ELECTRONIC INDUSTRIES

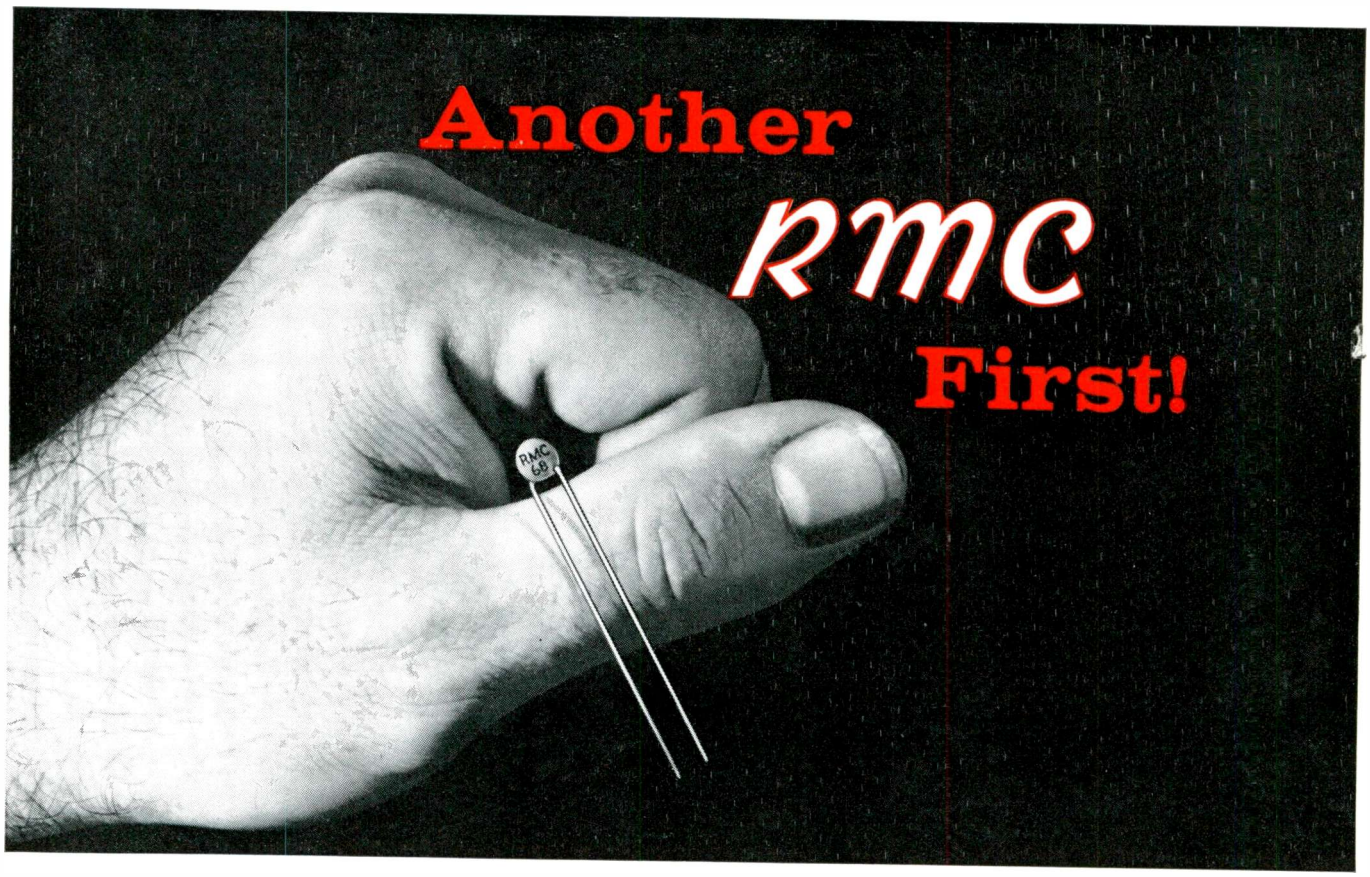
A CHILTON PUBLICATION

"ANALYZING RELAY DYNAMIC CHARACTERISTICS"

— page 70

- Electronic Hardware — II: Fasteners
- Heat Sinks For Power Transistors

September
1959



SUBMINIATURE TEMPERATURE COMPENSATING DISCAPS

SPECIFICATIONS

POWER FACTOR: Over 10 MMF less than .1% at 1 megacycle. Under 10 MMF less than .2% at 1 megacycle.

WORKING VOLTAGE: 500 V.D.C.

TEST VOLTAGE (FLASH): 1250 V.D.C.

CODING: Capacity, tolerance and TC stamped on disc

INSULATION: Durez phenolic-vacuum waxed

INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms

AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms

LEADS: No. 22 tinned copper (.026 dia.)

TOLERANCES: ±5% ±10% ±20%

The capacity of these capacitors will not change under voltage.

T. C. TOLERANCES:

Capacity MMFD.	NOP	N75	N150	N220	N330	N470	N750	N1500	N2200
1.5 to 9	±120	±120	±120	±120	±120	±120	±120	±250	±500
10 to 68	±60	±60	±60	±60	±120	±120	±120	±250	±500

Modern electronic design demands miniaturization of all component parts but it is axiomatic that small size is difficult to achieve and still maintain performance characteristics.

RMC has now incorporated the features of the Type C temperature compensating DISCAPS in a subminiature size. The maximum diameter of the disc is only .235 and these new subminiatures are available in the following TC values and capacities:

NPO	1.5-13
N- 75	3-13
N- 150	3-15
N- 220	3-15
N- 330	3-15
N- 470	3-20
N- 750	3.6-24
N-1500	10-51
N-2200	20-68

Now you can depend on RMC for your requirements for subminiature temperature compensating capacitors.

DISCAP CERAMIC CAPACITORS

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RADIO MATERIALS COMPANY
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GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
Two RMC Plants Devoted Exclusively to Ceramic Capacitors
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ELECTRONIC INDUSTRIES

ROBERT E. McKENNA, Publisher • BERNARD F. OSBAHR, Editor

Three Regional Shows

Several years ago, in August and again in October 1955 to be exact, we commented on the desirability of having three regional conventions. We suggested the March IRE National Convention in New York as one, the August WESCON activity on the West Coast as a second. We picked the National Electronic Conference held in Chicago in October as a logical third.

Since our original suggestion, both the Eastern and Western shows have demonstrated growth patterns that are in keeping with overall industry growth. The midwest conference, however, has failed to blossom forth. Why should this be? Well for one thing the conference ran into some competition with the newly established Canadian annual IRE show. There are also several other "splinter-type" conventions in other mid-west areas. Then, too, perhaps past NEC conferences have lacked that "professional spark" because until recently it has been a committee-type operation that involved new appointments annually. Also, its exhibit area has not been comparable to the other larger shows.

We are gratified to see the new efforts being made this year to spur interest in this regional event and we hope to witness future NEC growth on a par with the other two "main" events. Three overall regional electronic shows can effect important industry economics to attendees and exhibitors alike. They should also do a better job of disseminating technical information because more of the industry principals and personalities would attend the broader base shows. In next month's issue, October, we'll be telling you more about this year's NEC Conference which we hope will be the forerunner to our original idea and suggestion.

We'd Like to See . . .

More of a marriage between Educational TV and municipal and state sponsorship or ownership. In recent months much has been written on the relative merits of free vs. paid TV. Not much has been said about educational TV and the great possibilities it offers as public services. In the days of "radio" municipality or civic-sponsored stations met with some success. If similar support could be extended to areas now having educational TV outlets, many benefits would be obtained.

For one thing, the public could be made more civic-minded through local programs of a type that are not available on commercial outlets. They could be made more conscious of state and civic problems through interstate networking. They might come closer to understanding how all various departments of the national government functions through "national" educational networking. Civic-sponsored educational-TV would permit many of the lesser known government officials and agencies to get their message to the public. At election time we could get more of a first hand picture of who's who and doing what.

It seems to us that Commercial-TV is providing essentially what the mass of the public seems to want by way of entertainment. Add pay-TV and we add "more-select" entertainment. This medium, however, would largely have to parallel the commercial TV programming roads too, in order to stay alive economically. Educational TV, coupled with civic financial support or ownership, could offer on both local and on a national basis the programming of depth and broadened dimensions that many people seek.

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ELECTRONIC INDUSTRIES

Vol. 18, No. 9 **September, 1959**

MONTHLY NEWS ROUND-UP

NEW PRODUCTS & TECH DATA

DEPARTMENTS

Highlights

Of This Issue

Analyzing the Dynamic Characteristics of Relays page 70

Though little has been written about them, the dynamic characteristics of an electromagnetic relay are most significant in deciding where and how a specific relay should be applied. The dynamic characteristics of a relay describe its behaviour during the transient time, when the armature moves and contacts are opened or closed.

Cooling Power Transistors page 77

The present mounting methods used for power transistors can be broken down into three classes: plate heat sink, cold plate and baffling. This article compares them and goes on to describe five mounting methods for future electronic equipment that are suitable for all silicon type power transistors.

Designing a Video Amplifier with 30 MC Bandwith page 86

A design procedure for common-emitter video amplifiers requiring a very high bandwith is presented. Grown-diffused germanium tetrode transistors are used in the amplifier section. The procedure applies to certain other types of high frequency transistors such as the graded or diffused base types.

Flip-Flop Circuits Using Saturated Transistors page 88

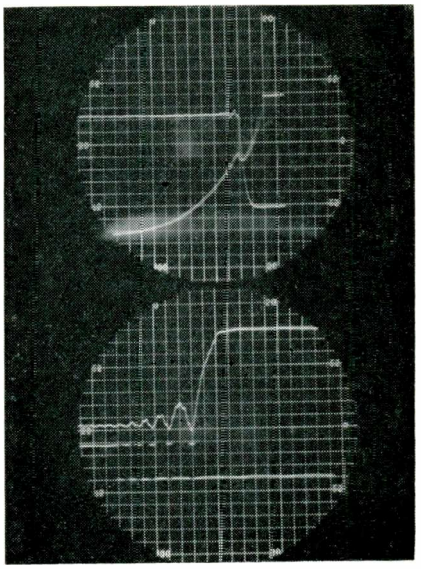
Several methods have been used to design bistable flip-flop circuits using transistors as saturated switches. The method presented here separates the design into a steady-state solution and a transient solution, with the steady-state solution subdivided into the ON state and the OFF state for each transistor.

Shrinking the Directional Coupler page 91

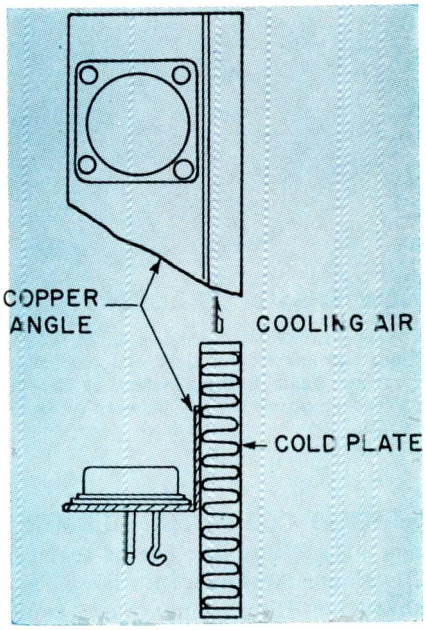
A new directional coupler configuration adapted to shielded stripline construction is described, in which significant size reduction has been achieved. Design data and performance curves illustrate how the design lends itself to broadbanding. A secondary feature is the property of coupling variation simply by dielectric shim substitution.

Electronic Hardware Chart—II: Fasteners page 102

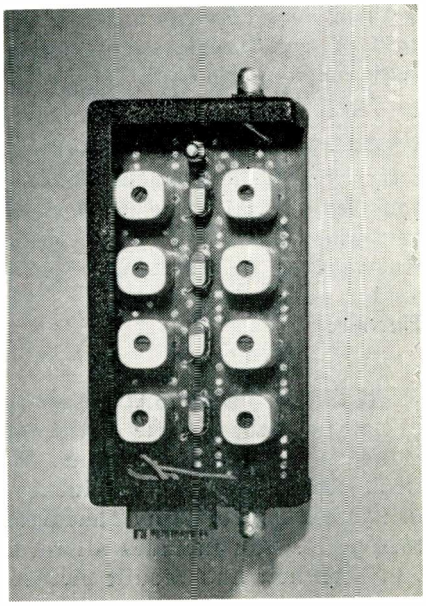
Second in the series that began in last month's Electronic Industries: The first installment covered male-threaded fasteners; this second part of the series covers female-threaded fasteners. This study is the most exhaustive survey of electronic hardware ever conducted.



Dynamics of Relays!

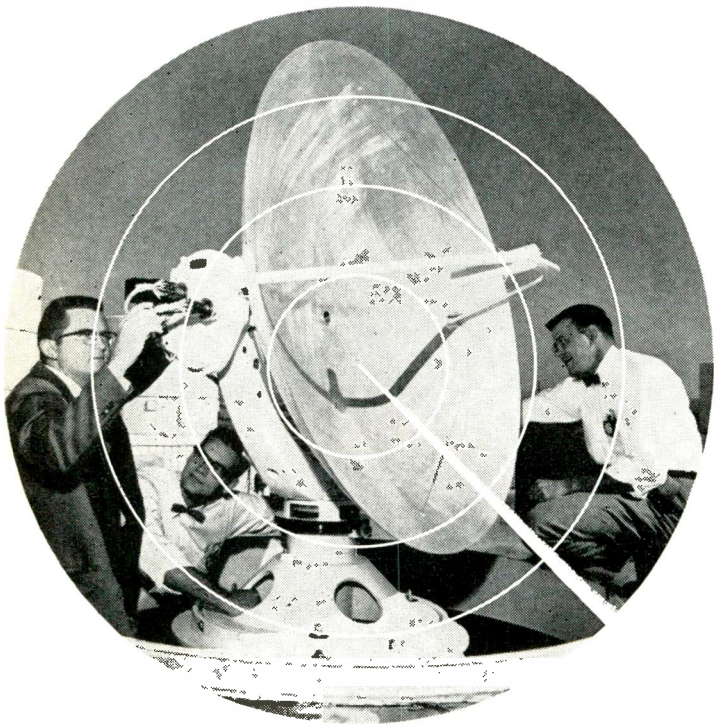


Cooling Power Transistors



Wideband Video Amplifier

RADARSCOPE



NEW MISSILE TRACKERS

Convair-Astronautics engineers C. M. Hay, J. Moody and R. Christy check out one of the eight new parabolic antennas to be installed in a new Azusa tracking system, at Cape Canaveral, Fla. The 4-ft. parabolics transmit signals between airborne missiles and the ground station.

NEWEST COMPUTER ELEMENT, called "Biax," is a small rectangular bar of ferrite magnetic material. Developer Aeronutronic Div., Ford Motor Co., claims that 3,000 Biax elements can replace 12,000 to 15,000 semiconductors in a computer. They operate from 30°F. to over 260°F. Biax elements have been interrogated over 100 billion times at a 10 megacycle rate with no loss of output signal. The basic concept is that of flux interference between orthogonal magnetic fields or two fields at right angles to each other.

USSR-WESTERN EUROPE TV LINK may be a reality by 1962. Red officials have expressed the hope that the coaxial cable network now being installed to connect Hungary, Poland and East Germany with Russia may be eventually tied in with the Eurovision system of television that services all of Europe.

ELECTRON TUBE SALES are expected to top $1 billion by 1965, in spite of the rapid advances being made by semiconductors. W. Walter Watts, RCA Group Executive Vice President, foresees tube sales of 930 million for 1960. That figure is based on factory prices and includes all receiving, transmitting and both new and rebuilt picture tubes.

THE FAA is considering a rule that would require all passenger carrying air transport aircraft to be equipped with weather radar. The excellent safety record of air carriers having weather radar has emphasized the effective role that radar can play in increasing air safety.

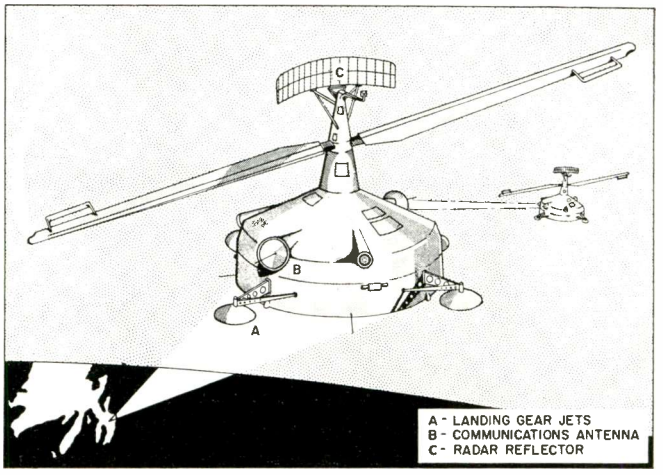
RADIO IMPORTS from Japan are accounting for about 85% of the total dollar buying of Japanese exports to U. S. For the first four months of 1959, Japanese electronic equipment totaled $11.4 million factory price. This is more than half as much as the entire 1958 volume and nearly four times the volume for the same period of 1958.

TV TAPE RECORDING will greatly increase its flexibility through a new "picture freezer" introduced by Hughes Aircraft at WESCON. When hooked into TV monitor circuit, the new device will halt the picture, and hold it for as long as 10 minutes.

IMPORTANT STEP toward standardizing FM stereocasting was taken last month by the National Stereophonic Radio Committee (NSRC). It agreed to narrow technical considerations to three types of stereo broadcast transmission systems: systems using a frequency modulated subcarrier; those having an amplitude modulated subcarrier to the main FM carrier; and the third is a foreign import—the British EMI Percival system which offers some significant electrical advantages but which will yet have to prove its worth in performance tests.

SPACE PLATFORM

This artist's conception shows construction of the space platform being designed by Raytheon for the military. It will function as a radar or TV relay station suspended high in the sky and powered by helicopter-type rotors. Power for the unit will be beamed from the ground by high power microwave stations. Microwaves will be turned to heat, and heat to steam.



Photo—Aircraft and Missiles Manufacturing

DETONATING ENEMY MISSILE warheads by extremely high power microwave radiation is being investigated by Varo Manufacturing Co. under an Air Force contract. The Air Force believes it may be possible to destroy the missiles over distances of 1000 miles or more.

NEW CRT's IN SIGHT include square 19 in. tube which would replace the 18 in. square tube. It is now being sampled to manufacturers. Glass bulb manufacturers are also looking to build a number of other sizes and shapes.

COLOR TV PEOPLE are particularly optimistic as the Fall buying season nears. Backed up for the first time by a really significant effort from another major TV manufacturer—Admiral—RCA executives expect color sales this Fall to exceed last year's by 250% to 300%.

AUTOMATIC TRANSISTOR PRODUCTION is a great step closer through research at Westinghouse in constructing long ribbons of semiconductor devices by forming them along the surface of long, thin crystals of germanium. The crystals are only a fraction of an inch wide and a few thousandths of an inch thick. The technique was developed under the $2 million "molecular electronics" contract awarded to Westinghouse by the Air Force.

NEW SILICON POWER TRANSISTOR capable of delivering 5 watts power at 30 MC was introduced at WESCON by Pacific Semiconductors Inc.

"IT'S YOUR PROBLEM" was the answer that Commerce Dept. reportedly gave to electronic industry officials' plea for protection against foreign imports. The answer, not unexpected, makes it clear that industry must adopt its own methods of meeting the challenge. Three are being mentioned. Already in the wind, and likely to get strong labor backing, is a "buy American" campaign. Another would require any product containing foreign parts to indicate this fact legibly on the cabinet. Whether either program will gain any support is questionable. Component manufacturers are happily totaling up record profits, in spite of the inroads made by foreign imports, so it is unlikely that very much steam can can be put into a program aimed at staving off trouble unlikely to reach really serious proportions for 5 to 10 years. Most likely reaction to the threat will be a very accelerated move to automation, in every phase of manufacturing possible. But here manufacturers will have to face the opposition of the labor unions.

STEEL STRIKE should not bother consumer electronic industry too much, unless it stretches out more than 7-8 weeks.

NASA, since its formation in October 1958, has let R&D contracts amounting to $183 million. More than 75% went to the aerospace industry.

LOOK FOR a scramble by American companies for licensing and distribution arrangements with foreign manufacturers, on a reciprocal basis. Advantages are two-fold: the U. S. firm gets a cut of the profits from imports; at the same time his foreign distribution and sales are facilitated in foreign countries. Example: CBS Electronics and Ronette of Amsterdam, Holland, last month swapped licensing and distribution rights for Ronette line of phono-cartridges and microphones against the Columbia CD phono-cartridge, in their respective areas.

PADDLEWHEEL SATELLITE

Explorer VI gets last minute check before launching at Atlantic Missile Range. Shown is the satellite package which the big Thor-Able rocket boosted into earth-girdling orbit. Panels folded down to sides are the banks of silicon solar cells.

SPRAGUE® RELIABILITY in these two dependable wirewound resistors

MINIATURE

Blue Jacket®

VITREOUS-ENAMEL POWER RESISTORS

Sprague's new improved construction gives even greater reliability and higher wattage ratings to famous Blue Jacket miniature axial lead resistors.

A look at the small *actual sizes* illustrated, emphasizes how ideal they are for use in miniature electronic equipment with either conventional wiring or printed wiring boards.

Get complete data on these dependable minified resistors, **write for Engineering Bulletin 7410.**

TAB-TYPE BLUE JACKETS: For industrial applications, a wide selection of wattage ratings from 5 to 218 watts are available in Sprague's famous Tab-Type Blue Jacket close-tolerance, power-type wirewound resistors. Ideal for use in radio transmitters, electronic and industrial equipment, etc. **For complete data, send for Engineering Bulletin 7400A.**

NEW SMALLER SIZE

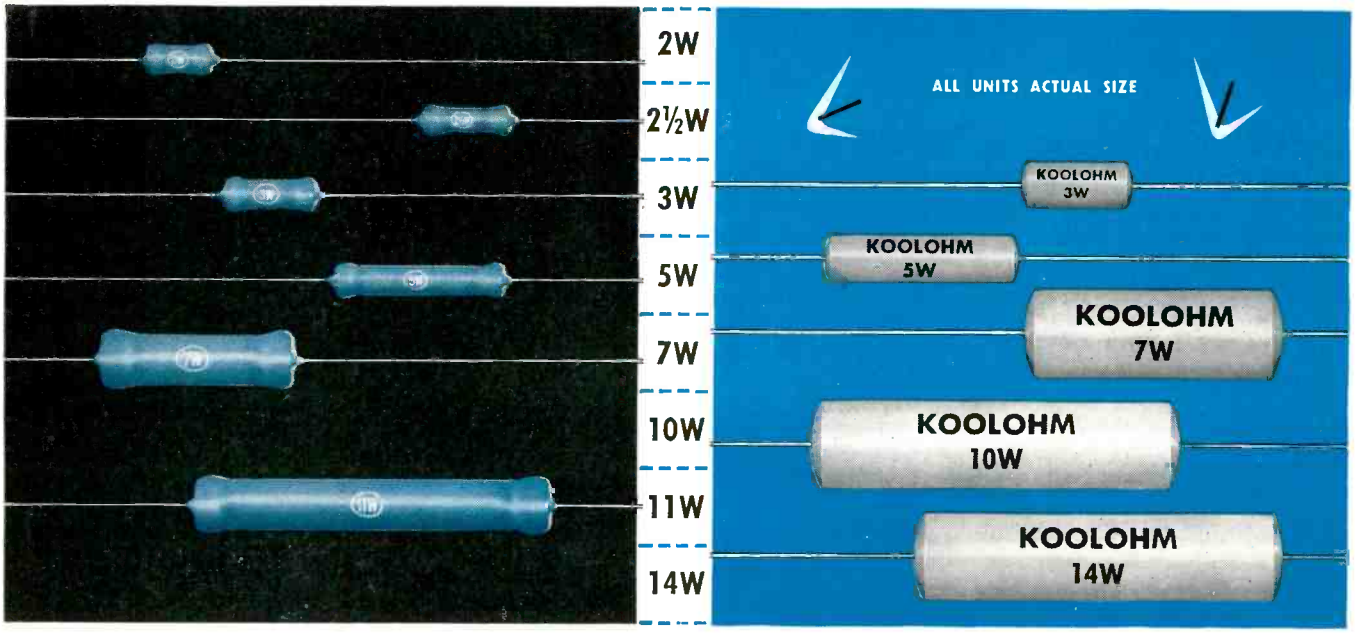
KOOLOHM®

INSULATED-SHELL POWER RESISTORS

New Koolohm construction features include welded leads and winding terminations—Ceron ceramic-insulated resistance wire, wound on special ceramic core—multi-layer non-inductive windings or high resistance value conventional windings—sealed, insulated, non-porous ceramic outer shells—*aged-on-load* to stabilize resistance value.

You can depend upon them to carry maximum rated load for any given physical size.

Send for Engineering Bulletin 7300 for complete technical data.



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As We Go To Press...

"5,000-Mi. Radar" From Ionospheric Bending

A method of detecting guided missiles by their trails of ionized gas has been developed by an Office of Naval Research team under Dr. William J. Thaler.

The technique has been developed from two comparatively recent discoveries. One is the phenomena of ionospheric bending, in which r-f waves aimed at certain angles to the ionosphere cover great distances by bouncing repeatedly from the ionosphere to earth and back again.

The other discovery, originally by Stanford University, was that ionized meteor trails are effective reflectors of r-f energy.

Dr. Thaler and his team, organized as Project Teepee (reportedly Thaler's Project) combined these techniques into the "Ionospheric Back Shatter Radar."

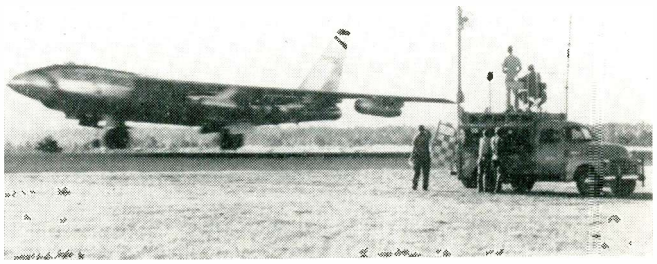
R-F waves on frequencies between 5 MC and 30 MC are beamed at the ionosphere. The waves bounce back to earth and again are reflected toward the ionosphere, and the process is repeated until the wave is interrupted by an object which will give a "return."

Ground equipment shows on a 'scope face how many times the r-f wave has been reflected, so that distance can be computed.

As to results, Dr. Thaler reports, "Using breadboard equipment, promising results have been obtained over long ranges. We are confident that a system capable of reliable detection over intercontinental ranges is feasible."

HANDS-OFF

Air Force and Lockheed technicians ease giant B-47 Stratojet to smooth landing by remote control from truck in foreground at Eglin AFB, Florida. Drone version of bomber will be used as target for missiles.



Vacuum Tube Cathodes of Semiconductors?

The possibility that electrons flow can be induced in an electron tube without the power-consuming function of heating the cathode has been raised by Westinghouse research scientists.

Physicists have recently discovered how to obtain a constant flow of electrons directly out of the surface of certain semiconductor materials.

The latest semiconductor to yield this unique flow of electrons, two Westinghouse research physicists report, is silicon carbide. The density of the electron flow, they find, is equal to that in the average electronic tube of today.

Dr. Clarence Zener, director of Westinghouse research, said, "By removing the most serious limitation of the ordinary electronic tube, this discovery in semiconductors may bring a new lease on life to the very device which semiconductors seem destined to outmode.

"One can visualize a tube in which the usual heated cathode is replaced by a small semiconductor crystal having a built-in 'junction' like that in a transistor. The crystal would consume a negligible amount of power and would yield electrons instantly and indefinitely when a small electric voltage is applied across it.

"Such a device would, in effect, combine into a single operating unit many of the inherent advantages of both semiconductors and vacuum tubes. It would result in what one might call a 'solid state' electronic tube."

First "Value Analysis" Contract Let By Navy

Westinghouse Electric Corp. last month received the first Navy Bureau of Aeronautic development contract calling for "value analysis." The $508,190 contract is for development of airborne radar target simulators.

Under a newly formed Value Analysis Committee the development contract will come under continuing scrutiny to assure the Navy that it is getting the greatest possible value for the defense dollar.

More News on Page 8

Field Tactical Air Defense System Goes Overseas

AN/MSQ-18 tactical air defense system now being deployed overseas was designed by Hughes Aircraft Co. to give field commanders immediate control over AA missile batteries. Complete system mounts in 5 2½-ton trucks. By automatic plotting the time for pinpointing targets is reduced from minutes to split seconds.

ELECTRONIC SHORTS

▶ A $1,920,000 contract has been awarded Ryan Aeronautical Company's Electronic Div. by the U. S. Navy for additional spare parts and other support equipment for the Model APN-122 (V) Doppler Radar Navigator. The system automatically computes and displays ground speed and drift angle without the aid of ground stations, wind estimates or true air-speed data.

▶ Florida Div., Radiation Inc., has received a contract from the Boeing Airplane Co., Seattle, for telemetry equipment for the Minuteman Missile Program. The contract is for the ground portion of the PCM/FM telemetry equipment for the Minuteman ICBM. This contract, plus a recently awarded airborne portion, places with Radiation the entire PCM Telemetry responsibility for the Minuteman. Total amt. of both contracts is $5,900,000.

▶ A dish antenna as tall as a 15-story building will soon appear on the Stanford University campus. It will be a "radar telescope" with a parabolic reflector 142 ft. in dia. When completed in about a year, the big dish will be America's largest and the world's second largest. A 20-60 MC radio transmitter, requiring a 1,000,000 w power supply, will be installed with the dish.

▶ The University of Michigan Research Institute has announced a program aimed at the development of a high altitude sounding rocket. The project under the direction of L. M. Jones and W. Spencer, is covered by a $75,000 budget with funds from Ballistic Research Laboratory.

▶ A study program to identify new approaches to anti-missile defense during the next two decades has been established by the Advanced Research Projects Agency of the Dept. of Defense. The Program known as GLIPAR —Guide Line Identification Program for Anti-Missile Research—is to identify any unorthodox approaches to ballistic missile defense which might provide a very high capability over the next 20 years. Twelve contracts totalling $1.5 million for the initial phase of GLIPAR will be let by the Office of Naval Research acting on behalf of ARPA.

▶ Dept. of Defense has awarded three contracts for the design and development of a delayed-relay communications satellite, to be known as PROJECT COURIER. Firing of a satellite to test the capability of PROJECT COURIER is expected to take place within a year and at a relatively low orbit of 500 miles. The contracts are: Philco Corp., Phila., Pa., $3,614,415; (communications package); International Telephone and Telegraph Co., Nutley, N. J., $4,046,119 (ground-based communications stations); and Radiation Inc., Melbourne, Fla., $1,283,740 (ground-based antennas).

▶ Electrical power for the heavily-instrumented Explorer VI "paddle-wheel" satellite, shot into orbit recently is being provided by solar energy converters. The converters developed by Hoffman Electronics Corp., Los Angeles, consists of 21,000 silicon solar cells. Fifty cells will produce about ¾ watt under direct sunlight.

▶ Sperry Gyroscope Co., Great Neck, N. Y., has revealed that it has been working for 2 years on the development of a high-powered target tracking radar transmitter for the Nike-Zeus anti-missile system. The radar is used for tracking an incoming missile to obtain data for directing the Nike-Zeus missile against the target. Work is being done under a $4,000,000 contract from Bell Telephone Laboratories.

▶ Minneapolis-Honeywell is building a space capsule to simulate living conditions on man's first extended trip into outer space. Designed for two astronauts for a period of 30 days, it will be used for research by the Dept. of Astroecology of the Air Force School of Aviation Medicine at Brooks Air Force Base, Texas.

▶ Consolidated Systems Corp., a wholly-owned subsidiary of Consolidated Electrodynamics Corp., has received a $98,600 contract from the Goddard Space Flight Center of the National Aeronautics and Space Administration for development of miniature mass spectrometers that will be placed in orbit within a satellite in 1961 to analyze and measure the elements of the exosphere, the region of the atmosphere 150 to 600 miles above the earth.

As We Go To Press (cont.)

High Resolution Tube Spots Close Targets

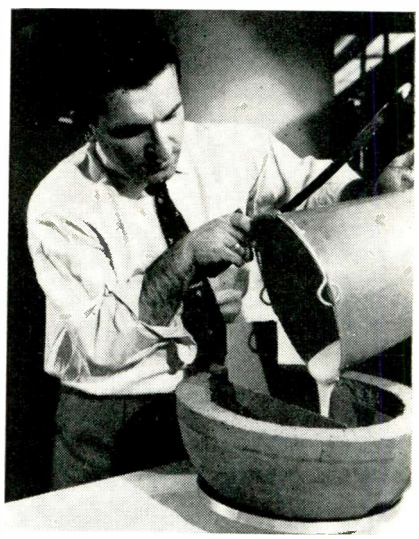
A new display storage tube, reportedly providing twice the resolution capability of similar display tubes, has been developed by the RCA Electron Tube Division for use in radar and specialized television applications.

When used as a radar indicator, the tube is capable of distinguishing between two closely spaced targets. Previous display storage tubes would often make two such targets appear as one object.

The new tube is capable of resolving more than 800 TV lines per display diameter of 3.8 in. when operated at a display or picture brightness of approximately 100 ft.-lamberts. This brightness is adequate for viewing in a well lighted room without a light shield.

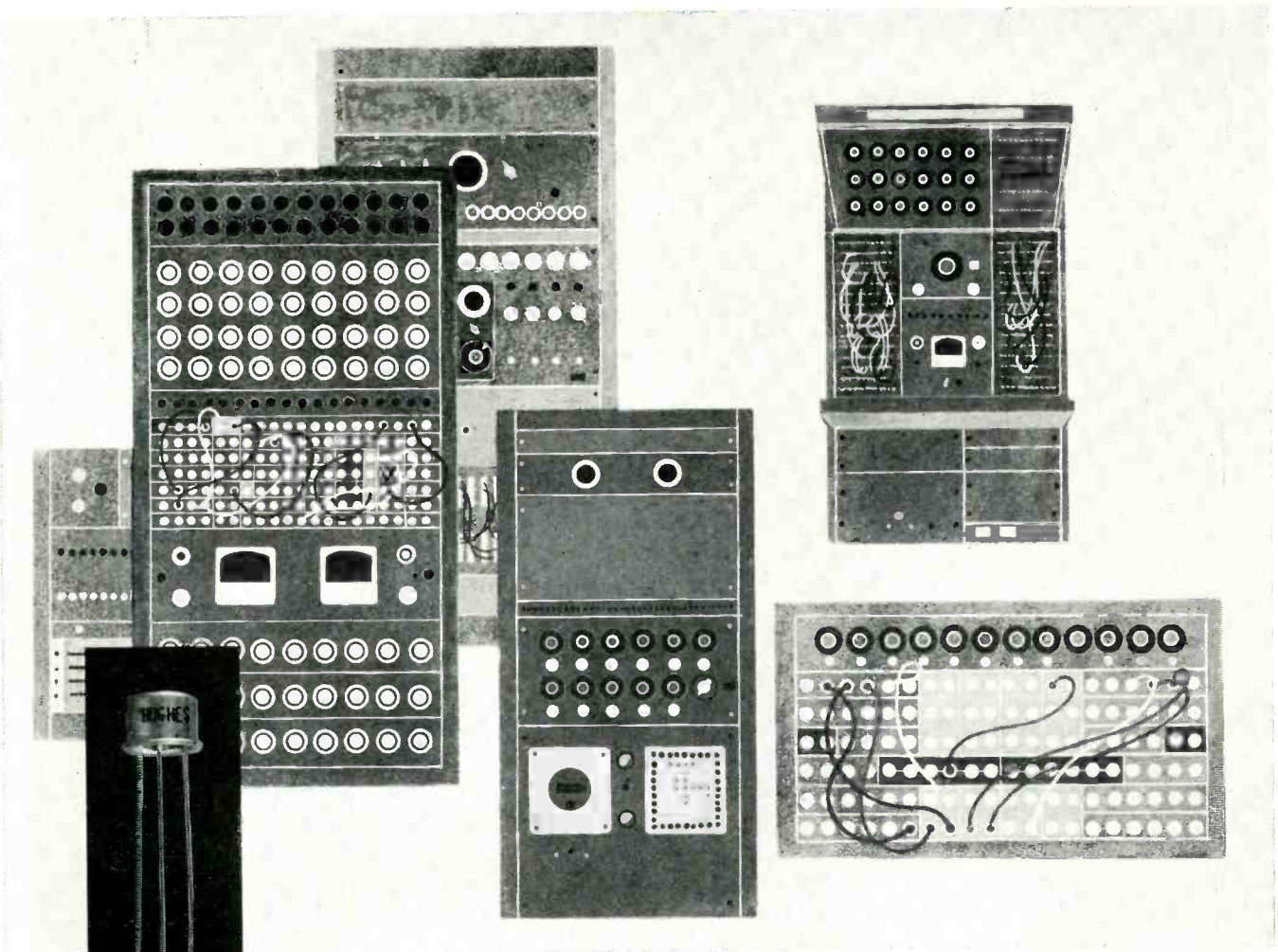
The tube can be utilized in electronic equipment for long-range radar display and airport surveillance radar. In addition, it can be employed for data transmission including half-tones and for specialized television applications involving narrow bandwidth transmission over telephone lines.

HIGH-RISING MIX



Mixture being poured by G. E. Technician will become a buoyant plastic foam capsule containing space-information gathering devices in missile nose cones. Capsule is ejected just before impact, floats until recovery.

More News
On Page 17



HIGH-SPEED COMPUTER SWITCHING TRANSISTORS

SILICON DDMT—Double Diffused Mesa Transistor . . . now available from Hughes to solve your high-speed switching problems. This new silicon PNP transistor, which operates at low and medium current levels, gives you a cut-off frequency greater than 50 megacycles. In addition, Beta—as a function of collector current—is flat over 80 per cent of the operating range.

Two other advantages: 1. This Hughes transistor offers you all the desirable characteristics inherent in the solid state diffusion technique. 2. The tiny flexible leads of its gold plated package may be soldered directly into circuits or used with standard plug-in sockets.

This new device, while designed primarily for computers, is also an excellent amplifier and oscillator, lending itself to an unusually broad range of applications.

As in all Hughes semiconductor devices, reliability has been specifically designed into this mesa transistor. They are manufactured in the new multi-million dollar Hughes Semiconductor facility . . . using the finest equipment and newest techniques.

Your inquiry regarding these transistors will be given prompt attention. Just write or call the Hughes sales office nearest you. They are located in:

Boston, *4 Federal Street; Woburn, Mass.; WElls 3-4824*
Minneapolis, *6121 Excelsior; Minneapolis 16, Minn.; WEst 9-0461*
Newark, *80 Mulberry Street; Newark 2, N. J.; MArket 3-3520*
San Francisco, *535 Middlefield Road; Palo Alto, Calif.; DA 6-7780*
Syracuse, *224 Harrison Street; Syracuse 2, N. Y.; GRanite 1-0163*
Chicago, *1515 N. Harlem Ave.; Oak Park, Ill.; NAtional 2-0283*
Cincinnati, *816 Swifton Center; Cincinnati, Ohio; ELmhurst 1-5665*
Philadelphia, *1 Bala Avenue; Bala-Cynwyd, Penn.; MOhawk 4-8365*
Los Angeles, *690 N. Sepulveda; El Segundo, Calif.; OR 8-6125*

Or write, Hughes Products, Marketing Department,
SEMICONDUCTOR DIVISION, NEWPORT BEACH, CALIFORNIA.
For export, write: Hughes International, Culver City, Calif.

SPECIFICATIONS: Absolute Maximum Ratings (25°C)

	2N1254	2N1255	2N1256	2N1257	2N1258	2N1219
BV_{CEO}	15V	15V	30V	30V	50V	50V
BV_{CBO}	15V	15V	30V	30V	50V	50V
BV_{EBO}	5V	5V	5V	5V	50V	3V
Power Dissipation	250 mw					
Ambient Temperature	−65°C + 175°C					

SEMICONDUCTOR DIVISION

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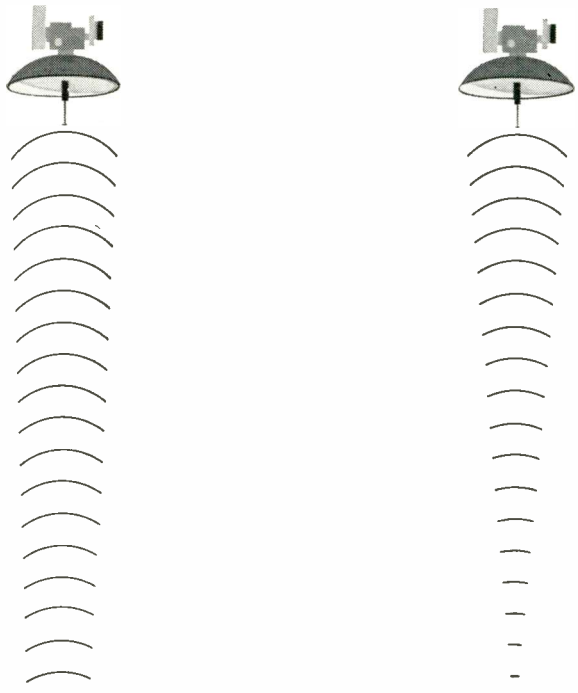
SEMICONDUCTOR DEVICES • STORAGE TUBES AND DEVICES • MICROWAVE TUBES • VACUUM TUBES AND COMPONENTS • CRYSTAL FILTERS • MEMO-SCOPE® OSCILLOSCOPES • INDUSTRIAL CONTROL SYSTEMS



DOUBLE YOUR RANGE!

WITH ONLY ONE CHANGE—ON X-BAND AND S-BAND MICROWAVE SYSTEMS

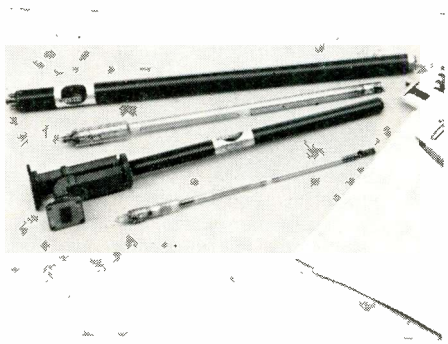
You can now double the effective range of your X-band or S-band microwave system applications with no change in power requirements, no change in antennas, **no change in other system equipment!**

How? By using Hughes PAX-1 or PAS-2B backward-wave amplifiers in your microwave systems you will achieve noise characteristics much lower than from any other traveling-wave tube. **The lower the noise level, the longer the effective range!**

Recent advances in electron gun design (resulting from noise phenomena studies conducted by Hughes R & D laboratories) make possible the extremely low noise characteristics of the Hughes PAX-1 and PAS-2B tubes.

In your microwave system applications, these amplifiers alone offer you **advantages not obtainable by any combination of other low-noise devices.**

Only one voltage to vary... Another important feature of the PAX-1 and PAS-2B backward-wave amplifiers is a narrow, electronically tunable passband covering the entire X-band or S-band spectrum. This feature automatically provides image rejection, excellent selectivity and anti-jamming capability. And, once the initial setup has been made, **only the tuning voltage needs to be varied for complete operation.**



SPECIFICATIONS:	PAX-1 (X-Band)	PAS-2B (S-Band)
Minimum noise figure	4.5 db	under 4.0 db
Gain	over 20 db	10-25 db
Tuning voltage	420-650 v	780-1150 v
Maximum voltage	1500 v	2750 v
Bandwidth	12 mc	11 mc
Input-output isolation	over 50 db	over 50 db
Filament power	6 w	10 w
Magnetic field	1300 gauss	1000 gauss
Saturation power output	0.2 mw	1 mw

Write now for detailed specifications on the PAX-1 and PAS-2B: HUGHES PRODUCTS, Electron Tube Division, International Airport Station, Los Angeles 45, Calif. For export information, write: HUGHES INTERNATIONAL, Culver City, Calif.

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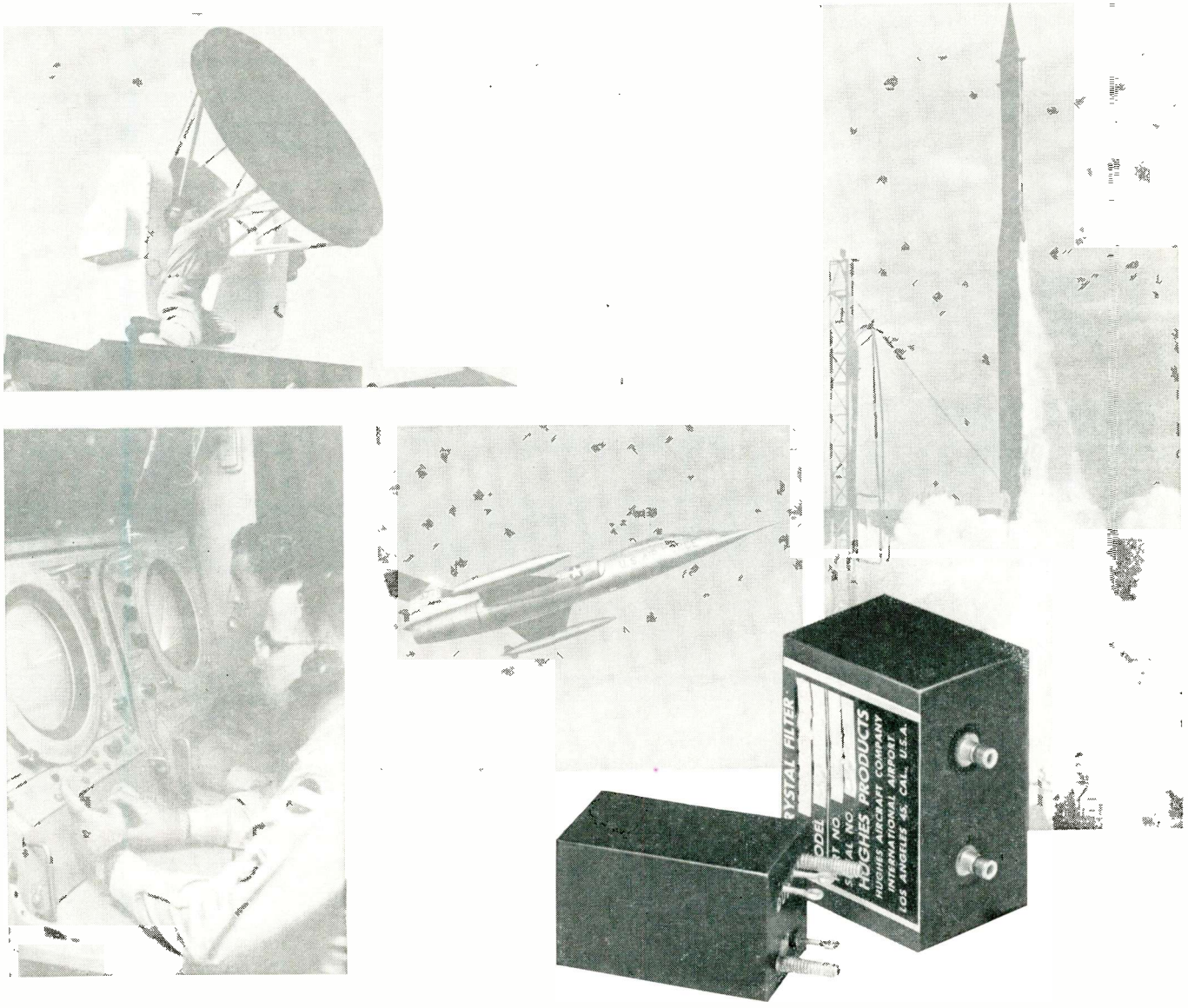

If you're looking for a high-performance crystal filter

At your service is a group of highly talented Hughes Crystal Filter engineers who specialize in solving difficult network problems. These men can design and produce a crystal filter to meet your most exacting requirements! In addition, Hughes offers you tremendous production capacity—over 10,000 filters per month of a single type. With Hughes Crystal Filters you get:

Precise Selectivity—Eliminates cross talk between channels, makes new systems possible.

Small Size—Reduces overall equipment size, makes filter more reliable by eliminating air space, results in higher stress factor.

High Frequency—Saves circuit costs, eliminates the need for double conversion. Center frequencies 30 kc to 40 mc.

Low Passband Ripple—Eliminates errors in information, enables end equipment to be more precise.

Wide Temperature Stability—Provides flexibility of use, contributes to high reliability.

Low Insertion Loss—Enables system to operate on low signal level—thereby combating noise and cutting circuit costs.

To avail yourself of the Hughes applications engineering service, or for additional information concerning performance levels please write: HUGHES PRODUCTS, *Industrial Systems Division, Marketing Dept., International Airport Station, Los Angeles 45, California. For Export, write: Hughes International, Culver City, California.*

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Antenna Rotor Cable

Vinyl insulated for optimum resistance to sun and weather. Provides longer trouble-free service.

Mil-Spec Hook-Up and Lead Wire

Exceed rigid requirements of all military specifications. Wide variety of sizes, insulations and jackets.

High-Voltage Cathode Ray Tube Lead

High dielectric strength. Small diameter with maximum flexibility.

line of Cable

Hook-Up and Lead Wires

Widest variety of sizes, insulations, and jackets for all electronic and electrical applications.

Portable Cordage and Rubber Multiple Conductor Cables

Two to five conductors for power supply, speaker lines, and unshielded control cable. Abrasion and impact resistant, limp and flexible—always lie flat. Also complete cord sets.

RG/U Transmission Line Cables

Widest variety of RG/U sizes and types. Approved under Mil-C-17B. Cables manufactured with strict adherence to government specifications.

These and many more

AVAILABLE from Stock

Community and Multiple Set TV Antenna Cables

Provide clear picture reception on all multiple TV set hook-ups. Sweep tested.

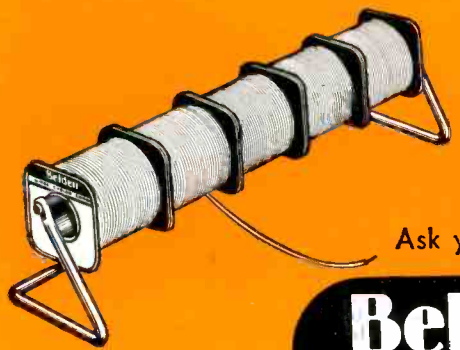
Test Prod Wire

Extremely limp and flexible. High dielectric strength. Long-life rubber jacket.

Unshielded All-purpose Sound and Intercom Cable

Three conductors. Also for power supply cords, speaker lines, and unshielded control lines.

Belden Electronic Wire and Cable is available in many different packages



This handy Workbench Hook-Up Dispenser Kit is an example of how Belden's packaging program helps minimize waste . . makes stock maintenance easy. Each kit contains an assortment of Hook-Up Wire colors and types. The dispenser is designed for workbench or wall mounting.

Ask your Belden jobber

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

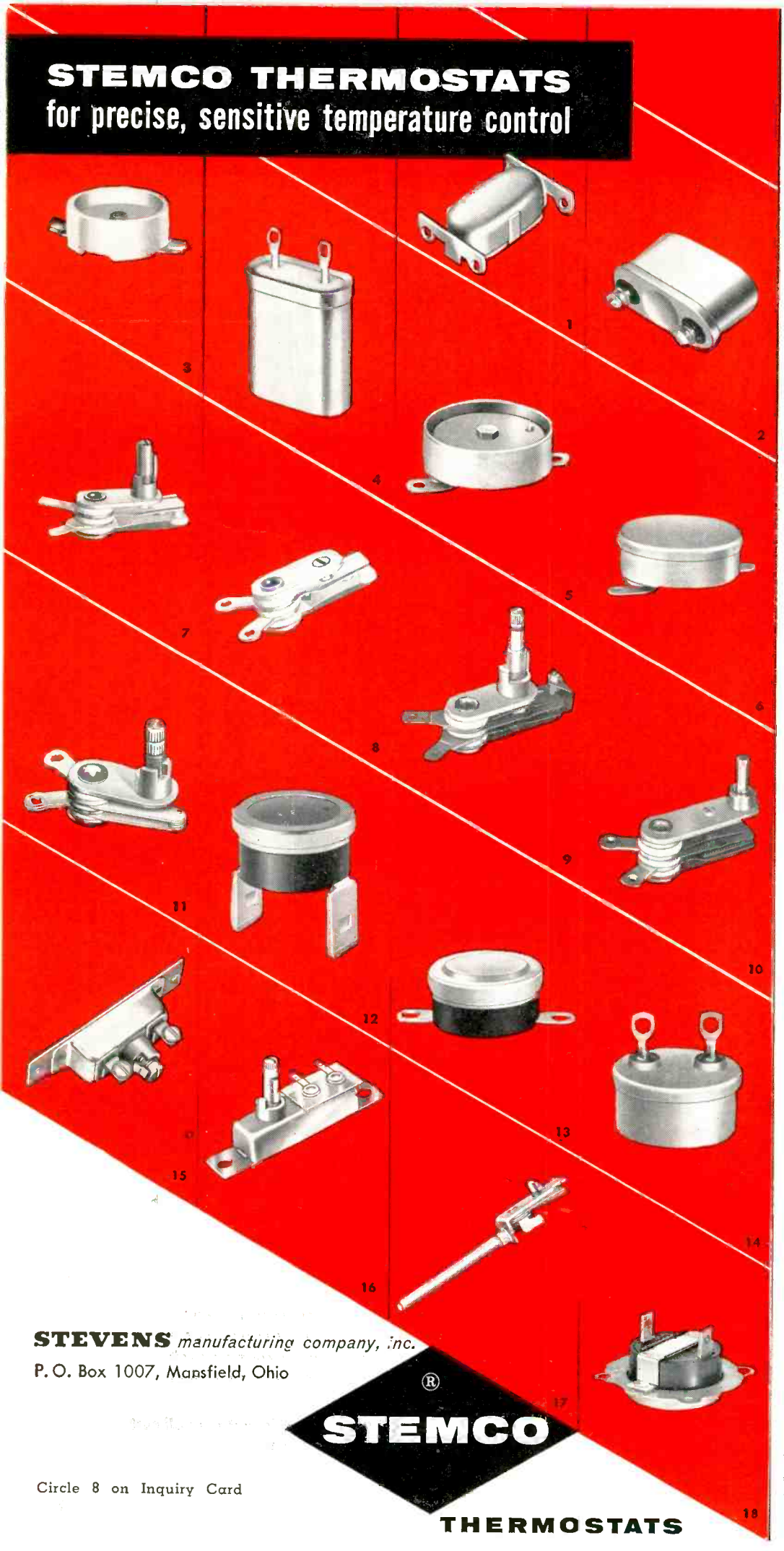
magnet wire • lead wire • power supply cords • cord sets • portable cordage • electronic wire • automotive replacement wire and cable • aircraft wire • electrical household replacement cords

One wire source for everything electronic and electrical.

Belden wires, cords and cables mean the lowest over-all cost from your assembly line to field operation

8-2-9

STEMCO THERMOSTATS
for precise, sensitive temperature control



1, 2, TYPE C† *semi-enclosed* (1), *hermetically sealed* (2). Small positive acting with electrically independent bimetal strip for operation from −10° to 300°F. Rated at approximately 3 amps, depending on application. Hermetically sealed type can be furnished as double thermostat "alarm" type. Various terminals and mountings. Bulletin 5000.

3, 4, TYPE M*† *semi-enclosed* (3), *hermetically sealed* (4). Snap acting bimetal disc type for appliance and electronic applications from −20° to 300°F. Rated: 3 to 10 amps at 115 VAC and 28 VAC/DC. Available with a variety of mounting brackets, type of terminals and/or wire leads. Bulletin 6000.

5, 6, TYPE MX† *semi-enclosed* (5), *hermetically sealed* (6). Snap acting miniature units to open on temperature rise for missile, avionic, electronic and similar uses. Temperature 10° to 260°F, 2° to 6°F differential. Depending on duty cycle, rated: 1 to 3 amps, 115 VAC and 28 VAC/DC. Also available in ceramic bases and hermetically sealed HC-6/U cans, with various mounting brackets. Bulletin 6100.

7, 8, TYPE S*† *adjustable* (7), *non-adjustable* (8). Positive acting with single stud or nozzle mounting. Operation to 600°F. Rated at 15 amps at 115 VAC, 7 amps at 230 VAC. Spade, screw or formed terminals, various adjusting stems, etc. Bulletin 1000.

9, TYPE SA*† *adjustable* (9), *or non-adjustable.* Snap acting with electrically independent bimetal. Also single-pole, double throw. Single stud or nozzle mounting. Rated at 1650 watts at 115-230 VAC only. Spade or screw terminals. Bulletin 2000.

10, TYPE SM*† *manual reset.* Electrically same as Type SA (above) except for manual reset feature. Bulletin 2000.

11, TYPE B *adjustable* (11) *or non-adjustable.* For uses where heat generated by passage of current through bimetal strip is desirable. Various terminals, single stud or nozzle mounting. Operation to 400°F. Average rating 5½ amps, 115 VAC. Bulletin 9000.

12, 13, 14 TYPE A*† *semi-enclosed* (12, 13), *hermetically sealed* (14). Insulated, electrically independent bimetal disc gives fast response and quick, snap action control for appliance and electronic applications from −20° to 300°F. Lower or higher temperatures special. Depending on duty, rated: 4 to 13.3 amperes, 115 VAC and 28 VAC/DC. Various terminals and mounting brackets available. Bulletin 3000.

15, TYPE R*† *sealed adjustable* (15), *sealed non-adjustable.* Positive acting for operation to 600°F. Rated at 15 amps at 115 VAC, 4 amps at 230 VAC. Screw terminals. Bulletin 7000.

16, TYPE W*† *adjustable* (16), *or non-adjustable.* Snap action bimetal strip type for operation to 300°F. Depending on duty, rated: 5 to 10 amps, 115 or 230 VAC. Screw or nozzle mountings; spade or screw terminals. Bulletin 4000.

17, TYPE H† *adjustable.* Positive acting for fry pans, skillets, sauce pans, etc. Fail-safe, open in low to 500°F in high. Rated at 1650 watts at 115 VAC. Bulletin 10,000.

18, TYPE D* *automatic* (18), *or manual reset.* For laundry dryers or other surface and warm air applications. Snap acting disc type for operation to 350°F. Open or enclosed. Rated: 25 to 40 amps at 120-240 VAC. Screw or spade terminals. Bulletin 8000.

Illustrations, for general information only, do not necessarily show size comparisons. Fully dimensioned and certified prints on request. Manufacturer reserves right to alter specifications without notice.

*Refer to Guide 400 EO for UL or CSA approved ratings.
†These thermostats covered by patents issued or applied for.

STEVENS *manufacturing company, inc.*
P. O. Box 1007, Mansfield, Ohio

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THERMOSTATS

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Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period September-October that are of special interest to electronic engineers

Aug. 31-Sept. 2: Army-Navy Instrumentation Program, Symposium and Industry Briefing, Statler Hilton Hotel, Dallas, Tex.

Aug. 31-Sept. 2: Conference on Semiconductors, Metallurgical Society of AIME, Statler Hotel, Boston, Mass.

Sept. 1: 6th International Meeting, Institute of Management Sciences; Paris, France.

Sept. 3-6: 13th Annual National Convention and Aerospace Panorama, Air Force Association; Miami Beach, Fla.

Sept. 5-6: New England Division Convention, American Radio Relay League; Hartford, Conn. (Tent.)

Sept. 6-16: Production Engineering Show; Navy Pier, Chicago, Ill.

Sept. 10-11: Midwest Sections Conf., SPI; Sheraton Hotel, French Lick, Ind.

Sept. 10-21: Radio, TV, and Records Exhibition, Federation Nationale Des Industries Electroniques; Exhibition Park, Porte de Versailles, Paris, France.

Sept. 11-13: Southwest Stereo/Hi-Fi Show, Southwest Hi-Fi Representatives, Inc., Shamrock-Hilton Hotel, Houston, Texas.

Sept. 12-21: 6th European Machine Tool Exhibition, Rond-Point de la Defense, Puteaux (Seine), Paris, France.

Sept. 13-16: 11th Electronic Industry Conf., Electronic Representatives Assoc.; Excelsior Springs, Missouri.

Sept. 15: Conf. on Photosensitive Materials and Silk Screen Processes, Western Assoc. of Circuit Manufacturers; Rodger Young Aud., Los Angeles, Calif.

Sept. 16-18: Engineering Management Conference, ASME; Statler Hilton Hotel, Los Angeles, Calif.

Sept. 17-18: Engineering Writing & Speech Symposium, IRE (PEGWS); Boston & Los Angeles.

Sept. 17-18: 2nd Conf. on Nuclear Radiation Effects on Semiconductor Devices, Materials, and Circuits, ODR, Advisory Group on Electron Tubes; Western Union Auditorium, New York City.

Sept. 18: Dinner Meeting, Association of Electronic Parts & Equipment Manufacturers, Chicago, Ill.

Sept. 18-20: Southwest Stereo/Hi-Fi Show, Southwest Representatives, Inc., Hotel Adolphus, Dallas, Texas.

Sept. 20-23: Petroleum Mech. Engrg. Conf., ASME; Rice, Houston, Tex.

Sept. 21-22: 8th Annual Meeting, Investment in Survival, Standards Engineering Society; Somerset Hotel, Boston, Mass.

Sept. 21-23: 8th Annual Meeting, Standards Engineers Society; Somerset Hotel, Boston, Mass.

Sept. 21-25: 14th Annual Instrument-Automation Conf. & Exhibition, ISA; International Amphitheater, Chicago, Ill.

Sept. 22-24: Quarterly Conf., Electronic Industries Assoc., Plaza Hotel, New York City.

Sept. 22-24: 3rd Industrial Nuclear Technology Conf. ARF, AEC; Morrison Hotel, Chicago, Ill.

Sept. 23-25: 4th Annual Special Technical Conf. on Non-linear Magnetics & Magnetic Amplifiers, AIEE, IRE; Shoreham Hotel, Washington, D. C.

Sept. 23-25: The Business Equipment Exposition, Office Equipment Manufacturers Exhibits, Inc.; National Guard Armory; Washington, D. C.

Sept. 25-26: 9th Annual Broadcast Symposium, AIEE, IRE; Willard Hotel, Washington, D. C.

Sept. 28-30: National Symposium on Telemetering, IRE (PGTRC); Civic Auditorium and Whitcomb Hotel, San Francisco, Calif.

Sept. 28-Oct. 1: National Fall Meeting, American Welding Society; Sheraton-Cadillac Hotel, Detroit, Mich.

Sept. 30-Oct. 1: Industrial Electronics Symposium, IRE, AIEE; Mellon Institute, Pittsburgh, Pa.

Oct. 1-2: 15th New England Section Conf., SPI; Wentworth-by-the-Sea, Portsmouth, N. H.

Oct. 5-7: 5th National Communications Symposium, IRE; Hotel Utica, Utica, N. Y.

Oct. 5-9: 11th Annual Convention, Audio Engineering Society; Hotel New Yorker, New York, N. Y.

Oct. 5-9: 86th Semiannual Convention, including Equipment Exhibit, Society of Motion Picture & TV Engineers; Statler Hotel, New York, N. Y.

Oct. 5-16: 7th Anglo-American Conference, IAS, Royal Aeronautical Society, Canadian Aeronautical Institute, Institute of the Aeronautical Sciences; Hotel Astor, New York, N. Y.

Oct. 6-7: Value Engineering Symposium, EIA; University of Pennsylvania, Phila., Pa.

Oct. 6-8: 5th Conf. on Radio-Interference Reduction, Armour Research Foundation, IRE, U. S. Army Signal Research and Development Labs; Chicago, Ill.

Oct. 6-9: 2nd International Symposium on High Temperature Technology, Stanford Research Institute; Asilomar Conference Grounds, Cal.

Oct. 7-9: National Symposium on Vac. Tech., American Vacuum Society; Hotel Sheraton, Phila., Pa.

Oct. 7-9: Canadian Convention, IRE; Toronto, Canada.

Oct. 8-10: Meeting, Optical Society of America; Chateau Laurier, Ottawa, Canada.

Oct. 11-15: 3rd Pacific Area National Meeting, ASTM; Sheraton-Palace Hotel, San Francisco, Calif.

Oct. 11-16: all General Meeting, AIEE; Morrison Hotel, Chicago, Ill.

Oct. 12-15: Annual Conference, National Electronics Conference, IRE, AIEE, EIA, SMPTE; Hotel Sherman, Chicago, Ill.

Oct. 13-14: Technical Conference, Society of Plastics Engineers, Southern Calif. section; Ambassador Hotel, Los Angeles, Calif.

Oct. 13-16: Midyear Meeting of Lab Apparatus & Optical Sections; Scientific Apparatus Makers Assoc; The Cavalier, Virginia Beach, Va.

Oct. 15-16: Meeting, National Assoc. of Broadcasters; Mayflower Hotel, Washington, D. C.

Oct. 15-17: Fall Meeting, National Society of Professional Engineers, Olympic Hotel, Seattle, Wash.

Oct. 17-25: International Fair of Plastics Ind., Dusseldorf, Germany.

Oct. 18-22: Meeting, The Electrochemical Society, Inc., Deshler-Hilton Hotel, Columbus, Ohio.

Oct. 19-20: Meeting, National Assoc. of Broadcasters; Sheraton Hotel, Chicago, Ill.

Oct. 19-21: Fall Meeting, URSI, IRE; Balboa Park, San Diego, Calif.

Oct. 19-22: Annual Conf. Int'l Municipal Signal Assoc.; Stardust Hotel, Las Vegas, Nev.

Abbreviations

AIEE: American Institute of Electrical Engineers
AIME: American Institute of Mining & Metallurgical Engineers
AIP: American Institute of Physics
ARF: Armour Research Foundation
AEC: Atomic Energy Commission
ASME: American Society for Mechanical Engineers
ASTM: American Society for Testing Materials
EIA: Electronic Industries Association
IRE: Institute of Radio Engineers
ODR: Office of Director of Defense Research
SMPTE: Society of Motion Picture & TV Engineers

CLEVITE . . . . . DIFFUSED SILICON RECTIFIERS

TECHNICAL DATA:			
Diode Type	Maximum DC Inverse Operating Voltage (volts)	Maximum Average Forward Current @ 25°C (ma)	Maximum Forward Voltage Drop @ 25°C (volts @ ma)
1N645	225	400	1.0 @ 400
1N647	400	400	1.0 @ 400
1N649	600	400	1.0 @ 400
1N677	100	400	1.0 @ 400
1N681	300	200	1.0 @ 200
1N683	400	200	1.0 @ 200
1N685	500	200	1.0 @ 200
1N687	600	200	1.0 @ 200

Clevite offers silicon rectifiers designed for maximum reliability in the severest military and commercial applications.

Check these features:

- **HIGH DISSIPATION — 600 mw**
- **SUBMINIATURE GLASS PACKAGE**
- **HIGH VOLTAGE — up to 600 volts**
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Circle 9 on Inquiry Card

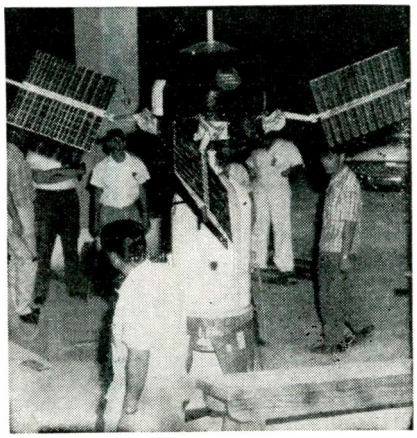
"Paddlewheel" Carries Heavy Load of Gear

The 15 major experiments in the 142-pound "Paddlewheel" satellite, together with its advanced electronics, make it the most comprehensive scientific package the United States has yet put in an earth orbit.

The body of the satellite is spheroid-shaped with a slightly flattened bottom. It is 26 in. in diameter, 29 in. deep and its aluminum skin is 1/16 in. thick. From its waist jut four paddles of power-generating solar cells.

Most of the experiments ride bolted to a plastic and metal floor within the satellite. They break down into six main categories:

1. Three devices to map the radiation belt ringing the earth.
2. A 2½-lb. scanning device—similar to a TV camera—designed



Extension devices of the solar paddles are checked before launching at Cape Canaveral

to relay a crude picture of the earth's cloud cover.

