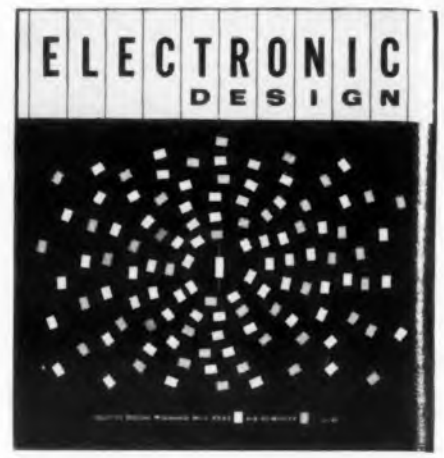
ELECTRONIC DESIGN

OCTOBER 14, 1959

Improved Resistor Withstands More HEAT and HUMIDITY . . . p. 62

HIGHLIGHTS OF ISSUE



CONTENTS FOR OCTOBER 14, 1959 VOL. 7 NUMBER 21

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

NEWS

EDITORIAL

FEATURES

DEPARTMENTS

STAFF

EDITOR: Edward E. Grazda; *MANAGING EDITOR:* J. A. Lippke; *ASSOCIATE EDITORS:* L. D. Shergalis, G. H. Rostky, H. Bierman, R. N. DeFloria; *ASSISTANT EDITORS:* T. E. Mount, D. S. Viebig, L. N. Tolopko, A. Corneretto, A. Caprioglio; *CONTRIBUTING EDITORS:* S. H. Hubelbank, E. Brenner, B. Bernstein, E. Kahn, B. B. Daien; *EDITORIAL ASSISTANTS:* M. S. Buckley, A. M. Sickler, A. R. Abramoff, R. N. Ross, R. M. Moore; *ART DIRECTOR:* R. A. Schulze; *TECHNICAL ILLUSTRATOR:* B. L. Armstrong; *ART ASSISTANTS:* C. Bank, D. Ramos; *PRODUCTION MANAGER:* T. V. Sedita; *ASST. PRODUCTION MANAGER:* H. De Polo; *PRODUCTION ASSISTANTS:* M. C. Alexich, C. E. Moodhe; *CIRCULATION MANAGER:* N. M. Elston; *ASST. CIRCULATION MANAGER:* A. C. Lovett; *READER-SERVICE* J. E. Medina

CO-PUBLISHERS

T. Richard Gascoigne

James S. Mulholland, Jr.

ADVERTISING REPRESENTATIVES

ADVERTISING SALES MANAGER: Bryce Gray, Jr.: *NEW YORK:* Owen A. Kean, Robert W. Gascoigne, Richard Parker, Blair McClenachan, James P. Quinn, Ralph Richardson, D. J. Liska *830 Third Avenue, PLaza 1-5530; CHICAGO:* Thomas P. Kavooras, Berry Conner, Jr., Fred T. Bruce *664 N. Michigan Avenue, SUperior 1-8054; LOS ANGELES:* Robert E. Ahrensdorf, John V. Quillman, Stanley I. Ehrenclou *3275 Wilshire Blvd., DUnkirk 2-7337; SOUTHEASTERN:* Lucien Neff *15 Castle Harbor Isle, Fort Lauderdale, Florida, LOgan 6-5656.*

SUBSCRIPTION POLICY

ELECTRONIC DESIGN is circulated only to qualified electronic design engineers of U. S. manufacturing companies, industrial consultants, and government agencies. If design for manufacturing is your responsibility, you qualify for subscription without charge provided you send us the following information on your company's letterhead: Your name and engineering title, your company's main products, and description of your design duties. The letter must be signed by you personally.

ANY ADDRESS CHANGES FOR OLD SUBSCRIBERS NECESSITATE A RESTATEMENT OF THESE QUALIFICATIONS. Subscription rate for non-qualified subscribers—$25.00 per year U.S.A., $30.00 per year all other countries. Single copy $1.50.

NEP BPA

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

The Bettmann Archive

ELECTRONIC DESIGN
NEWS

Soviet Electronic Design Decentralizing

FLAWS IN the Soviet electronic R & D setup are leading to decentralized designing, a major change for the U.S.S.R.'s electronic industry.

Reasons for the decentralization reflect a large part of the Soviet electronics picture.

Design Center Is Moscow

Until recently, electronic equipment, non-military especially, was designed centrally, in the Moscow laboratories of the State Committee on Radio and Electronics. This work falls into two general types.

The first is conducted by extremely able, well-trained academicians with complete freedom to choose their projects and requisition equipment. Theoretical work dominates but often turns practical when made part of specific product development.

Practical work is the second type—turning theoretical designs into breadboard models, models into preproduction units, and speculation into test data.

Theoretical work is reviewed by a product planning group, which decides whether a project will be followed up. When the decision is yes, a design is prepared for bench models and the product is assigned to a specific plant—with quotas.

Though the academicians are of outstanding quality and capable of top work, to the visiting Americans the other "designers" seemed equivalent to U.S. technicians.

This, coupled with the lack of plant experience by either academicians or technicians often result in designs that are not suited to production. In the past, the equipment was produced anyway, causing production difficulties, waste and poor performance. Needless cost and low reliability were the two worst results.

Now, plants assigned to manufacture specific products change designs sent from Moscow if they feel improvements can be made. Some plants, with a reputation for modifying all designs that come their way, have, in effect, an in-plant design staff with production experience.

These production engineers, as well as the central designers, have complete and prompt access to the latest foreign publications, an added impetus to local design. (Committee members were uniformly impressed with the speed with which the Soviet electronic industry became thoroughly aware of the newest American developments.)

Another cause of Soviet design decentralization is the competition developing among individual production plants. In some types of consumer electronics, particularly radio and TV sets, supply is greater than demand. The plants are starting to do what they can to earn a reputation for quality work and to keep their production lines going. Local redesigning to avoid production difficulties and to increase reliability is part of this effort.

A third reason for the drift from Moscow is the government's current policy of general economic decentralization and strengthening of the country's 104 economic divisions.

District planners are trying to draw as much work as possible into their areas, and to minimize supply-demand imbalances. Manufacture of new products and promotion of increased consumption of products already manufactured locally are two ways this is being done. To help, time-payment purchases and advertising are being instituted.

Designers Badly Handicapped

Soviet designers, whether in Moscow or in distant plants, work under handicaps that would discourage their American counterparts. Some of restricting influences on design are:

- The narrow range of available parts. This is a result of stringent State part standardization and is the most limiting condition.

This article . . .

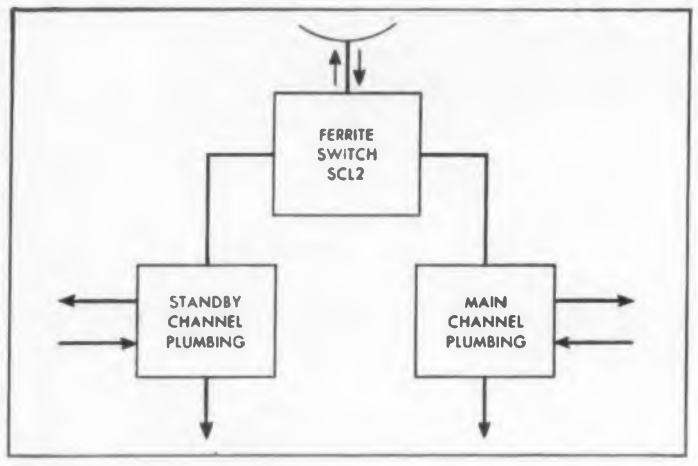
. . . is a result of interviews conducted by ELECTRONIC DESIGN with members of a six-man electronic industry team that recently returned from an 8000-mile, three-week visit to the Soviet Union.

The group, which was sponsored by the State Department and the Electronics Industries Asociation prepared a confidential report and gave a brief review of the trip at the last quarterly meeting of the EIA.

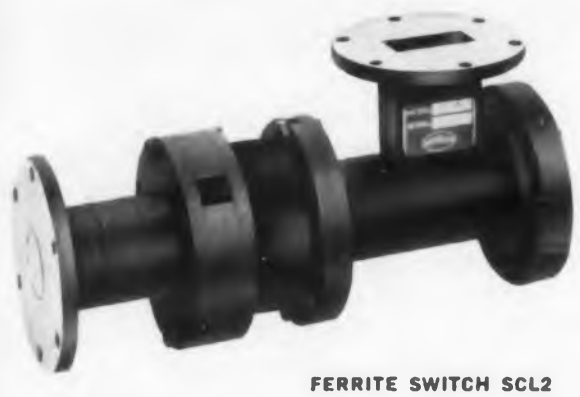
Chairman of the team was Ray Ellis, of Raytheon. The other members were semiconductor specialists Conrad Zierdt of GE; Julian Sprague, of Sprague Electric; telephone expert Imre Molnar, of General Telephone Labs; economist Frank Mansfield, of Sylvania; and Charles Marsden of NBS.

In three weeks the group visited 16 Soviet establishments and talked with 120 top electronics men.

THREE-POSITION FERRITE SWITCH FOR C-BAND



TYPICAL MICROWAVE CIRCUIT in which Raytheon ferrite switch is now being used. Switch has three positions: antenna to main channel; antenna to standby channel; antenna to both channels simultaneously.



FERRITE SWITCH SCL2

FERRITE SWITCH IS ACTIVATED when fault is detected in sensing unit. Receiver fault causes switch to transfer to intermediate position for comparison of main and standby. Normal baseband receiver noise and pilot tone allow switch to complete switchover.

ADVANCED SWITCHOVER PROTECTION PERMITS MORE RAPID AND FLEXIBLE OPERATION THAN EVER BEFORE

A completely new ferrite switch has just been introduced by Raytheon. The device, which is controlled by a specially designed switchover unit, provides foolproof switchover protection. It has three positions, connecting:

1. antenna to main channel
2. antenna to standby channel
3. antenna to both channels simultaneously

In the third position, the received signal is divided equally between the arms feeding the main and standby receivers.

This allows an actual comparison of the two receiver signals before switching and eliminates the need for complex and unreliable signal injection systems.

To learn more about this significant development or other important Raytheon advances in microwave ferrite devices, please write to the address below stating your particular area of interest.

TYPICAL SPECIFICATIONS

	SCL2
Frequency range (mc)	*6,575-6,875*
Isolation, minimum	*20db*
Isolation, maximum	*30db*
Insertion loss, minimum	*0.5db*
Insertion loss, maximum	*0.8db*
Power, average	*10 watts*
Power, peak	*1 kw*
VSWR, minimum	*1.02*
VSWR, maximum	*1.28*
Type of switch	*SPDT reciprocal*
Coil current	*400 ma*
Coil resistance	*60 ohms*
Length	*8 in.*
Waveguide	*RG-50/U**

*Mates with

RAYTHEON COMPANY
SPECIAL MICROWAVE DEVICES
WALTHAM 54, MASSACHUSETTS

RAYTHEON *Excellence in Electronics*

CIRCLE 4 ON READER-SERVICE CARD

NEWS

■ Parts are often of ancient style. Soviet part designs were frequently frozen at illogical points along the march of technology.

■ Parts are overdesigned in the least desirable ways. They seem designed to resist twisting, bending and other stresses unlikely in their environments. They are often bulky, heavy and wasteful of material.

■ Parts and components have low reliability. For the Soviets, reliability efforts mean over designing in the first place, then adjusting the manufacturing formula when components are returned for repairs. In one component plant visited, finished units were not tested. In another, no parts were given life tests. In none of the plants toured was there a snow-white operation resembling those in this country. The impurity problem is compounded by low-quality materials in general electronic use and the complete absence of plant maintenance programs, at least in the facilities visited. Resistors, however, are good, even though one plant was using a production process identical in every detail with one used by IRC twenty years ago.

But under a current drive steps are being taken to raise the low reliability of Soviet products. Reliability is so low, one team member said, 70 per cent of consumer products need repairs during their six-month warranty. Heavy in-line testing is being instituted and very little printed circuitry is being used.

■ The absence of an electronic service industry means equipment goes back to the factory for repairs, though burned-out crt's are not rebuilt. The government service organization was described as completely inadequate. And because of poor servicing, designers are under pressure from plant managers to provide designs that will not mar the reputations of the plants nor those of the plant managers, who keep their positions by producing to expectations.

■ The most unpredictable design influence is the Soviet state and its bureaucracy. Large-scale work in color TV underway for some time in the U.S.S.R. is now relatively marking time while a choice is being made between the centrally designed three-color dot-sequential system using a shadow-mask tube and a similar system designed by a Leningrad group. The choice will not be made until after tests are conducted on complete installations of both systems in both cities.

Another example of bureaucracy, Soviet style, is the attention being focused on early-model surface-barrier transistors, now considered outdated in the West. They are being produced in quantity in the U.S.S.R. Why? Once, in a routine report on a Philadelphia conference paper, specific reliability figures happened to be mentioned

for two of many transistor types being discussed. The early surface-barrier type had the better of the two figures, and that was enough for the Soviet planners.

■ Another important design factor is the relatively late Soviet technological start. For instance, there are not enough microwave and coaxial links for both civilian and military use. TV and telephone designers must design for a present net of only 1500 miles of operating connections. By 1965 there will be only 45,000 miles—if goals are met. There are 200,000 miles of such links in the U.S.

Other Observations Revealing

■ Engineers engaged in direct design work in the Soviet Union publish very little. Most papers are produced by academicians reporting theoretical developments. One Russian commented on the vast amount of design material published in the U.S., wondering how engineers here are able to choose among promising ideas.

■ The group visited 16 facilities carefully screened to reveal nothing of military interest. The plants were of old design and were inefficient. The touring group concluded that American electronic workers were two-and-a-half to three times more productive than Soviet workers and earned four times as much, with fringe benefits included.

■ Not a single computer was seen, nor were there any evidences of computer availability to designers and production engineers, apart from the fact that the Soviet's large transistor output could not be accounted for by requirements of the industries observed.

■ There is a long lag in electronics between development of a new idea and its exploitation. Quality of electronic research is of high quality and great depth. The design academy is able to reproduce fairly rapidly samples of new devices from descriptions, when ordered to by the planners. But because the technology of engineering and production is roughly five years behind that of the U.S., new developments find their way relatively slowly into the Soviet economy.

■ Most designs are outright copies of Western designs. Some are developed, as mentioned, from descriptions, some from examination of purchased equipment, and some, the U.S. observers surmise, are made from parts and equipment obtained "informally."

■ In the 16 establishments visited, only two production processes were of any interest to the Americans: a subminiature-tube operation and a process for making telephone relay springs.

■ Soviet design and production methods were judged to cost consumers 40 per cent more than necessary. And quality, in general, was about 25 per cent less than that usual in the U. S. ■ ■

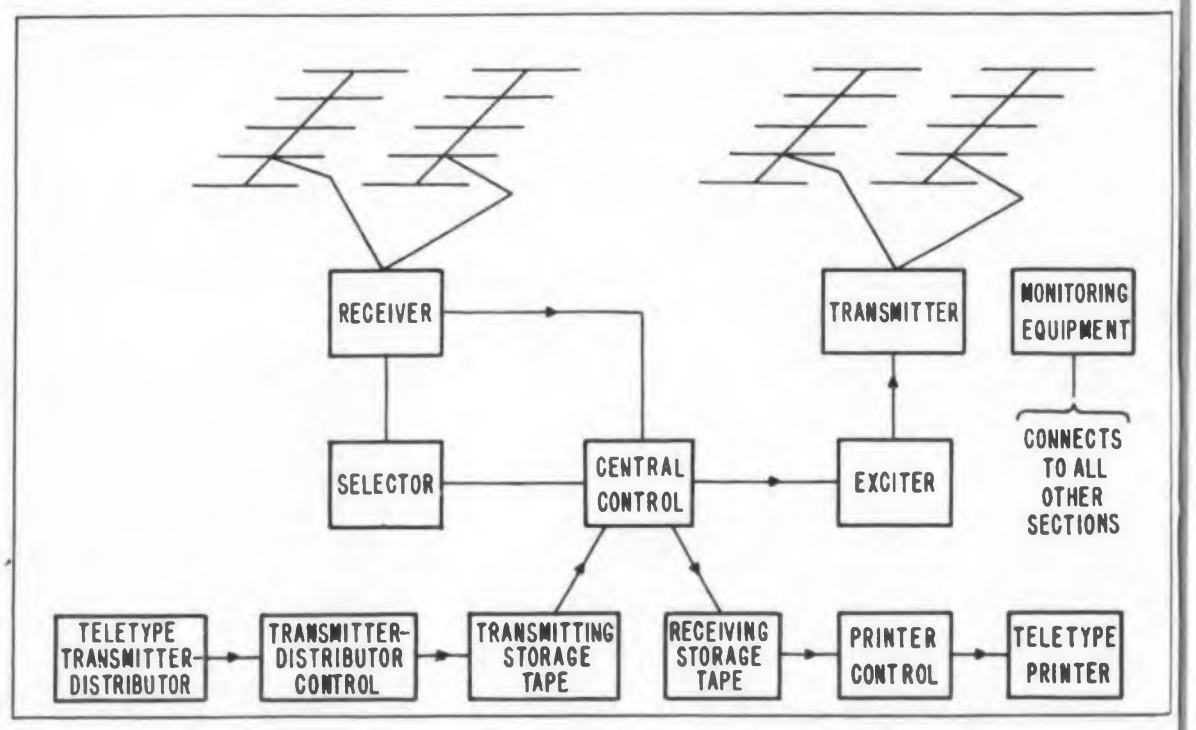
Automatic message-handling equipment helped the NBS meteor burst communications system achieve an error rate of only 0.004 per cent at 30 wpm during a three-week period of good atmospheric conditions.

Meteor-Burst System Transmits at 4800 WPM

AN EXPERIMENTAL meteor-burst communication system developed by the National Bureau of Standards has sent messages at speeds up to 4800 wpm with error rates as low as 0.004 per cent.

The system is part of an Air Force sponsored project to determine the feasibility of long-distance vhf communications based on reflections from meteor trails. Results so far indicate that intermittent meteor-burst communication can compete effectively with other long-distance systems, and that they are relatively free from ionospheric disturbances that affect long-distance hf communication.

The system's control equipment deter-



System uses commercial transmitters and twin arrays of Yagi antennas.

mines when conditions are acceptable for transmission of messages. This decision is based on (1) the amplitude-versus-time characteristics of the received signal, (2) the modulation of the received signal, (3) the availability of storage space for incoming messages, and (4) the availability of messages for transmission. In order to measure attenuation on the two oppositely directed radio paths, the transmitters at both stations are kept in continuous service.

Trails Detected in Milliseconds

With both transmitters on the air, the system can detect the presence of a suitably located meteor trail within a few thousandths of a second. When either station "hears" a signal reflected by a meteor trail, it shifts its transmitting frequency, thus indicating to the other its readiness to transmit messages. After both stations have received this signal, message transmission is initiated.

Should either terminal run out of magnetic tape or should the signal strength fall too low, the two stations "converse" with each other and agree to stop transmission temporarily.

At the end of a meteor burst, signal fading or obvious error in received messages causes the system to stop transmitting, and the transmitters return to their original frequency. Under normal conditions, the command to start and stop and associated events are so timed that no messages are lost.

The experimental meteor burst system was designed for a study of two-way communications over paths from 400 to 1200 miles in length.

The system's receivers are double-conversion superheterodynes. Each contains an FM detector for messages and an AM detector to measure a signal strength. With each change in speed-up ratio, the transmitter frequency shift is changed. Then it becomes necessary to match this change by a change in the electromechanical filter in the receiver. This filter sets the receiver pass

band to correspond to the modulation. Another filter, between the antenna and the receiver, rejects signals from the system's adjacent transmitter—an unavoidable source of disturbance because of its proximity to the receiver. With this filter (a quarter-wavelength resonant-line tuned circuit), it is possible to operate with only 480 kc difference between receiver and transmitter frequencies.

The transmitters, commercial units intended for base-station use in mobile communication service, are operated at 49 mc with a power output of 2 kw. Frequency control is by a direct current-coupled, frequency-modulated exciter. The deviation of the transmitter is adjustable so as to provide shifts of 800, 2000, 3700, and 5000 cps at the output frequency.

The antenna system is composed of two arrays, each consisting of two five-element Yagi antennas. To reduce the effect of a strong local transmitter on the sensitive receiving system, one array is always used for receiving, the other for transmitting. Also, contrary to the usual convention, the two antennas of each pair are fed out of phase to produce a split-beam pattern with a null on the great circle connecting the stations. This arrangement made it possible to aim the signals at directions most suited to the meteor burst path, inasmuch as most meteoric propagation takes place on either side of the great circle path. The antenna design is based on meteoric ionization at an elevation of 110 kilometers.

Performance Varies With Conditions

Because of the complexity and high-speed operation of the system, automatic monitoring devices were used to analyze its performance. This was found to vary considerably with equipment settings and atmospheric conditions. The characteristics of the signals received during the experiment indicate that it is advantageous to operate intermittently at transmission speeds higher than the average signalling rate.

From the data on speed-up ratios, it appears that the system operates most effectively at 2400 wpm (40 times normal teletype speed). With this speed and a suitable operating threshold setting, a daily average of 40 wpm may be expected at a character error rate of 0.35 per cent. Higher transmission rates should give better results if improved control systems and rapid-access storage facilities can be substituted. At lower transmission rates, noise interference is a greater factor because the signals have to remain error-free for a longer period for transmissions to be successfully ended. This results in an increase in the probability of error.

What Meteor-Burst Systems Mean to Designers

Meteor-burst systems require a new approach to message handling and control. The systems must operate intermittently at very high speed, and must go into operation automatically when a suitable meteor trail is available for signal enhancement. And there must be provision for storing messages during periods when no meteor trails are available.

Although meteor burst systems do not provide continuous operation, they offer lower power consumption, small antenna requirements, a wider usable spectrum and greater security in message transfer than do forward-scatter systems.

Because of the highly directive character of meteor burst reflections, there is less jamming and interference caused by reception of signals from other transmitters.

System Has Disadvantages, Too

The experiments indicate that signals from two coexistent meteor trails occur frequently enough to be a serious source of error. The system is also seriously affected by electrical storms, precipitation static, and nearby ignition systems and power lines.

Other sources of interference are ionospheric forward scatter, sporadic E-layer propagation, and at the higher-latitude installations, auroral-reflected signals. Tropospheric scatter signals are a problem, but only over fairly short paths, 100 to 200 miles in length. To avoid these sources of interference, the bureau recommends that a practical meteor burst communication system contain an automatic device for setting the system's threshold at a fixed margin above the short-term median signal strength. ■ ■

Signal Corps Sends 500 Kilobit PCM Pulses Over Tropo Circuit

What is claimed to be the first beyond-line-of-sight transmission of high-pulse-rate signals has been made by Army researchers.

Using an AN/GRC-50 radio set, an AN/TCC-40 multiplexer and an ITT Labs microwave power amplifier, Signal Corps engineers sent 500 kilobit pulses successfully over a troposheric scatter path of 93 miles.

The 12-channel, 1830 mc pcm signal was sent at 1 kw through use of 15-foot parabolic antennas. Subjective talking tests made over the path indicate that voice transmission is not degraded by the randomly varying scatter signal above threshold.

NEWS

Radar Studies of Meteor Trails Aimed at Better Communications

Harvard researchers using sensitive radars hope to record and analyze meteor showers with twice the accuracy previously obtained. Their forward-scatter studies may lead to day-to-day prediction of meteor arrivals.

If meteor showers were predictable, it might prove feasible to use meteor trails for long-range communication, making practicable an almost continuous system of world-wide communication. Meteor-trail forward scatter might prove a better method for this than microwave relay satellites, report Raytheon engineers supplying the microwave equipment.

Behind the research is the ionizing effect of meteors in air. Tiny particles of meteor dust hitting the atmosphere ionizes the air around them. Though the meteors may burn out almost instantly, the air they have passed through may remain ionized for several minutes.

It is these ionized columns of air that can be used for signal transmission. In fact, the investigators report, this meteor ionization may contribute significantly to the general level of ionization in the nighttime E-region.

Under the research program, sponsored by the National Bureau of Standards, three observation stations are being set up, linked by line-of-sight microwave pulse train with a huge antenna farm. Three more stations may be added.

A 40-mc transmitter of 4-megawatt peak power will be used with one of the largest corner reflectors ever made (see photo) to form Y plots on a scope screen. The plots will enable astronomers to determine radiants and orbits of the meteors for measurements of the time difference in signal arrivals.

Design requirements of the relay equipment included a wide dynamic range in the receiver and a high percentage of propagation reliability in the system.

One of the largest corner reflectors ever made is installed at Havana, Ill., to receive radar returns from meteor trails. The 35-foot-high antenna forms a 7-meter double-trough waveguide with an aperture 200 feet long, 70 feet wide.

EIA Asks U.S. to Stem Imports of Japanese Transistors

Claiming the "increasing penetration of the transistor market will impair the efforts of American producers to provide the capacity to meet existing and potential national security requirements," the Electronics Industries Association last month petitioned the Office of Civil and Defense Mobilization to "investigate growing imports of Japanese transistors and other semiconductor products and determine whether they threaten American security."

Production of Japanese transistors increased from 560,000 in 1956, to 26.7 million in 1958 to 14.9 million in the first quarter of this year, noted the EIA, which pointing out that U.S. transistor production rose only to 47 million in 1958 from 12.8 million in 1956.

A Japanese delegate to the ISA show in Chicago, Dr. H. Imai, of Tokyo's giant Toshiba Co., declared after hearing of the EIA action that imports of Japanese electronic equipment are not a threat to U.S. security, and that the growing strength of Japanese industry in this field is in reality an aid to America's defense.

Dr. Imai also stated that a "restrictive change in trade agreements legislation may, in effect have adverse reactions upon large segments of the U.S. electronic industry."

He pointed out that 1958 exports to Japan were $829 million while imports from Japan were only $673 million.

In another EIA action, taken at the organization's Fall meeting in Atlantic City, a "Buy American" campaign was approved.

End-equipment manufacturers will be encouraged to inform consumers with stickers that the products are "Made in America by Americans." Another part of the drive will be informing electronics employes that they are helping their own security by buying products made with U.S. parts.

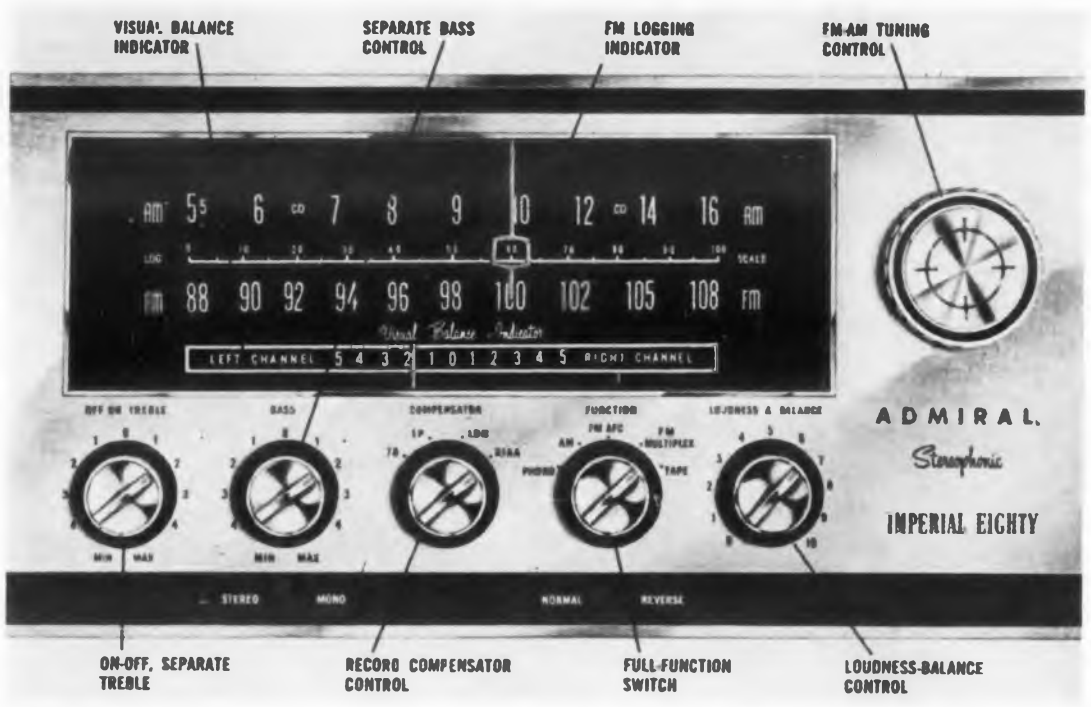
Gage Measures Plating to Sixth Place

Gage at Bureau of Standards operates on both magnetic and radiation principles to measure platings.

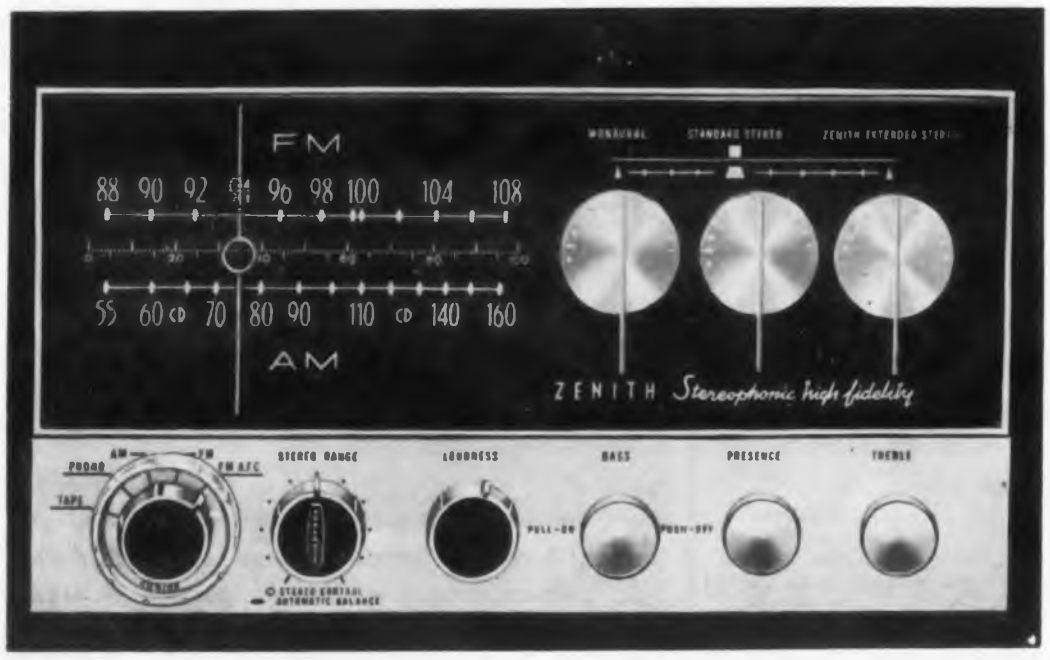
Major Manufacturers Launch Drive for Hi-Fi St

RCA (left) features push-button controls plus visual balance and tuning indicators in its control panel design.

Philco's "Stereo-Dors" (below) act as acoustic mirrors to reflect middle and high stereo channels to the sides with lows radiated from cabinet front.



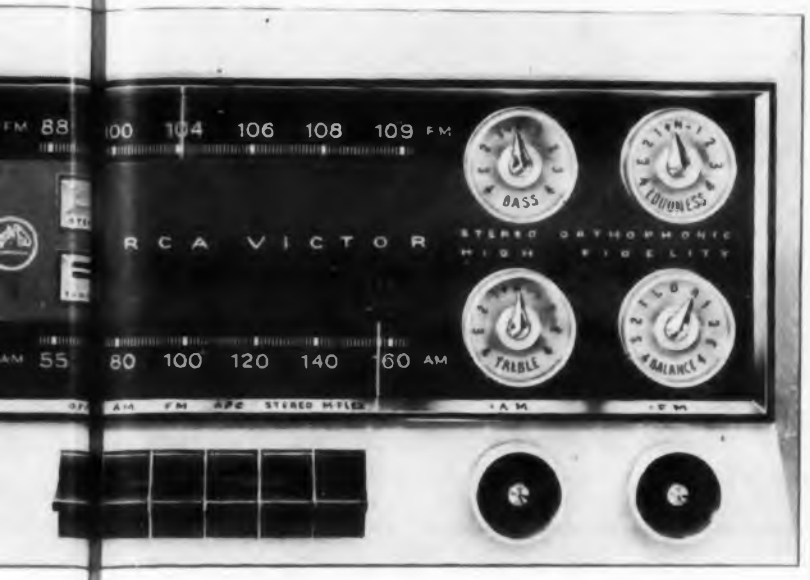
Admiral's Control Center (above) features a visual balance indicator for stereo adjustments.



Prestige and quality are reflected in the professional-looking control panels designed for the RCA, Zenith, Philco and Admiral units illustrated here. Function controls include stereo balance with visual indication on the RCA and Admiral units.

Zenith's automatic balance control, (left) once set for desired stereo effect, retains the balance for all settings of the volume control.

-Fi Stereo Market



HIGH OUTPUT power, professionally-styled control panels, and versatile speaker combinations—housed in luxurious cabinets—highlighted the design philosophy of major manufacturers exhibiting at the Chicago Hi-Fi® show. In an all-out effort to woo the public from "component" competition, companies such as RCA, Philco, Westinghouse, Zenith, Admiral and Motorola have assembled "packages" equipped with features previously available only with separate components.

Transistors Still Far Off

Circuit design ideas were disappointingly absent. Major component manufacturers in the tuner and amplifier field have concentrated their efforts on the task of combining tuner, preamplifier, and power amplifier units into one package.

Transistors, according to spokesmen for leading manufacturers, will not find their way into hi-fi equipment this year. Price, performance, and (perhaps most important) necessity do not warrant a switchover from tubes. With the present demand for higher and higher output power, completely transistorized equipment would be considered impractical. Hybrid units, produced strictly for glamour and promotion, might be a poor gamble.

Power Ratings High

An eye-opener to the die-hard hi-fi fan might be the unusually high power ratings specified in brochures handed out by major manufacturers of

stereo "packages." As high as 100 w were specified with 40 to 80 w claimed by several companies. Quick checks revealed that peak power ratings were stated; these values are cut in half to convert to the more common maximum undistorted available power. Dividing the resulting number by two yields the power output for each channel of the stereo unit.

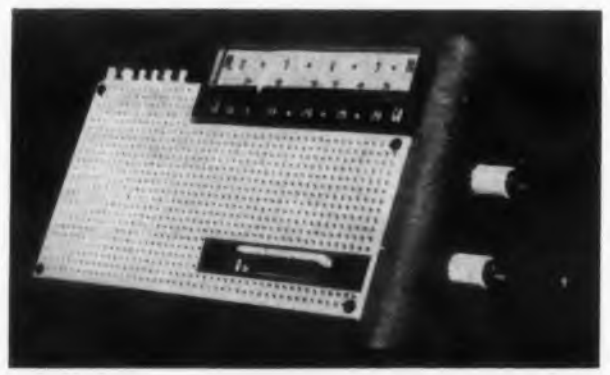
Versatile Cabinetry

Stereo had a slow start, most marketing people believe, because of the need for separate remote speakers with visible, often unsightly wiring between units. Housewives balked and refused to buy.

To placate the influential lady, latest "package" designs include modular assemblies which permit speaker sections to be self-contained, swiveled, or completely removed. In another approach, doors can be opened at the sides of the cabinet

French Cabinet Design

These unusual cabinets by French designer Madame Doliet were shown recently at the Paris Radio and Television Salon, where they were launched with high-fashion techniques. The cabinets, of rf-processed plywood, are made with high precision at low cost. All designs are protected by law.



to permit sound to emerge from a source other than the front.

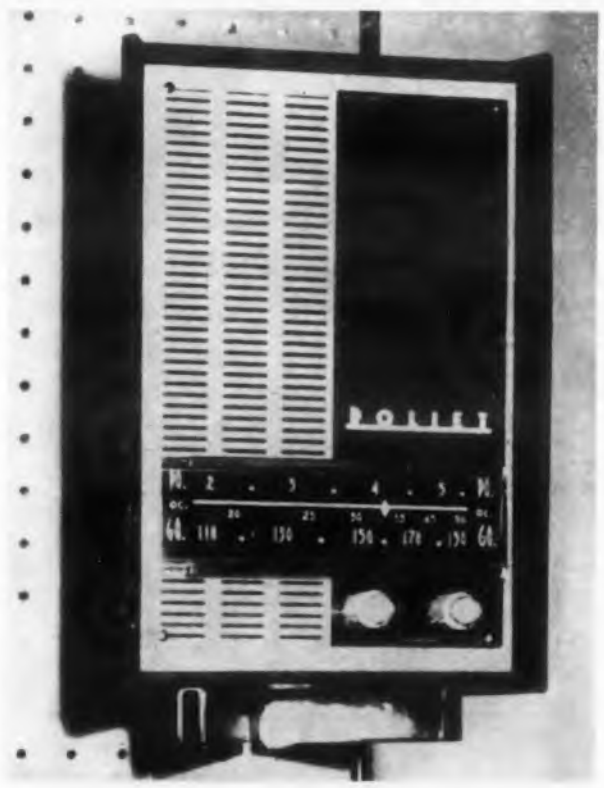
FM Multiplexing

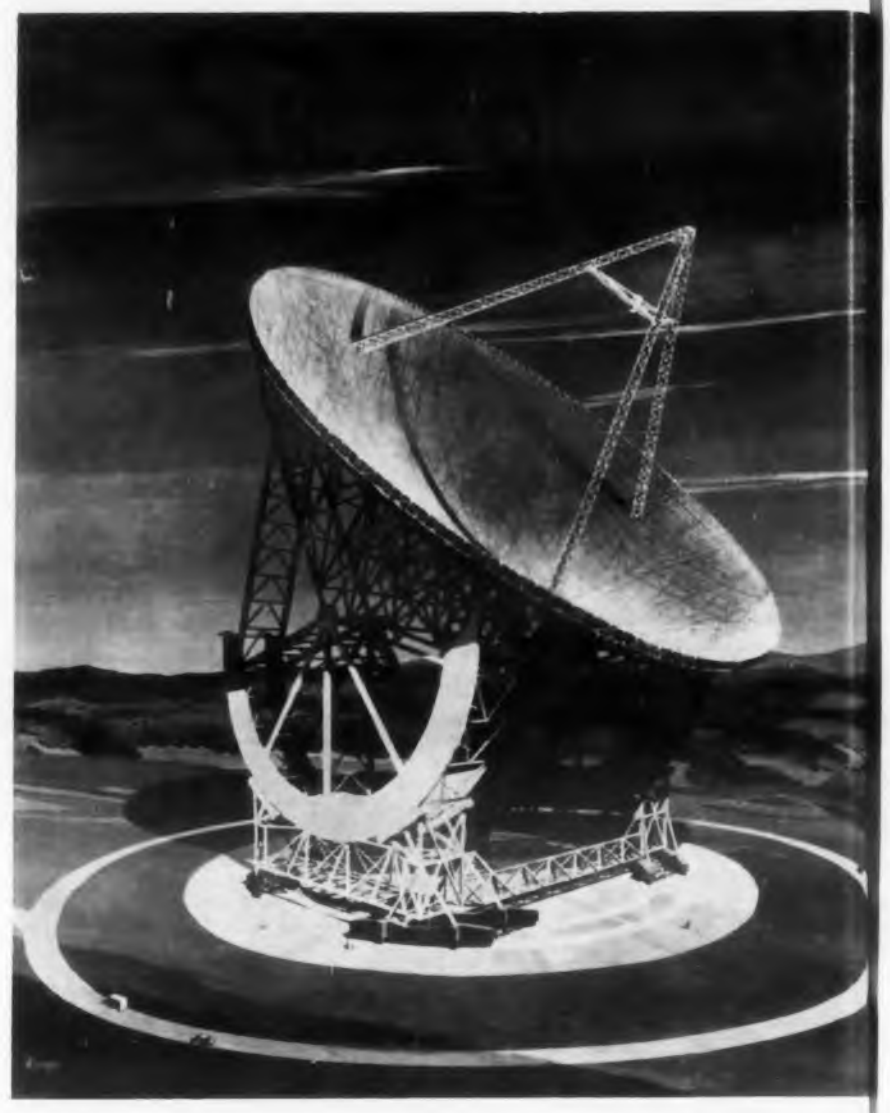
Many of the 20,000 hi-fi enthusiasts shuffling along the three floors at the Palmer House September 18-20 were interested in fm multiplexing. Concerns marketing fm receivers, tuners, and "packages" were besieged with questions pertaining to the availability of multiplex adapters. Since the FCC has not yet approved any one system, potential customers were told "none available, but equipment will be ready the instant approval is granted."

Optimistic buyers seemed rather doubtful; skeptics mumbled that they refused to buy an expensive unit which might shortly become obsolete. ■ ■

*This issue went to press immediately prior to the New York Hi-Fi Show, Oct. 6-9. Interesting designs revealed at that show will be reported in a future issue.

Going High-Fashion?

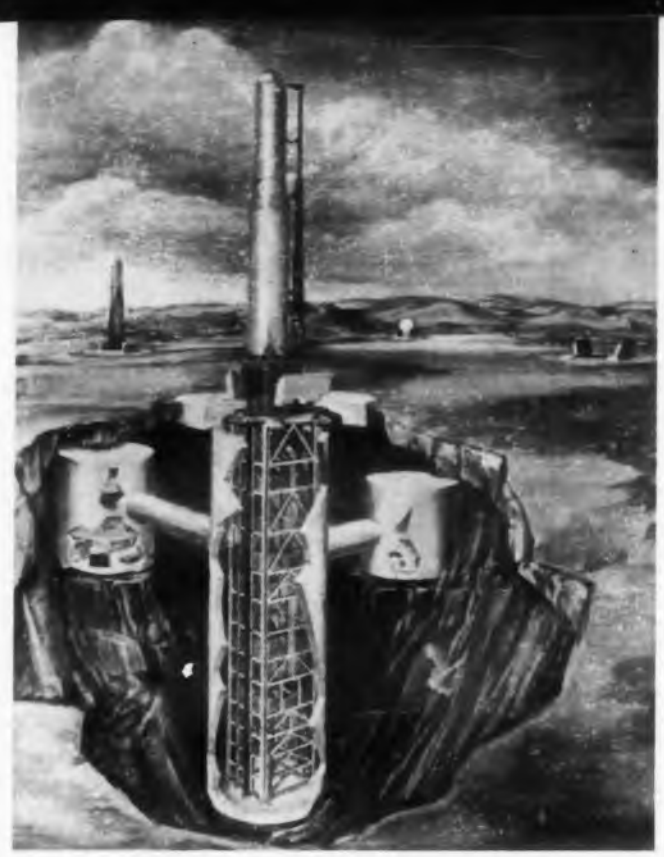




First drawing of Navy's giant radiotelescope now being built near Sugar Grove, W. Va., shows how rocker arms will be used to elevate the 600-foot-diameter reflector. Receiving surface of the dish will be made of aluminum mesh. Inertial guidance will control focussing and servos will adjust individual sections of the dish. Completion is scheduled for 1962.

Design News in Photos

Radar target simulator permits display of both real and synthetic radar returns. According to Philco, high degree of realism is achieved through *x-y* integration programming and incorporation of an accelerated-time-scale azimuth-gating circuit.



Titan launching system in artist's conception shows how missile will be stored underground, lifted to surface for firing. Facility also includes fuel storage chamber, guidance antenna, control centers and several tunnels. American Machine and Foundry, recipient of a $42 million contract for building, testing and equipping the facilities, will install 18 launching sites at Lowry Air Force Base, near Denver.

Lockheed scientists inspect instrumentation package designed for Air Force Javelin program set up to measure radiation in the Van Allen belt above the earth. The 15-pound package includes scintillation radiation counters, a Schoenstedt magnetic aspect sensor and a hydromagnetic wave detector.

NEWS

Cone protruding from last of the Vanguards houses a magnetometer. The 20-inch sphere is expected to orbit for 200 years.

Last of Vanguards Up; Was Project Worth It?

Through successful orbiting of the last of its scheduled satellites in September, the Vanguard program was able to leave the space scene in a favorable light. Question? Was this country's first space age program worth its immense cost and effort?

Dr. J. P. Hagen of the National Aeronautics and Space Agency, and a leading figure in the Vanguard program says yes: "In retrospect, I think it has all been worth it."

Yet only three of the eleven attempted launchings were successful. And the first, widely publicized, failure was labeled at the time a major propaganda setback.

What was achieved besides experience useful in the Discoverer and Explorer programs?

The first Vanguard, a tiny test vehicle, provided useful cloud-cover data. Vanguard II, a full-scale satellite, proved the practicality of solar-cell power supply in space and added support to the view that the earth is somewhat pear-shaped.

Vanguard III, just beginning its expected 200-year hitch in space, carries 50 pounds of instruments and electronic equipment and is expected to provide valuable information on space conditions for a long time. With its launching, one of the program's original goals has been exceeded: putting up one full-scale satellite in six tries.

Value of Japanese Electronic Production Skyrocketing

Figures on Japanese electronic production compiled by the Business and Defense Services Administration of the Commerce Department show, when converted to dollars, that if Japan's electronic growth continues at its present rate for the rest of the year, 1959 value of electronic production will be double that of 1957.

Figures include factory prices and taxes for equipment listed.

Japanese Electronics Value
Value in Thousand $

	1957	1958	Jan.-Mar. 1959
Consumer Products	170,901	266,226	99,345
Industrial, Military Products	77,356	85,159	26,809
Tubes	69,502	76,466	27,295
Semiconductors	10,703	24,470	11,455
Other Parts	33,735	45,602	19,532

Quadruple Diversity Scatter Link Due for West Indies

A tropospheric scatter system using quadruple diversity uhf will be installed to link Trinidad and Barbados with six telephone speech channels.

Also to be incorporated, for automatic error correction, will be Marconi autoplex equipment.

One of the six channels will be used for telegraphy and will be made up of three 100-baud fm/vf channels. One fm/vf channel will be in two-channel (50 baud) time-division multiplex.

Quadruple diversity will be achieved by using a pair of 30-foot dish antennas at each end. Each pair will be separated by 100 feet and transmit signals separated by 4 mc. A different set of frequencies will be used for the two antenna pairs.

Cross-polarizing probes in each antenna feed horn will permit each dish to receive signals polarized at right angles to signals each transmits, enabling each antenna to be used simultaneously for transmission and reception.

Because of the physical spacing of the antennas, signals arriving at one are in space diversity with signals arriving at the other. This combined with the 4-mc frequency diversity gives quadruple diversity.

Marconi's Wireless and Telegraph Co., Ltd., will provide the uhf equipment and system design.

NEWS

Balloon Raises Antenna

Antenna wire is carried aloft by helium-filled balloon, part of a radio rescue beacon. Balloon-lofted antenna permitted signal reception up to 4500 miles from transmitter in FAA tests, according to the beacon designer Crosley Div., Avco Corp.

Speed of 120 IPS Records Half-Cycle FM to 1 MC

A recording system capable of taping extended fm lows down to a half cycle and the video band to 1 mc is operated at a 120-ips speed and has specially designed recording and playback heads.

The CV-107 was designed by Minnesota Mining's Minicom Division to measure time intervals in the megacycle range and to record transient wave forms of one mc.

The system can be operated in three modes: seven direct-recording and playback tracks of 400-cps-to-1-mc range; four analog tracks of that range plus three fm channels with half-cycle-to-100-kc range; and three tracks of the full range from one-half cycle to 1 mc plus one track with a 400-cps-to-1-mc range.

A single half-inch tape is used.

Miniaturization Award Entries Invited

The miniaturization Awards Committee is ready to receive entries for the 1959 miniaturization competition.

In making this announcement, the contest sponsors, Miniature Precision Bearings, Inc., stated that the basis for awards will be:

- Ingenuity in solving basic miniaturization problems of broad interest to industry;
- New design concepts having wide potential;
- Development or manufacture of new types of components or assemblies that extend the frontier of miniaturization.

In addition, other criteria must be met by entries to be considered for an award. A kit with detailed information on the contest is available from the Miniaturization Awards Committee, Box 604, Keene, N. H.

Last year's winner was the Martin Co. for its five-pound SNAP nuclear-powered generator.

NBS Method Predicts Transmission Loss

Using data on terrain profiles and ground meteorological conditions, the National Bureau of Standards has developed a method of predicting the cumulative distribution with time of radio transmission loss at frequencies above 10 mc. The method is valid for transmissions over paths of arbitrary length.

Bases for the technique are standard atmospheres in which the radio refractive index decreases linearly with height for the first kilometer above ground, then decreases exponentially with height.

At frequencies of 40 to 10,000 mc, the Bureau reports, and at distance out to and just beyond the radio horizon, the dominant propagation mechanism is diffraction. At greater distances, to 1000 miles, the dominant mechanism is usually forward scatter.

The Office of Technical Services is publishing the NBS findings.

Engineer A. M. Darbie installs a Tung-Sol/Chatham 6336A twin power triode in a Harrison Labs 2B regulator, part of a 200B high current power supply. Superior power handling ability of the 6336A lets Harrison Labs offer the regulator with a 5-tube complement in addition to a 7-tube model.

NEWS

European Control Going Electrical, ISA Hears

Sixty per cent of all European industrial processes will be controlled electrically. This prediction was made by Holland's Prof. C.J.D.M. Verhagen at the 14th Annual Instrumentation-Automation Conference, held last month in Chicago.

Prof. Verhagen, chairman of the International Instrumentation Session, reported that an overwhelming number of processes are being installed with, or planned for, electrical rather than pneumatic or hydraulic control.

Automation in Europe has been slow because of the relatively small mass-production needs of the individual countries. Most top European industrialists are cautious and unwilling to gamble fortunes on automation, the professor added.

In the keynote session, Dr. Henry L. Cox, an industrial instrumentation consultant, pointed out that census figures predict a 40 per cent increase (70 million people) in U. S. population by 1975. This increase will mean demands for better living that will be beyond the range of labor available by that time. Either working hours will be increased (an unlikely event, in the opinion of Dr. Cox) or automation will have to be increased.

Therefore, automation is not only desirable, concluded Dr. Cox in a statement aimed at those who worry about the link between automation and unemployment, but automation is a necessary step for large-scale industries if shortages and accompanying inflation are to be avoided.

At the ISA show more than 400 exhibits displayed the full range of recent instrumentation developments. Over 180 papers were given, including papers on nuclear plant control, aircraft and weather equipment, and space equipment design from actual experience with Titan and Atlas missiles.

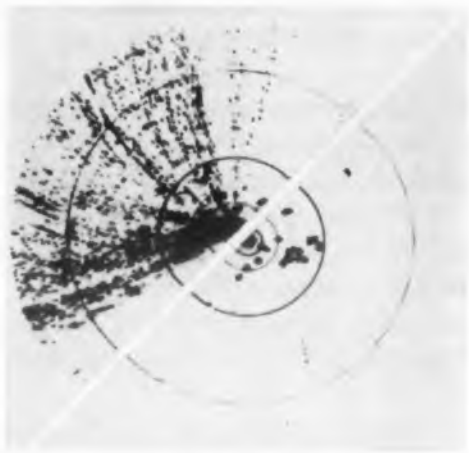
In pointing out the significance of the show, ISA president, H. C. Frost stated that Premier Khrushchev's confidence in the ability of

◀ CIRCLE 19 ON READER-SERVICE CARD

the U.S.S.R. to exceed the industrial output of the U.S. would have "evaporated" had the Soviet leader been able to spend even 15 minutes at the show.

ISA attendees who had visited the U.S.S.R. reported that only in photoelectric pyrometry does Soviet intrumentation exceed the U.S.

Defruiting Equipment Aids Beacon System

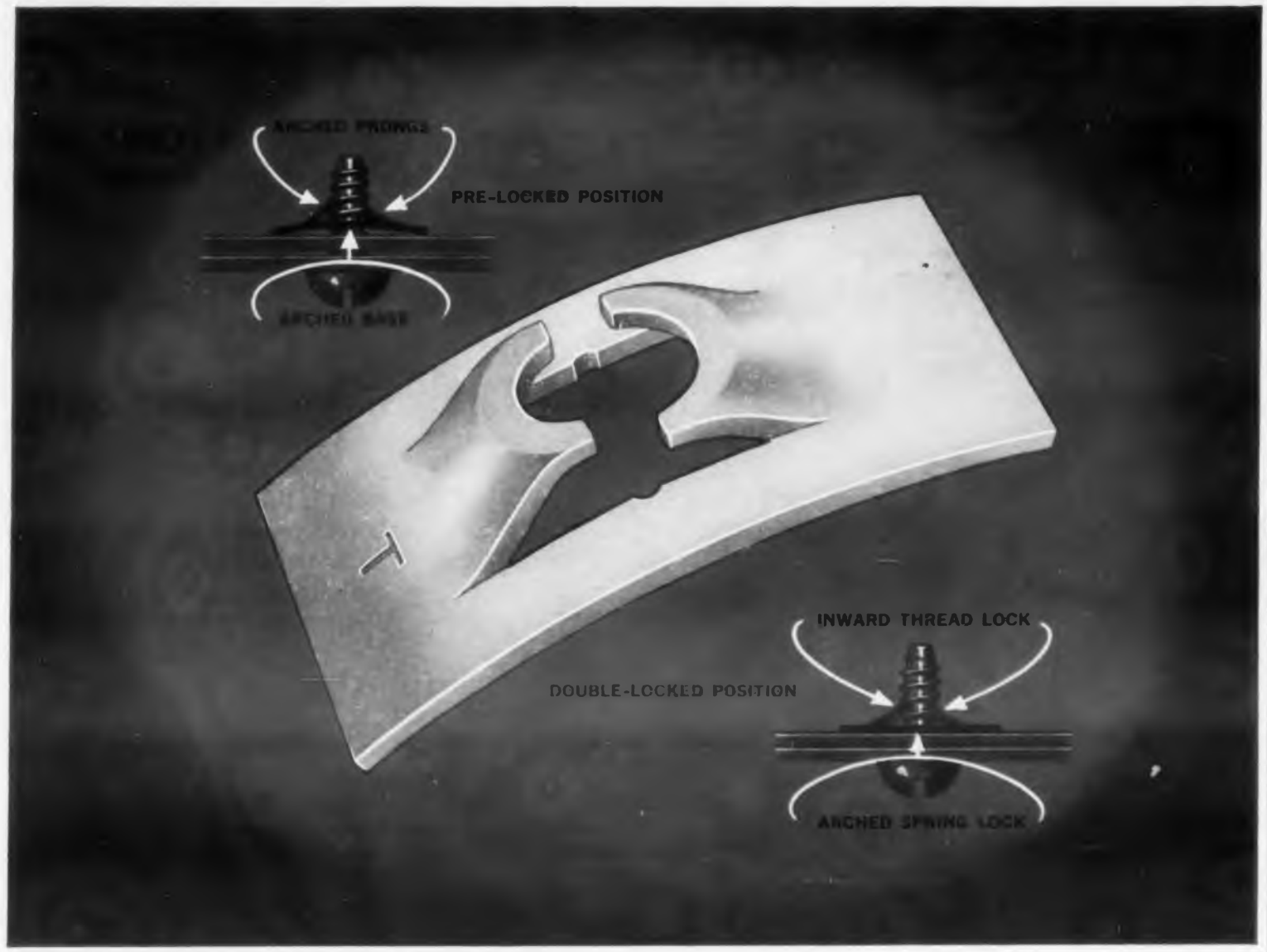


Display of aircraft over airport is shown both without (left) and with (right) defruiting by Airborne Instruments lab equipment operating as part of newly installed beacon system at New York's Idlewild and Newark airports. To eliminate spiral lines caused by nearby beacon interrogators, replies of transponders to successive interrogations are compared in a coincidence mixer. Beacon system, which is a modification of World War II's IFF recogaition method, will be used in all FAA installations. Up to 63 recognition codes can be pulsed over the system's primary radar.

Form Space Spectrum Group

A committee to recommend designation of "the parts of the radio spectrum where frequency allocation should be made for space research" has been formed by the International Telecommunications Union. Committee members are the U.S., the Soviet Union, Britain, France and Czechoslovakia.

The group was also asked to recommend bandwidths suitable for space studies.



NEWS

Soviet Moon Rocket Carried Three Transmitters

Two transmitters in the lunar rocket's instrument compartment and one in the vehicle's second stage telemetered back data on five types of space phenomena, according to Soviet reports: micrometeorites, interplanetary gases, cosmic radiation, and radiation and magnetic fields of the moon.

The most significant finding announced so far is the fact that the rocket's instruments were not able to detect a magnetic field around the moon.

Scientists have predicted that no moon magnetic field exists, and the corroboration supports the view that the earth's magnetic field is a result of a rotating liquid core.

The transmitters, which operated at 19.993 and 39.986 mc, 19.997 and 20.003 mc, and 183.6 mc, made it possible for several stations around the world to track the moon rocket.

A Soviet announcement reported an increase in ionized particles within several thousand miles of the moon.

Moon Hit or No: U.S. Still Instrument Leader

Engineers interviewed by ELECTRONIC DESIGN at the ISA conference last month praised the Soviet moon-shot success while asserting that instrument technology is further advanced in the U.S. than in the U.S.S.R.

Soviet success in missile guidance, *Electronic Design* was told, is a result of great concentration on a large-scale space-vehicle program.

Some experts feel that the Soviets have been forced to do the best with the least complex, while the U.S. is continually making state-of-the-art improvements throughout the breadth of the industry. (For other news of the ISA show see p. 23)

NEWS BRIEFS . . .

. . . **VALIDITY OF PATENTS** awarded late Major Edwin Armstrong, developer of frequency modulation, regenerative circuit, and superheterodyne receiver, has been upheld in Federal Court. Action supports his widow's suit against Emerson Radio, and could lead to successful patent-infringement suits against many other firms.

. . . **COMPUTER-PLANNED MEETINGS** will be studied with support of the National Sciences Foundation. Idea is to reduce magnitude and complexity of scheduling, and to avoid conflicts.

. . **FIRST OF FLYING WEATHER LABS** has completed flight tests as part of AN/AMQ-15 Air Weather Reconnaissance System. Goal is a wide-area, 3-D, continuous picture of the weather, which could provide insights into the causes and effects of weather. Boeing 707 jet, loaded with Bendix probes, sensors, cloud and storm radars and instrument-carrying sondes, made the tests.

. . . **PHONOGRAPHS ARE READY** to pass radios as second-largest dollar-volume product of consumer electronic industry, according to TV Digest. Under impetus of stereo, phono sales might reach $425 million by end of 1959. Last year's radio sales were $382 million, states the publication.

. . . **NEW COMPUTER ELEMENT,** Transwitch, claimed to eliminate need for flip-flops designed with two transistors, will be available to computer designers soon from Transitron Electronic Corp. To operate in the 2-10-ma range at up to 20 v, the units will stay on and off when turned on and off, but will remember their last instruction.

. . . **MOBILE TELEPHONE** service on a country-wide basis, a possibility if the FCC releases new frequencies now under study, would involve closer coordination than in any previous venture by some 4100 companies serving the two-thirds of the nation handled by independent companies, reported A. C. Culbertson, of Lenkurt Electric Co., at an IIEE meeting.

. . . **THERMOELECTRIC MARKET** of $100,000,000 is predicted in five years by General Instrument Corp., which has formed a thermoelectric division to finish development of a small nuclear generator, a conventionally fueled thermoelectric power supply, and refrigerating units.

. . . **TELEPHONE CALL RESTRICTOR** has been developed at North Electric Co., Galion, Ohio, that will pass, outgoing, only calls with approved combination of digits. Purpose: discouraging personal long-distance calls.

. . . **MAGNETIC DOMAIN COMPUTING** techniques will be investigated by two more companies: Servomechanisms, Inc., will explore use of magnetic-domain interaction in thin evaporated films to miniaturize and boost reliability of digital circuitry, and Litton Industries will study, for Douglas Aircraft, design of a radical, magnetic-domain digital computer. Servomechanism has also announced entry into thermoelectric research; concentration will be on materials that can retain thermoelectric properties at very high temperatures.

WASHINGTON REPORT

Ephraim Kahn

More Money Recommended For Military R & D

More money for military R & D has been enthusiastically recommended by the House Science and Astronautics Committee. Even though the Defense Department will spend almost $6 billion on about 2000 distinct projects incorporating many thousand separate sub-programs in fiscal 1960, more would be helpful, particularly to the Army and the Navy.

Electronics would participate generously if more money were voted to the Army, for example. "Budgetwise," says the Committee "the Army research and development program is, at present, just barely 'getting by'." The Army's chief of R & D, Lt. Gen. Arthur G. Trudeau, feels that it is not following up more than half of the possible research areas that might be of genuine utility. Brig. Gen. William T. Ely, the Army's R & D director, has laid great stress on the importance of electronics in meeting the dispersed battlefield conditions of the future. Electronics in general, he says, has seen a tenfold increase since World War II and another tenfold increase can be expected by 1970. Nevertheless, budget conditions for the coming fiscal year will be "considerably tighter" than they have been in the past.

In view of the speed of scientific advances, "research and development money clearly seems inadequate" at all levels. "The amount allocated for research within the total administration budget appears inadequate; the amount allocated to the Army within the Defense Department budget appears inadequate; and the amount allocated by the Army within its own budget may also be inadequate in view of its dependence on research and development." As a consequence of the "fiscal anemia" which appears to afflict the Army, its spending on "basic and applied research, as distinguished from its developmental, test, and evaluation activities, appears to be very low."

Four Problems Beset Army R & D

Four big problems are faced by the Army's R & D program:

(1) Overcoming lengthy lead-times, now thought to be about double the Soviet Union's

four to five years from conception to operation of a weapons system.

(2) Obtaining adequate and timely funding. This will entail guaranteeing enough money for the whole research period for any program.

(3) Streamlining research management within the Defense establishment. The legislators complain that "only a few have the power to say 'Yes' to a given research and development project, while many have the authority to say 'No'." While it may be useful and economic to have many "decision levels" in some government activities, the committee says it is "dangerous" in R & D, "where a high degree of vision and imagination is essential." It then twists the knife by adding: "Unfortunately, many of those with the power of veto over research and development projects do not have the training or foresight necessary to recognize the ultimate potential of these projects."

(4) Obtaining scientific information. Though the group believes that interchange of data within the Armed Services is "reasonably good," scientific information developing "outside military contract areas and in foreign countries is neither comprehensive, properly capsuled, nor adequately disseminated."

Developmental Publications Dangerous?

With seeming ambivalence, however, the lawmakers recommend that the Defense Department "confer on a broad scale with industrial leaders and private contractors in efforts to restrict the output of scientific *developmental* publications which may contain information useful to totalitarian governments—insofar as such restrictions may be consistent with (a) traditional freedoms of information and (b) palpable security needs."

Navy R & D Funds Shrinking

Navy R & D is handicapped because the sum available for basic and supporting research is becoming relatively smaller each year. A subcommittee commented that research and development in the field of electronics (for both detection and communications) appears to be making good progress, "but at too low a level of support." Data-processing systems are receiving "major emphasis." Navy witnesses told the group that major gaps in the R & D program are "basic and supporting research, component development, and electronics." The subcommittee recommended that these be beefed up, "regardless of budgetary levels."

The Air Force subcommittee—in contrast to the Navy group—praised the weapons system concept, at least to the extent that it encourages concurrent development of components.

MEETINGS

Calendar of Events

October

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

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

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

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

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

*Includes meetings described herewith.

Michigan Industrial Electronics Exposition, October 28-29

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

5th Electron Devices Meeting, October 29-30

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

6th Annual East Coast IRE Aero-Electronics Conference, October 26-28

The unclassified sessions of the IRE PGANE conference, sponsored by the Air Research and Development Command, are as follows:

Monday, October 26—9:30 to 12:30 A.M.

Session 1. Communications

Application and Design Consideration for Public Address Amplifier in Commercial Aircraft,

C. K. Hartwigsen Bendix Radio

Selective Calling Equipment, Allen I. Perlin, Bendix Radio

Integration of Radio Equipment Controls for High Performance Aircraft, W. D. Philips, Bendix Radio

Reliable Communications, W. M. Pulford, Bendix Radio

Design Analysis of Airborne Electronics Equipment for Aircraft-Imposed Vibration Loads, Charles Mitropoulos, Sylvania Electronic Systems

Monday, October 26—
2:00 to 5:00 P.M.

Session 3. Navigation

Automatic Flight Scheduling in the Volscan Air Traffic Control Central, J. A. Herndon, Avco Manufacturing Corp.

A Multi-Bearing Radio Range For Air Navigation, Jos. T. Nessmith, Jr.

An All-Transistor 75 Megacycle 3 Light Marker Beacon Receiver, J. M. Tewksbury, Bendix Radio

A Bellini-Tosi ADF Loop Using Ferrite, Alfred A. Hemphill, Bendix Radio

Accuracy of the Loran-C System, Walter N. Dean, Sperry Gyroscope Co.

Tuesday, October 27—
9:30 to 12:30 A.M.

Session 5. Antennas

Flat Array Antenna For a Doppler Navigation System, Robert E. Willey, Bendix Radio

A Simple Inertialess Scan Antenna Type, E. Wolff, M. Ringerbach, Westinghouse Electric Corp.

Coupling Effects Between Antenna Arrays of Different Frequency Bands as a Function of Skew Angle & Spacing on a Cylindrical Missile Body, Sheldon Isaccson, Martin Co.

Combined Antenna-Mixer-Filter Circuit, Edwin M. Turner, Wright Air Development Center

Antennas for Microwave Radiometry, H. Warren Cooper, Westinghouse Electric Corp.

A Yagi Adcock System for Satellite Tracking, H. W. Ehrenspeck & W. J. Kearns, Air Force Cambridge Research Center

(Continued on page 30)

MEETINGS

Tuesday, October 27—2:00 to 5:00 P.M.

Session 7. Space Problems

Tracking of Satellites, Werner W. Gerbes & Otho E. Kerr, Air Force Cambridge Research Center

Diagrammatic Methods for Coordinate Conversion, Solomon A. Zadoff, Radio Receptor Co.

Relative Motion of Two Bodies With Small Velocity Differences on Gravitational Field, Werner Furth, The Martin Co.

Simplification of Certain Orbit Characteristics by Use of e^{io}, Roy C. Spencer, The Martin Co.

A Pure Inertial Attitude Reference System for Orbital Vehicles, Robert L. Gordon, Sperry Gyroscope Co.

Gyro Configuration Requirements for Optimum Accuracy, J. B. Chatterton, Moeller Instrument Co.

Wednesday, October 28—9:30 to 12:30 A.M.

Session 9. Human Factors

Moderator: M. Scott Hasler, The Martin Co.

The Design Engineer and Human Engineer—A Coordinated Approach, Douglas R. Nicklas & Don Petersen, The Martin Co.

Design of Integrated Cockpit, Gerald J. Fox, and Clifford Seitz, Gruman Aircraft Co.

Visibility of Cockpit Cathode Ray Tube Navigation Displays, C. Thomas Goldsmith & Milton A. Grodsky, The Martin Co.

Reliability and Man in Space, R. D. Sorkin & Milton A. Grodsky, The Martin Co.

Consideration for Electronic Equipment for Space Suit, R. K. Cassatt & F. J. Conley, Jr., and Milton A. Grodsky, The Martin Co.

Maintenance of Electronic Equipment in Space, Milton A. Grodsky, The Martin Co.

Wednesday, October 28—9:30 to 12:30 A.M.

Session 10. Doppler

A Doppler Navigational Radar Utilizing New Techniques, B. L. Cordry, Bendix Radio

Applications of Doppler Radar to the Navigation Problem, C. C. Bath, Bendix Radio

Doppler Navigator Accuracy by Photogrammetric Measurement, Gerald Cooper, Raytheon Co.

A New Doppler Radar Frequency Tracker, E. O. Kirner, Bendix Radio

A Hybrid Airborne Computer for Doppler Application, T. Owens & C. Christianson, Bendix Radio

A Transistorized Frequency Summing and Differencing Device Capable of Coherent Algebraic Manipulation of the Four Data Frequencies in a Doppler Radar Computer, W. G. Gunkel & C. L. Christiansen, Bendix Radio

Wednesday, October 28—9:30 to 12:30 A.M.

Session 11. Radar

Radar Cartography, Daniel Levine, Consulting Engineer.

A New Technique for Measuring Operational Radar Antenna Patterns, A. E. F. Grempler, Bendix Radio

Active Radar Target Area Cross-section Enhancement, A. G. Cheney, Convair

An Automatic, Quantitative and Qualitative Performance Test Set, H. Dean Gulnac, Motorola, Inc.

Spherical Radar Reflectors With High-Gain Omnidirectional Response, Helmut E. Schrank, Westinghouse Electric Corp.

CW Velocity Track Loop Simulation by DC Electronic Analogue Computer, S. Baida, T. A. Prinscilla, Westinghouse Electric Corp.

Wednesday, October 28—2:00 to 5:00 P.M.

Session 12(H) Panel Discussion

Opportunities for Engineers—Today and Tomorrow

Wednesday, October 28—2:00 to 5:00 P.M.

Session 13. Panel Discussion

The Air Force Applied Research Planning Document on Computer and Data Processing Techniques

Wednesday, October 28—2:00 to 5:00 P.M.

Session 14. Circuits and Techniques

Design and Evaluation of Space Transmission Systems Using Computer Simulation Techniques, D. R. J. White, American Machine & Foundry Co.

Hit-Miss Detector, Jerome Machlis, Radioplane, Northrop Corp.

Pedestal Free Switches, S. L. Anema, Bendix Radio

A Transistorized True Integrator, Wesley H. Jory, Bendix Radio

Accurate Diode Rate Counters and Some Applications, John Collins, Raytheon Co.

Impact of Electronic Costs on Weapon Systems Evaluation, Russell E. Winslow, Boeing Airplane Co.

The classified sessions will be held concurrent with the unclassified presentations and will cover: "Correlation Techniques of Data Processing," "Advanced Radar Techniques," and "Phased-Array Radars." Correspondence concerning clearance may be addressed to T. M. O'Connor, Security Coordinator, IRE ECCANE, Bendix Radio, Baltimore 4, Md. The location of all sessions will be the Lord Baltimore Hotel, Baltimore, Md. Dr. R. C. Spencer of the Glenn L. Martin Co., Baltimore 3, Md., is Papers Chairman.

EDITORIAL

Engineering By Fear

"Better be safe than sorry" is a fairly sound admonishment. But an adage it is and not a law of nature. Too many an engineer seems to proceed on the assumption that it is a law. He thus saves himself the trouble of investigating alternate choices —he simply buys a familiar part from a familiar supplier.

This is engineering by fear. No gamble, no risk, no selling his supervisor on a new idea or a new product. Such an approach to problem solving might occasionally be just plain laziness or it might be too much busy-ness. But when it's timidity to stretch one's neck out, it is engineering by fear. The outcome is nice, safe mediocrity.

An even more insidious form of engineering by fear is the practice of over-specifying the accuracy, the precision, or the tolerances needed for electronic parts when one doesn't know. Fearful that an admission of ignorance will lessen his standing with his boss or peers, this engineer protects himself by asking for the impossible from others. Others fail in accomplishing the near-miraculous and our insecure engineer fortifies his masquerade as a knowledgeable man by showing up others as failing.

For the fellow who is working beyond his ken, some form of subterfuge might be necessary so that he can live with his fears. The engineer who is willing to learn, who is disposed to master the unknown, need not engineer from fear nor need he be fearful to question, to show his lack of knowledge in areas where he has had experience.

The designer who does not engineer by fear will make some occasional mistakes but he will also make some outstanding engineering contributions. Because he does not lack confidence, he becomes an ever-better engineer by openly seeking new information from fellow engineers, sales engineers, professional meetings, trade literature, books, and progressive magazines such as the one you are now reading.

James G. Kippton

Achieving Stable High-Frequency Design With the Mesa Transistor

Considerable differences of opinion exist regarding the "when" and "how" of unilateralization of high-frequency transistor amplifier stages. Donald Paterson feels that his suggested design procedure, unilateralization by mismatching, will permit the design engineer to directly determine stability and performance from manufacturers' data sheets.

