and 16 cm without adjustment of the stub while stub adjustments extend this



Thermistor termination used for power measurements in the 9-16 or 12-20 cm range, with a VSWR of less than 1.1.

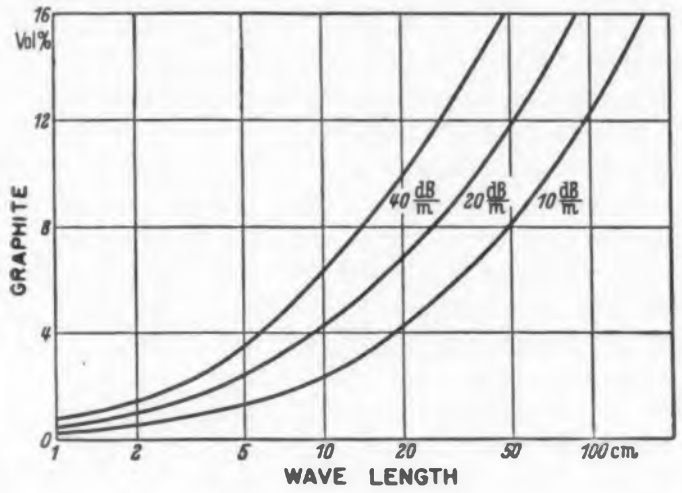
range from 9 to 17 cm with VSWR values as low as 1.05. Similar results are obtained with a second thermistor in the range 12-20 cm.

The sensitivity of the thermistors which were used in the experimental work was 11.3 to 12.3 ohms per mw, the nominal resistance was 275 ohms. The matching bridge circuit was established experimentally. Moreover the maximum measurable high frequency power for a direct reading bridge is limited to 1.5 mw because of the matching problem as well as the linearity limitation of such bridge circuits. *(Abstracted from an article by H. Rieck and F. Panniger,* Nachrichtentechnik, *Vol. 7 No. 3, March 1957, p101-104).*

Artificial Dielectrics at 3 cm

The embedding of powdered iron and graphite in paraffin results in an artificial dielectric which has large attenuation in the centimeter waveband and appears to give reasonable broad-banding.

Precise measurements of the electric and magnetic loss tangent show that in general various powders in different concentrations added to pure paraffin result in an increased dielectric constant and corresponding decreased phase velocity. Electrical losses occur for substantially increased conductivity. The powders which are reported in this paper (all mixed in paraffin) are copper, zinc, iron, bismuth, silicon, graphite, and cupric sulphide.



Curves for obtaining a prescribed attenuation showing the percent (by volume) of graphite powder in paraffin as a function of wavelength.

The figure shows an application of a graphite powder-paraffin mixture for attenuators. The graphite is 99.5 per cent carbon.

The paper reports in detail the results for the other mixtures. Theoretical justification and detailed measurements procedures are also included. *(Abstracted from an article by E. Meyer, H. J. Schmitt and H. Severin,* Zeitschrift für Angewadte Physik, *Vol. 8, No. 6, June 1956, p 257-263).*

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Abstract—German

Cylindrical Reflex Klystron

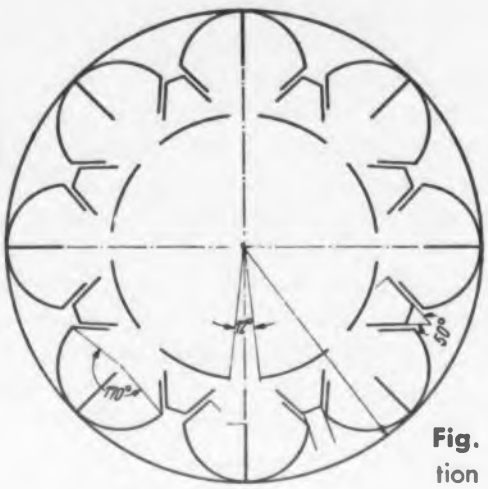

Fig. 1. Cross section of klystron.

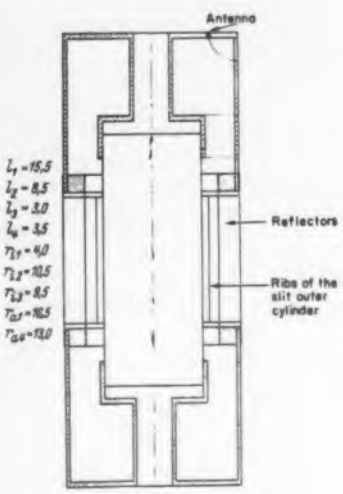

Fig. 2. Side view of klystron. Cathode and control structure have been omitted.

THIS PAPER describes the development of a cylindrical reflex klystron. In this tube the oscillatory circuit is a (tubular) *Lecher* system which can be made accessible externally through a suitable glass-seal. Consequently the frequency can be controlled through external circuitry continuously over a wide range. With conventional klystrons, the frequency is controlled through mechanical deformation of the cavity within the tube and only a few per cent control is possible. A second advantage of the new configuration lies in the higher efficiency. This improvement can be ascribed to the fact that the field at the output coupling exceeds the fields in the control region.

The new tube, which is still in the experimental stage, consists essentially of a cathode concentric with a cylindrical tube in which an electron-optical (e.g. control or grid) system is inserted. A *Lecher* system is hollow, cylindrical and has slits behind which the reflectors are located. The control structure assures that a large percentage of the emitted electrons travel through the slits in the *Lecher* system and reach the reflector space. The electrons are reflected and return through the slits of the *Lecher* cylinder, ending up at the inner surface of that cylinder.

In the experimental model (built at the *Institut fur Angewandte Physik*, Hamburg University) the Lecher system has eight slits as shown in Fig. 1. Consequently eight control sections and eight reflectors are used. While fewer sections could be used this would result in lowering the ratio of electrons which pass into the reflected region to emitted electrons.

