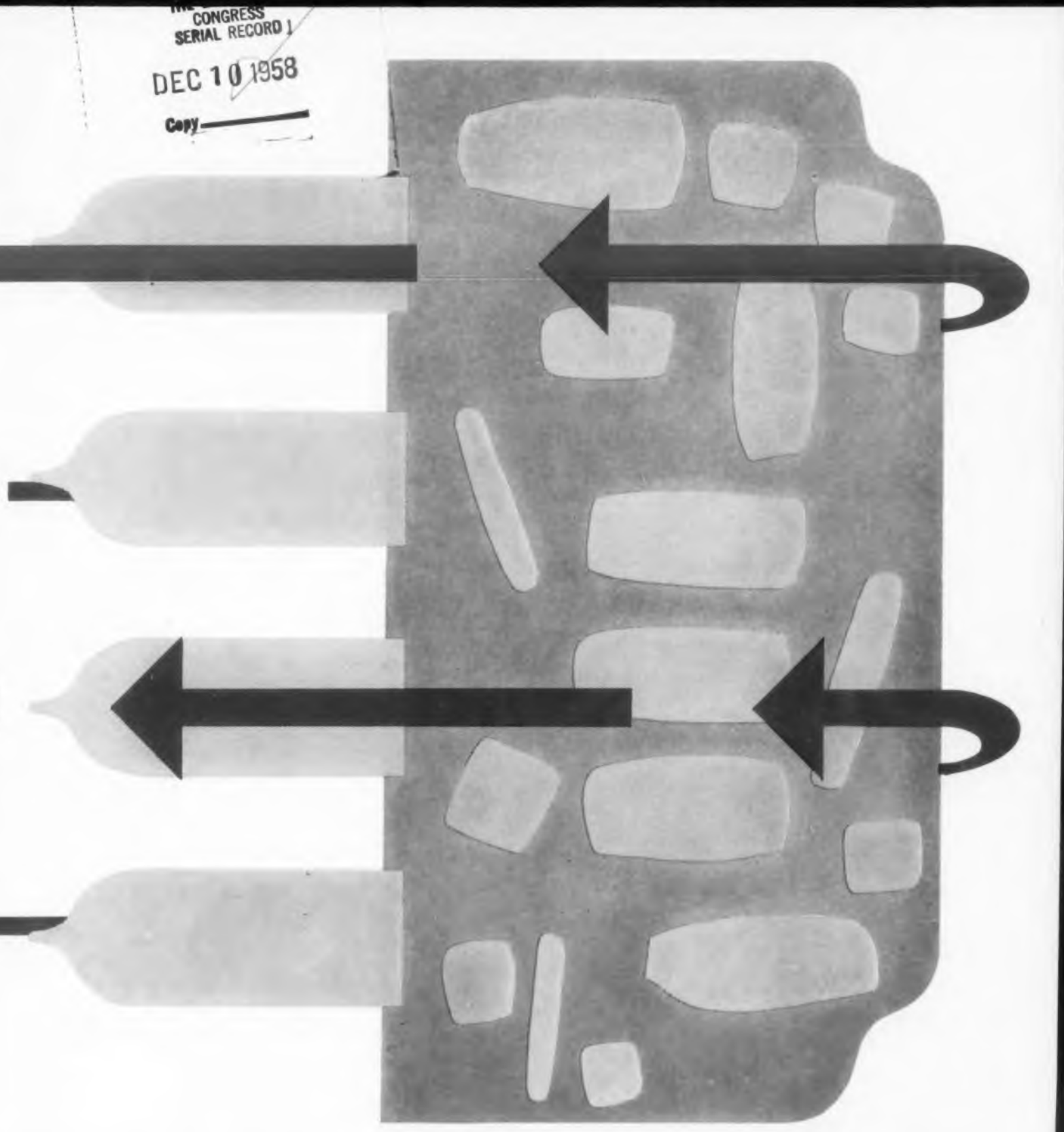
ELECTRONIC DESIGN



HIGHLIGHTS OF ISSUE

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Thousands of significant developments happened in 1958. ELECTRONIC DESIGN will attempt to pull all of these events into focus for the design engineer in its December 24 issue.

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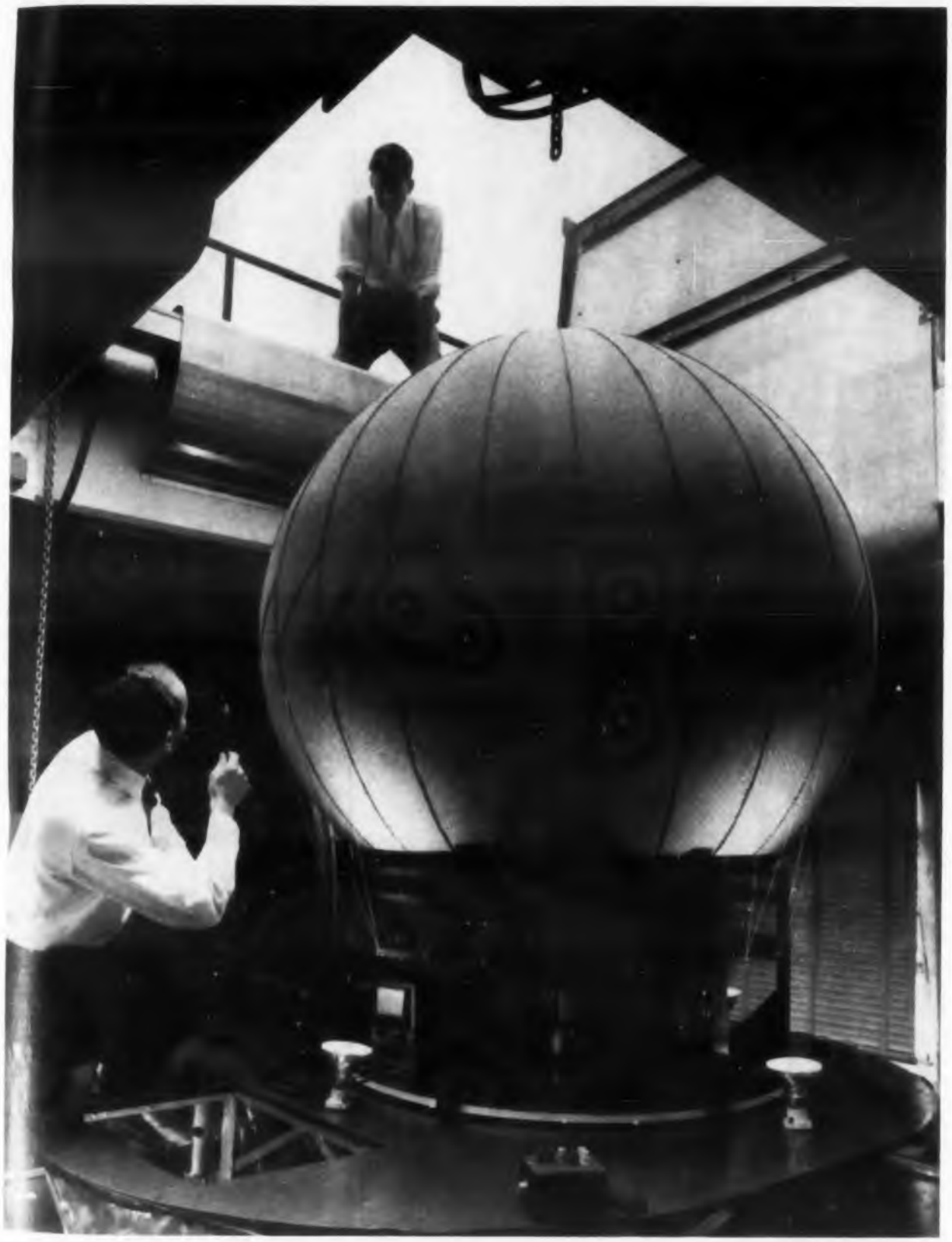
BEHIND THE NEWS



New Radar Antenna Scans The Sky Without Moving

With 50 yards of drapery material bought in a Pittsburgh department store, Westinghouse scientists have built a working model of a new radar antenna which they say may be the forerunner of future antennas for powerful, long-range anti-missile radars.

Known as a Helisphere, it concentrates high-frequency radar waves into an intense, narrow, moving beam, scanning the sky in a complete circle without any motion of the antenna structure itself.

Dr. John W. Coltman, manager of the electronics and nuclear physics department, Westinghouse Research Labs, explained:

"A nonrotating design permits faster scan and track rates, and eliminates the driving power normally required to turn it. Antenna construction is simplified, and the problem of rotating bearings—especially acute in large ground-based

(*continued on following page*)

Ready to emerge through roof of Westinghouse Research Labs for its first test is six-foot model of Helisphere, an inflated drapery-material antenna which produces a rotating radar beam without rotation of the antenna structure itself.

BEHIND THE NEWS

radar systems—is done away with. The Helisphere secures these advantages by substituting motion of radar energy inside the antenna for the customary rotation of the antenna structure itself."

Immovability of the structure would be particularly effective for stations of the early warning lines.

The Helisphere antenna is a sphere, either inflated like a balloon or rigid like a globe. Imbedded in the surface are narrow metal conducting strips wound in an endless spiral shape, or helix. In the drapery-material model, the helix was formed by the decorative metallic threads woven into the fabric when it was loomed. The fabric was placed around a rubber bladder inflated with air.

In operation, polarized radar waves are sprayed against the inside surface of the sphere so they vibrate parallel to the conducting strips and reverse their direction.

Portable Luxury

Described by Zenith as "the world's most elegant clock radio," the $150 cordless, all transistor "Golden Triangle" powers its Swiss clock with a single flashlight "D" battery, its AM radio receiver with four mercury flashlight batteries. The three-sided die cast cabinet, with satin and gold surfaces, rotates at a touch to show its faces—the clock, radio dial and radio speaker grille. Designed for "move about" use, it includes a wake-to-music alarm.

Extensive studies in daylight photography of stars and planets through use of the "Cat Eye" are being conducted at Wittenberg College Observatory, Springfield, Ohio.

Direct View of Full Moon Photographed by "Cat Eye"

"Cat Eye," the new Air Force-Westinghouse opto-electronic telescope permitting previously impossible daylight photos of planets and stars, already has been used to produce a 40-in.-wide composite picture of the full moon. More than 200 separate frames show details invisible to ordinary photographic methods.

Because the moon was shot in direct view, the distortion accompanying photos made at oblique angles was eliminated. Oblique photographing heretofore had been necessary so shadows would produce sufficient contrast. Direct view was made possible because "Cat Eye" is three to four times more sensitive to white light than tubes previously used for telescopes, and is particularly sensitive to longer wave lengths in the spectrum from yellow to red.

Now in operation at Weaver Observatory, Wittenberg College, Springfield, Ohio, "Cat Eye" operates on principles similar to closed circuit TV, but contains an optical amplifier affording a sensitivity more than 1000 times that of an ordinary TV camera, and 10,000 times that of the best photographic film.

Images picked up through the 10-in. refracting telescope are transformed into electrical impulses by the camera tube, and are made visible on a cathode ray tube after passing through the video amplifier. Photographs then are made from the face of the picture tube.

"Cat Eye" may be the means of announcing the arrival on the moon of an earth-launched rocket, say its developers. It's the conception of Radames K. H. Gebel, civilian scientist at the Wright Air Development Center's lab.

BEHIND THE NEWS

Model of solar-propelled space ship, which may provide man's simplest and cheapest transportation to nearby planets, is studied by Westinghouse aerodynamicist, Dr. T. C. Tsu.

Solar Sails May Propel First Space Explorers

When man explores the solar system, he may travel in space ships propelled simply and cheaply by sails—"solar sails" of aluminum foil or lightweight plastic unfurled to capture the sun's energy.

Explorers have employed the principle of the sail for 3500 years, and for 85 years man has known that light exerts a small but definite pressure when it shines on a body such as a sail. But now a Westinghouse Research Lab aerodynamicist, Dr. T. C. Tsu, has utilized the theories in constructing a model of a space ship with solar sails no more than one-thousandth of an inch thick.

His space ship would be launched by rocket, but once in orbit the parachute-shaped sail could be unfurled and attached to a gondola carrying payload and crew.

For a 1000-lb payload, Dr. Tsu estimates the sail diameter at 1600 ft—"somewhat larger than the Pentagon." But where a rocket ship with a one-ton payload would have to weigh 73 tons for a Mars round trip, a solar sail ship—requiring no fuel—would weigh little more than one ton.

Such a propulsion method not only is cheap but it can be realized quickly. "The necessary basic information," says Dr. Tsu, "already is at hand and no extensive research is required."

"Ham" Sends 16,000 Miles With Tiny Low-Power Set

With a power input to his final amplifier of only 90 milliwatts supplied by a 15-volt battery, a "ham" with a small transistorized transmitter has sent readable signals 16,000 miles from Ontario, Calif., to Johannesburg, South Africa. Donald L. Stoner (W6TNS) said his circuit consists of an RCA-2N371 crystal-controlled oscillator driving an RCA-2N370 as a class C radio frequency amplifier. Both are pnp alloy-junction "drift" transistors.

Texas Instruments Wins Landis Contest Awards

Three work simplification training films prepared by Texas Instruments Inc. won awards in the Ralph H. Landis Methods Improvement Competition in Chicago. The motion pictures were part of a work simplification program expected to save the Semiconductor-Components Division $700,000 this year.

Tiny "Brains" Seen For Vending Machines

Doubling of sales in the automatic merchandising industry within the next five years will go hand in hand with new advances in control systems, says D. M. Strathern, Controls Co. of America v-p.

Vending machines of the future, he told the National Automatic Merchandising Assn.'s 22nd annual convention in St. Louis, will have controls with the same degree of efficiency achieved by giant electronic computers. But they must be much smaller—in effect, miniaturized control systems.

Research aimed at modification, simplification and miniaturization of controls is being intensively directed, Strathern said, toward solution of control problems.

These include such vending factors as mixing or blending, meter or measure, stop and start, control pressure, temperature and flow, control pressure differential, and control rotary or lateral motion.

CIRCLE 7 ON READER-SERVICE CARD ➤

BEHIND THE NEWS

For Remote Stations Like DEWline: Portable Reactors

The first Argonne Low Power Reactor (ALPR) has been installed at Idaho's National Reactor Testing Station to train personnel in operating subsequent models—portable "package" power plant reactors considered ideal for such remote installations as DEWline radar bases.

The twin-function ALPR is designed to produce 200 kw of electricity, and 400 kw of space heat—the power for radar equipment, the heat for offices and barracks.

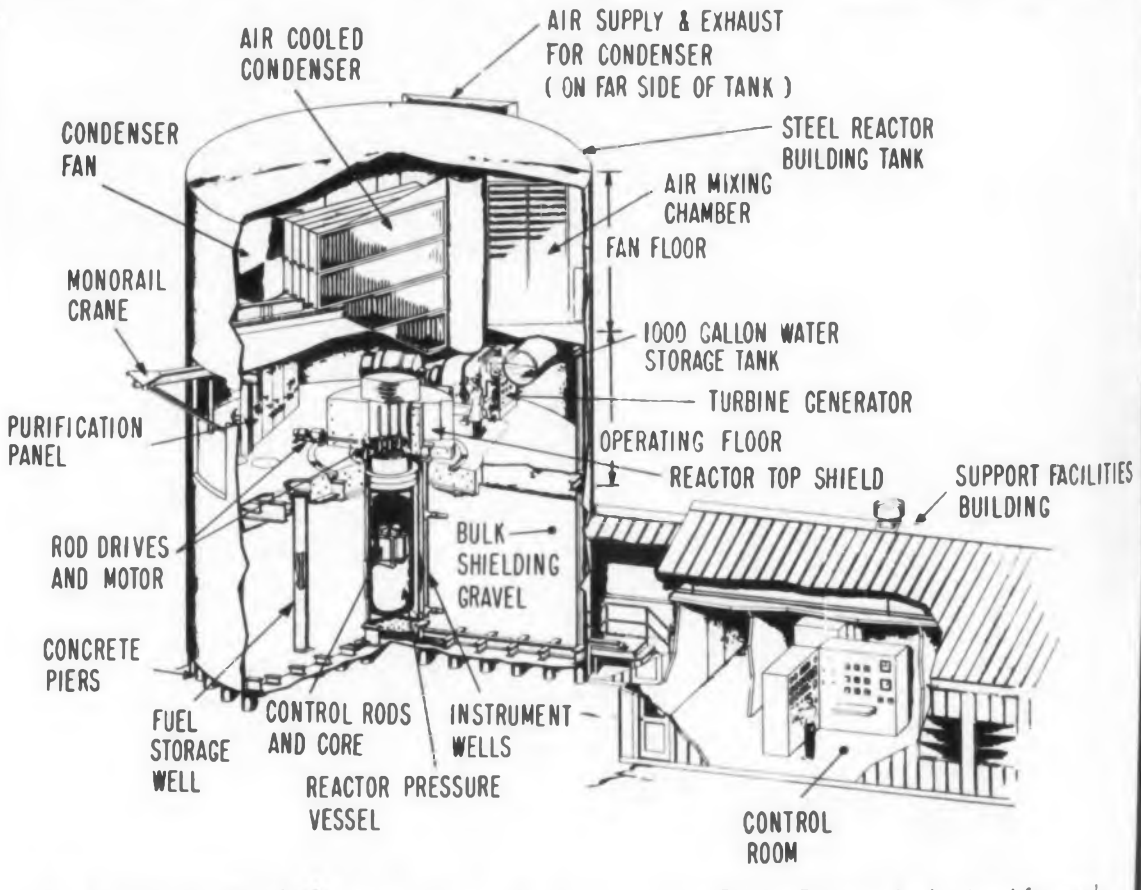
Designed and engineered at Argonne National Laboratory, Lemont, Ill., it was dedicated Dec. 2, the date pinpointed by the AEC as the 16th anniversary of the birth of atomic energy.

The ALPR, for which Pioneer Engineering and Services of Chicago did the mechanical and engineering design, is a direct-cycle boiling water reactor of 3000-kw gross reactor heat, with enriched uranium fuel. It is moderated and cooled by natural circulation of ordinary water, is air transportable, and has a high degree of inherent safety.

The Army Reactors Branch of the AEC calls ALPR "a major step in development of nuclear power" for such isolated areas as DEWline radar stations, and cites these advantages:

- It is designed for easy transportation in Air Force cargo planes, with no single component weighing more than 20,000 lbs or measuring more than 20 x 7 x 9 ft.
- It operates continuously for three years with a single fuel loading.
- It is simple to operate and maintain; continuous supervision may not be necessary because of automatic controls for the reactor and power-generating equipment.

(continued on next page)



Easily transportable in cargo planes, this Argonne Low Power Reactor is destined for such remote stations as DEWline radar bases. It provides 200 kw of electricity, 400 kw of heat.

■ ... requires minimum on-site construction, no ex...vation, and maximum use of site components. Ordinary gravel is used as a shield against radio...tivity.

■ It ...needs a minimum supply of water, as the all-al...inum condenser is air-cooled.

A ...w aluminum-nickel alloy (X-8001) was used ...xtensively; fuel elements were clad with the al...oy, and it was used to fabricate the entire reactor core, with the exception of minor items. X-8001 is inexpensive to fabricate and process, and should have great resistance to corrosion at high temperatures and pressures.

In operation, saturated steam is generated in the ALPR pressure vessel at 300 lbs per sq in. and at 420 F. About 85 per cent of the steam generates power; the rest bypasses the turbine and can be used for space heating.

Among the "firsts" resulting from ALPR's development were (1) practical application of aluminum-clad fuel elements for a reactor power plant, and (2) use of an air-cooled condenser made entirely of aluminum.

Atomic-Age Giant

Berke...y Nuclear Power Station, Gloucestershire, Eng. due ...r completion in 1960, is one of several large nucle... power stations now under construction in Brita... It will have two reactors, 16 giant heat exchan...rs, and an output of 275,000 kw. The first of Berk...y's heat exchangers is being placed in position. 70 f...igh, 17-1/2 ft. in diam, it weighs 133 tons.

WASHINGTON REPORT

Airframers Edge Deeper Into Electronics

Airframe workers' request for a new and broader wage floor from the Labor Department is fraught with serious implications to the electronics industry. Immediately affected, if the Labor Department should rule in favor of the aircraft companies, are the manufacturers of both airframes and electronics—such as General Electric and Philco. They would be forced to bring into line the wages of airframe workers with their electronics people working on the same project. The airframers' proposal would tend to confuse wage rates throughout the missile and aircraft companies, irrespective of major product. Zenith, for example, would have to pay the missile electronics worker at a rate differing from the TV electronics man—although the job may be similar.

Obviously, this determination would tend to equalize wage rates for all missile workers from coast to coast. It puts the airframe manufacturers in a better position to bid on electronics proposals in competition with non-airframe companies in the East and Midwest.

The wage determination is just one in a series of steps the airframe manufacturers are taking to achieve balance between productive capacity and demands for their services. Republic Aircraft's new multi-million dollar research center is going to be well staffed with electronics people.

Douglas Aircraft has recently set up a new organization called Weapon Systems. Its main jobs are to keep top management informed of military WS programs in being and planned, so as to develop plans to get Douglas into them.

At Chance Vought, former Space Technology Lab scientist Dr. James F. Reagan has been hired to head up a new, "full-fledged" electronics department. So far the department has concerned itself with products for its own programs —but will soon branch out into the competitive market in such fields an antenna design, stabilizing systems, aircraft instrumentation, and ground support equipment.

In spite of Defense Department directives to the contrary, Convair is going ahead with the Wizard anti-ballistic missile program with its

newly won funds. But this is only one of many strictly electronics projects Convair engineers are concerned with. One of great interest is applied research in antigravity techniques.

Nortronics Division of Northrup Aircraft is making a mark with its Datico. This "go, no-go" test instrument is said to save about $150 million in the testing of missile components. The Air Force has ordered the unit, and Nortronics is now working on an Army version.

The attraction to electronics by the aircraft industry is underscored by recent fiscal reports by Douglas. Nine-month earnings were less than two per cent.

Where Do You Stand?

Defense contracting, by anybody's yardstick, is big business. DOD's listing of military prime contractors shows the first ten divided $5.8 billion of nearly $12 billion awarded during 1957 to the top 100. The $12 billion figure represents 69.1 per cent of a total defense procurement budget of $17.3 billion. Over the years — since July, 1950 — the top ten contractors have been represented by aircraft firms. Gradually, wholly electronic firms have crept into the coveted lineup. Some airframe manufacturers have solidified positions by going into electronics.

For the 1957 period, the top ten, in order of income, were: General Dynamics Corp. ($1.1 billion), General Electric Co. ($916 million), United Aircraft Corp. ($699 million), Boeing Airplane Co. ($638 million), American Telephone and Telegraph Co. ($471 million), North American Aviation, Inc. ($456 million), Hughes Aircraft Co. ($369 million), Chance Vought Aircraft, Inc. ($341 million), Martin Co. ($322 million), and General Motors Corp. ($309 million).

General Motors, which is actively searching every avenue to become more intimately associated with the missile business, moved up from position 16 during the 1955-1957 period. Significantly, Ford Motor Co., equally seeking missile contracts, moved down from the 12th slot for the earlier period right out of the top 100.

Douglas Aircraft, which publically avows that it wants to stay out of electronics, moved out of the top ten into position number 17.

But electronics remains all-powerful in this listing of the most influential manufacturers in the country. Going down the list after the first ten are: IBM (13), Sperry-Rand (14), Westinghouse (21), Raytheon (23), American Bosch Arma (27), RCA (31), IT & T (34), Collins Radio (39), MIT (45), Philco (49), Minneapolis-Honeywell (51), Ramo-Wooldridge (57), General Precision Equipment (58), Burroughs (60), Westinghouse Air Brake (69), Rand Corp. (79), Lear, Inc. (84), Hazeltine (88), Gilfillan Bros. (91), Johns Hopkins U (96) and Motorola (97).

NEWS BRIEFS . . .

. . . **UNDERWATER COMMUNICATI(S IS NEEDED** by the Navy if it is to play its le in controlling the seas, on, under, and ov The Navy's super weapon, the missile-bearing tom-powered sub, can operate as an inflexibl pre-programmed device only if underwater co mu-nication techniques are not improved. Naval operations is generally concerned. They nee l sys-tems to talk to both subs and aircraft.

. . . **RADAR JAMMING SIMULATOR** in pro-duction run at Fairchild Engine and Airplane Corp. Device will train radar operators to recog-nize various types of jamming so that they may learn to read through them. Simulator is used with radars in the 1220-1350 mc range. Basic rf signal can be cw or varied with sine wave, square wave, pulse or noise modulations. Means for sweeping the rf signal over the complete tuning range in 50-mc sectors are included.

. . . **LOCALIZED SOLDER COATING** in the production of printed circuits allows the solder to be applied only to the areas of electrical con-tact. Method is reportedly up to twenty times faster than methods now in use. Miller Dial & Name Plate Co., El Monte, California has in-troduced method.

. . . **NEW RADAR EQUIPMENT** for the B-52 bomber boosting its protective coverage from all angles about ready to roll from GE. The new "black box" developed by the GE division is under a $5-million sponsorship of the Air Research and Development Command. Forward surveillance radar integrates with other elec-tronic systems in feeding data to a common display indicator (scope watched by an opera-tor in a B-52).

. . . **ULTRA-FLEXIBLE COMPUTER,** which can change is own internal structure to solve a broad range of problems, is in the planning stage at National Cash Register's Los Angeles elec-tronics division. Aimed at solving problems in the handling, storage and use of high-energy liquid rocket fuels, the machine is being hailed by NCR as the most flexible yet devised, "the first true general-purpose computer."

. . . **JOB OF RCA'S** new high-level Advanced Military Systems, which is to get its own Prince-ton, N.J., building, will be to "spearhead studies leading to the creation of new, complex and ever more effective weapons systems," says RCA. Dr. Nathaniel Korman is director.

CIRCLE 194 ON READER-SERVICE CARD

MICROWAVE INSTRUMENTATION

Coming Soon . . .
New printed circuit Standing Wave Amplifier.

BROADBAND SPECTRUM ANALYZER, 701

Type L701A: 950 to 2000 Mc/s (Fund.)
Type S701A: 1900 to 4000 Mc/s (Fund.)
Harmonic Operation: to 16,000 Mc/s
Swept IF: 7 Kc and 50 Kc
Sweep Width: 50 Mc
RF Attenuator: 100 db Range
Video Markers

SIGNAL SOURCES, 771, 772

Type L771B: 950 to 2000 Mc/s
Type S771B: 1900 to 4000 Mc/s
Type C772A: 3950 to 8200 Mc/s
Type X772A: 7000 to 11,000 Mc/s
Output Power: 50 mw (average)
Direct Reading Frequency Dial: 1%
Internal Modulation: Pulsed. Square Wave, C.W.
Integral RF Level Set Attenuator

UNIVERSAL RATIOMETER, 811

(COMBINED RATIO METER AND STANDING WAVE AMPLIFIER)

RATIO METER—1000 cps operation
VSWR Ranges: 1.02 to 1.22, 1.20 to ∞
Reflection Coefficient: .01 to .1, .1 to 1.0
Other Scales: db. Slotted Line VSWR
Standing Wave Amplifier—1000 cps operation
Range: 70 db in 10 db steps
Noise Level: .03 mv
Scales: VSWR, db, Expanded VSWR
Bolometer Bias: 4.5 and 8.75 ma
Input Impedance: 200 ohms or 200 K ohms

UNIVERSAL KLYSTRON POWER SUPPLY, 815

Beam: 200 to 2000 V, 125 ma max., 1800 to 3600 V, 100 ma or 250 W max.
Reflector: 0 to 1000 V
Control Grid: −300 to 0 to +150 V, 5 ma max.
Regulation: 0.03%
Ripple: 3 mv max.
Internal Reflector Modulation: Square Wave, Pulse, Sawtooth, Sine Wave

UNIVERSAL MICROWAVE POWER SUPPLY, 817

Helix or Beam: 0 to 1800 V, 125 ma max. 1700 to 3500 V, 100 ma or 250 W max.
Collector: 0 to 300 V, 100 ma max.
Anode: 0 to 600 V, 60 ma max.
G-1: 0 to 300 V, 5 ma max.
G-2 or Reflector: 0 to ±1200, 1 ma max.
G-3: 0 to ±750, 1 ma max.
G-4: 0 to ±500, 1 ma max.
Regulation: 0.03%. **Ripple:** 3 mv max
Heater: 0 to 15 V D.C., Regulated.
Internal G-1 or G-2 Modulation: Sine Wave Square Wave, Pulse, Sawtooth

KLYSTRON POWER SUPPLY, 819

Beam: 300 to 1000 V, 85 ma max.
Reflector: 0 to 900 V, 20 μa max.
Control Grid: −300 to 0 to +150 V, 5 ma max.
Regulation: 1%
Ripple: 7 mv max.
Internal Reflector Modulation: Square Wave, Pulse, Sawtooth

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EDITORIAL

Go, No-Go, No Good

My 1956 Ford, like everyone else's late model car, doesn't have an ammeter. A red light warns me if my battery is not charging. I don't know the rate of discharge. Consequently, I was caught with a dead battery after a few weeks of hard starting. My down time was about an hour. If I were equipped with a 95¢ ammeter I would have realized that I was requiring a maximum charge rate all of the time and that the battery was depleting itself. I could have remedied the hard starting before it caused serious down time. With all the emphasis on go, no-go test equipment in the electronics industry, I hope we know the true technical state of affairs. I hope our missiles will be ready to go if or when the time comes.

Go, no-go equipment is ideal for production line testing. This philosophy of testing can fail, however, to fully indicate operational readiness or to predict trouble-free operating time. When go, no-go tests are used by equipment operating personnel in the field, there can be huge wastes of manpower. We have heard of missiles being shot back to the factory because they registered no-go. The factory inspectors' tests said go. You can easily imagine the time lost in resolving the differences.

A man in the field with a quantitative indicator can be taught to use his head. He can then be employed as a human being rather than a two-condition robot. Light green: module stays; light red: module replaced. Admittedly, go, no-go equipment seems quite desirable because you don't have to count on the judgment of G.I.'s. But does this philosophy of test make the best use of available manpower or brainpower? What about over-all logistic problems? Do we really know when to adjust or repair in the field and when to go to a higher echelon repair or test station? When all we require of a man is sub-moronic intelligence, there is room to doubt. What kind of systems thinking has been given to this problem? What do the human-factors psychologists say? Fast check-out requiring go, no-go answers are often essential, but the degree to which yes or no is right, is crucial. There are few black and white answers in this world and one could doubt if red and green are any better absolutes.

James G. Ryptes

Microwave Test Instruments

Part 1

David Fidelman

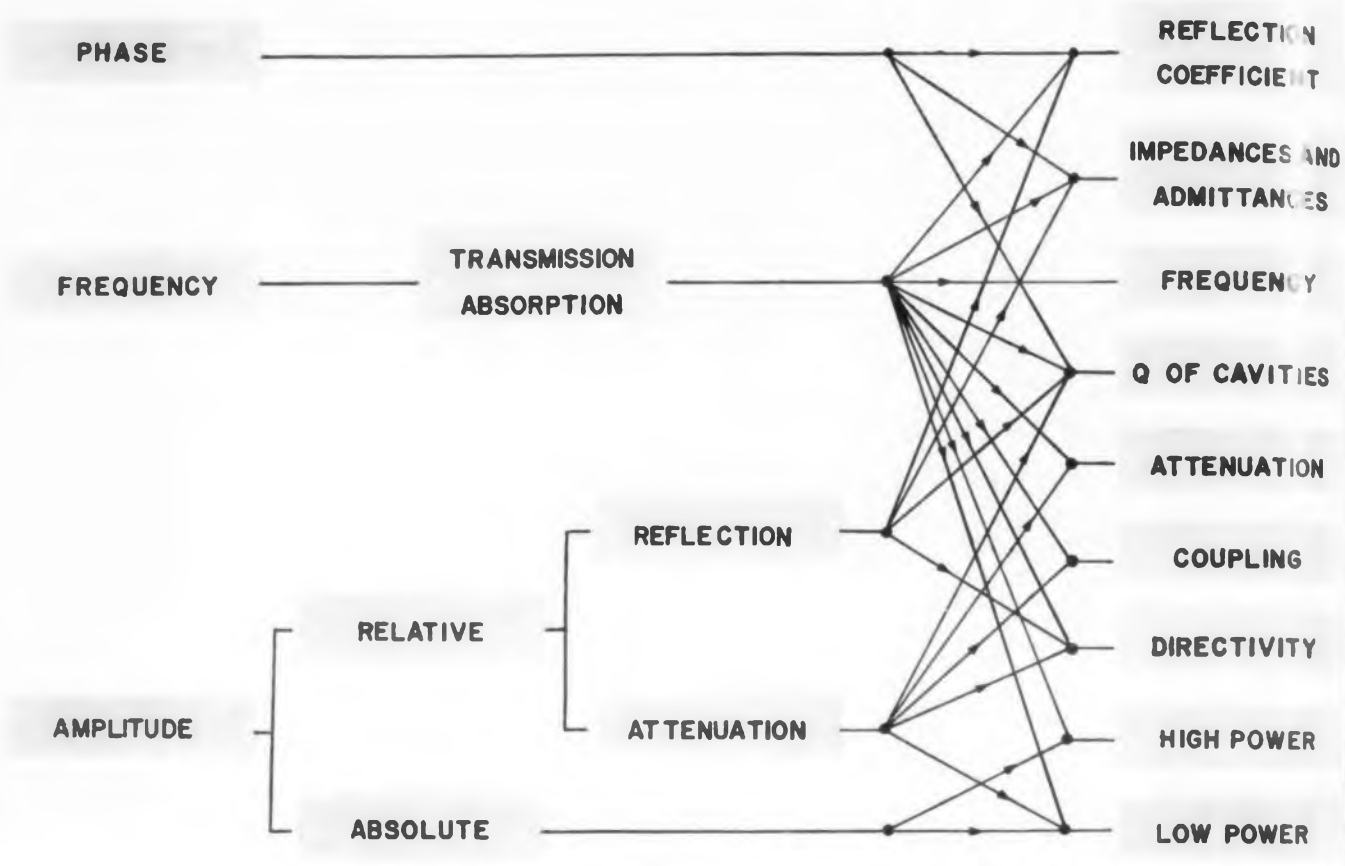


Fig. 1. Classification of microwave measurements

This series of articles on microwave test instruments should help the design engineer pick the proper instrument to do a proper job of measuring. The six parts to appear will discuss the following:

Part 1. Types of measurement

Includes a table of different measuring techniques and a list of manufacturers.

Part 2. Signal Generators

Describes and tabulates signal generators.

Part 3. Typical Test Setup

Included in this section is a description of test sets, terminations, attenuators and directional couplers, slide-screw and stub tuners, phase shifters and adjustable shorts.

Part 4. Power and Frequency Measuring Equipment

Available power and frequency meters are tabulated.

Part 5. Impedance Measuring Equipment

Slotted lines, VSWR indicators and impedance indicators and displayers are discussed.

Part 6. Miscellaneous Instruments

This concluding article will discuss such accessory equipment as spectrum analyzers, wave guide benches and test stands, crystal calibrators, standard gain horns, echo boxes and microwave receivers.

TECHNIQUES and instruments for microwave measurement are considerably different from those used at lower frequencies. The outstanding difference is the use of hollow waveguides as transmission elements, with coaxial lines also being used at the lower microwave frequencies. The range of frequencies in the microwave spectrum is not accurately defined. But this series of articles will include all instruments designed to have a major part of their operating frequency range above 100 mc. Almost all of the coaxial line and wave guide instruments will be included in the tables and listings.

Types of Measurements

The microwave measurement classification shown in Fig. 1, lists some of the more important specific measurements currently made in laboratories. The chart lists the different types of measurements and classifies them in several different ways: measurements of amplitude, frequency, and phase.

A further subclassification of these different measurements of can be considered as:

Absolute amplitude (or power) measurements to determine the total energy in the signal relative amplitude measurements, if a comparison is required between the amplitudes of two signals at the same frequency, regardless of the absolute values. These may be subdivided into:

1. Attenuation measurements, to determine the relative amplitudes at two different points in the system.
2. Reflection measurements, to determine the relative amplitudes of two waves traveling in opposite directions at some point in the system.

Frequency measurements are always absolute, but may be subdivided according to whether they are made with an absorption, transmission, or reaction type of wavemeter. However, this subdivision refers to the method of measurement, and not to the measured quantity. Phase measurements are always relative, since they always require definition of a reference plane.

A summary of the different types of measurements which are made in microwave work is given in Table 1. This table lists the types of input and output signals required to perform each measurement, the method of measurement, and

TABLE 1. DIFFERENT TYPES OF MEASUREMENT

Type of Measurement	Type of Signal	Signal Source	Measuring Instrument	Manner of Measurement	Accessories Required	General Comments
Power measurement	CW, Pulsed, Modulated or Noise	Equipment under test	**Calorimeter power meter**	**Temperature rise measured**		**Generally useful only for large powers**
			Bolometer power meter	Measures changes in resistance due to heating	Bolometer mounts, attenuators, bolometer bridges	Useful for powers up to several milliwatts
Frequency measurement	CW, Pulsed or Modulated	Equipment under test, signal generator, or frequency reference	Cavity wavemeters Slotted sections	Frequency of reaction in system or transmission of maximum power is measured Measure wavelength from VSWR	Attenuators, directional couplers, stub tuners, crystal mount and power meter, crystal frequency calibrators	Slotted sections accurate 0.1 to 5 per cent; cavity meters accurate 0.01 to 0.1 per cent; use of crystal reference standards permits accuracies of 0.02 to 0.0001 per cent
Impedance and Admittance	Variable-frequency modulated (CW)	Signal generator	Slotted line, probe, and VSWR indicator	Reflection coefficient measured and impedance plotted on Smith chart	Attenuator, frequency meter	Measurements made at various frequencies; accuracy depends upon slotted line
	Variable-frequency sweep-frequency signal	Signal generator	Impedance plotter	Impedance indicated directly on oscilloscope with chart reticle	Attenuator, frequency meter	Measurements made directly; eliminates need for point by point measurement and plotting
Attenuation	Modulated (CW)	Signal generator	Crystal or bolometer mount and power meter	Substitution method is used—measure tested component against known value of attenuation	Variable attenuator	Not accurate for small values of attenuation because resolution of test equipment is generally too low
Reflection coefficient and VSWR	Modulated (CW)	Signal generator	Slotted line, probe and VSWR indicator	(a) Measure ratio of maximum and minimum field with VSWR indicator, and distance between max. and min. (b) Measure required attenuation to give same maximum and minimum reading on meter	Termination, calibrated attenuator	Method (b) gives more reliable readings when VSWR greater than about 3
Measurement of Q	Modulated	Signal generator	Slotted line, probe and VSWR meter	Measure reflection coefficient at three equally spaced frequencies near resonance then obtain Q graphically on Smith chart	Attenuator, frequency meter	Suitable for low Q measurements
	Sweep-frequency signal	Signal generator	Precision wavemeter, crystal mount, oscilloscope	Frequency response is indicated on oscilloscope; 3 db points are measured with wavemeter and precision attenuator	Precision attenuator, directional coupler	Suitable for low Q measurements
	Pulsed	Q meter	Q meter	Amperes rate of decay of free oscillations in cavity under test with rate of discharge of known capacity into known resistance		Does not require highly stable oscillators, or accurate frequency or attenuation settings; accuracy of measurement ±1 per cent.
Frequency spectrum analysis	Signals in frequency band under observation	Equipment or other source under test	Spectrum analyzer	Frequency band is displayed on screen of oscilloscope; signal amplitudes are displayed vertically, at horizontal positions corresponding to frequencies	Attenuators, directional couplers, etc.	Resolution depends on speed of sweep and bandwidth of analyzer
Noise measurements	Noise level of system and comparison signal of known level	Equipment under test and reference signal generator	Power indicator	Known amount of signal is added to the input, and noise level is determined from the change in output level	Directional coupler, precision attenuator	Comparison signal which is added must be of same order of level as noise in system; care must be taken not to mismatch input by insertion of test signal
Antenna measurements	CW or modulated	Medium or high power signal generator and auxiliary antenna	Antenna under test, receiver and power meter	Antenna under test is illuminated by auxiliary antenna, and gain on pattern measured	Standard gain horn, directional couplers, attenuators, frequency meter, crystal mount and power meter	Power required from signal generator depends upon noise level and required dynamic range; servo drive and automatic plotter may be used for pattern measurements
Radar performance	Pulsed	Radar under test	Radar under test	Small portion of transmitter signal is coupled into echo box.	Echo box, directional coupler, attenuator	Simple method of checking some of the basic performance characteristics of radar systems.

the instruments and accessories required.

Types of Microwave Instruments

Microwave instruments fall into certain logical categories as listed in the introduction. The names and addresses of all the leading manufacturers of microwave test equipment are shown below*.

* Based upon a survey by ELECTRONIC DESIGN and verified by Technical Information Corp., 41 Union Square, New York 3, N.Y.

MANUFACTURERS

Acton Labs., Inc.
533 Main St.
Acton, Mass.

Admittance-Namco Corp.
Farmingdale, L.I., N.Y.

Airborne Instruments Laboratory, Inc.
Mineola, L.I., N.Y.

Aircraft Armaments, Inc.
Cockeysville, Md.

Airtron, Inc.
Linden, N.J.

Alford Mfg. Co.
299 Atlantic Ave.
Boston, Mass.

Alfred Electronics
897 Commercial St.
Palo Alto, Calif.

Amerac, Inc.
116 Topsfield Rd.
Wenham, Mass.

Andrew Corp.
363 East 75 St.
Chicago, Ill.

A. R. F. Products, Inc.
7627 Lake St.
River Forest, Ill.

Barker & Williamson, Inc.
237 Fairfield Ave.
Upper Darby, Penn.

Bird Electronic Corp.
1800 East 38 St.
Cleveland, Ohio

B J Electronics (Borg-Warner Corp.)
Santa Ana, Calif.

Bogart Manufacturing Co.
315 Seigel St.
Brooklyn, N.Y.

Browning Laboratories, Inc.
Winchester, Mass.

Cascade Research Corp.
53 Victory Lane
Los Gatos, Calif.

California Technical Industries
Belmont, Calif.

Chemalloy Electronics Corp.
Gillespie Airport
Santee, Calif.

Cubic Corp.
5575 Kearney Villa Road
San Diego, Calif.

DeMornay-Bonardi Corp.
780 S. Arroyo Parkway
Pasadena, Calif.

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

Dorsett Lab., Inc.
401 East Boyd
Norman, Oklahoma

Douglas Microwave Co.
252 East 3 St.
Mount Vernon, N.Y.

Dynac, Inc.
395 Page Mill Road
Palo Alto, Calif.

Empire Devices Products Corp.
38-15 Bell Boulevard
Bayside, N.Y.

Engineering Associates
434 Patterson Road
Dayton, Ohio

Entron, Inc.
Box 287
Bladensburg, Md.

Espey Manufacturing Co., Inc.
528 East 72 St.
New York, N.Y.

Federal Telephone & Radio Co., Inc.
100 Kingsland Road
Clifton, N.J.

Ferranti Electric, Inc.
30 Rockefeller Plaza
New York, N.Y.

Ferris Instrument Co.
Boonton, N.J.

F-R Machine Works, Inc.
26-12 Borough Pl.
Woodside, N.Y.

Frequency Standards
P. O. Box 504
Asbury Park, N.J.

General Communication Co.
681 Beacon St.
Boston, Mass.

General Radio Co.
275 Massachusetts Ave.
Cambridge, Mass.

Gertsch Products, Inc.
3211 S. La Cienega Blvd.
Los Angeles, Calif.

Hewlett-Packard Co.
275 Page Mill Road
Palo Alto, Calif.

Hickok Electrical Instrument Co.
10514 Dupont Ave.
Cleveland, Ohio

Intercontinental Dynamics Corp.
170 Coolidge Ave.
Englewood, N.J.

Jarrell-Ash Co.
26 Farwell St.
Newtonville, Mass.

M. C. Jones Co., Inc.
Bristol, Conn.

Kay Electric Co.
14 Maple Ave.
Pine Brook, N.J.

Kearfott Co., Inc.
Little Falls, N.J.

Wayne Kerr Instruments
P. O. Box 81
Philadelphia, Pa.

Laboratory for Electronics, Inc.
75 Pitts St.
Boston, Mass.

Lambda-Pacific Engineering, Inc.
14725 Arminta St.
Van Nuys, Calif.

Lavoie Laboratories, Inc.
Morganville, N.J.

LIECO, Inc.
3610 Oceanside Rd.
Oceanside, N.Y.

Loral Electronics Corp.
794 East 140 St.
New York, N.Y.

Marconi Instruments
111 Cedar Lane
Englewood, N.J.

Maxson Instruments Corp.
47-37 Austell Place
Long Island City, N.Y.

Metronix, Inc.
Trumbull Airport
Groton, Conn.

Mico Instrument Co.
80 Trowbridge St.
Cambridge, Mass.

Microlab
71 Okner Parkway
Livingston, N.J.

Microwave Associates, Inc.
Burlington, Mass.

Microwave Development Labs., Inc.
92 Broad St.
Babson Park, Mass.

J. Millen Mfg. Co.
150 Exchange St.
Malden, Mass.

Narda Corp.
160 Herricks Rd.
Mineola, N.Y.

New London Instrument Co.
New London, Conn.

Northeastern Engineering, Inc.
Manchester, New Hampshire

Panoramic Radio Products, Inc.
520 South Fulton Ave.
Mount Vernon, N.Y.

Polarad Electronics Corp.
43-20 34 St.
Long Island City, N.Y.

Polytechnic Research & Development Co., Inc.
202 Tillary St.
Brooklyn, N.Y.

Presto Recording Corp.
Paramus, N.J.

Radar Design Corp.
3309 James St.
Syracuse, N.Y.

Radiation, Inc.
Melbourne, Fla.

Radio Corp. of America
Camden, N.J.

Radiometer
3355 Edgecliff Terrace
Cleveland, Ohio

Rohde & Schwarz
230 Garibaldi
Lodi, N.J.

Sanders Associates, Inc.
Nashua, New Hampshire

Scientific-Atlanta, Inc.
2162 Piedmont Rd., N.E.
Atlanta, Ga.

Sierra Electronic Corp.
3885 Bohannon Dr.
Menlo Park, Calif.

Sivers Lab
Stockholm, Sweden

Sperry Gyroscope Co.
Great Neck, N.Y.

Stoddart Aircraft Radio Co.
6644 Santa Monica Blvd.
Hollywood, Calif.

Technical Materiel Corp.
700 Fenimore Road
Mamaroneck, N.Y.

Technicraft Lab., Inc.
Thomaston, Conn.

Telechrome, Inc.
80 Merrick Rd.
Amityville, L.I., N.Y.

Telerad Manufacturing Corp.
1440 Broadway
New York, N.Y.

Telonic Industries, Inc.
Beech Grove, Ind.

Trad Electronics Corp.
1001 First Ave.
Asbury Park, N.J.

Transitron, Inc.
186 Granite St.
Manchester, N.H.

Uniwave, Inc.
109 Marine St.
Farmingdale, N.Y.

Van Norman Industries, Inc.
186 Granite St.
Manchester, N.H.

Varian Assoc.
Palo Alto, Calif.

Vectron, Inc.
1605 Trapelo Rd.
Waltham, Mass.

Wandel und Goltermann
230 Garibaldi Ave.
Lodi, N.J.

Waveline, Inc.
Caldwell, N.J.

Wave/Particle Corp.
P. O. Box 718
W. Caldwell, N.J.

Weinschel Engineering
10503 Metropolitan Ave.
Kensington, Maryland

Roger White Electronic Devices, Inc.
92 Fourth Ave.
Haskell, N.J.

Communicating in Space

Laurence D. Shergalis
Associate Editor

Gen. Urhane: Modernize communications now.

NEW METHODS of communication, with emphasis on space communications problems, were discussed at the Fourth National IRE Aero-Com Symposium, October 20-22nd in Utica, N.Y. First two sessions covered communications media and equipment, the third covered systems, and the fourth session was devoted to space communications.

Big topic of discussion outside the lecture room was 456L, the proposed Air Force global communications net. Many designers are looking forward to getting in on the early design phases of the project. It means designing an entirely new system from the ground up.

See New System Coming

Most engineers feel that a new digital communications system will result from 456L. However, controversy still exists between the "analog" men and those favoring a digital system. Higher speeds of getting the called station are a must. A method of working the military priority system into the net will involve much ingenious design thinking.

But the basic problem, engineers say, will be to find a common "language." Telephone, teletype, video, etc., must be translated into just one form for transmission. Another problem will be the modernization of existing facilities. We need more high-grade telephone circuits, faster switching and more automatic equipment. Many old problems will be getting increased attention.

Featured luncheon speaker was Brig. Gen. Francis F. Urhane, Deputy Chief of Staff, Communications and Electronics, NORAD. His topic was NORAD's communications problems. In modernizing its communication system, said Urhane, NORAD needs to standardize its equipment. Its plant facilities are outmoded; switching speed is too slow. There is a definite need to convert to automatic facilities. Present circuit quality must be improved. NORAD needs more high grade trunk circuits. There isn't time to waste in modernizing, he said. We must take the big jump into the future now.

Interference Studied

One of the most interesting papers presented at the technical sessions discussed results of IT & T's automobile ignition interference tests. Raymond Schildknecht, project engineer, presented results of interference tests on about 10,600 autos. Trucks, they discovered, generate about 10 times the electrical interference as autos. Also, spark plug suppressors are not too effective at the higher broadcast and TV frequencies.

A great deal of data was presented discussing results of long-range communications tests. In the first paper given, Rudolph Penndorf and Sam Coroniti, AVCO, investigated possibilities of reliable communications over polar routes. Their data is expected to be of importance to planning communications links between the U. S. and the Arctic. But the authors need processing facilities to put their data to use. Properly evaluated, they point out, their data will provide much useful information for both the theoretical ionospheric physicist and the practical engineer.

Terrain irregularities and weather are the principal causes of variations in radio transmission losses above 40 mc. Three National Bureau of Standards authors, P. C. Rice, A. G. Longley and K. A. Norton disclosed their prediction method and test data.

Study Pulse Distortion

Authors Losee and Lutz, Hughes Aircraft, have completed extensive investigation of ionospheric multipath distortion. Their paper warned that more extensive knowledge of multipath smearing is needed before applying some of the many pulse transmission techniques. Test indicated that there is frequent occurrence of abrupt phase changes during reception of any one pulse. But they also showed that the rate of phase change between portions of successive pulses was gradual. Results of test show that data transmission using millisecond pulses over distances of about 3000 miles are possible with little error.

S. C. Fritsch, Western Electric Co., reported on path loss studies for beyond-the-horizon radio systems. Data presented was the result of engineering studies on the White Alice communications net in Alaska. A method of estimating path loss was discussed as well as suggestions for im-

proving accuracy of estimates for knife-edge diffraction paths using the effective distance concept.

Using White Alice again as a test site, tests were made to determine if the network could be used for data transmission of 750 bits per second and higher. Using several different modes of transmission the authors, F. E. Willson and W. A. Runge, Bell Labs, found that high speed data may successfully be transmitted in a tropo-scatter system. But it must be a well engineered system, they say.

Frequencies between 100-10,000 mc are considered feasible for space communication. Thermal noise in receivers at these frequencies is a problem. L. P. Yeh, Westinghouse, limited his paper on space communication design to a discussion of thermal noise problems. A minimum usable carrier-to-noise power ratio depends upon the type of modulation used. An average acceptable figure seems to be about 15 db.

Two types of fading have been encountered in reception of signals from satellites. One has a period of seconds and is believed due to moon echos. Another, with a period of about an hour, is believed due to the Faraday effect. A fading margin of 10-20 db should be allowed for a workable system.

Many problems are still to be solved. The immediate problem, says Yeh, is to put up a large space vehicle with a high power transmitter and a large and elaborate antenna system. If this can be accomplished, more needed research can be done. Yeh believes that the time when the moon or a satellite can be used as a passive reflector is here now.

Communication between space vehicles and polar locations was discussed by Lt. William Stuart and Luther Kelley, U. S. Army Signal Radio Propagation Agency, Ft. Monmouth. Many unexpected propagation phenomena were reported during reception of Sputnik I signals. Long distance reception is dependent upon sunspot cycles and is affected by radio noise from the aurora. A great deal of data has been compiled giving variations in the number of useable frequencies with sunspot activity.