Donald G. Paterson
Semiconductor Products Div.
Motorola Inc.
Phoenix, Ariz.

STABILIZATION of cascaded high-frequency transistor amplifiers by neutralization methods is generally costly, time-consuming, and optimized for only one frequency. By introducing deliberate interstage mismatch, lower net gain per stage is realized but unilateralization can be achieved even in wideband applications.

A basic approach to the matching technique involves the calculation or measurement of the forward gain and reverse attenuation of an amplifier stage; a criterion is then established such that the reverse gain numerically must exceed the forward gain by a margin large enough to ensure stability.

The high frequency equivalent circuit of a Mesa transistor becomes increasingly complex as the operating frequency rises. The parameters listed in Table 1, together with the power gain and noise figure of Fig. 1, illustrate the type of performance typical of this device. The 8 db per octave reduction in gain is explained by the 6 db per octave fall-off in current gain, Fig. 2, and an approximate 2 dv per octave loss incurred by the changing impedance ratio of the unit. Plots of the change in input and output impedance respectively with both frequency and collector current are given in Figs. 3 and 4. Two equivalent circuits with typical parameters and operating conditions are shown in Fig. 5.

Table 1. General Electrical Characteristics of 2N700 UHF Mesa Transistor

Maximum Collector to Emitter Voltage	(at 100 μa)	30 v
Maximum Emitter to Base Voltage	(at 100 μa)	0.5 v
Maximum Collector Dissipation in Free Air Derate 1.0 mw/C above 50 C		50 mw
Collector Cut-off Current	($V_{CB} = -12$ v) ($I_E = 0$)	1 μamp
Collector Capacitance	($V_{CE} = -6$ v) ($I_E = 0$)	0.8 $\mu\mu$f
Small Signal Current Gain	(1 kc $V_{CE} = -6$ v) ($I_C = 2$ ma)	20
Small Signal Current Gain	(100 mc $V_{CE} = -6$ v) ($I_C = 2$ ma)	5
Base Connection Resistance		50 ohms

Basic Design Problem

As operating frequency increases, one of the basic problems of high-gain amplifiers is that of stability. The emitter-collector capacitance, although minimized in the Mesa construction, causes components of signal current to feed back from output to input, and given the proper conditions of gain and phase, produces regeneration. This signal transfer, in the reverse direction to the desired signal flow, may be represented as a reverse transfer impedance. A well-designed amplifier stage will maintain a low forward-transfer impedance and a high reverse-transfer impedance. This ratio of reverse-to-forward transfer impedances then becomes a useful measure of the design stability.

Many designers feel a value of at least 10 db to be minimum for this ratio. For example, an amplifier with 29 db of forward power gain should have at least 39 db attenuation from output to input to insure stability.

Isolation by Neutralization

While circuits commonly employ feedback neutralization at lower frequencies to cancel the effects of the transistor's bilateral nature, the method becomes difficult to use as frequency increases. Several circuits, however, have been investigated using the 2N700 Mesa transistor with this technique.

The amplifier of Fig. 6 achieves isolation by employing an additional winding to feed back to the input a component of output current equal in

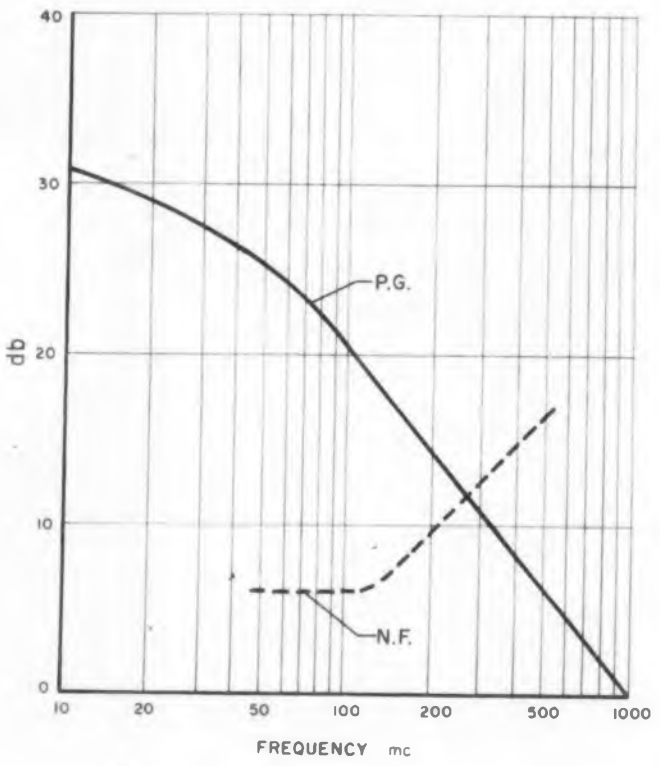


Fig. 1. (left) Neutralized power gain and noise figure vs frequency.

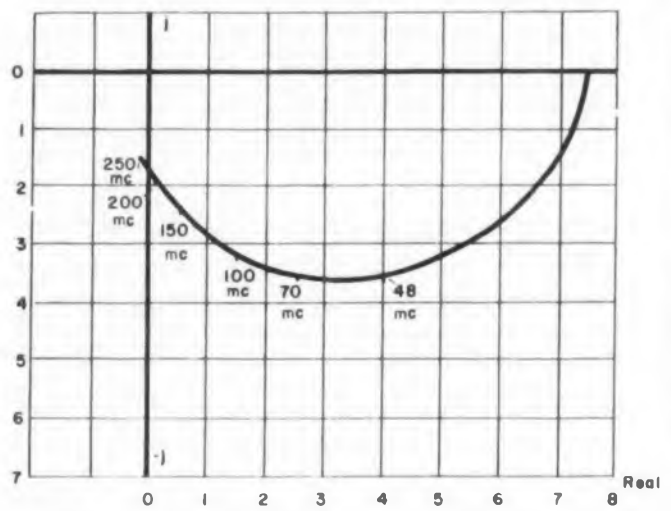


Fig. 2. Magnitude and phase variation of grounded emitter current gain with frequency for the 2N700 uhf amplifier.

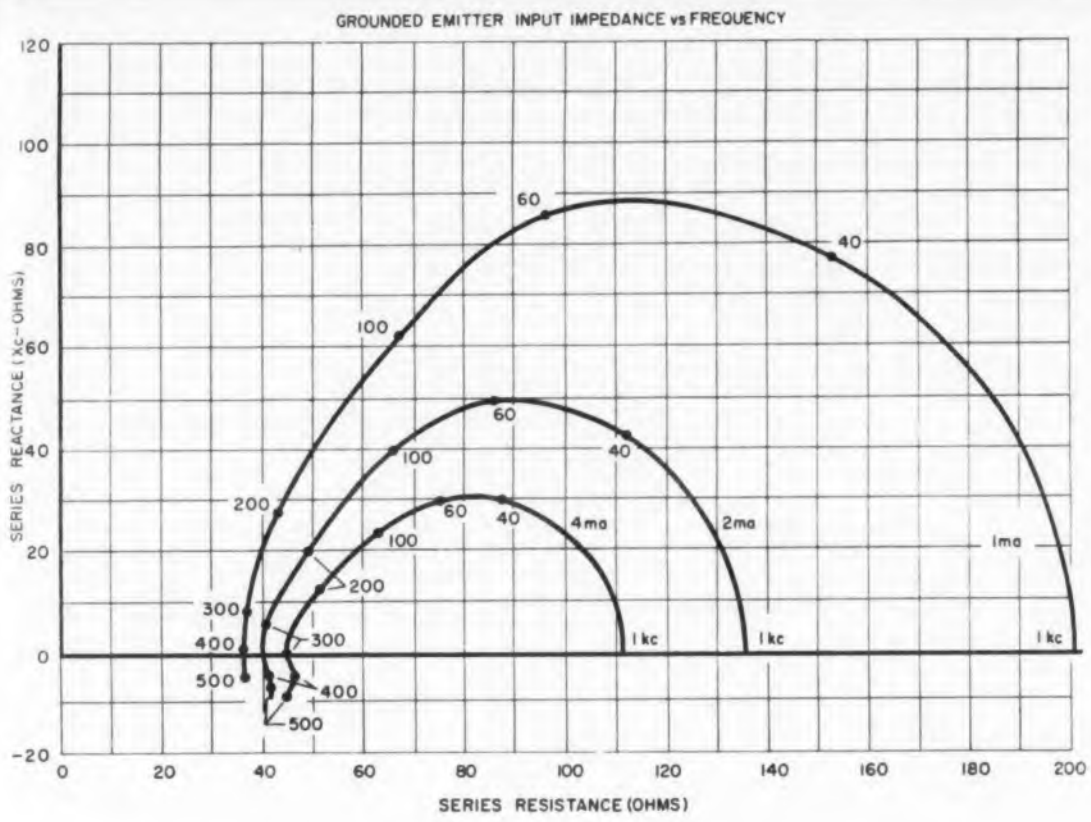


Fig. 3. Grounded emitter input impedance vs frequency.

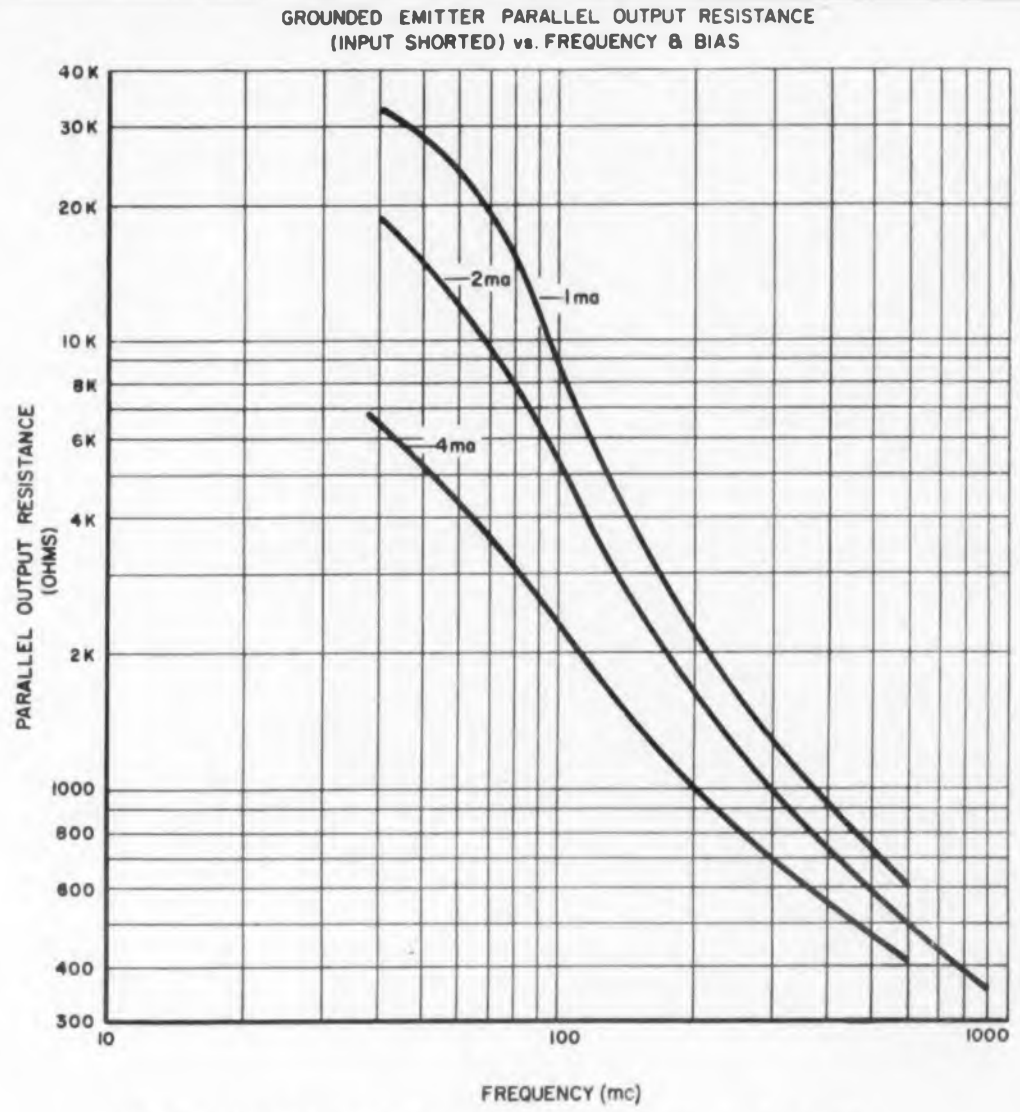
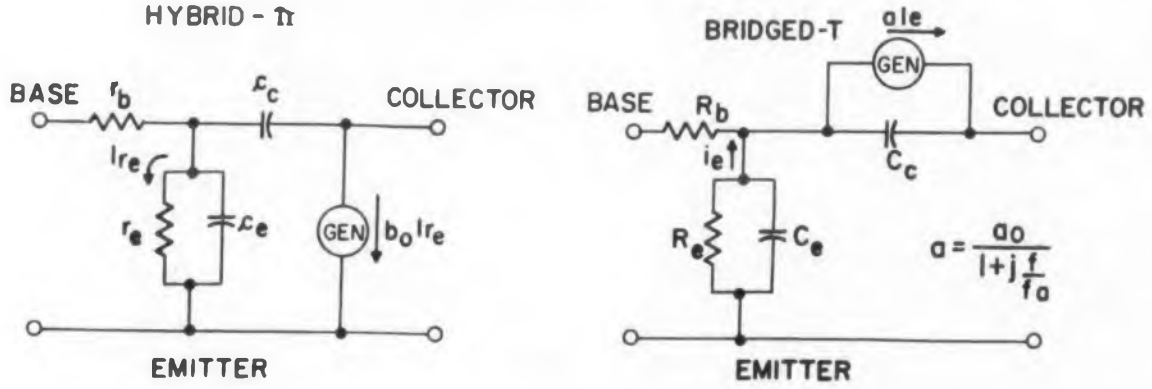


Fig. 4. (right) Grounded emitter parallel output resistance (input shorted) vs frequency and bias.

Fig. 5. Two equivalent circuits for the 2N700.



magnitude but opposite in phase to the reverse transfer current. The component values shown are chosen for a center frequency of 70 mc and the performance is illustrated in Table 2 and Fig. 7.

Another method of achieving the same end result is illustrated by Fig. 8. Here the bypass capacitor C_3 is chosen so that its impedance through the passband of the amplifier provides a divider network with the reactance of timing capacitor C_2. The equivalent circuit is shown in Fig. 8b. Complete cancellation of the undesired component is difficult, owing to the phase shift produced by R. This circuit is somewhat simpler to construct in practice and, although compensation is not perfect, offers the advantage of economy over the former method.

Isolation by Mismatch at the Interstages

It soon becomes obvious to the designer of high-frequency equipment intended ultimately for mass production that isolation by neutralization is expensive, both from the standpoint of component cost and adjustment time. Wideband amplifiers (that is, circuit Q less than 10) particularly present compensation problems since lumped parameter values change over the passband and the neutralization circuit can be made optimum for only one set of values and frequency. It is possible to reduce the effects of the transistor's bilateral nature and avoid compensation for the large number of lumped elements in the high frequency equivalent circuit by sacrificing gain at the interstage networks. Isolation by this technique is illustrated in Fig. 9 and will be discussed in the following example.

Basically, the problem involves calculation of the forward and reverse power gain in terms of

Table 2. Performance Data for Conjugate Matched and Neutralized 70 mc Amplifier

Emitter Current	I_e = 1 ma	I_e = 2 ma
Forward Gain	21 db	24 db
—3 db points	65.5 mc, 73.5 mc	64.5 mc, 73.7 mc
Reverse Gain	70 mc—42 db 73.5 mc—33 db 64.5 mc—35.3 db	—42 db —33 db —37 db

the transistor's internal and matching impedances. The condition may then be imposed that the reverse gain numerically exceeds the forward by a margin large enough to insure stability (as determined in the previous criterion) and the matching network calculated from the resulting solution.

Consider the circuit of Fig. 10 which represents the passive network seen at the load, approximating the effect of the actual transistor. (The circuit is derived from the equivalent "pi" network of Fig. 5.) The reverse power gain or attenuation is found by impressing a voltage $v_{ce} = V_{ce}\,\varepsilon^{j\omega t}$ at c.

Consider as an actual case a matched single-stage 70 mc amplifier using the 2N700 Mesa transistor, with a source impedance of 100 ohms and a load of 10 k ohms. At this frequency, the impedance of C_c is much greater than the base and emitter impedances, so that very nearly

$$i = \frac{v_{ce}}{X_{Cc}} \tag{1}$$

The current divides in the ratio

$$\frac{Z'_{be}}{Z'_{be} + Z'_{bb} + Z_g} = k \tag{2}$$

The voltage developed across Z_g is then $Z_g \cdot k \cdot i$ numerically, at 70 mc

(3)

$Z'_{be} = 15$ ohms $\qquad Z_g = 100$ ohms

$Z'_{bb} = 50$ ohms $\qquad X_{Cc} = 2280$ ohms

$$k = \frac{15}{15 + 50 + 100} = 0.091$$

$$i = \frac{jv_{ce}}{2280}$$

$$|V_{be}| = 100 \times 0.091 \times \frac{v_{ce}}{2280}$$

Then $$\left|\frac{v_{be}}{v_{ce}}\right| = \frac{100 \times 0.091}{2280} = 250$$

Now the attenuation is given by

$$\frac{(v_{be})^2}{Z_g}\,\frac{Z_L}{(v_{ce})^2} = \frac{(v_{be})^2}{(v_{ce})^2}\,\frac{Z_L}{Z_g} \tag{4}$$

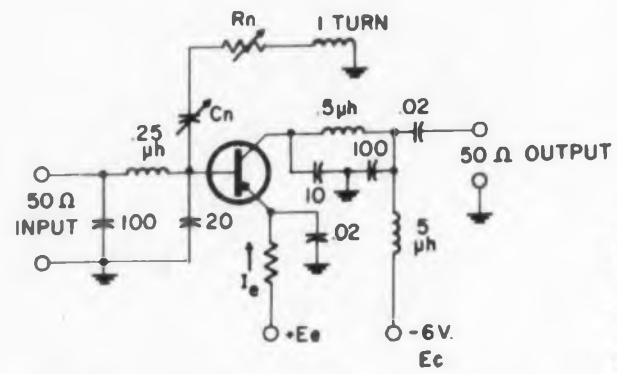


Fig. 6. Conjugate matched and neutralized amplifier for 70 mc using the 2N700.

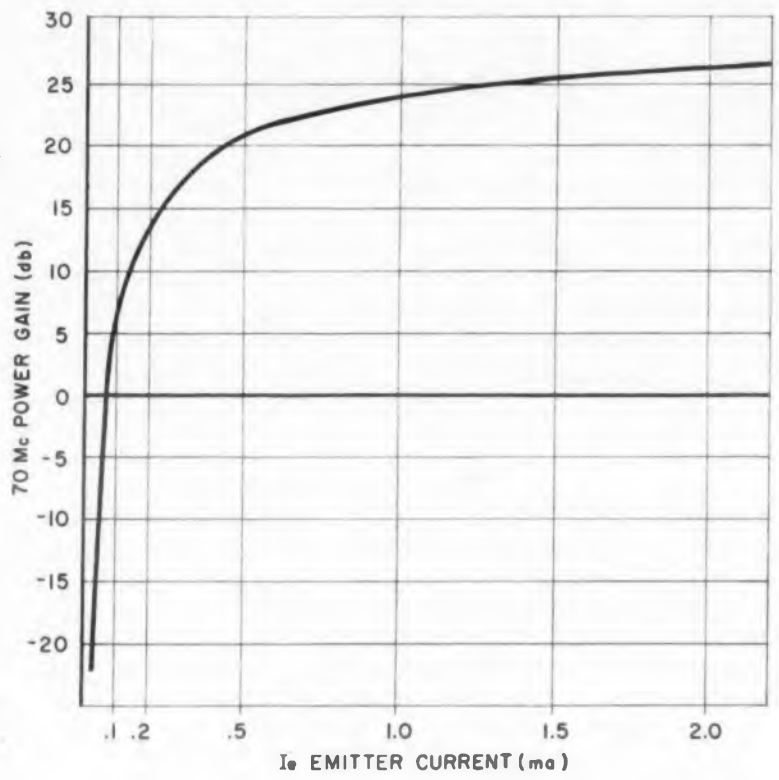


Fig. 7. (right) Plot of 70 mc power gain (db) vs emitter current (ma) for the circuit of Fig. 6.

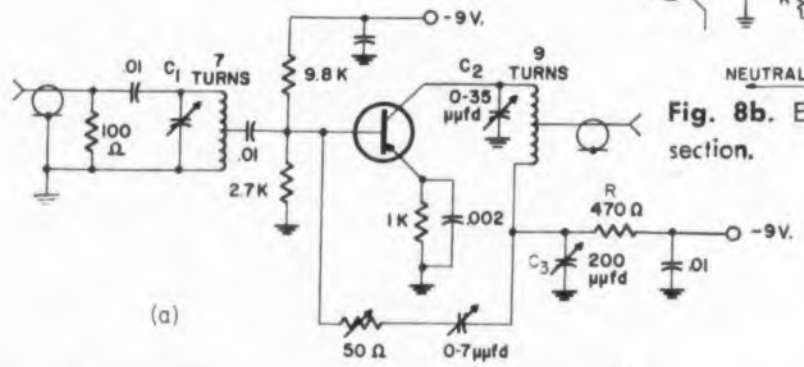


Fig. 8a. Amplifier neutralization by capacitive divider.

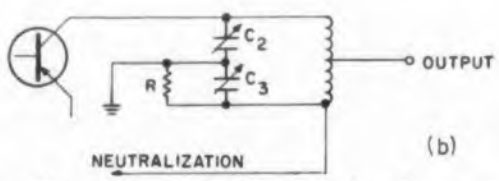


Fig. 8b. Equivalent circuit of output section.

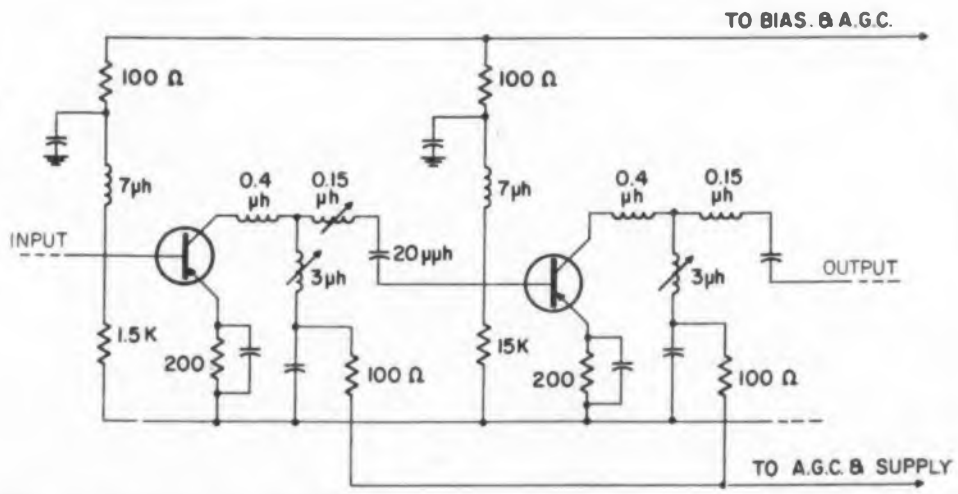


Fig. 9. Isolation by interstage networks.

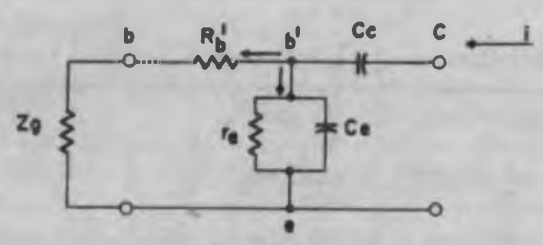


Fig. 10. Approximate equivalent circuit of a high-frequency amplifier.

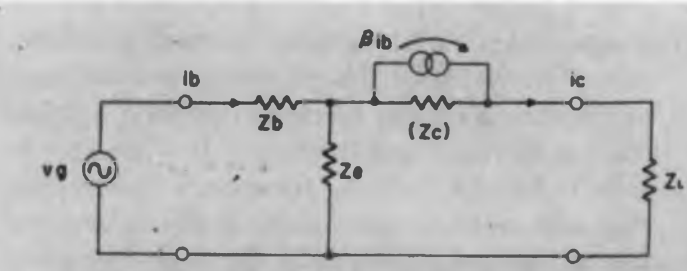


Fig. 11. Equivalent T circuit of a high-frequency amplifier.

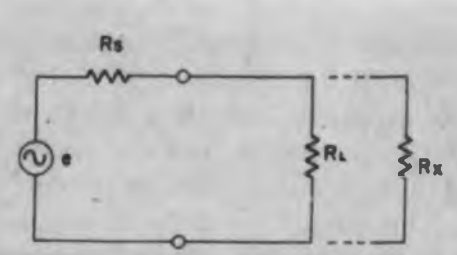


Fig. 12. Simplified circuit for output power reduction.

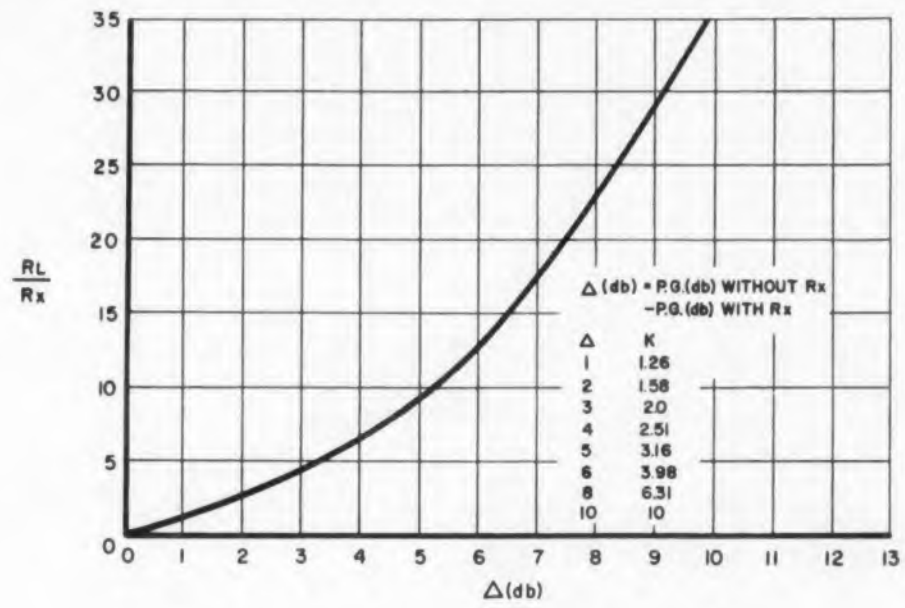


Fig. 13. Reduction in power gain (△-db) with mismatch.

or $$N_{db} = -20 \log \frac{v_{ce}}{v_{be}} + 10 \log \frac{Z_L}{Z_g}$$

$$= -48 + 20 = -28 \text{ db} \qquad (5)$$

Then, approximately, the unneutralized Mesa transistor shows about —28 *db* reverse attenuation at this frequency.

Forward power gain from the standard equivalent circuit shown in Fig. 11 in terms of the load impedance, Z_L, may be expressed by:

$$\text{P.G.} = \frac{i_b^2 \dfrac{(\beta Z_c)^2}{(Z_e + Z_c + Z_L)^2} Z_L}{i_b^2 \left(Z_b + Z_e - \dfrac{\beta Z_c Z_e}{Z_L + Z_e + Z_c} \right)} \qquad (6)$$

Now in the actual circuit,

$$Z_b = R_b = 50 \text{ ohms}$$

$$Z_e = R_e \| C_e = 15 \text{ ohms}$$

$$Z_c = X_{Cc} = 2280 \text{ — } 90 \text{ deg ohms}$$

The output resistance of the 2N700 at 70 mc is about 10,000 ohms. So, assuming matched conditions (with the output reactances tuned out)

$$Z_L = R_L = 10{,}000 \text{ ohms} \qquad (7)$$

Substitution in (6) gives P.G. = 800 = 29.2 db

It is obvious that the criterion of 10 db difference between forward power gain and reverse attenuation is not met in this case. In fact, at 70 mc an unneutralized matched amplifier using the Mesa transistor has tendencies toward instability. If the reverse attenuation is numerically equal to or less than the forward power gain, the circuit becomes oscillatory.

Lowering the source impedance will help in some cases by increasing the reverse attenuation, but the transistor input impedance at 70 mc is already low. The other alternative is to lower the power gain by mismatching the output. The decrease in amplifier power gain with load mismatch has been discussed in the literature.[2] Fig. 13 shows a curve of mismatch ratio to gain loss in db calculated for the 2N700 at 70 mc, the curve, or discrete values of load, necessary for a given gain reduction at a given frequency may be found in the following manner.

Consider the circuit of Fig. 12. Assume the output power is to be reduced by a factor $1/K$ where K is the numeric equivalent of the number of decibels loss in power gain required. If the generator is matched by the load R_L, the new output power is

$$\text{P.G.} = \frac{1}{K} \frac{e^2}{4R_L} \quad \text{when } R_L = R_S \qquad (8)$$

The value of load R_X necessary to decrease the gain by the factor $1/K$ is found by placing a resistance R_X in parallel with load resistance, and solving with Eq. (8)

Then R_X is given by $$\frac{R_L}{2} \pm \sqrt{\frac{K}{K-1}} \qquad (9)$$

In essence, the design procedure involves first checking the stability of the matched amplifier at the frequency in question and determining the reduction in gain required to reach the desired stability. The numeric equivalent of the gain reduction may then be substituted in Eq. 9 to determine the necessary parallel resistance for correct mismatch. The experimental results from circuits designed with this technique show correlation within two to three db of the calculated values for both gain and stability. ■ ■

References

1. V. R. Saari, "Transistor 70 MC IF Amplifier," 1958 Transistor and Solid State Circuits Conference, Philadelphia, Pa.
2. L. Arguimbau, R. Adler, "Vacuum Tube Circuits and Transistors," 1956, Wiley.

Selection of Alloy Tubing for Glass Sealing

Malcolm W. Keenan
Superior Tube Co.
Norristown, Pa.

Solid pins, tubular pins, ribbon and wire are generally used for glass-to-metal sealed feed-through terminals. Headers with tubular pins are sometimes preferred, since the glass-sealing alloys available are generally not good electrical conductors.

With the hollow-tube pin, a lead wire is fed through to carry current. The inside extension of the tube can be held to a minimum, since the lead wire is fed directly through without an interior joint being made.

Mr. Keenan includes a table of coefficients of expansion for glass-sealing alloys and outlines the considerations for selecting these alloys.

SEVERAL METHODS are used to bring metal tubing in contact with glass: an *inside seal*, in which the metal is enclosed or surrounded by glass; an *outside seal*, where the glass is surrounded by metal; and the *inside-outside* seal, in which glass covers both the inside and outside of the metal.

Tubular seals are further differentiated as *normal-edge* and *thin-edge* seals. The normal-edge ones require a good match in thermal expansion of glass and metal. Thin-edge seals—made by tapering the end of the tube in contact with the glass to a feather edge—permit a wider variation, because the thin metal yields during expansion and contraction.

Expansion and Other Factors

The principal factor governing the selection of alloy for pins is the coefficient of expansion in relation to the glass in the seal. Thermal expansions for 12 glass-sealing alloys are shown in Fig. 1. The mean thermal expansion coefficients for the same alloys are listed in Table 1, along with the chemical composition and mechanical and physical properties. If the expansion curve of the glass is available, the curves of Fig. 1 are more useful than the coefficients listed in the table, however.

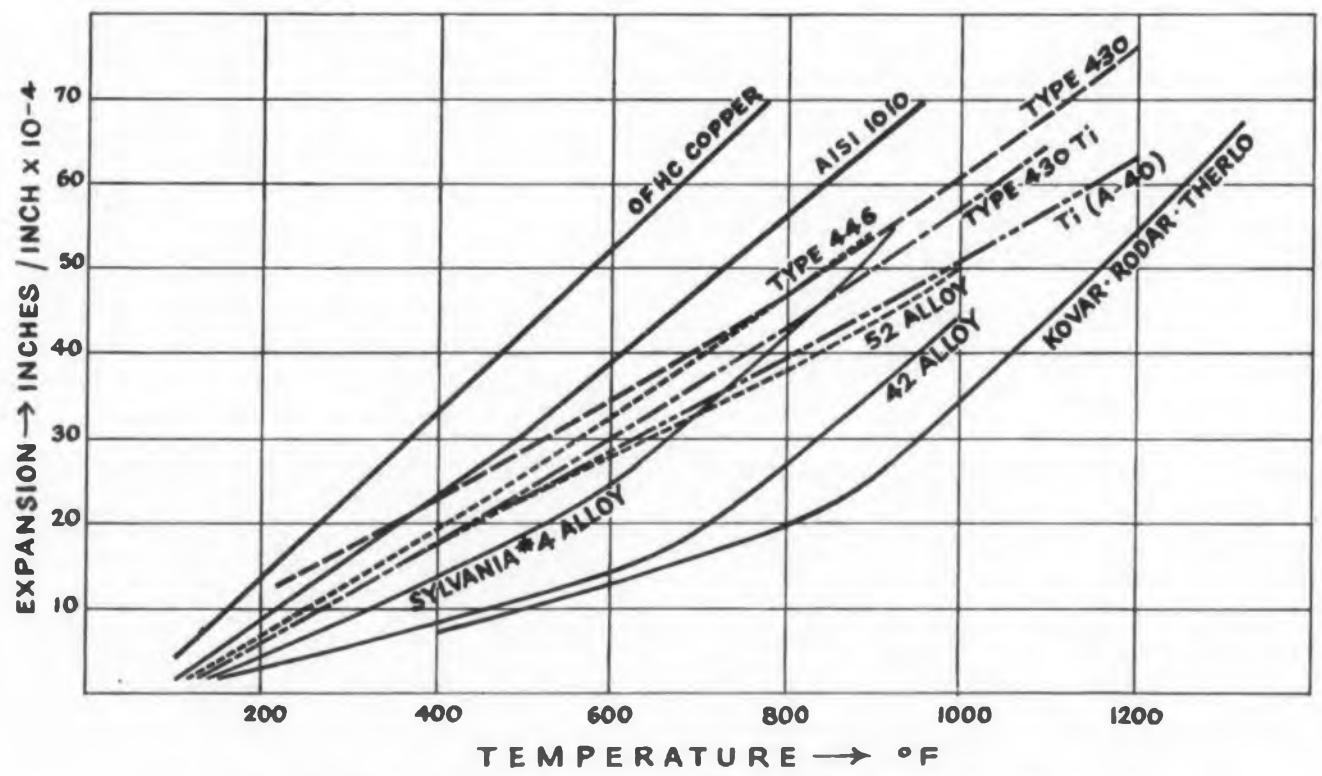


Fig. 1. Thermal expansion curves for 12 standard glass-sealing alloys.

As noted above, the effect of different coefficients of expansion between glass and metal can be minimized by giving the tubing a thin edge. But since this is an additional production step, it should be avoided if possible.

Other considerations in selecting an alloy are strength especially if the tubular element has to support tube parts); thermal conductivity; ease of fabrication and machining; ease of cold welding or crimping; ease of welding, soldering or brazing; magnetic permeability, and oxidation and corrosion resistance. Figures for the first three properties are given in Table 1.

Since we are talking about tubular rather than solid pins, electrical conductivity is not a factor.

Types of Alloys

Here are alloys from which to choose:

■ ***Iron-Nickel-Cobalt Alloys.*** *Kovar, Rodar and Therlo:* All three are practically identical in chemical composition. Their thermal expansion curve is a very close match for certain hard glasses. Their oxides fuse into the glass, forming a vacuum-tight chemical bond. They are readily machined, welded, soldered and brazed. These alloys are used for nearly all types of glass-metal seals and for sealing high alumina ceramics in ceramic-to-metal seals. They resist attack by mercury.

■ ***Nickel-Iron Alloys.*** *#42 Alloy:* Its coefficient of expansion makes it suitable for use with soft glasses. *#52 Alloy:* Its coefficient of expansion is about the same as that of Forsterite type ceramics and several commercial glasses. With a high magnetic permeability at both low and high-flux densities, it is popular for use in sensitive magnetic applications and in thermostats.

■ ***Nickel-Chromium-Iron Alloy.*** *Sylvania #4:* Its coefficient of expansion is well-matched to

Composition and properties of glass-sealing alloys

Material	Chemical Composition	Temper	Tensile Strength X 1000 psi	Yield Strength X 1000 psi	Elongation % in 2 in.	Mean Linear Thermal Expansion in./in. x 10^{-7}	Thermal Conductivity Cal./CM^3/Sec/°C	Remarks
Kovar Rodar Therlo	Ni 29.0% nominal Co 17.0% nominal Mn .50% max. Sl .20% max. C .06% max. Fe Remainder	1 2 3	80 max. 85-105 105-125	40-60 60-75 75-90	40-25 24-10 10-3	50.3-53.7 (30-450C)	0.0395	Hard Glasses
42 Alloy	Ni + Co 40.5-41.75% Mn 1.00% max. Si .15-.35% C .10% max. Fe Remainder	1 2 3	82 max. 95-115 115-140	40 max. 45-65 70-90	30-40 15-25 12-3	53 (20-400C)	0.038	Soft Glasses
52 Alloy	Ni + Co 50.0-51.0% Mn .60% max. Si .30% max. C .10% max. Fe Remainder	1 2 3	85 max. 85-105 105-125	40 max. 45-65 70-100	30-50 15-28 12-3	95 (20-400C)	0.04	Soft Glasses Ceramic Seals
Sylvania #4	Ni 41.50-42.50% C .07% max. Mn .15-.25% Si .15-.30% Cr 5.40-5.90% Al .15% max. Fe Remainder	1 2 3	75 max. 75-95 95-140	40-55 60-80 80-95	30-40 12-25 10-2	85 (25-300C)	0.032	Soft Glasses
430	C .12% max. Mn 1.00% max. Si .75% max. Cr 16.00-18.00% Ni .50% max. Fe Remainder	1 2 3	85 max. 82-96 98-112	40-55 60-88 82-95	40-25 24-11 13-5	62 (20-500C)	0.057	Soft Glasses
430 Ti	C .10% max. Mn 1.00% max. Si 1.00% max. Cr 16.00-18.00% Ti 5 x C min. Fe Remainder	1 2 3	85 max. 82-96 98-112	40-55 60-88 82-95	40-25 24-11 13-5	61 (20-500C)	0.057	Soft Glasses
446	C .20% max. Mn 1.50% max. Si .75% max. Cr 25.00-30.00% Fe Remainder	1 2 3	95 max. 98-115 118-135	45-75 70-90 85-105	35-20 22-10 14-4	105 (25-300C)	0.06	Soft Glasses
Titanium (A-40)	Si .10% max. Fe .25% max. Mn .15% max. N .05% max. C .10% max. Ti Remainder	1 2 3	80 max. 75-95 90-115	35-60 50-75 75-95	35-22 20-7 15-5	97.2 (20-426C)	0.036	Ceramic Seals
MT-1010	C .05-.15% Mn .30-.60% Si .10% max. Fe Remainder	1 2 3	57 max. 58-70 72-87	28-40 45-62 60-78	45-35 28-14 17-15	125 (25-300C)	0.108	Soft Glasses
OFHC Copper	Cu + Ag 99.9% P .015-.040%	1 2 3	40 max. 42-52 52-65	— 28-40 38-47	45-30 32-15 17-15	165 (25-300C)	0.92	Soft or Hard Glasses with thin Edge Seal

Mechanical properties are for tubing with 1/8-inch OD by 0.015 wall and larger. Elongation values are the same as expected from tubing where wall thickness is within 6 to 20 per cent of the OD. Temper designations are: *1.* fully annealed; *2.* half-hard; *3.* full-hard.

certain soft glasses. Its thermal conductivity is the lowest of any of the 12 standard glass sealing alloys listed in the table.

■ ***Stainless Steels.*** *AISI Type 446:* A high chromium iron ferritic stainless steel used with soft glasses. It has the highest heat resistance of the chromium irons used for glass sealing. Welding is difficult because the result tends to be large-grained and rather brittle. *AISI Type 430:* With less chromium content than Type 446, it is more readily fabricated and is easier to work. It is used with soft glasses.

Thermal and electrical conductivity is slightly better than for Type 446. Type 430 requires special care to avoid coarse-grain welds of low ductility. *AISI Type 430 Ti:* Properties are the same as for Type 430, but welding has been improved with the addition of titanium.

■ ***Titanium.*** The coefficient of expansion for titanium is a very close match for that of Forsterite type ceramics. Titanium is also used as a bonding agent in ceramic-to-nickel seals. Because it absorbs nitrogen, hydrogen and oxygen at elevated temperatures, titanium is used as a getter inside electron tubes. It has very good corrosion resistance and is a better thermal conductor than either Type 446 or Type 430 stainless steel.

■ ***Low Carbon Steel.*** *AISI Type MT-1010:* This steel is easily bent and flared. It is used as inserts in the headers of button stems. When used

Table 2. Commercial Tolerances for glass-sealing alloy tubing*

Outside Diameter Range (in.)	Nominal OD (in.)	Nominal ID (in.)	Nominal Wall (+)
Up to, but not including 3/32 OD	+0.002, −0.000	+0.000, −0.002	10%
3/32 to, but not including 3/16 OD	+0.003, −0.000	+0.000, −0.003	10%
3/16 to, but not including 1/2 OD	+0.004, −0.000	+0.000, −0.004	10%
1/2 to, but not including 1-1/2 OD	+0.005, −0.000	+0.000, −0.005	10%

for internal seals, it is usually copper or silver-plated to prevent oxidation. Internal seals with Type MT-1010 tubing require high-expansion glasses. External seals can use glass with a rate of expansion different from that of the metal, since stresses in the glass are all compressive.

■ ***Copper.*** *OFHC Copper:* The letters stand for "oxygen free high conductivity." Since its expansion coefficient is far above that of any glass, thin-edge seals are necessary. With the thin-edge seal, copper can be used with either soft or hard glasses. Because of its high conductivity it has been widely used for anodes of air-cooled transmitting tubes. It is readily cold-welded, permitting quick closing of the ends of tubes.

Temper Influences Properties

Selection of a glass-sealing alloy may require the weighing of a number of properties, with a final compromise on the material that gives the most desirable combination. The mechanical properties are influenced by the temper in which the alloy is furnished. The effect of temper on tensile strength is shown in Table I.

Temper also has a considerable effect on forming and machining properties and may also affect, to a lesser extent, the other selection factors that have been listed.

The availability of all 12 alloys in three different tempers—fully annealed, half-hard and full-hard—gives more latitude in the selection of an alloy. For example, an alloy may have the desired coefficient of expansion but may be hard to machine. Selection of the right temper may solve that problem.

Size and Length

Most glass-sealing alloys are supplied in standard sizes for small-diameter tubing. Commercial tolerances are listed in Table II. Closer-than-commercial tolerances can be supplied when required.

Tubing is furnished in random lengths or in cut lengths. Commercial random lengths in sizes up to 1/8-inch OD, and thin wall tubes over this OD, are subject to a range of one to 15 feet. Sizes over 1/8-inch OD are subject to a range of five to 22 feet and long random lengths to a range of 15 to 22 feet.

Addenda

The following alloys, listed in this article, are trademarked and registered at the U. S. Patent Office:

Kovar, by Westinghouse Electric Corp. Kovar alloy tubing is stocked and sold through the Stupakoff Div. of the Carborundum Co., Latrobe, Pa.

Sylvania #4, by Sylvania Electric Products, Inc.

Therlo, by Driver-Harris Co.

Rodar, by Wilbur B. Driver Co.

Standard Meters Read Frequency

Almost any circuit in which current or voltage varies with frequency can be used for measuring frequency. This article discusses a new design which results in a frequency meter offering flexibility, economy and uniformity.

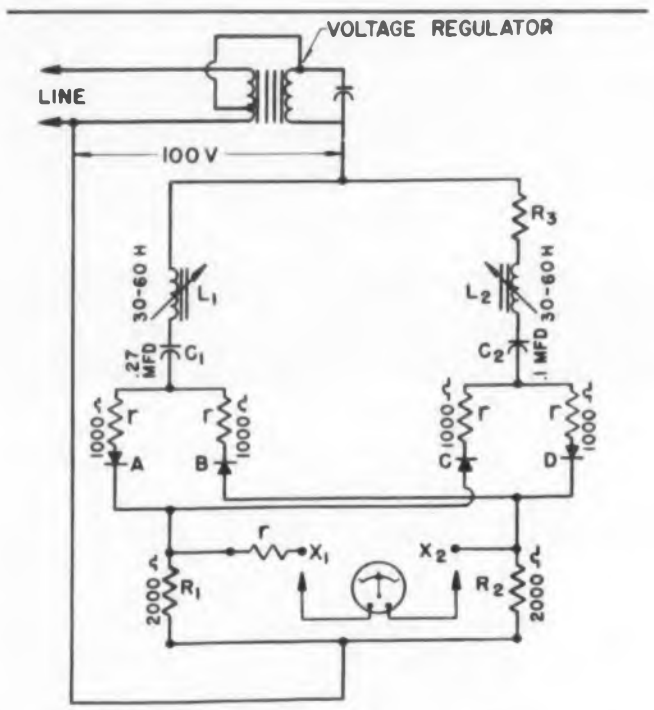


Fig. 1. Circuit of a non-reed frequency meter designed to use standard indicating instruments.

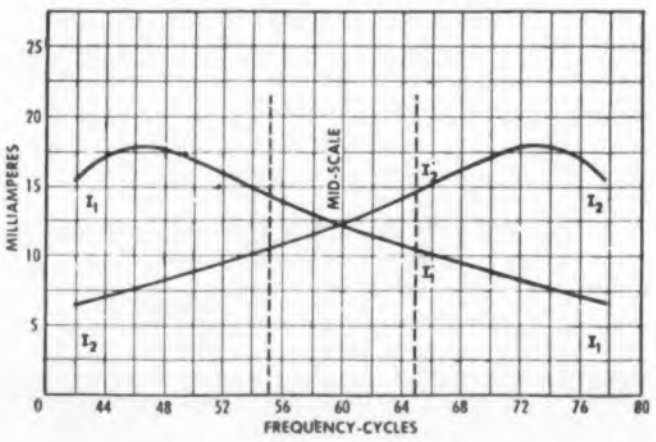


Fig. 2. Relationship of frequency and current.

FREQUENCY meters have been developed to combine in one unit a device that can be used with all sizes and classes of instruments and, as far as possible, to use standard non-reed instruments for indicating.

A frequency "transducer" developed by U. L. Smith, design engineer with Westinghouse Electric Corp., Newark, N.J., uses a circuit that relates frequency to dc voltage.

Any conventional dc voltmeter, either indicating or recording with electrical characteristics selected and adjusted to the output and with scale marked in cycles, may be used to measure its output.

A device of this type provides several functional advantages:

- It permits the use of conventional dc indicating or recording voltmeter merely by selecting and adjusting the instrument's calibrating resistance to match the output of the transducer.
- Any size or shape of instrument may be used and the performance is well within ASA standard requirements.
- Ranges as narrow as 59 to 61 cps can be built, but broad ranges such as 50 to 70 cps are equally practical.
- The instrument can be furnished for any basic frequency such as 50, 60, or 400 cps.
- Only one size and type of meter circuit is needed.
- The scale is nearly uniform over the entire range.
- It eliminates the necessity for tooling, building, servicing and stocking mechanisms that are used only for frequency meters.

The circuit, Fig. 1, is completely separate network. Either an indicating or recording instrument is connected to the point X_1 and X_2. The instrument and the circuit are calibrated together to make a frequency meter.

Each branch of the circuit contains inductance, capacitance, and resistance in series. The value of each component in Fig. 1 is for a 60 cps circuit. Branch *1* is adjusted for resonance below the operating range and branch *2* is adjusted for resonance above the operating range. Currents through the circuits are shown in Fig. 2. The null or balance point is located at the 60 cps point in this figure but this balance point can be located any place within the range by changing the positions of the resonant points.

Easily Calibrated

In the circuit described, this is done by varying the inductances L_1 and L_2. These two inductances are adjustable, by screwdriver, over a range of 30 to 60 h. They afford a flexible means of widely adjusting the circuit. For broad frequency coverage, the resonant points are set far apart. For narrow frequency ranges, where it is necessary to obtain more sensitivity from the circuit, they are set closer together. They also provide a ready and quick means of calibrating the circuit to a fixed output by changing the resonant points slightly.

The currents I_1 and I_2 are rectified so a dc instrument can be used. The instrument actually measures the difference in voltage produced in R_1 and R_2. At the balance point the voltages are the same across these resistors and there is no voltage across the dc instrument. A red mark is put on the instrument dial at this point and the pointer must be set to this mark before energizing. With a

Fig. 3. Frequency meter being adjusted for use with a dc indicating voltmeter which will be calibrated to read frequency in cps.

change of frequency, one of the currents I_1 or I_2 will increase and the other decrease. The voltages across R_1 and R_2 will be unequal and the dc instrument will read right or left, depending on which of the two currents I_1 and I_2 is larger. These resistors R_1 and R_2 affect the output and different values can be used, depending on the output desired. In the circuit shown these resistors are fixed at 2000 ohms and were selected to provide enough output to operate a direct reading recorder as well as indicating instruments. For a 55 to 65 cps range, the output is approximately 1-1/2-0-1-1/2 volts across a load of 3000 ohms. The four 1000 ohm resistors shown in Fig. 1 limit the current in one branch from being shunted into the other branch.

Can Change Frequency

The circuit shown is a basic 60 cps design and will cover ranges from 45 to 70 cps, such as 50 to 70, 59 to 61, etc. The instrument or recorder used is a 0.5-0-0.5 ma and the different ranges are obtained by adding resistance (r) in series with the instrument. For other basic ranges, such as 400 cps, it is necessary to change the inductances and capacitors, but the resistors, rectifiers, and instruments remain the same and the output is the same. The inductances and capacitors vary as the inverse of the basic frequency and for 400 cps they will be 60/400 of the values shown. These values may be varied so standard value capacitors can be used, as long as the relation $\omega L = 1/\omega C$ is met for the resonant points.

In circuits of this kind, the dc output is influenced by changes in line voltage except at the null point where the output voltage is zero. To make the entire scale independent of voltage charge, the transducer contains a saturation-type regulator that holds the voltage constant over a range of 100 to 130 volts.

Fig. 3 shows the transducer without cover. All the components, with the exception of the inductances, are mounted on a printed circuit. The two inductances are adjustable by screwdriver, as indicated by the arrows in Fig. 1; and openings are provided in the shields and cover so it can be done after the unit is completely assembled. Fig. 1 also shows the resistor (r) that goes in series with the instrument and is adjusted to the range desired. It is placed in the transducer so that a standard 0.5-0-0.5 dc milliammeter can be used on all ranges. ■ ■

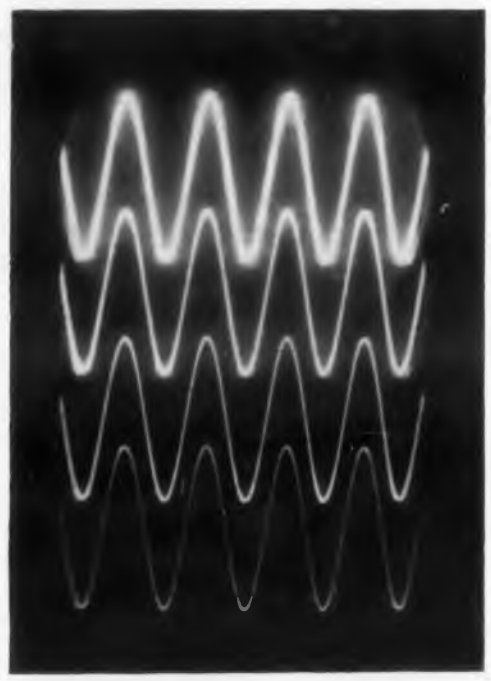
Oscilloscope Trace Recording With Polaroid Land Photography

Part 2. Camera and Oscilloscope Settings

This is the second of a three-part series on oscilloscope trace recording. The first part, which appeared in the September 16th issue of ELECTRONIC DESIGN, covered Films and Cameras. The final part will cover Special Techniques, Tube Phosphors, and Projection Films.

Kemon P. Taschioglou
Polaroid Corp.
Cambridge, Mass.

Hy P. Mansberg
Airborne Instruments Lab.
Mineola, L. I.



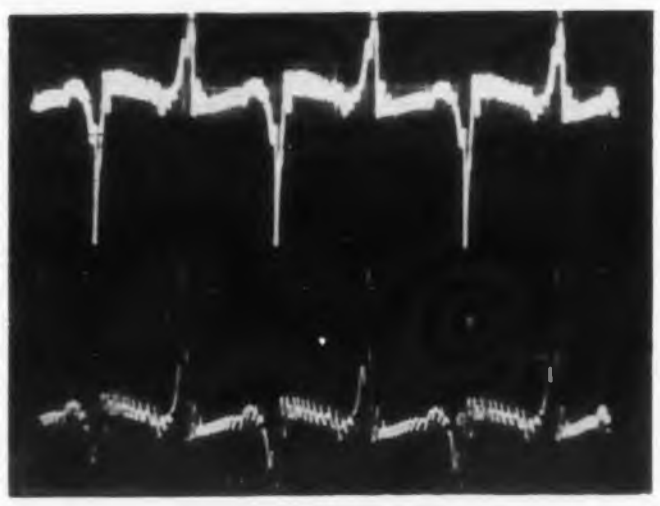


Fig. 4. (left) Top trace overexposed at f/4, 1/25 sec. Lower trace slightly underexposed at f/16, 1/50 sec. Intensity remained unchanged.

Fig. 3. (left) Exposures over a wide range produce acceptable pictures. Aperture settings, reading from top to bottom, were f/2.8, f/5.6, f/11 and f/22. Shutter speed constant at 1/100 sec. Intensity was set for comfortable viewing of sharp 30 kc trace on P-11 phosphor.

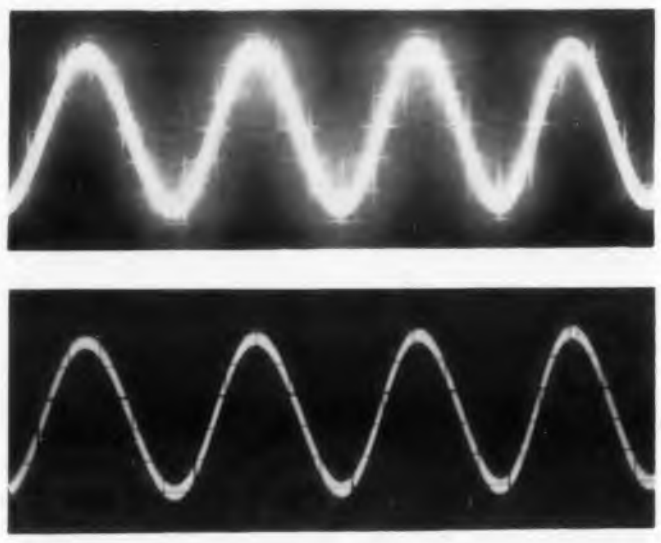


Fig. 5. Blooming of upper trace (as it appeared to the eye) is eliminated in lower trace by deliberate underexposure. Upper trace exposed at f/1.9 for 1/100 sec. Lower trace shot at same speed at f/16.

KNOWING THE EFFECTS of camera settings, cro settings, and of the signal waveform can save an engineer time and film. It can help him rapidly select the best exposure for a given trace.

Camera Setting

Most scope cameras have conventional shutter and aperture settings. F/numbers usually range from f/1.9 to f/22. The f/numbers commonly listed on the lens are in a progression such that, with each increase in f/number, the amount of light reaching the film is cut in half.

Similarly, shutter speed settings are marked off in progressive half-time intevals, from one second, 1/2 second, 1/4 second, down to 1/100 of a second. Just as in conventional photography if the shutter speed is doubled, for example, from 1/25 to 1/50 second and, simultaneously, the aperture setting is doubled from f/8 to f/5.6, there is no change in the exposure (total light reaching the film).

The exposure of the film is the product of the size of the opening through which the light passes and the length of time the shutter is open. Changing exposure by a factor of two, i. e., doubling or halving either aperture or time, changes exposure by one "stop".

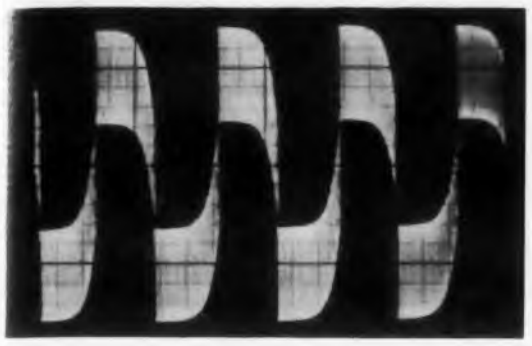


Fig. 6. Left signal has slow modulation, gave blurred record when exposed for 1/2 sec. Increase of shutter speed to 1/50 gave well-defined right trace. Aperture setting changed from f/16 to f/4.

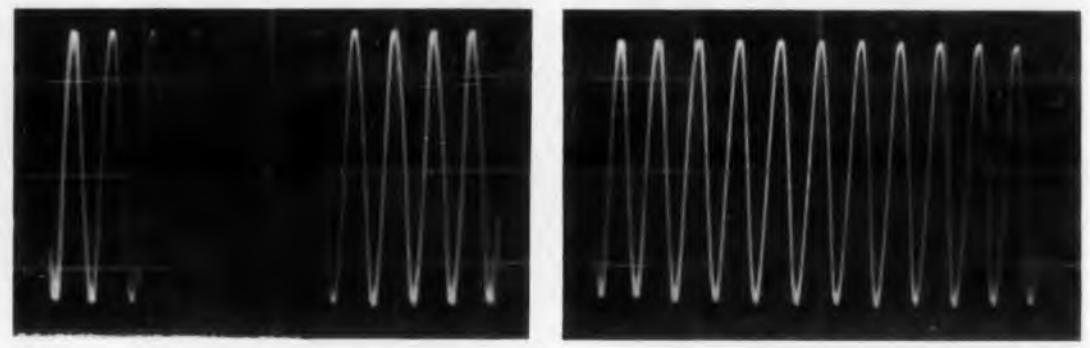


Fig. 7. Part of left trace was lost due to shutter being open long enough (1/10 sec.) for only two to three sweeps. Keeping the shutter open longer (1/2 sec.) for right trace yielded uniform trace intensity.

The "B" or bulb setting and the "T" or time setting are most often used in recording single transients. The technique requires holding the shutter open and waiting for the transient to appear. Exposure for single transients is usually controlled by varying only the aperture setting.

Range of Exposures. For most repetitive traces, an acceptable picture of a trace is usually possible within a range of exposure settings of four to six "stops". All of the traces in Fig. 3 were taken with the same beam intensity, set for comfortable viewin on a P-11 phosphor.

Notice that with a maximum exposure (upper trace) the film begins to record spot halo objectionably. The trace appears to "bloom" as if the intensity setting were too high. From this point of "blooming" to the other extreme of a too-faint trace, there are about six stops.

A medium intensity trace, when overexposed, does appear to bloom, while an underexposed trace will indicate fine detail. This point is illustrated in Fig. 4.

Incidentally, when the intensity setting is too high and visible blooming actually appears on the tube face, it can be reduced in the picture by cutting down the exposure, as illustrated in Fig. 5.

Aperture and Shutter Speed. In all the examples given, shutter speed and aperture controls can be varied together to achieve different effects on the film. Each can be changed to compensate for required changes in the other. Together, they cover a wide range of exposures needed to record variations in image intensities with different films.

Aperture control is the only variant used in recording transients, because the shutter is usually left on the "Bulb" or "Time" setting. In general, for both transients and stationary traces, it is desirable to keep aperture to a minimum for sharper focus and less optical distortion.

Precise selection of shutter speed becomes important in recording continuously varying traces, signals with a slow jitter, and signals requiring very low sweep repetition rates. In Fig. 6, for example, a severely jittering signal was clearly defined in the picture by shortening the time setting from one second to 1/50 second.

When very low sweep rates are used, the camera shutter must remain open for at least the time of one sweep, or an undesired blank space may occur in the recording. Even if the shutter is open slightly longer than the sweep duration, uneven exposure of the trace may result, as shown in Fig. 7. As a general rule, exposure time should be at least five to ten times the sweep duration for uniform recording.

Scope Choice

A cro should be chosen for design features such as amplifier sensitivity, bandwidth, stability, sweep range, sync characteristics, cost, etc. But, other factors being equal, these are the two most important features affecting cro photography:

1. Accelerating Potential. Cro's with higher accelerating potentials usually produce greater spot intensity and more actinic light output. This is particularly important when recording high speed transients. Wideband cro's with accelerating potentials greater than 3 kv are usually needed, both to see, as well as to record fast-moving transients. As a guide, one can assume that the amount of actinic light available under given signal conditions varies roughly as the accelerating potential.

2. Tube Phosphor. Polaroid° Land films are recommended for recording with all of the commonly used crt phosphors. Some are more effective than others in photo recording. Some of these phosphors are used with filters for observation and for photo recording. Some have two color outputs, an initial emission resulting from the direct flash of the electron beam and the afterglow which remains after the beam has passed.

The selection of tube phosphors and use of filters are discussed in more detail in Part 3 of this article.

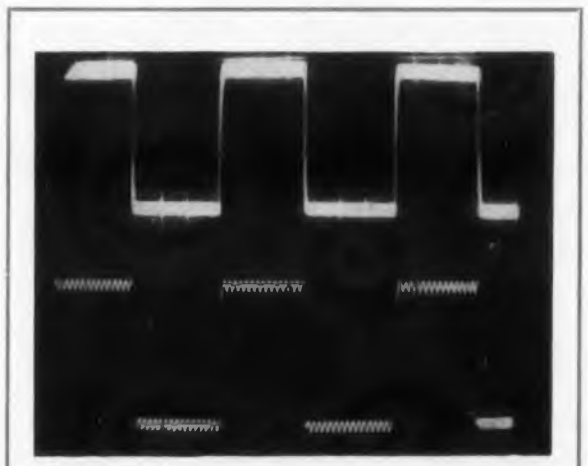


Fig. 8. Upper trace exposed at f/1.9, 1/10 sec. to show rise time while losing detail on flat top. Exposure decreased eight stops to f/11, 1/50 sec. to show flat top. Rise time was underexposed.

Cro Settings and the Signal

Intensity. The intensity setting on the cro controls the beam current and, thus, can have the greatest effect on proper photographic exposure. Slight changes in intensity settings, almost unnoticeable to the eye, can have the same effect as the change of one or two "stops" in camera settings. However, the film latitude yields good exposures within a wide range of intensity settings.

Spot Size. Cro's which produce smaller and more uniform spot size over the entire screen area are best for obtaining good resolution and detail. Those with higher accelerating potential generally produce smaller spot diameter, but usually at some sacrifice in the viewing area covered by the entire trace. Naturally, the focus and astigmation controls of the cro should be set for the best spot size and uniformity at any particular intensity setting.

However, it is sometimes beneficial to misadjust the astigmatism controls for optimum focus in one

°Polaroid is a registered trademark of the Polaroid Corporation.

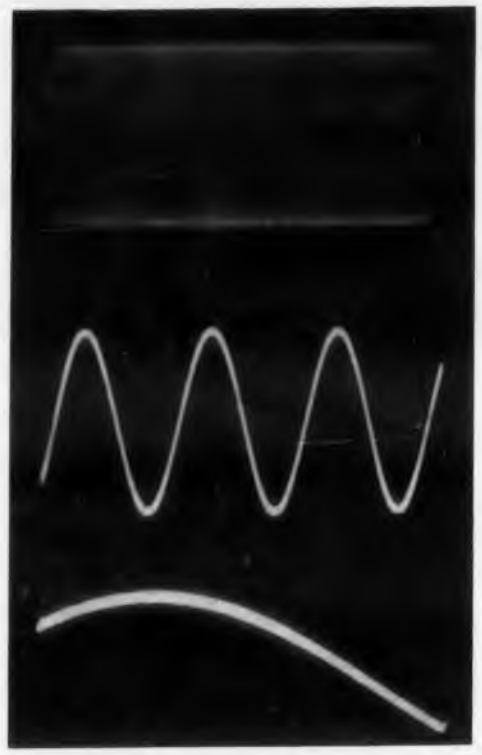


Fig. 9. Only the sweep rate was changed for these three pictures of a 30 kc trace. Top picture shows 16 cycles/in.; middle shows 1 cycle/in., and bottom picture shows 1/16 cycle/in. on the crt. Camera set at f/5.6, 1/50.

Fig. 10. Only the X-gain was changed for these three pictures. A 30 kc trace was expanded from 16 cycles/in. on the crt. Camera set at f/5.6, 1/50.

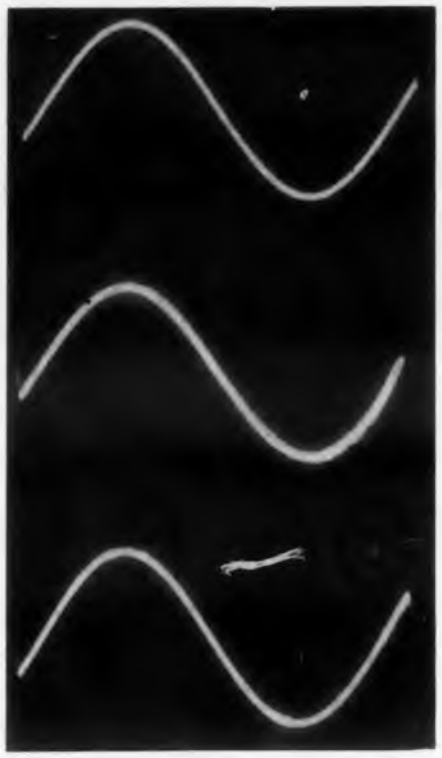


Fig. 11. No change in exposure is seen as signal frequency is increased from 30 kc to 300 kc to 3 mc. Sweep rate was adjusted to maintain 1/4 cycle/in. on the crt. X-gain was held constant. Camera set at f/5.6, 1/50.

Fig. 12. Intensity was too high to record details in the transient on the left. Intensity turned down for picture on the right. Both taken at f/1.9. (Courtesy Avco Corp.)

Fig. 13. Effect of prefogging Type 47 film to increase maximum writing rate. Left transient recorded with no prefogging. Prefogged film used for right transient with same camera and intensity settings. Maximum writing rate was doubled.

coordinate of spot motion. For example, to record a very fast rise time on a square wave pulse, one can misadjust the astigmatism control to favor focus on the vertical position, sacrificing focus on the flat-top portion.

Spot Speed. The exposure produced by the spot varies inversely as the spot writing speed. As the speed of the spot increases, more exposure or higher intensity may be required.

When recording traces with peaks, one must remember that the spot speed decreases near the peaks. The exposure must be selected to catch the interesting portion of the trace. In Fig. 8, a portion of the trace is deliberately under-exposed to increase detail in another portion.

Similarly, increasing the amplitude of either axis will increase the spot speed and lower the brightness. A trace, four inches from peak to peak, may require four times as much exposure as one which is one inch high.

Frequency and Sweep Rates. Changing the frequency or sweep repetition rate of a given signal affects exposure, but not drastically, as long as a high duty cycle sweep is used. When a repetitive sweep of high duty cycle ratio is used, an increase in sweep speed also results in increased repetition rate. So, even though exposure time per sweep is less, more sweeps occur during this time.

For example, in Fig. 9, the intensity of the 30 kc trace was kept constant, and the sweep rate was increased from 16 cycles per inch on the screen to 1/16 cycle per inch. All traces are readable, yet they could be improved by changes in exposure.

Fig. 10 shows the effect of changing gain to compress the pattern. All traces are made at the same exposure and beam intensity.

Increasing the frequency and changing the sweep repetition rate to produce the same number of cycles on the screen would have no effect on the exposure—again, as long as a high duty cycle sweep is used. In Fig. 11, there is no noticeable change in exposure of the 30 kc, 100 kc, and 3 mc traces; intensity and gain controls were held constant.

Occasionally, a high frequency signal has to be displayed on the cro with a very low duty cycle sweep, rendering the signal practically invisible to the eye. The maximum exposure with high speed Type 47 film will often record such a low duty cycle trace.

Recording Stationary Traces

The technique for recording stationary patterns is straightforward. If the trace can be seen, it can be photographed. Actually, with Type 47 film, one can photograph traces invisible to the eye under normal conditions. Here are some general rules:

1. Settings on the cro should provide the sharpest trace and most comfortable viewing that brings out the details of greatest interest.

2. Whenever possible, apertures should be small—down to f/5.6 or f/8 (higher f/numbers)—to increase depth of field, to improve camera focus, and to reduce optical aberrations.

3. With slow sweeps, the shutter speed should be at least low enough to record a single full sweep and preferably five to ten sweeps if no jitter of drift is apparent.

4. Exposure time should be minimized to reduce fogging or blurring caused by drift or undesirable modulation.

It is impractical to determine precisely the combined effect of intensity settings, spot speed, spot size, etc. The choice of best exposure values is made, at first, by trial and error. But it very soon becomes almost intuitive.

As a rough guide for first exposures, the following can be used:

For Type 42—f/8 at 1/5 sec.
For Types 46, 46-L—f/8 at 1/10 sec.
For Type 47—f/8 at 1/50 sec.

This assumes recording a 50 kc trace with four cycles on a P-11 phosphor. Intensity is set at a comfortable level for viewing with a cro of 3 kv accelerating potential. Camera reduction ratio is 2:1.

Camera settings of two stops either side of the above would, of course, give acceptable pictures.

Recording Transients

Basically, the same considerations apply in recording transients as in recording stationary patterns. Exposure is controlled by varying the aperture, for the shutter is usually held open to record one complete sweep. With a non-repetitive transient (whether controlled or random) there is no choice but to leave the shutter open until the transient occurs.

In general, the spot is positioned on the left side of the screen; the camera shutter is held open with the "B" or "T" setting; the transient is initiated, and the shutter is closed.

With cro's having automatic beam gate circuits, the intensity control is usually turned down so that the spot is invisible, to avoid fogging the film while waiting for the transient. When a transient is initiated, the beam is automatically gated on, brightening the trace at the same time the sweep is triggered.

Because available light from the trace is usually at a premium, trial exposures should be made with the lens aperture wide open. But, of course, intensity and apertures have to be adjusted for best exposures as in recording stationary patterns. Fig. 12 illustrates exposure correction in recording a transient.

Maximum Writing Rate

The term "maximum writing rate" is used to indicate the sensitivity of a particular film for recording transients. Maximum writing rate specifies the maximum linear speed of the crt spot, in a single traverse, that can produce a barely readable record on a film for a particular combination of cro, camera, and settings.

Maximum writing rate is, in a sense, analogous to the ASA exposure index, which is used to indicate the sensitivity of a film for recording daylight scenes. Exposure index and maximum writing rate, however, are not necessarily related.

Most important, ASA exposure indicates are determined from the film's response to daylight or tungsten light, both of which have spectra much different from that of any particular tube phosphor. For very high speed transients, the exposure time is very short (with short persistence phosphors). For extremely short exposures, the reciprocity relationship of brightness and exposure time fails, and the ASA index loses significance.

Furthermore, exposure index is a measure of the exposure required to reach a particular contrast gradient in the film's characteristic curve, while readings for maximum writing rates are retermined in the threshold region of the characteristic curve of the films. The threshold region on a positive print is the region of deepest black.

There are three ways of increasing the maximum writing rates of Land films. All can be very useful when a film is being pushed for its maximum sensitivity. Increasing the maximum writing rate will often reveal invisible portions of a fast trace.