The control structure design was carried out by use of rubber models, electrolytic trough and other methods because of its critical nature. Details for all other tube dimensions and performance are also included. Experimental results cited appear in good agreement with calculations so that further developmental work is intended. *(Abstracted from an article by J. Koch,* Zeitschrift fur Angewandte Physik, *Vol. 9, No. 1, Jan. 1957, pp 1-8).*

Frequency Control of Synchronous Converters

THE schematic diagram shown in Fig. 1 stabilizes the frequency of a rotary converter although the same procedure can in principle be used for the control of small shunt motors. The circuit of Fig. 1 depends primarily on the transformer, T, together with the frequency dependent rectification. The ac voltage is fed to the low pass filter formed by C_1 and $R_1 = R_1' + P_1$ and the high pass filter formed by R_2 and C_2. Both filter outputs are rectified and subtracted from each other; this differential output voltage (across R_3 and R_4) controls the field current of the machine through a two-stage amplifier. The choice of the operating point determines the frequency for the control voltage null.

In a typical application the field current had to be varied by 70 ma between no load and full load. The first stage of amplification (T_1) had a gain of 50 and the second stage (T_2) gave 7 ma of current change per input volt. Although the theoretical frequency deviation for these values can be shown to be 0.05 cps in 50 cps, the actual value was slightly higher but below 0.1 cps of deviation.

Because the frequency control is accomplished by field control, the output amplitude is affected and subsequent amplitude stabilization is indicated. *(Abstracted from an article by H. Voelz,* Elektronische Rundschau, *Vol. 11, No. 2, Feb. 1957, p. 55.)*

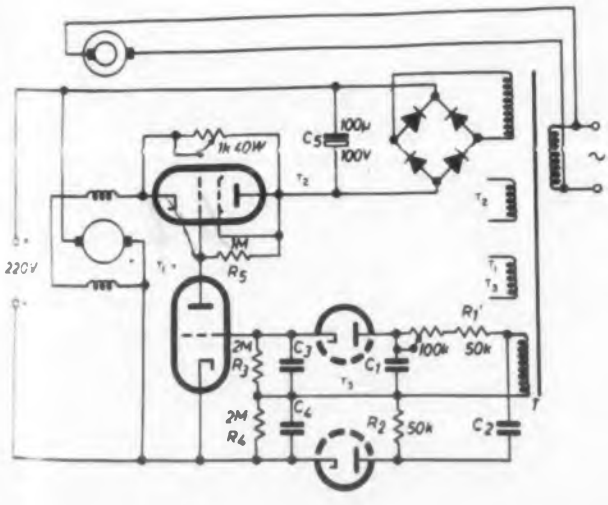

Fig. 1. Diagram of rotary converter stabilizer. P_1 is used to adjust the nominal frequency, and P_2 selects the operating point of T_2.

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CIRCLE 357 ON READER-SERVICE CARD FOR MORE INFORMATION

Abstracts

Standardization of Mu-Min Relays

NONSTANDARDIZATION of microminiature relays imposes on the user all the undesirable byproducts of a single source of supply. The electronic design engineer usually selects components on the basis of his background—he has had good results with one manufacturer's μmin relays and specifies these relays on his engineering drawings. The trouble is that all too often these particular relays have unique mounting configurations or dimensions for a given set of electrical characteristics. When a large supply of the relays is necessary due to increased production, the purchasing department finds that no other company manufactures these relays with the same mounting styles, terminal arrangements, mounting dimensions or some other characteristic, which forbids their use without a major design change. The engineer has inadvertently esablished a single source of supply.

The physical size and electrical characteristics of μmin relays make them very suitable for printed and transistorized circuit applications. This means that the demand for these relays is likely to increase far beyond that of subminiature types in the not-too-distant future. Some standardization of umin relay is obviously necessary.

Mechanical-Electrical Spec

Electrical and dimensional characteristics of five presently available μmin relays are tabulated in Fig. 1. Corresponding values for the proposed standard are included. These are adjusted so that all manufacturers can comply without undue hardship.

The proposed electrical values of Table I are similarly compiled and adjusted from those of presently available types. The proposed standards are for general-purpose relays but dry-circuit and power sensitive applications should be provided for. A reasonable target for power sensitive types would be 25 to 50 mw using a 5K coil. If this sensitivity is not compatible with the minimum vibration requirement of 30g at 5 to 2,000 cps, the power consumption could be increased up to 200 mw. In any case the power requirement should not exceed the amount absolutely necessary to meet vibration resistance characteristics.

Note that a target life of 10^6 operations has been suggested. This figure is for dry circuit applications. It is this high because the μmin relay will very likely perform other functions in addition to switching circuits. When used as a computing element any life limitation below one million operations would introduce scheduled maintenance problems.

Mounting Spec

Presently available mounting styles are shown in Fig. 2. Plug-in mountings, using a friction type receptacle, are strongly discouraged for airborne use. They are generally unsatisfactory for severe vibration environments, and the difficulty of maintaining a low contact resistance for low-current low-voltage switching is materially increased with the additional series resistance of the plug and receptable. The only disadvantage involved in stud mounting is that a damaged stud represents a non-

Manufacturer	Type	Contact Rating (Resistive)	Nom. Coil Resistance (Ohms)	Dimensions		
				A	B	C
A	SPDT	2A 28VDC	550	.796	.781	.350
B	DPDT	2A 28VDC	600	.875	.790	.350
C	DPDT	2A 28VDC	600	.875	.790	.350
D	DPDT	1A 28VDC	750	.875	.750	.350
E	DPDT	.5A 28VDC	800	.888	.800	.396
Proposed Standard	DPDT	1 Amp 28 VDC	700 Min.	.900 Max.	.800 Max.	.360 Max.

Fig. 1. Electrical and dimensional characteristics of five presently available μmin relays. A proposed standard with values adjusted as a compromise between the current five values is included.

usable relay. Side-mounting is useful where the relay is mounted on the chassis side. But when the relay is mounted on the base of the chassis, it is usually wasteful of panel space.

The end-mounted screw-fastened relay mounting is used with solder-type terminals and plug-in terminals soldered to printed circuit boards. Fig. 2 shows top-of-panel mounting but the angle brackets may be inverted for mounting on the underside of the panel. The versatility, convenience and structural advantages of this mounting should encourage its acceptance as a standard.