3. Solar cells on each side of the four paddles, to create voltage to recharge the satellite's chemical batteries in flight. The electronic gear in the satellite includes three transmitters and two receivers.
4. A micrometeorite detector built to gauge the size and speed of meteoric particles hitting the satellite.
5. Two types of magnetometers to map the earth's magnetic field.
6. Four experiments to study the behavior of radio waves.

The electronic gear in the satellite includes 3 transmitters and 2 receivers.

The transmitters duplicate each other in sending information on nearly every experiment. Two of the transmitters, operating at 108.06 megacycles and 108.09 megacycles, send analogue information which is recorded on tapes and later graphed and analyzed.

A third transmitter, broadcasting at an undisclosed UHF frequency is the primary transmitter. It sends digital data or coded impulses which allow fairly rapid data translation.

A low-frequency receiver is used exclusively in one of the radio wave propagation experiments. A second high-frequency receiver can command 30 different functions in the satellite, including turning off and on the primary transmitter.

The main transmitter is used only an hour and a half out of every six hours because it requires more power (40 watts) than the solar cells and batteries can supply.

EIA, NEMA Split Up Semiconductor Roles

The Electronic Industries Assoc. (EIA) and the Nationale Electrical Manufacturers Assoc. (NEMA) agreed last month to split up the role that they have been jointly filling in supplying marketing data and general services to the semiconductor field.

Under the new arrangement EIA's responsibility covers diodes and transistors generally used in signal and low-level applications, and the semiconductors used in home instruments.

NEMA becomes responsible for all power and control rectifiers, excluding those intended for use in home entertainment devices.

Power transistors are divided between the two associations.

Westinghouse Donates Lab Equipment to Univ. of Pa.

The University of Pennsylvania has received laboratory equipment designed to teach the basic principles of electrical-mechanical energy conversion from the Westinghouse Educational Foundation.

The lab units include a fractional dc motor and a 3 hp dc motor, 2 tachometers, a torque meter, and a specialized rotating device that can be operated either as a motor or a generator on ac or dc.

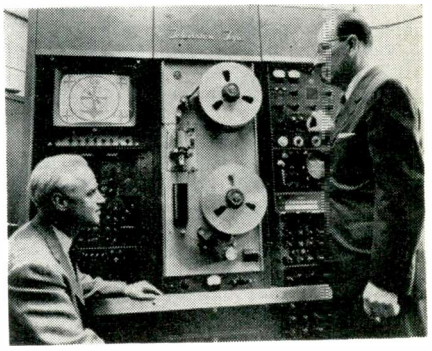
Video Tape Recordings Can Be Edited, Mixed

A new method of producing TV programs on tape, permitting for the first time the electronic editing or mixing of taped scenes and sounds, has been developed by engineers of Reeves Sound Studios, Inc., and RCA.

The new concept permits mixing information on television tape with much the same flexibility as on motion picture film.

A new Reeves facility will provide clients with video recording as well as audio signals on magnetic tape.

The new method of assembling a TV production on tape involves the use of pre-recorded tapes bearing



RCA's E. C. Tracy (r) and C. H. Colledge check TV tape recorder ordered by Reeves

picture information from any number of cameras, along with the sound tracks. By employing several tape recording and playback machines, with matching monitors, the system will enable the producer and director to see different views simultaneously and choose the most desirable scenes. Then he can schedule the complete program and electronically edit, or "splice," the desired sequences into a master monitor and recorder.

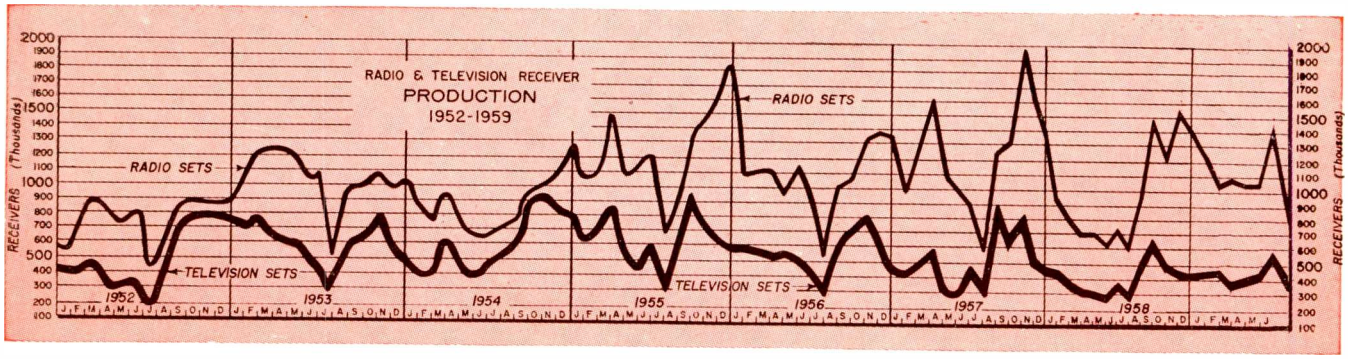
The Reeves firm has contracted for the purchase from RCA of a battery of television tape recorders and a large amount of related equipment.

The new flexibility is gained through a recent development of the David Sarnoff Research Center which makes it possible to achieve synchronization of television tape machines. This synchronization is necessary so that electronic switching between pictures on one tape machine and another does not cause roll-over, or a vertical shifting of the picture frame.

More News on Page 20

TOTALS ELECRONIC INDUSTRIES

Facts and Figures Round-up
September, 1959



JAPANESE ELECTRONICS

It is estimated that output by 1962 will exceed $1,240 million and exports will approximate $81 million.

The value of production has jumped from about $269 million in 1956 to more than $550 million in 1958. In October 1958 the monthly production reached 120,000 TV sets, 300,000 transistor radios, and 3.2 million transistors. The monthly output of transistors was to approach 4.6 million by April 1959.

Exports of electronic equipment have increased rapidly. Radio receivers (mainly portable) accounted for an impressive share of exports and for the January through October period totaled $24 million, including shipments to the United States valued at approximately $12.8 million (1.9 million units). —*U. S. Department of Commerce*

DRY CELL BATTERIES—1958

During 1958, manufacturers' shipments of dry cell batteries totaled 1.4 billion, valued at $97.5 million.

Flashlight and radio dry cells accounted for over 90% of the quantity and 80% of the total value of civilian type dry cell batteries shipped during 1958. Export shipments represent less than 10% of the total quantity and value of manufacturers' shipments during the year.

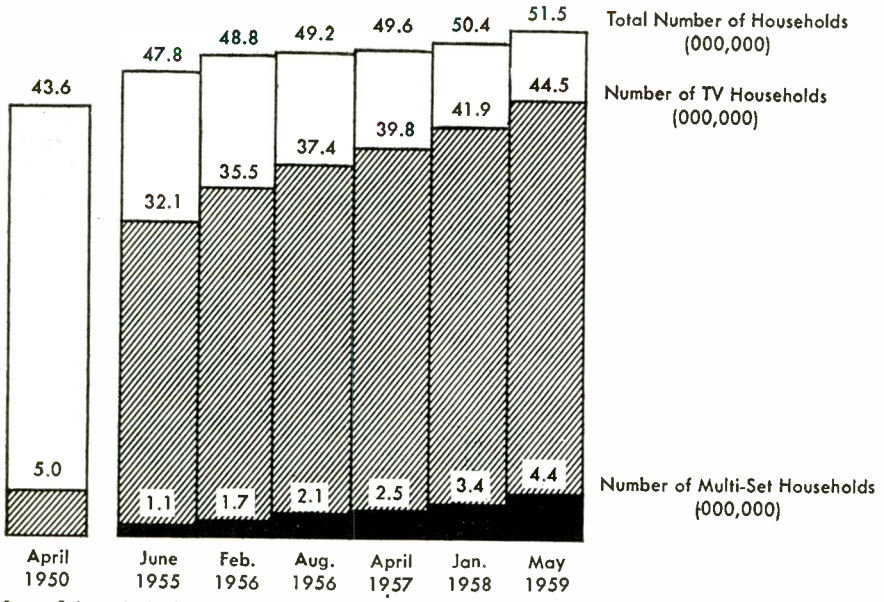
—U. S. Department of Commerce

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in July, 1959.

Amplifiers	166,840
Amplifiers, synchro signal	733,738
Analyzers	35,752
Analyzer, frequency	23,632
Analyzer & recording system, digital data	49,306
Analyzer, spectrograph	165,550
Antennas & antenna systems	2,489,820
Attenuators	143,360
Batteries, dry	593,073
Batteries, storage	90,120
Bridge, impedance	41,594
Cable, electronic	636,089
Cable, telephone	299,542
Calibrators	32,500
Capacitors	143,550
Cells, solar	34,480
Chargers, battery	85,522
Circuit breakers	118,927
Coils, r-f	25,120
Computers	424,500
Computers, analog	65,950
Computers, digital	316,800
Connectors	244,566
Controls, radio	342,576
Converters, radiosonde data	184,350
Converters, SSB	176,505
Dummy loads	45,045
Equipment, telephone	88,518
Filters, band pass	66,603
Fuses	140,369
Fuses, cartridge	165,742
Generators, time mark	126,197
Handsets-headsets	121,251
Integraters, video	250,000
Limiters, fuse	91,329
Loudspeaker	121,759
Meters, radio interference	126,837
Meters, milliamp	47,775
Meters, ohm	150,660
Meters, Q	41,125
Meters, radiac	520,667
Monitors, coordinate data	740,250
Multiplexer	125,957
Multimeters	539,880
Multipliers, electronic	216,250
Oscillators	294,540
Oscilloscopes	1,166,892
Oscillographs	170,632
Paper, recording	60,550
Plotter, coordinate data	64,520
Potentiometers	63,193
Power supplies	758,483
Radio sets	141,781
Radiosonde equipment	934,815
Receivers, radio	7,917,689
Receiver/transmitters	111,074
Recorder, facsimile	222,440
Recorder, flight data	137,837
Recorder, video tape	109,309
Recorder/reproducers & accessories	1,122,822
Reflector, parabolic	58,650
Relay, armature	45,195
Relay assemblies	39,992
Resistors	1,206,389
Semiconductor devices	156,868
Signal generators	87,866
Solenoids	29,961
Switchboard equipment	219,635
Switches	169,792
Switches, pressure	96,893
Switches, toggle	39,927
Switches, thermostatic	126,382
Systems, data processing	688,297
Systems, telemetry	210,764
Synchros	1,929,823
Tape, magnetic	156,793
Tape reader	73,353
Teletypewriter	3,234,294
Test sets, radio	89,997
Testers	173,875
Transducers	50,783
Transformers	32,220
Transistors	88,000
Transmitters	360,773
Transmitters, radio	260,287
Tranceiver	31,752
Transmitters, synchro	48,390
Transponders	1,860,322
Tubes, electron	2,389,756
Tubes, klystron	181,300
Tubes, magnetron	541,632
Waveguide assemblies	122,368
Wire	331,934

GROWTH OF TELEVISION IN HOUSEHOLDS
1950-1959



Source: Estimates by A.R.F. based on data from U.S. Bureau of the Census.

ANOTHER FIRST FROM PHILCO

PHILCO MADT* TRANSISTORS MAKE POSSIBLE THE WORLD'S FIRST BATTERY-POWERED PORTABLE TV

High Frequency MADTs*
for tuner, video IF, sound IF

Alloy Junction Units
for sweep, synchronizing and audio stages

Special MADTs*
(with revolutionary Philco cathode ray tube) for display circuits

Television breaks free from the electrical outlet! Philco's sensational new Safari plays *anywhere* without plugging in . . . and only Philco Transistors make it possible.

Philco Micro Alloy Diffused-base Transistors (MADT*) for the tuner and IF stages are products of Philco's famous FAT Lines (Fast Automatic Transfer) . . . the first automatic transistor production lines in the world. They are the *only* transistors manufactured by mass production methods to meet the exacting standards of performance, uniformity and economy to make transistorized television a practical reality. Their excellent high frequency capabilities provide sensitivity and low noise performance comparable with conventional vacuum tube receivers.

This is another example of Philco's leadership in Transistor engineering and production. To meet *your* transistor requirements, consult Philco first. *For complete information, write Dept.EI-959.*

**Trademark Philco Corp. for Micro Alloy Diffused-base Transistor*

PHILCO®

LANSDALE TUBE COMPANY DIVISION • LANSDALE, PENNSYLVANIA

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TRANSISTOR CENTER U.S.A.®

Electronic Industries' News Briefs

Capsule summaries of important happenings in affairs of equipment and component manufacturers

EAST

FEDERAL ELECTRIC CORP., Paramus, N. J., has just received an Air Force contract for $42 million for the operation and maintenance of the DEW Line. They are a service organization of ITT.

POLARAD ELECTRONICS CORP. announced the receipt of $2,194,000 in contracts in the closing days of its fiscal year. Included were Air Force contracts for a specialized electronic countermeasures receiving system to be developed, a contract for continued production of automatic ground checkout equipment for the B-58, a contract for classified vacuum tube research, and a Navy production contract for microwave signal generators.

GRAND SLIDING MECHANISMS, INC., a new manufacturer of precision drawer and chassis slides for the electronic industry, has gone into production at 2401 W. Ohio St., Chicago 12, Ill.

SYLVANIA ELECTRONIC SYSTEMS, div. Sylvania Electric Products Inc., has announced plans for a 67,000 sq. ft. addition to their Data Systems Operations in Needham, Mass. The addition will be utilized to expand engineering and manufacturing space.

RADIATION, INC., has entered into a contractual agreement with the U. S. Air Force Air Research & Development Command, on a tactical Air-to-Surface Missile study program to be performed by the Research Div. of Radiation, Inc., in Orlando, Fla. At present details of this program are classified.

BENDIX AVIATION CORP., Radio Div., Baltimore, Md., has been awarded 2 contracts in the amounts of $1,429,185 and $3,871,500 by the Rome Air Materiel Areas, Griffiss Air Force Base, Rome, N. Y. The contracts are for new modification kits to update GCA radar and continental air defense radar systems, originally built by Bendix.

AMPEREX ELECTRONIC CORP., Hicksville, L. I., N. Y., has announced the beginning of construction of a new, 2-story, modern, air conditioned engineering wing to the present Amperex building. Completion is slated for October of this year.

STROMBERG-CARLSON has received a half million dollar extension of a subcontract for their automatic test equipment for testing the electronic portion of the Nike-Zeus missile. Contract was awarded by Bell Telephone laboratories.

WALDORF ELECTRONICS is the new name for the Electronics Div., Waldorf Instrument Co.

EPSCO INC., Systems Div., Cambridge, Mass., has received a contract from the Naval Ordnance Laboratory, Silver Springs, Md., for a Digital Data Printing System to be used with a Digital Data Handling System, recently delivered to NOL by Epsco.

MAGNETIC METALS CO. of Camden, N. J., has purchased a 22-acre tract in a Pennsauken, N. J., Industrial Park. They have already broken ground for construction of manufacturing facilities and administrative offices at this location.

NARDA MICROWAVE CORP. has formed a new High Power Electronics Div., to design and build a new range of products for microwave communications systems.

WALTHAM PRECISION INSTRUMENT CO. is now developing a new timepiece, the "satellite clock and time programmer." It is expected to be used in the first manned satellite sent by the U. S. into outer space.

AMERICAN MACHINE & FOUNDRY CO., has organized a Research and Development Div. for proprietary products.

NEW HERMES ENGRAVING MACHINE CORP. and its subsidiary, Hermes Plastics Inc., have moved to a larger factory at 154 W. 14th St., New York City. The new plant contains the most modern equipment, is completely air-conditioned, and has been organized to streamline production and speed up service facilities in all phases of their operation.

RAYTHEON CO. has received now contracts totaling more than $20 million for the Army Hawk missile program. More than $9 million of this will be for maintenance parts.

ELECTRO-MECHANICAL RESEARCH, INC., of Sarasota, Fla., has contracted to purchase all of the assets of Applied Science Corp. of Princeton. This agreement has been approved by the Boards of Directors of both companies and is subject to the approval of the stockholders of ASCOP.

REYNOLDS METALS CO. is expanding its aluminum strip conductor coil winding facilities in Richmond, Va., to meet the industry's increasing need for prototype and quantity-production coils.

RADAR MEASUREMENTS CORP., manufacturers of electronics systems and system components, has started full scale operations in their new engineering-production facilities in Hicksville, L. I., N. Y.

TAYLOR FIBRE CO., Norristown, Pa., reports that new technical advances in the bonding of various metallic and non-metallic materials to laminated materials have been made. They say this will open up new design opportunities using combination laminates.

MID-WEST

TULLAMORE ELECTRONICS CORP., a subsidiary of the Victoreen Instrument Co. of Cleveland, is moving to new headquarters and plant facilities at 6726 S. Ashland Ave., Chicago.

MINNESOTA MINING & MFG. CO. has been awarded a 1 year research contract by the National Institutes of Health for work on the synthesis of new compounds to be evaluated as possible cancer chemotherapy agents.

P. R. MALLORY & CO. INC., has announced that the Mallory Capacitor Co. facilities for the production of solid tantalum capacitors have been moved to new Indianapolis quarters and that output has been doubled.

HAZELTINE CORP. has begun operations at the new electronics test and engineering center established at the Weir-Cook Municipal Airport in Indianapolis, Ind., by their division, Hazeltine Technical Development Center, Inc.

HARRIS MANUFACTURING CO., INC., St. Louis, now has a printed circuitry division. They have complete precision printed circuit board production facilities including tool and die, and fabricating equipment.

FORMICA CORP.'s new glass melamine grade FF-60 will head their list of new qualified products of type GME material, under the revision of specification MIL-P-15037. This is said to be the first approval in the industry of glass melamine under this new classification. It will be used for circuit-breakers, panel boards, switch bases and shipboard power generation and distribution systems.

WEST

WESTERN GEAR CORP. has acquired a financial interest in Tridea Electronics, Inc., of Pasadena, Calif. Tridea has been active in radar, air navigation computers, and missile guidance systems.

AMPEX CORP. has received an order of $2.5 million for Videotape® Television Recorders. The order was placed by the National Education Television and Radio Center for 43 U. S. educational television stations.

HOFFMAN ELECTRONICS CORP., Los Angeles, Calif., has received a contract for the production of specialized test equipment to be used with TACAN air navigation systems. The $5 million contract was awarded by the U. S. Air Force.

ARNOUX CORP. announced receipt of a Navy contract for approximately $300,000. The order is for a telemetry data, receiving and recording station to be installed at Point Mugu, Pacific Missile Range.

PACKARD-BELL ELECTRONICS CORP. has been awarded an initial subcontract in excess of $2 million by the Lockheed Missiles and Space Div. for elements of the automatic checkout system for the U. S. Navy "Polaris" fleet ballistic missile.

EITEL-McCULLOUGH, INC., San Carlos, Calif., has announced expansions totaling 53,400 sq. ft., including 27,000 sq. ft. of a new building to be completed by October.

INTERNATIONAL ELECTRONIC RESEARCH CORP., Burbank, Calif., has started construction of an office building. The new building will be completed by January 1960.

THE NATIONAL CASH REGISTER CO., Electronics Div., Hawthorne, Calif., will utilize their "ROD" magnetic memory element as the key component of a computer buffer memory, they are building for the Naval Ordnance Test Station at China Lake, Calif.

ROBERTSHAW-FULTON CONTROLS CO., the Aeronautical and Instrument Div., has recently been awarded contracts totaling almost $500,000 by the Martin Co., Denver Div. These contracts, repeat orders, call for helium pressure regulators to be used on the TITAN ICBM, now under development.

THE SIEGLER CORP. has been awarded a $100,000 contract from the Sperry Utah Engineering Co. for the manufacture of special electronic test gear for the Army's "Sergeant" missile.

PARABAUM, INC., of Hawthorne, Calif., has been awarded over $400,000 in new contracts for the production of astrodome type shelters. These shelters, designed for the protection of missile tracking instruments, are to be used by White Sand Missile Range, New Mexico and Naval Ordnance Test Station, China Lake, Calif.

LENKURT ELECTRIC CO.'s contract to develop the AN/FCC-17 Multiplexer Set for the Air Force has been amended to add more than $1 million in design and construction of prototypes. The proposed all-purpose system for both fixed plant and tactical applications will transmit voice, teletype and data signals and will anticipate future requirements for high-speed data and graphics.

LIBRASCOPE, INC., a subsidiary of General Precision Equipment Corp. has been selected as a member of an industry-Navy team working on a submarine integrated control system (SUBIC) that may permit manpower reduction on atomic powered submarines from the present average 100-man crew to 12 men.

it's for the BIRDS*

THE KERNEL

... A New Microminiaturized Toroidal Inductor

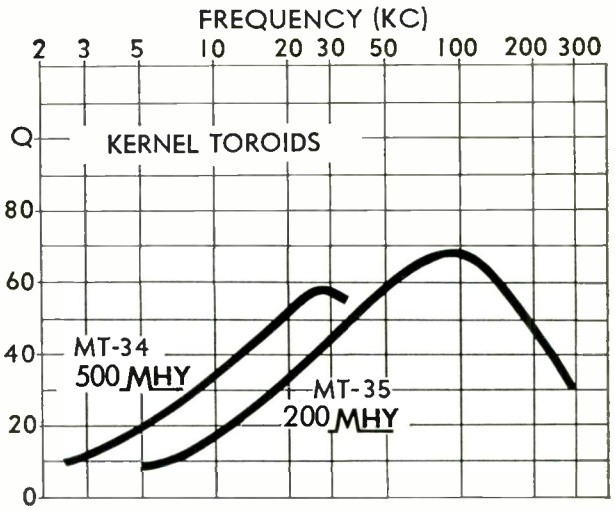
The new Burnell & Co. MT 34 and MT 35 microminiature Kernel toroidal inductors are made to order for the engineer who isn't content with outer husk solutions but gets right to the core of second generation missile communication problems.

MT 34 microminiature Kernels can be supplied with inductances up to 500 mhys and the Kernel MT 35 is available in inductances up to 200 mhys. MT 34 Kernels are recommended for frequencies to 30 kcs and the MT 35 is applicable to frequencies up to 200 kcs depending on inductance values. Q for the MT 34 is greater than 55 at 25 kc and for the MT 35 more than 60 at 100 kcs.

Size of the MT 34 and MT 35 is .417″ OD x .215″, spacing between leads .3″ x 1″ L with a weight of .06 ounces.

The new microminiature Burnell MT 34 and MT 35 Kernels provide maximum reliability as well as considerable economy in printed circuit use. Completely encapsulated, the Kernels will withstand unusually high acceleration, shock and vibration environments.

Write for special filter bulletin MTF to help solve your circuit problems.



*missiles

Burnell & Co., Inc.

PIONEERS IN microminiaturization OF TOROIDS, FILTERS AND RELATED NETWORKS

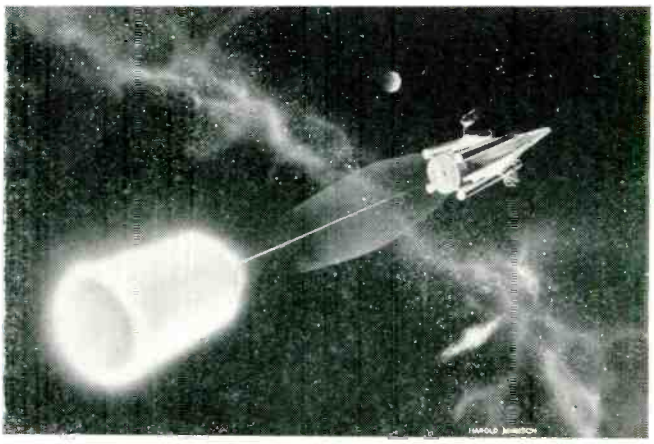
EASTERN DIVISION
DEPT. I-21
10 PELHAM PARKWAY
PELHAM, N. Y.
PELHAM 8-5000
TELETYPE PELHAM 3633

PACIFIC DIVISION
DEPT. I-21
720 MISSION ST.
SOUTH PASADENA, CAL.
RYAN 1-2841
TELETYPE: PASACAL 7578

Snapshots . . . of the Electronic Industries

AIR-PORTABLE TOWER

Surveying a proposed microwave route in remote Snoqualmie Pass, Wash., this helicopter handles an entire 200 ft. aluminum tower in one flight. Upright Scaffolds, Inc., made the tower.

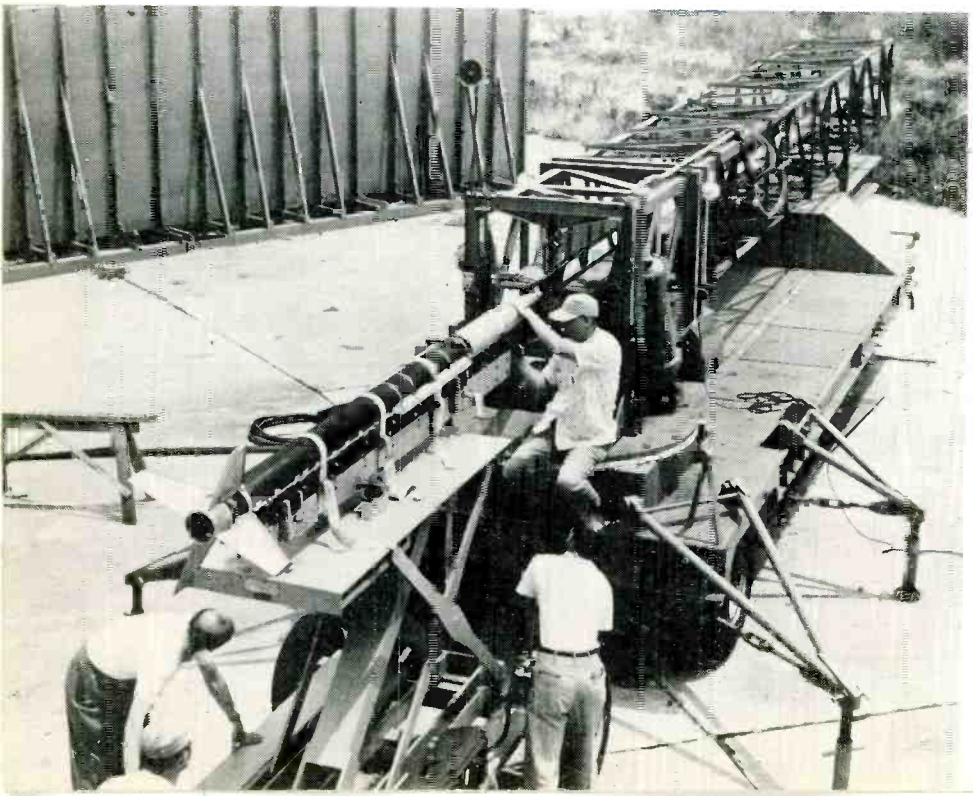


NUCLEAR SPACE SHIP

Nuclear powered space ship proposed by Lockheed would have reactor separated from spacecraft by mile-long coaxial cable. Reactor, glowing at 2,100°C., "boils" electrons off outer cells.

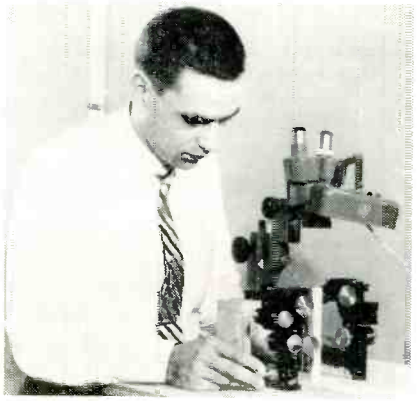
RESEARCH ROCKET

ARCON, upper air research rocket developed by Atlantic Research, goes into its launcher for a shot at NASA's Wallops Island, Va., as part of its final flight test program.



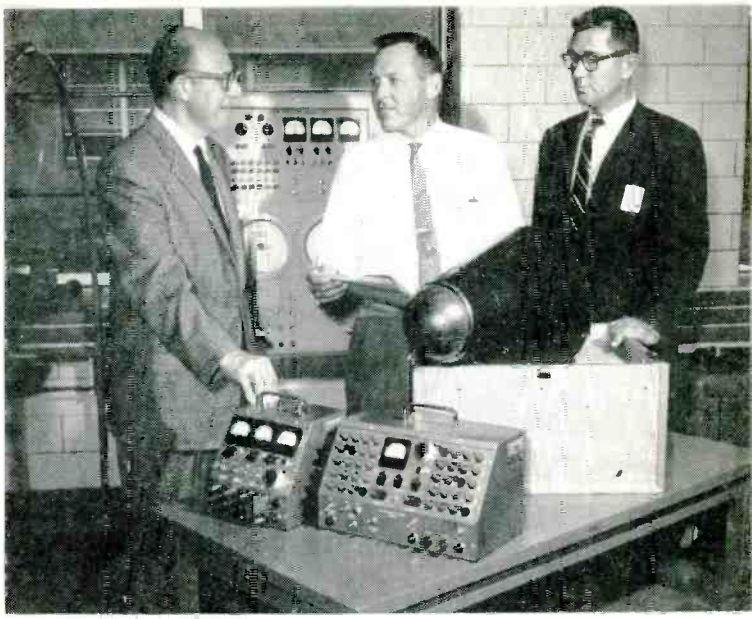
MICRO-POSITIONING

The 15 micro-miniature components in Melpar's new miniaturized circuit are positioned with this new micro-manipulator by lab physicist Stanley Bryla.



CHECKOUT

At West Coast Div. of Magnetic Amplifiers, Inc. technicians check out static sequencer that controls count-down activities for launching and handling of Polaris missile.

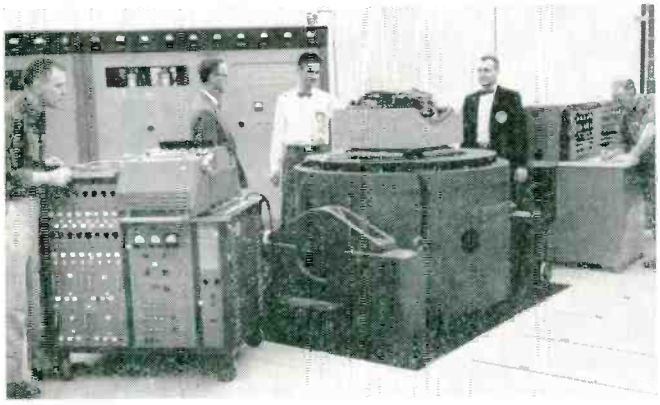


"Q"-BALL

Nortronics' A. Vogel (above) and G. Click, and NASA's K. Sanderson inspect the "Q"-ball attitude sensor designed and produced by Northrop Corp. for use in NASA's X-15 near-space aircraft.

VIBRATION SYSTEM

Giant 200 KW shaker (below) manufactured for Boeing by Ling Electronics is one of the two largest in the world. It will exert a vibratory force of 25,000 lbs through test frequency ranges from 5 to 2,000 cycles per second. It mounts on 200,000 lb. slab.

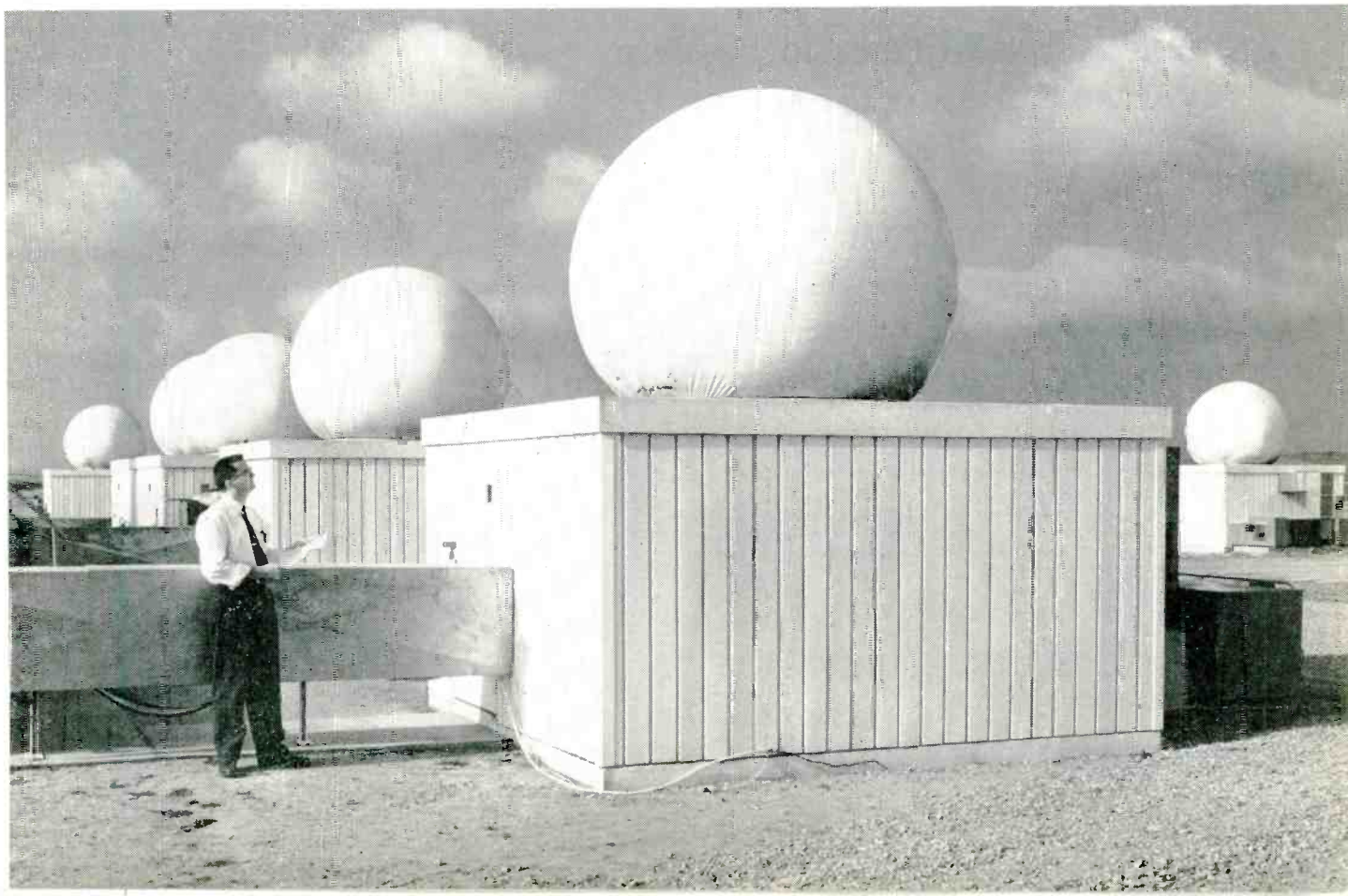


LAB MACHINES

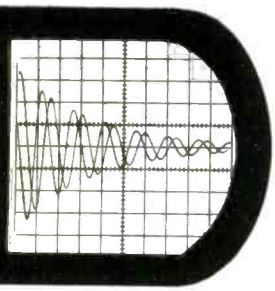
Details of the generalized lab machines being donated by Westinghouse to accredited college electrical engineering departments are explained to educators at meeting in Pittsburgh.

NEW TRACKING SYSTEM

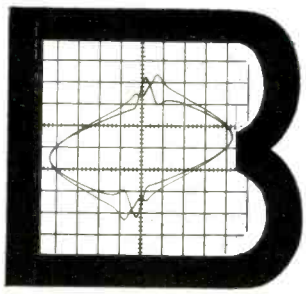
The new Azusa tracking system for the Atlantic Missile Range, Cape Canaveral, Fla., is undergoing final checkout at the San Diego plant of Convair (Astronautics) Div. of General Dynamics. C. M. Hay, Convair-Astranautics engineer, checks plastic radomes.



Dual Beam

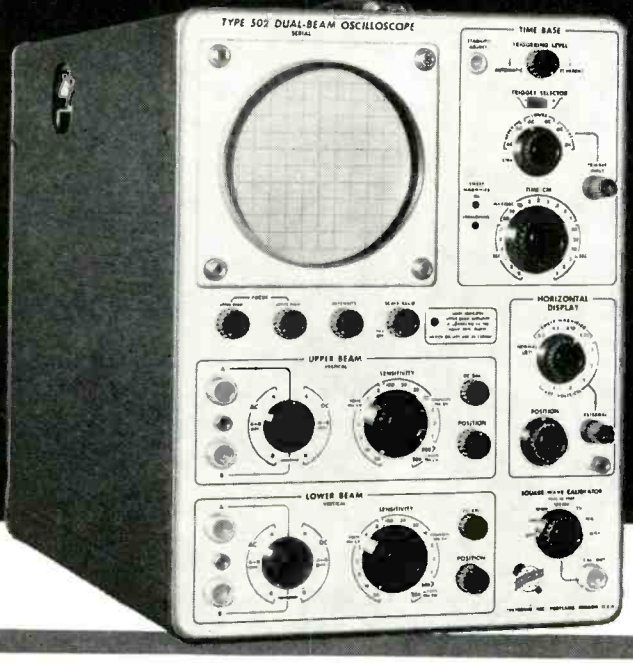


DUAL DISPLAY ON LINEAR TIME BASE—Comparison of waveforms at two points in a ringing circuit. This kind of display is useful in many types of investigation.



DUAL-BEAM X-Y CURVE TRACING—Typical production-test application: display of EI loops of two transformers manufactured under identical conditions.

Type 502 Tektronix Oscilloscope



TWO-GUN CATHODE-RAY TUBE.

200 μv/cm SENSITIVITY, BOTH BEAMS.

DIFFERENTIAL INPUT, ALL SENSITIVITIES.

2, 5, 10, and 20 TIMES SWEEP MAGNIFICATION.

X-Y CURVE TRACING with TWO BEAMS—(horizontal input sensitivity to 0.1 v/cm).

SINGLE-BEAM X-Y CURVE TRACING at 200 μv/cm, BOTH AXES.

EXTRA FEATURE—Both amplifiers have transistor-regulated parallel heater supply.

TYPE 502 CHARACTERISTICS

HIGH-GAIN AMPLIFIERS

200-microvolts/cm deflection factors, both dc-coupled and ac-coupled. 16 calibrated steps from 200 μv/cm to 20 v/cm.

Passbands — dc-to-100 kc at 200 μv/cm, increasing to dc-to-200 kc at 1 mv/cm, dc-to-400 kc at 50 mv/cm, and to dc-to-1 mc at 0.2 v/cm. Vertical response at the lower sensitivities varies according to switch position as follows: 0.5 v/cm—dc-to-300 kc; 1 v/cm—dc-to-500 kc; 2 v/cm—dc-to-1 mc; 5 v/cm—dc-to-300 kc; 10 v/cm—dc-to-500 kc; 20 v/cm—dc-to-1 mc.

Differential Input, Both Channels—Rejection ratios: 1000-to-1 at 1 mv/cm or less, 100-to-1 at 0.2 v/cm, 50-to-1 at 5 to 20 v/cm.

Constant Input Impedance, 1 megohm, 47 μμf, both channels.

WIDE-RANGE SWEEP CIRCUIT (Common to both beams)

Single-knob control for selecting any of 22 accurately-calibrated sweep rates from 1 μsec/cm to 5 sec/cm.

Sweep Magnification—2, 5, 10, and 20 times, accurate within the maximum calibrated sweep rate.

Automatic Triggering—fully automatic, or preset with amplitude-level selection when desired. Sweep can also be operated free-running.

X-Y CURVE TRACING OPERATION

Horizontal-input amplifier permits curve-tracing with both beams simultaneously at sensitivities to 0.1 v/cm. For curve-tracing at higher sensitivities (to 200 μv/cm) with one beam, one of the vertical amplifiers can be switched to the horizontal-deflection plates.

OTHER FEATURES

Amplitude calibrator, 1 mv to 100 v in decade steps — square wave, frequency about 1 kc.

3-kv accelerating potential in new Tektronix 5" dual-beam crt. 8-cm by 10-cm linear-display area, each beam, 6-cm overlap.

Electronically-regulated power supplies.

Price . . . **$825** f.o.b. factory

Here are a few uses for the Type 502:

IN ELECTRONICS—Use the Type 502 as a general-purpose oscilloscope and also to show simultaneously the waveforms at any two points in a circuit, e.g. input and output, opposite sides of a push-pull circuit, trigger and triggered waveform, etc.

IN MECHANICS—Display, compare, and measure outputs of two transducers on the same time base; plot one transducer output against another—pressure against volume or temperature for instance; measure phase angles, frequency differences, etc.

IN MEDICINE—Display, compare, and measure stimulus and reaction, or the outputs of two probes, on the same time base; use differential input to cancel out common-mode signals, or to eliminate the need for a common terminal; use in routine investigations, etc.

IN ALL FIELDS—The Type 502 can save you more than its cost in time—in as little as one application!

Tektronix, Inc.

P. O. Box 831 • Portland 7, Oregon

Phone CYpress 2-2611 • TWX-PD 311 • Cable: TEKTRONIX

TEKTRONIX FIELD OFFICES: Albertson, L. I., N.Y. • Albuquerque • Atlanta, Ga. • Bronxville, N.Y. • Buffalo • Cleveland • Dallas • Dayton • Elmwood Park, Ill. • Endwell, N.Y. • Houston Lathrup Village, Mich. • East Los Angeles • West Los Angeles • Minneapolis • Mission, Kansas Newtonville, Mass. • Orlando, Fla. • Palo Alto, Calif. • Philadelphia • Phoenix • San Diego St. Petersburg, Fla. • Syracuse • Towson, Md. • Union, N.J. • Washington, D.C. • Willowdale, Ont.

TEKTRONIX ENGINEERING REPRESENTATIVES: Hawthorne Electronics, Portland, Oregon., Seattle, Wash.; Hytronic Measurements, Denver, Colo., Salt Lake City, Utah.

Tektronix is represented in 20 overseas countries by qualified engineering organizations.

Trimpot® Trio

MODEL 236 MODEL 260 MODEL 200

MODEL 236 HUMIDITY-PROOF TRIMPOT
Completely sealed to meet Mil Specs for humidity, sand, dust and salt spray, this proved wirewound potentiometer dissipates 0.8 watt at 70°C., operates reliably at temperatures up to 135°C. Resistances from 10Ω to 100K. Choice of terminals and mounting types.

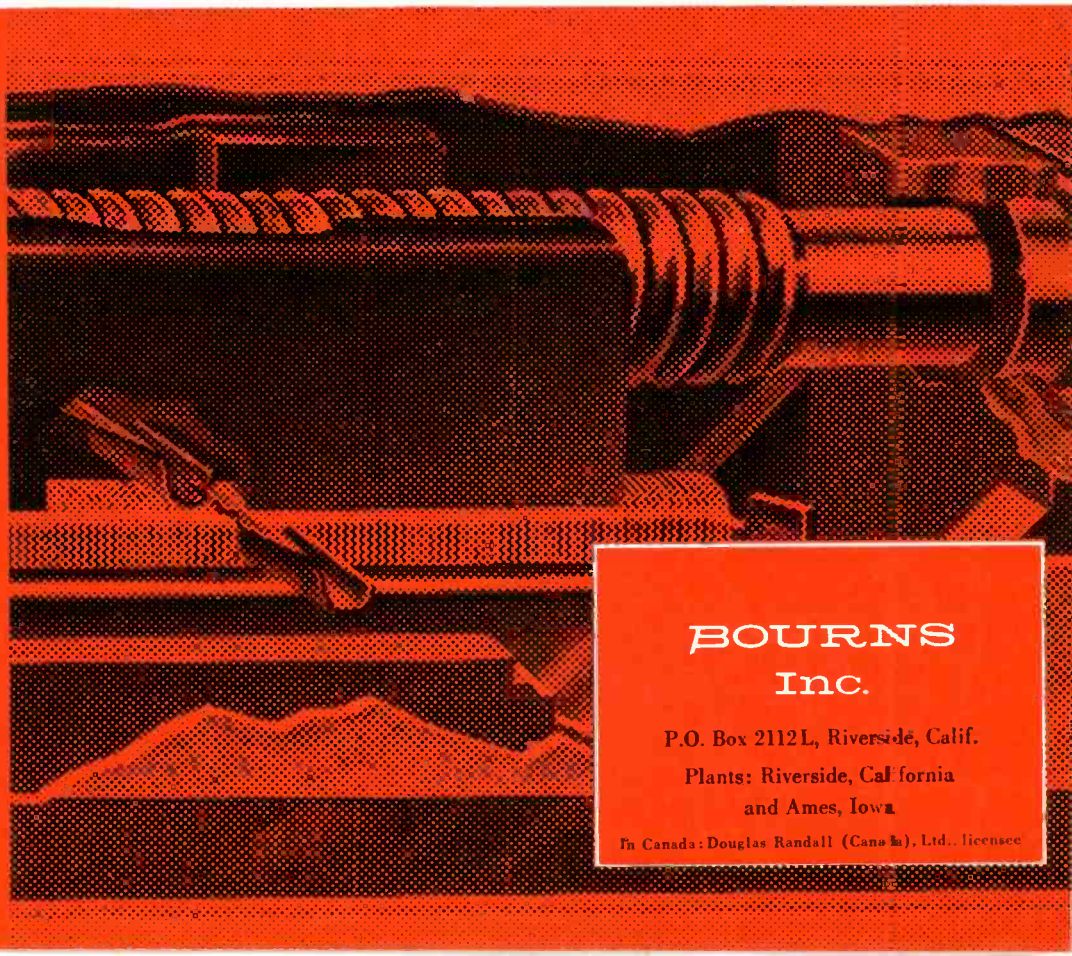
MODEL 260 HIGH-TEMP, HIGH-POWER TRIMPOT
A favorite Mil Spec wirewound unit for hot spots. Use it where you need dependable, continuous operation from —65°C. to +175°C. Dissipates 1.0 watt at 70°C. Resistances from 10Ω to 100K. Choice of terminals and mounting types.

MODEL 200 GENERAL-PURPOSE TRIMPOT
Up-to-the-minute version of the original wirewound Trimpot—used in more military and commercial programs than any other leadscrew-actuated potentiometer. Maximum operating temperature is 105°C. Dissipates 0.25 watt at 70°C. Resistances from10Ω to 100K. Choice of terminals and mounting types.

The reliability of this well-known Trimpot trio has been proved repeatedly in America's toughest military programs. The Trimpot design has become the standard of the industry since Bourns introduced the leadscrew-actuated potentiometer seven years ago. Screwdriver settings are pinpoint sharp and virtually unaffected by vibration, acceleration and shock. Small size and space-saving shape permit installation of 12 units in one square inch.

For your wirewound or carbon potentiometer applications, Bourns offers you an inventory of 500,000 units—stocked by the factory and franchised electronic distributors across the nation. Besides the Trimpot Trio, there are 20 other basic models—each available in a variety of terminal and mounting types. *Terminals:* insulated stranded leads, solder lugs, printed circuit pins and bare wires. *Mounting types:* Panel, chassis and printed circuit. Write for new summary brochure no. 4.

Circle 13 on Inquiry Card



BOURNS
Inc.

P.O. Box 2112L, Riverside, Calif.

Plants: Riverside, California and Ames, Iowa

In Canada: Douglas Randall (Canada), Ltd., licensee

Electronic Industries International

WESTERN EUROPE

Standards Chief on Tour

Harvey W. Lance, Chief of the Electronic Calibration Center at the National Bureau of Standards, Boulder, Col., is visiting 15 countries of Western Europe and North Africa to investigate the electronic standards structure of those countries. Countries include: England, France, Germany, Spain, Portugal, Italy, Greece, Turkey, Morocco, Belgium, Holland, Switzerland, Norway, Sweden, and Denmark.

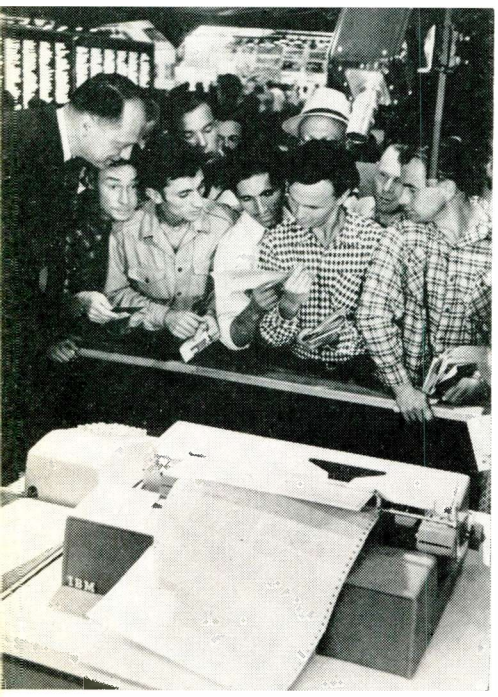
The USAF has a number of contractors in Western Europe and North Africa doing such work as overhauling aircraft and electronic apparatus, as well as producing original equipment. Mr. Lance will act as an electronics expert in a survey being made by the Air Force of the sources of standards in these countries and the application of these standards to Air Force Contracts. It is important that consistent standards be used in all of these countries and that they in turn agree with the standards used in the U. S. Although the NBS is well informed on European work in most areas, there has been little liaison with some countries on high frequency and microwave standards.

CBS to Market Dutch Line

CBS Electronics, a div. of Columbia Broadcasting Systems, Inc., has reached an agreement with Ronette (Ronette Piezo-Electriche Industrie N.V.) of Amsterdam, Holland, for the distribution and license rights in the U. S. for the company's line of phonograph cartridges, microphones, tone arms, and other products. Ronette will be licensed to mfg and sell the Columbia CD cartridge in the European market.

Computer Draws Crowds

IBM RAMAC 305 Computer answers questions about America for these visitors to the American National Exhibition in Moscow. Million word memory answers over 4000 questions.



U.S.S.R.

Protest Russian Use of Admiral Trademark

The Admiral Corporation, Chicago, has protested strongly to the general manager of the Soviet Exhibition of Science, Technology and Culture, held recently in New York, over the Russians' display of a TV receiver with an Admiral trademark. The company claimed infringement by the Russians of its proprietary trade mark which is registered in the U. S. Patent Office and in most of the countries throughout the world.

Admiral asked that the Russian TV set be removed from public display and that the Exhibition "Cease and desist from displaying anywhere any TV or radio receiver bearing the Admiral name."

Said Ross D. Siragusa, president of Admiral, "We have no intention of starting an international incident, but we definitely want to safeguard our trade mark. While we manufacture and sell Admiral TV receivers and other products in 90 countries throughout the world, we do not want anyone to think we are manufacturing or offering our products for sale in Russia."

UNITED KINGDOM

Ampex Represents Marconi in U. S.

Ampex Corp., Redwood City, Calif., has been appointed sole distributor in the U. S. for Marconi's Wireless Telegraph Co., Ltd., TV and broadcasting equipment. Ampex will maintain a stock of complete systems, components, and spare parts for all of the Marconi broadcasting division products it distributes, and will also provide regular quality control checks.

Marconi equipment in the agreement includes the Mark IV TV cameras, camera control units; power supplies, studio cabinets, intercommunication equipment, remote control equipment, master and waveform monitors, diascopes, stabilizing amplifiers, video mixers, distributing amplifiers, sweep generators and other test equipment.

AUSTRALIA

New Licensee for Elco

Elco Corp.'s (Philadelphia) newest affiliate is International Resistance Holding Company, Sydney, Australia, which will operate as Elco-Australasia. Arrangements include manufacture of Elco's products and the contribution of the company's technical skill in manufacturing. The parent company manufactures a line of tube-sockets, shields and varicon connectors for the electronics, nucleonic and missile fields.

Visits U. S.

Robert Eland (right), Standard Coil Products Director of R & D, greets Alfred Deutsch, Director of Thorn Electrical Industries, Eng., in Los Angeles. Deutsch visited Standard's R & D lab.

WEST GERMANY

General Radio Displays at West German Congress

The General Radio Company, West Concord, Mass., will display its complete line of sound meters and analyzers during the Third International Congress for Acoustics, September 1-8 in Stuttgart, West Germany.

German Jets to Get Bendix Navigation Equipment

Bendix Aviation Corp., International Div., will supply an advanced electronic navigation device to equip Lockheed F-104 "Starfighter" jet interceptors for the West German Air Force. The initial order is for $1,600,000.

Developed by Computing Devices of

(*Continued on Page 30*)

IRC Resistance Strips and Concentric Disc Resistors

BASIC CONSTRUCTION

Insulator coated with a resistance material. Insulator usually recommended is a paper grade of XXXP laminated phenolic but other fillers (such as fabric base, woven fiber glass, glass fiber mat or ceramics) are also supplied.

Standard Shapes

Design Shapes

THICKNESSES

Standard: .027" ±.005"

Minimum thickness: .015"

WIDTHS

Maximum: 5"

TERMINATIONS

1. Conductive colloidal silver (available in a variety of terminal patterns). Nonsolderable; requires clips, spring jaws, rivets, eyelets, or other pressure contacts.
2. Solderable silver or conductive adhesives.
3. Copper laminated base for solderable applications.

DESIGN CONSIDERATIONS

a. Diameter of punched holes should be equal to, or larger than, thickness of material.

b. Dimensions should not be less than 1½ times thickness of material.

c. Distance from any outside edge to any hole should preferably be a minimum of 1½ times thickness of material, and never less than material thickness.

d. Ratio of length of strip to width should be as large as possible.

PROTECTIVE COATINGS

Where no contact is to be made to the resistive film, it may be coated for protection from handling and environment.

RESISTANCE VALUES

Discs: 5 to 100,000 ohms.

Strips: 19 ohms/square to 1.0 megohm/square

RESISTANCE TOLERANCES

Discs: ±20% Standard; ±10% or ±5% available.

Strips: ± 20% Standard; ±10% available.

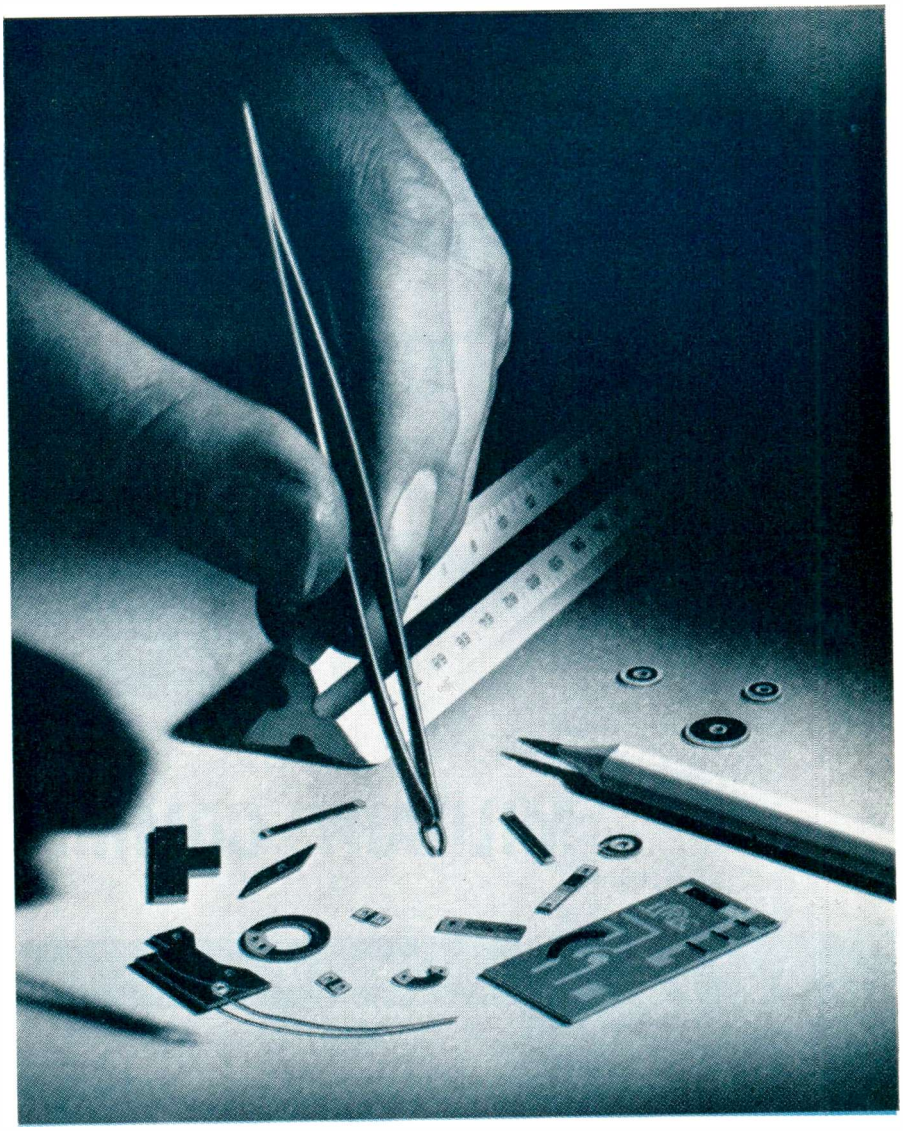
STANDARD DIMENSIONS

Discs: ¼" to 1½" Diam. Thickness—.027" ± .005". Special diameters and thicknesses available.

Strips: Length—12", Width—⅞" to 2¾". Special lengths, widths and thicknesses available.

MAXIMUM POWER RATING

Limited by surface operating temperature—which should not exceed 100°C.



A Way to Miniaturize that Challenges Your Imagination

Electronic components are shrinking in size and weight: Important in the current miniaturizing process is a wafer-thin resistance material with startling design possibilities.

This material, available from IRC originally as Resistance Strips and Concentric Disc Resistors, may now be shaped, punched, and terminated in a variety of ways and sizes. The uses are limitless to anyone with imagination requiring miniature volume controls, say for hearing aids, or miniature adjustable resistors for matching transistors. And now, new IRC techniques can produce on many insulating surfaces microminiature printed resistors!

APPLICATIONS INVITED

IRC has a wealth of design and manufacturing experience with strip and disc resistors and is prepared to counsel with you or take over production and even assembly. Whether your use is standard or special, write for information today . . . Bulletin T-1A

IRC®

INTERNATIONAL RESISTANCE CO., 401 N. BROAD STREET, PHILADELPHIA 8, PA.

DELCO RADIO

NEW POWER TRANSISTORS

MILITARY–COMMERCIAL

	2N1168	2N392	2N1011	2N1159	2N1160
V_{cb} max.	50	60	80	80	80 volts
I_c max.	5	5	5	5	7 amp.
I_{co} (V_{ec} 2 volts) Typical 25 °C.	65	65	65	65	65 μa.
HFE (3 amp.)	–	60-150	30-75	30-75	–
HFE (5 amp.)	–	–	–	–	20-50
AC Power Gain (I_c = 0.6 amp.)	37 DB	–	–	–	–
V_{ceo} (I_c = 1 amp.)	40 typical	50 typical	60 min.	60 min.	60 volts min.
Thermal Gradient max.	1.5	1.5	1.2	1.2	1.2° c/w

Delco Radio rounds out its power transistor line with this new 5-ampere germanium PNP series. Types 2N1168 and 2N392 are specially designed for low-distortion linear applications, while 2N1159 and 2N1160 are outstanding in reliable switching mode operations.

Type 2N1011 is designed to meet MIL-T-19500/67 (Sig. C). It joins 2N665, MIL-T-19500/68 (Sig. C); 2N297A, MIL-T-19500/36 (Sig. C) and JAN2N174, MIL-T-19500/-13A to provide a selection for military uses.

Write today for engineering data on Delco Radio's line of High Power Transistors.

DELCO RADIO

DIVISION OF GENERAL MOTORS
KOKOMO, INDIANA

BRANCH OFFICES

Newark, New Jersey
1180 Raymond Boulevard
Tel: Mitchell 2-6165

Santa Monica, California
726 Santa Monica Boulevard
Tel: Exbrook 3-1465

Circle 15 on Inquiry Card

ELECTRONIC INDUSTRIES *International*

(*Continued from page 26*)

Canada Ltd., Ottawa, a Bendix affiliate, the device is an advanced "dead reckoning" navigation system for single-seater fighter aircraft. Called a position and homing indicator, it computes where it is and keeps track of all course changes and speeds. The pilot has a choice of five pushbuttons, each marked with the name of a target or destination. Pushing a button causes the pilot's indicator to show him the heading to fly and the distance to go in nautical miles. Heart of the system is a miniature analog computer.

U.S.S.R.

Executive Delivers Videotape of Nixon-Khrushchev Debate

Phillip L. Gundy, Vice President of Ampex Corp., Redwood City, Calif., personally carried the tape which recorded the now famous debate between Vice President Nixon and Soviet Premier Nikita Khrushchev at the opening of the American National Exhibition in Moscow. He carried the tape, two inches wide and approximately 1200 feet long, to New York in a briefcase.

The Russian Premier had demanded assurance from the Vice President that the tape would be shown to U. S. TV audiences. Mr. Nixon urged the Soviet Premier to agree that the Russian people also would be permitted an opportunity to see the taped broadcast. Mr. Gundy reported that copies of the tape were reproduced and furnished not only to U. S. networks and to independent stations, and also to the Canadian Broadcasting Co., but both a tape and a kine copy of the tape were rushed to Moscow by air.

NORTH AFRICA

New Telephone System for Tunis

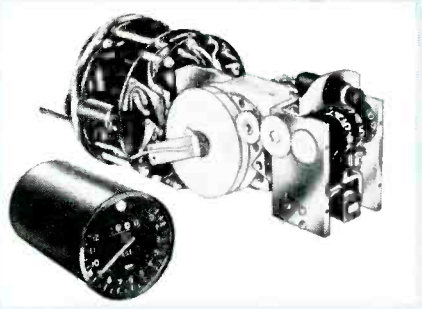
The existing telephone system in Tunis, capital city of Tunisia, comprising 13,000 lines of two different automatic systems, will be dismantled and replaced with 21,000 lines of modern crossbar system under a $2,500,000 contract with the Ericsson Group, Stockholm, Sweden. In addition, a long distance central exchange will be built, and suburban exchanges will be automated with 4,000 lines. The contract also calls for installation of an automatic, 1,000 line system in the city of Bizerte.

Scheduled for completion in four years, the project will be under the direction of Ericsson technicians from Sweden who will train local manpower for operations. 25 Tunisian technicians will receive telecommunications training in Stockholm.

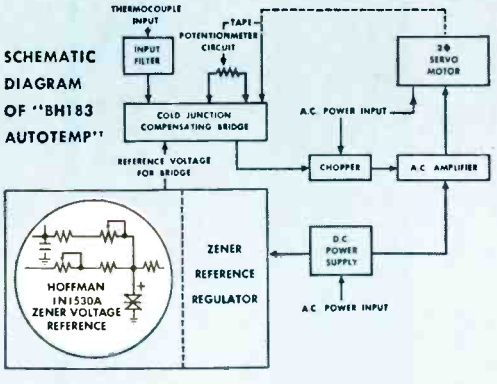
A HOFFMAN SEMICONDUCTOR APPLICATION CASE HISTORY

THIS VOLTAGE STABILITY PROBLEM HAD TO BE SOLVED

FOR CIRCUIT RELIABILITY IN A JET ENGINE TEMPERATURE INDICATOR



Hoffman Zener Voltage Reference Elements were the solution



Engineers of the B & H Instrument Company, Fort Worth, Texas, required an extremely reliable voltage reference device for their BH183 AutoTemp jet engine temperature indicator, used in the Lockheed Electra. . . . They chose a Hoffman 1N1530A Zener Reference Element, because of its STABLE characteristics even when subjected to widely varying environmental conditions.

The low 8.4 volt, zener operating voltage of Hoffman 1N430 and 1N1530 Zener Reference Elements, makes them uniquely suited for use in circuits which are operating at a low D.C. voltage level (from 10 to 30 volts). The units have a voltage stability of ±0.1%, or less, over a temperature range from −55°C to +100°C, at 10mA.

There are over 180 Hoffman Zener Devices available . . . now in the widest possible range of voltage and power dissipation ratings. Write us . . . tell us your problem . . . the Hoffman semiconductor sales engineer in your area will provide the solutions.

If you need a job in electronics done quicker and better, contact

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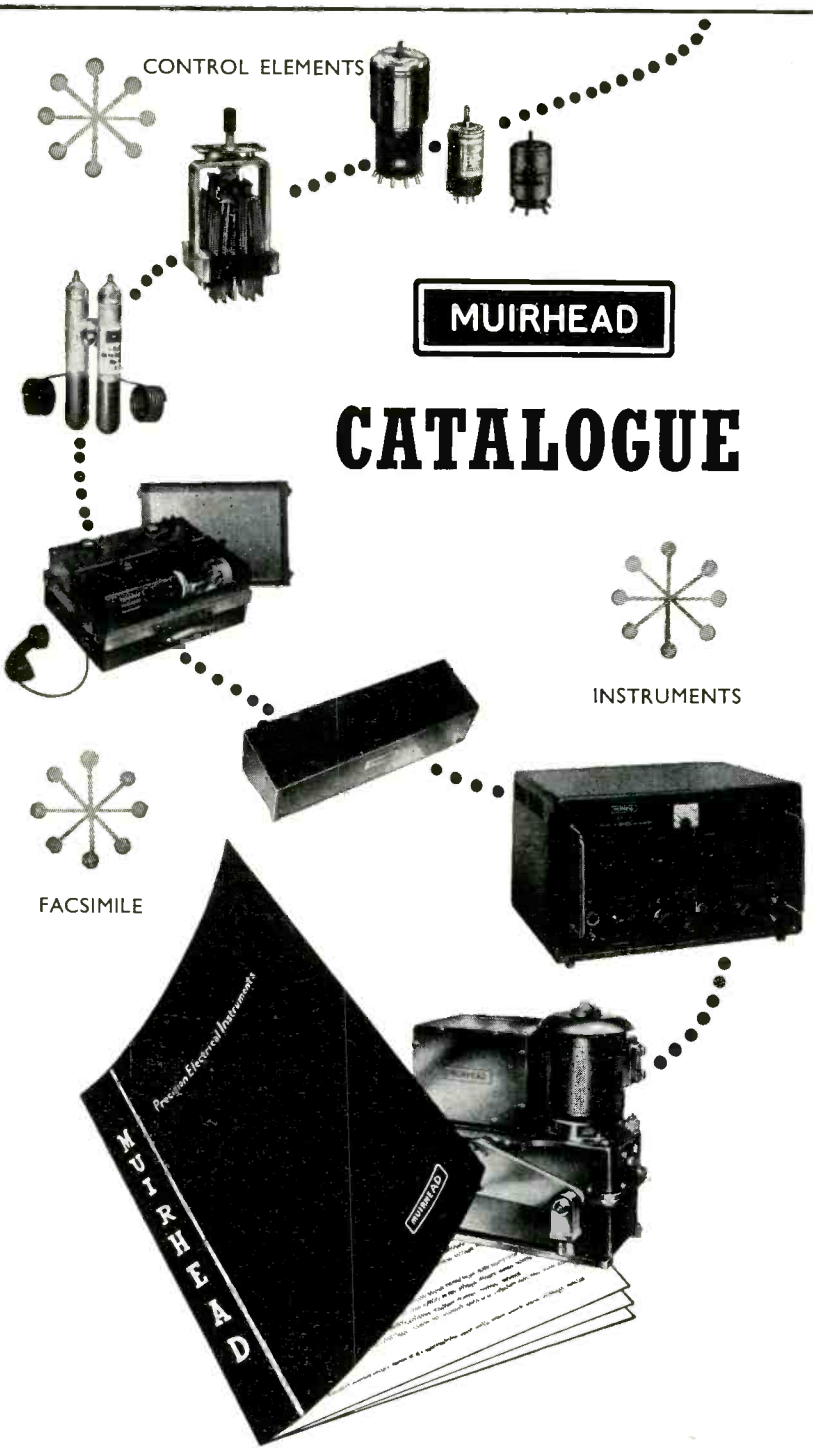
Hoffman Electronics
CORPORATION
SEMICONDUCTOR DIVISION
930 PITNER AVENUE EVANSTON, ILLINOIS



MUIRHEAD CATALOGUE

This 8-page abridged catalogue is intended as an introduction to the Muirhead range of precision products. It contains abridged specifications and descriptions of Muirhead Analysers, Oscillators, A.C. Bridges and associated equipment; Tuning Forks; Laboratory Equipment and Precision Components; Control Units and Facsimile Transmission Equipment.
It is available without charge and will be mailed upon request.