1. Decreasing the Development Time. Developing Land prints only 20 to 30 sec will about double maximum writing rate. The best period is about 20 sec. The picture is removed from the back door 20 sec after pulling the tab. The overall background is considerably lighter and contrast is lowered, but detail can be seen in parts of a fast trace which would not be visible with 45 to 60 sec development.

This method requires no extra effort and could be used at all times when one is shooting high speed transients.

2. Prefogging. Controlled marginal exposure of the film to a light source before exposure to the trace will increase maximum writing rate two to three times as shown in Fig. 13. Prefogging is the most effective single method for increasing maximum writing rate.

Prefogging does not cause as sharp a drop in contrast as underdevelopment, and it is not necessary to prefog enough to lighten the background considerably.

A variety of different procedures can be used to prefog. A convenient method is to point the camera at an Eastman Kodak 10 in. x 10 in. transparency viewer or sheet of ground glass, illuminated with a 15-watt bulb covered with three or four thicknesses of tissue paper. Type 47 should be exposed at f/16 at 1/100 sec. The camera should be far enough away (a foot is sufficient) so that the texture of the tissue paper or ground glass is out of focus, and yet close enough so that the illuminator covers the entire field of view of the camera.

Other easy methods of prefogging can be developed by experiment. One can, for example, point the camera at a light wall or white card with the proper brightness. A reflection brightness reading of 30 candles per square foot from a light source is a good guide.

A handy guide for determining the best combination of exposure and light source is to develop an unprefogged Type 47 picture for 30 seconds. The background gray level in this picture is about the same density as optimum prefogging would create on a picture developed for 60 seconds.

3. Transillumination. When parts of a trace are not quite readable, a print viewed directly over a bright diffused light source such as a 100-watt lamp will render visible very dim or unreadable traces with surprising clarity. Another technique which may come in handy when a fast trace is not readable is to glance at the negative still in the back of camera. Though it will rapidly fog under light, valuable information is often available.

A still greater increase of writing rate can be achieved by combining prefogging and underdevelopment. To keep the background dark enough and to achieve best results, one should develop for a slightly longer period (30-35 sec.), and use the same prefogging techniques.

Table 3 lists the maximum writing rates of Land films for normal development and for prefogging. A guide for prefogging exposure is also given. ■ ■

Table 3. Typical Maximum Writing Rates of Land Films

Film Type	*ASA	Maximum Writing Rate– Normal (cm. per microsecond)	Maximum Writing Rate–Prefogged (cm. per microsecond)	Prefogging Exposure with 30 Candles/ft.^{2} Illumination
42	200	400	700	1/100 sec. at f/8.
46, 46-L	600	490	1000	1/100 sec. at f/11.
47†	3000	(over 3500)	(over 8500)	1/100 sec. at f/16.

Note: Maximum writing rate measurements made on Tektronix 517A cro, 24 kv accelerating potential. Displayed was single 450 mc damped sine wave transient. Camera reduction ratio 1:1 at f/1.9.

*ASA equivalent daylight exposure index.

†Figures extrapolated from results with smaller aperture than f/1.9.

Phase Multilock Receiver

Needs No Local Oscillator

HIGH SIGNAL-TO-NOISE ratio without phase ambiguity for any digital data transmission system results from an unusual receiver design. Input phase modulated signals provide their own phase reference signal: they are rectified, multiplied and divided, until they have the same frequency they came in with and a standard phase.

With the trend toward phase-shift communication growing, because of the extremely narrow bandwidths required, the new system will find application in telemetering, teletyping, remote control and computer digital data transmission.

Developed at the Robertshaw-Fulton Controls Co. of Anaheim, Calif., by Cecil A. Crafts, engineering supervisor, and Maynard McFarlane, research scientist, the phase multilock system is fully coherent. It can transmit pulse code modulation, pulse position modulation and

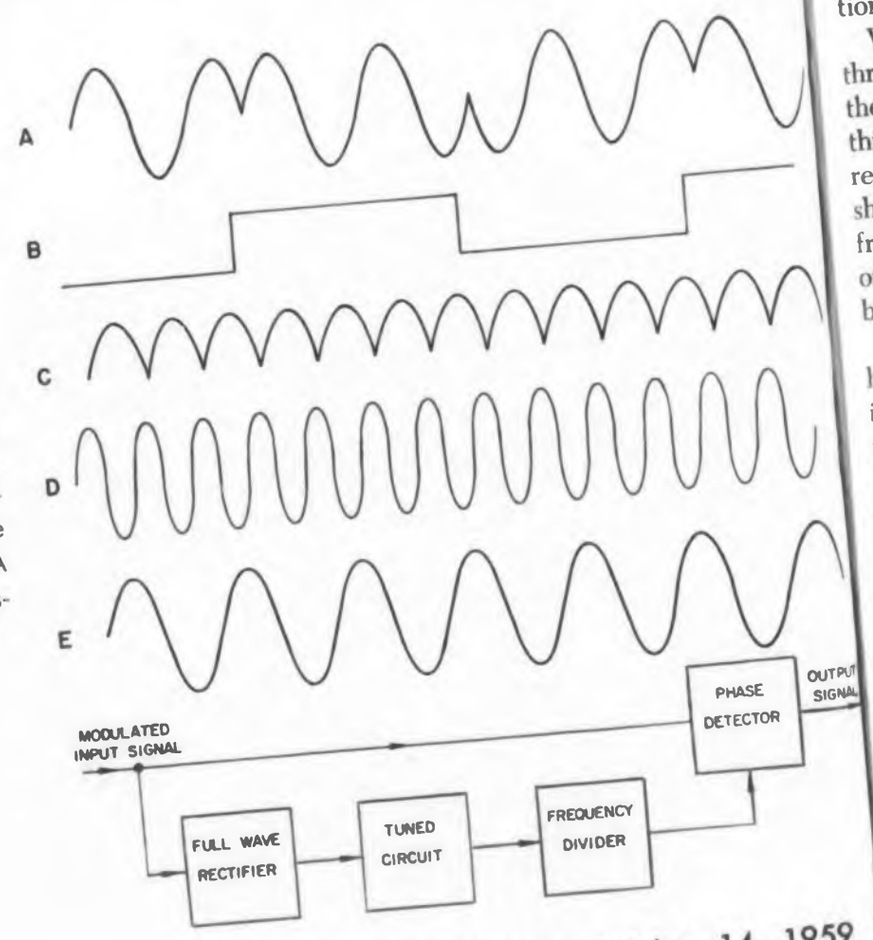


Fig. 1. Phase reference signal formation is shown above block diagram of circuits. Keying provides 180-degree phase shift. On Line A shift occurs at axis crossings for convenience.

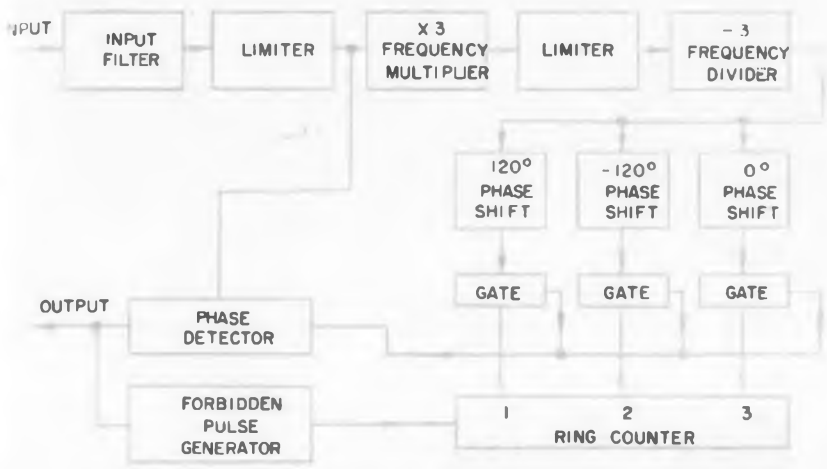


Fig. 2. Phase multilock receiver block diagram. Input signal is shifted 120 degrees. Two phases are used for information; the third provides non-ambiguity by means of the correction circuit.

pulse width modulation. It is not restricted—as are differentially coherent systems now in use—to one of the three modulations.

How It Works

The essential requirement of a coherent phase-shift keying system is an extremely stable reference phase at the receiver, so the phase shifts of the transmitted signal can be interpreted. In the phase multilock device, the incoming carrier is used to produce the reference.

A two-phase system (180-deg phase shift) is diagrammed in Fig. 1. Line A is a 180-deg phase-shift keyed signal produced by the signal of line B. That the phase shifts occur at the axis crossing is merely a convenience for illustrative purposes and not necessary to system operation.

When the input of line A is passed through a conventional full-wave rectifier, the output takes the form of line C. After this signal is applied to a high Q parallel resonant circuit, the signal appears as shown on line D—with twice the input frequency but with no remaining traces of the phase shift. The same result can be produced by a two-time multiplier.

An additional purpose served by the high Q resonant circuit, Mr. Crafts says, is to smooth distortion caused by noise, momentary signal interruptions and keying transients. The double-frequency signal is then divided by two in a frequency divider with a sinusoidal output, as on line E. This output is at the carrier frequency—but has no phase-shift modulation. It now constitutes the phase-stable reference wave, since its phase characteristic is not affected by phase shifts in the transmitted frequency.

This is fine—so long as the received signal is strong enough to maintain the phase lock condition.

Resolve Phase Ambiguity

But what happens when the signal is lost in noise momentarily? The reference signal may be displaced to another transmitted phase, when it starts again. A variation of the basic circuit avoids this problem. The phase shift used is the equivalent of a three-phase system: while actually only two phases are used for the information, a third phase is used at the receiver to restore proper phasing if it should be in error.

For example, mark and space teletype signals may be transmitted at 0-deg and 120-deg phase shift by means of the phase shifting network at the transmitter. The transmitter sends out no signal at the 240-deg phase-shift position.

At the receiver, signals received in the 0-deg and 120-deg phase positions are recorded properly as mark and space signals; any signal occurring in the 240-deg phase-shift position indicates an error in the phase of the reference signal, since this is a forbidden phase for transmission.

On receipt of a forbidden signal, a correction circuit (Fig. 2) shifts the phase of the reference by 120-deg steps until the forbidden phase is no longer receiving a signal. When this occurs, the transmission is taking place between the predetermined phases, and the reference signal is in correct phase with the transmitter carrier or subcarrier.

In the three-phase system, the incoming signal is multiplied by three. The circuit remains operative on a phase spacing of 120 deg, and the stable phase reference wave is produced by dividing this triple frequency by three. The operation is exactly analogous to the phase reversal case described in Fig. 1.

For further information on this phase multilock system, turn to the Reader-Service Card and circle **101**.

Like many engineers, R. H. Parvin felt a need for a more graphic picture of the various design parameters involved in choosing servo gear ratios. In this article he provides graphical data on these parameters.

How To Choose A Servo Gear Ratio

Richard H. Parvin
Senior Systems Engineer
Minneapolis-Honeywell Inertial Guidance Center
St. Petersburg, Fla.

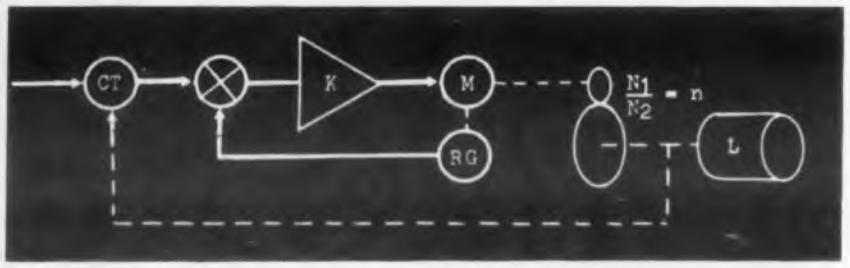


Fig. 1. Block diagram of basic position servo. The servo gear ratio is "n".

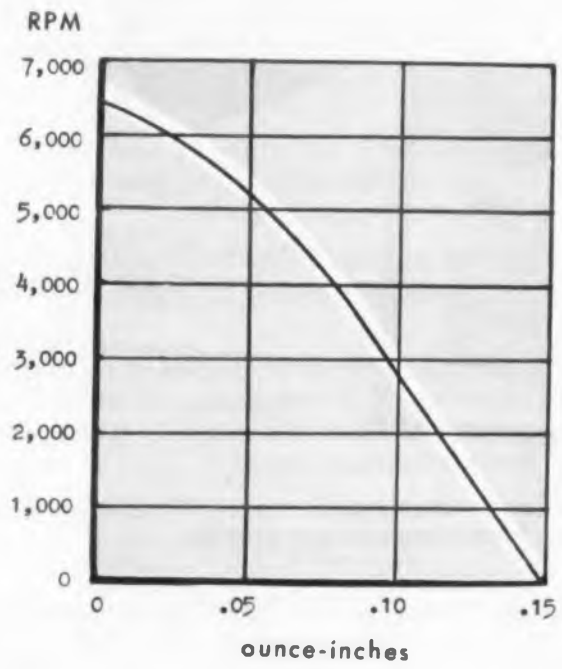


Fig. 2. Typical servo motor torque-to-speed curve.

Compatible Units Of Angular Momentum

Torque = Moment of Inertia × Angular Acceleration

*lb-ft = slug-ft² × radians/sec²
lb-ft = lb-ft² × 32.2 radians/sec²
*dyno-cm = gram-cm² × radians/sec²
gram-cm = gram-cm² × radians/sec² / 980

*preferred

THE GEAR RATIO in the servomechanism is an impedance matching device, like an output transformer. An analytical look at the load specifications of a servomechanism will show how to choose the gear ratio that requires minimum driving torque.

The load specifications influence the servo's power requirements, which are:

- Overcoming friction and moving the load.
- Driving the load to a specified maximum velocity.
- Following a specified maximum rate of change of velocity (acceleration).

Motor torque required to do this depends on the gear ratio between the shafts of the driving motor and the load. To overcome the load friction (F_l), the torque required is:

$$T = F_l\, n$$

where n is the ratio of the motor shaft to the output shaft. It is normally less than 1.

The synchro control transformer must be included in the calculations as part of the load. See Fig. 1. The friction of the gearing adds to the torque required, but it can be measured from the input shaft and is:

$$T = F_s$$

Effects of Drag

Viscous drag (friction that is proportional to velocity) of the load also requires a motor torque proportional to gear ratio:

$$T = f_l\, \dot{\theta}_l\, n$$

In the equation,

f_l = coefficient of viscous drag of the load
$\dot{\theta}_l$ = load shaft speed

This term is normally negligible if light lubrication is used and if the load shaft speeds are not high. The two-phase servo motor, however, characteristically delivers maximum torque at stall and no torque at maximum speed, as shown in Fig. 2. This torque-to-speed ratio is the electrical equivalent of viscous drag. Since the mtor speed is $1/n$ times the load shaft speed, the torque required (or lost by the motor is

$$T = f_m \left(\frac{\dot{\theta}_l}{n} \right)$$

where f_m is the torque-to-speed ratio of the motor.

Acceleration Requirements

The torque required to accelerate the load shaft is proportional to the moment of inertia of the load and to the gear ratio:

$$T = J_l\, \ddot{\theta}_l\, n$$

But since the motor shaft is accelerating at $\ddot{\theta}_l/n$, the torque required to accelerate the motor (and the rate generator in the case shown in Fig. 1) is:

$$T = (J_m + J_{r_g}) \frac{\ddot{\theta}_l}{n}$$

These terms are shown graphically in Fig. 3. The effect of gear ratio, n, is in each term.

(Continued on p. 52)

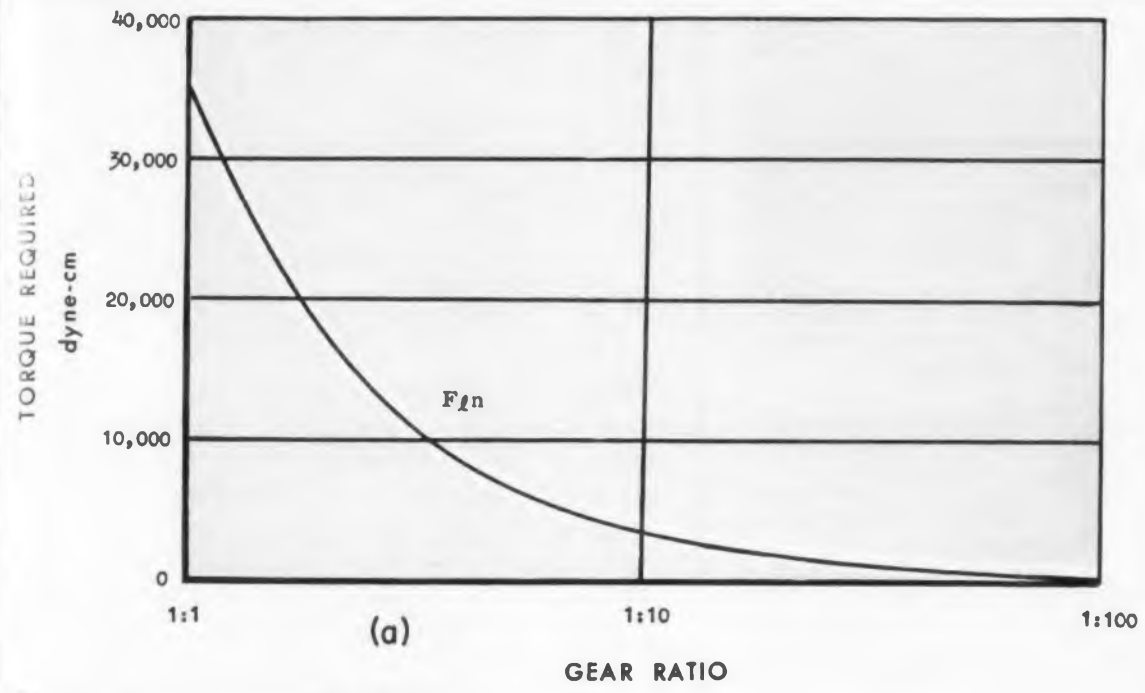


Fig. 3a. Torque required by friction.

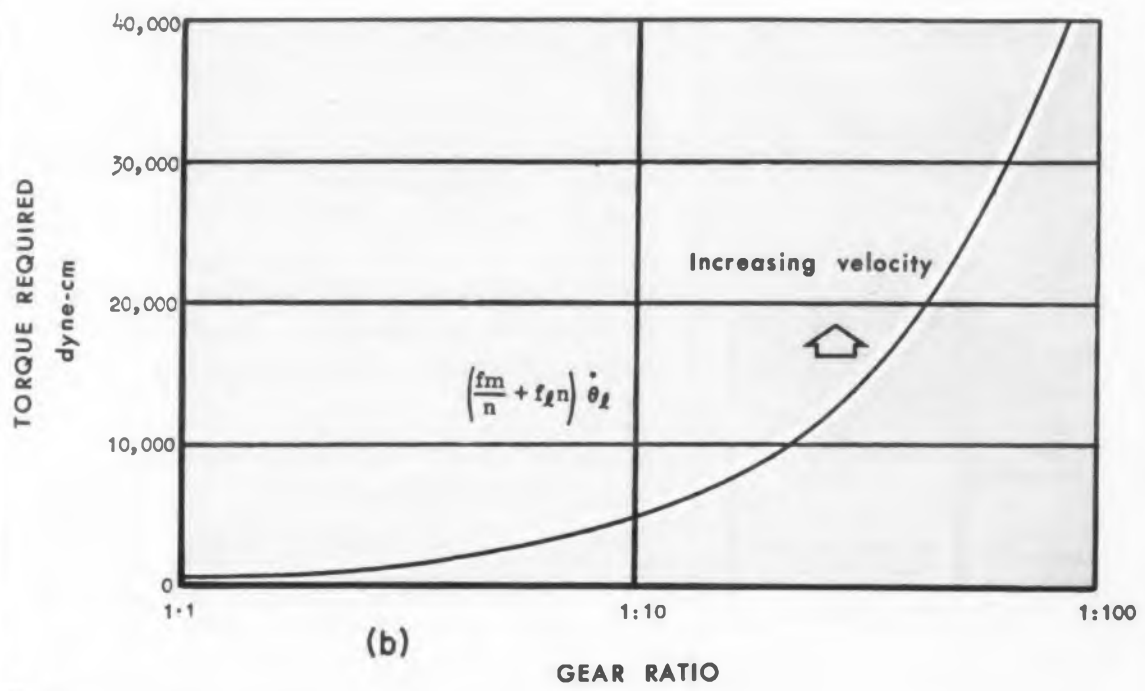


Fig. 3b. Torque required by viscous drag.

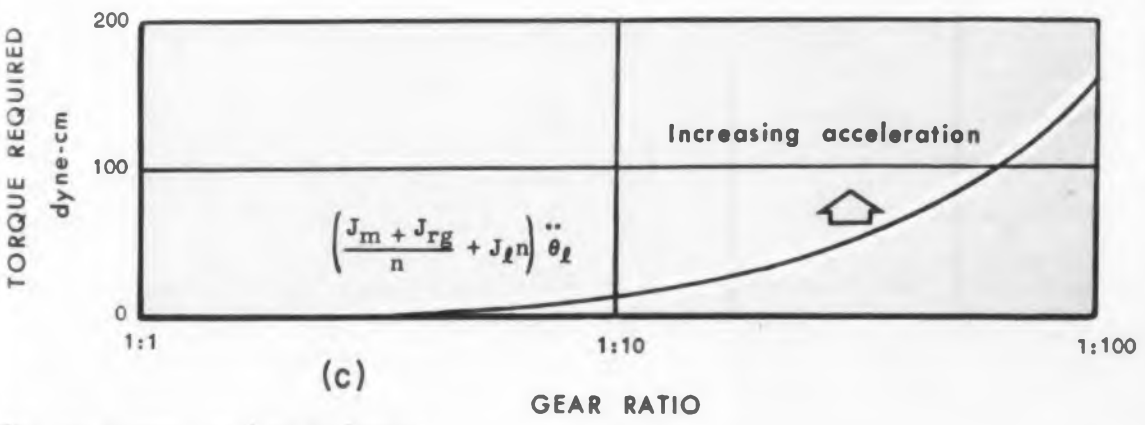


Fig. 3c. Torque required by inertia.

Dynamic Equation For Torque Requirements

Total torque required of the servo motor is a combination of all these factors. It is:

$$T = \left[\frac{(J_m + J_{rg})}{n} + J_l\, n\right]\ddot{\theta}_l + \left[\frac{f_m}{n} + f_l\, n\right]\dot{\theta}_l + F_l\, n + F_g$$

Motor friction does not appear in the equation because the torque required is the output of the motor. The maximum torque required of the motor is when the load shaft is at its maximum specified velocity and acceleration combined. By substituting known, specified or estimated values in the above equation, a value of n at which T is minimum can be found.

An Example

In the case of an instrument servo, such as in inertial navigation instrumentation, it is required that the servo motor drive the indicator at a maximum acceleration of two radians per second squared and at a maximum velocity of 300 rpm. The load friction is estimated to be less than 0.5 oz-in. A small motor/rate generator was selected for the first approximation.

It is here that calculations often get snarled in an attempt to make the units compatible. Several systems of compatible units are shown in the table. By converting specifications, manufacturer's data and estimated values to a common system:

$\dot{\theta}_l = 30$ rad/sec

$\ddot{\theta}_l = 2$ rad/sec^2

$J_m + J_{rg} = 0.8$ gm cm^2

f_m = (stall torque)/(no-load speed), or
= 15.5 dyne-cm/rad/sec

$J_l = 1$ gm cm^2

f_l = negligible

$F_l = 35 \times 10^3$ dyne-cm

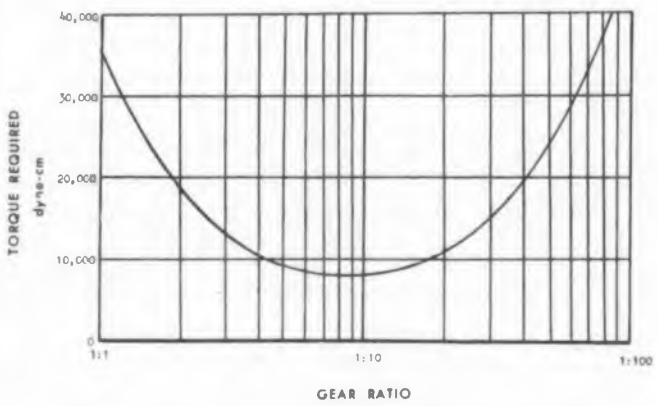


Fig. 4. Total torque required vs gear ratio.

Fig. 5. A splined output shaft reduces the inertia of the first mesh.

Gear inertia can be assumed to be negligible in comparison with motor inertia when a splined shaft is used for the first gear. The inertia of subsequent gears is reduced by the ratio of the preceding mesh. This is assuming that spur gears are used; worm gearing is usually avoided because of its much higher friction level.

The above values are substituted in the torque equation, and torque required vs. gear ratio is plotted as shown in Fig. 4. The rated torque of the selected motor, 10,600 dyne-cm, is seen to be adequate with any gear ratio between 4 and 25. By examining the effects of individual terms as shown in Fig. 3, it can be seen that this margin may be used to exceed the specs in acceleration or as insurance against higher-than-estimated friction levels by choosing a gear ratio near the high end of the range. Or the margin may be used to exceed the specs in velocity by selecting a gear ratio near the low end of the range.

Stock gear reducers are available in a wide range of gear ratios, with spline or spur gear input, and in a standard servo motor frame size. A larger or smaller motor would be selected if the motor torque were very far from the calculated torque required. ■ ■

Diode in Feedback Loop Makes

Stable Transistor Bias Circuit

G. Franklin Montgomery
U.S. Department of Commerce
Washington 25, D.C.

By adding a constant-potential device to transistor amplifier bias networks, excellent stability is obtained without sacrifice in gain. Mr. Montgomery believes that this is a useful way to compensate for transistor variations. He is convinced the design should rely on circuit design rather than transistor type specifications.

BY INCLUDING a constant-potential device in a negative current-feedback loop, excellent operating-point stability is achieved in a direct coupled transistor amplifier. Ac amplification is not sacrificed and few components are needed.

Compromise in Bias Circuit

In any direct-coupled or resistance-coupled transistor amplifier, the choice of a bias circuit involves compromise. Bias currents for the transistor electrodes are supplied through resistors, some of which are shunts for the signal current. In general, as the bias resistances are chosen to improve the stability of the dc operating currents and voltages, a smaller fraction of the signal current is transferred from one stage to the next. Signal amplification is thus sacrificed for stability of operating point.

The proper use of a constant-potential device in a direct-coupled amplifier makes this compromise less rigid. In addition, excellent stability can be achieved with few components.

A particularly useful circuit is shown in Fig. 1, where diode D is the constant-potential device. A silicon junction diode, for example, provides a nearly constant forward drop of about 0.5 v over a wide range of bias current. Several diodes may be connected in series if a greater potential is wanted. Alternatively, a Zener diode can be used, in which case the polarity would be the reverse of that shown.

Circuit Design Steps

The biasing action of Fig. 1 can be analyzed by using the simpler circuit of Fig. 2, where E_B represents the diode potential. The stability factor

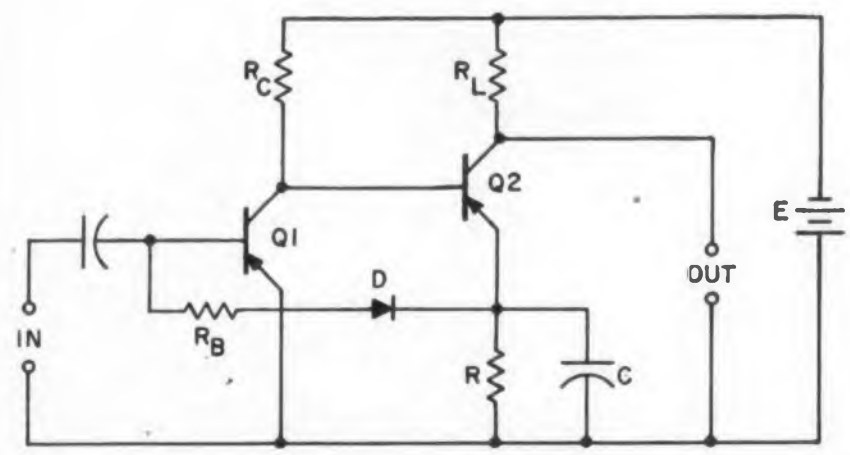


Fig. 1. Two stage direct-coupled amplifier with diode *D* providing a constant forward drop over a wide range of bias current.

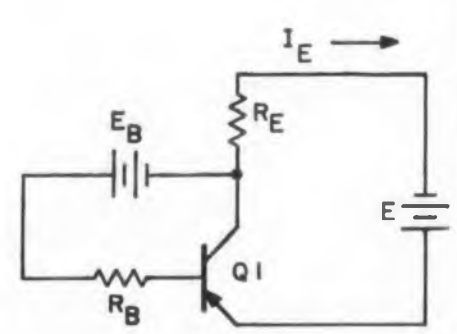


Fig. 2. Simplified schematic with E_B representing the constant potential of diode *D*.

S (more properly an instability factor[1], since it is desirable that S be as small as possible) is defined[2] by

$$S = \frac{dI_E}{dI_{CO}} \tag{1}$$

where I_E is the direct emitter current of Q_1 and I_{CO} is its collector-to-base leakage current. A good approximation for germanium transistors is

$$S = \frac{1}{\frac{E - V_{CB}}{I_{ERB}} + \frac{1}{1 + h_{FE}}} \tag{2}$$

where V_{CB} is the collector-to-base bias voltage, h_{FE} is the d-c common-emitter current amplification, and

$$E_B = V_{CB} + \left[I_{CO} - \frac{I_E}{1 + h_{FE}} \right] R_B \tag{3}$$

Given a supply voltage E and a transistor Q_1 for which I_{CO} and h_{FE} are specified, the stability factor is directly calculable from (2) in terms of three design parameters: the emitter current I_E, the collector-to-base voltage V_{CB}, and the base bias resistance R_B. The introduction of E_B permits independent choices for V_{CB} and R_B, allowing a smaller R_B and consequently greater stability than would be available otherwise.

A practical design for the circuit of Fig. 1 can be completed very quickly. Given the supply voltage E, a diode voltage E_B, and the direct emitter currents I_{E1} and I_{E2} for the two transistors, simply calculate

$$R = E_B / I_{E2} \tag{4}$$

$$R_C = \frac{E - E_B}{I_{E1}} \tag{5}$$

and chooses R_B to be several times the expected input impedance of Q_1. The operating currents using these calculated resistances will be close to the design values for any germanium transistors having h_{FE} values greater than 10 or so. Of course the d-c resistance of R_L must not exceed $(E - E_B)/I_{E2}$. For maximum amplification, E must be sufficient to permit an R_C several times the input impedance of Q_2 for a reasonable I_{E1}. Capacitance C must be large enough to prevent degenerative a-c feedback to the base of Q_1.

The equations given are not good approximations for silicon transistors; a design using these types must take into account their appreciable emitter-to-base potential. In the simplest case, the junction diode D can be considered "built-in" to the base electrode of Q_1 with a drop of about 0.6 v, and the design can proceed with R_B directly connected to the emitter of Q_2. ▪▪

References

1. H. S. Armstrong, "A Straightforward Description of Temperature Effects on Transistor Stages," Proc. I. R. E., Vol. 47, pp. 1002-1003; May, 1959.

2. R. F. Shea, Transistor Circuit Engineering, John Wiley & Sons, Inc., New York, p. 55; 1957.

Making The Most of Flat Cables

G. E. Robert Smith,
William Richter
Tape Cable Corp.
Rochester, N.Y.

Part 1

In this article, the first of two, Robert Smith (right) and William Richter cover some of the handling techniques of flat cables. Because little is known about this subject, they say, electronic design engineers have been unable to take advantage of the unusual characteristics of flat cables.

FLAT CABLES for simple wiring systems can be handled in many ways. Some methods are new. Others have withstood the test of time in industry. Basic to working with the cables are procedures for stripping them and fashioning some method of strain relief.

Some of the stripping methods now used are:

By Hand. Polyester, which is used as the insulation for some flat cables, melts without carbonizing in the temperature range of +525 to +600 F. A ball of solder on the tip of a hot soldering iron will strip and tin one conductor at a time. Wiping away molten insulation with a cloth speeds the process. This method is used to service polyester-insulated cable in the field, and is handy for laboratory and prototype construction.

With a Solder Pot. Some thermoplastic insulations, such as polyester, can be stripped and the conductors tinned by dipping the cable end in a solder pot. After a few seconds of immersion, the cable is pulled from the solder through a clean folded rag, which removes the softened insulation. The cable end may be dipped again in the solder to remove any residual insulation and to tin the conductors, thus immediately protecting the conductors against corrosion and making subsequent soldering easy.

Hot Wire Stripping. Insulation can be removed with a hot wire. Remaining traces of insulation disappear during tinning.

Machine Stripping. For production, stripping machines are very rapid. They remove insulation from as many as 300 conductor ends in a minute after one to three hours of operator training. These same machines have been used by industry for stripping magnet wire. (See Fig. 2.) Stripping action is the result of simultaneous frictional heat and brushing action caused by fine bonded glass fibers in the high-speed stripping wheels. The conductors are left clean, bright, free of oxides and ready for termination.

Chemical Stripping. Polyester and fluorocarbon

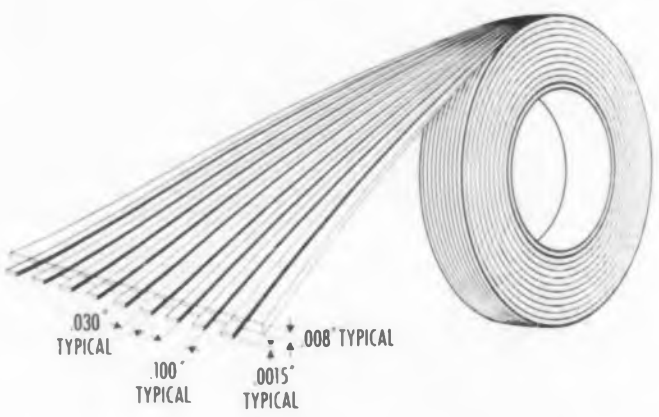


Fig. 1. Flat cable has thin, flat, parallel conductors embedded in tough, thin insulation. Shown are the dimensions of a cable made by the Tape Cable Corp.

Fig. 2. For production, stripping machines can be used to remove insulation from as many as 300 conductor ends in a minute.

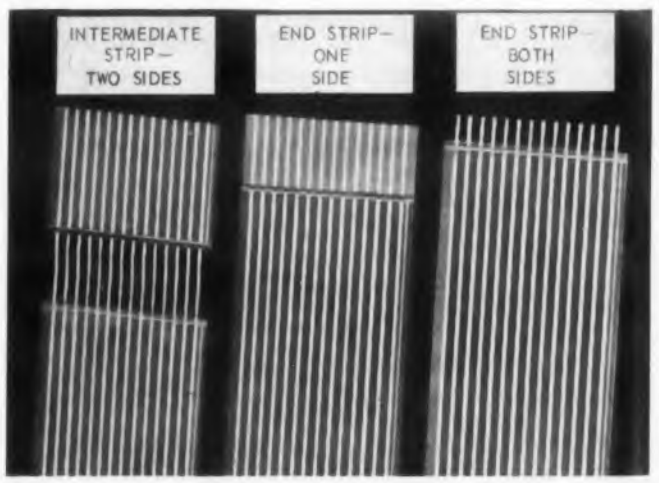


Fig. 3. Various types of stripping are used to perform varied functions.

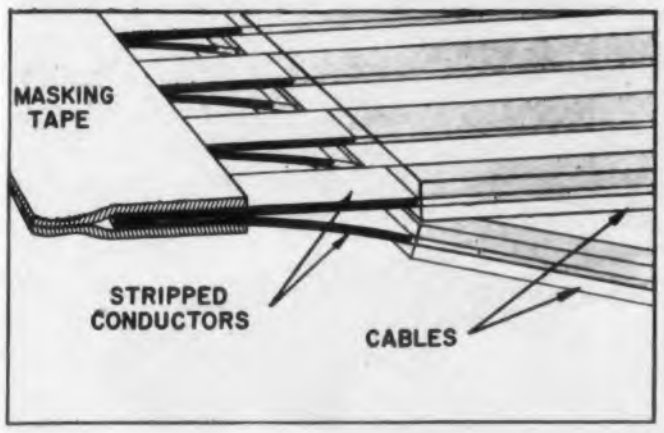


Fig. 4. Cables that have end stripped conductors are taped together for soldering.

Fig. 5. End-stripped cables can be either hand soldered or dipped in solder, as shown.

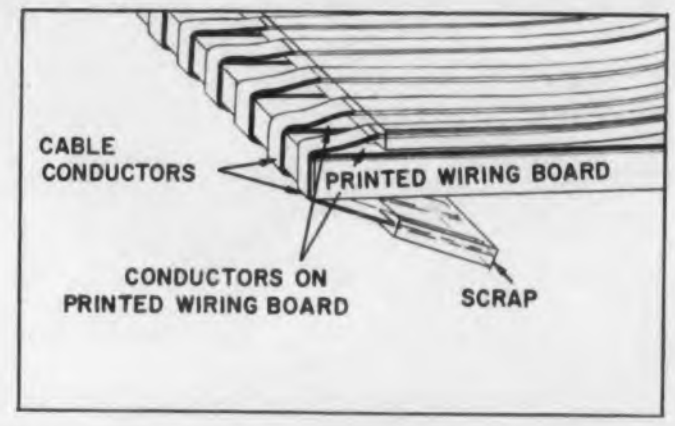


Fig. 6. Intermediate stripping is useful when the cables are attached to a printed wiring board.

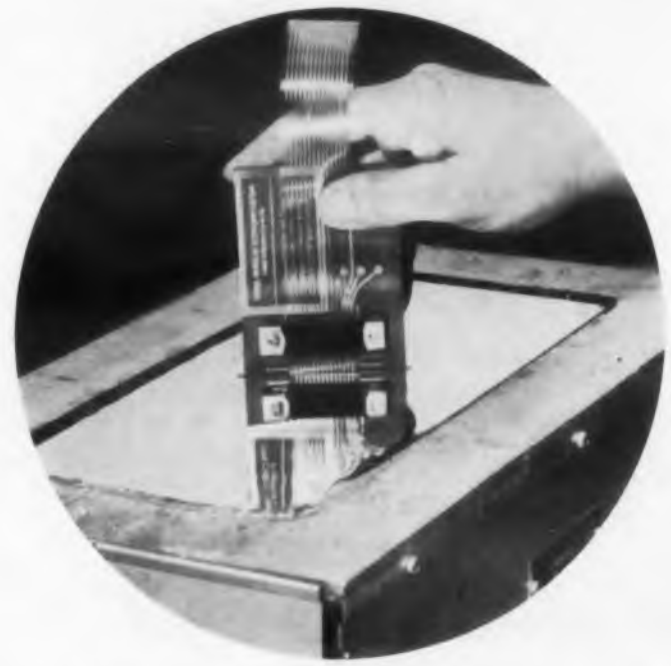


Fig. 7. (above) Dip soldering can be used to attach flat cable to a printed wiring board.

insulations are inherently inert to chemical attack. No suitable chemical stripping method has been found.

Types of Stripping and Applications

Various types of stripping are used to perform varied functions. Among the types and applications are:

End Strip, Both Sides. Insulation may be removed from both surfaces of the ends of all conductors. (Splicing of some cables is easily done by stripping the cable end in this way.) The cables are then placed together, with the stripped ends pointing in the same direction, and held with masking tape or a special jig. (See Fig. 4.) After fluxing, the conductors are dipped in solder above the level of the masking tape, or they can be hand-soldered with flux-cored solder. The masking tape is then trimmed off with scissors. Flux residues may be removed with a solvent. The cable is then unfolded and encapsulated, or a suitable adhesive-coated insulating tape is applied to both sides of the splice to restore the mechanical and electrical strength of the cable.

Intermediate Strip, Both Sides. This method is used for dip-soldering some cables to printed wiring connectors. A short length of unstripped cable is left at the end, which helps position the conductors and keeps them parallel. The exposed cable conductors are matched with the printed wiring conductors at the edge of the board and then clamped to the board. (See Fig. 6.) The edge of the board is now dipped in a suitable printed

Fig. 8. Excess cable is trimmed off with one pass of a file

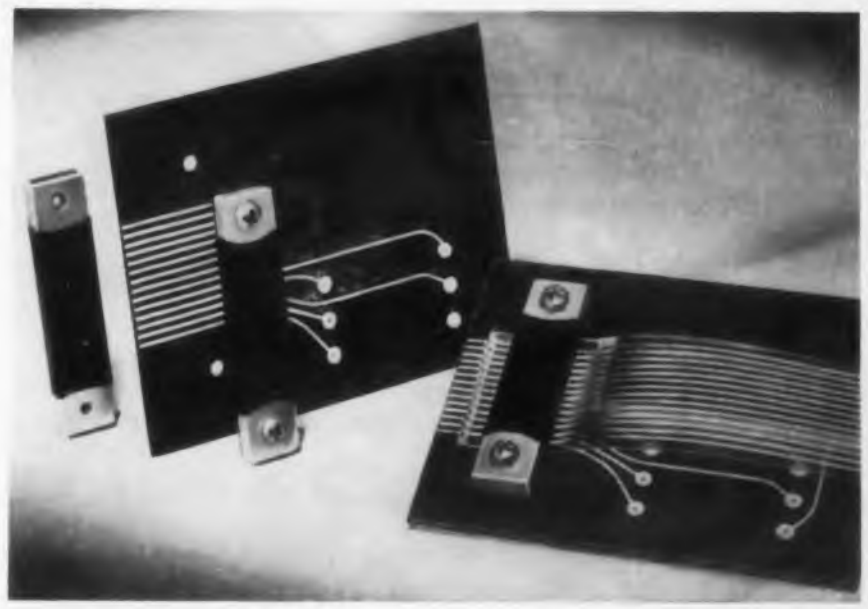


Fig. 9. (right) The "bar" strain relief can be used to distribute the mechanical load across the width of the cable.

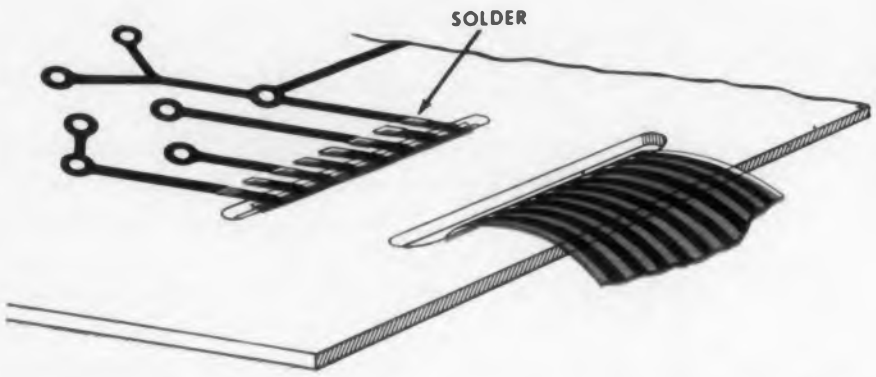
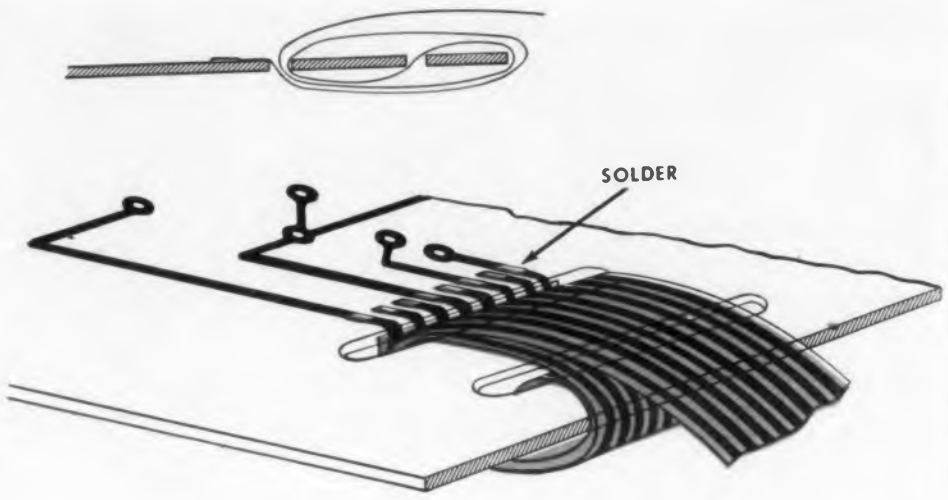


Fig. 10. (above) The double slot strain relief is made simply by providing two slots in a board or panel and weaving the cable through the termination.

Fig. 11. (right) More positive strain relief can be obtained by weaving the cable through in this fashion. It is called a break-band relief.



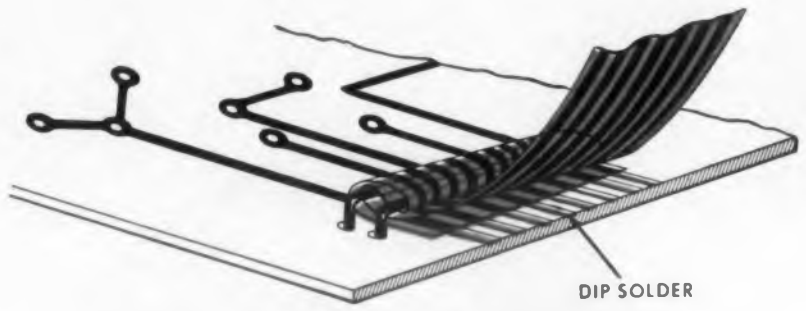


Fig. 12. Two staples in a board may be used as a strain relief.

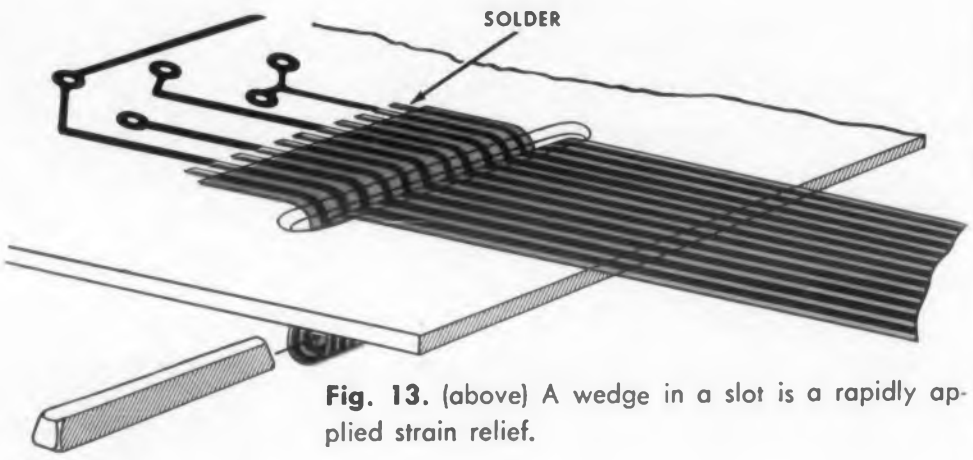


Fig. 13. (above) A wedge in a slot is a rapidly applied strain relief.

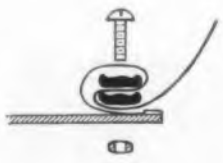


Fig. 14. (right) Perforated Nylon strapping such as Weckesser No. N6-167, can be used as a strain relief.

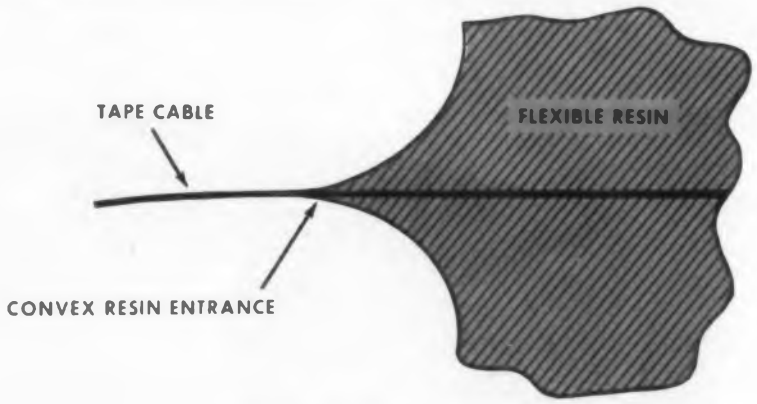


Fig. 15a. Encapsulation is an effective strain relief.

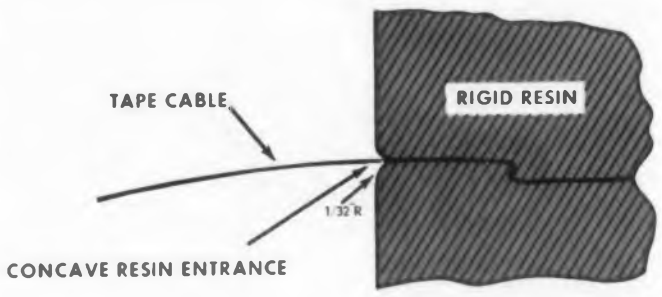


Fig. 15b. Where extremely high lateral forces on the cable are encountered, and a hard encapsulating resin is used, a radius is recommended at the resin entrance.

Fig. 15c. A bond is necessary between the cable and the resin if the encapsulation section is thin, such as an encapsulated splice, or if the encapsulation resin is flexible. Here a clear lacquer strain relief holds the insulation and conductors in place on some infra-red cells.

wiring flux and then in solder. Scrap cable is trimmed off the board with a file and residual flux can be removed with solvent, such as Xylol.

End Strip, One Side. Some cables can be stripped on one side by holding a piece of one or two-ounce copper foil on the bottom side of the cable as it is inserted in the stripper. The foil seems to act as a heat sink, as well as to prevent the generation of frictional heat on the bottom side of the cable, thus permitting insulation to be removed from only the top side. Copper foil employed for this purpose can be used for months, showing that there is practically no abrasive action on the copper conductors in the stripping process. Thus it is possible to remove cable insulation without materially reducing conductor thickness. Stripping one side is useful in making pressure connections of some cables to printed wiring, to other flat cables, or to connectors.

Selective Stripping. Individual conductors can be stripped at any point in the cable with narrow stripping wheels. "Programed" stripping is possible with this method. With a small soldering iron, individual conductors can be stripped and tinned at any point in the cable.

Strain Reliefs

A substantial part of a flat cable's strength is in its insulation. This means the cable should be terminated mechanically by its insulation. The greatest strength of a flat cable can be realized by stress distribution. A strain relief, therefore, should be designed to distribute the mechanical load across the width of the cable, avoiding very sharp edges or points if high stresses are involved. To be fully effective, a strain relief must withstand all mechanical stresses on the cable and must not permit any to reach the electrical termination area of the conductors. Strain reliefs are very important in cables with small conductor sizes, where the insulation represents the bulk of the strength of the cable. Some applications, though, need no strain relief, particularly in conductor sizes of 200 square mils or more, where vibration or destructive stresses are not present.

Various strain reliefs are shown in Figures 10 through 13. Reversing the direction of the cable is the basis for most of these reliefs, and in general, the greater the number of reversals, the more effective the relief.

Another strain relief is to use perforated nylon strapping (as shown in Fig. 14). If cables are potted, then two closely spaced opposing creases in the cable inside the resin serve as a strain relief and do not damage the cable or its conductors. (See Figures 15a and 15b.) In some applications some bond, such as clear lacquer, is necessary for strain relief. (See Fig. 15c).

Next Issue: Shaping flat cables and terminating them.

A mock-up is made using yarn to outline the recorder rack. "Average man," right, assists in determining most comfortable operating positions.

How Full-Scale Models Aid Product Design

FULL-SCALE models are used to advantage by Ampex Corp., Redwood City, Calif. Ampex has found that a full-scale model offers these desirable features:

Ideal arrangements of components. An effective model can prohibit an unnecessarily awkward and costly package at a later date.

Increased safety factors. Clearances of doors and panels are readily apparent with a design model.

Service accessibility. If a machine is loaded with items that have to be removed for servicing, or if design requires that the machine has to be moved for servicing, it will prove more costly to the owner.

Three-dimensional Breadboard. As the careful program of testing and developing a product continues, the performance characteristics of the machine are subject to qualitative and comparative tests.

Visual Aid. The model offers the designer an opportunity to try any number of colors, forms, and details to realistically find how they will affect the end product.

Sales Asset. As the production of the

This quarter-scale model was made up to determine ease of interchangeability of various sections of the machine.

product nears, the model is an aid to sales and advertising, because it is ready from three to six months before the prototypes are available.

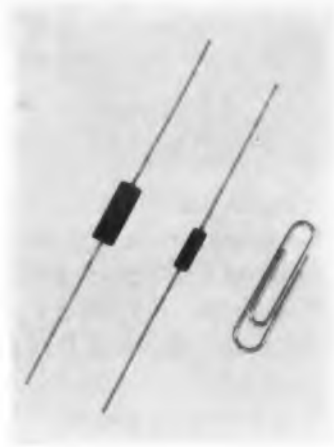
Speeds Tooling and Production. As a manufacturing guide, the full-scale model illustrates to toolmakers and vendors what is desired.

To perform full-scale model construction, Ampex has its industrial design model shop within its Instrumentation Division. It includes varied types of tool and finishing facilities. Each Industrial Designer must be as experienced in building three-dimensional models as he is in making two-dimensional illustrations. This allows the industrial-design team to work concurrently on the model which may be constructed from pattern-maker's pine, birch, Shena (an imported Japanese hardwood), a fine-grain oak, and aluminum.

Believing that isolation of industrial design from engineering results in unrealistic design, a strong liaison and exchange of information is a continual part of product design at Ampex. Through this close co-ordination, the preliminary and full-scale models become an effective medium for determining the best product design. ■ ■

Industrial designer fits dummy of oscilloscope portion of a tape recorder into a full-scale model.

Improved Resistor Withstands More Heat and Humidity



Three lines of these resistors have had their wattage rating doubled. A smaller resistor can now do the job of a former larger unit.

MORE HEAT, more humidity, and more severe operating conditions—that's what a new type of deposited film resistor can withstand. The improved performance characteristics result from using a carbon alloy film. Also improved were the resistor's terminating paint, coating and mold material.

Made by the International Resistance Co., 401 North Broad St., Philadelphia 8, Pa., the improvements permit doubling the wattage rating of the film type resistor. For its electrical ratings, the unit comes in the smallest size known.

Wattage Ratings Doubled

The MDA (RN60) series, which was rated at 1/8 w at 70 C, is now rated at 1/4 w at 70 C and 1/8 w at 125 C. The MDB (RN65) series, which was rated at 1/4 w, is now 1/2 w at 70 C and 1/4 w at 125 C. And the MDC (RN70) series is now 1w at 70 C and 1/2 w at 125 C. Each unit meets all the requirements of MIL-R-10509C, Characteristic B, for its respective size.

This means that for a given wattage rating, a resistor can be had that is reduced in size and weight by more than 50 per cent.

The resistors are available with resistance values ranging from 10 ohms to 25 meg. Standard tolerance is 1 per cent. But 0.5 and 2 per cent types are also available.

Behind this improved resistor was the development of a new deposited carbon alloy. The film (which was pure carbon in the past) is now made from carbon and an unspecified silicon compound. In addition, the carbon is derived from the source by the evaporation of liquid rather than from gas.

The alloy film is created in a furnace consisting of a large ceramic cylinder at high temperature and in high vacuum. It is nearly impervious to moisture, temperature, and is extremely hard.

Exposed to a Bunsen burner's flame, the batch film (on left) has burned off, exposing the substrate. The new alloy film remains.

Diamond Cuts Film

This new film required a redesign of almost every element in the resistor and revamping the manufacturing process. An insulating spiral path, which determines the resistance value, is now diamond-cut in the much harder alloy film. The spiral path was sand-blasted in the previous resistors. Using the diamond results in a more precise incision with consequent improvement in stability and reliability.

The silver terminating paint used to make contact between the film and the leads has also been improved. It has a higher temperature capability than before.

A new mold material is also being used in this resistor. The material is less susceptible to the effects of thermal shocks and is capable of withstanding high temperatures. It also conducts the internal heat away from the substrate more rapidly than the previous material used. In addition, the coefficient of expansion of the material is more compatible with the substrate than were the coefficients of expansion of other mold materials used in the past.

Especially developed for the resistors were two new types of moisture-resistant undercoats. The coatings serve two purposes. First, they give additional protection to the film from moisture. Second, they protect the film from shear or mechanical damage resulting from the forces exerted during molding.

The over-all improvement in the MDA series is 65 per cent. It is 62 per cent for both the MDB and MDC series. The improvement figure is based on tests made for load life, moisture, short time overload, temperature cycle, and low temperature operation.

For more information on this resistor, turn to the Reader-Service Card and circle number 102.

One-ounce size 5 motor-generator is dwarfed by its size 8 counterpart.

Tach Feedback For Size 5 Servo Loop

FOR THE first time, the designer of size 5 servomechanisms can enjoy the design flexibility of tachometer feedback. Reported to be the smallest servomotor-generator in the industry, the size 5 unit halves the weight and volume of the size 8, presently the workhorse of miniature motor-tachs.

Until development of this motor-generator, designers working with size 5 components had to content themselves with inertial or viscous damping. While these methods have their own advantages for some applications, the rigidity of the design is intolerable for others. Changes in amplifier gain and other loop parameters can be accommodated in a tachometer feedback servo much more readily.

Developing a practical size 5 generator represents an engineering achievement considerably more than a simple "scaling down" of existing larger units. Daystrom Transicoil, Worcester, Montgomery County, Pa. took advantage of the control versatility of a tachometer feedback servo loop to permit use of a four-pole motor stator instead of the more usual six-pole construction. With a tachometer feedback, a four-pole design is completely suitable, since the no-load speed is not dictated by the number of poles. High no-load speed, often cited as an objection to four-pole design, is no problem here. A four-pole stator design helps prevent structural weakness, that might otherwise be a problem in so small a unit.

Transicoil employs epoxy encapsulation to keep stator windings in their slots dependably. In order to prevent the epoxy encapsulating material from seizing the

Four-pole design avoids structural weakness in the tiny laminations of this unit.

Cutting out 3/4 the weight of a size 9 motor-generator is the basis of a chain of weight-saving steps in the system design.

rotor or shaft during operation, centrifugal encapsulation is used. In this process, the stator is spun rapidly while the epoxy is setting. The centrifugal force throws the epoxy outward away from the rotor aperture, producing a clearance that makes seizure impossible.

The one-ounce unit has a no-load speed of 10,000 rpm. The motor requires 1.7 w of 400 cps power and develops 0.1 in.-oz stall torque. Moment of inertia is 0.33 g-cm.^{2} Rated voltage for both motor phases is 26 v. In intermittent applications, the unit has been submitted to 33 v and more with no damage.

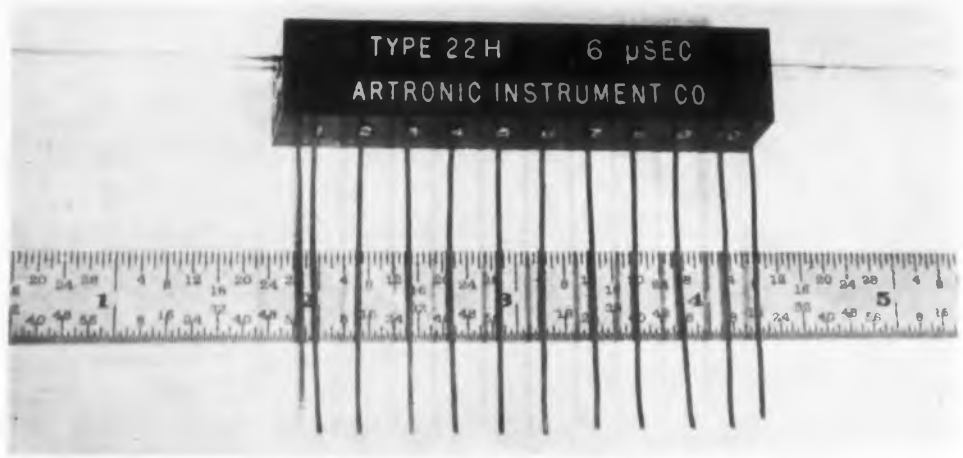
The tachometer generator output is 0.1 v per 1000 rpm, with a tolerance of ±5 per cent and a maximum null of 12 mv. Input requirements is 1.5 w at 26 v 400 cps.

Length of the unit to the mounting flange is 1.5 in. maximum. Overall diameter is 0.5 in. Integrally mounted gear heads, providing speed reductions up to 360 to 1, will be available with these units.

For more information on the servo motor-generator, turn to the Reader-Service Card and circle 103.

NEW PRODUCTS

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



Delay Lines Have 3% Tolerance

Designed with a delay tolerance of ±3%, the type 22H and 22L tapped delay lines come with delay times ranging from 0.05 to 15 μsec. They measure 1/2 x 1/2 x 2.5 in. and the rise time is 20% of the delay time. They have 10 taps, equally spaced. Working voltage is 300 v dc, pulse voltage is 300 v peak, and the temperature range is −65 to +125 C. The units are encapsulated in an epoxy casting resin and meet MIL-STD-202A.

The Artronic Instrument Co., Dept. ED, 11232 Triangle Lane, Silver Spring, Md.

CIRCLE 49 ON READER-SERVICE CARD

Voltmeter's Accuracy Is 1% From DC to 100 mc

Having an accuracy of 1% or better from dc to 100 mc, this voltmeter was designed for use as a laboratory standard instrument to check all types of vtvm's. The instrument is of the thermocouple type. Five different units are available from a low range of 0 to 1 v to a high range of 0 to 100 v, at reduced frequency response. Calibration is essentially permanent and it may be certified by the Bureau of Standards.

Rawson Electrical Instrument Co., Dept. ED, 130 Potter St., Cambridge, Mass.

CIRCLE 50 ON READER-SERVICE CARD

Knob Potentiometer Measures 1/2 in.

This 1/2 in. knob potentiometer, model K-050, is a wirewound unit. It is completely encased in a sealed watertight metallic housing. The unit is constructed to meet Mil specs, and has an operating temperature range of −55 to +55 C. Mechanical and electrical rotation are 340 deg. Resistance values to 20,000 ohms are available on order. Overall length is 5/8 in.

DeJur-Amsco Corp., Electronic Sales Div., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N.Y.

CIRCLE 51 ON READER-SERVICE CARD

Indicator Lamps Have 0.05 in. OD

Models M-1 and M-2 incandescent lamps are designed for microminiature modules. They have an 0.05 in. OD and a length of about 0.09 in. They operate in the range of 1 to 1.5 v and draw from 25 to 35 ma. The filament is wound from 0.0005 and 0.00025 in. tungsten wire over a 0.0015 mandrel.

The Meninger Co., Dept. ED., P.O. Box 243, West Caldwell, N.J.

CIRCLE 52 ON READER-SERVICE CARD

Commutators Mounted in Modular Packages

The Scanalog series of mechanical commutators are mounted in modularized packages which interlock to give mechanical strength to the total assembly. The interlocking modules allow from 24 to 90 contacts in one to six poles to be assembled in one of the two basic frame sizes (1.5 in. and 1.875 in. diameters). Built to conform to military environmental specifications, the commutators may be used in: airborne PAM and PDM telemetering; data sampling in fixed ground or shipboard installations; and data sampling in vehicles.

Fifth Dimension Inc., Dept. ED, Princeton Research Park, North Ewing St., Princeton, N.J.

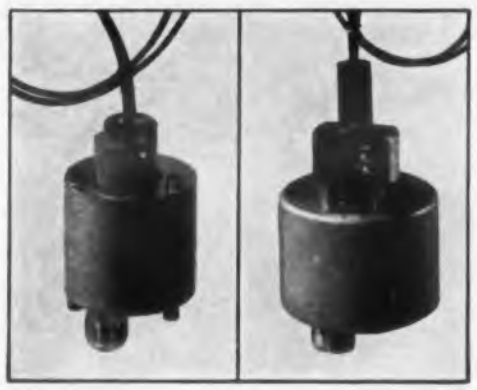
CIRCLE 53 ON READER-SERVICE CARD

Creative Microwave Technology

Published by MICROWAVE AND POWER TUBE DIVISION, RAYTHEON COMPANY, WALTHAM 54, MASS., Vol. 1, No. 5

NEW RAYTHEON MICROWAVE TUBE DEVELOPMENTS

Miniature pulsed magnetrons for missile beacon applications are ruggedly constructed with integral magnets. The RK-7461 is tunable from 9,300 to 9,500 mc and has minimum peak power output of 60 watts. It is 1¼" in diameter and 2½" long, and weighs only 6 ounces.



RK-7461 QK-735

The QK-735 is tunable from 5,400 to 5,900 mc with minimum peak power output of 400 watts. 1½" in diameter and 3¼" long, it weighs 8 ounces.

CIRCLE 771
Reader Service Card

* * *

Designed for electronic countermeasures and FM/CW operations, the QK-625 BWO provides a minimum CW power output of 180 watts and a nominal CW power output of 250 to 350 watts over the 2,500 to 3,000 mc band. The tube is voltage tunable over the entire range with tuning sensitivity of approximately 0.4 mc/volt. Liquid-cooled, the QK-625 BWO is equipped with an integral

permanent magnet, and can be mounted in any position.

CIRCLE 772
Reader Service Card

* * *

Small-signal gain of up to 35 db in microwave relay links is achieved by means of a new compact traveling wave tube amplifier -- the QK-542. This permanent-magnet focused CW tube has nominal saturated power output of 5 watts over 5,900 to 7,400 mc. An integral UG 344/U waveguide-type flange is supplied as standard. With an optional coaxial output coupler the QK-542 covers 4,000 to 8,000 mc.

CIRCLE 773
Reader Service Card

A Leader in Creative Microwave Technology

RAYTHEON

Ideal for linear accelerators and high-power radar systems. The QK-783 and QK-622 Amplitrons operate over the 2,700-2,900 mc and 2,900-3,100 mc bands, respectively, at a peak power of 3 megawatts and a typical efficiency of 75%. Because no heater is required, these tubes are capable of exceptionally long life. RF gain is 8 db under rated conditions, and as high as 12 db at lower peak power outputs. Phase pushing figure is less than 0.5 degrees for a 1% variation of anode current.

CIRCLE 774
Reader Service Card

* * *

Compiled as a Raytheon service to the field, new Consolidated Data Booklet contains comprehensive information about principal unclassified magnetrons, klystrons, backward wave oscillators and special purpose tubes manufactured by Raytheon. Characteristics presented include maximum ratings, typical operating values, band or frequency ranges and other essential data for microwave engineers and purchasing departments.

CIRCLE 775
Reader Service Card

NEW PRODUCTS

Microwave Equipment

G-band and F-band types

This complete line of G- and F-band instruments has frequency ranges of 90 to 140 kmc and 140 to 220 kmc. Included are waveguides and flanges, slotted sections, variable attenuators, detector mounts, phase shifters, frequency meters, standard gain horns, and harmonic generators.

FXR, Inc., Dept. ED, 26-12 Borough Place, Woodside 77, N.Y.

CIRCLE 56 ON READER-SERVICE CARD

Digital Plug-In Circuits

Have input and output buffering

For digital systems and computer applications, these transistorized plug-in circuits have complete input and output buffering which allows going directly from logic diagrams to circuitry. Modules for binary and linear counter stages, pulse shapers, pulse generators, multiple coincidence gates, and relay or neon drivers are provided as shelf items.

Vitro Labs, Dept. ED, 200 Pleasant Valley Way, W. Orange, N.J.

CIRCLE 57 ON READER-SERVICE CARD

Data Recording System

For missile tracking

This missile tracking system records dynamic radar data that is correlated to 0.001 sec. The data can be entered in the IBM-704 computer. The servo repeater units drive shaft position encoders for encoding range, azimuth, and elevation. The range resolution is 1 yd per 10^6 yd; azimuth and elevation is 0.2 mils per 6400 mils. Data is recorded at rates to 10 samples per sec, by means of an IBM-523 card punch. The unit is suited to industrial as well as military applications.

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

CIRCLE 58 ON READER-SERVICE CARD

DC Power Supply

Solid state

This completely solid state dc power supply delivers ±100 to ±250 v with a 6-amp continuous load. This unit is designed for mounting in a standard 19 in. relay rack.

Dynatronics, Inc., Dept. ED, Box 2566, Orlando, Fla.

CIRCLE 59 ON READER-SERVICE CARD

Indicator

Zeros synchros and resolvers

The EZ indicator is for system manufacturing operations where large quantities of synchros and resolvers must be rapidly zeroed. Required power is 115 v 60 cps; excitation voltage is 7 to 115 v; and the excitation frequency is 30 cps to 5 kc. The unit conforms to MIL-S-20708A and measures 9-1/2 x 5-1/4 x 5 in.

Theta Instrument Corp., Dept. ED, 520 Victor St., Saddle Brook, N.J.

CIRCLE 60 ON READER-SERVICE CARD

Audio Output Tubes

Come in matched pairs

Types 7189 and 6L6GC audio output tubes have matched critical audio characteristics to help minimize the harmonic distortion in push-pull amplifiers. Distortion is lower than that attained by the use of controls for balancing plate currents. Other tubes in matched-pair line are types, 6BQ5, 6V6GT, 5881, and 6550.

CBS Electronics, Dept. ED, Danvers, Mass.

CIRCLE 61 ON READER-SERVICE CARD

NEW PRODUCTS

Circuit Board

Has 352 contact cells

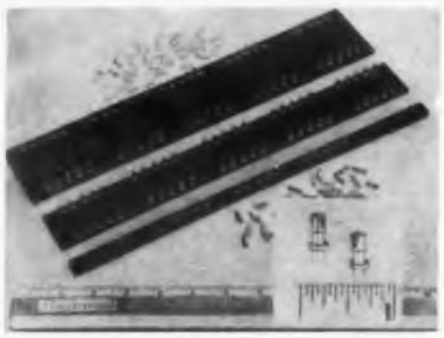
Model 24 circuit board contains 352 separate contact cells for the rapid assembly of experimental circuits using standard components and subsystems. Wires and component leads are electrically connected by inserting their ends into individual cells. Two bus bars are also provided. Solderless connections are used throughout.

Plastic Associates, Dept. ED, 185 Mountain Rd., Laguna Beach, Calif.

CIRCLE 63 ON READER-SERVICE CARD

Terminal Boards

Have castellated terminals



Equipped with type 1010 castellated terminals, types 1411, 1416, 1421, 1426, and 1431 terminal boards have widths of 1/2, 1-1/2, 2, 2-1/2, and 3 in. and are 13-1/8 in. long. The boards are available in laminated phenolic as required in MIL-P-15035B, laminated nylon phenolic as required in MIL-P-15047B, and laminated thermosetting glass cloth as required in MIL-P-18177B. The terminals are mounted on 3/8 in. centers. All boards are sectioned into five 2-5/8 in. sections for convenient breaking into suitable lengths. Each section is drilled for 14 terminals with 10 mounted. The hole size is 0.12 in. Conforming to QQ-B-626a, the terminals are brass. Terminals are supplied in six shank lengths from 5/64 to 19/64 in.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 64 ON READER-SERVICE CARD

s –with no maintenance!

d Contact Relays on test 4 years

A FULL LINE OF THE MOST RELIABLE, MOST DURABLE RELAYS EVER MADE

single form D

Type HG. Capable of up to 100 operations a second. Load-handling capacity to 5 amperes and up to 500 volts. (250 va max. with proper contact protection.)

single form D

Type HGP. Can be factory adjusted to provide single side-stable, bi-stable or chopper characteristics.

single form D

Type HGS. Biased with permanent magnets. Speed up to 200 cps. Sensitivity as low as ±2.5 milliwatts. Handles up to 2 amperes, up to 500 volts (100 va max. with proper contact protection.)

four form D

Type HG4. Four form D switches enclosed in a single housing with coil. Plug-in assembly (shown) is standard. Other mountings available.

two or three form D

Types HG2 and HG3. Two or three form D Switches enclosed in a single housing. HG2 has 8 or 11-pin octal style plug. An 11-pin base is standard for HG3.

six in-line flat pack

Type HG6F. Six switches mounted in line on printed circuit panel surrounded by single coil. Flat, compact assembly. Over-all dimensions: 3.640" x 3.125" x 1.046". Uses standard 32 or 36 terminal printed circuit socket.