Assembly and Board Design

The μmin relay should be suitable for automatic assembly of printed circuits. The automatic process includes circuit printing, punching, shearing, component assembling and lead crimping, solder immersion and testing.

RETMA is proposing (RETMA Standard Proposal 459 October 1955) a standard dimensional system for automation requirements. This proposal ought to be considered in a μmin relay standard. The RETMA proposal covers a systematic series of dimensions designed to coordinate equipment design, and the necessary assembling equipment. All dimensions must be controlled, to be in increments of 0.025 in., with all spacing in multiples of four increments. This may be likened to a piece of paper ruled vertically and horizontally with the lines spaced at 0.1 in. Terminals of components and the

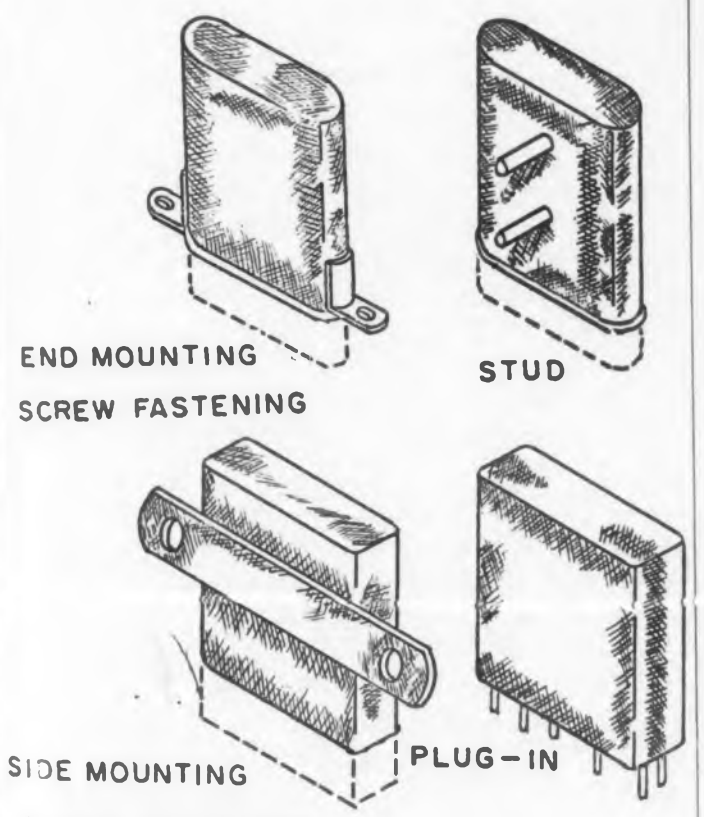
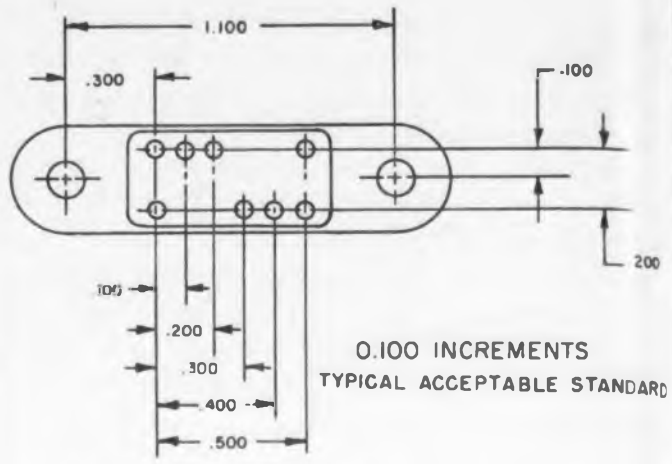


Fig. 2. Microminiature relay mounting styles offered by industry.



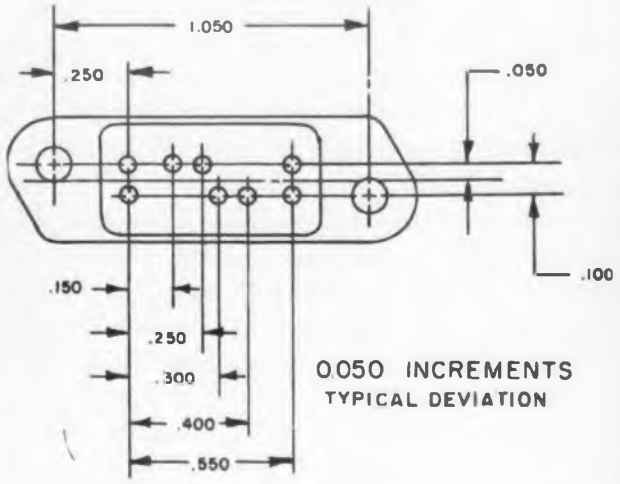


Fig. 3. Two acceptable terminal and mounting hole arrangements.

center line of mounting holes are located at the intersection of these lines. This pattern of imaginary lines is known as the "standard grid."

A grid master can be drawn, which when placed under tracing paper, establishes all possible connection points for the draftsman. Another advantage is that it permits the use of standard stops for positioning the drills for drilling the holes in the boards. Automatic programming of all drilling, punching, and crimping operations is made possible.

Terminal Spec

The tentative standard printed circuit hole diameter is 0.052 in., while the minimum diameter of plated-through holes at the present time is 0.032 in. or one-half the board thickness, whichever is greater. Each terminal hole must be completely encircled by a printed conductor at least 0.018 in. wide. The terminal should be approximately 0.012 in. smaller than the terminal hole; the minimum spacing between conductors not electrically connected is 0.032 in. although 0.05 in. is actually more desirable.

Using opposing holes with the 0.1 in. grid, it is necessary to use the 0.32 in. hole diameter to obtain a 0.018 in. encircling conductor and maintain a 0.032 in. clearance. If the two holes are placed on

a bias they will have 0.141 in. centers and use of the standard 0.052 in. hole will result in a 0.53 in.