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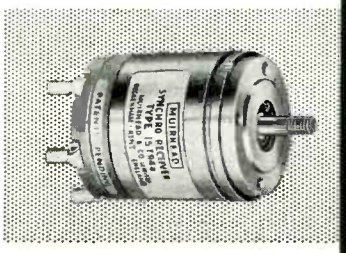


by their superior performance as

MUIRHEAD

Synchros

392

CALIBRATED MICROWAVE FIELD INTENSITY RECEIVER

1000 to 10,000 mc

Absolute measurements of microwave interference and susceptibility

Model FIM

POLARAD

Polarad Model FIM is approved Class A MIL SPEC under MIL-I-006181C (MIL-I-22600) and Ramo- Woolridge Weapons System Specification WDD-M-PRO-2

For the first time, one single microwave test system—Polarad Model FIM Field Intensity Receiver—is capable not only of measuring the absolute level of radiated or conducted interference, but also of determining the signal susceptibility of other instruments and components to such external interference. It combines a **calibrated antenna system, a calibrated receiver** and an **internal calibrated signal generator.**

This versatile precision test instrument serves also for field intensity measurements, propagation studies, antenna pattern analysis, r-f leakage measurements, analysis of r-f signals—and characteristics of transmitters, receivers, and other microwave components.

Four sensitive plug-in tuning units, each with UNI-DIAL control. Meter indicates average, peak or quasi-peak value of r-f signals. Audio, video and recorder outputs.

FREE LIFETIME SERVICE ON ALL POLARAD INSTRUMENTS

MAIL THIS CARD
for detailed specifications. Ask your nearest Polarad representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements"

POLARAD ELECTRONICS CORPORATION
43-20 34th Street, Long Island City 1, N. Y.
Representatives in principal cities

POLARAD ELECTRONICS CORPORATION:

Please send me information and specifications on:

- ☐ Model FIM Calibrated Field Intensity Receiver — EI
- ☐ Model K-200 Microwave Tube Tester* — EDN
- ☐ Model P-3 Transistorized Power Meter*

My application is: _____

Name _____

Title _____ Dept. _____

Company _____

Address _____

City _____ Zone _____ State _____

*See reverse side of this page.

PORTABLE TRANSISTORIZED MICROWAVE POWER METER

- 10 to 39,000 mc
- Battery or line operated
- Light and rugged
- Measures absolute r-f power instantly without tuning

Used for: field or laboratory measurement of absolute r-f power levels; testing and calibration of signal generators, attenuators, traveling wave tubes; testing coax and waveguide systems; measurement of power at locations where AC power lines are not available.

Thermistor elements make the unit safe from accidental overload. Thermistor mounts available in coaxial and waveguide sizes.

Model P-3

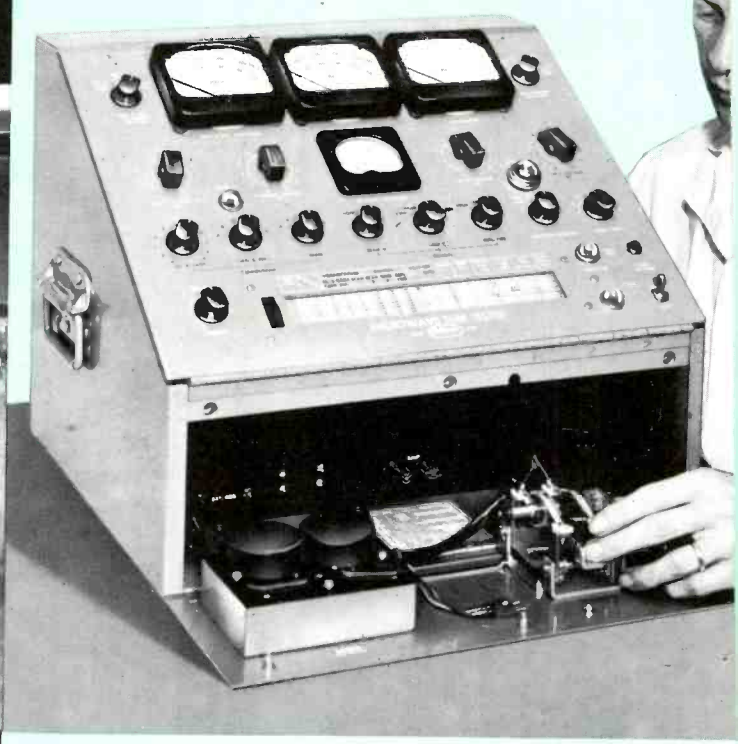
MICROWAVE TUBE TESTER

Simplified Test Saves Engineering Man Hours

No guesswork. No need to fire up complete equipments to determine microwave tube performance. Model K-200 gives rapid, positive decision on costly microwave tubes. Quickly pays for itself by enabling you to reclaim questionable tubes from salvage. Allows Incoming Inspection to check tubes upon receipt and throughout warranty period, without tying up expensive personnel.

Tests all microwave tubes including internal and external cavity types, pencil triodes, rocket and lighthouse tubes. A scroll indicates quick setups to test for filament continuity, short circuits, static d-c tests, life tests, and dynamic tests.

Model K-200



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Need Better Electrical and Thermal Conductivity in a Glass-to-Steel Hermetic Terminal?

For most applications, solid 446 stainless alloy electrodes are best suited to our users needs. They are ideally suited to the perfect mating between our V24M glass and the pin. This fusion of glass and metal together with compression accounts for the rugged leak-proof character of Fusite Terminals under rough production handling and makes for easy solderability.

CONSIDER THE PLUS OF COPPER CORED ELECTRODES

When your application indicates the need for greatly improved electrical or thermal conductivity, you still need not sacrifice these inherent Fusite advantages. At slight additional cost, any of our terminals can be ordered with electrodes that have a copper core of as much as 25% of the total electrode area. Copper cored wire has up to 10 times increased current carrying capacity, yet, you maintain nearly all the advantages of solid 446 stainless.

Would you like to make tests?

Write Department G-5

INSULATE ELECTRICALLY
GLASS TO METAL
FUSITE
TERMINALS
PROTECT PRODUCT PERFORMANCE
SEAL HERMETICALLY

THE FUSITE CORPORATION

6000 FERNVIEW AVE., CINCINNATI 13, OHIO

Woodford Mfg. Co., Versailles, Kentucky.
In Europe: FUSITE N. V. Königsweg 16, Almelo, Holland

Tele-Tips

THE ENGINEER and his involved private life is the subject of a new book, "The Angers of Spring." The jacket blurb is right from Freud; "An American novel about electronics engineers and the women they want, but do not understand."

CAN A COMPUTER be built that will duplicate the learning behavior of the human brain? Dr. David G. Willis of Lockheed believes so. Willis' theory is that changes take place each time the neuron is excited, and this change affects the subsequent behavior. In effect, by retaining a record of their activities throughout their whole life, neurons function as memory elements.

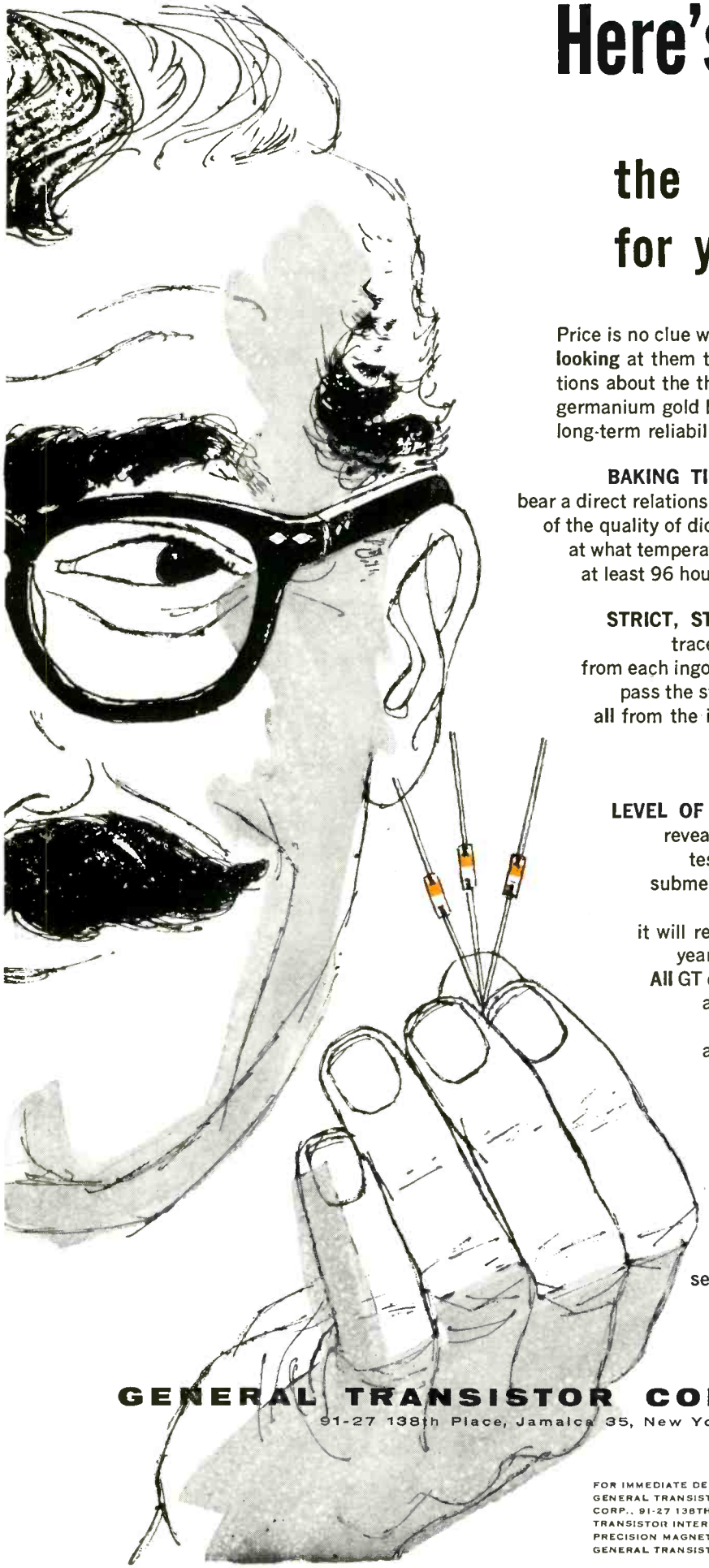
NEW ARMY RADAR is so sensitive that it can spot a man walking 2 miles away. In fact, in a test under ideal conditions in a desert, the radar picked up a soldier walking 15 miles away. It can even distinguish men from women, by the differences in their walks.

ELECTRONIC WRIST WATCH will be marketed some time next year by Bulova. Designed around transistors and powered by a chemical battery, the watch eliminates mainspring and balance wheel. Models will run approximately 17-18 months without changing battery.

"FLYING SAUCERS" are getting less and less attention, as the Air Force steps up its investigation of UFO's (Unidentified Flying Objects). The latest report, for the first six months of this year, shows 143 reports of UFO's, with only 3 not definitely identified as being either balloons, aircraft, astronomical, birds, searchlights or hoaxes.

SPACE GENERATOR that uses solar energy has been developed by Westinghouse and Boeing for space vehicles. Actually a thermo-

(*Continued on page* 40)



Here's how to pick the best DIODES for your money

Price is no clue when diodes sell for about the same, and just **looking** at them tells nothing. But if you ask the right questions about the three key factors in the production of **quality** germanium gold bonded diodes, you have your clues to more long-term reliability for your money. Here they are:

BAKING TIME AND TEMPERATURE
bear a direct relationship to long-term stability. You get a measure of the quality of diodes by asking: "How long do you bake, and at what temperature?" (**All** GT diodes are baked at 140°C for at least 96 hours—the highest and longest in the industry!)

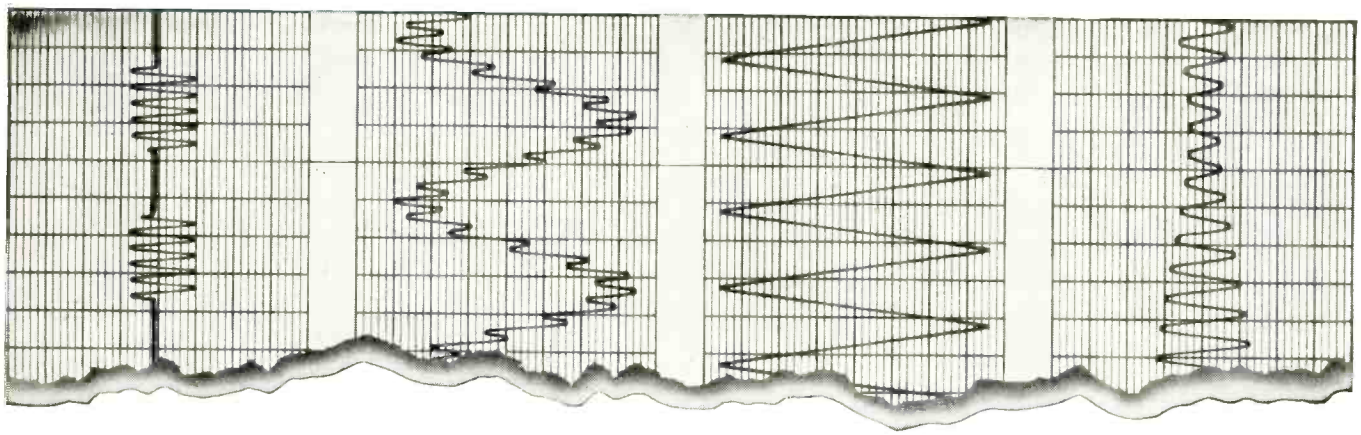
STRICT, STATISTICAL, HISTORY LOGGING
traces the progress of every single wafer made from each ingot of germanium. At GT, if a few wafers fail to pass the stringent GT quality tests along the way, then **all** from the ingot are suspect and can be identified and pulled out. There are no "stowaways" in a shipment of GT quality diodes.

LEVEL OF TESTING STANDARDS
reveals the level of quality. Ask about "everyday" test standards. (In the GT Seal Test, diodes are submerged in a penetrant-dye solution for 24 hours under 75 psi. This test is so sensitive that it will reveal a leak so small it would take over 300 years for 1 cc of gas to diffuse through the case.) **All** GT quality tests—100% electrical, 100% shock and vibration, and 100% temperature cycling—are at the highest industry level... and as a final mark of quality, the color bands on GT Germanium Gold Bonded Diodes are baked on to stay.

GT is equipped to supply diodes tested to individual customer requirements, such as JAN Qualification Inspection Tests and many others.
To get the full measure of quality in Germanium Gold Bonded Diodes, see your GT representative; or write directly to the company with know-how **NOW.**

GENERAL TRANSISTOR CORPORATION
91-27 138th Place, Jamaica 35, New York

FOR IMMEDIATE DELIVERY FROM STOCK, CONTACT YOUR NEAREST AUTHORIZED GENERAL TRANSISTOR DISTRIBUTOR OR GENERAL TRANSISTOR DISTRIBUTING CORP., 91-27 138TH PLACE, JAMAICA 35, NEW YORK. FOR EXPORT: GENERAL TRANSISTOR INTERNATIONAL CORP., 91-27 138TH PLACE, JAMAICA 35, NEW YORK. PRECISION MAGNETIC RECORDING HEADS AVAILABLE FROM GENERAL TRANSISTOR WESTERN CORP., 6110 VENICE BLVD., LOS ANGELES, CALIF.



TO USERS OF BRUSH DIRECT-WRITING RECORDERS!

Specify only Brush engineered chart paper for highest quality records!

THERE is an important difference in chart papers and recording supplies . . . and the reason is that all Brush equipment and supplies are *engineered as a total entity.*

Chart paper, pens, ink and the equipment are specifically designed to realize the full potential of the recording system. The result —highest quality chart records attainable.

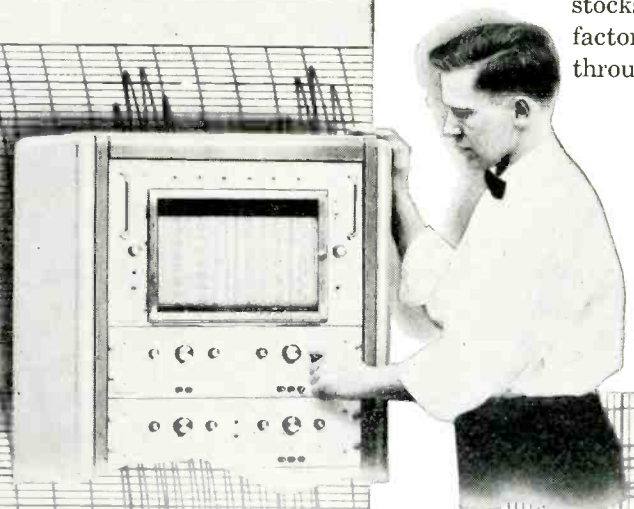
Brush chart paper is:

—precision ruled to insure exact calibration.
—dimensionally stable in any atmosphere.
—super-smooth to minimize erratic trace and pen wear.

Your records are accurate, permanent, immediately usable, legible and easily reproduced when you use Brush chart paper.

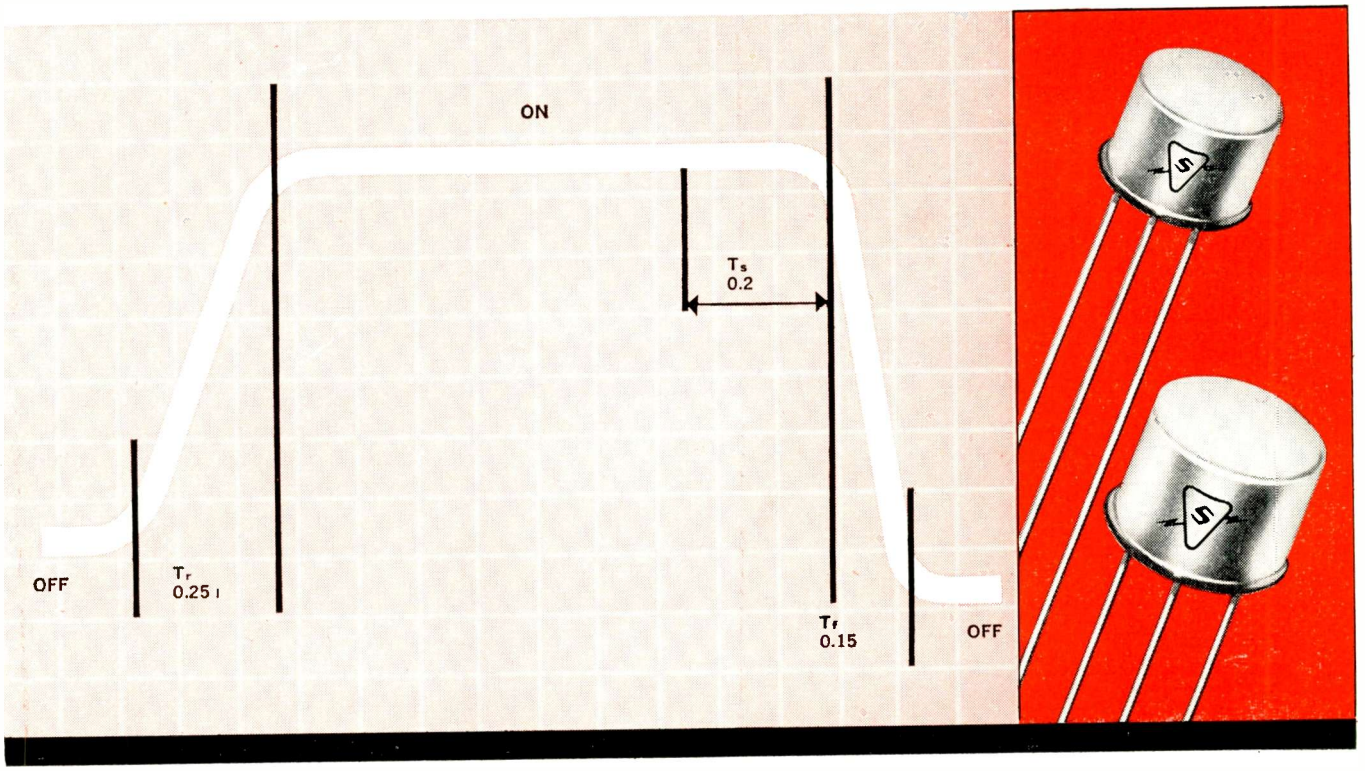
For the most dependable results from your Brush equipment — make certain you specify Brush chart paper and supplies. Complete stocks available from strategically located factory branches and sales representatives throughout the U. S. and Canada.

Write for free literature "Check the Record," containing samples of Brush engineered chart paper.



brush INSTRUMENTS
DIVISION OF
CLEVITE CORPORATION
37TH AND PERKINS CLEVELAND 14, OHIO

SYLVANIA MEDIUM AND *HIGH SPEED* SWITCHING TRANSISTORS



Both NPN and PNP types that switch in tenths of microseconds

Design engineers can get both NPN and PNP medium and high-speed switching transistors in quantity from Sylvania. Each type in the line is designed especially for computer and switching applications. They feature close control of current gain and frequency cut-off and are especially adaptable to high-temperature use.

These Sylvania medium and high-speed switching transistors are widely used in military equipment because of their outstanding reliability and stability. Each of the types is subjected to 100% leak tests and stabilizing tests that assure top performance under the toughest operating conditions.

Each type is encased in a JEDEC TO-5 package with the Sylvania welded hermetic seal for full protection against humidity and other severe environmental conditions.

Send for your free booklet on Sylvania computer transistors, or call your representative.

SYLVANIA MEDIUM AND HIGH-SPEED SWITCHING TRANSISTORS

Type	Collector to Base V	Emitter to Base V	Power Diss.	Freq. Cutoff, fab V_{CB} = 6 v. I_c = 1 ma min.
		NPN		
2N358	25 v	25 v	100 mw	5 mc
2N377	25 v	15 v	150 mw	2.5 mc
2N385	25 v	15 v	150 mw	4 mc
2N388	25 v	15 v	150 mw	5 mc
2N438	25 v	25 v	100 mw	2.5 mc
2N438A	25 v	25 v	150 mw	2.5 mc
2N439	25 v	25 v	100 mw	5 mc
2N439A	25 v	25 v	150 mw	5 mc
2N440	25 v	25 v	100 mw	10 mc
2N440A	25 v	25 v	150 mw	10 mc
2N679	25 v	15 v	150 mw	2 mc
		PNP		V_{CB} = 5 I_E = 1 ma min.
2N404	−25 v	−12 v	120 mw	4.0 mc
2N425	−30 v	−20 v	150 mw	2.5 mc
2N426	−30 v	−20 v	150 mw	3.0 mc
2N427	−30 v	−20 v	150 mw	5.0 mc
2N428	−30 v	−20 v	150 mw	10.0 mc

SYLVANIA
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

Sylvania Electric Products Inc.
Semiconductor Division
100 Sylvan Rd., Woburn, Mass.

Circle 25 on Inquiry Card

Tele-Tips

(*Continued from page* 36)

electric generator the new device takes heat from the sun and by means of generating materials converts it to electricity.

LATEST RED JOKE making the rounds in Moscow identifies the foremost Russian inventor as Comrade Reguspatoff (Reg. U. S. Pat. Off.).

HIGH-SPEED PRINTER developed by A. B. Dick Co. for use with computers uses a cathode-ray electrostatic printing tube, which beams the characters onto resin-coated paper. Printing rate is 20,000 characters/sec, or up to 180 ft/min of standard rolls of paper.

COMPUTERS are being put into use to help the airlines meet the scheduling and passenger handling problems of the jet age. Bendix Aviation Corp. is building a special computer for United Airlines that selects an optimum flight plan from data on the type of aircraft, route to be flown, wind and temperature in relation to the altitudes available, fuel consumption and gross weight.

RUSSIANS are accused of pirating American trademarks. Admiral Corp. asked the Soviet Exhibition of Science, Technology and Culture in New York to remove a TV set bearing Admiral's trademarks.

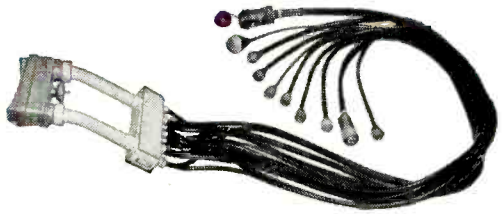
PHYSICIST Dr. Otto Halpern won an important victory for science and engineering last month by wresting a $340,000 settlement from the Defense Dept. for his invention of an absorbing material that prevents aircraft from being detected by enemy radar. His 18-year fight for patent rights, turned down repeatedly by the government on security grounds, thus ended with him relinquishing completely his rights to "the development of a material and method for absorbing electromagnetic radiation." The device is still in use.

Cable assemblies by BENDIX

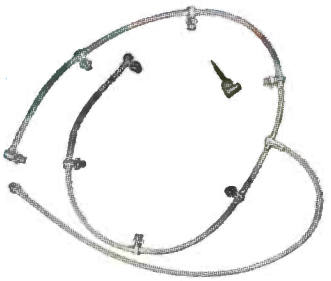
Specialized designs for the most exacting requirements

The versatility of design and reliability of performance offered by Bendix* Cable Assemblies result from over a quarter century of precision manufacturing in this field. Our outstanding research and design facilities are available for custom designing cable assemblies to meet your specialized requirements on each installation. Cable assemblies shown are typical Scintilla Division developments in cabling for aircraft, electronic and missile applications.

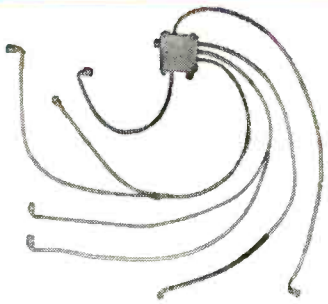
*REG. U. S. PAT. OFF.



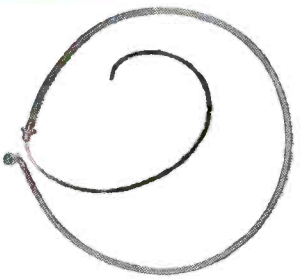
MISSILE CONTROL CABLE: This cable is fabricated using both Benseal® (a plastic molded covering) and Bendix electrical connectors. Protects vital circuitry controlling the firing of missiles.



THERMOCOUPLE HARNESS: Flexible, completely sealed and suitable for continuous operation in ambient temperatures of —65°F to 1500°F. Thermocouples are singly detachable and the sealed harness eliminates any chance of trouble from altitude, moisture or other contaminants.

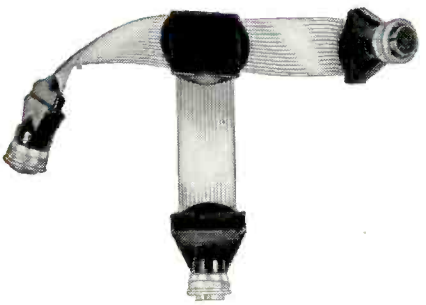


CONTROL HARNESS: This configuration, encased and sealed in metal braid and complete with junction box, can safely withstand the adverse effects of engine environment such as heat, vibration, and oils.



FUEL CELL CABLE: Safely conducts electricity to fuel control valves, pumps, switches and gaging devices immersed within fuel cells. Features: unbroken stainless steel bellows type conduit, double layer protection between current carrying conductors, stainless steel integral connector shells.

HEAVY DUTY CABLE: Ground support cable assembly built and designed for hard usage at missile launching sites. Heavy duty moldings and a tough neoprene tubing combine to resist wear.



RIBBON CABLE: Ribbon type cable terminated to both standard MS or Bendix Pygmy® connectors. Advantages offered by this type of wiring include durability, performance, lightness, plus minimum space requirements.

Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N.Y. Canadian Affiliate: Aviation Electric Ltd., 200 Laurentien Blvd., Montreal 9, Quebec

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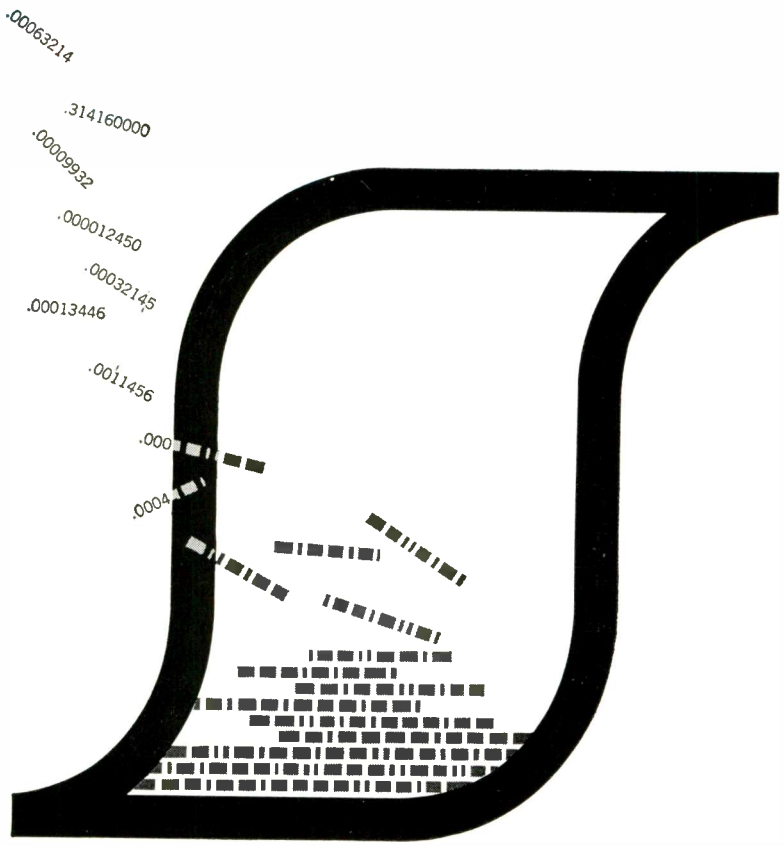
Circle 27 on Inquiry Card

TAPING CRITICAL INFORMATION?

"SCOTCH" Brand high potency oxides let you pack more bits per inch!

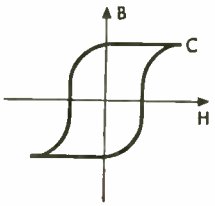


Every day SCOTCH Brand High Resolution Tapes are getting the nod for more instrumentation jobs. The reason? Performance. In taping high frequency data, the sharper resolution lets you pack more pulses to the inch—a greater density of information to each foot of tape.

At the root of this advance are the high potency oxides used in the magnetic coating. The higher magnetic retentivity of these oxides—about a third more than standard—offers distinct advantages. It permits the use of a thinner magnetic coating which may be combined with a thinner polyester base. Naturally, this means a more flexible tape — one that conforms for more intimate tape-to-head contact, automatically improving resolution in the taping of high frequencies.

Even so, you don't have to sacrifice output in low frequencies. For in addition to the marked increase in sensitivity to short wave lengths, SCOTCH Brand High Resolution Tapes show some increase in sensitivity even to long wave lengths.

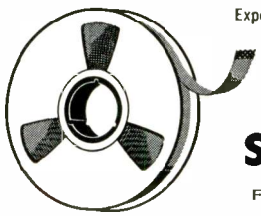
These more flexible tapes cut drop-outs, too. With better tape-to-head contact, there's less chance that a stray bit of dust can sneak between tape and head to cause a drop-out. The superior magnetic properties of SCOTCH Brand High Resolution Tape No. 159 show up in oscilloscope tests—producing a good squared-up hysteresis curve like that shown at the right, and symbolically illustrated at the left.



Whatever your application—data acquisition, reduction or control programming—you can count on SCOTCH Brand technology to create tapes of higher uniformity and reliability for error-free performance.

SCOTCH Brand High Output Tape No. 128 provides the sensitivity for good output in low frequencies, even under extremes of ambient temperature. SCOTCH Brand Sandwich Tapes No. 188 and 189 offer extremely long life and reduced head wear in digital work and many AM, FM and PDM applications. Finally, for top performance at low cost per foot, SCOTCH Brand Instrumentation Tapes No. 108 and 109 remain the standard for the industry.

Where there's no margin for error, there's no tape like SCOTCH Brand. For more details, mail reader inquiry card or write Magnetic Products Div., Dept. MBR-99, 3M Co., St. Paul 6, Minn.



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FOR INSTRUMENTATION

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COAXICON offers not only the fastest method of attaching disconnects to your shielded wire . . . it is not only the most reliable disconnect you can buy—for either free hanging or panel mounted applications . . . not only the most economical on the market . . . but . . . COAXICON now fits shielded cable sizes up to ¼" O.D. with interchangeable contacts that permit a wide variation of inner conductor diameters in each cable size.

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Personals

Solomon Charp has been appointed a Consulting Engineer at General Electric Co.'s Missile and Space Vehicle Dept. He had been Sr. Staff Engineer with the Franklin Institute.

Robert E. Lewis joins Beckman & Whitley, Inc. of San Carlos, Calif., as a Sr. Optical Engineer on the development of optical systems for high-speed instrumentation. He was previously in the Scientific Bureau of Bausch & Lomb Optical Co.

Harvey M. Ross, Chief Engineer of the Defense Systems Lab. at Motorola's Western Military Electronics Center, has been named Manager of Program Development.

H. M. Ross

R. W. Hanford

Richard W. Hanford has joined the Engineering Staff of Advanced Military Systems, Defense Electronic Products, Radio Corp. of America. He had been Technical Director, Missouri Research Labs., St. Louis.

Robert Beagles has joined Packard Bell Electronics as Chief Engineer of Advanced Development, Technical Products Div. He has previously been associated with three major companies—RCA, Bendix and North American Aviation.

Promotion of three engineers to Sr. Scientists at ITT Laboratories, Nutley, N. J., has been announced. Named were **Richard E. Gray**, former Sr. Project Engineer of the Radio Communication Lab., and **Henry F. Herbig** and **Malcolm C. Vosburgh**, former Executive Engineers of the Wire Communication and the Avionic Systems Labs. respectively.

Dr. Robert M. Witucki has joined Hoffman Electronics Corp.'s new Science Center in Santa Barbara, Calif., as a Sr. Scientist.

J. James Farzan has joined The Thompson-Ramo-Wooldridge Products Co. as a Project Engineer.

Bernard R. Garrett has been appointed Acting Chief Engineer of Loral Electronics Corp. He was formerly Assistant Chief Engineer.

Telechrome brings to TV broadcasters a vastly improved system for producing a wide variety of dramatic wipes, inserts, keying and other special effects. The superb engineering of the Telechrome Special Effects System provides outstanding reliability and technical performance when used for either color or monochrome TV. Simplicity of pattern selection and wipe speed is provided by manual switches on the remote control unit.

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- Simplest to operate. All 72 wipes available at all times
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- Additional camera input allows keying from camera signal.
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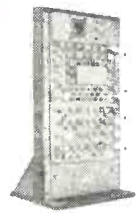
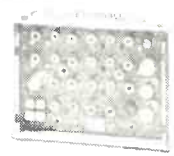


Rack Mounted

490W1 Waveform generator. Generates keying signals for the 72 different wipes.



490S1 Switching Amplifier. Combines two picture signals in accordance with applied keying waveform.

490R1 Remote Control Unit. Selects and controls desired effect. Designed for console or desk mounting. Easily modified for integration into existing studio facilities. Complete with power supply — 512CR.

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Letters

to the Editor

"How to Specify Filters"

Editor, ELECTRONIC INDUSTRIES:

Thank you for the opportunity to answer the letter reflecting the criticism of the EIA committee, SQ-19, regarding my article in your publication.

I must take issue with the first sentence of the third paragraph of Mr. Gross' letter. I have tried to take a practical approach in a field that until recently has been handled in a very theoretical manner. Perhaps my answer to the committee's main point of contention, insertion loss measurement, will substantiate my statement.

When an engineer decides he will use a filter, he must determine what driving circuit he will use. While the filter is being designed and built, he can proceed with the design of the driving circuit by substituting a resistor for the filter, using a value that represents the filter input impedance.

When the completed filter is received, it can be substituted in the driving circuit for the resistor. The input voltage to the filter will be the same as the driving circuit voltage when the resistor was in the circuit. Thus, from the practical viewpoint, the insertion loss of the filter (or more appropriately the voltage transfer constant) is:

$$DB = 20 \log \frac{E_{in}}{E_o}$$

Where E_{in} = input voltage to the filter at the reference frequency

and E_o = output voltage at the reference frequency.

Academically, I would never argue with the correctness of the generalized formula for insertion loss stated by so well known an authority as author Shea. However, those engineers who have used a filter to comlete the d.c. path to the plate of the driver tube, would find themselves hard pressed to determine insertion loss by measuring the current on the load side of the filter before and after insertion. Obviously, the current is non-existent before insertion of the filter.

I believe as long as impedance values are kept in mind, either insertion loss or voltage transfer constant as I establish them are correct.

The formula for attenuation or frequency response, as stated in the letter, is identical to the one given in my article so therefore I am at a loss to determine why it is reiterated.

The committee is correct in disagreeing with the labeling of the pass band as the band of minimum attenuation in band reject filters. Reject band is correct and I referred to it as such in my text when discussing the attenuation reference level. The drawing was in error.

Again, I was misleading in my statement about phase shift. Although I was referring to single section filters I did not state so in the article.

Regarding input or output impedance measurement, the filter impedance is usually largely resistive at the center band or reference frequency where the measurement is made. For all practical purposes, the measurement is sufficient and correct.

I feel the committee misinterpreted my remarks regarding size. For a given type of filter the fact remains that filter size decreases with increasing frequency, and, for equal numbers of sections and similar electrical parameters, low pass and high pass filters are physically larger than band pass and band rejection types.

Toroids are notoriously affected by voltage levels, exhibiting changes in inductance. Below one volt the inductance variation is negligible. The effect is most apparent on extremely narrow, band pass or band reject filters. For example on a 30 cycle band pass filter (3 db bandwidth) measured at one volt rms input the bandwidth will reduce to about 24 cycles at a 10 volt rms input level, due to detuning because of inductance change. Again, I repeat, that low level operation below one volt rms reduces this effect to a great extent. Filters can be operated at high levels but the engineer should be fully aware of the complications. Of great importance is measuring filter response and other characteristics at exactly the same voltage level as is to be applied to it in the circuit.

Most texts, when discussing filters, refer to the 3 db points when mentioning band edge frequencies or cutoff frequencies. In recent years 6 db and 10 db points have been used quite frequently. I have found that in conversations with various engineers, unless a specific db reference is given, each engineer is referring to a different standard. I am recommending that the 3 db points remain the standard reference, not that other important points should be neglected.

Quoting from my article, I stated, "Although the pass band is one particular part of the frequency response curve, it is the most important characteristic and therefore, should be specifically defined."

I hope this letter eliminates any reader confusion caused by my article. If better military and industrial filter specifications are created, at least in part due to the article, then I am quite satisfied.

Stanley Boyle
Supervisor

Radioplane,
Div. of Northrup Corp.

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Resistance range	10 ohms to 30K ohms	10 ohms to 50K ohms
Standard tolerance	± 5%	± 5%
Size	.180" x .300" x 1.000"	.180" x .300" x 1.25"
Screw adjustment	17 ± 2 revolutions	25 ± 2 revolutions
Weight	.2 grams	2.5 grams

- Completely sealed
- Meets humidity requirements of MIL-STD-202A, Method 106A or MIL-E-5272A, Procedure 1
- End resistance is 3%, maximum
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*or exceed

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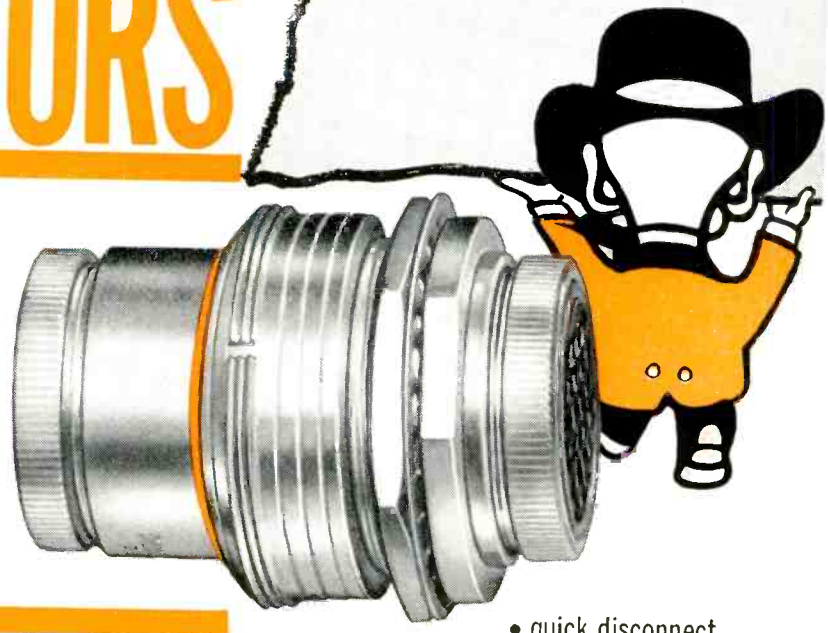

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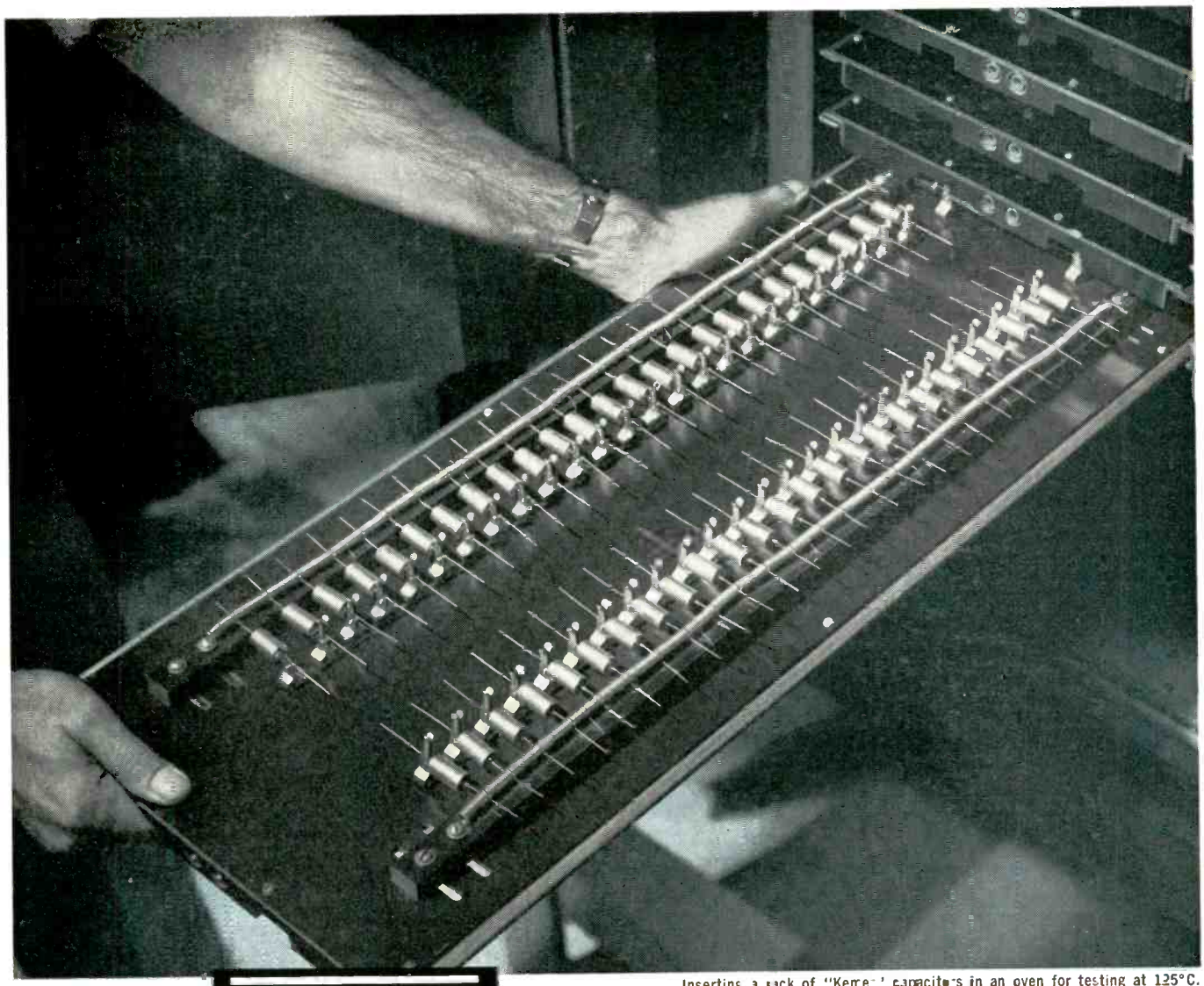

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...and more than 90% of regular production capacitors have been life tested for at least 300 hours.

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OFFICES: 11901 Madison Avenue, Cleveland 1, Ohio

How Indiana Steel's engineers help you solve micro-wave magnetic problems

Engineers at The Indiana Steel Products Company are in constant contact with leading manufacturers of micro-wave equipment on problems involving permanent magnets. Consultations with Indiana's magnet specialists have resulted in time and cost savings — often eliminating expensive redesign.

CASE IN POINT:

A leading micro-wave component manufacturer. *Problem:* Produce a special load isolator magnet to fit smaller space contour in a new radar unit. Also, deliver the new magnet to the customer in 12 days.

Solution: Indiana engineers turned to their previous design files, selected an existing magnet and modified it to meet the new size specifications. Gauss tests showed that the new design met the customer's specified magnetic field range. The magnet was delivered within the time specified.

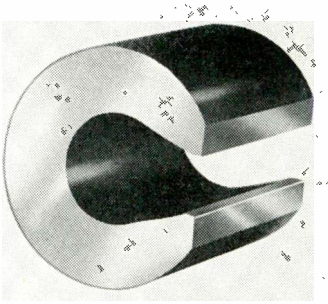
This is just one of many hundreds of cases where Indiana permanent magnet specialists have applied their unequaled experience to solve a magnet problem *ahead* of a customer's deadline. Indiana not only has the engineering know-how, but also manufacturing equipment from previously designed magnets which may be quickly adapted to meet special requirements.

THREE BASIC DESIGNS FOR LOAD ISOLATOR APPLICATIONS

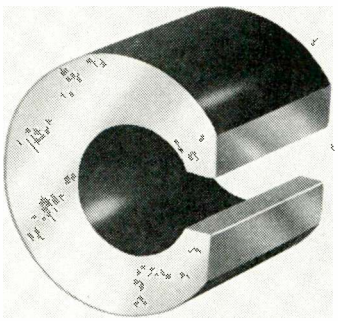
Permanent magnet specialists at Indiana Steel utilize three basic magnet designs for load isolator applications. These are, two variations of the C magnet, and the U magnet. All three of these designs can be varied to meet specific customer requirements. Actual size and shape of any individual magnet is dependent upon size limitation of the load isolator, and the magnetic field strength needed.

WIDE EXPERIENCE IN MICRO-WAVE APPLICATIONS

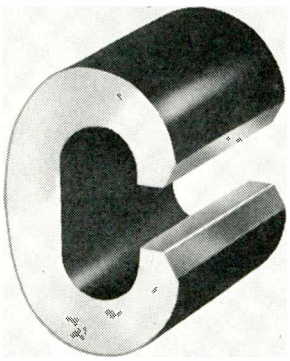
Magnet specialists at Indiana have designed and produced permanent magnets for a wide range of micro-wave applications including pm-focus traveling wave tubes, load isolators, radar magnetrons, backward wave oscillators. And, you can be sure the material selected is *best* for your particular application because Indiana Steel produces *all* permanent magnet materials. Our engineers will give prompt attention to your micro-wave problems or any other permanent magnet applications. Call your Indiana man or write us direct. Ask for Catalog No. 20, "Alnico V Load Isolator Magnets." Dept. N-9.



U Magnet



C Magnet



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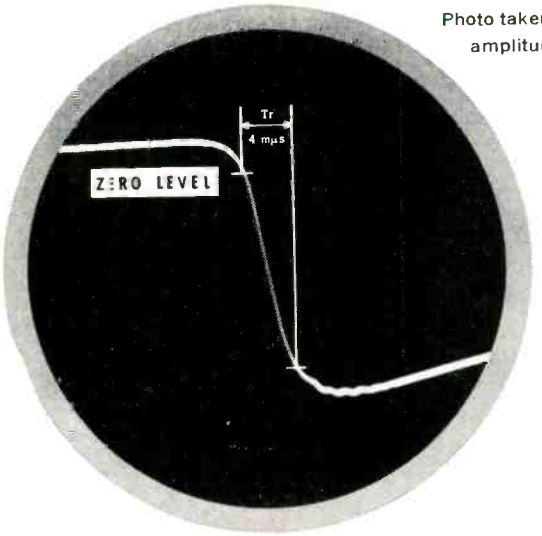
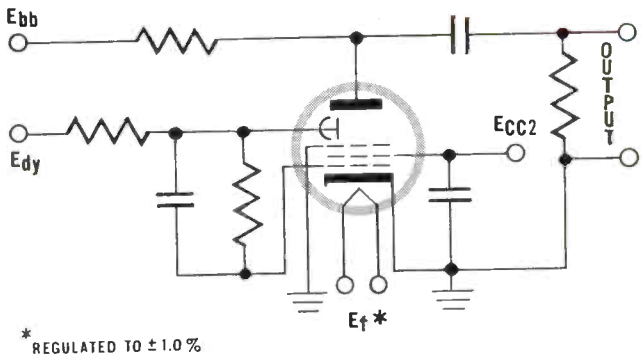
ULTRA-FAST RISE TIME
HIGH PULSE CURRENT
AND DEPENDABLE LIFE

Photo taken with direct coupling to CRT. (T_r 1.5mμs): amplitude 1 amp., rep. rate 100kc.





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Pulse output current	1 amp max
Rise time	4 mμs (N.S.)
Transconductance (I_b = 18 ma)	25,000 μmhos

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Plate voltage	1000 vdc
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Screen voltage	200 vdc
Plate dissipation	4 w
Dynode dissipation	3 w
Screen dissipation	1.4 w

The new CBS 7548 easily outperforms conventional tubes and transistors in triggered or free-running pulse generators. This practical secondary-emission tube generates in the circuit shown pulses with a rise time of less than 5 millimicroseconds. Its high dissipation ratings for plate and dynode permit an amplitude of one ampere or a repetition rate up to 300 kc. Under specified operating conditions, the tube has a life expectancy of 5000 hours. Note the simplicity of circuit made possible by this new break-through by CBS advanced engineering.

The miniature CBS 7548 also combines high transconductance with low capacitances for a gain-bandwidth product of 350 compared with 120 for a 6AK5. Check the characteristics. Write for Bulletin E-352 giving complete data.

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Books

Portfolio Selection: Efficient Diversification of Investment

By Harry M. Markowitz. Published 1959 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 344 pages. Price $7.50.

Embracing several fields of widespread and growing interest—finance, economics, operation research, and electronic computers—this book applies modern techniques of analysis and computation to the problem of finding combinations of securities which best meet the needs of the private or institutional investor. Efficient diversification is sought, taking into account factors such as lightly income and appreciation, uncertainty of income and appreciation, and the degree to which various security returns tend to rise and fall together.

The author discusses the theory of rational behavior under risk and uncertainty and its relationship to problems such as the choice of criteria and a portfolio analysis. He seeks a firm theoretical foundation for financial practice and makes use of conceptual and computational advances—mostly post World War II—not previously available in financial literature.

Of particular interest to the Operations Research specialist is the development of a computing technique for solving "quadratic programming" problems that arise in analyzing portfolios.

Paris Symposium on Radio Astronomy

Edited by Ronald N. Bracewell. Published 1959 by Standard University Press, Stanford, Calif. 612 pages. Price $15.00.

Sponsored jointly by International Astronomical Union and the International Scientific Radio Union, the Paris symposium of 1958 brought together the world's leading researchers in radio astronomy to exchange information on the latest advances in their field. This volume records the research papers presented at this symposium, a report of the discussions, and a dozen detailed summaries of the background and current state of major fields of radio astronomy. The index incorporates a key to the technical literature.

The main topics covered are moon reflections; radio emissions from Jupiter and other planets and from the quiet and active sun; radio studies of the discreet radio sources (radio stars); radio evidence from the large-scale structure of our own and external galaxies; cosmology; and mechanisms by which solar and cosmic radio waves are generated.

This book will be useful not only to an astronomer but also to scientists and engineers concerned with new results bearing on interplanetary space, as well as to other scientists and amateur astronomers interested in the latest discoveries throughout the universe.

(*Continued on page* 54)

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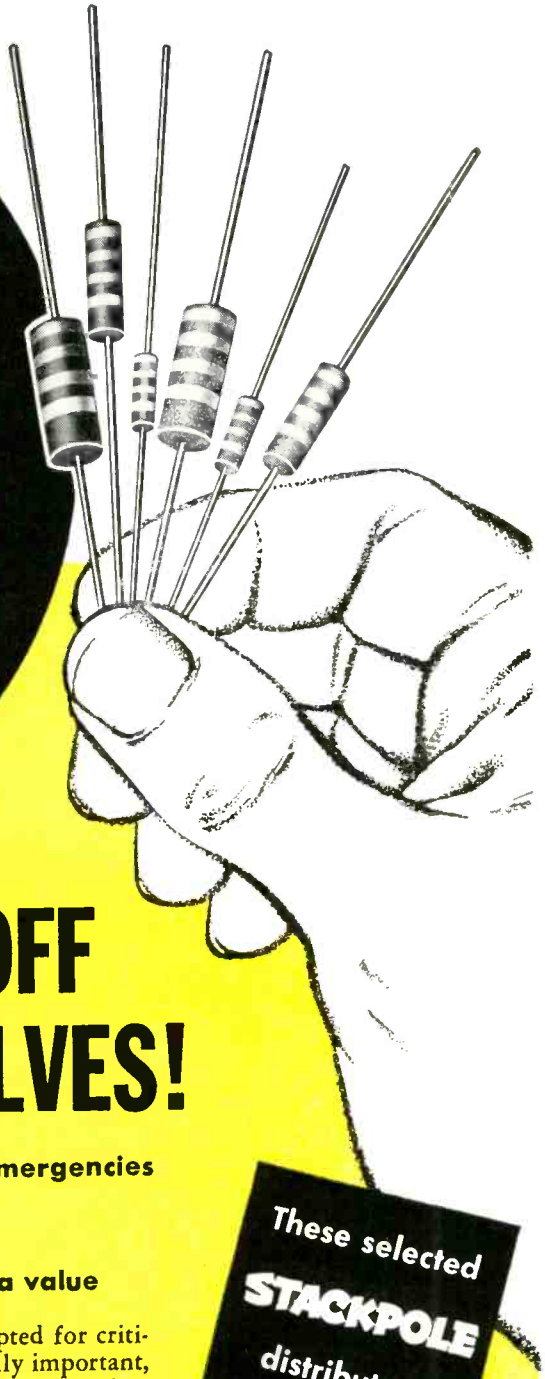

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. . . in any standard value or tolerance

. . . at lowest prices in lots up to 1,000 resistors of a value

Complete stocks — and we mean *complete*—in the hands of the 28 selected Stackpole distributors listed below help you handle every job with highest quality resistors, fully proved and accepted for critical applications. Equally important, you actually get them at less than factory prices in lots up to 1,000 of a value!

These selected STACKPOLE distributors have them!

BALTIMORE, MD.
Kann-Ellert Electronics, Inc.

BATTLE CREEK, MICH.
Electronic Supply Corp.

BIRMINGHAM, ALA.
MG Electrical Supply Co.

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Sager Electrical Supply

BROOKLYN, N. Y.
Electronic Equipment Corp.

CLEVELAND, OHIO
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DALLAS, TEXAS
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Electronic Wholesalers, Inc.

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WICHITA, KANSAS
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. . . and G C/STACKPOLE, TOO!

Attractively packaged by G-C Electronics for service replacement uses, Caldite 70+ Resistors are also available through over 800 G-C distributors.

Books

(*Continued from page* 52)

Programming Business Computers

By Daniel D. McCracken, Harold E. Weiss and Tsai-Hwa Lee. Published 1959 by John F. Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 510 pages. Price $10.25.

This volume is directed to the reader who lacks an extensive background in mathematics but who is involved or expects to be involved in day-to-day application of electronic computers to business data processing problems. The book begins with a discussion in fundamental topics, such as: the nature of the data processing problem, the central concept of the file, flow charting, and general characteristics of electronic computers.

The authors then employ numerous examples to explain all the standard techniques of coding. These examples are written in terms of a hypothetical computer called DATAC, which is a compilation of the features of many machines. The reader who understands the principles which are presented in terms of DATAC will find no difficulty in applying them to real machines.

The authors also include an examination of such advanced techniques as the principles of sorting, rerun, timing estimates, file organization, automatic coding, and large random access storage devices.

The book concludes with a summary of the steps involved in establishing a computer application, and a critical examination of the accounting and auditing problems associated with electronic data processing.

Automation, Cybernetics, and Society

By F. H. George, Ph.D. Published 1959 by Philosophical library, Inc., 15 E. 40th St., New York 16. 283 pages. Price $12.00.

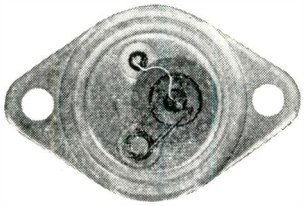
The age of automation will see whole fields of daily human labor revolutionized and lives shaped and molded by the machine. The possibilities are endless and yet are the cause of much confused thinking and many doubts. How far will it reach and where will it lead us? How little is known of cybernetics and its application as automation, yet these are among the vital scientific domains of the future. There is no more exciting development of the various disciplines of logic, psychology, physiology, and philosophy than in these new fields. Yet these are not purely scientific problems, for there is nobody whose life will not be influenced by automation.

This book is an essential overall picture of these new subjects and the ramifications. It is not a text intended for specialists in any field, for it is primarily aimed to clarify this important problem, not only for the scientists, but for the executive and the layman.

(*Continued on page* 58)

BUILT-IN RELIABILITY

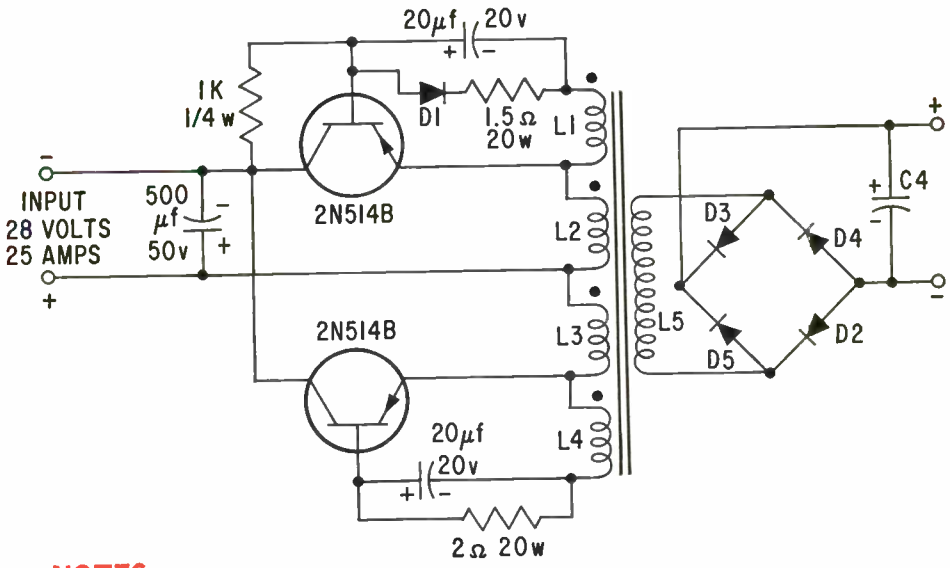
GERMANIUM TRANSISTOR APPLICATION NOTES



Low R_{CS} (0.05Ω) at high temperatures insured by large ring emitter-base area. Leakage currents minimized by all welded construction . . . no contaminating solders or fluxes used!

High current-carrying capacity and maximum safety against over-heating provided by heavy 90-mil emitter lead.

630 WATT DC-TO-DC POWER CONVERTER 90% EFFICIENT



NOTES

L5 may be wound according to the output voltage desired, allowing about 0.639 turns per volt. The wire size should be large enough to allow one circular mil per millampere. The output current and load will then determine D2, D3, D4, D5, and C4.

L2, L3—17 turns each #10 bifilar wound

L1, L2—4 turns each #16

Core-type 50022-2A Magnetics, Inc.

Q1, Q2—2N514B 80 volt 25 amp each mounted on a minimum of 200 sq in. of ¼" aluminum for operation up to 50°C.

D1—1N1124 mounted on a minimum of I sq in. of exposed aluminum 1/16" thick. Operation to 50°C.

Frequency about 1 kc.

REDUCE YOUR COMPONENT COSTS WITH ONE TI POWER TRANSISTOR!

Save on overall costs and *up your circuit reliability* by selecting one *specific* TI germanium power transistor for your high power circuitry job. The need for transistor paralleling is greatly reduced . . . and, in many applications, eliminated . . . with TI's newest high current alloy-junction power transistor series. If you are using two types in parallel for a 25-amp job, save by using *one* TI high current alloy-junction transistor!

Ranging from 10 to 25 amps in 40, 60, or 80 volt types, all units feature guaranteed gain at maximum rated currents and *1.5 volts* V_{CE}. For your high current switching applications, all types highlight typical switching times at 25°C of 12.0 usecs (t_{on}) and 7.0 usecs (t_{off}).

Contact your nearest Texas Instruments sales engineer for applications assistance or your nearby TI distributor for off-the-shelf delivery at factory prices. For high reliability, high performance, and a full year product guarantee, you can rely . . . on TI!

maximum ratings at 25° C

		2N511	2N511A	2N511B	2N512	2N512A	2N512B	2N513	2N513A	2N513B	2N514	2N514A	2N514B	unit
V_{CBO}	Collector-to-Base Voltage (I_C = −5ma, I_E = 0)	−40	−60	−80	−40	−60	−80	−40	−60	−80	−40	−60	−80	v
V_{CEX}	Collector-to-Emitter Voltage (V_{BE} = +0.2 v, I_C = −5ma)	−40	−60	−80	−40	−60	−80	−40	−60	−80	−40	−60	−80	v
V_{EBO}	Emitter-to-Base Voltage (I_E = −5ma, I_C = 0)	←	−30	→	←	−30	→	←	−30	→	←	−30	→	v
I_C	DC Collector Current	←	−10	→	←	−15	→	←	−20	→	←	−25	→	a
I_E	DC Emitter Current	←	10	→	←	15	→	←	20	→	←	25	→	a
I_B	Base Current	←						−5			→			a
	Total Dissipation	←						80			→			w
T_J	Junction Temperature	←						95			→			°C

germanium and silicon transistors
silicon diodes and rectifiers
tan-TIcap solid tantalum capacitors
precision carbon film resistors
sensistor silicon resistors

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Circle 41 on Inquiry Card

Hold your frequency under fire (and ice)!

New linear permalloy core keeps filters frequency-stable over a wide range of temperature conditions—at half the cost

Designers of audio filter networks, faced with the high price of components and the need for frequency stability over a wide swing in ambient temperatures, can now benefit from a most significant development—the linear molybdenum permalloy powder core.

The linear cores we've developed are used with polystyrene capacitors. This combination costs as little as half the price of temperature-stabilized moly-permalloy cores and the silvered mica capacitors with which they must be used.

What's more, frequency stability is increased! For temperatures ranging from −55°C to +85°C we have observed frequency stability variations as low as 0.05%. This is considerably less frequency shift than normally expected with temperature-stabilized combinations.

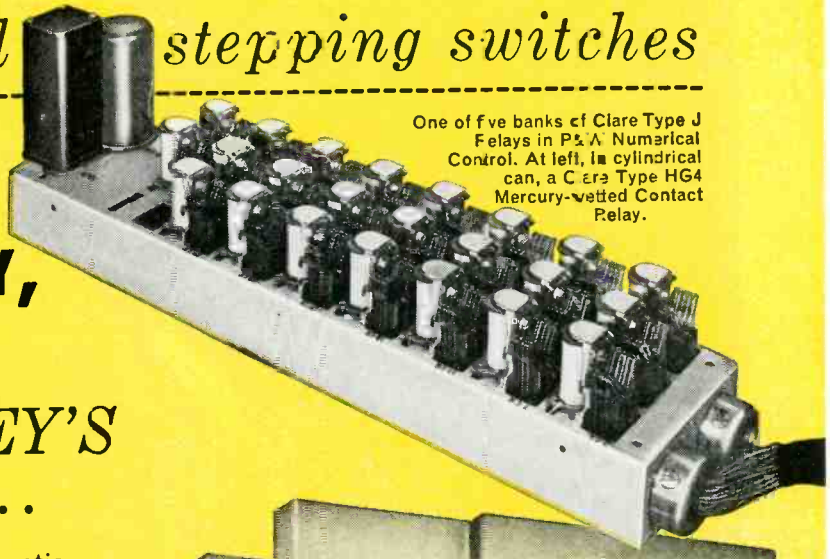
We guarantee the temperature coefficient of these linear cores within a very narrow range! Information regarding sizes, prices and performance behavior awaits your request. Popular sizes,. in 125 permeability only, available immediately from stock. *Magnetics, Inc., Dept. EI-74, Butler, Pa.*

MAGNETICS inc.

Circle 42 on Inquiry Card

Circle 43 on Inquiry Card →

CLARE relays and stepping switches



One of five banks of Clare Type J Relays in P&W Numerical Control. At left, in cylindrical can, a Clare Type HG4 Mercury-wetted Contact Relay.

INSURE ACCURACY, INCREASE RELIABILITY, REDUCE SIZE *of*

PRATT & WHITNEY'S Numerical Control...

Pratt & Whitney's Numerical Control is a fully automatic, ultra-precise means of translating blueprint data into a series of machine positions. Applied to jig borers and other precision Pratt & Whitney machine tools, settings are made quickly, with high reliability to .0001" accuracy.

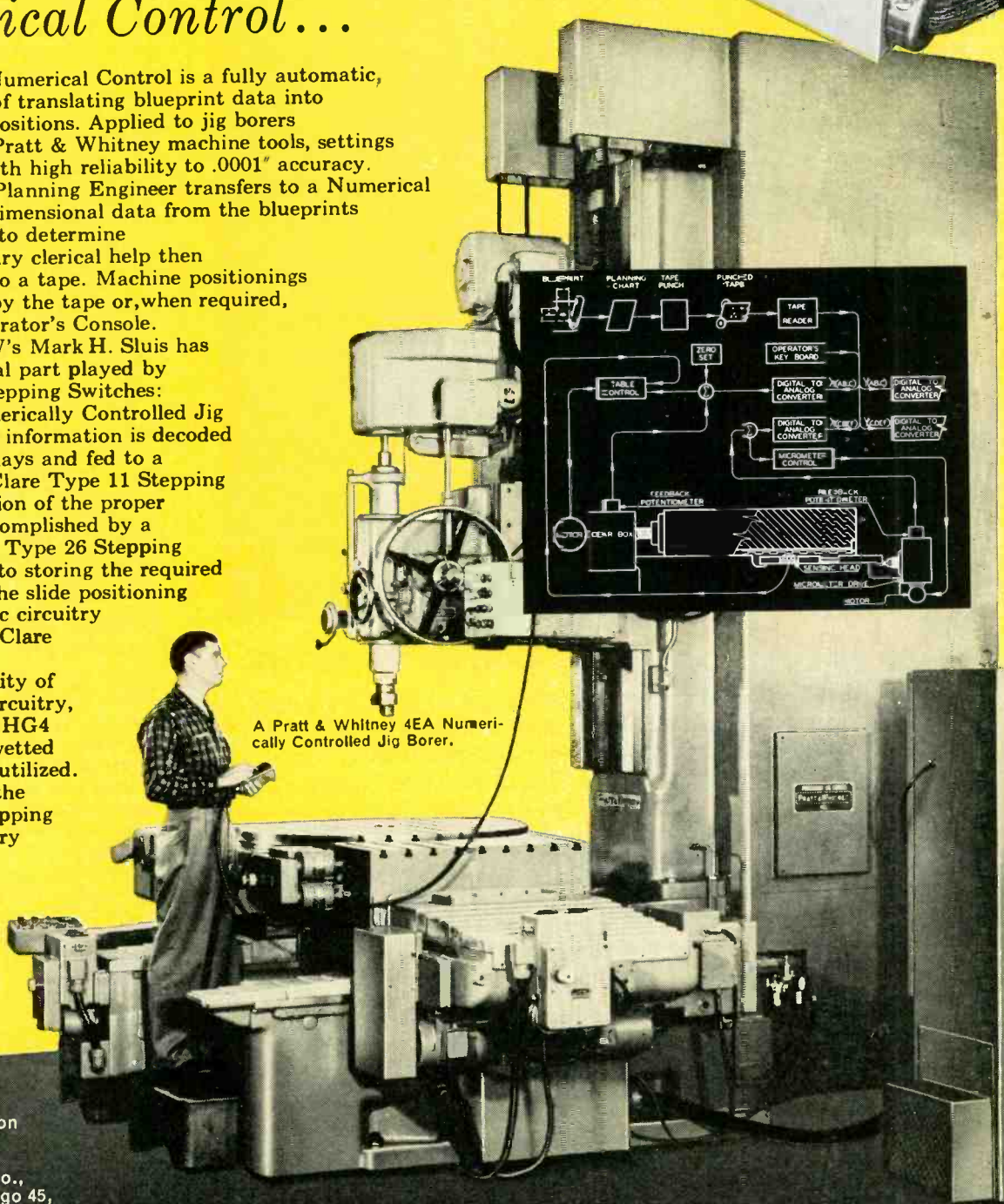
In operation, the Planning Engineer transfers to a Numerical Planning Chart all dimensional data from the blueprints which are necessary to determine the positions. Ordinary clerical help then punch these data into a tape. Machine positionings are then controlled by the tape or, when required, by a dial on the Operator's Console.