For complete information on CLARE Mercury-Wetted Contact Relays or on the entire CLARE line of superior relays and electronic components address: C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Limited, P. O. Box 73, 2700 Jane Street, Downsview, Ontario. Cable Address: CLARELAY.

Send for Catalog 201

CLARE RELAYS

FIRST in the Industrial Field

Inductors and Transformers

Toroidal type

These toroidal inductors and transformers operate at temperatures to 105 C. Type 2A10E inductors have a distributed capacity of 3 μμf and inductance is 10 mh. At a frequency of 100 kc the figure of merit is 130. Type 2A4ET transformer has a distributed capacity of 7.8 μμf. The inductance at terminals 1 and 3 is 4 mh and the inductance at terminals 4 and 5 is 100 μh. The figure of merit at terminals 1 and 3 is 120. At a frequency of 455 kc the coefficient of coupling is 0.88.

Universal Toroid Coil Winding, Inc., Dept. ED, 171 Coit St., Irvington 11, N.J.

CIRCLE 65 ON READER-SERVICE CARD

IF Amplifier

Center frequency is 30 mc

Made to meet Mil specs, this if amplifier has a center frequency of 30 mc, a bandwidth of 2 mc, and a maximum noise figure of 1.5 db. The source impedance is 400 ohms shunted by 10 μμf and the gain is 90 db. The unit operates from a 150 v, 130 ma source. It has a linear-logarithmic response with 15 db gain in the linear section followed by 75 db gain in the logarithmic section. The dynamic range of the logarithmic section is 70 db and the dynamic range of the linear section is 10 db. The unit measures 15-1/8 x 2-7/8 x 3-1/2 in. Modified versions which meet special physical and electrical requirements are also available.

RS Electronics Corp., Dept. ED, 435 Portage Ave., Palo Alto, Calif.

CIRCLE 66 ON READER-SERVICE CARD

CIRCLE 67 ON READER-SERVICE CARD

NEW PRODUCTS

Accelerometer

Angular type

This angular accelerometer is used in missile and aircraft applications, ground support equipment, and various industrial applications. Operating as a miniature servo system, the basic unit consists of a seismic system and associated position-error detector, a restoring mechanism, and a servo error signal. Pitch, yaw, and roll accelerations can be monitored. The ranges available are from ± 1 radian per sec^2 to ± 50 radians per sec^2. The output, full scale, is ± 20 v across a 12,500 ohm load. Resolution is 0.01% full scale, linearity is 0.1% full scale, and hysteresis is less than 0.01% full scale. The unit measures 3.7 in. in diameter and 3.7 in. high and weighs 2 lb.

Donner Scientific Co., Dept. ED, Concord, Calif.

CIRCLE 68 ON READER-SERVICE CARD

Vacuum System

For below-atmospheric pressures

Model 702EY vacuum system is for laboratory testing of devices and materials at below atmospheric pressures. It obtains a pressure of 5×10^{-6} mm Hg in two minutes and a pressure of 5×10^{-7} mm Hg in ten minutes. It operates from a 220 v, 60 cps, three-phase, 500 w power supply. The system is demountable, measures 66 x 41 x 29 in., and weighs 1200 lb. No special precautions are required when cleaning and handling parts to be placed in the test chamber.

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

CIRCLE 69 ON READER-SERVICE CARD

CIRCLE 70 ON READER-SERVICE CARD

for immediate delivery of

General Instrument semiconductors

at factory prices

call your stocking distributor

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

SILICON RECTIFIERS
SILICON DIODES
GERMANIUM DIODES

CALIFORNIA
Newark Electric Company
4736 W. Century Blvd., Inglewood
Valley Electronic Supply Co.
1302 W. Magnolia Blvd., Burbank
Shanks & Wright, Inc.
2045 Kettner Blvd., San Diego
Pacific Wholesale Co.
1850 Mission St., San Francisco

DISTRICT OF COLUMBIA
Silberne Industrial Sales Corp.
3400 Georgia Ave., NW

ILLINOIS
Merquip Company
5904 W. Roosevelt Rd., Chicago
Newark Electric Company
223 W. Madison St., Chicago

INDIANA
Brown Electronics, Inc.
1032 Broadway, Fort Wayne
Graham Electronics Supply, Inc.
122 S. Senate Ave., Indianapolis

MASSACHUSETTS
The Greene Shaw Co., Inc.
341-347 Watertown St., Newton

NEW YORK
Hudson Radio & TV Corp.
37 W. 65th St., NYC
Sun Radio & Electronic Co., Inc.
650 Sixth Ave., NYC

OHIO
The Mytronic Company
2145 Florence Ave., Cincinnati
Pioneer Electronic Supply Co.
2115 Prospect Ave., Cleveland
Buckeye Electronic Distributors, Inc.
236-246 E. Long St., Columbus

OKLAHOMA
Oil Capitol Electronics
708 S. Sheridan, P.O. Box 5423, Tulsa

PENNSYLVANIA
D & H Distributing Co.
2535 N. 7th St., Harrisburg
Herbach & Rademan, Inc.
1204 Arch St., Philadelphia

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

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

CIRCLE 71 ON READER-SERVICE CARD

GENERAL INSTRUMENT SEMICONDUCTOR DIVISION

JAN TYPE RADIO RECEPTOR SILICON DIODES

IN457
IN458
IN459

When JAN type diodes are required, you can be certain that General Instrument's engineering skills and manufacturing facilities will enable us to deliver them at prices that reflect years of volume production experience.

The Radio Receptor line of silicon *and* germanium diodes is the most complete available to the industry – with the widest possible range of characteristics. You'll find them at authorized distributors across the country. Complete information and data sheets are available upon request.

Code No.	Min. Fwd. DC Cur. @ +1V	Max. Rev. DC Cur. @ Test V. 25° C.	150° C.	Test Voltage	Max. Inv. Voltage	Min. Breakdown Voltage*	Avg. Fwd. DC Cur. (Max.)
1N457	20 mA	.025 μA	5 μA	60V	60V	70V	75 mA
1N458	7 mA	.025 μA	5 μA	125V	125V	150V	55 mA
1N459	3 mA	.025 μA	5 μA	175V	175V	200V	40 mA

*Reverse voltage at which a reverse current of 100 uA flows.
All ratings and characteristics are at 25° C. unless otherwise noted.
Operating temperature range −80° C. to +200° C.

Semiconductor Division

GENERAL INSTRUMENT CORPORATION
65 Gouverneur Street, Newark 4, N J

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

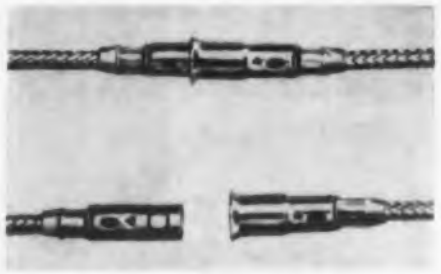
GENERAL INSTRUMENT DISTRIBUTORS: Baltimore: D & H Distributing Co. • Chicago: Merquip Co. • Cleveland: Pioneer Electronic Supply • Los Angeles: Valley Electronics Supply Co. • Burbank • Milwaukee: Radio Parts Co., Inc. • New York City: Hudson Radio & Television Corp., Sun Radio & Electronic Co. • Philadelphia: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

CIRCLE 72 ON READER-SERVICE CARD

NEW PRODUCTS

Connectors

For coaxial and shielded cable



These coaxial and shielded cable disconnects fit cables having an OD to 1/4 in. The interchangeable contacts permit a variety of inner conductor diameters in solid or stranded types.

Amp, Inc., Dept. ED, Harrisburg, Pa.

CIRCLE 73 ON READER-SERVICE CARD

Temperature Alarm Readout

Monitors to 100 temperature points

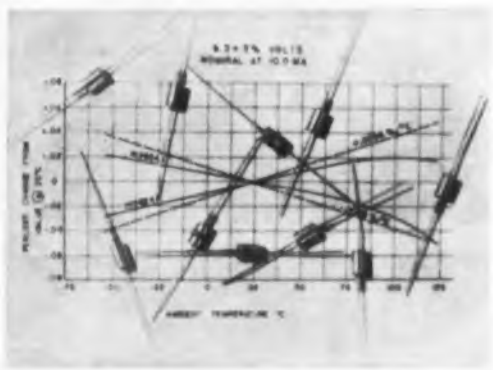
This temperature alarm readout monitors up to 100 temperature points, depending upon the number of 10 unit panels used. It operates by sounding an alarm and indicating the critical point by a numbered light on the control panel. Each channel operates independently. Over-all accuracy is ±3 deg F. The unit is transistorized and uses printed circuit cards. The construction is standard relay rack type and the weight is 125 lb.

Fischer & Porter Co., Dept. ED, 303 Jacksonville Rd., Hatboro, Pa.

CIRCLE 74 ON READER-SERVICE CARD

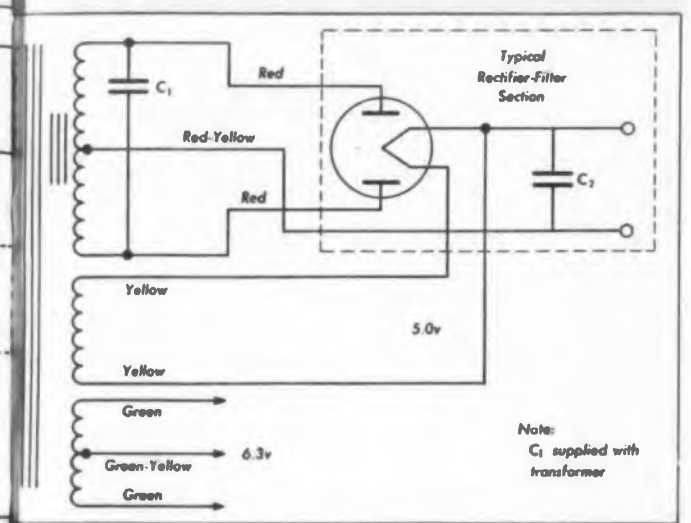
Zener Reference Diodes

Measure 1/4 x 1/3 in.



These Zener reference diodes are in axial-lead, flangeless packages measuring about 1/4 x 1/3 in. and can be easily inserted in printed circuit boards. They serve as a stable 9.3 v reference source over temperature ranges of 0 to 75 C, −55 to +100 C, and −55 to +150 C. Designated types 1N2620 through 1N2624, they have tem-

TRANSFORMERS . . . . . .



CIRCUIT DIAGRAM shows Raytheon Voltage Regulating Transformer in typical full-wave rectifier circuit. Three standard models with ratings up to 380 VDC @ 250 MA are immediately available from stock.

THIS BOOKLET GIVES YOU COMPLETE SPECIFICATIONS. For your copy plus a companion data booklet, write Raytheon, Manchester, N. H.

Transformers that regulate voltage to within ± 3%

This versatile Raytheon unit looks like a transformer, but does the combined job of transformer plus voltage regulator.

In a conventional power supply circuit, the voltage regulating transformer maintains a dc output voltage within ±3% with line variations of ±15%.

For custom requirements, please write our Applications Engineering Group for an answer to your particular need. Raytheon Company, Manchester, New Hampshire.

RAYTHEON COMPANY
Industrial Apparatus Division

RAYTHEON
Excellence in Electronics

CIRCLE 78 ON READER-SERVICE CARD

perature coefficients of 0.01, 0.005, 0.002, 0.001, and 0.0005% per deg C. At 10 ma they have a dynamic impedance of 15 ohms max.

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

CIRCLE 75 ON READER-SERVICE CARD

IF Amplifiers

For use at 30 and 60 mc

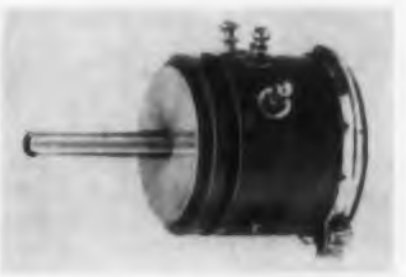
Using silicon tetrode transistors, these five models of if amplifiers are used at 30 and 60 mc. Incorporating a 7077 ceramic triode front end, hybrid units type T610 and T615, shown, yield 3.5 db of noise. Type T35 has a noise figure of 2 db. These units may be ordered with a self-contained transistorized power supply to power the tube. Completely transistorized units with the front end designed for a minimum vswr are types T35M and T61M with vswr ratios of 1.3:1. Suitable for missile and airborne applications, all units measure 7-1/8 x 2-3/4 x 1-1/8 in. and withstand temperatures to 85 C. Special models for use at any center frequency to 80 mc can be supplied.

Remanco, Inc., Dept. ED, 1630 Euclid, Santa Monica, Calif.

CIRCLE 76 ON READER-SERVICE CARD

Potentiometer

Linearity is ±3%



Having a linearity of ±3%, this 1-1/16 in. potentiometer is available with resistances from 100 to 500,000 ohms. It is rated at 3 w, has a temperature range of −55 to +165 C, and has a rated life of over 1000 hr. Bushing or servo configurations are available. Special units with closer linearity, also nonlinears and multi-gangs can be supplied.

Acc Electronics Assoc., Inc., Dept. ED, 99 Dover St., Somerville, Mass.

CIRCLE 77 ON READER-SERVICE CARD

NEW PRODUCTS

Potentiometer

Resistance range is 10 to 100 K

Having a resistance range of 10 to 100 K, model 200 Trimpot potentiometer dissipates 0.25 w at 70 C. The operating temperature range is −55 to +105 C, resolution is 0.17%, and mechanical life is in excess of 25,000 revolutions of the shaft. The unit meets or exceeds Mil specs for shock, vibration, and acceleration. Three terminal types are available: stranded insulated leads, solder lugs, and printed circuit pins.

Bourns, Inc., Dept. ED, P.O. Box 2112, Riverside, Calif.

CIRCLE 80 ON READER-SERVICE CARD

Germanium Transistors

Junction temperature is 100 C

These germanium transistors, including units meeting Mil specs which call for 1000 hr storage at 95 C, are rated at 100 C junction temperature. They are capable of withstanding temperatures to 125 C.

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

CIRCLE 81 ON READER-SERVICE CARD

Rectifiers

For printed circuits

Series 160, 160-C, and 160-ERM rectifiers, either copper oxide or selenium, are available with flat nickel silver filiform leads. These leads match No. 23 AWG solid wire and can fit printed conductors or turret terminals, or be used in mounting.

Conant Labs., Dept. ED, 6500 O St., Lincoln 5, Nebr.

CIRCLE 82 ON READER-SERVICE CARD

Vacuum-Rectifier Tubes

Stand 26,000 v piv

For use as rectifiers of high-voltage pulses in scanning systems of black and white TV receivers, types 1J3 and 1K3 half-wave vacuum-rectifier tubes use a coated filament. Both types withstand a maximum piv plate voltage of 26,000 v. They supply a maximum peak plate current of 50 ma and a maximum average plate current of 0.5 ma. Both have glass-octal design. Type 1K3 is like type 1J3 but has a shorter bulb.

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

CIRCLE 83 ON READER-SERVICE CARD

Lumped-Constant Delay Line

Delay is 200 μsec

Model 61-34 lumped-constant delay line has a delay of 200 μsec and a rise time of 1.16 μsec. The attenuation is less than 2 db; frequency response at 3 db is 325 kc. The unit has 50 taps with an accuracy of ±0.2 μsec at each tap. It measures 6 x 9 x 13-1/2 in.

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

CIRCLE 84 ON READER-SERVICE CARD

Parabolic Reflector And Antenna Cover

Stands windloading of 50 lb per sq ft

This parabolic reflector and antenna cover is molded of fiberglass reinforced resin and withstands windloading of 50 lb per sq ft. There is no signal attenuation through the 10,000 mc range. It offers protection against ice and the accumulation of several inches of snow and debris. Available for 4, 6, 8, and 10 ft diameter antennas, the cover is furnished with mounting clamps.

Redman Pattern Works, Dept. ED, Kansas City, Mo.

CIRCLE 85 ON READER-SERVICE CARD

CIRCLE 86 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Annunciator

Has 2 lamps per point

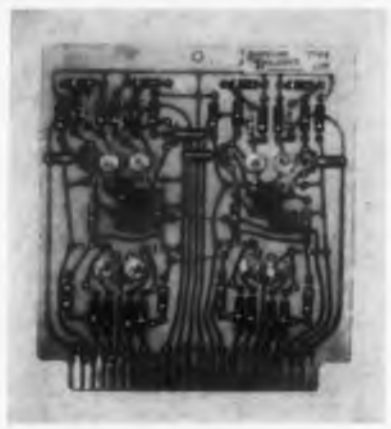
Utilizing 2 lamps per annunciator point, series 50FS annunciator enables the operator to differentiate between failure of component in the unit and an off-normal field condition. It also instantly identifies the position of the failure and informs the operator when a point is in the alert condition despite annunciator component failure. The unit provides optional lock-in, remote alarm, and auxiliary contacts, a flashing alert signifying field abnormalities, and a trouble lamp test with an acknowledgment push button.

Panellit, Inc., Panalarm Div., Dept. ED, 7401 N. Hamlin Ave., Skokie, Ill.

CIRCLE 87 ON READER-SERVICE CARD

Flip-Flops

Two circuits packaged as one card



For use in computer and control systems, type 2HX flip-flop consists of two independent 1 mc flip-flop circuits packaged as one plug-in printed circuit card. Each of the flip-flops uses two transistors. A transistor amplifier provides the output and two transistors at the input provide for gating of the input signals. Noise discrimination of 3 v is provided at the input gates. The unit has a 1-mc clock pulse for timing. Set 0 and 1 levels of ± 5 to ± 12 v are accommodated. Outputs are common ± 12 v unloaded for 0 levels and ± 12 v unloaded common for 1 levels. Output rise time is less than 0.5 μsec; fall time is less than

0.2 μsec. The operating temperature range is 0 to 50 C. The unit is assembled on a 4-1/2 x 5 in. circuit card and has a 22 pin PC connector.

Ransom Research, Dept. ED, 323 W. 7th St., San Pedro, Calif.

CIRCLE 88 ON READER-SERVICE CARD

Linear Amplifier

Recovery time is less than 7 μsec

Designed for scintillation spectrometry and proportional counting applications, model 851, DD-2 linear amplifier has a recovery time of less than 7 μsec for up to 200 times overload. Recovery time is better than 20 μsec with an overload to 1000. The unit is built to ORNL Q-1593-8. Model 851 A, has, in addition, a differential and integral pulse height analyzer.

The Victoreen Instrument Co., Dept. ED, 5806 Hough Ave., Cleveland 3, Ohio.

CIRCLE 89 ON READER-SERVICE CARD

High-Vacuum Pumps

Operate at 0.7 liter per sec

Able to pump 0.7 liter per sec, the series 110 high-vacuum pumps are used on microwave, storage, display, and X-ray tubes and other devices to extend cathode life by removing gas liberated during operation. Other uses include vacuum-jacketed vessels. The pump unit and the magnet weigh 1.6 lb; the magnet has a 2 in. OD. They have cold-cathode discharge and stainless steel construction. Four designs are available: two are arranged so that the tube is evacuated directly through the pump unit with no tube exhaust required.

Ultek Corp., Dept. ED, 920 Commercial St., Palo Alto, Calif.

CIRCLE 90 ON READER-SERVICE CARD

◀ CIRCLE 91 ON READER-SERVICE CARD

NEW PRODUCTS

DC Power Supplies

Respond in less than 10 μsec

Made for use in computers, telemetering, and automation systems, series T-200B transistorized dc power supplies respond in less than 10 μsec. Eight models are available, with output ratings from between 0 and 10 v to between 0 and 150 v, and current ratings from between 0 and 0.75 amp to between 0 and 30 amp. The output voltage is regulated with a total envelope of uncertainty of ±0.08%.

Armour Electronics Div. of Cardinal Instrumentation Corp., Dept. ED, 4201 Redwood Ave., Los Angeles 66, Calif.

CIRCLE 93 ON READER-SERVICE CARD

Silicon Diodes

Have forward-current to 200 ma

These silicon diodes, types 1N837 through 1N845, have a minimum forward-current, at 25 C and 1 v, of 100 to 200 ma. Maximum recovery time is 0.3 to 0.5 μsec. Their typical capacity at −2 v is less than 4 μμf. They have a reverse resistance of 400 to 2000 meg and an operating temperature range of −65 to +150 C. Hermetically sealed in one-piece glass envelopes with glass to metal seals at the leads, the diodes are 0.265 in. long and 0.107 in. in diameter.

Hughes Products, Semiconductor Div., Dept. ED, P.O. Box 278, Newport Beach, Calif.

CIRCLE 94 ON READER-SERVICE CARD

Indicator Lights

Rated at 1/25 w

The 1/25 w neon indicator light is enclosed in a translucent urea plastic case. It can be used alone or as part of a larger unit. Self-adjusting mounting clips permit insertion on 0.031 to 0.093

gage metal; the light also fits the perforations of most standard switchplates. Standard units have 6 in. stranded copper, plastic covered leads with 1/2 in. stripped ends. Lights can be provided for 125 or 250 v operation, with white or red cases, and with a choice of imprints. Nonstandard leads or special wording can be ordered.

Westmoreland Plastics Co., Inc., Dept. ED, Gertrude St., Latrobe, Pa.

CIRCLE 95 ON READER-SERVICE CARD

DC Amplifier

Transistorized

Model DA-12 transistorized dc amplifier has 5 μv noise, peak-to-peak, a response time to a step function input of 7 μsec, and an overload recovery time of 50 μsec. The heat control system insures low drift. The unit is supplied with both differential input and differential output circuits which function with either or both the input and the output single-ended.

United ElectroDynamics, Dept. ED, 200 Allendale Rd., Pasadena, Calif.

CIRCLE 96 ON READER-SERVICE CARD

Miniature Power Supply

Provides 900 to 1200 v

Measuring 1-1/2 x 1-7/8 x 2-7/8 in., model 61-R transistorized power supply operates from 6 v dc and delivers 900 to 1200 v. A Zener bridge used for reference regulates the output by means of a closed-loop servo system. The unit can operate in high altitudes and in temperatures to 85 C. Its applications include operating photomultipliers used in infrared detection systems and nuclear scintillation counters. It weighs 6-1/2 oz.

Components Corp., Dept. ED, Denville, N.J.

CIRCLE 97 ON READER-SERVICE CARD

NEW PRODUCTS

Automatic Time Reader

For magnetic tape

Model 1060 automatic time reader compares the timing track of a magnetic tape with switches set to designate the beginning and the end of tape sections of interest. Control signals are generated to effect print-out or other action. Generation of the start and stop signals occurs precisely at the beginning of a frame of interest and before reading time by means of a presensing device. The unit is composed of transistorized plug-in modules mounted with a power supply on a chassis 16 in. deep. A 7 x 19 in. front panel holds the operating controls.

Vitro Labs., Dept. ED, 200 Pleasant Valley Way, W. Orange, N.J.

CIRCLE 106 ON READER-SERVICE CARD

Secondary Frequency Standard

Provides 400 cps sine wave

For airborne and missile use, model U secondary frequency standard provides a 400 cps sine wave source with an accuracy of ±0.009 cps at 25 C. The output power is 55 mw; required input is 28 v dc. The total harmonic distortion is 10% max. The operating temperature range is 0 to 60 C. The unit has three unijunction countdown stages, one binary divider stage, and a tuned power output stage. It comes in a square envelope 1-3/4 x 1-3/4 x 3-1/16 in. and its over-all weight is 8 oz.

Designers for Industry, Dept. ED, 4241 Fulton Parkway, Cleveland 9, Ohio.

CIRCLE 107 ON READER-SERVICE CARD

Laminates

Epoxy-impregnated

Types GB-16EV-2 and GB-28EV-2 epoxy-impregnated, glass-base laminated plastics are available as plain sheets or as copper-clad sheets for printed circuit use. Sheet sizes are 38 x 42 in. and 38 x 38 in. Type GB-16EV-2 is from 1/100 to 1/8 in. thick. Type GB-28EV-2 is from 1/32 to 1 in. thick and is also available as rolled tubing in sizes from 2 to 12-3/4 in. OD and 2-1/2 to 13-1/2 in. OD with a minimum wall thickness of 1/4 in. Both types meet the requirements of MIL-P-18177B; type GB-16EV-2 is more suitable for close tolerance machining.

Continental-Diamond Fibre Corp., Dept. ED, Newark, Del.

CIRCLE 109 ON READER-SERVICE CARD

Film Potentiometer

Has 1/2 in. diam

Designed for use in servo systems, model 50 single-turn, precision potentiometer has a case diameter of 1/2 in. It has a film resistance element, operates over the temperature range of −55 to +150 C, and is treated to resist corrosion. The linearity is 0.2% and operation life is over 30,000,000 revolutions at 100 rpm. Nonlinear outputs, tapped elements, and ganged units can also be supplied.

Computer Instruments Corp., Dept. ED, 92 Madison Ave., Hempstead, L.I., N.Y.

CIRCLE 110 ON READER-SERVICE CARD

CIRCLE 111 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Variable Speed Controls

Instantly reversed

These variable speed controls can be instantly reversed whether running or stopped by means of a bell crank mechanism controlled by a lever. Instant reversing is possible to a torque limit of 450 lb-in. Models 54 and M54 have 0.5 hp max, and models 24 and M24 have 0.75 hp max. These controls are designed for power feeds, positioners, conveyors, and machine tools in metal working, mixing, blending, and measuring.

Zero-Max Co., Dept. ED, 1900 Lyndale Ave. S., Minneapolis 5, Minn.

CIRCLE 113 ON READER-SERVICE CARD

Transistors

Have ratings of 3 and 10 amp

These two types of power transistors are for both linear and switching applications. Type 2N1011, similar to the 2N297A, has a 3-amp collector current rating. Type 2N1120 has a 10-amp rating. Both units have copper strap internal construction and meet Mil specs.

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

CIRCLE 114 ON READER-SERVICE CARD

Laminated Forms

Shells, cases, and cups

These thin-wall, glass laminated shells, cases, and cups are for encasing transformers, delay lines, and other magnetic components. The materials available include glass silicone, melamine, polyester, epoxy, and phenolic. The glass cloth reinforcement provides rigidity and a high dielectric. Thé laminated forms are tooled to the customer's specifications; lengths of tubing are available as stock items.

Stevens Products, Inc., Dept. ED, 86-88 Main St., E. Orange, N.J.

CIRCLE 115 ON READER-SERVICE CARD

Potentiometer-Clutch

Linearity is to 0.15%

Model 120 potentiometer-clutch consists of an electro-magnetic clutch and rotary film potentiometer. The 1 in. diam unit pictured here is available with linearities to 0.15% and resistances of 1 to 200 K. Resolution is better than 1 part per 40,000 and guaranteed life is in excess of 10,000,000 revolutions. Engagement time is under 20 μsec and running speed is to 1000 rpm. Having a volume of 1-1/2 cu in., the unit weighs 3-1/2 oz.

Computer Instruments Corp., Dept. ED, 92 Madison Ave., Hempstead, L.I., N.Y.

CIRCLE 127 ON READER-SERVICE CARD

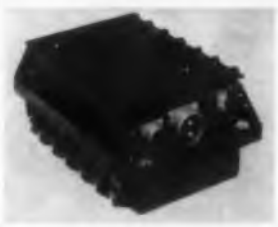
Miniature Power Connectors

Have up to 52 contacts

For heavy duty applications in guided missiles, aircraft, and electronic equipment requiring high dielectric and mechanical strength, four types of miniature power connectors are available. Type GA has spring action center screwlock and is available in 10, 32, 35, 40, 48, and 52 contacts. Chassis mounted units are pressurized, and contacts are individually spring loaded. Types 14 and 15 are compact, heavy-duty rectangular power connectors with a current rating of 10 amp and a voltage breakdown of 4500 to 4700 rms. They are available in 7, 9, 10, 15, 18, 19, and 20 contacts with turret, solder cup or taper pin terminations. Type E-Z connectors have individually spring-loaded pin contacts, polarizing screwlocks, and aluminum hoods.

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

CIRCLE 128 ON READER-SERVICE CARD



Transistor Inverter

Has 2000 va output

Model 4311 transistor inverter is an airborne power supply with a 2000 va, 3 p, 4 wire output. Voltage regulation is ±1.0% from one-half to full load. Output frequency is 400 cps ±0.1%; efficiency is 75% at full load and power factor is 0.9. This unit weighs 35 lb and measures 16.1 x 9.75 x 7.5 in. It is designed for continuous operation with air cooling during pre-launch checkout; it operates without cooling during missile flight.

Varo Manufacturing Co., Inc., Dept. ED, 2201 Walnut St., Garland, Tex.

CIRCLE 129 ON READER-SERVICE CARD

NEW PRODUCTS

Relays

Mechanically-held

These 25 amp, mechanically-held ac relays have up to 24 poles. Standard control voltages are: 24, 110 to 120, and 208 to 240 v at 25, 50 or 60 cps; and 440 and 550 v at 60 cps. Electrical spacings are adequate for 600 v. These units can be used as primary relay devices controlling contactors, solenoid valves, and similar equipment, or as branch circuit devices to control electric ovens, furnaces or lights.

Automatic Switch Co., Dept. ED, Florham Park, N.J.

CIRCLE 131 ON READER-SERVICE CARD

Amplifier

Miniature

This amplifier unit is approximately the size of two cigarette packs. It is used for high accuracy data reporting devices to act as a preamplifier between low level signals and direct writing type oscillograph pens. This unit is adaptable to any oscillograph data recording units.

Leach Corp., Dept. ED, 18435 Susana Rd., Compton, Calif.

CIRCLE 132 ON READER-SERVICE CARD

Gyro

Floated rate type

This floated rate gyro operates during and after exposure to temperatures from −40 to +200 F. The natural frequency ranges from 30 cps for a low rate to 100 cps for a high rate. The instrument withstands steady state acceleration of 60 g along each of the three major axes and transient accelerations to 100 g along each axis. It withstands vibration to 15 g and shock to 60 g. It has 1 deg of freedom and achieves vibration and shock isolation by flotation of the gimbal structure.

Telecomputing Corp., Dept. ED, 16217 Lindbergh St., Van Nuys, Calif.

CIRCLE 133 ON READER-SERVICE CARD

◀ CIRCLE 134 ON READER-SERVICE CARD

Servomotors

Operating range from −54 to +150 C

These size 11 servomotors operate effectively at temperatures ranging from −54 to +150 C. The R133-003 pinion shaft and the R133-004 plain shaft motors have a no load speed of 6200 rpm, a stall torque of 0.45 in.-oz, and weigh 4.5 oz. These motors are constructed of advanced temperature-resistant parts and impregnating materials, and have high torque-to-inertia ratios.

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

CIRCLE 135 ON READER-SERVICE CARD

Radar Beacon

C-Band and S-Band

Radar beacon type 149 is used as an air-borne, pulse-type tracking aid for long-range missile or space applications. Completely transistorized except for the local oscillator and the transmitter, it is small and light-weight. A transistor power supply develops regulated operating voltages from a 24 to 28 v dc power source. The beacon operates in the C-Band or S-Band and responds to coded or uncoded pulse interrogations from radars.

ACF Industries, Inc., Avion Div., Dept. ED, 11 Park Place, Paramus, N.J.

CIRCLE 136 ON READER-SERVICE CARD

Thermocouple Wire

Metal sheathed

Pycopak thermocouple wire is magnesium oxide packed, with metal-sheathed construction. It is available in seven sizes ranging from 5/16 to 1/40 in. sheath OD, with standard materials of 304 stainless steel, Inconel and platinum. The wire may be supplied in lengths up to 50 ft. Complete thermocouple assemblies, consisting of wire with integral, insulated or exposed junctions, together with head and block or quick-connect plug, are also standard items.

Pyrometer Company of America, Inc., Dept. ED, Penndel, Pa.

CIRCLE 137 ON READER-SERVICE CARD

CIRCLE 138 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Resistors

Wire wound

Series S.AL precision wire wound resistors are available in the following standard sizes: 1, 2, 3, 5, 7, 10, 15, and 20 w. Resistances are 1 to 90,000 ohms. These axial-lead resistors are made with all welded construction and have silicone coating.

Tru-Ohm Products, Div. of Model Engineering & Manufacturing, Inc., Dept. ED, 2800 N. Milwaukee Ave., Chicago 18, Ill.

CIRCLE 139 ON READER-SERVICE CARD

Tetrode

High-frequency, sharp-cutoff type

Type 6EV5 tetrode is used as an rf amplifier in vhf tuners. With a plate voltage of 250 v and a screen voltage of 80 v dc, it has a transconductance of 8800 μmhos for a plate current of 11.5 ma and a screen current of 0.9 ma. This tube is similar in construction to the 6CY5, but has higher gain, high input impedance and a noise figure 1.3 db below that of the 6CY5. The 6EV5 can be operated directly from a 250-v supply without use of a dropping resistor.

Westinghouse Electric Corp., Dept. ED, P.O. Box 2099, Pittsburgh 30, Pa.

CIRCLE 140 ON READER-SERVICE CARD

Indicator Light

Is 15/64 in. in diam. and 35/64 in. long

Series L10000 indicator lights are 15/64 in. in diam and 35/64 in. long. They have a 60,000-hr life at 5 v dc and 0.060 amp. The lamp-lens assembly is molded to the mounting stem, making this light moisture proof. These units will mount in a clearance hole for a No. 10 screw, and extend behind the panel 13/64 in.

Hetherington Inc., Dept. ED, 1420 Delmar Drive, Folcroft, Pa.

CIRCLE 141 ON READER-SERVICE CARD

◀ CIRCLE 142 ON READER-SERVICE CARD

Phase Sequence Indicators

For use with three-phase power systems

These portable phase sequence indicators, designed for use in three-phase power systems, have three insulated test leads connected at random to the three-phase conductors. Model 40 is for 60 cps systems and is adjustable to 120, 240 or 480 v. It measures 3 x 5 x 2 in. and has no moving parts or batteries. Model 44, for use with 400 cps systems, is also available.

Associated Research, Inc., Dept. ED, 3777 W. Belmont Ave., Chicago 18, Ill.

CIRCLE 143 ON READER-SERVICE CARD

Silicon Rectifiers

Are rated at 25 amp

These silicon rectifiers are rated at a forward current of 25 amp in a single-phase circuit at a stud temperature of 145 C. Maximum one-cycle surge current rating is 300 amp. Seven conventional types, 1N2154 through 1N2160, have the stud as the cathode; seven reverse-current types, 1N2154R through 1N2160R, have the stud as the anode. These units are rated at from 50 to 600 piv.

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

CIRCLE 144 ON READER-SERVICE CARD

Motor Alternators

Rated to 10 kva

These two-bearing, common-shaft 400 cps motor alternators are rated from 500 w to 10 kva. A one-piece rotor with cast windings and a brushless design make this inductor type alternator almost maintenance free. The 10 kva unit has a power factor of 0.9 and is available with either an electronic exciter or a magnetic amplifier voltage regulator. Other inductor alternators, in four-bearing designs, rated as high as 30 kva, can be supplied.

American Electronics, Inc., Dept. ED, 1025 W. Seventh St., Los Angeles 17, Calif.

CIRCLE 145 ON READER-SERVICE CARD
CIRCLE 146 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Wiring Ducts

Modular

This modular panel wireway system has independent top, bottom and sides for adaptability. This system eliminates wire lacing and bundling, and permits wire inspection. Constructed of flame-resistant plastic, the units can be disassembled at any time and converted to a different size.

ECP Corp., Dept. ED, 4726 Superior Ave., Cleveland 3, Ohio.

CIRCLE 147 ON READER-SERVICE CARD

Antenna Mount

Manually-controlled

Type HM-2 manually operated antenna mount is for azimuth and elevation positioning. It has a 5 in. diam mast and a heavy base for bolting to the supporting foundation. Especially designed for easy focusing and locking, the mount can be used with parabolic reflectors up to 10 ft in diameter and with helical antennas for telemetry applications.

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

CIRCLE 148 ON READER-SERVICE CARD

Relays

Impulse totalizing type

For multiunit metering of power distribution systems, these impulse totalizing relays use semiconductor devices to combine demand impulses from as many as seven sources and to retransmit them over a single output circuit. Available with capacities of 3, 5, or 7 input channels, they have a common maximum output rate of 450 impulses per min. The maximum input rate depends on the number of input channels to be totaled. The three units are available in output-impulse to input-impulse ratios of 1:1, 2:1, or 4:1. These WT relays measure 16 x 6 x 8 in.

Westinghouse Electric Corp., Dept. ED, P.O. Box 2099, Pittsburgh 30, Pa.

CIRCLE 149 ON READER-SERVICE CARD

CIRCLE 150 ON READER-SERVICE CARD

Accelerometers

Operate from −65 to +350 F

Models 2232 and 2235 hermetic sealed accelerometers operate in the temperature range of −65 to +350 F. Model 2235 provides a nominal sensitivity of 25 mv per g; model 2232 provides 6 mv per g. The resonant frequency for model 2232 is 50 kc and for model 2235, 40 kc. Both units offer a frequency range response of 1 cps to 10 kc ±5% with 1000 meg load. Nominal capacity is 1800 μμf. These units weigh less than 1.1 oz and measure 0.71 in. in length x 0.61 in. diam with a 5/8 in. hex base.

Endevco Corp., Dept. ED, 161 E. California Blvd., Pasadena, Calif.

CIRCLE 151 ON READER-SERVICE CARD

Refrigerated Blower

Has 36,000 Btu capacity

The BR-36 refrigerated blower maintains a pre-set temperature within from four to six completely equipped cabinets. This unit may be pre-set from 60 to 100 F. It has a 36,000 Btu capacity, and operates from a 220 v ac source. Humidity within the cabinets is reduced to less than 50%. This blower is 66-1/2 in. high, and mounts in a standard 19 in. insulated cabinet.

Western Devices, Inc., Dept. ED, 600 W. Florence Ave., Inglewood 1, Calif.

CIRCLE 152 ON READER-SERVICE CARD

Stalo Exciter-Driver

Output of 5 to 10 w

Model 86 stalo exciter-driver provides a stable frequency power source in radar systems; it may also be used as a klystron driver source. It is used where 5 to 10 w cw or pulsed rf are required over the S-Band. This unit consists of an L-Band cavity oscillator, cavity doubler to S-Band and cavity rf amplifier. The amplifier stage may be pulsed at any repetition rate. IFM is less than 150 cps throughout the frequency range.

BJ Electronics, Borg-Warner Corp., Dept. ED, 3300 Newport Boulevard, Santa Ana, Calif.

CIRCLE 153 ON READER-SERVICE CARD

CIRCLE 154 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Power Supply

Rated at 100 v dc at 2 amp

Model ME 100-2FM fixed voltage power supply is rated at 100 v dc at 2 amp. Regulation is 0.5% for line variations and 0.1% for load changes. Ripple is 0.01%, recovery time is less than 50 μsec, and overshoot is less than 1% of voltage setting. Required input is 105 to 125 v ac, 60 cps, single phase.

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

CIRCLE 156 ON READER-SERVICE CARD

Magnetic Shield

For cathode ray tubes

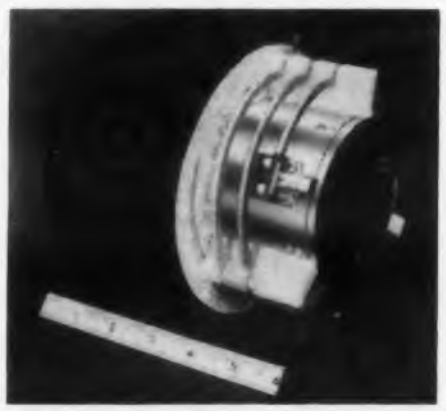
Designed for cathode ray tubes 20 in. or larger, this Netic Co-Netic magnetic shield has a shielded enclosure for electromechanically driven yoke assemblies. The enclosure prevents interference from the driven yoke assembly from affecting the performance of companion circuitry. The shield diverts stray magnetic fields by allowing them to be mounted near the tube without upsetting the display. Possible uses are in tracking systems and in radar telescope applications.

Perfection Mica Co., Magnetic Shield Div., Dept. ED, 1322 N. Elston Ave., Chicago 22, Ill.

CIRCLE 157 ON READER-SERVICE CARD

Delay Lines

Microwave type



These S-Band helical microwave delay lines provide a time delay of 0.1 μsec for signals in the 2.2 to 4.2 kmc range. Made of a ceramic material with a high dielectric constant, these delay lines weigh 25 oz and can replace 100 ft of coaxial cable.

Thompson Ramo Wooldridge Inc., Dept. ED, P.O. Box 90534 Airport Station, Los Angeles 45, Calif.

CIRCLE 158 ON READER-SERVICE CARD

Diodes

High power

This line of high power, lightweight diodes includes a 35 w Zener diode and single diffused junction Zeners with voltages ranging from 8.2 to 100 v and rectifiers with 50 to 600 piv. The rectifiers have high forward conductance, forward currents up to 40 amp at 1 v, and 1 ma saturation current at rated piv. Resistant to vibration, these hermetically sealed diodes have plated copper heat sinks and provide good thermal conduction.

U.S. Semiconductor Products, Dept. ED, 3540 W. Osborn Rd., Phoenix, Ariz.

CIRCLE 160 ON READER-SERVICE CARD

Converter

Has frequency range of 50 cps to 250 kc

Model 710 ac to dc converter has ±0.25% accuracy over the frequency range of 50 cps to 10 kc, ±0.5% over the range of 30 cps to 50 kc, and ±1% at 250 kc. It covers an input voltage range of 1 mv to 1000 v ac, divided into six decades. For every decade range the dc output varies from 0.1 to 1 v. The input impedance has a resistive component of 2 meg shunted by 15 to 25 μμf.

Ballantine Laboratories, Inc., Dept. ED, Boonton, N.J.

CIRCLE 161 ON READER-SERVICE CARD

Power Supply

Has magnetic control elements

Model RSS-1 current regulated power supply uses magnetic control elements. The current range is 3.2 to 5.1 amp dc into a 20 ohm load. Regulation is better than 2% for line variations of ±10% and load variation of ±20%. Ripple is less than 1%. Input requirements are 110 v ac, 60 cps, single phase. The unit measures 19 x 7 x 15 in.

Menlo Park Engineering, Dept. ED, 711 Hamilton Ave., Menlo Park, Calif.

CIRCLE 162 ON READER-SERVICE CARD

CIRCLE 163 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Servomotors

Have temperature range of —54 to +200 C

Model P112-001 size 10 servomotors are designed to operate at temperatures from —54 to +200 C. The stall torque is 0.035 oz-in. No-load speed is 3800 rpm. The unit weighs 1.45 oz.

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

CIRCLE 164 ON READER-SERVICE CARD

Permanent Magnets

High-energy type

Type V-7 permanent magnet, having a high degree of crystal orientation, has a residual induction of 12,750 gauss and a coercive force of 765 oersteds. This material is suited to applications requiring high energy-per-unit weight or volume. Typical applications include lightweight ground and airborne generators and alternators.

Indiana Steel Products Co., Dept. ED, Valparaiso, Ind.

CIRCLE 165 ON READER-SERVICE CARD

Frequency Monitor

Accuracy is 0.0035%

Model 660 frequency monitor provides low frequency measurement and control to an accuracy of 0.0035%. Direct digital readout from the in-line display unit is in cycles per second. Continuous frequency indication without blur or roll of digits is maintained with an integral memory unit. A digital to analog conversion provides an error voltage of proper sense and magnitude for frequency control with an error less than 0.005%. The unit can be adapted to monitor any frequency from 20 to 1600 cps with 5 digit resolution.

Erie-Pacific Div. of Erie Resistor Corp., Dept. ED, 12932 S. Weber Way, Hawthorne, Calif.

CIRCLE 166 ON READER-SERVICE CARD

Precision Potentiometers

Two types available

These two types of side-actuated precision potentiometers are suitable for control surface feedbacks on missiles because of their long life and low noise characteristics when subjected to high-frequency dithering. Type 3063 has a stroke length of 2.85 in. They withstand shock, acceleration, and vibration in excess of 50 g without opening or discontinuity. Linearity is better than ±0.5%.

Markite Products Corp., Dept. ED, 155 Waverly Place, New York 14, N.Y.

CIRCLE 167 ON READER-SERVICE CARD

Gauss-Flux Meter

Measures to 20,000 gauss

This instrument includes a gaussmeter ranging from 0 to 50 gauss through 0 to 20,000 gauss with a small generator and ranging from 0 to 200 milligauss with a field concentrator. Combined with the gaussmeter is a ballistic flux meter having a sensitivity of 500 Maxwell turns per division. The galvanometer has an 8 in. dial and a time constant of 2 sec. Zero can be shifted to either end of the dial or can be suppressed for gradient measurements.

GRH Halltest Co., Dept. ED, 157 S. Morgan Blvd., Valparaiso, Ind.

CIRCLE 168 ON READER-SERVICE CARD

Cathode Ray Tube

For hf oscilloscopes

Type K1546 cathode ray tube for high frequency oscilloscopes records single millimicrosecond transients. It has linear post-acceleration for low pattern distortion and for obtaining high deflection sensitivity. Separate pattern adjustment and astigmatism electrodes are provided for use with oscilloscope controls. Post-accelerator voltage is 24,000 v and accelerator voltage is 4000 v. The tube has a 5-1/4 in. diam.

Allen B. Du Mont Labs, Inc., Electronic Tube Div., Dept. ED, 750 Bloomfield Ave., Clifton, N.J.

CIRCLE 169 ON READER-SERVICE CARD

NEW PRODUCTS

Detector Cell

Photo-voltaic type

Silicon photo-voltaic detector cell model EA7 generates a minimum of 300 μa into a 1000-ohm load at an illumination level of 1250 ft-c of tungsten light at 2800 K. Its response time is less than 20 μsec. The active area is 0.13 x 0.05 in.; operating temperature is 55 C. The unit is 0.08 in. in diam and 0.5 in. long. Primary application is in computers as a punched-card or tape readout.

Hoffman Electronics Corp., Semiconductor Div., Dept. ED, 930 Pitner Ave., Evanston, Ill.

CIRCLE 171 ON READER-SERVICE CARD

DC Voltmeter

Also used as standard dc power supply

This dc voltmeter is also used as a secondary standard dc power supply. As a voltmeter the unit measures from 1 to 501 v full scale, at an absolute accuracy of 0.02%. It is also used as a null meter to provide accurate measurement of an unknown input. Null meter ranges are from 50 mv to 50 v. When used as a dc power supply, the instrument supplies 1 to 501 v at up to 20 ma. Called model 301, the unit has a stability of ±50 ppm for short periods, and ±100 ppm for long terms. It is available as a portable bench model or a 19 in. rack mount type.

Kin Tel, Div. of Cohu Electronics, Inc., Dept. ED, 5725 Kearny Villa Rd., San Diego 12, Calif.

CIRCLE 172 ON READER-SERVICE CARD

Power Controls

Have output to 2500 w

These power controls have outputs from 200 to 2500 w and sensitivity of 100 μa for full output. They utilize magnetic gating amplifiers which drive silicon-controlled rectifiers. These units are for 60 or 400 cps systems and operate at temperatures from −55 to +100 C. They provide regulation of power to ac or dc loads, full wave single-ended output, push-pull control of ac servo motors, or reversible dc output regulation of split field series motors. Their applications are in missiles, ground support handling equipment, radar tracking systems, and industrial control systems.

Magnetic Amplifiers, Inc., Dept. ED, 632 Tinton Ave., New York 55, N.Y.

CIRCLE 173 ON READER-SERVICE CARD

differential DC amplifier

amplifies low-level telemetering signals with high efficiency

Smallest size available—only 2½" long x 1 3/16" square. Weighs only 8 ounces. ±10 millivolts "in"...±5 volts "out."

Excellent linearity. From null to 5 VDC output, the linearity is 0.5%. From null to 2.5 VDC, it's 0.25%.

High stability—1% of gain and null value in 5 minutes from a cold start. Unit is stable over the full environmental range, and over power input variations.

Sources floating—input, output and power sources are completely isolated from one another.

Meets MIL-E-5272A for humidity, vibration and shock. Designed with magnetic amplifier reliability.

Write for complete data.

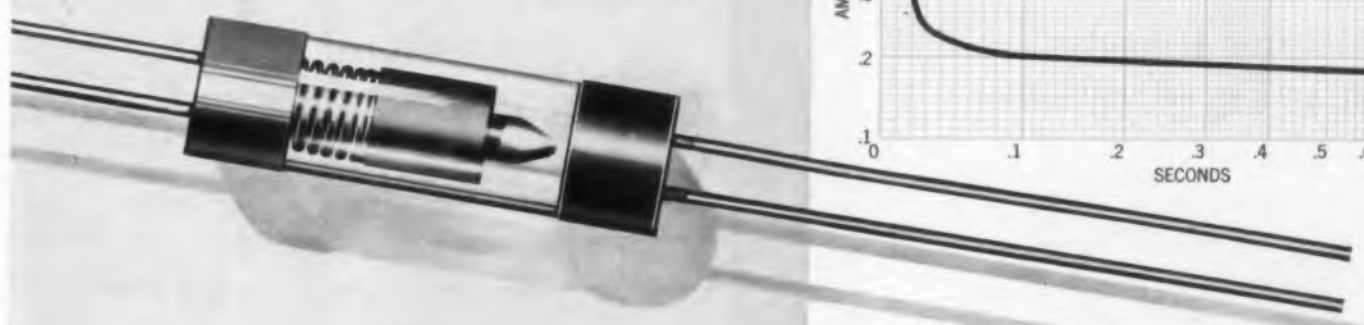
NETWORKS ELECTRONIC CORPORATION
14806 Oxnard Street, Van Nuys, Calif.
Telephone: STate 2-3114

CIRCLE 174 ON READER-SERVICE CARD

NETWORKS ELECTRONIC

—originators of the glass-enclosed thermal relay —announce a **NEW**

LOW-CURRENT THERMAL RELAY



FOR SOLID STATE APPLICATIONS

—miniature size...hermetically sealed, and 99.99% proven reliability

Protect your costly transistors with this tiny new N.O. thermal relay, only .0125 cubic inch in volume. It fires positively at .180 amp. For higher firing currents see graph for time delays obtainable. The fuse supports .120 amp. max. continuous current without burning. Operation is based on the "fuse burnout" principle which gives wide latitude to systems designers. The N.C. type fires positively at .350 amp. and supports .230 amp. max. continuous current without burning.

Hermetically sealed in glass by NETWORKS' exclusive method of bonding metal headers to glass housings which are resistant to heat and shock. The glass provides interior visibility—a great advantage over metal or potted types.

Qualification tested in the completely equipped NETWORKS' environmental laboratories. Normally-open type is tested to withstand:

Temperature: —100°F to +400°F
Vibration: 20 to 2000 cps at 15 G's
Shock: 50 G's for 2 to 4 MS

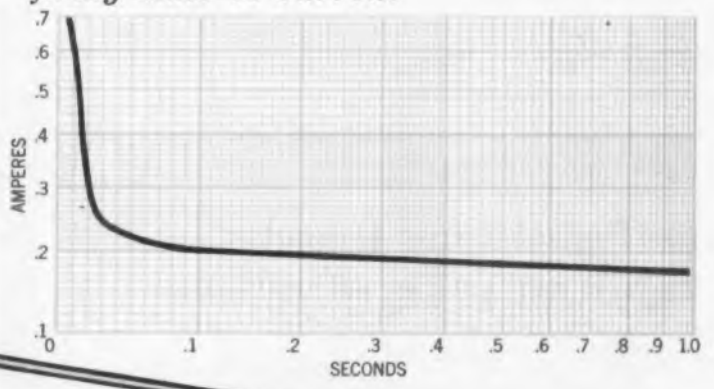
Higher ratings for Normally-closed type.

NETWORKS relays meet all pertinent Mil. Specs.

99.99% reliability. NETWORKS maintains continuous checks on daily production. If failure occurs in a lot, the entire lot is scrapped. There has been no failure in 1,000,000 delivered units.

Designed for use as a low-current sensing device, or for overload protection in guided-missile circuitry and complex electronic equipment. Used extensively to program parameters into pre-flight or flight computers.

firing time vs current



normally open type **NO. M555** (Actual Size)

Maximum Dimensions: .165" dia. x .550" long

normally closed type **NO. M449** (Actual Size)

Maximum Dimensions: .250" dia. x .860" long

Send for complete data.

NETWORKS ELECTRONIC CORPORATION
14806 OXNARD STREET • VAN NUYS, CALIFORNIA • STATE 2-3114

CIRCLE 175 ON READER-SERVICE CARD

NEW PRODUCTS

Feed-Through Terminal

Slotted-lug type

Type FT-1025 slotted-lug feed-through terminal can be simply pressed into a hole without nuts, washers, or lockwashers. It is especially suited for assemblies requiring potting or other sealed-in equipment requiring external connections.

Sealectro Corp., Dept. ED, 139 Hoyt St., Mamaroneck, N.Y.

CIRCLE 176 ON READER-SERVICE CARD

Digital Readout

Characters are 2 x 3 in.

In-line, in-plane digital readout has 2 x 3 in. characters. Called model SGS-103, it requires 2-1/2 in. of back panel. Multiple units may be arranged in-line, occupying 3 x 4 in. of panel space per digit. Operating voltage is 350 v, dc or ac. Eleven inputs are provided; decimal point is available. Applications include digital voltmeters and aircraft instruments.

I.D.E.A., Inc., Electronic Equipment Div., Dept. ED, 7900 Pendleton Pike, Indianapolis 26, Ind.

CIRCLE 177 ON READER-SERVICE CARD

Digital Strain Indicator

Response time is 0.4 sec per 1000 counts

This digital strain indicator provides direct readout in any specified units and offers a response time of 0.4 sec per 1000 counts. It can also be equipped to operate printers, tape punch units, and typewriters. The instrument applies dc power to the bridge which may have 50 to 500 ohms resistance with no change in calibration or accuracy. Dual potentiometers permit the measurement of open circuit output voltage of the bridge.

Datran Electronics, Dept. ED, 1836 Rosecrans Ave., Manhattan Beach, Calif.

CIRCLE 178 ON READER-SERVICE CARD

Headset

Has frequency response of 50 to 5000 cps

This boom-mike headset features a receiver with a rising response curve at voice range for maximum intelligibility and a uniform frequency response of 50 to 5000 cps. The unit pictured here has a noise canceling dynamic microphone which meets TSO C-58. Carbon, reluctance, and crystal microphones are also available. Weighing 3.5 oz, the unit has many communications applications. It meets FAA requirements.

Telex, Inc., Dept. ED, St. Paul, Minn.

CIRCLE 180 ON READER-SERVICE CARD

Silicon Transistors

Dissipate 500 mw

The series A silicon transistors, types 2N332 through 2N336, can dissipate 500 mw at 25 C with no heat sink. They have a minimum collector-to-emitter breakdown voltage of 45 v and a minimum emitter to base breakdown voltage of 4 v. The alpha cut-off frequency rating ranges from 10 mc for type 2N332A to 15 mc for 2N336A. The transistors are npn type and are designed for amplifier applications in af and rf ranges and for general purpose switching. They are hermetically sealed in welded cases.

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

CIRCLE 181 ON READER-SERVICE CARD

Panel Enclosures

NEMA type 12

This line of NEMA type 12 panel enclosures have two Z-bar supports welded to the enclosure wall, permitting secure bolting of wired panels from the form without stud shearing or stripping. They are of all-steel construction with leakproof seams and have a neoprene door gasket. Single-door wall-mounted enclosures, as well as two-door floor-mounted types, are available in sizes from 12 x 24 x 6 in. to 72 x 72 x 12 in. to meet standard NEMA specs.

Michigan Controls Co., Dept. ED, 8790 Grinnell Ave., Detroit 13, Mich.

CIRCLE 182 ON READER-SERVICE CARD

NEW PRODUCTS

Cradle Relays

Weigh 1 oz

These cradle relays weigh 1 oz max and have a contact rating of 2 amp resistive, 1 amp inductive; low-level or 5 amp contacts are also available. Contact arrangements include dpdt, 4pdt, 6pstno and 6pstnc. A 6pdt arrangement is supplied in the open-type relay. Dc coil resistances range from 1.3 to 15,000 ohms. Dielectric strength is 1000 v rms; insulation resistance is 1000 meg. Operate-to-make time is 7.5 msec; release-to-break time is 3.5 msec.

Allied Control Co., Inc., Dept. ED, 2 East End Ave., New York 21, N.Y.

CIRCLE 184 ON READER-SERVICE CARD

Gaussmeter

Has range of 0 to 30,000 gauss

Model 100 gaussmeter gives readings in three scales: 0 to 300, 0 to 3000, and 0 to 30,000 gauss. Designed to measure direction and magnitude of flux density, this instrument can also be used to plot flux paths or to measure flux leakage. High-purity indium arsenide, having a temperature coefficient of 0.1%, is used as the sensing element. This element, which measures 0.019 x 0.125 in., permits insertion of the flat probe tip into narrow air gaps. The instrument will read dc flux in the presence of a strong ac field. No amplifier is used. A 4.5 v battery is built into the unit. Dimensions are 10-1/8 x 4-3/8 x 7-1/2 in. and weight is 5 lb.

F. W. Bell, Inc., Dept. ED, 975 S. High St., Columbus 6, Ohio.

CIRCLE 185 ON READER-SERVICE CARD

CANNON PLUGS

Schweber

FOR IMMEDIATE LARGE QUANTITY DELIVERY AT FACTORY PRICES

2500

Yes! You can now order up to 2500 each of such popular Cannon Connector types as Miniature D, KO, DPD, DPA, DPX, etc. Immediate shipment at factory prices.

Schweber ELECTRONICS

60 HERRICKS ROAD, MINEOLA, L.I., N.Y.
PIONEER 6-6520 TWX G-CY-NY-580

CIRCLE 187 ON READER-SERVICE CARD

RELIABLE MULTI-PURPOSE "K" SERIES

cam-8-k

K STANDARD

FOR AIRCRAFT, ELECTRONIC, INSTRUMENT, MILITARY, MISSILE, INDUSTRIAL AND COMMERCIAL APPLICATIONS Standard K and RK . in straight and angle 90° plugs with wall mounting receptacles. Conduit and clamp entry types. 1 to 110 contacts in 250 different insert arrangements. 10, 15, 30, 40, 60, 80, 115 and 200 amp. silver plated brass on copper contacts. High quality phenolic, melamine, and formica insulators. Cadmium-plated aluminum alloy shells. Flashover voltages: 110 to 5000V, 60 cps ac rms.

KH-RKH

FOR USE UNDER CRITICAL PRESSURE AND LEAKAGE CONDITIONS—Hermetically sealed plugs with steel shells, steel contacts, and Canseal glass insulators for true hermetic sealing. Electro tin plating over cadmium plate over copper flash provides highly receptive surface for soldering and corrosion resistance.

RK

FOR FLUSH OR SEMI-FLUSH MOUNTING—Cannon RK Plug assemblies are equipped with an external threaded coupling nut which is the reverse of the standard K Series. Note: RK will mate only with RK's.

TBF-K

FOR CARRYING CIRCUITS THROUGH BULKHEADS Cannon TBF-K Bulkhead Plugs feature a double-faced construction allowing mating at both ends. Pin inserts. Single piece shell.

RLKL-LKL

FOR TV AND OTHER PANEL SWITCHING OPERATIONS—Quick connect and disconnect RLKL Plugs are designed for one-hand fast disconnect use on TV station program switching panels and similar type operations. Feature a quick coupling means. Latch-lock secures plug to mated fitting (RLKL receptacle). Thumb pressure releases it.

FW-K FWR-K

FOR OPEN FLAME PROTECTION AGAINST HIGH TEMPERATURES—Cannon K Firewall Plugs are available in straight and angle 90° shell types. Wall mounting receptacles also available. Phenolic or fireproof inserts of glass-filled materials. Crimp type contacts. Cannon originated the firewall connector and continues to be the leader in this important field.

SK-M7-21C

FOR USE IN TELEPHONE "BEEPER" AND SIMILAR APPLICATIONS—Widely used on telephone recording units known as "beepers." Adaptable for other similar applications.

K ACCESSORIES—Cannon K Series Accessories include Straight and Angle 90° Junction Shells, Dust Caps, Bonding Rings, Gland Nuts, Clamps, and Dummy Receptacles to hold and protect plugs when not in use.

Cannon has available a wide variety of other Plug designs FOR EVERY CONCEIVABLE APPLICATION...including aircraft and electronic Plugs conforming to Specification MIL-C-5015D; Unit-Plug-In Rack/Panel and Modular; Audio and Low-Level Circuit Plugs; Miniature and Sub-Miniatures; Coaxial RF Series Plugs, Printed Circuit Plugs; GM Plugs and Cannon Plug/Harness Systems: "Kwik-Term" Terminals and DC Solenoids.

FOR ADDITIONAL INFORMATION on the typical designs illustrated...other configurations for your specific applications...or the design, engineering and manufacture to your special needs...write to **Cannon Electric Company**—3208 Humboldt Street, Los Angeles 31, California. Please refer to Dept. 438

LARGEST FACILITY IN THE WORLD FOR PLUG RESEARCH-DEVELOPMENT-MANUFACTURE

CANNON PLUGS

MARCA REG IN MEXICO

Factories in Los Angeles, Santa Ana Salem, Toronto, London, Paris Melbourne, and Tokyo Distributors and Representatives in the Principal Cities of the World.

CIRCLE 188 ON READER-SERVICE CARD

NEW PRODUCTS

Power Supplies

Have 15 w output

Made for use with computing systems or strain gage apparatus, the PI series of power supplies has 15 w output with 0.1% regulation. The range of voltage available is 0 to 300 v dc. Recovery is less than 50 μsec, ripple is 0.01%, and overshoot is less than 1% of the voltage setting. The unit is programmable over a narrow voltage range. It measures 4-1/16 x 4-7/8 x 6-1/2 in., weighs 3 lb.

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

CIRCLE 189 ON READER-SERVICE CARD

Digital Voltmeter

Compact design

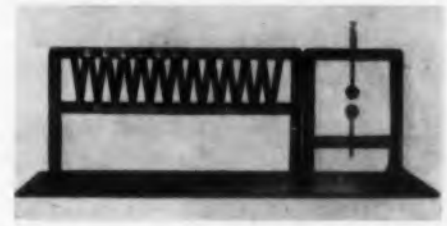
Measuring 6-1/2 x 8-1/2 x 8-1/4 in. and weighing 11 lb, this digital voltmeter has no mechanical step-switches. Accuracy is within 1% of full scale on all dc ranges and is better than 2% above 20% of full scale on all ac ranges, from 50 cps to 0.6 mc. The ranges are manually set with automatic indication at 1, 10, 100, and 1000 v ac and dc. The dc polarity indication is also automatic. Other features are: mercury cell calibration, seven tubes and seven transistors, and three cold-cathode counting tubes. Internal print-out connections are available.

Communications & Control Div. of Franklin Electronics, Inc., Dept. ED, 5901 Noble Ave., Van Nuys, Calif.

CIRCLE 190 ON READER-SERVICE CARD

Sphere-Gap Assembly

For high-voltage measurements



Voltages up to 120,000 v may be measured at accuracies of ±3% with this calibrated sphere-gap assembly. Measurements are made of dc potentials and crests of ac voltages at commercial power frequencies. A current limiting resistor assembly is incorporated to minimize sphere pitting and to suppress oscillation. Spacing of the two 6.25 cm spheres is controlled by a micrometer adjustment calibrated in thousandths of an inch.

Associated Research, Inc., Dept. ED, 3777 W. Belmont Ave., Chicago 18, Ill.

CIRCLE 192 ON READER-SERVICE CARD

Tape Search System

Transistorized

The Univac tape searchwriter searches a magnetic tape file for a desired item and automatically types the information. Transistorized, this device may also be used as an error-checking interrogator. Power supplies, read-write amplifiers, control circuits, error-checking circuits, and tape control are included. Any standard Univac characters can be entered from the keyboard or paper tape as the identifying data.

Remington Rand Univac, Dept. ED, 315 Park Ave. S., New York 10, N.Y.

CIRCLE 193 ON READER-SERVICE CARD

Pulse Modulator

Output is to 10 kw

Type BL-P-030 pulse modulator powers small magnetrons requiring inputs to 10 kw peak at a duty cycle to 0.002. Pulse widths from 0.1 to 2 μsec can be supplied. Meters are provided for pulse voltage, average voltage, average magnetron current, and magnetron filament current. Jacks are also provided for monitoring peak pulse current, pulse voltage, and the trigger repetition rate.

Bomac Labs., Inc., Dept. ED, 1 Salem Road, Beverly, Mass.

CIRCLE 194 ON READER-SERVICE CARD

NEW PRODUCTS

Recorder

Servo type

This servo recorder has a span step response time of less than 0.5 sec on a 4.5 in. chart. Its power sensitivity is better than 10^{-17} w with 4 meg off-balance input resistance and 2.5 mv dc electrical span. A ten-speed chart drive and a high-capacity ink handling system are incorporated in the unit. The recorder function can be easily changed with plug-in input units. Models with 9.75 in. charts are also available.

Texas Instruments, Inc., Dept. ED, 3609 Buffalo Speedway, Houston 6, Tex.

CIRCLE 195 ON READER-SERVICE CARD

Connectors

For miniature coaxial cable

This compression-type connector will connect RG195U cable and No. 24 coaxial cable. The connector frames will accomodate three, five or eight inserts, snapped in from either front or back. The inserts handle up to 21 pins or sockets. A plug or receptacle insert holds male or female contacts which may be intermixed. Coaxial cable inserts and standard wire inserts may be mounted in the same frame. The pin and socket contacts are crimped to both inner and outer conductors.

Burndy Corp., Dept. ED, Norwalk, Conn.

CIRCLE 196 ON READER-SERVICE CARD

Plastic Capacitors

Have ratings to 30 kv

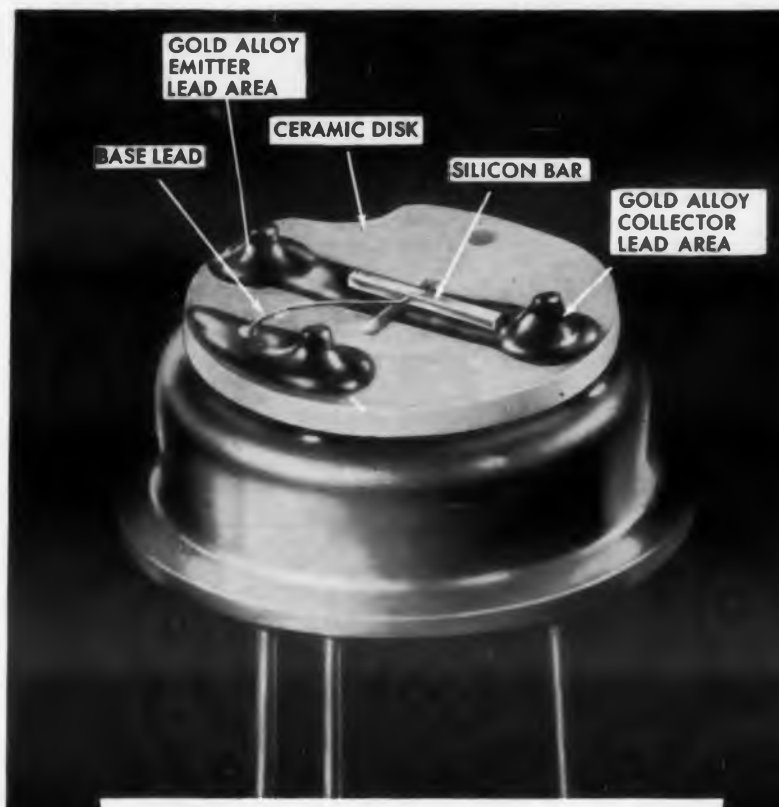
These capacitors, designated the HV series, are made of arc-resistant plastic and are available in rated voltages of 6, 10, 12, 15, 20, 25, and 30 kv. A wide range of capacities and three different terminal types can be supplied. Typical applications are in fly-back circuits.

Aerovox, Hi-Q Div., Dept. ED, Olean, N.Y.

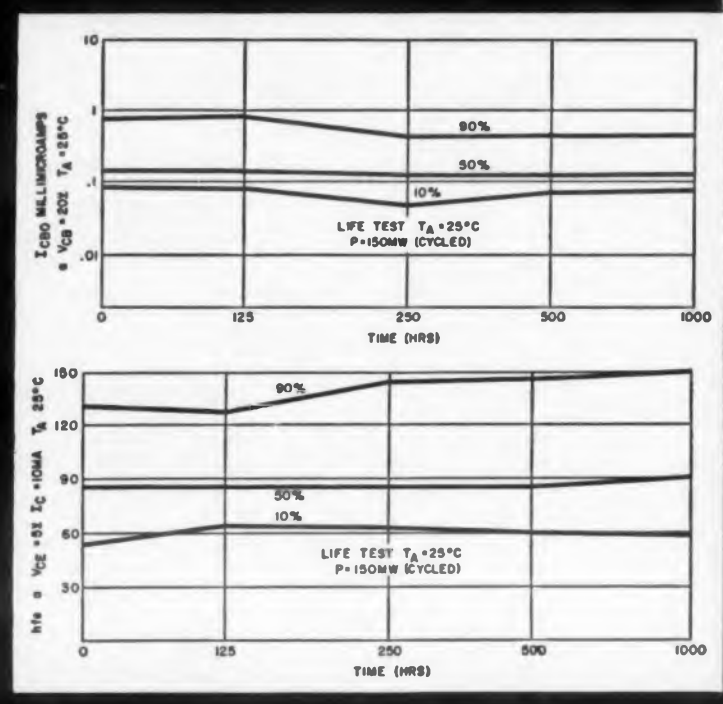
CIRCLE 197 ON READER-SERVICE CARD

General Electric Semiconductor News

New life test data prove superior



Magnified photo of silicon transistor showing Fixed Bed Construction. All parts are firmly fastened, with no suspended parts except wire lead. Transistor reacts as a solid block in resisting shock and vibration.



Charts show extreme stability of performance throughout 1000 hours of life for beta and I_{CBO}. Test conditions were 150 mw at 25°C, 200°C storage and 25 mw at 125°C. Drift rates were substantially the same under all conditions.

New NPN Tetrodes: Higher gain at high temperature and low current

LARGE QUANTITIES OF TYPES 3N36 AND 3N37 TESTED AND PROVED, HIGH RELIABILITY THE RESULT OF TWO YEARS OF MANUFACTURING EXPERIENCE*

Test	Results	% Survival
Mechanical Reliability		
3-ft drop-shock (2500 G's. Mil Std calls for 500G's)	2 out of 595 did not survive	99.66
Temperature cycling (−55°C to 100°C)	1 out of 375 did not survive	99.78
Life Test Reliability		
Cycled power @ 50 mw (device rated at 30 mw)	6 out of 500 exceeded parameter limits at 1000 hours	98.8
Oven @ 85°C	17 out of 500 exceeded parameter limits at 1000 hours	96.8
Shelf	No parameter failures of 500 units at 1000 hours	100.0

*General Electric's rigid standards call for only a slight shift in parameters to be a "failure." Many of these "failures" are still within EIA limits.

Here are two new germanium transistors that operate on lower voltages, require less current and are more rugged (see box below) than any other transistors that perform a like function. Furthermore, they deliver a high and constant gain at various voltages and at low power dissipation levels. Therefore, they are not only useful at high temperatures, but they also simplify circuit design and eliminate the need for close voltage regulation.

Features: Maximum gain at 1 ma, 5 volts or 5 mw. Flat gain noise factor from 1 ma to 5 ma. *Where to use them:* Mobile communications (made possible the first transistorized portable receiver). Wide band amplifier, oscillator and switching applications for radar and video at frequencies to 200 mc. *Availability:* Now . . . from your General Electric Semiconductor Sales Representative and in stock at your G-E Semiconductor Distributor's.