Reentry Problems

Other space communications problems discussed included regulation of space communication frequencies and communication during hypersonic reentry. Reentry communications are limited to two spectral regions: millimeter wavelengths and optical-infrared range. Transmission properties of the atmosphere determine these choice of operating frequencies. Also, thermal ionization of the air surrounding the vehicle on reentry attenuates signals in the normal range. ■■

Carl Tishler hopes that, as an outcome of this article, transistor manufacturers will produce transistors which are as uniform in the extended voltage range as they are in the low voltage ranges. There is a need to operate the transistors in these ranges.

He is a graduate of University of Michigan, BSEE. At Remington Rand Univac, he is a project engineer concerned with transistorizing computers and computer component design.

Rating Collecting to Emitter Voltage For Switching Transistors

Carl Tishler
Remington Rand Univac
Div. of Sperry Rand Corp.
Norwalk, Conn.

Here is a practical method needed by both users and manufacturers of switching transistors for accurately determining the maximum collector-to-emitter voltage rating. In many cases there actually exists as much as a two-to-one difference between the specified voltage rating and that at which a transistor can be safely used. Such a method has been developed and is described here.

TRANSISTORS for high current switching purposes are most frequently used in the common emitter configuration and biased at or beyond cutoff. The base is pulsed, driving the transistor into saturation which effectively connects the collector load to ground through a low impedance path. At the termination of the pulse, the circuit returns to its initial condition.

To make the collector current during saturation relatively independent of the drop across the transistor, the collector load resistor should be as large as possible. The designer has no choice in many cases where both current and resistance are specified. When the transistor is saturated, the amplitude of the collector current is simply the supply voltage divided by the total series resistance. To maintain a specified current when the series resistance is large, severe requirements are placed on the voltage rating of the transistor as the entire supply voltage bridges the transistor when cutoff. Thus, the voltage rating between collector and emitter is of great practical importance for many applications.

During high current switching applications, certain phenomena were observed which could not be explained by any available information. For example, it was found that the application of a single short duration pulse to the base of a reversed biased switching transistor could destroy the transistor. This led to a series of investigations to learn more about what was happening. A logical explanation was developed which led to the establishment of a new method of voltage rating transistors. Many experiments have been conducted which seem to substantiate the validity of this approach.

Conventional Voltage Rating Methods

There are two methods by which manufacturers specify the collector-to-emitter voltage rating. In a common emitter configuration, a variable reversed bias voltage is applied to the collector and the base left disconnected while monitoring the collector current. Beginning at a low value, the collector voltage is increased until there is a sharp rise in collector current. When some arbitrary value of current is reached on the knee of the V_c-I_c curve, the voltage then present on the collector is called the rated maximum. This is illustrated in Fig. 1.

As an alternative method, one proceeds as above except that a reverse bias is applied to the base-emitter junction as illustrated in Fig. 2. The voltage rating with the base reverse-biased will be two to three times that obtained with the base disconnected. This voltage rating will change considerably as the magnitude of the reverse bias is changed. Between the two extremes obtained with the base open and reverse-biased, the practical voltage rating of a transistor may be found as explained in what follows.

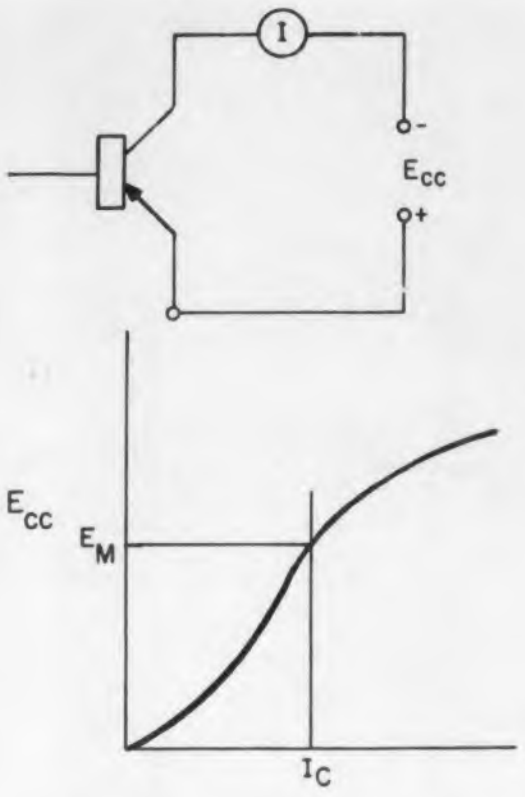


Fig. 1. Common emitter configuration. The voltage E_m is called the rated maximum. This is the collector voltage when some arbitary value of current is reached on the knee of the V_c-I_c curve.

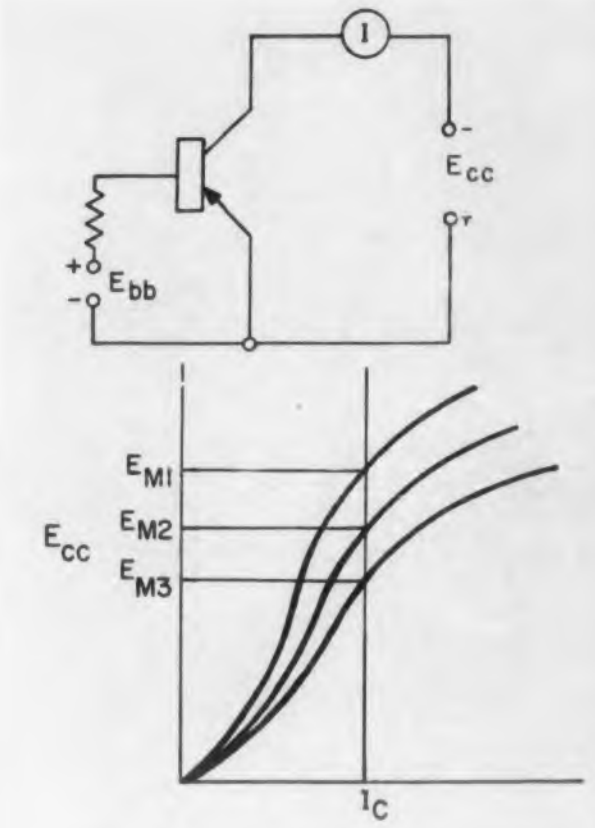


Fig. 2. A reverse bias is applied to the base-emitter junction. The voltage rating is 2 to 3 times than that obtained with base disconnected.

New Voltage Rating Method

Extending the dc collector characteristics past the normal operating range of the transistor, the idealized V_c-I_c curves generally resemble those of Fig. 3. The information normally available from manufacturers represents performance in region II. If the base swing in the reverse-biased condition is included, region IV will be seen. The output impedance of the transistor is considerably less in this region than in II and the transistor is stable if biased anywhere in this region provided that the operating conditions do not cause the transistor to be over-dissipated.

The hyperbolic curve shown in Fig. 3 is the maximum dissipation boundary which is commonly drawn on output characteristics. The placement of the curve is approximately correct for a switching transistor in the 150 mw class. Operation between this curve and the coordinate axis will insure that the transistor is being operated within safe limits of dissipation. Operating beyond this region may cause the dissipation rating of the transistor to be exceeded depending upon the length of time. For high current switching applications, the transistor is usually driven from cutoff to saturation during the switching period as illustrated by load line #1 which includes regions I, II, IV and V.

In region V, the V_c-I_c curves have a negative slope indicating negative resistance or an unstable operating region. Region V lies almost entirely in the area of excessive dissipation; there-

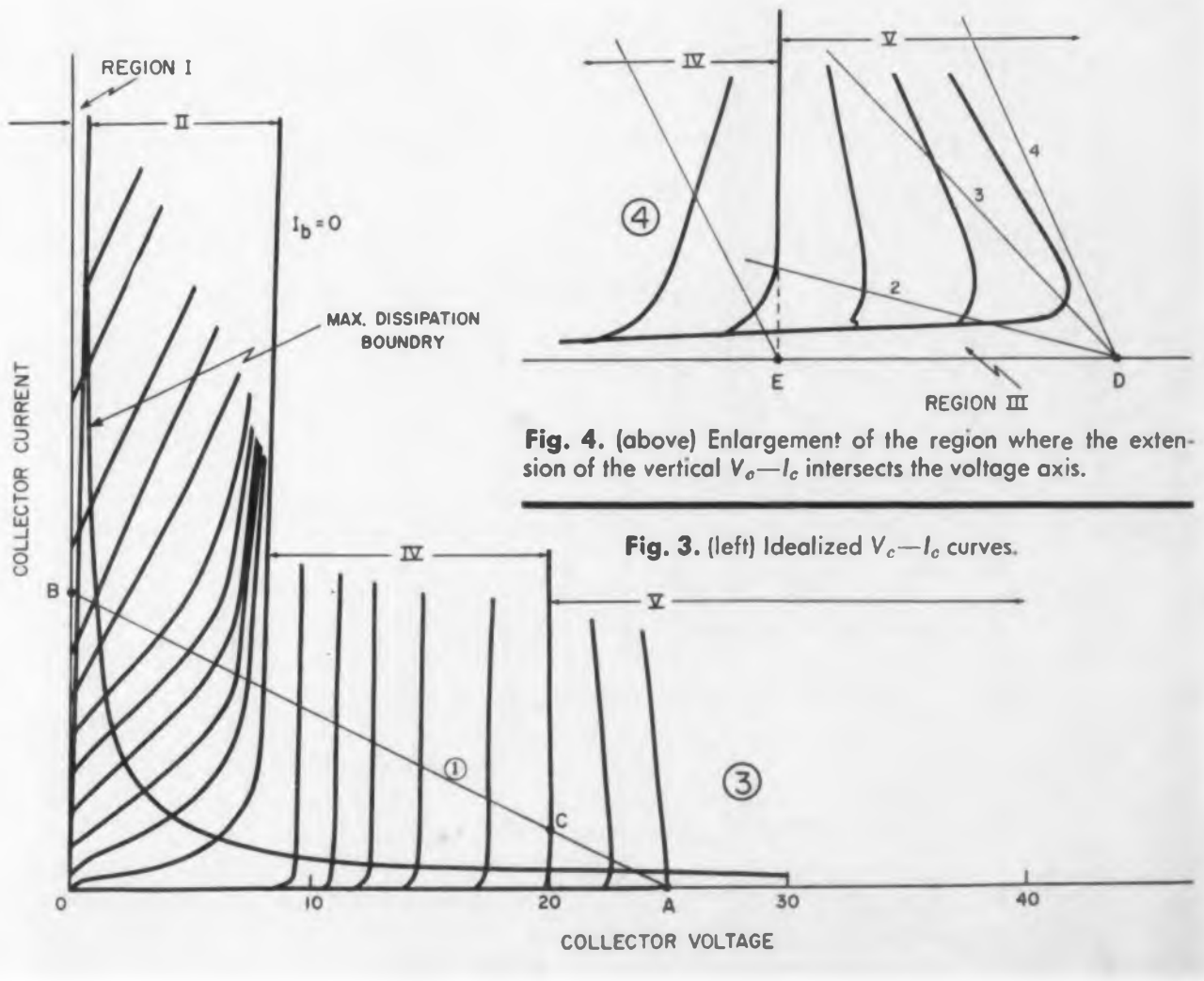


Fig. 4. (above) Enlargement of the region where the extension of the vertical V_c—I_c intersects the voltage axis.

Fig. 3. (left) Idealized V_c—I_c curves.

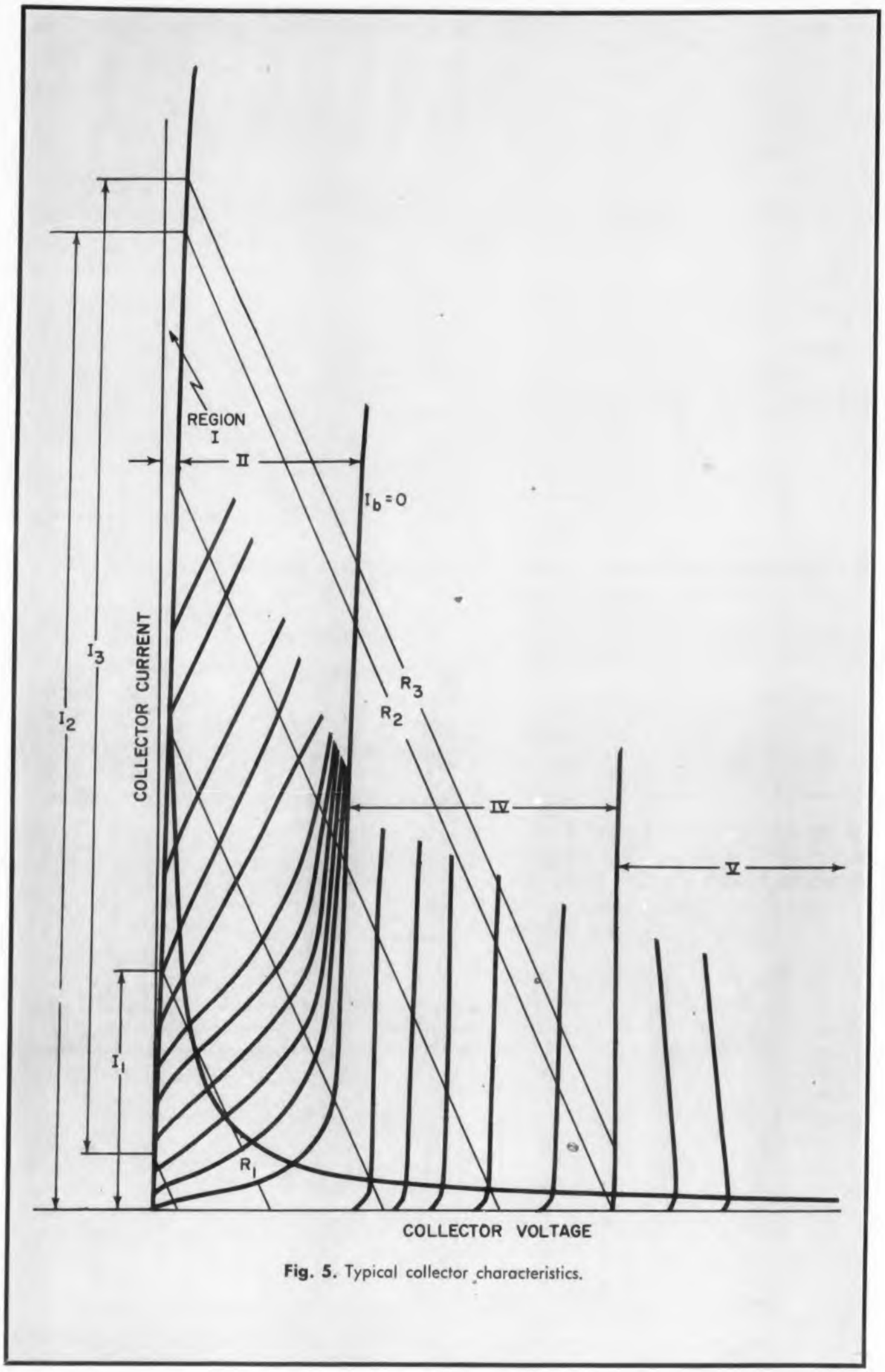


Fig. 5. Typical collector characteristics.

fore, any lingering in this area will usually be destructive to the transistor.

Consider a load having a characteristic represented by line #1. With no pulse applied, a collector voltage of 25 v, and the base biased with a sufficient reversed current, the transistor will be sitting at the quiescent operating point *A* which is in a low dissipation region. If a single pulse drives the transistor into saturation, the operating point will quickly pass through the safe operating point in a low dissipation region, high dissipation area to point *B* which is another As long as the rise time of the pulse is fast enough, the average dissipation in moving from point *A* to *B* will be low. The operating point may remain at *B* indefinitely without heating the transistor excessively.

When the pulse has ended, the operating point wants to return to point *A*, but it has to pass through the unstable region V. It cannot reach point *A* as the operating point upon entering the unstable region is working against a gradient which increases in instability as the depth of penetration into the region is increased. Therefore, the point will penetrate slightly, stop, reverse its direction, and go to point *C* which is the boundary between the stable and the unstable operating regions. The depth that the point will penetrate into the negative resistance region will vary slightly due to the dynamic properties of the transistor such as fall time and number of carriers.

During the time that the operating point is returning to *C* or while at *C*, the transistor will burn out. Since the only region having negative characteristics is region V, this phenomenon can not take place if operation in this region is prohibited. Therefore, for high current pulse operation, the maximum voltage rating between collector and emitter is that voltage which is determined by the intersection of the extension of the V_c-I_c characteristic separating regions IV and V and the voltage axis. The value of reversed base current represented by this characteristic must be known. The value of maximum voltage rating determined by this method is conservative as long as the minimum reverse bias current is supplied.

Fig. 4 is an enlarged portion of Fig. 3 of the region where the extension of the vertical V_c-I_c curve intersects the voltage axis. Point *E* represents the maximum voltage rating mentioned above at which operation with any value of load, such as represented by load line #1, will be stable. Point *D* represents a higher voltage at which operation with a load represented by line #2 is stable and at which operation represented by line #3 or #4 is unstable. Therefore, the safe maximum operating voltage may be increased slightly as the resistance of the load increases.

However, operation with a voltage to the left of or at point E will insure stable operation with any load resistor.

A quick nondestructive method of determining the maximum voltage rating without determining the characteristics of each transistor is possible. A low value of load resistor is chosen. The base is sufficiently reverse biased and pulsed into saturation at very low duty cycle. The collector voltage beginning at a low value is slowly increased while the collector current pulse is monitored with an oscilloscope having a dc amplifier. As the collector voltage is increased, the collector current will increase until a further increase of collector voltage will not result in an increase of collector current but a small dc shift will be seen. The collector voltage should be noted and quickly reduced.

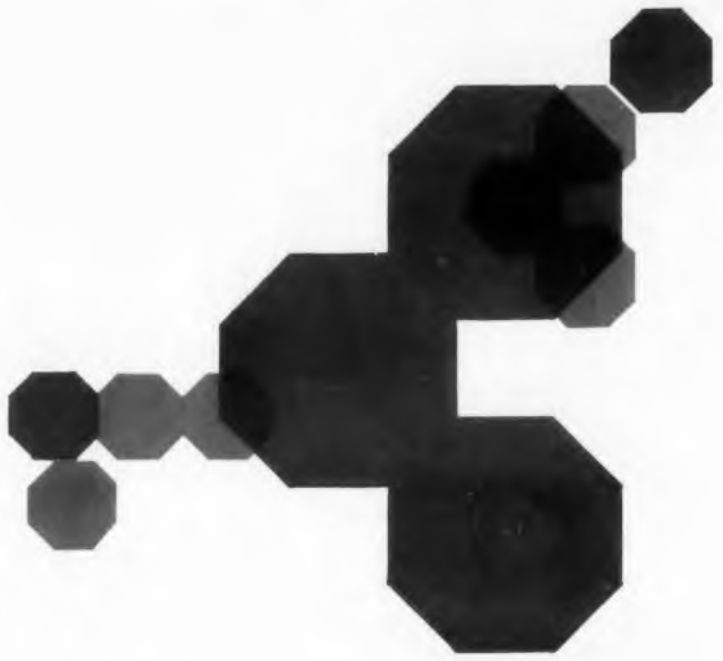
This phenomenon can be seen by referring to Fig. 5. These characteristics are the same as Fig. 3 except that the family of parallel lines R_1, R_2 etc. represents a fixed load for various values of collector supply voltage. As the voltage is increased, the load line will shift from the lower left hand corner. At a given collector voltage, the corresponding load line R_1, shows the collector current, when the base is pulsed driving the transistor from cutoff to saturation, to be I_1. As the voltage is increased, the output current will increase uniformly until the knee of the vertical V_c-I_c characteristic separating regions IV and V is reached. This is represented by load line R_2 and its corresponding current I_2. A further increase in voltage will not result in an increase in output current since the operating point when returning down the load line cannot penetrate the negative resistance region.

The transistor will not return to cutoff resulting in the above mentioned dc shift with no change in amplitude. This is illustrated by the load line R_3, at which the pulse current amplitude I is no greater than I_2 but merely subjected to a dc shift. The noted maximum voltage at the dc shift will coincide with the extension of the vertical constant current base line if the load resistor is chosen sufficiently small.

Ambiguity in the maximum voltage rating of switching transistors can be eliminated by specifying that voltage determined by the intersection of the voltage axis and the extension of the V_{cc}-I_c characteristic separating the stable and unstable operating regions under reversed base bias conditions. Operating at or below this voltage insures breakdown-free performance with any value of load resistor.

Reference

1. J. C. Kidd, W. Hasenberg and W. M. Webster, Delayed Collector Conduction, New Effect in Junction Transistors, *RCA Review*, Vol. XV 1, March, 1955, pp 16-32



Calculating With Octal Mathematics

Roger T. Stevens
Senior Engineer
Electronics Systems, Inc.
Boston, Mass.

MANY desk calculators used for preliminary preparation of computer problems operate in the octal number system. You can too. Here's how.

Number Theory

A number system is essentially a method of counting. The octal number system, like the decimal system, is a special case of a general technique for producing number systems.

In counting, different symbols are chosen to represent different sized groups of objects. The counting proce consists of assigning the symbols, order, to the members of the group. Th symbol assigned to the last member the group represents the total size of t group. To count the number of cards a poker hand we assign numbers to eac card: "*1*" to the first card, "*2*" to the se ond . . . "5" to the last. Since "5" w the number assigned to the last card. represents the total number of cards the hand.

Infinite different counts are possibl

0	1	2	3	4	5	6	7
1	2	3	4	5	6	7	10
2	3	4	5	6	7	10	11
3	4	5	6	7	10	11	12
4	5	6	7	10	11	12	13
5	6	7	10	11	12	13	14
6	7	10	11	12	13	14	15
7	10	11	12	13	14	15	16

Fig. 1. Octal addition table.

This would require infinite different symbols. And this would be inconvenient. To make all possible counts with a limited number of symbols requires the symbol *"0."* It represents a count of nothing. In counting, when all of the available symbols except zero are used up, we call the next count *0* and add *1* to the left of the zero. The *1* indicates that we have one group containing as many individuals as there are symbols in all (including *0*). In continuing the count, the point is reached where there are two of these groups (*20*) and so on. When there are no more symbols for these groups, a *1* is placed in the column to the left. Thus, if there are N available symbols including *0*, the number *ABCD* represents $D + CN + BN^2 + AN^3$. This technique is familiar in the everyday decimal notation. But there is no reason why the total number of symbols, including *0*, should be ten. There can be eight, as in the octal system.

Octal System

The octal number system is a system in which the available symbols are *1*, *2*, *3*, *4*, *5*, *6*, *7* and *0*. This system is often used in computer work because it is more compact than the binary system for manual computations.

Addition, subtraction, multiplication and division are only the application of tables you have memorized. The tables were originally derived from the counting process. For example, there is no process of mathematics by which you can add $5 + 4$ and get 9 except by taking five individuals and four individuals and placing them together and counting them. The alternate is by remembering that $5 + 4 = 9$.

Octal adding and multiplying tables operate like the decimal tables.

Addition

The addition table for the octal system is given in Fig. 1. This table is used by taking a number to be added in the top row and the other in the left column and moving straight down from the first and straight over from the second to the square of intersection. This is the number of the sum. This table may be used in reverse for subtraction.

Multiplying

The multiplications table for the octal system is given in Fig. 2. This table is used in the same way as the addition table. Using these tables any mathematical manipulation may be performed in a manner similar to those in the decimal system.

Octal to Decimal Conversion

Octal numbers may be easily converted into decimal numbers, and vice versa. For the octal to decimal conversion, the places in the octal number represent powers of eight. The octal number 4375 is:

8^3	8^2	8^1	8^0
4	3	7	5

which is equal to $4 \times 512 + 3 \times 64 + 7 \times 8 + 5 = 2301$ in the decimal system.

Decimal to Octal Conversion

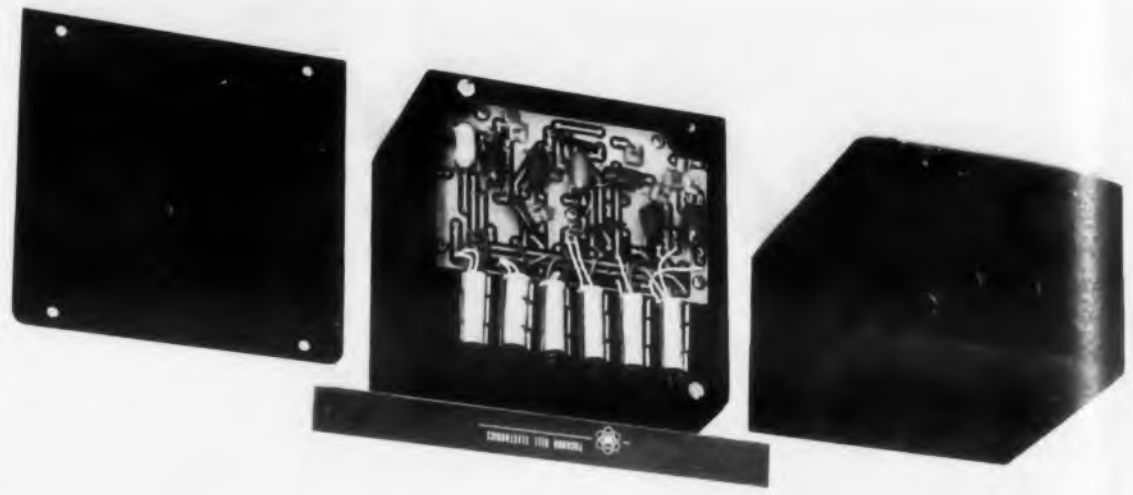
To convert decimal to octal successive divisions by eight are performed. With the decimal number 2301:

8	2301	
8	287	5 remainder
8	35	7 remainder
8	4	3 remainder
	0	4 remainder

4375 is the octal equivalent.

	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7
2	0	2	4	6	10	12	14	16
3	0	3	6	11	14	17	22	25
4	0	4	10	14	20	24	30	34
5	0	5	12	17	24	31	36	43
6	0	6	14	22	30	36	44	52
7	0	7	16	25	34	43	52	61

Fig. 2. Octal multiplication table.



Cooled to 225 C by ram air, this amplifier-decoder is one-third the size of its prototype. The i-f strip exposed above has 75 db gain, measures 1/2 x 4-1/8 x 3-3/4 in.

Hot Air Cools Hot Components in this Ram-Air Cooled Amplifier

AIR—HOT 200 C AIR cools the miniature 60 mc amplifier-decoder shown in the photo. The device doesn't need any refrigeration; just the friction-heated air rammed through a hole in the skin of a high-speed aircraft. Temperature of the unit stays below 225 C.

But that's still pretty warm.

How do you go about building a small 60 mc amplifier to work at 225 C? We went down to Packard-Bell Electronics Technical Products Division, 12333 W. Olympic Blvd, Los Angeles 64, Calif., to learn more about the unit. We found

- a lot of research went into discovering which manufacturers could—or would—supply components to work at exalted temperatures, and
- some clever design techniques that gave best cooling efficiency and reduced the size of the device from 1728 cu in. to 560 cu in.

PBE in the persons of Stan Plass, the senior project engineer and George Kis, Mechanical Engineer, reasoned that refrigeration units for the electronic gear in an airplane are large, heavy and expensive: the thing to do is avoid the need for them. Any electronics that doesn't need refrigeration saves just that much more money.

"We looked at all the ways we could reduce heat dissipation by design—like using a passive diode matrix instead of tubes in the spike discriminator and decoder—and then looked for components that would operate at high temperatures," Leuck told us.

Components

A combination of diodes, capacitors, resistors, tubes, fixed-tuned coils, printed circuit boards and a delay line were used in the unit. Manufacturers' catalogs were pored over and samples ordered. Hours of testing the samples were spent to weed out the unsuitable ones. Most manufacturers, PBE found, were very cooperative; sometimes discovered they could do better than they thought when it came to manufacturing high-temperature components.

Transitron Electronics Corp. in Wakefield, Mass., got special bouquets. Seems they supplied the only diodes that would work in the circuit up to 225 C. The PBE device uses 1N252's in the spike discriminator and decoder and S10G's for the tuning indicator and the detector, both operating at 60 mc. Problem: the circuits were designed so a difference of no less than ten per cent between forward and back resistances would work. Solution: Transitron diodes usually showed a greater difference.

Groundwork for the capacitors was laid by Valcap, North Hollywood, Calif., continued by Telecomputing Corp., Hollywood. Telecomputing's capacitors, in sizes up to 100 μμf, showed less than 10 per cent change in capacitance.

Above 100 μμf, capacitors are all used for decoupling: larger changes are tolerable, particularly since capacitance goes up with temperature. Glenco, Metuchen, N. J., is used for capacitances above 100 μμf.

Three kinds of resistors are contained in the unit, all derated considerably. In the two watt size, IRC's metal film resistors, Dalohm's RS series (wirewound) and Pyrofilm Resistor Co.'s PT 501 series perform well. Pyrofilm's resistors are tested at 400 C, show less than one per cent change after storage for three months at 500 C.

Subminiature 5639's made by Sylvania are mounted in silver tube clamps. Any hard glass tube would do, Leuck reveals; and eventually PBE hopes to use Westinghouse's new matchbox type, comparable to the 5639 or 6AK5: it

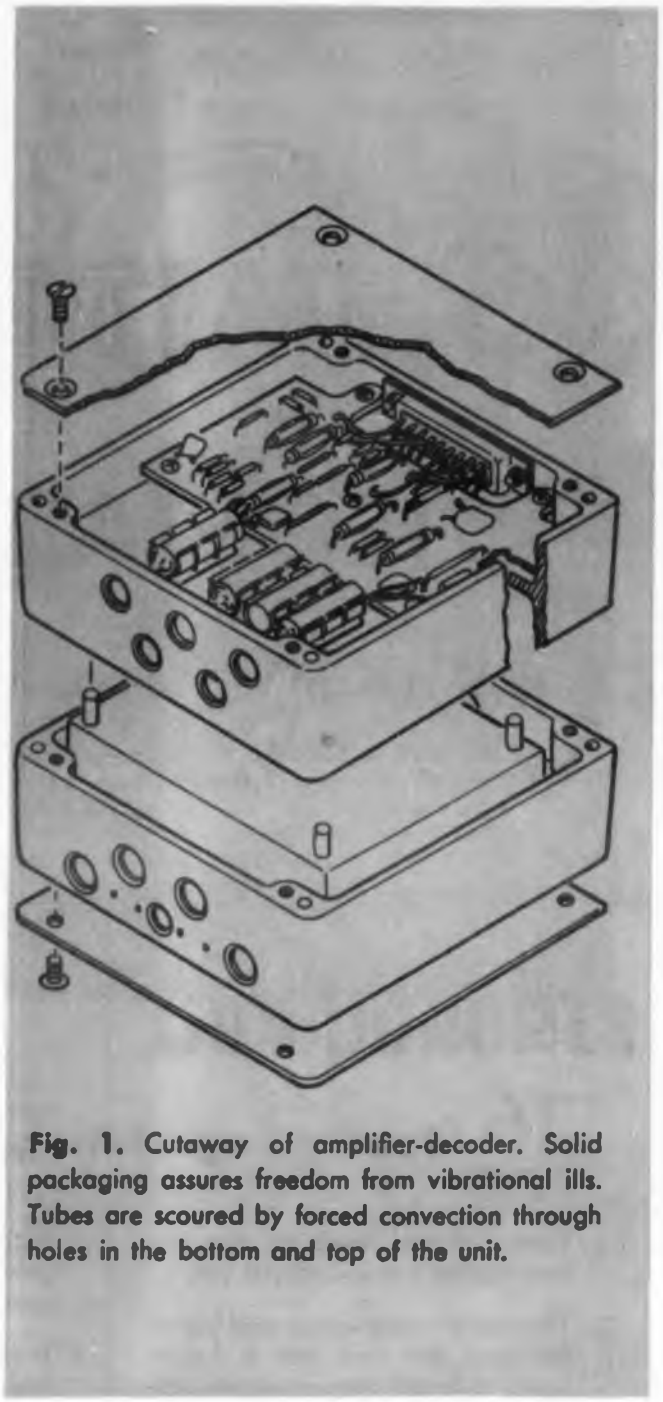


Fig. 1. Cutaway of amplifier-decoder. Solid packaging assures freedom from vibrational ills. Tubes are scoured by forced convection through holes in the bottom and top of the unit.

has a Fotoceram bottle and will withsta l even higher temperatures.

Any one of these materials would be itable for the printed circuit board: silicon gl , cop-per-clad Teflon or copper-clad Fotocera Plass and Leuck chose the last. It is made by rning Glass, withstands 500 C. Silicon glass is right, the engineers claim, but just on the bo lerline of working at 225 C. Copper-clad Teflo flexes, and under heavy vibration may cause co ponent leads to break.

"The delay line is a little goody all ou own," Leuck grinned. The Technical Product Com-ponents Lab covered wire with Eccoseal potting compound, pressure-sensitive Teflon tape and silicon rubber to come up with a delay line that works at 200 C with less than 0.1 μsec change. The i-f coils in the unit are constructed in the same way—using Teflon-covered wire manufac-tured by Hitemp; bound with Teflon tape; sealed with silicon rubber to avoid thermal shock; and potted with the Eccoseal compound.

Design

The packaging of the module is important fo cooling. As shown in Fig. 1 air enters through holes in the bottom, flows over the low-dissi-pation components first and is brought up around the tubes; ejected through holes in the top. Size of the holes is such as to force the air to scour the tubes thoroughly to eliminate hot spots.

The 60 mc i-f strip (shown in the photo achieves a bandwidth of 9.5 to 14.5 mc and has from 75 to 80 db gain. It is exactly half an inch thick by 4-1/8 by 3-3/4 in. The wide bandwidth is mainly a result of using degenerative feedback. The i-f strip has avc and automatic overload control; one gain control varies the gain over a 35 db range.

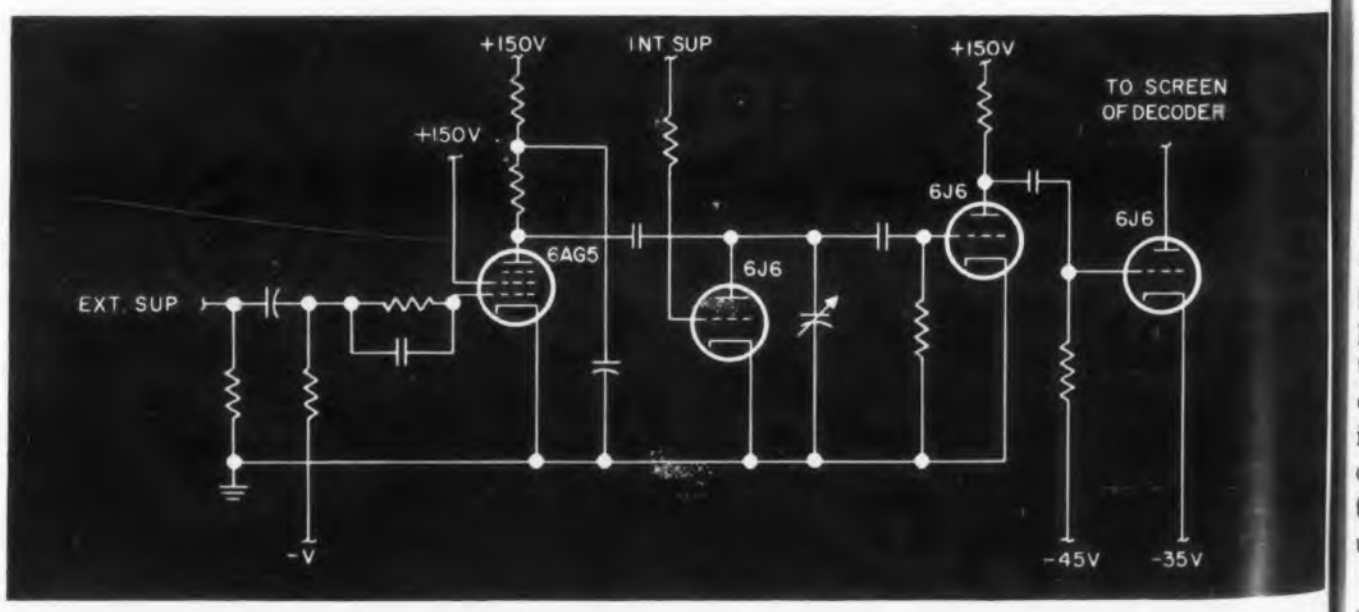


Fig. 2. Conventional suppression circuit, designed with tubes.

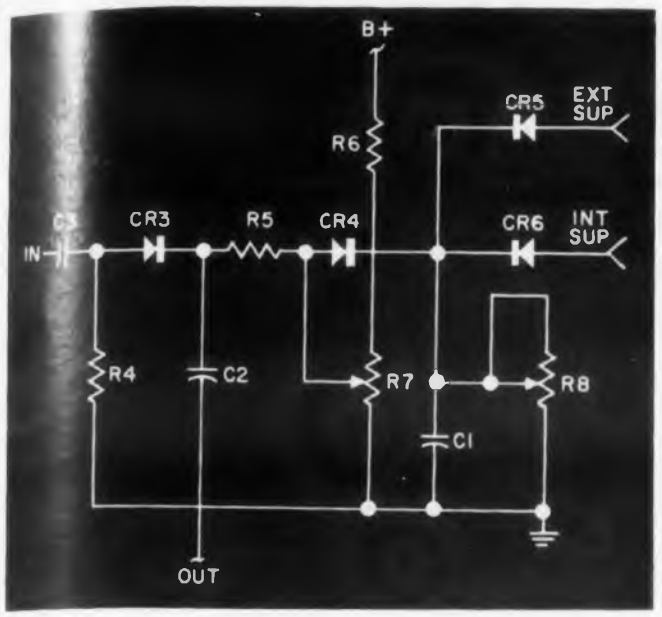


Fig. 3. Diode version of the suppression circuit shown in Fig. 2. Use of a passive diode matrix eliminates heat generated by tubes. Transitron diodes were the only ones showing a greater-than-10 per cent difference between forward and back resistances at 225 C.

Three major diode circuits were designed to replace conventional tube circuits. A three-tube decoder unit was replaced by a matrix of five diodes, and a spike discriminator uses two diodes in place of a pentode.

A clever suppression circuit, which allows the amplifier-decoder to accept only original pulses and reject all spurious pulses and echoes, was developed using a four-diode matrix in place of four tubes. The presence of a positive pulse at the suppressor input prevents the passage of interference pulses to the decoder.

The original tube circuit is shown in Fig. 2; its diode substitute in Fig. 3. Normally, with capacitor *C1* in Fig. 3 not charged, the gate diode *CR3* conducts with its cathode returned to ground through *R5* and *CR4*. The small bias on *CR3* from resistor *R5* and the rest of the network act to 'base clip' the noise coming in with the signal pulses.

When a suppression pulse appears *C1* charges and can discharge only through *R8*. This resistor is adjusted to provide an adequate *RC* time (100 μsec) for suppression after the removal of the pulse. Shunt diode *CR4* is blocked by the positive potential at its cathode, causing the cathode of *CR3* to rise to the level of *R7* alone. This level is set to block the gate diode *CR3* for the time of the suppression pulse plus the *RC* time. In this way suppression is accomplished without using tubes.

For further information on this ram-air cooled amplifier-decoder unit, turn to the Readers Service Card and circle 107.

Graphical Aids for Determining Tank Circuit Q Quickly

Elliott W. Markow
Wayland Laboratory
Raytheon Manufacturing Co.
Wayland, Mass.

These valuable curves make for quick and simple determination of tank circuit Q's, given bandwidth and normalized impedance.

THE Q of a resonant circuit is customarily determined by specifying the center frequency and the required bandwidth between the two 0.707 impedance points as shown in Fig. 1. From the usual relationship for Q_o, $Q_o = f_o/\Delta f$.

When it is necessary to determine the required tank circuit Q for a given bandwidth between two impedance points other than the 0.707 points the equation

$$Z_N(f) = \frac{1}{\sqrt{1 + \left[\frac{Q\,\Delta f}{f_o}\right]^2}}$$

is used, where $Z_N(f)$ is the impedance of a single section normalized with respect to impedance at f_o. In most circuits this is identical with normalized gain. Solution for the required Q, given any desired Δf and any value of $Z_N(f)$ is then

$$Q = \frac{f_o}{\Delta f}\sqrt{\frac{1}{Z_N^2} - 1}$$

By defining $\sqrt{1/Z_N^2 - 1}$ as the term r, the solution for required Q of the circuit may be expressed as

$$Q = f_o/\Delta f \cdot r = Q_o\, r$$

Plotting values of r as in Fig. 2, the required circuit Q can be immediately determined by this last equation, using the data from Fig. 2.

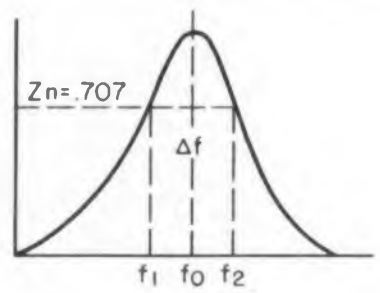


Fig. 1. Typical response of resonant circuit.

As a simple example, suppose the value of Q of a tank circuit centered at 1 mc, with a bandwidth of 10 kc between the $Z_N(f) = 0.9$ impedance points is wanted. (This is, of course, in most circuits identical with the normalized 0.9 voltage gain points.) From the curve for r in Fig. 2 with $k = 1$, $r = 0.48$ is read. The required Q is therefore

$$Q = 10^6/10^4\,(0.48) = 48$$

The problem becomes a bit more complex when a number of circuits are cascaded and synchronously tuned. Assuming k tank circuits the general expression for Q for each tank circuit then becomes

$$Q = f_o/\Delta f\,\sqrt{(1/Z_N)^{2/k} - 1} = Q_o r$$

Suppose the value of Q for each of three synchronous tank circuits is desired which gives a bandwidth of 10 kc between the 0.9 impedance points. From the curve of $k = 3$ in Fig. 2 the value of $r = 0.415$ at $Z_N = 0.9$. Therefore

$$Q_{avg} = 100 \times .415 = 41.5 = Q_1 = Q_2 = Q_3$$

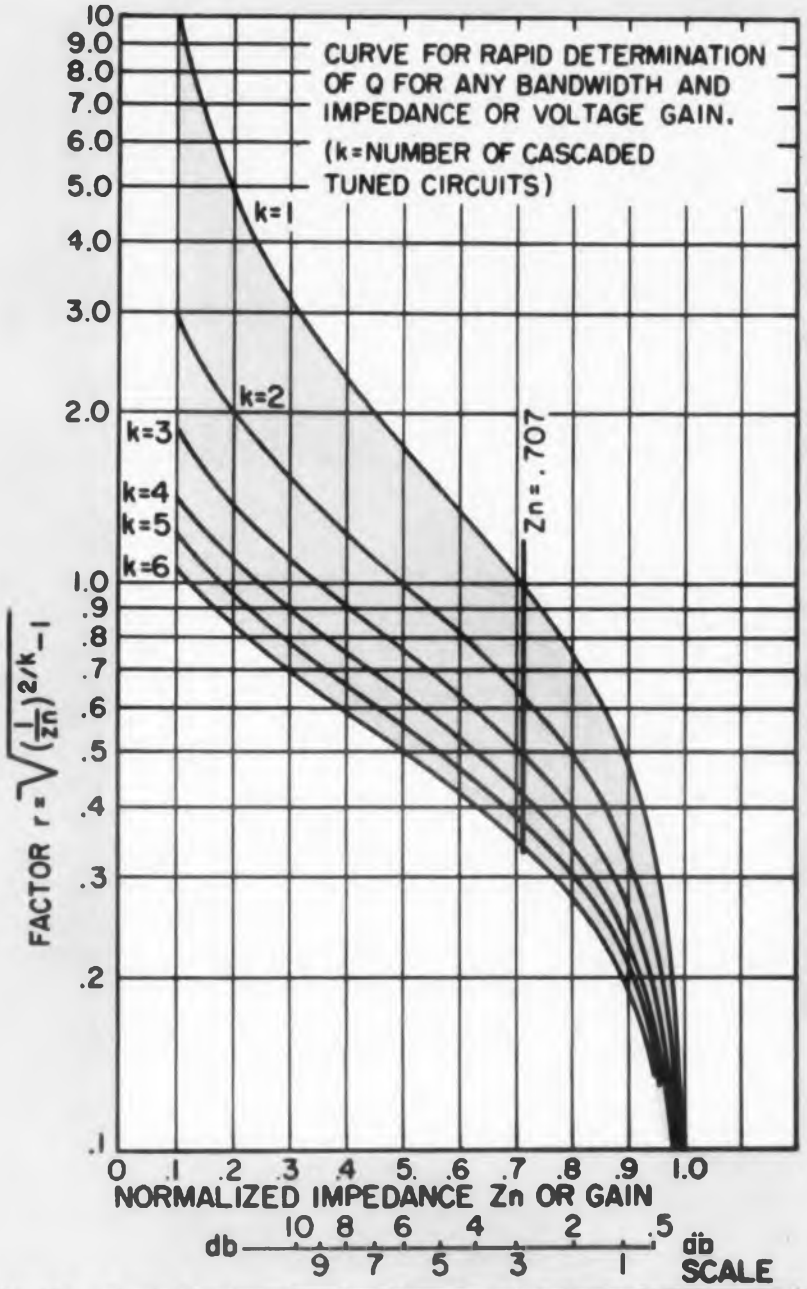
where Q_1, Q_2, Q_3 are the Q's of each of the three circuits.

For synchronously tuned circuits it can be shown that the Q of each of the circuits need not be the calculated value to satisfy the specified conditions, but only that the mean value of the individual Q's must equal the calculated value. Expressed analytically it is necessary that

$$Q_{avg} = \sqrt[k]{Q_1\, Q_2 \ldots Q_N}$$

Thus there is some freedom of choice for the individual Q's as long as equation 5 is satisfied.

For many applications the Z_N^2 or power relationship is the improved parameter. A plot of r versus $(Z_N)^2$ is shown in Fig. 3.



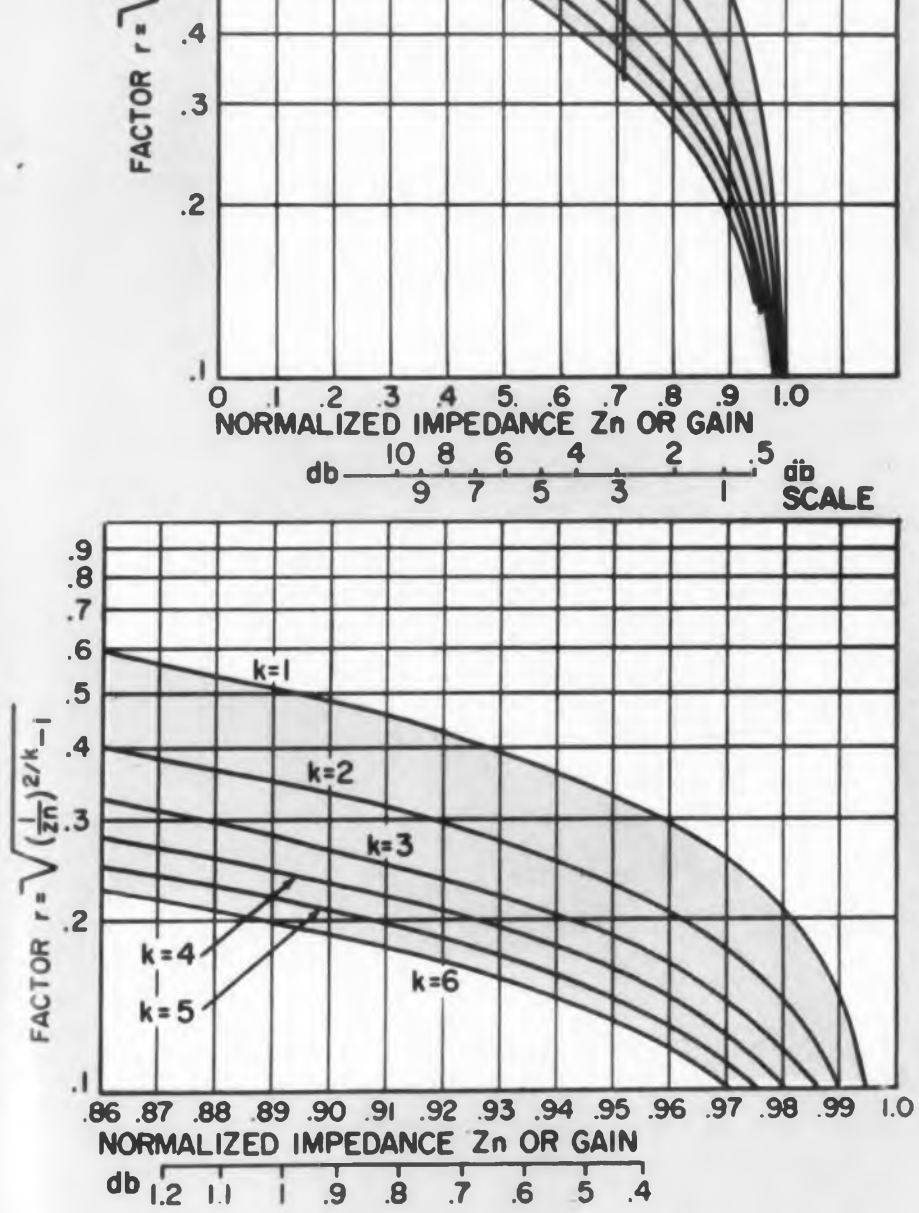
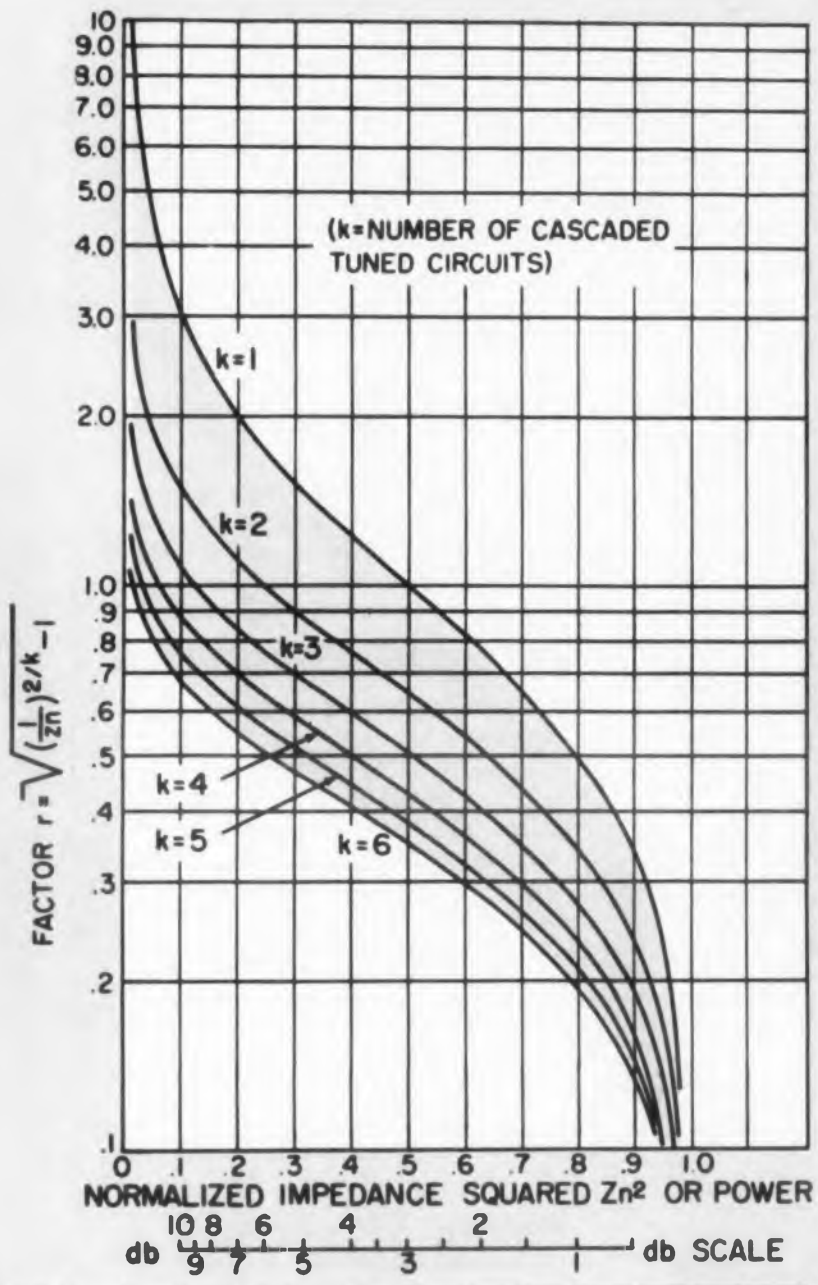


Fig. 2. Curves of r as a function of normalized impedance, Z_N, for various values of k. Region around the nose of the curve where Z_N is nearly unity is replotted on an enlarged scale for convenience.