Fig. 3 illustrates two acceptable terminal and mounting hole arrangements. For a hole diameter of 0.05 in. a terminal diameter of from 0.018 to 0.038 in. is required; while for a hole diameter of 0.032 in. a terminal diameter of from 0.015 to 0.021 in. is required.

Abstracted from A Proposal for the Standardization of Micro-Miniature Relays, *by* A. H. Maschmeyer, *a paper presented at the Fifth National Symposium on Electro-Magnetic Relays, Oklahoma 1957.*

Proposed Relay Standards

Electrical Requirements—General Purpose

Nominal coil voltage[1]	26.5 vdc
Max coil voltage[1]	32.5 vdc
Max pull-in voltage[3]	18 vdc
Max drop-out voltage[3]	14 vdc
Min coil resistance[1]	700 ohms
Max coil current (at nominal voltage)	38 ma
Max coil power (at nominal voltage)[1]	1.1 watts
Contact rating (for general purpose types)	
Resistive	Max-1a at 28 vdc or 115 vac
	Min 0.05a at 28 vdc
Inductive	Max-0.25a at 28 vdc or 115 vac
Tungsten Lamp	Max-0.25a at 28 vdc or 115 vac
Max operate time (n. o. contacts)[2]	4 msec
Max Release time (n. c. contacts)	4 msec
Max contact bounce	1 msec
Min dielectric strength	400v rms 60 cycle (sea level)
Min insulation resistance[3]	100 megohms
Max contact resistance[2]	0.05 ohms (initial)
	0.10 ohms (after life)

Mechanical and Environmental Requirements

Terminal strength	3 lbs (not appl. to plug-in type)
Temperature range	−65 to +125 C
Operating Shock	30g for 11 msec
Vibration	per detail specification (Graded)
	Target 30g 5 to 2000 cps
Life	Min—100,000 operations
	Target—1,000,000 operations
Max weight	0.5 oz

1 Measured at 25 C
2 Measured at 25 C with 26.5 vdc applied to coil
3 Measured at 125 C

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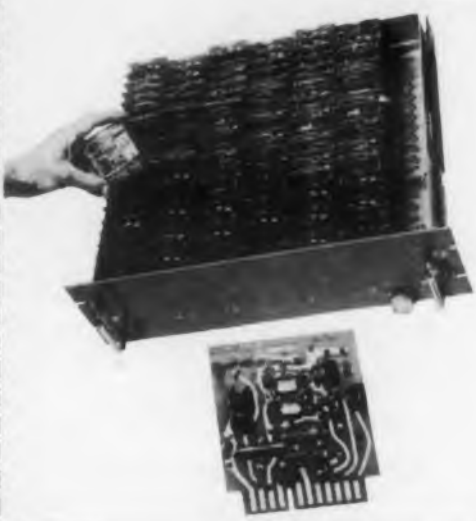

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CIRCLE 357 ON READER-SERVICE CARD FOR MORE INFORMATION

Abstract

Test System for Memory Stores

DEVELOPED to test bistable memory capacitors, determine the best operating conditions and to select matched units, this apparatus is designed to produce pulses having variable amplitude, duration and repetition rate. Pulse patterns simulating conditions prevailing in a capacitor in a particular multi-capacitor structure and with a variable amplitude ratio are produced.

The fact that a full pulse V switches the bistable capacitor in a memory structure and that a fractional pulse V/K must leave it practically unaffected, imposes very special requirements on the capacitor. The memory feature requires high retentivity; selection calls for high nonlinearity. It is these properties that are to be tested.

The following limits of operation were set:

- **Pulse amplitude.** Variable from 0 to 40 v with a 0.15 μsec rise time, and 100 ohm internal impedance pulse source
- **Pulse duration.** 0.6 to 5 μsec
- **Repetition rate** in the pulse pattern, from 1 kc to 100 kc
- **Pulse pattern.** Six different patterns can be produced. Two such patterns are shown in Fig. 1.

The block diagram of Fig 2 shows the three main sections of the test system. The *driver units* and *gates* produce the ±V and ±V/K pulses for the test circuit. Each driver unit is triggered by a coincidence gate. The gate inputs are fed by properly delayed clock pulses and the sequential gate pulses. A *sequential gate pulse generator* supplies the gate pulses in proper sequence to the gates. In Fig 2 this section consists of the variable trigger pulse generator—phantastron—and the Burroughs beam switching tube from which the gate pulses are fed in the sequence shown. Targets *1* and 2 are not used. The *test circuit* consists of the bistable capacitor under inspection and a resistance-capacitance load circuit; a *read-out* circuit is essentially an amplifier, a clipping and sampling circuit in series. The output of the read-out circuit is fed into an oscilloscope for viewing.

Operation

The pulse schedule shown in Fig. 3 shows the timing operation. Section II shows two actual test pulse patterns as they appear on the common output. Each driver unit produces a different type of pulse train such as ±V and ±V/K, the amplitudes of which can be controlled individually or simultaneously with an attenuator in the common output. Minus pulses are derived from the plate loads, and positive pulses, from the cathode resistors. The "0" gate and "1" gates of the beam switching tube are driven by variable trig-

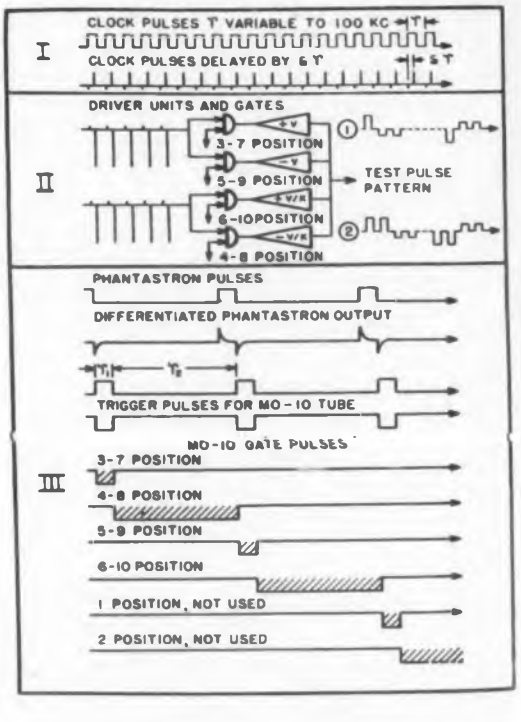

Fig. 3. Pulse schedule for the apparatus.