Absolute Maximum Ratings (25°C)	2N36	2N37	
Collector voltage to base 1 or base 2 (V_{CB})	+ 7	+ 7	V
Emitter to base 1 or base 2 (V_{EB})	+ 2	+ 2	V
Collector current (I_C)	+ 20	+ 20	ma
Emitter current (I_E)	− 20	− 20	ma
Base 2 current (I_{B2})	2	2	ma
Total Power dissipation	30	30	mw

Electrical Characteristics (25°C)			
Output capacity (C_{ob})	2	1.5	μμf
Noise figure (NF)	11	11	db
Input impedance (h_{ie})	100-j27	80-j10	ohms
Current transfer ratio (h_{fe})	$2.2\angle -81°$	$1.1\angle -100°$	
Common base cutoff frequency (f_{ab})	50 MIN.	90 MIN.	mc
Common Emitter power gain (G_e)	11.5	9	db
Measurement frequency	60	150	mc

Tape Readers

For punched or printed information

These tape readers are capable of reading 80, 160 or 240 bits of information simultaneously on a 1 in. frame of tape, in single-, dual- or triple-tape models. They have a 26.5 v dc bi-directional tape drive, are self-contained with storage reels to hold 250 ft of tape, and provide random or sequential access to 3000 discrete tests. Designed for programming automatic test equipment, model TP-201A, shown here, is an 80-bit reader using 2 in. tape, with 1 in. for punched information and 1 in. for printed information. It reads 10 transverse rows of 8 holes in standard teletype configuration. Contacts are rated at 0.05 amp.

Anaheim Electronics Co., Inc., Dept. ED, 1016 Raymond Way, Anaheim, Calif.

CIRCLE 199 ON READER-SERVICE CARD

Controlled Infrared Source

Temperature range is 50 to 600 C

Having a temperature range of 50 to 600 C, model PE521-4 controlled infrared source measures the sensitivity of infrared detectors and infrared systems. It can also be used as a reference standard to determine remote target temperature and emissivity or as a standard of radiant energy. The device can accommodate a thermocouple in its heated core. The radiating element is a pure silver core with a cone-shaped cavity. Radiation has a cosine distribution over a 20 deg field within 2%. The unit is supplied with a 0.5 in. diam aperture plate; other sizes are interchangeable. Power requirements are 160 w max, dimensions are 6-1/2 x 7-1/8 in., and weight is 6 lb. The source operates with PE521-5 temperature controller. Source temperature can be reset to within 0.3 deg C. The controller requires 300 w max at 115 v, 60 cps; it can also be furnished to operate at 110 v, 400 cps.

Perkin-Elmer Corp., Dept. ED, Norwalk, Conn.

CIRCLE 200 ON READER-SERVICE CARD

NEW PRODUCTS

Single-Channel Oscilloscope

With plug-in sweep delay

Model K-120 single-channel oscilloscope has a plug-in sweep delay with 18 calibrated ranges from 2 μsec to 1 sec per cm. The unit includes a wide-band vertical amplifier with 0.017 μsec rise time, sweep lock-out, beam position indicators, single-knob calibrator, and sweep controls. The unit may be used in pulse applications such as radar, guidance systems, and nuclear work. In addition to the plug-in sweep delay, these plug-in pre-amplifiers are available: type 20A, dc to 20 mc, 0.05 v per cm; and type 20B, an electronic switch pre-amplifier.

Electronic Tube Corp., Dept. ED, 1200 E. Mermaid Lane, Philadelphia 18, Pa.

CIRCLE 201 ON READER-SERVICE CARD

Initiator

Weighs less than 0.5 lb

Weighing less than 0.5 lb, this initiator is used for missile or rocket high explosive destruct applications. It may be placed in an igniter configuration to initiate solid and liquid propellant rocket motors. The device is capable of remote arming and disarming by means of an electrical signal either carried by land lines prior to launching or by telemetry when the missile is in flight. This unit will operate at 99.85% reliability under any environmental conditions encountered by space vehicles.

McCormick Selph Associates, Dept. ED, Hollister Airport, Hollister, Calif.

CIRCLE 202 ON READER-SERVICE CARD

...other silicones aid miniaturization

Light Silicone-Glass Parts Resist Heat

Where space is small, silicone-glass laminates make ideal parts. Reasons: they resist heat and humidity; are easy to fabricate into miniature components; resist creep and delamination. Silicone-glass laminates are light weight, strong, have good dimensional stability, withstand operating temperatures to 250 C, have low loss factor; permit adjacent soldering and have high resistance to moisture, ozone, arcing and corona.

In the geophysical well-logging instrument shown, Schlumberger Well Surveying Corporation specified terminal boards of silicone-glass laminate. The silicone laminate proved more reliable under operating conditions and easier to fabricate than other materials.

CIRCLE 601 ON READER-SERVICE CARD

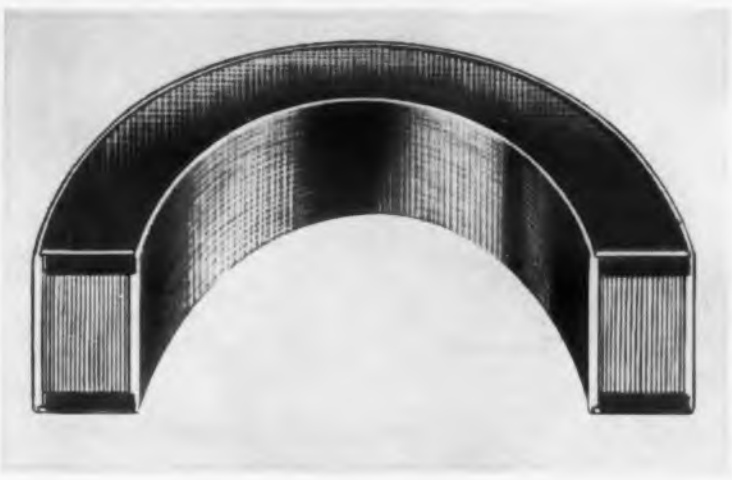
Silastic Assures Reliability Of Miniature Tube

Here's a good example of how miniaturization is aided by Silastic®, the Dow Corning silicone rubber.

A single tube from the line of Beam Switching Tubes developed by the Electronic Tube Division of Burroughs Corporation can replace as many as 90 transistors, diodes and resistors in electronic distributing, switching, and counting circuits. But proper operation and continued reliability depend upon the relationship of crossed magnetic and electrical fields . . . determined by the relative position of the glass envelope and the magnet which surrounds it. This positioning is very critical.

A cushion of Silastic assures proper alignment, bonds the glass envelope and magnet, provides greater shock resistance than any other material tested . . . contributes to the ease with which the tube meets military shock, vibration and other environmental requirements. Easily applied by simple injection techniques, Silastic is also used between magnet and tube shield.

CIRCLE 602 ON READER-SERVICE CARD

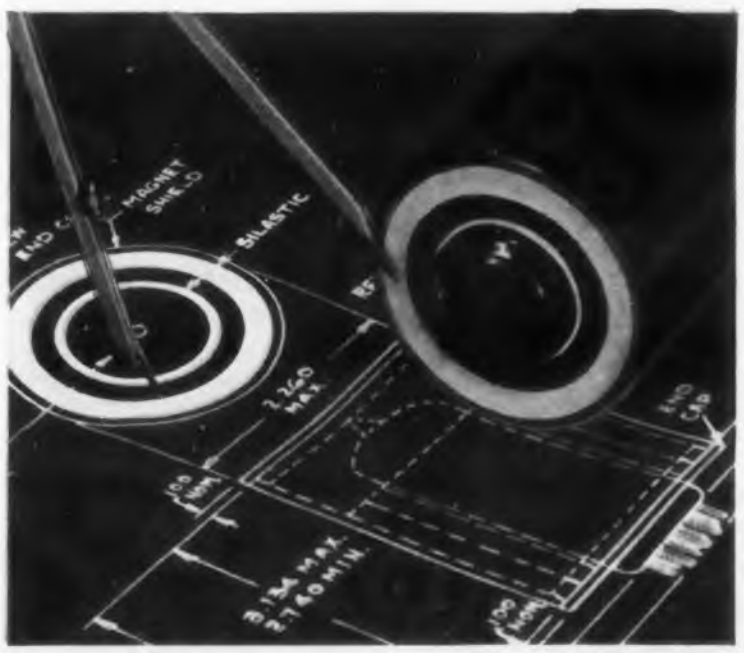


Silicone Compounds Cushion Small Cores

Tape wound toroidal cores, in both miniature and large sizes, are cushioned with silicone compounds between core and outer box by Magnetics Inc. Through the damping effects of the grease-like Dow Corning compounds, their phenolic-boxed cores are protected against vibration, shock effects and strain due to temperature change. They're "performance-guaranteed" up to 177°C.

Dow Corning silicone compounds were selected because they're inert, have high heat resistance and are easily applied. The compounds are nongumming, nonmelting, maintain a stable viscosity from —75 to 200 C. They have excellent dielectric, damping and heat-dissipation qualities, and are superior barriers to moisture. Other firms use silicone compounds for heat-sinks, sealants and similar applications, both mechanical and electrical.

CIRCLE 603 ON READER-SERVICE CARD



CORPORATION MIDLAND, MICHIGAN

branches: ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D.C.

CIRCLE 600, 601, 602, 603 ON READER-SERVICE CARD

Optical Silicon

For use in infrared detection devices

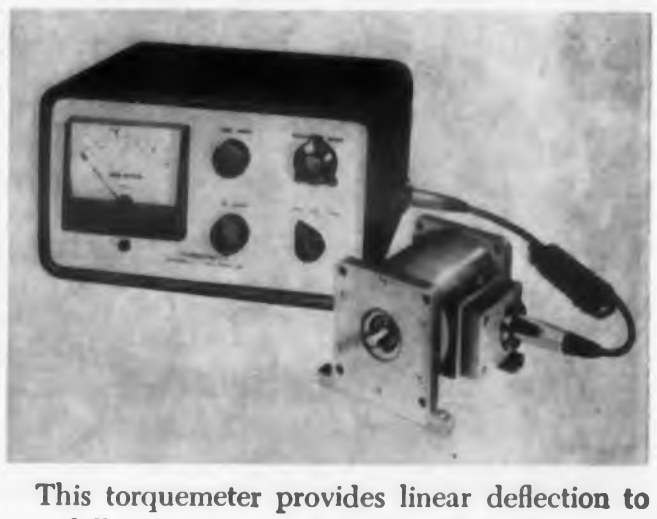
For use in infrared surveillance and detection devices, this optical silicon is made from ingots having impurities of less than 2 parts per 100,000,000. Individual blanks for lenses, optical windows, and hollow domes with diameters to 7 in. are manufactured. More than 95% transmission of a signal of any wavelength between 1 and 6 microns is provided. The melting point is 1420 C and resistance to thermal shock is high.

Dow Corning Corp., Dept. ED, Midland, Mich.

CIRCLE 203 ON READER-SERVICE CARD

Torquemeter

Has ratings from 10 to 400 lb-in.



This torquemeter provides linear deflection to any full scale torque desired within the range of 50 to 100% of the sensor maximum torque. The interchangeable sensors have maximum torque ratings from 10 to 400 lb-in. The sensor detects dynamic torque transmitted by shafts rotating at speeds up to 2400 rpm without brush contact with the rotating element. The torque is continuously displayed at the indicator with an accuracy within 2% of full-scale reading.

Rotiform Co., Dept. ED, 1509 Colorado Ave., Santa Monica, Calif.

CIRCLE 204 ON READER-SERVICE CARD

Epoxide Bobbins

Encapsulate wire-wound resistors

This series of winding forms and bobbins are used to hermetically seal wire-wound resistors. The shell is heat sealed to the bobbin, enclosing the resistor in an epoxide resin container. The thermosetting resin has good physical and electrical characteristics, high tensile strength, a dielectric constant of 3.7 at 60 cps, and a loss factor of 0.009 at 60 cps. These units have diameters from 1/8 in. and heights from 1/4 in., and withstand 150 C.

Thor Ceramics, Dept. ED, Bloomfield, N.J.

CIRCLE 205 ON READER-SERVICE CARD

NEW PRODUCTS

Time Meters

Register from 0.1 sec to 99,999 hr

For recording elapsed time in industrial or laboratory operations, type 632 time meters register from 0.1 sec to 99,999 hr. Time ranges available are seconds or tenths of seconds, minutes, tenths or hundredths of minutes, and hours, tenths or hundredths of hours. The meters are available with or without reset and have hermetically sealed cases which meet MIL-E-5272A. Motors can be specified for 115 or 220 v ac at 60, 50 or 25 cps; and in limited time ranges, for 115 v ac at 400 cps, or for any voltage from 6 to 32 v dc. The dials can be square, as shown, or round.

Cramer Controls Corp., Dept. ED, Centerbrook, Conn.

CIRCLE 207 ON READER-SERVICE CARD

Fiberglass Honeycomb

For circuit panels

Reinforced fiberglass honeycomb core may be used in the construction of strong and lightweight circuit panels. The core permits the use of very thin printed facings on the panel, simplifying the problem of solder-connecting circuitry through the facing. A 9 x 3-1/2 in. panel remains rigid under four-point suspension at temperatures ranging from —48 to +160 F.

Hexcel Products Inc., Dept. ED, 2332 Fourth St., Berkeley 10, Calif.

CIRCLE 208 ON READER-SERVICE CARD

Counter

Rate is 6,000,000 counts per min

Model 300T solid-state multiple preset counter offers a rate of 6,000,000 counts per min. The standard range is 1 to 9999; 5 to 8 digit units are also available. The unit requires 18 v dc at 0.2 amp. The standard power supply operates from 115 or 230 v at 60 cps. The dimensions are 3-1/2 x 9-1/2 x 13 in. and the weight is less than 10 lb.

Erie-Pacific Div. of Erie Resistor Corp., Dept. ED, 12932 S. Weber Way, Hawthorne, Calif.

CIRCLE 209 ON READER-SERVICE CARD

CIRCLE 210 ON READER-SERVICE CARD

Potentiometer

Linear motion type

This 1/2 in. linear motion potentiometer, type C 76, has a temperature range of −65 to +275 F and withstands a vibration of 35 g. Its ranges are 1/8 to 12 in. and linearity is 0.5% of full range. Critical elements are isolated and oil-sealed in a high-strength alloy case. The unit meets MIL-E-5272A for sand, dust, and humidity. Designed specifically for internal installation in hydraulic actuators, the unit can be used to measure displacement of missile and aircraft actuators, and has a single or double potentiometer output.

Servonic Instruments, Inc., Dept. ED, 640 Terminal Way, Costa Mesa, Calif.

CIRCLE 211 ON READER-SERVICE CARD

Miniature Flexible Couplings

For servos and computers

Suitable for servos and computers, these flexible couplings have 0.125 in. diam and 0.245 in. length, over-all dimensions. Torque is 0.1 to 250 oz-in., side thrusts are from 1 g at 0.005 in. off-set, and twist angles are less than 0.3 deg. The bellows type couplings can provide a wall thinness as low as 0.007 in. and are used in preference to other couplings where a rigid drive between two shafts is required.

Servometer Corp., Dept. ED, 222 Main Ave., Passaic, N.J.

CIRCLE 212 ON READER-SERVICE CARD

Resistor Standards

Two lines available

These two lines of resistor standards are available: reference resistors in values of 100, 1000, 10,000, 100,000, 1,000,000 and 10,000,000 meg certified within 1% and laboratory standard resistors in values of 10, 100, 1000, 10,000 and 100,000 meg certified within 0.2%. Each unit is aged and has less than −0.2% drift during the first year. Voltage coefficient is about −0.0001%. Temperature coefficient for the low megohm units is about 20 ppm per deg C and for the high megohm units is about −0.2% per deg F.

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

CIRCLE 213 ON READER-SERVICE CARD

CIRCLE 210 ON READER-SERVICE CARD

NEW PRODUCTS

Clock

Has increments of 0.02 sec

This 24 hr clock, model 4000, has increments of 0.02 sec. A 12 v dc high-speed, push-button-actuated motor allows for presetting of hours and minutes. Seconds are set by a manual reset knob. Since low torque is required to drive the clock, the timing motor may be miniature type. The numbers are 3/8 in. high and may be black on white or white on black; fluorescent numbers may also be provided. Model 4500, also available, has a 12 hr drum.

Haydon Instrument Co., Dept. ED, Waterbury, Conn.

CIRCLE 216 ON READER-SERVICE CARD

Circuit Board

Measures 9.5 x 12.5 x 1 in.

Model 23 circuit board measures 9.5 x 12.5 x 1 in. and contains 108 contact cells arranged in 9 rows, 12 columns. The 0.25 in. cells consist of gold-plated eyelets and rubber cores. Spacing between cells is 1 in., center to center. The board is made of cellulose-filled phenolic.

Plastic Associates, Dept. ED, 185 Mountain Rd., Laguna Beach, Calif.

CIRCLE 217 ON READER-SERVICE CARD

Servomotor

Size 15

Type T1311-22 size 15 inertial damped servomotor operates in the temperature range of —54 to +200 C. No-load speed is 4500 rpm, stall torque is 1.45 oz-in., and weight is 12 oz. The unit consists of a standard servomotor and a drag cup integral with a rear shaft extension.

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

CIRCLE 218 ON READER-SERVICE CARD

Sequence Controller

Switches from 2 to 12 circuits

This controller switches from 2 to 12 circuits in a predetermined sequence, repeating the sequence as long as actuating pulses are fed into it. Designated model SC 500, it takes one step in the switching sequence for each energizing pulse, but it can be supplied to take two or more steps. Switch contacts are pilot duty, 3 amp at 115 v ac.

Warco Industries, Inc., Dept. ED, 6625 Delmar Blvd., St. Louis 3, Mo.

CIRCLE 219 ON READER-SERVICE CARD

Oscillogram Scanner

Has two-foot viewing area

Oscillogram scanner model S-2 is a self-contained, electrically driven record transport system with a backlighted viewing area two feet wide. The drive system consists of two independent rollers, each containing a variable speed assembly. The record speed can be varied from 0 to 100 ft per min. A transparent cursor is mounted on a horizontal bar for direct editing purposes. This instrument requires 110 v, 60 cps, 250 w of input power; record widths may be 0 to 12 or 0 to 16 in.

Gerber Scientific Instrument Co., Dept. ED, 89 Spruce St., Hartford 1, Conn.

CIRCLE 220 ON READER-SERVICE CARD

Tantalum Capacitors

Liquid electrolyte type

These liquid electrolyte tantalum capacitors, types CL-15, CL-39, CL-40, and CL-43 have ratings of 150 μf at 30 v and 50 μf at 90 v. Their operating temperature range is −55 to +125 C. The units are hermetically sealed, and will meet test requirements for salt spray, shock, vibration, moisture resistance, and reduced pressure. They conform to applicable parts of MIL-C-3965B. Cases are 7/8 in. in diam.

The Magnavox Co., Dept. ED, Fort Wayne, Ind.

CIRCLE 221 ON READER-SERVICE CARD

NEW PRODUCTS

Test Chamber

Has two doors

Series FB-30 high and low temperature test chamber has two full opening doors opposite each other. Equipment can be on test and observed through the 24 x 24 in. viewing window provided in each door. Possible applications include volume production testing techniques. Capacity is 30 cu ft.

Conrad, Inc., Dept. ED, 141 Jefferson St., Holland, Mich.

CIRCLE 223 ON READER-SERVICE CARD

Silicon Rectifier

Delivers 300 ma dc

Type S-5130 continuous duty silicon rectifier delivers 300 ma dc at 10,400 piv with a resistive inductive load. Maximum peak current is 3000 ma and maximum dc current is 300 ma. The unit operates at temperatures to 100 C. Impregnated housing insures against shock. The unit replaces type 866 mercury vapor rectifier tubes.

Sarkes Tarzian, Inc., Rectifier Div., Dept. ED, 415 N. College Ave., Bloomington, Ind.

CIRCLE 224 ON READER-SERVICE CARD

Power Supply

Portable, transistorized

Model P-100-1 portable power supply is completely transistorized and provides a continuously variable output over two ranges, 0 to 50 v dc at 0 to 2 amp, and 0 to 100 v dc at 0 to 1 amp. Voltage regulation is 0.1% for both line and load variations. Output is floating and incorporates remote load change sensing. Ripple is 1 mv rms max, recovery is 50 μsec max, overshoot is less than 1% of the voltage setting. The unit measures 7-1/4 x 11-1/4 x 12 in.

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

CIRCLE 225 ON READER-SERVICE CARD

Selenium Rectifiers

Are rated at 45 and 26 v

Model 45 selenium rectifier is rated at 45 v, with NEMA current densities of 0.32 amp per in². It is available in cell sizes up to 2 in. sq. Rated at 26 v, with NEMA current densities of 0.64 amp per in²., model 26X is available in all cell sizes.

International Telephone and Telegraph Corp., Components Div., Dept. ED, Clifton, N.J.

CIRCLE 227 ON READER-SERVICE CARD

Transfer Switch

Doubles heating output stations

This transfer switch converts a single or two-position output induction heating generator into a dual output system. Changeover time for tooling is eliminated because the fixtures and coils can be left set up and ready for use. The switch is for use with work stations equipped with output transformers.

Induction Heating Corp., Dept. ED, 181 Wythe Ave., Brooklyn 11, N.Y.

CIRCLE 228 ON READER-SERVICE CARD

Telemetry Package

Compact design

This compact fm-fm telemetry package is designed for airborne use in small missile systems. The unit includes a 20 v, 60 ma power supply, ten subcarrier oscillators, a mixer-amplifier, and a 2 w transmitter, the only non-transistorized circuit. The unit is a 10 channel, go/no-go type.

The Martin Co., Orlando Div., Dept. ED, Orlando, Fla.

CIRCLE 229 ON READER-SERVICE CARD

Precision Potentiometer

Resolution is 0.1% at 50 K

This 7/8 in. precision potentiometer has less than 0.1% resolution at 50 K and has ±3% linearity. It is available in resistance ranges from 100 to 500,000 ohms. Rated at 3 w, it operates from −55 to +165 C. The noise level remains low over rated life of 1000 hr at 2.5 w.

Ace Electronics Associates, Inc., Dept. ED, 99 Dover St., Somerville 44, Mass.

CIRCLE 230 ON READER-SERVICE CARD

CIRCLE 231 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Testing Transformer

Has 10 kva capacity

For dielectric and corona level testing, thi testing transformer has a capacity of 10 kva. Th unit is corona free to at least 75 kv rms; the hig voltage oil-filled bushing is corona free to 150 k rms. The size is 30 x 26 x 83 in. and weight i 900 lb. Applications are dielectric testing in ac cordance with ASTM standards, corona testin in connection with general missile program, and testing ceramic bushings, cable components, ap paratus or insulation.

Peschel Electronics, Inc., Dept. ED, Towners Patterson, N. Y.

CIRCLE 233 ON READER-SERVICE CARD

Pressure Transducer

Available in 11 ranges

Model 725 miniature pressure transducer i available in 11 standard pressure ranges from 0 t 200 through 0 to 5000 for measuring pneumati and hydraulic media. Resistance elements ar available from 1000 to 10,000 ohms. Power ratin is 1 w. The static error band, based on termina base calibration and including hysteresis, friction resolution, and deviation from theoretical perfec calibration, is ±0.8%. The dynamic error band fo all effects, including vibration, is ±1.8% for swee or dwell vibration in the range of 20 to 2000 cp up to 35 g. The instrument measures 1-3/4 in. i diam and 7/8 in. high.

Bourns, Inc., Dept. ED, P.O. Box 2112, River side, Calif.

CIRCLE 234 ON READER-SERVICE CARD

Silicon Rectifiers

For use in power supplies

Types 1N536, 1N537, 1N538, 1N539, 1N54 1N547, and 1N1095 hermetically sealed, diffused junction type silicon rectifiers are specifically de signed for use in power supplies of industri and military equipment capable of operating a dc forward currents to 750 ma and temperature of −65 to +165 C. The piv ratings are 50 to 5 v and maximum reverse current is 5 μa at max mum rated peak inverse voltage. Ambient tem perature is 25 C. The maximum forward-voltag drop at a dc forward current of 500 ma is 1.1 v

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

CIRCLE 235 ON READER-SERVICE CARD

Cycle Timer

Motor-driven

Type AC-42 motor-driven cycle timer repeats a set sequence of switching operations when the motor circuit is energized. This timer is available with intervals of 15 sec to 24 hr. Operation is 120 or 240 v at 50 or 60 cps. The switch is rated at 25 amp or 1/3 hp at 250 v ac. A spdt switch is used and all terminal and blade configurations are heavy gage spring brass without welded or staked joints.

General Time Corp., Haydon Div., Dept. ED, New Britain, Conn.

CIRCLE 236 ON READER-SERVICE CARD

Hand Winder

Variable speed

This heavy duty hand winder is available in a choice of 6 variable speed/torque ranges: up to 54, 103, 108, 135, 207, or 258 rpm. Model 610-AM winds wire sizes up to No. 8 AWG at 12 in. diam; maximum coil OD is 12 in. The machine is furnished with 1/4 hp, 5000 rpm, 115 v 60 cps motor.

Geo. Stevens Manufacturing Co., Inc., Dept. ED, Pulaski Rd. at Peterson, Chicago 46, Ill.

CIRCLE 237 ON READER-SERVIC ECARD

Resistance Thermometer

Operates from −100 to +500 F

Model S-22 resistance thermometer operates from −100 to +500 F. It has a resistance of 470 ohms at 32 F, which varies about 1 ohm per deg F. The platinum sensing element is potted for maximum environmental capabilities, dielectric and mechanical strength. The lead wires provide 5 lb min pull strength. The thermometer measures 0.156 in. in diam and 0.281 in. in length. Calibration accuracies of ±0.25%, ±0.5%, and 1% are available.

Minco Products, Inc., Dept. ED, 740 Washington Ave. N., Minneapolis 1, Minn.

CIRCLE 238 ON READER-SERVICE CARD

NEW PRODUCTS

RF Signal Sources

For radar and microwave use

Model 700 high power rf signal sources for radar and microwave use are available for cw, pulse or dual modes of operation. Klystrons, pulse magnetrons, cw magnetrons, or traveling wave tubes are used as generator elements in this series. Each unit has rf power monitors, filament regulators, band switching, generator tube protective circuits, vacuum or semiconductor power supplies, and complete control function indicators. Frequency ranges available are from uhf through the K-band frequencies.

Burmac Electronics Co., Inc., Dept. ED, Rockville Center, N.Y.

CIRCLE 241 ON READER-SERVICE CARD

Millivoltmeter

Is chopper stabilized

This chopper-stabilized millivoltmeter measures dc voltage from 0.0005 to 300 v. Operating on power frequency of either 60 or 400 cps, model 301 has 10 voltage ranges; the meter has an arc length of 5-1/8 in. Model 301C has a zero-center and is used as a voltage-sensitive null indicator. For applications where control as well as indication is required, the instrument is available with a meter-relay instead of the conventional meter. Models 301-CMR and 301-C-CMR are equipped with double-locking contacts mounted on adjustable pointers.

Metronix, Inc., Dept. ED, Chesterland, Ohio.

CIRCLE 242 ON READER-SERVICE CARD

Frequency Generators

For aircraft and missile use

Made for aircraft and missile use, type T frequency generators have a range of 240 to 3200 cps and an accuracy of 0.001%. The output signal may be either square or sine wave. The unit operates at temperatures from −55 to +100 C, withstands vibration of 20 g from 5 to 2000 cps, and withstands 150 g shock at 11 msec. Minimum operating life is 5000 hr. Required input is less than 20 ma. Hermetically sealed, the unit conforms to MIL-E-5272A. It measures 1 x 1 x 3 in. and weighs 5.5 oz.

Gyrex Corp., Dept. ED, 3003 Pennsylvania Ave., Santa Monica, Calif.

CIRCLE 243 ON READER-SERVICE CARD

Transistor

Collector current rating is 5 amp

Type 2N297A transistor has a collector voltage rating of 60 v and a collector current rating of 5 amp. It dissipates 35 w at 25 C and 10 w at 175 C. Made for use in missiles and supersonic aircraft, the transistor conforms to MIL-T-19500/36A (Sig C). It also has applications in high-current switching, audio amplification, voltage regulators, power supply circuits, and power oscillator circuits.

Bendix Aviation Corp., Red Bank Div., Dept. ED, Long Branch, N.J.

CIRCLE 244 ON READER-SERVICE CARD

Preamplifier

For telemetering applications

Designed to operate from a 50-ohm source, type TP-4 telemetering preamplifier covers 215 to 260 mc. Minimum gain is 22 db and maximum noise is 4 db. A power supply is contained in the unit. Weatherproof housing and a sun shield are provided.

LEL, Inc., Dept. ED, 380 Oak St., Copiague, L. I., N.Y.

CIRCLE 245 ON READER-SERVICE CARD

Scaler

Has 1 μsec resolving time

Model 49-19 decimal scaler has a 1 μsec resolving time and a total count capacity of 10^8. Included in the unit is a linear amplifier, precision discriminator and fixed mercury pulse generator, as well as an electrometer type high voltage supply which is continuously variable between 500 and 5000 v. Preset count to 10^6 is provided along with an electrically reset elapsed timer.

Radiation Instrument Development Laboratory, Inc., Dept. ED, 5737 S. Halstead St., Chicago 21, Ill.

CIRCLE 248 ON READER-SERVICE CARD

Beam Power Tubes

High perveance

These high-perveance beam power tubes have high power gain and are used in vhf power amplifiers, and as af power amplifiers and modulators. The 7270 has a 6.3 v, 3.1 amp heater; the 7271 has a 13.5 v, 1.25 amp heater. Each has a maximum plate-dissipation rating of 80 w under ICAS conditions, and can be operated under these conditions with a cw input of 315 w up to 60 mc or with 235 w cw input at 175 mc. As linear rf power amplifiers in single-sideband suppressed-carrier service, they can each provide a useful power output of 135 w.

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

CIRCLE 249 ON READER-SERVICE CARD

Pressure Switches

Pressure range is 1 to 500 psig

These hermetically sealed pressure switches, designated model 419, have a pressure range of 1 to 500 psig; overpressure without shift is 3000 psig. Designed for switching circuits in response to pressure changes in hydraulic fluids, fuels, and other gases or liquids, the switches are isolated from the pressure media. The output contacts are spst and the operating temperature range is —65 to +165 F. These switches are available in three design configurations, measure about 5/16 x 1/2 in., and weigh 1/4 oz. They conform to MIL-E-005272B, procedure 1, for vibration level, shock, acceleration, and humidity.

Bourns, Inc., Dept. ED, P.O. Box 2112, Riverside, Calif.

CIRCLE 250 ON READER-SERVICE CARD

Receivers

Frequency range from 30 to 260 mc

These miniature receivers cover frequencies from 30 to 260 mc in two bands: 30 to 60 mc and 60 to 260 mc. Model 1905 reception is am and cw; model 1906 reception is fm, am, and cw. The tuners have a low noise figure; the first rf stage uses a planar triode to assure that the noise figure of 6 db is not exceeded at any frequency. The receivers have panels 19 in. wide x 3-1/2 in. high x 15 in. deep.

Nems-Clarke Co., Dept ED, 919 Jesup-Blair Drive, Silver Spring, Md.

CIRCLE 251 ON READER-SERVICE CARD

Delay Lines

Plug-in type

These delay lines cover delay times from 0.05 to 80 μsec and have impedances of 50 to 2000 ohms. Standard tolerance on delay is ±2% and the temperature stability of delay is 50 ppm per deg C. Test voltage rating is 600 v dc and working voltage rating is 300 v dc. The temperature range is —65 to +125 C. The lines are encapsulated in epoxy casting resin and are protected from moisture, shock, and vibration. Designated series P6, P11, P16, and P24, these delay lines have a rise time of 1/6, 1/11, 1/16, and 1/24 of delay time.

Artronic Instrument Co., Dept. ED, 11232 Tringle Lane, Silver Spring, Md.

CIRCLE 252 ON READER-SERVICE CARD

NEW PRODUCTS

Wheatstone Bridge

Measures resistances to 11,111 meg

Model 4232-B wheatstone bridge provides complete guarding, eliminating errors caused by adverse humidity conditions and resulting leakage currents. The bridge has a measurement range from 0 to 11,111 meg; accuracy is ±0.01% up to 1 meg and ±0.02% up to 100 meg. Resistors may be tested at full battery potentials up to 100 v. Guard terminals are provided so that the bridge guard system may be completed with a guarded dc bridge power supply and a guarded detector. Housed in a gray metal case, the bridge may be mounted in a 19-in. relay rack; brackets permit table-top mounting.

Leeds & Northrup Co., Dept. ED, 4934 Stenton Ave., Philadelphia 44, Pa.

CIRCLE 255 ON READER-SERVICE CARD

UHF Beam Power Tube

Has 180 kw peak-pulse output

Type 7214 is a small, forced-air-cooled beam power tube designed for use in grid-pulsed and plate- and screen-pulsed rf amplifiers. It is used with full ratings at frequencies from 960 to 1215 mc. Maximum plate dissipation is 1500 w. When used under CCS conditions as a plate-and-screen-pulsed rf amplifier tube in a cathode-drive circuit at 1215 mc with a 10 μsec pulse duration and a duty factor of 0.01, the 7214 is capable of delivering a useful peak-pulse power output of about 65 kw with a driver power output of about 11 kw at peak of pulse. Under similar conditions at 400 mc, it can deliver about 100 kw.

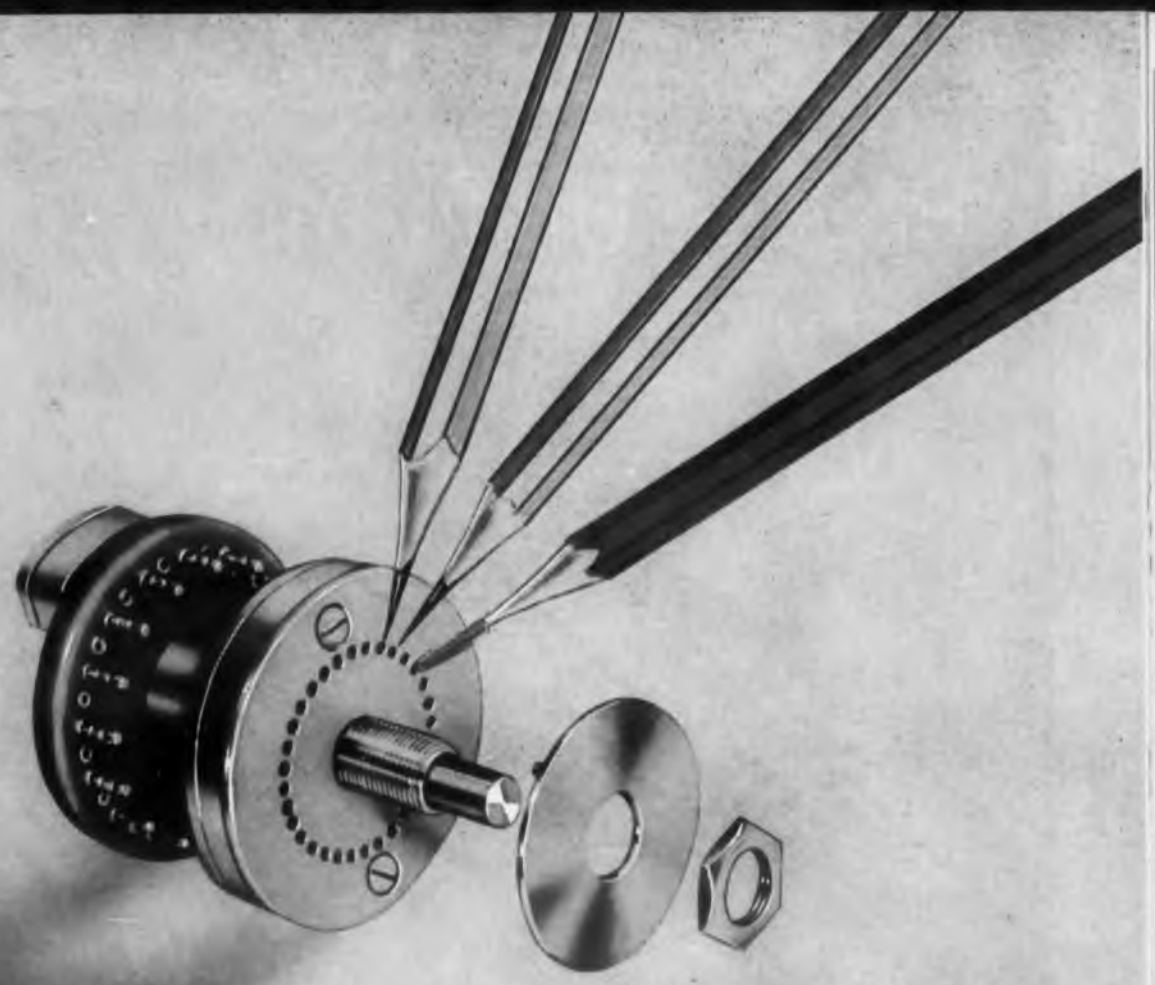
Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 256 ON READER-SERVICE CARD

DAVEN

All DAVEN components are now available in your area through these local franchised distributors:

AKRON, OHIO
AKRON ELECTRONIC SUPPLY CO.
ASHEVILLE, NORTH CAROLINA
FRECK RADIO & SUPPLY CO., INC.
ATLANTA, GEORGIA
SPECIALTY DISTRIBUTING CO.
BALTIMORE, MARYLAND
KANN-ELLERT ELECTRONICS, INC.
BATTLE CREEK, MICHIGAN
ELECTRONIC SUPPLY CORPORATION
BIRMINGHAM, ALABAMA
MG ELECTRICAL EQUIPMENT CO.
BOSTON, MASSACHUSETTS
DE MAMBRO RADIO SUPPLY CO.
SAGER ELECTRICAL SUPPLY CO.
CAMDEN, NEW JERSEY
GENERAL RADIO SUPPLY COMPANY
CEDAR RAPIDS, IOWA
DEECO, INC.
CHICAGO, ILLINOIS
ALLIED RADIO CORPORATION
NEWARK ELECTRIC COMPANY
CINCINNATI, OHIO
UNITED RADIO, INC.
DALLAS, TEXAS
WHOLESALE ELECTRONICS SUPPLY CO.
DAYTON, OHIO
McGUIRE PRODUCTS COMPANY
DENVER, COLORADO
DENVER ELECTRONICS SUPPLY CO.
FORT WAYNE, INDIANA
BROWN ELECTRONICS, INC.
HARRISBURG, PENNSYLVANIA
D & H DISTRIBUTING COMPANY
INDIANAPOLIS, INDIANA
RADIO DISTRIBUTING COMPANY
JACKSONVILLE, FLORIDA
SOUTHEAST AUDIO COMPANY
LOS ANGELES, CALIFORNIA
KIERULFF ELECTRONICS, INC.
RADIO PRODUCTS SALES, INC.
UNIVERSAL RADIO SUPPLY CO.
MILWAUKEE, WISCONSIN
RADIO PARTS COMPANY, INC.
MINEOLA, LONG ISLAND, N. Y.
SCHWEBER ELECTRONICS
NASHVILLE, TENNESSEE
ELECTRA DISTRIBUTING COMPANY
NEW YORK, NEW YORK
HARVEY RADIO COMPANY, INC.
MILO RADIO & ELECTRONICS CORP.
TERMINAL RADIO CORP.
PORTLAND, OREGON
LOU JOHNSON COMPANY, INC.
ROME, NEW YORK
ROME ELECTRONICS, INC.
SAN DIEGO, CALIFORNIA
RADIO PARTS CO. (AMSAC INC.)
SAN FRANCISCO, CALIFORNIA
PACIFIC WHOLESALERS
SEATTLE, WASHINGTON
WESTERN ELECTRONIC SUPPLY CO.
ST. LOUIS, MISSOURI
INTERSTATE SUPPLY COMPANY
SYRACUSE, NEW YORK
MORRIS ELECTRONICS OF SYRACUSE
TOLEDO, OHIO
WARREN RADIO CO.
TULSA, OKLAHOMA
RADIO, INC.
WASHINGTON, D. C.
ELECTRONIC WHOLESALERS, INC.
WEST PALM BEACH, FLORIDA
GODDARD DISTRIBUTORS COMPANY
WINSTON-SALEM, NORTH CAROLINA
DALTON-HEGE RADIO SUPPLY
CANADA
VANCOUVER, BRITISH COLUMBIA
VARAH, LTD.



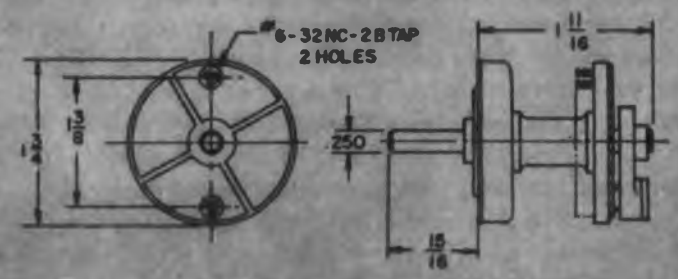
Stop it ... where you want it!

Daven's New Rotary Switch with Adjustable Stop

For flexibility in all types of circuit experimentation, laboratory work, breadboard setups, and in circuitry where the exact number of switch positions might be changed at a later date, the new DAVEN Rotary Switch with an Adjustable Stop is ideal. This unit, as a single pole switch, can have a maximum of either 24 shorting positions with 15° spacing or 32 shorting positions with 11¼° spacing. One, two, three, and four pole units are available in this design.

In common with all other DAVEN Rotary Switches, the Adjustable Stop Switch features sturdy, dependable construction; silver alloy contacts and slip rings; tamper-proof, KNEE ACTION* silver alloy rotor blades; high grade, accurately machined dielectric; and gold flashed turret-type terminals for ease of soldering.

*Patented



Write for complete information.

THE DAVEN CO.

LIVINGSTON, NEW JERSEY

TODAY, MORE THAN EVER, THE DAVEN [illegible] FOR DEPENDABILITY!

NEW PRODUCTS

Battery Power Packs

Have shock resistance to 2000 g

These battery power packs, having shock resistance to 2000 g, consist of permanently rechargeable nickel-cadmium battery cells, potted in a plastic case for production in various sizes, shapes, colors, and in a wide range of electrical capacities. Designed for use in satellites, missiles, rockets, and telemetry applications, these battery power packs are hermetically sealed. They are available with 80, 180, 250, 500, 800, and 1750 ma-hr cells, each of which has a nominal rating of 1.2 v.

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

CIRCLE 259 ON READER-SERVICE CARD

Flush Circuits

Have 0.0002 in. dimensional tolerances

These flush circuits consist of electrical conductors in unlimited configurations. Minimum commercial line width and spacing is about 0.002 in. and dimensional tolerances of 0.0002 in. can be achieved. Angular tolerance is 5 sec of arc over 360 deg. The circuits are flush to less than 1 micron with a finish of 5 μin. min. Flatness of 0.001 per in. is guaranteed. Surface resins can be epoxy, melamine, phenolic, polystyrene, and teflon. The circuits can be used as commutators, coding discs, emitter discs or switching plates.

Scientific Components, Inc., Dept. ED, 30 S. Salsipuedes St., Santa Barbara, Calif.

CIRCLE 260 ON READER-SERVICE CARD

Tee Circulator

Handles 300 kw peak power

This tee circulator is a three-port unit which can be supplied at various bands from 3 to 16 kmc. At C-Band, it can handle 300 kw peak power. Insertion loss is 0.5 db max, isolation is 15 db min. Two of these units joined in an H configuration provide four-port circulator action for medium power duplexing. These circulators are used in radar beacon applications and duplexing for radar systems where moderate power handling and narrow bands are required.

Litton Industries, Dept. ED, 336 N. Foothill Rd., Beverly Hills, Calif.

CIRCLE 262 ON READER-SERVICE CARD

Counters

Two types available

The series AD-1 counters eliminate transfer masks or shades and have no interrupted gearing. Type 1400 reads through 359.9 deg to zero and repeat with continued rotation. Type 1401 reads through 6399 mils to zero. Both types are bi-directional and add with clockwise rotation of the input shaft. Their operating temperature is from −60 to +165 F and they meet MIL-E-16400-B and the applicable parts of MIL-STD-167.

Chicago Dynamic Industries, Inc., Precision Products Div., Dept. ED, Diversey Blvd., Chicago 14, Ill.

CIRCLE 263 ON READER-SERVICE CARD

Toroid Transformers

Have outputs to 500 va

These encapsulated toroid transistor power transformers and magnetic amplifiers range from milliwatt size to 500 va outputs with efficiencies to 95%. Meeting all requirements of MIL-T-27A, grades 1, 2, and 5, these toroids withstand mechanical shock and vibration requirements to MIL-E-5272A. Possible uses are in airborne and missile applications.

Mercury Transformer Corp., Dept. ED, 12964 Panama St., Los Angeles 66, Calif.

CIRCLE 264 ON READER-SERVICE CARD

NEW PRODUCTS

Indicator Lights

Miniature

The DLR series miniature indicator lights have replaceable flange type lamps. The lamps may be neon or incandescent type. The unit features single-nut mounting on a 3/8 in. hole. Two-terminal construction permits complete isolation from the metal body. Standard lens colors are available.

Transistor Electronics Corp., Dept. ED, 3357 Republic Ave., Minneapolis, Minn.

CIRCLE 266 ON READER-SERVICE CARD

Noise Generator

Variable frequency spectrum

Model NG1000A noise generator provides a source of random noise with a gaussian amplitude distribution and a variable frequency spectrum. The rms output voltage is variable depending upon the shaping filter used: 6 v rms for the widest bandwidth filter to 1 v rms for the narrowest filter. The unit is made for a standard 19 in. rack.

GPS Instrument Co., Inc., Dept. ED, 180 Needham St., Newton, Mass.

CIRCLE 267 ON READER-SERVICE CARD

Amplifier

With power splitters

Model SA-23 amplifier provides a band pass of 54 to 88 mc and 174 to 216 mc with 38 db gain on each band. It has a multi-channel output of 53 dbmv, 10,000-hr, type 6922 input tubes, and silicon rectifiers. Separate tilt and gain controls are provided for each band with a 13 db gain control range. Models ES-2 and ES-4 power splitters have a bandwidth of 50 to 225 mc with an impedance of 75 ohms. The amplifier weighs 6-1/2 lb and measures 12 x 4-1/2 x 5 in., model ES-2 power splitter measures 2-1/8 x 2-1/4 x 1-1/4 in., and model ES-4 measures 2-1/8 x 2-1/2 x 2-1/4 in.

Entron, Inc., Dept. ED, P.O. Box 287, Bladensburg, Md.

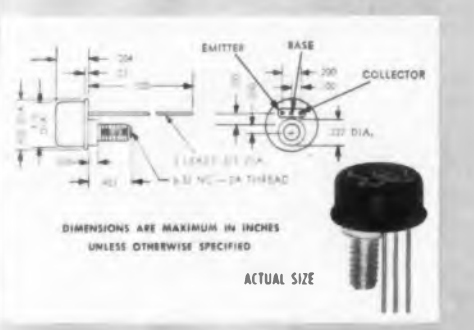
CIRCLE 268 ON READER-SERVICE CARD

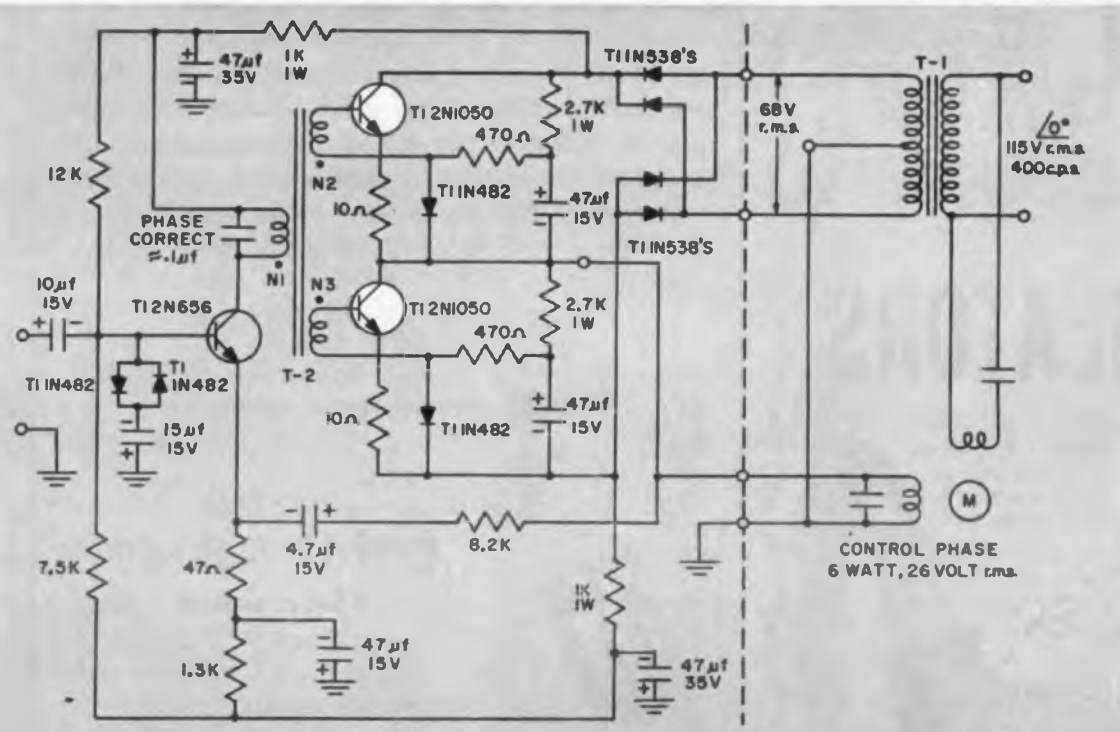
How to get 55% over-all efficiency in transistorized 6-watt servo amplifier

HIGH-EFFICIENCY SERVO CIRCUIT REQUIRES . . .

- **no output transformer**
- **no center-tap motor winding**

Higher over-all efficiency than in a conventional Class-B push-pull amplifier is achieved in this servo by use of unfiltered rectified a-c for current supply voltage—with resulting reduction in size, weight and power supply requirements. This higher efficiency means greater transistor reliability, smaller heat sink and/or higher allowable ambient temperatures. Output will remain sinusoidal when amplifier is overdriven.





TRANSFORMERS

T-1 400 cps. 12-watt power transformer step-down 115 volt to 68 volt c.t.

T-2 400 cps. 65-mw driver transformer. Turns ratio N1: N2: N3 = 2: 1: 1
Primary Current = 10 ma d-c. Primary Inductance = 1.5 hy.

...with TI 2N1050 N-P-N silicon transistors!

Exclusive TI 2N1047 intermediate-power series now gives you maximum design flexibility plus high efficiency . . . all in a miniature package!

Consider the design flexibility made possible by the exclusive features of this series . . . 40 watts dissipation at 25°C case temperature . . . unique stud mounting for maximum thermal efficiency . . . 80- and 120-volt BV_{CEX} . . . 15-ohm R_{CS} . . . −65°C to +200°C operating and storage range . . . choice of beta spreads.

Apply TI's guaranteed specs to your design situations today. This use-proved series is available off-the-shelf — *at factory prices* — in 1-999 quantities from your nearby authorized TI distributor, and in production quantities from your TI sales office.

Write on your company letterhead for illustrated TI APPLICATION NOTES on the transistorized servo amplifier.

PARAMETER	TEST CONDITIONS		2N1047		2N1048		2N1049		2N1050		unit
			min.	max.	min.	max.	min.	max.	min.	max.	
BV_{CEX} Breakdown Voltage	$I_C = 250\ \mu a$	$V_{BE} = -1.5v$	80		120		80		120		v
BV_{EBO} Breakdown Voltage	$I_E = 250\ \mu a$	$I_C = 0$	10		10		10		10		v
I_{CBO} Collector Cutoff Current	$V_{CB} = 30v$	$I_E = 0$		15		15		15		15	µa
h_{FE} Current Transfer Ratio †	$V_{CE} = 10v$	$I_C = 200ma$	12	36	12	36	30	90	30	90	—
h_{IE} Input Impedance †	$V_{CE} = 10v$	$I_B = 8ma$		500		500		500		500	ohm
R_{CS} Saturation Resistance †	$I_C = 200$ ma	$I_B = 40ma$		15		15		15		15	ohm
V_{BE} Base Voltage †	$V_{CE} = 15v$	$I_C = 500ma$		10		10		10		10	v

†Semiautomatic testing is facilitated by using pulse techniques to measure these parameters. A 300-microsecond pulse (approximately 2% duty cycle) is utilized. Thus, the unit can be tested under maximum current conditions without a significant increase in junction temperature, even though no heat sink is used. The parameter values obtained in this manner are particularly pertinent for switching circuit design and, in general, indicate the true capabilities of the device.

germanium and silicon transistors
silicon diodes and rectifiers
tan-Ti-cap solid tantalum capacitors
precision carbon film resistors
sensistor silicon resistors

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

CIRCLE 270 ON READER-SERVICE CARD

NEW PRODUCTS

Leak Detector

For sealed components

Type C2D5 leak detector is designed for testing hermetically sealed components for leakage up to 10^{-12} cc per sec. The programmed, fully automatic, push-button operation of this unit permits low-cost inspection of such components as transistors, diodes, crystal holders, and relays.

American Electronics, Inc., American Nuclear Div., Dept. ED, 9459 W. Jefferson Blvd., Culver City, Calif.

CIRCLE 273 ON READER-SERVICE CARD

Read-Through Lamp

Subminiature

No. 4 subminiature read-through lamp is designed for computer use as a light source in photoelectric readout applications. This 2.5 v, 400 ma lamp is less than 1/4 in. in diameter and 13/16 in. long. Its bulb concentrates a 1/4 in. spot pattern 3/8 in. in front of the lamp for maximum read-through efficiency. Its life is almost 10,000 hr and is available with either a brass midget snap-in base (pictured), or as a wire lamp suitable for direct soldering.

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

CIRCLE 274 ON READER-SERVICE CARD

Waveguide Flange Seals

Two designs available

The design of these waveguide flange seals provides separate rf and pressure seal regions. Types WG(G711-1)S-5 and WG(G711-1)A-5 are one-piece molded synthetic rubber and have a temperature range of −65 to +250 F. Types WG(S5811-2-F)S-5 and WG(S811-2-F)S-5 have an inner ring of molded plastic, which forms a bond with the conducting coating, and an outer pressure ring of silicon rubber. Each of the two designs can be furnished with silver or aluminum coating.

Industrial Electronic Rubber Co., Dept. ED, 31945 Aurora Rd., Solon, Ohio.

CIRCLE 275 ON READER-SERVICE CARD

CABINET COOLER.—Model RC-6 maintains temperature control of rack mounted electronic equipment. It requires 12-1/4 in. of rack height, and has permanently lubricated bearings, automatic temperature control, and sealed refrigeration system.

Airflow Co., Dept. ED, 400 S. Stonestreet Ave., Rockville, Md.

CIRCLE 278 ON READER-SERVICE CARD

SERVO MOTOR.—Model 18 SM 691, 115 v, 60 cps, can be wound for any standard carrier voltage supply. It requires an input of 9 w per phase with 0.64 pf. No-load speed is 3200 rpm, torque at stall is 4 oz.-in., and acceleration at stall is 70,000 radians per sec^2. This size 18 motor operates at temperatures to 200 C and weighs 15 oz.

Beckman Instruments, Inc., Helipot Div., Dept. ED, 2500 Fullerton, Calif.

CIRCLE 279 ON READER-SERVICE CARD

NUCLEAR BATTERIES.—Model K-11 Krypton 85 batteries have current ratings of 200 to 1000 μμa, an open circuit potential of several thousand volts, and a linear charging rate to 1000 v.

Universal Winding Co., Dept. ED, P.O. Box 1605, Providence 1, R.I.

CIRCLE 280 ON READER-SERVICE CARD

INSULATION SLEEVING.—This Zippertubing is available in red, white, green, yellow, and blue for ready identification of cables, pipes, or conduits.

Zippertubing Co., Dept. ED, 752 S. San Pedro St., Los Angeles, Calif.

CIRCLE 281 ON READER-SERVICE CARD

SERVO KIT.—Contains standard parts from which a variety of 1-7/8 in. diam electro-mechanical instrumentation can be assembled. Kit model 20-200 contains over 274 pieces.

Servo Development Corp., Dept. ED, 567 Main St., Westbury, N.Y.

CIRCLE 282 ON READER-SERVICE CARD

MOMENTARY CONTACT SWITCH.—Rated at 0.5 amp at 115 v ac, it will withstand a dielectric test of 1000 v. A normally open push type, No. 425-1 has nipple mounting; terminals are solder type.

Alcor Manufacturing Co., Dept. ED, 4444 W. Roosevelt Rd., Chicago 24, Ill.

CIRCLE 283 ON READER-SERVICE CARD

CERAMIC TRANSDUCER ELEMENT.—Has high stability at temperatures up to 300 C. US 500 has a high linear coupling coefficient and is used either as a sensor, or as a high power driver.

U.S. Sonics Corp., Dept. ED, 625 McGrath Highway, Somerville, Mass.

CIRCLE 284 ON READER-SERVICE CARD

NEW PRODUCTS

Power Supply

Output is 750 v dc

Model BL-N-004 power supply has an output of 170 μa at 750 v dc with a 28 v dc source. The output voltage variation is ±3% when the input varies between 22 and 34 v. The output current is limited by a self-contained 4.7 meg resistor. Both the input and the output terminals are isolated from the case. The unit measures 5 x 2 x 1-1/8 in.

Bomac Labs, Inc., Dept. ED, 1 Salem Rd., Beverly, Mass.

CIRCLE 286 ON READER-SERVICE CARD

Magnetic Control Reactors

Have outputs from 7 to 300 w

This line of 60 cps magnetic control reactors are supplied to operate on any ac line from 26 to 115 v. Their output rating is from 7 to 300 w. The use of high-gain toroidal coils provides complete control with 2 to 5 ampere-turns. Applications include motor and generator speed controls, battery chargers, regulators, and regulated power supplies. All units are packaged in standard MIL-T-27 cases and are fully potted and hermetically sealed.

Magnetico, Inc., T.A. Div., Dept. ED, 6 Richter Court, E. Northport, N.Y.

CIRCLE 287 ON READER-SERVICE CARD

Telemetry Calibrator

Transistorized

Model TG-72 telemetry calibrator is fully transistorized, utilizes miniature components, and has easily removable printed circuit boards. Eighteen IRIG channels can be simultaneously monitored, or checked individually, automatically or manually, on a sequencing basis. All channels can be scanned at ±7.5% of center frequency; the upper five channels can be scanned at ±15% of center frequency. Either 3- or 11-point calibration per channel is available. All frequencies are crystal controlled to an accuracy of 0.01%; remote control is optional.

◀ CIRCLE 288 ON READER-SERVICE CARD

Power requirements are 115 v, 60 cps, 80 w. The unit measures 7 x 19 x 16-3/8 in. and weighs 40 lb. Model TG-71, a 5 point calibrator, is also available.

Thompson Ramo Wooldridge Inc., Dept. ED, P.O. Box 90534 Airport Station, Los Angeles 45, Calif.

CIRCLE 289 ON READER-SERVICE CARD

Switches

Pull-push type

For applications requiring greater simplicity of motion than possible with rotary and toggle switches, these pull-push switches are available in two types. Type SK-1 has 8 to 17 oz actuating force with 3 amp 125 v ac rating. Type S-MK has under 6 oz actuating force and a 1 amp 125 v ac rating. Shaft travel is 5/32 ±1/64 in., shaft diameters are 0.25 and 0.187 in., and shaft lengths are in increments of 1/16 in.

Chicago Telephone Supply Corp., Dept. ED, Elkhart, Ind.

CIRCLE 290 ON READER-SERVICE CARD

Environmental Test Fixture

Resonant-free

Type T environmental test fixture is resonant-free below 2000 cps and may be used to mount test specimens during vibration, shock, and acceleration tests. Designed to convey only the desired environment, the unit tests specimens in three mutually perpendicular axes, simultaneously. The transmissibility factor is under 1.1 at frequencies to 2000 cps. The unit is available in a small size with a dimensional capacity of 6 x 6 x 4-1/2 in. and a weight capacity to 6 lb, for use with a 1500 g-lb exciter. A larger unit, with a dimensional capacity of 12 x 12 x 9-1/2 in. and a weight capacity of 25 lb, for use with a 5000 g-lb exciter, is also available.

Avco Mfg. Corp., Research and Advanced Development Div., Dept. ED, 201 Lowell St., Wilmington, Mass.

CIRCLE 291 ON READER-SERVICE CARD

NEW PRODUCTS

Racks

Frames are 22 in. wide

The F series of modular transmitter racks have front and rear rounded tops, 22 in. wide frames made of 14-gage steel, and two adjustable panel mounting angles. Doors, end panels, flush doors, shelves, and turrets can be furnished.

Premier Metal Products Co., Dept. ED, 357 Manida St., New York 59, N.Y.

CIRCLE 293 ON READER-SERVICE CARD

Pulse Counter

Low torque

Model 2010 low torque pulse counter has six drums, but is also available in two, three, four, and five drum types. Activated by a stepping motor, the drums have speeds up to 40 counts per sec. The stepping motor has no ratchets, contacts or springs to wear out, assuring a long life. The gear's positive meshing feature eliminates skipping or missing a count. Easy direct reading is accomplished with 5/16 in. numbers.

Haydon Instrument Co., Dept. ED, Waterbury 20, Conn.

CIRCLE 294 ON READER-SERVICE CARD

Silver-zinc Battery

Activates in 0.5 sec

Weighing 2.7 lb and measuring 3 x 3 x 4.5 in., model P14A silver zinc, 19-cell battery activates in 0.5 sec. The signal required for activation is 28 v at 2 amp. The battery provides 1 ampere-hour of 28 v current; maximum current is 5 amp. It withstands vibration to 10 g, acceleration to 20 g, and shock to 5 g, in all three major axes. The temperature range is 50 to 150 F; other models are available with temperature ranges of —65 to +165 F. Estimated pre-activation shelf life is 5 yr. The battery has automatic activation and contains only one moving part.

Cook Batteries, Dept. ED, 3850 Olive St., Denver 7, Colo.

CIRCLE 295 ON READER-SERVICE CARD

Silicon Rectifiers

Diffused-junction type

Types 1N440-B, 1N441-B, 1N442-B, 1N443-B, 1N444-B, and 1N445-B hermetically sealed, diffused-junction type silicon rectifiers are designed to meet very low reverse current requirements in magnetic amplifiers, dc blocking circuits, and power supplies. These units have a maximum forward-current rating of 750 ma at an ambient temperature of 25 C, and piv ratings of 100 to 600 v.

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

CIRCLE 296 ON READER-SERVICE CARD

Oscilloscope

Has single plug-in unit

Model K-160 oscilloscope has a single plug-in system for all signal generating and processing circuitry. The main frame indicator of this model consists of a 5 in. single-gun cathode ray tube, its associated beam controls, identical X and Y main amplifiers, and a power supply capable of handling plug-in load requirements.

Electronic Tube Corp., Dept. ED, 1200 E. Mermaid Lane, Philadelphia 18, Pa.

CIRCLE 297 ON READER-SERVICE CARD

Anode Connector

Right angle type

Having the positive-locking connection clip and dust-proof cap set at right angles to the lead wire, this high voltage anode connector is especially designed for use in cramped picture tube areas. The spring clip provides a positive, vibration-proof lock when engaged in the picture tube receptacle. The cap is made from ozone and corona-resistant neoprene and withstands 30,000 v. Standard lead wires are 18-gage with 16 of 30 stranding and 20-gage with 10 of 30 stranding. The wire insulation is 0.045-in. white rulan and the outer jacket is 0.02-in. red vinyl.

Mandex Mfg. Co., Inc., Dept. ED, 2614 W. 8th St, Chicago 32, Ill.

CIRCLE 298 ON READER-SERVICE CARD

NEW PRODUCTS

Indicator

Has 12-3/4 in. scale

Model 721 indicator has 300 deg indication and total scale length of 12-3/4 in. When used with accessories, it can be used to indicate such values as flow, liquid level, temperature, pressure, input motion, oxygen level, and resistance. Either a differential transformer receiver or a slidewire receiver can be incorporated for operation with suitable transmitters. Construction is 14-gage sheet steel.

The Hays Corp., Dept. ED, Michigan City, Ind.

CIRCLE 301 ON READER-SERVICE CARD

Power Supplies

Have outputs to 30 kv

These power supplies have continuously variable outputs from 0 to 30 kv in 0.5% increments. Model KV30-5 is rated at 5 ma; model KV30-2.5 is rated at 2.5 ma. The supplies may be operated with either negative or positive polarity. Input power is removed when load exceeds 110% of rated current. A series current limiter protects the supply against damage by short circuits. Both units weigh 55 lb; operation from 220 v 50/60 cps, single phase, may be obtained.

Kilovolt Corp., Dept. ED, 2 Manor House Square, Yonkers, N.Y.

CIRCLE 302 ON READER-SERVICE CARD

Overvoltage Tester

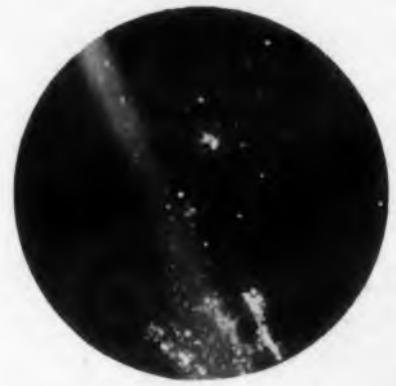
Provides 150 kv dc

This 150 kv dc overvoltage tester is rated at 5 ma, but provides 20 ma for burning. The use of air insulation accounts for smaller size and weight. Selenium rectifiers and corona shields are included. The open design of the unit facilitates maintenance. The required input is 115 v ac.

Peschel Electronics, Inc., Dept. ED, Towners, Patterson, N. Y.

CIRCLE 303 ON READER-SERVICE CARD

Biggest thirst in the universe



If your thirst for advancement is unslaked...

DOUGLAS AIRCRAFT COMPANY
MISSILES AND SPACE SYSTEMS

has immediate openings in the following fields—

Electrical and Electronics:
- Control System Analysis & Design
- Antenna & Radome Design
- Radar System Analysis and Design
- Instrumentation
- Equipment Installation
- Test Procedures
- Logic Design
- Power System Design

Mechanical Engineering—
Analysis and Design of the following:
- Servo Units
- Hydraulic Power Systems
- Air Conditioning Systems
- Missile Launcher Systems
- Propulsion Units and Systems
- Auxiliary Power Supplies

Aeronautical Engineering:
- Aerodynamic Design
- Advanced Aerodynamic Study
- Aerodynamic Heating
- Structural Analysis
- Strength Testing
- Dynamic Analysis of Flutter and Vibration
- Aeroelasticity
- Design of Complex Structure
- Trajectory Analysis
- Space Mechanics
- Welding
- Metallurgy

Physics and Mathematics:
- Experimental Thermodynamics
- General Advanced Analysis in all fields
- Computer Application Analysis
- Computer Programming and Analysis
- Mathematical Analysis

For full information write to:

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

Each 6,000,000 pound thrust rocket ship now being planned for manned interplanetary exploration will gulp as much propellant as the entire capacity of a 170 passenger DC-8 Jetliner in less than 4 seconds! It will consume 1,140 tons in the rocket's approximately 2 minutes of burning time. Required to carry this vast quantity of propellant will be tanks tall as 8 story buildings, strong enough to withstand tremendous G forces, yet of minimum weight. Douglas is especially qualified to build giant-sized space ships of this type because of familiarity with every structural and environmental problem involved. This has been gained through 18 years of experience in producing missile and space systems. We are seeking qualified engineers and scientists to aid us in these and other projects.

Dr. Henry Ponsford, Chief, Structures Section, discusses valve and fuel flow requirements for space vehicles with Donald W. Douglas, Jr., President of DOUGLAS

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

Please write direct to advertiser mentioning ELECTRONIC DESIGN

CIRCLE 305 ON READER-SERVICE CARD

NEW PRODUCTS

LAVALIER MICROPHONE. — Model D-12 is 3-25/32 in. long. Frequency response is 70 to 12,000 cps; impedance is 50 ohms. Output level is −57 db.

American Microphone Manufacturing Co., Dept. ED, 412 S. Wyman St., Rockford, Ill.

CIRCLE 307 ON READER-SERVICE CARD

STEPPING SWITCH.—Stepping rate is over 15 per sec. This unit switches 1 amp inductive at 24 v. Operating range is −60 to +160 F. It can be supplied with rotary interrupter springs and off-normal springs.

Electrodyne Corp., Dept. ED, 503 S. McClay St., Santa Ana, Calif.

CIRCLE 308 ON READER-SERVICE CARD

CERAMIC DISC CAPACITORS. — Have capacitances of 0.03, 0.04, and 0.05 μf, 600 wvdc. Part of the DD series, they measure 7/8 in. in diam and are 15/64 in. thick.

Centralab, Div. of Globe-Union Inc., Dept. ED, 900 E. Keefe Ave., Milwaukee 1, Wis.

CIRCLE 309 ON READER-SERVICE CARD

PERMANENT MAGNET ALLOY.—Alnico VII A has an energy value of 2.8 million oriented. It has a high coercive force and resists demagnetization when subjected to high environmental heat. Applications include magnetic core meters and instruments.

Indiana Steel Products Co., Dept. ED, Valparaiso, Ind.

CIRCLE 310 ON READER-SERVICE CARD

TAPE DUPLICATOR.—Produces 150 copies in 8 hr. Model 10 makes three high-speed copies simultaneously and operates at 30 ips. Frequency response is from 50 to 10,000 cps.

Magnetic Recording Industries, Dept. ED, 126 Fifth Ave., New York 11, N.Y.

CIRCLE 311 ON READER-SERVICE CARD

MERCURY TIMER RELAY.—Operates on half the current of former models. This relay is available with normally open or normally closed contacts and time delays on opening or closing or both, in dc or ac types.

Durakool, Inc., Dept. ED, Elkhart, Ind.

CIRCLE 312 ON READER-SERVICE CARD

PLIERS.—Will skin 22- or 24-gage wire. Insulation is cracked in the slot provided in the nose. For telephone or electronic use, they are 6 in. long.

Mathias Klein & Sons, Dept. ED, 7200 McCormick Rd., Chicago 45, Ill.

CIRCLE 757 ON READER-SERVICE CARD

Coaxial Cables

Four Types Available

These four types of coaxial cable meet or exceed MIL-C-17B. Type SSD single-shield, solid-dielectric is a minimum loss type with solid or stranded copper wire conductor, solid polyethylene dielectric, braided annealed copper shielding, and standard vinyl jacketing. It is also available in high or low temperature cable, with armor jackets of aluminum or steel and double shielding construction. Type SSDS single-shield, semi-solid dielectric cable has a higher velocity of propagation and lower capacitance than SSD cable due to the semi-solid polyethylene dielectric. Type JEL double-shielded, double-jacketed triaxial cable is for use where low radiation loss is required. It has solid copper or copper weld center conductor, solid polyethylene dielectric, braided annealed bare copper shielding, and Xelon jacketing. Type SSDL single-shield, solid-dielectric cable has an outside diameter of over 1 in. and is used at high power levels.

Times Wire and Cable Co., Inc., Dept. ED, Wallingford, Conn.

CIRCLE 314 ON READER-SERVICE CARD

Servo Amplifiers

Operate in −55 to +100 C range

These 400 cps transistorized servo amplifiers deliver rated power continuously in an ambient temperature of −55 to +100 C. They are designed to drive any standard size 11, 15, or 18 servo motor with a 40 v center tapped control winding. Type T2000 has a voltage gain of 1000 and a power output capability of 3.5 w at 40 v rms. It measures 1 x 1 x 1 in. Type T5000 measures 1-7/8 x 1-5/8 x 3, has a gain of 1500 and an output capability of 6.2 w. Type T6000 has a voltage gain of 1000 and an output capability of 9.3 w. It measures 2-3/8 x 1-3/4 x 3-3/4 in. All units operate from a 28 v dc source and have a 10,000 ohm input impedance.