Here is what P&W's Mark H. Sluis has to say about the vital part played by Clare Relays and Stepping Switches:

"In the 4EA Numerically Controlled Jig Borer, punched-tape information is decoded by Clare Type J Relays and fed to a storage bank of 25 Clare Type 11 Stepping Switches. The selection of the proper storage switch is accomplished by a distributor—a Clare Type 26 Stepping Switch. In addition to storing the required command data for the slide positioning of this machine, logic circuitry comprises some 115 Clare Type J Relays.

"For ultra-reliability of the digit-selection circuitry, a dozen Clare Type HG4 four-pole Mercury-wetted Contact Relays are utilized.

"Through use of the Clare relays and stepping switches, our circuitry has increased in reliability, and a large contribution was made which enabled us to realize a 6:1 size reduction of the control system."



A Pratt & Whitney 4EA Numerically Controlled Jig Borer.

For complete information on Clare Relays and Stepping Switches contact C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Canada Ltd., P.O. Box 134, Downsview, Ontario. Cable Address: CLARELAY

CLARE RELAYS *First in the Industrial Field*

Books

(*Continued from page 54*)

Control Engineering

By Gordon J. Murphy. Published 1959 by E. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 385 pages. Price $7.50.

Mathematically sound and up-to-date, this new book presents a thorough coverage of modern automatic control theory at an intermediate level. It treats both elementary and advanced topics in some detail, filling the gap between general introductions and exhaustive treatments.

Dr. Murphy draws problems and illustrations from many fields, including process control, fire control, inertial guidance, and nuclear reactor control. His extensive and clear presentation of the subject makes the book invaluable for students and workers in all areas of control engineering.

Following an introductory chapter is a thorough discussion of time response, including a development of Laplace transformations which is applied extensively throughout the book. The characteristics of a large number of control-system components are then presented, and design in the complex domain (the S-plane) is carefully covered.

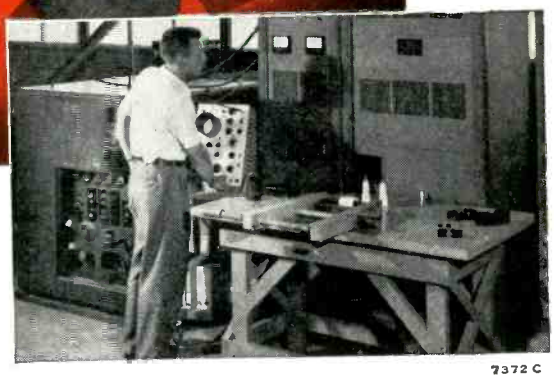
The use of frequency-response techniques, a complete treatment of ac carrier systems, and the analysis of systems with time lag are next presented. The author then deals at length with sampled-data systems and the statistical analysis of linear control systems. The final two chapters are devoted to non-linear control theory, including the use of describing functions and the phase plane.

Molecular Science and Molecular Engineering

By Arthur R. von Hittel. Published 1959 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 446 pages. Price $18.50.

This is the third and final volume in a series of modern materials research. Written for the professional scientist and engineer, it presents the fundamental molecular properties of matter and their applications derived by molecular strategy.

Proceeding from classical to molecular science, the chapters advance in unifying vision from the structure of atoms and molecules and the behavior of charge carriers and gases to the formation and structure of condensed systems, to dipoles and their spontaneous alignment in photo electrics and photo magnetics, and finally to ions and electrons in liquids and solids. Thunder storms and explosions, gas-discharge and solid-state devices, the molecular concepts producing mazers and memory systems, transducers, transistors, parametric amplifiers, ion-exchange resins, etc., appear in an exciting sequence of contributions supported by numerous tables and illustrations.

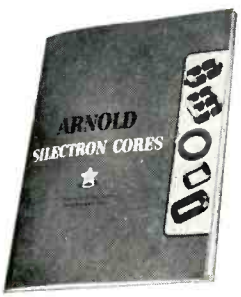


7372 C

Arnold Pulse Transformer Cores are individually tested under actual pulse conditions

Here's technical data on

ARNOLD SILECTRON CORES



Bulletin SC-107 A . . . this newly-reprinted 52-page bulletin contains design information on Arnold Tape Cores wound from Silectron (grain-oriented silicon steel). It includes data on cut C and E cores, and uncut toroids and rectangular shapes. Sizes range from a fraction of an ounce to more than a hundred pounds, in standard tape thicknesses of 1, 2, 4 and 12 mils.

Cores are listed in the order of their power-handling capacity, to permit easier selection to fit your requirements, and curves showing the effect of impregnation on core material properties are included. A valuable addition to your engineering files—*write for your copy today.*

ADDRESS DEPT. T-99

The inset photograph above illustrates a special Arnold advantage: a 10-megawatt pulse-testing installation which enables us to test-prove pulse cores to an extent unequalled elsewhere in the industry.

For example, Arnold 1 mil Silectron "C" cores—supplied with a guaranteed minimum pulse permeability of 300—are tested at 0.25 microseconds, 1000 pulses per second, at a peak flux density of 2500 gausses. The 2 mil cores, with a guaranteed minimum pulse permeability of 600, receive standard tests at 2 microseconds, 400 pulses per second, at a peak flux density of 10,000 gausses.

The test equipment has a variable range which may enable us to make special tests duplicating the actual operating conditions of the transformer. The pulser permits tests at .05, .25, 2.0 and 10.0 microsecond pulse duration, at repetition rates varying anywhere from 50 to 1000 pulses per second.

This is just another of Arnold's facilities for better service on magnetic materials of all description. ● Let us supply *your* requirements. *The Arnold Engineering Company, Main Office & Plant, Marengo, Ill.*

ARNOLD
SPECIALISTS in MAGNETIC MATERIALS

BRANCH OFFICES and REPRESENTATIVES in PRINCIPAL CITIES
Find them FAST in the YELLOW PAGES

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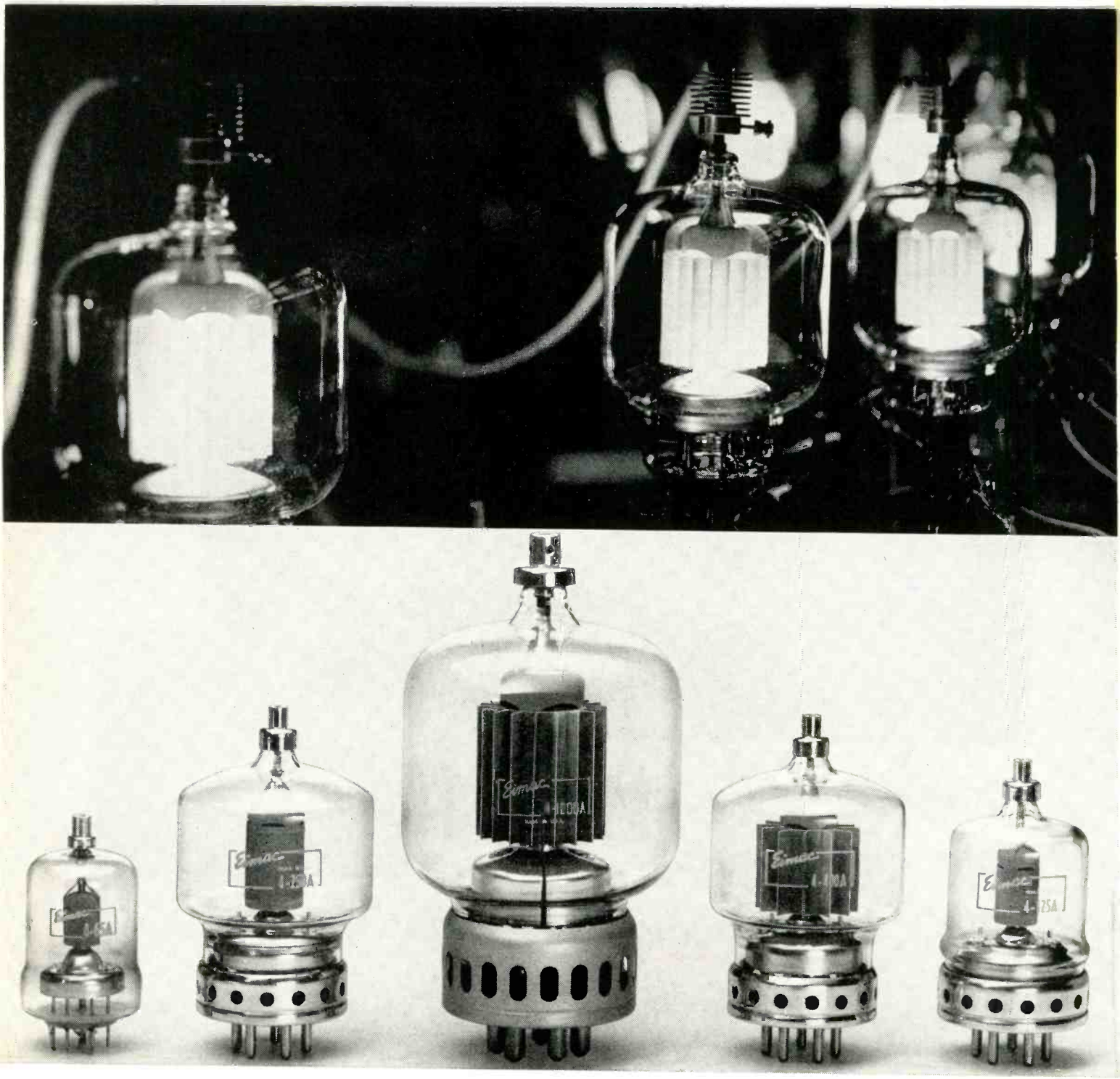

EIMAC PIONEERED INTERNAL-ANODE TETRODES— PERFORMANCE LEADERS FOR OVER A DECADE

Developed and introduced to the industry in the mid 1940's, Eimac's line of internal-anode radial-beam tetrodes immediately received widespread and enthusiastic acceptance. Well over a million have been sold since that time. These tubes, quality leaders from the very start, still maintain that position through advanced processing techniques, inherently sound design and continuing concern with production refinements.

Clean electrode design, for example, and the exceptionally hard vacuums achieved on Eimac-developed rotary vacuum pumps, result in consistently reliable tubes with an exceptional ability to withstand high momentary overloads and peak powers. Rugged filament design with high reserve emission contributes greatly to their reliability and long life.

Stable operation at high frequencies is assured by low inter-electrode capacitances and low lead inductances. Driver requirements and associated circuitry are simplified by the high power gain and low driving power requirements of these tube types.

These features, plus other Eimac design innovations such as the Pyrovac* plate and non-emitting grids make Eimac internal-anode tetrodes your logical choice for new equipment designs, as well as tube replacements, when exceptional performance and reliability are required. Most types available for immediate delivery.

*Registered Trademark

EITEL-McCULLOUGH, INC.

Eimac

San Carlos, California

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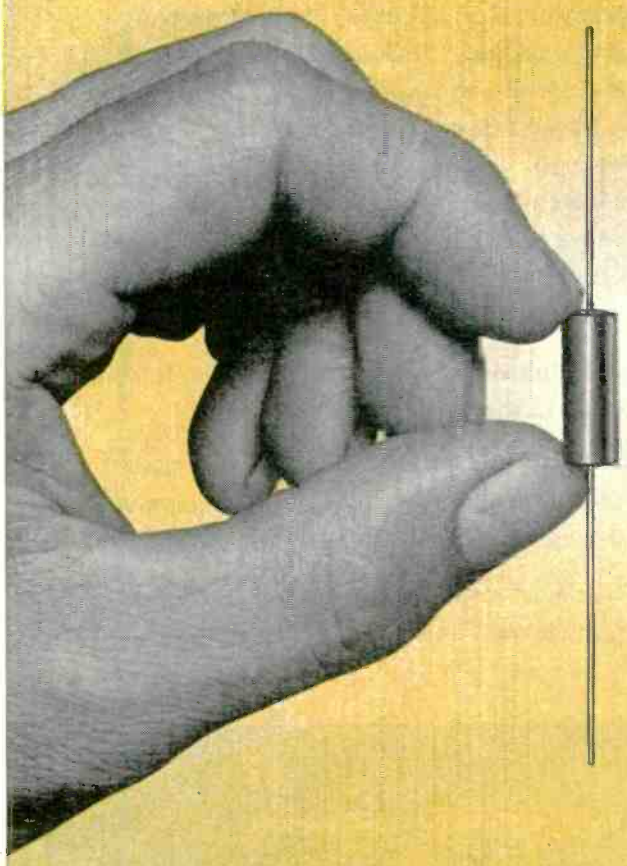

OUT-PERFORMS WIRE WOUND... YET SMALLER IN SIZE, LOWER IN COST

New Electra Precision Metal Film Resistor

Here is an entirely new achievement in electronic components; one of the biggest steps forward in years. This precision metal film resistor offers you precision and stability that formerly was available only in a wire wound resistor, yet it is much smaller in size, much lower in cost, also has far superior high frequency characteristics. Available in five sizes from ⅛ to 2 watts, the new Electra Precision Metal Film Resistor meets or exceeds Mil-R-10509C, Characteristic C, and can be supplied in any of eight standard temperature coefficient tolerances. Why not let us supply you full details by return mail. Write today

CHECK THESE OUTSTANDING TEST RESULTS

MIL-R-10509C (TYPICAL DATA - 237K MF1/2

TEMPERATURE CYCLE			MOISTURE			LOAD LIFE 125°C			SHORT TIME OVER-LOAD		
				% Change							
Initial	Final	% Change	Initial	Wet	Dry	Initial	Final	% Change	Initial	Final	% Change
236.9	236.9	0	236.8	−.21	−.04	237.4	237.5	.04	237.2	237.2	0
237.5	237.5	0	237.1	0	0	237.5	238.0	.21	237.0	236.9	.04
238.1	238.1	0	238.1	0	0	238.0	238.8	.34	237.3	237.3	0
237.1	237.1	0	237.1	0	0	237.0	237.0	0	237.2	237.2	0
237.9	237.9	0	237.9	0	0	237.5	238.0	.21	237.7	237.5	.08
236.6	236.5	.04	236.5	.04	.04	237.3	237.8	.21	237.2	237.2	0
236.9	236.8	.04	236.8	.04	.04	237.6	238.1	.21	237.0	236.9	.04
237.4	237.4	0	237.3	.04	.04	236.9	237.4	.21	238.0	238.0	0
237.2	237.2	0	237.2	−.08	.04	237.8	238.2	.14	237.6	237.6	0
237.7	237.7	0	237.7	.04	.04	237.0	237.3	.13	237.8	237.8	0

Electra MANUFACTURING COMPANY
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Before Buying Ultrasonic Cleaning Equipment

GET A FREE ULTRASONIC CLEANING ANALYSIS

To show you . . . at no cost . . . how ultrasonic cleaning equipment fits into your operation, National Ultrasonic Corporation now offers you a free ultrasonic cleaning analysis. An Applications Laboratory is maintained in which your sample parts are cleaned by specialists and returned within two weeks of their receipt together with the equipment and cleaning agent recommended for your particular application and their costs.

For your ultrasonic cleaning requirements, National Ultrasonic Corporation provides:

- Two lines of cleaners which cover the complete range of ultrasonic cleaning equipment through extremely high power units.
- NUclean® solvents and detergents, especially formulated for ultrasonic cleaning.

STANDARDLINE for all applications requiring average energy levels

Model 100

Model No. (115 volts A.C. 1 phase 60 cycle)	Capacity (gallons)	Power Output (watts) Average	Power Output (watts) Peak	Inside Tank Dimensions (in.) Length	Width	Depth	Crystal Radiating Surface (sq. in.)	% of bottom covered with crystals
100	1	60	240	9¼	5	6	12	25
120	2	125	500	10½	8½	6	24	27
140	7	250	1000	14¾	11¾	10	48	27.5
160	13	500	2000	20	16	10	96	30

HEAVYDUTYLINE for industrial applications requiring high energy density

Model 240

Model No. (115 volts A.C. 1 phase 60 cycle)	Capacity (gallons)	Power Output (watts) Average	Power Output (watts) Peak	Inside Tank Dimensions (in.) Length	Width	Depth	Crystal Radiating Surface (sq. in.)	% of bottom covered with crystals
200	1	60	240	7	4	7	12	43
220	2	125	500	9	6	10	24	44.5
240	5	250	1000	12	9	12	48	44.5
260	12	500	2000	16	12	16	96	50

WRITE FOR COMPLETE INFORMATION

National Ultrasonic corp.

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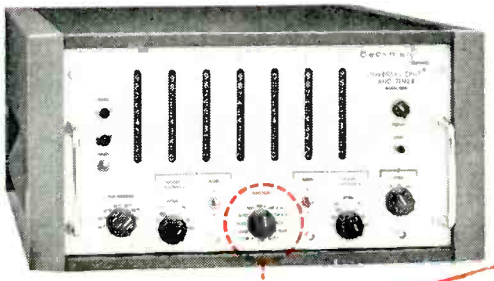
ESsex 1-0550 • TWX NK 1030

10 Mc COUNTER

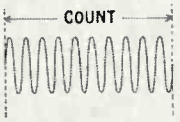
does everything without plug-ins



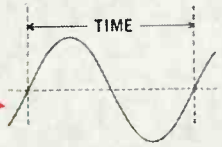
MODEL 7370

FUNCTION

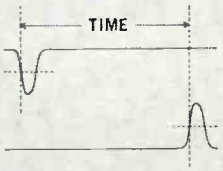
TEST
PER B
PER B×10
E/UT
TIM B-A
SCAN
E/B
E/UT×10
E/B×10
COUNT-E
OFF
E/B-A



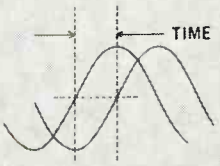
Frequency counting to 10Mc **with 0.1v sensitivity**



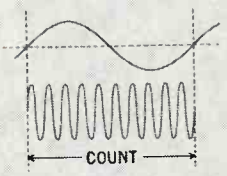
Period measurements in 0. 1μsec units



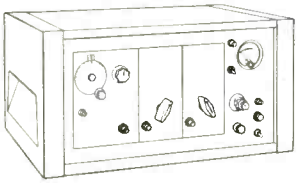
2-channel time interval measurements



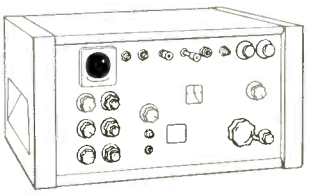
Phase difference measurements



Frequency ratio measurements



Add this heterodyne unit (Model 7570 Series) to measure frequencies up to 1000Mc.



Or add this computing transfer oscillator (Model 7580) to get a counter display of frequencies up to 15,000Mc.

Complete specifications on Models 7370, 7570 and 7580 will be sent on request.

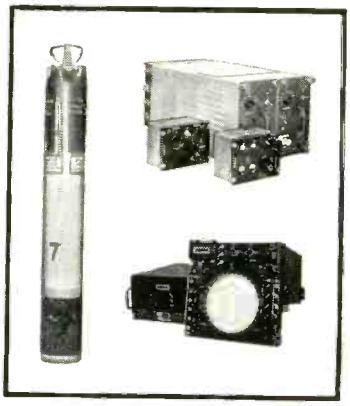
Beckman

Berkeley Division
2200 Wright Avenue, Richmond 3, California
a division of Beckman Instruments, Inc.

T21

AN ASW SYSTEM... DISPLAY/AIRBORNE RECEIVER/SONOBUOYS

Anti-submarine warfare equipment designed, developed and produced by *The Magnavox Company*, in conjunction with the Navy Department, provides patrol aircraft with eyes that see underwater by day and by night. The AN/ASA-16 Display System, together with SONOBUOYS, AN/ARR-26 Receiver systems and other associated equipment provide aircraft with a clear picture of the ocean-depths below them. They are part of the continuing contributions of *The Magnavox Company* in aiding the U.S. Navy to combat the growing submarine menace.



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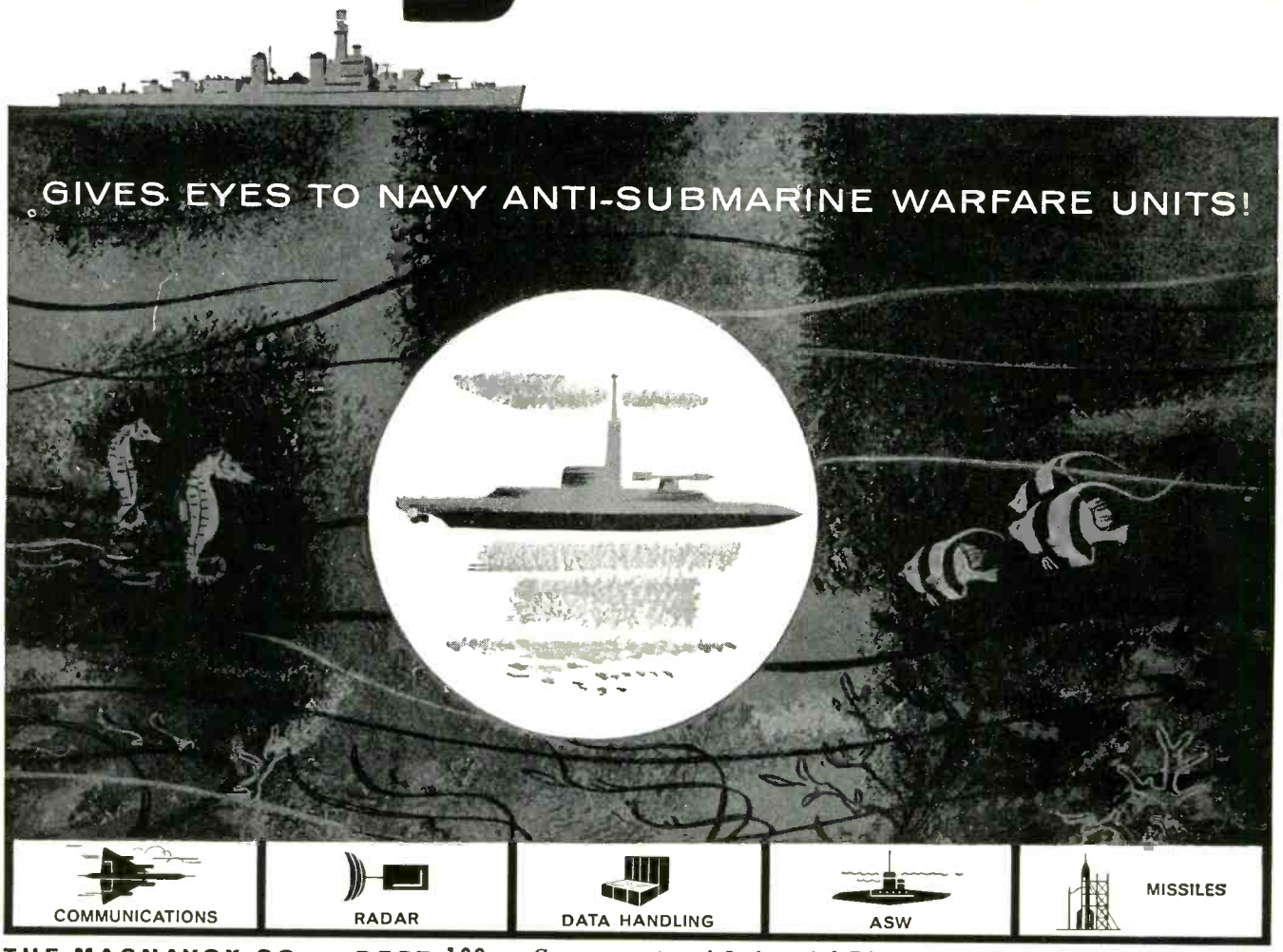

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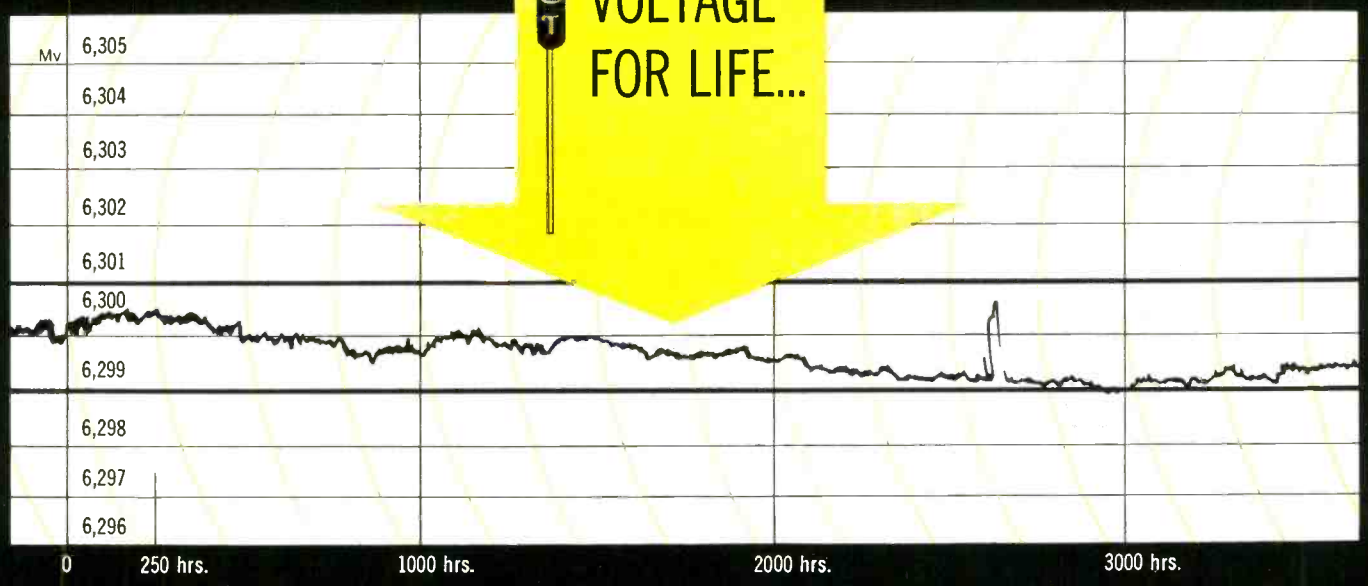

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Type	Voltage Range at I_Z = 7.5 ma at 25°C (Volts) Min.	Max.	Temp. Coefficient[2] (−55°C to +100°C) at I_Z = 7.5 ma (%/°C)	Maximum Dynamic[3] Resistance at 25°C at I_Z = 7.5 ma (ohms)	Operating and Storage Temperature Range (°C)	Max. Operating Temp. at I_Z = 7.5 ma (°C)
1N821	5.9	6.5	±.01	15	−65 to +150	+125
1N822[1]	±5.9	±6.5	±.01	15	−65 to +150	+125
1N823	5.9	6.5	±.005	15	−65 to +150	+125
1N824[1]	±5.9	±6.5	±.005	15	−65 to +150	+125
1N825	5.9	6.5	±.002	15	−65 to +150	+125
1N827	5.9	6.5	±.001	15	−65 to +150	+125

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[1]Double anode types.
[2]Determined by measuring a change of voltage from −55°C to +25°C and a change of voltage from +25°C to +100°C.
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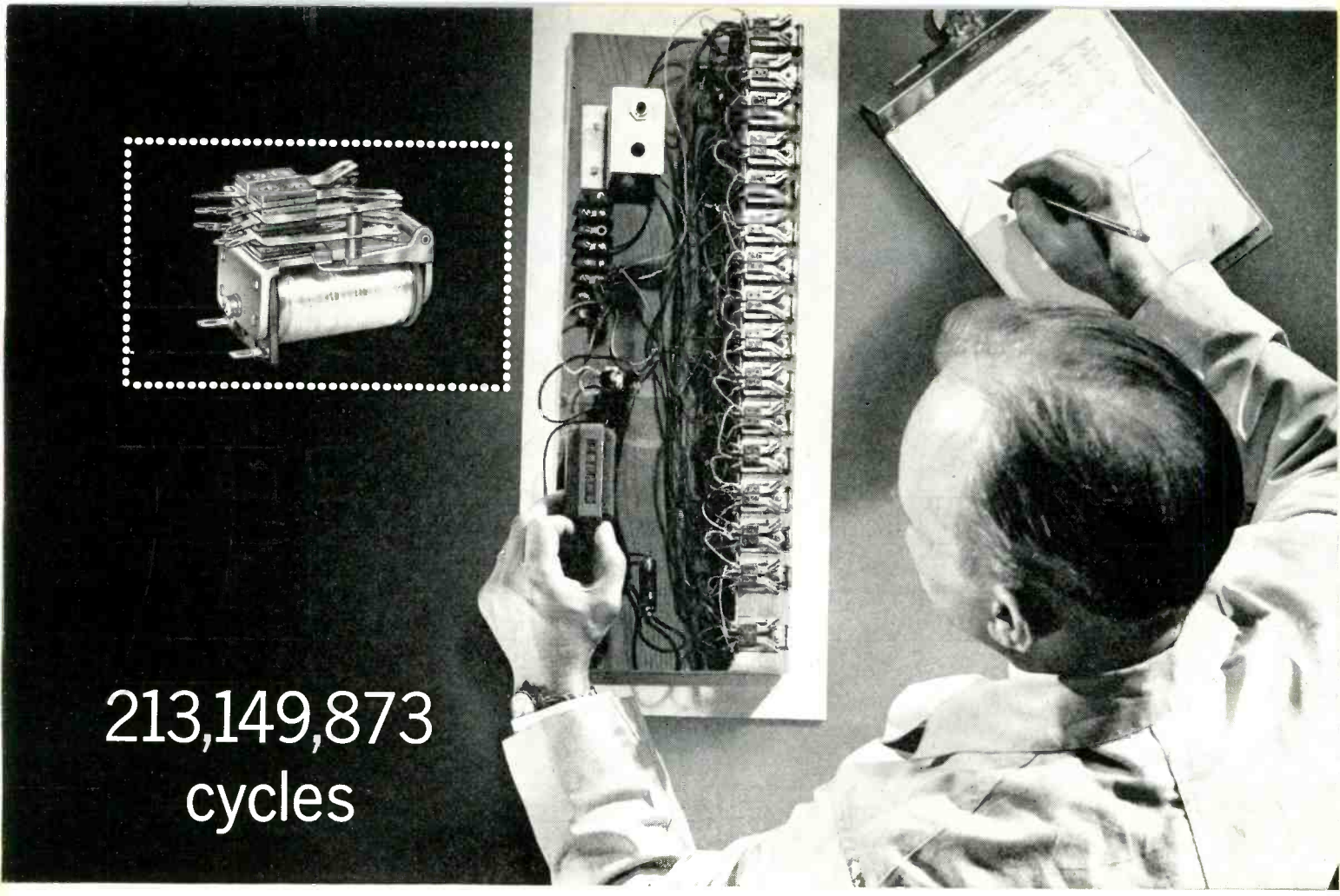

Test proves reliability of P&B's LS telephone type relay

These 16 LS relays, wired into a self-cycling chain, each operated 213,149,873 times before the test was discontinued. This test was made for a nationally prominent manufacturer and the certified results are available upon request.

Here is proof of the inherent reliability of P&B telephone type relays . . . and of the kind of performance you can expect when you specify them. LS relays are available with up to 20 springs (10 per stack) and are adaptable for printed circuit mounting.

Whenever multiple switching of loads up to 4 amperes is required, the LS can usually meet space, weight and—importantly—price considerations. Get full information today by calling or writing Zeke R. Smith, vice president, Engineering, or contact your nearest P&B representative.

LS ENGINEERING DATA

GENERAL:

Breakdown Voltage: 1,000 volts rms 60 cy. min. between all elements.
Ambient Temperature: —55° to +85° C.
Weight: 3 to 4 oz.
Dimensions: 1½" W. x 2⅜" L. x 1½" H. (4 Form C)
Enclosures: Sealed or dust cover (W can) Sealed or dust cover, up to 6 Form C, single contacts (D can)
Mountings: Four #6-32 tapped holes ¾" x 5⁄16" o.c. Other mountings available.

CONTACTS:

Arrangements: 20 springs (10 per stack) max.
Material: 1⁄16" dia. twin palladium. Other materials available for specific applications.
Load: 4 amps @ 115 volts 60 cy. resistive.

COIL:

Resistance: 55,000 ohms max.
Power: 65 mw DC per movable standard (50 mw possible); 3.5 watts max. at 25° C.
Voltage: Up to 200 volts DC.

TERMINALS:

Contacts: Three #18 AWG wires.
Coil: Three #20 AWG wires.
Available with octal plug, taper tabs or printed circuit pins.

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

TS RELAY
Short coil relay is available in AC and DC versions. Long life construction. Can be supplied (DC) with up to 20 springs (10 per stack).

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Excellent sensitivity: 50 mw per movable arm minimum (DC). For applications requiring many switching elements in small space.

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Long coil provides high sensitivity (25 mw per movable arm) and room for slugs for pull-in delays (150 milliseconds max.) or drop-out delays (600 milliseconds max.).

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Send today for booklet containing certified results of recent test described above. Data includes test circuit, interim and final measurements.

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Pin plugs quickly assembled with a single nut after cable connection.

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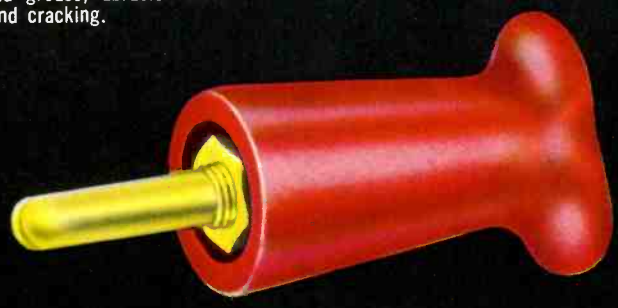

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Positive-grip, functionally designed plugs provide best handling ease and convenience.

Plugs can be connected to a range of cable sizes by fastening screws or by soldering.

PIN RECEPTACLE

SOCKET PLUG

Wide variety of colors permits greater latitude in patchcord distribution layouts.

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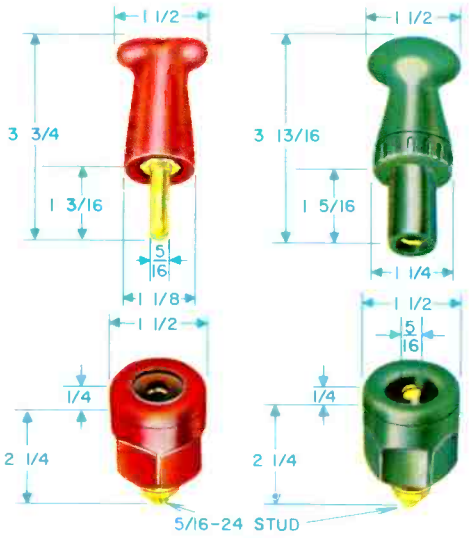
1/4" MAXIMUM PANEL THICKNESS

50 AMPERE TYPES



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FAST... EASY... 2 STEP ASSEMBLY

PIN PLUGS

1

Attach the cable to the pin plug with the two fastening screws or by soldering.

2

Slip the grip over the pin plug and tighten in place with the assembly nut.

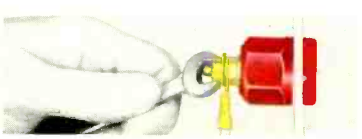
SOCKET PLUGS

Slip the socket plug grip over the cable and attach the cable to the socket plug with the screws or by soldering.

Screw the socket plug shield and grip together securely.

RECEPTACLES

After opening the panel hole, screw the cap and the base together securely.



Attach the wiring by lug, clip-lead, wrap-around or by soldering.

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Next month

ANALYZING DYNAMIC CHARACTERISTICS OF RELAYS—II

Second of the three-part series which begins in this month's EI. In the first section Prof. Cameron defines the terms that would be used in describing relay action. In this, the second part, he discusses exactly how a relay behaves during the period when the armature is moving from an open to a closed position.

HIGH ACCURACY SHAFT ANGLE ENCODER

As the trend increases toward the use of digital data it becomes more and more important to convert analog data to digital data with maximum accuracy. Where it is possible to obtain data in the form of shaft rotation the optical shaft angle encoder can convert analog data to digital data with extremely high accuracy. Described in this article is a highly advanced device now moving into the machine tool and industrial production fields.

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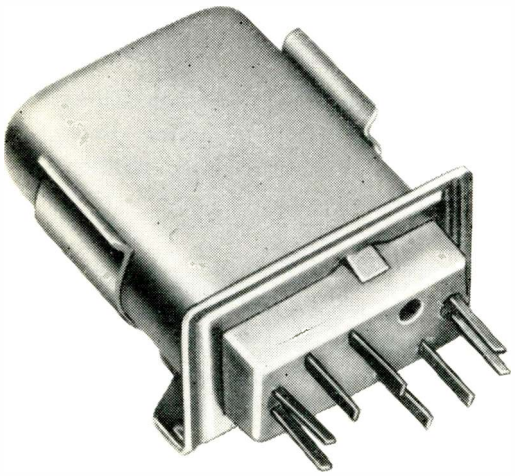
***NOVEMBER**
Microwave Issue

***JANUARY**
Industry Review

***MARCH**
Annual IRE Issue

It is during the transient period when the current is building up in the coil and the armature is moving from the open position to the closed position that most of the relay problems occur. This article first defines the relay terms we are dealing with, and then analyzes what happens during this period by means of oscillographic presentations.



By PROF. CHARLES E. CAMERON
Oklahoma State University, Stillwater, Okla.

The Dynamics of Relays

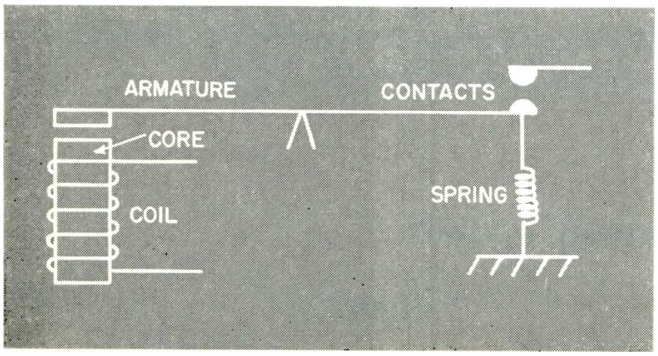
Part One of Three Parts

THOUGH little has been written about them, the dynamic characteristics of an electromagnetic relay are most significant in deciding where and how a specific relay should be applied. The dynamic characteristics of a relay occur during the transient time, when the armature moves and contacts are opened or closed.

A relay can be defined as an electrically controlled device which closes and opens electrical contacts or circuits. The electrical control might have one of several forms; however, here we are concerned only with those called "electromechanical."

This device functions when the contacts are closed or opened. Generally speaking, the functional operation of a relay is no problem when the relay is open, or when it is closed. But even so, the parameters which determine the static characteristics should not be arbitrarily or entirely fixed. The parameters which determine the static characteristics are related, and as such only a definite number should be specified. There is some tendency in writing specifications to somewhat arbitrarily specify too many of the parameters. Impossible values sometimes result when trying to design a relay to satisfy the specifications. Only during the transient period when the current builds up in the coil and the armature moves from the open position to the closed position do most of the perplexing problems arise. Yet, the dynamic behavior of a relay has received very little attention.

Fig. 1: An elementary relay.



The relay must be studied in relation to the network in which the coil is placed because the operate time and release time of a relay are determined in part by the circuit. It is misleading to indicate operate or release time without telling something about the circuit as well.

It must be recognized that the transient characteristics of a relay have, as yet, not been defined. It is, therefore, proposed to explore some of these little understood relay attributes in an attempt to clarify some of the confusion.

The drawing of Fig. 1 is a schematic diagram of an elementary relay. It is well to have in mind some of these fundamental concepts when attempting to visualize the performance of this device.

Relay Classification

Any attempt to classify relays into different classes or types meets with numerous difficulties but for our purpose we will use six different classes. Much disagreement will arise from some of the subdivisions, but this scheme does recognize the extensive varieties which occur in the types of relay which are or may be manufactured. There are perhaps other types which have not been included.

Unfortunately, the words used to classify relays into different types and categories will not meet with general acceptance. In fact, much difficulty has been encountered in working out a satisfactory definition of the word "relay." There are two general phases of relay application (a) control, and (b) protection. This discussion is confined to the area which has been called "control." Protective relays are usually of the inductance disk types and they are used on power systems for various methods of protective schemes.

The variation of electrical, mechanical, and magnetic structures have led to numerous varieties. Each year new adoptions are devised to meet more exacting demands of circuits designers. This relay classification is an attempt to divide the whole field of relays into different areas and then sort out existing relays and place them under different classifications. This helps to emphasize the magnitude of the problem and the countless variations which presently are being made.

Static Characteristics

The force exerted on the armature of a relay by the magnetic field is a function of the length of the air-gap as well as the coil current. The static force-distance characteristic shows the force on the armature at various positions including the open and closed values. Several schemes have been developed for recording the force on the armature of a relay for various locations of the armature. The force in grams is plotted against the armature travel in inches.

For a specific relay with a given coil and spring, there are several variables which are interrelated. The static characteristics of a relay show how these terms may be used and their significance. These variables are: (1) ampere-turns, watt input, or current to actuate the relay, (2) release current, (3) spring tension, (4) residual air-gap, and (5) armature travel. Fig. 2 shows the performance curves or the static characteristic curves for a relay. If the spring tension remains unchanged from the open position to the closed position, this would be indicated by a horizontal line on the curve sheet. On the other hand, if the spring tension has changed, it would be so indicated. In most instances, the change, if any, may be neglected.

A typical set of excitation curves which are plotted for different values of magnetic pull on the armature against the length of the air-gap is given in the figure. With one value of ampere-turns, the force on the armature will vary from the open position of the relay to the closed position of the relay similar to the so-called excitation curves. In other words, the horizontal projection of an ampere-turn curve (or watt input) will show the air-gap and the vertical projection of the ampere-turn curve will show the force exerted on the armature. It will be assumed that the equation:

$$F = 6.409 \times 10^{-6} \frac{N^2 I^2 A}{X^2} \text{ grams}$$

where F = force in grams
N = number of turns
I = current in amperes
X = air-gap in inches

RELAY CLASSIFICATION

I. D. C. RELAYS
- (a) Neutral
- (b) Polarized

II. A. C. RELAYS
- (a) Specify frequency range

III. CONTACT REQUIREMENT
- (a) Direct current
- (b) Alternating current
- (c) Radio frequency

IV. TYPE OF PERFORMANCE
- (a) General purpose
- (b) Marginal
- (c) Fast
- (d) Slow
- (e) Sensitive
- (f) Timing
- (g) Latching
- (h) Sequential
- (i) Frequency sensitive

V. METHOD OF ELECTRICAL CONTROL
- (a) Electromagnetic
  1. Moving iron (plunger, clapper, ball, rotary)
  2. Moving permanent magnet
  3. Moving conductor
  4. Electric coil
- (b) Thermal
  1. Bimetal drive
  2. Pressure drive
  3. Expansion drive
- (c) Magnetostrictive
- (d) Electric field
  1. Piezo-electric
  2. Electrostrictive
  3. Electrostatic

VI. MECHANICAL ACTION
- (a) Two-position
  1. Interlock
  2. Latching
  3. Ratchet
- (b) Three-position
  (i.e., neutral, positive or negative)
- (c) Multi-position
  1. Stepping
  2. Coordinate
  3. Crossbar
  4. Sequential

Relay Dynamics *(Continued)*

expresses a relationship which meets the actual conditions in a relay.

When three of the five variables are known or assumed, they may be used to fix a point on the operational cycle and the limits of the other two variables may be found. Let it be assumed that (1) the residual air-gap, (2) armature travel or air-gap, and (3) the initial spring tension are known. The intersection of an NI curve on the vertical line which represents the air-gap in the open position at the value of the initial spring tension will locate the "pick-up" value for the armature. Any value of ampere-turns (or current) in excess of this position of balance will cause the armature to start moving toward the closed position. The closed position will be found by the intersection of the ampere-turn curve with the vertical line which represents the closed position of the armature. The length of the residual air-gap will determine the closed position.

The vertical distance to point "B" will represent the force on the armature when it is in the closed position. The vertical distance to point "A" represents the initial spring tension or bias on the armature. When it is assumed that the initial spring tension has not changed the difference between the final tension and the initial tension will be the force exerted on the core and on the contact springs or the contact pressure. When the current through the coil of the relay is decreased, a value of ampere-turns is found which intersects the line which represents the initial spring tension and contact force, and the vertical line which represents the residual air-gap. This value is located at point "C" for zero contact force. The relay releases at this value of current. The release value of ampere-turns intersects the vertical open position line at point "D." To cause the relay to close again, the current will have to be increased until point "A" is reached. It is to be noted that the release current is considerably less than that value which will actuate the relay.

When the coil current has been increased so that the force on the armature is slightly in excess of the pull by the spring, point "A" is reached and the armature closes. The force on the armature is increased up to the point "B" where the armature has closed. If the coil current is decreased gradually, the force on the armature is decreased until the armature spring pulls it into the open position.

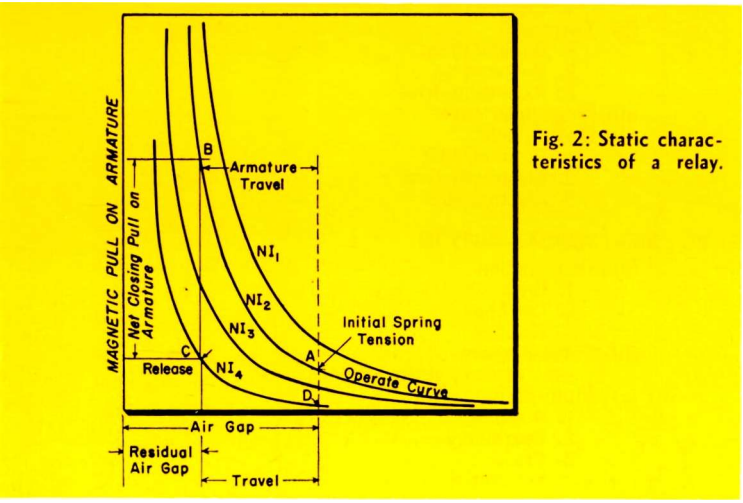


Fig. 2: Static characteristics of a relay.

These relationships are called the "Static Characteristics" since time or motion is not a part of the diagram. The force is represented as being measured at an armature position when the armature is not moving. It is seen that as such, it does not give the moving or dynamic characteristics of the relay.

The pull which is exerted by the magnetic field on the armature of the relay must be sufficient to overcome the initial spring tension, the friction of the moving mechanical parts, produce the desired velocity of the armature and have sufficient contact pressure. No indication is given by the pull equation as to what velocity would be expected of the armature.

It is evident that as the ampere-turns or watt input to the coil are increased the armature velocity will also increase. High speed relays will require more watt input than slow speed relays.

A residual air-gap is used on direct current relays to prevent freezing of the armature to the core. Residual magnetism which is present in an iron circuit after the exciting current has been removed is sufficient to hold the armature closed in some instances. By moving the vertical line back and forth, it is seen that the residual air-gap influences the retaining current and the release time. As the air-gap becomes larger, the release current increases and the release time is made shorter.

It has been convenient to discuss the normally-open relay unless otherwise indicated. A restoring spring is used to supply the restoring force to the armature which will cause it to return to the open position when the magnetic force supplied by the coil is removed. When the spring tension is increased, a larger operating current is required as well as a longer operating time. On release, the higher spring tension gives a higher release current and a shorter release time.

Relay Performance Definitions

Relay performance and some of the items which are of interest are illustrated in Fig. 3 and Fig. 4. Some of the definitions of relay performance are likewise illustrated by these drawings.

It is noticed that *operate time* is measured to the instant that the contacts *make*. There is a short period of time before the armature has completed its travel, and this represents *overtravel*. In this particular case a "NO" contact arrangement is used. Chatter time is illustrated by a series of short lines. If, in a relay there is appreciable chatter time, the *final actuation time* becomes important. Where the final actuation time would be defined as the time from coil energization to termination of chatter following contact actuation.

The word *chatter* has been used as a generic term to include intermittent opening and closing of contacts regardless of the cause. The word *"bounce"* implies rebound as a result of the impact of the contacts, which is a form of chatter.

If the current to the relay coil is gradually increased, a value is found for which the relay will *just operate*. In most instances, the *must operate* value is of more importance and this value is larger than the just operate value.

Fig. 4 shows the current decay upon release conditions. The *release time* is indicated as the time interval from coil de-energization to the functioning of the NO contacts, since NO contacts were used as an illustration.

Relay Definitions

Operate time: The time interval from coil energization to the functioning time of the last contact.

Release time: The time interval from coil de-energization to the functioning of the last contact.

Seating time: The elapsed time after the coil of the relay has energized to the time required for the armature to seat.

Armature overtravel: Overtravel of the armature is that portion of the available stroke which takes place after the contacts have touched.

Adjustment: Relay adjustment is the modification of the shape or position of the parts of a relay to affect the operating characteristics, i.e., armature gap, restoring spring, contact gap.

Must operate: A specified functioning value, such as current, at which all relays meeting the specification must operate.

Just operate: The just operate voltage or current is the measured functioning value at which a particular relay operates.

Contact actuation time: The contact actuation time is the time at which a specified set of contacts function.

Contact chatter: Contact chatter is the intermittent closure of open contacts or the opening of closed contacts.

Chatter time: The measurement of chatter time is made on an oscillogram of the trace which is a record of the contact current of the relay.

Relay Transient Characteristics

The electromagnetic relay has an electric circuit which converts the energy to actuate the device. This is accomplished by the interrelated magnetic circuit. A second electric circuit which is of considerable importance is the circuit in which the contacts are placed. When the contacts do not function as intended, the relay is not satisfactory. The other parts of the relay—in particular, the mechanical moving parts—might be termed the mechanical circuit. The diagram of an elementary relay (Fig. 1) shows the working parts of a relay with the exception of the magnetic circuit. The flux path of the magnetic circuit may be visualized through the core, armature air-gap, armature and part of the frame and then back to the core. The flux leakage path is one item which should not be neglected in the analysis of the relay structure.

It has been said that an ideal relay should function in zero time, consume zero power and control any desired value of current for any and all conditions. This is most certainly an ideal state of conditions.

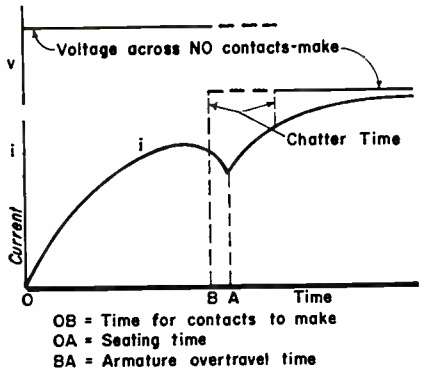


Fig. 3: Voltage and current transients for NO relay-operate.

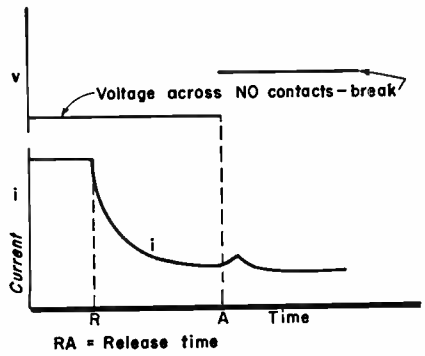


Fig. 4: Release transients for NO relay.

Under satisfactory conditions it is most surprising that relays can and do perform a wide variety of duties. It must be realized that the coil must be energized and since this coil is an inductive circuit, a definite time is required for the current to buildup sufficiently to pull the armature into the desired position.

The armature is a mass of iron and it must be moved from one position to another at a comparatively high velocity. When this mass of iron has reached the end of its travel, it should not rebound. A short time before the end of the armature travel the contacts should have touched. These contacts should offer a minimum of resistance and function perfectly in every case. With all of these extreme requirements, it is quite interesting to know that literally millions of relays perform their allotted functions every day with a minimum of trouble.

There are several transient conditions which exist in a relay. They are: electrical, mechanical, magnetic, thermal, and many others. The electrical and mechanical transients are interrelated through the magnetic circuit. The equations which describe the electrical and mechanical transients are nonlinear, which complicates the solution. It is difficult to measure the magnetic quantities and this gives more complications.

An analysis of the performance of a relay by oscillographic evidence does assist in this study.

Circuit Used in Obtaining Oscillograms

The diagram of Fig. 5 shows the circuit which was used to obtain the oscillograms for the electric transients of electromagnetic relays. The circuit in Fig. 5 is simplified to show only the basic elements. The current shunt connected in the ground lead of the test relay is used to obtain a voltage which is proportional to the current in the relay coil. This voltage then is applied to the Y input of an oscilloscope.

Relay Dynamics *(Continued)*

The discharge resistance serves two purposes: one is to provide for a complete circuit to ground and the other is to provide arc suppression for the contacts on the control relay. By providing a complete circuit to ground the coil current decay can be observed, otherwise the circuit would have to be completed through the opening contact of the control relay and the supply voltage. The opening contact of the control relay would result in an arc, which exhibits variable resistance, causing a peculiar coil current decay. The energy stored in the magnetic field of the relay test coil would have to be dissipated in the arc of the control relay contact if the discharge resistance was not connected across the test relay coil.

The control relay is used to provide the necessary isolation between the voltage required for the test relay and control relay. This also allows other refinements such as providing a triggering pulse for the oscilloscope.

All of the oscillograms presented in this article were recorded from a dual beam oscilloscope. Sometimes only a single beam was used when showing multiple traces of the same variable but under different conditions. Multiple traces were obtained by taking multiple exposures and relocating the camera after each exposure.

The relays were operated from lead acid batteries of 175 ampere-hour capacity placed in a separate room from the relay test lab.

Operate Transient Coil Current

In a circuit which consists of resistance and inductance, or an R-L circuit, it is desired to find the current equation during a short interval after the switch is closed. The use of Kirchhoff's emf law gives

$$i\,R + L\frac{di}{dt} = E \qquad (1)$$

which may be solved for the instantaneous value of current, i, or

$$i = \frac{E}{R}\,(1 - \epsilon^{-Rt/L}) \qquad (2)$$

where i = circuit current
R = circuit resistance
E = applied d-c voltage
L = circuit self inductance
ϵ = base of natural logarithms
t = time
N = turns linked by the flux
x = distance

Eq. 2 gives the instantaneous value of current at some time, t, after the switch was closed. This equation applies to a circuit where the inductance is constant. It does not apply to the inductance of the relay coil because the inductance will vary with the change of flux.

Eq. 1 may be changed to give

$$i\,R + N\frac{d\phi}{dt} = \qquad (3)$$

where $N\dfrac{d\phi}{dt} = L\dfrac{di}{dt}$

and where $\phi = f\,(i, x)$

or stated in words, the flux in the magnetic circuit is a function of the current in circuit and it is also a function of the air-gap of the magnetic circuit. Then

$$i = \frac{E - N\left(\frac{\partial\phi}{\partial i}\frac{di}{dt} + \frac{\partial\phi}{\partial x}\frac{dx}{dt}\right)}{R} \qquad (4)$$

It can be shown that Eq. 4 satisfies the transient coil current build-up curve. An oscillogram of the transient buildup current is shown in Fig. 6. In Eq. 4, x is the air-gap and when dx/dt=0, the armature has stopped moving. At that instant the armature has touched the core of the relay. The second term within the parentheses becomes zero and the current continues to build-up until the Ohm's law value has been reached.

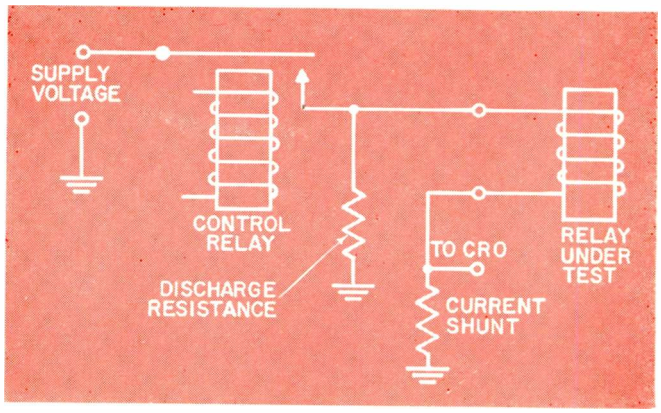


Fig. 5: Circuit used to obtain relay transients.

Oscillogram Fig. 16 shows the transient current and the armature motion for the period of "operate" or "make" for a normally-open relay. These two traces on the oscillogram were recorded simultaneously. It is interesting to note that the armature does not start to move until some time after the coil has been energized. It has been found that the instant at which the armature starts its motion is not the same for all relays. This would be expected since the design parameters would not be identical for every relay.

The significance of Eq. 4 is that it is not an exponential relation such as exists in Eq. 2 and that it does satisfy the requirement of the relay magnetic circuit to have a variable flux dependent upon the change of armature position. Eq. 4 is an equation of rate of change for four different terms:

$$\partial\phi/\partial i,\ \partial\phi/\partial x,\ di/dt, \text{ and } dx/dt.$$

It is recognized that dynamic relationships of the relay must be expressed in the equation for current if that equation is to represent the current-time transient values.

A study of the transient coil current trace which is recorded simultaneously with a trace which gives armature travel or motion reveals many significant details about relay behavior. At the time the current

has reached the lowest part of the cusp on the build-up current in Fig. 16, it should be noted that the motion of the armature of the relay has practically ceased. There is a small amount of motion recorded after the seating time of the armature. This may or may not cause contact chatter but in any event, it is worth an investigation.

Since the magnetic circuit of a relay consists of iron and an air-gap, it would be expected that the inductance of the circuit would not be constant. When the magnetic circuit is further complicated during transient conditions by motion of the armature, it is hazardous to make any assumption about the transient current. In Fig. 6 the bottom traces show the transient coil current when the armature was free to move. A second trace was obtained by blocking the armature closed, and a third trace was obtained with the armature blocked open. The top part of the oscillogram shows these three traces superimposed. This study indicates that the final Ohm's law value of current is reached in due time but by three widely different routes.

It has been found that many interesting details about relay operation may be observed by study of the transient current for "make" and for "release." When the trace of the transient current and motion of the armature are recorded simultaneously, this method of study reveals many characteristics not previously suspected.

The location of the cusp on the trace of the transient coil current build-up is not the same for different relays or for different conditions of operation. For example, compare the build-up currents of Fig. 17. For the top trace, the cusp takes place near the final value of current; whereas, in the lower traces this is not the case.

With traces of two different functions recorded simultaneously some interesting conclusions may be reached. In Fig. 8 the horizontal traces indicate the

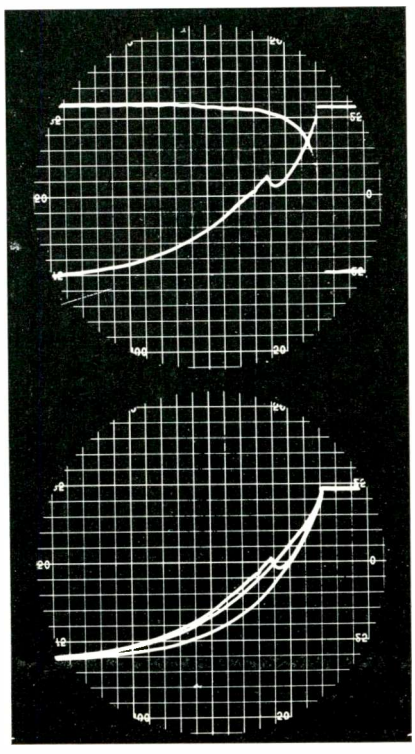
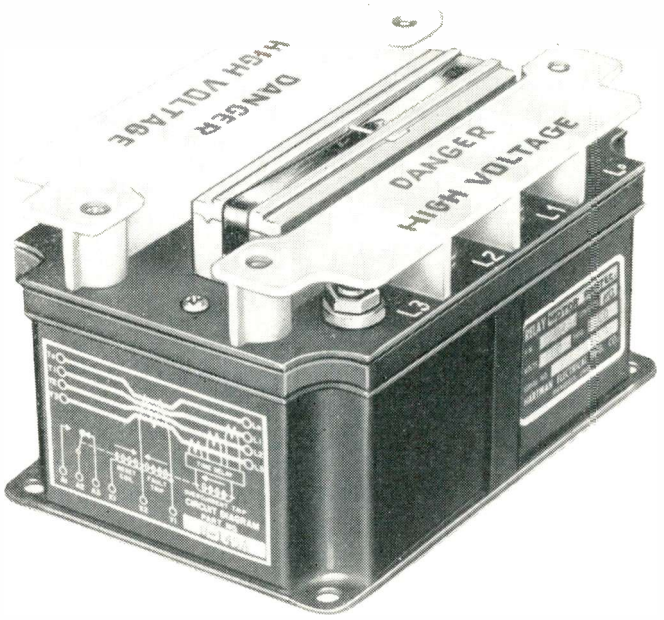


Fig. 6: (Top) Coil current with armature blocked open (top), free to move and blocked closed. (Bottom) Coil current decay armature free to move and coil current build-up with armature free to move. Time scale: 15 msecs/in. of scope face.



closing of normally-open (NO) contacts. The instant at which the contacts touch may be located on the oscillogram. As would be suspected, the time during the stroke of the armature at which the contacts first touch is not the same for all relays. The armature travel and the contact air-gap would vary from one relay design to another.

Decay of Coil Current

Let it be assumed that the coil of a relay has been energized and the magnetic field has been established by moving the armature to the closed position. If the voltage across the coil is suddenly removed and simultaneously the coil is short-circuited, the flux and current will not be reduced to zero instantaneously. Under these conditions, the differential Eq. 5 will be

$$i\,(R + R_1) + N\frac{d\phi}{dt} = 0 \qquad (5)$$

or

$$i\,(R + R_1) + N\left(\frac{\partial\phi}{\partial i}\,\frac{di}{dt} + \frac{\partial\phi}{\partial x}\,\frac{dx}{dt}\right) = 0 \qquad (6)$$

and

$$i = \frac{-N\left(\frac{\partial\phi}{\partial i}\,\frac{di}{dt} + \frac{\partial\phi}{\partial x}\,\frac{dx}{dt}\right)}{R + R_1} \qquad (7)$$

where R_1 is the discharge resistance and R is the coil resistance.

The terms inside the parentheses of the current decay equation are rates of change. The relative magnitudes of these rates of change determine the current decay. An inspection of Fig. 18 shows that with the lowest value of discharge resistance, the decay of current required a longer time than that for the largest value of discharge resistance. In other tests, it has been found that the current will drop almost instantaneously to the zero value and then become negative for a short period of time before it comes back to a positive value and then reduces to zero. An optimum value of resistance may be found to give the shortest release time. The delay in release time decreases up to the optimum value of discharge resistance.

For the oscillogram in Fig. 18, the armature does

Relay Dynamics *(Continued)*

not start to move until the coil current has decreased to less than one-tenth of the initial value of current. Up to this time

$$\frac{dx}{dt} = 0$$

and

$$i = \frac{-N\left(\frac{\partial\phi}{\partial i}\frac{di}{dt}\right)}{R + R_1} \qquad (8)$$

This equation shows that two rates of change $\partial\phi/\partial i$ and di/dt are the factors which determine the instantaneous value of current before the armature starts to move. During the short period of time that the armature releases, the current tends to increase, as shown by the characteristic hump on the current decay trace. The lower part of the oscillogram of Fig. 18 shows the current decay for a discharge resistance equal to the coil resistance. The two traces are a record of the current decay and armature motion which were a simultaneous record of each.

Eq. 8 may be interpreted to give the explanation for the characteristic hump in the decay current. While numerical values of the different rates of change in Eq. 7 might be somewhat difficult to determine, the equation does serve the useful purpose of offering a satisfactory explanation of the relay behavior under release conditions.

The equation for current decay 7 is a relation for a general case of an R-L circuit which may or may not have an iron core for the inductance. In a relay, before the armature has started to move, Eq. 8 shows the instantaneous value of current. It is instructive to consider the use of Eq. 8 for a simple R-L circuit where the inductance is linear or the coil does not have an iron core. Then

$$\frac{\partial\phi}{\partial i} = \text{a constant } K_1$$

and

$$i = \frac{-K_1 N \frac{di}{dt}}{R + R_1}$$

then

$$i(R + R_1) + K_1 N \frac{di}{dt} = 0$$

or

$$i(R + R_1) + L\frac{di}{dt} = 0 \quad \text{where} \quad L = K_1 N$$

and the solution of this differential equation yields

$$i = \frac{E}{R} e^{\frac{-(R + R1)t}{L}}$$

which is the classical solution for current decay in an R-L circuit with an external discharge resistance of R_1.

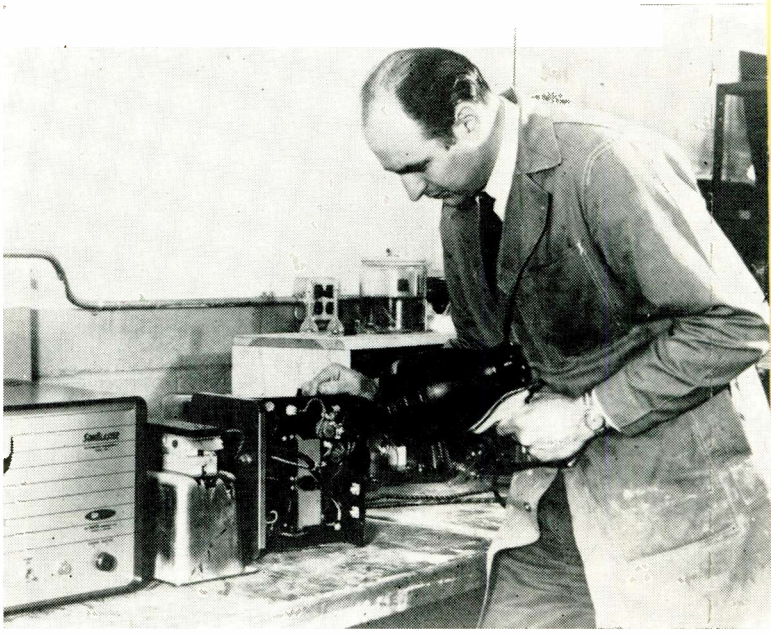
This argument shows that Eq. 7 and Eq. 4 are general expressions which may be used for linear or nonlinear inductances. More specifically, these equations then tell something about the transient conditions in a relay.

What's New . . .

'Black Light' Detects Contaminants

PRESENT techniques for inspecting parts for residual solder flux, brazing flux, welding slag, and certain lints, hydrocarbons, resins, etc., require that the discerning eye of the inspector be able to note traces of the various contaminants. If the inspection requirements are critical, the inspector may find a low power microscope a necessity. This makes inspection a costly part of the production system in time, labor, and necessary equipment and space.

It is now possible for cleanliness standards to be set up and maintained at reduced cost in time, labor, & space requirements. Even unskilled help can detect the most minute traces of solder flux and other contaminants in the smallest crevices of printed circuit board or miniaturized electronic sub assemblies, or particles of hydrocarbons in threads of fittings for oxygen service equipment.