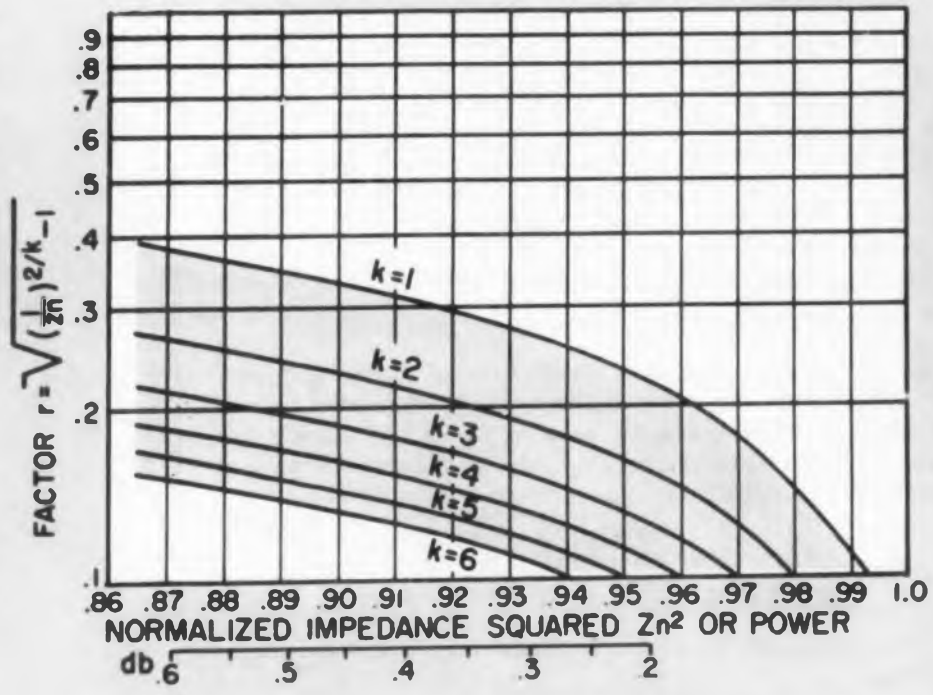


Fig. 3. Curves of r as a function of Z_N^2 or power for various values of k. Region around Z_N^2 value of 1 has been redrawn on an expanded scale.

NEW IDEAS IN PACKAGED POWER

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0.01% regulation—Why be half safe? You can get a-c line voltage regulation to the exact degree of precision you need from Sorensen. Model 2501 (left) regulates a-c line voltage to ±0.01% at 2500 VA. Other Sorensen a-c models range in precision from meter calibrators to rugged "constant voltage transformers," designed to give you maximum volt-amps per dollar.

Fully-transistorized regulated d-c supplies—The most complete line of transistorized low-voltage d-c power supplies on the market—like the new Model Q6-2 (left)—is offered by Sorensen. Regulation accuracy is ±0.25% (line and load combined). Life is exceptional. Response speed is extremely fast. They come with voltage adjustable over 2:1 range (Model Q Series) in 6, 12, 28 vdc and capacities to 200 watts. Also in 0-36, or 0-75 vdc continuously variable "Rangers" (Model QR Series) of 150-watt capacity.

Here's a d-c workhorse for rack-panel equipment—New Sorensen Model MD supplies feature magnetic regulation, semiconductor rectifiers, capacitance-input filters—and low cost. What's more you get any factory preset voltage you want, from 2.5 vdc to 1000 vdc. Available in 8 sizes from 25 to 3000 watts. No switches, no fuses (short circuited output is not recommended, but is not damaging). Ideal for powering your 19" rack-panel equipment.

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8.6

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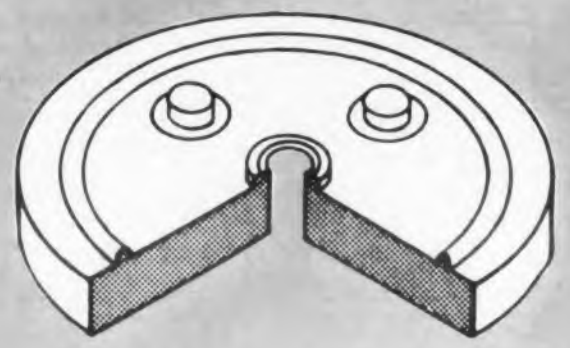
CIRCLE 27 ON READER-SERVICE CARD

New Approach to High Reliability and Long Life in this . . .

Conductive Plastic Potentiometer



Conductive plastic potentiometer element. The raised ring is conductive throughout its cross section and circumference except for the short section between terminals. Rear ball bearing and wiper contacts are also shown.

CONDUCTIVE filler molded in thermosetting plastic produces the long-wearing resistance element in this precision potentiometer. High reliability, negligible noise and improved linearity are but a few of the advantages gained. Wire breakage, discontinuities, moisture absorption and corrosive action, as well as limited resistance range, are overcome.

The conductive plastic, in the form of a solid homogenous body, serves as the potentiometer element in the unit made by the New England Instrument Co., 320 Main St., Woonsocket, R.I. Diallyl phthalate and alkyd molding components are used for optimum freedom from moisture effects while a specially-filled phenolic material is satisfactory for standard applications.

Unusual Mechanical Construction

The insulating material, conductive track, and silver leads to the terminals are molded in one operation resulting in a single, rugged assembly, as shown. The wiper is free to rotate over a full 360 deg range without mechanical discontinuity; electrical discontinuity is achieved by the inclusion of a nonconductive section along a small region of the track.

Due to the smooth, polished surface of the conductive track, the coefficient of friction is extremely low. Thus, a torque of 0.5 in. oz is sufficient to initiate rotation. Wiper force can be set between wide limits without sacrifice in reliability.

Can Be Made Nonlinear

Nonlinear functions which have severe slopes can be duplicated by altering the cross section of the conductive track. This particular feature may be used to distinct advantage in analog computer applications.

Independent linearity is less than 0.04 per cent on 1-5/16 in. diam units; this figure is difficult to attain in wire-wound versions of twice this diameter. Further accuracy is possible by trimming the edge of the conductive track.

Test Results

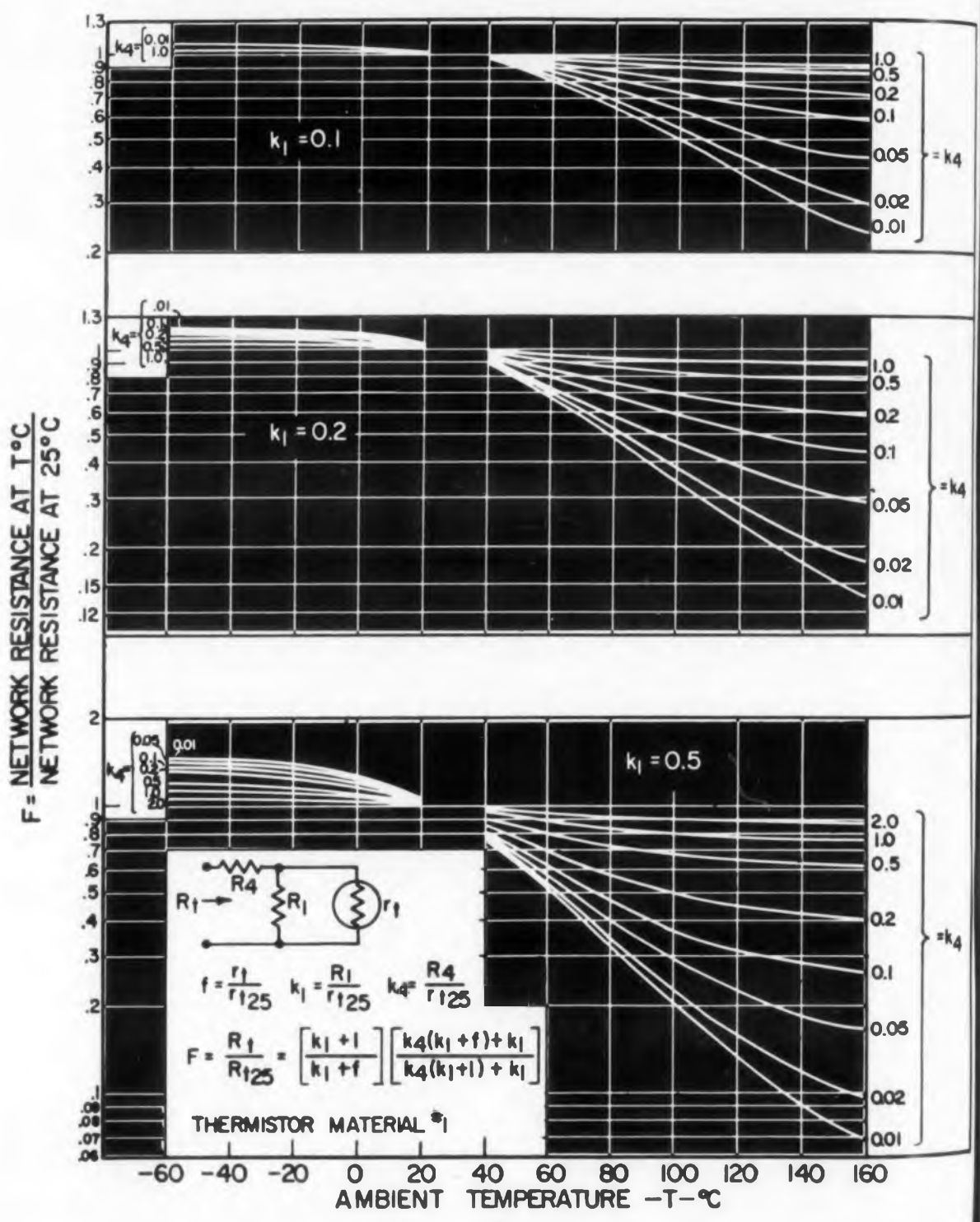
Checks made after 35 million revolutions show no significant electrical change in resistance, noise, or linearity. When used in servo applications, it is claimed that potentiometer life should be comparable to that of the servo motor.

Total resistance values from 500 ohms to 10 meg are available with power ratings up to 2 w at 20 C. Temperature range extends from −55 C to +125 C. Components are offered with bushing or servo mount as well as rectilinear design for instrumentation applications.

For more information, turn to the Reader-Service card and circle **106**.

Quick Design of Thermistor Compensation Networks—3

Bernard R. Schwartz
Radio Corp. of America
Defense Electronic Products
Camden, N. J.



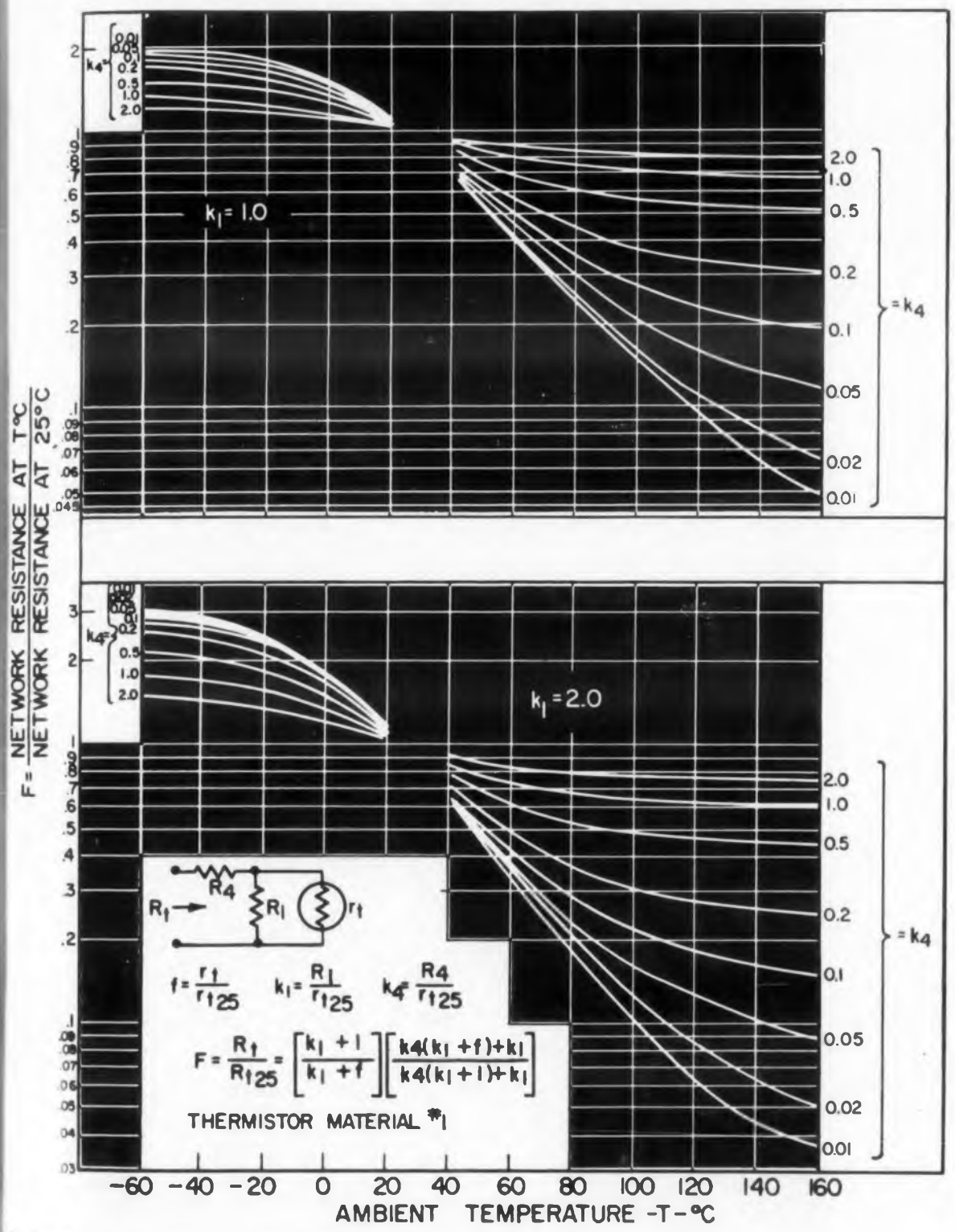
Two-resistor network compensation circuit and characteristics for common thermistor materials are identified on opposite page. Additional information on these materials is given in April 30 and October 15 ELECTRONIC DESIGN.

THE TWO-RESISTOR thermistor compensation network to be considered is illustrated in the accompanying curves. The procedure to follow in solving design problems with these curves and the nomogram was outlined in both preceding segments.

Example. A network is desired which has the following resistance-temperature response:

Resistance (ohms)	Temp. (C)
10,800	—55
10,200	—25
8,520	**0**
6,000	25
3,600	50
2,130	80

(Continued on following page)



Common thermistor materials applicable are: Carborundum Corp.—type H; Fenwal Electronics—type No. 1; G. E.-Carboloy—Grade 1; Keystone Carbon—type 97; Thermistor Corp. of America (Gulton)—type D; Victory Engrg. Corp.—Type

Step 1:

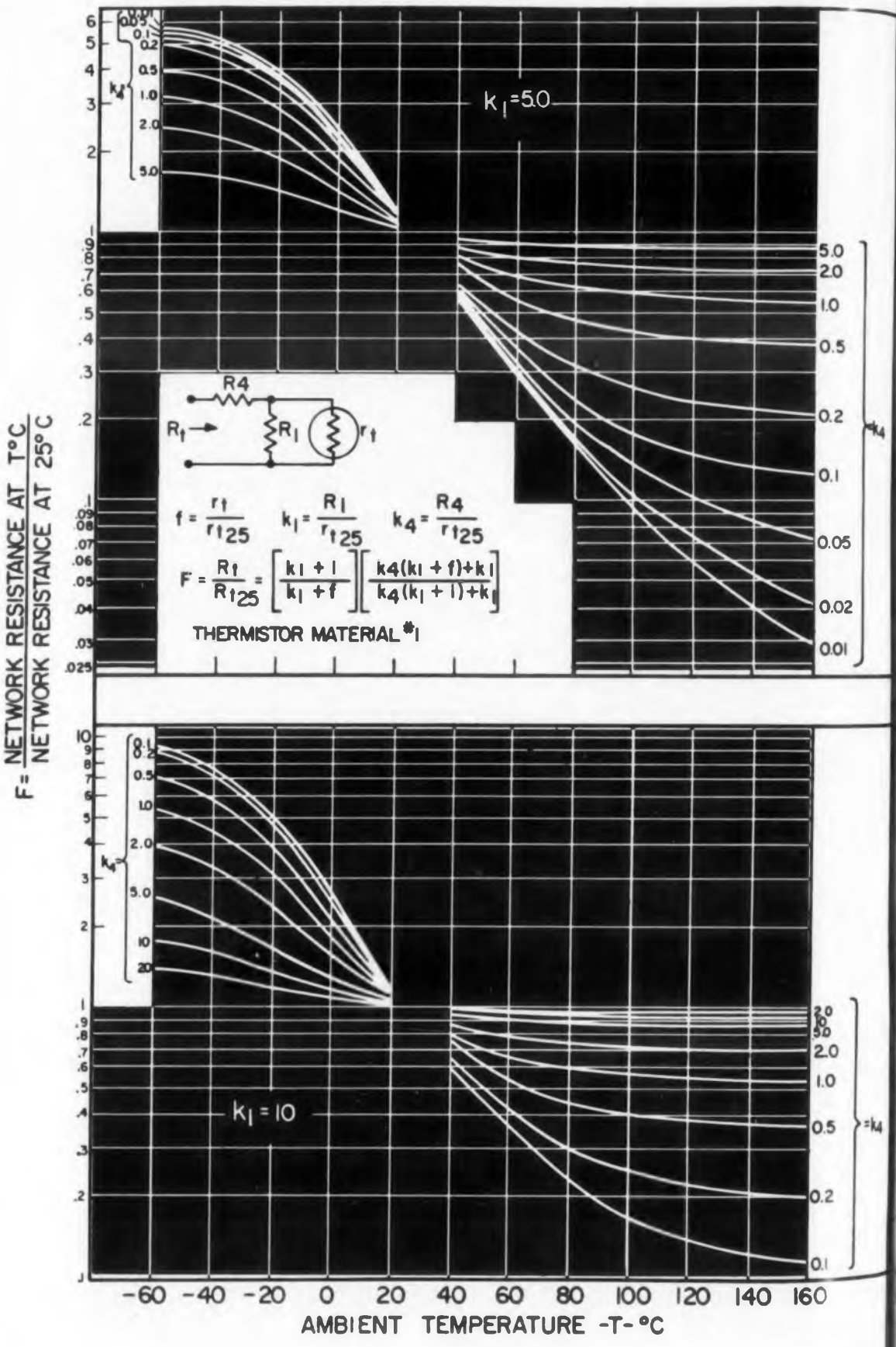
The network resistance value variation is then normalized with respect to the 25 C value. F (norm.

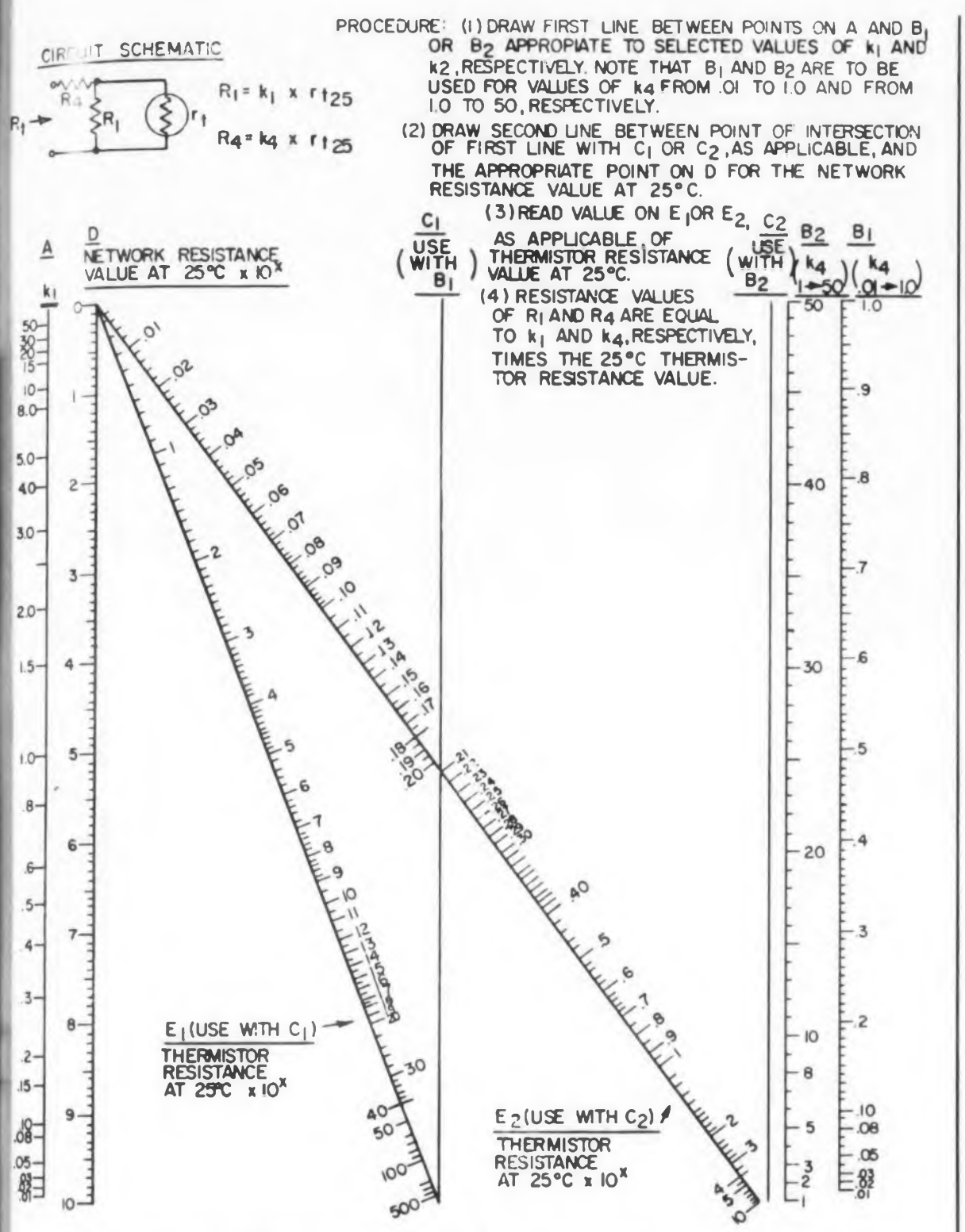
network resistance)	Temp. (C)
1.8	−55
1.7	−25
1.42	0
1.00	25
.60	50
.355	80

Step 2:

The graphs below yield a s lution. When $k_1 = 1$ and $k_4 = 0.1$ the fo owing network values are obtained.

F	Temp. (C)
1.8	−55
1.69	−25
1.41	0
1.00	25
.60	50
.36	80





Nomogram for selecting values of R_t and R_1 in the two-resistor network shown.

Step 3:

Referring to the nomogram, scale B_1 is used for the k_4 value of 0.1. A line drawn between the A scale (k_1) 1.0 point and the B_1 scale (k_4) 0.1 point intersects the C_1 scale. Another line drawn from the marked point on the C_1 scale and the D scale (network resistance value at 25 C x 10 6.0 point intersects the E_1 scale at point number 10.

Step 4:

Since the value of x is 3 in the 10^x scale factor used with scale D, the thermistor resistance value at 25 C is 10,000 ohms. R_1 then is equal to k_1 (1.0) times 10,000 ohms or 10,000 ohms. R_4 is equal to k_4 (0.1) times 10,000 ohms or 1000 ohms.

Netwo **compensation** characteristics (left) for $K_1 = 5.0$ and K 10. (Opposite page)

DESIGN FORUM

Measuring RF Power Between 10 mw and 10 w

CONVENTIONAL calorimeters and bolometers are useful instruments for the measurement of microwave power. But their range is limited. The calorimeter, for example, has a lower power limit in the 1 to 10 w range. The bolometer, on the other hand, has an upper limit of 10 to 100 mw. Here is a description of the Hewlett-Packard model 434A rf power meter, which uses both calorimeter and bolometer techniques to close this gap. The description of the design of this instrument is from B. P. Hand, development engineer at Hewlett-Packard.

The input of the 434A is a type-N connector which accepts power for measurement at any frequency from dc to 12 kmc without barretters, thermistors, external power terminations or external plumbing. It has two operating controls, the meter range switch and a zero set. Power is read directly in watts and dbw on the meter, on ranges from 10 mw full scale to 10 w full scale. Response time is less than 5 sec, and an accuracy of about ±2 per cent is obtainable.

The instrument consists of a self-balancing bridge which has identical temperature-sensitive resistors (gages) in two legs, an indicating meter and two load resistors, one for the unknown input power and one for the comparison power. The circuit diagram is shown in Fig. 1.

The principles of operation are as follows: The input connector is terminated in a 50-ohm axial resistor, over which flows a thin film of oil. The oil, which is heated by the resistor, then flows over a nickel-wire resistance gage. A rise in oil temperature results in an increased gage resistance.

High sensitivity is achieved by the unique use of an oil film for heat transfer, rather than a coaxial oil line. To eliminate calculations and to speed up response, a self-balancing bridge using negative feedback is employed. This is accomplished by the use of a comparison head which incorporates a load resistor and a resistance gage similar to the input head.

All elements of the oil system, shown in Fig. 2. are in series to insure equal flow rates in the two heads. Equal power inputs to the two heads then result in equal temperature rises. Prior to entering the heads, the two oil streams pass through a parallel-flow heat exchanger to bring their temperatures to about the same level. The effect of any small difference is eliminated in zero-setting, so that only output temperature gages are required.

The two resistance gages, which are closely matched in value, are arranged as two legs of a bridge. This bridge is driven by an audio oscillator, and zero-set potentiometers are provided to balance the bridge prior to the application of power.

When power is applied to the input, the resistance of the corresponding gage increases, unbalancing the bridge. The resulting audio signal is amplified in an ac amplifier, rectified in a synchronous detector, further amplified in a dc amplifier, and fed to the feedback-head load resistor. This heats the corresponding gage and brings the bridge back toward balance. The meter reads the dc voltage across the feedback head load resistor required to produce the matching rate of heat transfer.

Since the amplifier has finite gain, a small difference exists between the power applied to the input head and the power applied to the feedback head. At full scale on the meter, this difference is nominally 2 per cent. The meter is calibrated in terms of power applied to the input head.

This feedback system makes the instrument relatively independent of variations in both gain and oil flow rate. For example, a reduction in gain to 1/2 the nominal value merely doubles the difference between the two powers, resulting in a 2 per cent reduction in reading. Since an increase in flow rate causes a reduction in temperature rise for a given amount of power, it is the same as a reduction in gain. Therefore, doubling the flow rate results in an error of only 2 per cent.

When a signal coming from the ac amplifier has the correct phase relative to the oscillator, a positive dc voltage is developed. If the input signal is reversed in phase, a negative voltage is developed. The output stage of the dc amplifier is biased almost to cutoff in order to pass only the positive voltages. The non-linear tube char-

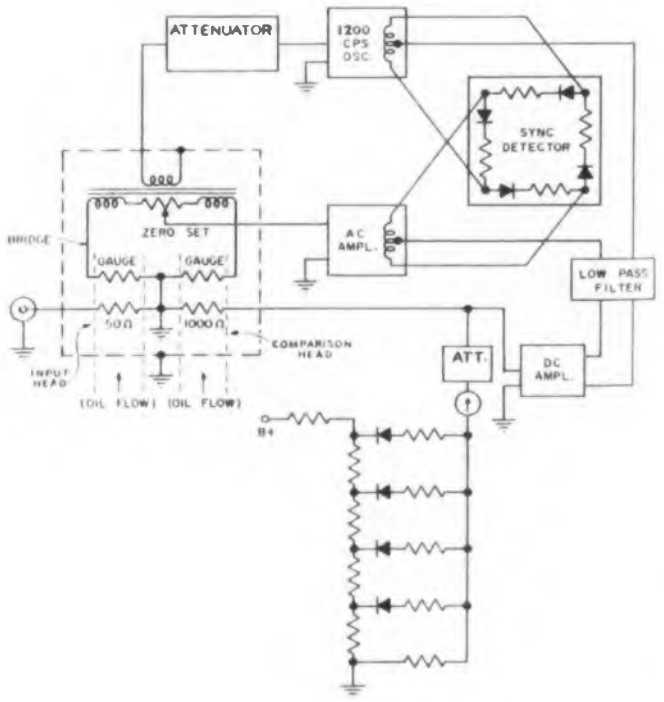


Fig. 1. Circuit diagram of the rf power meter.

acteristic of the output stage necessitates the use of feedback around the dc amplifier to linearize the overall gain.

Since it is impossible to provide enough gain and feedback to make the dc amplifier linear right down to zero tube current, the feedback network is returned to the negative power supply and has relatively low resistance. Thus several milliamperes flow through the output tube and the network when the cathode is at ground potential, making the dc feedback effective even though no current flows through the load resistor and the meter reads zero.

The circuit is designed to allow a small degree of runaway so that the meter may be moved through zero. When the meter is below zero, the grid of the output tube is driven toward cutoff. When this occurs the cathode drops below ground potential, allowing a reverse current to flow through the feedback-head load resistor and through the feedback network to the negative supply. Until the tube is completely cut off, the circuit runs away. A diode is provided on the lower ranges to shunt most of this reverse current around the load resistor so that the reverse power is never more than a few per cent of full-scale power.

A shaping circuit is used wherein the current through the meter passes through a series of diodes which are biased to various dc voltages. As the voltage applied to the circuit increases, the diodes start conducting in turn so that sensitivity is low at low voltages and high at high voltages. The result is a scale almost linear in power, and one which is easy to zero-set to a line.

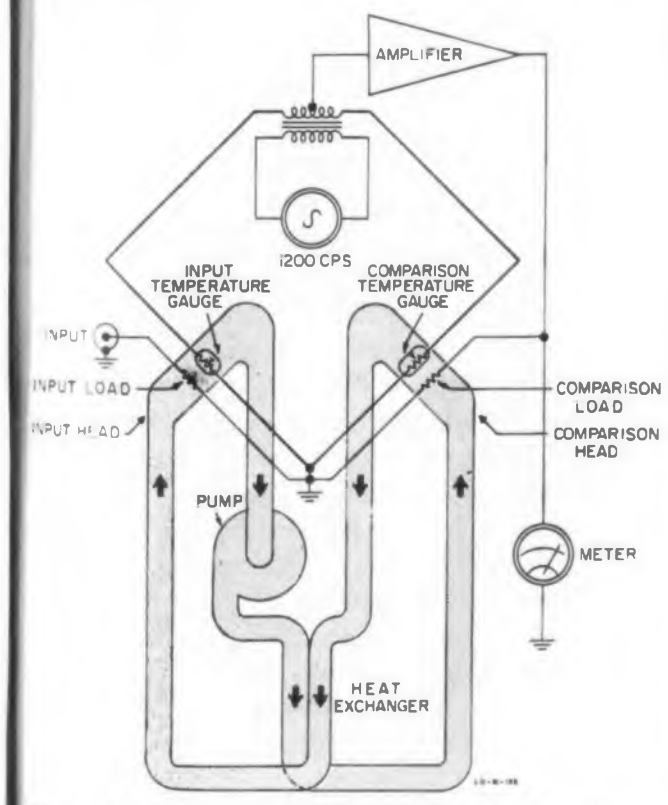


Fig. . . The series operation of the oil flow guarantees equal flow rates over both sensing elements.

Fig. 1. From left to right are the shell, the premetered pellet, the component and the header.

Encapsulation in Three Easy Steps

MAKING an encapsulated plug-in module is easy with the "E-Pak" system. Only three processes are necessary: soldering, assembling and heating.

To make an "E-Pak" module you need four things: (1) a component(s), (2) an all-epoxy header with lead wires, (3) an epoxy shell and (4) a premetered pellet. These are shown in Fig. 1. The last three items are manufactured by Epoxy Products, Inc., Div. of Joseph Waldman and Sons, 137 Coit St., Irvington, N. J.

Solder First

To start, the leads on the component(s) are soldered to the header. Since this

Potentiometer Shows What

Fig. 1. End cap of potentiometer is dual-calibrated. Unit is enlarged over three times.

THIS precision trimmer potentiometer has a dual-calibrated dial. By looking at the scribe on the side of the unit, or on the mounting panel, an operator can tell where the potentiometer is set.

The calibrated end cap, shown in Fig. 1, is attached to the potentiometer's slider. Rotation of the cap can be made by hand or screwdriver. The end cap is calibrated twice—radially for side reading, and on the end for top reading. Designed primarily for printed circuit applications, the trimmer is made by Waters Mfg., Inc., Wayland, Mass.

Graduations on the cap are from 0 to 10 in the 300 degree winding angle. The unit is available with a variety of mounting terminals. For printed circuit applications plug-in terminals are provided; standard terminals are solder type.

header is made of epoxy, the coefficient of expansion of the lead wires is not critical. The header won't split if too much heat is applied.

Then Assemble

Next comes the assembly process. A premetered epoxy pellet is dropped into the cured epoxy shell. Then the header and component(s) are placed into the shell.

And Heat

Last, the entire package is placed into an oven and heated. The pellet automatically melts and cures. It embeds the component and seals the header. Within the shell is a chemically-inert seal which promotes reliability of the component.

Where encapsulation is desired without embedment, a self-sealing epoxy cover is available.

The shell, designed for miniature applications, can be obtained in diameters up to about three inches.

The "E-Pak" system is adaptable to the automatic manufacturing procedures of most components.

For more information on this encapsulation system, turn to the Readers-Service card and circle **101.**

You Set

Size of the unit varies. For resistances up to 20 K, over-all length is 1/2 in. Up to 100 K, length is 5/8 in. Up to 250 K, length is 3/4 in. The diameter in all cases is 1/2 in.

Maximum dissipation of the potentiometer is 1 w at 400 C. Independent linearity, above 500 ohms, is 3 per cent. Equivalent noise resistance is 140 ohms, maximum.

The potentiometer meets the requirements of MIL-E-5272A, MIL-R-19 and others as applicable.

Uses of the potentiometer include encapsulated subassemblies. The entire unit can be encapsulated, leaving only the dial free for adjustment.

For more information on this calibrated potentiometer, turn to the Readers-Service card and circle **100.**

About The Author

Among the responsibilities of Donald P. Allen, a manager in the Instrumentation Division of Ampex Corp., is planning all future product development programs. He has had experience in designing analog and digital instrumentation recorders and military electronics. A registered professional engineer, Mr. Allen envisions actuator devices based on electrostatic or vacuum principles. His article shows how a classic principle can be used as a basis for solving new problems.

Polar Relay Principle Speeds Tape Actuator

Donald P. Allen
Ampex Corp.
Redwood City, Calif.

ACCELERATING magnetic tape from 0 to 150 in. per sec in less than 2 ms was the challenge accepted by the Ampex Corp., Redwood City, Calif. Par for the course in the past were start and stop times of 5 ms and tape speeds of 75 in. per sec. Better operation was restricted by the limitations of the actuators being used.

Digital tape handlers have to do two things: accelerate tape from rest to a uniform speed and then stop it. And these functions have to be performed fast and in a uniformly reproducible manner. Basic design of the tape handler requires that the tape pass between a capstan and a pinch roller, both continuously rotating. How to actuate the pinch roller becomes a critical factor because it is the key both to start-stop time and to reproducible, consistent start-stop time distances on the tape. In exploring the problem, polarized relay principles were given careful study and finally adapted to the tape actuator.

Polar Relay Principles

The polar relay has an armature which is centered by a spring, as shown in Fig. 1, and is

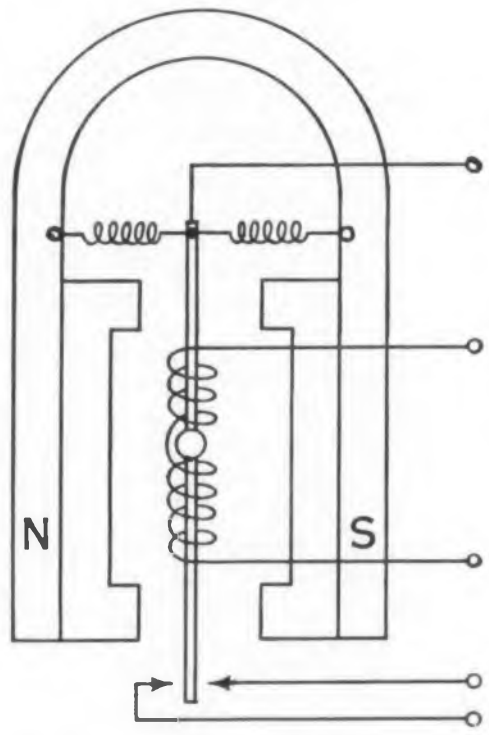


Fig. 1. Basic polar relay construction.

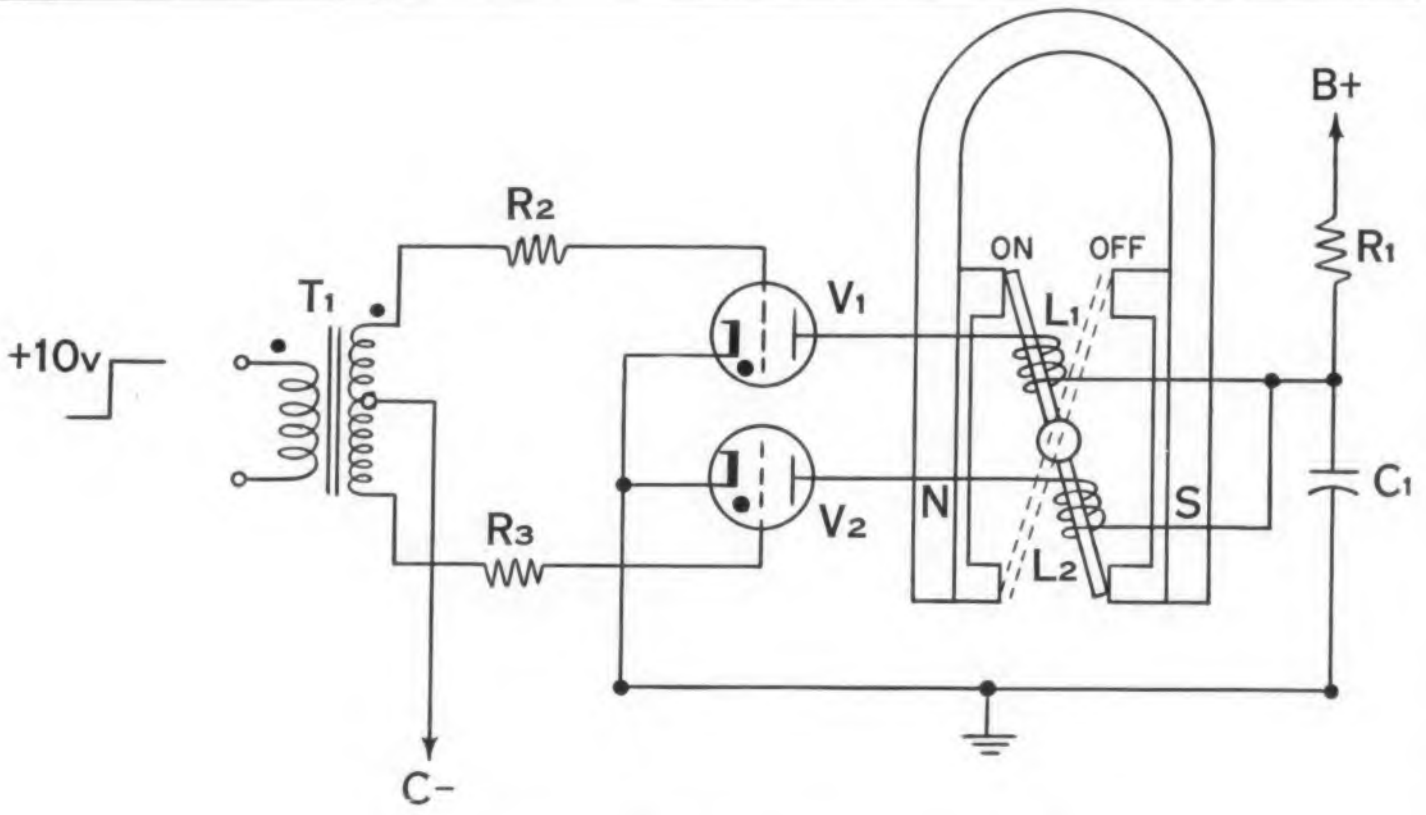


Fig. 2. Modified polar relay interconnected to a firing circuit.

rotated to its contacts by passing direct current of the proper polarity through the armature winding. Rotation results from the interaction of the induced and permanent magnetic fields. The basic scheme is inefficient because the actuating current must produce a field force sufficient to overcome the fixed magnetic field and because the current must be supplied continuously to provide holding torque (or force).

Adaptation of this principle, which combined an electro-magnetic armature and permanently magnetized poles, produced a simple but effective answer which is illustrated in Fig. 2. The basic concept now became that of a dc motor with a limited armature rotation. By eliminating the spring, the permanent field provides the holding torque. The armature, if centered, is immediately attracted to a stable position against one of the poles. A pulse of the proper polarity through the armature winding will move the armature to the other stable position. In this manner, "on" and "off" or flip-flop operation is achieved. Circuitry that might be used to pulse the armature is shown in Fig. 2.

Assume the armature to be in the "off" position. If a pulse is passed through L-1 in such a manner that a south pole is created at the top of the armature and a north at the bottom, the armature will move to the "on" position. This, of course, occurs through the attraction of unlike poles. When the armature current is removed, the armature is held in this position by virtue of completing the flux path of the permanent magnet. To bring the armature back to the original "off" position, a current is passed through L-2 in such a manner to produce a south pole at the bottom of the armature and a north pole at the top.

The electronic firing circuit works this way: When a +10 volt square wave is applied to the input of T-1 the leading edge will appear across the secondary of T-1 as a pulse. The grid of V-1 will see a positive going pulse and the grid of V-2 will see a negative going pulse, since the secondary is returned to ac ground through the center tap. If both grids are biased to a −10 v, V-2 will remain cut off, but the bias on V-1 will be overcome. V-1 will then conduct the charge stored in C-1 through L-1, thereby providing the necessary current to rotate the armature. The armature will remain in this position until the input voltage swings back to zero. The discharge path of current is an LCR circuit and, as a result, the plate of V-1 will tend to swing negative. This negative voltage swing, which occurs after the discharge of C-1, will extinguish V-1 effectively and allow C-1 to recharge through the voltage supply isolating resistor R-1. At this time a positive pulse will be induced on the grid of V-2 and current will flow through L-2 in a similar

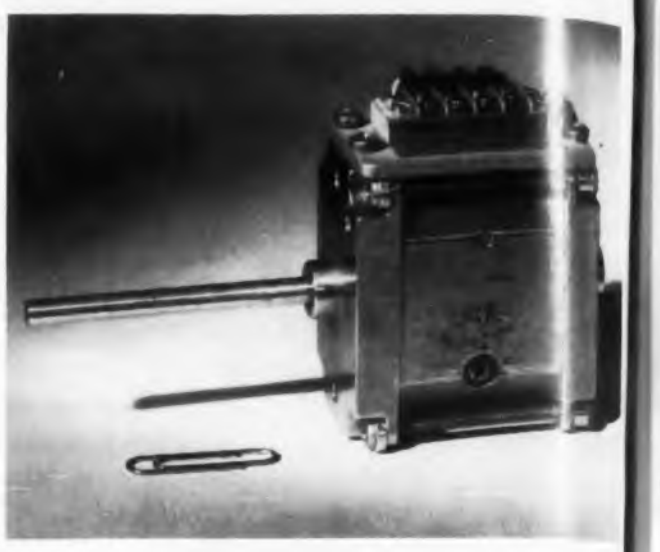


Fig. 3. Assembled high-speed magnetic actuator.

manner, returning the actuator to the original "off" position. Resistors R-2 and R-3 limit grid current and prevent overheating of the control grid.

Results

Optimizing the actuator design has resulted in a compact hardware assembly with an armature rotation of only 1.15 degrees between pole pieces. Measured at the point of pinch roller contact, this amounts to a mere 0.010 in. and a mechanical transfer that can be achieved in only 200 μs. It provides a holding torque of 15 in.-lb and there is no "bounce" in its action. Despite experiencing an acceleration of 2000 g, the design has been tested over 150 million cycles without failure.

Advantages and Comparisons

Practical advantages of the magnetic actuator are its small input power requirements and resulting low operating temperature. It is cool enough to touch even when operating at 100 cps. In addition to moving the pinch roller in or out from the capstan, the actuator also serves as a brake when disengaging. This is accomplished by the action of a pincher brake which, connected by a flat spring to the rotary shaft, engages the tape momentarily as the pinch roller disengages.

The new magnetic actuator overcomes the defects of the principle actuating mechanisms designed in the past. Loudspeaker voice-coil units and linear solenoids were the two outstanding devices. The loudspeaker systems were heavy and expensive, and they usually involved linkages and inertia that limited performance. Solenoids suffered from wear and had characteristics that were temperature- and duty-sensitive. The continuous power required by these devices resulted in excessive heating. And their

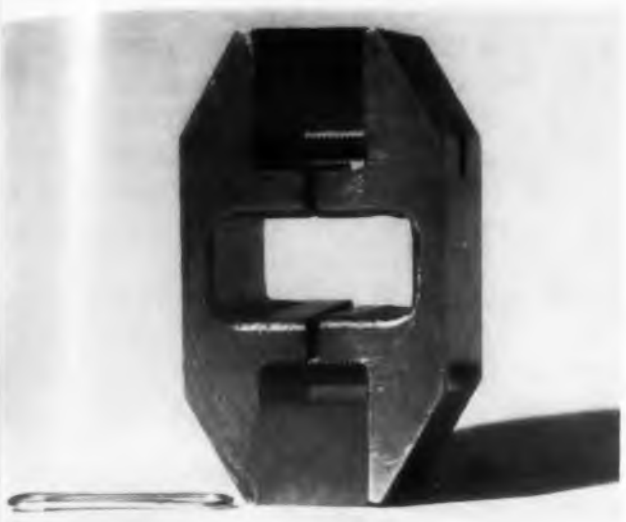


Fig. 4. Pole-piece design, showing detail of special silicon steel extrusions.

actuation time was limited by inductance and eddy current effects.

Construction Compromises

The assembled actuator, shown in Fig. 3, represents a balance among conflicting parameters, as well as special adaptation of seemingly standard or conventional elements. The size of the actuator lever arm is a point in case. A short lever implied greater angular travel, and accordingly, the possibility of slower action. This, in turn, was related to actuator pulse durations, which are determined by armature coil inductance and source capacity and must be long enough for the armature to complete one-half of its travel between pole pieces. A longer lever, on the other hand, raised problems of inertia and implied less holding torque.

Minimizing actuation time also led to study of pole piece construction. Eddy currents have a delaying effect on rapid changes of magnetic state. A common solution is the use of laminated pole pieces. But it was found that expensive laminations could be avoided by employing solid silicon steel, inherently high in resistivity. The choice of an extruded form provided further economy. Pole piece design is shown in Fig. 4.

Extensive tests of the magnetic actuator revealed interesting mechanical problems. As an example, the limiting element to long life proved initially to be the support bearings. Since the whole design is miniaturized, small shielded ball bearings were first employed. But it was soon observed that the extreme angular acceleration experienced by the bearings caused a fretting action that literally corroded them to death. A solution was found in the use of dry journal bearings made from a special Teflon compound. They show scarcely measurable wear after 150 million cycles.

Electrically-Rugged Power Supply

Rene N. Foss
University of Washington
Applied Physics Lab.
Seattle, Wash.

Do you need a regulated power-supply that cannot be damaged by overload? Here is one, transistorized, electrically-rugged, and easy to design.

THIS TRANSISTORIZED, regulated power supply will supply up to 3.5 amps at a voltage from about 0.5 to 30 v. One of the features of the device is that it cannot be damaged by overload of its output. The output can be simply shorted and left shorted indefinitely, and normal voltage will return immediately when the overload is removed. The circuit is arranged so that most of the semiconductor devices which require a heat sink have their hot elements at the same electrical potential so that no mica-washers are necessary, and a low thermal gradient to one common heat sink is possible.

Basic Design

Referring to Fig. 1, *CR* 1 and *CR* 3 are the rectifiers for obtaining the main voltage supply. It is a conventional full wave rectifier operating into a 4000 μf, filter capacitor. *CR* 2 and *CR* 4 also use the same transformer as full wave rectifiers to generate the positive voltage necessary for some of the control circuitry. The power transistors *Q*4 through *Q*8 represent the main series element in the voltage regulation circuit. The output voltage is sampled across *R*8 (POT). Transistor *Q*2 is the regulator amplifier. Transistor *Q*3 is an additional stage of current amplification to tighten up the voltage stabilizing properties of the power supply. The purpose of the capacitor *C*3 is to make the ac gain around the regulating loop a maximum value regardless of the setting of the dc voltage control "POT." This is to obtain the maximum amount of ripple filtering action from the voltage control circuit.

With the amount of filter capacitor used and the regulating properties of the voltage stabilizing circuit the ripple is essentially zero at small currents and increases to a maximum of about 50 mv when 4 amps is drawn from the device. This, of course, can be decreased, if desired, by increasing the value of *C*1.

The purpose of the large capacitor *C*4 across the output is to render the unit free of transients caused by sudden changes of load. The storage in this capacitor causes sufficient "electrical inertia" to hold any actual change in output to a rate that the voltage regulation circuits can handle without overshoot. This capacitor does not contribute to ripple suppression as it is connected across a very low dynamic impedance point.

Immune to Overloads

The feature of this power supply which makes it immune to damage by overload is the circuitry involving *Q*1, *CR* 5 and 6 and *R*4. *R*4 is in the path of the return flow of current and thus the voltage across this will be directly proportional to the output current. When this voltage exceeds

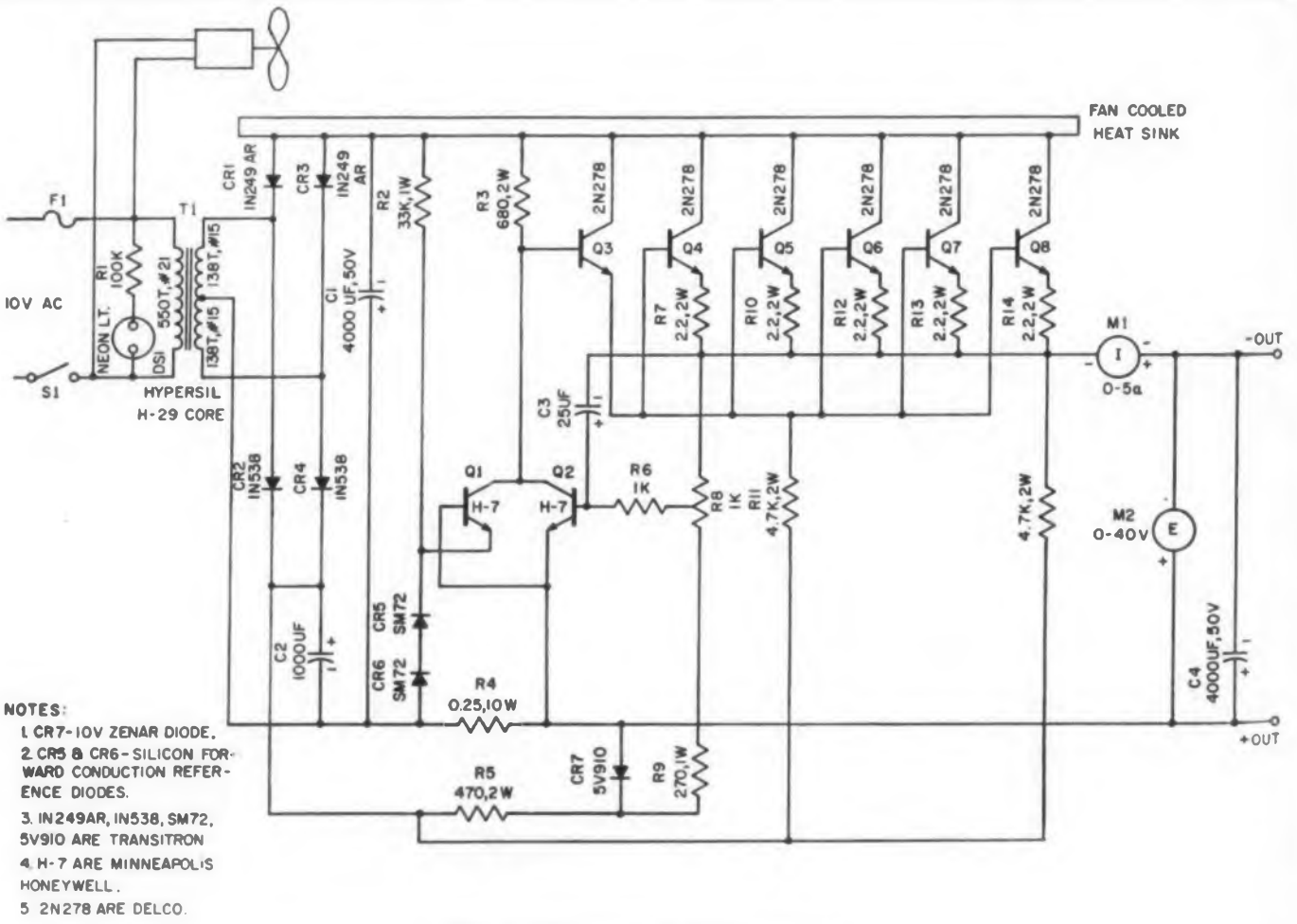


Fig. 1. Schematic of power supply.