Magnetico, Inc., T.A. Div., Dept. ED, 6 Richter Court, E. Northport, N.Y.

CIRCLE 315 ON READER-SERVICE CARD

CIRCLE 316 ON READER-SERVICE CARD ➤

NPN Germanium Transistors

Five types available

Types 2N444, 2N445, 2N446, 2N447, and 2N306 germanium npn alloy junction transistors are made to conform to JETEC, TO-9 outline. Types 2N444, 2N445, 2N446, and 2N447 are for small-signal amplifier and high-speed switching applications. The ac current gain and alpha cut-off frequency increase progressively with the type numbers. Type 2N306, for lf general purpose applications, has a collector to base voltage of 20 v dc at 25 C. The other transistors have a collector to base voltage of 15 v dc.

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

CIRCLE 317 ON READER-SERVICE CARD

Acoustic Vibration System

Produces 147 db white noise

For testing aircraft and missile components, this acoustic vibration system produces 147 db of white noise. The 30 cu ft reverberation chamber contains 16 lf and 16 hf loudspeakers and two microphones. Eight 260 w power amplifiers supply electronic signals.

Ling-Altec Electronics, Inc., Dept. ED, Anaheim, Calif.

CIRCLE 318 ON READER-SERVICE CARD

Generator Relay

Minimum operating current is 0.14 amp

Type SA high-speed generator relay, for all protective circuit functions, has a minimum operating current of 0.14 amp through one restraint circuit and the operating circuit in series. No auxiliary transformers or other external compo-

M FLUOROCHEMICAL FC-75 has a pour oint of —150°F., giving it a useful iquid range of —150°F. to 212°F. t atmospheric pressure. In addi-ion, it offers these other useful roperties: High dielectric strength n both liquid and vapor state (37 KV @ 0.1″ gap for liquid) . . . self-ealing in high voltage electrical quipment after repeated arcing . . excellent wetting power on all ypes of surfaces . . . compatible ith materials commonly used in he construction of high tempera-ure equipment . . . thermally table to temperatures in excess of 50°F. and, even under extreme se conditions does not form sludge r corrosive products. Heat capa-ities in both liquid and vapor state re approximately equal.

nents are required; the relay is simply connected to conventional current transformers. At 5 amp, 60 cps, the relay requires 0.25 va from each current transformer.

Westinghouse Electric Corp., Dept. ED, P.O. Box 2099, Pittsburgh 30, Pa.

CIRCLE 319 ON READER-SERVICE CARD

Angular Position Transducer

Output is 6 v ac

Providing an ac output as a function of shaft rotation, model 2203 angular position transducer delivers 6 v full scale or 5.5 ±0.1 mv per v per deg of arc. The range is ±45 deg and shaft rotation is continuous. The unit withstands acceleration to 50 g, shock to 100 g, and vibration to 35 g with less than ±0.1% error. Sensitivity is better than 0.005 deg of arc. The required input is 24 v 400 cps. Having a life expectancy of over 10,000,000 cycles, the unit meets the environmental requirements of MIL-E-5272A procedure I and the altitude requirements for MIL-E-5272A procedure II.

Bourns, Inc., Dept. ED, P.O. Box 2112, Riverside, Calif.

CIRCLE 321 ON READER-SERVICE CARD

Electrometer

Measures below 3 x 10^{-15} amp

Model 201C electrometer amplifier can measure ac or dc currents below 3 x 10^{-15} amp. It has a low grid current pentode input, single-ended filamentary amplifier stages, and Zener stabilization.

E-H Research Laboratories, Inc., Dept. ED, 1922 Park Blvd., Oakland 6, Calif.

CIRCLE 322 ON READER-SERVICE CARD

NEW PRODUCTS

Cooling Units

Available in sizes from 10 to 50,000 w

Available in sizes from 10 to 50,000 w, these cooling units are used to cool electronic tubes and high-power resistors or as heat exchangers for calorimeters. Transformer oil OS45 or DC200 fluid can be used. Operation is from 28 v dc or 110 v ac. The heat exchanger, circulating pump, storage tank, and flow and pressure interlocks are contained in the unit. The model shown dissipates 1500 w.

Electro Impulse Laboratory, Dept. ED, 208 River St., Red Bank, N.J.

CIRCLE 325 ON READER-SERVICE CARD

NPN Germanium Transistors

For switching applications

These npn germanium transistors are for switching and flip-flop circuits. Types 2N556 and 2N558 are for computer switching applications. Types 2N1000 and 2N1012 are for high-speed computer switching. Type 2N312 is for low-power switching in the audio and ultrasonic frequency spectrum. The transistors conform to the JETEC, TO-9 outline.

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

CIRCLE 326 ON READER-SERVICE CARD

Miniature Plugs

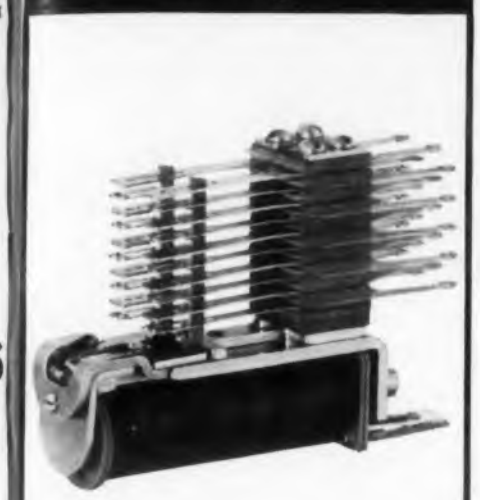
Four types available

These miniature plugs, designated the Golden D series, are available with four types of contacts: miniature, grounded coaxial, ungrounded coaxial, and high voltage. The miniature contacts are for wire size 20 or smaller. The ungrounded coaxial contacts are snapped into the insulators after they are attached to cables. The plugs have one-piece

Stromberg-Carlson

"TELEPHONE QUALITY"

Relays



. . . featuring new high-voltage types for test equipment or other high-voltage applications.

THE insulation in the new relays withstands 1500 volts A.C.—3 times normal. These high-voltage models are available in Types A, B and E. They are the latest additions to the Stromberg-Carlson line of twin contact relays—all available for immediate delivery.

The following regular types are representative of our complete line:

Type A: *general-purpose relay with up to 20 Form "A" spring combinations. This relay is excellent for switching operations.*

Type B: *a gang-type relay with up to 60 Form "A" spring combinations.*

Type BB: *relay accommodates up to 100 Form "A" springs.*

Type C: *two relays on the same frame. A "must" where space is at a premium.*

Type E: *has the same characteristics as the Type A relay, plus universal mounting arrangement. Interchangeable with many other makes.*

Complete details and specifications are contained in our new relay catalog, available on request. Write Stromberg-Carlson Telecommunication Industrial Sales.

STROMBERG-CARLSON
A DIVISION OF GENERAL DYNAMICS
1 CARLSON RD. • ROCHESTER 3, N.Y.

CIRCLE 329 ON READER-SERVICE CARD

insulators, and a finish of gold Iridite over cadmium plate. Low engagement and separation forces are required.

Cannon Electric Co., Dept. ED, P.O. Box 3765, Terminal Annex, Los Angeles 54, Calif.

CIRCLE 328 ON READER-SERVICE CARD

Variable Delay Lines

Resolution time is less than 0.08 mμsec

Delay times to 32 μsec and resolution times of less than 0.08 mμsec are available in these two series of variable delay lines. Series 611a is a continuously variable and step variable delay line. Series 611b is a 12-position tapped step delay line. Rise time for both series is less than 7% of time delay. Both types have more than 150 sections of LC networks; each section produces linear phase shift of more than 70% of the cut-off frequency. Eight models are available having the following total delay: 8, 12, 16, and 32 μsec. The output impedances are 150, 400, 750, 800, and 1300 ohms. The units measure 7-3/4 x 7-3/4 x 5-1/2 in.

Electronics Laboratory, Inc., Dept. ED, 249-259 Terhune Ave., Passaic, N.J.

CIRCLE 330 ON READER-SERVICE CARD

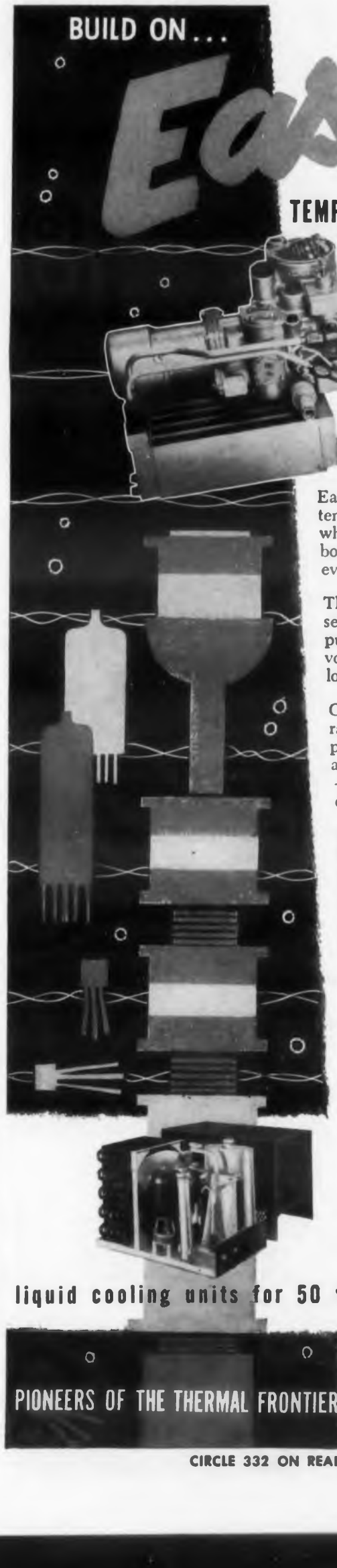
Miniature Motor

Has 1.5 hp

Model 38BG3 miniature 10-pole, 200 v, 400 cps motor has 1.5 hp. For application on a centrifugal blower, the motor has an output shaft speed of 4600 rpm and is designed for continuous duty. It measures 3 in. in diameter.

Western Gear Corp., Electro Products Div., Dept. ED, 132 W. Colorado Blvd., Pasadena, Calif.

CIRCLE 331 ON READER-SERVICE CARD



CIRCLE 332 ON READER-SERVICE CARD

NEW PRODUCTS

VHF Transceiver

For aviation use

Designed for panel mounting in light and medium aircraft, this 360-channel transceiver, model 618F-1, covers the range of 118 to 135.95 mc with 50 kc spacing. The transceiver provides pilots with a transmitter output of 6 w min. Model 427D-1 power supply, for use with the transceiver, contains the fixed if amplifier, audio amplifier-modulator, and power supply. It is adaptable to 13.75 or 27.5 v. The entire transceiver system weighs 12.6 lb and measures 3-3/4 x 5-3/4 x 9-7/32 in.

Collins Radio Co., Dept. ED, P.O. 1891, Dallas 21, Tex.

CIRCLE 334 ON READER-SERVICE CARD

Electro-Magnetic Clutch

Wet-type

For use in semi-automatic and fully automatic process machines and in program and tracer machines, type KA wet-type electro-magnetic clutch permits a wide variety of spindle speeds, feeds and traverse movements, and directional changes. The capacity range is 0.25 to 34.5 hp at 100 rpm with maximum torque of 14.5 to 1812 ft-lb. Standard coils are 90 v dc; coils with other voltages can be supplied. The standard unit needs no transformer. The clutch operates with the annular flux through the plates. Eight sizes with diameters from 3.3 to 11.5 in. are available.

Twin Disc Clutch Co., Dept. ED, Racine, Wis.

CIRCLE 335 ON READER-SERVICE CARD

Scanning Printer

Scans one column in 0.25 sec

Made to print data from high impedance decimal sources, this solenoid-actuated, self contained scanning printer scans and prints numbers stored in glow counter tubes, digital ohmmeters, and Nixie display counters.

The printer makes simple listings, adds, subtracts, multiplies, and divides. In normal operation it scans one column in 0.25 sec. An additional 0.27 sec is added with non-totalizing printers and 0.35 with totalizing models. It operates on a minimum of 10 v dc. Models with special symbols can be supplied.

Victor Adding Machine Co., Dept. ED, 3900 N. Rockwell St., Chicago 18, Ill.

CIRCLE 336 ON READER-SERVICE CARD

Counter

Dual bank type

Model Y dual bank counter is for use in navigation and tracking equipment, machine tools, and all digital readout equipment where plus and minus readings are needed. It is available in right hand drive, left hand drive, clockwise, and counterclockwise rotation with 3, 4, and 5 digits.

It operates over the temperature range of −55 to +75 C and has nylon wheels and pinions to reduce torque and moment of inertia.

Durant Manufacturing Co., Dept. ED, 1993 N. Buffum St., Milwaukee 1, Wis.

CIRCLE 337 ON READER-SERVICE CARD

NEW PRODUCTS

Laboratory Cabinet

Has 17 ft capacity

This laboratory cabinet automatically controls temperature and humidity to simulate changing environmental conditions for testing products and controlling research processes. Standard type LSC-16 cabinet has over 17 ft capacity. The temperature range is to 180 F and relative humidity is to 96%. A special version of this cabinet is available offering a temperature range of 0 to 300 F. Its cycling time pattern controls and cooling unit meet JAN and Mil specs. Made of polished stainless steel, these cabinets can be equipped with side ports for inspection of instrument leads to data recorders. The doors are sealed with heavy molded-rubber gaskets; a door with thermopane inspection window and built-in wiper can be supplied.

Anetsberg Brothers, Inc., Dept. ED, 186 N. Anets Dr., Northbrook, Ill.

CIRCLE 340 ON READER-SERVICE CARD

Rotary Switches

Handle shaft speeds to 1000 rpm

For use in missiles and aircraft systems, type P1280-11A precision rotary switches can handle up to 1000 rpm shaft speed. These components are used to sequence or switch circuitry as a function of time or of shaft position. They are suitable for sensitive relays or solid state switching.

Each unit has two switching tracks. The starting and running torque is 0.1 oz-in. Current capacity is 50 ma at 28 v per brush.

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

CIRCLE 342 ON READER-SERVICE CARD

Power Supply

Provides three regulated outputs

Model 155 transistorized power supply provides three regulated outputs: 15 v dc at 300 ma, 8 v dc at 700 ma, and 30 v dc at 1.5 amp. Regulation is within 0.1%. The outputs are floating. Either the negative or positive side may be grounded and voltages are adjustable over about 10% of the range. Ripple is 0.1%, maximum recovery time is 50 μsec, and overshoot is less than 1% of the voltage setting. The required input is 105 to 125 v 400 cps. Designed for a 19 in. relay rack, the unit is 7 in. high.

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

CIRCLE 344 ON READER-SERVICE CARD

Radar Display Tube

Electrostatic

For single-stage transistor drive, type K1868 cathode ray tube is focused and deflected electrostatically. This 12-1/2 in. diameter tube requires 10 v grid drive from extinction of a focused non-deflected spot or 7 v from raster cut-off for 50 μa screen current. Maximum deflection factors of 125 v per in. are maintained in both scan directions at accelerator and post accelerator voltages of 5.5 and 9.5 kv.

Allen B. Du Mont Laboratories, Inc., Dept. ED, Clifton, N.J.

CIRCLE 345 ON READER-SERVICE CARD

NEW PRODUCTS

Servo Amplifier

Drives size 18 servo motor

Transistorized, 60 cps servo amplifier model 762A drives a size 18 servo motor from synchro, resolver, or ac pot data. Full output is obtained for 200 mv rms into the input impedance of 100 K. The carrier phase shift is +90 deg. Having a built-in power supply, the unit operates from a 117 v 60 cps line. Damping is adjustable. The weight is 3-1/4 lb and the dimensions are 6-1/8 x 2-7/8 x 4-1/4 in.

Industrial Control Co., Dept. ED, 805 Albin Ave., Lindenhurst, L.I., N.Y.

CIRCLE 348 ON READER-SERVICE CARD

Coaxial Plug

For crimping

This coaxial plug is assembled by crimping the cable braid between two concentric ferrules which are placed over the cable jacket. Once crimped, 101.5 lb of force are required to separate the cable from the plug. The plug is available in five cable sizes: RG-8/U, 9/U, 11/U, 58/U, and 59/U; it is interchangeable with MIL-PL-259 plugs and mates with the SO-239. Its applications include mobile communications equipment and TV master antenna sets.

Cannon Electric Co., Dept. ED, P.O. Box 3765, Terminal Annex, Los Angeles 54, Calif.

CIRCLE 349 ON READER-SERVICE CARD

Power Supply

Output is 2 to 32 v dc at 0 to 10 amp

Made for laboratory use, model AA 1032 transistorized power supply has a fully adjustable range from 2 to 32 v dc at 0 to 10 amp. Regulation is better than 1% over the output range with

1 mv rms ripple. Recovery time is 100 μsec. Square wave pulse loading is provided for. The input is 105 to 125 v dc 60 cps. Designed for bench use, the unit can be rack mounted without the chassis.

American Avionics, Dept. ED, 11513 W. Washington Blvd., Los Angeles, Calif.

CIRCLE 762 ON READER-SERVICE CARD

Noise Generators

Provide to 170 db noise

Capable of simulating the power level and sound pressure of a high thrust rocket engine, these noise generators are available in two sizes. The Stentor 205 generates 170 db sound power level for 6.7 lb per sec mass air-flow; the Stentor 204 delivers 160 db at 0.67 lb per sec. They have two or more overlapping rotors with different speeds for a sequence of rectangular pulses. The distances between the pulse and the width of pulses are variable. The sinusoidal rotors, a matching horn, drives, and controls are included with the units, which are usually made to customer specifications. Reverberant chambers and wave tubes are also available.

PAM Assoc., Inc., Dept. ED, 7315 Hartford Rd., Baltimore 14, Md.

CIRCLE 351 ON READER-SERVICE CARD

Voltage Divider

Linearity is 0.01%

This transformer type, relay operated voltage divider, called Dekamatic model X-551, has a linearity of 0.01% and a resolution of about 0.006%. Programming is by a standard binary code which can be supplied from punched cards or tape. Ten complete units can be mounted across a standard relay rack. Its applications include missile checkout devices and machine control systems and it can be used as a binary to analog converter as well as for calibration and inspection.

Electro Measurements, Inc., Dept. ED, 7524 S. W. Macadam Ave., Portland 1, Ore.

CIRCLE 352 ON READER-SERVICE CARD

NEW PRODUCTS

Epoxy Pellets

Aluminum-filled

These aluminum-filled epoxy pellets, designated E-Form, cure at temperatures as low as 85 C. They enable transistors to withstand shock and vibration to 100 g. The pellets may be used in all-epoxy packages or with a metal can and glass to metal seals. Many shapes and sizes are available for oval or JETEC packages.

Epoxy Products, Inc., Dept. ED, 137 Coit St., Irvington, N.J.

CIRCLE 355 ON READER-SERVICE CARD

Signal Generators

For use at 400 to 450 mc

For use as an fm radio receiver or wherever modulated rf carrier signals are required, type BSG-7 signal generators are available covering any consecutive 15 frequencies over the range of 400 to 450 mc. Variable carrier deviation is from 0 to ±300 kc; the rf signal accuracy is 0.01%. Internal modulation providing the first six standard af channels or external modulation to 80 kc is included. The units can be bench type or standard 19 in. rack design.

Babcock Radio Engineering, Inc., Dept. ED, 1640 Monrovia Ave., P.O. Box 344, Costa Mesa, Calif.

CIRCLE 356 ON READER-SERVICE CARD

Prefabricated T-Sections

For panel-wiring raceways

Made to match the firm's line of channel sections and corners, these T-sections are reinforced, thermosetting plastic. Eliminating the need for mitering operations in the construction of wiring raceways, these sections have notches in the top of the sidewalls which permit the covers on the legs of each section to fit neatly. They have three elongated mounting slots in the bottom.

Stahlin Brothers, Inc., Dept. ED, 361 Maple St., Belding, Mich.

CIRCLE 357 ON READER-SERVICE CARD

Pushbutton Switches

Life is rated at 500,000 operations

For console and instrument applications, the MBS series miniature pushbutton switches are rated at 100 ma with a life of 500,000 operations. Designed to match the firm's line of indicator lights, the switches have gold-plated contacts with wiping action. The unit mounts with a single nut in a 3/8 in. hole.

Transistor Electronics Corp., Dept. ED, 3357 Republic Ave., Minneapolis 26, Minn.

CIRCLE 361 ON READER-SERVICE CARD

Control Switch

Compact design

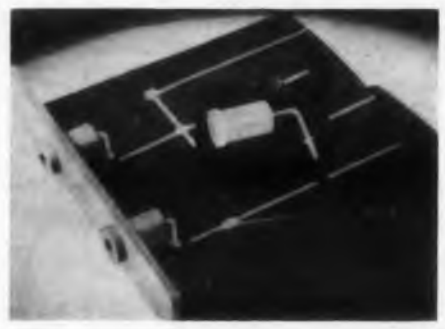
Type SBM compact control switch has two mechanically and electrically independent contacts per stage and has 1 to 10 stages. The switch is rated at 300 v ac or dc, 20 amp continuous. Its mechanical life is rated at 500,000 operations. The terminal connections are screw-type, positioned at an angle. A self-enclosing envelope, open at the bottom, houses each stage of cams and contacts.

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

CIRCLE 362 ON READER-SERVICE CARD

Jacks

For printed wiring



Type SKT-100 PC Jack mounts in a metal angle-iron edging designed for the printed circuit board and the rear right-angle lug fits in a hole for the connection. It accepts a probe 0.08 in. in diameter and up to 0.25 in. long. The contacts are made of beryllium-copper and the insulator body is made of Teflon.

Sealectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N.Y.

CIRCLE 363 ON READER-SERVICE CARD

NEW PRODUCTS

Servomotors

Size 18

These three models of size 18 servomotors are for missile and high-speed aircraft applications. Type 422012-1 operates at temperatures of —54 to +175 C, has a no load speed of 5300 rpm, and 2.4 oz-in. stall torque. Type 422013-1 operates at —54 to +175 C, has a no load speed of 9800 rpm, and 2.8 oz-in. stall torque. Type V112-32 operates at temperatures of —54 to +200 C, has a no load speed of 9800 rpm, and 3.7 oz-in. stall torque. The stator assemblies of all units are integrally cast in a thermosetting resin. Each unit weighs 12.2 oz.

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

CIRCLE 366 ON READER-SERVICE CARD

Voltage Regulating Transformer

Keeps voltage within ±3% of rated output

This voltage regulating transformer keeps voltage within ±3% of rated output with line variation from 100 to 130 v. Type PF-50 requires 275 v dc at 50 ma, type PF-110 requires 385 v dc at 110 ma, and type PF-250 requires 380 v dc at 250 ma. Other models can be made to customer specifications.

Raytheon Co., Industrial Apparatus Div., Dept. ED, Manchester, N.H.

CIRCLE 367 ON READER-SERVICE CARD

Ceramic Transducer Element

Resonant frequency is constant to 200 C

Type US600 ceramic transducer element has a resonant frequency that is constant to 200 C. The dielectric constant is 1350, the radial coupling coefficient is 0.46, and the linear coupling coefficient is 0.67. The Curie temperature is 310 C. For use as a sensor or a high power driver, it has applications in underwater sounding, thickness gage detectors, and if filter or ladder networks.

U.S. Sonics Corp., Dept. ED, 625 McGrath Highway, Somerville, Mass.

CIRCLE 368 ON READER-SERVICE CARD

Switch

Rated at 250 ma

Series 200 tone switch has a current rating of 250 ma at 115 v ac and 1.75 amp at 24 v dc. Combining the mounting and the index frame die cast as a single unit, this switch can be supplied with two or three positions and with 3, 4, 6, or 9 contact clips. The insulation is laminated phenolic type as specified in MIL-P-3115. Voltage breakdown between critical parts is at 100 v, rms.

Centralab, Div. of Glove-Union, Inc., Dept. ED, 900 E. Keefe Ave., Milwaukee 1, Wis.

CIRCLE 369 ON READER-SERVICE CARD

Glass-Bonded Mica

For continuous operation at 1100 F

This glass-bonded synthetic mica, designated Mykroy 20-7, is for continuous operation at 1100 F. The volume resistivity at 1100 F is greater than 1 meg. The specific gravity is 2.4. It is molded to customer specifications and can be used in high temperature feed-through bushings, molded-in thermocouple devices, relay spacers, and coil forms. Stainless steel, monel, and nickel inserts may be molded within the material.

Electronic Mechanics, Inc., Dept. ED, 101 Clifton Blvd., Clifton, N.J.

CIRCLE 370 ON READER-SERVICE CARD

NEW PRODUCTS

EIR Meter

Dc accuracy is 1.5% of full scale

Model 270 volt-ohm-milliammeter has a dc accuracy of 1.5% of full scale and an ac accuracy of 2% of full scale at 77 F. The temperature range is 67 to 87 F and the resistance accuracy is ±1.5 deg of arc. Similar to the model 260, model 270 has, in addition, a mirror scale, gold bonded diodes, a polarity switch, and a knife edge pointer.

Simpson Electric Co., Dept. ED, 5200 W. Kinzie St., Chicago 44, Ill.

CIRCLE 373 ON READER-SERVICE CARD

120 w Transformer

Is 1-3/16 in. thick

This 120 w transformer is 1-3/16 in. thick and has widely distributed, shallow windings of wire providing a short thermal path. The standard units operate on 115 v 400 cps and have secondary voltages from 5 to 2000 v. Regulation is 5% max, no load to full load, and the ambient temperature range is —55 to +100 C. Life expectancy is 10,000 hr. Weighing 15 oz each, these units are fully encapsulated and hermetically sealed in a steel container. They meet the requirements of MIL-E-5272C and MIL-T-27A, class S.

Arnold Magnetics Corp., Dept. ED, 4613 W. Jefferson Blvd., Los Angeles, Calif.

CIRCLE 374 ON READER-SERVICE CARD

Potentiometers

Are rated at 2 w

These 7/8 in. in diam, 10-turn potentiometers are available in two models: type 7220 has a power rating of 2 w at 25 C, derating to zero at 125 C; type 7230 is rated at 2 w at 65 C, derating to zero at 125 C. Both have a minimum operating temperature of —55 C. Standard resistance range of the 7220 is 10 ohms to 125 K ±5%, for the 7230, 300 ohms to 90 K ±5%. The standard linearity tolerance for both models is ±0.5%; a linearity of 0.05% can be obtained. The moment of inertia is 0.02 g-cm² and starting torque is 0.5 oz-in. Re-

quirements of NAS 710 and MIL-R-19 are met or exceeded. Three mounting styles are available with the 7220: bushing mount with sleeve bearing, servo mount with sleeve bearing, and servo mount with ball bearing. The 7230 has servo mount and ball bearing.

Beckman Instruments, Inc., Helipot Div., Dept. ED, 2500 Fullerton Rd., Fullerton, Calif.

CIRCLE 379 ON READER-SERVICE CARD

Relays

Miniature type

For dry circuit and high level switching, series 700 miniature relays are of resilient bifurcated contact construction. Type R700, dpdt, and type RS700, spdt, are current-sensitive units; type R750 dpdt is a magnetic-latch unit; and types R780 dpdt and RS780 spdt are voltage sensitive units. The contact life is rated at 100,000 operations, at 125 C at 2 amp, 28 v dc or 115 v ac. The dry circuit life is rated at 5,000,000 operations at 20 cps, 125 C at 10 μa, 10 mv dc or ac.

Iron Fireman Mfg. Co., Electronics Div., Dept. ED, 2838 S.E. Ninth Ave., Portland 2, Ore.

CIRCLE 380 ON READER-SERVICE CARD

Environmental Chamber

Provides —80 to +180 F

This 3 cu-ft test chamber has an adjustable temperature range of —80 to +180 F. Altitudes from sea level to 100,000 ft can be simulated in 15 min control time. A steam vapor generator provides to 100% relative humidity. The water supply is mounted on the unit. Radiation is provided by a 1 in. in diam tube; other special accessories include program controllers for wet and dry bulb temperatures and for absolute pressure. The chamber has interior illumination, a 2 in. entrance port, and an 8 x 8 in. observation window. External dimensions are 66 x 54 x 28 in.

Cincinnati Sub Zero Products, Dept. ED, 3932 Reading Rd., Cincinnati 29, Ohio.

CIRCLE 381 ON READER-SERVICE CARD

NEW PRODUCTS

Cycle Timer

For any timing sequence

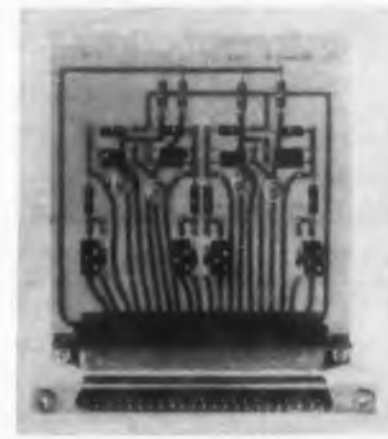
Designed for interrupting electric circuits on prearranged time settings, this cycle timer can be used to set up any sequence of on and off combinations within a basic cycle of 150 sec. Having a contact rating of 15 amp at 115 v ac, the unit can be used in pulsing circuits, cleaning equipment, and many laboratory and industrial processes. Dual and multi-circuit models are also available and special timers can be built to customer specifications.

Signatrol, Inc., Dept. ED, Danville, Ill.

CIRCLE 384 ON READER-SERVICE CARD

Module Building Blocks

Transistorized



These transistorized module building blocks, called the series 200 Logiblock, include NOR circuits, flip-flops, one-shot multivibrators, blocking oscillators, coupling circuits, and drivers for indicators or electro-mechanical devices. Each unit performs different functions by using different connections on the socket. Floating sleeves and pins are used for the plug-in connection. The blocks are rated at 200 kc; some operate at 400 kc or higher. Two voltage supplies are needed: −12 v and +6 v.

Wang Labs., Inc., Dept. ED, 12 Huron Dr., Natick, Mass.

CIRCLE 385 ON READER-SERVICE CARD

Wirewound Potentiometer

Has 5/16 in. diam

Having a 5/16 in. diam, the Comp-U-Trim model F wirewound linear trimming potentiometer is designed for mounting through the front panel of equipment or below the chassis. Rated at 0.75 w at 85 C and 0.5 w at 125 C, the potentiometer is available in resistance ranges from 10 ohms to 50 K with a tolerance of ±10% and a temperature coefficient of ±20 ppm. It meets

or exceeds applicable parts of MIL-R-19, MIL-202, and MIL-5272. The unit is encapsulated.

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

CIRCLE 336 ON READER-SERVICE CARD

Acoustic Test System

For airborne equipment

Designed for testing aircraft and missile parts, this acoustic test system consists of a reverberation chamber and a control console which contains the audio power equipment. The control console provides for three noise source inputs: a sine wave, random noise, or an external source such as a tape recorder. Sound pressure levels to 150 db are produced. Interlocking switches allow adjustment of passband and bandwidth over the range of 20 to 20,000 cps in 0.5 octave increments. Model TS-5201 system, consisting of the TE-5205 test chamber and the TE-5215 control console, tests small components. For larger components, model TS-5202 system consists of the TE-5206 test chamber, having a volume of 2 cu ft, and the TE-5215 control console. Model TS-5203 system is made up of the TE-5216 control console and the TE-5207 test chamber, shown here, which has a 6 cu ft volume. Control console model TE-5217 has detailed instrumentation for sound synthesis and analysis and can be used with any of the larger test chambers.

Stromberg-Carlson, Div. of General Dynamics Corp., Dept. ED, Rochester 3, N.Y.

CIRCLE 387 ON READER-SERVICE CARD

Circuit Breaker

Rated at 200 amp

Type SE33 circuit breaker is rated at 200 amp. The two poles are located in separate compartments and are externally linked by a single handle. Magnetically actuated, it reacts only to load current changes produced in a solenoid sensing coil. Instantaneous tripping is at least 10 times the breaker rating. Rated at 120 or 240 v ac, it has an interrupting capacity of 10,000 amp. It is also available in ampere rating of 125, 150, and 175 amp.

Heinemann Electric Co., Dept. ED, 355 Plum St., Trenton, N.J.

CIRCLE 388 ON READER-SERVICE CARD

NEW PRODUCTS

15 W RESISTOR.—High temperature, wirewound type PW15 with all inorganic materials for protection against flame or decomposition at overload conditions. Available in values from 1 ohm to 25 K with tolerances of 10% or, on special order, 5%.

International Resistance Co., Dept. ED, 401 N. Broad St., Philadelphia 8, Pa.

CIRCLE 396 ON READER-SERVICE CARD

SOCKET.—Type S416 eliminates mechanical and electrical problems in designing the 416B/6280E tube into military equipment, permits fixed indexing of the base pins by the adjustable grid ring. Comes with self-contained power lead filters and heat dissipating plate cap; has provisions for addition of circuit components.

LEL, Inc., Dept. ED, 380 Oak St., Copiague, N.Y.

CIRCLE 397 ON READER-SERVICE CARD

INTERVAL TIMER. – Programmer model 640A for scientific, medical, missile, or industrial research and product development. Unit can turn three separate electrical loads on and off at predetermined times, may also be programmed for momentary switch closings.

Camera equipment Co., Inc., Dept. ED, 315 W. 43rd St., New York, N.Y.

CIRCLE 398 ON READER-SERVICE CARD

MOISTURE INHIBITOR.—Chemical liquid type CRC drives absorbed moisture out of electrical equipment, eliminates effect of wicking, reduces electrical failure, prevents corrosion, preserves insulation. Can be applied by immersion, pouring, brushing, or spraying on motors, controls, switches, solenoids, relays, electronic circuits.

Corrosion Reaction Consultants, Inc., Dept. ED, 116 Chestnut St., Philadelphia 6, Pa.

CIRCLE 399 ON READER-SERVICE CARD

STEPPING SWITCH.—Spring driven type 211 accommodates twelve 11-

point levels and up to four 33-point levels, operates for about 100 million steps between adjustments.

C. P. Clare & Co., Dept. ED, 3101 Pratt Blvd., Chicago 45, Ill.

CIRCLE 401 ON READER-SERVICE CARD

CONSOLE UNIT.—Converts a standard relay rack cabinet into a slope-front console with flat writing surface and slanted instrument panel. Standard unit is 19 in. wide, but is also available in 2, 3, or 4 section widths. Sloped front is angled 15 deg from vertical and may be 12-1/4, 14, or 17-1/2 in. high. Writing surface may be 12-1/4, 14, or 17-1/2 in. deep.

Western Devices, Inc., Dept. ED, 600 W. Florence Ave., Inglewood 1, Calif.

CIRCLE 402 ON READER-SERVICE CARD

INTEGRATOR.—Converts the air pressure input from pneumatic process control equipment into a proportionate electrical output of contact closures. The output, up to 500 cpm, can then be indicated or recorded. The unit operates on a 115 v, 60 cps.

Royson Engineering Co., Dept. ED, Hatboro, Pa.

CIRCLE 403 ON READER-SERVICE CARD

SPEED REDUCER.—Available in 34 ratios from 1:1 to 27:1. The 5A series handles 16 oz-in. of torque at the low speed shaft. Speeds up to 3600 rpm on the high speed shaft may be obtained without excessive wear. It weighs 2-1/4 oz.

Metron Instrument Co., Dept. ED, 432 Lincoln St., Denver 3, Colo.

CIRCLE 404 ON READER-SERVICE CARD

RF CABLE RECEPTACLE.—Right-angle bulkhead type. When the type 3009 receptacle is engaged with a straight plug, the cable is only 3/16 in. away from the panel.

Sealectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N.Y.

CIRCLE 405 ON READER-SERVICE CARD

SUBMINIATURE FEEDTHROUGH TERMINAL.—Teflon insulated. Type FT-SM-36 TUR-L has a current rating of 10 amp continuous duty, and an operating voltage of 1750 v dc.

Sealectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N.Y.

CIRCLE 406 ON READER-SERVICE CARD

NEW PRODUCTS

Transistor

High frequency type

Models ST6006 and 2N1205 high frequency transistors are for if and video amplifiers. Model ST6006 has a typical power gain of 25 db at 12.5 mc and model 2N1205 has a typical power gain of 30 db at 4.3 mc. Both units have a low noise figure.

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

CIRCLE 410 ON READER-SERVICE CARD

Ultrasonic Cleaner

Has 5-gal capacity

For high energy density ultrasonic cleaning, model 240 cleaner has a 5-gal heavy-gage stainless steel tank measuring 12 x 12 x 9 in. Driving elements cover 44.5% of the tank bottom. Radiating surface is 48 sq in. Designed for continuous operation, the 115 v ac, single-phase generator delivers 250 w avg and 1000 w peak. Other features of the unit are: a 0 to 60 min timer, a one tube oscillator, provisions for remote control, and front panel switching which permits a choice of either of two transducers and circuit breaker.

National Ultrasonic Corp., Dept. ED, 111 Montgomery Ave., Irvington 11, N.J.

CIRCLE 411 ON READER-SERVICE CARD

Pulse Transformers

Have pulse widths of 0.05 to 5 μsec

For use with transistorized blocking oscillator and interstage coupling circuits, type AME miniature pulse transformers are available with pulse widths from 0.05 to 5 μsec at repetition rates to 500 kc. Three grades of environmental characteristics can be obtained: a commercial grade having an operating temperature of −25 to +105 C, a military grade having an operating temperature of −55 to +105 C and exceeding most of the requirements of MIL-T-27A, and X grade which operates to +150 C and meets all Mil specs. The units are wound on ferrite cup cores

and are epoxy encapsulated in cylindrical aluminum cases 1/2 in. long and 0.369 in. in diameter. They are available with two or three windings; connections are through pig-tail leads 1-7/8 in. min. length.

Technitrol Engineering Co., Dept. ED, 1952 Allegheny Ave., Philadelphia 34, Pa.

CIRCLE 412 ON READER-SERVICE CARD

Bias-Voltage Regulator

Dual type

For use in transistor or tube circuit design, model RK 60 transistorized bias regulator consists of two independent bias-voltage regulators. Each regulator provides 0 to −6 or −6 to −30 v dc, continuously variable. The outputs can be metered with automatic range switching. The maximum input is 35 v dc; the minimum input is 5 v greater than desired output. The load regulation is 0.3% from zero to full load; there is 0.1% regulation for ±10% change of input v dc. Minimum load resistance is 1000 ohms and ripple reduction is 40 db.

Arkay Engineering, Inc., Dept. ED, 225 Santa Monica Blvd., Santa Monica, Calif.

CIRCLE 413 ON READER-SERVICE CARD

Servo Amplifiers

Three types available

Designed to drive any standard size 11, 15 or 18 servo motor with a 40 v center-tapped control winding, these servo amplifiers are available in three types. Type T1000 has a 2500 v gain, 3.5 w output, and measures 1-3/8 x 1-3/8 x 3 in. Type T4000 has a 1500 v gain, 6.2 w output, and measures 1-7/8 x 1-5/8 x 3-1/2 in. Type T7000 has 3000 v gain, 9.3 w output and measures 2-3/8 x 1-3/4 x 3-3/4 in. All three types feature stabilized stages to prevent thermal runaway and internal negative feedback. They operate in an ambient temperature of −55 to +75 C, require a 28 v dc power supply, and have a 10,000 ohm input impedance.

Magnetico, Inc., T. A. Div., Dept. ED, 6 Richter Court, E. Northport, N.Y.

CIRCLE 414 ON READER-SERVICE CARD

NEW PRODUCTS

MAGNIFER.—Equipped with swivel clamp, this magnifier is 4-in., +5 diopter type. The precision ground lens has an 8-in. focal length. It can be used on assembly lines and inspection benches.

Edmund Scientific Co., Dept. ED, Barrington, N.J.

CIRCLE 417 ON READER-SERVICE CARD

ANALOG COMPUTER.—Incorporates high-speed memory and automatic iteration capability. Called Dystac, the new system has logic elements that operate with a frequency adequate for 50 solutions per sec.

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

CIRCLE 758 ON READER-SERVICE CARD

POROUS SPONGE TEFLON.—Used in filtration, for thermal insulation, and for vibration absorption. Liquids can be passed through the product to help control temperature in extreme temperature applications.

Liquid Nitrogen Processing Corp., Dept ED, 451 Booth St., Chester, Pa.

CIRCLE 418 ON READER-SERVICE CARD

PHOTOCONDUCTIVE CELL.—Type 7536 is a side-on version of head-on type 7412. Illumination sensitivity is 300 μa per ft-c at 25 C.

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

CIRCLE 419 ON READER-SERVICE CARD

TERMINAL BOARDS.—For resistor mounting. They are 1/16 in. thick fibre glass, with eight lugs. No. 1450 is 7/8 x 23/32 in. with terminal rows 1/2 in. apart; No. 1451 is 1-7/32 x 1-1/32 in. with rows 3/4 in. apart; No. 1452 is 1-1/2 x 1-5/32 in. with rows 7/8 in. apart. Terminals extend 3/16 in. above boards.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 420 ON READER-SERVICE CARD

PORTABLE COMPUTER.—Used as training instrument, or to simulate processes. Programming is plug-in type; input is 110 v ac. Unit has dual power supply.

Ebex Sales Inc., Dept. ED, Orem, Utah.

CIRCLE 422 ON READER-SERVICE CARD

STRIPPING TOOLS.—Kit K-500 consists of 6 wire strippers and 5 extra bits. They handle sheath diameters of 0.025 to 0.25 in. The strippers can be used in die holders. The cutting operation is in full view.

Continental Sensing, Inc., Dept. ED, 1950 N. Ruby St., Melrose, Ill.

CIRCLE 759 ON READER-SERVICE CARD

CAPACITANCE BRIDGE.—Reads capacity and dissipation factor of electrolytic capacitors up to 100,000 μf, at 60 and 120 cps.

Electronic Applications, Inc., Dept. ED, 194 Richmond Hill Ave., Stamford, Conn.

CIRCLE 423 ON READER-SERVICE CARD

GAS MONITOR.—Detects low levels of radio-active gas in the atmosphere. The unit is portable and self contained.

Land-Air, Inc., I & E Div., Dept. ED, 2133 Adams Ave., San Leandro, Calif.

CIRCLE 424 ON READER-SERVICE CARD

CHROMATOGRAM SCANNER.—Simultaneously counts both sides of one or more continuous radio-chromatogram strips up to 50 ft long.

Atomic Accessories, Inc., Dept. ED, 244-02 Jamaica Ave., Bellrose 26, N.Y.

CIRCLE 425 ON READER-SERVICE CARD

DIFFUSION FURNACE.—Temperature control to within 1 deg C. It has a 15-in. effective heating length with a 2-in. quartz tube.

A. D. Alpine, Inc., Dept. ED, Culver City, Calif.

CIRCLE 756 ON READER-SERVICE CARD

TELEMETRY VOLTAGE CALIBRATOR.—For subcarrier oscillators. It operates under extreme variations of altitude, temperature and shock.

Dynatronics, Inc., Dept. ED, Box 2566, Orlando, Calif.

CIRCLE 426 ON READER-SERVICE CARD

NEW PRODUCTS

NPN Transistors

Are hf type

These three types of npn hf computer transistors conform to the JETEC, TO-9 outline. Types 2N377 and 2N388 have a collector to base voltage of 25 v dc, a collector to emitter voltage of 20 v dc, and an emitter to base voltage of 15 v dc. Type 2N385 has a collector to base voltage of 25 v dc, a collector to emitter voltage of 25 v dc, and an emitter to base voltage of 15 v dc. For all three types, the total dissipation is 150 mw; derating per deg C increase in ambient temperature is 2 mw; and the operating and storage temperature range is −55 to +100 C.

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

CIRCLE 432 ON READER-SERVICE CARD

Interval Timer

Has intervals to 180 min

Type AT-31 interval timer, having intervals of 1, 5, 15, 30, 60, 120, and 180 min, is a totally enclosed motor-driven switching device for use with fans, heaters, battery chargers, and photographic equipment. The timer is manually set. The housing is molded phenolic; terminal and blade configurations are heavy gage spring brass and have no welded or stacked joints. Operation is at 120 or 240 v, 50 or 60 cps.

General Time Corp., Haydon Div., Dept. ED, 245 E. Elm St., Torrington, Conn.

CIRCLE 433 ON READER-SERVICE CARD

Interval Timer

With ranges of 1 sec to 3 hr

Series PAF panel-mounting interval timer is available in 12 models with a time cycle from 1 sec, having minimum setting of 1/60 sec, to a time cycle of 3 hr, having a minimum setting of 3 min. Started from a momentary pulse, the unit has a load rating of 15 amp, rated at 115 v 60 cps non-inductive. The timer resets at the end of each cycle; reset time is less than 0.02 sec over the complete time scale, regardless of time cycle. Re-

peat accuracy is ±3 to ±5 msec over a complete 1 sec scale. The unit can be supplied for 115 and 230 v at 25, 50, 60, and 400 cps.

Industrial Timer Corp., Dept. ED, 1407 McCarter Highway, Newark, N. J.

CIRCLE 434 ON READER-SERVICE CARD

Filament Transformers

For use with magnetrons

These magnetron filament transformers use fluorochemical gas as the dielectric and have nominal capacitances of 10 μμf. They meet most filament voltages and operating pulse voltages from 15 to 30 kv. Model L3-2D, shown here, is used with a 4J52 magnetron. The input is 115 v, 400 cps and the output is 12.9 v at 2 amp. The operating pulse is 16 kv, capacitance is 11 μμf, and temperature range is −55 to +125 C. It weighs 16 oz and measures 2-9/16 in. in diameter and 5-3/8 in. long. The complete line of filament transformers have been tested to MIL-T-27A.

RS Electronics Corp., Dept. ED, P.O. Box 368, Station A, Palo Alto, Calif.

CIRCLE 435 ON READER-SERVICE CARD

Precision Differentials

For heavy-duty electro-mechanical systems

For heavy-duty electro-mechanical systems such as computers and fire control devices, these precision differentials are available in hollow or solid shaft types. Typical of this line, the 5/16 in. solid shaft model has a backlash of 5 min and a breakaway torque of 0.1 oz-in. The working circle is 2.375. Other models include a 1/16 in. hollow shaft, 1/8 in. hollow and solid shafts, 3/16 in. hollow and solid shafts, and a 1/4 in. solid shaft.

Arch Instrument Co., Inc., Dept. ED, 101 Holmes St., N. Quincy 71, Mass.

CIRCLE 436 ON READER-SERVICE CARD

NEW PRODUCTS

Connectors

Rectangular type

These miniature, rectangular type environmental connectors, series WP, P, and J, have stainless steel shells, molded sealing gaskets, and glass-fiber jackscrews which exceed MIL-C-8384. The closed entry beryllium copper contacts meet applicable parts of MIL-C-5015. The connectors are available with up to 104 contacts and have face sealing gaskets for high voltages. They have been tested to 200,000 ft.

Airborn Connectors, Inc., Dept. ED, 2618 Manana Drive, P.O. Box 13251, Dallas, Tex.

CIRCLE 441 ON READER-SERVICE CARD

Pulse Modulators

For transmitting tubes

Designed to pulse magnetrons, klystrons, traveling wave tubes, and other transmitting tubes, series 223 pulse modulators have built-in repetition rate and pulse width generators. They also have metered low capacity filament supplies and continuously variable output power levels. Units are available for either 60 or 400 cps operation and all circuits are interlocked. Typical of this series, model 223-A, illustrated, operates at 115 v 400 cps and generates 19 kv peak at 15 amp peak at 2 μsec, 600 pps pulse. The filament power is 0 to 15 v dc at 5 amp.

Burmac Electronics Co., Inc., Dept. ED, 142 S. Long Beach Rd., Rockville Centre, N.Y.

CIRCLE 442 ON READER-SERVICE CARD

NPN Transistors

For switching circuits

These npn hf computer transistors are for switching and flip-flop circuits. Types 2N438, 2N439, and 2N440 have 100 mw dissipation and derate 1.7 mw per deg C increase in ambient temperature. Types 2N438A, 2N439A, and 2N440A have 150 mw dissipation and derate 2.5 mw per deg C. All types have a collector to base voltage of 30 v dc, and an emitter to base voltage of 25 v

dc. Types 2N438 and 2N438A have a rise time of 0.7 μsec, types 2N439 and 2N439A, 0.5 μsec, and types 2N440 and 2N440A, 0.3 μsec. The temperature range is −55 to +85 C.

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

CIRCLE 445 ON READER-SERVICE CARD

Pumping Systems

For high-vacuum use

For high-vacuum use, series 1400 pumping systems use diffusion pumps with mechanically refrigerated or liquid-nitrogen cooled traps. The valves are manual or air-operated; standard instrumentation may be indicating type or fully-automatic. Types 1402, 1404, and 1406 are 2, 4, and 6 in. caster-mounted portable units. Types 1410, 1416, and 1432 are 10, 16, and 32 in. skid-mounted assemblies. Type 1410 is shown here.

General Vacuum Corp., Dept. ED, 400 Border St., E. Boston 28, Mass.

CIRCLE 446 ON READER-SERVICE CARD

NPN Germanium Transistors

For switching circuits

Made for switching and flip-flop circuits, types 2N356, 2N357, and 2N358 npn hf computer transistors have a welded package which conforms to JETEC, TO-9. All three types have the following ratings at 25 C: collector to base voltage, 20 v dc; emitter to base voltage, 20 v dc; total dissipation, 100 mw; and derating per deg C increase in ambient temperature, 1.67 mw. The operating and storage temperature range is −55 to +85 C. Maximum rise time is 2 μsec for 2N356, 1.2 μsec for 2N357, and 0.8 μsec for 2N358.

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

CIRCLE 447 ON READER-SERVICE CARD

NEW PRODUCTS

NPN Germanium Transistors

Three types available

Types 2N634, 2N635, and 2N636 npn germanium transistors are for switching and flip-flop circuits and conform to JETEC, TO-9. They have the following ratings at 25 C: collector to base voltage, 20 v dc; collector to emitter voltage, 20 v dc, emitter to base voltage, 15 v dc; total dissipation, 150 mw; and derating per deg C increase in ambient temperature, 2.5 mw. The temperature range is −65 to +85 C.

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

CIRCLE 450 ON READER-SERVICE CARD

Induction Heating Unit

Has 10 kw output

Made for processing semiconductor materials, model LI-10C-1 induction heating unit operates at about 4 mc and has an output of 10 kw. The power input is 230 to 460 v 60 cps, three phase and the power consumption is 20 kva max at 90% power factor. Three meters for monitoring the oscillator tube plate current, grid current, and plate voltage are mounted on the front of the cabinet. A total time meter indicating filament hours is inside the enclosure. Over-all dimensions are 40 x 40 x 76 in.

Lindberg Engineering Co., Dept. ED, 2450 W. Hubbard St., Chicago 12, Ill.

CIRCLE 451 ON READER-SERVICE CARD

Resistor Networks

Are matched to 0.01%

These resistor networks are matched to 0.01% resistance. Temperature coefficients are matched to 1 ppm per deg C. Nine resistors with up to

10 meg occupy less than 1 cu in. They can be used as: feedback networks, of which the ratio determines the gain of an amplifier; voltage dividers for instrument input or reference voltage selection; and summing networks, for adding multiples of several input voltages.

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

CIRCLE 454 ON READER-SERVICE CARD

Voltage Regulator

Has 99% efficiency

This electro-mechanical automatic voltage regulator, designated Stabiline EM4108MR maintains a constant output voltage regardless of line or load changes and has an efficiency of 99%. Speed of response is 0.1 sec per v, accuracy is ±1%, and waveform distortion is claimed to be zero. The input is 105 to 135 v, 45 to 65 cps; the output is 120 v rms nominal and is adjustable from 115 to 125 v. The output current is 66.6 amp. The unit meets MIL-E-4158B and is suitable for rack mounting. It weighs 75 lb.

Superior Electric Co., Dept. ED, 83 Laurel St., Bristol, Conn.

CIRCLE 455 ON READER-SERVICE CARD

Frequency Detector

Accuracy is 0.1%

This solid state frequency detector, called Magmeter, delivers a dc output proportional to the input frequency at an accuracy of 0.1%. It covers a 10% bandwidth at any center frequency to 10,000 cps at a linearity better than 0.25%. The output will operate any 0 to 50 ma device. Its uses include instrumentation, tachometry, telemetering, and automatic control. The temperature range is −55 to +72 C. The weight is less than 4 oz and the height is 2 in.

Airpax Electronics Inc., Seminole Div., Dept. ED, Fort Lauderdale, Fla.

CIRCLE 456 ON READER-SERVICE CARD

NEW PRODUCTS

DUAL TRIODES.—Types 6DE7 and 10DE7 have 9-pin miniature design and contain a low-mu unit and a high-mu unit in a single envelope. They are for use in vertical-deflection-oscillator and vertical-deflection-amplifier applications in TV receivers.

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

CIRCLE 459 ON READER-SERVICE CARD

POWER SUPPLY MOUNTING KIT.—Permits use of power supply modules from breadboard through mass production stages. Model 70-101 will mount up to four modules.

Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo St., Pasadena, Calif.

CIRCLE 460 ON READER-SERVICE CARD

COMMUNICATIONS TOWER.—Provides rigidity at heights to 630 ft. Sections of the No. 60 tower are galvanized after fabrication and are 10 ft long. Each section is a 26-1/4 in. equilateral triangle with 5/8 in. solid steel rod cross-bracing attached to 2 in. 11-gage tubing.

Rohn Manufacturing Co., Dept. ED, 116 Limestone, Bellevue, Peoria, Ill.

CIRCLE 461 ON READER-SERVICE CARD

TUBE SPACERS.—For photomultiplier tubes. Made of chemically etchable glass, they can withstand the high operating temperatures of photomultipliers, and can be produced to ±0.002 in. hole diam specs.

Corning Glass Works, Dept. ED, Corning, N.Y.

CIRCLE 462 ON READER-SERVICE CARD

ANALYZER.—Optional feature in model 34-2 200-channel analyzer is the

multi-channel scaler mode of operation. In this mode, analyzer will store information in one channel for preset time. At the end of this time interval, the address will automatically advance to the next channel and the analyzer will again store information.

Radiation Instrument Development Laboratory, Inc., Dept. ED, 5737 S. Halstead St., Chicago 21, Ill.

CIRCLE 464 ON READER-SERVICE CARD

SILICON DIODES.—For circuitry where bank-mounting or other close-quarter mounting procedures are used. The entire range of silicon pigtail diodes are available with an insulating Teflon coating over the diode case. The transparent insulating jacket will maintain its electrical and mechanical properties from −67 to +250 C.

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

CIRCLE 760 ON READER-SERVICE CARD

ETCHED RETICLES.—For use as space filters to process infrared target information and other precision optical systems.

Thompson Ramo-Wooldridge Inc., Dept. ED, P.O. Box 90534 Airport Sta., Los Angeles 45, Calif.

CIRCLE 465 ON READER-SERVICE CARD

CONNECTORS.—For cables such as RG-68 C/U and RG-59 A/U, ConheX types 3040 and 3050 plugs mate with 75-ohm ConheX receptacles and jacks.

Sealectro Corp., Dept. ED, 139 Hoyt St., Mamaroneck, N.Y.

CIRCLE 466 ON READER-SERVICE CARD

TWIN TRIODE.—For use in tv receivers, type 6CN7 9-pin miniature, high-mu triode operates from a 6.3 or 3.15 v supply.

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

CIRCLE 467 ON READER-SERVICE CARD

SILICON ZENER VOLTAGE REGULATORS.—Available in ratings of 0.75, 1, 3.5, and 10 w, the Gold Crown units extend the control range to 100 v.

International Telephone and Telegraph Corp., Dept. ED, 67 Broad St., New York 4, N.Y.

CIRCLE 468 ON READER-SERVICE CARD

NEW PRODUCTS

TWIN DIODE AND POWER TETRODE.—Type 12DS7-A, 9-pin miniature design, contains two diodes and a high-perveance power tetrode in a single envelope. It is used in hybrid automobile radio receivers.

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

CIRCLE 472 ON READER-SERVICE CARD

WIRE-WOUND CONTROL.—Has terminals suitable for printed circuits requiring dip-soldering. The series 43, 1-1/8 in. diam control is used in circuits requiring up to 2 w of power.

Clarostat Manufacturing Co., Inc., Dept. ED, Dover, N.H.

CIRCLE 473 ON READER-SERVICE CARD

SPLIT OUTS.—Feed a single source to two or more fully isolated loads. They are used to combine networks for complete recordings of two or more independent sources.

Studio Supply Co., Dept. ED, 711 S. Victory Blvd., Burbank, Calif.

CIRCLE 474 ON READER-SERVICE CARD

PRINTED CIRCUIT BOARD HOLDER.—Can be turned to horizontal, vertical or angular working positions. Called the Little Joe No. 160, it has a holding spread of 8-1/2 in. max and takes 9 x 10 in. work space on table. Clamps are aluminum.

Macdonald & Co., Dept. ED, 1324 Ethel Ave., Glendale 7, Calif.

CIRCLE 475 ON READER-SERVICE CARD

BEAM POWER TUBE.—Type 7027-A, glass-octal design, high-per-

veance tube is used in push-pull power-amplifier circuits of Hi-Fi audio equipment.

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

CIRCLE 477 ON READER-SERVICE CARD

SLIDE RULE.—The 1776 "Redirule" slide rule is made of nonwarping, acrylic plastic with 15 deep-etched scales: K, A, B, T, ST, S, D, DI, and DF, CF, CIF, CI, C, D, L. It comes with a complete instruction manual, and is pocket size.

Eugene Dietzgen Co., Dept. ED, 2425 N. Sheffield Ave., Chicago 14, Ill.

CIRCLE 761 ON READER-SERVICE CARD

RESIN SOLVENT.—Cleans components that have been embedded in epoxy or polyester resins and equipment used for casting or potting.

Resin Consultants & Mfg. Co., Inc., Dept. ED, 132 Nassau St., New York 38, N.Y.

CIRCLE 478 ON READER-SERVICE CARD

ROLLER-WELDER.—Seam welds light gage aluminum sheets at speeds greater than 30 ft per min. This ultrasonic splicing technique is used with sheets ranging from 0.006 to 0.010 in. thick.

Aluminum Company of America, Dept. ED, 1501 Alcoa Bldg., Pittsburgh 19, Pa.

CIRCLE 479 ON READER-SERVICE CARD

CLEANER AND LUBRICANT.—For tuners and controls, type Rx cleans and lubricates with each rotation.

Superex Electronics Corp., Dept. ED, 4-6 Radford Place, Yonkers, N.Y.

CIRCLE 480 ON READER-SERVICE CARD

PENTODES. — Types 4EW6 and 6EW6 are 7-pin miniature, sharp-cutoff tubes for use in TV receivers at an if of about 40 mc. Transconductance is 14,000 μmhos. Type 6EW6 has a 6.3 v, 0.4 amp heater; type 4EW6 has a 4.2 v, 0.6 amp heater with controlled warm-up time.

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

CIRCLE 481 ON READER-SERVICE CARD

NEW PRODUCTS

Transistors

Come in 11 types

Among the transistors available are types 2N1386 through 2N1390 npn diffused base silicon transistors. Types 2N1386 and 2N1387 switching transistors have frequency cutoff ratings of 60 and 50 mc, respectively. Types 2N1388, 2N1389, and 2N1390 are hf and video amplifiers.

Raytheon Co., Semiconductor Div., Dept. ED, 215 First Ave., Needham, Mass.

CIRCLE 763 ON READER-SERVICE CARD

Vibration Testing System

Operates over range of 5 to 10,000 cps

The Randomatic random wave vibration testing system for automatic programming operates over the frequency range of 5 to 10,000 cps. It provides a peak random force of 2500 lb and sine wave vector force of 1500 lb when used with model A-174 shaker. The power generator, field and degaussing supply, cycling oscillator, servo system and stop-start controls are housed in a metal console measuring 4 x 10 ft; the electro-dynamic shaker is external.

Ling Electronics, Inc., Dept. ED, Culver City, Calif.

CIRCLE 485 ON READER-SERVICE CARD

Dual Polarized Antennas

For 1700 to 1850 and 1850 to 1990 mc ranges

These four dual polarized parabolic antennas cover two frequency ranges: 1700 to 1850 mc and 1850 to 1990 mc. They are available with a six- or ten-foot parabolic reflector. The reflector can withstand 100 mph wind loads and a 2 in. radial ice load. The feed horn is a watertight assembly having a fiberglass window across its aperture. Cross talk is kept at a minimum by the use of vanes located to act as short-

ing plates for the probe closest to the horn aperture.

Prodelin Inc., Dept. ED, 307 Bergen Ave., Kearny, N.J.

CIRCLE 486 ON READER-SERVICE CARD

Ferrites

For 100 to 2000 mc applications

These three types of ferrites were developed for devices which operate in the 100 to 2000 mc range. Type MCL 1110 has a saturation magnetization of 1200 gauss per cc; type MCL 1116, 600 gauss per cc; and type MCL 1118, 800 gauss per cc. All types are available in standard sizes and shapes.

Microwave Chemicals Laboratory, Inc., Dept. ED, 282 Seventh Ave., New York 1, N.Y.

CIRCLE 488 ON READER-SERVICE CARD

Thermocouple Tubes

Stabilized zirconia

Thermocouple tubes made of high-purity stabilized zirconia are available in OD measurements down to 0.030 in. with single and double holes as small as 0.007 in. ID. The grade of zirconia used is free from contaminating elements such as cadmium and boron and is spectographically low in hafnium.

Saxonburg Ceramics, Inc., Dept. ED, Saxonburg, Pa.

CIRCLE 489 ON READER-SERVICE CARD

Connectors

For plug-in connections

The designated Tub-Plug connectors, for use in master TV antenna systems, are easily installed because of plug-in design. Type EP-600 fits all 300-ohm twin lead wires. Two types are available for RG-59/U cable: type EP-700 with insulated plastic pull-out grip and type EP-700A, a precision aluminum version of EP-700. All types provide matched impedance.

Entron, Inc., Dept. ED, P.O. Box 287, Bladensburg, Md.

CIRCLE 490 ON READER-SERVICE CARD

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

New Series of Small, Light Radio Interference Filters

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

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

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

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

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

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

For assistance in solving unusual interference, rating, or space problems, contact Interference Control Field Service Manager, Sprague Electric Co., at 12870 Panama Street, Los Angeles 66, California; 224 Leo Street, Dayton 4, Ohio; or 47 Marshall Street, North Adams, Massachusetts.

CIRCLE 493 ON READER-SERVICE CARD

NEW PRODUCTS

Multi-Unit Tube

Triode and three-plate tetrode

For harmonic-generator applications, type 6FH8 multi-unit tube is a 9-pin miniature type containing in one envelope a medium-mu triode and a sharp-cutoff tetrode with a pair of additional plates. The tetrode unit utilizes three separate plates; the cathode and grids are common to all three plates. Maximum dissipation ratings are 2.3 w for one plate and 0.3 w for the other two. Filament voltage is 6.3 v ±10%. The triode unit has an amplification factor of 40 and a transconductance of 5400 μmhos.

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

CIRCLE 494 ON READER-SERVICE CARD

Potting Compound and Adhesive

Is a heat conductor

This electrical potting compound and adhesive, called Temporell 1501, is both a heat conductor and an electrical insulator. The temperature range is −65 to +1500 F. It is cured at 180 F until volatiles are removed; a 1 in. cube requires about 6 hr. It adheres to metal, glass, ceramics, but not to rubber.

Orell, Inc., Dept. ED, Box 527, South Gate, Calif.

CIRCLE 495 ON READER-SERVICE CARD

Laminate

Track resistant

This fiberglass, polyester laminate, called Resistrac, is for use in apparatus operating at voltages above one kv or in applications with short creep distances. It is especially suitable where humidity and surface contamination conditions are present. The track resistance is rated at 200 hr when tested according to ASTM requirements. The laminate is flame retardant; its other characteristics meet NEMA GPO-1 specifications. Standard sizes are 36 x 72 in. and 24 x 36 in., with thicknesses of 1/8 to 3/4 in.

Glastic Corp., Dept. ED, 4321 Glenridge Rd., Cleveland 21, Ohio.

CIRCLE 496 ON READER-SERVICE CARD

Time Delay Relay

Has solid state components

Available in six models, this time delay relay uses a solid state timing system, eliminating cycling and repeatability problems. Three time delay ranges and tolerances may be obtained in either of two types of operation: model EL 102 is normally closed; model EL 101 is normally open. The ranges are: general purpose—0.05 to 950 sec, 20% accuracy; special purpose—0.05 to 90 sec, 10% accuracy; precision—0.30 to 60 sec, 5% accuracy. The relay weighs 4 oz and measures 1-1/2 x 1-5/16 x 1-5/8 in. Standard operating voltages are 24 to 3 v dc; contact resistive load is 2 amp.

George Harmon Co., Inc., Dept. ED, 18232 Parthenia St., Northridge, Calif.

CIRCLE 497 ON READER-SERVICE CARD

Converters

Dc-to-dc type

Series 200 dc-to-dc converter handles up to 500 w. The unit has conversion efficiencies to 85% at temperatures to 80 C. Regulation is available to 1%. Designed to OEM specifications, it also meets Mil specs for radio interference.

Standard Electronics Co., Dept. ED, 1611 W. 63rd St., Chicago 21, Ill.

CIRCLE 498 ON READER-SERVICE CARD

Vibration Isolation System

For gyroscopes

For gyroscopes and other navigation equipment, this vibration isolation system provides for omni-directional rectilinear motion, but maintains high-stiffness constraint against rotation. The mount assembly uses metal C-shaped springs. System damping is provided by elastically supported unit dampers. The mount provides good shock attenuation, improved vibration isolation at high frequencies, low resonant peaks, decoupled angular and translational modes, and good angular alignment characteristics.

Allied Research Associates, Inc., Dept. ED, 43 Leon St., Boston 15, Mass.

CIRCLE 499 ON READER-SERVICE CARD

Motor-Driven Switch

Weighs 7 lb

This motor-driven power changeover switch weighs 7 lb and exhibits no contact chatter over the vibration spectrum of from 5 to 2000 cps, 40 g. Voltage drop across switch contacts is less than 10 mv at 22 amp. Once the switch is transferred, no power is required to hold it in position. The switch is available in almost any size required and may be adapted to most missile systems.

Kinetics Corp., Dept. ED, 410 S. Cedros Ave., Solana Beach, Calif.

CIRCLE 500 ON READER-SERVICE CARD

Controlled Rectifiers

Outputs to 500 kw

This line of fully automatic selenium, germanium and silicon rectifiers are available with outputs from 50 w up to 500 kw with normal convection, forced air, oil convection or oil circulating cooling. These dc supplies provide constant voltage or constant current within ±0.01 with load variations from 0 to 100% or line variations within ±10%. The power factor is up to 1 and the efficiency is up to 96%.

Djordjevic Engineering Co., Dept. ED, 1933 N. Damen, Chicago 47, Ill.

CIRCLE 501 ON READER-SERVICE CARD

DC Reset Timer

Accuracy to 0.25%

For automatic control of industrial and machine process functions, the series 305 dc reset timer controls dc loads within variable timed intervals or sequences with a repeat accuracy of 0.25%. It resets full scale length in less than 0.1 sec and stops on power failure or interruption. The unit has seven basic circuit arrangements, a metal-to-neoprene impingement clutch, and heavy-duty silver contacts. The power requirements are 6, 12, 24, 28, 32, 42, 125, or 250 v dc.

Automatic Timing & Controls, Inc., Dept. ED, King of Prussia, Pa.

CIRCLE 502 ON READER-SERVICE CARD

Medium-Mu Triode

Transconductance is 8000 μmhos

For use as an rf-amplifier tube in vhf tuners of TV receivers, type 68N4-A medium-mu triode is similar to the 6BN4 but has a transconductance of 8000 μmhos. A 7-pin miniature type, the tube has double base-pin connections for both cathode and grid. Input and output circuits are isolated. The filament voltage is 6.3 v ac or dc ±10%. Direct interelectrode capacitances are: grid to plate, 1.2 μμf; grid to cathode and heater, 3.2 μμf; and plate to cathode and heater, 1.4 μμf.

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

CIRCLE 503 ON READER-SERVICE CARD

NEW PRODUCTS

Ultrasonic Cleaner

Operates automatically

Made for cleaning pellets, wafers, and headers, this ultrasonic cleaning unit cleans, rinses, and dries automatically. The unit features precise control of the timing cycles in each stage.

L & R Mfg. Co., Dept. ED, 577 Elm St., Kearny, Arlington, N.J.

CIRCLE 764 ON READER-SERVICE CARD

Vibration System

Provides 70 lb of force

This 70-lb force, sine wave vibration system consists of model RA-250 power generator driving a model 227 electro-dynamic shaker. The generator can also be used to drive an acoustic vibration system. Power generator components are housed in a metal cabinet measuring 2 x 2 x 4 ft. The system provides continuous operation over a frequency range of 5 to 2000 cps. No impedance changing or manual power factor correction is required over this range. The shaker has a maximum output force of 150 lb. It measures 1-1/2 x 1-1/2 x 2 ft.

Ling Electronics, Inc., Dept. ED, Culver City, Calif.

CIRCLE 506 ON READER-SERVICE CARD

Test Stand

For differential transformers

Model PMB-100-C test stand is used to obtain precise measurements of linear variable differential transformer response to linear core motion. The transformer case is clamped in the mount, and a nonmagnetic, non-conductive core rod is used to position and support the core as the micrometer is adjusted. Base and micrometer mounting block are constructed of silver-anodized aluminum. There are five push-type binding posts mounted on the terminal strip for interconnect-

ing the transformer and the test circuitry.

Schaevitz Engineering, Dept. ED, Pennsauken, N.J.

CIRCLE 507 ON READER-SERVICE CARD

Tape Editing Console

Has speed of 60 characters per sec

This tape preparation and editing console automatically verifies and duplicates paper tapes. The unit consists of a numerical keyboard, a control and comparison section with 6-digit decimal readout, two tape readers and one tape perforator. Tape-to-Tape duplication and verification is at 60 characters per sec. The unit accepts standard tape widths of 0.687, 0.875, and 1.00 in.

Tally Register Corp., Dept. ED, 5300 14 Ave., N.W., Seattle 7, Wash.

CIRCLE 509 ON READER-SERVICE CARD

Tantalum Capacitors

Solid anode type

Type S solid anode capacitors maintain their reliability and stable characteristics through the operating temperature range of from −55 to +125 C. These miniature components are hermetically sealed and use a sintered tantalum anode with a solid electrolyte. This provides protection against moisture, atmospheric pressure extremes, and other adverse environments.

International Telephone and Telegraph Corp., Components Div., Dept. ED, Palo Alto, Calif.

CIRCLE 510 ON READER-SERVICE CARD

Memory Tape

Has 50 channels

This 50-channel memory tape is for production testing of electrical circuits, voltages, and stepping switches. It can produce 50 electrical impulses simultaneously using only one line of the tape's capacity. The over-all capacity of one tape is 15,000 horizontal lines.

American Automatic Typewriter Co., Dept. ED, 2323 N. Pulaski Road, Chicago 39, Ill.

CIRCLE 511 ON READER-SERVICE CARD

NEW PRODUCTS

Wiring Channel

Has rounded corners

This wiring channel provides rounded corners and is grooved on one side to slip onto the ends of two channel sections set at right angles. It is supplied in 6 in. lengths that can be cut to the required size.

Stahlin Brothers, Inc., Dept. ED, Belding, Mich.

CIRCLE 515 ON READER-SERVICE CARD

Accelerometer

Has 15/16 in. diam and 7/8 in. length

Designed for measurement of linear acceleration in missiles and aircraft, type TA-400 accelerometer measures 15/16 in. in diam and 7/8 in. in length. It withstands 100 g shock and 20 g vibration over the range of 50 to 2000 cps. The unit is hermetically sealed and measures accelerations from ±14 to ±50 g with an accuracy of 0.5% of full scale to half scale. The undamped frequency range is 10 to 175 cps. The unit weighs less than 2.5 oz.