Operator uses ultraviolet lamp to check assemblies after cleaning. Ultraviolet rays fluoresce solder flux and hydrocarbons showing up invisible contamination not revealed by ordinary light.

The high intensity, filtered, near ultraviolet Blak-Ray lamp (3600 a. u.) available from Black Light Eastern Corp., 201-04 Northern Blvd., Bayside 61, N. Y., causes many of the common contaminants in the electronics and missiles fields to fluoresce in brilliant colors, even though they are invisible in ordi-

(*Continued on page* 197)

Cooling Power Transistors

Presently used mounting methods—plate heat sink, cold plate, and baffling—for forced air cooling are studied. For future electronic equipment, five mounting methods, suitable for all silicon type power transistors, are suggested.

By STANLEY STERN
Staff Engineer
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Pleasantville, New York

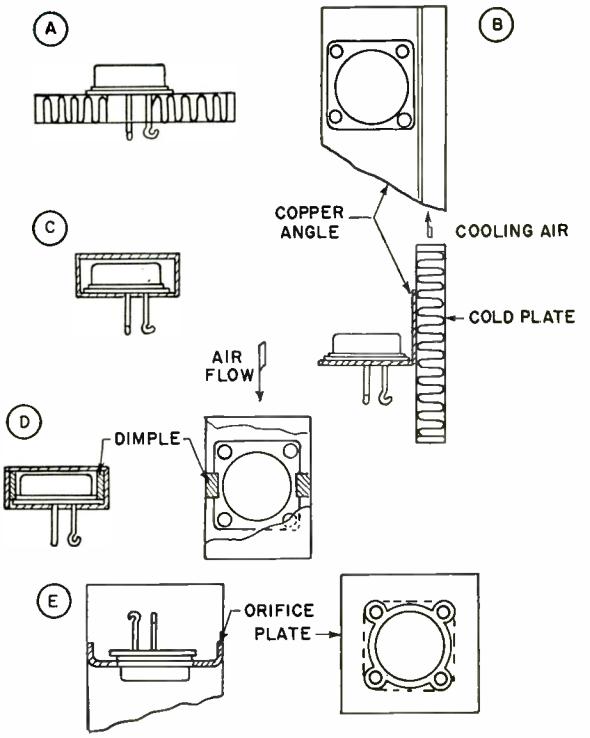


Fig. 1: Transistor mountings; A) directly to cold plate; B) on copper angle which is soldered to cold plate; C) in baffling duct; D) in baffling duct with dimples; and E) with 'hat' in orifice.

THE various mounting methods used for power transistors can be broken down into the following classes:

1. *Plate Heat Sink:* The "plate heat sink" method consists of attaching the power transistor to a suitable metal plate that will provide a rapid dispersion of the heat generated by the transistor junction. A metal with a high thermal conductivity should be used to obtain a rapid dispersion of the heat. The "heat sink," or plate, should be sufficient in size to dissipate the heat generated by the transistor to the ambient by natural convection and radiation. This method is limited by the ability of the ambient to act as the "ultimate heat sink."

2. *Cold Plate:* This method is similar to the above method in that a metal of high thermal conductivity for rapid dispersion of the heat is used. However, in this method, the heat is removed from the "cold plate" by forced convection. The "cold plate" is actually a plate finned heat exchanger. United Air-

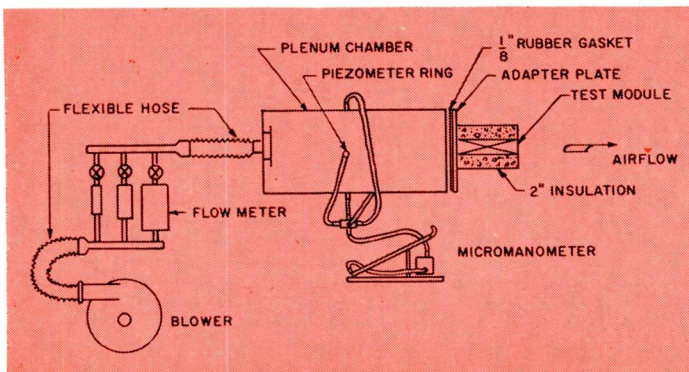


Fig. 2 (left): Set-up used for testing various mounting methods.

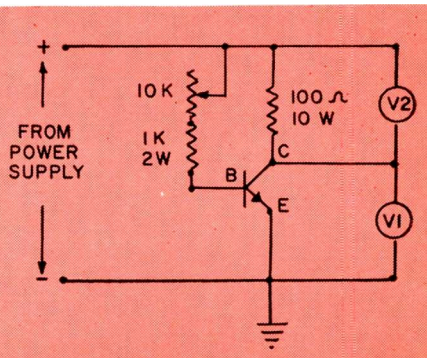


Fig. 3 (right): Wiring used for testing.

craft Products and The Trane Company are the two leading manufacturers of this type of heat exchanger.

3. *Baffling:* In this type mounting, the cooling air comes in direct contact with the transistor. The thermal efficiency for this type can be improved by increasing the surface area, "A," and the cooling air surface coefficient of convection, "h", This can be shown from the equation, $Q = h_c A \Delta T$, where "h_c," the surface coefficient of convection, is a function of the velocity of the air stream.

The surface area, "A," can be increased by

a. Attachment of the transistor to a plate of high thermal conductivity, or

b. Attachment of fins to the case of the transistor.

The surface coefficient of convection, "h_c," of the cooling air can be increased by

a. Enclosing the transistor in a small duct,

b. Breaking up of the air flow with bolts or rivets, or

c. Placing the "hat" of the transistor in an orifice plate.

Suggested Mounting Methods

In Fig. 1, five basic transistor mountings are shown that could be applied in future electronic equipment. Depending on the given application in a given environment, one or more of these methods could be

Mounting Details

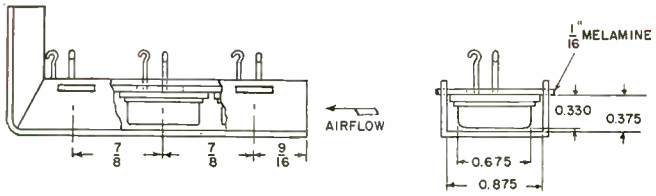


Fig. 4 (above): Three units mounted in baffling duct add to realism.

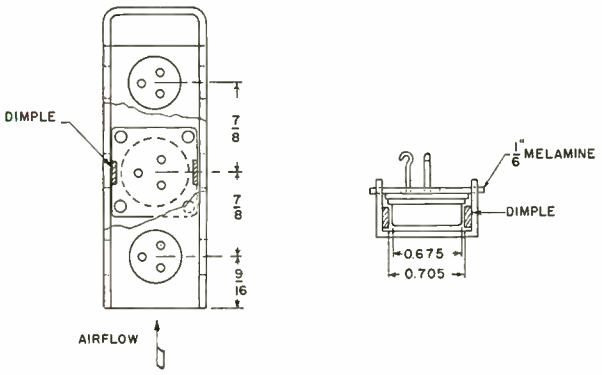


Fig. 5 (above): Dimples are made by 8-22 flathead screw, heads filed.

Fig. 6 (right): Plastic washer is filed on one edge to clear shoulder of hat when mounted in orifice.

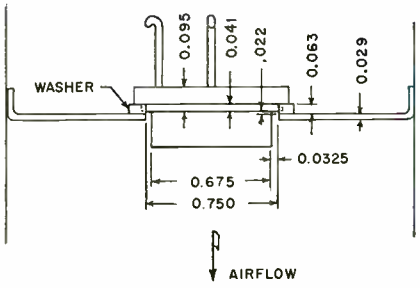


Fig. 7 (below): One cooling method uses this type of test module.

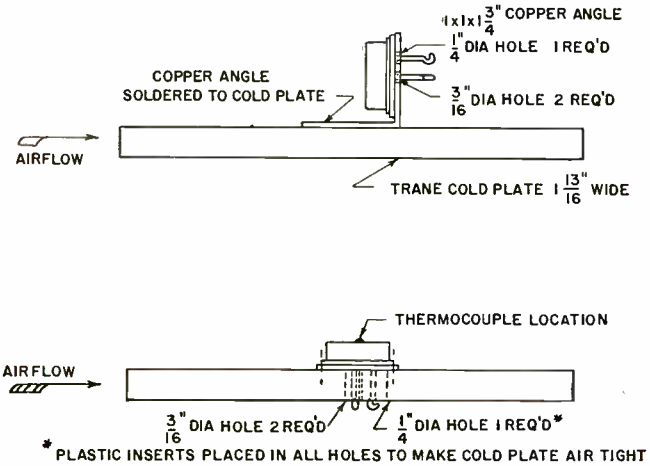


Fig. 8 (above): The unit is mounted directly to the cold plate.

Table 1
Suggested Mounting Methods

Type of Mount	Figure 1 (Sketch No.)	Advantages	Disadvantages
Transistor mounted directly to "cold plate"	1	Rapid dispersion of heat Large heat transfer area Suitability for hermetic sealing Suitability for encapsulation	Weight Volume Necessary electrical insulation Surface contact between transistor and "cold plate" Indirect cooling of transistor
Transistor mounted on copper angle soldered to "cold plate"	2	Rapid dispersion of heat Large heat transfer area Adaptability to printed circuit cards	Weight Volume Necessary electrical insulation Surface contact between transistor and "cold plate" Indirect cooling of transistor
Transistor mounted in baffling duct with or without dimples	3 and 4	Simplicity of design Maintenance Direct cooling of transistor Adaptability to modular construction	Subjected to environmental conditions Poor air flow control
Transistor mounted with "hat" in orifice	5	Simplicity of design Maintenance Direct cooling of transistor Adaptability to modular construction Good air flow control	Subjected to environmental conditions Mounting of orifice plate

used. In the sketches of Fig. 1, Texas Instruments' 2N389 transistor was used for its physical size. However, the designs are such that any power transistor of similar shape can be used. In Table 1, the applications, advantages, and disadvantages of each design are listed for convenience.

Editor's Note: For other work on "radiators," it is suggested that the reader refer to "Increased Cooling for Power Transistors" by C. Booher, page 66, August 1958 issue of ELECTRONICS INDUSTRIES.

Evaluation of Methods

Six transistor mounting methods were thermally evaluated to determine an optimum mounting method for forced air cooling. In all of the tests, a Texas Instruments' 2N389N-P-N power transistor was used. The mounting methods tested were as follows:

Test Results

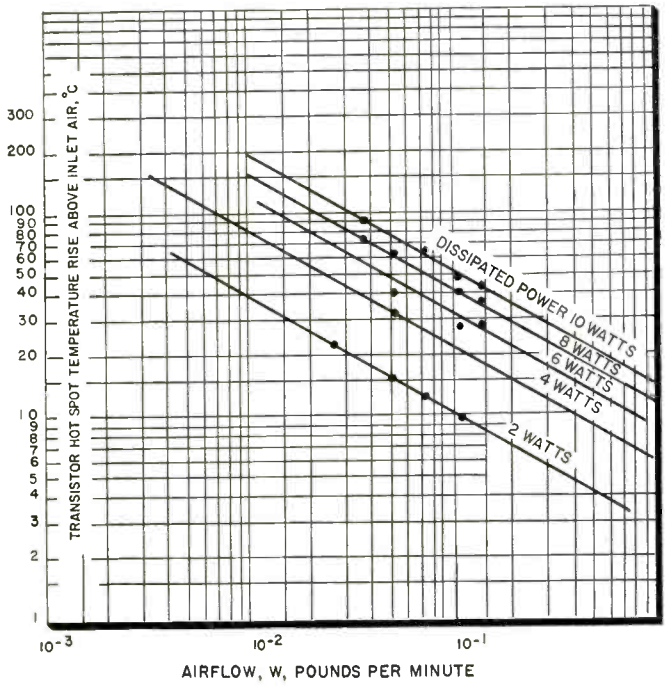


Fig. 9: Transistor mounted in baffling duct.

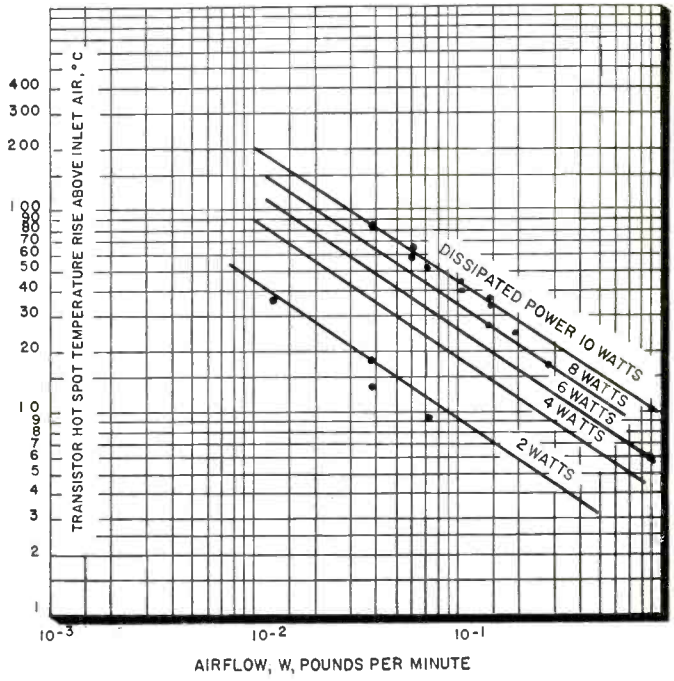


Fig. 10: Transistor mounted in baffling duct with dimples.

Fig. 11: Transistor mounted in 0.029 in. thick orifice plate.

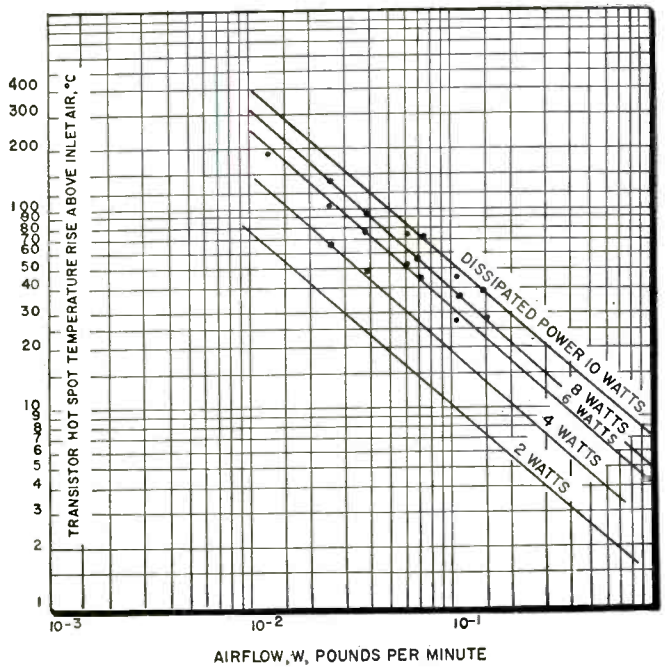
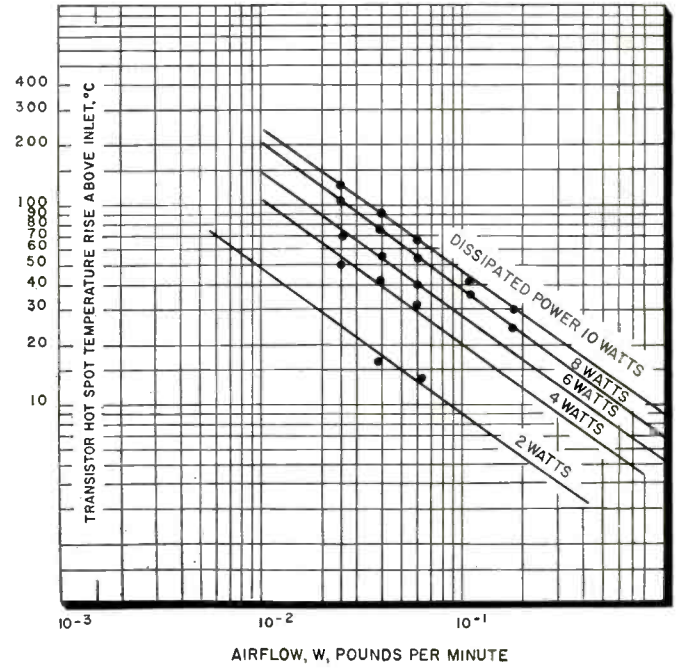


Fig. 12: Transistor mounted in 0.0625 in. thick orifice plate.



Cooling Transistors

(Continued)

1. In baffling duct,
2. In baffling duct with dimples,
3. In ¾ in. dia., 0.029 in. thick orifice plate,
4. In ¾ in. dia., 0.0625 in. thick orifice plate,
5. To copper angle with the angle soldered to a cold plate, and
6. Directly to the cold plate.

The cold plate technique is generally recommended for use in high temperature applications (80°-110°C) and for use when small modular units are to be used as shelf items. The orifice plate or baffling method should be used in applications when the cooling air temperature is below 80°C. The orifice plate technique, however, is optimum from a manufacturing and cost standpoint.

Testing

In the test set-up the air flow rates were measured with Fisher and Porter flow rate meters and controlled by opening or closing the valves. The pressure drop across the unit was obtained by measuring the static pressure in the plenum chamber, using a piezometer ring connected to an E. Vernon Hill micromanometer.

The inlet, outlet, and transistor temperatures were measured with 30-gage copper constantan thermocouples. Two thermocouples measured the transistor temperatures; one, soldered on top of the hat; the other, between the leads. The higher temperature is referred to as the "hot spot" temperature.

Test modules, connected to the plenum chamber by various adapter plates, were insulated with 2 in. of Fiberglas blanket insulation, minimizing the heat loss to the ambient by natural convection and radiation. This was done in an attempt to make the test module heat transfer parameters independent of the ambient, and dependent only upon the internal forced convective cooling of the transistor.

Test runs were made by maintaining the wattage dissipation constant at 2, 4, 6, 8, and 10 watts. The air flow rates were varied at each setting so that six to eight points were obtained at each wattage dissipation setting.

The air flow rates were chosen so that they would fall in the approximate range required for high temperature cooling.

Test Data

A heat balance was made on each set of data to determine the amount accountable for, and that lost to the ambient, i.e., the electrical wattage dissipation. Q_E, is equal to the heat gained by the cooling air, Q_T, plus the heat lost to the ambient. It was noted that the heat balance percentages, $HB\% = \frac{Q_T}{Q_E} \times 100$, at the low air flow rates and the low wattages were between 40% and 50%. At the higher air flow ranges, the heat balances were between 75% and 95%.

The losses to the ambient at the low flow rates and the low wattages, in which we are mainly interested, were considered excessive, and necessitated the correction of the test data. The "hot spot" temperature rise of the transistor over the inlet cooling air temperature for all runs was therefore corrected.

Example

Where:

t_o' = Corrected "hot spot" temp. °C.

t_o = Test "hot spot" temp. °C.

HB% = Heat balance percentage, equal to calculated wattage dissipated divided by measured electrical wattage dissipation.

Table 2—Comparison of Cooling Requirements

Inlet Cooling Air Temperature	71°C				95°C				110°C			
	W #/Min.	$\sigma_1\Delta P$ "H_2O	P Cooling Power Watts X10-4	#/Min. / KW	W #/Min.	$\sigma_1\Delta P$ "H_2O	P Cooling Power Watts X10-4	#/Min. / KW	W #/Min.	$\sigma_1\Delta P$ "H_2O	P Cooling Power Watts X10-4	#/Min. / KW
Transistor Mounted in Baffling Duct	0.011	0.068	11.5	3.67	0.0265	0.280	114	8.8	0.062	1.02	970	20.7
Transistor Mounted in Baffling Duct with dimples	0.011	0.102	17.2	3.67	0.0240	0.325	120	8.0	0.045	0.92	635	15.0
Transistor Mounted in 0.029" Thick Orifice Plate	0.021	0.098	31.6	7.0	0.037	0.181	103	10.6	0.067	0.57	586	22.3
Transistor Mounted in 0.0625" Thick Orifice Plate	0.014	0.087	18.7	4.67	0.0280	0.25	107	9.3	0.060	0.8	737	20.0
Transistor Mounted to copper angles with angle soldered to cold plate	0.0092	0.0055	0.78	3.06	0.0167	0.013	3.33	5.56	0.032	0.034	16.7	10.6
Transistor Mounted directly to cold plate	0.0093	0.0090	1.29	3.10	0.0155	0.019	4.52	5.15	0.029	0.050	22.3	9.64

Test Results (Continued)

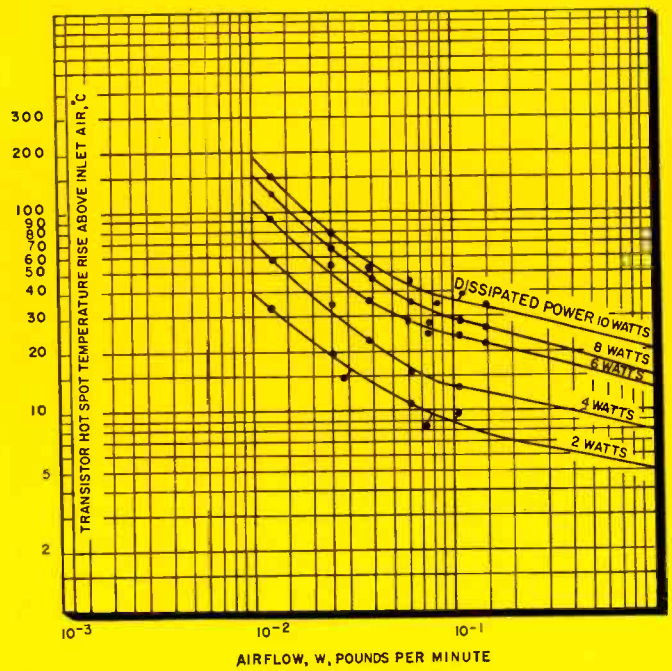


Fig. 13: Transistor mounted on copper angle which is soldered to cold plate.

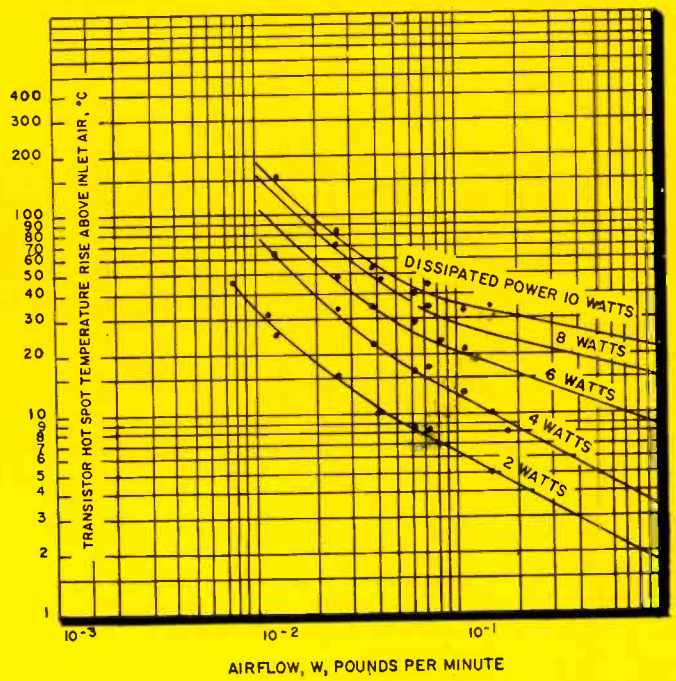


Fig. 14: Transistor mounted directly to cold plate (lead holes airtight).

Q_E = Wattage dissipated, measured electrically.

Q_T = Calculated wattage dissipated to the cooling air.

Mounting Data, Test 1, Run No. 89

t_1 = 26 °C, inlet temp.

t_2 = 42 °C, outlet temp.

W = 0.00763 lb/min., cooling air weight flow rate.

t_c = 55 °C, "hot spot" temp.

E_1 = 30 v.

E_2 = 6.6 v.

1. Wattage dissipated electrically:

$$Q_E = \frac{E_1}{100} \times E_2 = \frac{30 \times 6}{100} = 1.98 \approx 2 \text{ w.}$$

2. Wattage dissipated to the cooling air:

$$Q_T = 7.6 \text{ W } (t_2 - t_1)$$

$$= 7.6 \frac{\text{watt-min.}}{\text{lb.-°C}} \text{ 0.00763 lb./min. (42-26) °C.}$$

$$Q_T = 0.927 \text{ w.}$$

3. Heat Balance %:

$$HB\% = \frac{Q_T}{Q_E} \times 100 = \frac{0.927}{2} \times 100 = 46.3\%$$

4. The corrected "hot spot" temp. rise over the inlet air:

$$\Delta t_c' = (t_c' - t_1) = \frac{(t_c - t_1)}{HB}$$

$$\Delta t_c' = \frac{\Delta t_c}{HB} = \frac{(55 - 26)}{0.463} = 62.5 \text{ °C}$$

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Results

The corrected test results are shown in Figs. 9 through 14. The curves theoretically should be straight lines when plotted on log paper.

The corrected pressure drops of the test modules are shown in Fig. 15. The reference standard air density used in the pressure corrections was 0.0765 lb/ft³.

A comparison of the different mounting methods can be made by comparing the cooling power requirements for each module at any power dissipation. A power dissipation of 3 watts was chosen as a point for comparison as most of our applications will be

Table 3

Temperature of Cooling Air	71°C	95°C	110°C
	Total Weight (lbs.) due to air flow + Cooling Hardware		
Transistor mounted directly to cold plate with mica washer	0.264	0.346	0.586
Transistor mounted directly to redesigned cold plate with mica washer	0.176	0.269	0.508
Orifice plate 0.625" thick	0.140	0.280	0.600

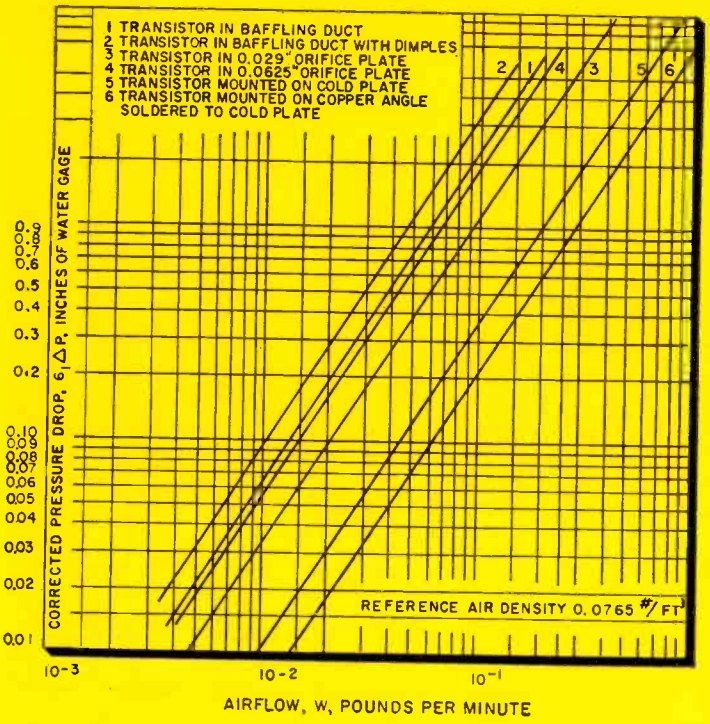

Fig. 15 (above): The pressure drop of each test module at required air flow rate.

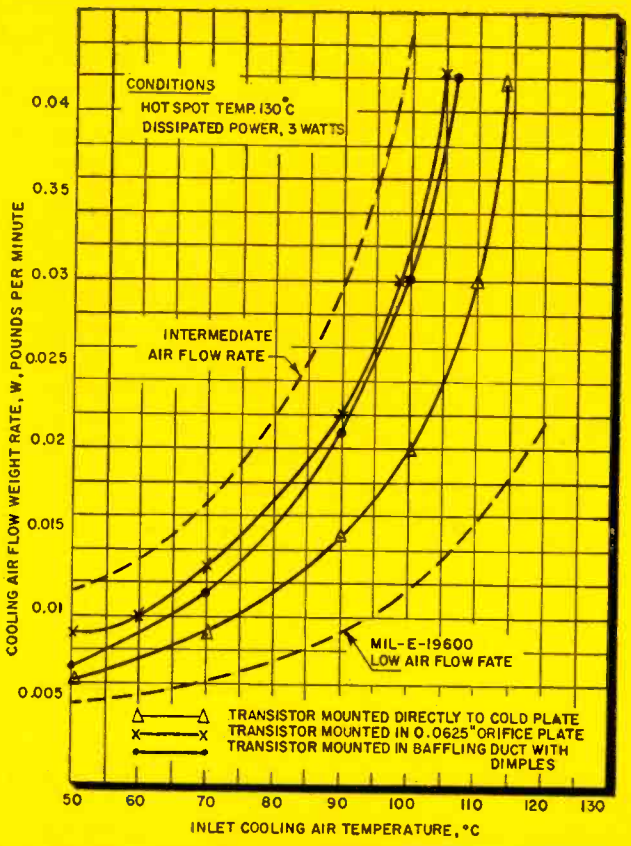

Fig. 16 (right): Comparison of required air flow rates as a function of inlet temperature.

at or near this value. The cooling power requirements in watts is equal to:

$$P = 1.535\ \delta_1\ \Delta P\ W$$

where:

P = cooling power required, watts.

δ_1 = ratio of air density to standard air density of 0.0765 lb/ft.³

ΔP = air pressure drop, inches of water gage.

W = weight air flow rate, lb/min.

Another figure of merit that is often used in the thermal evaluation of an electronic module is the required weight air flow rate per kilowatt dissipated.

At a power dissipation of 3 watts, Texas Instruments, Inc., recommends a case temperature of 137°C for its 2N389N-P-N transistor. However, from a reliability standpoint, let us assume it has been decided to maintain the case "hot spot" temperature at 130°C.

In Table 2, a comparison of the cooling requirements is made using inlet cooling air temperatures of 71°C, 95°C, and 110°C. The required air flow rate, to maintain the "hot spot" temperature at 130°C, can be read from Figs. 9 through 14 using temperature rises of the transistor over the inlet cooling air of 59°C (130 - 71), 35°C (130 - 95), and 20°C (130-110).

The pressure drop ($\delta_1 \Delta P$) of each test module at the required weight air flow rate can be read from Fig. 15.

A comparison of the required air flow rates as a function of the inlet temperature is also shown in Fig. 16. All of the test modules air flow requirements fall between the designated low and intermediate air flow regions specified in MIL-E-19600[7]. This specification also calls out a maximum pressure drop of one inch of water across the module at sea level. All of these modules fall below this maximum for inlet cooling air temperatures well over 100°C, see Table 2.

Recommendations

1. For a transistorized amplifier to be used as an all purpose shelf item, the cold plate technique should be used. This unit could be hermetically sealed.

2. The cold plate should be redesigned to be consistent with the power dissipated by it.

3. For an application using 70°C to 80°C cooling air, the orifice plate or baffling duct will be optimum and should be used. It will also save the cost of a cold plate.

4. The orifice plate technique is optimum from a manufacturing and cost standpoint and should be used wherever possible.

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What's New

Electronic Larynx

A NEW artificial larynx for persons who have lost their voices through surgical removal (laryngectomy) or paralysis of their vocal cords has been developed by Bell Telephone Laboratories. Still in the experimental stage, it is the result of a considerable background of research in an interdisciplinary field of science known as psychoacoustics.

With a minimum of difficulty and training, laryngectomees can use the new electronic larynx to speak conversationally. It is especially effective when conversing over the telephone.

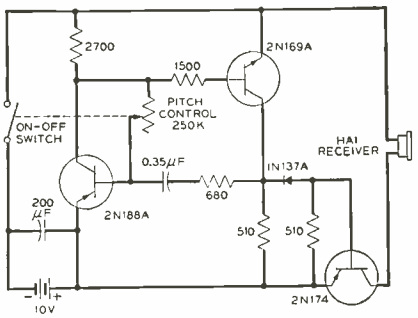
By means of a finger-operated combination push-to-talk switch and inflection control, the user can easily control the pitch of his artificial voice, thus giving his speech a natural sounding quality previously unobtainable.

Construction

The underlying principle of the new artificial larynx is a vibrating driver (transducer) held against the throat. Completely self-contained and cylindrically shaped, it measures only 1¾ inches in diameter by 3¼ inches long—thus acceding to plaints of laryngectomized people for an unobstrusive device. Included in this one small package is a modified telephone receiver serving as the throat vibrator, a highly-efficient transistorized pulse generator with pitch control, and a battery power supply. To miniaturize the new artificial larynx, experimental units were built using modular techniques. However, printed-circuit techniques will permit an even more compact unit.

To use the unit, the laryngectomized person presses the vibrator against his throat. Switching on the pulse generator with his finger, he transforms vibrations transmitted into his throat cavities into speech sounds by normal use of the articulatory mechanisms, i.e., throat cavity or pharynx, tongue, mouth, teeth, and lips, in his vocal tract.

Output speech volume obtained with the artificial larynx is equal to that of a person speaking at a normal conversational level, though the sound is a bit buzzy and mechanical. Nevertheless, the frequency spectra of vowel sounds show that the frequency range transmitted into the person's throat is sufficient for satisfactory production of such sounds. And while intelligibility tests give results lower than those of normal speech, they are superior to those of any other artificial larynx. Users



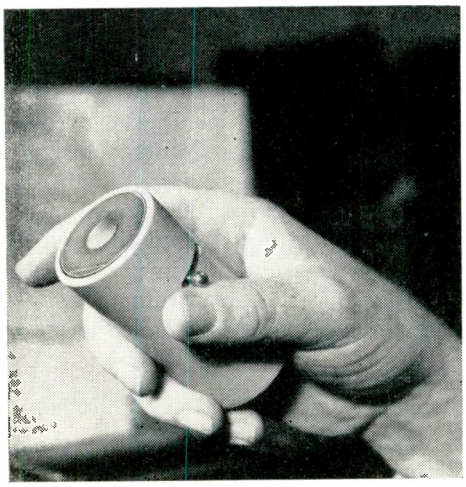
Highly efficient pulse generator with pitch control uses three transistors.

of the new artificial larynx can achieve a sentence intelligibility of 97% or more, depending on their experience.

Power Supply

Because the artificial larynx requires an economical, self-contained power source, circuit parameters had to be adjusted to yield maximum acoustic output with a minimum of current drain. Accordingly, two transistors are used in a relaxation oscillator whose frequency is controlled by a variable resistance, and whose pulse width is determined by a feedback network. The output is a negative pulse which occurs at a frequency of about 100 cps. This repetition frequency may be varied from about 100 to 200 cps by a rheostat which the user operates by pressure on the push-to-talk switch—or inflection control—while speaking, thus changing the pitch of his voice. For use by women talkers, the frequency range is adjusted to 200 to 400 cps, to correspond with the normal range of pitch of a woman's voice.

(*Continued on page* 196)



Electronic larynx uses a modified telephone receiver which transmits sound through flesh into person's throat. By moving pitch control switch while talking, user's "voice" can sound very natural.

Sound - level meter shows output speech volume of artificial larynx is equivalent to that of normal talker.

By W. A. ZINS
Electronics Department
Baltimore Div.
The Martin Co.

How to Design

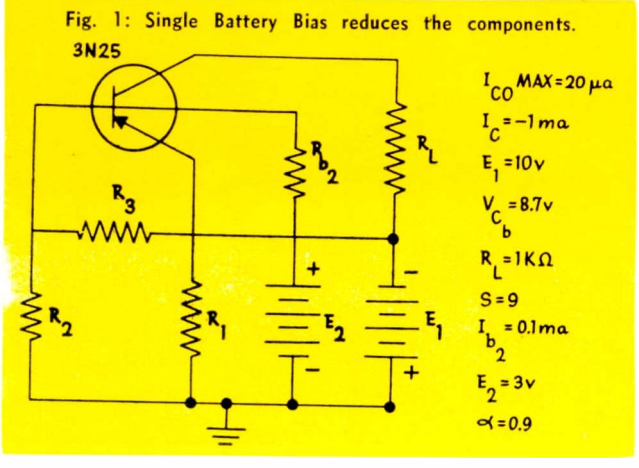
A Video Amplifier With a 30 MC Bandwidth

A design procedure for common-emitter video amplifiers requiring a very high bandwidth is presented. Grown-diffused germanium tetrode transistors are used in the amplifier section. The procedure applies to certain other types of high frequency transistors such as the graded or diffused base types.

THIS transistorized video amplifier has a 30MC bandwith and a 40 db voltage gain. The unit has four stages of amplification and a low impedance output stage.

Four tetrode transistors connected in the common emitter configuration are used in the amplifier section. Each stage uses a frequency-dependent degenerative feedback network in the emitter and a shunt compensating inductance in the collector. Two amplifier stages are treated as a separate pair and a series peaking coil is used in the coupling network. Negative feedback is also used over two stages. Each amplifier is then tuned separately before connecting the stages together.

Fig. 1: Single Battery Bias reduces the components.



The low impedance output stage consists of a single-stage graded-base transistor connected in the emitter follower or common-collector configuration. The output is designed to feed a 50-ohm coaxial cable.

Circuit Configuration

A single-stage tetrode transistor in the common emitter configuration was designed to permit the evaluation of gain vs bandwith. Test results indicate that the average value of gain bandwidth product for all load resistances is 80 MC. A load resistor of 1000 ohms, approximately equal to the output resistance of the tetrode, was shown to give the maximum frequency response while still maintaining a voltage gain of 10 or greater. The bandwidth for this test stage is 6 MC.

The tetrode transistor was chosen for two main reasons: (1) it has a very high alpha cutoff frequency, and (2) the gain of the transistor is reduced by the tetrode action, thereby improving the frequency response in the common emitter configuration.

The common emitter configuration is used throughout the amplifier stages. Thus voltage gain per stage is maximum and there is no need for coupling transformers or other means of matching impedance levels between stages.

Biasing

The two-battery biasing method was used in the early developmental stages of the amplifier. The main

advantage of this system is the high dc resistance in the emitter and collector, which results in a constant current type generator in these circuits. The constant current generators make the overall stage rather independent of small changes in circuit parameters. However, a big disadvantage of the two-battery bias method is that additional components are required. The biasing emitter resistor for each stage must be heavily by-passed with capacitance so that no undesirable degeneration feedback exists over the frequencies that are to be amplified.

In order to reduce the number of components in the amplifier, a single-battery biasing method exclusive of the second base connection, was developed. The basic circuit diagram of a tetrode amplifier stage appears in Fig. 1 with the design equations and a list of typical transistor parameters.[1]

$$R_{b_2} = \frac{E_2}{I_{b_2}} \tag{1}$$

$$R_1 = \frac{\alpha\,(E_1 - R_L\,I_c - V_{c_b})}{I_c - I_{c_b}} \tag{2}$$

$$R_3 = \frac{E_1\,(S-1)}{I_c - I_{c_o}} \tag{3}$$

$$R_2 = \frac{R_1\,R_3\,(S-1)}{R_3\,S\,\alpha - (S-1)\,(R_1 + R_3)} \tag{4}$$

Emitter Degeneration

A certain amount of emitter degeneration, series feedback, is used in the amplifier stages for three reasons: (1) the input and output impedances are increased with series feedback; (2) a resistance in the emitter circuit increases the stability of the amplifier; and (3) with proper capacitance by-passing of the emitter resistor, the bandwidth of the amplifier is increased.

The value of this resistor (R_1) was chosen experimentally at approximately one-half the calculated value. This is done to limit the loss in voltage gain to 1 db per stage when compared to the case where the resistor is heavily by-passed. A suitable by-passing capacitor to improve frequency response is then calculated. This critical frequency for by-passing is chosen at approximately one-half the total bandwidth.

Feedback

Two separate types of feedback are used in the amplifier. The first is the series feedback in a single stage, discussed previously as emitter degeneration. The second type is overall feedback over more than one stage.

The electrical characteristics of the transistor make it impractical to use voltage feedback over three stages. Excessive phase shift in the transistors causes positive feedback at high frequencies. A cumbersome solution would be to place phase correcting networks in the feedback path.

In order to simplify the circuity, the overall feedback is limited to two stages of amplification. Since the maximum phase shift of each transistor at very high frequencies is 90°, only in the extreme limiting case would positive feedback result.

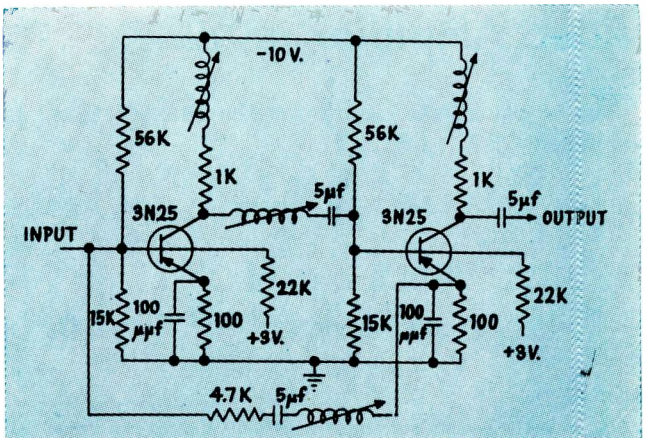


Fig. 2: Peaking coils compensate for β drop at high frequencies.

With a two-stage common-emitter amplifier, there are only two possible feedback combinations which give negative feedback due to the 180° phase shift from base to collector. The two types of feedback that might be used are: (1) The second-stage collector to first-stage emitter, or (2) second-stage emitter to first-stage base. The first method of collector to emitter feedback is not desirable due to the collector loading effect. The collector presents a relatively high impedance to ground whereas the emitter has a low impedance to ground. Connecting these through a feedback loop will then present a loading effect on the collector of the second stage. The second method of emitter to base feedback presents a much more desirable impedance match since both the emitter and base present a low impedance to ground.

The feedback loop consists of a R-L-C series circuit. A large value of capacitance is chosen so that the feedback network would pass all amplified frequencies and thereby act as a dc blocking condenser only. The resistance is chosen experimentally and is a compromise value at maximum bandwidth with usable gain. An inductance is used in the feedback loop to vary the amount of feedback at high frequencies. It essentially offers another control in obtaining a flat frequency response curve. All these feedback circuits reduce the low frequency response rather than increase the high frequency response as a means of obtaining a flat frequency response curve.

Peaking Circuits

Perhaps the greatest factor involved in obtaining a wide bandwidth is the peaking circuits. For this reason both shunt and series peaking coils are used in the amplifier (see Fig. 2). These peaking coils have little effect on the low frequencies, but rather raise the high frequency response as a means of compensating for a drop in the beta of the transistor at high frequencies. The amplifier has shunt peaking coils in each stage and series peaking coils between the first and second stages, and between the third and fourth stages.

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Video Amplifier *(Continued)*

The ac equivalent circuit for the shunt peaking is given below.[2]

$$R_p = \frac{R_{in} \times R_{out}}{R_{in} + R_{out}} \quad (5)$$

$$Q_o = W_2 L/R_{eq} \quad (6)$$

$$R_s = R_p/1 + Q_o^2 \quad (7)$$

$$R_o = 1/W_2 C_2 \quad (8)$$

$$R_{eq} = R_o + R_s \quad (9)$$

where:

R_p = is the equivalent shunt resistance due to the input and output resistances of each stage

Q_o is the "Q" of the coil for maximum flatness ($Q_o = 0.642$)

R_s = is the equivalent series resistance of R_p

R_o = is the actual series resistance

C_2 = is the sum of the input and output capacitances of the transistor stages

W_2 = is uncompensated 3 db point of the amplifier

L = is the shunt peaking inductance

The shunt peaking network essentially acts as an anti-resonant load for an amplifier stage. However, this resonant circuit has a very low "Q" and therefore the increase in output voltage is spread over a large frequency spectrum. The anti-resonant point is made to lie beyond the uncompensated 3 db point, so that an increase in bandwidth will result.

The action of the series peaking coil is to create a current gain at high frequencies. This is done by means of a transformer action formed by the input and output transistor capacitances and the peaking coil.[3]

Emitter Follower

A low impedance output is required of the amplifier so that it will not be loaded by the network it is feeding. Without this isolation, the distributed capacity of the coaxial cable will be sufficient to seriously distort the response at high frequencies. The requirements for the output stage are that the distributed capacity of 1.5 feet of coaxial cable (approximately 20 μf.) would not deteriorate the response curve, and the input impedance be sufficiently large to prevent any serious loading effects on the last amplifier stage.

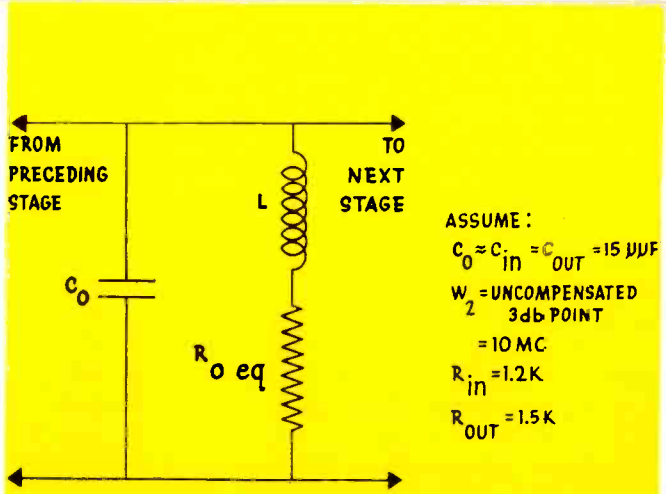
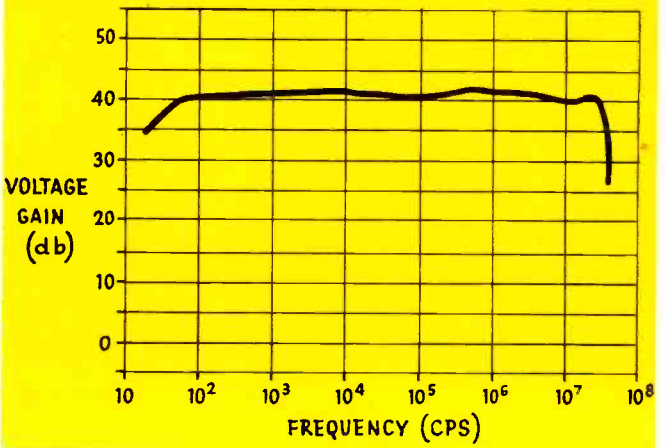


Fig. 3: Shunt peaking net is an anti-resonant load for an amplifier stage.

Fig. 4: Video amplifier voltage gain vs frequency shows bandwidth.



In order to produce a low output impedance, the current drive of the output stage must be high. This in turn requires a transistor with a high collector dissipation since the output voltage swing is to become appreciable with respect to the supply voltage. Since the tetrode does not meet these requirements, a higher power triode is used.

Noise Figure

Due to the low level of input signal amplitude, the noise figure of the amplifier is of some concern.

The noise figure of a transistor may be defined as:

$$F = \frac{\text{Total mean square noise voltage at output of transistor}}{\text{Mean square noise voltage at output resulting from thermal noise in } R_g}$$

where R_g is the equivalent series resistance of the signal generator.[4] The source generator has an optimum value for which the noise figure will be a minimum. This is given by:

$$R_g\,(F_{opt}) = \left(K_2^2 + \frac{K_1}{K_3}\right)^{\frac{1}{2}} \quad (10)$$

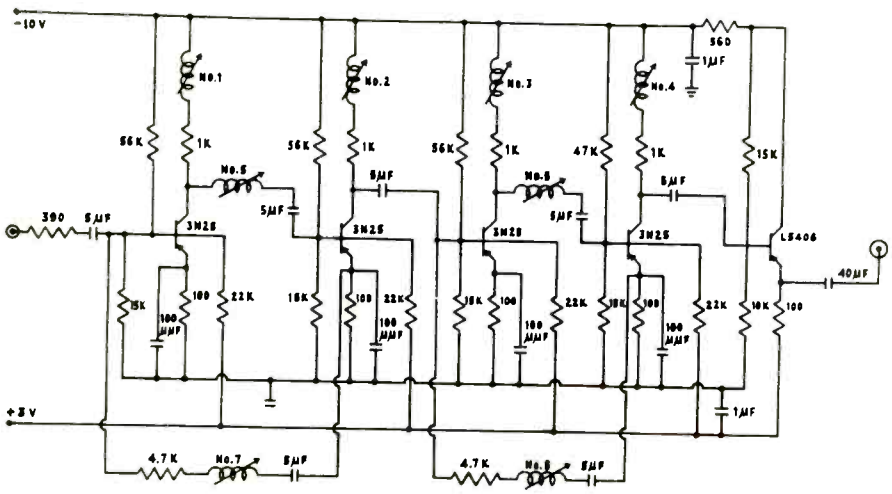


Fig. 5: Complete Wide Band Video Amplifier Schematic.

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where:

$$K_1 = r'_b + \frac{re}{2} \tag{11}$$

$$K_2 = r'_b + re \tag{12}$$

$$K_3 = \frac{(1 + \alpha_o)\left(1 + \frac{f^2}{f_d \sqrt{1 + \alpha_o}}\right)}{2\,\alpha_o\, re} \tag{13}$$

a theoretical noise figure may then be calculated for any value of Rg by the formula:

$$F = 1 + \frac{K_1}{R_g} + \frac{(K_2 + R_g)\,K_3}{R_g} \tag{14}$$

where K_1, K_2 and K_3 are defined by (11), (12), and (13), respectively. The actual value for the noise figure of the video amplifier may be calculated by:

$$F = \frac{N_o}{G_A\, N_i}$$

where:

N_o is the noise power output

N_i is the noise power input

G_A is the power gain of the amplifier

This method of calculation gives a theoretical noise figure of the amplifier of 7 db when $R_g = 390$ ohms

Test Results

The load resistor for each amplifier stage was set at 1000 ohms. This value gave the optimum bandwidth while still maintaining usable gain. It also closely corresponds to the value obtained by equation (8) when $C_2 = 15\mu\mu f$ and $W_2 = 62.8 \times 10^6$ rad/sec.

The impedance in the emitter circuit which gave the best results was found to be 100 ohms shunted by 100μμf. This too conforms closely to the theoretical values.

The shunt peaking inductance, as calculated by equation (6), yields 15.6 μh. All inductors in the circuit are in the 10-50 μh range.

The theoretical noise figure for $R_g = 390$ is F = 7 db. From data taken in the laboratory, the noise figure was found to be F = 16 db. However, the frequency response of the amplifier exceeded the capacity of the available complete noise measuring equipment.

The complete video amplifier voltage gain vs frequency is given in Fig. 4 and the final schematic in Fig. 5.

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4. Nielsen, E. G., "Behavior of Noise Figure in Junction Transistors," *Proceedings of the I.R.E.*, July 1957.

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Thermoplastic Replaces Die-cast Metals

TABLE 1 TYPICAL PROPERTIES

Property	Units	ASTM No.	Average Values* for "Delrin" 500X	150X
Elongation, 73°F.	%	D638	16	75
158°F.	%	D638	330	460
Impact strength, Izod, 40°F.	ft. lb./in.	D256	1.2	1.8
73°F.	ft. lb./in.	D256	1.4	2.3
Tensile strength and yield point, 73°F.	psi	D638		10,000
158°F.	psi	D638		7,500
Flexural modulus, 73°F.	psi	D790		410,000
Flexural strength	psi	D790		14,100
Fatigue endurance limit, 73°F., 100% RH	psi	—		5,000
Shear strength	psi	D732		9,510
Heat distortion temperature, 264 psi	°F.	D648		212
66 psi	°F.	D648		338
Deformation underload (2000 psi at 122°F.)	%	D621		0.5
Compressive stress at 1% deformation	psi	D695		5,200
Water absorption, 24 hours immersion	%	D570		0.4
50% RH (Equilibrium)	%	D570		0.2
Specific gravity	—	D792		1.425
Rockwell hardness	—	D785		M94, R120
Flammability	in./min.	D635		1.1
Melting point (crystalline)	°F.	—		347
Flow temperature	°F.	D569		363
Coefficient of linear thermal expansion	per °F.	D696		4.5×10^{-5}
Thermal conductivity	BTU/hr./sq. ft./°F./in.	—		1.6
Specific heat	cal/gm.	—		0.35

* These values are representative of those obtained under standard ASTM conditions and should not be used to design parts which function under different conditions.

IN MID-1959, E. I. DuPont De Nemours & Co. will begin commercial manufacture at Parkersburg, W. Va., of a new tough, rigid thermoplastic developed primarily for use in fields now dominated by die-cast metals. The material, "Delrin" acetal resin, will replace steel, brass, aluminum, and zinc in many applications.

Properties

"Delrin" is a highly crystalline, high-melting thermoplastic polymer, known chemically as a linear acetal resin or as polyoxymethylene. Its dense crystalline structure accounts for many of its key properties—strength and stiffness, high temperature behavior, solvent resistance. It is the first plastic with strength properties approaching those of the nonferrous metals, and in a real sense is metal-like, in that it will do many jobs heretofore performed only by metals.

Its outstanding feature is a unique combination of properties. It is extremely rigid without being brittle. It is both tough and resilient, much like spring steel and it retains these properties under adverse conditions of temperature and humidity during an extended time under stress, and during exposure to most solvents. "Delrin" is tasteless, odorless, and non-toxic. Though hefty by comparison to most other plastics, it is lighter than any of the die-casting alloys: 80% lighter than zinc, 45% lighter than aluminum, and over 20% lighter than magnesium.

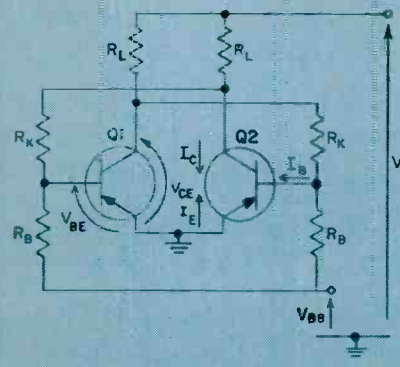


Fig. 1 (left): The dc portion of a saturated flip-flop circuit.

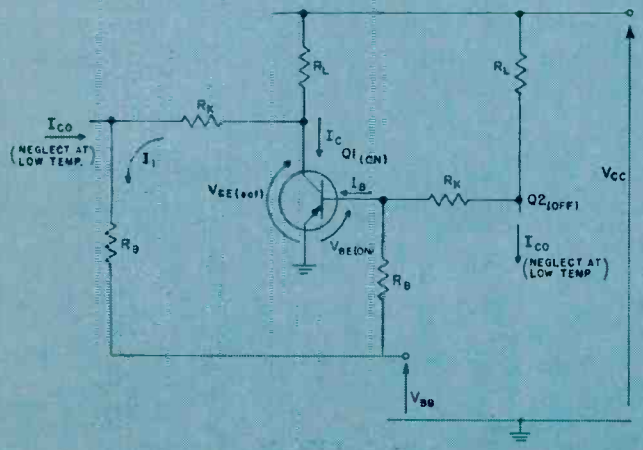


Fig. 2 (above): The ON equation is developed from this circuit.

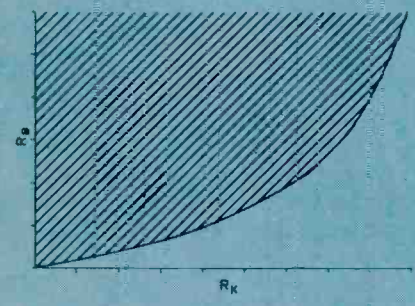


Fig. 3 (left): Any value within the shaded area will keep the ON transistor saturated.

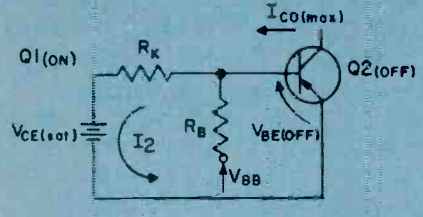
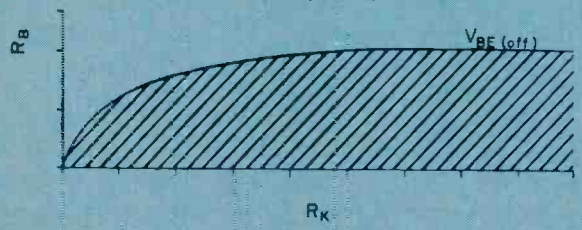


Fig. 4 (left): The OFF equation is developed from this circuit.

Fig. 5 (below): Any value within the shaded area will keep the OFF transistor cut off.



Several methods have been used to design bistable flip-flop circuits using transistors as saturated switches. The method presented here separates the design into a steady-state solution and a transient solution.

Flip-Flop Circuit Using Saturated Transistors

Part One of Two Parts

By JAMES E. HULL

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THE equations for stable ON and OFF conditions, subdivisions of the steady-state solution, are developed. From a graphical solution of these equations, the required values of resistors are obtained. Using these resistor values, a composite curve representing the loci of all operating points of the bistable circuit is presented. With the appropriate load line superimposed, the composite curve shows the safety factor contained in the design. The composite curve also shows the current necessary to trigger the flip-flop circuit. The transient solution discusses the time constant for the circuit and the triggering levels and pulse widths required. A presentation of triggering methods concludes the discussion.

STEADY-STATE SOLUTION

Fig. 1 shows the d-c portion of a saturated flip-flop circuit with assumed directions of currents and voltages. Table I lists the polarities for npn and pnp units for the assumed directions of currents and voltages.

There are five unknowns in the circuit: V_{CC}, V_{BB}, R_L, R_B, and R_K. It will be assumed that V_{CC}, V_{BB}, and $I_{C(max)}$ are known since they are dependent on device and design considerations, and R_L can be found by the equation $R_L = \frac{V_{CC}}{I_{C\ (max)}}$. To find R_B and R_K, the circuit must be synthesized. For high-speed triggering, it is generally best to use fairly low values of resistors and thus low values of voltages. In other cases where low transistor dissipation is required, somewhat lower values of load current should be used.

ON Equation

Since h_{FE} usually decreases with a decrease in temperature, the equation for the ON condition is developed for the low-temperature case which constitutes the most adverse operating condition. All variable parameters for the ON equation are low-temperature values. The ON equation is developed from the circuit of Fig. 2.

$$\frac{V_{BE\ (ON)} - V_{BB}}{R_B} + I_B = \frac{V_{CC} - V_{BE\ (ON)}}{R_L + R_K} \tag{1}$$

$$I_B = \frac{I_C}{h_{FE\ (min)}} \tag{2}$$

$$I_C = \frac{V_{CC} - V_{CE\ (sat)}}{R_L} - I \tag{3}$$

$$I_1 = \frac{V_{CE\ (sat)} - V_{BB}}{R_K + R_B} \tag{4}$$

Substituting Eq. (3) and (4) into Eq. (2) yields:

$$I_B = \frac{V_{CC} - V_{CE\ (sat)}}{R_L\, h_{FE\ (min)}} + \frac{V_{BB} - V_{CE\ (sat)}}{(R_K + R_B)\, h_{FE\ (min)}} \tag{5}$$

Substituting Eq. (5) into Eq. (1) yields:

$$\frac{V_{BE\ (ON)} - V_{BB}}{R_B} + \frac{V_{CC} - V_{CE\ (sat)}}{R_L\, h_{FE\ (min)}} + \frac{V_{BB} - V_{CE\ (sat)}}{(R_K + R_B)\, h_{FE\ (min)}} = \frac{V_{CC} - V_{BE\ (ON)}}{R_L + R_K} \tag{6}$$

Eq. (6) involves the solution of a quadratic equation. In most cases, I_1 is small and can be safely neglected since this lowers the minimum h_{FE} required.

To keep within a 3% error, I_1 can be neglected when it is $\leqq$ 3% of the load current. Therefore, if

$$R_B + R_K \geqq \left| \frac{R_L\,(V_{CE\ (sat)} - V_{BB})}{0.03\,(V_{CC} - V_{CE\ (sat)}} \right| \tag{7}$$

then I_1 can be neglected. This changes the ON equation from Eq. (6) to:

$$\frac{V_{BE\ (ON)} - V_{BB}}{R_B} + \frac{V_{CC} - V_{CE\ (sat)}}{R_L\, h_{FE\ (min)}} = \frac{V_{CC} - V_{BE\ (ON)}}{R_L + R_K} \tag{8}$$

This simplification can be used in most cases and avoids the solution of a quadratic equation. In general, V_{BE} increases with decreasing temperature at the rate of about 2.5 mv/°C for both germanium and silicon.

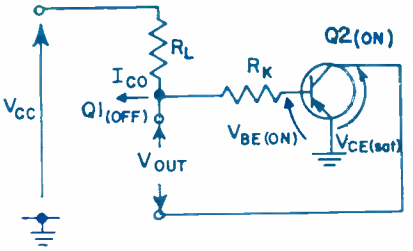

Fig. 6 (right): Circuit used for the output voltage swing.

Plotting a curve of R_B vs R_K from Eq. (8) gives a locus of points which satisfies the ON condition. The general shape of the curve is shown in Fig. 3. Any value of R_K, R_B within the crosshatched region will keep the ON transistor saturated.

If the flip-flop output is loaded with a resistor R_1, Eq. (1) through (8) must be modified by replacing V_{CC} with

$$\frac{V_{CC}\, R_1}{R_1 + R_L} \text{ and } R_L \text{ with } \frac{R_1\, R_L}{R_1 + R_L}.$$

OFF Equation

The OFF equation is developed at the high-temperature limit since this represents the most adverse condition. All variable parameters for the OFF equation are high-temperature values. The OFF equation is developed from the circuit of Fig. 4.

$$I_2 = \frac{(V_{BB} + I_{CO\ (max)}\, R_B) - V_{CE\ (sat)}}{R_B + R_K} \tag{9}$$

$$V_{BE\ (OFF)} = V_{BB} - (I_2 - I_{CO\ (max)})\, R_B \tag{10}$$

Substituting Eq. (9) into Eq. (10) yields:

$$V_{BE\ (OFF)} = V_{BB} - \left[\frac{V_{BB} + I_{CO\ (max)}\, R_B - V_{CE\ (sat)}}{R_B + R_K} - I_{CO\ (max)} \right] R_B$$

$$= V_{BB} - \left[\frac{V_{BB} - V_{CE\ (sat)} - I_{CO\ (max)}\, R_K}{R_B + R_K} \right] R_B \tag{11}$$

Fig. 7 (below): Combined ON-OFF curve is used in the design example.

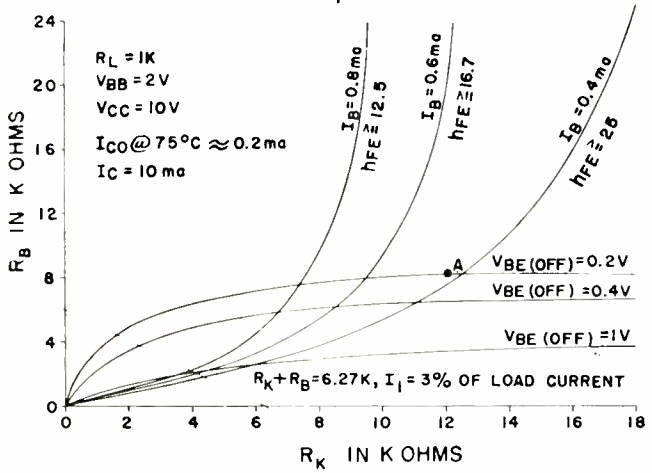

TABLE I

Values which are: + for npn, − for pnp		Values which are: − for npn, + for pnp
$V_{BE\ (ON)}$	I_C	$V_{BE\ (OFF)}$
V_{CE}	I_{CO}	V_{BB}
$V_{CE\ (sat)}$	I_B	
V_{CC}		

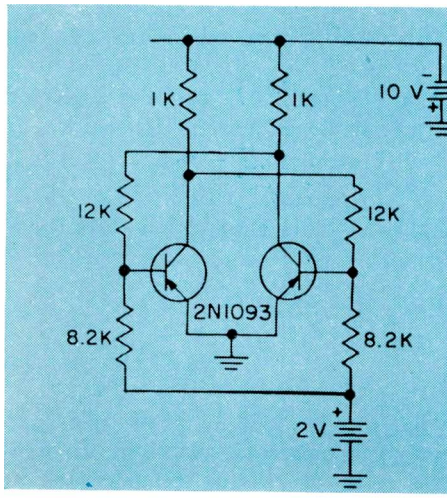

Fig. 8 (left): DC portion of the developed saturated flip-flop circuit.

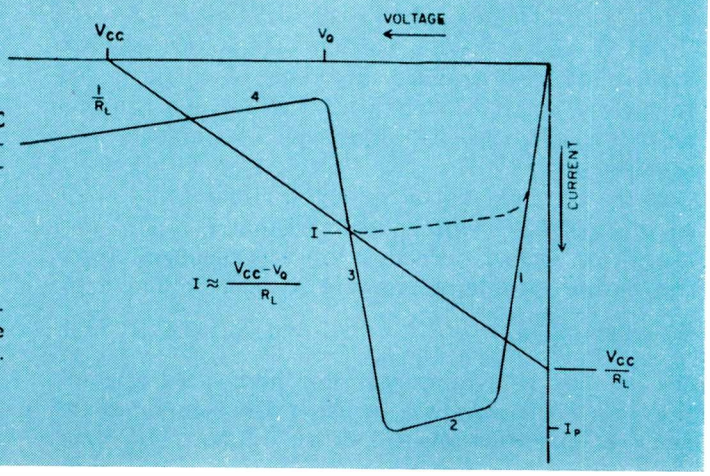

Fig. 10 (right): Typical composite curve for a flip-flop circuit.

The reverse voltage, $V_{BE(OFF)}$, sufficient to hold the transistor OFF, will usually be only a few tenths of a volt. Plotting a curve of R_B vs R_K from Eq. (11) gives a locus of points which satisfies the OFF condition. The general shape of the curve is shown in Fig. 5. Any value of R_K, R_B within the crosshatched region will keep the OFF transistor cut off.

If we superimpose the ON and OFF curves from Fig. 3 and 5, the common area between the two curves includes all combinations of R_K and R_B that satisfy both the ON and OFF conditions.

However, the ON transistor may try to turn OFF at the high-temperature limit if (I_{CO} R_L) reduced the $V_{CE(OFF)}$ to a value that would not turn the other transistor ON completely. Usually, h_{FE} increases with temperature to more than compensate for the effect of I_{CO} on the conducting state. If h_{FE} does not increase sufficiently with temperature, then V_C in the ON equation should be replaced by ($V_C - I_{CO(max)}$ R_L). This will ensure an ON condition even for no change in h_{FE}.

The output voltage swing for the flip-flop circuit shown in Fig. 6 is given by Eq. (12).

$$\text{V output swing} = V_{CC} - I_{CO\,(max)}\,R_L - \left(\frac{V_{CC} - I_{CO\,(max)}\,R_L - V_{BE\,(ON)}}{R_L + R_K}\right) R_L - V_{CE\,(sat)} \quad (12)$$

Solution of Equations

To plot the ON curve, the minimum h_{FE} at the lowest operating temperature must be known. A safety factor can then be applied. The minimum h_{FE} for a group of alloy junction units, Texas Instruments 2N1093, was found to be approximately 28 at −65°C. Inserting a minimum of 25 for h_{FE} *in* Eq. (2), I_B must be:

$$I_B = \frac{I_{C\,(max)}}{h_{FE\,(min)}} = \frac{10}{25} = 0.4 \text{ ma}$$

Knowing I_B, V_{CC}, V_{BB}, $I_{CO(max)}$, $V_{CE(sat)}$, $V_{BE(ON)}$, $V_{BE(OFF)}$, the ON and OFF curves shown in Fig. 7 were plotted. The curves for h_{FE} = 16.7 and 12.5 are also shown, as are curves for $V_{BE(OFF)}$ = 0.2, 0.4 and 1 volt. Usually a reverse bias of about 0.1 or 0.2 volt will be sufficient to hold the unit OFF. As a design example, we will select h_{FE} = 25, $V_{BE(OFF)}$ = 0.2 volt, and Point A on Fig. 7. With these conditions, R_K = 12K ohms and R_B = 8.2K ohms.

This provides the value of the two unknown resistors. From Eq. (7), the collector current will be within 3% of the calculated value if:

$$R_B + R_K \geq \left|\frac{R_L\,(V_{CE\,(sat)} - V_{BB})}{0.03\,(V_{CC} - V_{CE\,(sat)}}\right| = 6.27 \text{ K}$$

This equation is also plotted on Fig. 7 and is termed the 3% error line. With the operating point to the upper right of the 3% error curve, the collector current will be within 3% of

$$\frac{V_{CC} - V_{CE\,(sat)}}{R_L}$$

The d-c portion of our flip-flop circuit example is shown in Fig. 8.