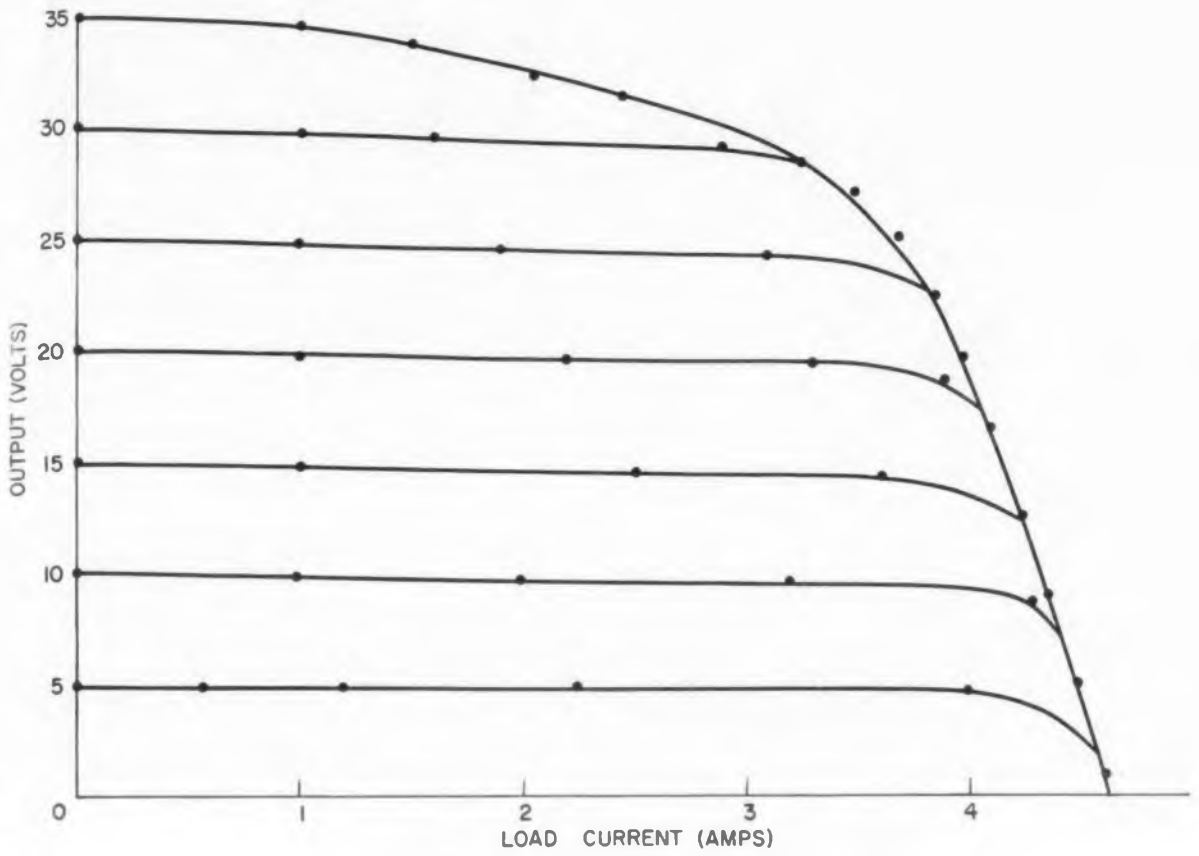


Fig. 2. Regulation curves.

the reference voltage of CR 6 and CR 5, which is a little over a volt, $Q1$ will start to conduct. Conduction of $Q1$ pulls down the base of the $Q3$ which causes the output voltage and thus the current to be cut down. With the values given the maximum current is limited on short circuit to about 4.6 amps. This, of course, can be changed to any desired value of limitation by simply changing the value of $R4$. $R4$ could, of course, be a front panel controlled variable element.

With power supplies which do not have this short circuit protection it is possible to gang the voltage control "POT" with a variac (in 110 v input line) so that the nonregulated voltage is, at all times, only a little above the desired regulated voltage and the series regulating elements only have to dissipate the difference in power between these two voltages. However, in a device of this sort, this is not possible, since, if the voltage is set to the maximum value and short circuit occurs, it will be necessary for the series elements to dissipate the full power of the device. This means that a good heat sink is required and that the series regulating elements have sufficient power dissipation to stand this drain.

Fig. 2 shows the regulation curves for this power supply. The voltage was set, with no load initially, to the various values of 5, 10, 15, 20, 25, 30 and 35 v and then for each of these initial settings the output load was increased up to short circuit condition and the resulting voltage output versus current is plotted. It will be noticed that at low output voltages the dynamic output impedance is lower than at higher values. This is because the feedback around the loop is a little higher at low values because the TAP on the POT is higher, thus taking a larger dynamic sample. It will also be seen that the supply is useful to about 3.5 amps over most of the voltage range, with the current limited to 4.6 amps on short circuit.

The resistor $R6$, as long as the circuit is operating normally, will actually degrade the performance somewhat by decreasing the amount of current that is fed into the base of $Q2$. Its purpose, however, is to prevent damage to $Q2$ and the other elements if the internal pot is set to deliver a low voltage and the output voltage does not fall externally (for example if the supply is connected to a battery or some other source). In this case this resistor will protect $Q2$ from excessive base current. This slight degradation of normal performance is accepted in the interest of giving a more rugged, trouble-free device. A large diode can also be put in series with the output, if its added drop is not bothersome, and this will also do some of the same work.

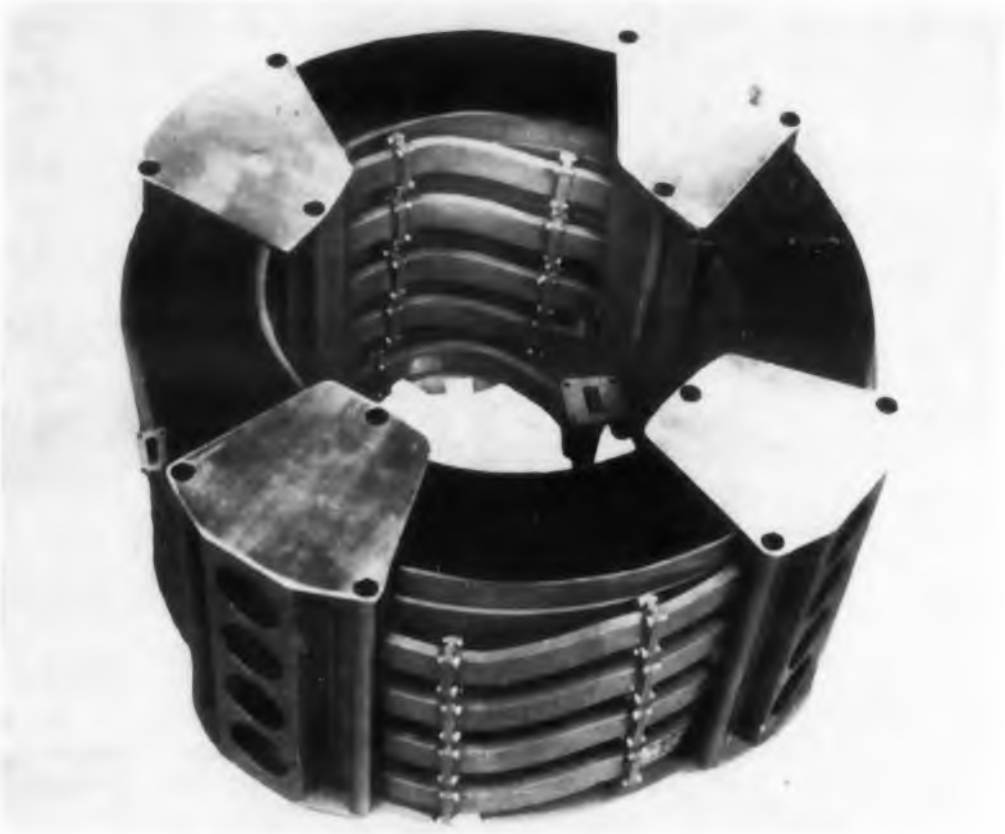
This power supply is electrically rugged and can stand to be loaded in any manner without injury to the power supply. Short circuits of any duration are acceptable and voltage is restored immediately on removal of the short. It is designed to be light, portable, and capable of giving rugged trouble-free service around the laboratory.

NEW PRODUCTS

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

BIG AND SMALL

Electronic components come in a variety of sizes that range from miniature to mammoth. On this page are some of the latest components which show how big or small components can be.

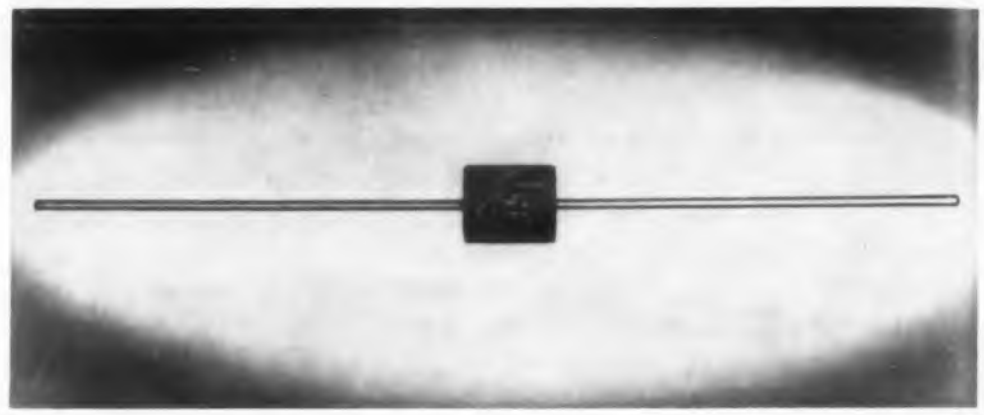


DELAY LINE

These spiral waveguide delay lines come in single coils up to 78 ft in length and multiple interconnected systems of any length. Typical input vswr measurements of these units are less than 1.2 at any X-band frequency. Insertion loss is less than 0.1 db per ft. Designs are available for assemblies of any length and are furnished with necessary accessories. A typical 1000 ft assembly at X-band occupies a cylindrical volume of diameter 2 ft, height 15 in.

Turbo Machine Co., Dept. ED, Lansdale, Pa.

CIRCLE 42 ON READER-SERVICE CARD



EPOXY-CASED RECTIFIERS

Handling an average forward current of 750 ma, the 1N20270 series silicon rectifiers are packaged in a nylon-cased epoxy capsule. They pass MIL-STD-202A immersion tests and have minimum lead-to-case insulation resistance of 10^{10} ohms at 600 v. Typed as 1N2069, 1N2070 and 1N2071, the three rectifiers have piv ratings at 200, 400 and 600 v, respectively. They can handle a 6 amp recurrent peak current and a surge current of over 32 amp for 1 ms.

Texas Instruments, Inc., Dept. ED, 6000 Lemmon Ave., Dallas 9, Tex.

CIRCLE 43 ON READER-SERVICE CARD

THERMOCOUPLES

Metal clad and ceramic insulated from the high temperature sheath, these thermocouples are available in diameters from 0.02 in. OD, 2-wire, to 0.04 in. OD, 2-wire. Readily formed, they resist corrosion, abrasion and erosion. Units come in several sheath materials and most conductor combinations.

Pyro-Electric, Inc., Dept. ED, P.O. Box 232, Barrington, Ill.

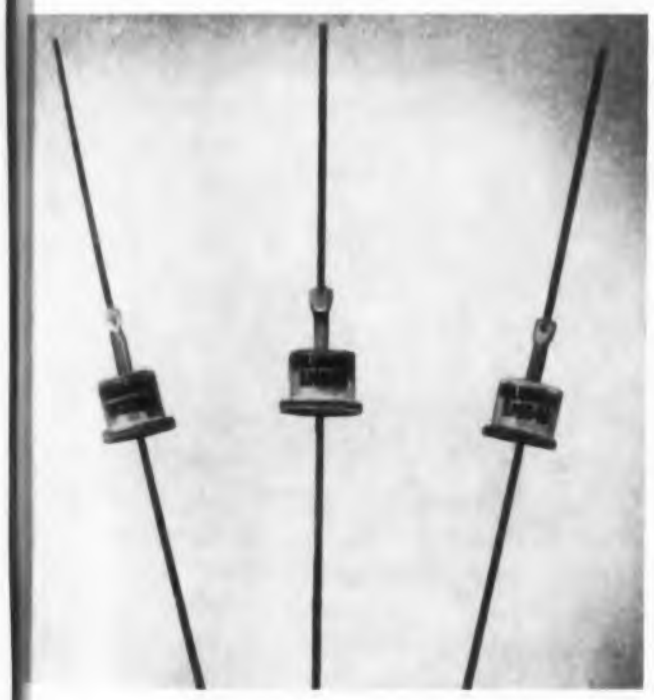
CIRCLE 44 ON READER-SERVICE CARD

MINIATURE CONNECTORS

These coaxial cable connectors, labeled the TM series, are a miniaturized version of the TNC series. TM connectors are matched electrically for 50 ohm impedance and some designs are available for 70 and 93 ohm cables. The series will withstand 500 v rms. TM connectors have gold plated contacts and thread coupling for positive locking.

General RF Fittings, Inc., Dept. ED, 702 Beacon St., Boston, Mass.

CIRCLE 45 ON READER-SERVICE CARD



SILICON RECTIFIERS

Available in hermetically sealed, axial lead top hat design, these double-diffused silicon rectifiers come in two Jetec series: 1N536 through 1N540 and 1N2080 through 1N2086. The units have current outputs ranging from 500 to 750 ma, and withstand up to 600 piv without heat sink.

Colorbus Electronics Corp., Dept. ED, 1010 Saw Mill River Road, Yonkers, N.Y.

CIRCLE 46 ON READER-SERVICE CARD

VRPS **Kepco** for the most complete line of POWER SUPPLIES

REGULATION and STABILITY 0.1%

VOLTAGE REGULATED POWER SUPPLIES

MODEL	OUTPUT VOLTS DC	OUTPUT AMPERES DC	OUTPUT IMPEDANCE DC-1KC	OUTPUT IMPEDANCE 1KC-100KC	SIZE W	SIZE H	SIZE D
SC-18-0.5	0-18	0-0.5	.04	.4	8¼"	4 5/32"	13⅝"
SC-18-1	0-18	0-1	.02	.2	8¼"	4 5/32"	13⅝"
SC-18-2	0-18	0-2	.01	.1	8¼"	4 5/32"	13⅝"
SC-18-4	0-18	0-4	.005	.05	19"	3½"	13"
SC-36-0.5	0-36	0-0.5	.08	.8	8¼"	4 5/32"	13⅝"
SC-36-1	0-36	0-1	.04	.4	8¼"	4 5/32"	13⅝"
SC-36-2	0-36	0-2	.02	.2	19"	3½"	13"
SC-3672-0.5	36-72	0-0.5	.15	1.0	8¼"	4 5/32"	13⅝"
SC-3672-1	36-72	0-1	.08	.8	19"	3½"	13"

Patent Pending

Model SC-18-2-M

*Two units mounted in Rack Adapter RA-2

Model SC-18-4-M

(TUBELESS) TRANSISTORIZED

SHORT CIRCUIT PROTECTED

- **REGULATION:** 0.1% for line changes 105-125 volts at any output voltage in the range minimum to maximum.

  0.1% or 0.003 volt for load changes 0 to maximum (whichever is greater) at any output voltage in the range minimum to maximum.
- **RIPPLE:** 1 mv. RMS.
- **RECOVERY TIME:** 50 microseconds.
- **STABILITY:** (for 8 hours) 0.1% or 0.003 volt (whichever is greater).
- **AMBIENT OPERATING TEMPERATURE:** 50°C maximum. Over-temperature protection provided. Unit turns off when over-temperature occurs. Power-on-off switch on front panel resets unit.
- **TEMPERATURE COEFFICIENT:** Output voltage changes less than 0.05% per °C.
- **SHORT CIRCUIT PROTECTION:** No fuses, circuit breakers or relays! Designed to operate continuously into a short circuit. Returns instantly to operating voltage when overload is removed. Ideal for lighting lamps and charging capacitive loads.
- **OVER-CURRENT CONTROL:** Can be set from 0 to 120% of full load. Current is limited to preset value for any load including short circuit.
- **REMOTE PROGRAMMING** at 1000 ohms per volt is provided. Remote programming allows mounting a voltage control at a remote point.
- **REMOTE ERROR SIGNAL SENSING** is provided to maintain stated regulation directly at load.
- **CONSTANT CURRENT OPERATION:** These units can be set up for constant current operation without internal modification.
- **POWER REQUIREMENTS:** 105-125 volts, 50-65 cycles. 400 cycle units available.
- **OUTPUT TERMINATIONS:** DC terminals are clearly marked on the front panel. All terminals are isolated from the chassis. Either positive or negative terminal of each DC output may be grounded. A terminal is provided for connecting to the chassis. The DC terminals, the remote programming terminals and the remote error signal sensing terminals are brought out at the rear of the unit.
- **CONTROLS:** Power-on-off switch, one turn voltage control, on front panel. Over-current control on rear of unit. Ten turn voltage control available on special order.
- Continuously Variable Output Voltage. No voltage switching.
- Suitable for square wave pulsed loading.
- Either positive or negative can be grounded.
- Units can be series connected.
- High efficiency
- Low heat dissipation.
- Compact, light weight
- For bench or rack use.
- Color: Gray hammertone. (Special finishes available).

ORDERING INFORMATION:

Units without meters use model numbers indicated in table. To include meters add M to the Model No. (e.g. SC-18-1-M).

*Rack adapter for mounting any two 8¼" x 4 5/32" units is available. Model No. RA2 is 5¼" high 19" wide.

*Rack adapter for mounting any one 8¼" x 4 5/32" unit is available. Model No. RA3 is 5¼" high 19" wide.

AN 0.01% SERIES IS AVAILABLE IN 13 NEW MODELS

KEPCO OFFERS MORE THAN 120 STANDARD VOLTAGE REGULATED POWER SUPPLIES COVERING A WIDE RANGE OF MAGNETIC, TUBE AND TRANSISTOR TYPES. MOST MODELS AVAILABLE FROM STOCK. SEND FOR BROCHURE B-587

KEPCO LABORATORIES, INC.

131-38 SANFORD AVENUE • FLUSHING 55, N.Y.

INDEPENDENCE 1-7000

CIRCLE 47 ON READER-SERVICE CARD

NEW PRODUCTS

Miniature Motor

1/100 hp

Rated 1/100 hp at 11,000 rpm, model 2PP1 miniature motor is qualified according to MIL-M-8609 specifications. A 26.5 v dc unit, it is 1.18 in. in diameter and 1.9 in. long and weighs 3.5 oz. It will run 500 hours without change of brushes.

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

CIRCLE 48 ON READER-SERVICE CARD

SSB Generators

8.5 to 9.6 kmc

Single sideband generators GS1032A and GS1032B are iridite treated aluminum and silver plated beryllium copper assemblies, respectively. Sideband output power is 1 mw min; carrier suppression, 15 db min; and sideband suppression, 15 db min. Rf carrier input is 50 mw at 8.5 to 9.6 kmc. The two modulation inputs, 90 degrees out of phase with each other, are at a frequency of 30 mc. Crystals and pin terminal crystal inputs will be supplied with each unit unless otherwise specified. BNC, miniature, or bridge connections will be supplied on request.

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

CIRCLE 49 ON READER-SERVICE CARD

◀ CIRCLE 50 ON READER-SERVICE CARD

Cathode Ray Oscilloscope

Dc to 30 mc

A fast-rise, cathode ray oscilloscope, type 543 handles dc to 30 mc. For versatility, nine plug-in preamplifiers are available. Sweep range is 0.02 usec per cm to 15 sec per cm; accelerating potential is 10 kv. The built-in voltage calibrator has 18 outputs from 0.2 mv to 100 v peak-to-peak. The unit has sweep magnifications of 2, 5, 10, 20, 50, and 100 times. A single knob controls 24 direct-reading calibrated sweep rates.

Tektronix, Inc., Dept. ED, P.O. Box 831, Portland 7, Ore.

CIRCLE 51 ON READER-SERVICE CARD

Frequency Voltmeter

Checks 400 cps power

Combining model 6506 frequency meter and a voltmeter in one portable unit, the 7500 meter can be used to check 400 cps power in aircraft or missiles. Frequency accuracy is 0.05% at 400 cps. The voltmeter has a duel scale with ±2% accuracy from 0 to 150 v and ±3% from 110 to 120 v. The meter maintains its precision from −55 to −71 C. With leads clipped to the points to be measured and plugged into the single set of input terminals, the unit is furnished with operating power. This same power provides the signal for simultaneous measurement of frequency and voltage while using a maximum of 100 ma at normal operating temperature.

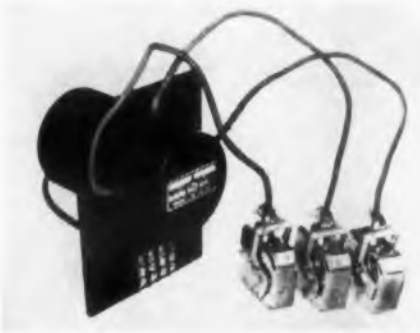
Varo Mfg. Co., Dept. ED, 2201 Walnut St., Garland, Tex.

CIRCLE 52 ON READER-SERVICE CARD

NEW PRODUCTS

Rotary Sampling Switch

Easy brush replacement



Driven by a single phase hysteresis motor, the 105A sampling switch has three poles, each with 30 shorting or 15 nonshorting channels at 1 rps. No brush force or phase adjustments are needed to replace the rotor and brush assembly. The unit has multipin connectors.

General Devices, Inc., Dept. ED, P.O. Box 253, Princeton, N.J.

CIRCLE 55 ON READER-SERVICE CARD

Digital Indicator

For extended environments

Meant for extreme environments, this digital indicator meets MIL-E-5272A and other tests. With characters 0 to 9 and two blank spaces in ascending order, it is 9/16 x 1-5/8 x 5-1/4 in.

Union Switch & Signal, Div. of Westinghouse Air Brake Co., Dept. ED, Pittsburgh 18, Pa.

CIRCLE 56 ON READER-SERVICE CARD

Audio Tone Oscillators

400 cps to 30 kc range

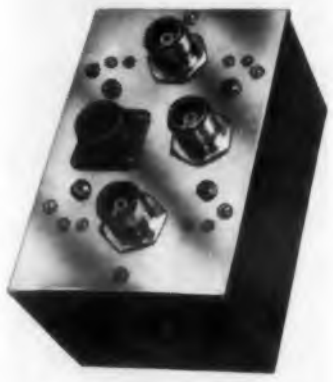
Operating from 12 or 28 v, series 101 and 102 audio tone oscillators have respective accuracies of ±5% and ±2%. Pretuned, they have frequencies in the 400 cps to 30 kc range. Harmonic distortion is 1%.

M F Electronics Co., Dept. ED, 122 E. 25th St., New York 10, N.Y.

CIRCLE 57 ON READER-SERVICE CARD

Coaxial Lobing Switch

1020 to 1100 mc range



Model D18H2GA is an spdt coaxial lobing switch with a frequency range of 1020 to 1100 mc and an input vswr of 1.2 to 1 maximum. Crosstalk is 21 db; insertion loss, 1 db maximum; switching rate, 20 cps. The actuator is 115 v ac, 400 cps, single phase. Measuring 5-7/8 x 3-5/8 x 4-3/4 in. and weighing 2.75 lb, the switch has a life of 1000 hours and is designed to meet airborne environmental requirements. Its HN connectors can be changed to suit specific requirements.

Thompson Products, Inc., Tapco Group, Dept. ED, 23555 Euclid Ave., Cleveland 17, Ohio.

CIRCLE 58 ON READER-SERVICE CARD

Deposited Carbon Resistors

Have molded thermoplastic insulation

In values from 10 ohms to 100 meg, type N deposited carbon resistors are molded into a clear thermoplastic with 10^{13} ohms effective insulation. However close the leads are soldered to the component the insulation will not be harmed or melted. The units meet MIL-R-10509B specifications.

Wewyn International Inc., Dept. ED, 355 Edgecliff Terrace, Cleveland 1, Ohio.

CIRCLE 59 ON READER-SERVICE CARD

CIRCLE 60 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Electrical Heaters

0.065 in. thick

Flexible and rugged, Thermal-Heaters are designed for airborne and other electronic equipment. These 43 w circular heaters weigh less than 1/4 oz, including the 12 in. leads. They are under 0.03 in. thick over the element and less than 0.065 in. thick over the leads. They may be clamped or cemented to flat or curved surfaces. Insulation resistance is 1000 v rms. Heaters in various sizes and shapes are made to customer specifications.

Minco Products, Inc., Dept. ED, 740 Washington Ave. N., Minneapolis 1, Minn.

CIRCLE 62 ON READER-SERVICE CARD

Audio Compressor and Expander

Speeds data readout

Vari-Vox is a speech-time compressor and expander. Repeating or discarding minute signal parts such as vowels, consonants, and pauses, it retransmits complex signals with full intelligibility. The expander helps interpretation of foreign language monitoring; difficult stenographic transcription; intelligibility in noise; and readout signal frequency division. The compressor helps speed data readout; cut monitoring time and tape storage; speed analysis of complex signals; reduce time in speech records; and increase information rate for signal monitoring.

Kay Electric Co., Dept. ED, Maple Ave., Pine Brook, N.J.

CIRCLE 63 ON READER-SERVICE CARD

Stepper Motor

Bidirectional

A bidirectional size 11 permanent magnet stepper motor, the M112A8 provides rotary motion without reciprocating parts. Stepping rate is 90 pulses per sec in random pulse direction. The unit has a rotor inertia of 3 gm cm². It can be supplied with internal logic circuitry.

American Electronics, Inc., Dept. ED, 655 W. Washington Blvd., Los Angeles 15, Calif.

CIRCLE 64 ON READER-SERVICE CARD

Random Access Memory System

12 μsec access time

With random access for both writing and reading, the 3122 memory system has a capacity of 12 8 binary digit characters. Access time is 12 μsec. The system is modular and may be expanded in storage capacity and word length. Read and write access cycles may be mixed.

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

CIRCLE 65 ON READER-SERVICE CARD

Transistor Transformers

5 and 10 w outputs

In both driver and voice coil types, these hermetically sealed transistor transformers operate from 30 cps to 20 kc. The H-280 driver transformer has a primary impedance of 200 ohms center tapped with secondary 400 ohms split. The H-281 is a 5 w output from 48 ohms center tapped to 16, and 4 ohms. The H-282 is a 10 w output from 20 ohms center tapped 16, 8, and 4 ohms.

United Transformer Corp., Dept. ED, 150 Varick St., New York 13, N.Y.

CIRCLE 66 ON READER-SERVICE CARD

CIRCLE 67 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Transistorized Power Supply

24 to 32 v dc

Providing 24 to 32 v dc at 10 amp, the M-1136A transistorized power supply has an overload capacity of 125 amp for 15 minutes. Input is 208 v ac ±10%, three phase, 57 to 63 cps. Regulation is ±0.1% for line changes from 19 to 229 v ac.

Perkins Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

CIRCLE 68 ON READER-SERVICE CARD

Coaxial Balanced Bar Hybrid

For L-band

Model NL5805 coaxial bar hybrid can be used as a power splitter with 900 to 1500 mc aircraft antennas. Power applied to one arm will divide equally between two other arms matched to 50 ohms or having the same degree of mismatch. The fourth arm ends in a matched load.

Bogart Mfg. Corp., Dept. ED, 315 Seigel St., Brooklyn 6, N.Y.

CIRCLE 69 ON READER-SERVICE CARD

Pulse Timer

Has own power source

With self-contained power sources from 1.5 to 12 v, these dc timers have ±0.02% accuracy from 10 to 110 F. They can serve as interval timers, slow dc motors, pulse source timers, and low frequency oscillators. On a 1.5 v C cell, the 2.4 in. diameter movement will operate two years.

Hamilton Watch Co., Allied Products Industrial Div., Dept. ED, Lancaster, Pa.

CIRCLE 70 ON READER-SERVICE CARD

◀ CIRCLE 71 ON READER-SERVICE CARD

Miniature Power Supplies

No moving parts

There are no moving parts or vibrators in this rugged power supply. Converting battery to B voltages with 80% efficiency, the unit has 0.05% output ripple and 0.3 v rms input ripple. It is 3.5 in. sq and 1.7 in. high. Models TPS-1 and TPS-2 have outputs of 100 ma, 150 v and 200 ma, 250 v, respectively. Inputs are 12 and 24 v. P. R. Mallory & Co., Inc., Vibrator Div., Dept. ED, DuQuoin, Ill.

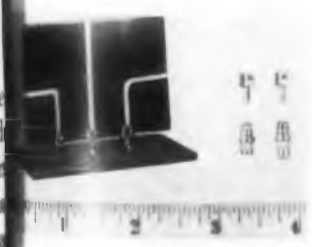
CIRCLE 72 ON READER-SERVICE CARD

Converters

Binary to binary decimal

By simple switching, this converter translates pure binary code to binary decimal code. No error is introduced in the translation process. Aeronca Mfg. Corp., Baltimore Div., Dept. ED, Hilltop and Frederick Rds., Baltimore 28, Md.

CIRCLE 73 ON READER-SERVICE CARD



Printed Circuit Connectors

For vertical board mounting

Model 2319 plug and 2320 jack are designed for mounting one printed circuit form perpendicular to another. The plug has a 0.0635 in. bore through the rectangular shank, which is slotted for boards 1/32 in. thick. The jack comes in four shank lengths for boards 1/16 to 3/16 in. thick. Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 74 ON READER-SERVICE CARD

NEW PRODUCTS

Digital Ratiometer

±0.1% full scale accuracy

Measuring ac and dc voltage ratios from 0 to 1 in direct numerical values, model 1594 digital ratiometer has a full scale accuracy of ±0.1%. Inputs range from 0 to 6 v dc and 0 to 6.3 v ac at 400 cps. Reference input impedance for both ac and dc ratios is 1 K.

Performance Measurements Co., Dept. ED, 15301 W. McNichols, Detroit 35, Mich.

CIRCLE 77 ON READER-SERVICE CARD

Microwave Leveler

Flattens rf power to ±1 db

Model 703 microwave leveler flattens rf power to ±1 db from 2 to 4 kmc. It may be used with backward wave oscillators, klystrons, signal generators, and twt amplifiers. The unit also provides variable attenuation over the dynamic range of an associated control device.

Alfred Electronics, Dept. ED, 897 Commercial St., Palo Alto, Calif.

CIRCLE 78 ON READER-SERVICE CARD

Linear AC Ammeter

2% accuracy

Over a 300 to 2000 cps range, this linear ac ammeter provides 2% full scale accuracy. Self-contained up to 10 amp, the unit withstands 1000% overload for 5 sec or 100% continuously. It meets MIL-M-10304A standards.

Voltron Products, Dept. ED, 1010 Mission St., South Pasadena, Calif.

CIRCLE 79 ON READER-SERVICE CARD

Mass Flow Transducers

No moving parts

The range of this mass flow transducer is 20 to 180 lb of air per minute in a 6-in. duct. Without moving parts, it gives direct measurements of true mass flow independent of the temperature or pressure of the gas. It consists of two platinum resistance probes which form the active elements in opposite arms of a dc resistance bridge. The longer one is heated by a high, steady current and takes the fundamental density-velocity measurement as it is cooled by the mass flow in the duct. The shorter one is unheated and provides compensation for changes in the output of the heated probe as a function of the gas temperature. The transducer provides a 100 μa output signal as a function of the mass flow of air or other gas from 0 to 150 F. It has an input of 28 v dc and weighs under 1 lb.

Trans-Sonics, Inc., Dept. ED, Burlington, Mass.

CIRCLE 80 ON READER-SERVICE CARD

Microwave Antenna

For subsonic aircraft

Mounted on the underside of subsonic aircraft, the 15-200-S antenna gives circularly polarized horizon-and-down-coverage from 200 to 3300 mc.

Radiation, Inc., Dept. ED, P.O. Box 37, Melbourne, Fla.

CIRCLE 81 ON READER-SERVICE CARD

Ka Band Magnetrons

For missile radar

Ka band magnetrons M4063, M4064, and M4155 are rated at 70, and 40 kw respectively. For missile radar use, these rugged units weigh 9 to 13 lb.

Sylvania Electric Products, Inc., Special Tube Operations, Dept. ED, Williamsport, Pa.

CIRCLE ON READER-SERVICE CARD

NEW PRODUCTS

Vibration Meter

Permits remote testing

Type B-731A meter may be used for JAN MIL vibration tests on electronic components. It permits remote measurement of vibration displacements from 50 μin. to 0.5 in. and vibration rates from 1 cps to 10 kc. Accurate to 2%, the unit has a noncontacting probe and can measure the dilation and eccentricity of rotating parts.

Wayne Kerr Corp., Dept. ED, 2920 N. 4th St., Philadelphia 33, Pa.

CIRCLE 85 ON READER-SERVICE CARD

Precision Potentiometers

Miniature

Miniature model 1410 is a 1 w, 200 to 25,000 ohm precision potentiometer with an electrically isolated shaft and wiper. The stop mechanism, associated only with the shaft, permits high rotational accuracy. The unit withstands 50 g acceleration and meets JAN-R-19, JAN-P-13, JAN-P-79, JAN-R-38, and MIL-E-5400 specifications.

S. A. Asquith Co., Dept. ED, 427 W. Chevy Chase Drive, Glendale 4, Calif.

CIRCLE 86 ON READER-SERVICE CARD

Pulse Height Analyzer

Operates at 1 million counts a minute

Pulse height analyzer PHA-2 can operate at counting rates above 1 million cpm without appreciable data distortion. Input range is 0 to 5 v positive. The unit has 10 turn continuous controls for window level and width adjustment. Integral or differential operation are switch selected.

Tullamore Electronics Lab, Dept. ED, 6055 S. Ashland Ave., Chicago 36, Ill.

CIRCLE 87 ON READER-SERVICE CARD

Capacitors

Operate continuously at 315 C

The E-315 capacitor operates from —55 to +315 C. Capacitance is 0.05 to 4 μf at 600 v dc, with higher voltages available. The unit has been tested for 1000 hours at maximum temperature and rated voltage.

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

CIRCLE 88 ON READER-SERVICE CARD

Miniature Motor

20 lb thrust

When 100 ergs at 1.5 v or 0.2 amp are applied to it, this squib-actuated piston motor responds in 1 msec with a 20 lb thrust. The unit is 1/4 in. in diameter and 15/16 in. long. It functions from −65 to +165 F and withstands 20,000 g shock and acceleration.

Atlas Powder Co., Ordnance Materiel Dept., Dept. ED, Wilmington 99, Del.

CIRCLE 89 ON READER-SERVICE CARD

Limiting Audio Amplifier

50 cps to 15 kc range

For a-m or f-m the 26U-1 limiting amplifier has a 12 to 1 compression ratio for the first 10 db above the verge of compression. Frequency range is 50 cps to 15 kc ±1.5 db; input level, −20 to +20 dbm. Input impedance is 600 ohms unbalanced, and output impedance is 600 ohms unbalanced adjustable or balanced fixed. Harmonic distortion is 1.5% at 25 db compression.

Collins Radio Co., Dept. ED, Cedar Rapids, Iowa.

CIRCLE 90 ON READER-SERVICE CARD

NEW PRODUCTS

Silicon Rectifiers

50 to 500 piv

Providing 6 amp over a 50 to 500 piv range, these diffused junction silicon rectifiers operate at diode base temperatures up to 150 C. They can be used for airborne power supplies, electrical instrument testing, and oscilloscopes.

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

CIRCLE 93 ON READER-SERVICE CARD

Potentiometers

Rated at 0.2 w

For transistorized circuits, series 44 0.2-w carbon potentiometers have standard resistances of 25 and 500 K with taper. Units may be ordered in 200 ohms to 5 meg linear, and 1500 ohms to 2.5 meg tapered.

Clarostat Mfg. Co., Inc., Dept. ED, Dover, N.H.

CIRCLE 94 ON READER-SERVICE CARD

Oscilloscope

100 μv per division sensitivity

Type 403 oscilloscope and its rack-mounted version, 403-R, have a full scale range of 1 mv to 500 v, continuously variable in 17 steps. Maximum sensitivity is 100 μv per division; maximum drift, 1 mv. The unit has 19 sweeps from 1 sec to 1 μsec per cm. Full scale accuracy is ±5%.

Allen B. Du Mont Labs, Inc., Dept. ED, 760 Bloomfield Ave., Clifton, N.J.

CIRCLE 95 ON READER-SERVICE CARD

Differential Relay

Voltage sensing

This differential voltage sensing relay protects radar gear, microwave relay systems, and other equipment. Its control range is 70 to 100% of rated voltage for both dropout and pickup with a minimum 1 v differential. Dc ranges are 6 to 49 v and 50 to 250 v; ac ranges are 1 and 3 phase, 3 and 4 wire.

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

CIRCLE 96 ON READER-SERVICE CARD

Time and Distance Actuator

Fires squibs

At a preset time or distance, model N10A time delay relay and distance sensor produces a 22 amp peak pulse to fire squibs. Times up to 3 sec and distances to 200 ft can be set on the dial.

Alto Scientific Co., Inc., Dept. ED, 855 Commercial St., Palo Alto, Calif.

CIRCLE 97 ON READER-SERVICE CARD

Tubeaxial Blower

Delivers 50 to 160 cfm

For cooling electronic equipment, the MSA 4707 tubeaxial blower is 6 in. in diameter, 4 in. long, and weighs 16 oz. It delivers 50 to 160 cfm and has an ac or dc motor.

The Torrington Mfg. Co., Dept. ED, Torrington, Conn.

CIRCLE 98 ON READER-SERVICE CARD

CIRCLE 99 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Transistor Tester

Checks 720 units an hou

In one hour, the T-200 transistor tester automatically runs 720 transistors through a series of ten tests. The test units may be pnp or npn, silicon or germanium. The T-200 will also perform three tests on 2400 silicon or germanium diodes in an hour. The plug-in unit is 2% accurate.

Atlantis Engineering Corp., Dept. ED, 1807 Stratford Dr., Garland, Tex.

CIRCLE 111 ON READER-SERVICE CARD

Snap Action Switch

Has mounting ears

These snap action Klikswitches have integrally molded ears with side mounting holes. Spdt or spst normally closed, they are rated at 8 amp, 115 v ac, noninductive load.

General Controls Co., Dept. ED, 8078D McCormick Blvd., Skokie, Ill.

CIRCLE 112 ON READER-SERVICE CARD

Alarm Control

2-7/8 in. diameter

Self-contained, this alarm control is 2-7/8 in. in diameter and 4-3/4 in. deep. It controls signals from almost any variable, usually without amplification. It may be used with any of the company's 4-1/2 in. meter-relays.

Assembly Products, Inc., Dept. ED, Chesterland, Ohio.

CIRCLE 113 ON READER-SERVICE CARD

◀ CIRCLE 110 ON READER-SERVICE CARD

Time Delay Relays

Instantaneous Reset

Preset for 20 to 180 sec delays and voltage compensated from 22 to 32 v dc, these time delay relays operate from −65 to +125 C. Series IR units are spno or spnc; series TR are dpdt; and series STR are spdt. All are rated 2 amp at 28 v dc, resistive.

Curtiss-Wright Corp., Electronics Div., Dept. ED, 260 Passaic Ave., West Caldwell, N.J.

CIRCLE 114 ON READER-SERVICE CARD

Solenoid

Has 20 msec stroke

Designed to operate with a 24 lb load, the R.S. 5174 solenoid operates from −65 to +160 F. Its 0.02 in. stroke occurs at 14 msec maximum and is completed in less than 20 msec. At 78 F, voltage rating is 24 v dc and coil resistance is 19.2 ohms.

Telecomputing Corp., Dept. ED, 915 N. Citrus Ave., Los Angeles 38, Calif.

CIRCLE 115 ON READER-SERVICE CARD

Servo Potentiometer

7/8 to 3 in. diameters

Linear or nonlinear with multiple taps, these precision servo potentiometers feature low torque operation. In various materials, they may be ganged to order. Diameters are 7/8 to 3 in.

Circuit Instruments Inc., 2801 Anvil St., N., St. Petersburg 33, Fla.

CIRCLE 116 ON READER-SERVICE CARD

CIRCLE 117 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Axial Lead Rectifiers

Rated at 1500 v

At 150 C, axial lead silicon rectifiers SL615 and SL715 are rated to 1500 v at 50 and 100 ma respectively.

Transitron Electronic Corp., Dept. ED, Wakefield, Mass.

CIRCLE 119 ON READER-SERVICE CARD

Oscillator

Center frequencies to 250 kc

A dual channel, voltage controlled oscillator model 956 has center frequencies that cover all IRIG channels and extend to 250 kc. Input is ±2.5 v for any deviation up to ±40% of center frequency; output is variable from 0 to 1.5 rms.

Midwestern Instruments, Dept. ED, 41st and Sheridan, Tulsa, Okla.

CIRCLE 120 ON READER-SERVICE CARD

Storage Tube

1000-line resolution

A single-gun, recording storage tube, the QK 685 has a resolution of 1000 lines at 50% modulation, and shading-to-signal ratios of less than 10%. Output capacitance is under 10 μμf. The tetrode gun is designed for magnetic deflection and focusing, with provisions for dynamic electrostatic focusing.

Raytheon Mfg. Co., Microwave and Power Tube Div., Dept. ED, Waltham 54, Mass.

CIRCLE 121 ON READER-SERVICE CARD

Toroidal Inductors

5 mh to 5 h

Wound toroidally on molybdenum permalloy powder cores, these high Q coils have inductances from 5 mh to 5 h, accurate to 1%. Open, epoxy encapsulated, or molded, they are 1-5/16 in. in diameter and 11/16 in. high.

Magnetico, Inc., Dept. ED, 6 Richter Court, East Northport, N.Y.

CIRCLE 122 ON READER-SERVICE CARD

Power Amplifier Tubes

Performance matched

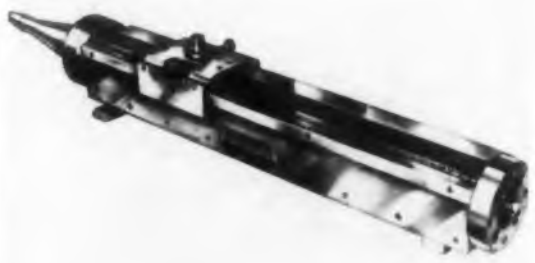
Packed in pairs, type 6550 and 5881 beam power amplifier tubes are performance-matched to tight limits. The matching eliminates much of the higher order distortion, thus improving sound reproduction. The 5881 is for use in amplifiers of 50 w and under; the 6550, for amplifiers of 100 w or less.

Tung-Sol Electric Inc., Dept. ED, 95 Eighth Ave., Newark 4, N.J.

CIRCLE 123 ON READER-SERVICE CARD

Slotted Line

Under 1.01 residual vswr



Slotted line type 1026 has a residual vswr below 1.01 and less than 1.005 rated error in detected signal. Important outer conductor surfaces are hand scraped to fine tolerance. The inner conductor is supported by compensated dielectric pins. The unit is furnished in 20, 40, 60, 80, and 130 in. lengths and comes in standard impedances from 50 to 75 ohms. It may be used with tapered reducers for measurements of 6-1/8 in., 3-1/8 in., 1-5/8 in., and type N coaxial transmission lines.

Alford Mfg. Co., Dept. ED, 299 Atlantic Ave., Boston 10, Mass.

CIRCLE 124 ON READER-SERVICE CARD

NEW PRODUCTS

Coaxial Relay

Provides remote switching

For 3-1/8 in. coaxial lines, type RC10 relay provides remote switching at frequencies to 60 mc at 50 kw. It has a latching type actuator and vacuum enclosed contacts. Impedance is 50 ohms; frequency range, 0 to 100 mc; vswr, 1.02 at 30 mc and 1.05 at 60 mc.

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

CIRCLE 127 ON READER-SERVICE CARD

Servo Motors

60 and 400 cps

In several sizes from 8 to 23, these 60 and 400 cps servo motors operate to 200 C ambient and meet MIL-E-5272A requirements. The line includes damping and tachometer generators, and inertia damped and synchronous motors.

Servo Dynamics Corp., Dept. ED, Somersworth, N.H.

CIRCLE 128 ON READER-SERVICE CARD

Pulse Tube

Provides 2 amp peak current

The 7318 miniature twin-triode is a 9-pin, medium-mu amplifier that provides 2 amp peak in 10 μsec pulses. It operates from −62 to +100 C, and provides 80% emission after a 10 sec warm-up.

CBS-Hytron, Dept. ED, Danvers, Mass.

CIRCLE 129 ON READER-SERVICE CARD

◀ CIRCLE 126 ON READER-SERVICE CARD

Vernier Potentiometer

Three decade voltage divider

Vernier potentiometer 81-A is a three decade voltage divider with a Kelvin-Varley circuit and a parallax-free dial that registers to four places. Standard resistance is 10 K; accuracy, ±0.05%; linearity, ±0.01%; resolution, 0.002%; power rating, 5 w; frequency range, dc to 10 kc.

Rinco, Inc., Dept. ED, 7962 E. Powell Blvd., Portland 6, Ore.

CIRCLE 130 ON READER-SERVICE CARD

Oscillographic Recorders

6 and 8 channel

Series 850 direct writing oscillographic recording systems contain six or eight interchangeable preamplifier modules in a cabinet 5 ft high. Available preamplifiers include the 850-1200 phase sensitive demodulator for use with resolvers, synchros, and differential transformers, and the 850-1300A dc coupling for single-ended or balanced input signals. Power for up to eight preamplifiers is provided by a single 850-500A power supply at the rear of the module. The complete module with power supply and rack is available for separate use. The recorder assembly consists of a flush-front recorder, a power supply, and transistorized current feedback amplifiers. It provides nine chart speeds from 0.25 to 100 mm per sec; individual stylus heat controls; 8 in. of visible record; contacts for remote control; and inkless recordings in true rectangular coordinates on plastic coated charts.

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

CIRCLE 131 ON READER-SERVICE CARD
CIRCLE 132 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Drive Amplifier

Dual channel

Model 940 dual channel amplifiers are designed to drive the company's 102 and 120 galvanometers. Frequency response is dc to 10 kc ±1 db; input impedance, 1 meg constant; input sensitivity, ±1 to ±100 v for full scale output. The unit can provide ±10 v at 200 ma.

Midwestern Instruments, Dept. ED, 41st and Sheridan, Tulsa, Okla.

CIRCLE 134 ON READER-SERVICE CARD

Stand-Off Terminals

0.36 in. long

These stand-off terminals are 0.36 in. long and weigh 0.75 oz per hundred. Hi-Alumina insulated, series 1480 units withstand 1000 F and are resistant to nuclear radiation. Teflon insulated series 1490 combine low electrical loss and good dielectric characteristics.

Litton Industries, Components Div., Dept. ED, 5873 Rodeo Rd., Los Angeles 16, Calif.

CIRCLE 135 ON READER-SERVICE CARD

Transistor Tester

For pnp and npn types

For checking positive leakage and gain in pnp and npn transistors, the 690-A tester measures dc beta from 5 to infinity. It also checks diode forward and reverse leakage.

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

CIRCLE 136 ON READER-SERVICE CARD

Patch Panels

Custom made

For control instruments and switching computer circuits, the 256 patch panel is custom made from a 6 x 6 x 1/8 in. aluminum panel. Gold plated, the pins are 0.045 in. in diameter and spaced on 0.2 in. centers. Individual contacts have a minimum capacity of 1 amp.

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

CIRCLE 137 ON READER-SERVICE CARD

Oscilloscope

For rack mounting

Oscilloscope 90923 is a rack panel type 3.5 in. high. It has a 2 cps to 30 kc linear sweep and 2000 v accelerating potential. The vertical and horizontal balanced deflection amplifiers have frequencies of 7 cps to 125 kc ±2 db and 2 cps to 125 kc ±2 db, respectively. The 3XP tube is 3 x 1.5 in.

The James Millen Mfg. Co., Inc., Dept. ED, Malden, Mass.

CIRCLE 138 ON READER-SERVICE CARD

Size 8 Servomotor

Inertia-damped

No-load speed of the 8 IM 420 size 8 servomotor is 6000 rpm. Flywheel inertia is 2 gm cm² and flywheel damping factor is 40 dyne-cm-sec/rad. The unit has a 26 v fixed and a 40 v center-tapped control phase. It stands 30 g vibration and 100 g shock to 2000 cps and operates in ambients from −55 to +130 C. It also meets MIL-E-5272A requirements. Power input is 2.6 w per phase.

Beckman Instruments, Inc., Helipot Div., Dept. ED, Fullerton, Calif.

CIRCLE 139 ON READER-SERVICE CARD

NEW PRODUCTS

Pilot Lights

Neon

For voltages including 110 and 200 v NE2H and NE51H neon lamps are over eig times as bright as their NE2 and NE51 counte parts. In many styles and lengths, they mount 1/2 in. holes. They last 5000 hours.

Industrial Devices, Inc., Dept. ED, 982 R Rd., Edgewater, N.J.

CIRCLE 141 ON READER-SERVICE CARD

Rate Turntable

12 in. diameter

The T848 turntable is an accurate rate of t test machine for calibrating and evaluating r gyros. It is 12 in. in diameter and has an 8 in. ameter reading scale which expands in logari mic fashion. Axis wobble is less than 20 sec of with full 100 lb loading.

Sterling Precision Corp., Dept. ED, 17 Mat cock Ave., Port Washington, N.Y.

CIRCLE 142 ON READER-SERVICE CARD

Galvanometer

Has built-in shunt

With instant varying sensitivity and critic damping, this galvanometer provides deflecti and null measurements. It has a built-in 6-po tion shunt and a protective shorting switch. T curved scales are 0-150 mm and 75-0-75 mm.

Ealing Corp., Dept. ED, 40 University R Cambridge 38, Mass.

CIRCLE 143 ON READER-SERVICE CARD

Pulse Generator

Has four prf ranges

The 2620 pulse generator has four continuously variable pulse repetition frequency ranges from 10 to 100,000 pulses per sec. It also has four pulse duration ranges continuously variable from 0.1 to 1000 μsec. Rise time is 0.02 μsec; decay time, 0.03 μsec; output impedance, 93 ohms. Accuracy is ±5%.

Simpson Electric Co., Dept. ED, 5200 W. Kinzie St., Chicago, Ill.