Fairchild Controls Corp., Components Div., Dept. ED, 225 Park Ave., Hicksville, N.Y.

CIRCLE 516 ON READER-SERVICE CARD

Fastener

Completely self-contained

Having applications in electrical, hydraulic, and pneumatic lines, type TA5000 fastener is completely self-contained and can be opened and closed without being removed from its fixed mount. Available in diameter sizes from 1/4 to 6 in, the fastener is made of No. 321 stainless steel. Four cushioning materials are offered: asbestos-teflon, neoprene rubber, fuel and weather resistant cushion, and corrugated stainless steel.

TA Manufacturing Corp., Dept. ED, 4607 Alger St., Los Angeles 39, Calif.

CIRCLE 518 ON READER-SERVICE CARD

Precision Resistors

Have accuracies to 0.005%

These encapsulated precision resistors are available in sizes as small as 1/4 in. in diam and 9/16 in. long, and have absolute accuracies from 0.005% to 0.1%, with a stability of 0.003% per year. Resistances are from 1 ohm to 4 meg. Accuracy over military temperature ranges (−30 to +85 C) is ±0.02%, and matched sets which track within 0.005% from −45 to +85 C can be provided.

Julie Research Laboratories Inc., 556 W. 168 St., New York 32, N.Y.

CIRCLE 519 ON READER-SERVICE CARD

Power Supply

Ac, dc type

Model 154 transistorized power supply has four regulated outputs: 200 v dc at 50 ma, 100 v dc at 50 ma, −50 v dc at 5 ma, and 6.3 v ac at 5 amp. All outputs are regulated to within 0.25%. The input power is 105 to 125 v 60 cps. Ripple is 0.01%, recovery time is less than 50 μsec, and overshoot is less than 1% of voltage setting. The panel is 8-3/4 in. high and fits in a standard 19 in. rack.

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

CIRCLE 520 ON READER-SERVICE CARD

Silicon Rectifiers

Maintain 4 amp

These 18 silicon rectifiers maintain 4 amp avg rectified current even at room temperature, low reverse current ratings, and piv through 600 v. Three mechanical configurations are offered: six types have fully insulated mounting studs, six have studs connected to anode, and six have studs connected to cathode.

Raytheon Co., Semiconductor Div., Dept. ED, 215 First Ave., Needham, Mass.

CIRCLE 765 ON READER-SERVICE CARD

NEW PRODUCTS

Dial

Dual type

Type 4838 calibrated-band dial has two pointers, one for band selection and one for band spread. The fitted scale is printed in degrees; the user may calibrate the band spread. Search is about 8:1 and band spread is 50:1. The unit is supplied with black crackle escutcheon and glass.

Jackson Bros., Dept. ED, 258 Broadway, New York 7, N.Y.

CIRCLE 526 ON READER-SERVICE CARD

Rotary Transducer

Temperature range is −65 to +500 F

Operating at temperatures from −65 to +500 F, type RK3600 electromechanical rotary transducer has phase shift. This 10-turn model has variable permeance circuitry and operates on a 400 cps carrier frequency. It is made for use as a servo angular position feedback element or for angular position instrumentation where total shaft rotation is less than 3600 deg. Mounting is standard size 15 synchro type.

Crescent Engineering and Research Co., Dept. ED., N. Peck Rd., El Monte, Calif.

CIRCLE 528 ON READER-SERVICE CARD

Photomodulators

Modulating frequency is from dc to 400 cps

Types M-10 and M-20 photomodulators are used where a low level dc signal must be modulated into square-waves or ac form to allow amplification, and demodulated back to dc. The modulating 1% linearity and ±15 deg max

frequency is variable from dc to 400 cps. Models are available for operation in circuits with impedances from 1 K to 10 meg. The sensitivity is 2 μv and the drift is less than 1 μv. Both spst and dpst switching is available. The units operate in a temperature range of −20 to +100 C. Life is in excess of 5000 hr. Dimensions are 2-1/2 in. in length and 5/8 in. in diameter and the weight is 1 oz.

Cambridge Electronics Corp., Dept. ED, Box 23, Newton Lower Falls 62, Mass.

CIRCLE 525 ON READER-SERVICE CARD

Digital Transport

For low speed applications

Specifically designed for low speed applications, model 3280 digital transport may be used as a coupling device to digital communication circuits or as a recorder of long term data. The speed range is 10 to 0.1 in. per sec. Dual speed combinations are available with standardized ratios. The unit has fast start-stop capability. It is completely transistorized and is adaptable to various reel configurations.

Potter Instrument Co., Inc., Dept. ED, Plainview, N.Y.

CIRCLE 529 ON READER-SERVICE CARD

Linear Actuator

Has load capacity of 100 lb tension

This linear actuator provides load capacities of 100 lb tension up to 600 lb compression with little change in ram speed. The ram operates at 0.3 to 0.6 in. per sec; signals are transmitted accurately to 0.001 in. Potentiometer resistance is 10,000 ohms ±5% for a 1.65 in. stroke. The actuator operates on 25 to 29 v dc; maximum current is 12 amp. It weighs 3 lb.

Hydro-Aire Co., Dept. ED, 3000 Winona Ave., Burbank, Calif.

CIRCLE 530 ON READER-SERVICE CARD

A NEW PERSPECTIVE ON THE NEWS

Look for the *new* news in ELECTRONIC DESIGN—news specially gathered and written, interpreted and edited for one group only, electronic design engineers.

The news section of ELECTRONIC DESIGN has been expanded and fortified to give design engineers news they cannot get elsewhere: first reports on design trends; developments that spell change for designers; news from Washington, from technical meetings, from military sources and from overseas—all written from the design point of view.

To report this ELECTRONIC DESIGN NEWS, two new editors have joined the staff:

Alan Corneretto
Interest in electronics started with military radio schools and service as radio technician. After journalism studies at Columbia, began 10 year career in technical writing on business papers, including Petroleum Processing *and* Product Engineering. *Has traveled widely in industry writing news and feature articles.*

Howard Bierman
B.E.E. from City College of New York. Former electronic design chief engineer in audio and hi fi equipment at Mark Simpson Mfg. Co., senior engineer in TV design at Tech Master Corp., also presently a color TV instructor at RCA Institute. Author of "Handbook of 630-type TV Receivers" and other books.

Watch for, and read, ELECTRONIC DESIGN NEWS . . . in every issue of ELECTRONIC DESIGN.

NEW PRODUCTS

Viscosity Modifier

For use with epoxy resins

This viscosity modifier, called Terpox, is a liquid oxy derivative of a terpene and is miscible with epoxy resins at room temperature. It promotes penetration and wetting in both amine and anhydride cured epoxy systems and permits increased filler loading of epoxies for potting, casting, laminating, coating, and adhesive formulations.

Heyden Newport Chemical Corp., Dept. ED, 342 Madison Ave., New York 17, N.Y.

CIRCLE 534 ON READER-SERVICE CARD

Digital Module

Transistorized

Model BD-101 transistorized digital module consists of four flip-flops. The required input is +20 v at 20 ma and −90 v at 1 ma; the maximum input rate is 100 kc. It can be externally connected as a binary counter, a binary coded decimal counter, or as a multi-stage counter requiring feedback.

Computer Control Co., Inc., Dept. ED, 983 Concord St., Framingham, Mass.

CIRCLE 535 ON READER-SERVICE CARD

Ball Drive

For dial or pointer

For dial or pointer, this planetary type ball drive unit fits directly to the condenser spindle or is used to give increased ratio to other mechanisms with 1/4 in. shafts. The following types are available: type 4511 without flange, 4511DA with two mounting lugs, and 4511DAF with flange and two mounting lugs. The ratio is 6:1. The unit measures 1-3/32 in. in diam and 11/16 in. long.

Jackson Bros., Dept. ED, 258 Broadway, New York 7, N.Y.

CIRCLE 536 ON READER-SERVICE CARD

Teleprinter Repeaters

Three models available

These teleprinter repeaters, designated Diamond-Trepac 560 series, have rechargable standby batteries which allow continued operation three months after failure of the external power source. They have no electron tubes and the only moving part is a mercury relay. Each repeater is bi-directional and has pilot lamps to indicate the direction of transmission. They operate from 115 v 60 cps power or 12 to 14 v dc, and require 15 ma in the line closed condition. The models available include 561-A, a neutral single-line repeater; 562-A, a half-duplex neutral repeater; and 563-A, a half-duplex polar-neutral hybrid repeater.

Trepac Corp. of America, Dept. ED, 30 W. Hamilton Ave., Englewood, N.J.

CIRCLE 538 ON READER-SERVICE CARD

Gadolinium-Iron-Garnet Crystals

For microwave applications

Large single crystals of gadolinium-iron-garnet are available in weights of 4 g and over for use in hf and microwave equipment and magneto-optical devices. They have a density of 6.49 g per cc based on a lattice constant of 12.469 A $\pm$0.005. Saturation magnetization is 50 gauss per cc at room temperature. The Curie temperature of these crystals is 296 C $\pm$1. They may be made into lenses; an optical finish is obtainable.

Microwave Chemicals Lab., Inc., Dept. ED, 282 Seventh Ave., New York 1, N.Y.

CIRCLE 539 ON READER-SERVICE CARD

NEW PRODUCTS

Transistor

Has 0.3 v dc saturation voltage

Designed for application in single-ended class B drivers and output amplifiers, type 2N1176, series A and B transistor has a saturation voltage of 0.3 v dc. It can be supplied in 15, 40, and 60 v ratings with a 300 ma dc max collector current rating.

Bendix Aviation Corp., Red Bank Div., Dept. ED, Long Branch, N.J.

CIRCLE 544 ON READER-SERVICE CARD

Vibration Analyzer

Portable

Model PVA portable vibration analyzer measures the peak-to-peak displacement and frequency of mechanical vibrations. Four velocity-type seismic pickups and cables are furnished. The pickups have a flat frequency response from 20 to 2000 cps, are calibrated to 1% accuracy, and are designed for omnidirectional mounting. The power supply is a 12 v, nickel-cadmium battery with a self-contained charging system which may be plugged into a 115 v, 60 cps source.

Sun Electric Corp., Dept. ED, Harlem and Avondale, Chicago 31, Ill.

CIRCLE 545 ON READER-SERVICE CARD

Vinyl Sleeving

Flexible to −95 F

This vinyl insulation sleeving is flexible to −95 F, is resistant to fungus and corrosion, and is self-extinguishing in 1 to 5 sec. Called resinite EP-93C, it meets MIL-I-7444B. It is rated at 250 to 340 v per mil of wall thickness. The sleeving is colorless and transparent; it may also be produced in a variety of colors. Sizes range from No. 24 AWG up to 2-1/2 in. in diam.

Borden Chemical Co., Dept. ED, 350 Madison Ave., New York 17, N.Y.

CIRCLE 546 ON READER-SERVICE CARD

Power Supplies

Operate at −55 to +120 C

Designed to operate at temperatures of −55 to +120 C, these power supplies are silicon-transistor regulated with silicon rectifiers, tantalum capacitors, and a Zener diode reference. Ripple and output impedance are low.

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

CIRCLE 548 ON READER-SERVICE CARD

Circuit Cards

Two types available

Series C100 transistor digital circuit cards provide a set of 200 kc digital modules. This series includes flip-flop cards for logical and control functions, binary and decade counters, diode and transistor gates, amplifier units, and a delay multivibrator unit for signal delay and shaping purposes. They operate from ±6 and ±18 v power and use signal levels of 0 and −6 v. The 1 mc series 1000 transistor digital circuits, a compatible extension of series 100, uses a supply voltage of ±6 v and −18 v and signals of 0 and −6 v. Signal transition and circuit recovery times permit operation in excess of 1 mc. The ambient temperature range for both types is −10 to +55 C.

Epsco Inc., Dept. ED, 275 Massachusetts Ave., Cambridge, Mass.

CIRCLE 549 ON READER-SERVICE CARD

Induction Heater

Operates at 120 mc

This induction heater operates at 120 mc and, used in conjunction with an output fixture, heats highly resistive conductors such as silicon, boron, titanium boride, and yttrium-iron-garnet. Available in 1-kw and 5-kw sizes, this unit may also be used as a dielectric heater.

Radio Frequency Co., Inc., Dept. ED, 44-46 Park St., Medfield, Mass.

CIRCLE 550 ON READER-SERVICE CARD

SERVICES FOR DESIGNERS

Composite Laminates

Recent technical advances in the bonding of various metallic and non-metallic materials to laminated plastics have opened up new design opportunities using combination laminates, reports Taylor Fibre Co., Norristown, Pa., manufacturers of laminated plastics and vulcanized fibre.

It is now possible, the company says, to bond virtually any compatible material with a laminate to form a composite which combines the advantages of both.

One of the first combination materials was copper-clad laminates used for etched printed circuits. With the rapidly increasing use of printed circuits, copper-clad laminate has become a standard engineering material in the electronics industry.

More recent composite laminates are usually manufactured to customer specifications, Taylor Fibre states. Among those which it has produced are:

- Vulcanized fibre-clad laminates. These combine the high strength of laminated plastics with the superior hot arc resistance of vulcanized fibre. They have been used in switch gear for both low and high voltage applications. Other applications are suggested where the high impact strength of vulcanized fibre may prove advantageous.
- Rubber-clad laminates. Almost any type of natural or synthetic rubber, including Buna N and Buna S, may be used as the cladding material. The composite laminates are widely used for condensor tops in wet condensors to protect the laminate against highly alkaline electrolytes. They have application in any part where sealing or chemical resistance is needed (as in battery tops) and for isolating vibration (as in shock absorbers).
- Asbestos-clad laminates. Laminated plastic clad with untreated asbestos paper has high heat resistance and arc resistance.
- Laminate-clad lead. Lead sheets bonded between Grade XX paper-base laminates have been used for X-ray shields. The laminate provides strength and also contributes to the high shielding properties of the lead.
- Aluminum-clad laminate. Laminated plastic with aluminum cladding have been used extensively for engraving stock. The laminate base is black in color, providing a good contrast with the aluminum when the design is etched away. Aluminum-clad laminates also offer possibilities as a printed circuit material, but soldering problems remain to be solved. Another application

for plate holders for X-ray machines where the aluminum not only acts as a shield but also resists abrasion.

- Beryllium copper-clad laminates. Beryllium copper is non-magnetic and a good conductor. The composite material has possibilities for printed circuit applications.
- Stainless steel-clad laminates. This material also has application where non-magnetic properties are required. Other applications are in certain corrosive environments where stainless steel's resistance to attack is an asset.
- Magnesium-clad laminates. Taylor Fibre has supplied 108-inch long sheets of this material for use as a screen for X-ray operators. The lightness of the magnesium greatly reduces the weight of this large-size piece.
- Silver- and gold-faced laminates. The extremely high electrical conductivity of silver and gold indicates possible use of the composite materials for electrical contacts. The laminate provides strength and insulation properties.

Taylor Fibre Co., Dept. ED, Morristown, Pa.

CIRCLE 557 ON READER-SERVICE CARD

PW Assemblies to Order

A printed circuitry division is announced by the Harris Manufacturing Co., Inc., St. Louis, makers of electro-mechanical components for aircraft. The company now has complete precision printed circuit board production facilities including tool and die fabricating equipment.

Harris is also staffed and equipped to install components on printed circuit boards to provide functioning electronic assemblies. Design and development of electronic components, utilizing printed circuits is performed by Harris' engineering department.

Inquiries should be addressed to Mr. Paul Guth, Manager, Printed Circuit Div., Harris Manufacturing Co., Inc., Dept. ED, 8031 Litzinger, St. Louis 17, Mo.

CIRCLE 558 ON READER-SERVICE CARD

Hermetic Sealing of Components

Expansion of facilities for the sealing of electronic parts has been completed by Electrical Industries. The company handles a wide range of components from simple shapes and sizes to complex multi-head assemblies. Manufacturers can ship their components to Electrical Industries where they are sealed to meet required specifications and returned quickly.

This custom-sealing service supplements the company's standard line of glass-to-metal seals for all applications, commercial and military.

Electrical Industries, Dept. ED, 691 Central Ave., Murray Hill, N.J.

CIRCLE 559 ON READER-SERVICE CARD

SERVICES FOR DESIGNERS

Silicon Single Crystal

Tang Industries, Inc. is now offering a complete service to Silicon diode and transistor manufacturers. Silicon, either "N" or "P" type single crystals, wafers and dices ranging from 0.5 ohm-cm to 500 ohm-cm in resistivity are available. Diameter and length of silicon crystals are up to 1 1/4 in. and 9 1/4 in. respectively. The service combines exacting control and the improved techniques of the Czochralski method of crystal growing. Tang makes available guaranteed uniformity of silicon single crystal quality in production quantity. Minimum dislocation density and low oxygen content are achieved.

Sliced wafers are furnished to tight dimensional tolerances with or without "damaged" surfaces. Dices are supplied in round, square, or rectangular shapes.

Tang Industries, Inc., Dept. ED, 49 Jones Rd., Waltham, Mass.

CIRCLE 562 ON READER-SERVICE CARD

Custom-Made Coils

Expansion of aluminum strip conductor coil winding facilities, to meet the electrical industry's increasing need for prototype and quantity-production coils, was announced by Reynolds Metal Co.

Harold W. Adams, Reynolds director of electrical conductor products, said the company is adding new equipment and consolidating at its Richmond North Plant its coil winding facilities for foil gauge and sheet gauge strip conductor. Previously the two types of facilities were at separate Richmond locations.

Reynolds Metals Co., Dept. ED, Richmond, Va.

CIRCLE 563 ON READER-SERVICE CARD

Structural Testing Facility

Treating the subject of its increased capabilities for the development, design, and evaluation testing of missile and aircraft structures and components, a new booklet has been issued by the Missile and Space Vehicle Dept. of the General Electric Co.

The booklet describes elaborate and often unique laboratory facilities, for test programs in the areas of vibration, shock, acceleration, static, hydraulics, electrical, thermal, and acoustic testing and evaluation; as well as for conducting experimental stress analysis. The booklet is entitled "Advanced Facilities for Structural Testing."

General Electric Co., Missile and Space Vehicle Dept., Dept. ED, Room 4B, 3198 Chestnut St., Philadelphia 4, Pa.

CIRCLE 564 ON READER-SERVICE CARD

Precious Metal Components

New developments, announced by the Wilkinson Company, include the availability of doped gold discs which provide ohmic contact for silicon diodes, gold and platinum ribbon for diode whiskers, high purity aluminum wire, segments and foil, and a wide variety of precious metal, rare metal and metal alloy items.

Available upon request is a twelve page two color Brochure which illustrates and describes processing and high precision fabrication facilities.

Wilkinson Co., Dept. ED, 1660 Ninth St., Santa Monica, Calif.

CIRCLE 567 ON READER-SERVICE CARD

Customer Service Program

A new program to provide users of Elgin-Advance relays with high quality and the best service available in the relay industry has been announced.

To insure high quality, the Electronics Div. of the Elgin National Watch Co. has equipped its Burbank, Calif., plant to keep temperature, humidity, and dust conditions under rigid control. The entire plant is under "white coat" operating conditions, and the most modern equipment is being used in laboratory, production, and quality control operations, and in the complete Reliability Test Center. During the past six months, over $100,000 has been expended for a Radiflo nuclear leak tester, MB and Calidyne vibration machines and other reliable test equipment.

Two field applications engineers have been appointed for the purpose of providing technical assistance to customers, and helping to establish closer customer-factory contacts in solving relay requirement problems. Supplementing the other phases of the program, new staff members have been added to the Burbank facilities.

Elgin National Watch Co., Dept. ED, Burbank, Cal.

CIRCLE 568 ON READER-SERVICE CARD

Antenna Field Service

New 4-page bulletin describing field service facilities for the antenna industry has been released by D. S. Kennedy Co., Cohasset, Mass. Antenna installation and maintenance through specialized field service departments has become an important facet in today's huge, complex electronic equipments. The bulletin delineates the various types of field engineering service available, such as site selection, construction, supervision, antenna erection, maintenance and training.

D. S. Kennedy & Co., Dept. ED, Cohasset, Mass.

CIRCLE 569 ON READER-SERVICE CARD

NEW LITERATURE

Pulse Generators 574

Complete technical data on a broad range of pulse instrumentation, including pulse generators, word generators, time delay generators, and electronic counters, are given in "1959-1960 General Catalog." Electrical, physical, and mechanical specifications and illustrations are also provided in this 48-page catalog. Electro-Pulse, Inc., 11861 Teale St., Culver City, Calif.

Lead Wire Insulation 575

Four-page bulletin CDS-179 illustrates the use of silicone rubber for lead wire insulation. Included is a comparison between silicone rubber, polyvinyl chloride, neoprene and natural rubber as insulating materials. Electrical, physical, and chemical properties are given. General Electric Co., Silicone Products Dept., Waterford, N.Y.

Circuit Breakers 576

Bulletin B-07 describes miniature, hermetically sealed, inverse time delay, magnetic circuit breakers. Illustrations, dimensional diagrams, and electrical specifications are given in this four-page brochure. Airpax Electronics, Cambridge, Md.

Transistor Chopper 577

Two-page bulletin C-98 illustrates and describes a transistor chopper which has a power requirement of less than 20 mw. Electrical, mechanical and environmental characteristics and performance specifications are given. Airpax Electronics Inc., Cambridge, Md.

Flight Controls 578

Eight-page illustrated bulletin GEA-59APJ-67 describes a complete line of flight controls. Application information is

given on self-adaptive flight control, all-transistor control amplifier, inertial guidance platform, gyros, accelerometers and automatic ground support test equipment. General Electric Co., Light Military Electronics Dept., 600 Main St., Johnson City, N.Y.

Input Scanner 583

Data sheet 19-46 illustrates and describes a multiple-point input scanner. Information on operation, application and available accessories for model 453M are given. Kin Tel, Div. of Cohu Electronics, Inc., 5725 Kearny Villa Rd., San Diego 12, Calif.

Molded Sheets, Rods and Tubes 584

Four-page brochure No. 3 describes a line of molded Teflon sheets, rods and tubes. Available sizes, physical properties, and typical uses are given. Chemplast, Inc., 3 Central Ave., E. Newark, N.J.

Switches 585

Catalog 63, "Small Basic Switches," describes miniature and subminiature basic switches. Electrical, mechanical, and dimensional data are given, as well as illustrations of the switches. Typical auxiliary actuators and assemblies are shown. Micro Switch, Freeport, Ill.

Electronic Generator 586

A 250 va electronic generator is described in this data sheet. Electrical, physical, and dimensional data are included. Industrial Test Equipment Co., 55 E. 11 St., New York 3, N.Y.

Optical Data 587

"Basic Optical Data for Electronics Engineers," a three-page reprint, is a summary of useful optical formulae and basic optical systems. Included are illustrations of basic lens arrangements, a table of definitions of symbols and sign convention, and a listing of common design terms. Leo Levi, 80 Bennett Ave., New York 33, N.Y.

NEW LITERATURE

Memory Core Tester 594

A high-speed magnetic memory core analyzer is described in four-page bulletin 59-A. Included are illustrations of the modular test system design approach, basic core test program, pulse programming, and complete system operation. Also given are a block diagram of the tester, complete specifications and illustrations of components. Rose Engineering, Inc., 731 Arch St., Philadelphia 6, Pa.

Contact Modulator 595

This 29-page booklet is the fourth in the Contact Modulator series. Called "Part 4: Application and Performance," it discusses input circuits, phase relationship, and ambient changes in contact modulators. Circuit diagrams, wave traces, tables, and graphs are included. Airpax Electronics, Inc., P.O. Box 8488, Fort Lauderdale, Fla.

Film Capacitors 596

Bulletin 2510A, 11 pages, provides electrical and dimensional data on a series of film capacitors which are hermetically sealed in metal cases. Application notes, electrical vs. temperature characteristic curves, and performance characteristics are given. Sprague Electric Co., N. Adams, Mass.

Microwave Stability Tester 597

Applications, specifications and features of the firm's microwave stability tester appear in this four-page bulletin. Tunable stalos are also illustrated and described. Pitometer Log Corp., 237 Lafayette St., New York 12, N.Y.

Precision Resistors 598

This two-page table provides electrical and physical specifications on a series of precision carbon film resistors. Included are illustrations, weights, dimensions, and MIL designations. Also provided is a table

of standard precision resistance values. Texas Instruments Inc., Semiconductor Components Div., P.O. Box 312, 13500 N. Central Expressway, Dallas, Tex.

Fasteners 604

This 179-page brochure is a combination price handbook and catalog of stainless steel and nylon fasteners. Included are AN and MS designations, technical data on nylon, product descriptions and applications, and a discussion of stainless steel. Anti-Corrosive Metal Products Co., Inc., P.O. Box 1894, Albany, N.Y.

Entertainment Transistors 605

"Entertainment Transistors for Every Design Approach" contains maximum ratings and electrical characteristics for a variety of npn, pnp, and drift transistors. Also included in this 32-page booklet are diagrams illustrating the mechanical specifications and connections of all types in the firm's transistor line. Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N.Y.

Protective Coatings 606

Suggestions for proper use of Humi-Seal insulating and protective coatings in electronic applications are given in 14-page bulletin 79. Also included are examples of coating procedures. Columbia Technical Corp., 61-02 31 Ave., Woodside 77, N.Y.

Complex Film Capacitors 607

Bulletin 2073A, four pages, illustrates and describes a series of complex film capacitors. Electrical and dimensional specifications, as well as electrical vs. temperature characteristic curves, are given. Sprague Electric Co., N. Adams, Mass.

Voltage Monitors 608

Bulletin 146, two pages, describes and illustrates solid state voltage monitors which have a range of 5 to 40 v dc. Specifications and application data are given for three models: single trip, dual trip, and double dual trip. Alto Scientific Co., 855 Commercial St., Palo Alto, Calif.

NEW LITERATURE

Frequency Detector 615

Schematics, graphs and waveforms describe typical operations of the firm's frequency detector in bulletin F-25, four pages. Circuit diagrams indicate use with tube or transistor drive for low-level input signals. Electrical and mechanical characteristics are also discussed. Airpax Electronics, Inc., Fort Lauderdale, Florida.

Rectifiers 616

Bulletin 100, 16, pages, describes various types of selenium, germanium and silicon rectifiers for electroplating and other applications. Specifications and illustrations of laboratory type dc power supplies are included. Djordjevic Engineering & Consulting Co., 1933 N. Damen, Chicago 47, Ill.

Capacitors, Switches 617

Variable capacitors, rotary switches, and tuners are listed and illustrated in this two-page bulletin. These components are made by the Kataoka Electric Co. Ltd., Japan. Kanematsu New York, Inc., 150 Broadway, New York 38, N.Y.

Hermetic Connectors 618

Technical Notes P & PM 60-2 gives instructions on the installation of hermetic connectors. Included is a step-by-step procedure for fusing hermetic connectors to plates, boxes or cans. Details are given on the protection of the connector during the fusing process. Deutsch Co., Electronic Components Div., Municipal Airport, Banning, Calif.

Servomotors 619

Size 15 servomotors are described in this 16-page catalog. Electrical and mechanical specifications, dimensional drawings, schematics, and torque-speed curves are presented for servomotors, servomotor-rate generators, inertia-damp and adjustable velocity-damp servomotors. Beckman Instruments, Helipot Div., Technical Information Service, Fullerton, Calif.

Analog Computer 624

A universal linear operator is described in four-page bulletin K5-U. General specifications and application notes on this building-block of analog computing systems are given. George A. Philbrick Researches, Inc., 285 Columbus Ave., Boston 16, Mass.

Magnetic Amplifiers 625

Magnetic Amplifiers for servo applications are described in this four-page brochure. Electrical, environmental, and performance characteristics are given for two models. Typical performance curves are provided for low-level, switching, and integrating servo amplifiers. Milwaukee Transformer Co., 5231 N. Hopkins St., Milwaukee 9, Wis.

Wattmeters 626

Four two-page data sheets illustrate and describe directional wattmeters and water- and air-cooled rf load wattmeters. Electrical, physical and dimensional specifications are given in bulletins TW 676, TW 606, No. 406, and W-436. Bird Electronics Corp., 1800 E. 38 St., Cleveland 14, Ohio.

Capacitors 627

Capacitors for TV and radio, and general purpose ac capacitors made by Kansainii Works Co. Ltd., Japan are described in these two brochures, six and seven pages. Illustrations and electrical and physical specifications are provided. Itoh and Co., 425 Park Ave., New York 22, N.Y.

Electrolytic Capacitors 628

Electrolytic and oil tubular capacitors manufactured by Nippon Chemical Condenser Co. Ltd. are described in this two-page bulletin. Electrical and dimensional specifications are given on tubular, lug terminal, prong base, and block types. Kanematsu New York, Inc., 150 Broadway, New York 38, N.Y.

NEW LITERATURE

Electrolytic Capacitors 635

This two-page bulletin describes a series of electrolytic capacitors manufactured by the Toky Denki Co. Ltd., of Japan. Electrical and physical specifications are given for tubular, prong base, lug terminal, and miniature types. Kinsho Trading Co., 10 E. 40 St., New York 16, N.Y.

Semiconductor Directory 636

This "Semiconductor Directory" is a comprehensive listing of the latest in germanium transistors, silicon transistors, diodes, and rectifiers. All major manufacturers and types are numerically listed complete with descriptions and applications. Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N.Y.

Parts Catalog

"1960 Guide to Electronic Buying" lists 40,000 items of electronic merchandise with illustrations. It includes 200 pages of industrial and service items and over 100 pages of hi-fi products. *Write on company letterhead to Radio Shack Corp., Dept. ED, 730 Commonwealth Ave., Boston, Mass.*

Transformers 637

The firm's complete industrial transformer line is listed in 31-page catalog TR-60. It contains over 1000 items, including several new lines, such as microminiature transformers and transformers for transistor applications. Also given are electrical, physical, and dimensional specifications and illustrations. Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.

Potentiometer Field Tapping 638

This four-page illustrated brochure describes the use of a potentiometer field tapping kit. Installation of adjustable shorted areas are also described. DeJur-Amsco Corp., Electronic Sales Div., 45-01 Northern Boulevard, Long Island City 1, N.Y.

Instrument Enclosure Systems 644

This six-page bulletin illustrates and describes a line of semi-custom modular instrument enclosure systems. Included are 16 pages of dimensional drawings of the various models. Amco Engineering Co., 7333 W. Ainslie St., Chicago 31, Ill.

RF Filters 645

This four-page bulletin illustrates and describes multiplexers, harmonic filters, and bandpass filters for communications and space systems. These rf filters use resonator techniques in the frequency range of 25 to 1000 mc to meet unusually low loss or difficult discrimination requirements. The brochure gives electrical and physical specifications as well as graphs and schematics. C. A. Rypinski Co., 2005 N. Fair Oaks Ave., Pasadena, Calif.

Data Control Chassis 646

Bulletin 111, two pages, describes the model K-111 control chassis. Included is a summary of the operational principles, a description of the chassis circuitry and the storage circuit. Also given are electrical and physical specifications, dimensional drawings and a block diagram. Datex Corp., 307 S. Myrtle Ave., Monrovia, Calif.

Trouble Spotter 647

Two-page bulletin illustrates and describes an electronic trouble spotter for production testing. The unit locates vibration sources and diagnoses air-borne sounds. Electrical and physical data is provided. Erwood, Inc., 1770 Berteau St., Chicago 13, Ill.

Reflector Antennas 648

Reflector antennas especially designed for celestial study, missile and satellite tracking, and radar control, are described in 12-page booklet No. 2556. It illustrates equatorially-mounted, azimuth elevation, and stationary type antennas, and outlines specifications for some of these units. Blaw-Knox Co., Blaw-Knox Equipment Div., P.O. Box 1198, Pittsburgh 30, Pa.

NEW LITERATURE

Lamps 655

Electrical and physical characteristics for 284 miniature and sealed beam lamps together with technical information on the relationship of applied voltage to life, current and light-output, appear in catalog A-21. A set of line drawings provides external dimensions and appearance, basing information and filament designs. Tung-Sol Electric Inc., 95 Eighth Ave., Newark 4, N.J.

Digital Voltmeter 656

Four-page illustrated bulletin 309 describes a series of digital voltmeters and multimeters for use in automatic data systems and for precision laboratory use. Electrical and mechanical specifications are given, as well as a comparison of obtainable precision vs. input resistance. Conversion time and overall speed are also defined. Franklin Electronics Inc., Bridgeport, Pa.

Gyros 656

Two four-page illustrated brochures describe floated free gyros and rate gyros. Major design features and applications are given. Specifications are provided for two series of free gyros, FC35 and FC45, and one for series of rate gyros, R151. Daystrom Pacific, 9320 Lincoln Blvd., Los Angeles 45, Calif.

Micro-Miniature Connector 667

Four-page bulletin 114 describes the 8100 series of microminiature varicon connectors. Complete electrical, physical, and dimensional specifications are given, as well as photographs. These connectors are used where high contact density is a necessity. Elco Corp., M St. below Erie Ave., Philadelphia 24, Pa.

Semiconductors 657

Catalog TE-1340A lists and describes all of the firm's basic silicon and germanium products. Included are illustrations and data charts giving the range of performance of each device. Transitron Electronic Corp., 168-182 Albion St., Wakefield, Mass.

Indicator Lights 658

Miniature indicator lights for use in data processing equipment, computers, and automation applications are described in eight-page brochure L-160A. Complete lamp data, illustrations, electrical specifications, and schematics are included. Dialight Corp., 60 Stewart Ave., Brooklyn 37, N.Y.

Battery Index 659

This index is a cross reference and interchangeable numbers compilation of all of the batteries available to industry. Included are A, B, industrial, transistor, and special purpose batteries. National Electronic Distributors Association, Inc., 343 S. Dearborn St., Chicago 4, Ill.

Magnetic Tape Transport 664

Bulletin 3215, four pages, describes model 546 magnetic tape transport. This unit is used with digital computer and control systems. Electrical and physical specifications, as well as typical performance characteristics, are included in this illustrated bulletin. Burroughs Corp., ElectroData Div., 460 Sierra Madre Villa, Pasadena, Calif.

Time Indicator 665

The physical and electrical characteristics of model WT-1 subminiature elapsed time indicator are given in bulletin 5001, two pages. Dimension drawings and an actual size template for panel layout also appear. Waltham Precision Instrument Co., 221 Crescent St., Waltham 54, Mass.

Inside-Out Twin-T Varies Rejection Frequency

THE RC TWIN-T network is a three terminal device commonly used to reject a certain spot frequency in the lower frequency regions up to, say, 100 kc. By varying the components in the filter, it can be used as a passive modulator, oscillator, or frequency acceptance circuit when in an amplifier feedback circuit.

These uses have been well treated in the literature. But, what apparently has not been covered is a means to vary the rejection frequency over a wide range by means of a single potentiometer, independent of the output impedance.

Essentially the scheme consists of unraveling the twin-T and putting the input voltage E on one end and a variable resistive fraction xE on the other. The output is then taken from the center as the sequence of figures shows.

Fig. 2 consists of two T sections and these reduce to impedances of the form shown in Fig. 3. From Fig. 3 it is evident that if the voltage drop across E and Z_1 equals the drop across xE and Z_2, there will be no output e. This condition amounts to

$$XZ_1 + Z_2 = 0$$

Fig. 1. Normal twin-T rejection filter with resistor and capacitor ratios shown and a voltage source E.

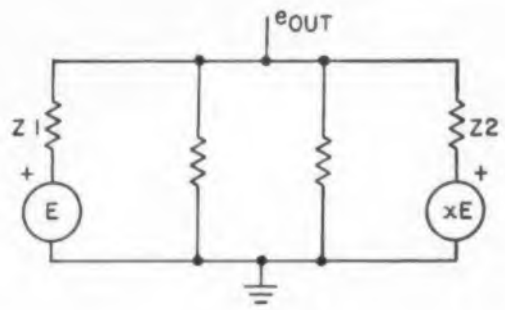


Fig. 3. Transformed version of unravelled twin-T.

Fig. 2. Splitting the twin-T and applying original signal E to one end, and a fraction xE to the other.

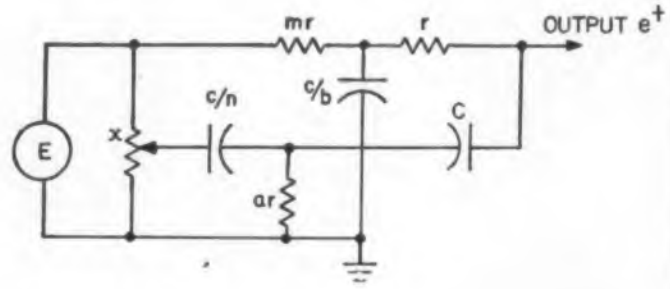


Fig. 4. Complete twin-T variable frequency extinction filter showing how the fraction is derived from a potentiometer setting.

However, Z_1 and Z_2 are complex, and when evaluated and substituted in the above relation, yield two necessary and sufficient conditions for frequency cutoff, namely:

$$(r\omega_c)^2 = \frac{n}{ax\,(m+1)}$$

$$(r\omega_c)^2 = \frac{b\,(n+1)}{xm}$$

Consequently, the frequency at extinction is proportional to the inverse root of x.

However, to show that x does not affect the network components relationship, it is only necessary to eliminate $r\omega_c$ from the above equations to obtain a necessary ratio condition:

$$mn = ab\,(m+1)\,(n+1)$$

This is the condition that the filter have zero output at some frequency ω. It is possible also to show that the circuit Q is the same as in the straight twin-T case, namely:

$$Q = \frac{b}{b\,(m+1) + m\left(1+\frac{r}{R}\right)} \cdot \left[\frac{a\left[1+(m+1)\,\frac{r}{R}\right]}{n}\right]$$

where R is the resistive output load. Q, for RC components never exceeds more than about 1/3 in this case, but is independent of x.

The final circuit showing the potentiometer frequency cutoff control reduces to that shown in Fig. 4.

In practice, this circuit, when turned to 10 cps, gave a 100:1 frequency range to 1 kc.

Patrick F. Howden, Consolidated Systems Corp., Monrovia, Calif.

for reliability in heavy-duty power control...specify new

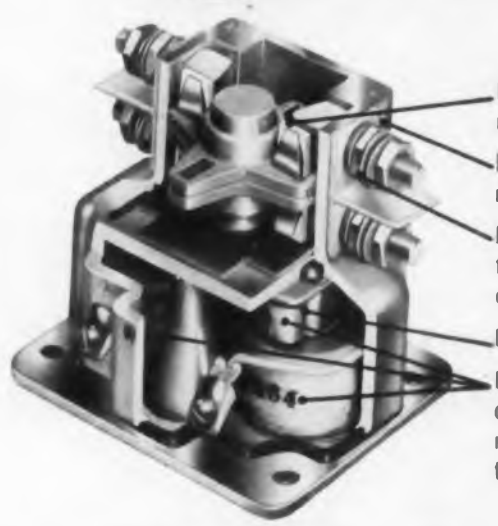
LEACH POWER CONTACTORS

Your airborne and electronic high performance requirements dictated the design and construction of Leach Rotary Contactors—the new power control devices that operate with unequaled reliability under extremes of high temperature, altitude, shock and vibration.

These bi-polar, rotary mechanisms incorporate the balanced armature principle to help solve application problems of inverter control, motor control, motor reversal, and power transfer. Compact design achieves the advantages of small size and light weight to meet the needs of the aircraft, missile and electronic industries.

Leach Rotary Contactors meet and, in many cases, surpass the stringent requirements of MIL-R-6106.

Write today for specifications and a complete description of operating characteristics. Ask for the new Leach Power Contactors Brochure.



- Double-break contacts guarantee maximum circuit-breaking capacity.
- Lightweight, high dielectric strength materials are used throughout.
- Positive lock terminals guard against faulty operation caused by movement of terminals.
- Bi-polar rotary design.
- Balanced armature construction and dual coil design provide the most efficient magnetic circuit for maximum resistance to shock and vibration.

RELIABILITY

LOOK TO LEACH

RELAY DIVISION...LEACH CORPORATION

5915 AVALON BOULEVARD, LOS ANGELES 3

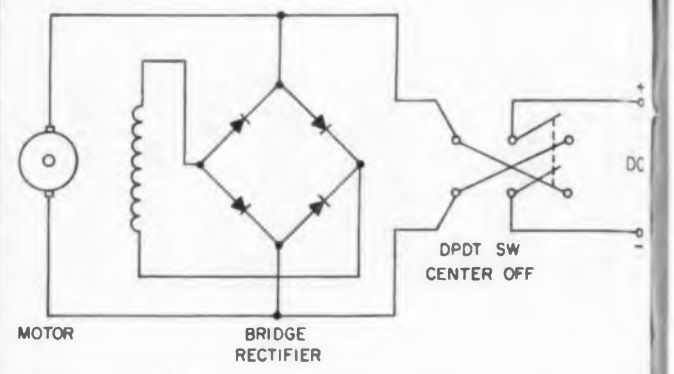
DISTRICT OFFICES AND FIELD REPRESENTATIVES IN PRINCIPAL CITIES OF U.S. AND CANADA • EXPORT: LEACH CORP., INTERNATIONAL DIVISION

CIRCLE 674 ON READER-SERVICE CARD

IDEAS FOR DESIGN

Motor Rotation Determined Via Two Wires

It is often necessary to control the direction of rotation of a dc motor via a two wire line without the use of relays.



Bridge rectifier allows polarity change across armature, not across field, so motor rotation can be controlled via two wires.

The circuit shown solves the problem neatly. Reversal of the line polarity reverses the armature voltage but not the field voltage.

K. C. Herrick, Staff Engineer, The Reflectone Corp., Stamford, Conn.

Simpler, Better Brake for Capacitor Motors

The circuit of Richard Ceier, which appeared in the Ideas for Design section of July 22, can be improved and simplified. The arrangement he gives results in considerable "jitter" of the motor rotor as is evidenced in low ratio reduction motors or in ungeared motors.

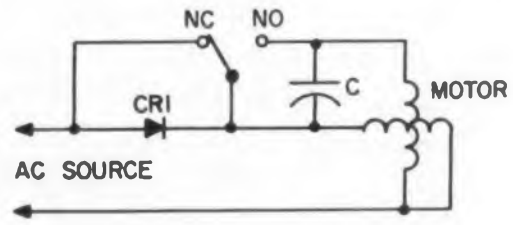


Fig. 1. Simple one-way brake.

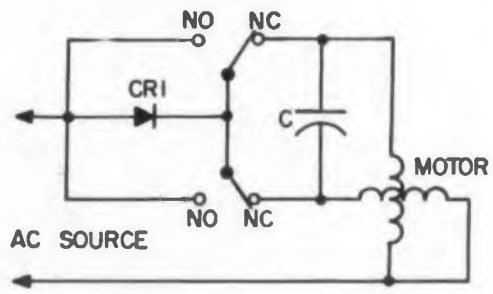


Fig. 2. Simple reversible brake.

We have built many laboratory devices using the circuit shown in Fig. 1 to obtain a fast brake. The circuit shown in Fig. 2 is our arrangement for push-button reversing of capacitor motors with electrical braking.

For reduction motors with high-gear ratios, effective braking can sometimes be accomplished by simply shorting the capacitor so that both windings have the same voltage applied to them without phase displacement.

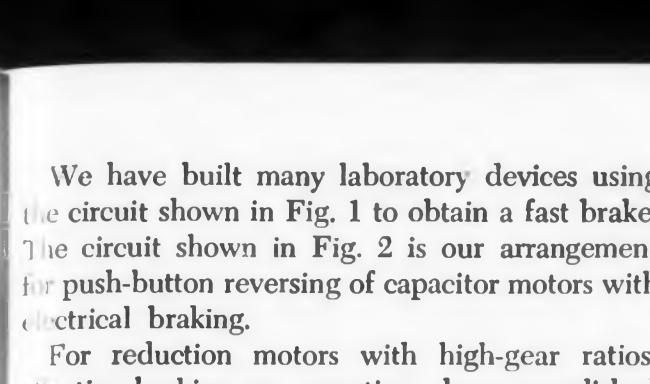
Louis E. Owen, Supervisor, Spectrochemistry Dept., Goodyear Atomic Corp., Portsmouth, Ohio.

Switching Circuit Works, But How?

While designing a switching unit using neon glow lamps and "standard" charging circuits, I tried the accompanying circuit. To my amazement, one glow lamp fired for a definite period, extinguished itself, and then the other glow lamp fired.

The cycle repeated itself, the respective periods depending on the values of the resistors, the capacitor, and the applied voltage. Periods less than a second and up to about five seconds were achieved.

A pot may be substituted for fixed resistors for



Switching circuit should not work—but it does. There is certainly no clearly defined charge and discharge path for the capacitor.

continuous control. In that event current limiting resistors are necessary, as shown in the schematic.

The circuit was tested by connecting the coil of a Weston Model 534 current relay, as shown. Other sensitive relays work equally well. Latching, polarized relays, such as Sigma 72 series (two amperes contact rating) may prove to be more useful.

Glow lamps used were 1/4-w NE-2's or 1/25-w NE-51's.

To my knowledge, this circuit is the simplest. However, I am unable to explain why it functions as it does. Can readers of ELECTRONIC DESIGN shed some light on this?

Mark D. Bedrossyan, Atlantic Electronics Labs., Asbury Park, N.J.

IDEAS FOR DESIGN

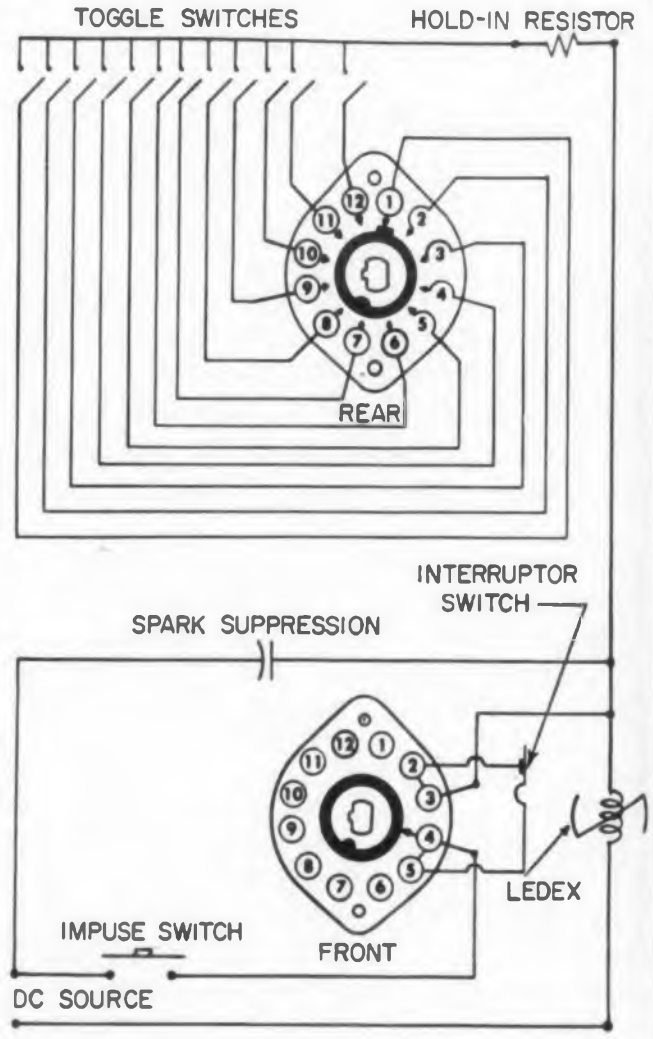
Rotary Selector Controls Function Sequence

An extremely simple and versatile programming circuit uses a Ledex Rotary Selector to control a sequence of functions in automatic equipment. With this circuit, a specific sequence of operations can be set up to perform one job; then the sequence can be altered to perform another job.

The selector, which is normally impulsed from one position to the next position on a control wafer, can be made to skip unwanted positions by the flick of a switch.

The stepping sequence of the selector is varied by a toggle switch between each homing contact and a hold-in resistor. The solenoid drives the programming selector through a ratchet.

Five degrees before the end of each stroke a Bakelite cam opens the interrupter switch. With a toggle switch closed, the resistor is placed in parallel with the interrupter. When the interrupter is opened, the solenoid is still energized through this resistor. The selector will remain at this position until the impulse switch is released and another impulse is received.



A flick of a switch can change the sequence of functions in automatic equipment.

An open toggle switch allows the selector to step past that position automatically when the impulse switch is closed. This takes place because the rotary solenoid is now energized only through the interrupter switch. When the interrupter switch is opened, the solenoid drops back. It is re-energized as the interrupter switch closes, picks up the ratchet, and advances the selector. This automatic advance continues until the selector reaches a position where the toggle switch is closed.

The Ledex selector, manufactured by G. H. Leland, Inc., Dayton, Ohio, can be wired for any voltage from six to 350 vdc. As many as ten additional decks can be stacked on the shaft with the control wafer.

Block Diagram Travels With Portable Equipment

Instruction pamphlets for portable test equipment have two big failings—they are often too wordy, and they are much too easily mislaid. Here is one sure cure for both ills.

Block diagram and simple operating instructions for all new Southwestern Industrial Electronics Co., Houston, Tex., "Advanced Design Instruments" are mounted under a plastic sheet retained by the legs of the instrument as shown. In battery powered models, battery connections are also indicated. All needed information has been distilled onto this one card.

Operating data travels along with this portable test instrument—can't possibly be mislaid.

IDEAS FOR DESIGN

Back-to-Back VR's Calibrate Scope

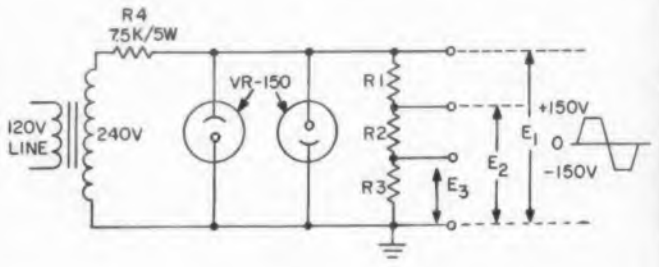
The circuit shown delivers a reasonably accurate, stable, temperature-insensitive calibrating signal for a scope.

Two VR tubes are connected back-to-back so as to fire on alternate half cycles. Resistor *R4* limits the tube current to a nominal value at which satisfactory regulation results.

The VR tubes clip the transformer secondary voltage at plus and minus 150 v, yielding a 300 v peak to peak trapezoid. The output voltage varies less than 1.5 per cent for line variations from 108 to 130 v.

Resistors *R1*, *R2*, and *R3* are chosen to provide required calibrating levels.

P. Cutler, Project Engineer, Universal Electronic Controls, Garden Grove, Calif.



Inexpensive scope calibrator uses back-to-back VR's.

Socketless Tubes Make Compact Circuits

The virtues of stacked-ceramic tubes are by now, pretty well known, particularly with regard to their ruggedness and high temperature performance. Less well known are their advantages in compact, high frequency circuitry.

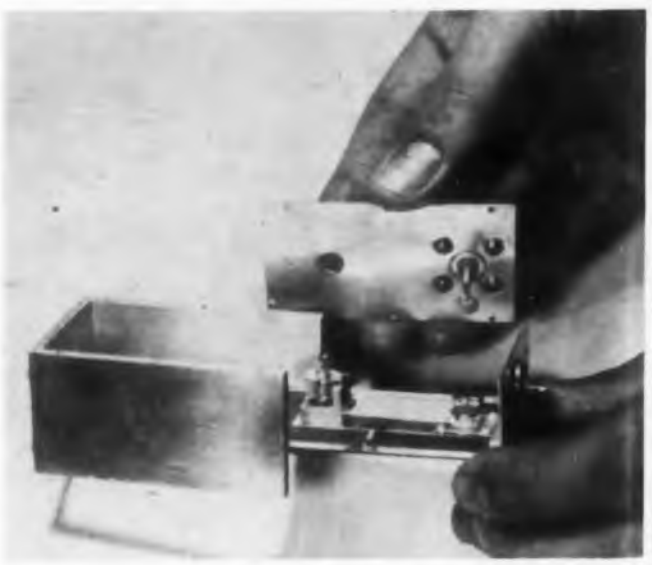


Fig. 1. Strip-line circuit and printed board connect directly to the ceramic tube in this 1200 mc oscillator.

Fig. 2. Six-stage if amplifier using ceramic tubes squeezes neatly into $2^1/_2$ cu in.

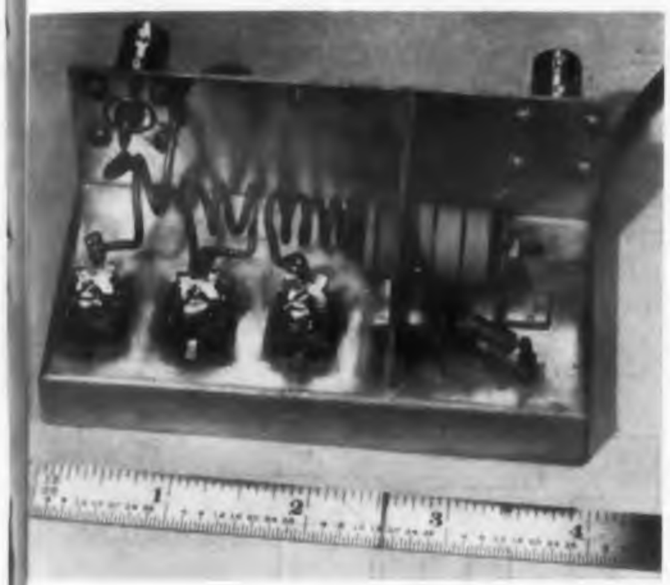


Fig. 3. No sockets in this broadband amplifier. Components are soldered directly to the gold-plated ceramic tube.

As an example, in Fig. 1, a General Electric type 7486 is combined with a strip-line circuit and a printed board in a 1200 mc oscillator. Both the strip-line and the printed board are secured directly to the ceramic tube. A high impedance probe (shown in the man's right hand) takes the output directly from the tube.

Fig. 2 shows how simple and compact a 60 mc, six-stage, if amplifier can be. Using GE type 7462 tubes, this amplifier provides a 90 db gain with a noise figure of only 1.2 db.

No socket is used in the 400 to 450 mc broadband amplifier of Fig. 3. The gold-plated GE 7296 mounts on a bracket, the plate tank coil is soldered directly to the anode, the grid is grounded, and filament and cathode chokes are attached directly to soldering lugs on the tube.

These tubes are manufactured by General Electric's Receiving Tube Department at Owensboro, Kentucky.

IDEAS FOR DESIGN

Optical Superposition Makes Versatile Dual-Beam Scope

A two-gun, dual-beam scope is quite expensive. A very satisfactory substitute can be made using two crt's and optical superposition.

The crt's used in one such instrument are type 902 P1's. One tube is viewed directly through a sheet of plexiglass while the other is viewed by its reflection in the plexiglass. The plexiglass is at an angle of 45 degrees to the planes of the screens of both tubes as shown in Fig. 1. One sweep circuit serves both crt's.

An interior view of the instrument is shown in Fig. 2. The crt's cannot be seen in the photograph because the "A" tube is behind the sweeping switch and the "B" take is behind a filter capacitor.

Each vertical amplifier is normally connected to its own tube but an arrangement of switches, jacks, and plugs makes it possible to cascade both amplifiers on one tube or to use them as vertical and horizontal amplifiers on one tube.

The sweeping capacitors are connected with a row of separate switches so they can be paralleled for slow sweeps.

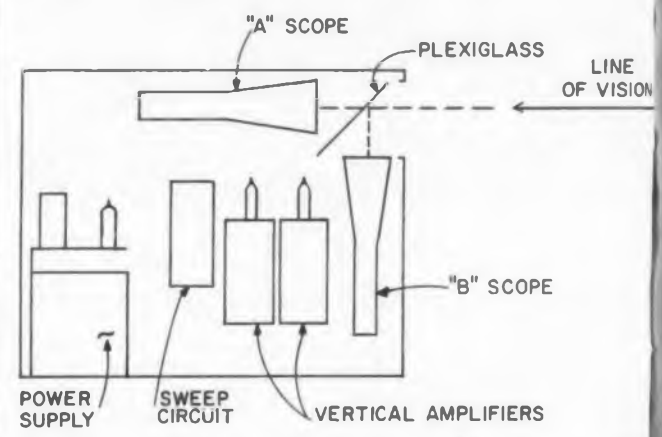


Fig. 1. Layout of optical superposition, dual-beam scope.

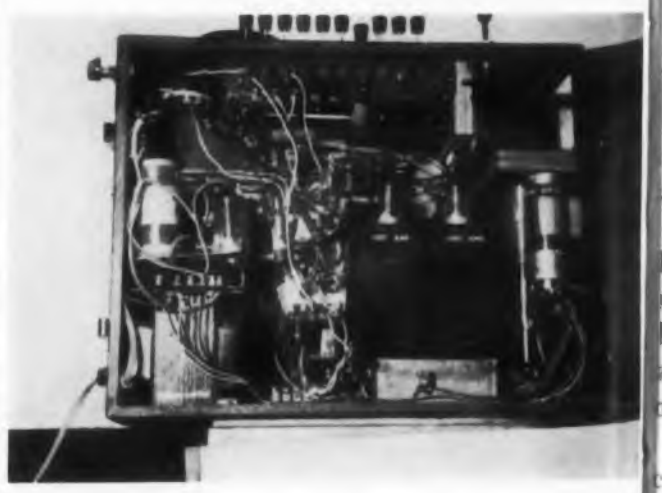


Fig. 2. Inside view of the dual-beam scope. The entire instrument is in a case 5 x 13 x 16 in.

The vertical attenuators are step-type and are identical so quick comparison of peak voltages can be made.

The usability of optical superposition has been proved in the military scope, TS-239/U where the coordinate lines are obtained by this method.

A more modern redesign of this scope might use the 3YP tube which was described in ELECTRONIC DESIGN, Feb. 18, 1959, p 88.

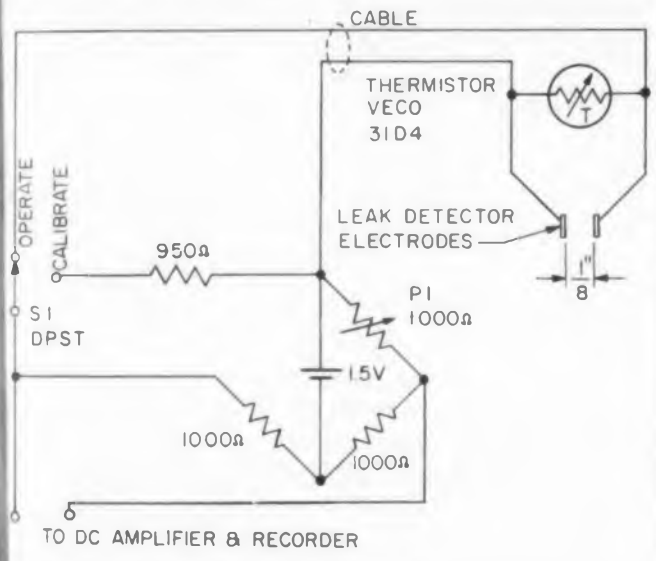
Marriett Dickey, Electronics Engineer, Richmond, Calif.

Monitor Heat or Leaks Via Only Two Wires

We had to monitor temperature and water leakage in an underwater, towed vehicle with only two available signal leads.

Both temperature and leakage were to be recorded continuously. The temperature measurement was not required when leakage was indicated.

The circuit shown solves both the problems of temperature measurement and leak detection. It's



Thermistor with leads extended as electrodes, measures temperature or indicates water leaks.

a bridge circuit using a thermistor as the fourth arm.

The thermistor is calibrated at 25 C by replacing it with a 950 ohm resistance. Potentiometer *P1* adjusts the bridge to a reference point.

Leaks are detected by extending the thermistor leads, as electrodes, to the lowest point in the vehicle where water is most likely to collect. A leak shorts out the thermistor and greatly unbalances the bridge. This yields an immediate and obvious full scale indication on the recording.

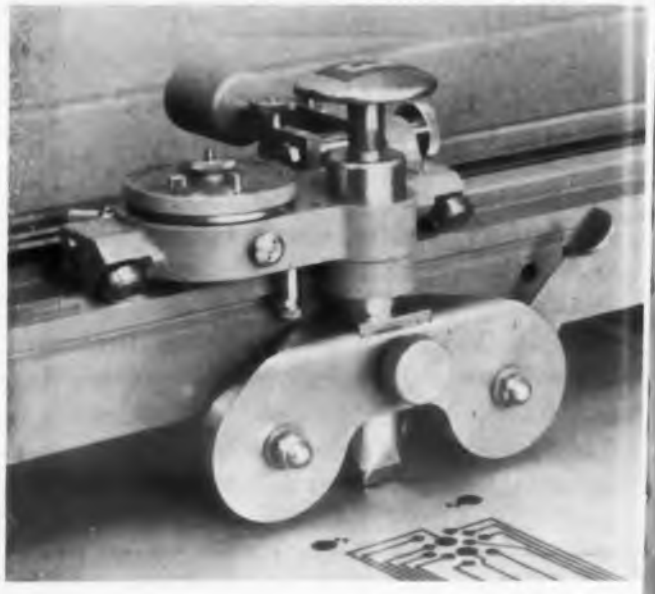
The entire sensor occupies less than one half cubic inch.

George E. Chambers, Electronics Scientist, U.S. Navy Mine Defense Labs, Panama City, Fla.

IDEAS FOR DESIGN

Tape-Puncher and Roll-Feeder Speeds P-C Paste-Up

Printed circuit masters sometimes require hundreds of lines and lands. (A land is the opaque circle corresponding to the electrical contact at the end of each line.) Masters are prepared faster and more accurately, and corrected more easily by means of precut, adhesive backed, opaque plastic lines and lands. These are usually placed by hand on dimensionally stable polyester film.



Printed Circuit lands are punched, positioned and pasted in P-C master with this precision device.

Some applications of printed circuits, however, require that the land be located to extreme accuracy. Since hand placement of lands to any degree of accuracy is tedious and time consuming, a commercially available coordinate layout machine having an accuracy of 0.0015 inch can be used. A mechanical device for placing lands has been designed at Sandia Corporation for use with this machine, as shown in the photo.

When the machine is positioned in accordance with the P-C engineering drawing, a punch is struck and the land is cut from a roll of opaque tape and impressed on the film at precisely the required location. On masters with hundreds of lands, important savings in time, money, and manpower are achieved—and without sacrificing the required high degree of accuracy.

The device consists of a compound punch, and a tape feed mechanism. The punch is a 3-inch long barrel containing an outer punch, an inner punch, springs, and at the lower end, a die. A series of dies may be made for various land sizes and shapes. The tape feed mechanism consists of a supply and a take-up reel, the tape running across the bottom of the punch in a slot between the punches and the die. Striking the handle

the punch drives the outer punch through the die, cutting the land, and impressing it on the master. When travel of the outer punch is stopped by the table on which the work is supported, the handle picks up the spring-loaded hollow inner punch. This inner punch strikes the land and cuts the small center hole in the land.

The engineering drawings for this device are contained in AEC bulletin Sand-3 Tape Punching and Roll-Feeding Device. *Copies are available from the AEC Technical Information Service Extension, PO Box 62, Oak Ridge, Tenn., Attn: Engineering Materials Section.*

Calculate Iron Core N and L Quickly

Whenever an iron-cored coil has an air gap exceeding 3 per cent of the core length, the inductance is primarily determined by the area and length of the air gap. It is essentially independent of the incremental permeability (assumed greater than 100). The inductance in henries is given by the simple relation

$$L = \frac{3.2\ N^2 A}{10^8\ l}$$

where N is the number of turns, A is the gap area, l is the gap length (inch units). This formula is useul in the design of relays, chokes, solenoids and similar devices.

Lawrence E. Cowles, Electronic Design Engineer, Superior Oil Co., Bellaire, Tex.

Quick and Clean Pilot Light Jewels

A method for making quick and inexpensive pilot-light "jewels" is often needed on experimental test panels. A simple solution is provided by colored cellophane or plastic tape.

After drilling the desired-size hole for the "window," a strip of colored tape is pasted over the hole on the inside surface of the panel. Any size hole may be employed, and covered with tape of the desired color. Light shining through the various tape colors gives a soft, pleasing display—functional as well as decorative.

Joseph Leeb, Electrical Engineer, Bulova Watch Co., 549 Green Valley Road, Paramus, N.J.

Oops!

A misprint crept into the caption for Fig. 3 in the Idea for Design on firing series VR tubes (*ED*, Sept. 2, 1959, p. 33). The caption should read "for firing three VR's in series, supply voltage must equal the sum of the operating voltages of VR1 and VR2 and the ignition voltage of VR3."

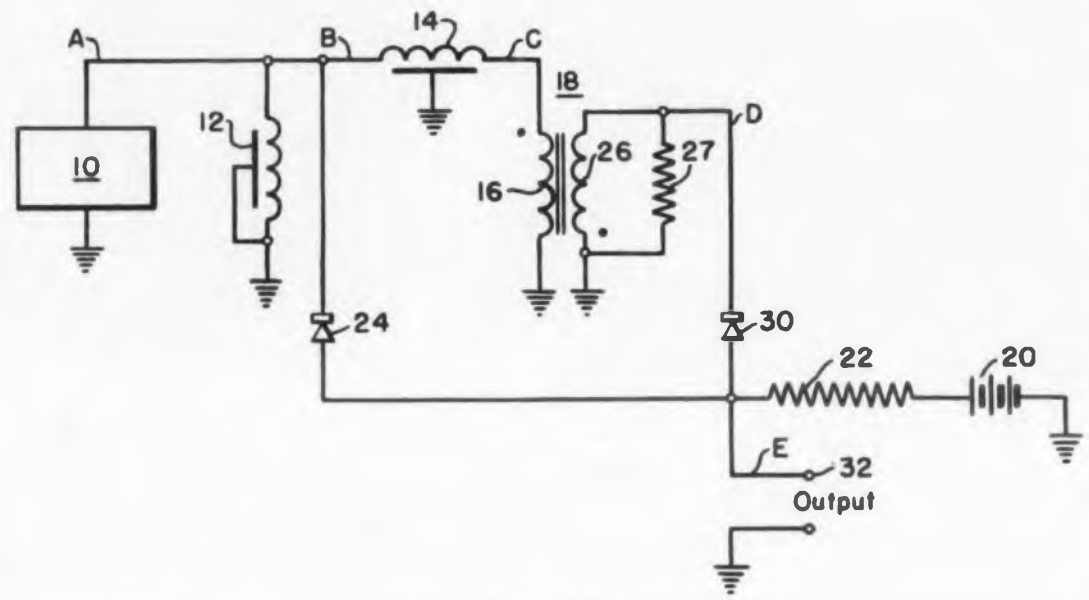
PATENTS

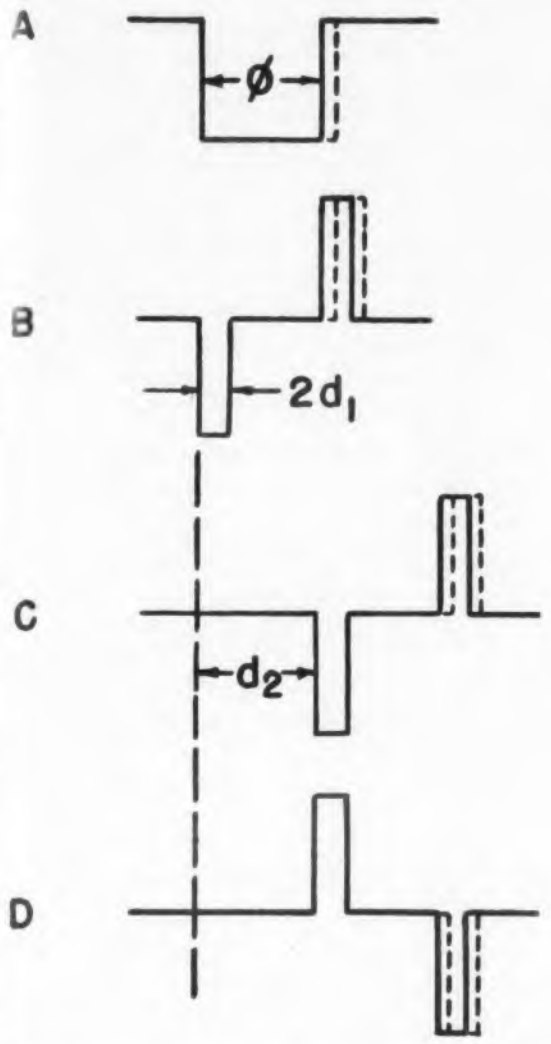
Pulse Length Discriminator

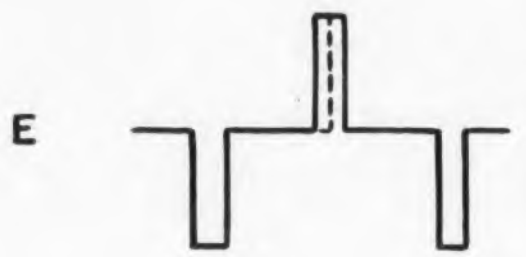
Patent No. 2,896,093. Peter A. Castruccio and Martin G. Woolfson. (Assigned to Westinghouse Electric Corp.)

An output pulse is available across terminal 32 when the pulse width of generator *10* equals the time delay of line *14*. The duration of the output pulse is twice the delay time in line *12*.

When a negative pulse is applied by generator *10*, the pulse travels down shorted line *12* and, after reflection, the pulses cancel to produce a resultant pulse delayed in time equal to the duration of the applied pulse and having a pulse







width twice the delay of the line. This pulse passes through line *14* after an interval d_2 equal to the length of the applied pulse. The two pulses simultaneously cut off diodes *24* and *30* such that a pulse appears in the output as long as both pulses are "on." The diodes are biased by battery *20* to produce negligible output if either diode is independently cut off.

Correction

Patent No. 2,855,524 on semiconductive switching by W. Shockley was listed incorrectly as 2,885,524 in the Sept. 16 issue.

IMPULSE

A DIGEST OF NEW DEVELOPMENTS IN ELECTRONICS AND AUTOMATION

PUBLISHED BY ROME CABLE CORPORATION, ROME, N. Y.
PIONEERS IN INSTRUMENTATION CABLE ENGINEERING

ELECTRONIC "VOICE" FOR MUTES. Persons who have lost their voices through surgical removal (laryngectomy) or paralysis of their vocal cords should be heartened by the news of an artificial "voice," utilizing electronic parts, that is presently being developed. This artificial larynx—cylindrical in shape, 2 inches in diameter and 3 inches long—is held against the throat to produce a slightly mechanical but highly intelligible sound. User can control pitch, thus giving speech a natural conversational sound not previously obtainable. Frequency can be adjusted to correspond with the normal range of pitch of a woman's voice, when desired. Utilizing the principle of a vibrating transducer, the device consists of a modified telephone receiver and a transistorized pulse generator, and is powered by a battery.

TELEMETRY STATIONS-IN-THE-SKY. Aircraft of one Air Force squadron at the Missile Test Center in Florida act as "flying laboratories" in gathering data from missiles and locating nose cones. Nine of the planes are KC-54's—elaborately instrumented aircraft that are complete telemetry stations in themselves. Instrumentation is the latest and best of its type, giving them multiple capability. They obtain missile mid-course and terminal flight telemetry data, measure re-entry radiation and assist in nose cone recoveries. In addition to the nine JC-54's, this squadron has other planes which have various jobs over the missile range, including simulating cruise missile flights and helping to align ground missile-tracking equipment.

THOSE JAPANESE IMPORTS. Japanese electronic products are being imported in increasing numbers. In the first quarter of this year alone, our imports from Japan were almost four times greater than in the first quarter of 1958—an estimated $24-32 million of retail business. An increase of 36% of imported transistor and other wireless communications equipment is anticipated for the fiscal year beginning last April 1.