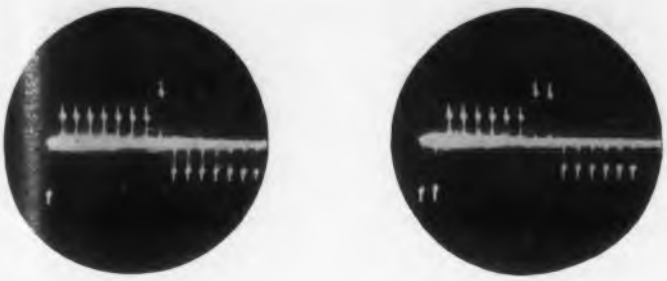

Fig. 1. Two typical pulse trains obtained from output of test apparatus.

ger pulses produced by the phantastron circuit shown in Fig. 4. With this circuit pulses may be produced with a duration of τ_1, separated from each other by a time τ_2; both times τ_1 and τ_2 are variable, as shown in Fig. 2, according to the specification set before. The phantastron pulses and the derived trigger pulses for the MO-10 tubes are shown in Fig. 3, Section III, while the MO-10 gate pulses, as they appear on the beams switching targets, are scheduled in the lower part of Section III. The input of the phantastron is driven by the undelayed clock pulses, shown in the first line of Section I, Fig. 3.

The test pulse pattern thus produced is used in the test circuit for the measurement of characteristic data of ferroelectric capacitors in general, and to storage capacitors in particular.

The study of switching transients—step function response of the ferroelectric storage capacitor—permits a determination of the most suitable load and the most useful signal, as well as measurement of switching time and current. The retentivity properties can also be examined, by determining the number of half-amplitude pulses necessary to change a given percentage of the remanent polarization caused by a full-amplitude pulse.

Abstracted from Test Apparatus for Ferroelectric Memory Condensers, Charles F. Pulvari, The Catholic University of America, PB 121204, Dept. of Commerce, Washington 25, D.C.

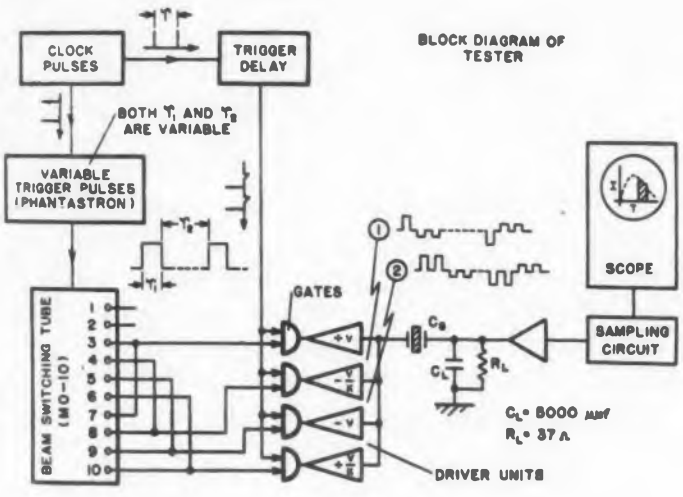

Fig. 2. Block diagram of bistable ferroelectric capacitor tester.

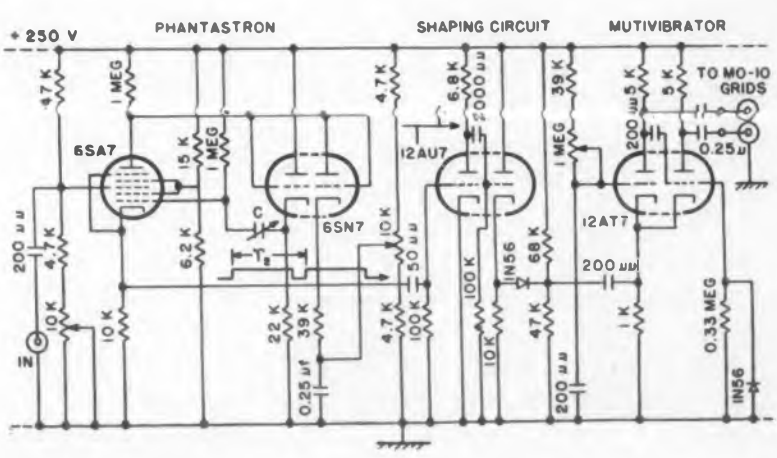

Fig. 4. Variable trigger pulse circuit.