CIRCLE 144 ON READER-SERVICE CARD

AC Potentiometer

Linearity of 0.05%

Having a terminal linearity of 0.05%, the Series 4 Vernistat's diameter measures 1.062 in. Units are available with maximum output impedances of 200, 100, and 40 ohms. Resolution is 0.01%. Weighing in at 2 oz, the unit can be produced in nonlinear versions.

Perkin-Elmer Corp., Dept. ED, Norwalk, Conn.

CIRCLE 145 ON READER-SERVICE CARD

Filament Transformers

Vacuum molded

These 400 cps filament transformers are vacuum molded to MIL-T-27 Grade 5 specifications. Primary voltage is 105 or 115 v, 380 to 1000 cps. Secondary voltage is 6.3 v center tapped. Current ratings are 3, 5.5, 10 and 20 amp; sizes, 1-5/8 x 1-3/4 x 2 in. to 2-1/2 x 2-13/16 x 3 in.

United Transformer Corp., Dept. ED, 150 Varick St., New York 13, N.Y.

CIRCLE 146 ON READER-SERVICE CARD

NEW PRODUCTS

Decommutation Equipment

Handles pam and pwm coding

Made up of plug-in M-series modules, the telemetry decommutator and display handles up to 100 data channels. A 24 to 3600 pps sampling capacity makes the system compatible with all standard IRIG pwm and pam rates and many nonstandard rates. The unit operates with high-speed electronic multiplexers and plays tape recorded data back in faster than real time. It has an undecommutated, fully corrected output for digitizing, and a variety of corrected and separated analog voltage outputs. Long-term system accuracy is ±0.5%.

Applied Science Corporation of Princeton, Dept. ED, P.O. Box 44, Princeton, N.J.

CIRCLE 149 ON READER-SERVICE CARD

Magnetic Shielding

Increases storage tube capacity

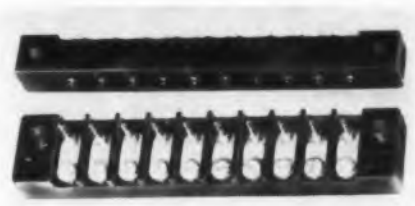
Netic Co-Netic dual laminae magnetic shielding improves resolution and capacity of data storage tubes. It is nonretentive and insensitive to shock. Effective indefinitely, it needs no periodic annealing.

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

CIRCLE 150 ON READER-SERVICE CARD

Terminal Block

Handles 15 amp



Rugged, 10-contact units, 200-19 terminal blocks can handle 15 amp and 10 kv rms at sea level. Each pin contact is common with individual buss plates and separated by molded barriers. Solder cups accept 14 awg wire.

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

CIRCLE 151 ON READER-SERVICE CARD

Resonant Reed Relays

Weigh 1.7 oz

Low cost electrochemical filters, these resonant reed relays can actuate sensitive relays, vacuum tubes, thyratrons, and transistors. They have 8 reeds with 280 to 500 cps spacing and weigh 1.7 oz. Operating power is 0.5 mw; maximum reed switch power, 0.5 w; and maximum contact voltage, 380 v dc. Respectively, models A and N have 6 K and 200 ohms dc resistance, 40 and 1.6 K ac resistance at 400 cps, and 5 and 0.8 rms operating voltage. The units can be remote controlled.

Remote Control Mfg. Co., Dept. ED, 268 Marlborough Dr., Pontiac, Mich.

CIRCLE 152 ON READER-SERVICE CARD

Shaft Encoder

No ambiguity

For computer control of automatic machinery, model 740 encoder translates analog shaft position to true binary digital information. It provides 10-bit resolution with a 3.5 in. disc that yields 1024 discrete position representations per turn. Special logic in the disc pattern eliminates ambiguity. The encoder is 4-3/16 in. in diameter and 1-1/4 in. thick. It has a life expectancy of over 1 million revolutions at 25 rpm input speed. Temperature range is −50 to +150 F.

Librascope, Inc., Dept. ED, 808 Western Ave., Glendale, Calif.

CIRCLE 153 ON READER-SERVICE CARD

UHF Receiver

Covers 225 to 400 mc

Model 201 is a fixed frequency, superheterodyne airborne receiver with a 225 to 400 mc range. It operates from a 10.5 v dc source. Sensitivity is 1 μv for a 12 db signal to noise ratio, and attenuation of the intermediate frequency is 80 db. Image or spurious frequency response is 60 db below the desired signal.

General Antronics Corp., Dept. ED, 9036 Culver Blvd., Culver City, Calif.

CIRCLE 154 ON READER-SERVICE CARD

NEW PRODUCTS

Power Supply

Low voltage

From an input of 105 to 125 v ac, single phase, 60 cps, the MTR28-30-2 power supply provides 24 to 32 v dc at 30 amp. The transistorized unit is short circuit proof and has ±2% regulation no load to full load. Ripple is 5 mv rms and dynamic impedance is 0.03 ohms from 0 to 20 kc.

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

CIRCLE 156 ON READER-SERVICE CARD

Registration Buffer

Holds 1092 1 to 7 bit characters

Storing and interpreting data and instructions from digital computers, the M-10 registration buffer directs the printing format of the company's S-C 5000 high speed printer. It permits the S-C 5000 to print up to 5000 lines a minute. The unit stores up to 1092 1 to 7 bit characters and accepts 35,000 characters a second.

Stromberg-Carlson Co., Dept. ED, 1895 Hancock St., San Diego 12, Calif.

CIRCLE 157 ON READER-SERVICE CARD

DC Amplifiers

Weigh 7 oz

These dc amplifiers have adjustable voltage gains of 100 to 500. Linearity is ±0.5% based on a 5 v dc output value. The units are 2.5 x 1.19 x 1.19 in. and weigh 7 oz.

Networks Electronic Corp., Dept. ED, 14806 Oxnard St., Van Nuys, Calif.

CIRCLE 158 ON READER-SERVICE CARD

Binary Translator

For digital output devices

Binary translator DT-2 transfers parallel digital data from most standard electronic counters to various digital output devices. It automatically translates 1-2-2-4 or 1-2-4-8 code to 1-2-4-8 parallel binary.

Aeronca Mfg. Corp., Dept. ED, Hilltop and Frederick Rds., Baltimore 28, Md.

CIRCLE 159 ON READER-SERVICE CARD

Distortion Meter

Covers af spectrum

This distortion meter measures fundamentals from 30 cps to 15 kc, and harmonics to 45 kc. It provides full scale readings of 0.3, 0.1, 0.03, 0.01, and 0.003 v for measurements of low level audio voltages in determining noise and harmonic content.

Barker & Williamson, Inc., Dept. ED, Bristol, Pa.

CIRCLE 160 ON READER-SERVICE CARD

Mercury Battery Packs

Secondary voltage standards

Made from basic cells of 1.357 v ±0.5% these mercury battery packs can be supplied in any voltage to serve as secondary standards. Voltage declines 1% in two years of storage at 70 F.

The Mallory Battery Co., Dept. ED, 60 Elm St., North Tarrytown, N.Y.

CIRCLE 161 ON READER-SERVICE CARD

Program Timer

Handles 16 circuit functions

For missile, aircraft, and ground use, model 1000 program timer can handle 16 separate circuit functions. Its switch and linear and nonlinear potentiometer function strips are interchangeable. MIL-E-5272 designed, it has ±0.5% repeat and timing accuracy.

Hub-Pot, Inc., Dept. ED, 13827 Saticoy St., Van Nuys, Calif.

CIRCLE 162 ON READER-SERVICE CARD

◀ CIRCLE 163 ON READER-SERVICE CARD

NEW PRODUCTS

Power Supplies

Provide dc and ac outputs

Variable output, unregulated power supplies, the Nobatron RC series, provide both dc and ac. Available models, each with an ac output of 0 to 130 v, supply 0 to 36 and 0 to 150 v dc. Both the 36 and 150 v models come with maximum dc power ratings of 500 to 1000 w.

Sorensen & Co., Inc., Dept. ED, Richards Ave., South Norwalk, Conn.

CIRCLE 165 ON READER-SERVICE CARD

Test Set

Checks out magnetic tape equipment

Designed for the company's 752 magnetic tape recorder-reproducer, the Datatape 23-203 tester is also for general use. The mobile cabinet contains a volt-ohm milliammeter, audio oscillator, vtvm, oscilloscope, and voice amplifier.

Consolidated Electrodynamics Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena, Calif.

CIRCLE 167 ON READER-SERVICE CARD

Signal Generator

±1 ppm stability

For automatic frequency control of doppler radar, missiles, and other frequency comparison circuits, this uhf signal source has ±1 ppm stability from 32 to 105 F. Noise is −64 db; output frequency 450 to 460 mc; power output, 15 mw into 51.5 ohms.

The Hallicrafters Co., Dept. ED, 4401 W. Fifth Ave., Chicago 24, Ill.

CIRCLE 168 ON READER-SERVICE CARD

Panel Indicator

Integrally lighted

Filled with inert gas, type IN-9811-02 is a 1 in., integrally lighted indicator built to MIL-I-25950 and

CIRCLE 164 ON READER-SERVICE CARD

MIL-L-25467A specifications. Designed for remote indication of jet engine oil pressure, it can be adapted to any indicator function. Ambient range is −65 to +160 F.

John Oster Mfg. Co., Avionic Div., Dept. ED, 1 Main St., Racine, Wis.

CIRCLE 169 ON READER-SERVICE CARD

Digital Displays

Plug-in type

These plug-in, in-line digital display units incorporate an Amphenol Blue Ribbon connector. They are easily changed without disturbing the internal wiring of the system where they are being used. The digits, 0 to 9, are 1 in. high and include a shifting decimal point.

Industrial Electronic Engineers Inc., Dept. ED, 3973 Lankershim Blvd., North Hollywood, Calif.

CIRCLE 170 ON READER-SERVICE CARD

Demodulator

Phase sensitive

The 10043 demodulator is designed for missile and aircraft instrumentation systems. It provides three phase sensitive demodulation channels and one ac rectification channel for reference signals. Inputs are 400 or 1200 cps; outputs, 0 to 5 or ±2.5 v dc.

Hoover Electronics Co., Dept. ED, 110 W. Timonium Rd., Timonium, Md.

CIRCLE 171 ON READER-SERVICE CARD

Power Supplies

Portable

ToroPak P14-65 portable power supply can provide 110 v 60 cps single phase power to 200 w for eight hours. It can also provide 12 v dc for an extended period. It can then be recharged with ac or dc current in several hours.

Frantis Bros., Dept. ED, 446 C Street, Tustin, Calif.

CIRCLE 172 ON READER-SERVICE CARD

CIRCLE 173 ON READER-SERVICE CARD ➤

NEW PRODUCTS

Servo Control

Corrects nonlinear outputs

Linearizer model 110 is an electronic servomechanism which corrects the output data of a nonlinear instrument. The output it produces is directly proportional to the input of the nonlinear instrument. Eliminating the need to replot nonlinear data for final interpretations, the unit saves a lot of time in processing families of curves or integrating under a data curve. The linearizing is continuous and automatic once a correction template is inserted and a few adjustments are made. The nonlinear output is fed into the linearizer, and the corrected data output can be fed into a recorder amplifier or any other readout device. The instrument acts on input voltages up to 100 v and has a frequency response from dc to 2000 cps.

Custom Engineering and Development Co., Dept. ED, 1429 S. Ewing Ave., St. Louis 4, Mo.

CIRCLE 174 ON READER-SERVICE CARD

Transponder Test Set

For L-band units

This tester checks out L-band airborne transponders built to ARINC characteristics 532B and ANDB (AMB) 2.3 NAIB. Frequency range is 950 to 1220 mc; repetition rate, 15 to 2000; pulse spacing, 1 to 30 μsec.

Kearfott Co., Inc., Microwave Div., Dept. ED, 14844 Oxnard St., Van Nuys, Calif.

CIRCLE 175 ON READER-SERVICE CARD

Static Inverter

±1 cps frequency regulation

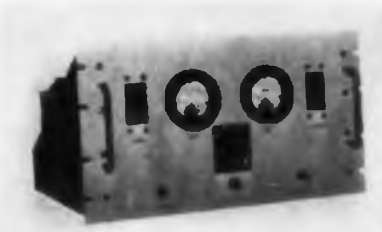
For converting dc to ac, model W-1347 static inverter has an output frequency of 400 ±1 cps. Output voltage is 115 v ±2%. The 3-phase, 100 va unit is designed to meet MIL-E-5272A specifications.

Electrosolids Corp., Dept. ED, 13745 Saticoy St., Panorama City, Calif.

CIRCLE 176 ON READER-SERVICE CARD

DC Power Supply

Delivers 28 v at 10 amp



Transistorized power supply M-1137 provide 24 to 32 v dc at 10 amp. Regulation is ±1% n load to full load; ripple is 5 mv rms; and outpu impedance is 0.05 ohms. The unit operates fron 105 to 125 v ac, single phase, 60 cps.

Perkin Engineering Corp., Dept. ED, 34 Kansas St., El Segundo, Calif.

CIRCLE 178 ON READER-SERVICE CARD

Bandpass Filters

For 12 frequencies

These filters consist of a model A49 3-stage am plifier, Twin-T networks, and a model F508-I switching chassis. The amplifier has a voltag gain adjustable to 60 db and a 500 K input im pedance. The output voltage is 3 v across 10 K The switching chassis has a panel switch tha selects any one of 12 filter frequencies.

T T Electronics, Inc., Dept. ED, P.O.Box 180 Culver City, Calif.

CIRCLE 179 ON READER-SERVICE CARD

Coaxial Switch

For 6⅛ in. transmission lines

Type 1038 coaxial switch has a 0 to 450 m frequency range and a vswr under 1.05. It i designed for 6-1/8 in. coaxial transmission line and has about the same cw power rating as they do. It comes in motor and manually operated models.

Alford Mfg. Co., Dept. ED, 299 Atlantic Ave. Boston 10, Mass.

CIRCLE 180 ON READER-SERVICE CARD

NEW PRODUCTS

Temperature Test Chambe

±2 F accuracy

Portable temperature test chamber mod l 6545 W cools to −100 F in 6 minutes, and h ats to 500 F in 30 minutes. Over the whole r nge it keeps within ±2 F of the desired tempe rature. Test capacity is 16 x 7 x 7 in.; outside dim nsion are 24 x 10 x 14.5 in.

Delta Design Engineers, Inc., Dept. ED, 3038 Adams Ave., San Diego 16, Calif.

CIRCLE 182 ON READER-SERVICE CARD

Digital Torque Indicator

For direct hp measurements

The DTI-2 digital torque indicator suppli an output proportional to horsepower. It i equipped with a slidewire which, when excite by the output of a tachometer generator, wi supply a strip chart recorder with direct hors power readings. For 115 v, 60 cps ac operatio the indicator has an accuracy of ±0.15%. A co stant voltage supply within the unit prevents from responding to line transients.

Performance Measurements Co., Dept. ED 15301 W. McNichols, Detroit 35, Mich.

CIRCLE 183 ON READER-SERVICE CARD

Power Amplifier Tube

Dissipates 1500 w

A forced-air cooled, uhf beam power tube, th 7213 can be used as a linear or class C rf powe amplifier. Its maximum plate dissipation ratin is 1500 w. The unit will operate with full ratin up through the 960 to 1215 mc band.

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

CIRCLE 470 ON READER-SERVICE CARD

Dustproof Relays

6 mw sensitivity

Dust protected, series 23D spdt relays have sensitivities down to 6 mw with 2.25 w maximum coil dissipation. The adjustable contacts can carry 2 amp, 115 v ac or 28 v dc. Coils may be wound up to 13 K for ac or dc operation. Mounting is 8 pin octal plug-in. The unit is 1-3/8 in. sq and 2-1/16 in. high.

Kurman Electric Co., Dept. ED, 191 Newel St., Brooklyn 22, N.Y.

CIRCLE 184 ON READER-SERVICE CARD

Digital Ohmmeter

Low cost

Providing continuous automatic measurements, the low cost model 781 digital ohmmeter was designed mainly for receiving inspection and production checking of resistors. It measures resistance from 0.1 ohm to 10 meg in five ranges. Accuracy is 0.05% of reading plus one digit. Maximum voltage across the test resistor at balance is 6.3 v at the top of each range and zero volts at zero resistance. Average balancing time is 1 sec.

Non-Linear Systems, Inc., Dept. ED, Del Mar, Calif.

CIRCLE 185 ON READER-SERVICE CARD

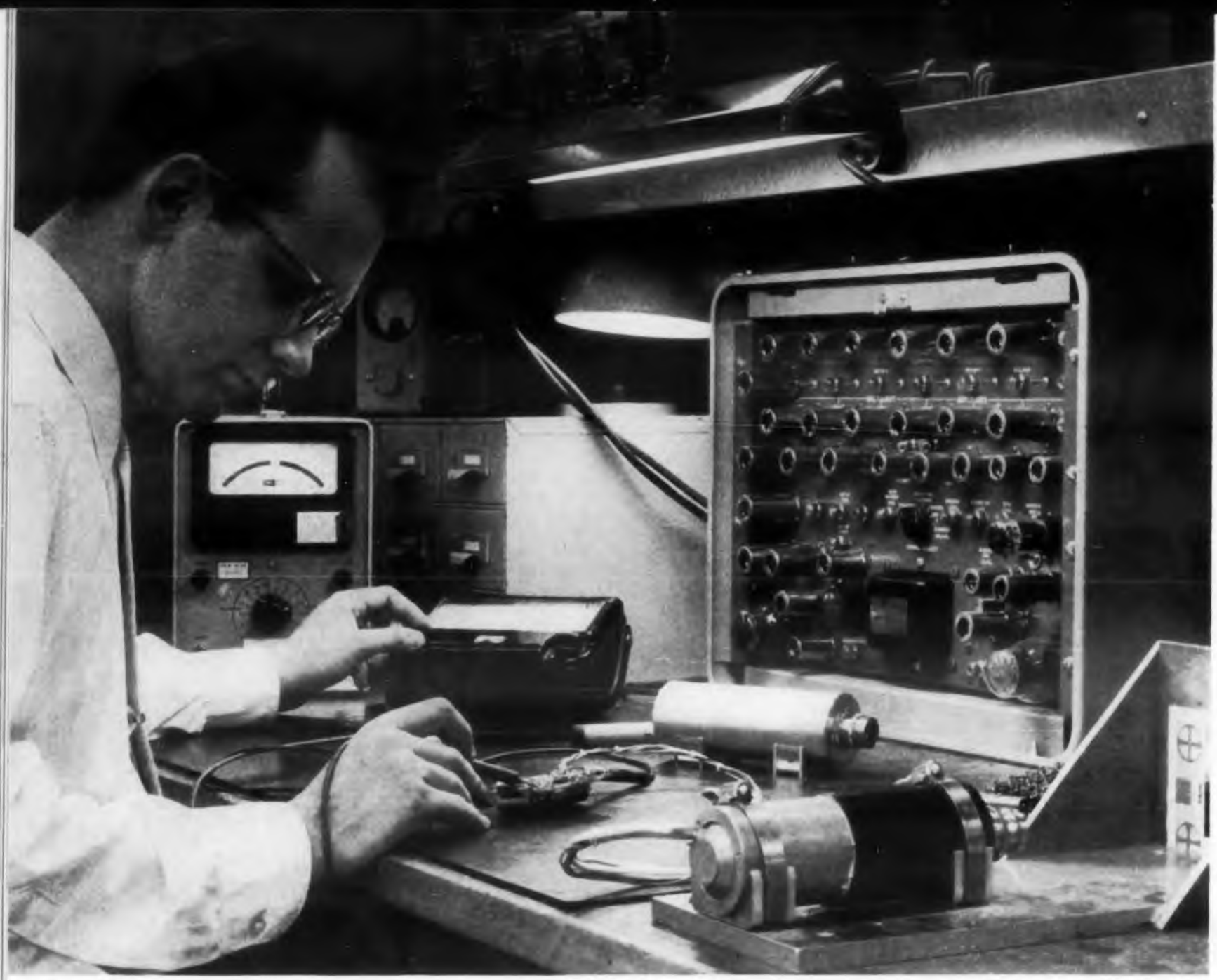
Miniature Power Transformer

Toroidal

Encapsulated and hermetically sealed, series 835 1-w toroidal power transformer passes MIL-E-5272 and MIL-T-27A tests. OD is 1 1/16 in.; height, 15/32 in.; and weights, 0.5 oz. Temperature range is —55 to +100 C. Primary voltage 115 v, 400 cps and secondary voltage is 1 to 100 v, 400 cps. The unit is designed for printed circuit boards or stacking on a single screw for chassis mounting.

Arnold Magnetics Corp., Dept. ED, 4613 W. Jefferson Blvd., Los Angeles 16, Calif.

CIRCLE 186 ON READER-SERVICE CARD



A MISSILE AND TELEVISION INDUSTRY FIRST. Lockheed-developed, miniaturized TV cameras, designed for both government and commercial use. Only 6 inches long and 2¼ inches in diameter, tiny cameras extend man's vision into the unexplored. Unmanned lunar probes to the far side of the moon; lunar landings; monitoring interiors of manned spacecraft and remote TV coverage of on-the-spot happenings on a scope never before possible are some of the uses foreseen for the cameras.

NEW PRODUCTS

Pressure Standard

0.05% accuracy

Portable type Q3401 secondary standard has plug-in units for gage, differential, and absolute pressures and is suited for calibration or direct parameter measurement. Accuracy is 0.05% for ranges up to 2500 psig, psid, or psia.

Wiancko Engineering Co., Dept. ED, 255 N. Halstead Ave., Pasadena, Calif.

CIRCLE 188 ON READER-SERVICE CARD

Oscillogram Scanner

Speeds to 100 ft per min

The S-10 oscillogram scanner has a 66 in. illuminated surface across which strips of 1000 ft may be tracked. Record speed may be adjusted to a max. of 100 ft per min.

The Gerber Scientific Instrument Co., Dept. ED, 89 Spruce St., Hartford, Conn.

CIRCLE 189 ON READER-SERVICE CARD

Microwave Filter

For 2 to 4 kmc range

This coaxial filter covers the 2 to 4 kmc range. Its single micrometer knob is set to reject any frequency in this range to the extent of about 30 db with less than 1 lb loss at nonresonant frequencies.

Radar Design Corp., Dept. ED, Pickard Dr., Syracuse 11, N.Y.

CIRCLE 190 ON READER-SERVICE CARD

← CIRCLE 557 ON READER SERVICE CARD

Voltage Calibrator

±1% accuracy

Voltage calibrator model 600 has two ranges, 0 to 5 and 0 to 50 v dc, with available current up to 5 ma. Each is divided into 10 steps with ±1% accuracy of adjustment. Input is 115 v ac, 60 cps.

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

CIRCLE 191 ON READER-SERVICE CARD

Delay Lines

0.05 to 1 μsec delays

In varied standard cases, these distributed parameter delay lines have delays from 0.05 to 1 μsec per 6 in. length. Impedances are 330 to 4700 ohms, and rise times are 0.02 to 0.21. Standard tolerance is ±5%.

Technitrol Engineering Co., Dept. ED, 1952 W. Allegheny Ave., Philadelphia 34, Pa.

CIRCLE 192 ON READER-SERVICE CARD

Electronic Counter

Bidirectional

With a single zero, this decimal electronic counter indicates true positive and negative numbers. Counting to ±99999, it operates at rates up to 50 kc. Available with a buffer storage unit, the counter receives its input from a photoelectric shaft to pulse converter which generates 10 000 counts per shaft revolution.

Beckman-Berkeley-Lehner Corp., Dept. ED, 11930 Olympic Blvd., Los Angeles, Calif.

CIRCLE 193 ON READER-SERVICE CARD

NEW PRODUCTS

Key Switches

Locking and nonlocking

Small, lever action switches, series 12000 h silver contacts rated at 3 amp, noninduct load. In 2 and 3 position types, they are lock and nonlocking. A 3 position model locks on side only.

Switchcraft, Inc., Dept. ED, 5555 N. El Ave., Chicago 30, Ill.

CIRCLE 196 ON READER-SERVICE CARD

Power Supply

Two ranges

Tubeless magnetic power supply KM-255 two ranges: 60 to 120 v, 0 to 2 amp, and 12 180 v, 0 to 1.4 amp. Regulation is ±1%; rip 0.03%.

Kepco Labs, Inc., Dept. ED, 131-38 San Ave., Flushing 55, N.Y.

CIRCLE 197 ON READER-SERVICE CARD

Preset Counter

Five decade

Made of printed circuit plug-in modules. 7250C five decade preset counter operates to kc. It will recycle at rates to 5 kc without miss counts. The unit features pulse and varia duration or locking relay contact output gated input.

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

CIRCLE 198 ON READER-SERVICE CARD

Converter Toroids

For dc to ac and dc to dc

Used with transistors, these toroids convert dc voltage to higher potential ac or rectified dc. The ac output can serve as a source of 60 cps, 400 cps, or any design frequency. The dc output can supply B+, B−, or bias voltage for vacuum tubes, transistors, and like devices. The units cover 6, 12, or 28 v dc source power, and provide 10, 50, 100, or 200 w at 250 v dc.

Magnetico, Inc., Dept. ED, 6 Richter Court, East Northport, N.Y.

CIRCLE 199 ON READER-SERVICE CARD

Connectors

Weatherproof

Weatherproof LR and MR connectors have clear and black anodic coating to resist corrosion and rubber glands and gland nuts to seal out moisture. Chain-attached caps seal unmated units. Coupling threads and sizes are standard to MIL-C-5015.

Cannon Electric Co., Dept. ED, 3208 Humboldt St., Los Angeles 31, Calif.

CIRCLE 200 ON READER-SERVICE CARD

Infrared Detectors

6 to 9 micron wavelength cutoffs

These three detectors provide high sensitivities to the far infrared. The n and p type gold-doped germanium units are photoconductors with 1 meg impedance levels and respective wavelength cutoffs of 6 and 9 microns. Respective time constants are 30 and 0.1 μsec. The indium antimonide unit is a low impedance, low noise photovoltaic detector with a 6 micron wavelength cutoff and a 2 μsec time constant.

Philco Corp., Dept. ED, 4700 Wissahickon Ave., Philadelphia, Pa.

CIRCLE 201 ON READER-SERVICE CARD

Tube Tester

3000 to 60,000 μmho range

Tube tester 1700 can be used to evaluate the G_m of electron tubes according to Army-Navy specifications, or to study tube behavior. Its G_m meter has eight overlapping ranges that cover 3000 to 60,000 μmhos with 3% accuracy. In addition, the unit has eight 1% meters for other parameters.

The Hickok Electrical Instrument Co., Dept ED, 10514 Dupont Ave., Cleveland 8, Ohio.

CIRCLE 204 ON READER-SERVICE CARD

Wattmeter-Var Adapter

Universal

For 60 cps measurements, model 100 wattmeter-var adapter may be used with all dynamometer wattmeters. It permits them to function as var-meters and power factor meters and improves their over-all accuracy. This adapter indicates the nature of the load with regard to leading or lagging power factor, and the amount of reactive volt-ampere compensation for unity power factor systems.

Vars Co., Dept. ED, P.O. Box 272, Park Ridge, Ill.

CIRCLE 205 ON READER-SERVICE CARD

Coupling

Supplies oxygen and electrical contacts

Series 1000 coupling supplies oxygen, electrical heating, and communications through one unit. Designed for pilot breathing apparatus and survival kits, the unit is adaptable for ground handling and test equipment. When the coupling is connected, the seal engages before electrical contact is made and vice versa. This makes the unit suitable for use with inert and inflammable gases.

Perfecting Service Co., Dept. ED, 332 Atando Ave., Charlotte 6, N.C.

CIRCLE 206 ON READER-SERVICE CARD

Servo Amplifier

For panel mounting

Panel mounted, type T861 servo amplifier is a self-contained module for driving turntable servo motors or motor generators. It has a provision for tachometer damping. The unit has a straight proportional single channel and also provides for the addition of one or more channels for carrier or dc lead and lag loop compensation.

Sterling Precision Corp., Dept. ED, 17 Matinecock Ave., Port Washington, N.Y.

CIRCLE 207 ON READER-SERVICE CARD

Potentiometers

For high voltage

Designed for the kilovolt range, type HVC high voltage potentiometers may be used in color TV, radar, computers, telemetry, infrared detection, ion accelerators, and nuclear research. The unit has a high power rating, and close resistance tolerance.

International Resistance Co., Dept. ED, 401 N. Broad St., Philadelphia 8, Pa.

CIRCLE 208 ON READER-SERVICE CARD

Pulse Generator

0.02 μsec rise time

From an internal oscillator, model B-7 pulse generator provides repetition rates from 20 cps to 2 mc. The unit may also be triggered externally. Pulse widths are 0.05 to 1000 μsec; pulse delays, 0 to 10 msec. Output is ±50 v into a 50 ohm load. Rise and fall time is 0.02 μsec.

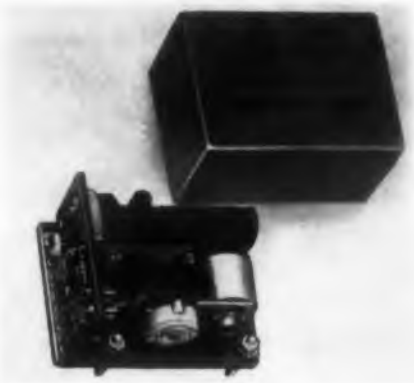
Ruthe[illegible]ord Electronics Co., Dept. ED, 8944 Lindbla[illegible] St., Culver City, Calif.

CIRCLE 209 ON READER-SERVICE CARD

NEW PRODUCTS

Crystal Controlled Oscillators

Variable frequency



Series VCF oscillators are small, variable crystal controlled units with a 10 kc to 20 mc range. Variations are up to 6 cps at 10 kc, up to 12 kc at 20 mc. Resolution is infinite and drift 1 part in 1 million. The following models are on hand: AM-03, AM-02, AM-015, MB 101-V, OS-1.

Bulova Watch Co., Electronics Div., Dept. E, 40-06 62nd St., Woodside 77, N.Y.

CIRCLE 212 ON READER-SERVICE CARD

Pressure Switch

Measures gas density

Miniature RM-73 gas density switch detects gas leakage and critical arc-over gas density. It actuates along a temperature line of 0.05 psia per deg Rankin. Rated 28 v dc, 110 v ac, 5 amp, spst or spdt, the unit stands ±20 g shock, 10 g vibration from 5 to 1000 cps, and −85 to +200 F. It meets MIL-E-5272 specifications.

Newark Controls Co., Dept. ED, 15 Ward St., Bloomfield, N.J.

CIRCLE 213 ON READER-SERVICE CARD

Servo Amplifers

0.2 amp dc output

Transistorized power amplifiers SC-AU20-001 and -002 are designed for servo control systems

From ac inputs below 1 v they produce enough output to drive 5 w ac and dc motors. Input impedance is 2.5 K; input power, 25 w, 115 v, 60 cps; maximum output, 0.2 amp dc into a 100 ohm load.

The Oilgear Co., Dept. ED, 1560 W. Pierce St., Milwaukee 4, Wis.

CIRCLE 214 ON READER-SERVICE CARD

Ultrasonic Cleaner

For small parts

For cleaning small parts, blind holes, and printed circuits, model 1106 low frequency ultrasonic cleaner also removes radioactive contamination. The unit is designed so that two tanks may be used alternately without either being disconnected. The tank is 9-1/4 x 6 x 5 in.

Alcar Instruments, Inc., Dept. ED, 17 Industrial Ave., Little Ferry, N.J.

CIRCLE 215 ON READER-SERVICE CARD

Spectrum Analyzer

Center frequencies from 40 cps to 32 kc

Spectrum analyzer model 2110 has switch selected true rms, average, and peak readout. Produced by Bruel & Kjaer, Denmark, the unit is 1/3 octave type with center frequencies from 40 cps to 32 kc. The filters have tops flat within ±0.5 db, sides with maximum slope of 120 db per octave; and skirt selectivity of more than 70 db per octave, 70 db per 2 octaves, from the center frequency.

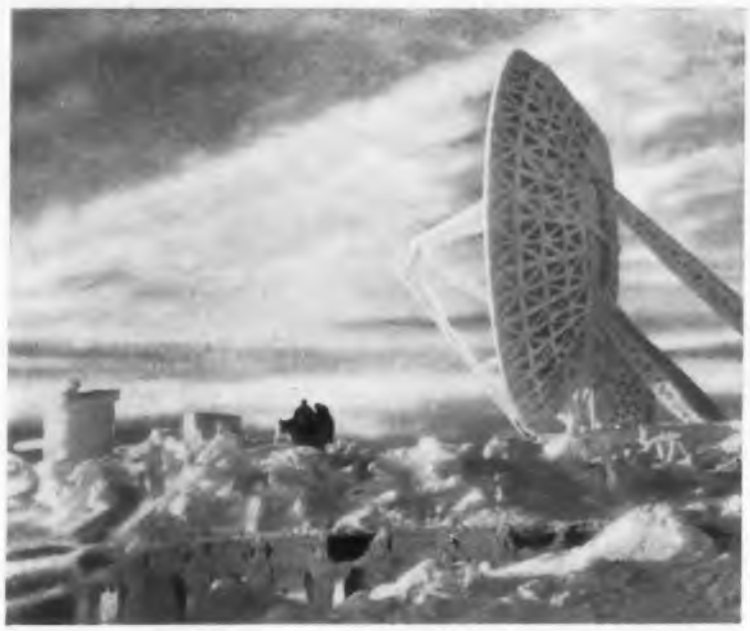
B & K Instruments, Inc., Dept. ED, 3044 W. 106th St., Cleveland, Ohio.

CIRCLE 216 ON READER-SERVICE CARD

WESTERN ELECTRIC PHOTO

WHITE ALICE

DEW LINE



POLE VAULT

OFFICIAL U.S. AIR FORCE PHOTO

TEXAS TOWERS

NEW PRODUCTS

Wire Marker

Dyes 500 ft a minute

Spectra-Coder model 701 dyes 500 ft of w a minute. It handles any vinyl insulated wi wire, and can be used with Spectra-Ink or a other instant drying ink.

Spectra-Strip Wire & Cable Corp., Dept. E P.O. Box 415, Garden Grove, Calif.

CIRCLE 219 ON READER-SERVICE CARD

Impact Grinder

Ultrasonic

Model 2-335 ultrasonic impact grinder cu slices, drills, and trepans regular and irregu shapes. It handles semiconductors, ceram ferrites, carbides, metals, jewels, and other ha or brittle materials. Its magnetostrictive tra ducer permits a 100% duty cycle.

Raytheon Mfg. Co., Dept. ED, Waltham Mass.

CIRCLE 220 ON READER-SERVICE CARD

NEW PRODUCTS

Precision Resist ors

Molded metal film

These molded metal film resist feature low controlled temperat coefficient, low noise level, and h stability under severe humid conditions. Their precision is co parable to that of wirewound res tors. The units offer good rf p formance, and uniformity of s over wide resistance ranges. Th come in five sizes from 1/8 to 2

Electra Mfg. Co., Dept. E 4051 Broadway, Kansas City, M

CIRCLE 226 ON READER-SERVICE CAR

In-Line Input Transforme

Microphone type

Ruggedly built, this in-line micr phone input transformer is d signed for insert into cable circui Mumetal and electrostatic shieldi improve its signal to noise ratio. T unit has a frequency response of cps to 20 kc ±2 db. Supplied with in. shielded microphone cable, mates with Amphenol 91-PC- plugs. Weighs 11 oz; 1-1/8 diam., 2-3/8 in. long.

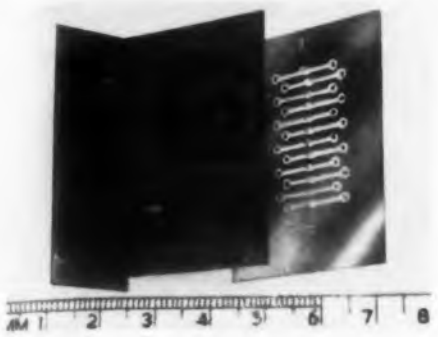
Microtran Co., Inc., Dept. E 145 E. Mineola Ave., Valley Strea N.Y.

CIRCLE 227 ON READER-SERVICE CARD

← CIRCLE 225 ON READER-SERVICE CA

Printed Circuit Connectors

8, 12, and 18 pole



Belling & Lee type L.1355 printed circuit connectors are molded from Bakelite and have gold-plated beryllium copper contact springs. The 0.1 in. modules have 8 poles; the 0.15 in. modules, 8, 12, or 18 poles. The contacts are suited for dip soldering.

Ercona Corp., Dept. ED, 16 W. 46th St., New York 36, N.Y.

CIRCLE 228 ON READER-SERVICE CARD

Silicon Rectifiers

50 to 600 piv ratings

With piv's from 50 to 600, these diffused junction silicon rectifiers deliver 750 ma dc at 50 C, 250 ma dc at 150 C. EIA numbers are 1N536, 1N537, 1N538, 1N539, 1N540, and 1N547.

Bendix Aviation Corp., Semiconductor Products, Red Bank Div., 201 Westwood Ave., Long Branch, N.J.

CIRCLE 229 ON READER-SERVICE CARD

Carbon Film Resistors

Fully insulated

Fully insulated, type DCF deposited carbon film resistors have a strong, stable coating that enables them to operate in severe environments and surpass MIL-R-10509B tests. The units have 1/8 to 2 w ratings; 1 ohm to 50 meg resistances; and 1% tolerance.

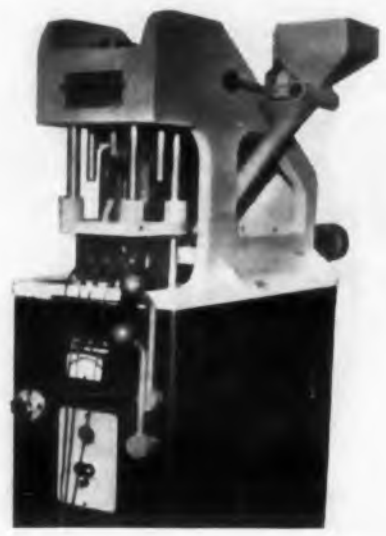
Dale Products, Inc., Dept. ED, Columbus, Nebr.

CIRCLE 230 ON READER-SERVICE CARD

NEW PRODUCTS

Injection Molding Machine

For small plastic parts



Mini-Jector 70VC95 is a precision injection molder for intricate parts requiring inserts or loose cores. It handles 0.33 to 1.5 oz parts and all thermoplastics, including Nylon. Maximum injecting pressure is about 30,000 lb.

Newbury Industries, Inc., Dept. ED, Newbury, Ohio.

CIRCLE 233 ON READER-SERVICE CARD

Terminal Blocks

125 and 250 amp capacity

Insulated from one another and ground, these sectional power unit terminal blocks provide high pressure, solderless connection for machine tools or switchboards. Model P-3 carries 125 amps, model HP-3, 250 amp. Three circuits are standard, but added ones can be provided.

Marathon Special Products Corp., Dept. ED, 12th and Cranberry Sts., Erie, Pa.

CIRCLE 234 ON READER-SERVICE CARD

Commutator Switch

Has 0.03 in. rectangular contacts

With a high sampling speed for PDM telemetry, this commutator switch has 180 contacts which obtain 90 individual pulses on a break-before-make basis from a contact pin ring 2.5 in. in diameter. The rectangular, gold-plated sil-

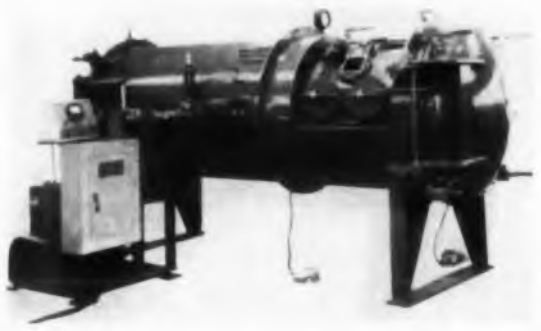
...er co...acts are 0.03 in. and similar to the segmented contact rings of printed circuit commutator plates. Precision molded to the Supramica 555 ceramoplastic commutator plate, their placement is accurate to within ±1 min.

Mycalex Electronics Corp., Dept. ED, Clifton, N.J.

CIRCLE 235 ON READER-SERVICE CARD

Inert Gas Welding Machine

For reactive materials



Type 742 inert gas welding machine is a production unit for reactive materials such as zirconium, tantalum, and columbium. For manual or semiautomatic operation, it has dual welding positions with glove ports, sight glasses, automatic welding shields, and lights. It has a high speed, high vacuum pumping system and an inert gas backfill system. In lengths from 6 ft, the units are 42 in. in diameter.

General Vacuum Corp., Dept. ED, 400 Border St., East Boston 28, Mass.

CIRCLE 236 ON READER-SERVICE CARD

Automatic Component Dispenser

Handles 4000 parts an hour

This automatic component dispenser cuts and forms leads at the assembly station. It processes 4000 parts per hour for inventory. Four quick adjustments change the cut or bend, and the six hoppers dispense components in a precise order.

Schmitt Engineering Co., Dept. ED, 862 Fabian Way, Palo Alto, Calif.

CIRCLE 237 ON READER-SERVICE CARD

NEW PRODUCTS

Wire Cutter Cartridge Kits

Permit 1000 combinations

Designed to set up the company's Mark II wire cutter and stripper for one-time production, each of these kits can be made into 1000 cartridge sets. Model 65-101 is for 14 to 20 awg wire; model 65-102, for 18 to 24 awg; model 65-103, for 22 to 28 awg; and model 65-104 for 14 to 30 awg. The 65-105 is a custom kit.

Technical Devices Co., Dept. ED, 2340 Centinela Ave., Los Angeles 64, Calif.

CIRCLE 239 ON READER-SERVICE CARD

Automatic Cable Maker

Produces up to 900 ft per hour

With this automatic cable machine, any type of Zippertubing cable can be made at speeds up to 900 ft an hour. Easily operated, the unit eliminates an extruder. It makes cables of up to 108 conductors and from 3/8 to 2-1/2 in. in diameter.

The Zippertubing Co., Dept. ED, 752 S. San Pedro St., Los Angeles 14, Calif.

CIRCLE 240 ON READER-SERVICE CARD

Molding Compound

Thermoplastic

A methylstyrene thermoplastic molding and extrusion compound, Cymac 325 is an insulating and dielectric material which retains its properties in high temperature and humidity. It exceeds the 10 kv minimum radio frequency heating and breakdown requirement for antenna components specified in MIL-A-7965-ASG. Under test, the strain insulator withstood 18 kv at 3.44 in. of mercury and 3 mc. It also satisfied the insulation to space and other electrical requirements of the above specification, both before and after exposure to the severe environmental testing conditions set forth in MIL-E-5272.

American Cyanamid Co., Plastics and Resins Div., Dept. ED, 30 Rockefeller Plaza, New York 20, N.Y.

CIRCLE 241 ON READER-SERVICE CARD

Microwave Horn

Has two waveguide inputs

With two waveguide inputs, this dual polarized feed horn provides the same center of radiation for both signals. It handles 10 kw with more than 30 db decoupling between the signals. Standard frequencies are 400 to 450, 755 to 985, and 1700 to 2400 mc. Others are available.

D. S. Kennedy & Co., Dept. ED, Cohasset, Mass.

CIRCLE 244 ON READER-SERVICE CARD

Multimeter

For R, I, and E

Multimeter 5620 measures 2 x 10^{2} to 2 x 10^{8} meg with ±1.7% to ±6% accuracy; 1 x 10^{-12} to 5 x 10^{-6} amp with 1.5% to 3% accuracy; and 0.005 to 500 v with ±0.5% to ±3% accuracy. Measurements are drift free.

Leeds & Northrup Co., Dept. ED, 4934 Stenton Ave., Philadelphia 44, Pa.

CIRCLE 245 ON READER-SERVICE CARD

Remote Angular Readout

0.5% accuracy

Using a dc synchro and a potentiometer transmitter, this remote readout system reads valve flapper and shaft angles through 360 deg. Accurate to 0.5%, it operates from 28 v dc and requires less than 0.1 w.

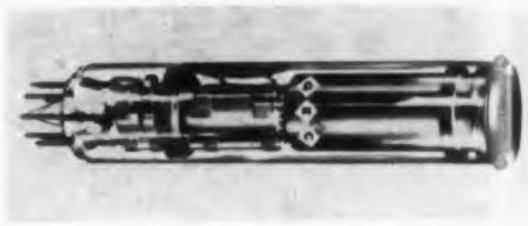
Induction Motors of California, Dept. ED, 6058 Walker Ave., Maywood, Calif.

CIRCLE 246 ON READER-SERVICE CARD

NEW PRODUCTS

TV Camera Pickup Tubes

5.15 in. long



Vidicon 7226 and the ruggedized 7226A are meant for transistorized cameras. They are 5.15 in. long and have 150 ma heaters. Built to MIL-E-5272A requirements, the 7226A gives good pictures despite severe noise, vibration, and shock.

General Electrodynamics Corp., Electronic Tube Div., Dept. ED, Garland, Tex.

CIRCLE 249 ON READER-SERVICE CARD

Control Motor

Permanent magnet type

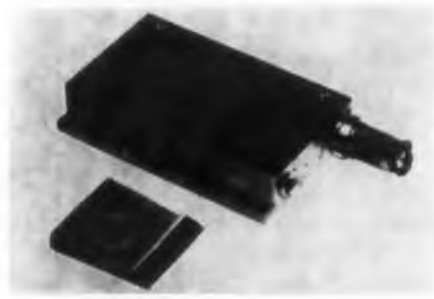
Designed as a building block for control equipment, this industrial dc motor is built to withstand severe abuse in adverse environments. A 1/6 hp, permanent magnet type, the motor is available with an integral tachometer generator which gives a 0 to 5 ma output signal linearly proportional to its speed. Torque is 40 oz-in. speed, 0 to 4000 rpm.

Rotron Controls Corp., Dept. ED, Woodstock, N.Y.

CIRCLE 250 ON READER-SERVICE CARD

Telemetry Amplifiers

2 cps to 20 kc range



Airborne amplifier 2617 has a 2 cps to 20 kc range and 1000 meg input impedance with less than 50 mv residual noise. Preset fixed gain may be 10, 30, or 100. Current requirement is 5 ma. Used with the company's accelerometers and 2980 mounting studs, the 2617 forms an electrically isolated system.

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

CIRCLE 251 ON READER-SERVICE CARD

CORROSION TEST CHAMBER.—Model G-S for salt, Corrodkote, and humidity tests. Meets ASTM and government specifications. Test-heats to 150 F with all temperatures held to 0.5 F.

The C. S. Equipment Co., Dept. ED, 15583 Brookpark Rd., Cleveland, Ohio.

CIRCLE 252 ON READER-SERVICE CARD

INSULATING SLEEVES.—Type V-105 polyvinyl chloride sleeving 1 to 1000 ft long. Temperature range, −30 to +105 C.

Illumitronic Engineering, Dept. ED, 680 E. Taylor, Sunnyvale, Calif.

CIRCLE 253 ON READER-SERVICE CARD

CRYSTAL PROTECTORS.—About 1/2 the size of previous types. X-band tube is 3/4 in. between flange faces. For all microwave bands.

Bomac Labs, Inc., Dept. ED, 1 Salem Rd., Beverly, Mass.

CIRCLE 254 ON READER-SERVICE CARD

TUBE CAP CONNECTORS.—Insulated with glass-filled silicone or silicone rubber, units stand 750 or 500 F. For high voltage, high altitude applications.

Alden Products Co., Dept. ED, 117 N. Main St., Brockton 64, Mass.

CIRCLE 255 ON READER-SERVICE CARD

PRECISION GEARS.—Two mechanical differentials with 1/8 in. hollow shaft. Units are 0.5 and 0.563 across inside face of end gears and have 0.88 and 1.032 diameter working circle.

Arch Instrument Co., Inc., Dept. ED, 101 Holmes St., North Quincy 71, Mass.

CIRCLE 256 ON READER-SERVICE CARD

DUAL POTENTIOMETER UNIT. – Improved model 209 Twinpot has Silverweld termination. Provides virtually 100% usable potentiometer range.

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

CIRCLE 257 ON READER-SERVICE CARD

MOLDING MATERIAL. – Castflex M-3 castable rubber makes flexible molds for casting cold-setting epoxy resins.

Cincinnati Research Co., Dept. ED, 10100 Beech Lane, Cincinnati 15, Ohio.

CIRCLE 258 ON READER-SERVICE CARD

NOBLE METAL CONTACT POLES.—Individual units to adapt industrial control relays to electronic and instrumentation circuits. Easily replace one or more relay poles without disturbing the others.

Clark Controller Co., Dept. ED, 1146 E. 152nd St., Cleveland 10, Ohio.

CIRCLE 259 ON READER-SERVICE CARD

ELECTRONIC MICROMETER.—Sets to 1.5, 5, 10, or 20 gram standard reference measuring pressures. Counter reads directly in decimal fractions of an inch. Last wheel reads to 20 millionths.

J. W. Dice Co., Dept. ED, Englewood, N. J.

CIRCLE 260 ON READER-SERVICE CARD

From General Electric . . .

PLAIN TALK ON TANTALYTIC* CAPACITOR AVAILABILITY

It's time for plain talk on the facts of tantalum electrolytic capacitor availability. There is no "availability" problem as far as General Electric is concerned.

Here's why:

- No metal shortage—Stocks of capacitor-grade tantalum have doubled within the past year.
- No production capability shortage—General Electric's production facilities have tripled in the past year.
- No delivery bottlenecks—General Electric's improved manufacturing processes and techniques have virtually eliminated production rescheduling.
- Few military directive priorities—Since the supply of Tantalytic capacitors has met demand, the military requirements can be met without directive priorities.

This is why we say—now and in the future, General Electric will continue to provide Tantalytic capacitors in the types and ratings you want—when you want them.

For specific information on Tantalytic capacitor ratings, prices, deliveries, contact your nearest General Electric Apparatus Sales Office or write to General Electric Co., Section 449-4, Schenectady 5, N. Y.

*Registered trade-mark of General Electric Co.

**Trade-mark of General Electric Co.

SOLID TANTALYTIC CAPACITORS—for transistorized circuit applications—rated up to 60 volts, polar units only—sizes down to 0.125 inches by 0.250 inches.

125C TANTALYTIC CAPACITORS—for aircraft electronic systems—ratings 10-180 mfd, 30 to 100 volts. Sizes ½ to 1⅛ inches in height. Also tubular, double-cased units.

KSR TANTALYTIC CAPACITORS**—for missiles, radar, airborne electronic equipment applications—ratings up to 3500 mfd—three case sizes 1.375, 2, 2.5 inches in height.

85C TANTALYTIC CAPACITORS—for applications requiring high quality but where temperatures are less severe.

GENERAL ELECTRIC

CIRCLE 262 ON READER-SERVICE CARD

NEW PRODUCTS

Test Turntable

Multimode

Designed to evaluate inertial navigation equipment, the 052 multimode turntable also determines transfer functions of gyros or other inertial devices to programmed sinusoids or step functions. It may be used either as a servo table or a sidereal rate table. Rugged and accurate, the table has a 26-in. diameter platform which handles loads up to 500 lb. The platform turns on precision roller bearings at rates from 0 to 2 rps. The microsyn drive maintains a positional accuracy of ±10 sec of theoretical value. The hollow platform drive shaft has 30 shielded slip rings with 3 amp capacity, providing the means for wiring platform test elements and the leads to the microsyn. The photoelectric readout system, accurate to 2 sec of arc, indicates turntable motion in the form of an electrical pulse coincident with each 6 or 10 sec of arc.

J. W. Fecker, Inc., Dept. ED, 6592 Hamilton Ave., Pittsburgh 6, Pa.

CIRCLE 263 ON READER-SERVICE CARD

Servo Motor

Size 11

For 60 or 400 cps, the 11M202 size 11 servo motor operates from 6 to 200 v ac. At maximum power output, torque is 0.3 oz-in. and speed is 3800 rpm. The unit operates from −65 to +200 C and meets MIL-E-5272A and MIL-S-17087 requirements.

Servo Dynamics Corp., Dept. ED, Somersworth, N.H.

CIRCLE 264 ON READER-SERVICE CARD

Silicon Rectifiers

0.004 cu in.

Rated at 750 ma dc and 200, 400 and 600 v, F series encapsulated silicon rectifiers take up less than 0.004 cu in.

Sarkes Tarzian, Inc., Dept. ED, 415 N. College Ave., Bloomington, Ind.