GOT TROUBLES? If you're troubled by equipment-wiring problems, you should consider the record being established by Rome Synthinol 901, a special 105° PVC compound for wire insulation and jacketing. Developed in Rome Cable's laboratory and first introduced in 1949, Rome Synthinol 901 has proved by test and actual use to be superior to conventional PVC compounds in many ways. A new booklet—so new it hasn't even been delivered by our printer yet—describes the properties and uses of this amazing compound. Be the first on your block to own a copy. We'll put your name on the advance-mailing list and send you a free copy as soon as it's available. Drop a line to IMPULSE, c/o Dept. 11-10, Rome Cable Corp., Rome, N. Y.

STATE OF SOVIET ENGINEERING. What is the state of Russian engineering as witnessed at the Soviet Exposition in New York City last July and part of August? Visitors studying the Russian electronic equipment and components at close range noted that most of it would probably meet all applicable JAN-MIL specifications. Modular design was very evident and transistors were widely used, but less use was made of printed circuits than in this country. As a result, transistorized equipment lacked full miniaturization. New circuit ideas? Not many to be seen. If anything, Russian engineers tend to overdesign—putting four stages where a more sophisticated single stage might do the job. But substantial progress was shown in electron-device work—especially traveling-wave tubes and transistors. There was no evidence of integrated or semiconductor solid circuits.

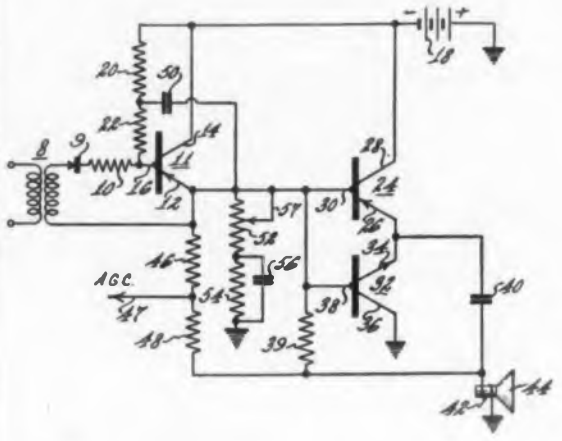
These news items represent a digest of information found in many of the publications and periodicals of the electronics industry or related industries. They appear in brief here for easy and concentrated reading. Further information on each can be found in the original source material. Sources will be forwarded on request. (11)

PATENTS

Push-Pull Signal Amplifier

Patent No. 2,878,380. David D. Holmes. (Assigned to Radio Corporation of America)

A push-pull transistor amplifier is driven at high output power without feedback. At low power the distortion is low due to feedback.



Driver stage 11, a pnp transistor, directly connects to the base electrodes of the complementary-symmetry pair, pnp transistor 24 and npn transistor 32. For high power output, volume control resistor 52 is at maximum resistance so that each output amplifier is driven between base and emitter. The output appears across speaker 44 which is connected between the emitter and collector electrodes. In this instance, the common emitter connection for the selected components produces negligible feedback. However, in the low output condition control resistor 52 is shorted and the output effectively is in series with the input. The output amplifiers are now connected as common-collector stages, i.e. the input is between base and collector, and output is between emitter and collector. To reduce distortion, the speaker voltage is fed back to cancel the input signal.

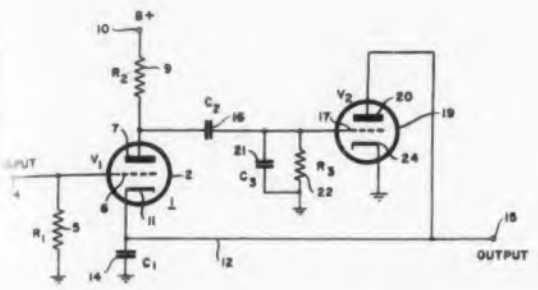
Self Recycling Pulse Stretcher

Patent No. 2,899,554. Samuel A. Rose (Assigned to Hughes Aircraft Co.)

The significant advantages of the dual triode pulse stretcher circuit are:

- The cathode follower permits high charging currents to quickly charge the condenser to peak signal value
- A long time constant set by the value

CIRCLE 689 ON READER-SERVICE CARD



the internal heater-cathode leakage

- Autorecycling abruptly to zero

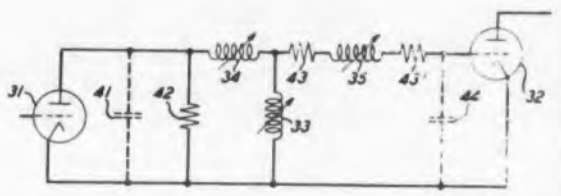
When the input is a positive-going pulse, capacitor C_1 voltage follows to the peak value and the voltage drop across resistor R_2 cuts off triode *19*. Capacitor C_3 discharges through resistor R_3 until triode *19* again conducts to fully discharge capacitor C_1.

Broad-band Amplifier Employing Parallel-Series Coupling Network

Patent No. 2,899,508. W. M. Goodall and Harrison E. Rowe. (Assigned to Bell Telephone Labs., Inc.)

A parallel-series tuned network has been designed as interstage coupling in a wide-band high-gain amplifier. Applied to amplifiers using tubes with high input to output capacitance ratios (3 or more) characterized by gm of 30,000 μmhos, a five stage network produces 27 mc pass-band centered at 70 mc with an overall gain of 64 db.

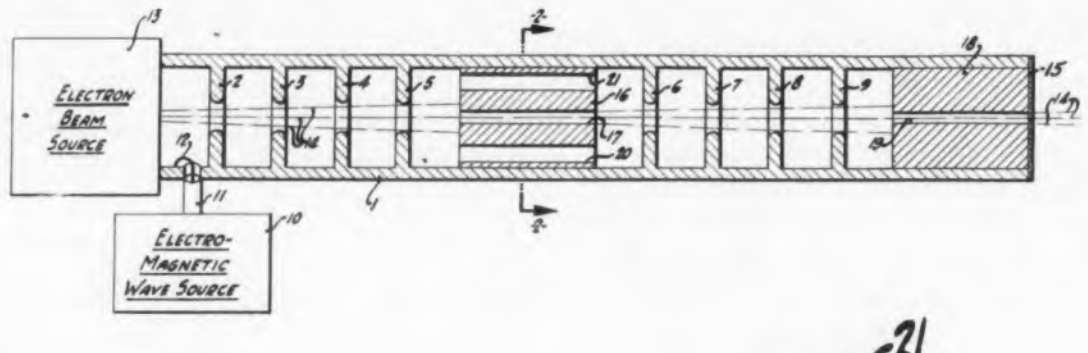
In the schematic is shown a single stage of the amplifier wherein the parallel

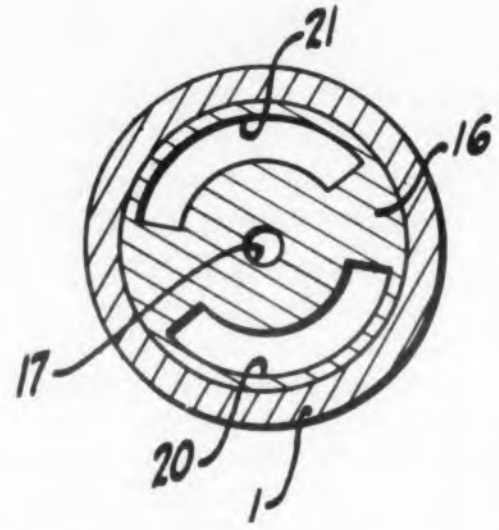


resonant arm essentially comprises coils *33* and *34* and the series resonant arm containing coils *33* and *35* with resistor *43* in the grid of the following tube. Tube 31, for example, has input and output capacitances of 22 μμf and 4 μμf, respectively.

Resistor *43* is placed in series with the grid to maintain constant bandwidth as amplification is changed. Ordinarily, as the transconductance of a tube is changed to vary the gain, a resistance is reflected into the grid. Since the value of resistor *43* is relatively high compared to the reflected resistance, the gain remains constant.

PATENTS





Linear Accelerator

Patent No. 2,899,598. Edward L. Ginzton. (Assigned to Trustees of the Leland Stanford Jr. University)

X-rays and neutrons are generated in a conventional linear accelerator due to stray electrons which bombard the slow-wave structure. Where the structure consists of high-conductance copper or silver, the X-ray emission may last as long as 13

hours after the electron beam is extinguished.

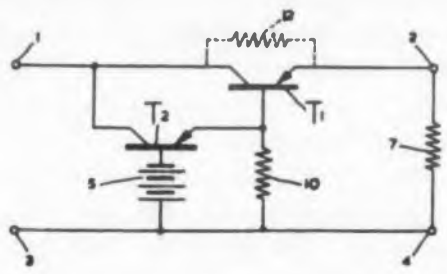
Aluminum is used to form successive apertures along the path of the beam. The aluminum structures *16* and *18* are apertured at *17* and *19* to focus the axial electron beam and are of sufficient length to be impervious to stray electrons. Bombardment of loading discs such as *6*, *7*, *8*, and *9*, etc., is thereby prevented. Slots *20* and *21* (inductive) are required to pass the electromagnetic wave energy since the long lengths of the aluminum structures reduce the otherwise capacitive coupling.

Voltage Stabilizing Circuit

Patent No. 2,897,431. Eric Wolfendale. (Assigned to North American Philips Co., Inc.)

The regulator has two unity emitter-collector current gain transistors connected as grounded collector stages so that the current drawn from the reference battery is reduced. There is provision for regulation even at zero load current.

The emitter voltage or transistor T_1 follows the base voltage; normally the base is connected directly to the battery. However, as shown, the base current is the emitter-collector current of transistor T_2. The battery current is effectively reduced according to the base-collector current gain of the second transistor. In addition, resistor *10* is inserted so that the output voltage is regulated at zero load without the need for current reversal in transistor T_2.



BOOKS

The Sound of High Fidelity

Robert Oakes Jordan, James Cunningham, Windsor Press, 200 E. Ontario St., Chicago 11, Ill., 208 pp, $3.95.

The first consolidation in one book of information necessary to understand the mechanics of high-fidelity sound and its reproduction has been accomplished.

As the fidelity of reproduced sound has increased over the years, so also has the complexity of the equipment used to achieve that fidelity. "The Sound of High Fidelity" is a handbook and guide to the proper operation and maintenance of such equipment.

The book points out that what began as an obsession on the part of a few electronics experimenters and musicians has now blossomed into a major industry.

A man who has felt the breadth and depth of a symphony orchestra through the medium of a stereophonic high-fidelity system is unlikely to ever again be satisfied with monaural sound reproduction.

The book contains a complete history of sound recording, which is only some 80 years old. Modern sound reproduction equipment is shown as the current solution to problems which the recording engineer has had to face from the beginning.

Going through the components of a high-fidelity system one by one, the authors parade the various devices which have filled the major roles. The reader then has a background that makes the "hows" and "whys" of contemporary de

...gn a good deal clearer. Excellent pic...res and diagrams are liberally used ...roughout the book.

...lectric Motors and Generators

E. T. G. Emery, F. Harrabin, B. C. Lee, ... H. R. Nixon, E. T. A. Rapson, Philo...phical Library, New York, N.Y., 384 ...p, $12.00.

The purpose of this book is to pro...de understanding for those outside ...lectrical engineering, as well as a ...seful survey for those professionally ...terested. Avoiding difficult electrical ...eory and mathematics as far as pos...ble, it describes all types of dc and ac ...otors and generators: their design, con...ruction, installation, operation, testing, ...d maintenance. While the emphasis ...roughout is on the practical, there is ...n appendix explaining the fundamentals ... electrical theory for the benefit of ...ose whose knowledge of the subject is ...ght or needs brushing up.

The lucid, easily understandable text ...as been written by a team of highly ...alified authors, including the chief ...gineers of leading firms in the elec...trical engineering industry, and univer...sity and technical college lecturers. Over 400 illustrations, both diagrammatic and pictorial, add to the value of this comprehensive work.

Alcoa Structural Handbook

Aluminum Co. of America, 789 Alcoa Bldg., Pittsburgh, Pa., 350 pp, Free on request.

"Alcoa Structural Handbook" has been used for a decade or more as a reference in several hundred colleges and universities. It is widely used in trade, vocational, and technical schools of all types.

The current revision involved changes in text, general up-dating of tables, and the addition of several new tables. Extensive data on the aluminum-magnesium alloys, and comprehensive coverage of welded structure design are included in the new handbook.

The new edition of "Alcoa Structural Handbook" is available in limited quantity from Alcoa sales offices, or from 789 Alcoa Building, Pittsburgh 19, Pa.

BOOKS

Property Measurements at High Temperature

W. D. Kingery, John Wiley and Sons Inc., 440 Fourth Ave., New York 16, N.Y., 416 pp, $16.50.

This book is intended for the reader who is involved or expects to be involved with the development or application of materials at unusually high temperatures. It concentrates on the factors affecting the properties of materials and their measurement at temperatures above 1400 C. All important high-temperature properties are discussed including heat conduction and radiation, density and thermal expansion, strength, elasticity of solids, viscosity, electrical and magnetic properties, and surface energy.

The author examines the most suitable method for determining each property at high temperatures and provides a basis for comparing various techniques of measurement. He also discusses the reliability and value of the available high-temperature literature.

Graphic Aids to Frequency Response Study of Feedback Control Systems

Boonshaft and Fuchs Inc., Hatboro Industrial Park, Hatboro, Pa., 25 pp, $5.00.

This new workbook contains a comprehensive set of graphs of linear transfer functions and nonlinear transfer functions and nonlinear describing functions. All graphs have a common scale of 60 db per inch, and 30 degrees per inch is used throughout to permit rapid, accurate reading or replotting. Graph size is 8-1/2″ x 11″. In addition, 50 transparent Nichols Charts are provided for plotting combinations of the linear terms against which the stability of nonlinear terms may be checked.

The Detection and Measurement of Infrared Radiation

R. A. Smith, F. E. Jones, R. P. Chasmar, Oxford University Press, 417 Fifth Ave., New York 16, N.Y., 458 pp, $11.20.

After a short introduction on the historical development of infrared tech-

niques, the text deals with the properties and limitations of such thermal detectors as thermopiles and bolometers. A section is devoted to modern photoconductive detectors which use the lead salts PbS, PbTe, PbSe.

The random fluctuations which limit the sensitivity of detectors are then considered, and a comparison of the various types is made. An account is given of the development of infrared spectrometers. The book goes on to discuss electronic techniques used in conjunction with detectors, and also covers the transmission of infrared radiation through the atmosphere.

Forging Product Information

Kaiser Aluminum and Chemical Sales, Inc., Kaiser Center, Oakland 12, Calif., 322 pp.

This forging book is designed to provide the reader with the advantages of both a textbook and a manual. For example, the production of a typical aluminum forging is traced and described in detail from original design, sinking of the die, progressive forging steps, finishing and through final inspection.

Numerous helpful tables are distributed throughout the text for easy reference. Also, an extensive engineering section is included in the book and gives additional tabular material and data in graph form. An extensive glossary of forging terms is included.

Radar Meteorology

Louis J. Battan, University of Chicago Press, Chicago 37, Ill., 161 pp, $6.00.

Research in radar by meteorologists, physicists, and engineers has proceeded rapidly since World War II. The resulting literature, however, is scattered in journals and out-of-print conference reports. Here are the advances of the last fifteen years summed up and systematized for the first time in book form.

This book covers the meteorological use of radar instruments, the meteorological quantities measured by radar, and the relationship of such measurements to more conventional meterological parameters.

Using a Directional Coupler to Measure Impedance

A. I. Zykov

A DIRECTIONAL coupler with a matched load in one of the arms of the secondary waveguide is used to find the modulus of the reflection coefficient ρ in the main waveguide at microwave frequencies. The modulus is calculated from the measured values of the ratio of the signal amplitudes in opposite branches of the coupler (cf., Southworth, G. C., Principles and Applications of Waveguide Transmission). However, in this procedure it is impossible to measure the reflection phase or small values of ρ, since square-law sensing is used, making the signal ratio equal to ρ^2. At low values of ρ it is necessary to use a wide-range indicator.

A directional coupler with a shorting plunger in the load waveguide is free of these shortcomings. The wave propagating towards the indicator (Fig. 1) may be expressed as:

$$\overline{E} = \frac{\overline{\tau}_1 (1 - \overline{\rho}\epsilon^{-j2\beta l}) + \overline{\tau}_2 (\overline{\rho} - \epsilon^{-j2\beta l})}{1 + \overline{\rho}_i \epsilon^{-j2\beta l}} \qquad (1)$$

where

$\overline{\tau}_1 = \tau_1 \epsilon^{-j\varphi_1}$ = transfer factor of coupler in the forward direction

$\overline{\tau}_2 = \tau_2 \epsilon^{-j\varphi_2}$ = transfer factor of coupler in the backward direction

$\overline{\rho} = \rho \epsilon^{-j\varphi}$ = reflection coefficient in the main waveguide

$\overline{\rho}_i = \rho_i \epsilon^{-j\varphi_i}$ = reflection coefficient in the main indicator

λ_2 = wavelength in the secondary waveguide

l = distance from the short-circuit plane to the boundary plane of the waveguide

$\beta = 2\pi/\lambda_2$

If the coupler is ideal and the indicator is matched ($\overline{\tau}_2 = 0$, $\rho_i = 0$), we get

$$E^2 = \tau_1^2 [1 - 2\rho \cos(2\beta l + \varphi) + \rho^2] \qquad (2)$$

It follows from (2) that the ratio of the maximum and minimum readings of the indicator, measured as the reflecting piston is displaced, is $\frac{1+\rho}{1-\rho}$, i.e., it equals the vswr in the main waveguide. Consequently, the vswr region closest to unity becomes more manageable when a coupler with a short-circuiting plunger is used.

For example, if ρ is measured directly using a coupler with load matched to the secondary waveguide, it becomes necessary to measure signals with a ratio of 4 to 10,000 if the vswr is 1.04,

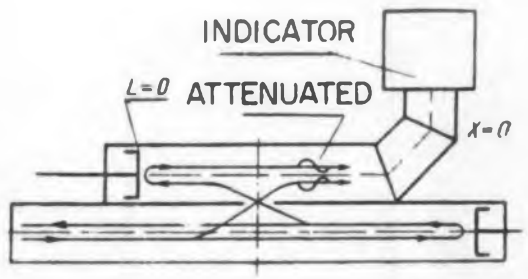


Fig. 1. Directional coupler with shorting plunger.

whereas a coupler with reflecting plunger is usable with a ratio $1.04^2 = 1.08$, which can be done more accurately. Such a directional coupler can also be used to measure the phase of the wave relative to a selected reference plane in the main waveguide.

Let the plane X = 0 (Fig. 2) be chosen as the reference, and let L = 0 be the corresponding plane in the waveguide of the coupler. If the plunger is placed in this plane, the indicator will read zero. The following relation exists between the displacement of the piston in the coupler waveguide relative to the plane L = 0 so as to set the indicator at a minimum when the main waveguide is adjusted for a reflection $\overline{\rho} = \rho e^{-j\varphi}$, and the displacement of the minimum of the electric field in the main waveguide relative to the plane X = 0:

$$\Delta X = \frac{\lambda_1}{\lambda_2} \Delta L \qquad (3)$$

where

λ_1 — wavelength in the main waveguide

λ_2 — wavelength in the coupler waveguide

The directional coupler with short-circuiting

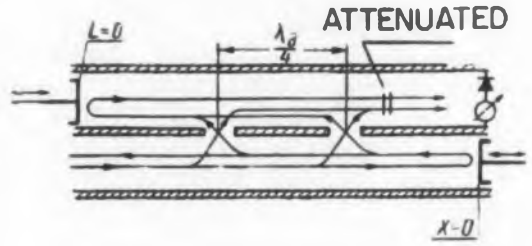


Fig. 2. Reference planes in directional coupler.

plunger, in contrast to the ordinary slotted-line type, is free of the errors due to the inconstancy of the insertion of the probe along the line, and slight skewing of the plunger does not change the amount of reflection.

Measurement Errors

Since real couplers have finite directivity ($\overline{\tau}_2 \neq 0$) and the indicator may not be perfectly matched ($\overline{\rho}_i \neq 0$), errors are introduced in the

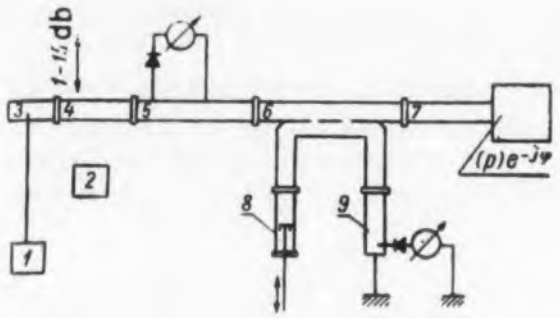


Fig. 3. Comparative measurement of total impedance, using directional coupler with shorting plunger and slotted line.

measurement of the total impedance. These errors can be estimated by using Eq. (1).

We obtain from (1)

$$E^2 = \frac{K - 2\,(B \cos 2\,\beta l - C \sin 2\beta l}{1 + 2\,\rho_i \cos\,(2\,\beta l + \varphi_i) + \rho_i^2} \qquad (4)$$

where

$$\begin{aligned} K &= 1 + \rho^2 + A^2 + \rho^2 A^2 + 4\,\rho\,A \cos\varphi \cos\alpha \\ B &= \rho\,(1+A^2) \cos\varphi + A\,(1+\rho^2) \cos\alpha \qquad (5) \\ C &= \rho\,(1-A^2) \sin\varphi + A\,(1-\rho^2) \sin\alpha \end{aligned}$$

By equating the derivative $d(E)^2/\mathrm{dt}$ to zero, we obtain the extreme values of the displacement l:

$$M \sin 2\,\beta l_{ext} + N \cos 2\,\beta l_{ext} = D \qquad (6)$$

where

$$\begin{aligned} M &= B\,(1+\rho_i^2) + K_{\rho_i} \cos\varphi_i \\ N &= C\,(1+\rho_i^2) + K_{\rho_i} \sin\varphi_i \qquad (7) \\ D &= 2\,\rho_i\,(B \sin\varphi_i - C \cos\varphi_i) \end{aligned}$$

We obtain from (6)

$$\cos 2\,\beta l_{max} = \frac{ND - M\sqrt{M^2 + N^2 - D^2}}{M^2 + N^2}$$

$$\cos 2\,\beta l_{min} = \frac{ND + M\sqrt{M^2 + N^2 - D^2}}{M^2 + N^2} \qquad (8)$$

$$\sin 2\,\beta l_{max} = \frac{MD + N\sqrt{M^2 + N^2 - D^2}}{M^2 + N^2}$$

$$\sin 2\,\beta l_{min} = \frac{MD - N\sqrt{M^2 + N^2 - D^2}}{M^2 + N^2}$$

Inserting (8) into (4) we obtain an expression for the square of the ratio of the amplitudes of the maximum and minimum signals received by the indicator:

$$\left(\frac{E_{max}}{E_{min}}\right)^2 = \frac{1 + \dfrac{2\,(BM + CN)}{K\sqrt{M^2 + N^2 - D^2}}}{1 - \dfrac{2\,(BM + CN)}{K\sqrt{M^2 + N^2 - D^2}}} \times \qquad (9)$$

$$\frac{1 + \dfrac{2\,\rho_i}{(1+\rho_i^2)} \cdot \dfrac{M \cos\varphi_i + N \sin\varphi_i}{\sqrt{M^2 + N^2 - D^2}}}{1 - \dfrac{2\,\rho_i}{(1+\rho_i^2)} \cdot \dfrac{M \cos\varphi_i + N \sin\varphi_i}{\sqrt{M^2 + N^2 - D^2}}}$$

RUSSIAN TRANSLATIONS

In the general case, when $\rho_i \neq 0$ and $A \neq 0$, Eq. (9) is quite cumbersome. It can be used to obtain the maximum possible error in the measurement of the vswr, which occurs when $\psi = \alpha = \varphi_i = 0$. In this case

$$\frac{E_{max}}{E_{min}} = \frac{1+\rho}{1-\rho} \cdot \frac{1+A}{1-A} \cdot \frac{1+\rho_i}{1-\rho_i} = \kappa\, \kappa_{coup}\, \kappa_i$$

where

κ = vswr in the main waveguide
κ_i = vswr of the indicator
κ_{coup} = vswr due to the finite directivity of the coupler, measured with the load in the main waveguide and the indicator matched.

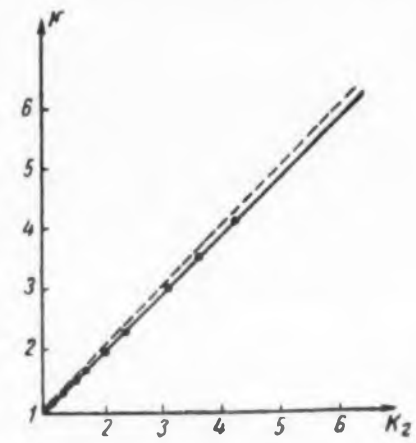


Fig. 4. Comparison of vswr values obtained by the two methods.

The maximum possible error in the measurement of the vswr in the main waveguide is

$$\delta\kappa_{max} = \left(\frac{\kappa\, \kappa_{coup}\, \kappa_i - \kappa}{\kappa} \right) \cdot 100\% = (\kappa_{coup}\, \kappa_i - 1)\ 100\% \qquad (10)$$

It must be noted that for equal mismatch of the indicator and load, the maximum measurement error in this method is the same as that produced when an absorbing load is used.

When measuring the ratio of the signal amplitudes in opposite arms of the coupler, the maximum error in the vswr is

$$\delta\kappa_{max} = \left[\frac{1 + \dfrac{\rho\tau_1 + \tau_2 + \rho_L(\tau_1 + \rho\tau_2)}{\tau_1 + \rho\tau_2 + \rho_L(\rho\tau_1 + \tau_2)}}{1 - \dfrac{\rho\tau_1 + \tau_2 + \rho_L(\tau_1 + \rho\tau_2)}{\tau_1 + \rho\tau_2 + \rho_L(\rho\tau_1 + \tau_2)}} \cdot \frac{1-\rho}{1+\rho} - 1 \right] \qquad (11)$$

$$\cdot 100\% = \left(\frac{1+A}{1-A} \cdot \frac{1+\rho_L}{1-\rho_L} - 1 \right) \cdot 100\%$$

$$= (\kappa_{coup}\, \kappa_i - 1) \cdot 100\%$$

That is, it is the same as given by Eq. (10) if $\kappa_i = \kappa$. Both methods are equivalent in the magnitude of the errors.

We obtain from (8)

$$2\beta\,(l_{min} - l_{max}) = \cos^{-1}\left[\frac{2\,D^2}{M^2 + N^2} - 1\right] \quad (12)$$

from which it follows that if the indicator is mismatched, the distance between the extreme positions of the plunger does not equal one-quarter of the wavelength. This can be used to check the matching of the indicator during the course of the measurements.

If a narrow-band indicator is available, the situation can be improved by using a decoupling attenuator, since the power level at the indicator is much higher than that used in measurements of the reflected power. If $\bar{\rho}_i = 0$ and $A << \epsilon$ the

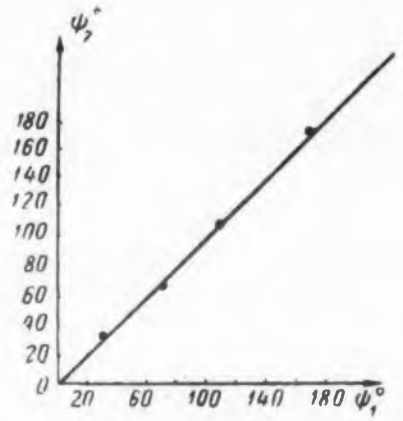


Fig. 5. Comparison of phase angles obtained by the two methods.

error in the measurement of the phase of the reflected wave is

$$\delta\varphi_{max} \approx \left[\frac{\cos^{-1}\left[\left(H\,\frac{A}{\rho}\right)\cos\varphi + \frac{A}{\rho}\right]}{\varphi} - 1\right] \cdot 100\% \quad (13)$$

Measurement Results

Fig. 3 shows the setup for comparative measurement of total impedance with the aid of a coupler with short-circuiting plunger and measuring line.

The directivity of the coupler was 40 db at $\lambda_0 = 10.7$ cm. Measurements were made in continuous operation.

Figs. 4 and 5 show plots of κ_1 vs. κ_2 and ψ_1 vs. ψ_2, where κ_1 and ψ_1 are the vswr and phase of the reflected wave, respectively, as determined by the coupler with the shorting plunger, while κ_2 and ψ_2 are the corresponding quantities measured with the slotted line. The indicator vswr was 1.02. The difference between κ_1 and κ_2 does not exceed 3 per cent; the phase error is even less.

This was translated from the Soviet Journal Measurement Engineering, *No. 3, March, 1959, pp. 44 to 46.*

E. Brenner

Gain-Control Transistor

USING THE h-parameter description of a transistor, i.e.

$$v_1 = h_{11}i_1 + h_{12}v_2$$
$$i_2 = h_{21}i_1 + h_{22}v_2$$

the parameter h_{21}, in the common emitter configuration for collector voltage above the "knee" value, is a function of base current as shown in Fig. 1. Below the knee voltage, h_{21} is a function of collector-emitter voltage at constant base current as shown in Fig. 2.

The basic controlled-transistor circuit is shown in Fig. 3. Three control possibilities exist, depending on the choice of parameter values. In the region of low base currents, $I_C R_3 \ll E_{batt}$, $V_c > V_{knee}$ and the control signal controls the base current. For small collector voltages, R_3 is chosen so that

$$V_{batt} - I_C R_3 < V_{knee}$$

and the control signal varies the base bias current changing both collector current and voltage. For large base current, the ratio R_1/R_2 is smaller than in the preceding case and R_3 is chosen so that V_c is below the knee value.

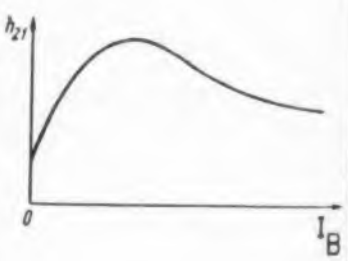


Fig. 1. Variation of h_{21} with base current. The curve for base currents gives maximum h_{21} can-above the value which not be used for all transistor types since the curve may be too flat.

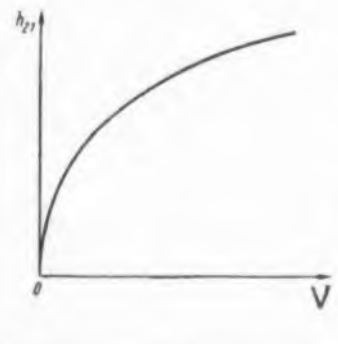


Fig. 2. Variation of h_{21} with collector-emitter voltage at constant base current.

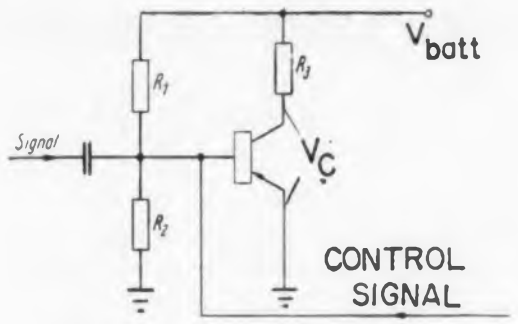


Fig. 3. Basic controlled transistor.

Several applications as well as the variation of other transistor parameters are discussed in the original paper.

Abstracted from an article by L. Steinke, Nachrichtentechnik, *Vol. 9, No. 6, June 1959, pp 261-264.*

Speech Reception In The Presence of Noise

IT IS GENERALLY known that the intelligibility of speech which is received in the presence of noise can be enhanced by emphasis of the high frequency components. The quantitative results cited below apply when the noise is caused by a combination of sources in the transmission channel or at the receiving end.

A series of measurements shows that the intelligibility of syllables is increased on the average of 37 per cent when the frequency response of the amplifier is nonuniform so that the gain at 4000 cps is 15 db above the gain at 200 cps. The improvement depends on the noise level at the receiving end and on the degree of volume increase. At fixed receiver noise level, high frequency emphasis of 10, 15 and 20 db result in improvement of syllable intelligibility of 27, 30 and 37 per cent respectively. At constant receiver sound level, the corresponding improvement was 4, 14 and 23 percent.

Detailed experimental procedures and results are cited in the original paper.

Abstracted from an article by O. Brosze, K. O. Schmidt and A. Schmoldt, Nachrichtentechnische Zeitschrift, *Vol. 12, No. 6, June 1959, pp 297-300.*

REPORT BRIEFS

Sandwich-Wire Antenna Design

A new microwave line source configuration consists basically of three continuous coplanar conductors. The two outer conductors, parallel to each other, are at ground potential; the excited center conductor is bent into sinusoidal form, with a period (for broadside radiation) equal to the wavelength. The polarization is transverse to the length of the array. Modifications of the basic design include a printed-circuit (metal on dielectric) two-dimensional array fed by a corporate structure feed. Design data, including attenuation and phase characteristics, are given for a flat-plate S-band model. An array to fit a cylindrical surface is discussed. These structures are mechanically simple, have good impedance characteristics, and allow good control over aperture illumination. *Sandwich-Wire Antenna Design, Walter Rotman and Nicholas Karas, Air Force Cambridge Research Center, Bedford, Mass., Dec. 1958, 34 pp, Microfilm $3.00, Photocopy $6.30, Order PB 140157 from Library of Congress, Washington 25, D.C.*

Two-Megawatt Magnetic Modulator

A practical design for a two-megawatt magnetic modulator is discussed, and a description of the model constructed and experimental results are given. Substantial agreement between predicted and experimental results is obtained for linear resistive load operation with and without a pulse transformer, and with a pulse-forming network. *A Two-Megawatt Magnetic Modulator, Joseph Antin, Microwave Research Institute, Polytechnic Institute of Brooklyn, N.Y., Feb. 1957, 65 pp, Microfilm $3.90, Photocopy $10.80. Order PB 136689 from Library of Congress, Washington 25, D. C.*

Traveling-Wave Amplifiers

The characteristics of traveling-wave amplifiers under large-signal conditions are discussed briefly. The large-signal equations, which were derived taking into account large values of the gain parameter C and the effects of ac space charge and series loss along the helix, are presented. The large-signal equations are valid with reasonable approximations for all values of the operating parameters which are encountered in typical large-signal tubes. The solution of the equations in also briefly discussed. *Large-Signal Traveling-Wave Amplifiers, Joseph E. Rowe, Electron Tube Laboratory, University of Michigan, Ann Arbor. Dec. 1956, 35 pp, Microfilm $3.00, Photocopy $6.30. Order PB 135511 from Library of Congress, Washington 25, D.C.*

Microwave Instrumentation

New or improved techniques of microwave measurements were investigated through the use of the special properties of ferrite materials. Consideration was given to possible techniques by which variation in ferrite properties can be used with suitable waveguide geometry to give a variable directional coupler. Such a device can, in addition to performing its primary function, act as a variable power divider, a variable attenuator, and by the addition of a ferrite phase shifter, a variable impedance. Various circulator circuits were also considered. The waveguide devices employing ferrites in a coupling region have potential application to broadband variable directional couplers, attenuators, power dividers, circulators, and electronically tuned matching elements. Further work is needed to obtain optimum broadbanding by appropriate changes of geometry or dielectric loading in the coupling region. The investigation of coaxial ferrite devices indicated the possibility of a broadband coaxial gyrator utilizing a mode which propagates down to dc. Variations of this basic scheme utilizing metallic fin loading and non-magnetic dielectric loading were studied and promising theoretical results obtained. In the case of rectangular guide elements, experimental verifications of some of the theoretical analysis was obtained but no complete experimental study was undertaken to exploit the analysis fully. *Application of Ferrite Materials to Microwave Instrumentation, Max Sucher, Microwave Research Institute, Polytechnic Institute of Brooklyn, N. Y., Apr. 1957, 65 pp, Microfilm $3.90, Photocopy $10.80. Order PB 130036 from Library of Congress, Washington 25, D. C.*

Electron Beams

Part I concerns the investigation of a space-charge-balanced flow, a generalized method of constraining an electron beam intended for use in beam-type tubes (klystrons and traveling-wave tubes) with axial symmetry in the presence of an axial magnetic field. In Part II, an investigation of the problem of controlling and modulating high-intensity electron beams of the sort employed in high-power microwave tubes is described. In Part III activity is reported on a theoretical and experimental investigation of the properties of certain gaseous devices, particularly with regard to the plasma of an arc as a source of electrons for cross-field tubes at extremely high power. *Production and Control of Electron Beams, D. H. Sloan and Charles Susskind, Electronics Research Laboratory, University of California, Berkeley, June, 1958, 87 pp, Microfilm $4.80, Photocopy $13.80. Order PB 135875 from Library of Congress, Washington 25, D.C.*

REPORT BRIEFS

Signal Summing With Electrolytic Capacitors

A method is described for obtaining the algebraic sum of several low-voltage dc signals. The apparatus consists of a polarized electrolytic capacitor and a double-pole double-throw switch for each signal entering the summation. In one position of the synchronized switches each capacitor is charged while in the other position of the switches the capacitors are connected in series for the summation. *Signal Summing With Electrolytic Capacitors, C. C. Minter, Naval Research Laboratory, Washington, D. C., Apr. 1959, 8 pp, Microfilm $1.80, Photocopy $1.80. Order PB 138795 from Library of Congress, Washington 25, D. C.*

Steady State Transmission

The purpose of this paper is to present a new method of steady state analysis of a linear network of arbitrary degree of complexity, containing a single periodically varying element. The proposed method makes full use of circuit theory ideas, such as impedance matching and tearing apart, and of iterating techniques which are particularly suitable for automatic computation. The proposed method has the additional feature of leading to the amplitude and phase of all side bands and of giving a bound on the error if the iterations are stopped at any particular point. *Steady State Transmission Through a Network Containing a Single Time Varying Element, C. A. Desoer, Electronics Research Laboratory, University of California, Berkeley, Dec. 22, 1958, 34 pp, Microfilm $3.00, Photocopy $6.30. Order PB 139993 from Library of Congress, Washington 25, D.C.*

Nonlinear Differentiating Filters

An unconventional method of differentiating a non-stationary electrical signal in the presence of noise is described. The input to a certain passive electrical network is assumed to consist of a signal voltage, having a finite discontinuity at zero time, mixed with a perturbing noise voltage. The electrical network serves the dual purpose of filtering out as much of the noise as possible, and providing in its output the exact value of the time derivative of the input signal in the shortest possible time. In this sense, then, the network shall be called a "differentiating filter." *Nonlinear Differentiating Filters, George R. Cooper and Jack E. Kemmerly, Purdue University, School of Electrical Engineering, Lafayette, Ind., Feb. 1956-May 1958, 85 pp, Microfilm $4.80, Photocopy $13.80. Order PB 137675 from Library of Congress, Washington 25, D. C.*

REPORT BRIEFS

Paramagnetic Maser

A cavity maser has been successfully operated with the *c* crystal axis of the ruby oriented at 82 and 24 deg relative to the dc magnetic field. The amplifier operates at 2600 mc with an X-band pump. Several slow-wave structures for traveling-wave masers have been designed and constructed. These include inter-digital line and comb structures. A completely filled cavity structure is also being fabricated to study its bandwidth capabilities. *Research and Development of a Solid State Paramagnetic Maser, Perry H. Vartanian, Microwave Engineering Laboratories, Inc., Palo Alto, Calif., Jan. 1959, 21 pp, Microfilm $2.70, Photocopy $4.80. Order PB 140405 from Library of Congress, Washington 25, D. C.*

400-cps Power Supply

A variable voltage, 400-cps power supply has been designed and fabricated for use in the laboratory. The design is electronic in nature. Output from a 400-cps oscillator stage, after amplification in a push-pull voltage amplifier, is fed into a pair of 807 power amplifier tubes. The attainable output voltage is continuously adjustable from 75 to 150 v. Approximately 30 w of output power is available at 115 v terminal voltage; 65 w power output can be attained if the series voltage-control tube is not used. Modifications are suggested to convert the basic unit into a three-phase, symmetrical or non-symmetrical power supply. Regulation of the output voltage can easily be added if desired. *Electronic 400-cycle Power Supply, Loren E. Bollinger, Ohio State University Research Foundation, Columbus, Feb. 1955, 50 pp, Microfilm $3.30, Photocopy $7.80. Order PB 140575 from Library of Congress, Washington 25, D. C.*

The Corner Array

An antenna has been designed and built which consists of an array located at the bisector of two intersecting conducting planes. The fields existing in such an antenna have been determined by ray tracing and by images. The advantages of using an array rather than a single element with a corner reflector are discussed. The results of an experimental verification are given, showing a 13 degree wide beam from a 60 degree beamwidth from a 30 degree corner array. *The Corner Array, Allan C. Shell, Air Force Cambridge Research Center, Bedford, Mass., Jan. 1959, 31 pp, Microfilm $3.00, Photocopy $6.30. Order PB 140637 from Library of Congress, Washington 25, D. C.*

IDEAS FOR DESIGN—*ENTRY BLANK*

To the *Ideas-For-Design* Editor of ELECTRONIC DESIGN —
830 3rd Ave., New York 22, N.Y. • PLaza 1-5530

Here is my design idea for possible publications in your *Ideas For Design* department. I can expect $10 for this idea if accepted for publication.

(Ideas suitable include: *1.* new circuits or circuit modifications, *2.* new design techniques, *3.* designs for new production methods, *4.* clever use of new materials or new components in design, *5.* design or drafting aids, *6.* new methods of packaging, *7.* design short cuts, or *8.* cost saving tips)

STATEMENT OF THE PROBLEM—

MY SOLUTION. AND WHY— (Please be explicit. Include sketches or photos that will help the idea across)

Name_____
Title_____
Company_____
Address_____

(Place illustrations on separate sheet if necessary)

REPORT BRIEFS

Low-Energy Pulse-Measuring Device

The "Thermergistor" is a device that can reliably measure energy pulses ranging from 10 to 200,000 ergs in electrical circuits. The output of this thermistor-heater assembly is linear and repeatable within 5%. It has been used for developing and testing firing circuits, evaluating firing-circuit components, and investigating undesirable electromagnetic coupling between circuits. A low-impedance Thermergistor is constructed by noninductively winding a short length of resistance wire about a thermistor; a high impedance Thermergistor, by embedding a thermistor in a composition resistor. *The Thermergistor: A Low-Energy Pulse-Measuring Device, J. C. Chambers and G. R. Bastedo, Naval Ordnance Laboratory, Apr. 1959, 11 pp, $0.50. Order PB 151686 from OTS, Washington 25, D. C.*

Resistor-Transmission-Line Networks

The purpose of this study is to summarize and extend available techniques of distributed-parameter network synthesis. The applicability of lumped-parameter techniques to this problem is demonstrated, as is the utility of several techniques which are peculiar to the distributed case. Additionally, those lumped-parameters synthesis techniques which avoid the use of mutual coupling by the parallel connection of networks are found to be much more powerful when applied to the distributed network problem. *Synthesis of Resistor - Transmission - Line Networks, N. R. Welsh and E. S. Kuh, Electronics Research Laboratory, University of California, Berkeley, July 1958, 60 pp, Microfilm $3.60, Photocopy $9.30. Order PB 140396 from Library of Congress, Washington 25, D. C.*

Transistor Crystal Oscillator

The analytical approach presented in this report is based upon the power relationships in feedback oscillators and has been simplified considerably by graphical techniques. Step-by-step design data sheets are given for four common circuits and are followed by six specific design examples. The report includes methods for prediction of output power and voltage and for the design of the feedback network. Sections are included on frequency and frequency stability, crystal characteristics, transistor considerations, and high-frequency experimental work. *Transistor Crystal Oscillator Circuitry, W. McSpadden, R. J. Shedko, and T. G. Evans, Motorola, Inc., Phoenix, Ariz., Aug. 1957, 157 pp, Microfilm $7.50, Photocopy $24.30. Order PB 139070 from Library of Congress, Washington 25, D. C.*

Digital Communication Systems

The work under this contract on the evaluation and comparison of digital communication systems is summarized, and a number of suggestions presented for improving the performance of such systems in the presence of interference and propagation anomalies. In particular, the theories of null-zone reception and communication feedback are emphasized, and certain coding concepts are considered. A critical review of work to date is included, and a number of promising areas for future investigation are outlined. *Evaluation and Optimization of Digital Communication Systems, S. S. L. Chang, B. Harris and others, New York University, College of Engineering, N.Y., Jan.-June 1958, 100 pp, Microfilm $5.40, Photocopy $15.30. Order PB 138488 from Library of Congress, Washington 25, D. C.*

Input Adaptive Systems

This work presents a theory for the design of input adaptive control systems. It is assumed that error-free measurement of the system input and the system behavior is permitted, but only limited changes in the system characteristics can be affected by the control variables at the designer's disposal. It is shown that within this limitation for a wide class of inputs and systems and for a certain class of measures of the system performance, an optional adaptive system behaves as a relay or switched system during periods in which the input is reproduced identically. *Theory and Design of Input Adaptive Systems, Herbert L. Groginsky, Electronics Research Laboratories, Columbia University, New York, N.Y., Sept. 1958, 139 pp, Microfilm $2.40, Photocopy $21.30. Order PB 140539 from Library of Congress, Washington 25, D. C.*

Transistor Amplifier

A three-terminal transformerless unilateralized common-collector amplifier is described. The device has an active feedback path and uses two complementary type transistors in hook connection. Very high input impedances, up to $r_m/2$, and very low output impedances, from $r_e+r_b/2$ to $r_e + r_b(1-\alpha)$, may be realized. Various compensating circuits for low and high audio frequencies are described; means to reduce the dependence of the compensation upon bias point and temperature are discussed. Extensive experimental verifications are included. *Unilateralized Common Collector Transistor Amplifier, L. M. Vallese, Microwave Research Institute, Polytechnic Institute of Brooklyn, N. Y., Oct. 1957, 28 pp, Microfilm $2.70, Photocopy $4.80. Order PB 136671 from Library of Congress, Washington 25, D. C.*

REPORT BRIEFS

Network Realizability Theory

A general theory of network realizability for linear, passive, time-invariant networks is presented from the point of view of energy conservation and causality. It is shown that four postulates defining the physical nature of a network suffice to give all the analytic properties of the network scattering matrix. These analytic properties define a bounded real scattering matrix, the possession of which is necessary and sufficient for an *n*-port network to satisfy physical realizability as stated by the given set of postulates. A theorem concerning the necessary and sufficient conditions for the existence of a Faltung-representation is proved and its implications discussed. *Network Realizability Theory and its Application to the Synthesis of Distributed Parameter Matching Network, L. J. Castriota and H. J. Carlin, Microwave Research Institute, Polytechnic Institute of Brooklyn, N. Y., May 1958, 91 pp, Microfilm $5.40, Photocopy $15.30. Order PB 135866 from Library of Congress, Washington 25, D. C.*

Drift Transistor

For a vacuum-tube amplifier, high frequency compensation using an infinite LC ladder with identical elements yields maximally-flat amplitude response. The same type of compensation is investigated in connection with a drift transistor. The design criterion for maximally-flat amplitude response is derived. In a numerical example applied to the 2N247 transistor, the amplitude response develops a 10.3 db peak immediately above the nominal cutoff frequency of the ladder, although considerable improvement in bandwidth is obtained. The time delay response also undergoes violent fluctuations. The conclusion is that the identical-element ladder is poor compensation for a drift transistor. Instead, given a desired frequency response it should be possible to synthesize an infinite RLC ladder of non-identical elements. *High Frequency Compensation of a Drift Transistor, Sid Deutsch, Microwave Research Institute, Polytechnic Institute of Brooklyn, N. Y., Jan. 1959, 22 pp, Microfilm $2.70, Photocopy $4.80. Order PB 139949 from Library of Congress, Washington 25, D. C.*

Parametric Amplification

Parametric amplifiers employing semiconductor junction diodes as nonlinear capacitors have been studied theoretically and experimentally. The theoretical analysis is based upon the principle of harmonic balance and leads to rapidly convergent series representations for the important circuit variables. This approach has the advantage of

simplicity of application and is probably a more reasonable approximation to the actual physical situation than the conventional calculation based upon Mathieu's or Hill's equation. Parametric amplifiers were constructed at frequencies of 13 kc and 1.14 mc in order to check the theoretical calculations. A bridge circuit was used in some instances to provide improved isolation of the signal and pumping circuits. *Study of Parametric Amplification, E. E. Bell and Y. P. Vaddiparty, Ohio State University, Research Foundation, Columbus, Ohio, Nov. 1958, 25 pp, Microfilm $2.70, Photocopy $4.80. Order PB 140143 from Library of Congress, Washington 25, D. C.*

Traveling-Wave Tube, I

This is a final report on the development of an electron tube designated as a low-noise, SHF-band, traveling-wave tube. The electrical specifications included a noise figure less than 13 db and a gain greater than 18 db with less than 5 db variation over the frequency band of 7.5 kmc to 11.3 kmc. The tube developed used a helix for the slow-wave circuit, cavity couplers, coupled helix attenuators, and a three region gun for noise reduction. A program was outlined for the construction of as many of these tubes as possible, each with a modification so as to empirically determine the best design for a broadband low-noise tube. By proper design it was possible to obtain tube noise figures as low as 8.4 db and less than 10.6 db over the band. *Low Noise, SHF Band Traveling-Wave Tube, Frederick B. Fank and Frederick M. Schumacher, General Electric Microwave Laboratory, Palo Alto, Calif., Dec. 1956, 42 pp, Microfilm $3.30, Photocopy $7.80. Order PB 140549 from Library of Congress, Washington 25, D. C.*

Traveling-Wave Tube, II

Investigations indicate that a transverse current TWT is superior to the longitudinal TWT as far as the minimum obtainable noise figure is concerned. Workable tube structures may be difficult to achieve to realize the theoretical advantages. The transverse-field, transverse-current SHF traveling-wave tube is a promising device, even though it would possess operating characteristics quite different from those of existing tubes. A discussion of the work accomplished and preliminary results obtained are given in this report. *Low Noise, SHF Band Traveling-Wave Tube, Howard H. C. Chang and Michael J. Ozeroff, General Electric Microwave Laboratory, Palo Alto, Calif., July 1957, 14 pp, Microfilm $2.40, Photocopy $3.30. Order PB 140550 from Library of Congress, Washington 25, D. C.*

STANDARDS AND SPECS

Sherman H. Hubelbank

Switch Boots

MIL-B-19257(SHIPS), BOOTS, DUST AND MOISTURE SEAL, WATERTIGHT, THREADED BUSHING MOUNTED SWITCH, AMENDMENT 4, 10 APRIL 1959

The six illustrations of the different types of boots have been revised.

Identification Plates

MIL-P-15024B(SHIPS), INFORMATION AND MARKING FOR IDENTIFICATION OF ELECTRICAL, ELECTRONIC AND MECHANICAL EQUIPMENT IDENTIFICATION PLATES, AMENDMENT 5, 5 MAY 1959

No significant change has been made to that portion of the spec dealing with electrical and electronic equipment.

Enclosures

MIL-E-2036C(NAVY), NAVAL SHIPBOARD ENCLOSURES FOR ELECTRIC AND ELECTRONIC EQUIPMENT, AMENDMENT 1, 17 APRIL 1959

Spot facing requirement has been clarified to establish that it is required for accommodating washers and mounting bolts. It is now required to provide access for the replacement of repair parts from the front of the enclosure without disassembly of the cabinet or removal of any permanently mounted subassembly or part. The requirements for dripproof and watertight enclosures have been drastically changed.

Insulation Materials

Current NEMA, AIEE, ASTM, MIL and FED standards and specs on electrical insulating materials are listed in a pamphlet released by the Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago, Ill.

Engineering Drawings

MIL-D-70327, DRAWINGS, ENGINEERING AND ASSOCIATED LISTS, 16 MARCH 1959

This spec will replace 158 overlapping specs formerly used by the military for the procurement of engineering drawings and associated lists. The types of drawings that the military may acquire are defined. A single system of drawing number

coding is established. This system uses the manufacturer's identification code as used in the Federal cataloging system to identify the source of the drawing. A standardized order of precedence for design identification of items is also established. Minimum requirements for data to be placed on lists of materials are also outlined.

Publications

MIL-M-16616(Ships), Electronic Equipment Technical Manual, Amendment 1, 1 January 1959

The reference to performance standards books and maintenance check off books has been changed to conform to the new specs. The typography requirement has been drastically modified to specify cold-type composition as a requirement except where it is more economical to use hot-type composition. Unjustified right-hand margins are also acceptable. Negatives must now be shipped within 30 days after the shipment of the first equipment. Publication status reports have now been included in this spec. However, these are only required when specified in the contract or order.

MIL-S-21740(Ships), Sheet, Technical Data, Performance Standards, 1 January 1959

The preparation and handling of performance standards sheets are covered by this spec. These sheets provide a reference list of the minimum acceptable limits for overall operation of electronic equipment.

MIL-M-21741(Ships), Manual, Technical, Maintenance Standards Book, 1 January 1959

This spec covers the minimum requirements for the preparing maintenance of standards books and revisions for ship or shore-based electronic equipment. In addition, it covers the requirements for the preparation of reproducible copy, negatives of reproducible copy, typography, reproduction, quantity, approval procedures and packing. This issue supersedes MIL-B-17530(Ships) and MIL-B-17535(Ships).

MIL-M-21742(Ships), Manual, Technical, Overhaul and Repair Instruction, 1 January 1959

The requirements for the preparation of overhaul instructions are established by this spec. They cover the overhaul and major repair of electronic equipments, systems and test equipment. These instructions shall be prepared as a standard for use by activities engaged in the major repair, rebuilding and restoration of electronic equipment. These manuals will only supplement the basic technical manuals for the equipment.

Money To Start A Small Business

Clarence Wetherill, ECC's Senior Technical Officer. He'll pass on the technical competence of your product. In background are two more executive offices, separated by glass.

EVER DREAM of getting together with a few friends and manufacturing that better electronic mouse trap? Probably the principal obstacle was money—funds for working capital, growth and eventual expansion or modernization.

You may find the solution to your problem in a completely new source of financing for small businesses. The Small Business Investment Act was passed by Congress in 1958. Since then a number of privately-owned small business investment companies have been established to provide individuals or small businesses with long-term and equity funds.

Tax advantages make the operation possible: under the Small Business Act an investment firm gets to keep three out of four dollars of profits, loses only one out of four dollars of losses. In the past most firms or individuals who were in a position to invest were in a bad tax position; now the current trend in Washington is to look favorably on giving contracts and otherwise helping out small business.

As an especially pertinent example of these new firms, Electronics Capital Corp., 1400 Fifth Ave., San Diego 1, Calif., the largest small business investment company in the U. S., devotes its entire resources to the needs of the electronics industry. The company is staffed by successful former electronics executives and engineers. The corporation's policy is to limit investment of long term funds to the electronics field, because it is a field the company's personnel understand thoroughly.

Prime objective of ECC is to provide continuing financial strength to its client companies during "fair and foul weather."

"You could call the Small Business Investment Act the start of a 'Fourth Banking System,'" Electronics Capital Corp.'s President Charles Salik says.

"Our interest is to keep 'em financially sound through thick and thin." Dick Silberman, executive v.p. of Electronics Capital Corp., describes ECC investment policies.

The firm recognizes the various phases through which an electronics company must pass before it can reach complete financial and management maturity. By relieving financial and other pressures, ECC hopes to accelerate the expansion of a large number of electronics companies.

What It Means to You

Suppose you came up with a product, invention or service concept you thought had real value. How would you go about getting money to implement it?

ELECTRONIC DESIGN talked with Charles Salik, president of ECC, and Richard Silberman, executive vice president, to find out the procedure necessary to obtain financing from ECC. "First," said Salik, "we tell the engineer about ourselves to find out if he's interested in our kind of organization. Then we go over the proposed technical area of operation with particular regard to its appreciation possibilities." What this means, Salik explained, is ECC tries to get a good idea of how good the idea is. Is the product soundly designed? Is there a market for it? And, most important, is there a good chance that the market can be expanded many times?

"If there is not a good possibility of *real* appreciation we're not interested," Dick Silberman said, "We don't want to invest in a company that will just get along—we're interested in companies that have a real growth potential. This is what our shareholders are looking for and this is what we're going to give them."

Next step is to investigate the applicant. ECC wants to know something about the engineer's technical background and his record in business. "In particular," Silberman said, "we want people who have some experience in business—who have made some mistakes before, so to speak, and consequently have learned their lesson." ECC requires a projection from the engineer or firm as to what the contemplated organization and sales and marketing operations will be, who the management people will be and how much money the engineer thinks he needs. If this checks with what ECC thinks is reasonable and proper after analysis, negotiations can begin.

Sure You Want Enough?

"Our interest," Silberman pointed out, "is to see the applicant has *enough* money for what he wants to do. Some people don't ask for enough—they're thinking about short-term capital, while what we are dealing with is long-term financing."

For engineers without much business experience, or small businesses that recognize management problems, ECC provides a management consulting service at nominal cost. In the cases where it is used it is usually negotiated as part of the contract. It is based, according to ECC, as much as possible on areas in which the client needs help. "We have unusually expert management counsel in the electronics area for the client," Charles Salik said. "It's the kind of help small business needs—all consultants are people who have made successes in small electronics businesses. In areas like technology, business procedures, financial planning, sales,

(Continued on p. 238)

DESIGNING YOUR FUTURE

(Continued from p. 237)

advertising, public relations and cost control we can offer considerable profit in experience to the client who uses us."

Each company is evaluated personally. "We can't give examples of some of our contracts because they'd be misleading," Elliot Lewis, Client Development, said. "Each specific case is different—wide open and negotiable."

While ECC generally owns an interest in the new company, policy is to avoid owning more than 50 per cent. "We don't want control of a company," said Silberman. If ECC ever has to make a deal where they own more than 50 per cent of a company a procedure will be set up where the engineer-president can buy back control out of profits.

Group Development is New Concept

ECC's new group development plan shows promise of success. Object here is to promote the "development of companies which have sympathetic fields of interest" and who are able, in terms of management, products and services, to associate in special groups to bid on industrial or military procurement requirements.

In this way individual companies can participate in contracts beyond their present financial and technical capabilities —the "team bid" idea updated. "It's already fairly apparent we are in a unique position to look at the total industry in all its facets," Salik said. "We feel we can be very helpful to our clients fitting them into their proper relationship with the rest of the industry. We have experience in seeing total relationships, a reservoir of up-to-date knowledge of industry, electronics technology and business trends."

ECC, in other words, will help put businesses together in joint ventures. It also "stands ready to sponsor the creation of new companies composed of people with proven experience who can take advantage of opportunities in sensitive areas of the electronics industry."

Companies or individuals with total assets less than $5 million and whose net income after taxes is less than $150,000 averaged for the past three years can qualify as ECC clients. Within the framework of this policy, the corporation invests in every facet of the electronics industry. ■ ■

Advancement Your Goal? Use New Form To Speed Action

ELECTRONIC DESIGN's new Career Inquiry Service form is designed to help engineers advertise themselves. This new service speeds applicants to the jobs they seek. It is the first such service offered in the electronics field and is receiving high praise from personnel managers.

To present your qualifications immediately to the personnel managers of companies that interest you, simply fill in the attached standardized short resume.

Study the employment opportunity ads in this section, and circle the numbers at the bottom of the form that correspond to the numbers of the ads that interest you.

ELECTRONIC DESIGN's Reader Service Department will act as your private secretary and type neat, duplicate copies of your standardized resume and send them to all companies you may select . . . *the same day the resume is received.* (ELECTRONIC DESIGN will detach the circle number portion of the form, so that no company will know how many numbers you circled.)

The standardized resume will permit personnel managers to inspect your qualifications rapidly. If they are interested, they will get in touch with you directly. In the past much time has been lost through personnel-manager requests for resumes from applicants who proved ineligible.

Mail Career Inquiry Service form to Reader Service, ELECTRONIC DESIGN, 830 Third Ave., New York 22, N. Y.

ELECTRONIC DESIGN **CAREER INQUIRY SERVICE** USE BEFORE NOV. 25, 1959

After completing, mail career form to *ELECTRONIC DESIGN*, 830 Third Avenue, New York, N. Y. Our Reader Service Department will forward copies to the companies you select below. (21)

(Please print with a soft pencil or type.)

Name _____ *Telephone* _____

Home Address _____ *City* _____ *Zone* _____ *State* _____

Date of Birth _____ *Place of Birth* _____ *Citizenship* _____

Position Desired _____

Educational History

College	*Dates*	*Degree*	*Major*	*Honors*

Recent Special Training _____

Employment History

Company	*City and State*	*Dates*	*Title*	*Engineering Specialty*

Outstanding Engineering and Administrative Experience _____

Professional Societies _____

Published Articles _____

Minimum Salary Requirements (Optional) _____

Use section below instead of Reader Service Card. Do not write personal data below this line. This section will be detached before processing.

Circle Career Inquiry numbers of companies that interest you

900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924
925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949

YOUR CAREER
NEWS, NOTES, NOTIONS

Recruiting techniques frequently amount to open piracy. Although recruiting officers think of themselves as out proselytizing for their company, their converts frequently consider themselves no better than prostitutes who have been had for an offer of a few more bucks.

Recruitment takes on the aura of a professional activity though, at the National Electronics Conference being held in Chicago this week. A panel session entitled "Recruitment of Scientific Personnel" was conducted Monday evening by the IRE Professional Group on Engineering Management. The tone of the meeting was set at a respectable plane by referring to the recruitment of "scientific" personnel rather than the "hiring" of engineers, and by including two panel participants from universities.

The sponsors of the East Coast Conference on Aeronautical and Navigational Electronics to be held in Baltimore later this month (October 26-28) take the problem of the need for engineers right to the halls of the universities. Industry and government panelists go to the campus of Johns Hopkins University to discuss before students "Opportunities For Engineers Today And Tomorrow." The Director of Placement, J. Lyon Rogers, of John Hopkins University will discuss career evaluation and selection.

° ° °

The engineer and his work was the scene of several other papers at NEC. Leadership requirements were discussed at a panel meeting on education for leadership. The occupational hazards of engineers and managers were the subject of a paper by Mr. J. R. Stovall, Jr. of Remington Rand.

The up-coming need of electronic company managers as military-political advisors was the subject of an NEC paper by Mr. Casper M. Bowers. The gist of Mr. Bowers' paper was not available to us at the time this page went to press, but a timely article on this same theme appeared in the SR/Research section of the September 5 *Saturday Review*.

In discussing the peaceful use of atoms, two former AEC lawyers, William Berman and Lee Hydeman, both now at the University of Michigan Law School, stress that engineers as well as legislators and policy makers will have to decide how the results of science will benefit society.

The view taken in this article is that scientists can't tell us where science is taking us. They can inform, can contribute details to enhance under-

standing, and can remind us of the unusual nature of knowledge and knowledge's refusal to be fettered. But the application of science depends on "rules and regulations to be worked out in the main by students and practitioners of law."

The authors illustrate their point by discussing President Eisenhower's Atoms-For-Peace plan which is failing. Science can describe the wonders that could come from nuclear power generating stations and radioisotope laboratories. But these advanced stages of industrialization are far ahead of the needs of these under-developed countries. First steps for these countries should be the building of roads and canals rather than the extraction of mineral deposits and increased productivity for extensive electrification. (The individual can't afford a light bulb in the first place.)

A hydrogen explosion could open the way for irrigation of barren acres and for mining buried minerals. Unfortunately, according to Messrs. Berman and Hydeman, no experiments have been made with the specific purpose of using nuclear explosions for peace. The United States didn't sell its project Plow Share Program well at the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva a year ago August.

It's not too late for a Hydrogen-For-Peace crusade, the article goes on, and the most exciting use is that of earth-moving. The advisory role of scientists and engineers is extremely important. Fear of the additional radiation hazard to the human race may thwart such plans unless the scientific community can prove otherwise. (According to the scientists at the Laurence Radiation Lab radiation for this purpose could be negligible.)

Prospects for peaceful tests to take place in the face of a nuclear weapons ban are good, providing engineers can agree what reasonable peaceful tests are and what kind of internal inspection is adequate.

• • •

A theory about flying saucers is also presented in the September 5 issue of the *Saturday Review*. We are sure every knowledgeable electronics engineer will want to be armed with physicist Donald H. Robey's argument before his next encounter with UFOs—that is, his next cocktail party. In fact, our engineer can bring up the subject by noting the similarity of the partially-melted ice cube in his drink to a flying saucer! Robey traces the likelihood that UFOs are ice-fragments that were once a part of a comet. The UFO controversy continues, but it all started in 1947 and that was the year that the earth's interplanetary space neighborhood was visited by more comets than ever before.

CIRCLE 905 ON CAREER INQUIRY FORM

CIRCLE 906 ON CAREER INQUIRY FORM

CIRCLE 907 ON CAREER INQUIRY FORM

Since this ad first appeared on June 16th 1959 43 engineers have joined HMED—and there are approx. 38 positions at all levels open now!

ENGINEERS

A FINER CLIMATE

TO WORK IN...

...TO LIVE IN

At Sylvania's Mountain View Operations in California
(SAN FRANCISCO BAY AREA)
you'll discover more than just one kind of climate.

PROFESSIONAL CLIMATE—Advanced programs will challenge your technical creativity. You'll make major contributions in the fields of electronic defense, radar, communications and data processing systems. Because Sylvania is one of the nation's fastest growing electronics organizations, there are an unusual number of growth opportunities.

LIVING CLIMATE—You and your family will enjoy the healthful atmosphere and sunny climate of the San Francisco Peninsula. You'll find plentiful housing, excellent shops, fine schools and year round recreation.

Openings in:

System Studies / Circuit Design / Computers & Data Handling / Electronic Packaging / Development Engineering / Concept & Planning / Advanced ECM Circuitry / Equipment Development / Product Engineering / Tube Engineering / Mechanical / Tube Application Engineering / Tube Engineering / Theoretical Physics / Tube Production Engineering / Mathematics / Experimental Physics / Engineering / Engineering Writing / Microwave Engineering / Tube Research Engineering

You may communicate in confidence to Wayne L. Pearson

Mountain View Operations | SYLVANIA ELECTRONIC SYSTEMS
A Division of
SYLVANIA
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

P.O. Box 188
Mountain View, California

CIRCLE 908 ON CAREER INQUIRY FORM

CIRCLE 909 ON CAREER INQUIRY FORM ➤

1959

212 L EXPEDITE

ENGINEERS • SCIENTISTS

General Electric's Heavy Military Electronics Dept.

AWARDED CONTRACT FOR

Systems Integration, Engineering, and Management of...

AIR WEAPONS CONTROL SYSTEM 212L

A universal electronic control system to meet the vast problem of Air Defense outside of the Continental United States.

Systems-oriented engineers and scientists will appreciate the broadband technical challenge of the Air Weapons Control System 212L. There are important openings for men who are experienced in: Weapons Systems Analysis • Mathematical Analysis of Engineering Problems • Computer Programming • Military Communication Systems • Radar Systems • Weapons Control Systems • Electronic Circuitry • Industrial & Military Psychology

● Working in close cooperation with the USAF, it is Heavy Military's responsibility to integrate all subsystems—data acquisition, communications, data processing and display—plus various defensive weapons into a well coordinated and efficient operating system.

VERSATILE AIR CONTROL APPLICATIONS The revolutionary 212L can be used to defend a single airfield, or, by linking control sites together, it could be used in a limited action to provide air control for an area the size of Alaska. Similarly, by linking the capabilities of countries together, a system could be provided for the air control of an entire continent. Designed for *both* fixed and mobile applications, the 212L will be used primarily outside the U. S. since the SAGE system is used for the defense of this country.

HMED IS ALSO DESIGNING THE "HEART" OF THE SYSTEM In addition to its prime mission of providing systems management, HMED will design, develop and produce the data processing and display subsystem which is the "heart" of the 212L. Capable of rapidly and automatically detecting and tracking air targets, the subsystem operates without human assistance, except under unusual circumstances.

OTHER FAR-RANGING PROGRAMS AT HEAVY MILITARY

At the present time additional far-ranging programs are being pursued in diverse and important areas at HMED:

- Fixed & Mobile Radar
- Shipborne Radar
- Underwater Detection Systems
- Missile Guidance
- Data Handling Systems
- Communications

Write today or call me collect at GR 6-4411, Ext. 7830
George Callender

Individuals with experience in systems analysis or specific equipment design in the areas listed above are invited to forward their resume in complete confidence to Mr. George Callender, Div. 76-SMP

HEAVY MILITARY ELECTRONICS DEPARTMENT
GENERAL ELECTRIC
Court Street, Syracuse, N. Y.

PROFESSIONAL DEVELOPMENT AND SELF-EXPRESSION

at General Electric's Ordnance Department, Pittsfield, Massachusetts

The Ordnance Department has given a considerable amount of thought and effort to organizing its facilities and activities in a manner that maximizes professional progress. In this message to engineers we would like to take this opportunity to explain why we afford ambitious men an exceptional environment in which to develop their full disciplinary talents. We hope that this brief account of us and our work will lead you to inquire further about a career position at the Ordnance Department.

PROGRAMS that range the broad design and development spectrum from launching and handling equipment for Talos, through advanced fire control and inertial guidance systems for such revolutionary weapons systems as the MK.44 torpedo and Polaris. Contributing to these ultrasensitive intricate systems, you'll utilize your full disciplinary skills in areas ranging from technological conception to proof of feasibility.

FACILITIES AND BENEFITS are a standard of the industry. Projected growth of G.E. will raise by a third the number of professional staff in the next 5 years and company-wide promotion opportunities are available through a centralized personnel register. There is a tuition-paid graduate study plan, in-plant courses, comprehensive orientation program, top salaries, comprehensive insurance and a fine savings and security plan.

LOCATION is in the heart of the beautiful Berkshires where the whole family can enjoy four-season sports and recreation together.

Why Not See If Your Background Fits You For An Opportunity At Ordnance?

ASSIGNMENTS . . . D & D electric and electronic equipment for submarine fire control system, integration of equipment with system.

EXPERIENCE . . . Servo loops; transistors; instrument and power servos; hydraulic or pneumatic servos.

ASSIGNMENTS . . . Circuit development, fire control systems; Design of electronic assemblies, packaging. Evaluation and specification of electronic components for circuit and product design groups.

EXPERIENCE . . . 2-6 years with electronic components.

ASSIGNMENTS . . . Design new computer components (control and guidance systems) and carry to prototype. Environmental testing; coordination of procurement, assembly and evaluation schedules.

EXPERIENCE . . . 5-10 years with digital and analog computers, inertial devices, techniques data transmission.

If you are ready for this kind of move—not just vaguely discontent with what you're doing now send a brief resume to R. G. O'Brien, Manager—Professional Relations, Dept. 76-SMO.

ORDNANCE DEPARTMENT
of the Defense Electronics Division

GENERAL ELECTRIC

100 Plastic Avenue Pittsfield, Massachusetts

CIRCLE 910 ON CAREER INQUIRY FORM

CAREER OPPORTUNITIES BROCHURES

RCA

" A New Girl in Town" is an illustrated folder designed to help the interested applicant and his family visualize the advantages of suburban life when associated with RCA's Semiconductor and Materials Division, Somerville, N.J.

Mr. R. W. Baumann, Employment Mgr., Radio Corporation of America, Semiconductor and Materials Div., Dept. ED, Somerville, N.J.

CIRCLE 870 ON READER-SERVICE CARD

Sylvania

"Today and Tomorrow With Sylvania" is a 15-page booklet geared to inform the new engineer and the college student of the present opportunities which are available in the fields of television, radio, lighting, electronics and photography at Sylvania.

This information is listed under the headings: Present Objectives, Decentralized Production, Centralized Adminstration, Orientation, Locations and Products, Engineers and Scientists, and Types of Positions.

On-the-job photographs supplement each section. Company policies and employe benefits are listed.

David W. Currier, Supervisor of Professional Placement, Sylvania Electric Products Inc., Dept. ED, 1740 Broadway, New York 19, N.Y.

CIRCLE 871 ON READER-SERVICE CARD

PAGES
MISSING
ARE NOT
AVAILABLE