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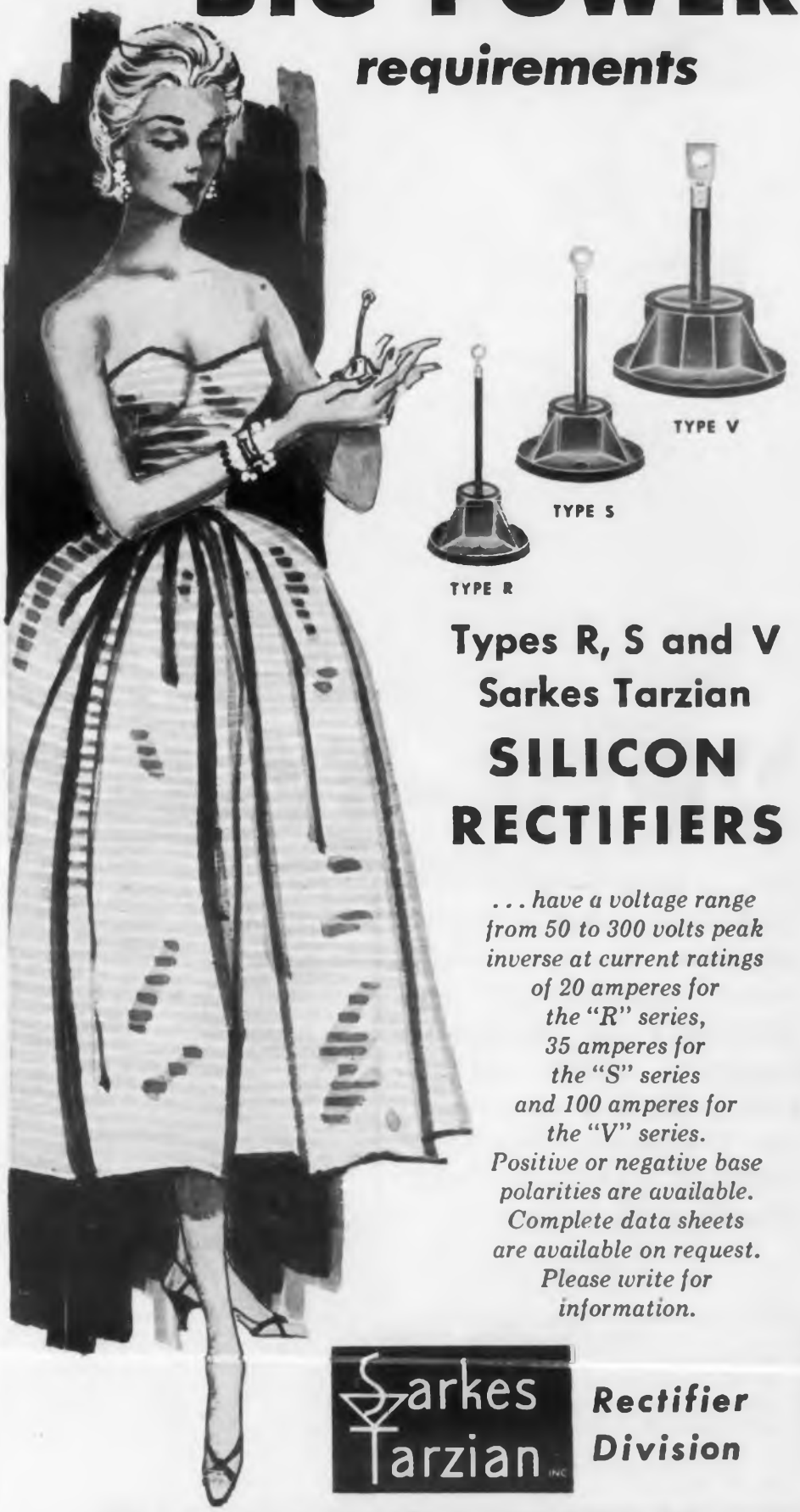

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Report Briefs

Microwave Resonance

The object of this work was to investigate resonance phenomena at microwave frequencies in gyromagnetic gaseous discharge plasmas. In particular, decaying rare-gas discharge plasmas in the presence of a magnetic field were studied at microwave frequencies of about 10,000 mc. Emphasis was placed upon the intrinsic properties of the medium which are associated with the cyclotron resonance of free electrons. *PB 123412 Resonance Phenomena at Microwave Frequencies in Gyromagnetic Gaseous Discharge Plasmas, M. Gilden and I. Goldstein, Engineering Experiment Station, Urbana, Ill. Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C. Feb. 1956, 107 pp. Microfilm $5.70, photocopy $16.80.*

Frequency Control No. 10

Contents: Piezoelectric survey of strain patterns in thickness shear quartz resonators, by K. S. Van Dyke.—Mathematical theory of vibrations of elastic plates, by R. D. Mindlin.—Structure sensitivity of quartz, by J. C. King—Frequency temperature behavior of AT-cut quartz resonators, by A. R. Chi.—Defects in quartz crystals, by G. W. Arnold, Jr.—Growth of quartz at high temperature and pressure in the United Kingdom, by L. A. Thomas.—Optimum methods for quartz synthesis, by Danforth R. Hale.—Physical chemistry of aqueous solutions, by James F. Corwin.—Aging study of quartz crystal resonators, by R. B. Belser and Walter H. Hicklin.—Some phenomena in VHF crystal units, by E. Hafner.—Crystal unit design for use in a ground station frequency standard, by A. W. Warner.—Frequency standard at low temperature, by W. D. George.—Comparison measurements on frequency standards, by J. A. Pierce.—Atomic and molecular frequency standards, by R. Dicke.—Evaluation of phase-stable oscillators for coherent communication system, by Walter K. Victor.—VHF crystal measurements, by G. K. Guttwein and D. Pochmerski.—New method for measuring the equivalent parameters of VHF quartz crystals, by Douglas W. Robertson.—High-frequency crystal filters, by D. I. Kosowsky.—Design data for crystal oscillators, by H. E. Gruen.—Long and short term frequency stability of UHF cavity-controlled oscillators, by R. E. Meek.—Precision crystal oven, by M. D. McFarlane

and Ramey B. Metz.—Crystal requirements for future military equipment, by J. M. Havel.—Transistorized 1 Mc/Sec frequency counter, by Nisson Sher and Ralph Goodwin.—Magnetron beam switching tube as a high speed frequency divider, by Hilary Moss.—Counter transfer oscillator system for microwave frequency measurements, by Alan Bagley and Dexter Hartke.—Change of state crystal ovens, by E. Snitzer and R. Strong.—Tests on hermetic enclosures of piezoelectric quartz crystals, by B. W. Schumacher.—Production procedures for VHF crystals, by R. D. Cortwright.—Manufacturing problems connected with high precision crystals, by J. M. Wolfskill.—Manufacturing problems connected with miniaturized crystals, by George K. Bistline, Jr.—Automatic X-ray sorter for crystal blanks, by Lester V. Wise. *PB 125393 Proceedings of the Tenth Annual Symposium on Frequency Control, Asbury Park, N.J., 15-16-17 May 1956. U. S. Signal Corps Eng. Labs., Ft. Monmouth, N.J. Library of Congress, Washington 25, D. C., June 1956, 597 pp, microfilm $11.10, photocopy $90.65.*