CIRCLE 265 ON READER-SERVICE CARD

Phase Sequence Indicator

For panel mounting

The VA5 phase sequence indicator instantly shows the order in which voltage peaks occur in a 3 phase, 115 v, 400 cps power line. A panel instrument, it consumes under 1 w. Voltage range is 75 to 135 v rms; frequency range, 300 to 500 cps.

Opad Electric Co., Dept. ED, 6 Murray St., New York 7, N.Y.

CIRCLE 266 ON READER-SERVICE CARD

Wirewound Power Resistors

3/16 in. in diameter

These Blue Jacket resistors are vitreous-enamel, wirewound power units with axial leads. The 2 w size is 3/8 in. long; the 2-1/2 w, 17/32 in. long. Diameters are 3/16 in. Tolerances are ±1, ±2, ±5, and ±10%. The series also includes 3, 5, 7, and 11 w units.

Sprague Electric Co., Dept. ED, 347 Marshall St., North Adams, Mass.

CIRCLE 267 ON READER-SERVICE CARD

Telephone Relays

Arrangements up to 4pdt

Hermetically sealed, series SM-400 miniature telephone relays are rated at 3 amp, 115 v ac, or 28 v dc, 0.5 amp. Contact arrangements are up to 4pdt. The units meet MIL-R-5757B requirements and come with solder lug terminals or plug-in header. They operate on 110 v ac, 60 to 400 cps.

Kurman Electric Co., Dept. ED, 191 Newel St., Brooklyn 22, N.Y.

CIRCLE 268 ON READER-SERVICE CARD

Static Converters

Deliver 25 amp at 28 v dc

Type 2596-A ac to dc static converters operate from −55 to +85 C and deliver 25 amp of load current at 28 v dc. They require a 3 phase input of 108 to 117 v ac, 400 cps. Maximum excursion is 26 to 30 v dc. The units are 5 3/4 x 4 1/4 x 4 in.

R/S Electronics Corp., Dept. ED, 435 Portage Ave., Palo Alto, Calif.

CIRCLE 271 ON READER-SERVICE CARD

Power Supplies

3% load regulation

Compact and light, these transistorized power supplies have 3% load regulation. Model PS-T-U6 has a 6 v output at 2 amp; model PS-T-G12 provides a selectable output of 6, 12, or 18 v at 2 amp.

The Reflectone Corp., Dept. ED, Post Rd. and Myano Lane, Stamford, Conn.

CIRCLE 269 ON READER-SERVICE CARD

Amplifiers

200 to 500 mc range

With ±1.5 db uniformity, amplifiers 90182, 90183, and 90214 cover the 200 to 500 mc band. With maximum noise figures of 3.5 to 5 db, they provide 20 to 22 db gains. The units operate from −30 to +180 F.

Resdel Engineering Corp., Dept. ED, 330 S. Fair Oaks Ave., Pasadena, Calif.

CIRCLE 272 ON READER-SERVICE CARD

Feed-Through Terminals

Miniature

Twelve FT-SM-125 feed-through terminals fit on a dime. These Press-Fit connectors have a truncated lug to keep wire leads in place until they can be soldered.

Sealectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N.Y.

CIRCLE 270 ON READER-SERVICE CARD

Oscilloscope

For medical measurements

Medical oscilloscope model P1B1X8 fits a 5-1/4 x 5-3/16 in. panel space. Its built-in signal amplifier has 2.4 mv rms per in. sensitivity and dc to 50 kc response. Input information is portrayed against one of five repetitive sweeps from 0.5 cps to 1 kc.

Waterman Products Co., Inc., Dept. ED, 2445 Emerald St., Philadelphia 25, Pa.

CIRCLE 273 ON READER-SERVICE CARD

NEW PRODUCTS

Power Supplies

Zener diode regulated

For regular, control, or measuring circuits, these voltage reference sources use cascade zener diode regulation. They come with ac or dc inputs, and outputs to 60 v dc. Typical output stability with ±10% input voltage change is ±0.1%.

Industrial Television, Inc., Dept. ED, 369 Lexington Ave., Clifton, N.J.

CIRCLE 276 ON READER-SERVICE CARD

Microwave Testers

For millimeter waveguide ranges

This line of test equipment measures microwave properties within the millimeter waveguide ranges. It includes variable attenuators, tuneable detectors, directional couplers, impedance meters, vswr amplifiers, terminations, E-H tuners, frequency meters, and waveguide clamps and stands for the K, V, Q, M, and E bands.

Narda Microwave Corp., Dept. ED, 118-160 Herricks Rd., Mineola, N.Y.

CIRCLE 277 ON READER-SERVICE CARD

Temperature Test Chamber

Holds −65 F for 12 hours

Test chamber model D-106, for high or low temperature, has a −100 to +400 F range. It holds enough dry ice to maintain −65 F for over 12 hours. The test compartment is 10 cu in. and has interchangeable doors so that tested units can be removed and new ones put in with no time loss for setup.

Mantec Inc., Dept. ED, El Segundo, Calif.

CIRCLE 278 ON READER-SERVICE CARD

Oscilloscope

DC to 8 mc range

Oscilloscope model 2610 has a frequency response of dc to 8 mc ±1.5 db. Internal generator outp is 3 cps to 500 kc in 10 ranges, A curacy is ±3% to ±5%; rise time, 0 μsec; input impedance, 1 meg. axis sensitivity is 6 mv rms per in. X-axis sensitivity, 30 mv rms p in. The unit has a 0.25 μsec del line.

Simpson Electric Co., Dept. E 5200 W. Kinzie St., Chicago, Ill.

CIRCLE 279 ON READER-SERVICE CARD

Mechanical Counter

Has digital readout

High-speed counter model 4 8963 is designed to present digi data from various instruments ma by Bendix Aviation's Eclipse-P neer Div. Used with the Eclip Pioneer airspeed indicator, t counter registers true airspeed knots.

Durant Mfg. Co., Dept. E 1929 N. Buffum St., Milwaukee Wis.

CIRCLE 280 ON READER-SERVICE CARD

Power Supply

0.1% regulation and stability

Model SC-3672-1 transistor power supply delivers 36 to 7 0 to 1 amp. Regulation and stabil are 0.1%. Ripple is 1 mv rms; r covery time, 50 μsec. Power r quirements are 105 to 125 v, 5 65 cps.

Kepco Labs, Inc., Dept. ED, 38 Sanford Ave., Flushing 55, N

CIRCLE 281 ON READER-SERVICE CARD

DC to DC Converters

Transistorized

These transistorized dc to dc c verters operate from 6, 12, or 2 inputs and provide outputs fr 100 to 2000 v. Standard units available with output power to va.

Datascan Inc., Dept. ED Notch Rd., Little Falls, N.J.

CIRCLE 282 ON READER-SERVICE CARD

Rotary Sampling Switches

Contact-saving design

Built with a wiper for each contact, these commutators wear no more at 100 rps than do conventional switches at 0.5 rps. The individual wipers are laminated into one piece and damped to eliminate flutter or vibration at high speeds. The contacts are so spaced that interchannel leakage resistance does not increase with wear, and back resistance remains close to infinite. Contact points not in use are suspended, causing no frictional loss or drain from the power source.

Lind Corp., Dept. ED, Research Park, Princeton, N.J.

CIRCLE 283 ON READER-SERVICE CARD

Automatic Tuners

For local or remote control

Instantuners automatically tune radio transmitters by local or remote control. Types 201 and 202, for airborne and mobile units, have 12 preset positions from 0 to 360 deg. Type 203 has 12 positions within a range of 0 to n x 360 deg, where n is less than 25. Types 106, 107, and 108, for large transmitters, have 6 preset positions.

Philips Electronics, Inc., Instruments Div., Dept. ED, 750 S. Fulton Ave., Mt. Vernon, N.Y.

CIRCLE 284 ON READER-SERVICE CARD

Potentiometers

Gang type

Resistance wipers in model 319 ganged type potentiometers can be phased and rephased independently with no effect on settings in adjacent cups. Available in resistances to 200 K with 0.05% linearity, the units also come in nonlinear functions. They are 7/8 in. in diameter and meet MIL-E-5272A, MIL-E-200, MIL-R-19, and NAS-710 requirements. Power dissipation is 2 w.

Daystrom Pacific, Potentiometer Div., Dept. ED, 9320 Lincoln Blvd., Los Angeles 45, Calif.

CIRCLE 285 ON READER-SERVICE CARD

Spring Motors

Constant-torque

Through the full extension of their 6 ft output cable, constant-torque spring motors A-2025-1 and -2 exert 1 and 2 lb tension, respectively. Their output torques are 0.75 and 1.5 lb-in. Both motor springs deliver 15 turns to the output bushings.

Hunter Spring Co., Neg'ator Div., Dept. ED, 1 Spring Ave., Lansdale, Pa.

CIRCLE 286 ON READER-SERVICE CARD

Autotransformers

Continuously adjustable

Type W20 continuously adjustable autotransformers are offered cased or uncased. The uncased models are for 115 and 230 v service with ratings of 3 and 2.4 kva, respectively. Cased models have knockouts for conduit or armored cables.

General Radio Co., Dept. ED, 275 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 287 ON READER-SERVICE CARD

Electrolytic Capacitors

10 year life expectancy

Used within their rated limits, type QE electrolytic capacitors will last more than 10 years. For computer equipment, power supply filters, telephone networks, and other precision devices, they are rated for −20 to +85 C operation.

Aerovox Corp., Dept. ED, New Bedford, Mass.

CIRCLE 288 ON READER-SERVICE CARD

Coaxial Switch

0 to 500 mc range

For 3-1/8 in. rigid coaxial transmission lines, type 1136 coaxial switch has a 0 to 500 mc range and a vswr under 1.05. Crosstalk through its unused branch is over 60 db down at 80 mc, over 40 db down at 500 ms.

Alford Mfg. Co., Dept. ED, 299 Atlantic Ave., Boston 10, Mass.

CIRCLE 464 ON READER-SERVICE CARD

NEW PRODUCTS

PUSHBUTTON SWITCH.—Oil-tight control panel unit for critical space requirements. Contains the company's type 16 switch, rated 10 amp, 125 or 250 v ac or 30 v dc, inductive.

Illinois Tool Works, Licon Div., Dept. ED, 6606 W. Dakin St., Chicago 34, Ill.

CIRCLE 291 ON READER-SERVICE CARD

SELENIUM DIODES. – Improved type K1615 center-tap and K1616 doubler encapsulated diodes have Bakelite cases and new fillers. For use in horizontal phase detector circuits of TV receivers.

International Telephone and Telegraph Corp., Dept. ED, Clifton, N. J.

CIRCLE 292 ON READER-SERVICE CARD

BULB ADAPTER.—W-series permits 40 mil bulbs to replace 100 mil bulbs in instrument control panels. Adapts 327 incandescent bulbs for 1819, 1820, and 1829 sockets.

Electrosnap Corp., Dept. ED, 4220 W. Lake St., Chicago 24, Ill.

CIRCLE 293 ON READER-SERVICE CARD

SLIDES.—Series 54 slides handle 50 lb per pair with wide safety margin. Can be equipped with pivot and locking mechanism for 45, 90, or 135 deg. In any length from 6 to 30 in.

Jonathan Mfg. Co., Dept. ED, 720 E. Walnut Ave., Fullerton, Calif.

CIRCLE 294 ON READER-SERVICE CARD

CLOSED-CIRCUIT TV.—System 1986 has built-in automatic light control. Instantly adjusts to light level variations up to 1000 to 1. Signal to noise ratio is over 25 db.

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

CIRCLE 295 ON READER-SERVICE CARD

ENCLOSURES.—MEK-6440 junior size NEMA 12 for small control panels, pushbutton enclosures, and electronic devices. Sizes from 4 x 4 x 3 in. to 26 x 20 x 8 in.

Machinery Electrification, Inc., Dept. ED, 56 Hudson St., Northboro, Mass.

CIRCLE 296 ON READER-SERVICE CARD

SWITCHING TRANSISTORS. – Germanium alloy junction units. Types 2N311, 2N404, 2N426, 2N427, and 2N428 are pnp; types 2N312, 2N439, and 2N440 are npn. Packaged in JETEC 30 cases.

General Transistor Corp., Dept. ED, 91-27 138th Place, Jamaica 35, N. Y.

CIRCLE 297 ON READER-SERVICE CARD

FLIGHT SIMULATION TABLE.—Single-axis, hydraulic model A916 for testing airborne components under simulated pitch, yaw, and roll. Range, ±15 deg maximum rotation; resolution, ±2.5 sec of arc; amplitude response, flat within ±2 db to 45 cps.

Gensico, Inc., Dept. ED, 2233 Federal Ave., Los Angeles 64, Calif.

CIRCLE 298 ON READER-SERVICE CARD

FLIGHT SIMULATOR.—Modified model 11A two-axis table has higher frequency response: 15 cps on one axis, 10 cps on the other, with a 25 lb load.

Micro Gee Products, Inc., Dept. ED, 6319 W. Slauson Ave., Culver City, Calif.

CIRCLE 301 ON READER-SERVICE CARD

MULTIPLIER PHOTOTUBE. – Model 7265 14-stage head-on type for use in scintillation counters. Response of 3000 to 7500 angstroms.

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

CIRCLE 471 ON READER-SERVICE CARD

TELEGRAPH EQUIPMENT.—Type 211 frequency shift tone keyer, 19 x 5 1/4 x 18 in., and type 212 frequency shift tone converter, 19 x 10 1/2 x 18 in., have 18 channels, transistorized circuitry.

Northern Radio Co., Inc., Dept. ED, 147-49 W. 22nd St., New York 11, N. Y.

CIRCLE 302 ON READER-SERVICE CARD

EPOXY ADHESIVE STICK.—Epistik rubs on heated parts like sealing wax. Parts are then assembled and cooled. Bonds any material that can stand curing temperature of 260 F.

Robert Marks Co., Dept. ED, 47 Goddard St., Providence, R. I.

CIRCLE 303 ON READER-SERVICE CARD

VIBRATION EXCITER.—Model LCM-100 has horizontal, air-supported shake table. Frequency range is 5 cps to 15 kc; force output, to 100 g.

L. C. Miller Co., Electrodynamic Div., Dept. ED, 5005 E. Slauson Ave., Los Angeles 22, Calif.

CIRCLE 304 ON READER-SERVICE CARD

INDUSTRIAL PRESSURE SWITCHES. – Models P428A, B, C, and D for control, signal, or alarm service. Units control liquid or gas pressures to 3000 psi.

Minneapolis-Honeywell Regulator Co., Industrial Div., Dept. ED, Wayne and Windrim Aves., Philadelphia 44, Pa.

CIRCLE 305 ON READER-SERVICE CARD

ADHESIVES. – Ray-Bond R-86009 and R-86044 two-component systems for bonding etched Teflon to wood, steel, glass, aluminum, ceramics, and plastics. Resistant to water and chemicals; cure at room or elevated temperatures.

Raybestos-Manhattan, Inc. Dept. ED, Bridgeport 2, Conn.

CIRCLE 306 ON READER-SERVICE CARD

PICK-UP ATTENUATOR.—Portable types 5890-A and -B measure transmitter signals directly from transmission line. Accommodate transmitter outputs from 25 to 250 w. Attenuation of 40 to 100 db from 25 to 54 mc; 35 to 80 db at 450 mc.

Allen B. Du Mont Labs., Inc., Dept. ED, 760 Bloomfield Ave., Clifton, N. J.

CIRCLE 307 ON READER-SERVICE CARD

NEW PRODUCTS

MAGNET WIRE.—For use in light weight moving coils. Specific resistance and temperature coefficient: 12.11 ohms and 0.00377 ohms per deg C for bare wire; 13.5 ohms and 0.00339 ohms per deg C for gold plated wire. Tensile strength: 115,000 psi.

Secon Metals Corp., Dept. ED, 17 Intervale St., White Plains, N. Y.

CIRCLE 380 ON READER-SERVICE CARD

SOLENOID VALVES.—SV-54 series 3-way units for general purpose and O.E.M. installations where millions of operating cycles are essential. Nylon seat and port threads outlast steel, are three times stronger. In all normal ac and dc voltages.

Valcor Engineering Corp., Dept. ED, 365 Carnegie Ave., Kenilworth, N. J.

CIRCLE 381 ON READER-SERVICE CARD

TV CAMERA PICKUP TUBE.—Vidicon 7262 for transistorized TV cameras. Bulb diameter of 1 in.; overall length of 5 1/8 in. Produces broadcast quality pictures with 1 ft-c of highlight illumination. Resolution of 600 lines.

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

CIRCLE 472 ON READER-SERVICE CARD

MICA FILM WAFERS.—Low cost, noncritical grade for transistors and other semiconductors. Prepunched to fit wide variety of bases, they insulate base from heat sink.

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

CIRCLE 382 ON READER-SERVICE CARD

MICROWAVE ANTENNA SYSTEMS. – Complete line featuring semiflexible Spir-O-line coaxial cable. Spun aluminum parabolic type with 2, 4, 6, 8, or 10 ft diameter. Aluminum mesh type with 4, 6, or 10 ft diameter.

Prodelin Inc., Dept. ED, 307 Bergen Ave., Kearny, N. J.

CIRCLE 383 ON READER-SERVICE CARD

INSULATING VARNISH.—Fast-curing brand 133 has oven dry time of 30 min at 275 F; mil pickup of 3 to 4 mils; dry dielectric strength of 2480 v per mil. Available in test or production quantities.

Minnesota Mining and Mfg. Co., Irvington Div., Dept. ED, 900 Bush St., St. Paul 6, Minn.

CIRCLE 384 ON READER-SERVICE CARD

ALARM SYSTEM.—Model ST-DF static switching annunciator for process and automation control. Self-contained unit with no relays or solenoids. Operates on 24 to 250 v ac or dc.

Scam Instrument Corp., Dept. ED, 1811 W. Irving Park Rd., Chicago 13, Ill.

CIRCLE 385 ON READER-SERVICE CARD

MINIATURE TWIN PENTODE. – 4BU8 sharp-cutoff, 9-pin tube for use in agc amplifier and TV receiver sync circuits.

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

CIRCLE 473 ON READER-SERVICE CARD

TITANIUM ALLOY.—MST 881 exceeds long time strength properties of most steels at 1100 F. Withstands 1500 F for short periods.

Mallory-Sharon Metals Corp., Dept. ED, Niles, Ohio.

CIRCLE 388 ON READER-SERVICE CARD

SWAGE NUTS.—Series SPS female-threaded steel fasteners can be firmly anchored in sections 0.02 to 0.25 in. thick. Strong enough to break 160,000 psi bolts before failing themselves.

Standard Pressed Steel Co., Dept. ED, Jenkintown, Pa.

CIRCLE 389 ON READER-SERVICE CARD

PUSHBUTTON LAMP.—Miniature Echo-Lite combination pushbutton switch and neon lamp for computers and control systems. Mounts in 3/8 in. panel hole.

Transistor Electronics Corp., Dept. ED, 3357 Republic Ave., Minneapolis 26, Minn.

CIRCLE 390 ON READER-SERVICE CARD

FHP MOTOR.—Model 35YH37 develops 1/20 hp at 6500 rpm. Rated 200 v ac, 400 cps, three phase; draws 0.42 amp. Diameter, 2.5 in.; length, 2.5 in.

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

CIRCLE 391 ON READER-SERVICE CARD

VIDICON CAMERA TUBE.—Model WL-7290 for slow speed scanning. Holds resolution of 350 lines for two minutes.

Westinghouse Electric Corp., Electron Tube Div., Dept. ED, P. O. Box 284, Elmira, N. Y.

STOP—Turc. .30

CIRCLE 392 ON READER-SERVICE CARD

ULTRASONIC GENERATOR.—Model APT-500 for large-scale automatic cleaning operations. Activates up to 6 sq ft of transducer area or 300 gal of cleaning solution. Average power output of 3 kw.

Branson Ultrasonic Corp., Dept. ED, 40 Brown House Rd., Stamford, Conn.

CIRCLE 393 ON READER-SERVICE CARD

RECEPTACLES.—Hart-Lock duplex receptacles for grounding electrical equipment. Rated at 10 amp, 250 v and 15 amp, 125 v. Variety of grounding arrangements.

The Arrow-Hart & Hegeman Electric Co., Dept. ED, 103 Hawthorn St., Hartford 6, Conn.

CIRCLE 394 ON READER-SERVICE CARD

SOLENOID VALVE.—Type TT single-seated angle type, 3-1/4 in. high. For air, gases, water, oil, steam, and other media not harmful to brass. Pressure range: 0 to 400 psi. Pipe sizes: 1/8 and 1/4 in.

Atkomatic Valve Co., Inc., Dept. ED, 545 W. Abbott St., Indianapolis 25, Ind.

CIRCLE 395 ON READER-SERVICE CARD

HANDLES.—Formed from rugged 0.035 in. aluminum tubing with 1/2 in. diameter grip. Three sizes: no. 2000-1, 5-5/16 x 1-3/4; no. 2000-2, 7-3/16 x 2; no. 2000-3, 9-3/4 x 2-1/4. Special sizes to order.

Alpine Electronic Components Corp., Dept. ED, Wolcott Rd., Waterbury, Conn.

CIRCLE 396 ON READER-SERVICE CARD

NEW PRODUCTS

EXTRUDED POLYETHYLENE PLATE.—Widths to 48 in., thicknesses to 1-1/2 in. For neutron shielding on nuclear reactors. Tensile strength of 1700 psi.

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

CIRCLE 309 ON READER-SERVICE CARD

MYLAR HARNESS. – Lightweight Zippertubing with chemical and tensile qualities of Mylar, reflective quality of aluminum, and abrasion and tear strength of vinyl. Stands 400 F. In ⅛ in. increments from 3/8 to 4 in. ID. Lengths from 20 ft.

The Zippertubing Co., Dept. ED, 752 S. San Pedro St., Los Angeles 14, Calif.

CIRCLE 310 ON READER-SERVICE CARD

RF SEALS.—Electr-O-Seals for X-band wave guides. Provide fluid sealing, prevent rf leakage, and eliminate burning and arcing. Made to fit EIA standard guides.

Parker Seal Co., Div. of Parker-Hannifin Corp., Dept. ED, 10567 W. Jefferson Blvd., Culver City, Calif.

CIRCLE 311 ON READER-SERVICE CARD

SHIELDING GASKETS.—Die-formed from knitted wire mesh. For shielding wireguide joints, feed-through interference filters, and other openings in rfi shields. Can be made in almost any shape.

Technical Wire Products, Dept. ED, 48 Brown Ave., Springfield, N. J.

CIRCLE 312 ON READER-SERVICE CARD

VIBRATION SYSTEM.—Consists of 10 K amplifier, type V1001 vibrator, and type 1001 dc field supply. Provides ±3000 lb thrust, 5 to 5000 cps. Meets requirements for vibration and fatigue testing to all MIL-E-5272A, -005272B, and -5422D procedures.

Genisco, Inc., Dept. ED, 2233 Federal Ave., Los Angeles 64, Calif.

CIRCLE 313 ON READER-SERVICE CARD

TV SILICON RECTIFIERS.—Unistac TV-500 delivers 750 ma and 130 v dc from 117 v rms input. Eyelet construction eliminates need for special sockets.

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

CIRCLE 314 ON READER-SERVICE CARD

PLIABLE ELECTRICAL CONDUIT.—Kopex tubing can be bent and set for corners and curves, eliminating need for bends and elbows. Can be easily cut with a knife. In standard sizes from 1/2 to 1-1/4 in.

Gemmer Mfg. Co., Kopex Div., Dept. ED, 6400 Mt. Elliott Ave., Detroit, Mich.

CIRCLE 315 ON READER-SERVICE CARD

MOLDED KNOBS.—Type K824 supplied with stainless steel skirts etched to suit. Military approved. Positive locking device, type L856, also available. Allows for locking without change in setting.

EPR Special Products Corp., Dept. ED, 675 Barbey St., Brooklyn 7, N. Y.

CIRCLE 318 ON READER-SERVICE CARD

REUSABLE CABLE LACING BOARD.—Type 120 permits unlimited cable pattern design and production with one or two board sizes per worker. Only drawings are needed for cable making preparations. In three sizes: 12 x 24, 20 x 24, and 24 x 30 in.

Fellows Engineering Co., Dept. ED, 1168 Meadowbrook Rd., Altadena, Calif.

CIRCLE 319 ON READER-SERVICE CARD

FHP MOTORS.—Ac, dc, pm, and universal types; speed governor and gear motors; induction and brake motors. Capacities from 1/1000 to 1/3 hp. Made by A. B. Ecliptic Co., Stockholm, Sweden.

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

CIRCLE 320 ON READER-SERVICE CARD

CATHODE RAY BULBS.—Optical quality high temperature alumina-silicate glass. Flaws can be held to 0.001 in. or less. Stands temperatures to 700 C. Radiation and shock resistant. Dielectric constant of 6.4; resistivity of 8 at 600 C.

Corning Glass Works, Dept. ED, Corning, N. Y.

CIRCLE 321 ON READER-SERVICE CARD

TR TUBES.—Self-contained units meet all standard electrical and mechanical specifications between −55 and +125 C. Interchangeable with present JAN TR tubes in all bands.

Bomac Labs, Inc., Dept. ED, Salem Rd., Beverly, Mass.

CIRCLE 322 ON READER-SERVICE CARD

CONTINUOUS TAPE MAGAZINE.—Model 203 for computer, automatic test equipment, and similar use. Holds up to 100 ft of paper or plastic punched tape. Needs no driving belts or external mechanisms other than the tape punch or reader itself.

Brooks Research, Inc., Dept. ED, P. O. Box 67, Rochester 10, N. Y.

CIRCLE 323 ON READER-SERVICE CARD

FLEXIBLE PLASTIC WIRE MARKERS.—Indeli-Dent markers on vinyl tubing. Resistant to ultra violet light, oils, gasoline, alcohol, hydraulic fluids, salt spray, and carbon tetrachloride. Unaffected by temperature or abrasion. Surpass requirements of military Janization program.

Atlas Products Corp., Dept. ED, 30 Rockefeller Plaza, New York 20, N. Y.

CIRCLE 324 ON READER-SERVICE CARD

PRODUCTION PRODUCTS

Tube Furnace

Grows silicon crystals

The growth of silicon crystals in an inert gas atmosphere takes place inside a 2-in. OD quartz tube in the G-02720-PT furnace. The furnace can maintain uniform temperatures up to 2560 F for 150 hours. The crystals are sliced into wafers then cubes, for use in semiconductors.

Hevi-Duty Electric Co., Dept. ED, 2040 W. Wisconsin Ave., Milwaukee 1, Wis.

CIRCLE 327 ON READER-SERVICE CARD

Reel Packaging Machine

For axial lead components

Designed expressly for diodes, this lead straightening and taping machine automatically reel packs axial lead components. It is adjustable for a variety of body lengths and diameters and can be adapted to lead or body taping.

Universal Instruments Corp., Dept. ED, 130 E. Frederick St., Binghamton, N.Y.

CIRCLE 328 ON READER-SERVICE CARD

Engravers

For drilling printed circuits

Unskilled operators can drill 100 holes a minute with the model D-2 printed circuit engraver. Various holes can be drilled without changing tools. For two dimensional work, this pantograph has an air cylinder attachment and a single micrometer adjustment for height.

Green Instrument Co., Dept. ED, 385 Putnam Ave., Cambridge, Mass.

CIRCLE 329 ON READER-SERVICE CARD

Silk Screen Press

For printed circuits

Model 12 silk screen press is designed for screening etched circuitry resists, nameplates, panels, and components. The press screens a single pattern at a time. Then the screen is moved laterally to a stop and the pattern repeated. With this step and repeat system, all circuits or designs can be screened from a single pattern. For economical handling, they can be screened onto strips up to 18 in. long. Fast setup with registry to tolerances of 0.005 in. is obtained with two heavy crossfeed motions adjusted by handwheels reading thousandths of an inch, and a rotary indexing head reading 0.25 deg. Instantaneous vertical positioning of the screen mechanism permits adjustment of off contact distance. The screen moves laterally a total of 15 in. and locks rigidly in printing position. Printing base dimensions are 19.5 x 15.5 in.; vacuum area is 10 x 6 in.

ECM Corp., Dept. ED, 8160 Orion Ave., Van Nuys, Calif.

CIRCLE 330 ON READER-SERVICE CARD

PRODUCTION PRODUCTS

Carbon Arc Printing Lamps

For printed circuit production

Fully automatic, Grafarc high intensity carbon arc printing lamps use a point source of light. This and the absence of undercutting permit speed and accuracy in printed circuit production. The lamps are single or three phase with power ranges for printing frames of all sizes.

The Strong Electric Corp., Dept. ED, 140 City Park Ave., Toledo 1, Ohio.

CIRCLE 333 ON READER-SERVICE CARD

Cold-Heading Machine

For small parts

The Omega 00 is an accurate cold-heading machine designed for miniature parts. It can produce electrical contacts, rivets, pins, and similar parts with diameters of 0.012 in. A standard solid die, double stroke machine, it cuts between 80 and 120 pieces a minute to length, head, and form. It handles wide diameters to 0.07 in. for most alloys, 0.12 for soft aluminum. Part lengths may range from 0.016 to 0.4 in. The Omega 00 will also hollow rivets. The depth of the hole is three times the wire diameter in aluminum, one and a half times in copper and brass. The cabinet has a double decker drawer to receive completed parts.

The Robert E. Morris Co., Dept. ED, 500 Farmington Ave., West Hartford, Conn.

CIRCLE 334 ON READER-SERVICE CARD

NEW MATERIALS

Epoxy Casting Systems

For low dielectric loss applications

Isocast 405 and 441 are 100 per cent solids epoxy resins containing no reactive diluents. The 405, suitable for most casting, potting, and encapsulating operations, may be used over a wide temperature range and facilitates encapsulation of heat sensitive components. The 441 is recommended for sealing, potting, and encapsulation of coils, resistors, transformers, rectifiers, capacitors, and other components.

Isochem Resins Corp., Dept. ED, 221 Oak St., Providence 9, R.I.

CIRCLE 335 ON READER-SERVICE CARD

Silicone Laminate

Heat resistant

Made from a coarse weave, continuous filament glass fabric bonded with a silicone laminating resin, CDF grade Dilecto GB-89S is resistant to heat, flame, arc, and moisture. The laminate comes in sheets or molded shapes. It is suited for such applications as terminal, mounting, and spacer blocks for motors and generators; spacers for separating coils in dry type transformers; terminal boards and switch bases in electronic equipment and dielectric heaters; and power devices, such as switchgear and electric welders, which involve arcing and localized or ambient temperatures to 200 C. Dielectric strength is 60 kv; dissipation factor, 0.0025 at 1 mc; dielectric constant, 4 at 1 mc; and loss factor, 0.01 at 1 mc. Surface resistance is 2000 meg; insulation resistance, 5000 meg.

Continental-Diamond Fibre Corp., Dept. ED, Newark 107, Del.

CIRCLE 336 ON READER-SERVICE CARD

NEW LITERATURE

Sealed Relays 339

The latest information on hermetically sealed relays for military and general purpose industrial applications is described in Bulletin GEA-6625. Photographs, circuit diagrams, coil data, and specifications for microminiature (including the new Type GS), subminiature, miniature, and high-speed relays are included. General Electric Co., Schenectady 5, N.Y.

Resistive Phase Dividing Systems 340

Six-page bulletin, complete with graphs and schematics, compares the sine-cosine and linear potentiometer methods of phase dividing. Also included are modified linear methods. Technology Instrument Corp., 7229 Atoll Ave., N. Hollywood, Calif.

Miniature Connectors 341

Illustrated bulletin gives specifications and outline dimensions for series C-18 miniature hexagonal connectors which were designed for use in small electronic instruments, aircraft and portable field equipment. As stated in the bulletin the series is available in 4, 5 and 7 contacts. Deutsch Jur-Amsco Corp., Electronic Sales Div., 45-01 Northern Blvd., Long Island City 1, N. Y.

Solder Terminals 342

For engineers working with circuit design problems a 21 x 27 in. wall chart of Cambion (R) solder terminals is being offered. The chart shows actual scale drawings, including dimensions and materials, of 60 of the most commonly used Cambion solder terminals. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass.

Graphite 343

Presented in a Handbook of Engineering Data are graphs, tables, and curves relating to the use of manufactured graphite in a range of industries including the chemical processing, metallurgical, electrical, and nuclear fields. Printed in loose-leaf form, the handbook emphasizes a number of different grade of graphite, each of which has mechanical, chemical, thermal, and electronic properties suiting it to a specific industrial application. Supplementary data will be released as new information becomes available. National Carbon Co., Div. of Union Carbide Corp., 30 E. 42 St., New York 17, N. Y.

Test Equipment 344

An expanded line of microwave and uhf test equipment and components is described in an 84-page catalog. It provides illustrations of typical component setups for the measurement of impedance, attenuation, and other properties of waveguide and coaxial systems. In addition, typical problems and recommended solutions are given. The Narda Microwave Corp., 118-160 Herricks Rd., Mineola, N. Y.

Power Supplies 345

Covered in a 6-page multi-color folder type catalog. It includes transistorized inverters and converters, Transpac miniaturized power packs, power supplies for transistor applications, transistorized power supplies, transistor regulated dc power supplies, and transistorized frequency changers. Technical decriptions, specifications, application notes, model numbers, and prices are provided. Electronic Research Assoc., Inc., 67 Factory Pl., Cedar Grove, N. J.

How *Not* To Use Resistors 346

A sequel to the folder "How Not To Use Transistors," is another idiot's delight entitled "How *Not* To Use Resistors." Requesting this folder places the reader under no obligation to laugh. General Transistor Corp., 91-27 138th Place, Jamaica 35, N.Y.

Restive Phase Dividing Systems 347

A six-page engineering bulletin, complete with graphs and schematics, discusses the comparison between sine-cosine and linear potentiometer methods of phase dividing. Technology Instrument Corp., 7229 Atoll Ave., North Hollywood, Calif.

Photosensitive Devices and Cathode-Ray Tubes

This revised catalog presents technical data, basing diagrams, and text descriptions of more than 130 tube types, with photographs of representative types. Included within its 32 pages are spectral-sensitivity curves on the photo-sensitive devices, dimensional outlines for all of the phototubes and the photoconductive cells, and a concise description of the features of each of the phosphor types used in the various cathode-ray tubes. *The catalog may be obtained from RCA Tube Distributors or by sending 30 cents direct to Radio Corporation of America, Commercial Engineering, Harrison, N. J.*

NEW LITERATURE

Wire Markers 350

4000 different self-adhesive wire markers are described in 8-page Perma-Code Wire Marker Bulletin, which includes markers for wire identification conforming to NEMA, National Machine Tool Builders Association specifications and ASA Std. C6. 1-1944, "Markings for Electrical Apparatus." Bulletin No. 130, W. H. Brady Co., 727 W. Glendale Ave., Milwaukee 9, Wis.

Transformers

"American Standard Requirements and Terminology for Specialty Transformers" is a 46-page publication including standards of ratings, dielectric strength, losses and impedance, regulation, temperature rise, construction, marking, service conditions, and definitions. *American Standard C89. 1-1957 at $2.50 a copy, available from: American Standards Association, Dept. PR 20, 70 E. 45 St., New York 17, N.Y.*

Tape Recorder 351

Brochure describes the characteristics, specifications, and operating features of Model C-100 series of instrumentation tape recorders. The four-page bulletin, printed in 2-colors, describes how the new tape recording system utilizes a tape transport unit with dynamic braking. In addition, engineering specifications of the new transistorized recording system are included. Minnesota Mining & Mfg. Co., Mincom Div., 2049 So. Barrington Ave., Los Angeles 25, Calif.

Relays 352

Bulletins 700 & 780 describes single-pole and double-pole microminiature relays with 0.2-in. modular pin spacing, particularly well suited for printed circuit applications. Electronics Div., Iron Fireman Mfg. Co., 2838 S. E. 9th Ave., Portland 2, Ore.

Industrial Tubes 354

A 30-page flip-style chart supplies electrical and physical characteristics for the most important electron tubes having industrial, special purpose and military applications. It indexes industrial tubes by class, explains the use of each class, and gives technical information pertinent to each type within the class. Design features and particular application data are also included. Tung-Sol Electric Inc., 95 Eighth Ave., New 4, N. J.

AC Capacitors 355

Bulletin GEA-6789 describes outstanding features of company's newly designed ac drawn-case capacitors used in a wide variety of industrial applications. General Electric Co., Schenectady 5, N.Y.

Control Cable 356

Various constructions available and suggested applications of Triangle control cables are described in four-page booklet. Lists the various sizes of control cables and describes the sheaths and insulations used. Triangle Conduit & Cable Co., New Brunswick, N.J.

Trimmer Potentiometer 357

Literature on the W-10 miniature trimmer potentiometer includes actual-size reproduction of product and diagrams showing its special features; physical, electrical and environmental specifications; de-rating chart; and resistance and resolution values. Bruce Industries, ATOHM Electronics Div., 515 E. Rosecrans Blvd., Gardena, Calif.

DC Amplifier 358

Bulletin AI 132.1 details new, high current, high voltage, wideband dc amplifier. Amplifier is designed for applications requiring a differential, isolated or grounded amplifier. Computer Engineering Associates, Inc., 350 N. Halstead, Pasadena, Calif.

NEW LITERATURE

Miniature Fan 362

Catalog sheet describes the Aximax-3 fan which delivers 165 cfm free delivery when turning at 20,000 rpm. The fan, meeting applicable Air Force specifications, is used for cooling electronic gear in missiles and aircraft. Mounting features and performance curves are given. Rotron Mfg. Co., Schoonmaker Lane, Woodstock, N. Y.

Batteries 363

This 16-page bulletin, T-533, covers the use, design, and construction of the firm's standard line of lead-antimony grid batteries of telephone, carrier and microwave service. The bulletin includes complete cell data on the entire line from 10 to 1680 amp hour ratings, curves on discharge characteristics, rack data, accessory details, and a complete listing of the company's sales and service offices. C & D Batteries, Inc., Conshohocken, Pa.

Transformers 36

Brochure describes facilitie for design and manufacture of custom transformers for industrial, military aviation missiles, and broadcast applicat ons. Li of transformer types include E pseal encapsulated and hermetically sealed transformers for aircraft and missile applications, high temperature transformers, high power audio and power transformers in ratings up to 300 kva. Electro Engineering Works, 401 Preda St., San Leandro, Calif.

Ampifiers 36

This 16-page booklet provides data the Model UPA-2 utility-packaged amplifier. Operation data, applications and schematic diagrams are included. Geo A. Philbrick Researches, Inc., 285 C lumbus Ave., Boston 16, Mass.

Wire 367

Brochure deals with comprehensive line of wire and wire bundle securing devices. The literature describes Dakota Bayonet Hangers, for fixed mountings with Dakota Straps, and the new Bundle-Tie Pliers, designed to facilitate fast firm strapping. Dakota Engineering, Inc., 4315 Sepulveda Blvd., Culver City, Calif.

Audio Connectors 368

Four-page catalog describes XLR Audio Electronic connector series for use on tape recorders, amplifiers, test instrumentation, computers, and other electronic instruments. Ordering nomenclature, construction details, and dimensions are included. Catalog XLR-3 from Cannon Electric Co., 3208 Humboldt St., Los Angeles 31, Calif.

Ceramics 369

Bulletin no. 858 includes mechanical and electrical properties of alumina ceramics AD-85, AD-94, AD-96, and AD-99; and porous ceramic AP-100. Also included is a discussion of production and forming techniques, precision facilities for finishing ceramic parts, and facilities for high temperature metalizing and brazing. Coors Porcelain Co., 600 Ninth St., Golden, Colo.

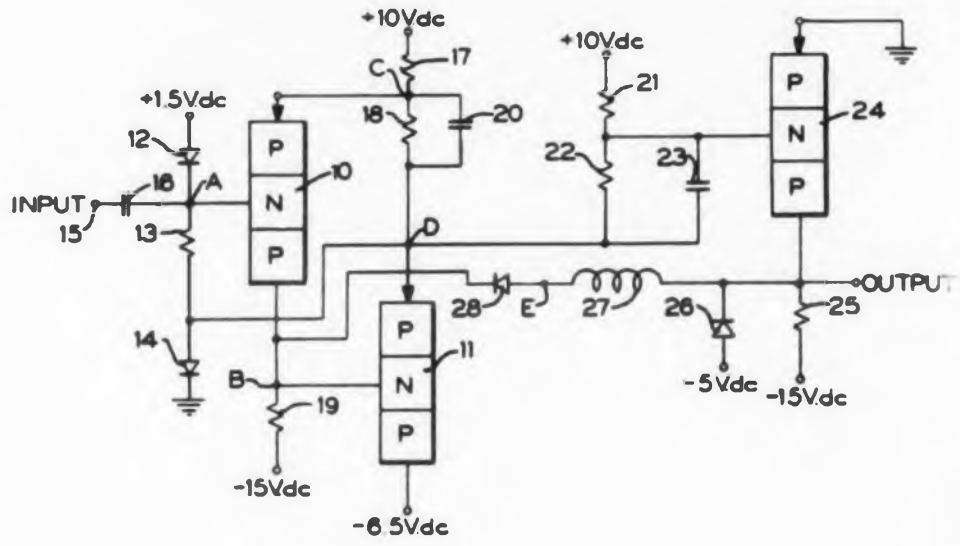
Test Chambers 370

One page bulletin—SP 58—describes Walk-in Altitude, Sand & Dust and other testing chambers, with advanced designs built to customer specifications. Mr. Jack Shamroth, President, American Research Corp., Farmington, Conn.

Switches 371

New 4-page bulletin 858A describes latest line of precision snap-acting switches. Unimax Type A. Type A switch line described with photographs, dimension drawings, circuit arrangements, force and movement specifications, and electrical ratings. Mr. J. Martinez, Unimax Switch Div., The W. L. Maxson Corp., Ives Road, Wallingford, Conn.

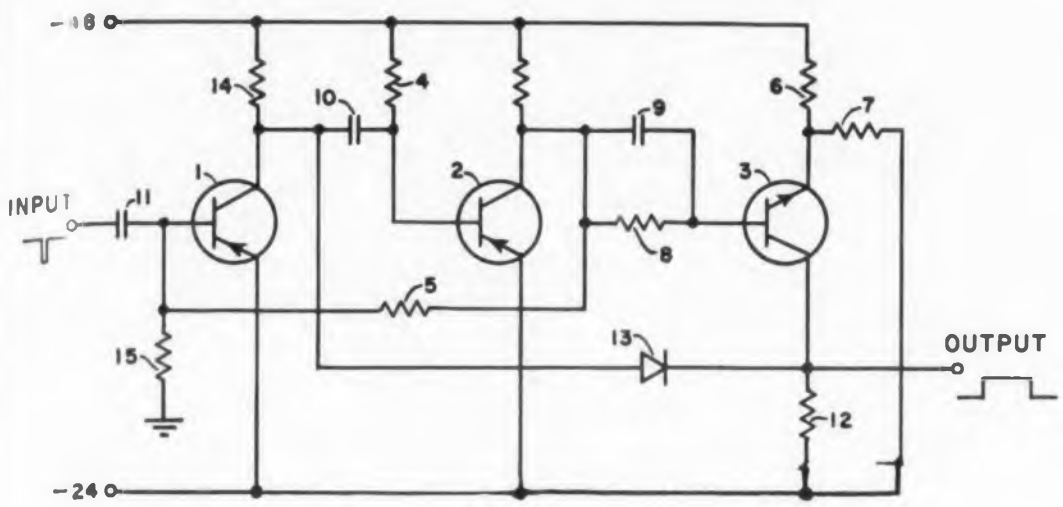
PATENTS



Pulse Generating Circuit
Patent No. 2,842,683. Genung L. Clapper (Assigned to International Business Machines Corp.)

The bistable transistor circuit generates a square wave pulse having a period of 0.3 μsec to 3.0 μsec which is fixed by delay line feedback.

A positive impulse cuts off transistor *10* and transistor *11* conducts. Inverter transistor *24* couples the step function to delay line *27*. The step is maintained in the output for the predetermined period until the delay line feeds back a pulse to cut off transistor *11*. Transistor *10* resets to its initially conducting state.



Monostable Trigger Circuit

Patent No. 2,837,663. Paul F. Walz. (Assigned to General Dynamics Corporation.

The circuit generates a 100 msec pulse when triggered by a 10 μsec pulse. Another imput pulse can trigger the circuit after output pulse terminates.

Initially pnp transistor *1* is cut off, pnp transistor *2* and inverter npn transistor *3* are conducting, capacitor *10* is charged through diode *13* to the voltage at the junction of resistors *6* and *7*. A negative input trigger causes the circuit to flip so that transistor *1* conducts and transistors *2* and *3* cut off. Therefore diode *13* cuts off since the plate and cathode are at equal voltage levels and capacitor *10* discharges through resistor *4*. When the base-emitter voltage of transistor *2* becomes negative, the circuit flops back to its initial state and capacitor *10* quickly recharges through diode *13*.

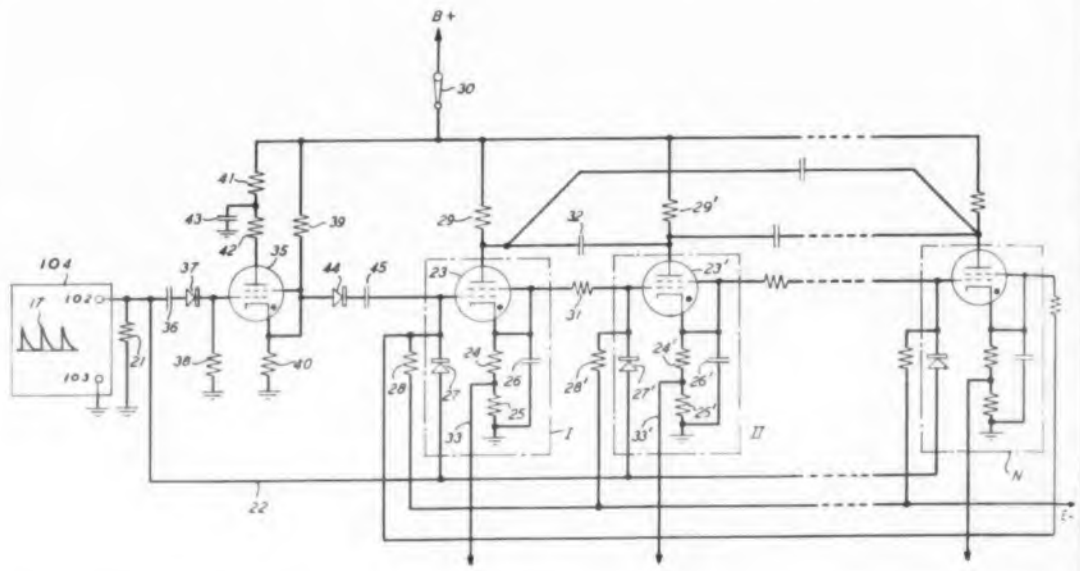
PATENTS

Pulse Initiator

Patent No. 2,851,635. Fred West (Assigned to Bell Telephone Laboratories, Inc.)

A ring counter consisting of several identical gas tube stages has provision for operating a preselected stage in response to the initial input pulse.

For the arrangement shown thyratrons 23, 23′, etc, are connected in cascade. The control grids are sufficiently biased to prevent firing of any stage by control pulses applied through cable 22. Closing switch 30 sets the circuit oper-



ating. The initial input pulse applied to terminal 102 fires tube 35. The rise in cathode voltage reduces the bias only on tube 23. This tube fires in response to the input pulse. When tube 23 conducts, its cathode voltage is raised and the bias on tube 23′ is thereby reduced. The next input pulse fires tube 23′ and the drop in plate voltage is fed back through capacitor 32, cutting off tube 23. The sequence continues with each stage cutting off the previous stage in response to successive pulses.

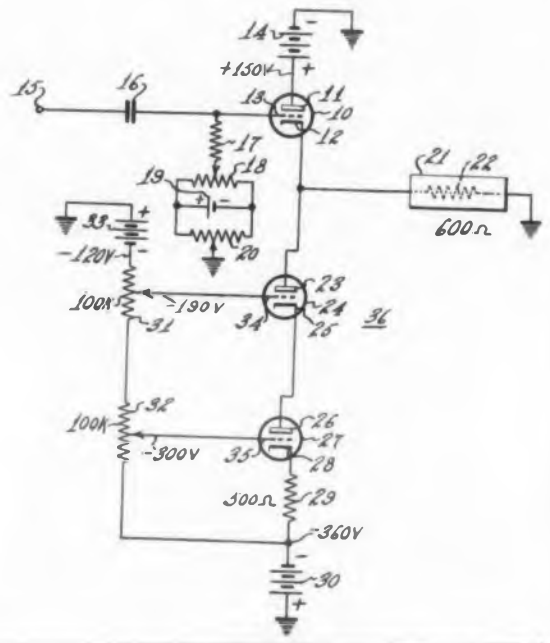
Adjustable Linear Amplifier

Patent No. 2,845,574. Louis Shapiro (Assigned to Radio Corporation of America.)

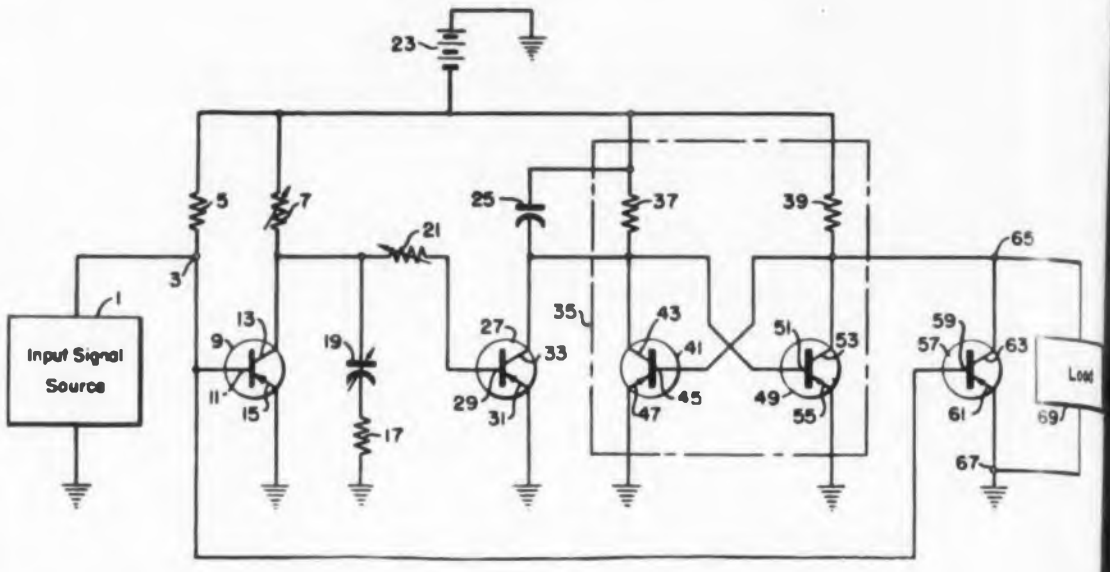
A cathode follower connected to the parallel combination of a load and a constant current source becomes a stable, adjustable, linear amplifier over a load current range of −120 to +120 ma.

When the signal applied to terminal 15 (see figure) goes positive, the cathode voltage remains fixed and the load current follows the increase in cathode current. A negative signal causes the cathode voltage to decrease below ground potential and the decrease in cathode follower current reflects as a linear decrease in the load current.

The varying source impedance is given $(1+u)^2 R_{29}$ which, for the illustrated circuit components, is about 200,000 ohms.



PATENTS



Static Time Delay Circuit
Patent No. 2,845,548. Sheldon D. Sillimon and John F. Reuther. (Assigned to Westinghouse Electric Corp.)

Time delay of a step-function is provided by a simple low-power transistor circuit.

In the circuit illustrated, transistor *9* is initially conducting. Capacitor *19* is shorted and transistor *57* which is conducting shorts the output load. The coupled multivibrator has transistor *41* cut off while transistor *49* is conducting.