V_{BB} may be replaced by an emitter resistor,

$$R_E = \frac{V_{BB}}{I_C + I_B}.$$

The two base resistors are then returned to ground. When this is done, the collector supply voltage, V_{CC}, must be increased by an amount equal to the turn-off voltage, V_{BB}. With these changes, if V_{CC} increases further, R_E will cause V_{BB} to increase proportionately. In the flip-flop circuit developed thus far,

$$R_E = \frac{2}{10 + 0.4} = 192 \text{ ohms} \approx 200 \text{ ohms}.$$

The d-c portion of the flip-flop with the common-emitter resistor added is shown in Fig. 9.

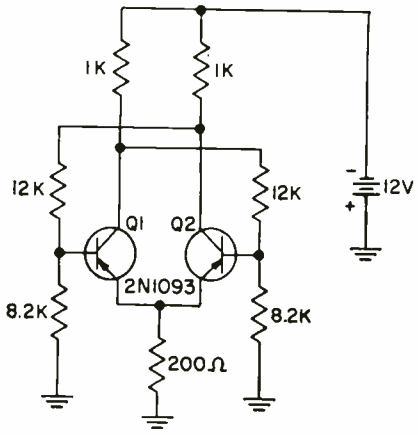

Fig. 9 (left): Developed flip-flop with common - emitter resistor.

Composite Curve

To determine the safety factors designed into the circuit, and the trigger current required to turn the

ON transistor OFF, the complete collector volt-ampere characteristic of the flip-flop circuit must be analyzed. A typical composite curve for a flip-flop circuit is shown in Fig. 10. This curve was obtained by removing one load resistor, R_L, and plotting the input volt-ampere characteristic of the resulting network shown in Fig. 11.

There are four distinct regions to the curve. Region 1 is where Q1 is saturated and Q2 is cut off. Region 2 is where Q1 is active and Q2 is cut off. Region 3 is where both Q1 and Q2 are active. Region 4 is where Q1 is cut off and Q2 is active or saturated. At the beginning of the fourth region, Q2 may be in the active region but at the end (highest voltage) it will be saturated.

Region 1 is simply the R_{CS} curve of the transistor. Region 2 is the $V_{CE} - I_C$ curve for the transistor in the active region with I_B found from previous calculations. Region 4 is simply the plot of R_K. The only region which must be calculated is region 3. To find the negative-resistance region 3, it is probably best to assume a base current in one of the transistors. In this case, it will be Q1 with its load resistor removed. This circuit was shown in Fig. 11.

After assuming I_{B1}, V_{CE2} can be found from:

$$\frac{V_{CE2} - V_{BE\ (ON)}}{R_K} + \frac{V_{BB} - V_{BE\ (ON)}}{R_B} = I_{B1} \qquad (13)$$

Knowing V_{CE2}, I_{B2} can be found from:

$$I_{B2} = \frac{I_C}{h_{FE}} = \left(\frac{V_{CC} - V_{CE2}}{R_L} - \frac{V_{CE2} - V_{BE\ (ON)}}{R_K}\right)\frac{1}{h_{FE}} \qquad (14)$$

I_{B2} can also be found graphically from the characteristic curve of the transistor with a load line of

$$\frac{R_K R_L}{R_K + R_L}$$

and a supply voltage of:

$$V_{CC} - \left(\frac{V_{CC} - V_{BE\ (ON)}}{R_L + R_K}\right) R_L.$$

Knowing V_{CE2}, I_{B2} can be found directly from the curve. V_{CE1} can now be found which will give this base current I_{B2}.

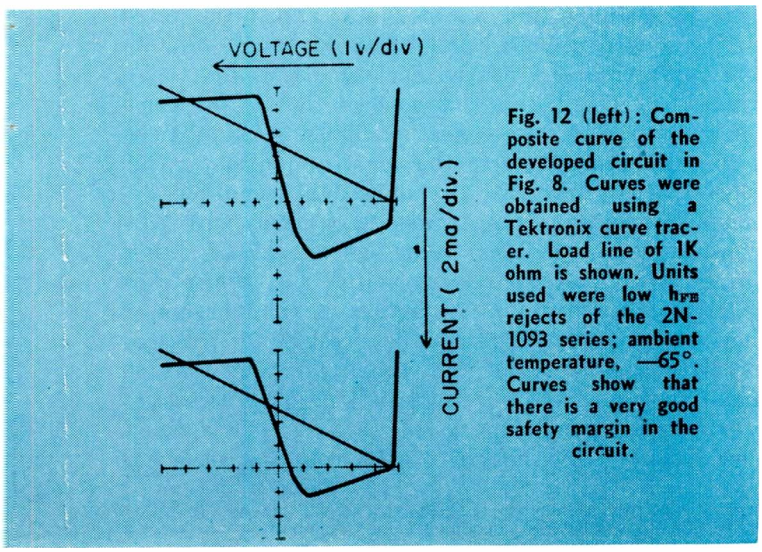

Fig. 12 (left): Composite curve of the developed circuit in Fig. 8. Curves were obtained using a Tektronix curve tracer. Load line of 1K ohm is shown. Units used were low h_{FE} rejects of the 2N-1093 series; ambient temperature, —65°. Curves show that there is a very good safety margin in the circuit.

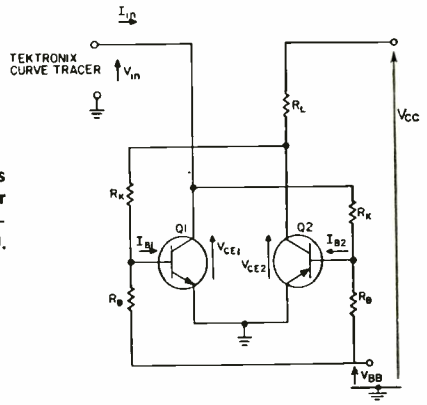

Fig. 11 (right): This network was used for plotting the composite curve of No. 10.

$$\frac{V_{CE1} - V_{BE\ (ON)}}{R_K} + \frac{V_{BB} - V_{BE\ (ON)}}{R_B} = I_{B2} \qquad (15)$$

Plotting V_{CE1} and I_{B1} will give the negative-resistance region. The current required to trigger the flip-flop will be the base current needed to shift the composite curve below the load line. The shifted composite curve is shown by dashed lines in Fig. 10. The change in base current will be:

$$\Delta I_B \approx \left(I_P - \frac{V_{CC} - V_Q}{R_L}\right)\frac{1}{h_{FE}} \qquad (16)$$

Usually, it will be necessary to use only the lowest and highest h_{FE} units in the above calculations to determine the maximum and minimum limits of the composite curve.

The main points on the characteristic curve are the peak current and valley voltage which can be calculated as follows:

The valley voltage, V_Q, occurs when the base current for Q1 *is* approximately equal to zero.

For $I_{B1} = 0$.

$$V_{CE1} = V_Q = R_K\left[\frac{\frac{V_{BB}}{R_B}(R_L + R_K) + V_{CC}}{R_L h_{FE}} - I_{CO2} - \frac{V_{BB}}{R_B}\right] \qquad (17)$$

The derivation of Eq. (17) is in the Appendix to this article. The peak current in Q1 occurs when Q2 is OFF. From Eq. (2), $I_{C1} = h_{FE}I_{B1}$

$$I_P \approx h_{FE}\left(\frac{V_{CC}}{R_K + R_L} + \frac{V_{BB}}{R_B}\right) \qquad (18)$$

The base current required to trigger the transistor from ON to OFF is approximately that required to lower the point I_P to $\frac{V_{CC} - V_Q}{R_L}$:

$$\Delta I_B \approx \frac{1}{h_{FE}}\left(I_P - \frac{V_{CC} - V_Q}{R_L}\right) \qquad (19)$$

Substituting Eq. (18) into Eq. (19) yields:

$$\Delta I_B \approx \frac{1}{h_{FE}}\left[h_{FE}\left(\frac{V_{CC}}{R_K + R_L} + \frac{V_{BB}}{R_B}\right) - \frac{V_{CC} - V_Q}{R_L}\right]$$

$$\approx \frac{V_{CC}}{R_K + R_L} + \frac{V_{BB}}{R_B} + \frac{V_Q - V_{CC}}{h_{FE} R_L} \qquad (20)$$

From Eq. (20), it is seen that high h_{FE} units will be the most difficult to trigger.

(Continued Next Month)

For Striplines . . .

Shrinking the Directional Coupler

A new directional coupler, particularly suited for shielded stripline construction, achieves a significant size reduction. Further, coupling may be varied by dielectric shim substitution. Design and performance data are presented.

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THIS directional coupler was developed to fill a need for a much smaller stripline coupler. It is basically a narrow band device providing about 10% bandwidth at 20 db directivity for 10 to 20 db coupling factors. However, it may be broadbanded by the addition of more coupling elements following the general theory of broadband multi-element couplers.

The coupler was evaluated over the frequency range in which it is likely to find major application—the miniaturization of microwave equipment operating below 4000 MC. It should be useful in such capacities as *r-f* monitoring, duplexing local oscillator injection, or AFC probe coupling. The general approach, although particularly adapted to stripline, could conceivably be used with other TEM mode transmission lines.

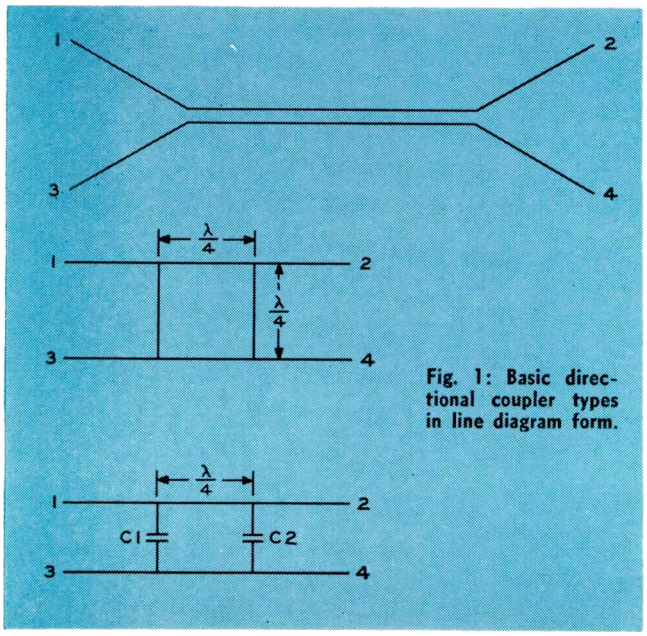


Fig. 1: Basic directional coupler types in line diagram form.

Design Approach

Fig. 1 shows, in schematic form, three common types of couplers. The first two have been widely used in stripline and microstrip circuits; the third has been used in both coaxial and waveguide circuits and represents one of the earliest basic directional coupler concepts. It is this concept that is the basis for the design of the couplers described in this article.

Physical limitations in the construction of quarter wave spaced capacitive (or inductive) coupling elements have always been a design problem with this type coupler. The ideal couplings should be either purely inductive or purely capacitive for proper cancellation at the terminal 3 junction. A combination of inductive and capacitive coupling results in a degree of directivity at each individual junction that is undesirable in this type of coupler. The necessary proximity of the primary and secondary transmission lines, or the nature of the coupling elements

Portions of this article were presented at the November, 1957, MAECON, Kansas City, Mo. Results of development carried on since that time are included.

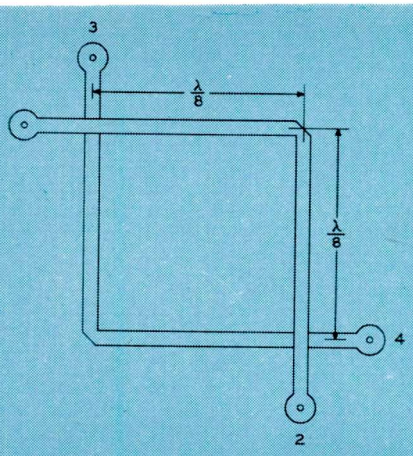


Fig. 2: In basic stripline coupler the two conductors are separated by a thin shim.

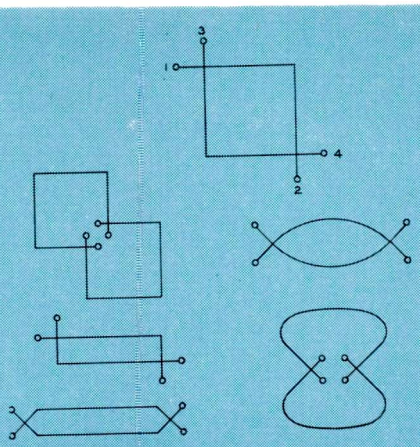


Fig. 3: Some mechanical layout variations of the basic stripline coupler of Fig. 2.

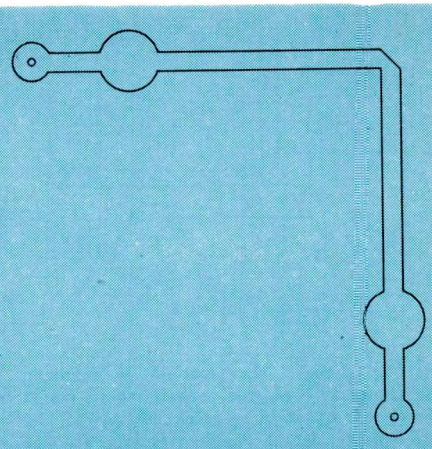


Fig. 4: A method of increasing the crossover area to obtain tighter couplings.

themselves, invariably results in a degree of the undesired type of coupling.

Fig. 2 shows how these two problems can be circumvented. Only the "center" conductors of a stripline circuit are shown. The two conductors are separated at the crossover points by a thin dielectric shim which results in essentially pure capacitive coupling.

In shielded stripline (sandwich) construction where two ground planes are used, the two halves of the circuit can be etched on the separate cards and assembled face to face with a sheet of dielectric between them. This is the generally preferred construction. The capacitor lead length inductance has been reduced to zero for all practical purposes. The undesired inductive coupling has been reduced to a negligible factor by crossing the two conductors at exactly 90°, representing the null orientation for inductive coupling. The coupling factor is dependent only on the thickness and dielectric constant of the insulating shim between the elements at the crossover. Note also that a quarter wavelength between junctions results in a circuit whose active portion is only ¼ the corresponding area of the circuit of Fig. 1b. This probably represents the smallest stripline directional coupler previously used.

At this point, the thought might occur that a single junction coupler of the Bethe[1] hole type might be possible in stripline construction. Such a coupler has not proven feasible because as the crossover angle between the lines is reduced from the null orientation to obtain the required magnetic coupling, the capacitive coupling increases in direct proportion to the crossover area. Thus, additional inductive coupling is needed requiring further reduction of the angle.

In short, the inductive coupling required never catches up with the increasing capacitive coupling as the crossover angle approaches zero. This approach evolves into the distributed constant coupler of Fig. 1b, wherein the lines no longer cross, but are adjacent.

Returning to the two-junction stripline coupler of Fig. 2, configurations other than a square may be used for this type coupler without violating the primary requirement that the conductors cross at right angles. Fig. 3 shows a few of the infinite variety of shapes possible. The terminal location and circuit shape are seen to be relatively flexible, a valuable design advantage in high density subminiaturized packages.

As the coupling is increased, practical limitations in shim thickness may be encountered. It has been found that increasing the crossover area by as much as ten times by means of circular pads is a good way of obtaining tight couplings at the lower frequencies. Fig. 4 illustrates this method. The junction discontinuities, being spaced $\lambda/4$ apart, tend to cancel.

Experimental Model

An experimental model was constructed that could be adjusted in both frequency and coupling. Fig. 5 shows the arbitrary circuit lengths chosen and the approximate resulting center frequencies. A photograph of the experimental model may be seen in Fig. 6.

The two printed stripline cards are bolted together with a thin sheet of Kel-F dielectric sandwiched between them to form the shielded stripline coupler. The successive rows of bolt holes are used to select the desired coupler size using the same circuit cards. Type "N" fittings were used in the transitions with two connections coming out of each side of the device to maintain mechanical simplicity in this experimental model.

The circuit material consists of 0.062 in. thick Teflon fiberglass material laminated on both sides with two ounce copper. The photo-etched circuit paths are 0.086 in. wide giving a nominal characteristic impedance of 50 ohms. Kel-F was selected for the coupling dielectric because of its excellent electrical properties and mechanical stability. The cold flow tendencies of Teflon would probably cause instability.

Since capacitive coupling is used, the coupling factor may be expected to vary 6 db per octave. This

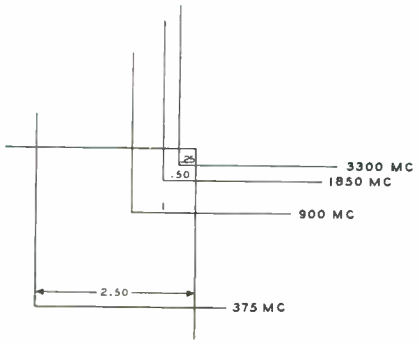


Fig. 5 (above): This method of changing the frequency of the experimental model shows the relative size of circuits tested and approximate center frequencies.

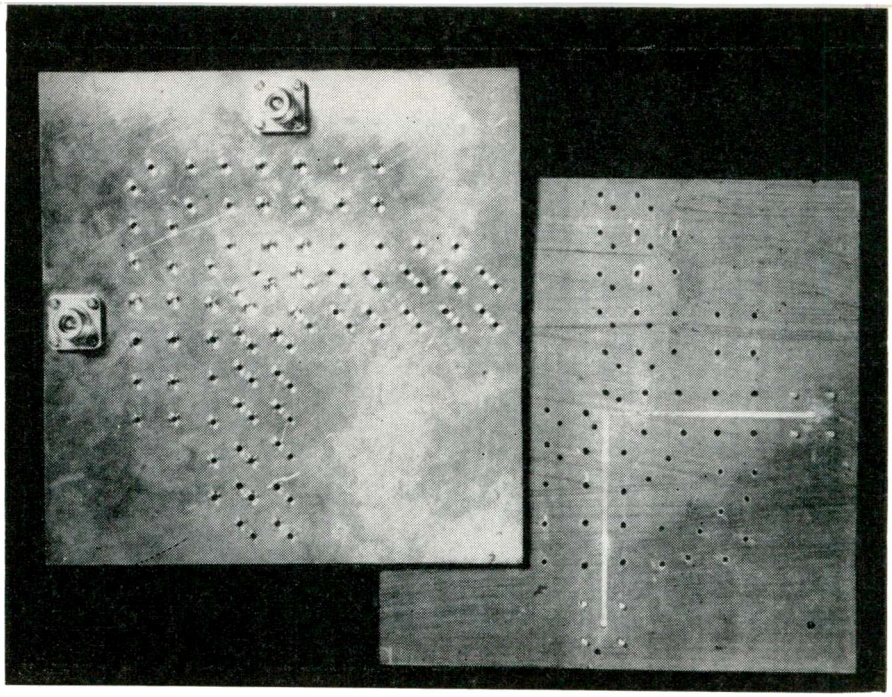


Fig. 6 (right): Experimental variable frequency model of the two junction coupler.

Directional Coupler *(Continued)*

frequency sensitivity of the coupling factor is an inherent disadvantage of all couplers of this type, but it is usually tolerable over the relatively narrow bands (10 to 20%).

Better circuit techniques are available for the more exacting needs of laboratory test equipment and instrumentation where size is not an important factor. The measured coupling factors of the half inch square and the one inch square versions of the experimental circuit are plotted in Fig. 7. The theoretical 6 db per octave curve has been superimposed for best fit on the measured points and shows good agreement. Fig 8 has been constructed from actual measured values in the experimental circuit using 4 different dielectric thicknesses, and may be used effectively for preliminary design work.

Performance

Typical measured directivity curves for various coupling factors are shown in Fig. 9. Several other characteristics of the circuit are seen in this figure. As the coupling is loosened, the maximum directivity drops almost db for db. Thus the maximum isolation, being the sum of directivity and coupling, tended to remain constant at about 40 db for this model. Also, as the coupling is tightened, the directivity response curve shifts downward in frequency. This is the same as saying that for tighter couplings, the spacing of the coupling capacitors becomes successively less than a quarter wavelength at the maximum cancellation frequency.

A moment's reflection on Fig. 10 will explain this simply as compensation for the fact that as the coupling is tightened, the current through the second capacitor leads the voltage at point 2 by an amount less than 30° (depending on the magnitude of the coupling into the load represented by the secondary

Fig. 7 (below): Measured coupling variation with frequency for the ½ in. & 1 in. models compared to the expected 6 db per octave variation.

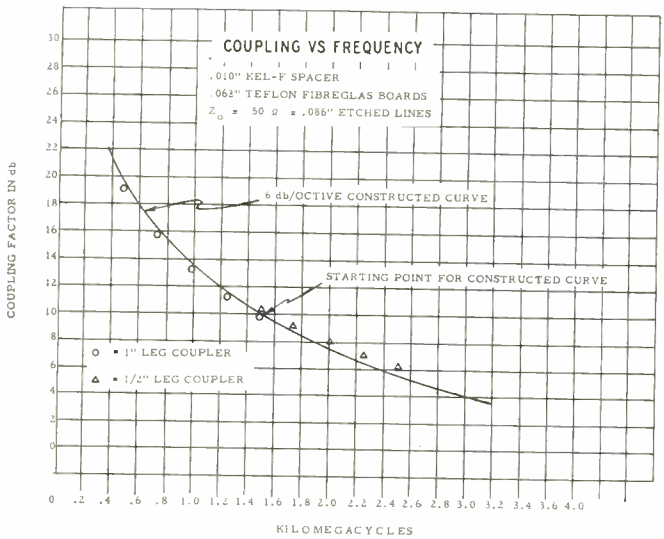
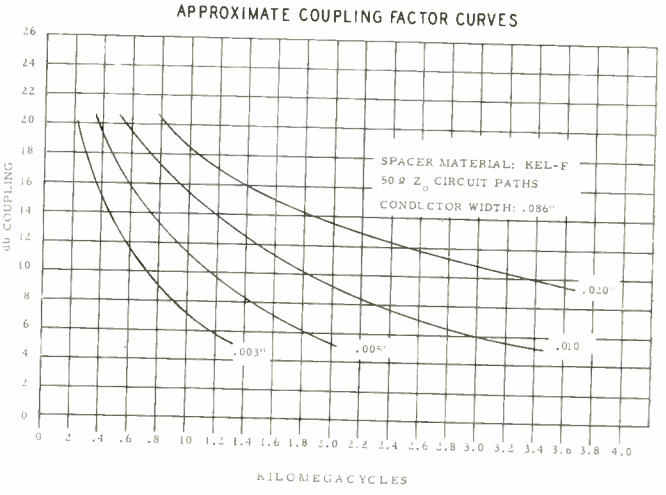


Fig. 8 (below): These approximate coupling factor curves for 4 dielectric thicknesses are useful for preliminary design estimates.



line). It is the component of this current flowing toward point 3 that must be phased to exactly cancel the current component from the first capacitor flowing toward R_3. Hence the capacitor spacing must be modified slightly to maintain proper phasing for cancellation at the desired frequency.

The experimental model used a nominal strip width of 0.086 in. This strip width becomes appreciable with respect to the other circuit dimensions at the higher frequencies, the effect being to deteriorate the maximum directivity obtainable (illustrated by Fig. 11 which shows the directivity curve of the half inch square coupler). The quarter inch square coupler was virtually worthless as a result of this type of deterioration. It has been found that as long as the strip width does not exceed 0.015λ, the "wide strip effect" will not become troublesome.

Note that the directivity curve of Fig. 11 represents a condition occurring at a strip width of 0.021λ. In general, the "wide strip effect" becomes more pronounced as the coupling is increased. From a practical design standpoint this means that 0.062 in. board material requiring 0.086 in. nominal strip width for a 50 ohm shielded stripline circuit is useable up to about 1500 MC, and that 0.031 in. material requiring approximately half the strip width is useable up to about 3000 MC.

It is often desirable to switch to the thinner material with the narrower strip for frequencies above 1500 MC for another reason. Shim thickness becomes excessive for the usually desired couplings with 0.086 in. wide strip operated at the higher frequencies, Fig. 8.

Fig. 12 illustrates the relatively constant percentage bandwidth characteristic that would be expected from a phase cancellation device such as this. The dotted portion of the highest frequency curve represents data that is incomplete due to the wide strip effect in the 0.086 in. wide circuit of the model.

Multiple resonance, which occurs at odd harmonics in any circuit of this type, is shown in Fig. 13 for the 2.5 in. square coupler. Note that the frequency ratio is less than 3:1. The effect of tighter coupling at the high frequency is to shift the second peak downward by a greater percentage. The percentage bandwidth of the second peak is considerably less, as is expected. The couplings are 3λ/4 spaced at the third harmonic.

Tighter couplings for lower frequency versions may be achieved by increasing the area at the point of crossover. Fig. 14 shows the addition of circular pads to the 2.5 in. square version and the results of this modification are shown in the normalized curves of Fig. 15.

Broadband Model

Mumford[2] showed that couplers of this general type could be broadbanded by the addition of more coupling elements, spaced λ/4 apart, whose coefficients of coupling were proportioned in accordance with the coefficients of the binomial expansion theorem. To evaluate the application of this type of broadbanding to the stripline coupler, a three element coupler of the type shown in Fig. 16 was constructed for direct comparison with the two element 12.5 db

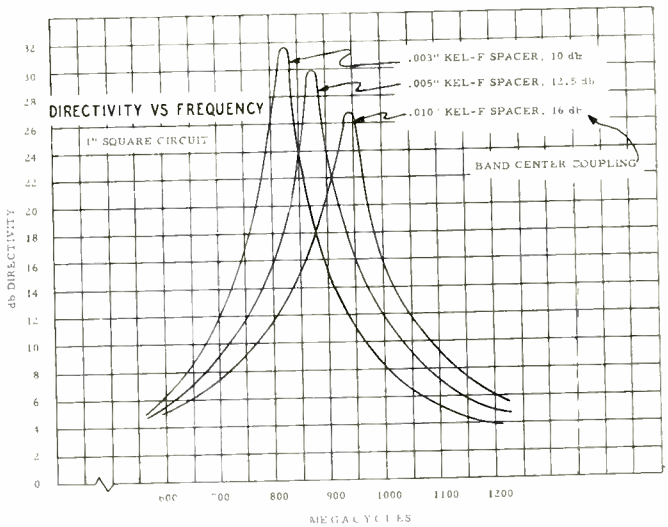


Fig. 9: Shift of directivity response curve as a result of variation of coupling factor while maintaining a constant circuit size.

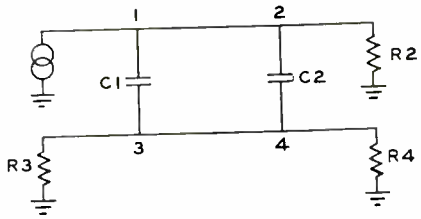


Fig. 10: Equivalent circuit for explanation of response shift of Fig. 9.

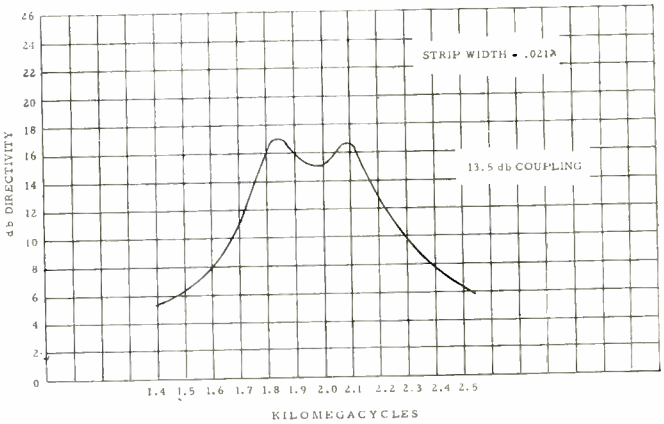
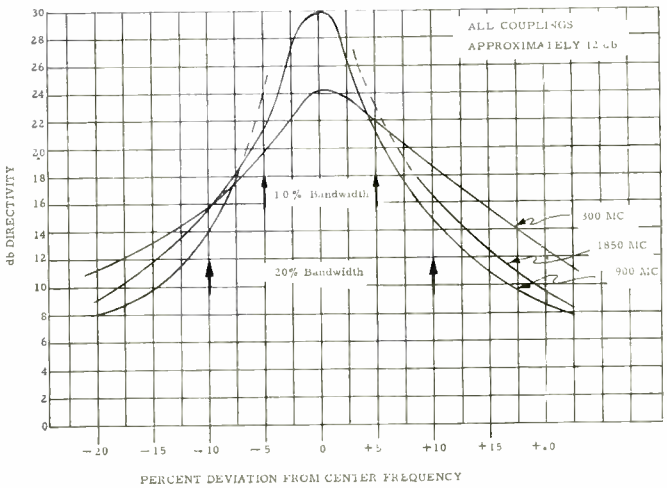


Fig. 11 (above): Wide strip effect on directivity of a coupler whose strip width is greater than the recommended 0.015 wavelength.

Fig. 12 (below): Normalized directivity curves for 50 ohm couplers having the same coupling factor at their respective band centers.



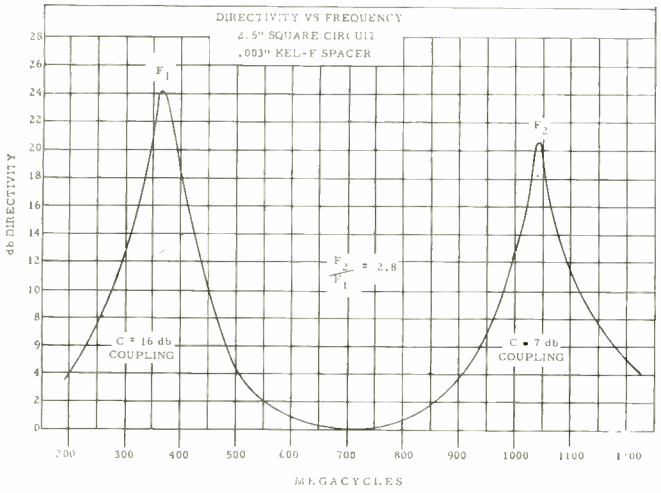


Fig. 13: The multiple resonance characteristic shows the increased coupling on the harmonics and the characteristic frequency shift of the directivity response resulting from coupling variation.

Directional Coupler *(Concluded)*

coupler of Fig. 9. Theoretical coupling coefficients of 1:2:1 were used as illustrated by the enlarged crossover area of the middle junction in Fig. 16. The measured performance comparison is shown by the normalized curves in Fig. 17, while the input VSWR of the three junction coupler is shown in Fig. 18. Additional coupling elements could be used to advantage in many applications.

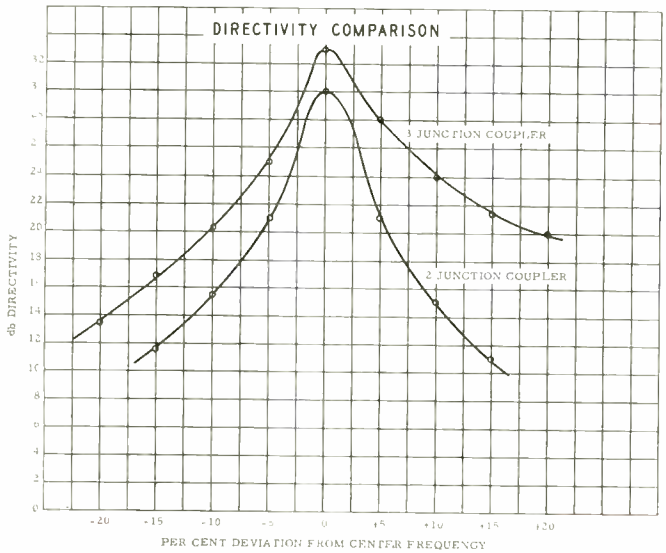
The author wishes to acknowledge the assistance of E. M. Bell who performed much of the early development work and L. F. Taylor who made the working models and ran the performance curves which are part of this article.

References

1. Ginzten, E. L. to Goodwin, P. S., "A Note on Coaxial Bethe-Hole Directional Couplers," *Proc. IRE*, Vol. 38, (March, 1950) pp 305-309.

2. Mumford, W. W., "Directional Couplers," *Proc IRE*, Vol. 35, (Feb., 1947) pp 160-165.

Fig. 17: Measured comparison of a two and a three junction coupler.



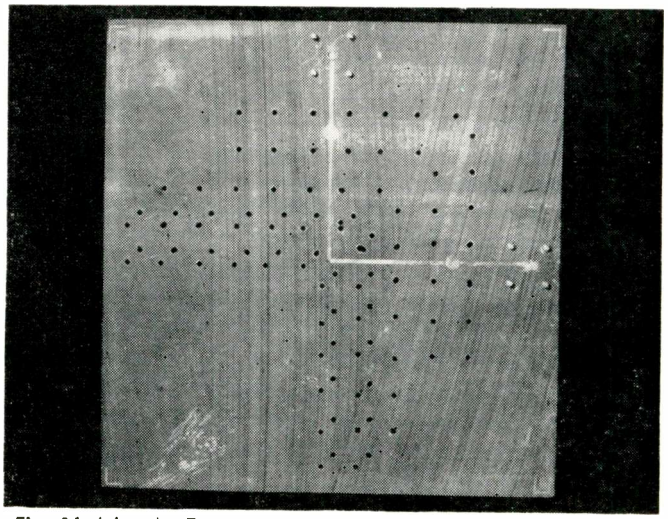


Fig. 14 (above): Experimental model with increased crossover area pads.

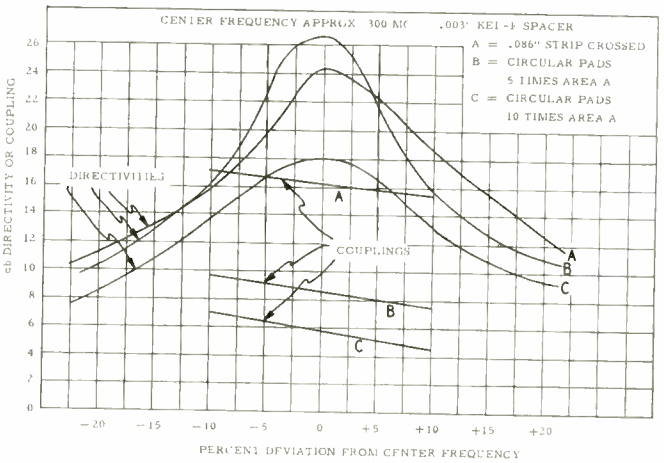


Fig. 15 (above): Effect of increasing crossover area on 2.5 in. model.

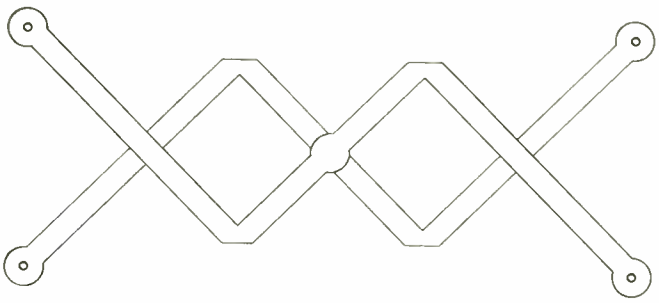
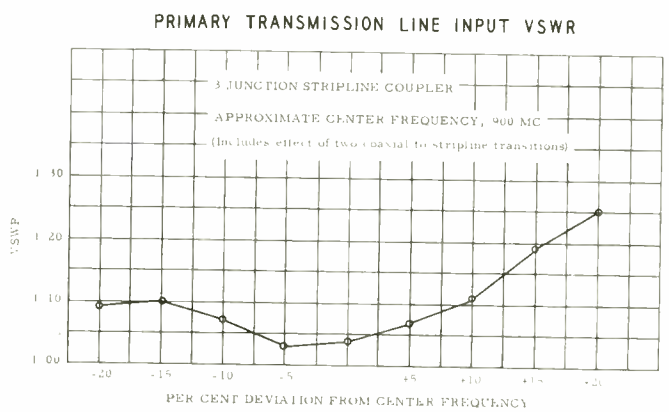


Fig. 16 (above): Diagram of a 3 junction coupler shows increased crossover area of center junction necessary for proper cancellation.

Fig. 18 (below): Input impedance match of 3 junction 50 ohm coupler.



This is the second in a series which describes hardware for the electronic industry. Part two presents, in tabular form, a description of the various types of nuts. Each item is clearly described and illustrated along with uses, types of material they are made of, size ranges, and known suppliers.

Electronic Hardware—

Female Threaded Fasteners

ELECTRONIC INDUSTRIES
SPECIAL REPORT

By L. H. HENSCHEL
Mechanical Standards Engineer
Radio Corp. of America
Camden 2, N. J.

NUTS are perhaps the most universally used fastener yet there are more varieties than any other fastener, each variation having a particular, specialized function. Nuts are made of almost every material and by almost every conceivable process, casting, machining, heading, stamping, extruding, etc. The two main categories are the removable nuts and the fixed nuts with each category containing both locking and non-locking types.

The removable nuts include the standard hex and square nuts, cap nuts, wing nuts, and special or unique variations of these standards. The removable nuts can be used on both fixed male threads such as studs and shafts or can be used with other movable components like machine screws. It must be remembered that the location of a removable nut must be easily accessible and that ample room has to be allowed for the wrench used to tighten or loosen the nut.

The constituents of the fixed nut category include plate nuts, weld nuts, clinch nuts, threaded inserts, captive nuts and a raft of variations of the mentioned types. These nuts are used in locations which are difficult to reach and where many nuts can be mounted quickly, eliminating the need for individual handling of each nut. Locking and non-locking varieties are available. It is important to remember that these nuts can only be used if the mating male thread is in a position where it is accessible and can be readily turned.

This part discusses in general terms these female threaded parts but does not attempt to cover all available items for use in the electronics industry or to cover every supplier, as many items are highly specialized. In cases where the item is a common one produced by many manufacturers, no specific supplier is called-out, but in the cases of proprietary items or those made by a limited few companies the known suppliers are listed.

The self locking nuts discussed are of the reusable type and are used to replace nut-washer-lock washer assemblies, nut-cotter pin assemblies, nut-lock wire assemblies, nut-staking compound assemblies, nut-jam nut assemblies and other devices used to prevent nuts from loosening. Some of the nuts are of the prevailing torque type which means they need not be seated to produce the desired anti-loosening and can be used in adjustable designs, while the other varieties of lock nuts require complete seating before the locking device becomes effective. The latter type requires less effort during installation as they are free spinning up till the last complete turn or turn and a half. The prevailing torque nuts lose their free spinning ability as soon as the end of the mating thread engages the locking element.

The clinch nut is a convenient type of fixed nut as it requires no additional hardware to make it stationary. Although some varieties require special tools to captivate them into the parent material, the installation is always simple and in most cases requires only a drilled or punched hole in the panel. Clinch nuts give load bearing threads to thin sheet material which would otherwise be incapable of carrying the load of the mating thread. Some of the nuts are self-clinching, which means that no secondary operation is required after they are placed in the panel hole. These are usually captivated by a standard press which causes panel material to flow into a captivating recess in the nut. This part carries the basic clinch nuts. More on clinch nuts in the next part.

Projection weld nuts are available in many varieties. However, the pilot type offers the advantage of not requiring special locating tooling, a fact which is extremely important in short run and development work. The round type nut offers the advantage of not requiring orientation with respect to each other and to the material's configuration. Although used mostly for creating load bearing, reusable threads in thin steel sheet, these nuts can be used in a variety of materials.

The insert section is sub-divided into plain internally-externally threaded, plain self locking, self tapping, self locking-self tapping, and miscellaneous types. Threaded inserts are designed to give load bearing, reuseable threads to soft or brittle materials, both metallic and non-metallic. A properly designed insert, if correctly installed, guarantees that the mating fastener, made of the same material, will fail before the insert twists or pulls out.

NUTS

NUTS


HEX NUT

The most commonly used nut in the electronics industry is the standard machine screw and stove bolt nut. This nut is available both as a square and hexagonal nut, but the hex nut is used more often because of its reduced 'across corners' dimension. This nut is so designed and standardized that its strength is equal to or greater than the mating screw. The hex nut can be chamfered on both sides, chamfered on one and flat on the other, or chamfered on one and washer faced on the other.

Sizes: #0 to 3/8 inch thread
Materials: Steel, stainless steel, aluminum, brass, nylon (colored or plain), monel, zinc.


CAP OR ACORN NUT

The acorn nut is used by the industry in cases where decoration is desired or where sealing of the projecting threads is required so as to limit abrasion of other components and wires. The acorn nut is usually blind tapped but they are also available with the end open.

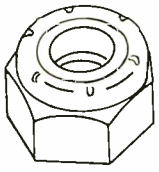
Sizes: #6 to 1 1/4 inch thread
Material: Steel, brass, zinc, aluminum, monel, stainless steel, lucite (colored or plain).


WING NUT

The wing nut is most often used where assembly and disassembly is to be done without tools or where frequent assembly and disassembly is anticipated. These nuts can be die cast, formed from sheet metal, or machined.

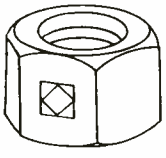
Sizes: #4 to 3/4 inch thread
Material: Zinc, steel, aluminum, stainless steel, brass, monel, bronze.

LOCK NUTS


STOP NUT

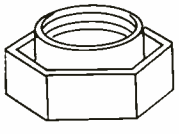
The most commonly used lock nut is the Stop Nut which is a hex nut that has a nylon insert crimped onto its top. The screw enters with normal ease until it reaches this prevailing torque locking section. The nylon holds tightly to the male threaded part and, because of the characteristics of the nylon, is highly reuseable. Variations include sealed cap nuts, small pattern nuts, low silhouette nuts, and special nuts. The temperature limitation of the insert is 250°F to —70°F.

Sizes: #0 to 4 1/2 inch thread size
Materials: Steel, brass, aluminum, stainless steel
Known suppliers: Elastic Stop Nut Corp. of America, Union, N. J.; Greer Stop Nut Co., Chicago, Ill.


NYLOK NUT

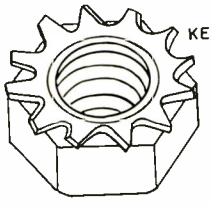
The Nylok nut is hexagon in shape and has a nylon plug installed in one of the hex faces to serve as the locking element. The temperature range is from 250°F to —70°F. Variations include a cap nut and an open-end cap nut.

Size: #0 to 1 inch thread size
Material: Steel, stainless steel, aluminum, brass
Known supplier: Nylok Corp., Paramus, N. J.


LIGHT WEIGHT NUT

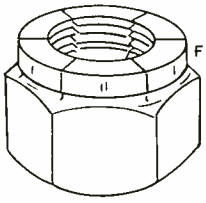
The all metal light weight lock nut is quickly gaining popularity in the electronics field. It is made from sheet steel or stainless steel, and heat treated. The locking element is designed on a deformed, out of round principle and, because of the heat treated steel characteristics, is highly reusable and can be used at temperatures as high as 550°F. Internal wrenching is also possible.

Sizes: #4 to 1/2 inch thread size
Materials: Steel, stainless steel (A-286)
Known suppliers: Kaynar Mfg. Co., Inc., Los Angeles, Calif.; Elastic Stop Nut Corp. of America, Union, N. J.; Boots Aircraft Nut Corp., Norwalk, Conn.; The Nutt-Shel Co., Glendale, Calif.


KEP

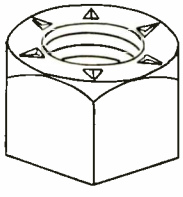
Another common lock nut is the Kep which is a combination of a hex nut and an integrally attached external toothed lock washer. As the nut is tightened and the washer contacts the metal surface the washer stays stationary and the nut is allowed to turn independently. As the nut is tightened still further the nut and washer seat properly. The use of this nut eliminates the need for handling the separate lock washer, as do the other lock nuts, and it also permits free movement of the nut until the last possible instant reducing the period over which extra torque is required.

Sizes: #5 to 3/8 inch thread size
Material: Steel
Known supplier: Shakeproof, Div. Illinois Tool Works, Elgin, Ill.; Eaton Mfg. Co., Massillon, Ohio.


FLEXLOC

The Flexloc nut works on the deflected beam principle. The slotted top is deformed so that as the mating screw enters, the top gives a firm radial locking action. The nut, being hexagonal can be installed with any standard wrench. Temperature limitation up to 1200°F. A miniature variety is also available in similar materials but with the deformed top acting as the locking element and ranging in size down to #0.

Sizes: #2 to 2 inch thread size
Material: Steel, stainless steel, aluminum, brass, bronze
Known supplier: Standard Pressed Steel Co., Jenkintown, Pa.

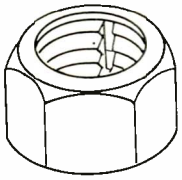

GRIPCO LOCK NUT

The Gripco lock nut is an all metal, hexagonal, prevailing torque lock nut. The top has six triangular impressions in it which serve to prevent its loosening. It can be reused many times without any great change resulting in the locking torque.

Sizes: #6 to 1 1/2 inch thread size
Materials: Steel, stainless steel, brass
Known supplier: Grip Nut Co., South Whitley, Ind.

LOCK NUTS (Continued)

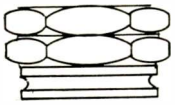
DURA-LOC NUT



The Dura-Loc nut is a two-piece all metal nut. The split center bushing is contained in a specially designed hexagon outer section. As the outer shell engages with the metal being fastened, it transmits a force to the tapered section of the bushing, causing it to grip the mating thread. Torquing the outer shell in the removal direction causes the bushing to open and release its hold on the screw. The outer shell and the bushing are keyed together.

Sizes: #6 to 7/16 inch thread size
Materials: Stainless steel
Known supplier: The Delron Co., Inc., South Gate, Calif.

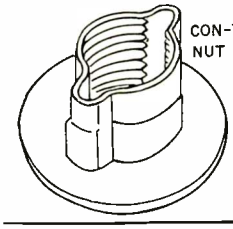
KLINCHER NUT



The Klincher nut is a one-piece all metal, free-spinning nut. It is not until the nut is properly seated that the locking device, the washer configuration at the bottom, goes into play. This special design deforms just enough to provide proper locking of the mating threads. It can be used up to 1600°F.

Sizes: #2 to 1 inch thread size
Material: Stainless Steel (303)
Known supplier: Klincher Locknut Corp., Indianapolis, Ind.

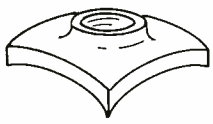
CON-TORQ NUT



The Con-Torque nut is an all metal, one-piece, prevailing torque lock nut. It is formed from sheet steel and has two wing shaped sections which provide the spring action required for the locking. It is so designed that an ordinary hex wrench can be used to install and remove it, although pliers can also be used.

Sizes: #2 to 3/8 inch thread size
Material: Steel
Known supplier: Con-Torq Inc., New Britain, Conn.

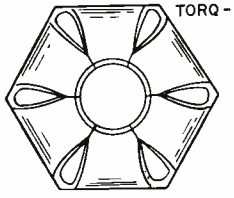
P-M NUT



The P-M nut is formed from a piece of sheet steel and is concave so that the four corner points can dig into the parent material serving both as the anti-torque feature and, because of the bowing, the locking feature.

Sizes: #6 to #10
Material: Steel
Known supplier: P-M Nut Div., Waterbury Pressed Metal Co., Waterbury, Conn.

TORQ-LOK

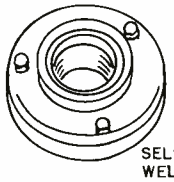


The Torq-lok nut is formed from sheet steel and is so designed that as the top grips the mating screw the bottom locks it in position. It is very light weight and simple to use.

Sizes: #2 to 1/4 inch thread size
Materials: Steel
Known supplier: Tubing Seal Cap, Inc., San Gabriel, Calif.

WELD NUTS

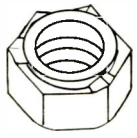
PEM SELF-LOCKING WELD NUT



The Pem self-locating weld nut has the advantages of having a pilot which allows it to locate itself and it is round, eliminating the need of orientation and precluding its removal with a wrench. The nut is placed in the panel hole and the electrodes cause the projections to weld themselves to the parent metal.

Sizes: #2 to 1/4 inch thread size
Material: Steel, stainless steel
Known supplier: Penn Engineering and Mfg. Corp., Doylestown, Pa.

GRIPCO WELD NUT



The Gripco weld nut is very similar to the Pem except that it is hexagonal rather than round. It is installed in the same manner and has a locating pilot. These nuts must be oriented.

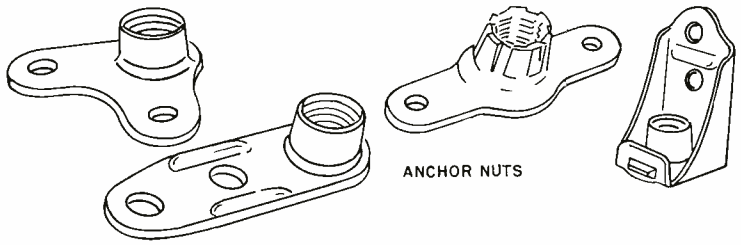
Sizes: #8 to 5/8 inch thread size
Material: Steel
Known supplier: Grip Nut Co., South Whitley, Ind.

OHIO WELD NUTS

The Ohio Nut and Bolt Company makes several varieties of weld nuts both with and without pilots. Variations include these shown and more, such as flange type weld nuts, nuts which mount on the reverse side of the panel, and angle mounting weld nuts.

Sizes: #6 to 3/8 inch thread size
Material: Steel
Known supplier: Ohio Nut and Bolt Co., Berea, Ohio.

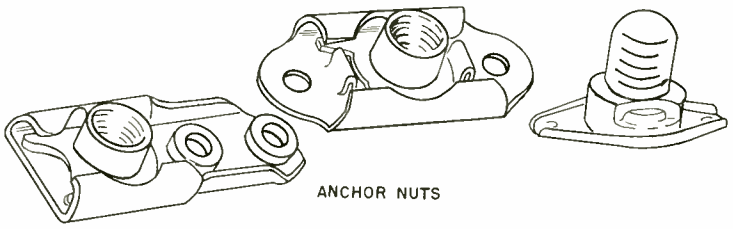
ANCHOR NUTS



ANCHOR OR PLATE NUTS

Anchor or plate nuts are available in many different configurations. The basic types are the nylon locking insert type, the all metal type, the floating type, the sealed type, the corner type, the angle mounting type, and the single lug type. Generally speaking, there are two categories of the fasteners, the regular size and the miniature size. The various suppliers have slightly different configurations but the mounting requirements are

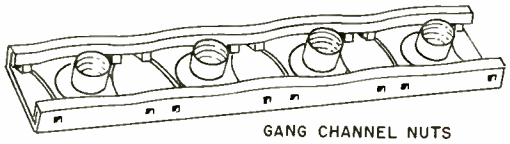
NUTS



ANCHOR OR PLATE NUTS

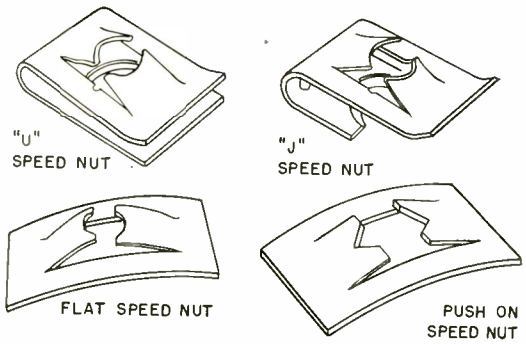
standard. The all metal type uses the deformed upper threads as the lock while the ESNA type uses the standard nylon locking ring.

Sizes: #4 to 3/8 inch thread size
Material: Steel, stainless steel
Known suppliers: Kaynar Mfg. Co., Los Angeles, Calif.; ESNA, Union, N. J.; Boots Aircraft Nut Corp., Norwalk, Conn.; Nutt-Shel Co., Glendale, Calif.



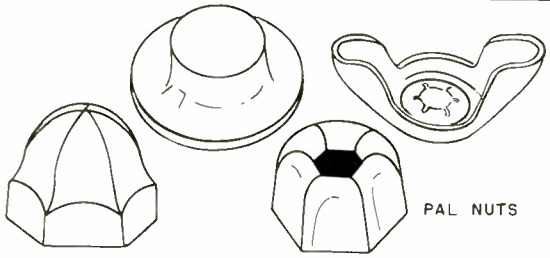
Gang Channel is very similar to plate nuts in principle. This channel is composed of many heat treated steel or stainless steel nuts assembled at predetermined locations along a channel. The channel is riveted or screwed to an assembly. Many screws at different locations can be installed without the need for affixing a plate nut for each screw. Some nut locations are standard, but in most cases the channel can be made to the customers specifications. Sizes, materials and suppliers are the same as for the plate nuts previously mentioned.

SPECIAL NUTS



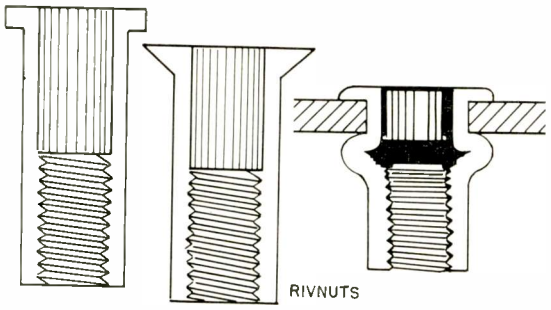
Speed nuts are made of sheet metal and so formed that they can accept the threads of a screw. They are made to be used with machine screws, thread forming screws, thread cutting screws, and to be pushed onto an unthreaded shaft or part. They make the installation of a nut very simple and fast and are designed so that they can fasten onto the parent material in what would otherwise be hard to reach places. Many standard configurations are available and many specials can be developed to customers specification.

Sizes: #2 to 3/8 inch thread size
Material: Steel, stainless steel, brass, bronze, copper
Known supplier: Tinnerman Products, Inc., Elgin, Ill.



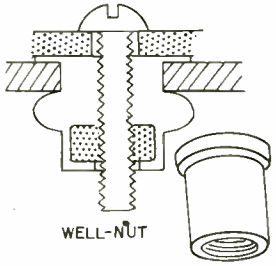
The Palnut Locknut comes in a variety of shapes. The most popular is the hex nut, but the wing nut, cap nut, push nut, and flat nut are also becoming popular. These nuts are made of sheet metal and can accomodate a machine screw or an unthreaded shaft.

Sizes: #3 to 2 1/2 inch thread sizes
Material: Steel, bronze
Known supplier: The Palnut Co., Mountainside, N. J.



The Rivnut is a one-piece metal bushing which is internally threaded only at the bottom section. It is inserted into a hole and a threaded stud is inserted which pulls the threaded section of the Rivnut toward the head thus captivating the Rivnut in the panel. Some varieties are keyed to prevent rotation. After installation it can be used to fasten additional sheets to the first sheet or the Rivnut itself can be used as a blind rivet. A blind type Rivnut is also available and can be used on pressure or liquid vessels. Power tools are available for rapid insertion.

Sizes: #4 to 5/16 inch internal thread size
Material: Steel, aluminum, brass, stainless steel.
Known Supplier: B. F. Goodrich, Aviation Products Div., Akron, Ohio.



The Well-Nut is a rubber bushing which has a threaded nut at one end. These nuts are used for applications similar to the Rivnut but they have the added advantage of being made of rubber so that they can be used as insulators or in other places where metal is undesirable.

Sizes: #6 to 1/4 inch screw size
Materials: Rubber with brass nut
Known supplier: Rockwell Products Corp., Newark, N. J.

/ISUAL ALIGNMENT UNNECESSARY
RIBBON SPRING CONTACTS
LOATING BUSHINGS

ıe Wedge principle with the strong spring action of the contacts holds e connector in positive contact, and provides ease of insertion and ithdrawal. The protective barriers between ribbon contacts insure ıiform spacing. The entire length of the contacts are supported by ıality dielectric. Mupltiple mounting makes it possible to make or eak any number of circuits simultaneously. Molded-in mounting plates e of corrosion resistant passivated stainless steel.

BLUE RIBBON CONNECTORS

The ribbon contact principle, with dielectric guide and support eliminates the ossibilities of damaged or bent contacts and prevents ifficulties of plug-in. No dependence on contact arangement or visual alignment is necessary.

24 CONTACT PLUG AND SOCKET

IMPROVED TYPE

The above illustrations show the improved design of the plug and socket castings which eliminates any possibility of breakage.

Commercial plating and contact material. Black Mica body Type MFE per Mil.-M-14E.

36 - 4100 - 8P (355)
36 - 4200 - 8S (355)
36 - 4100 - 16P (355)
36 - 4200 - 16S (355)
36 - 4100 - 24P (355)
36 - 4200 - 24S (355)
36 - 4100 - 32P (355)
36 - 4200 - 32S (355)

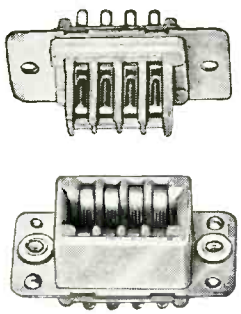
Military plating and contact material. Mineral filled Diallyl body Type MDG per Mil.-M-14E.

36 - 4100 - 8P (340)
36 - 4200 - 8S (340)
36 - 4100 - 16P (340)
36 - 4200 - 16S (340)
36 - 4100 - 24P (340)
36 - 4200 - 24S (340)
36 - 4100 - 32P (340)
36 - 4200 - 32S (340)

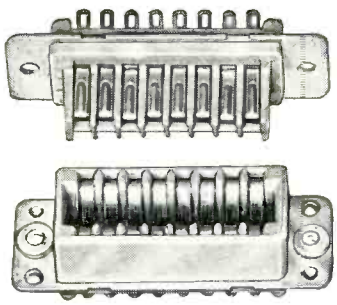
Commercial plating and contact material. Mineral filled Diallyl body Type MDG per Mil.-M-14E.

36 - 4100 - 8P (365)
36 - 4200 - 8S (365)
36 - 4100 - 16P (365)
36 - 4200 - 16S (365)
36 - 4100 - 24P (365)
36 - 4200 - 24S (365)
36 - 4100 - 32P (365)
36 - 4200 - 32S (365)

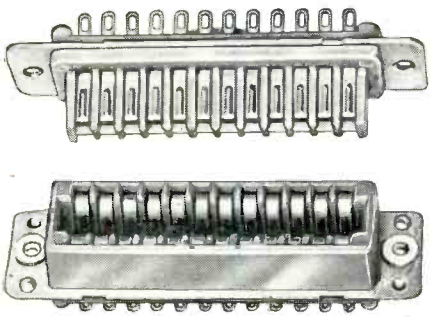
REGULAR TYPE:



8 CONTACT PLUG AND SOCKET



16 CONTACT PLUG AND SOCKET



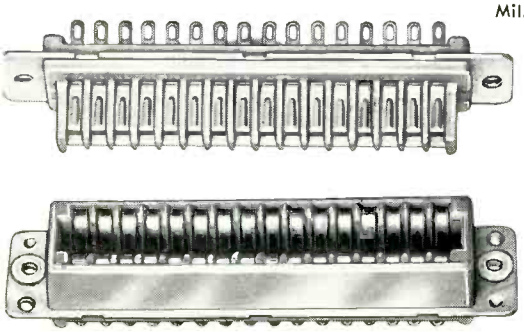
24 CONTACT PLUG AND SOCKET

Commercial plating and contact material. Mineral filled Diallyl body Type MDG per Mil.-M-14E.

36 - 4100 - 8P
36 - 4200 - 8S
36 - 4100 - 16P
36 - 4200 - 16S
36 - 4100 - 24P
36 - 4200 - 24S
36 - 4100 - 32P
36 - 4200 - 32S

Military plating and contact material. Mineral filled Diallyl body Type MDG per Mil.-M-14E.

36 - 4100 - 8P (334)
36 - 4200 - 8S (335)
36 - 4100 - 16P (334)
36 - 4200 - 16S (335)
36 - 4100 - 24P (334)
36 - 4200 - 24S (335)
36 - 4100 - 32P (334)
36 - 4200 - 32S (335)



32 CONTACT PLUG AND SOCKET

Manufactured by agreement with Amphenol Electronics Corporation

Cinch ELECTRONIC COMPONENTS

CINCH MANUFACTURING COMPANY

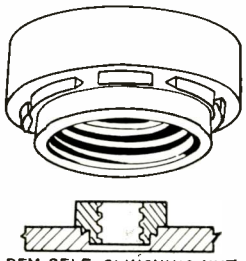
1026 South Homan Ave., Chicago 24, Illinois
Division of United-Carr Fastener Corporation, Boston, Mass.

Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; LaPuente, California; St. Louis, Missouri.

Circle 54 on Inquiry Card

NUTS & INSERTS

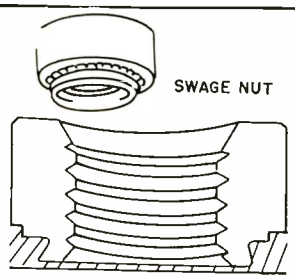
BASIC CLINCH NUTS



PEM SELF-CLINCHING NUT

The Pem Self-Clinching nut is cylindrical with a shank or pilot portion that is inserted into a drilled hole. The underside of the head is serrated or slotted to act as the anti-torque device. The nut is merely pressed into a drilled hole so that the pressure of the specially designed underside of the head causes the parent metal to flow into the groove in the shank portion. The round head precludes the possibility of someone using a wrench to remove it and eliminates need of orientation. The nuts can be used in aluminum, brass, cold rolled steel and similar materials. The shank does not protrude through the underside of the panel. Several shank lengths are available for use with different thicknesses of material, but it should be remembered that the shorter shanks can be used in the thicker panels so that in many cases inventory can be limited to the shorter shank sizes.

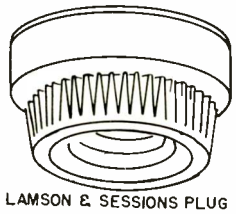
Sizes: #2 to ¾ inch
Material: Steel, stainless steel, monel, aluminum
Known supplier: Penn Engineering and Manufacturing Co., Doylestown, Pa.



SWAGE NUT

The Swage nut is a cylindrical steel nut that is installed in a manner similar to the Pem nut. They are also available in different shank lengths but the shorter shanks can be used in the thicker material. The anti-torque is achieved by surrations under the head.

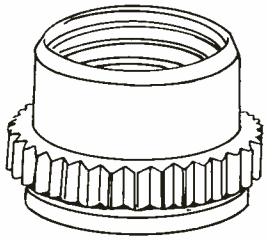
Sizes: #2 to ½ inch
Material: Steel
Known supplier: Standard Pressed Steel Co., Jenkintown, Pa.



LAMSON & SESSIONS PLUG NUT

The Plug Nut is a cylindrical nut which has a tapered pilot section. As the pilot is pressed into a slightly undersized hole it causes the metal to flow into the undercut section thus captivating the nut. A knurled pilot acts as the anti-torque device. Minimum material thickness is 0.029 in. Several shank lengths are available.

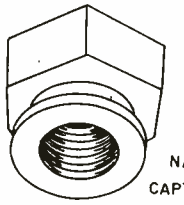
Sizes: #4 to ½ inch
Material: Hardened steel
Known supplier: Lamson & Sessions, Cleveland, Ohio.



ROSAN PRESS NUT

The Press Nut is a thin walled, cylindrical nut that has a specially designed larger diameter which is serrated. The pilot is placed in a slightly oversized hole, and as the serrated portion is pressed against the parent material, it causes the metal to flow into the undercut portion of the pilot captivating the nut in the parent material. The serrations, after becoming partially imbedded in the panel, prevent the nut from turning. One configuration is used for all material thicknesses.

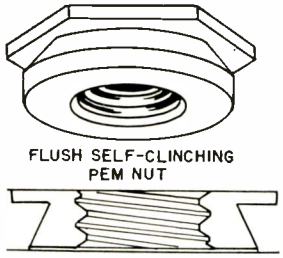
Sizes: #2 to ⅜ inch
Material: Steel, stainless steel (303)
Known supplier: Rosan Inc., Newport Beach, Calif.



NATIONAL CAPTIVE NUT

The National captive nut is machined from hexagonal stock so that the hex portion can act to resist the nut from turning out. The installation hole is slightly larger than the pilot diameter and after the pilot is inserted in the hole and pressure is applied to the hex portion, the parent metal flows into the undercut section of the nut, captivating it. When the nut is properly selected and installed correctly, the hex portion will be flush with the top surface of the panel and yet the pilot will not extend beyond the bottom of the panel. Minimum panel thickness is 0.040 in. Variations are available which give an above flush condition or an extended pilot condition as desired. Blind nuts are also available.

Sizes: #2 to ¼ inch
Material: Steel, stainless steel (303)
Known supplier: National Co., Malden, Mass.

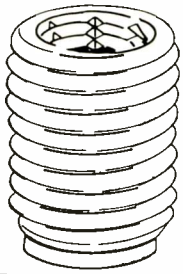


FLUSH SELF-CLINCHING PEM NUT

The Pem self-clinching flush nut is similar to the National nut except in the principle of the clinching area. These nuts can be used in aluminum, brass, copper, cold rolled steel, and similar materials. Installation is the same as for the National nuts and the hex portion should be completely imbedded in the sheet. There are no standard variation available in this nut. Two standard sizes are stocked, for sheets 0.061 to 0.090 in. and for sheets above 0.091 in.

Sizes: #2 to 10
Material: Stainless steel (303)
Known supplier: Penn Engineering and Manufacturing Corp., Doylestown, Pa.

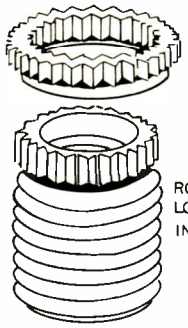
THREADED INSERTS



ROSAN U-TAP

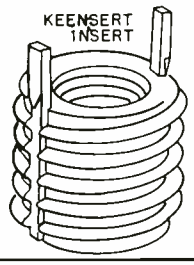
The Rosan U-Tap is an internally-externally threaded insert which is installed in a pretapped hole. The internal thread has six "V" shaped grooves cut longitudinally so as to accommodate the hex wrench which is used to install the insert. The insert is locked into place in the parent metal by the slightly deformed external threads located on the upper portion of the insert.

Sizes: #4 to ½ inch internal thread
Material: Steel
Known supplier: Rosan Inc., Newport Beach, Calif.



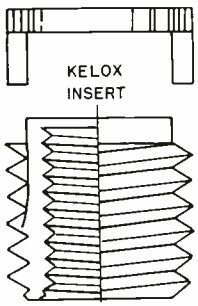
The Lock Ring insert is similar to the U-Tap except it is locked to the parent material by an internally-externally serrated lock ring which is driven into a counterbore in the parent material, and which engages similar serrations located at the top of the insert. The insert is threaded into the pre-tapped hole until the top is flush with the parent material.

Sizes: #4 to 1 inch internal thread
Material: Steel
Known supplier: Rosan Inc., Newport Beach, Calif.



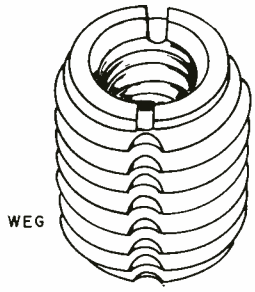
The Keensert is a one piece internally-externally threaded insert which has two grooves cut along its external length. It is threaded into a pre-tapped hole by holding the two integral pins which are attached to the top of the two grooves. When the insert is threaded to the proper depth, the two pins are driven down so they wedge themselves within the grooves and against the parent material.

Sizes: #4 to 1/2 inch internal thread
Material: Steel, Chrome steel, aluminum, stainless steel.
Known supplier: Newton Insert Co., Los Angeles, Calif.



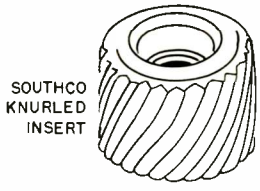
The Kelox insert is a two piece insert where the internally-externally threaded part is first threaded into a pre-tapped hole. The second part, a round retainer with two integral keys, is then slid over the installation so that the keys line up with the slots on the outer portion of the threaded part. This part is then driven into the parent material preventing rotation of the insert. No counterbore is required, as the upper portion of the threaded part is undercut to receive the circular retainer.