Subharmonics in Modular Supply

An analytic expression is derived for determining the amount of variation in the interpulse period when a pulse generator using saturable reactors as switching devices is being driven by an imperfect sine-wave source. This imperfect sine-wave source can very easily result from small mechanical imperfections in a multipole alternator. *PB 123404 Partial Analysis of the Effects of Subharmonics in the AC Supply Voltage of a Magnetic Modulator, Roy W. Roberts, Jr., USAF, Air Research and Development Command, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D.C., Feb. 1956, 12 pp. Microfilm $2.40, photocopy $3.30.*

Galvanic Anode Arrays

The current outputs of full-scale arrays of several anode sizes in use by the Navy for the cathodic protection of ship hulls were determined. Impress-current anodes formed from sheet steel were substituted for conventional galvanic anodes to reduce the weight and number of arrays necessary to obtain the desired information. A 1,500 ft steel sea wall located in water with a resistivity of 34 to 38 ohm-cm acted as an unpolarizable cathode. The data can be used to estimate for any galvanic material both the initial current output of an anode array, and the continuing current output against a cathode polarized to a known potential. *PB 121821 Current Voltage Relationship of Galvanic Anode Arrays in Cathodic Protection, L. J. Waldron and M. H. Peterson, U. S. Naval Research Lab, OTS, Washington 25, D.C. Feb 1957, 19 pp. $.50.*

Report Briefs

Periodic Surface Distribution

A variational method is presented which is used to calculate the energy appearing in the various diffracted orders set up when a plane wave is incident upon a periodic reflecting surface. Either the first or the second boundary condition can be so treated. A sample problem is worked showing that if the average absolute slope of the reflecting surface is small (segments of surface with large slope may be included) and if the displacement of the surface is not large compared with the wave length of the incident rediation, the formulation gives results correct to within a few per cent.

The calculation shows clearly the existence of Wood anomalies; these are discussed in some detail. Method described in report was presented in a paper before the thirty-eighth annual meeting of the Optical Society of America. *PB 124279 Variational Method for the Calculation of the Distribution of Energy Reflected from a Periodic Surface, William C. Meecham, Michigan University, Engineering Research Inst., Ann Arbor, Mich. Library of Congress, Washington 25, D. C., Nov. 1955, 29 pp, microfilm $2.70, photocopy $4.80.*

Portable Distance Measuring

Tests showed this simple—23 tubes—lightweight—25 lb—compact interrogator to be particularly adaptable to small commercial and private aircraft. Satisfactory operation was achieved with the 100-channel Model DIB distance-measuring equipment system to minimum accuracy requirements without the use of crystal-controlled rf oscillators, multistage intermediate-frequency amplifiers, magnetostrictive coders and decoders, mechanically driven ranging and indicating systems, and remote controls.

The Model DIC interrogator incorporates a number of design features not used in the Model DIB unit, yet was developed under the same specification. It contains 35 tubes and weighs 32.8 lb. The power requirement was reduced. The unit may be connected for either 13.5- or 27-v dc supplies; no additional inverter is required. An important advance in design is the introduction of direct crystal control to the interrogator. The unit exceeded specifications for accuracy of distance measurement and maximum range performance. *PB121789 Development of a Lightweight Distance-measuring Interrogator, Part 1: The Model DIB Interrogator, C. C. Trout and W. E. Haworth; PB 121787 Part 2: The Model DIC Interrogator, C. C. Trout, OTS, U. S. Dept. of Commerce, Washington 25, D.C. Dec. 1956, 34 pp. $1.00 (Part 1); Jan. 1957, 38 pp. $1.00 (Part 2.).*

Standards and Specs

Sherman H. Hubelbank

Component Parts Testing

RETMA RS-186, Standard Test Methods for Electronic Component Parts, April 1957

This standard establishes uniform methods for testing electronic component parts. The term "component part" includes basic circuit elements such as capacitors, resistors, switches, relays, transformers, and jacks. Specifically excluded are material and equipment test methods. These test methods provide a number of test conditions of varying degrees of severity so that appropriate test conditions may be selected for any component. Five test methods are specified in this standard. Method 1 covers humidity (steady state) and is intended to evaluate the effect of absorption and diffusion of moisture and moisture vapor on materials and parts. The test is an artificial-environmental test, accelerated to shorten the testing time. Within its limits, this test is of value in determining the resistance of the material or component parts to the inroads of moisture. The test should not be considered as a tropical test for all types of materials or components.