A negative step-function applied to the input signal source simultaneously cuts off transistors *9* and *57* to remove the shorts across both capacitor *19* and load. Capacitor *19* now charges through

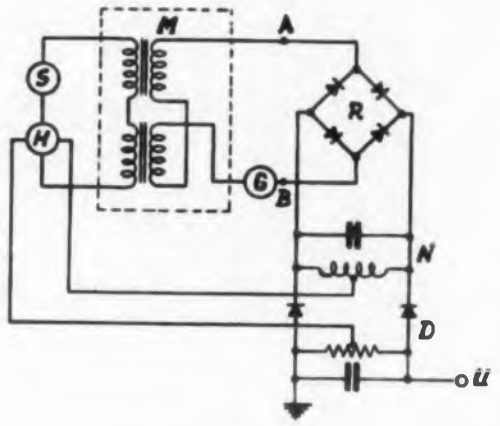
resistor increasing the current through transistor 27. After the predetermined period, the current through transistor 49 decreases regeneratively and a step-function is applied to the load. Finally, when the input signal terminates, capacitor 19 and the load are again shorted, the multivibrator switches back to its initial state and the step-function in the load terminates.

Magnetic or Dielectric Amplifier

Patent No. 2,835,747. Johannes Meijer Cluwen (Assigned to North American Philips Co., Inc.)

An auxiliary oscillator adjusts the degree of polarization of a magnetic or dielectric material to reduce nonlinear amplification. Even-numbered harmonics are thereby suppressed. By suitable adjustment of the magnitude of the oscillation, the third harmonic may likewise be reduced.

The magnetic amplifier shown consists of transformer *M*, tank circuit *N* tuned to the frequency of the auxiliary oscillator and detector *D*. The transformer primary contains signal source S and auxiliary generator *H*.



Supply generator *G*, which controls the ferromagnetic core, is connected into the secondary winding. The frequency of the auxiliary generator *H* is intermediate to that of the lower frequency signal source and that of the higher frequency supply source.

The amplifier input consisting of the combined signal and auxiliary voltages is modulated by the supply source. After detection amplification of the signal having low harmonic content is developed.

BOOKS

Introduction to the Design of Servomechanisms

John L. Bower, Peter M. Schultheiss, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. 510pp, $13.00.

Emphasis is placed on stability and feedback system design in both single and multiple-loops. The authors provide a systematic approach to design, dealing with the principal performance requirements, such as harmonic response, time response, error coefficients and noise response. They attend to the common aspects of nonlinear operation. An attempt is made to treat the synthesis problem on a basis that permits the specifications on performance, given components, and noise to be handled at the same time.

An appendix covering servome chanis components is included.

TV and Radio Tube Troubles

Sol Heller Gernsback Library, Inc., 1 West 14th St., New York 11, N.Y. 2 pp, $2.90 and $4.60 (hard cover).

The book is devoted to diagnosing an correcting electron tube troubles. De signed to be a workbench companion, covers a variety of tube troubles an associated symptoms that might be mis taken for signs of a faulty tube.

Nine chapters discuss tube and com ponent damage, tube troubles in T and radio, picture and sound trouble sync troubles, picture tube troubles, an replacement considerations.

Control System Components

John E. Gibson, Franz B. Tuteur, McGraw-Hill Book Co. 330 West 42nd St., New York 36, N.Y. 339 pp, $12.00.

Aim of this book is the calculation of transfer functions of a number of the most commonly used components in servo mechanisms and other feedback control systems. Methods of analysis and basic engineering principles are presented from the systems engineer's viewpoint. It is slanted towards the non-specialist interested in the analysis of components for application purposes. Electronic, electric, mechanical, hydraulic, and pneumatic components are discussed. In addition, recent advances, in magnetic amplifiers, transistors, hydraulic, and pneumatic systems are covered. Up-to-date information on network synthesis and thyratron amplifiers is provided.

The Plasma in a Magnetic Field

Edited by Rolf K. M. Landshoff, Stanford University Press, Stanford, Calif. 130 pp, $4.50.

This volume came out of a symposium on magnetohydrodynamics held last year. The papers deal with plasmas rather than with liquid metals. Section One, on kinetic theory, shows how individual orbit analysis of important configurations can be simplified The use of magnetic fields appears to be the most promising means for confining a hot deuterium plasma long enough to produce controlled thermonuclear power. However, the interface between a plasma and a magnetic field tends to be unstable. In Section Two evidence is presented for such an instability from both pinch effect studies and astrophysical observations. Section Three describes the method for generating flow.

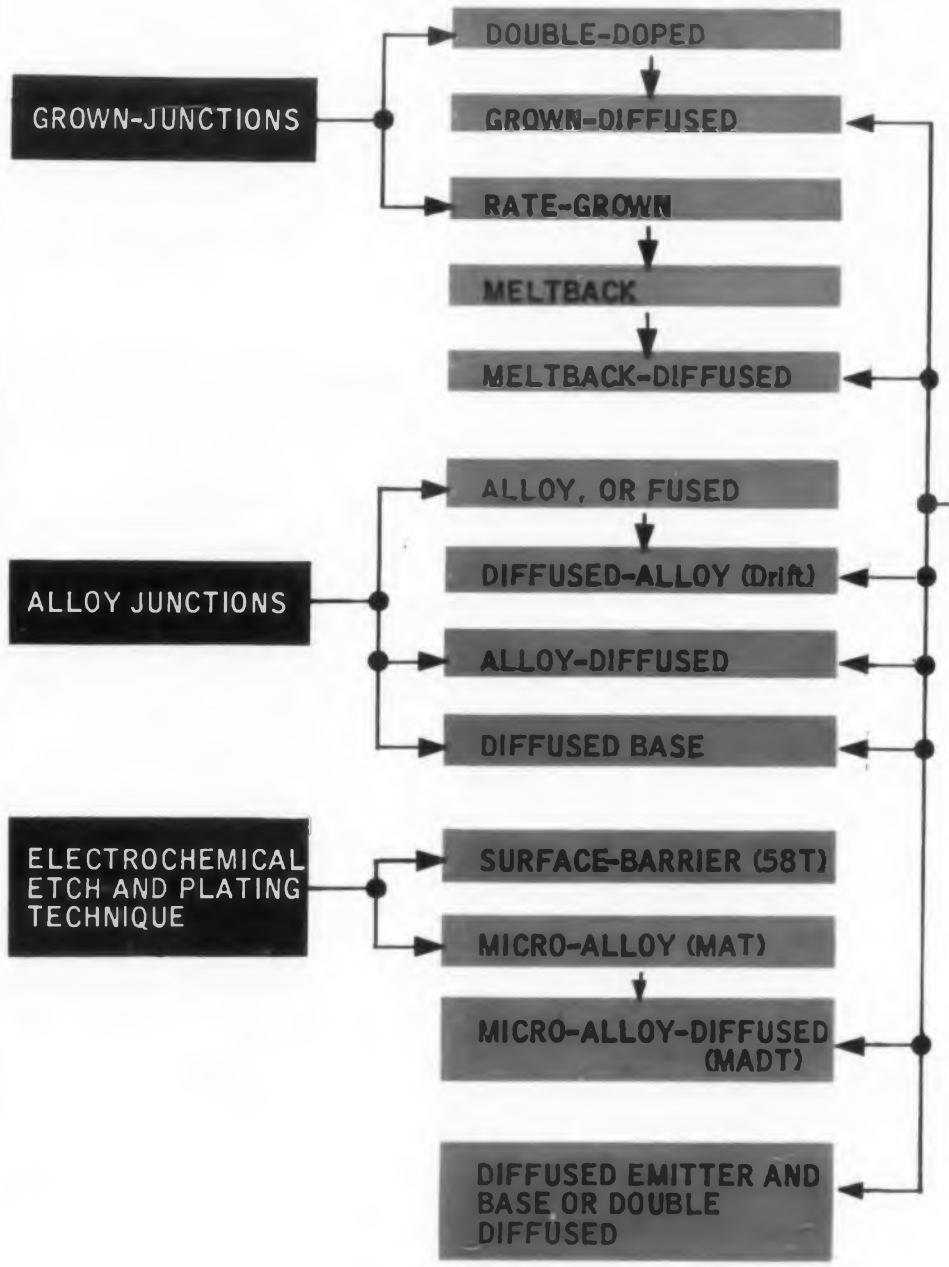
Industrial Electronics Handbook

Edited by William D. Cockrell, McGraw-Hill Book Co., 330 West 42nd St., New York 36, N.Y. 1385 pp, $22.50.

The product of more than 100 contributors, this handbook offers descriptive and reference material covering all phases of industrial electronics and control. Nine sections cover basic engineering and mathematics, physical laws, control elements, power supplies, control circuits, circuit applications, mechanical design, ultimate utilization requirements, and technical information sources. Components and devices are described more from the standpoint of function as an aid in using them for particular applications. Subjects covered include computers, industrial instrumentation, regulators, relays, transducers, amplifiers, military applications.

Classifying Junction Transistors

R. L. Pritchard
Texas Instruments Incorporated
Dallas, Tex.



Junction Transistor Classification Scheme

TRANSISTOR TYPES are classified according to four major categories: grown, alloy, electro-chemical, and diffusion, according to the technique used for fabricating the emitter region. In this classification scheme the diffusion category includes only one of many types of transistors made by diffusion. Other types of transistors made by diffusion are listed under alloy, grown and electro-chemical categories. For cross-reference purposes, an index is provided at the end of this article. A chart (see above) also is included to illustrate how diffusion is combined with the other transistor fabrication methods to produce different types of transistor structures. Only p-n-p and n-p-n structures are discussed here. However, transistors having an intrinsic region, that is, a p-n-i-p or n-p-i-n structure, also can be formed by the diffusion technique.

Grown-Junction Transistors

Double-doped Transistor. The original grown-junction transistor, formed by growing a crystal and successively adding p- and n-type impurities to the melt during the course of growing the crystal.[1]

Rate-grown or Graded-junction Transistor. A variation of the double-doped type described above, in which n- and p-type impurities are added to the melt from which the crystal is grown.[2,3] The growth rate then is varied in a periodic manner while the crystal is drawn from the melt. During one stage of the growth cycle, the crystal contains a predominance of p-type impurities. During the other stage of the cycle, n-type impurities dominate, resulting in a crystal from which n-p-n transistors can be cut.

Melt-back Transistor. A variation of the rate-grown transistor in which the rate growing is performed on a very small physical scale.[4] This results in a lower thermal time constant for the crystal growing system, so that thinner base regions, and hence higher frequency transistors, can be obtained.

Melt-quench Transistor Very similar to melt-back transistor described above.[5]

Grown-diffused Transistor. This transistor is made by combining diffusion techniques and the double-doped process.[6] In this case, suitable n- and p-type impurities are added simultaneously to the melt during the course of growing the crystal. Subsequently, the base region is formed by diffusion during the continued growth of the crystal.

Melt-back Diffused Transistor. This transistor is made by combining diffusion techniques and the melt-back process, analogous to the combination of the grown and diffusion techniques described above leading to grown-diffused transistors.[7,8,9] In this case, however, the impurities are added to the transistor bar by the melt-back process, and the base region subsequently is formed by diffusion by heating the transistor bar.

Alloy-Junction Transistors

Alloy or Fused Transistor. Comprises a wafer of semiconductor material of n- or p-type conductivity with two dots containing p- or n-type impurities, respectively fused, or alloyed, into the wafer on opposite sides of the wafer to provide emitter and base junctions, while the base region comprises the original semiconductor wafer.[10,11,12]

Drift Transistor. In scientific literature, a drift transistor refers to a type of transistor having a non-uniform, or graded, base region so that high-frequency response is improved relative to a similar uniform-base structure.[13] Drift transistor is also a commercial name (RCA) for what is called below diffused-alloy transistor.[14]

Diffused-alloy Transistor. A transistor made by combining diffusion and alloy techniques. The semiconductor wafer first is subjected to a gaseous diffusion to produce the non-uniform base region. Then alloy junctions are formed in exactly the same manner as in a conventional alloy transistor.[14] An intrinsic region transistor, e.g., a p-n-i-p unit, can be made by this technique by starting with a semiconductor wafer of essentially intrinsic conductivity.

Alloy-diffused Transistor. Another type of transistor is made by combining diffusion and alloy techniques. In this case, the alloy dot material contains both n- and p-type impurities. Then the emitter-base junction is formed by the conventional alloy process, while the base region and collector-base junction are formed by diffusion. The collector region comprises the original semiconductor wafer.[15,16] Alternatively, if the original wafer is of the same conductivity type as the base region, then

(continued on following page)

the emitter-base junction and the base region can be formed as described above, while the collector junction can be formed as in a conventional alloy transistor.[17] In this case, as in the case of the diffused-alloy transistor, an intrinsic region can be included between base and collector.

Diffused-base Transistor. Another type of transistor made by combining diffusion and alloy techniques. In this case, a non-uniform base region and the collector-base junction are formed by gaseous diffusion into a semiconductor wafer that constitutes the collector region. Then the emitter-base junction is formed by a conventional alloy junction on the base side of the diffused wafer.[18,19,20]

Etched and Plated Transistors

Surface-barrier Transistor (SBT). Comprises a wafer of semiconductor material into which depressions have been etched on opposite sides of the wafer by electrochemical techniques.[31] The emitter and collector base "junctions," or metal-semiconductor contacts, are formed by electroplating a suitable metal on the semiconductor in the depression areas on opposite sides of the wafer while the original wafer constitutes the base region.

Micro-alloy Transistor (MAT). A variation of the surface-barrier transistor described above in which suitable n- or p-type impurities are first plated in the etched depressions, and then alloyed into the p- or n-type semiconductor wafer.[22,23,24]

Micro-alloy Diffused Transistor (MADT). A transistor made by incorporating diffusion techniques with the micro-alloy transistor construction. In this case the semiconductor wafer is subjected to gaseous diffusion to provide a non-uniform base region prior to the electrochemical plating process.[24,25,26]

Diffusion Transistors

Diffused-emitter and Base, or Double-diffused Transistor. Comprises a semiconductor wafer which has been subjected to gaseous diffusion of both n- and p-type impurities to form two p-n junctions in the original semiconductor material.[27,28] An intrinsic-region transistor, e.g., p-n-i-p, also can be made by a variation of this process.[29]

Summary of Transistor Types

Alloy	Graded-junction
Alloy-diffused	Grown-diffused
Diffused	Grown-junction
Diffused-alloy	Intrinsic Barrier
Diffused-base	Melt Back
Diffused-base Diffused-emitter	Melt-back Diffused
Double Diffused	Melt Quench
Double Doped	Micro-alloy
Drift	Micro-alloy Diffused
Fused	Rate Grown
Surface Barrier	

Acknowledgement

The material presented here by no means describes original work. A number of other semiconductor-device workers have categorized transistors in similar schemes. In particular, R. N. Hall has written an excellent survey paper describing the methods used to fabricate transistors.[30] The concept of the chart shown in the figure originated with Harry L. Owens.

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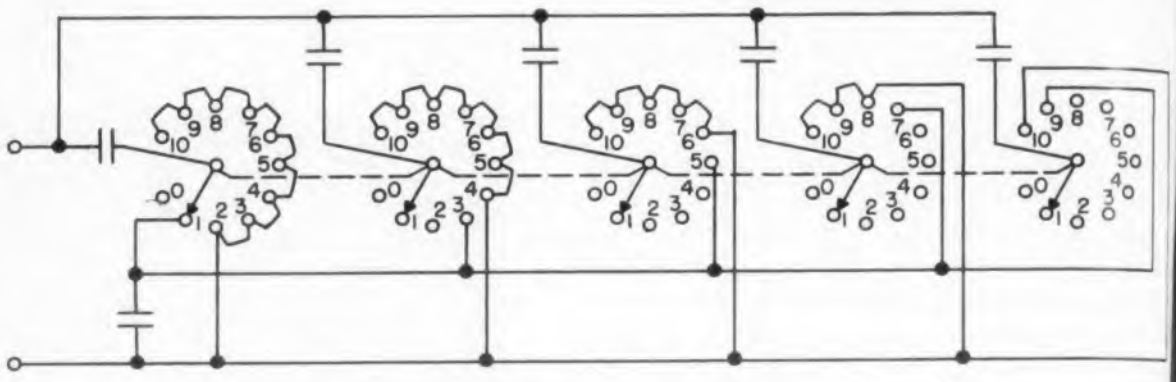
Noninterrupting Decade Capacitor



This decade capacitor doesn't open the circuit when it is switched from one value to the next.

Extra Scale For Better Measurements

DURING measurements of parallel resistance and capacitance on a group of high frequency resistors with a Boonton RX meter, it was found impossible to obtain the desired precision with resistors of 10K or greater at frequencies above 100 mc.

Resonance is indicated by a null deflection of the meter covering several divisions on the scale. Because the *Rp* scale is logarithmic, the length of divisions varies, the precise reading is often difficult to determine. A well known method can overcome the difficulty in reading the *Rp* scale: detuning slightly on either side of the null region, and noting readings on an equal-division scale.

This is quickly and inexpensively done, without affecting the calibration of the RX meter, by making a scale from a piece of polar coordinate paper and cementing it to the front of the control knet in back of the *Rp* control knob as shown in the photographs. A wire pointer is attached to the control knob.

The coordinate paper scale is divided into 180 divisions so, by noting the pointer settings for the two positions on either side and at resonance, it is easy to adjust the pointer to the mean position. The *Rp* scale reading is still difficult to read in many cases because it is logarithmic.

(*Continued on page*

t $10.0(plus a by-line for the time is takes u to jot own your clever design idea. Pay- nt is m de when the idea is accepted for blication. Full information and an "entry ank" can be obtained by circling #166 on e Reader's Service Card.

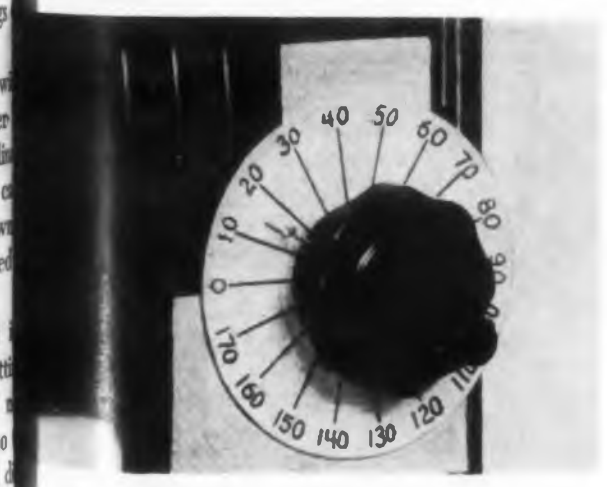
MOST DECADE capacitors interrupt the circuit in which they're placed when they are witched from one value to the next. Between apacity values there is usually a momentary pen circuit.

With the arrangement shown here there is a lean jump from one capacity value to the next, d there is always capacity in the circuit.

A five deck 11 position switch, of the make efore-break variety, is required for each decade, addition to six equal capacitors.

For the 0-10 μf range in 1 μf steps each capaci- is 2 μf. Naturally, other decades can be wired ross the terminal.

. Johannessen, North American Aviation, tronetics Div., Downey, Calif.



iliary ale, drawn on polar paper, extends the freque y usefulness of an RX meter.

IDEAS FOR DESIGN

If one wishes to further simplify the use of the auxiliary scale when obtaining the resonance point, it may be made of metal and arranged to be rotated about the shaft. Then it may be set to zero for one reading, and after the second reading, the pointer may be set at the mid point.

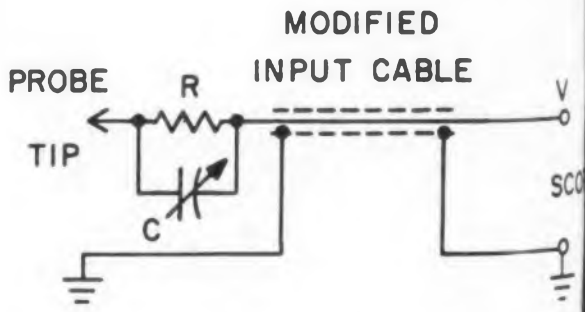
E. L. Hall, Diamond Ordnance Fuze Laboratories, Washington, D.C.

More Signal With Low C Probe

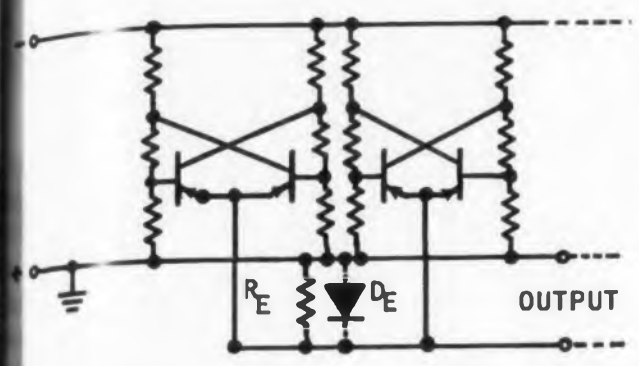
Here's how to obtain **less signal** attenuation with a low capacitance probe, without increasing the value of input capacitance. Conventional low capacitance probes provide signal attenuation of 10 to 1, with 1/10 of the input capacitance imposed by the input cable when used directly. It was desired in one case to raise the signal level by designing the probe system for 3 to 1 attenuation, with no increase in input capacitance.

Since the major portion of the input capacitance to a low capacitance probe is determined by the capacitance of the cable with which it is used, the shielded input cable was modified by removing the inner conductor. This was accomplished by clamping the inner conductor in a vise, and forcing the poly tube with braid and jacket off the inner conductor. The inner conductor was then replaced by threading a length of No. 32 copper wire through the poly tube. The probe resistor was next replaced with another resistor having twice the value of the scope input resistance. The trimmer capacitor was then adjusted to obtain uniform signal level at 60 cps and at 4 mc, and the probe assembly was completed.

R. G. Middleton, R. E. T. S. Schools, Detroit, Mich.



Modified low capacitance probe provides less signal attenuation with same capacitance. R = twice input resistance of the scope. C is a 2 to 12 μμf trimmer.



Uniform output is available from transistor flip-flops if a common emitter resistor (or diode) is used. The flip-flops are shown simplified (without capacitors or drive).

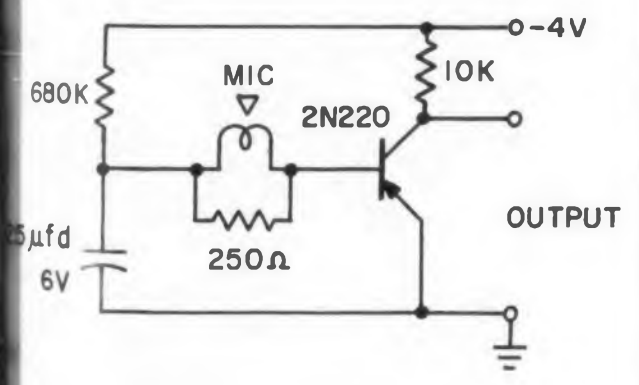
Uniform Output With Transistor Flip-Flops

It is often desirable to have a series of transistor flip-flops with their outputs as uniform as possible. This uniformity is difficult to achieve in the usual configuration without precision resistors. If all the emitters are connected together, though, the emitter voltages of each series are unnecessarily constant.

This system uses only one emitter resistor to carry the total current, instead of the usual one resistor per flip-flop. The "on" outputs are quite uniform, varying only with the saturation voltage variations.

Further improvement results if a silicon diode is used in place of the emitter resistor, as shown in the figure. This gives an emitter voltage of, say 1.0 v (the forward drop across the diode). This is constant in spite of changing load conditions.

John L. Nairn, Electronics Engineer, Naval Ordnance Test Station, Pasadena 8, Calif.



Low Noise Microphone Preamp

This simple microphone preamplifier for dynamic microphones can be made very compact. It can be built right into many microphone housings.

H. I. Sargeant, Electronics Eng., Interstate Electronics Co., Anaheim, Calif.

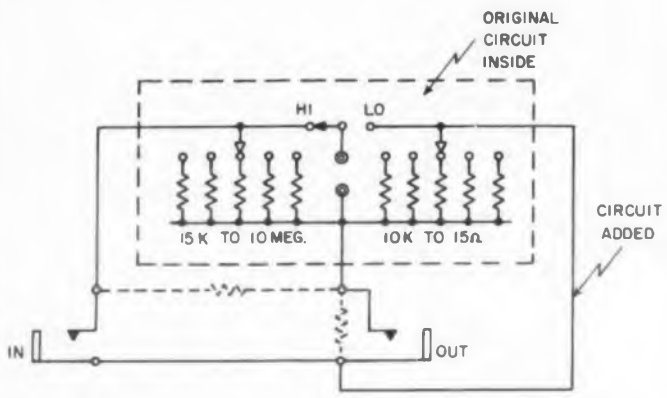
IDEAS FOR DESIGN

Low Cost Attenuators

We needed some voltage attenuators that had to be variable but not continuously variable. The voltages to be attenuated were at a telephone jack patchboard.

We had some Heath substitution boxes available with a circuit as shown in the figure. We added two telephone jacks as shown. The boxes were light enough to allow them to hang from the patchboard by cables connected to the jacks.

Joseph Augustine, Douglas Aircraft Co., Santa Monica, Calif.



Heath substitution box, modified to serve as attenuator. The attenuation equals the "Lo" resistance divided by the sum of the "Lo" and "Hi."

Multi Wire Cable Checker

This cable checker was designed to check cables automatically, one wire at a time. In the event an open or shorted wire is found, a *No-Go* lamp lights on the front panel. If no fault is found after testing the cable, the *OK* lamp lights.

Locating Shorted Wires. Each wire in the cable is connected to the cathode of tube V (Fig. 1) through a resistor which limits the plate current of the tube to a value which is insufficient to energize the *short* relay. If, on the other hand, there are two wires in the cable that are shorted to each other two of the resistors will be in parallel. As soon as the stepper switch comes to that position, the tube will draw sufficient current to energize the *short* relay.

Whenever the *short* relay is energized, the stepper and the pulser are disconnected from their supply voltage. Therefore, the normally closed contacts of the pulser relay will close the circuit to the *No-Go* lamp, which will remain on until the circuit is reset.

Locating Open Wires. Current for the *pulser* relay (Fig. 2) flows through the normally closed contacts of the *short* and the *pulser* relays and through the first wire of the cable under test.

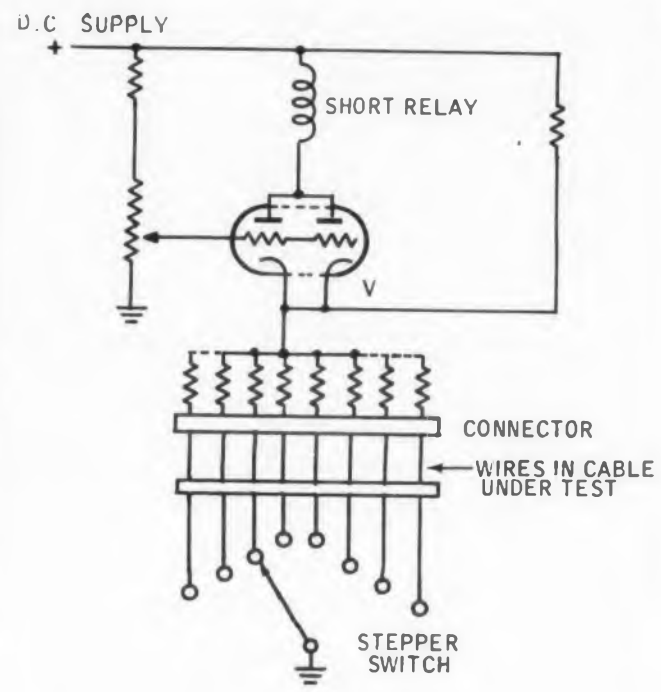


Fig. 1. Simplified drawing of short locater.

The *pulser* relay is energized and its contacts complete the circuit to the *stepper* coil. The *stepper* advances to the next wire. If no open wires are located, the *stepper* will automatically move from wire to wire. Since current for one *pulser* relay must flow through the wire under test, the relay will not be energized if the *stepper* switch encounters an open wire. The *No-Go* lamp will light and will remain on until the circuit is reset.

Herbert Piller, Consultant Engineer, Douglaston, N. Y.

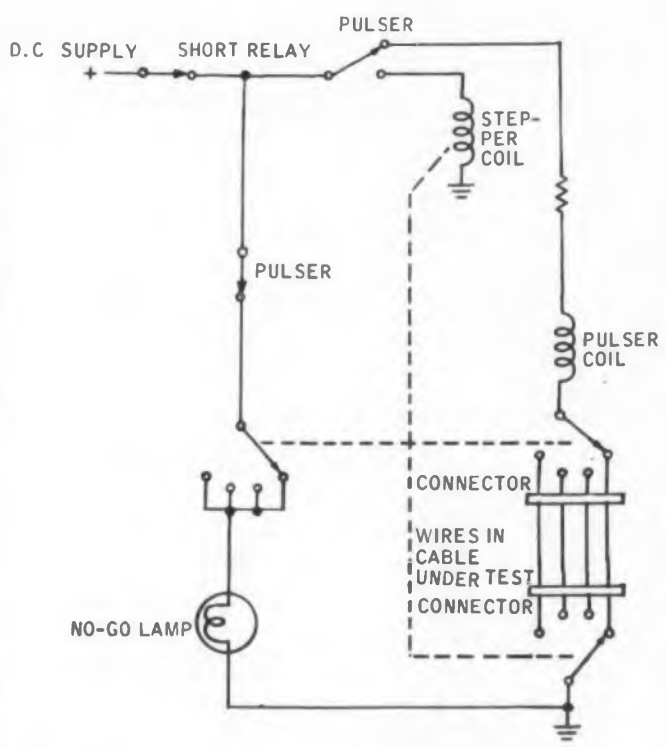
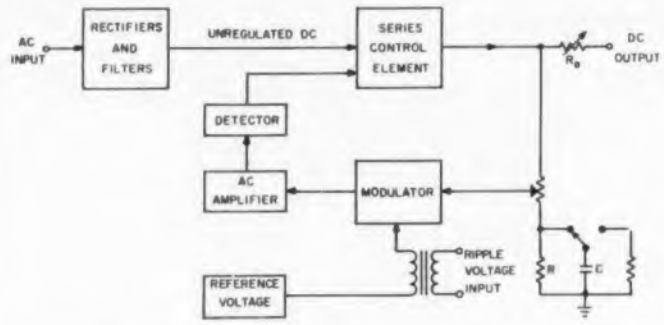


Fig. 2. Simplified drawing of open locater.

IDEAS FOR DESIGN



Block diagram of a typical regulated power supply with provision for increasing load regulation, introducing ripple, and creating transients.

Degrading Power Supplies

Analysis of electronic subsystems is not complete unless the performance of the system with its associated power supplies can be predicted or measured. Laboratory dc supplies are designed to give optimum performance. Their regulation is excellent (±0.1 per cent not unusual), their ripple content is teasingly low (a few mv), and transients have been evicted. With today's never ending attempt to miniaturize systems for space and weight savings, consideration must be given to using power supplies with minimum requirements.

Incorporating the features for accurate degrading of a regulated power supplies is simply accomplished as shown in the block diagram. Load regulation is increased by actually adding an external series resistor. Ripple at a continuously variable frequency and amplitude can be introduced at the point of comparison. Similarly, transients are created by switching (repetition rate) a capacitor across a resistor (duration proportional to $C \times R$ and amplitude a function of R).

Donald B. Stein, Sr., Electronic Engineer, Waldorf Instrument Co., N.Y.

Meter Protection Table

In the design of transistor test equipment for production use, it was found necessary to employ several sensitive microammeters. To protect these meters, conventional circuits using the sharp forward conduction characteristics of silicon diodes were employed.

A silicon diode, with its anode connected to the meter's positive terminal, is connected across the meter and a series resistor R. For zero-center meters, a second diode with the reverse polarity, is connected across the first.

The type 1N138A diode was found to be well suited for this application because of its sharp

forward conduction cut-off. The "*R* Plus R_m" suggested the table gives adequate protection and introduces negligible meter error.

Equipment employing these protection circuits has been in heavy use for two years by unskilled personnel without the need for meter maintenance.

Sanford J. Demby, The Liquidometer Corp., L. I. C., N. Y.

Full Scale Current	R Plus R_m (Ohms)	Approx. Diode Current
25 μa	12.8K	220 μa
100 μa	4.4K	10 ma
200 μa	2.4K	17 ma
500 μa	1.0K	20 ma

This table gives the sum of meter resistance and external resistance required to protect different microammeter movements with silicon diodes. The last column gives the approximate diode current for twice the full scale meter current applied across the terminals.

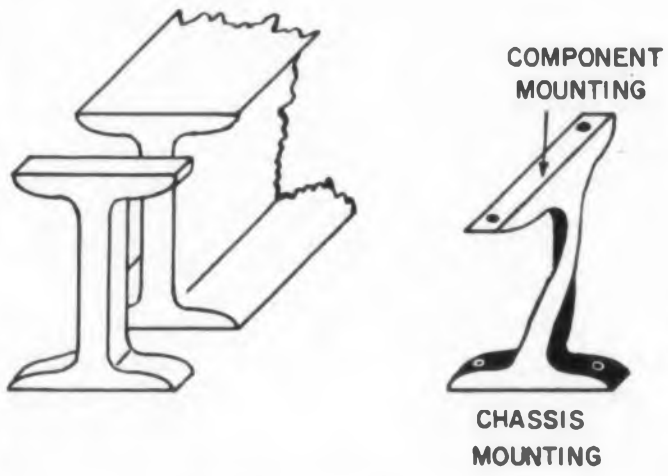
Sturdy Brackets from Flimsy Ones

A formed, flimsy bracket can be redesigned to fit fixed mounting holes and screw lengths, to be extremely rigid, and to require no tooling. In our case, it was necessary to hold a critical rf tuning capacitor in a fixed position above an array of similar components which were not to be disturbed.

A stiffer, formed bracket would have required extensive tooling. A large metal block would have disturbed the surrounding rf circuitry.

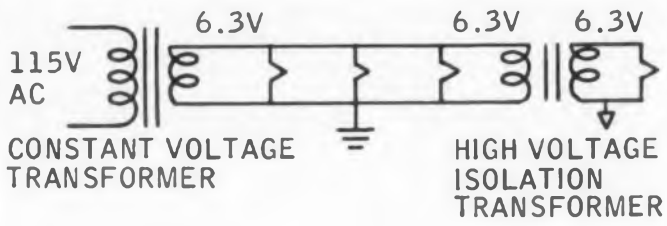
The solution was in a three in. deep stock, extruded, aluminum I-section. It was cut off in 1/4 in. lengths, tapped in all flanges, and twisted 90 degrees to accept the hole location of both chassis and part.

Robert A. LeMassena, Senior Engineer, Heiland Div., Minneapolis-Honeywell, Denver, Colo.



A twisted aluminum I-section for a sturdy bracket.

IDEAS FOR DESIGN



Stable Off-Ground Filament Voltages

In equipment where heater voltages must be stabilized against line voltage variations, constant voltage filament transformers are very useful. In some cases, due to heater-cathode voltage limitations, it is also necessary to operate heaters at various voltages above ground, usually only a small amount of current being necessary. While individual constant voltage transformers could be used they are comparatively bulky and do not have sufficient insulation for some applications.

There is a 6.3 to 6.3 volt isolation transformer available from several manufacturers for TV use. It has a secondary, usually rated at 1.2 amp with 5 kv secondary insulation. By using a single constant voltage filament transformer operating at the dc level of the majority of heaters, and isolation transformers where isolation is required a saving in space and weight can be achieved with little loss in regulation for the usual constant heater loads. The transformers also have sufficient insulation and current capacity for operating cathode ray tube heaters in most applications.

D. C. Harrington, Los Alamos Scientific Lab, Los Alamos, N.M.

Better Relay Control With Zener Diodes

To overcome relay hysteresis and large pull-in to drop-out ratio, one often has to resort to such "speed up" devices as magnetic switches. As shown typically in Fig. 1, they provide a good remedy. But they require bulky magnetic components which may be highly sensitive to temperature changes. Compensation is often successful, but it requires more complicated circuitry and added weight and size.

Zener diodes can often perform these "speed up" functions very effectively. For illustration, consider the following components: a relay with 30 vdc maximum pull-in voltage and 3 vdc minimum drop-out voltage, and a zener diode with a 20 v breakdown.

The relay alone has a pull-in to drop-out ratio of 10:1 for the worst case. If the zener is connected in series with the energizing coil, as shown in Fig. 2, a more sophisticated situation prevails.

Up to the 20 v zener breakdown level, all the voltage appears across the diode, and the very low diode leakage current flows in the loop. As the control signal rises above the 20 v level, the diode breaks down, allowing a current flow of

$$I = \frac{E - 20}{R_{relay} + R_{diode}}$$

When E reaches 50 v, sufficient power will be supplied to the relay to energize it. If the control voltage is decreased, the relay will remain energized due to its hysteresis till the 23 v level is reached. Then the relay will de-energize. Thus the pull-in to drop-out ratio has been reduced from 10:1 to 2.17:1. By selecting the proper zener, any ratio can be obtained.

This design is relatively insensitive to temperature changes. For the average zener, the breakdown level varies by only 0.08 per cent per degree. If the control voltage is ac, two zeners, connected back-to-back, are required as in Fig. 3.

E. Hartog and J. E. Rizzo, Project Engineers, Eclipse-Pioneer, Div. of Bendix Aviation Corp., Teterboro, N.J.

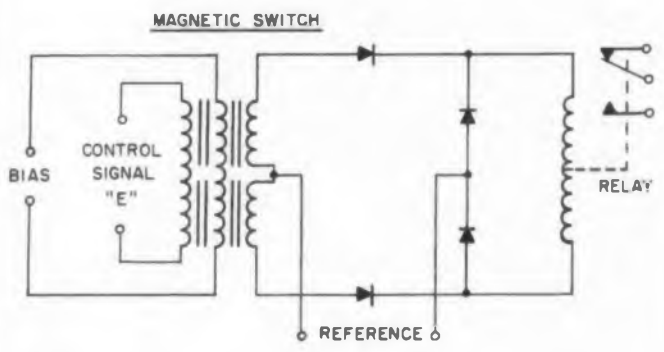


Fig. 1. Magnetic switches can speed up relays, but they're bulky and temperature sensitive.

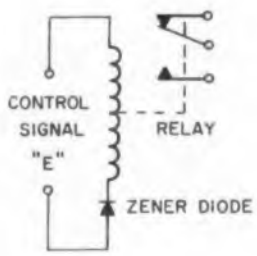


Fig. 2. (left) For dc circuits, a single zener diode can simplify relay speedup.

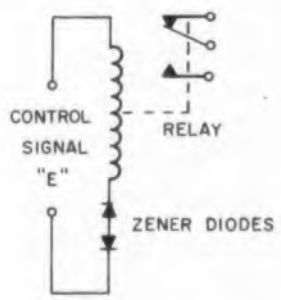


Fig. 3. (right) Two zeners back to back can speed up relays in ac circuits.

REPORT BRIEFS

New Low-Density Artificial Dielectric

The results are reported of an investigation into an isotropic, wide-band, artificial dielectric of low specific gravity for use at microwave frequency. Approximate relations for dielectric constant, permeability, and loss tangents are derived, and it is shown that experimental work to date support these formulae. *New Low-density Artificial Dielectric, J. A. Carruthers, McGill University, Eaton Electronics Research Laboratory, Montreal, Canada. 57 pp, microfilm $3.60, photocopy $9.30. Order PB 130871 from Library of Congress, Washington 25, D. C.*

R-F Tuners and I-F Amplifiers

Miniature transistorized inductive devices were developed for use in r-f tuners and i-f amplifiers. New i-f amplifiers use six double-tuned stages and each is constructed with newly developed miniature i-f coils with unloaded Q's as high as 250. The selectivity characteristics are said to be the best achieved in transistorized amplifiers to the date of the research. A novel permeability-type r-f tuner using a combined rotary and axial motion of two ferrite cups was also developed. It can operate in any of the frequency ranges from 0.5 mc to 1.5 mc, 1.5 mc to 5.0 mc and 5.0 mc to 15 mc with excellent linearity and tracking characteristics. The variable inductor was designed to operate with a transistorized oscillator-mixer circuit. It was shown that the "rotary-axial" tuner can cover a 15 to 1 tuning range when used as a semicontinuous tuner. *R-F Tuners and I-F Amplifiers for Transistors, E. Abbot, Emerson Radio & Phonograph Corp. Wright Air Development Center, U.S. Air Force, Oct. 1957, 53 pp, $1.50. Order PB 131602 from OTS, Washington 25, D.C.*

Standardizing Specs for Insulated Cable

The standardization study of specifications for multiconductor cables was designed to eliminate duplications and minor variations in cable materials, constructions, and test procedures, and to incorporate the results of the standardization in a single specification that would supersede all the specifications under study. *Study, Standardization of Specifications for Insulated Cable, Robert E. Barbiere, Philip M. Costanzi and Bruce Compton, Radio Corp. of America, Camden, N.J. Dec 1957, 244pp, $3.50. Order PB 131805 from OTS, Washington, D. C.*

Status of Thermal Radiometer

This report describes the progress made on the design and manufacture of the components of a thermal radiometer. It includes mathematical analyses of both the heat transfer and control system problems. Among other activities was the forming of a cone by an electroforming technique. Adhesives of epoxy resins filled with aluminum powder were developed to bond wires onto the system's copper sink. Simulators which approximated operating conditions were built and included in a complete electronic system from which data is obtained. The instrument responded properly over a range of operating conditions. Also included is a discussion of the specifications as originally outlined and revisions suggested on the basis of analytical and experimental work performed. *Status of Thermal Radiometer, State of development of thermal radiometer, A. Pfenninger, H. E. Henry, M. Godet, and C. A. Wogrin, Quantum Inc, U. S. Air Force, March 1958, 57pp $1.50. Order PB 131746 from OTS, Washington, D. C.*

Lumped-Filtered Circuits For TWTs

This report presents a family of curves of the properties of lumped-filter circuits which are useful as slow-wave circuits for external circuit traveling-wave tubes with distributed or lumped and distributed circuits. *Some Properties of Lumped-filtered Circuits for Traveling-wave Tubes, Chih Tang Sah and G. A. Loew, Stanford University, Electronics Laboratories, Stanford, Calif. Jul 1956, 169 pp, microfilm $7.80, photocopy $25.80. Order PB 127464 from Library of Congress, Washington 25, D. C.*

Nondestructive Readout of Multilevel Magnetic Memory

An infinite-resolution method of reading the flux level in a magnetic core without destroying this flux level was developed. The method uses solid-state devices and requires less than 10 mw supply during nondestructive interrogation, while standby power drain is in the microwatt range. Output information is in the form of an alternating waveform whose frequency is a function of the flux level of the storage core. Frequency ratios of 30:1 were obtained. Also developed was a circuit for clearing and resetting a core in preparation for further information storage. *Nondestructive Readout of Multilevel Magnetic Memory, R. L. Van Allen and C. B. House, Naval Research Laboratory. Feb. 1958, 26 pp, $1.75. Order PB 131475 from OTS, Washington 25, D.C.*

REPORT BRIEFS

250 C Ceramic Capacitor

New capacitors, with capacities up to 0.01 microfarad, were sought which would conform in general to the ratings described in MIL-C-11015A, with two important exceptions. These were (a) the reference temperature should be 250 C instead of 85 C, and (b) the insulation resistance sought would be in excess of 5 megohm microfarads at 200 C and 0.5 at 250 C. Products with desired capacities were developed with insulation resistances up to 6 megohm microfarads at 250 C and up to 50 megohm microfarads at 200 C. Final products were composed of 80.10 per cent of barium titanate, 16.99 per cent of lead titanate, and 2.91 per cent of tantalum oxide. Processing methods employed resulted in higher degrees of mixing and far greater reproducibility than was possible by conventional procedures. *250 C Ceramic Capacitor with Wide Temperature Range, Cameron G. Harman and Edward F. Mayer, Horizons, Inc., Cleveland, Ohio, Mar 1958, 66 pp, $3.00. Order PB 131893 from OTS, Washington 25, D. C.*

Test Data on Resistors

Report consists of tables and graphs, no text. *Test Data On Resistors, Wirewound, Variable (precision type), Battelle Memorial Institute, Columbus, Ohio, June 1954, 274pp, microfilm $11.10, photocopy $42.60. Order PB 127267 from Library of Congress, Washington 25 D. C.*

Estimation of Signal Parameters

This memorandum summarizes some results obtained in the study of certain aspects of signal reception in the presence of noise. Two types of difficulties are considered, as explained below. First, the problem of obtaining best estimates of pulse heights occurring with certain non-Gaussian distributions is treated. The solution in each case implies some nonlinear filtering operation. Second, pulse trains with Gaussian statistics but interdependence between adjacent pulses are considered. The "best" estimate of any pulse height is found to be a certain linear combination of the present and previous signal samples. Some suggestions for extending this result to the case of interdependence between an arbitrary number of pulses are included. *Some Results in the Estimation of Signal Parameters, D. R. Bennion, Stanford University, Electronics Laboratories, Stanford, Calif. Sept 1956, 23 pp, microfilm $2.70, photocopy $4.80. Order PB 128701 from Library of Congress, Washington 25, D. C.*

Interference From Radar Modulators—Vol. II

Includes Vol. I in table of contents. Vol. II deals with electromagnetic leakage from coaxial cables, estimation of required shielding, conducted interference and appendices on leakage from long slits, derivation of the calibration factor for surface transfer impedance measuring equipment, construction of a pressure chamber for gasket tests, and variation of cabinet attenuation with door size. *Investigation of Interference From Radar Modulators. Vol. II: Electromagnetic shielding principles, Rensselaer Polytechnic Institute, Research Division, Troy, N. Y. Mar 1956, 129 pp, microfilm $6.30, photocopy $19.80. Order PB 130459 from Library of Congress, Washington 25, D. C.*

VHF Communication System

A vhf teletype communications circuit has been established from Bozeman, Mont., to Palo Alto, Calif., using radio signals reflected from ionized meteor trails. The great circle distance between these two points is approximately 830 miles. This report discusses the design and operation of a teletype system which detects these reflected paths and controls the flow of information coincident with an acceptable signal strength from transmitter to receiver. Information is transmitted during meteor bursts at ten times the normal 60-wpm teletype rate. It is recorded and stored at the receiver and then read out at normal speed into standard teletype printers. *Long Range VHF Meteor-burst Communications System, Russell Wolfram and Bruce M. Sifford. Stanford Research Institute, Menlo Park, Calif. Sept. 1957, 55pp, microfilm $3.60, photocopy $9.30. Order PB 132115 from Library of Congress, Washington 25, D. C.*

Electron Tubes for Critical Environments

The present state of development of electron tubes for operation at temperatures up to 500 C at high levels of shock and vibration and in nuclear radiation has been investigated. The data presented were gathered from published reports, periodicals, interviews, and through questionnaires. The materials and techniques that enter into electron tube design are examined separately, and the effects of high temperature are analyzed. Those areas of technology requiring further research are enumerated. *Electron Tubes for Critical Environments, Walter H. Kohl and Philip Rice, Stanford Research Institute, Menlo Park, Calif. Mar 1958, 219pp, $3.50. Order PB 131852 from OTS, Washington 25, D. C.*

REPORT BRIEFS

Linear High-Gain Amplifier

This report presents some basic material on D'Arsonval galvanometers and cathode-coupled amplifiers, leading to the design of practical amplifiers suitable for use as drivers for recording meters. *Linear High-Gain Amplifier for Recording Meters, G. P. DuBose, Jr. and F. E. Brooks, Jr. Texas University, Electrical Engineering Research Laboratory, Austin, Tex., Nov. 1956, 48 pp, microfilm $3.30, photocopy $7.80. Order PB 130786 from Library of Congress, Washington 25, D. C.*

Backward-wave Local Oscillators

A contract was awarded to Hughes Aircraft to investigate and develop backward-wave oscillators at X-band (7.6 to 12.4 kmc) and Ku-band (11.6 to 18.0 kmc) that would meet certain rigid objective specifications. The first and principal phase of this contract on backward-wave oscillators is summarized in Part I of this Final Report. The investigation of noise reduction is described in Part II. *Backward-wave Local Oscillators, M. R. Currie, H. R. Johnson, and R. D. Weglein. Hughes Aircraft Co., Electron Tube Lab., Culver City, Calif. June 1956, 38pp, microfilm $3.00, photocopy $6.30. Order PB 132497 from Library of Congress, Washington 25, D. C.*

Circuit Properties of Hook Transistor

The following significant novel results are obtained: (a) the switching speed of hook common base circuits is much larger than that of hook common emitter circuits. Compared to the speed of similar circuits using point contact transistors with the same alpha cutoff frequency, it is somewhat lower. (b) The amplifying properties of hook common emitter and hook common cellector configurations are unique; in particular a stable unilateral amplifier may be designed with very large input impedance, very low output impedance and good transfer gain. The input impedance may also be adjusted to a preset value in a wide range, thus permitting input matching. The dual case (infinite input admittance, zero output admittance) may be synthesized similarly with a hook common base amplifier using positive feedback. *Circuit Properties of Hook Transistor, L. M. Vallese, Polytechnic Institute of Brooklyn, Microwave Research Institute, Brooklyn, N.Y. Mar 1957, 28pp, microfilm $2.70, photocopy $4.80. Order PB 132956 from Library of Congress, Washington 25, D. C.*

Electromagnetic Radiation Patterns and Sources

Reprinted from an electromagnetic wave theory symposium. 1. Waves, Electromagnetic—Radiation—Theory 2. Antennas—Radiation patterns—Mathematical analysis. Electromagnetic *Radiation Patterns and Sources, Claus Muller, New York University. Division of Electromagnetic Research, New York, N.Y. July 1956, 10pp, microfilm $1.80, photocopy $1.80. Order PB 127213 from Library of Congress, Washington 25, D. C.*

Microwave Resonant Cavity

Expressions are derived for the frequency shift of a microwave resonant cavity resulting from the insertion of a sample of magnetic material small compared with the wavelength. Principal consideration is given to spherical samples. Cavity perturbation theory is used. The internal field in the sample is specifically calculated and used in the integration over the sphere. Results of the theory are compared with measurements and with the results of recent theoretical treatments of the problem. *Effect of Ferrite Sample Size on the Frequency Shift of a Microwave Resonant Cavity, J. E. Tompkins and E. G. Spencer, U. S. Ordnance Corps, Diamond Ordnance Fuze Laboratories, Washington, D. C. Jan 1957, 22 pp, microfilm $2.70, photocopy $4.80. Order PB 132001 from Library of Congress, Washington 25, D. C.*

Resonance Phenomena At Microwave Frequencies

The present study of resonance phenomena at microwave frequencies in gaseous discharge plasmas was made to explore, in particular, the possibility of using such plasmas for the purpose of spectrum analysis of rf electromagnetic waves. The various resonances are classified in this report and a theoretical analysis for the case of linearly polarized waves, considering collisions, as well as for the circularly polarized waves, is given. *Further Studies of Resonance Phenomena at Microwave Frequencies in Gyromagnetic Gaseous Discharge Plasma: Application to Radio Frequency Spectrum Analysis, L. P. McGrath, A. K. Chatterjee, and J. P. Monier, Illinois University, Engineering Experiment Station, Electrical Engineering Research Laboratory, Gaseous Electronics Section, Urbana, Ill. Aug. 1957, 93 pp, microfilm $5.40, photocopy $15.30. Order PB 132099 from Library of Congress, Washington 25, D. C.*

REPORT BRIEFS

Circuit Parameters of Waveguide Tuning Post

This paper is concerned with the theoretical treatment of the circuit parameters of a tuning post in a rectangular waveguide. Some applications of the results to the approximate calculation of the circuit parameters of a radiating post in a trough guide and a resonant slot in a strip line, are given. *Circuit Parameters of the Tuning Post in a Rectangular Waveguide and Its Applications, Michio Suzuki, Polytechnic Institute of Brooklyn, Microwave Research Institute, Brooklyn, N.Y. July 1957, 61pp, microfilm $3.90, photocopy $10.80. Order PB 132147 from Library of Congress, Washington 25, D. C.*

Optimum Linear Filtering

This report considers the optimum linear filtering of polynomial message plus stationary random noise. The derivation is similar to that of Lees but is formulated differently. This formulation is more conventional and facilitates a consideration of desired operations on the message other than smoothing and prediction. *Optimum Filtering of Sampled Polynomial Message Plus Random Noise, Arthur R. Bergen, Columbia University, Dept. of Electrical Engineering, Electronics Research Laboratories, N. Y. May 1956, 24pp, microfilm $2.70. Order PB 126359 from Library of Congress, Washington 25, D.C.*

High-Power Beam Tubes

In summary the projects have progressed as follows: (1) The investigation of assembly techniques continues in the cross-wound helix project. The fundamental problem is the support of ringbar structures inside a metal envelope by means of ceramic disks. (2) Use of the cavity-probe device for study of the bunching phenomena in Brillouin-focused beams has provided a considerable amount of excellent data on the distribution of r-f current density in the klystron beam (under both small and large signal conditions, and for a wide range of parameters). (3) Construction of the velocity spectograph has been completed, and initial calibration measurements have been made. *Research in High-Power Beam Tubes, Scientific Report No. 5, Stanford University, W. W. Hansen Laboratories of Physics, Microwave Laboratory, Stanford, Calif. Sept 1956, 15 pp, microfilm $2.40, photocopy $3.30. Order PB126945 from Library of Congress, Washington 25, D. C.*

Scanning Arrays with Flat Spiral Antenna

A pair of equally excited but oppositely sensed Archimedean two-wire spirals situated close to one another in the same plane is used to generate a linearly polarized field in which the direction of polarization and phase is controlled or varied by rotation o fthe spiral radiators. The possibility of using a parasitic spiral in conjunction with a driven spiral for application to a broadside scanning array is indicated. A brief simplified analysis of the two-wire Archimedean spiral is presented. *Scanning Arrays Using the Flat Spiral Antenna. A. A. Kaiser, U.S. Naval Research Laboratory. March 1958, 23pp, microfilm $2.70. Order PB 130193 from Library of Congress, Washington 25, D.C.*

Electrode Process in Metal Deposition

When a metal electrode is immersed in an electrolyte an electric potential difference arises between metal and solution. Though it cannot be determined, the electrode potential can be measured. On electro-deposition the cathode potential decreases below its equilibrium value. The change is called (electrolytic) polarization and three types of it can be distinguished: concentration, ohmic polarization, and activation polarization. *Electrode Process in Metal Deposition from Aqueous Solutions, Einar Mattsson, Sweden. 1955, 58 pp, microfilm $3.60, photocopy $9.30. Order PB 124926 from Library of Congress, Washington 25, D.C.*

Low Pass Video Amplifiers

This paper deals with the design of low-pass video amplifiers for specified amplitude or phase response. This is accomplished by what is essentially stagger-tuning similar to that used for narrow-band amplifiers, except that in this case the problem is complicated by the presence of finite zeroes in the amplifier gain function. The method used is an iterative process by means of which the elements in the predetermined amplifier configuration can be adjusted so that the gain function may approximate the desired response. The performance of the resulting designs is shown to approach the theoretical limits of gain-bandwidth product in cascaded amplifiers. *Iterative Methods in Amplifier Interstage Synthesis, George A. Caryotakis, Stanford University, Electronics Research Laboratory, Stanford, Calif. May 1955, 101pp, microfilm $5.70. Order PB 126469 from Library of Congress, Washington 25, D.C.*

REPORT BRIEFS

Causality and Frequency-Response Functions

A general system is studied under the assumption of linearity, passivity, reproducibility, and causality. Under essentially no further assumption, frequency-response functions are defined for such systems and identified with positive functions, suitably defined. Through the Lebesgue decomposition theorem, any frequency-response function may be decomposed to be the sum of a minimum-reactive part and two reactive parts, one of which is of unfamiliar nature. This procedure is carried through for a system with one input-output and again for a system with multiple input-outputs. As an illustration, the result is applied to the study of the Kronig-Kramers relations. One of the relations is proved to be true under very general conditions, but not the other. *Causality and Frequency-Response Functions, T. T. Wu, Harvard University, Cruft Laboratory, Cambridge, Mass. April, 1955, 47 pp, microfilm $3.30, photocopy $7.80. Order PB126790 from Library of Congress, Washington 25, D. C.*

Reversible Properties of Ferromagnets

Using a statistical model, equations are developed for the variation of the reversible susceptibility, both parallel with and normal to the biasing magnetization, as a function of the magnetization assuming that the susceptibility arises by domain rotation. The results are contrasted with previous results based upon domain-wall motion. It is concluded that the theory points out a new technique for the separation of the origins of the susceptibility. Equations are also given for the expected variation of the differential magnetostriction with magnetization both parallel with and normal to the field and for both domain-wall motion and domain rotation. An expression is given for the susceptibility matrix arising from domain rotation as a function of magnetization. *Reversible Properties of Ferromagnets, I. Theory of the expected variation of the reversible susceptibility with magnetization, II. Comparison of theoretical and experimental susceptibility curves, III. Summary, Dale M. Grimes, Michigan University, Engineering Research Institute, and Dept. of Electrical Engineering, Solid State Devices Laboratory, Ann Arbor, Mich. Dec, 1956, 58 pp, microfilm $3.60, photocopy $9.30. Order PB 126868 from Library of Congress, Washington 25, D. C.*

All-Transistor DC Voltage Regulator

This report describes the all-transistor voltage regulator which was developed at this station to replace the carbon pile regulator Mk 1, Mod 0 in applications demanding precise voltage regulation. Embodied in the report are sections concerning specifications, theory of operation, and test results. *All-Transistor DC Voltage Regulator, Gerald M. Ford, U. S. Naval Ordnance Plant, Engineering Dept., Indianapolis, Ind. Mar 1955, 35 pp, microfilm $3.00, photocopy $6.30. Order PB130965 from Library of Congress, Washington 25, D. C.*

Reliability Stress Analysis

Presents basic techniques and numerical values required to calculate the reliability risk accumulated in the process of making electronic design commitments in the matter of component-part selection and application stress. *Reliability Stress Analysis for Electronic Equipment, John A. Connor, RCA, Engineering Standards and pp. Order PB131678 from OTS, Washington 25, D. C.*

Heater-Cathode Leakage Investigation

1. Vacuum tubes, Cathode ray—Materials; 2. Vacuum tubes, Cathode ray—Leakage. *Heater-Cathode Leakage Investigation, Julius Cohen, Paul Cutler, J. V. Florio, A. L. Wilson, and R. Rechtschaffner, Sylvania Electric Products, Inc., Product Development Labs, Kew Gardens, N.Y. December 1956, 36 pp, microfilm $3.00, photocopy $6.30. Order PB 126374 from Library of Congress, Washington 25, D.C.*

Electrochemical Behaviour of Metallic Crystals

A complete technique for investigating the electrochemical behaviour of metallic single crystals has been developed, including: (a) preparation (by a modified Bridgman method) of single crystals; (b) orientation, cutting (by chemical and electrochemical method avoiding stresses), electropolishing, surface finishing; (c) overvoltage measurements in suitable cells. *Researches on the Electrochemical Behaviour of Metallic Crystals, Roberto Piontelli, Ugo Bertocci, L. Bicelli, G. Poli, B. Rivolta, G. Sternheim, and C. Templenizza, Politecnico di Milano, Laboratorio di Elettrochimica, Chimica Fisica e Metallurgia, Milano, Italy. February 1957, 11 pp, microfilm $2.40, photocopy $3.30. Order PB 127914 from Library of Congress, Washington 25, D.C.*

Nonlinear and Parametric Phenomena in Radio Engineering

Part 7

A. A. Kharkevich

(Translated by J. George Adashko)

Chapter 1

Nonlinear Circuits and Fundamental Nonlinear Processes

Here, in Part 7, we conclude our translation of Professor Kharkevich's discussion of detection which appears in his Section 9. Our translation of his book continues in the December 24th issue of ELECTRONIC DESIGN.