Sizes: #0 to 1/2 inch internal thread
Material: Steel, stainless steel
Known supplier: Fasteners Inc., Pittsfield, Mass.



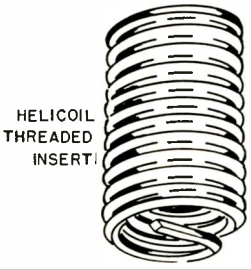
The Weg insert is very much like the other internally-externally threaded inserts except that it is composed of three parts, the threaded part, and 2 locking pins. After the threaded part is installed in a tapped hole, the two pins are driven into the parent material along the two grooves provided, preventing rotation while installing or removing the mating screw.

Sizes: #0 to 1 inch internal thread
Material: Steel
Known supplier: Roylyn Inc., Glendale, Calif.



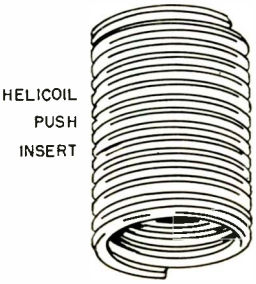
The knurled insert can be installed in either of two ways, directly into a drilled hole or into a counterbore with the load applied against the counterbore shoulder. This insert is internally threaded, class 2, and has a helical knurl on the outer circumference. A reduced diameter or pilot section facilitates insertion and insures perpendicularity.

Sizes: #5 to 5/16 inch internal thread
Material: Steel
Known supplier: South Chester Corp., Lester, Pa.



The Screw Thread insert is made of a coil of diamond shaped wire which is preformed into the proper shape. They are installed with specially developed tools into a specially tapped hole. They require a minimum of space but the accuracy of the tapped hole is all important as it also controls the internal thread. The coil is pre-wound in the insertion tool and, as it is inserted, unwinds creating pressure against the wall of the tapped hole which holds the assembled insert in place and prevents its rotation.

Sizes: #4 to 1 1/2 inches internal thread
Material: Stainless steel (18-8), phosphore bronze.
Known supplier: Heli-Coil Corp., Danbury, Conn.



The Heli-Coil Push insert is a helically wound wire which is merely pushed into a drilled or molded hole with a simple insertion tool. It occupies less space than a solid bushing and the spring action holds it firmly. It is recommended that they be installed against a shoulder of some kind and the loading be against this shoulder.

Sizes: #4 to 12 internal thread
Material: Steel, brass.
Known supplier: Heli-Coil Corp., Danbury, Conn.

Proceed-

OPERATION EXPANSION

September 1, 1959 — Raytheon Government Equipment Division today announced a major expansion into five operating subdivisions: Submarine Signal, Airborne Electronic, Systems Management, Heavy Electronic, and Santa Barbara.

Made necessary by expanding product activity, the decentralization has created managerial and technical staff positions in all areas.

Engineers and scientists of established technical competence are invited to investigate the several opportunities present in the area encompassing their particular interest.

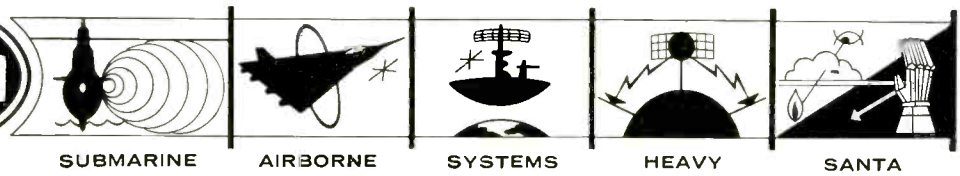
Inquiries should be forwarded to Mr. Donald Sweet, Engineering and Executive Placement, Government Equipment Division, Raytheon Company, 624B Worcester Road, Framingham, Mass.

H. R. OLDFIELD, JR.
Vice President & General Manager
Government Equipment Division

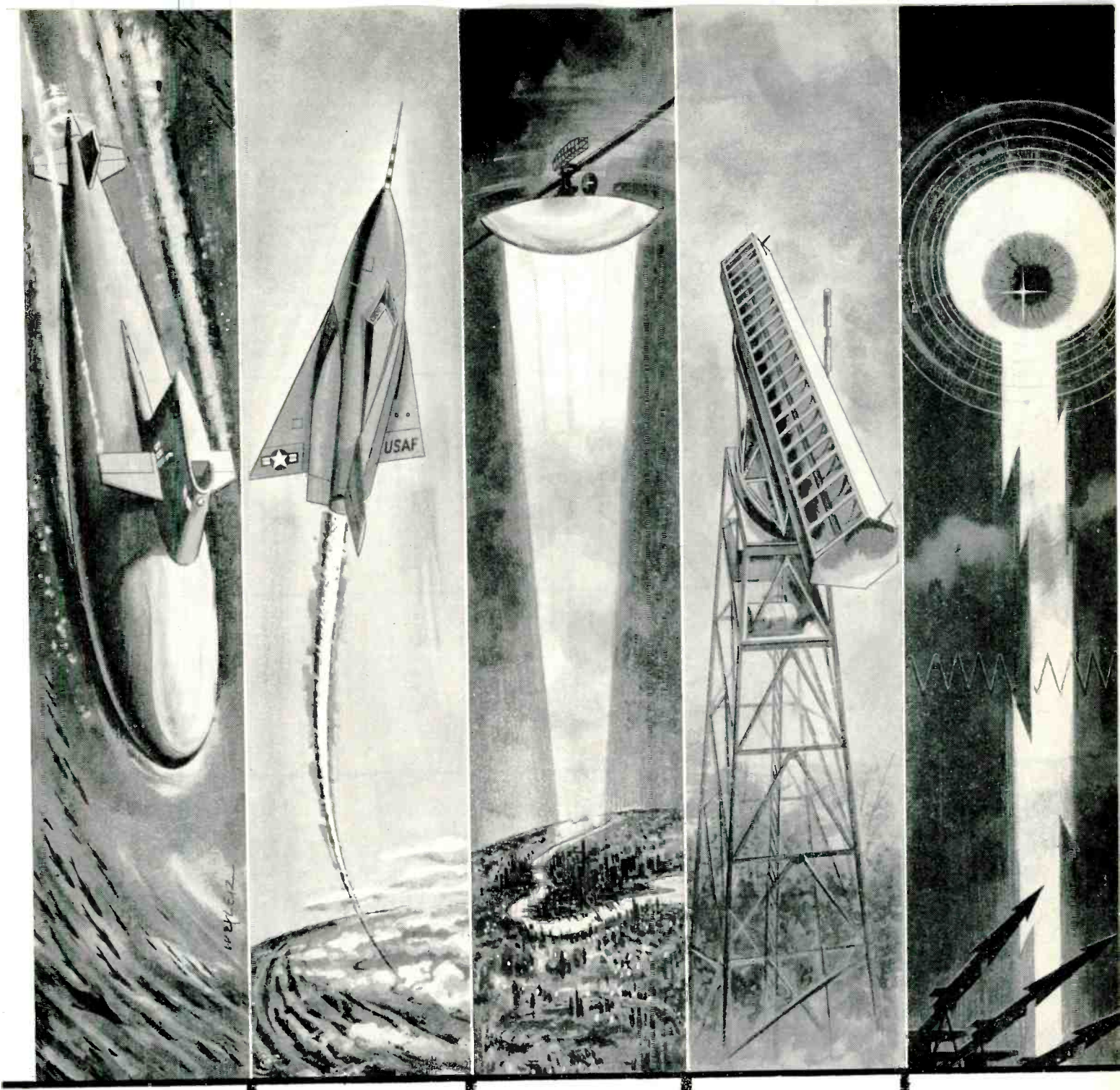
GOVERNMENT EQUIPMENT DIVISION

RAYTHEON

EXCELLENCE IN ELECTRONICS



SUBMARINE SIGNAL | AIRBORNE ELECTRONIC | SYSTEMS MANAGEMENT | HEAVY ELECTRONIC | SANTA BARBARA



SUBMARINE SIGNAL

Newport, Rhode Island
W. Rogers Hamel,
General Manager

Engineering, Marketing, and Production of comprehensive anti-submarine warfare systems. Major products: underwater detection, navigation, communications and fire control equipment.

AIRBORNE ELECTRONIC EQUIPMENT

Maynard, Sudbury, Waltham, Massachusetts
Glenn R. Lord,
General Manager

Engineering, Marketing, and Production of advanced aerospace systems. Major products: navigation, search, and fire control apparatus for manned aircraft, unmanned aircraft, and space vehicles.

SYSTEMS MANAGEMENT

West Newton, Massachusetts
Harold M. Hart,
General Manager

Engineering, Marketing, and Management of major electronic system programs. Activities include systems synthesis, learning machines, weapons studies, microwave supported platform.

HEAVY ELECTRONIC EQUIPMENT

Wayland, North Dighton, Massachusetts
Fritz A. Gross,
General Manager

Engineering, Marketing, and Production of long range surface radars, ordnance and communications sytems. Products encompass 800-ton ground warning systems, missile fire control radars, 96-voice channel pulse code modulation equipment.

SANTA BARBARA

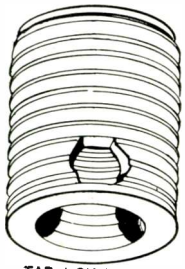
Santa Barbara, California
Gordon S. Humphrey,
General Manager

Engineering, Marketing and Production of infrared and countermeasures devices. Projects involve active and passive ECM equipment for aircraft, missiles, and satellites, infrared guidance, mapping, and fire control components.

INSERTS

THREADED INSERTS (continued)

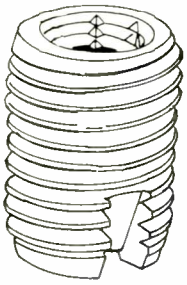
TAP-LOK INSERT
(Slotted Type)



TAP-LOK INSERT
(Hole Type)

The Tap-Loc insert can be installed directly into a drilled or cored hole in zinc die castings, aluminum castings and sheet, iron sand castings, and plastics. The external thread is formed with either two slots or three holes which act as the cutting surface and the insert is threaded into the hole. The upper portion of the insert has a deformed thread which acts as a lock against rotation once it is properly seated. A regular screw with two nuts can be used as an inserter or special hand or automatic tools can be purchased.

Sizes: #4 to ¾ inch internal thread
Materials: Steel, brass, stainless steel (18-8)
Known supplier: Groove-Pin Corp., Ridgefield, N. J.



INSERTO

The Inserto is similar to the U-Tap but can be installed directly into a drilled or cored hole without any pre-tapping. It taps its way into the parent material with two sharp cutting surfaces at the bottom and locks itself into position by the force fit of the upper threads. A hex driver is used to install it.

Sizes: #4 to ½ inch internal thread
Material: Steel
Known supplier: Rosan Inc., Newport Beach, Calif.

ROSAN
LOCK RING
SELF
TAPPING
INSERT

The Self Tapping Lock Ring Insert is identical to the standard Lock Ring Insert but has two slots located at the bottom which act as tapping surfaces. The lock ring is driven into the counterbore as in the standard.

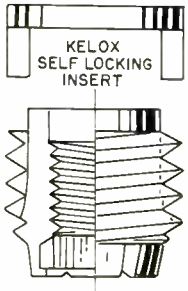
Sizes: #6 to ¾ inch internal thread
Material: Steel
Known supplier: Rosan Inc., Newport Beach, Calif.

SELF-LOCKING INSERTS

HELI-COIL
MID-GRIP
INSERT

The Mid-Grip insert is a helically formed piece of diamond shaped wire similar to the Screw Thread insert, but the center coil or coils are deformed out of round to produce a polygon shape which grabs the mating screw thread. Installation is identical to the Screw Thread insert except that a different inserter is used which allows for the defective thread.

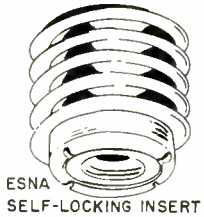
Sizes: #4 to 1 inch internal thread
Material: Stainless steel
Known supplier: Heli-Coil Corp., Danbury, Conn.



KELOX
SELF LOCKING
INSERT

The Kelox Self locking insert is threaded into the hole and locked in place by the separate keys which are attached to a key holder. The internal locking is achieved with a nylon locking insert which is similar to the Elastic Stop Nut type of lock nut.

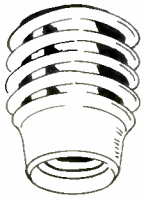
Sizes: #10 to 1 inch internal thread
Material: Steel
Known supplier: Fasteners Inc., Pittsfield, Mass.



ESNA
SELF-LOCKING INSERT

The ESNA self-locking insert is an internally-externally threaded insert which locks the internal thread by use of a piece of tough circular nylon. The external lock to the parent material is by force fit of the modified thread against the standard tapped thread.

Sizes: #10 to ⅜ inch internal thread
Material: Steel
Known supplier: Elastic Stop Nut Corp., of America, Union, N. J.

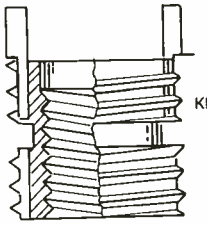


ESNA
SELF-LOCKING
ALL METAL
INSERT

The ESNA All Metal insert is the same as the above except that the internal thread is locked because of the deformation of the bottom most threads. This locking insert will withstand up to 550° F.

Sizes: #6 to ⅜ inch internal thread
Material: Steel
Known supplier: Elastic Stop Nut Corp., of America, Union, N. J.

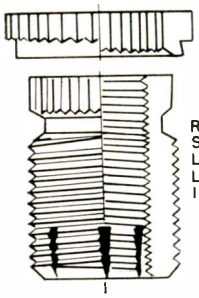
SELF-LOCKING INSERTS (continued)



KEENSERT SELF-LOCKING INSERT

The self-locking Keensert is the same standard Keensert but has the center threads deformed around the entire circumference to lock the mating threads.

Sizes: #4 to 1/2 inch internal thread
Material: Stainless Steel (type 303)
Known supplier: Newton Insert Co., Los Angeles, Calif.



ROSAN SELF-LOCKING LOCK RING INSERT

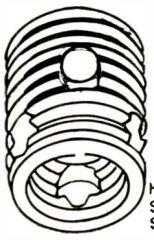
The self-locking Lock Ring insert has the bottom portion slotted and deformed to produce the locking action on the internal threads. External rotation is prevented by the serrated lock ring.

Sizes: #4 to 1/2 inch internal thread
Material: Steel
Known supplier: Rosan Inc., Newport Beach, Calif.

NYLOK INSERT

The Nylok insert is inserted in a pre-tapped hole by using a screw driver in the slot provided. The nylon plug which protrudes into the external and internal threads locks both the insert and the screw from turning.

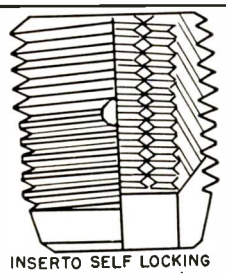
Sizes: #0 to 1/2 internal thread
Material: Stainless steel, steel, brass
Known supplier: Nylok Corp., Paramus, N. J.



TAP-LOK INSERT HOLE TYPE SELF-LOCKING SELF-TAPPING

The Hole Type Tap-Loc is available as a self-locking self-tapping insert. The insert taps its own thread in a drilled or molded hole with the edges of the three holes located at the bottom. The nylon plug extends out into the internal and external threads providing a lock for the insert and permitting the screw to be locked.

Sizes: #4 to 1/2 inch internal thread
Material: Steel, brass, stainless steel
Known supplier: Groove-Pin Corp., Ridgefield, N. J.

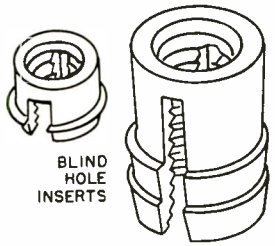


INSERTO SELF LOCKING SELF-TAPPING INSERT

The self-tapping self-locking Inserto is similar to the standard Inserto except for the locking device which is produced by a cylindrical pellet formed at the center of the internal thread.

Sizes: #4 to 1/2 inch internal thread
Material: Steel
Known supplier: Rosan Inc., Newport Beach, Calif.

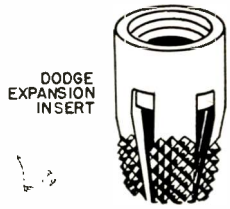
MISCELLANEOUS INSERTS



BLIND HOLE INSERTS

These self-locking inserts are installed in drilled or cast blind holes. As the insert is pushed into the hole in the parent metal, the two semi-circles are forced together. When the screw is inserted it forces these semi-circles apart once again and they dig into the parent material, preventing the insert from rotating or pulling out. Various modifications to the basic design are available making the insert adaptable for use in almost any material.

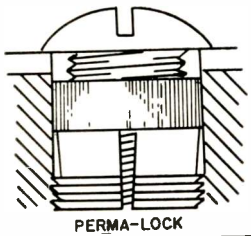
Sizes: #4 to 3/8 internal thread and for use in thin and thick panels.
Material: Brass, aluminum, steel, stainless steel
Known suppliers: Boots Aircraft Nut Corp., Norwalk, Conn.; Brush Insert Co., Greenwich, Conn.



DODGE EXPANSION INSERT

The Dodge expansion insert is pressed into a blind hole and then the self-contained star shaped spreader is forced downward to expand the slotted section. After this operation the insert is ready to receive the mating threaded part. The insert is very popular among custom molders and to a large extent has replaced molded inserts.

Sizes: #4 to 10
Material: Brass
Known supplier: Phelps Manufacturing Co., Westport, Conn.



PERMA-LOCK

This one piece metal insert has threads on the inside and both knurles and serrations on the outside. It is easily installed by pressing it into a drilled or molded hole. It locks in place as the screw is installed and expands the bottom section. The knurling acts as the anti-torque device. Variations to the basic are available.

Sizes: #4 to 3/8 inch
Material. Steel, brass, aluminum
Known supplier: J. B. Plevyak Mfg. Co., Newton, N. J.

Technical Data for Engineers

Conversion Factors

A reference table for engineers and other executives in wall chart form includes common conversions such as inches to centimeters or watts to H.P. as well as many conversions that are difficult to locate in reference manuals. Some such examples are atmospheres to Kgs/sq. cm, cm/sec to miles/hr, cu. ft. to liters, microns to meters, quintal to lbs., etc. Precision Equipment Co., 4411 E. Ravenswood Ave., Chicago 40, Ill.

Circle 188 on Inquiry Card

Bio-Assays

Users of Radioactive materials, processing uranium, thorium, and other nuclear materials, and organizations handling toxic materials are generally advised to include Bio-Assays as a major part of their health protection programs. Controls for Radiation, Inc., 130 Alewife Brook Pkwy., Cambridge, Mass., is expanding its Bio-Assay service and describes criteria used by ConRad in designing Bio-Assay programs, as well as a description of analytical procedures employed in a new 8-page brochure entitled "Bio-Assays for Hazard Control."

Circle 189 on Inquiry Card

Temperature Chambers

A bulletin offered by Missimers, Inc., 3737 San Fernando Rd., Glendale 4, Calif., describes the Model FT1 "packaged" temperature chamber. Complete specifications are included on this small chamber which can be moved about for Mil Spec temp. testing anywhere within a lab or on a production line.

Circle 190 on Inquiry Card

Mercury Relay

The Phaertltron, an improved mercury relay having a plunger bearing surface of Teflon, assures swifter, more silent operation and longer life of the relay's one moving part, is described and illustrated in a 4-page bulletin, 410, from Mack Electronic Devices, Inc., Wyncote, Pa. Photos and diagrams illustrate the relay's construction. Also described is the operating principle of the normally open type and the normally closed type. Other information: contact ratings of tubes, coil data for standard power type relays, special coils, and mercury relays with built in sensitizers.

Circle 191 on Inquiry Card

Power Supplies

A 2-page bulletin describing the ME series of transistorized power supplies gives specs and selective features for 64 basic models with continuously variable voltage ranges to 300 v and up to 25 adc output. Mideastern Electronics, Inc., 32 Commerce St., Springfield, N. J.

Circle 192 on Inquiry Card

! MORE !

The literature presented here has been selected for its contribution to or advancement of the electronic industries. They are selected from several hundred bulletins, catalogs, and data sheet announcements received during the past month by ELECTRONIC INDUSTRIES. The editors of EI feel that these items best reflect technological progress in the industry. However, to keep readers informed of all new developments, a record is kept of ALL new product and tech data announcements. For a copy of this month's list, please send your request on company letterhead.

Glass-Ceramic

The third in a series of progress reports on Pyroceram materials is now available from Corning Glass Works, Corning, N. Y. An 8-page brochure, Pyroceram Progress Report No. 3, gives a general description of the glass-ceramic, and has detailed data on 2 types of Pyroceram. Included are electrical, mechanical, thermal, and chemical properties. Effects of high energy radiation on Pyroceram Code 9606 are given. Design considerations and applications of both types of Pyroceram are explained. Featured is a comparative property chart and a new diagrammatic explanation of the Pyroceram manufacturing method.

Circle 194 on Inquiry Card

Antenna Service

A 4-page bulletin describes field service facilities for the antenna industry. The literature delineates the various types of field engineering service available, such as site selection, construction, supervision, antenna erection, maintenance and training. D. S. Kennedy & Co., Cohasset, Mass.

Circle 195 on Inquiry Card

Plastic Fasteners

A 6-page bulletin outlines advantages of nylon fasteners and insulators: screws, nuts, washers, set screws, insulators and bushings. Richco Platic Co., 4445 W. Fullerton, Chicago 39, Ill.

Circle 196 on Inquiry Card

Bidder's Guide

Blonder-Tongue Labs., Inc., 9 Alling St., Newark, N. J., has compiled a series of catalog sheet and specs. folders to form a master TV systems bidder's guide. This guide is available to those interested in competing on master TV or closed-circuit TV systems. The guide enables any bidder to write a complete spec. in architect's or engineer's vernacular. For calculating TV systems, a brochure illustrating the components of a system and their technical specs. is included. Also provided is a cost sheet for quick estimating, and instructions for installing master TV systems in motels. These instructions also apply to other master system jobs, such as, schools, apartments, hotels and institutions.

Circle 197 on Inquiry Card

FM Radio

Catalog page illustrates and gives complete technical data on Models PR-35 and PR-155 tunable FM receivers for the 30-50 MC or 152-174 MC bands. Monitoradio Div., I.D.E.A., Inc., 7900 Pendleton Pike, Indianapolis 26, Indiana.

Circle 198 on Inquiry Card

AC Potentiometer

Design details and performance characteristics of the Model 3B Vernistat prevision ac potentiometer are described in a 2-page data sheet from the Vernistat Div., Perkin-Elmer Corp., Norwalk, Conn. The potentiometer features an output impedance of 40 ohms and a terminal linearity of $\pm 0.01\%$ designed to meet requirements for an extremely accurate and reliable servo component. Featured are its low quadrature, high resolution and high input impedance. General application information is also included along with electrical and mechancal specifications.

Circle 199 on Inquiry Card

Computer Publication

Subject of the first issue of Donner Tech notes, a 4-page publication dealing with analog computer techniques and applications, is "How to Simulate a Non-Linear Control System with an Analog Computer." Diagrams of a typical control system and plots showing response of the system at various points with different parameters are included. Donner Scientific Co., 888 Galindo Rd., Concord, Calif.

Circle 200 on Inquiry Card

after routing, clip and save

a continuing series on technical topics of specific interest to engineers

Folio 59-6 REFERENCE DATA FILE SANGAMO

the significance of envelope delay in communication networks . . .

The design of electronic wave filters is an exact science requiring painstaking attention to even the most minute detail. Of no less importance is the preparation of filter performance specifications. The transmission of pulsed sinusoids, steep-front modulation envelopes and other complex wave forms in modern telemetry, speech and facsimile systems has made the preparation of adequate component specifications an absolute necessity. The omission of a single required performance detail can lead to serious malfunctioning of the component in the completed system.

Envelope delay is one of the important characteristics in filter applications requiring minimum distortion of the transmitted signal. The systems engineer must give proper attention to this requirement. Mathematically, envelope delay may be defined as:

$$T_d = -\frac{d\beta}{d\omega}$$

Where: T_d = envelope delay in seconds
β = phase shift in radians
ω = angular frequency in radians per second

To hold distortion to a minimum, the envelope delay must be nearly constant over the entire frequency spectrum of the transmitted signal. It is the constancy of envelope delay rather than the actual magnitude of the delay which governs a network's ability to transmit a complex wave form without introducing objectionable distortion. The distortion arising from non-constant envelope delay is termed envelope delay distortion. From the above equation it is apparent that T_d is constant as long as phase shift varies linearly with frequency. Unfortunately, the realization of a filter network with perfectly linear phase shift over its entire pass band is not always practical or even possible. For this reason, the systems engineer should carefully evaluate the degree of constancy of T_d which his system requires as well as the range of frequencies over which T_d must be maintained nearly constant.

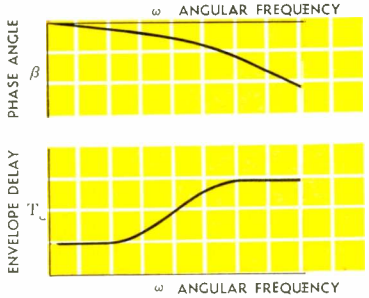


FIG. I *Illustrates the relationship between phase shift and envelope delay.*

The effect of envelope delay distortion on a transmitted signal is illustrated in figure 2. Figure 2 (a) shows the input signal. It is composed of a fundamental frequency plus the third and fifth harmonics. Figure 2 (b) shows the output signal. The network has shifted the fundamental frequency by 45°, the third harmonic by 90° and the fifth harmonic by 180°. The net result of such non-linear phase shift is a highly distorted output signal. If components of the wave had been shifted 45°, 135° and 225° respectively, the signal would have been transmitted without distortion.

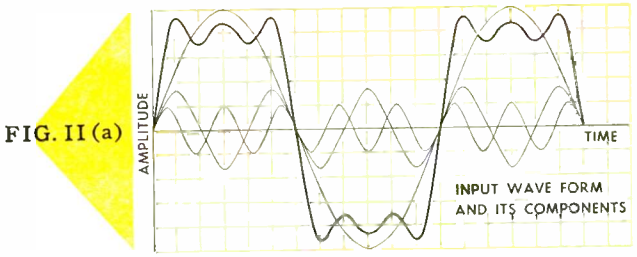


FIG. II(a)

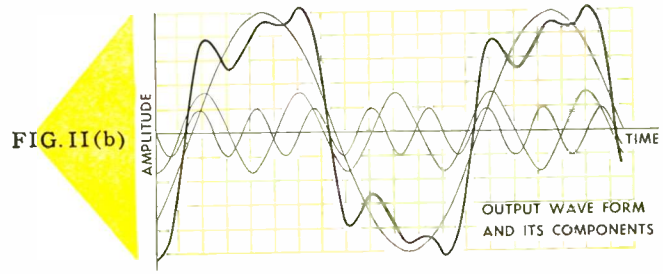


FIG. II(b)

Since envelope delay is defined as the derivitive of phase with respect to frequency, exact measurement of envelope delay is difficult. In practice, however, envelope delay may be approximated by the following definition:

$$T_{\Delta d} = -\left(\frac{\theta_2 - \theta_1}{f_2 - f_1}\right)\frac{1}{360}$$

Where: θ_2 = phase angle in degrees at f_2

θ_1 = phase angle in degrees at f_1

f_2 = frequency in cycles per second at which phase shift equals θ_2

f_1 = frequency in cycles per second at which phase shift equals θ_1

$T_{\Delta d}$ is the average envelope delay between f_2 and f_1. By convention, $T_{\Delta d}$ is assumed to be the envelope delay at a frequency equal to ½ $(f_1 + f_2)$. When the approximate formula is used to calculate envelope delay from empirical phase shift versus frequency data, it should be remembered that the approximation holds only for small differences between f_1 and f_2.

The IBM "650" computer services maintained at Sangamo materially aid our design engineers in solving complicated networks for envelope delay, phase shift and attenuation characteristics.

Write for Inductive Component Bulletin Series IC-260

SC-59-7

SANGAMO ELECTRIC COMPANY, Springfield, Illinois

--designing towards the promise of tomorrow

Circle 57 on Inquiry Card

New Products . . . for the Electronic Industries

ULTRASONIC CLEANER

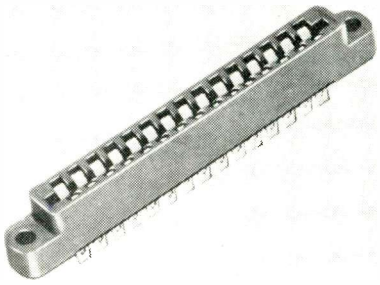
Ultrasonic cleaner, Model 200, features a one-gallon, heavy-gauge polished stainless steel tank with 43% of the bottom covered with driving elements. Actual radiating surface is

12 sq. in. The 115 v ac, single phase, 60 cycle generator, designed for continuous operation, delivers an average power output of 60 w and produces peaks of 240 w. Features include 0-60 minute timer, one tube oscillator, remote control, and front panel switching. National Ultrasonic Corp., 111 Montgomery Ave., Irvington 11, N. J.

Circle 201 on Inquiry Card

CARD RECEPTACLES

A new 3/32 and ⅛ in. capacity Reli-Acon card receptacles are made to the environmental requirements of MIL-C-21097. Designed to utilize the strength characteristics of printed

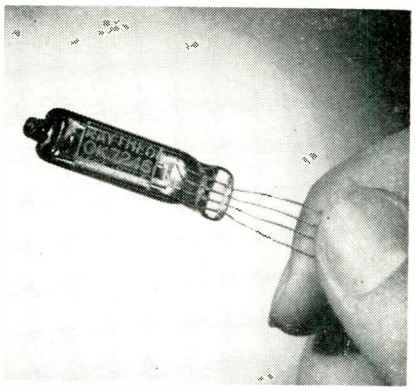


circuit boards to keep plug-in construction, the units are available with optional threaded mounting inserts and with vibration resistant card locking clips, with which a screw driver or similar instrument is employed to release the latch. Methode Manufacturing Corporation, 7447 W. Wilson Avenue, Chicago 31, Illinois.

Circle 203 on Inquiry Card

TRIODE

Filamentary subminiature triode tube Type CK7246, operates up to 500 MC. Operating characteristics: (Class A Amplifier) filament voltage (dc), 1.25 v.; filament current, 150

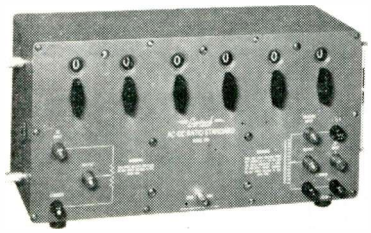


ma; plate voltage 105 v. plate current 4.5 ma; grid voltage, —2.5 v.; transconductance, 2700 μmhos; amplification factor, 22. (Class C Oscillator 465 MC) filament voltage (dc) 1.25 v.; filament current, 150 ma; plate voltage, 105 v.; plate current 6 ma; grid current 0.9 ma; power output 60 mw. Raytheon Co., Waltham 54, Mass.

Circle 204 on Inquiry Card

AC/DC RATIO STANDARD

Single instrument contains both ac and dc precision ratio standards. Model 1001 handles ac input voltages of 0.35 f (f in CPS) over the frequency range of 50 to 10,000 CPS. Model 1002 handles ac inputs of 2.5 f (f in CPS), and has a frequency range of 30 to 1000 CPS. In either model the dc section has an input resistance of 10,000 ohms; 5 w power rating. Both have



an ac terminal linearity of 0.0001%, and a dc linearity of 0.001%, with 6 place resolution. Gertsch Products, Inc., 3211 S. La Cienega Blvd., Los Angeles 16, Calif.

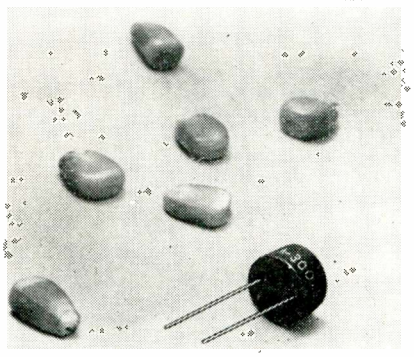
Circle 202 on Inquiry Card

! MORE !

The new products presented here have been selected for their contribution to or advancement of the electronic industries. They are selected from several hundred new product releases and catalog or data sheet announcements received during the past month by ELECTRONIC INDUSTRIES. The editors of EI feel that these items best reflect technological progress in the industry. However, to keep readers informed of all new developments, a record is kept of ALL new product and tech data announcements received. For a copy of this month's list, please send your request on company letterhead.

TOROIDAL INDUCTORS

MT series of microminiature Kernel toroidal inductors provide light weight, reliability and economy in printed circuit use. The MT 34 are for frequencies to 30 KC and can be supplied with inductances up to 500 mhys, MT 35 are applicable to frequencies ranging to 200 KC. Q for the MT 34 is greater than 55 at 25 KC and for the MT 35 more than 60 at 100



KC. Size of both is 0.437 OD x 9/32 in., spacing between leads, 0.3 x 1 in. long with a weight of 0.06 oz. Burnell & Co., 10 Pelham Parkway, Pelham, New York.

Circle 205 on Inquiry Card

Reeves INSTRUMENT CORPORATION

first in today's front page developments

GYRO TEST CONSOLE *(GTS-1001C)* First fully equipped COMPLETE test facility for testing of single axis integrating gyros. Can also be adapted for testing precision floated accelerometers.

GYRO TEST TABLE *(Model RD)* Positioning data accuracy guaranteed to 2 sec. arc. Complete electronics for testing any type of inertial gyro or complete inertial reference packages.

GYRO AND GYRO SYSTEM TEST EQUIPMENT

for today's front page missile programs

Reeves' research and development in the field of precision gyros has always paced the industry, resulting in over ten years of high level gyro production, based on exacting reliability standards subject to the most exhaustive quality control. Today's gyros and gyro systems demand high precision test equipment far beyond the capabilities of commercially available instruments. To meet this need, Reeves has specified, designed, and *built* test equipment capable of meeting the most stringent requirements — not only for today, but for the foreseeable future as well.

Through the years, this test equipment has been refined and packaged to the point where we now can present with confidence the most accurate and comprehensive line of gyro test equipment available.

DIFFERENTIAL WATTMETER High precision test detection of extremely small power consumption differentials in gyro spin motors and other types of rotating components.

superbly precise . . . fast, simplified operation . . . maximum reliability

TYPICAL ELECTRONICS GROUP for inertial reference package system test. All Reeves equipment offers Laboratory accuracy with production line practicality.

This equipment has numerous practical advantages for producers and users of gyros and gyro systems. Exceptional accuracy and flexibility permit rapid testing of today's most advanced gyros and inertial reference packages, as well as tomorrow's even more advanced designs.

Ease and reliability of operation, along with intelligent human engineering, allow for rapid training of equipment operators. Production quantities can be tested with laboratory precision.

Simplified maintenance and service assure against costly down-time.

Your inquiries are invited.

ENGINEERS:

Rewarding careers at Reeves in the fields of radar, guidance, and computer systems.

REEVES INSTRUMENT CORPORATION

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Reeves INSTRUMENT CORPORATION

8RV59

WASHINGTON News Letter

MICROWAVE DECISION—In a final report and order, with sweeping implications for the entire communications field, the FCC has thrown open much of the non-government frequency space above 890 MC for private point-to-point operation by its myriad of safety and special radio services licensees. Under the Commission order, safety-special licensees will be eligible for authorizations to operate private point-to-point systems in the operational fixed microwave bands which are or will be listed in their respective rules.

The FCC also established a policy that when such "open end" services as the business and citizens radio services are considered, practically anyone in the United States engaged in a legitimate pursuit is at least theoretically eligible to operate a private microwave system.

ALL-UHF TV SYSTEM PLAN—FCC Commissioner Robert E. Lee has submitted to the Senate Interstate & Foreign Commerce Committee views that studies of television allocation problems lead to the "inescapable conclusion" that all TV should be switched to the ultra-high frequency spectrum. The Commissioner also set forth a "tentative" plan under which a variety of existing and new non-broadcast radio services should be allocated the present VHF televison channels 2 through 13.

Commissioner Lee's statement to the Senate committee constituted his minority view to the FCC majority statement on television allocation problems which were submitted to the Senate body last April. The FCC majority proposed an agreement with federal government radio frequency users to permit the ultimate goal of 50 consecutive very high frequency TV channels and a 25-channel system beginning with the present TV channel 7 and continuing upward in the spectrum from that point.

BASIC RESEARCH IMPORTANCE—Dr. James W. McRae, Vice President of the American Telephone & Telegraph Co. in charge of defense activities and Chairman of the Army Scientific Advisory Committee, emphasized before an association of the United States Army panel on "modern army readiness through research," held in Washington recently, that basic research is essential to the military services and industrial civilian production, particularly in communications and electronics, in the "serious technological race" with the Soviets. A most important research and development field is in solid state physics, Dr. McRae, who has had a distinguished career with Bell Telephone Laboratories and the Western Electric Co. before his present position, stated.

National Press Building
Washington 4

ROLAND C. DAVIES

DOD UNDER FIRE—Senator John Sparkman said, " . . . The Department of Defense has become a prime factor in contributing to inflation." He claims that DOD negotiates defense contracts without competitive bidding. In many cases the Senator said this practice results in millions of dollars in overcharges. Senator Sparkman feels that this failure to apply sound economic principles and seeming indifference to the value of money has contributed to the depreciation of the dollar. He also stated that DOD should accept more competitive bids from certified small business instead of negotiating with only one or two larger firms. He said this would save millions of dollars.

SMALL BUSINESS WINS—The Ameco Electronic Corp. submitted a bid under an invitation issued by the Signal Corps. They were low bidder and recipient of a Certificate of Competency issued by the Small Business Administration. Despite this, the Signal Corps in response to an inquiry by Subcommittee No. 2 of the House Small Business Committee, advised that the final determination as to the award would be made by the Contracting Officer. The Subcommittee brought this situation to the Comptroller General's attention. A ruling was made in favor of Ameco.

LUNAR PROBE—Contracts for an instrument to probe the surface of the moon and the study of a new rocket engine concept are among nearly $16 million worth of contracts awarded by NASA.

Under NASA contracts, scientists at Columbia University and California Institute of Technology will collaborate on the construction of a "lunar seismograph."

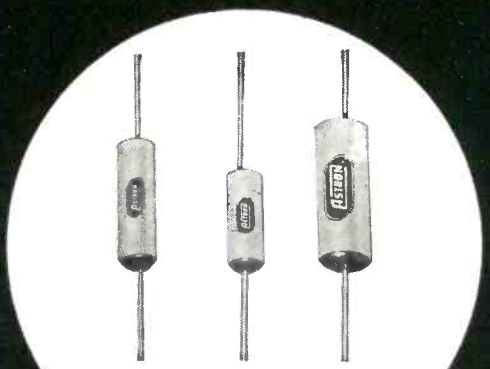
A moon landing isn't going to happen tomorrow, scientists emphasized. But if a roughed-out schedule moves along as planned, the United States may attempt to "soft-land" a seismograph on the moon within five to six years.

SURPLUS PROPERTY SALES—Closed circuit TV will be used on October 7th in an effort to promote competition among prospective buyers of federal surplus property says DOD. Large screen TV and radio hook-up will be located in Boston, New York, Philadelphia, Columbus, Chicago, and St. Louis. Purchasers in these locations will be able to bid on property for sale at three widely scattered installations.

for TRANSISTORIZED APPLICATIONS

New subminiature electrolytic

ASTRON DESIGNED CAPACITORS



TYPE EK
ACTUAL SIZE

Astron type EK subminiature ceramic cased electrolytics have been specifically designed for low voltage transistorized circuitry in industrial and commercial applications. A steatite case and epoxy end seal offer moisture and humidity resistance comparable to hermetically sealed metal cased units.

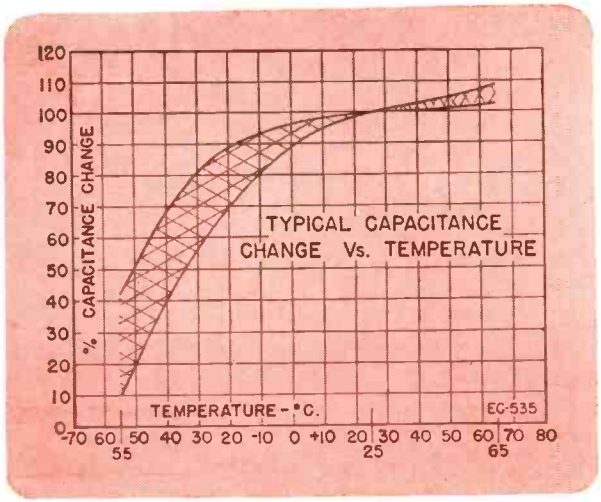
In the advanced Astron design, 99.99% high purity aluminum foil is used. This compact unit combines low impedance over a wide frequency range and extremely low leakage over a full range of ratings from 2 mfd to 100 mfd and voltages from 1 wvdc to 50 wvdc. Measurements of the leakage current are taken at 25°C immediately after the capacitor has been subjected to the rated DC voltage for five minutes. The leakage current shall not exceed the current value calculated from the formula: $I = KC + 3$

where: I = D. C. Leakage in microamperes
K = Constant as shown in the following table
C = Rated capacitance in MF

D. C. LEAKAGE CONSTANTS

WVDC	K
1 to 15	.1
16 to 50	.15

The operating temperature range is from —30°C to +65°C.



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FOR BULLETIN E-650

IN CANADA
CHARLES W. POINTON
6 ALCINA AVE.
TORONTO, ONTARIO

EXPORT DIVISION
ROCKE INTERNATIONAL CORP.
13 EAST 40TH ST.
NEW YORK, N. Y.

SPECIALISTS IN CAPACITOR MINIATURIZATION

ASTRON CORPORATION
255 Grant Avenue
East Newark, New Jersey

Circle 59 on Inquiry Card

For Portable Communication...

NEW RAYTHEON CK7246

1.25 VOLT SUBMIN TRIODE

OPERATES TO 500 MC.

This Raytheon filamentary subminiature triode was developed under U. S. Signal Corps contract, and is now commercially available for use in battery-operated communications equipment. Circuit applications include:

- **Superregenerative detector**
- **High frequency oscillator**
- **Class C amplifier**
- **Frequency multiplier**
- **Mixer**

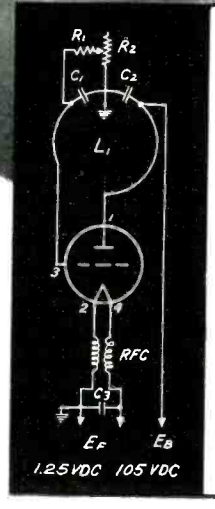
TYPICAL OPERATING CHARACTERISTICS

Class A Amplifier

Filament voltage (dc)	1.25 v.
Filament current	150 ma.
Plate voltage	105 v.
Plate current	4.5 ma.
Grid voltage	−2.5 v.
Transconductance	2700 μmhos
Amplification factor	22

Class C Oscillator (465 mc.)

Filament voltage (dc)	1.25 v.
Filament current	150 ma.
Plate voltage	105 v.
Plate current	6 ma.
Grid current	0.9 ma.
Power output	60 mw.



Typical CK7246 Circuit
465 mc. Class C Oscillator

L_1: 1 turn No. 12 copper, ¾ inch O.D.

RFC: bifilar wound 8 turns #26 En. ⅛" I.D., 1" long

C_1, C_2, C_3: 250 μμf feed-thru button type

R_1: 4.7K ½ w.

R_2: 10K 2w pot.

RAYTHEON®

INDUSTRIAL TUBE DIVISION

55 CHAPEL STREET, NEWTON 58, MASSACHUSETTS

RELIABLE MINIATURE & SUBMINIATURE TUBES • GAS & VAPOR TUBES • CATHODE RAY TUBES • HARD-GLASS POWER TUBES

BOSTON: BIgelow 4-7500 • **NEW YORK:** PLaza 9-3900 • **CHICAGO:** NAtional 5-4000 • **LOS ANGELES:** NOrmandy 5-4221
BALTIMORE: SOuthfield 1-1237 • **CLEVELAND:** WInton 1-7716 • **KANSAS CITY:** PLaza 3-5330
GOVERNMENT SALES . . . BOSTON: BIgelow 4-7500 . . . **WASHINGTON, D. C.:** MEtropolitan 8-5205 . . . **DAYTON:** BAldwin 3-8128

Small order and prototype quantities available directly from your local Raytheon electronic parts distributor

this rugged Video Telemetering System

THIS REMARKABLE NEW television system gives you the power of sight where human eyes cannot go. It can be directed outward for observation, or inward to "watch" internal operation from a range of 1,000 miles line-of-sight.

Capable of operation under extreme environmental conditions, and packaged for use under conditions requiring limited space, weight, and power, the Model 701 includes such features as: transistorized circuitry, 525 line, 30-frame fully interlaced picture, crystal controlled EIA synch, and high sensitivity.

Weight of the complete unit is under nine pounds. Total volume is less than 119 cubic inches. Its critical-design requirements are typical of all *LEAD* products. Each can be modified to meet many different requirements. Tell us what yours are. Contact our Marketing Branch, Lockheed Electronics & Avionics Division, 6201 E. Randolph St., Los Angeles 22...OVerbrook 5-7070.

Requirements exist for staff and supervisory engineers

LOCKHEED ELECTRONICS & AVIONICS DIVISION

Look to Lockheed for LEADership in Electronics

Circle 60 on Inquiry Card

Tele-Tech's ELECTRONIC OPERATIONS

The Systems Engineering Section of ELECTRONIC INDUSTRIES · SEPTEMBER 1959

SYSTEMS—WISE . . .

▸ WTAG-FM, Worcester, Mass. has joined the QXR Network. It is the 14th station to be added to the Network. WTAG-FM went on the air June 17, 1940. It is affiliated with the Worcester Telegram and Gazette and operates on 96.1 MC with 10 kw of power. It will carry 65 hr of QXR programming each week.

MICROWAVE SERVES TELEPHONE CO.

Microwave and multiplex equipment serves over 5000 customers of the North Carolina Telephone Co. A passive reflector type antenna is mounted on this 90 ft., Blaw-Knox Model MRH tower at Wadesboro, N. C. Frequencies are 5974.8, 6226.9, and 6345.5 MC.

▸ Authorizations in the Citizens Radio Service have passed the 50,000 mark. The Federal Communications Commission is currently granting about 300 applications daily. Citizens radio operation is limited to point-to-point, fixed point-to-mobile, and multiple address communication in the 460 to 470 MC band. 27.255 MC is also available for remote control of devices and paging systems.

▸ A contract for developing and producing a "satellite clock" and time programmer for the U.S.'s effort to put a man into space—and bring him back alive—has been awarded to Waltham Precision Instrument Co., Waltham, Mass. Called a "chronometric programmer," the device will record the elapsed time from launching and will automatically set into motion on a split second schedule 13 important activities including the re-entry from space to earth. It will also provide signals to be transmitted in a short span of time to earth through the telemetering system.

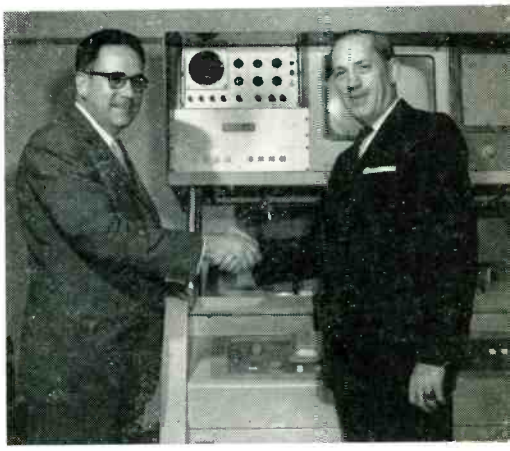
▸ A broadcast demonstration of a new system of AM radio —Single Station AM/AM Compatible Stereo—was held recently by WABC, American Broadcasting Company's New York City radio station, and Philco Corp., which developed both the transmission system and the stereophonic receivers. Armin Allen, vice president, product planning and development-electronics of Philco Corp., reported that Philco was prepared to market the new compatible stereophonic AM receivers as soon as the FCC approves standards for the new broadcasting system.

▸ Magnetic recordings of radiation data may be a way of speeding nuclear research, say nuclear physicists at Armour Research Foundation at work on a project for the U. S. Atomic Energy Commission. Object of taping is to speed data-taking on experiments involving gamma-ray measurement or to let researchers study research information when convenient by storing analogue pulse-height information (pulses from gamma-ray detectors) both accurately and reducibly on magnetic tape.

▸ The Federal Aviation Agency has announced that the National Association of Broadcasters will ask the nation's radio and TV stations when broadcasting news of impending emergencies or tragedies to include repeated warnings to all listeners to stay away from the scene of the emergency. FAA Administrator, E. R. Quesada, commented that the NAB's action will, in a large measure, help prevent a recurrence of the type of incident that so seriously compromised safety following the broadcast of the impending landing of a crippled airliner at Idlewild Airport, N. Y.

▸ An aircraft direction-finding system capable of measuring with near-perfect accuracy the direction from which a radio signal is being transmitted has been demonstrated by International Telephone and Telegraph Corp. A ground operator using the equipment can transmit the direction information to any aircraft equipped with a standard communications receiver. With two direction finders, the pilot can be told both his position and the direction he is heading.

RECORDERS FOR EDUCATIONAL TV



John F. White (right), Pres. National Television & Radio Center, and Neal McNaughten, Professional Products Mgr. Ampex Corp's. Div. seal agreement for $2,500,000 worth of Videotape recorders. They will go to 43 U.S. Educational TV stations.

▸ Two-way radio contact on 222 MC between the Hawaiian Islands and the mainland, previously believed impossible by experts, is reported by two radio amateurs. The communications set a new world's record of 2,540 mi. Contact was established on 222 MC on June 22 by Californian John Chambers, W6NLZ and Hawaiian Ralph Thomas, KH6UK. The VHF frequency is normally used for limited, short distance communications.

Synchro Shorts

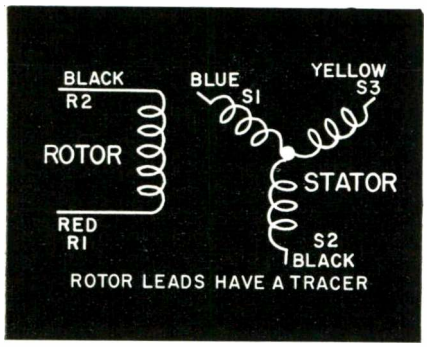
Reviewing the common types of synchros, and the functions that each performs. . . . . .

SYNCHROS are used to transmit positional information electrically to a distant point. Mechanically they correspond to a shaft or cable connecting two devices; in other applications, to a mechanical differential or to a cam.

In an airplane, indications of manifold pressure, cylinder head temperature, etc., are transmitted from the engines to the cockpit by means of synchros. Gun mounts, antennas, elevators, ailerons or rudder are driven in response to minute displacements of a gyro's gimbals and their movements monitored by means of synchros. Data from a compass element mounted remotely in a location free of magnetic disturbance is made available to guide the pilot or even actuate the control surfaces of the aircraft.

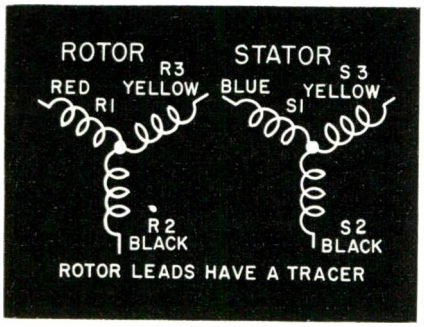
In fact, synchros supply the intelligence to most modern electronic devices and controls. They monitor the position of the fins of guided missiles; do the computing in modern anti-aircraft detectors; safeguard atomic reactors by controlling the position of the rods that keep the pile from reaching critical mass.

Below are listed the various types of synchros in a brief, tabular form along with schematic type diagrams of the units. In most cases the color coding in the drawings conforms to MIL-S-20708. For additional synchro information see pages 126, 127, 128 and 130 of the June issue of *Electronic Industries.*



TRANSMITTER

A Synchro Transmitter is a unit consisting of a stator and rotor which are inductively coupled. The rotor is mechanically positioned for transmitting electrical information corresponding to the angular position of the rotor in respect to the stator. Low impedance and relatively high power capabilities characterize Torque Transmitters used to drive synchro Receivers or combinations of Differentials and Control Transformers. Control Transmitters use less exciting current and they are most frequently connected to a Control Transformer or, less often, to a Differential and a C. T. in series.



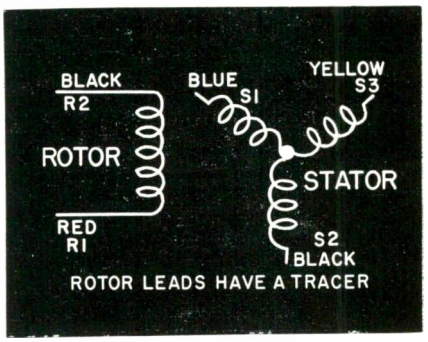
DIFFERENTIALS

A Differential Transmitter synchro is a unit in which the rotor is mechanically positioned. It modifies electrical angular information received from a Transmitter synchro and retransmits it to a Receiver synchro or a Control Transformer synchro as electical information corresponding to the sum or difference of the electrical input angle and its rotor position angle. In servo control systems the stator primary is excited by the stator voltages of a transmitter and the rotor leads are wired to those of another synchro stator. A Torque Differential Transmitter is constructed primarily for operation with Torque Receivers, while Control Differential Transmitters are primarily for operation with Control Transformers.

A Differential Receiver is a unit wherein the rotor is free to turn to assume a position with respect to the stator in accordance with the sum or difference of the electrical angular information received. This unit is primarily constructed for operation with two synchro Torque Transmitters.

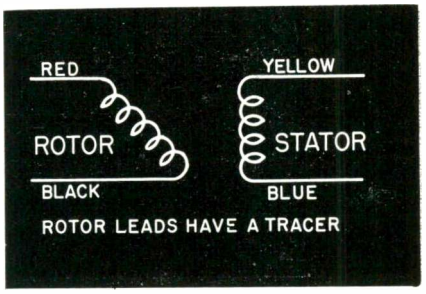
RECEIVER

A Receiver synchro consists of a stator and rotor which are inductively coupled. The rotor is free to turn, and when properly energized will assume a position in accordance with the electrical input from a Transmitter synchro. Receivers are internally damped to prevent the rotor's oscillating while following input signal. Damping also prevents oscillations due to transients. Receivers quite often will drive a "card" which may indicate range, bearing, angle of elevation, etc.



LINEAR TRANSFORMERS

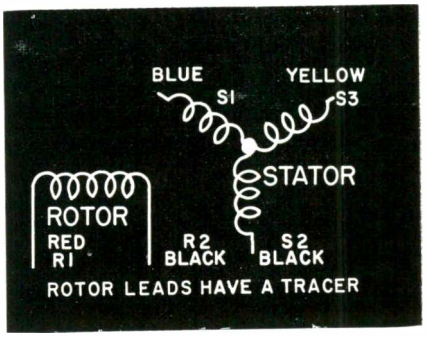
They are inductively coupled units that are wound for single phase. Being transformers, the windings are electrically isolated and the resolution is practically unlimited. The popularity of these units is due to their temperature cooefficients being the same as the resolvers with which they are most often used.



CONTROL TRANSFORMER

Unit consists of a 3-phase stator and a rotor which are inductively coupled. The electrical output of the rotor is dependent upon both the position of the rotor and the electrical input to the stator from another synchro. It establishes electrically, a directional field whose heading or angle is detected by the proper null output of the single phase winding on a cylindrical rotor.

There are several important differences between this unit and other synchro units. The rotor is never connected to an ac supply, so it never induces a voltage in the stator coils. As a result, the stator current is determined by the impedance of the windings, which is high, and it is not affected appreciably by the rotor's position. Also, there is no appreciable current in the rotor, and the rotor does not tend to turn to any particular position when voltages are applied to the stator. The shaft of this unit is mechanically driven.



RESOLVERS

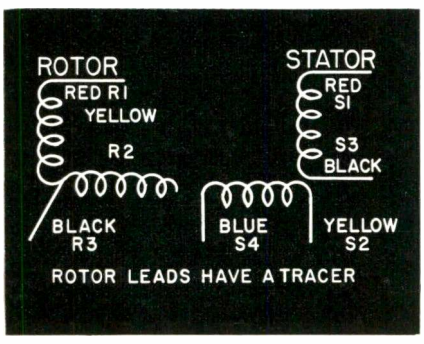
Generally, they are used for vector addition and also to resolve a vector representing voltage into its orthogonal components. The classic application is to solve the unknowns of a right triangle. As a vector adder, single frequency, sinusoidal voltages are applied, generally, to the 2-phase windings of the stator establishing a resultant field with which a 2-phase servo rotated rotor is turned to produce a null on one winding. The output of the other rotor winding represents the magnitude of the resultant, and the physical rotor angle is the direction. Resolvers may take several forms.

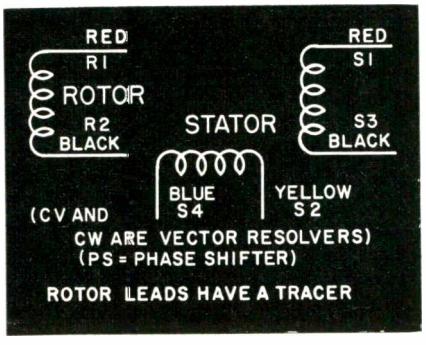
Resolver-Transmitter is a unit which may have two perpendicular windings on the rotor or stator, and has its rotor mechanically positioned for transmitting electrical information corresponding to angular position of the rotor with respect to the stator.

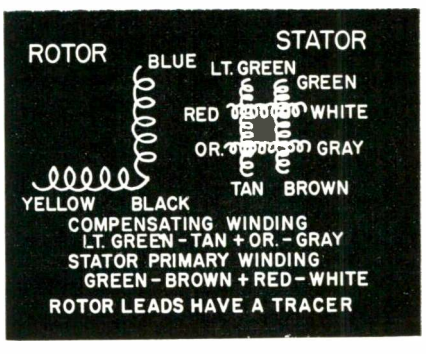
Resolver-Control Transformer may have two perpendicular windings on the rotor or stator that transforms electrical angular information from the stator to a voltage proportional to either the sine or cosine of the difference between the electrical input angle and the resolver control rotor angle.

Resolver-Differential may have two perpendicular windings on the rotor or stator. It has its rotor mechanically positioned for modifying electrical angular information received from a transmitter and re-transmitting the electrical information corresponding to the sum or difference of the electrical input angle and its rotor position angle, depending on the system wiring.

Two other forms are illustrated. They are the Vector Resolver (Sine-cosine generator) for applications that only requires the resolution of the vector into its components, and the Compensated Resolver made with feedback or compensated windings in the stator for extending the range, especially at the low end, over which the output will be a trigonometrically faithful function of the input amplitudes.







New Products

IMAGE ORTHICON

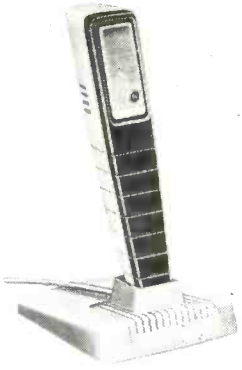
Television camera tube, 7513, is intended to provide high-quality performance in color cameras utilizing the simultaneous method of pickup, and in black-and-white cameras. Fea-

tured is precision construction which includes accurate alignment of each section of the tube with respect to the tube axis and maintenance of a high degree of uniformity for the location of all electrodes and interelectrode spacings. Radio Corporation of America, Electron Tube Div., Harrison, New Jersey.

Circle 247 on Inquiry Card

CARDIOID MICROPHONE

Model 729, a ceramic cardioid microphone, is designed for public address, call and paging systems, amateur radio, home recorders (especially stereo), and general communications. It is dead from the rear, making it especially suitable for amateur radio VOX operation. It is also tailored for



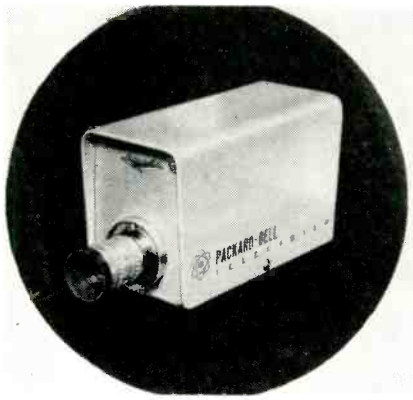
single sideband. The Model 729 may be used in any climate. It has an output level of —55 db and a frequency response from 60 to 8,000 CPS. Net weight less cable is 9 oz. Electro-Voice, Inc., Buchanan, Mich.

Circle 248 on Inquiry Card

New Products

CCTV CAMERA

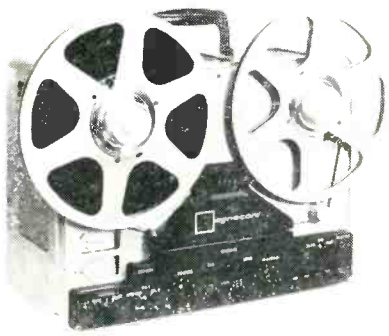
Closed circuit TV camera provides detail in excess of 600 line resolution. It has single operating control, regulated power supply, keyed automatic back level control and automatic light compensation. Specs are: Min. illumination for usable picture, 2 ft. candles; bandwidth, 8 MC video output, 1.4 v. peak to peak composite signal with 30% sync.; video output impedance, 75 ohms; interlace ratio, 2-1, 525 lines; frame frequency, 30 per sec.; vertical sweep frequency, 60 CPS; horizontal sweep frequency, 15,750 CPS; power input, 105 to 125 v. Packard-Bell Electronics Corp., 12333 W. Olympic Blvd., Los Angeles 64, Calif.



Circle 249 on Inquiry Card

TAPE RECORDER

Tape recorder, Model 728 "Professional," features 2-channel capacity, modular construction, wide flexibility of operation, low flutter and wow, and extended frequency response. It can have full-track, half-track, or split stereo heads. A fourth head may be mounted in the head bracket. The fourth head is ordinarily used to reproduce quarter track stereo tapes. It records stereophonic, sound-on-sound or monophonic. Multiple dubbing on up to a dozen separate "takes" have been accomplished. Midwestern Instruments Inc., Magnecord Div., P. O. Box 7186, Tulsa, Okla.



Circle 250 on Inquiry Card

CUES for Broadcasters

More on Silent Tape Recorder Operation

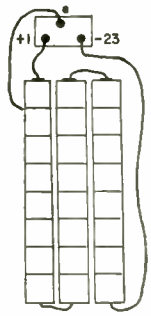
N. WAYNE OWENS, Ch. Eng
KSOK, Arkansas City, Kansas

Referring to article titled "Silent Tape Recorder Operation" as described by Albert J. Krukowski in "Cues for Broadcasters" in your July issue, we would like to report that we have been using this set-up for approximately three years with entirely satisfactory results. However, our initial purpose was to provide semi-remote operation rather than silent operation, although both needs are satisfied.

The added S_2 lever switches on all recorders were brought out and installed in a small 3 x 5 x 4 inch metal box located directly in front of the operator. The same was done with two turntables that are not within easy reach of the operator, except that the turntables switches were connected in parallel with the original switches rather than in series. We were apprehensive at first, thinking possibly that leaving the function switch engaged before and after operation would produce "flats" on the rubber "pressure roller." Our fears proved unfounded, however.

Care should be taken in selecting the switches in that they should be definitely SILENT. We selected Switchcraft locking type, #3006L, two positions, DPDT. After three years of use they are becoming mechanical noisy, although an occasional drop of light oil in the ball portion of the switch remedies the situation. In our case it was not necessary to install capacitors across the switch contacts to squelch an audible "click," but it might be in other installations.

A 6.3 vac filament transformer was installed within the box and small jeweled pilot lights incorporated with the extra contacts on the switches, serving as indicator lights. A "Twelve Pin" Jones plug was installed on the rear of the box to facilitate removal for service, etc., although no service has been needed.



Cuts in cardboard assembly case and battery case should be done carefully with a sharp razor blade to insure neat package after firing. Care should be used in soldering so that mercury batteries do not overheat.

COMPLETED WIRING

Battery Modification

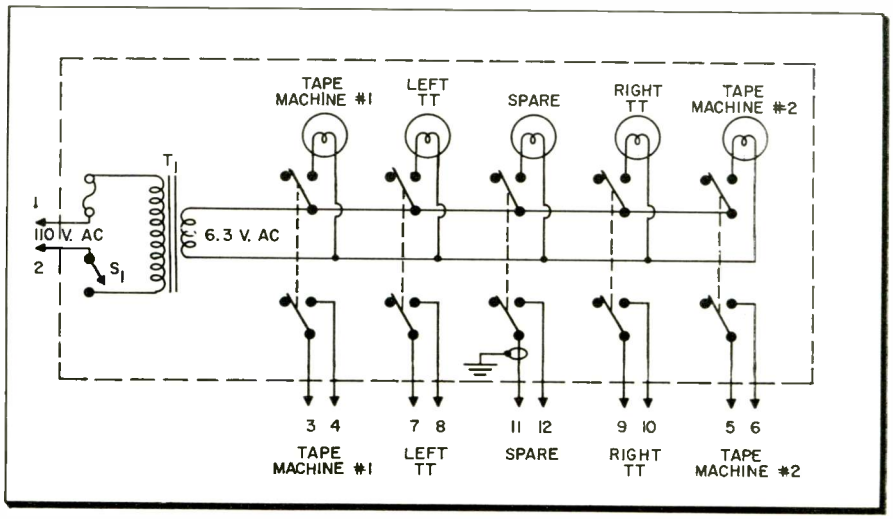
ART ROGERS, Ch. Eng.
KWYN, Wynne, Ark.

I thought someone might be interested in an engineering practice we use here which saves us about 30 per cent on battery needs for one of our remote amplifiers.

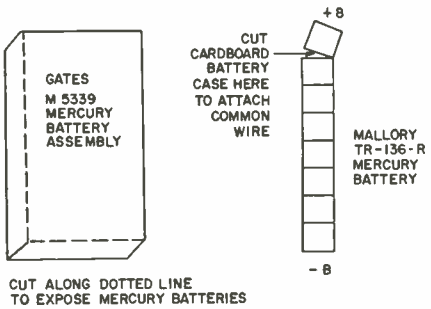
The plans for a battery modification for the Gates "Twinsistor" amplifier which a lot of stations in this area are using for remote sports, etc., are shown. We have been using the modified battery pack for some time, and have had excellent results.

(Continued on opposite page)

Modified for "silent recorder" operation this switching box also includes a 6.3 vac transformer and jeweled lights on the extra contacts to act as indicator lights.



The batteries I mention on the diagram are exact duplicates of the original batteries contained in the Gates M5339 assembly. All the engineer has to do on the packs is



to replace the batteries and do some minor wiring. This takes only a few minutes, and cuts the cost of remote broadcasts considerably. The Mallory 2 TR 136 R batteries are available in any radio supply house. The cut along the edges of the cardboard pack will expose the batteries and wiring. The old batteries are removed and the new ones installed with the same wire.

Softening Hard Neoprene Recorder Drive Wheels

CLOVIS L. BAILEY, Ch. Eng.
KJEF, Jennings, La.

After a few years of day-in, day-out use in Broadcast Stations, the Magnecorder PT-6 tape mechanism becomes erratic, slows down, won't start, etc. One drop of sewing machine oil around the capstan bearing usually starts it off again. However, after a day of operation, it slows down again—this time due to slippage of the neoprene drive wheels between the motor drive shaft and capstan drum. That drop of oil worked its ways to the surfaces of every neoprene wheel or idler in the assembly!

Then follows several days (or months) of cleaning them with "carbon-tet" or alcohol and drying them by holding cloth or pencil erasers against the pucks to restore traction. Eventually, the neoprene becomes hard from use of carbon-tet or alcohol.

These neoprene surfaces may be restored to their original soft flexible condition by applying "Transeal Automatic Transmission Sealer and Conditioner," a product of Radiator Specialty Co., Charlotte, N. C. It will also cure "fits and jerky starts" from hardened neoprene pucks in turntables like the Gates CB-11 we use here at KJEF. This liquid is sold at gasoline stations.

New Tech Data

(*Continued from page* 108)

Servo Clamps

Sterling Precision Corp., Instrument Div., 17 Matinecock Ave., Port Washington, L. I., N. Y., has published a new 48-page clamp catalog, devoted to a complete line of servo and related clamps. This line of miniature clamps is used by the servo computer, electro-mechanical and electronic industries

Circle 206 on Inquiry Card

Time Delay Relay

Folder SM-2 permits quick comprehension of a rugged time delay relay unit 4⅝ x 1 13/16 x 1½ in., has full specs. and diagrams giving details necessary for guidance in installations. AGA Div., Elastic Stop Nut Corp. of America, Elizabeth, N. J.