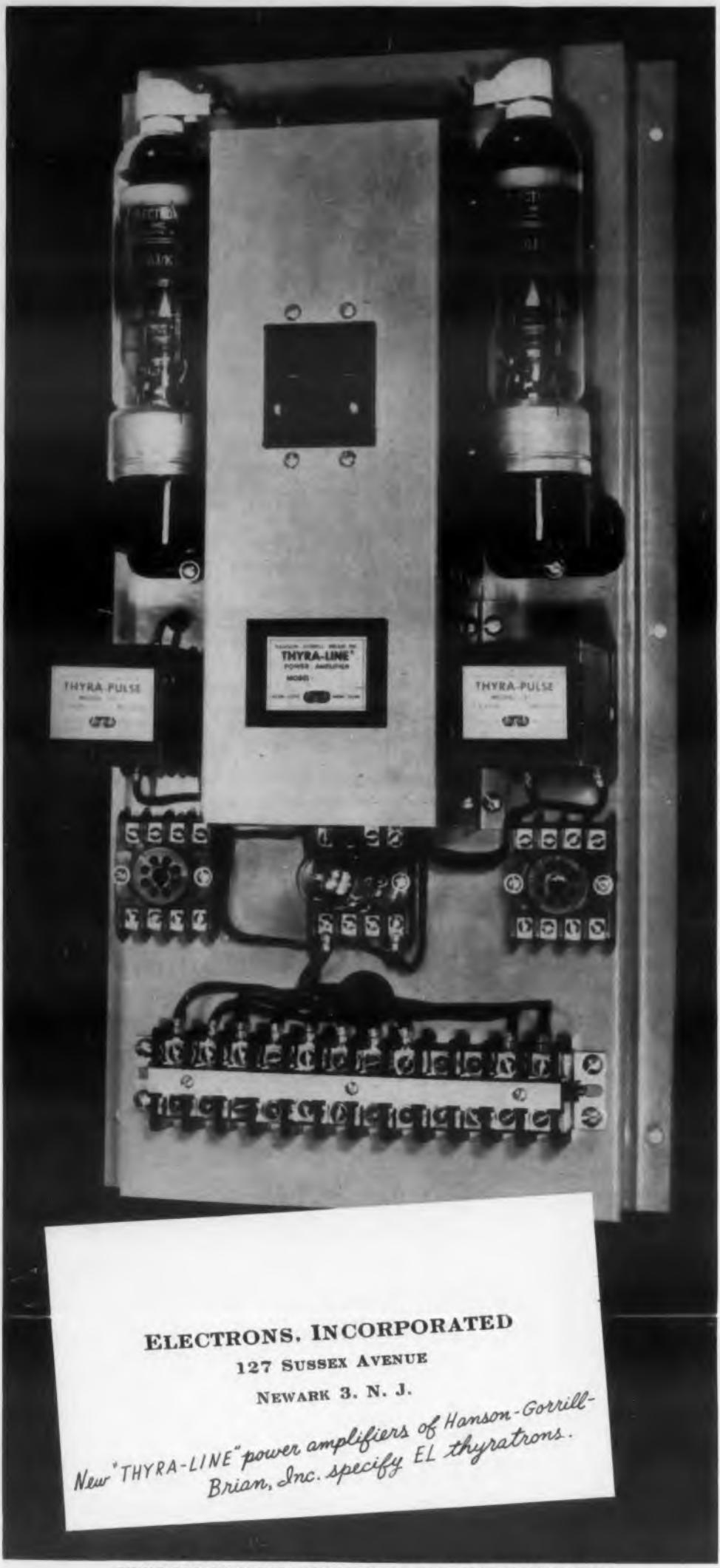
Method 2 covers moisture resistance (cycling) and is intended to evaluate in an accelerated manner the resistance of component parts and constituent materials to the deterioration resulting from high humidity and heat conditions typical of tropical environments. This test differs from the steady-state humidity test and derives added effectiveness from temperature cycling. This provides alternate periods of condensation and drying which is essential to the development of the corrosion process and in addition produces a "breathing" of moisture vapor into partially-sealed containers. The test provides a time during which optional low temperature or vibration subcycles may be inserted for revealing the otherwise undiscernible evidences of deterioration.

Method 3 covers humidity (steady state) and is intended to evaluate the effect of absorption and diffusion of moisture and moisture vapor on materials or parts. The test is an artificial-environmental and is severely accelerated to shorten testing time. This test is more severe than the Method 1 test. This test is of value in determining the resistance of the ma-

terial or component parts to the inroads of moisture however, it should not be considered as a tropical test for all types of materials or component parts.

Method 4 covers dielectric testing (withstanding voltage) and is intended to determine the ability of component parts or materials to withstand a potential at sea level or at a specified altitude. Although this test is often called a voltage breakdown test, or dielectric strength test, the intention is not to cause a breakdown of the insulation or to detect corona, but to determine whether insulation materials and spacings in the component part are adequate. If a specimen is faulty in these respects, application of the test voltage will result in either an air, surface, or puncture discharge.

Method 5 covers salt spray (corrosion) testing and is intended to determine the adequacy of protective coatings or finishes. It has been widely used to evaluate the resistance of metals to corrosion in marine service or in exposed shore locations. This test is useful as a practical qualitive check on the application of metallic and other finishes to metallic surfaces. The salt-spray test is an accelerated corrosion test and is a compromise since the test conditioning bears relation to the natural environment only to the extent possible within the defined test procedure.



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Power Transformers

RETMA RS-180, Power Transformers for Electronic Equipment

Iron core, power transformers up to 10kva for use in electronic equipment where long life, reliability, and continuity of operation is essential, are covered by this standard. Complete purchase specs have been established. Performance standards, performance tests, and moisture-resistance tests are specified. Minimum marking information has been established. Corona has been defined, and corona measurements have been specified. Standard dc supply voltages at the filter output are listed. This standard is a revision of TR-102-B and is available from the Engineering Department, Radio-Electronics-Television Manufacturers Association, 11 West 42nd Street, New York 36, N.Y. for 50 cents each.

Preferred Numbers

ISO Recommendation R17, Guide to the Use of Preferred Numbers and of Series of Preferred Numbers

Five series of numbers in geometrical progression, offering a logical increase in size, are provided in this guide. Explained in this guide are the basis on which these standard series have been developed, the characteristics of the geometrical progression, how to put the preferred numbers into use, and how calculations should be made in using the preferred numbers. Copies are available from ASA, 70 East 45 Street, New York 17, N.Y. for $1.20 each.

Drive Pulleys

RETMA RS-184, Drive Pulleys, April 1957

Four styles of drive pulleys have been established by this standard. The maximum O.D. pulley, the groove diameter, the groove width, the pulley thickness, and the string travel are specified. The total weave of the pulleys, the concentricity of the pulley groove, the thickness of the cord opening, and the type of finish are also specified. This standard revises REC-102-A, and is available from the Engineering Department, Radio-Electronics-Television Manufacturers Association, 11 West 42nd Street, New York 36, N.Y., for 25 cents per copy.

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ADVERTISING INDEX

August 1, 1957

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1944 RCA provided the military services with the first Image Orthicon—a supersensitive camera tube.

1946 RCA introduced the first Image Orthicon (the camera tube that revolutionized TV camera techniques)—for studio and outdoor pickup.

1952 RCA produced the first Color Image Orthicon—for use in compatible color television cameras.

1952 RCA announced the first commercial Vidicon—for industrial TV.

1955 RCA announced a developmental ½-inch Vidicon—for miniature portable TV cameras.

1956 RCA designed and built a low-light-level Image Orthicon—a new camera tube especially useful for "*night*" military operations.

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