9. Detection (contd.)

Square-Law Detection

Let the detector characteristic be given by the relation

$$I = k\,U^2$$

Inserting the expression for an oscillation, amplitude modulated by a sine wave, we get

$$I = kU^2_m\,(1 + m\sin\Omega t)^2 \sin^2\omega_0 t =$$

$$= \frac{k}{2}\,U^2_m\left[1 + \frac{m^2}{2} + 2m\sin\Omega t - \frac{m^2}{2}\cos 2\Omega t\right.$$

$$-\left(1 + \frac{m^2}{2}\right)\cos 2\omega_0 t - m\sin(2\omega_0 - \Omega)\,t$$

$$+ m\sin(2\omega_0 + \Omega)\,t + m^2\cos 2(\omega_0 - \Omega)\,t$$

$$\left. + m^2\cos 2(\omega_0 + \Omega)\,t\right].$$

We see that the resultant spectrum is limited; it contains only five high frequencies, namely

$$2\omega_0,\ 2\omega_0 \pm \Omega,\ 2(\omega_0 \pm \Omega).$$

However, the signal is distorted; in addition to the frequency Ω, the spectrum of the detected oscillation contains also the frequency 2Ω, i.e., the second harmonic of the signal (a distortion in the signal waveform). The spectra of the modulated oscillation before and after square-law detection are shown in Fig. 25.

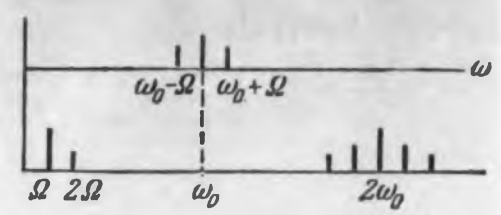


Fig. 25. Frequency spectra of modulated oscillation before and after square-law detection.

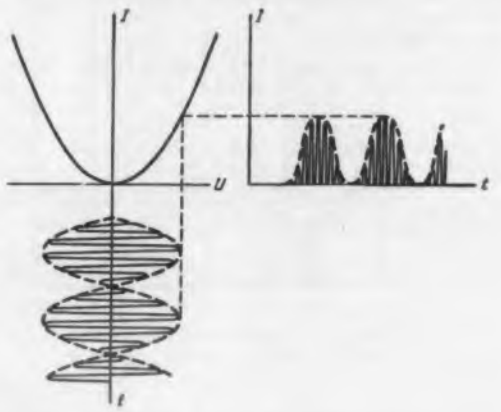


Fig. 26. Waveforms at the input and output of a beat detector.

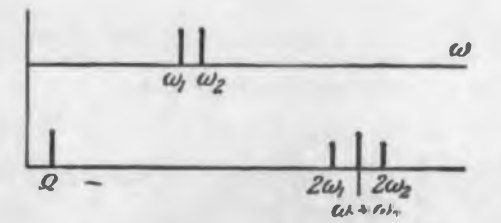


Fig. 27. The beat spectrum before and after square-law detection.

Thus, as expected, a detector with a square-law characteristic is not suitable for detecting amplitude modulated signals. Nevertheless, square-law detection plays a very important role in radio engineering.

It is used, for example, for detecting beats when the purpose of detection is to obtain a pure sinusoidal oscillation at the difference frequency. Exactly the same situation prevails in heterodyne audio frequency generators. The principle of these generators is based on adding the outputs of two high frequency oscillators so as to produce beats. The beats are detected and a low frequency oscillation is obtained, at a frequency equal to the difference of the two high frequencies. If one of the high frequency oscillators is made adjustable, one can obtain a low frequency that varies smoothly over a wide range.

Thus for example, to obtain a low frequency ranging from 0 to 10 kc, it is possible to employ two high frequency oscillators, one, say, with a 100 kc frequency, the other, adjustable from 100 to 110 kc (merely 10 per cent).

An obvious advantage of heterodyne audio-frequency generators is the simplicity of control: the entire range is covered by turning just one knob which controls a small variable capacitor in the tank circuit of one of the high frequency oscillators.

Let us analyze the problem of beat detection. We start by assuming that the amplitudes of both high frequency oscillations are equal, i.e.,

$$U = U_m (\sin \omega_1 t + \sin \omega_2 t).$$

Transforming, we obtain

$$U = 2U_m \sin \frac{\omega_1 + \omega_2}{2} t \cos \frac{\omega_1 - \omega_2}{2} t$$

$$= 2U_m \sin \omega_0 t \sqrt{\frac{1}{2}(1 + \cos \Omega t)}.$$

where

$$\omega_0 = \frac{\omega_1 + \omega_2}{2}, \quad \Omega = \omega_1 - \omega_2,$$

i.e., ω_0 denotes the average high frequency, and Ω the low beat frequency. The voltage waveform applied to the detector is shown in Fig. 26.

It must be noted, that beats can be considered as high frequency oscillations of frequency ω_0, modulated by the beat frequency. However (and this is an important factor), the modulation is nonsinusoidal, and the modulation factor is of the form.

$$\sqrt{\frac{1}{2}(1 + \cos \Omega t)}.$$

If we now apply square-law detection, we obtain

$$I = kU^2 = 2kU^2_m (1 + \cos \Omega t) \sin^2 \omega_0 t$$

$$= kU^2_m (1 + \cos \Omega t)(1 - \cos 2\omega_0 t)$$

$$= kU^2_m \left[1 + \cos \Omega t - \frac{1}{2} \cos 2\omega_1 t - \frac{1}{2} \cos 2\omega_2 t - \cos (\omega_1 + \omega_2) t\right],$$

i.e., purely sinusoidal oscillation at the difference frequency Ω, the sum of the initial high frequencies, and double the value of each high frequency. The beat spectrum before and after the square-law detection is shown in Fig. 27. Our conclusions concerning the advantages of

the square-law beat detector hold also in the more general case, when the amplitudes of both high frequency oscillations are unequal. Assume

$$U = U_1 \sin \omega_1 t + U_2 \sin \omega_2 t.$$

Fig. 28 shows a vector diagram, illustrating the addition of two voltages of unequal frequencies. We have for the amplitude of the resultant voltage

$$U^2_m = U^2_1 + U^2_2 - 2U_1U_2 \cos \alpha.$$

But, as can be seen from the diagram

$$\alpha = \pi - \Omega t$$

and consequently

$$-\cos \alpha = \cos \Omega t.$$

Thus,

$$U_m = U_1 \sqrt{1 + \frac{U^2_2}{U^2_1} + 2\frac{U_2}{U_1} \cos \Omega t}.$$

This formula represents the varying amplitude, i.e., the beat envelope, in the case of component oscillations of unequal amplitudes. In square-law detection, squaring causes the square root to disappear, and we obtain in this case a purely sinusoidal oscillation at the difference frequency Ω.

It must be noted that if there is a great difference between the amplitudes of the two voltages, i.e.,

$$U_2 \ll U_1$$

or

$$U_2 \gg U_1,$$

then a low frequency sinusoidal voltage can be obtained also with linear detection. This follows from the fact that, for example, if $U_2 \ll U_1$

$$U_m = U_1 \sqrt{1 + \frac{U^2_2}{U^2_1} + 2\frac{U_2}{U_1} \cos \Omega t} \cong$$

$$\cong U_1 \left(1 + 2\frac{U_2}{U_1} \cos \Omega t\right)^{\frac{1}{2}} \cong U_1 \left(1 + \frac{U_2}{U_1} \cos \Omega t\right).$$

An added comment concerning square-law detection is that this method plays a very important role in modulation and frequency-conversion circuits. This will be discussed later.

Detector Characteristics

We can now turn to a general discussion of detector characteristics. The characteristic of a detector must be nonlinear—this is obvious. But this is not enough. Were we to choose a nonlinear characteristic of the form

$$I = kU^3$$

no detection would result, since the oscillation, as shown in Fig. 29, although it would change its form, would remain symmetrical about the time axis. The only nonlinear relations suitable for detection are those asymmetrical with respect to the U axis which, consequently, yield a direct current component in response to an alternating voltage. Relations of this kind must contain even components.

Let us recall the following definitions:

An even function is one satisfying

$$f(x) = f(-x).$$

An odd function satisfies the condition

$$f(x) = -f(-x).$$

Some even functions are x^2, x^4, *cos* x, etc.

Examples of odd functions are x, x^3, *sin* x, etc.

A power function x^n is either even or odd, depending on whether the exponent n is even or odd.

A detector can detect, and a rectifier can rectify, only if its characteristic contains an even component. Any function can be expanded into a sum of even and odd parts. Let

$$f(x) = f_e(x) + f_o(x),$$

where f_e is the even part and f_o is the odd part. Let us reverse the sign of the argument. Then, by definition, we get

$$f(-x) = f_e(x) - f_o(x).$$

Adding and subtracting, we get

$$f_e(x) = \frac{1}{2}[f(x) + f(-x)],$$

$$f_o(x) = \frac{1}{2}[f(x) - f(-x)].$$

By way of an example, let us expand the broken characteristic of Fig. 30a into even and

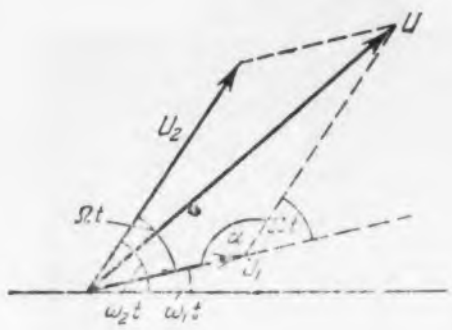


Fig. 28. Vectorial addition of two voltages of unequal frequencies.

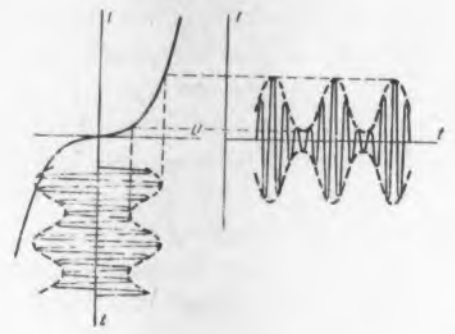


Fig. 29. The nonlinear characteristic $I = kU^3$ is not suitable for detection since the oscillation remains symmetrical about the time axis.

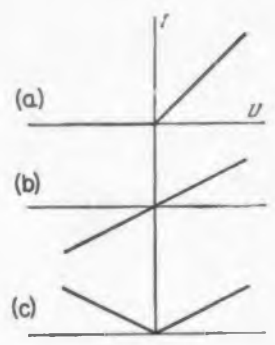


Fig. 30. Three basic nonlinear characteristics. Characteristics *b* and *c* can be added to form *a*.

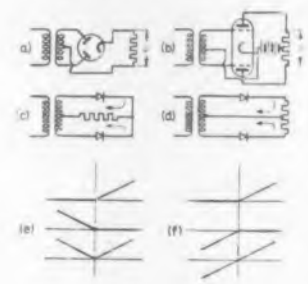


Fig. 31. Comparison of a full wave double-diode rectifier and a double-triode push-pull amplifier. The rectifier circuit, its general form, and its idealized characteristics are shown in *a*, *c*, and *e*; while *b*, *d*, and *f* show the counterparts for the amplifier.

odd parts. Analytically, this characteristic can be written as

$$I = \begin{cases} kU & U > 0, \\ 0 & U < 0. \end{cases}$$

The even part of the characteristic will be

$$I_e = \frac{k}{2} |U|,$$

and the odd one will be

$$I_o = \frac{k}{2} U$$

It is readily seen that by adding (b) and (c), we obtain (a). Thus, we can represent the broken characteristic in Fig. 30a by means of the formula

$$I = 1/2k\,(|U| + U)$$

which is suitable for all values of U, both positive and negative.

The detector or rectifier characteristic can contain an odd component, but this component is ineffective. It is natural, however, to use rectifiers and detectors with purely even characteristics. Such characteristics are inherent in all symmetrical push-pull circuits—the odd terms of the characteristics are eliminated in this circuit because the rectified or detected voltage is applied to both branches of the circuit with opposite signs (in counterphase), and the currents of both branches add up.

In this sense, the rectifier or detector circuit has properties that are the inverse of the properties of the push-pull amplifier circuit. In the latter, the voltage is also applied to both branches and in counterphase, but the output voltage is proportional not to the sum, but to the difference of the currents.

Thus, a full wave rectifier circuit employs only the even portion of the characteristic of the nonlinear element, while the push-pull amplifier circuit employs only the odd portion of the characteristic of the nonlinear element. This is why all the even harmonics drop out in a push-pull circuit.

It is understood that in the case of amplification the tendency is to retain, of all the odd harmonics, only the first one, corresponding to undistorted amplification, when the resultant characteristic is straight. To explain these concepts, Figs. 31a and 31b show the circuit of a full wave double-diode rectifier and that of the double triode push-pull amplifier. Figs. 31c and 31d show the same circuits in generalized form. Finally, Figs. 31e and 31f show the construction of the resultant characteristics, under the assumption that the characteristic of the individual element is a broken line. (*To be continued*)

RUSSIAN TRANSLATIONS

What The Russians Are Writing

J. George Adashko

AUTOMATIC CONTROL

Concerning One Method of the Analysis of Pulsed-Follow-Up Systems by Fan-Chun-Wui. AT 4/58, pp 296-305, 4 figs.

Known methods from the analysis of linear continuous systems are extended to include sampled-data systems through the use of the discrete Laplace transformation. The forced motion of a sampled-data system is qualitatively estimated on the basis of analysis. Reference is made to "Analysis of Errors in Sampled-Data Feedback Systems" by Sklansky and Ragazzini (*Transactions AIEE*, Volume 74, Part II, 1955) and "The Effect of Pole and Zero Locations On the Transient Response of Sampled-Data Systems" and "Correlation Between Root-Locus and Transient Response of Sampled-Data Control Systems" by Eliahu I. Jury (*Transactions AIEE*, Volume 74, Part II, 1955).

Improving the Transients in Corrective elements With Variable Parameters by Ye. K. Shigin. AT 4/58, pp 306-311, 4 figs.

Some means are proposed for improving transients in automatic control systems of fourth order with two integrating elements. It is shown that if differentiator element with variable ti constant is introduced into the syste it is advisable to introduce an integra with variable time constant into the c rection network.

Grapho-Analytical Method of Determ ing Relay System Characteristics by L. Kuz'min. AT 4/58, pp 285-295, 14 fig

A standard procedure for analyz relay systems groups together all t linear elements of the system and se rates them from the nonlinear porti If the nonlinear portion is a relay, t problem reduces essentially to the sponse of the linear portion to a quence of rectangular pulses of const amplitude. If periodic modes are sup imposed on the system, the problem g to be quite complicated, and requi a complicated analysis in the comp plane. Certain auxiliary graphs for purpose are offered in the article.

CIRCUITS

Simulation of the Input Admittance a Tube by A. M. Gasanov. RE 1/ pp 77-79.

To simulate a tube at high frequ cies, where the input conductance comes substantial, it is necessary to h

two-terminal network whose active resistance varies in proportion to the square of the frequency. If this two-terminal network contains a reactance, in addition to an active resistance, the latter must be independent of the frequency. The article deals with the synthesis of such a network.

Use of the Potential Analogy in the Design of Electric Filters by A. F. Ufel'man. EC 4/58, pp 49-58, 6 figs.

After giving a brief description of the potential-analog method of filter synthesis, the author describes a simple electrolytic trough to facilitate the choice of infinite-damping frequency and the summary attenuation curve of filters with considerable economy in time and labor.

New Circuits of Amplitude Selectors by A. Kornienko. R 5/58, pp 35-38, 4 figs.

Discussion of various modifications of amplitude selectors used in Russian television sets.

On the Design of Coaxial Tank Circuits for Decimeter Wave Amplifiers by V. P. Minashi. EC 4/58, pp 24-29, 9 figs.

Coaxial resonant circuit terminated by capacitances are considered. It is shown that the equivalent impedance of the coaxial tank circuit, terminated by capacitors, for a specified value of Q of the circuit, is greater than that of a tank circuit operating with two high frequency voltage nodes. In this case the resultant dimensions of the resonant circuit become quite suitable for practical application. Such tank circuits find application as plate loads for triode broadband amplifiers in the decimeter range.

Synthesis of Characteristics by V. V. Solomonov. EC 3/58, pp 3-10, 5 figs.

It is frequently necessary in experimental work to modify the amplitude-frequency and phase-frequency characteristics. This calls for laborious computations and experimentation. The article presents the theoretical principles of the construction of devices for a synthesis of characteristics, methods for the synthesis of characteristics, an investigation of the errors, and a brief description of the apparatus for the synthesis of characteristics, constructed in 1955-56 in the laboratory on the development of scientific problems of wire communications, Academy of Sciences, USSR.

Interconnection Between Parameters of a Vacuum Tube and Those of a Transistor by M. G. Margolin. RE 2†b58, pp 79-85, 8 figs.

Although there is a radical difference between the internal physical processes that take place in transistors in vacuum tubes, nevertheless the analysis of the processes connected with the external circuit permits the use of the same equivalent circuit and the same design procedure. The reason for this is that a transistor, like a vacuum tube, can be considered as a current generator. The system used in this article is of the h0parameters.

On the Theory of the Critical Overshoot of Multi-Stage Pulse Amplifiers by V. P. Shasherin. RE 3/58, pp 35-47, 4 figs. 5 tables.

It is shown that the previously formulated theory of the critical overshoot of multi-stage amplifiers is inaccurate, and the necessary corrections to the theory are made.

Automatic Frequency Control Circuit for a Synchronizing Oscillator by I. Yu. Klugman. RE 3/58, pp 48-60, 10 figs.

The article describes the "four diode" circuit, used in most Russian synchronizing oscillators. The stability condition for this circuit is derived and a connection is established between the circuit parameters and the stability conditions. Experimental confirmation of the stability criterion is given. The author also calculates the required parameters necessary to insure stable operation of the circuit for best regulation.

Matrix Method for the Synthesis of Multi-Cycle Relay-Contact Communication and Control Circuits by M. L. Tsetlin and G. S. Eydus. EC 4/58, pp 41-48, 4 figs.

The authors develop briefly the concepts of the matrices of the state of relay-contact circuits and employ this concept for the synthesis of control systems. Several examples of the procedure are given. It is stated that the method is effective for certain applications and can serve as a useful supplement to the standard method of algebraic logic.

RUSSIAN TRANSLATIONS

Self Excitation Conditions and Frequency of Self Oscillations of Junction Transistor Oscillators by P. D. Berestnev. RE 2/58, pp 36-43, 5 figs.

Expressions are derived for the self-excitation conditions and for the self-oscillation frequency for oscillators with transformer, auto transformer, and capacitive feedback. Ideas concerning the choice of elements of the phase-correction network as a function of the transistor parameters and the self-oscillation frequency are discussed. Reference is made to "Small-Signal Parameters for Transistors" by R. F. Pritchard (*Electrical Engineering*, October, 1954).

Graphic Determination of Input Impedance of a Two-Port Network by V. M. Drugov. EC 3/58, pp 49-53, 2 figs.

Description of a method of plotting the curves of the input impedances of two-port networks in the Z plane for changing load impedances within specified limits. Formulas and practical examples are given.

Semiconducotr RC-Oscillators With Phase Shift RE 2/58, pp 44-50, 7 figs.

Formulas are derived for the oscillation frequency and for the gain, without resorting to analogy with vacuum tube circuits. The concept of the coefficient of maximum possible stability is introduced.

Phase Detector for Multiple Frequencies by R. Ya. Berkman. AT 4/58, pp 360-365, 7 figs.

In many circuits the output voltage has a frequency that is a multiple of the excitation-voltage frequency. This is particularly true in magnetic-amplifier circuits. The detection of this output, usually second harmonic, with the aid of phase detectors of the ordinary type usually involves complication of the circuit, for a frequency doubler is required. The differential amplitude voltmeter, frequently used for the same purpose, has poor null stability, a narrow linearity range, and produces low output power. The author has developed a new phase detector circuit, employing nonlinear symmetry resistances.

Method of Analysis of Amplifiers With Distributed Constants by Yu. N. Prozorovskiy. REE 4/58, pp 518-521, 4 figs.

A method is given for the analysis of three types of distributed amplifiers (with grounded cathode, with grounded grids, or with grounded

anodes). The amplifier is considered as a system consisting of a finite number of multi-port networks connected in cascades. See Figs. 1 and 2.

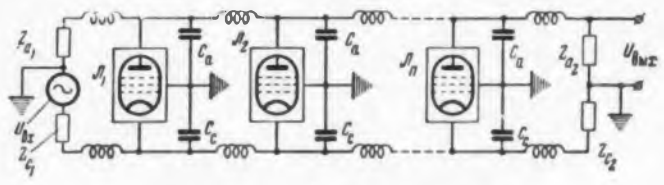


Fig. 1. Distributed amplifier.

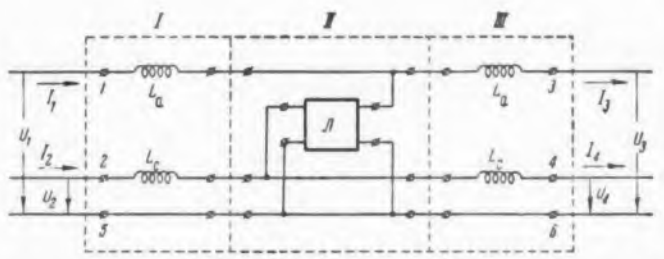


Fig. 2. Section of amplifier in the form of a chain of multi-port networks.

ELECTROMAGNETIC THEORY

Solution of Problems of Electrodynamics from Known Solutions of Corresponding Problems of Electrostatics and Magnetostatics by A. I. Potekhin. REE 5/58, pp 587-591.

A method is proposed for seeking the solution of certain boundary problems in electrodynamics from known solutions of corresponding problems in electrostatics or magnetostatics. The solution is expressed in terms of fractional-order Hankel functions. The method is applicable in those cases, when the dependence of the field intensity on the angular coordinates does not change with frequency.

Calculation of the Induced Magnetic Moment of a Flattened Ferromagnetic Ellipsoid of Rotation in an Alternating Magnetic Field by L. A. Gel'bukh. JTP 3/58, pp 592-598, 2 figs.

An approximate method is used to calculate the magnitude and the phase of the induced magnetic moment on the longitudinal and transverse axes of the ferrite.

WAVEGUIDES

Calculation of Lowest-Mode Critical Wave For Rectangular Waveguides with Longitudinal Rectangular Grooves and Projections. RE 3/58, pp 8-14, 4 figs.

A system of equations is derived, connecting the dimensions of the waveguide cross-section with the critical wavelength. The derivation is made by joining the solutions derived for individual rectangular regions, into which the entire complicated cross-section of the waveguide can be broken up. The author presents, in the form of graphs, certain calculation data on wave-

RUSSIAN TRANSLATIONS

guides with two longitudinal grooves and projections. Some of the calculated data are compared with experiment.

Effect of Asymmetry of Exciting Slit on the Accuracy of a Limiting Attenuator of the Capacitive Type by Ye. S. Zhavoronkova. RE 1/58, 29-39, 11 figs.

The author investigates the effect of mechanical precision with which the exciting slit is manufactured on the accuracy of a model limiting attenuator of the capacitive type. It is demonstrated that the amplitude of the E_{01} wave excited by the slit is independent of the frequency, while the amplitude of a H_{11} wave is proportional to the square of the frequency. The systematic error of the capacitive attenuator of this type, resulting from the excitation of a parasitic H_{11} mode along with the fundamental E_{01} mode, is calculated.

COMMUNICATION SYSTEMS

Radio Relay Communication System "Vesna" With Automatized Repeater Stations by N. I. Kalashnikov. CJ 5/58, pp 4-6.

This radio relay system is intended for communication over lines up to 5000 km. The described version of the system makes it possible to transmit intelligence over three high frequency trunks, to duplex trunks, and a single simplex one. The simplex trunk, serving for the transmission of television, permits reversal, i.e., change in the direction of transmission. This leads to a reduction in the equipment in those cases, when no simultaneous two-way exchange of television programs is necessary. A block diagram and the basic features of the equipment are described.

Reduction of Interference Between Aerial Telephone-Telegraph Lines by Means of Feedback Networks by M. A. Klimov. CJ 2/58, pp 10-12.

The author considers the problem of reducing the interference between aerial telephone-telegraph lines with the aid of feedback circuits. It is indicated that it is possible to employ such networks to reduce interference between steel circuits used in VS-3 carrier systems.

MISCELLANEOUS

Input Impedances of Germanium and Silicon Detectors in the Centimeter Wave Region by N. A. Penin, F. S. Rusin, and N. Ye. Skvortsova. REE 4/58, pp 543-546, 3 figs.

The authors calculated the dependence of the input impedances of germanium and silicon de-

KEY

The sources of the Russian articles and their dates of issue follow the authors' names. Here is the key to the names of the journals in which the articles originally appeared.

AJ	Acoustic Journal *(Akusticheskiy Zhurnal)*
AT	Automation and Telemechanics *(Avtomatika i Telemekhanika)*
CJ	Communications Journal *(Vestnik Svyazi)*
EC	Electrical Communications *(Elektrosvyaz)*
IET	Instruments and Experimental Techniques *(Pribori i Tekhnika Eksperimenta)*
JTP	Journal of Technical Physics *(Zhurnal Tekhnicheskoy Fisiki)*
ME	Measurement Engineering *(Izmeritel'naya Teknika)*
R	Radio
RE	Radio Engineering *(Radiotekhnika)*
REE	Radio Engineering and Electronics *(Radiotekhnika i Elektronika)*

tectors on the positive bias current and on the frequency. The experimental and calculated relations compare well.

Investigation of Ionospheric Irregularities by Radio Astronomical Methods by V. V. Vitkevich. REE 4/58, pp 478-486, 8 figs.

The radiation from radio stars is used to investigate the electronic irregularities in the ionosphere. Data on the irregularities of the vertical ionospheric refraction are used to calculate the dimensions and the electronic concentrations of large-scale irregularities. Data are given on the irregularities in the horizontal radio refraction, and also on electronic irregularities that disturb interference patterns.

Concentrators Used in the Central Telegraph Office of the USSR by M. I. Grebenshchika. CJ 5/58, pp 28-30.

Description of two types of concentrators used in the USSR Central Telegraph Office—key concentrators, and concentrators with use of automatic equipment of subscriber telegraph. The two types are described in detail.

Choice of the Ratios of the Dimensions of the Apertures of the Radiation and the Reflector in a Periscopic System by A. M. Pokras. EC 2/58, pp 20-24, 1 fig, 6 tables.

The periscopic antenna was treated by the same author in the November 1957 issue of *Radiotekhnika*. In this article he treats the best ratio between the dimensions of the antenna elements and shows that it is advisable to use a construction in which the radiator is larger than the reflector.

E. Brenner

Two-Frequency Oscillator

IN AN OSCILLATOR circuit it is possible to choose the reactive elements of the feedback network so that the conditions for oscillation are fulfilled at two frequencies. If the circuit elements are chosen so that the two frequencies involved are (approximately) multiples of each other, then the principles of synchronization can be used for frequency division or frequency multiplication.

A typical two-frequency oscillator is illustrated. A second arrangement is essentially the dual of the circuit shown, in the sense that the parallel resonant circuits are replaced by series resonant circuits. The condition for oscillations requires that the transconductance of the oscillator satisfy the equation

$$g_m = (Z_1 + Z_2 + Z_3)/Z_1 Z_2$$

Choosing $Z_1 = Z_2$, the two radian frequencies at which this condition is fulfilled are given by

$$\omega_1^2 = \frac{a}{2}\left[1 - (1-4b/a^2)^{\frac{1}{2}}\right]$$

$$\omega_2^2 = \frac{a}{2}\left[1 + (1-4b/a^2)^{\frac{1}{2}}\right]$$

where

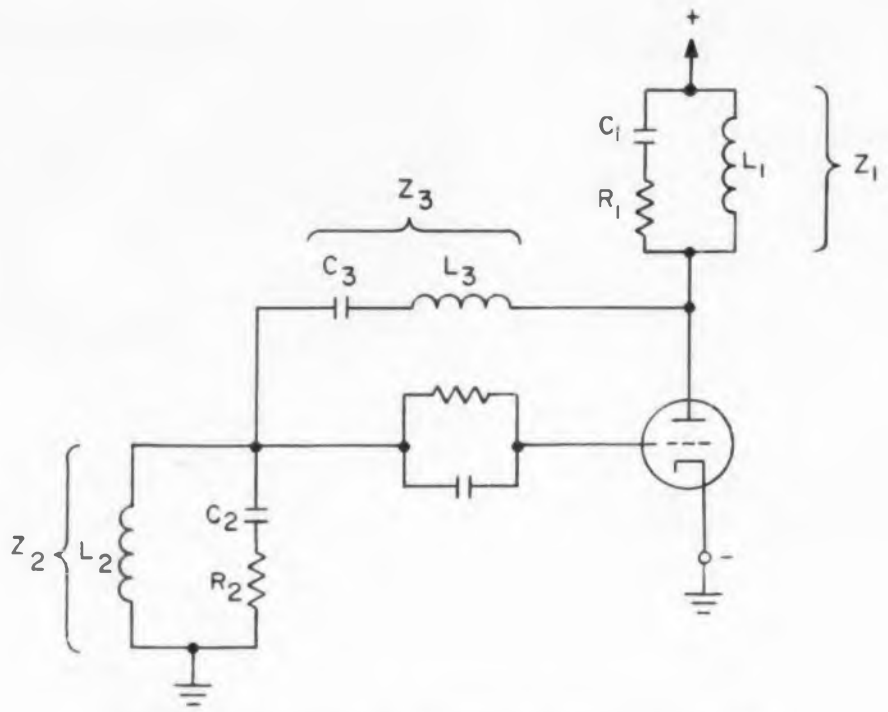
$$a = 1/L_3 C_3 + 1/L_2 C_2 + 2/C_2 L_3$$

and

$$b = 1/L_2 C_2 L_3 C_3$$

These expressions are approximate and are based on the assumption of high Q resonant circuits.

While the circuit can be used either as a frequency multiplier or a frequency divider it appears to be particularly suited for frequency division. A signal whose frequency is to be divided is coupled inductively into the high frequency resonant circuit, i.e., to L_3. Theoretical



Oscillator in which the conditions for oscillations can be fulfilled at two frequencies.

and experimental investigations show that exceedingly low signals are required because of the gain and internal synchronization provided by the circuit. Frequency division down to 100 kc from 0.8-8.0 mc, (i.e. in a ratio from 8 to 80) were possible in an experimental model.

Abstracted from an article by G. Becker, Frequenz, *Vol. 12, No. 14, April 1958, pp 98-103.*

Those Missing Illustrations

TWO GERMAN Abstracts in the November 26 issue were published without illustrations: "Design of Quartz Crystal Oscillators" and "Operating Temperature of Transistors," pp 104-105. The missing illustrations are reproduced below. A cut was left out in the November 12 issue in the article, "High Power Transistor Switches," p. 36, (Fig. 2). This illustration is also included here.

Design of Quartz Crystal Oscillators

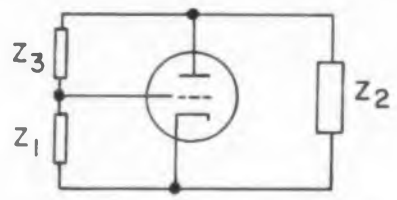


Fig. 1. Schematic of three pole oscillator (supply voltages not shown).

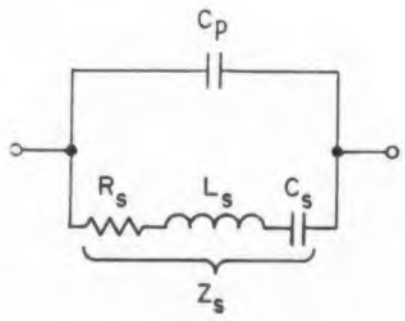


Fig. 2. Equivalent circuit of quartz crystal.

Operating Temperature of Transistors

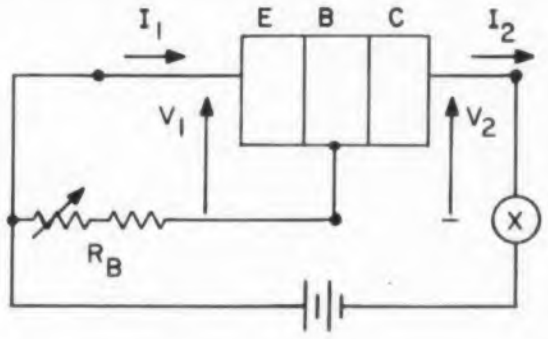


Fig. 1. Basic Circuit

High Power Transistor Switches

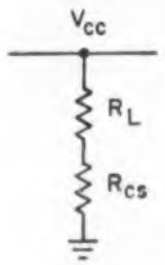


Fig. 2. Equivalent circuit, "on" state of single ended or push-pull transistor switch.

MEETINGS

Calendar of Events

December

18-20 American Physical Society, Los Angeles, Calif.

26-31 Annual Meeting American Assoc. for Advancement of Science, Washington, D. C.

January

12-14 5th National Symposium on Reliability and Quality Control in Electronics, Philadelphia, Pa.

26-29 27th Annual Meeting Institute of Aeronautical Sciences, New York, N.Y.

28-29 1st International Symposium on Nuclear Fuel Elements, New York, N.Y.

February

1- 6 AIEE Winter Meeting, New York, N.Y.

12-13 1959 Solid State Circuits Conference, Philadelphia, Pa.*

March

3- 5 Western Joint Computer Conference, San Francisco, Calif.

5- 6 Flight Propulsion Meeting, Cleveland, Ohio

17-21 8th Electrical Engineers' Exhibition, London

23-26 IRE National Convention, New York, N.Y.

26 15th Annual Quality Control Clinic, Rochester, N.Y.

31-Apr. 2 21st American Power Conference, Chicago, Ill.

31-Apr. 2 Symposium on Millimeter Waves, New York, N.Y.*

April

5-10 5th Nuclear Congress, Institute of the Aeronautical Sciences, Cleveland, Ohio

6- 8 3rd Annual Astronautics Symposium, Air Force Office Scientific Research, Washington, D. C.

6- 9 16th Annual Radio Component Show, London

16-18 SW IRE Regional Conf. and Elec. Show, Dallas, Tex.

20-21 New Techniques in Elec. Industrial Instrumentation, Philadelphia, Pa.

*Indicates meetings described below.

1959 Solid State Circuits Conference, Feb. 12-13

Philadelphia, Pa. Sponsored by IRE, AIEE, and Univ. of Pennsylvania. Devoted to transistor circuit technology, applications, and circuit technology, applications, and circuit techniques of a variety of solid state devices.

Symposium on Millimeter Waves, March 31-April 2

Engineering Societies Bldg., New York, N.Y. This is the ninth international symposium of the

Newest Tops in "Top Hat" Coil Forms

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Polytechnic Institute of Brooklyn, Microwave Research Institute under the co-sponsorship of the Air Force Office of Scientific Research, U.S. Army Signal Research and Development Laboratory, Office of Naval Research, and the IRE. Intended to highlight the present state of research in, and applications of, millimeter wave technology, the program will be devoted to the following topics: Interaction of millimeter waves and materials; Solid state active millimeter circuits; Millimeter electron tubes; Radiating circuits and antennas; Coupled line, multimode, and non-convention transmission systems; Millimeter components; Millimeter circuit measurement techniques.

Paper Deadlines

December 22: Deadline for receipt, in triplicate, of a detailed 750-word summary of papers for presentation at the **International Symposium on Circuit and Information Theory** to be held at the University of California at Los Angeles on June 16-18, 1959. All correspondence should be addressed to *Dr. G. L. Turin, Hughes Research Laboratories, Culver City, Calif.*

Jan. 30: Closing date for submission of papers and/or 100 word abstracts treating the generation, transmission, control, measurement, and detection of millimeter wave energy for presentation at the **Symposium on Millimeter Waves** to be held in New York, March 31-April 2. Address correspondence to *Professor Herbert J. Carlin, Polytechnic Institute of Brooklyn, Microwave Research Institute, 55 Johnson St., Brooklyn 1, N.Y.*

Feb. 15: Final deadline for contributors desiring to present papers at **Fifth Annual Symposium on Instrumental Methods of Analysis** to be sponsored by ISA in Houston, Texas on May 18-20. Theme of the Symposium: New Techniques in Analytical Instrumentation for Laboratories and for Processing Plants. Prospective contributors should send title, authors, and three copies of a 100-word abstract to *M. D. Weiss, Program Chairman, Special Instrumentation Div., Union Carbon Olefins Co., South Charleston, W. Va.*

Seminars

Jan. 13: Clear Technical Writing. Hotel Sheraton-West, Los Angeles, Calif. Jan. 15: Hotel Sheraton-Palace, San Francisco, Calif. Conducted by Robert Gunning, authority on writing and readability techniques. Further information and Seminar schedules may be obtained by writing *Industrial Education Institute, 25 Huntington Ave., Boston 16, Mass.*

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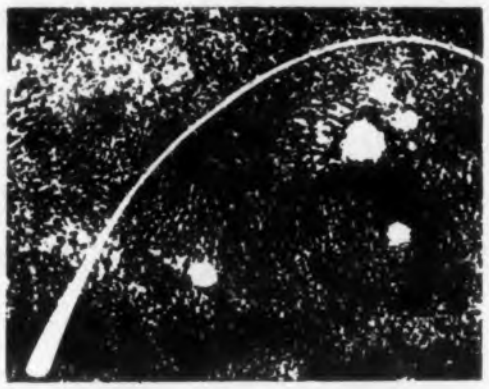

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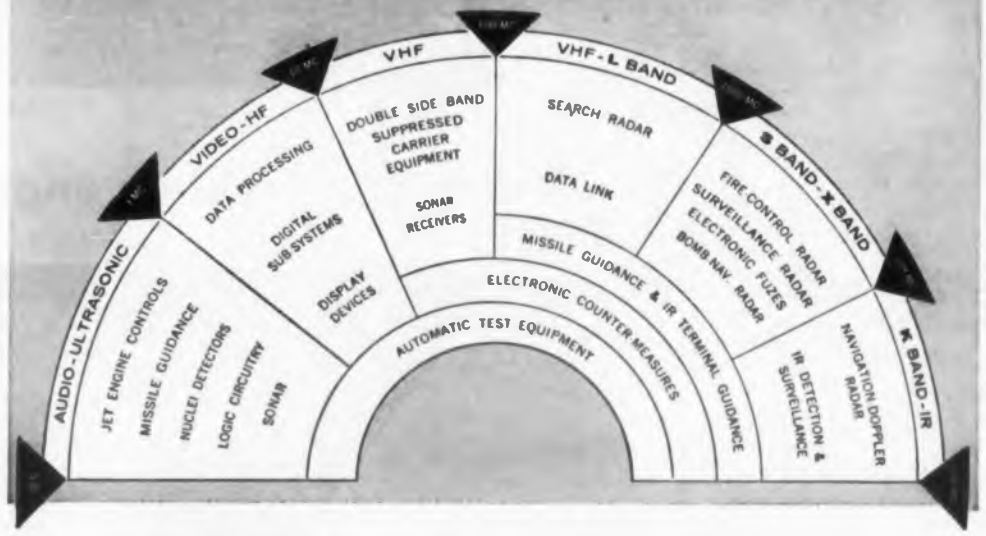

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CAREERS

ADVERTISERS' INDEX
December 10, 1958

Continued on page 174

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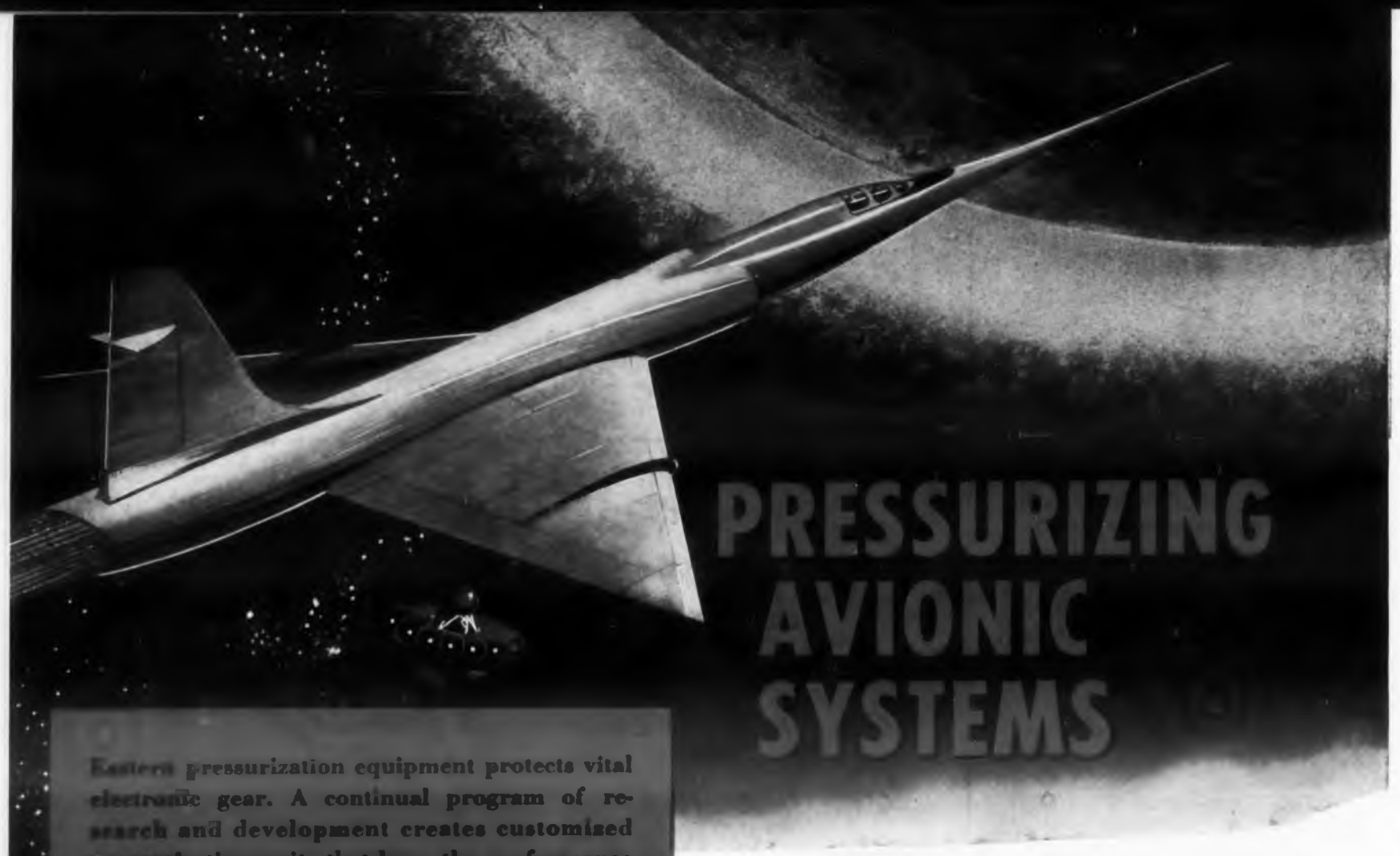

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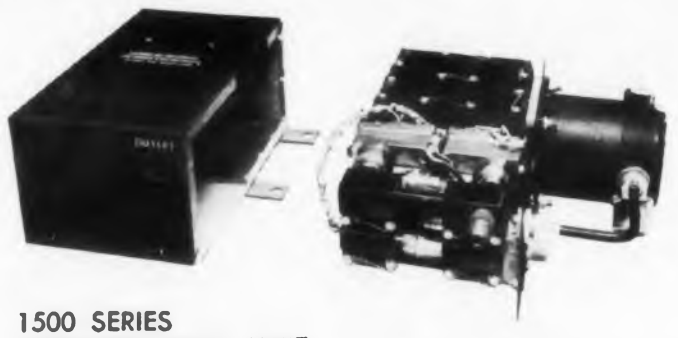

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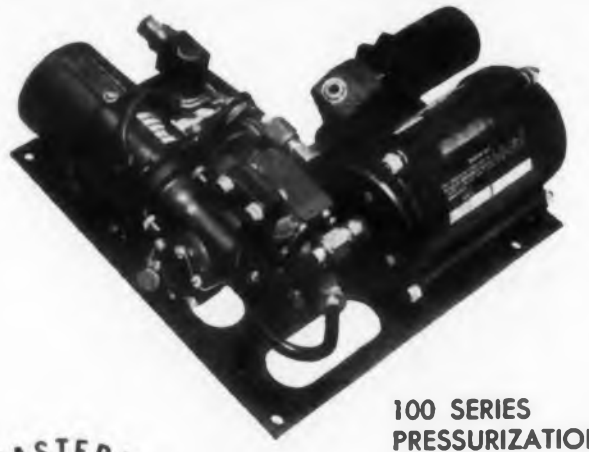

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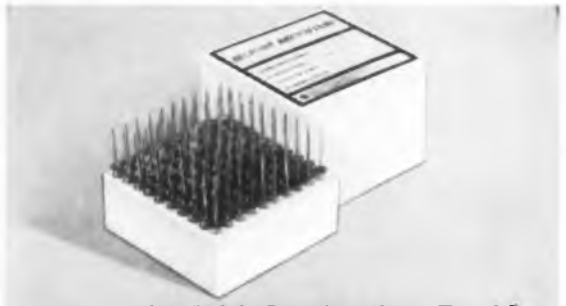

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