Circle 207 on Inquiry Card

PC Terminal

Data sheet describes "floating" printed circuit terminal which prevents lifting of conductor lines during the swaging operation, even under continued application of heat due to soldering. Litton Industries, USECO Div., 13536 Saticoy St., Van Nuys, Calif.

Circle 208 on Inquiry Card

Rotary Switch

Data sheet No. S-1 on the type JR Multiple Rotary Switch designed to meet MIL-S-21604 (BuShips). The data sheet provides complete specs and design information on 4 separate types with a cross reference to the applicable BuShips drawing number. Couch Ordnance, Inc., 3 Arlington St., N. Quincy 71, Mass.

Circle 209 on Inquiry Card

Sealed Relay Catalog

Bulletin GEA-6628, 24 pages, contains accurate up-to-date information on hermetically sealed microminiature, sub-miniature, miniature, and high speed relays for military and general purpose applications. Photographs, circuit diagrams, coil data, and specifications are provided. Order instructions are also included. General Electric Co., Schenectady 5, N. Y.

Circle 210 on Inquiry Card

Preamplifiers

Illustrated, 2-color brochure, Form 3023-9, covers 5 separate preamplifiers for use with scintillation, proportional counter, or GM tube detectors. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Circle 193 on Inquiry Card

(*Continued on page* 126)

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

Harrison Labs HLAB gains flexibility with Tung-Sol/Chatham 6336A!

Harrison Laboratories, quality manufacturer of Berkeley Heights, N. J., offers designers its 2B regulator with a 5 or 7-tube complement. Superior power handling ability of Tung-Sol/Chatham's 6336A twin power triode makes possible the 5-tube version that features operation over a wider line voltage variation without change of transformer taps.

Over more than a year, Tung-Sol/Chatham's 6336A has performed with exceptional reliability. Users of Harrison Labs 2B regulator especially appreciate the reduced downtime and maintenance stemming from 6336A's long life and electrical stability. In all, Harrison Labs evaluates the Tung-Sol/Chatham 6336A a wise design choice.

Harrison Labs adds another name to the growing list of manufacturers benefitting from the reliable efficiency of Tung-Sol tubes and semiconductors. So can you. Tung-Sol makes a quality unit for virtually every industrial and military need. Our applications engineers will gladly assess your circuitry and help discover how you can profit by specifying Tung-Sol. Tung-Sol Electric Inc., Newark 4, New Jersey. TWX:NK 193

ts TUNG-SOL®

Circle 67 on Inquiry Card

New Tech Data

(*Continued from page* 124)

Miniature Lamps

Tung-Sol Electric Co., 95 Eighth Ave., Newark 4, N. J., has announced the publication of its new A-21 lamp catalog. Designed for design engineers in the automotive, electronics and appliance fields, the catalog provides complete electrical and physical characteristics for 284 miniature and sealed beam lamps, together with full technical information on the relationship of applied voltage to life, current, and light-output. A set of line drawings provides external dimensions and appearance, basing information and filament designs.

Circle 211 on Inquiry Card

Wire-Wound Resistor

Miniature wire-wound resistor, RS 1/2, rated at 1/2 w up to 75°C ambient is described in bulletin RT-23 from Dale Products, Inc., Columbus, Nebr. Only 0.338 in. long x 0.071 in. dia., this resistor is silicone coated to provide protection from severe environmental conditions. Resistance ranges from 1 ohm to 6 K ohms depending on tolerance. Tolerances are: 0.05%, 0.1%, 0.25%, 0.5%, 1% and 3%. T.C. is 20 P.P.M. Operating range is from —55°C to 275°C.

Circle 212 on Inquiry Card

Synchro Testing

A 25-page report on techniques of control synchro and control resolver testing from Theta Instrument Corp., 48 Pine St., E. Paterson, N. J., describes the test procedures and application factors associated with electrical zero, electrical error, fundamental null, total null, transformation ratio, and phase shift. A new military specification, about to be released, will inaugurate new concepts in synchro testing which this report seeks to explain.

Circle 213 on Inquiry Card

Missile Regulators

A line of lightweight missile regulators is described in a detailed data sheet, Form 1237, from Linde Co. Div., Union Carbide Corp., Room 2840, 420 Lexington Ave., New York 17, N. Y. Designed for use in rocket and missile engines, the new regulators provide a solution to many of the fuel pressurization problems encountered in the operation of modern missiles. All of the new regulators are small and of lightweight construction to meet the exacting demands of missile design where size and weight are vital factors.

Circle 214 on Inquiry Card

(*Continued on page* 128)

METHODE
PLYO-DUCT
FLEXIBLE
Multi-Conductor Wiring

for Light, Compact, Reliable Harnessing of Complex Circuits

Plyo-Duct utilizes printed wiring techniques which offer higher efficiency use of conductors and many of the advantages in uniformity and freedom from assembly errors of printed circuit panels.

Write for prices and PLYO-DUCT booklet!

METHODE Manufacturing Corporation

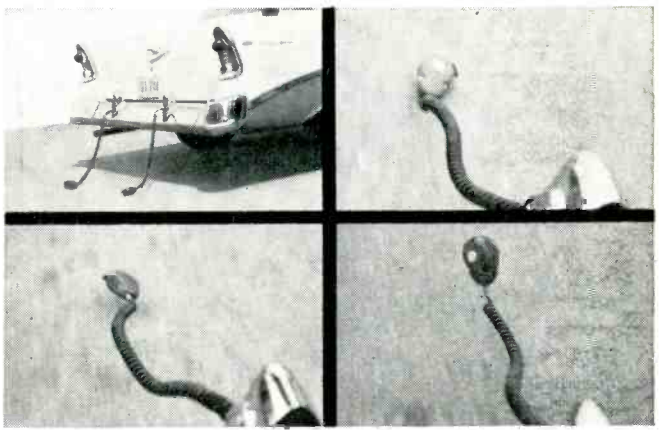
7447 West Wilson Avenue • Chicago 31, Ill.

Circle 56 on Inquiry Card

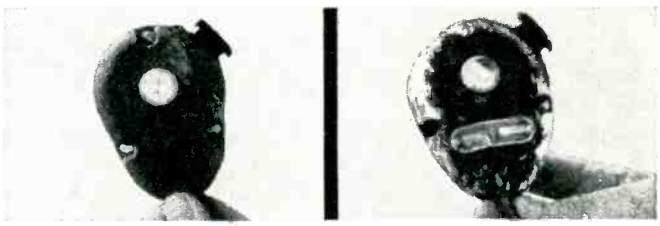
35,000 SMASHING, BATTERING IMPACTS—
and still working perfectly!

SHURE "TEN-FOUR"
COMMUNICATIONS MICROPHONE

proves its incredible durability in this gruelling destruction test!



New SHURE "TEN-FOUR" MICROPHONE, with exclusive Armo-Dur housing, and another microphone with standard die-cast metal housing were dragged for miles on a test drive over all kinds of pavements at speeds to 30 mph. In a matter of minutes, it was subjected to greater punishment than a lifetime of severest mishandling *and here's the result:*



Ten-Four with Armo-Dur Housing virtually unmarked—*still performed perfectly!*

Standard microphone with die-cast metal housing — cracked, broken, abraded—microphone inoperable.

For the microphone that stands up under severe operating conditions with no loss of high speech intelligibility, be sure to specify the Shure "Ten-Four" when you order your new communications equipment or replacements.

Available only to Manufacturers of Communications Equipment.
(Can be furnished with "Controlled Magnetic" or carbon cartridge.)

SHURE BROTHERS, INCORPORATED
222 Hartrey Avenue, Evanston, Illinois, Dept. 33-I
HIGHEST QUALITY MICROPHONES—FIXED-STATION AND MOBILE

Circle 70 on Inquiry Card

New Tech Data

(*Continued from page* 126)

Magnetic Shields

Data sheet 145 illustrates and describes how cascade ray tube magnetic shield costs can be lowered through new simplified designs and construction techniques using non-shock sensitive non-retentive Co-Netic Netic materials. Magnetic Shield Div., Perfection Mica Co., 1322 N. Elston Ave., Chicago 22, Ill.

Circle 251 on Inquiry Card

Oscillator

Data Sheets from Tele-Dynamics, Inc., 5000 Parkside Ave., Philadelphia, Pa., describe the TDI Type 1250A, Voltage-Controlled Oscillator. It is a subminiaturized device for converting information in the form of a varying voltage, into an FM signal. This signal can be applied to a radio transmitter, or mixed with the outputs of other oscillators and transmitted to a remote receiving location. Also available are data sheets describing the Type 4000B PAM and Type 4000 A PDM Dataplexers, mechanical commutators designed for high level electronic commutation.

Circle 215 on Inquiry Card

Measuring System

A 4-page, 3-color bulletin, 3018, describing systems that measure or calibrate pressures from Consolidated Systems Corp., subsidiary of Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif. Photos and a block diagram help explain systems for calibration benches, wind tunnel pressure measurement, propellant utilization system exercisers, liquid level control, determination of pressure ratios, ramjet engine testing, and calibration of pressure switches, aneroid barometers, and pressure pickups.

Circle 216 on Inquiry Card

Video System

Bulletin 6-99 describes a master video switching and distribution system, the KIN TEL AVS-X System, used in industrial closed-circuit TV circuits to switch a number of TV viewing monitors. Because the system is of the plug-in modular type, the bulletin contains detailed specs. on each of the individual modular sections. KIN TEL Div., Cohu Electronics, 5725 Kearny Villa Rd., San Diego 12, Calif.

Circle 217 on Inquiry Card

Krypton 85

Form ADC 884, a 4-page brochure, tells what Krypton 85 is, where it is used, why free electrons are necessary to start gas-filled tubes, how it can be obtained, where customers can get the necessary atomic energy commission license, and the federal regulations covering the sale, supply and storage of this radioactive material. Air Reduction Sales Co. Div., Air Reduction Co., Inc., 150 E. 42nd St., New York 17, N. Y.

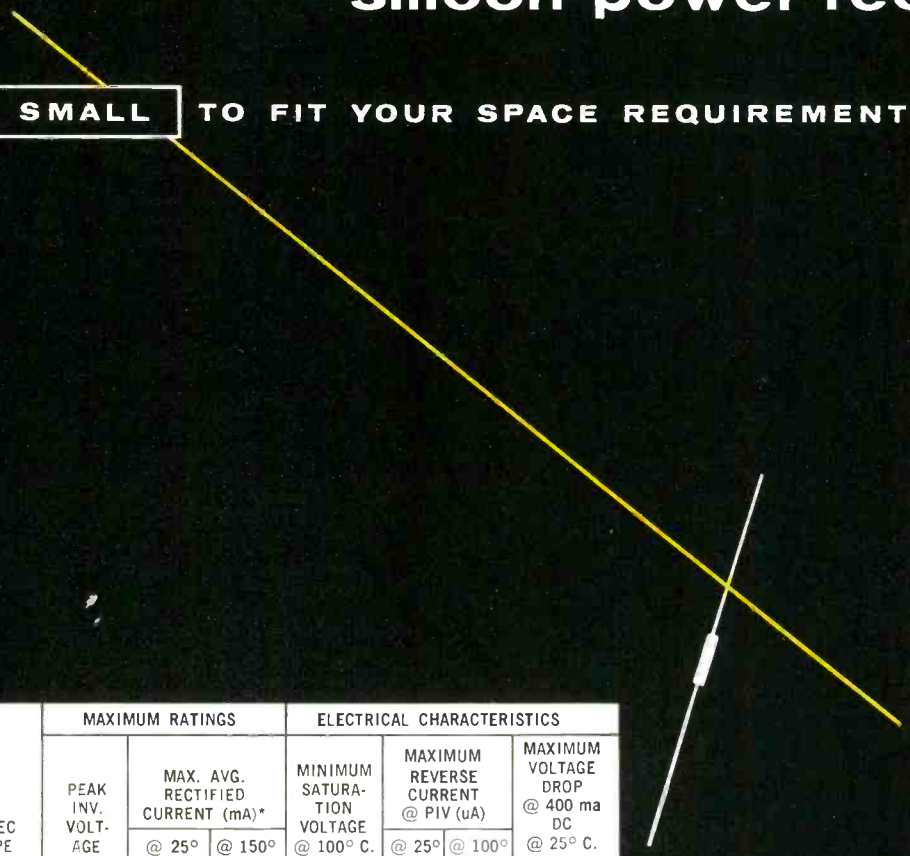
Circle 218 on Inquiry Card

(*Continued on page* 130)

GENERAL INSTRUMENT SEMICONDUCTOR DIVISION

AUTOMATIC MINIATURIZED silicon power rectifiers

SMALL TO FIT YOUR SPACE REQUIREMENTS



JEDEC TYPE NO.	MAXIMUM RATINGS			ELECTRICAL CHARACTERISTICS			
	PEAK INV. VOLTAGE (V)	MAX. AVG. RECTIFIED CURRENT (mA)*		MINIMUM SATURATION VOLTAGE @ 100° C. (VOLTS)	MAXIMUM REVERSE CURRENT @ PIV (uA)		MAXIMUM VOLTAGE DROP @ 400 ma DC @ 25° C. VOLTS DC
		@ 25° C.	@ 150° C.		@ 25° C.	@ 100° C.	
1N645	225	400	150	275	0.2	15	1.0
1N646	300	400	150	360	0.2	15	1.0
1N647	400	400	150	480	0.2	20	1.0
1N648	500	400	150	600	0.2	20	1.0
1N649	600	400	150	720	0.2	25	1.0

*Resistive or inductive load

We've shrunk the size, but not the quality. All the outstanding characteristics and reliability you expect of products from General Instrument Corporation are present in these miniaturized units. Data sheets on these and other Automatic silicon rectifiers are available upon request.

Semiconductor Division
GENERAL INSTRUMENT CORPORATION
65 Gouverneur Street, Newark 4, N. J.

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

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

New Tech Data

(*Continued from page* 128)

Transformer

Two-color data sheet describes a small, 50 w transformer that withstands military environment. Both standard and special units are supplied for filament use, synchro drive, isolation, and plate voltage. Input is 115 v., 400 cycles, single phase. Outputs can be any voltage from 1 to 1000 v. Arnold Magnetics Corp., 4613 W. Jefferson Blvd., Los Angeles 16, Calif.

Circle 241 on Inquiry Card

Power Supplies

Constant current and constant voltage automatic switchover regulated power supplies are described in Bulletin HVVC-95. These supplies are available in a wide variety of control configurations and power outputs into the KVA range. Matthew Labs., 3344 Ft. Independence St., New York 63, N. Y.

Circle 242 on Inquiry Card

Ultrasonic Cleaning

A 12-page booklet includes a simplified explanation of the basic principles of ultrasonics, a brief description of the generating equipment and transducers required for ultrasonic cleaning, a discussion of proven applications, and answers to a list of 17 most frequently asked questions about ultrasonics. Circo Ultrasonic Corp., 51 Terminal Ave., Clark, N. J.

Circle 243 on Inquiry Card

Coaxial Choppers

Catalog page gives complete electrical and mechanical specs of the James coaxial choppers that cancel the external effects of shock and vibration. James Vibrapowr Co., 4050 N. Rockwell St., Chicago 18, Ill.

Circle 244 on Inquiry Card

Tetrode Transistors

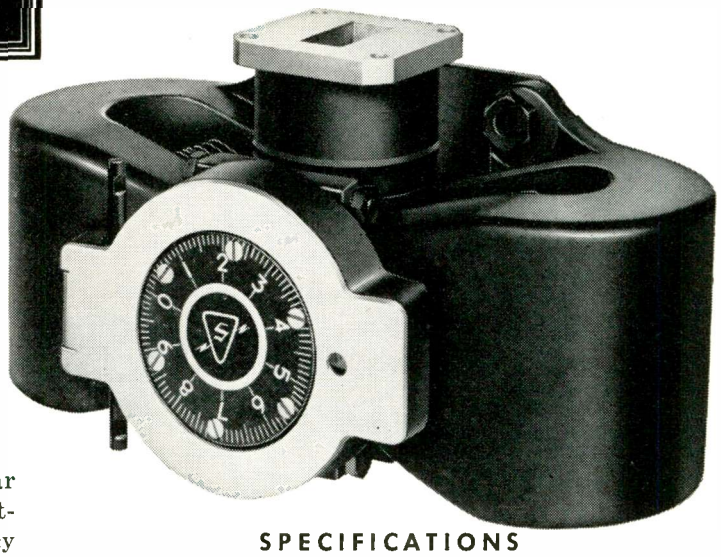
Two new germanium tetrode transistors for industrial and military applications are described in Bulletins GP-222 from General Electric Co., Semiconductor Products Dept., Liverpool, N. Y. These devices, the 3N36 and 3N37, are designed for use as wide band r-f amplifiers, radar i-f amplifiers, and high frequency mixers and oscillators. The 3N36 has an operating range of 30 to 100 MC and the 3N37 is recommended for use in the frequency range from 100 to 300 MC.

Circle 245 on Inquiry Card

Microwave Component News from SYLVANIA

New line of X-band magnetrons, servo-tunable over 1100 mc

M4164, M4193, M4163
cool without special ducts

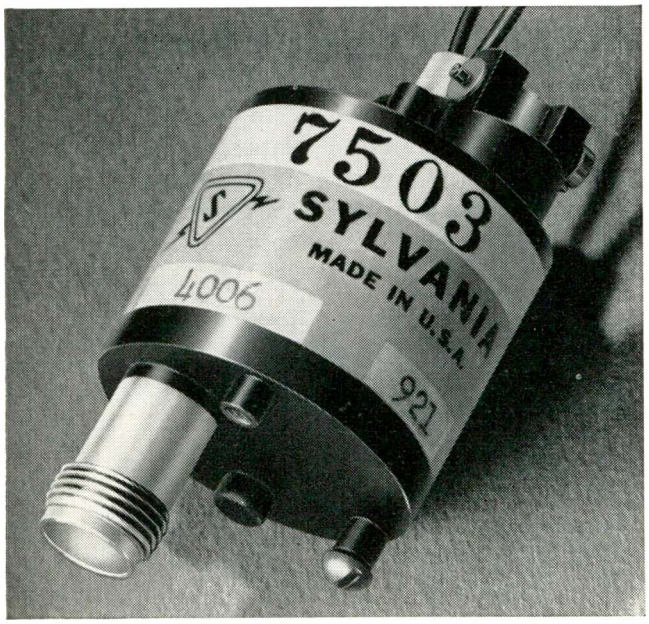


These three rugged new magnetrons, like the familiar 6874 and 7006, feature the same size, accessible mounting points, and high reliability of the fixed-frequency 4J50. The unique tapered-pin tuner, already proven highly successful in severe applications of the 6874 and 7006, has been incorporated in this line. Servo-tuning without a special oversized gear box and no change in outline is available in all five types on request. Easy tuner-dial readability and ruggedness, flexibility of tuner location, and standard through-bolt lug mounting from the top are regular benetfis featured by Sylvania. 1.5 mismatch at full power and atmospheric pressure is made possible by a new window design. Fin placement permits cooling without special ducting.

SPECIFICATIONS

TYPE	FREQUENCY RANGE, MC	AVER. POWER AT 1 US MIN., WATTS	RRV KV/US	STATUS
M4163	8500-9600	190	180	Pilot production
M4164	8500-9600	200	200	Pilot production
M4193*	8500-9600	200	225	Pilot production
6874	8800-9400	190	180	In production
7006	9000-9600	190	225	In production

*Has leading edge mode stability specification.



New ruggedized beacon magnetron delivers 100 watts peak power

Addition of TNC connector improves output

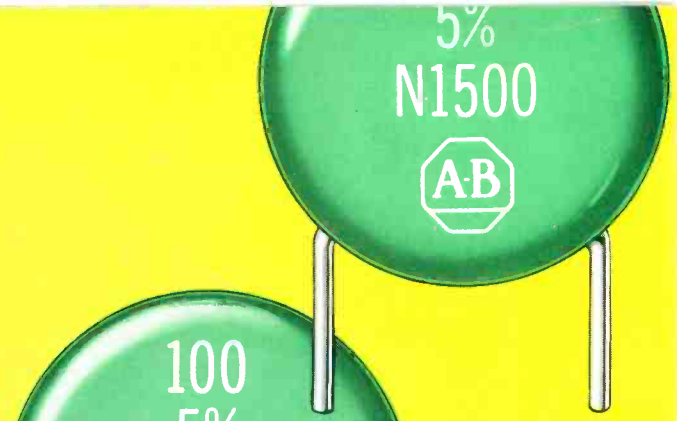
Sylvania type 7503 is a beacon magnetron specially ruggedized for missile applications. An advanced-design version of the 7098, the new tube delivers a minimum peak power of 100 watts and employs a TNC output connector which increases efficiency. Since the connector feeds into a broad-band coupler, it eliminates the need for adjusting for optimum power when the frequency is changed. The tubes withstand a 500 g, 1 millisecond shock. Additional ruggedness has been designed into the mounting bracket and tuner structure to increase the outstanding reliability of the tube.

For more information
write your nearest Sylvania tube sales office or
Sylvania Electric Products Inc.,
Special Tube Operations,
500 Evelyn Ave., Mountain View, Calif.

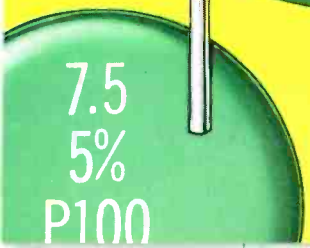
SYLVANIA
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

Circle 75 on Inquiry Card
Circle 76 on Inquiry Card

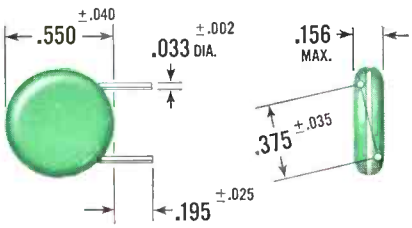
The beauty of this Capacitor is more than skin deep!



A-B QUALITY



ACTUAL SIZE TYPE A CAPACITORS



Allen-Bradley Type A capacitors are available in the most frequently used types and capacitance values.

General Purpose Type in capacitance values from 10 mmf to .01 mmf.

Stable Type in capacitance values from 10 mmf to 0.1 mmf.

Temperature Compensating Type in characteristics from N4700 to P100, and in capacitance values from 10 mmf to 510 mmf.

Type A Capacitor...

One size for all values...

Designed for high speed assembly

Compare the attractive Allen-Bradley Type A ceramic capacitors with all the rest... you'll see instantly why more and more engineers are specifying them and will not accept substitutes —because there aren't any! The exclusive "Auto-Coat" process makes possible—for the first time—a capacitor of real beauty, precise physical uniformity, plus consistent and reliable quality and performance.

The smooth, tough insulating coating and the inherent mechanical uniformity of Type A capacitors permit easy hand or accurate automatic insertion on printed boards. Also, the "Auto-Coat" process prevents rundown on leads—costly wire cleaning and crimping to prevent soldering failures are unnecessary.

For full information on the *superior* physical and electrical properties of A-B Type A capacitors, send for Technical Bulletin 5401.

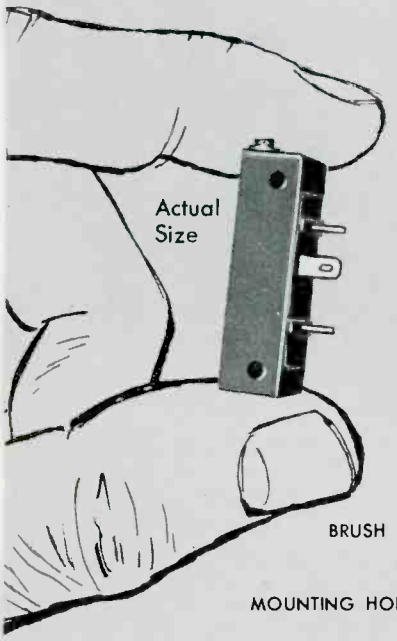
ALLEN-BRADLEY

MEMBER OF EIA

Quality Electronic Components

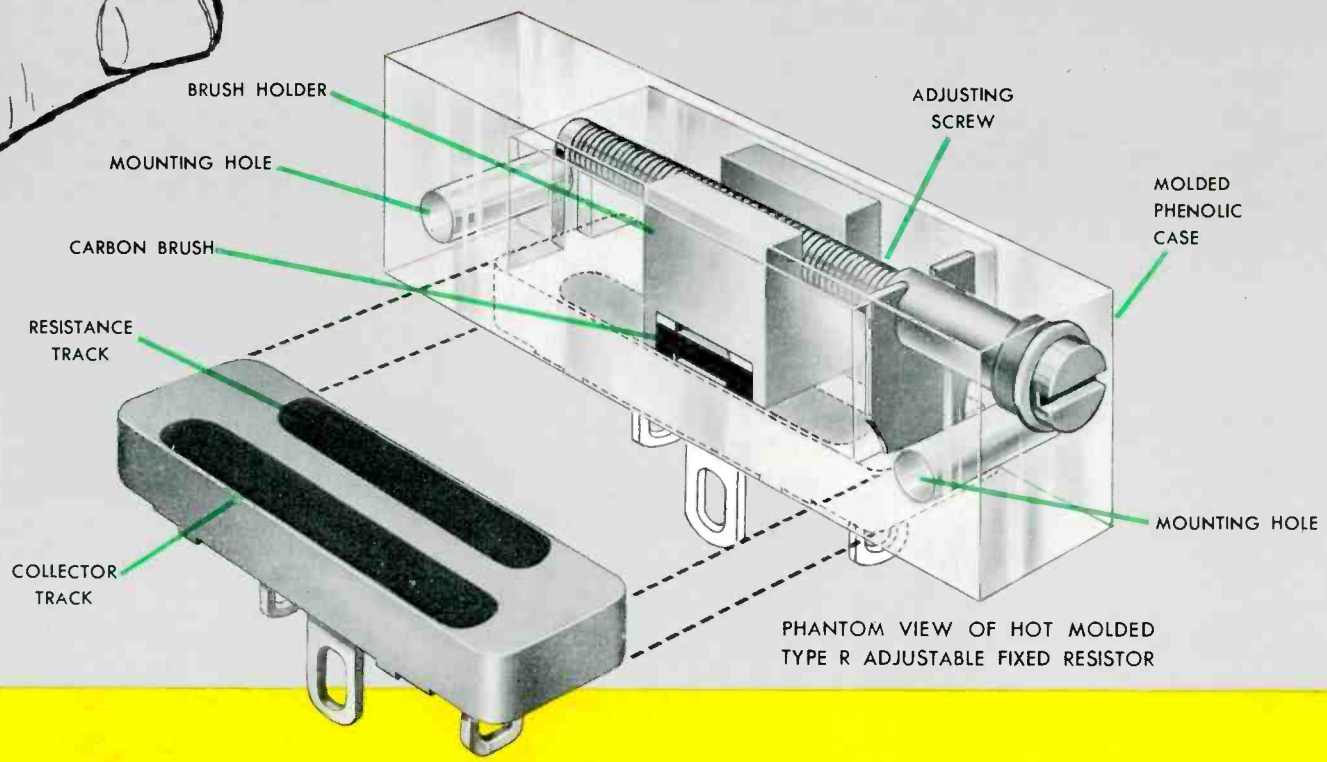
Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

4-59-E



NEW ALLEN-BRADLEY

Adjustable Fixed Resistor



PHANTOM VIEW OF HOT MOLDED TYPE R ADJUSTABLE FIXED RESISTOR

Exclusive hot molded dual track resistance element and carbon brush give unmatched reliability and long life

SPECIFICATIONS

Power Rating: ¼ watt at 70°C ambient

Voltage Rating: 350 volts maximum

Temperature Range: −55°C to 120°C

Resistance Range: total resistance values from 100 ohms to 2.5 megohms ±10% or ±20%

Adjustment: approximately 25 turns

Dimensions: approximately 1¼" x 21/64" x ¼"

Terminals: lug and pin type terminals on 0.1" grid system and are gold plated for ease of soldering.

Here's a new, compact, adjustable fixed resistor—the Type R—with Allen-Bradley's exclusive hot molded resistance element. It's the same type resistance element used in the popular Type J and Type G units . . . which have proved unequaled for reliability and long life. Operation is exceptionally smooth—no abrupt resistance changes occur with adjustment. The molded case of the Type R adjustable fixed resistor is watertight and dust-tight. The mounting for the moving element is self-locking to assure stable setting—and the entire unit can be "potted" after adjusting. The adjustment screw has a "free wheeling" clutch to prevent damage.

Send for complete information on this latest addition to the Allen-Bradley line of *quality* potentiometers.

Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

A-B QUALITY

ALLEN-BRADLEY

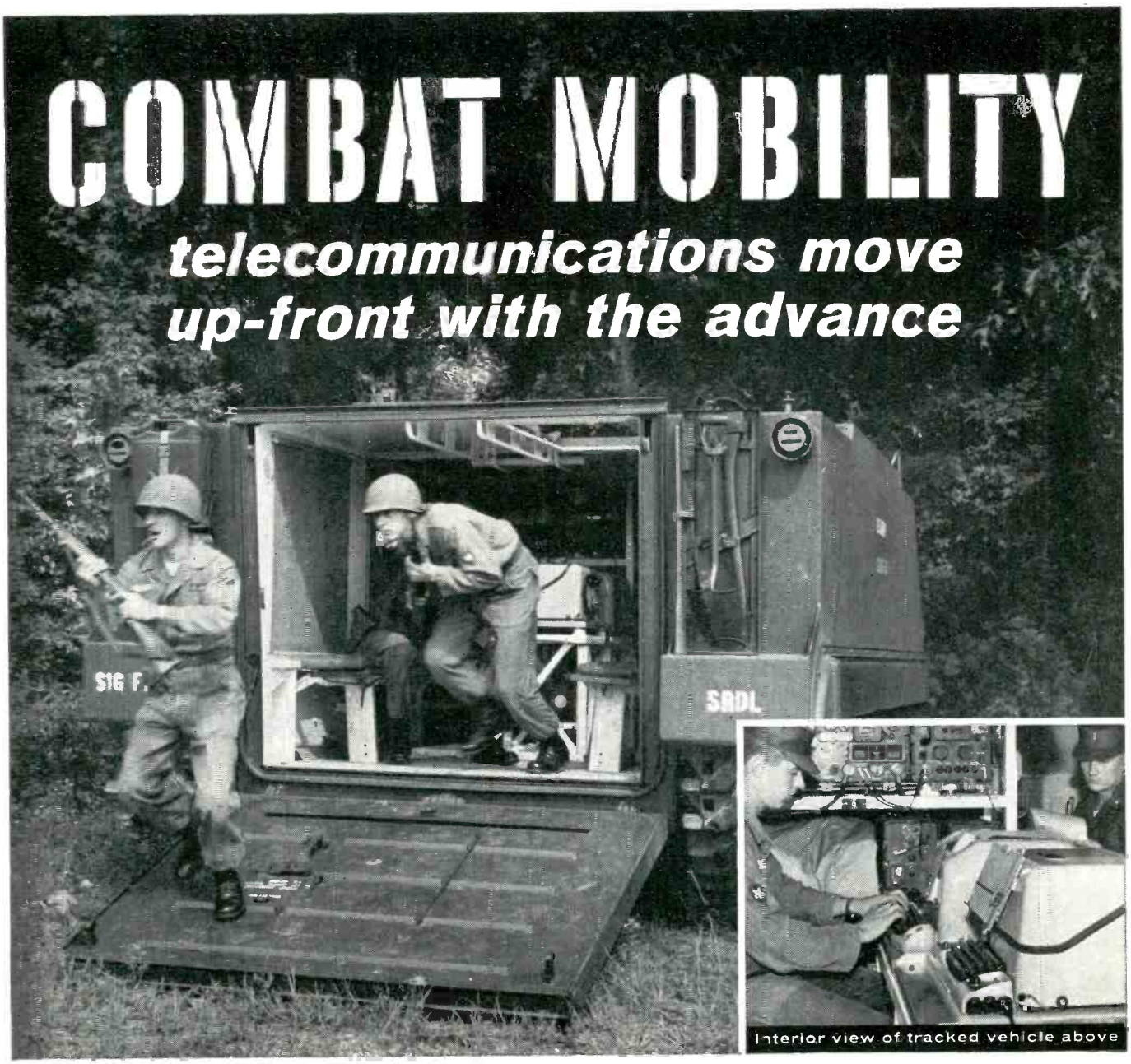
QUALITY

ELECTRONIC COMPONENTS

4-59-E

COMBAT MOBILITY

telecommunications move up-front with the advance



Interior view of tracked vehicle above

Kleinschmidt teletypewriters maintain constant contact, in print, between U. S. Army command and field positions

On the go...bouncing over bunker or beachhead ...Kleinschmidt teletypewriters accurately, efficiently send and receive printed messages. Developed in cooperation with the U. S. Army Signal Corps, these units instantly provide both sender and receiver with identical data...*printed on paper!* In recognition of its quality, Kleinschmidt equipment is manufactured for the U. S. Army under the Reduced Inspection Quality Assurance Plan. This kind of proved experience is now available for unlimited advances in electronic communications for business and industry.

KLEINSCHMIDT

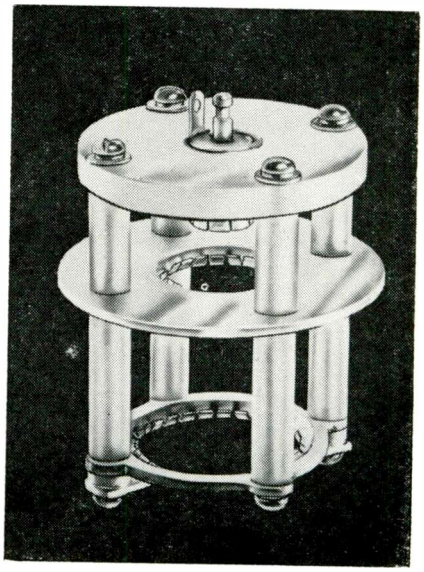
DIVISION OF SMITH-CORONA MARCHANT INC., DEERFIELD, ILLINOIS

Pioneer in teleprinted communications systems and equipment since 1911

New Products

UHF SOCKET

An ultra High Frequency Socket, No. CD-7620, features low capacitance from cathode to ground and from anode to ground, and will accept the General Electric GL-6897 and the

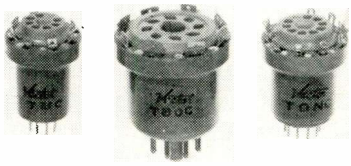


Eitel McCullough 3CX100A5 tubes, among others in the 2C39 series. Rexolite 1422 insulators are employed for their low loss and low dielectric constant characteristics at VHF and UHF. The socket construction prevents undue strain on the tube. Tube is not "clamped" in the socket, but held captive by 2 lugs at the anode end. Jettron Products, Inc., 56 Route 10, Hanover, N. J.

Circle 166 on Inquiry Card

CURRENT TEST ADAPTERS

Current test adapters permit exact tube circuit current measurement in operating equipment without cutting leads or computation. Supplied singly or in a set of 7, 8, and 9 pin types,



the adapters are inserted in the tube socket between chassis and tube. Current readings are made by inserting the provided dual sided test prod in the test tabs. Vector Electronic Co., 1100 Flower St., Glendale 1, Calf.

Circle 167 on Inquiry Card

FREQUENCY STANDARDS

*3⅛" high
400 - 1000 cy.

PRECISION FORK UNIT
TYPE 50

Size 1" dia. x 3¾" H. Wght., 4 oz.*

Frequencies: 240 to 1000 cycles
Accuracies:—
Type 50 (±.02% at —65° to 85°C)
Type R50 (±.002% at 15° to 35°C)
Double triode and 5 pigtail parts required
Input, Tube heater voltage and B voltage
Output, approx. 5V into 200,000 ohms

*3½" high
400 to 500 cy.
optional

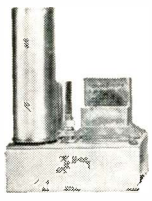
PRECISION FORK UNIT
TYPE 2003

Size 1½" dia. x 4½" H. Wght. 8 oz.*

Frequencies: 200 to 4000 cycles
Accuracies:—
Type 2003 (±.02% at —65° to 85°C)
Type R2003 (±.002% at 15° to 35°C)
Type W2003 (±.005% at —65° to 85°C)
Double triode and 5 pigtail parts required
Input and output same as Type 50, above

FREQUENCY STANDARD
TYPE 2007-6 *NEW*
TRANSISTORIZED, Silicon Type
Size 1½" dia. x 3½" H. Wght. 7 ozs.

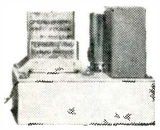
Frequencies: 400 — 500 or 1000 cycles
Accuracies:
2007-6 (± .02% at —50° to +85°C)
R2007-6 (±.002% at +15° to +35°C)
W2007-6 (±.005% at —65° to +125°C)
Input: 10 to 30 Volts, D. C., at 6 ma.
Output: Multitap, 75 to 100,000 ohms



FREQUENCY STANDARD
TYPE 2001-2

Size 3¾" x 4½" x 6" H., Wght. 26 oz.

Frequencies: 200 to 3000 cycles
Accuracy: ±.001% at 20° to 30°C
Output: 5V. at 250,000 ohms
Input: Heater voltage, 6.3 - 12 - 28
B voltage, 100 to 300 V., at 5 to 10 ma.



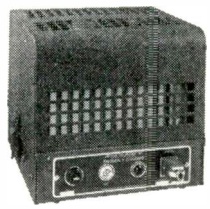
ACCESSORY UNITS
for TYPE 2001-2

L—For low frequencies multi-vibrator type, 40-200 cy.
D—For low frequencies counter type, 40-200 cy.
H—For high freqs, up to 20 KC.
M—Power Amplifier, 2W output.
P—Power supply.

FREQUENCY STANDARD
TYPE 50L

Size 3¾" x 4½" x 5½" High
Weight, 2 lbs.

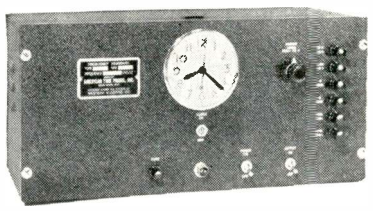
Frequencies: 50, 60, 75 or 100 cycles
Accuracies:—
Type 50L (±.02% at —65° to 85°C)
Type R50L (±.002% at 15° to 35°C)
Output, 3V into 200,000 ohms
Input, 150 to 300V, B (6V at .6 amps.)



FREQUENCY STANDARD
TYPE 2005

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

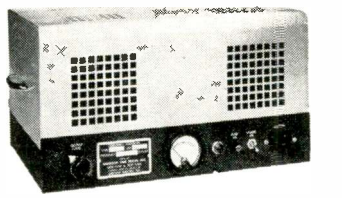
Frequencies: 50 to 400 cycles (Specify)
Accuracy: ±.001% from 20° to 30°C
Output, 10 Watts at 115 Volts
Input, 115V. (50 to 400 cycles)



FREQUENCY STANDARD
TYPE 2121A

Size
8¾" x 19" panel
Weight, 25 lbs.

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



FREQUENCY STANDARD
TYPE 2111C

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

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

This organization makes frequency standards within a range of 30 to 30,000 cycles. They are used extensively by aviation, industry, government departments, armed forces—where maximum accuracy and durability are required.

WHEN REQUESTING INFORMATION
PLEASE SPECIFY TYPE NUMBER

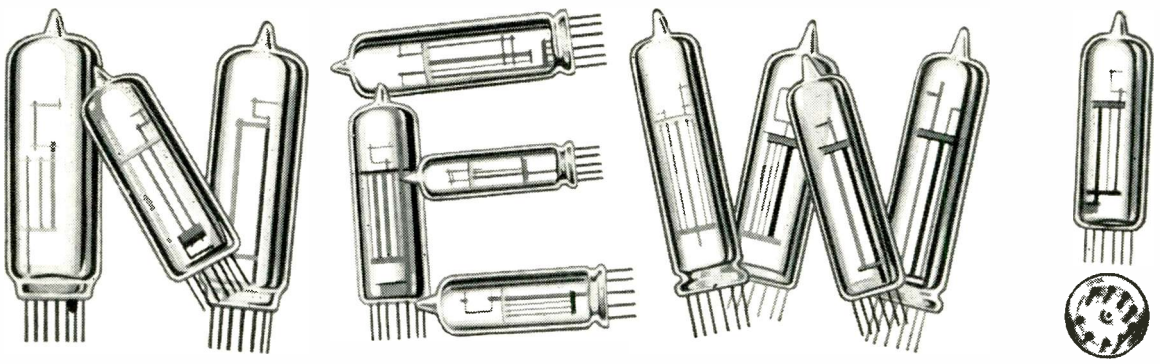
American Time Products, Inc.

Watch Master
Timing Systems

Telephone: PLaza 7-1430

580 Fifth Ave., New York 36, N. Y.

Circle 79 on Inquiry Card



More top-quality tubes from

Sonotone® CORP.

TUBE DIVISION, DEPT. TC-99, ELMSFORD, N. Y.

- Complete line of miniature and subminiature tubes for all purposes.
- Featuring many hard-to-get European types!
- Each tube tested and guaranteed for highest quality by Sonotone!
- Sonotone tube production has qualified for the U. S. Signal Corps Reduced Inspection Quality Assurance Program (RIQAP).
- Feature Sonotone for customer satisfaction, top profits!

CHECK THE BIG SONOTONE SELECTION NOW

1AJ4	6AX4GT	6K6GT	35DZ8	ECC85/6AQ8
1B3GT	6BL7GTA	6N8	35W4	ECF82/6U8
1L4	6BM8	6S4A	50BM8	ECH81/6AJ8
2AF4A	6BQ5	6SN7GTB	50C5	ECL80/6AB8
2AF4B	6BQ6GTB/6CU6	6T8	5928-6267	ECL82/6BM8
3AF4A	6BQ7A	6U8	7025	EF80/6BX6
3V4	6BR5	6V4	0Z4	EF85/6BY7
5AR4	6BX6	6W4GT	DC90	EF86/5928-6267
5J6	6BY7	9AQ8	DF96/1AJ4	EF89/6DA6
5U4GB	6BZ7	9DZ8	DK92/1L4	EL34/6CA7
6AB4	6CA4	12AT7	DL94/3V4	EL84/6BQ5
6AB8	6CA7	12AU7	EAA-EB91/6AL5	EL95
6AF4	6CB6	12AU7A	EABC80/6T8	EM80/6BR5
6AF4A	6CG7	12AX7	EBC91/6AV6	EM84/6FG6
6AJ8	6DA6	12AX7A	EBF80/6N8	EZ80/6V4
6AL5	6DC8	12BA6	EBF89/6DC8	EZ81/6CA4
6AN8	6DZ8	12BE6	EC92/6AB4	GZ34/5AR4
6AQ8	6FG6	12SN7GT	ECC81/12AT7	PCC85/9AQ8
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International Electronic Sources

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ANTENNAS, PROPAGATION

Ferromagnetic Aerials for Distress Transmitters, G. Ziehm. "El Rund." June 1959. 6 pps. In special circumstances ferromagnetic aerials are more suitable for transmitters than electric rod aerials, e.g., if shipwrecked persons wish to bring themselves to the notice of their helpers. Advantages: the ferrite aerials can be directly installed in the transmitter housing; alterations of the ambient conditions e.g. splashing the aerial by sea water, have less effect on a magnetic aerial than on an electrical one; the efficiencies of modern ferrite aerials are quite comparable with those of electrical aerials for such purposes. (Germany.)

The Correct Design of the Input End of Wideband Antennas, H. Meinke. "Nach Z." June 1959. 5 pps. The effect of the shape of the input zone on the impedance of an antenna is illustrated and treated quantitatively. (Germany.)

Design of "Optimum" Arrays for Direction-Finding, N. F. Barber. "E. & R. Eng." June 1959. 11 pps. (England.)

CIRCUITS

On a Class of Nonstationary Random Process Filtering, L. A. Boguslavsky. "Avto. i Tel." June 1959. 13 pps. The method of designing circuits of generalized non-shifting filtering of a random process is described. (U.S.S.R.)

Calculations and Measurements for an Optimum Design of a Low Noise Transistor Amplifier, K. Spindler. "Nach Z." May 1959. 7 pps. The relationship of the "white" noise factor as a function of generator impedance RG and emitter current IE in transistors is used to derive values for which the noise factor becomes a minimum. Furthermore, equations for the most favorable combination of both parameters and the appropriate absolutely minimized noise factor are quoted. (Germany.)

Signal-to-Noise Ratio and Dead Time of a Scintillation Counter, J. A. W. van der Does de Bye. "Phil. Tech." 20-9. 8 May 1959. 6 pps. The ratio between the height of scintillation pulses corresponding to a certain absorbed energy and the discriminator level at which no more than e.g. one noise pulse per second is counted, the "signal-to-noise ratio," depends on the decay constant of the scintillation effect, on the time constant of the anode circuit of the photomultiplier tube and on the frequency response of the amplifier. (Netherlands, in English.)

Low-Noise and Low-Output-Resistance Electronic Voltage-Regulators, G. Giachino. "Alta. Freq." Feb. 1959. 20 pp. A critical review of the parts composing the regulator main circuit is followed by an exemplifying resolution for a 150 v output voltage. From these results a calculation of the output impedance versus frequency is carried out in order to explain some possible improvements on the first circuit. (Italy.)

A procedure for Tuning a Bridge Stabilized Oscillator, M. Boella. "Alta. Freq." Feb. 1959. 7 pps. A method is described for tuning the r.f. transformers of a bridge stabilized oscillator of the Meacham type. The method has effected a considerable improvement in adjusting such oscillators for maximum stability. (Italy.)

Analysis of a Direct Coupled Astable Transistor Multivibrator, T. S. K. V. Iyer. "J. ITE." March 1959. 5 pps. Two grounded-emitter transistor amplifiers coupled capacitatively to each other work as an astable multivibrator which is similar to the free running plate coupled vacuum tube multivibrator. If one of the couplings is direct, under certain conditions, the system works as an astable multivibrator. (India, in English.)

The Modulator as a Phase Detector, A Note on the Error Due to a Finite Switching Voltage Applied to a Shunt Modulator, W. Fraser and R. E. Schemel. "El Eng." June 1959. 2 pps. Errors occur in the indication of a rectifier modulator when used as a phase detector if the switching voltage is not very much larger than the signal. (England.)

The Design of Balanced Amplifiers Using Components of Commercial Tolerance, D. J. Dewhurst. "El Eng." June 1959. 3 pps. Although many circuits intended to compensate for the use of commercial tolerance components in balanced amplifiers have been published, it is usually found that best results are obtained by the use of accurately matched pairs of components. (England.)

The Design of Biased Diode Function Generators, C. C. Ritchie and R. W. Young. "El Eng." June 1959. 5 pps. The design of biased diode function generators is considered and equations are derived relating the number of diode sections, the minimum error obtainable, and the spacing of the diode section to give this minimum error. (England.)

An Electronic Timer with Voltage Control of Setting, R. Gladstone. "El Eng." June 1959. 2 pps. This timer (which is believed to be new in principle) is a development of the creeping cathode-follower, or Bootstrap circuit. The difference lies in providing a power drive to the grid, to give a constant but easily adjustable rate of change over the full operating grid control range of the valve. (England.)

Network Characteristics; Source Resistance, Network Structure and Transfer Functions, J. T. Allanson. "E. & R. Eng." June 1959. 5 pp. (England.)

REGULARLY REVIEWED

AUSTRALIA

AWA Tech. Rev. AWA Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers

CANADA

Can. Elec. Eng. Canadian Electronics Engineering
El. & Comm. Electronics and Communications

ENGLAND

ATE J. ATE Journal
BBC Mono. BBC Engineering Monographs
Brit. C.&E. British Communications & Electronics
E. & R. Eng. Electronic & Radio Engineer
El. Energy. Electrical Energy
GEC J. General Electric Co. Journal
J. BIRE. Journal of the British Institution of Radio Engineers
Proc. BIEE. Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

Ann. de Radio. Annales de Radioelectricite
Bull. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Onde. L'Onde Electrique
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El Uber. Archiv der Elektrischen Ubertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electroakustik
NTF. Nachrichtentechnische Fachberichte
Nach. Z. Nachrichtentechnische Zeitschrift
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Arch. Auto. i Tel. Archiwum Automatyki i Telemechaniki
Prace ITR. Prace Instytutu Tele-I Radiotechnicznego
Roz. Elek. Rozprawy Electrotechniczne

USSR

Avto. i Tel Avtomatika i Telemakhanika
Radio. Radio
Radiotek. Radiotekhnika
Rad. i Elek. Radiotekhnika i Elektronika
Iz. Acad. Bulletin of Academy of Sciences USSR.

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International ELECTRONIC SOURCES

Axiom on Transactors, Gerald E. Sharpe. "ATE J." Jan. 1959. 11 pps. The paper begins with a plausible discussion of the general, stable, active four-pole. The activity may be ascribed to one particular part of the four-pole and can be shown actively to relate voltage and current. This encouraged the author to define an "electromagnetic action," which in turn may be linked with the concept of a dual set of ideal active or transactor elements. These elements are defined and discussed and it is shown that only elements having real transfer immittance need be considered fundamental. (England.)

Overloading Effects with Cathode Compensation. "E. & R. Eng." June 1959. 3 pps. (England.)

COMMUNICATIONS

The Practical Effects of a Statistical Definition of the Peak Busy Hours on the Planning and Supervision of Telephone Systems, R. Bottger. "Nach Z." May 1959. 5 pps. Numerous measurements have confirmed the opinion, this the statistical definition of the peak busy hour suits the random character of telephone traffic. Planning as well as supervision are greatly simplified by this method. (Germany.)

Tendencies of Development Work in Radio Engineering, with a Particular View to an Increased Application of Single Sideband Techniques, E. Frommer. "Nach Z." May 1959. 11 pps. A summary of the papers on an increased application of single sideband techniques published in the December 1956 issue of the Proceedings of the Institute of Radio Engineers (special copy). (Germany.)

Tests Relating to the Improvement of the Intelligibility of Speech in the Presence of Noise, O. Brosze, K. O. Schmidt, and A. Schmoldt. "Nach Z." June 1959. 4 pps. The intelligibility of syllables is greatly reduced during a transmission of speech when strong noise voltages are present at the same time. (Germany.)

The Telegraphy Distortions and the Frequency of Errors in VF-Telegraphy Due to Interruptions and Phase Jumps, H. Zuhrt, W. Reger, and W. Vollmeyer. "Nach Z." June 1959. 7 pps. Interferences which may lead to distortions or errors can be produced in VF-telegraphy channels when a basic pair of lines for VF-telegraphy suffers from interruptions without phase jumps or when phase jumps occur during a change-over of VF generators. (Germany.)

Telecommunications Equipment for the Defense Services, J. L. Marks. "Proc. AIRE." March 1959. 5 pps. This review outlines the differences that exist between commercial and Defense Service Type telecommunications equipment. It describes the relevant specifications governing general requirements, deals with climatic and durability testing, the methods of quality control and the various stages of design, development, prototype testing and production. (Australia.)

Developments in Automatic Trunk Telephony in France, R. Croze and A. Blanchard. "J. UIT." April 1959. 6 pps. (France.)

Some Operational Problems Regarding International Semi-Automatic Telephone Circuits, H. Zdziech and J. Dunin. "J. UIT." May 1959. 2 pps. (France.)

A Multiple Channel D.C. Recording System, H. D. Scott. "El Eng." June 1959. 5 pps. An amplitude modulation multiple carrier system has been designed to permit the tape recording of electrical signals in the range dc to 10c/s inclusive. Up to 12 independent data signals, a voice channel, and timing signals may be accommodated on a conventional single track portable magnetic tape recorder. (England.)

A Miniature Electroencephalograph Telemeter System, D. C. Gold and W. J. Perkins. "El. Eng." 3 pps. A telemeter system is described which enables the electrical activity of the brain of a normal free and unrestrained cat to be recorded. The voltage picked up by an electrode fixed into the skull is amplified sufficiently to modulate a transmitter carried on the cat's back. The transmissions are received and applied to a cathode-ray display unit or a tape recorder. (England.)

On Asymmetric Information Channels, R. B. Banerji. "J. Bire." May 1959. 4 pps. In the present paper, the capacity of asymmetric channels has been studied in terms of the probability of the possible errors. The theory sheds interesting light on pulse code modulation using ampliture keying. (England.)

A Quality-Checking Receiver for V.H.F. F.M. Sound Broadcasting. "BBC Mono." #25, June 1959. 11 pps. The development of a quality-checking receiver for VHF FM sound broadcasting is described. The results of tests on the original and final prototype models are given; both have a high standard of performance, the main advantage of the final model being its simpler design. (England.)

An Out-of-Band Pulse Code Signalling System, P. D. Wright, "ATE J." Jan 1959, 18 pps. The various methods of out-of-band signalling suitable for transmission over trunk circuits are outlined and the system using out-of-band coded impulses is described in detail. (England.)

The A.E.E. Electronically Controlled Crossbar System Type 5004, J. F. Denby. "ATE J." Jan. 1959. 28 pps. The principles of the system are described after some general remarks about the Strowger Works installation. (England.)

COMPONENTS

Transient and Frequency Responses of Differential Phase-Sensitive Detectors with R-C Load, V. I. Anisimov. "Avto. i Tel." June 1959. 9 pps. The method of calculating transient and frequency responses of differential phase-sensitive detectors with R-C load is considered. An equivalent circuit of the detector is given. Calculation of the output voltage ripple factor is described. (U.S.S.R.)

Electrical Elements Winding Limiting Sizes, S. P. Kolosov. "Avto. i Tel." June 1959. 5 pps. There is considered possibility of reducing sizes of electrical elements windings by increasing their overheat. It is stated that the sizes under consideration may be reduced to only quite definite minimum due to the effect of resistance temperature coefficient. (U.S.S.R.)

Use of Hall-Elements as Phase-Sensitive Detectors, V. N. Bogomolov and V. A. Mjasnikov. "Avto. i Tel." June 1959. 9 pps. The operation of the phase-sensitive detectors based on the Hall-effect is analyzed. Some principal relations are derived. The simple graphical method is suggested for proper choice of the elements to compensate the dependence of the Hall-element parameters on the surrounding temperature. The experimental data for three difference phase-sensitive detectors are presented. (U.S.S.R.)

Transients on Relay Contacts and Microrectifiers and Their Influence on a Special Telephone Circuit, S. Loly. "Alta Freq." Apr. 1959. 22 pps. The author starts with a research on some irregularities noted in a special telephone circuit referring them to transients occurring in the contacts of the relay (vibrations) and in the microrectifiers used in the circuit. The latter transients are partly due to capacity-leakage of the rectifiers, partly to the fact that some over-voltage at the opening of the current-flow through inductive coils widely overcomes the locking voltage which the rectifiers are able to withstand. (Italy.)

On the Stability of Negative Differential Resistors, L. Piglione. "Alta. Freq." Feb. 1959. 12 pps. The stability of negative differential resistors and their static characteristic configurations are put into relation. The method is a general one and no models of representation are considered. A specified condition of stability as well as its experimental results are also given. (Italy.)

Use of a Differential Transformer in Resistance Measurements at High Frequencies, B. Lavagnino and B. Alby. "Alta Freq." Apr. 1959. 14 pps. Resistance measurements of wires in acoustic and ultra-acoustic frequencies ranges may be performed by means of the differential transformer, properly worked. (Italy.)

COMPUTERS

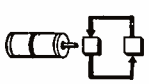
On Error of Linear Interpolator for Programme-Control Digital Device, V. V. Karibsky. "Avto. i Tel." June 1959. 8 pps. Operation of digital linear interpolator is described. Interpolation error is analyzed. General relation for the error is given. Maximum absolute error is determined. (U.S.S.R.)

Study of Algebraic Equations on Analog Computers, V. M. Elyasberg. "Avto. i Tel." June 1959. 6 pps. A simple method of solution of algebraic equations on analog computers is described. The method is based on plotting certain functions as a result of solving determinative differential equation and allows to find real and imaginary roots of n-order polynominal. (U.S.S.R.)

Selftesting Technique in Electronic Computers, F. Rausch. "El Rund." June 1959. 5 pps. With the growth of data processing numerous testing methods for monitoring single operations and data flow have been developed. Prerequisites for automatic error finding are given and a block diagram of a circuit for monitoring data flow, the checking of calculation operations and control as well as the possibility of correction being applied are briefly dealt with. (Germany.)

Magnetic Core Matrices for Logical Functions, A. L. Freedman. "El Eng." June 1959. 4 pps. The general principle of a method for performing logical functions using matrices of magnetic cores having a square hystersis loop is explained. (England.)

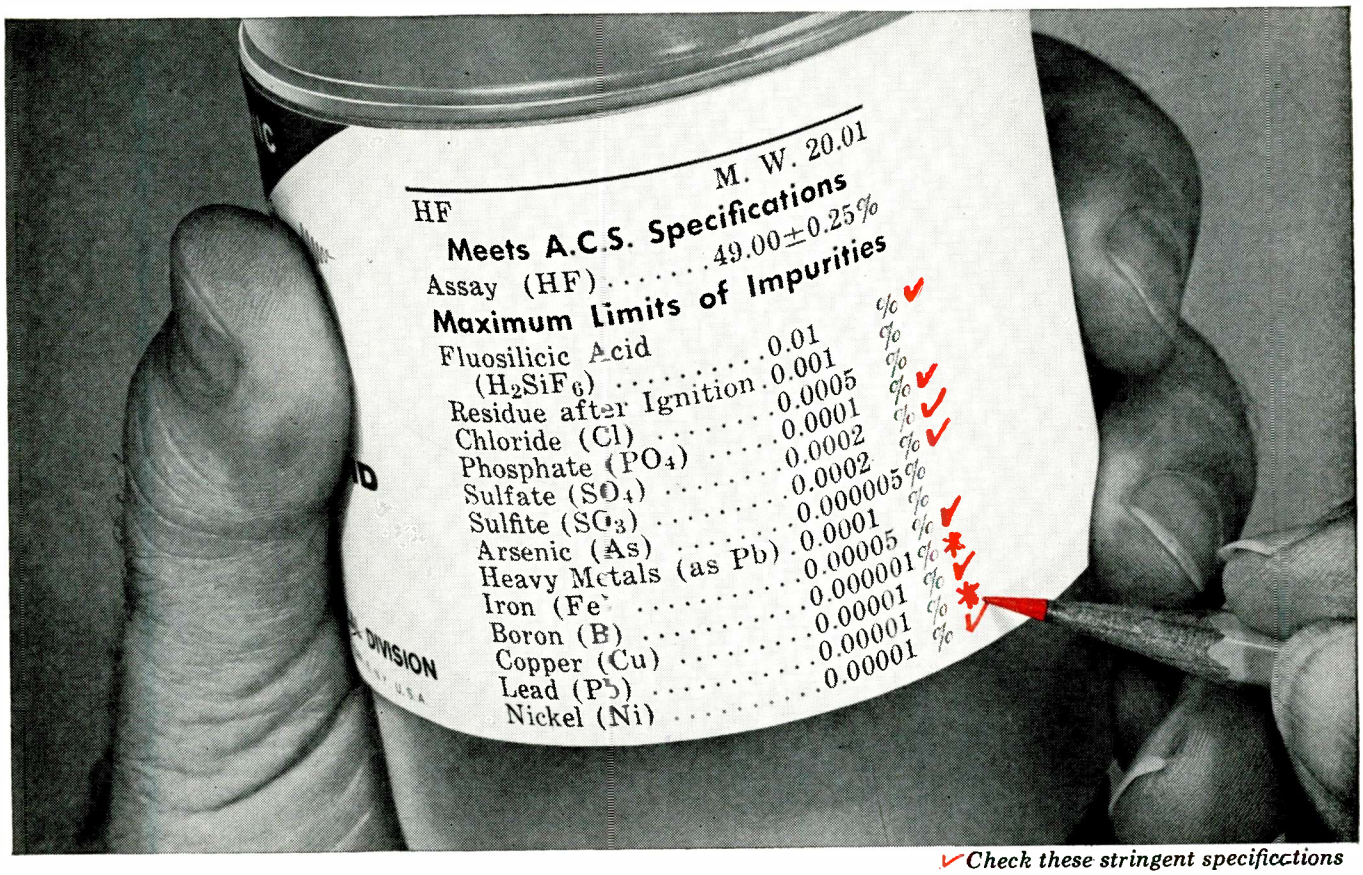
A Versatile Clock System for Setting-up and Testing Magnetic Drums, J. S. Arnold and D. L. Hood. "ATE J." Jan. 1959. 13 pps. The clock system described is a laboratory tool for setting and testing magnetic drums. Its particular quality is its adaptability to function with drums of widely differing specifications. (England.)



CONTROLS

Synthesis of Servosystem Compensation Devices with Noise, P. S. Matveev. "Avto. i Tel." June 1959. 8 pps. Results of (3, 4) are generalized for the case when an input is applied to two elements of a servosystem and for automatic stabilization systems as well. Examples illustrate the method described. (U.S.S.R.)

On Synthesis of Impulsive Compensation Devices of Servosystems, A. R. Krasovsky. "Avto. i Tel." June 1959. 11 pps. Optinum distributions of closed loop servosystems weighting coefficients are determined in the cases both of a slowly changing useful signal with the arbitrary stationary random noise and of the stationary random useful signal. Formulae



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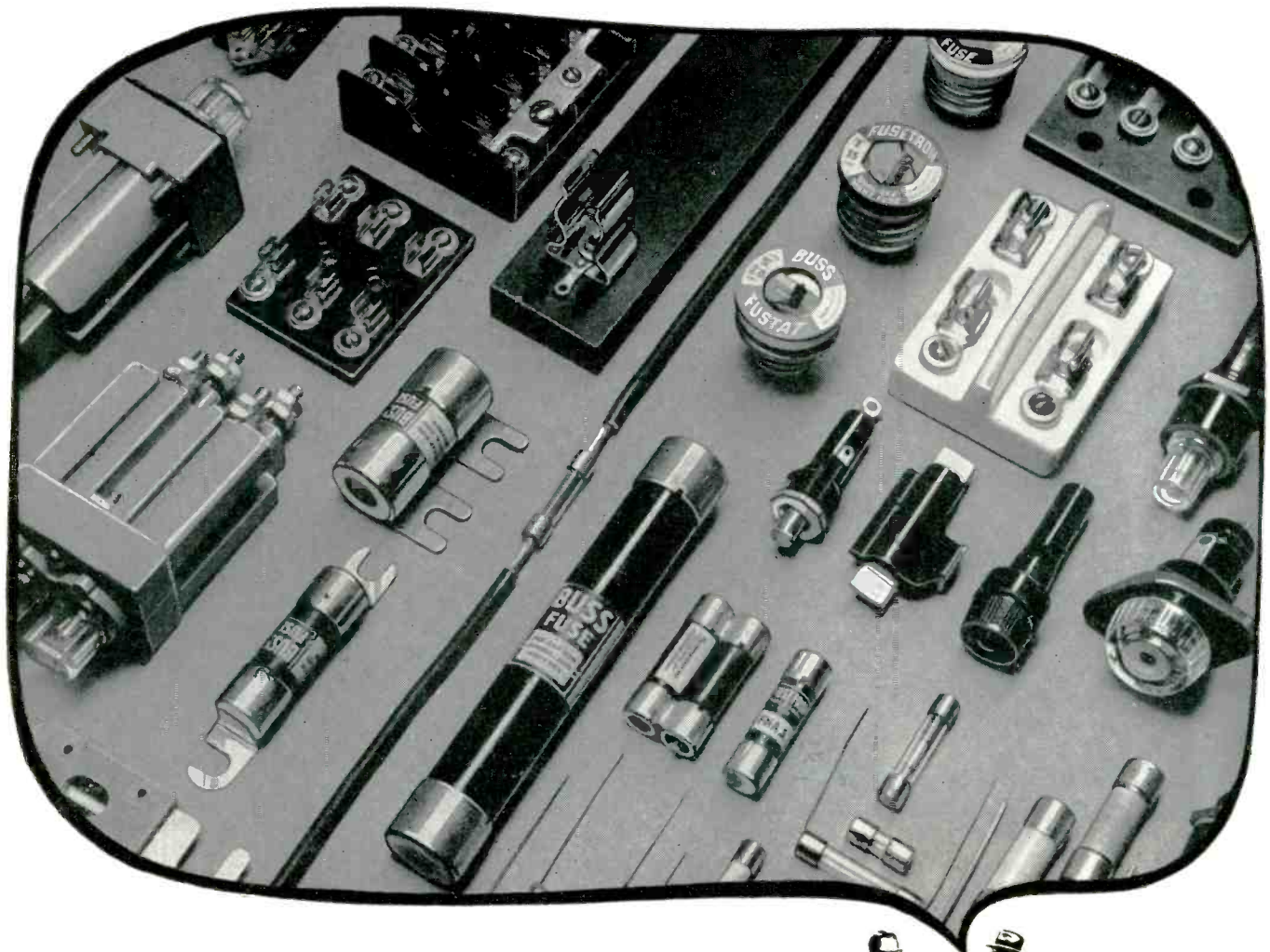

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are deduced for linear descrete compensation device coefficients corresponding to given closed-loop servosystems weighting coefficients. (U.S.S.R.)

Significance of Stability Criteria of Automatically Controlled Excitation in Synchronous Machine with Lost Motion, L. V. Tsukernik. "Avto. i Tel." June 1959. 8 pps. Synchronous machines with lost motion are analyzed when they perform parallel and are not connected with the whole power system. Stability of automatically controlled excitation in such machines is considered as necessary but not sufficient condition of the system stability. (U.S.S.R.)

Concerning Stability Problem of Nonlinear Control Systems, E. N. Rozenwasser. "Avto. i Tel." June 1959. 6 pps. There are mentioned some facts that allow to widen the field of application of the method which A. I. Lourie proposed for analysis of controlled system stability. (U.S.S.R.)

On Some Simplified Criteria of Nonlinear Control Systems Stability, A. K. Bedelbaev. "Avto. i Tel." June 1959. 13 pps. Some simplified criteria of nonlinear control systems stability are described. (U.S.S.R.)

Direct Current Synchros, D. J. Cole. "Proc. AIRE." April 1959. 3 pps. There are many applications in which torque amplification as well as accurate angular positioning are required. AC Synchros need to be operated in conjunction with a servo-mechanism in order to obtain torque amplification. To find a simpler solution several dc synchro systems are investigated. (Australia.)

Fluctuations in dc Output of Tachometer Generators and Their Influence on Automatic Controls, M. Pauer. "rt." June 1959. 4 pps. The various causes of this noise voltage are discussed, with a view to finding a basic for the design of suitable filter arrangements. The measures to minimize these oscillations are pointed out. (Germany.)

The Influence of Derivatives of the Controlled Condition in Control Loops with Statistical Disturbance, M. Mesarovic. "rt." June 1959. 6 pps. In this article the author has made use of the spectral density to calculate the optimum controller setting for disturbance patterns frequently occurring in practice by the method of minimizing the mean square error. (Germany.)

How the Influence of the Dead Time on the Dynamic Properties of Non-Linear Impulse-Regulated Control Systems Can Be Eliminated, Ja S. Zypkin. "rt." June 1959. 3 pps. Dead time may have a strongly unfavorable influence on the dynamic properties of impulse-regulated control systems. This contribution describes two methods which enable this influence to be reduced by compensation so that, compared to the same system without dead time, the corrective action is but delayed by a constant time. (Germany.)

Semigraphical Method of Calculating Characteristics of Throttling Control of Induction Motor with Massive Steel Rotor, O. B. Rosenbauli and R. N. Rodin. "Avto. i Tel." June 1959. 6 pps. The paper deals with the semigraphical method of calculating characteristics of throttling control of induction motor with massive steel rotor. An example of plotting characteristics mentioned is given. (U.S.S.R.)

GENERAL

Traffic Regulation with Microwave Relay and Television. "El Rund." June 1959. 3 pps. The increasing number of motor cars puts an ever increasing demand on good traffic regulation. For the continuous monitoring of exceptionally busy junction, television over cable has been in use for some time. (Germany.)

Modern High Frequency Generators for Welding of Thermoplastics, K. H. Knobbe. "El Rund." June 1959. 6 pps. Nowadays high frequency is used more and more for the welding of thermoplastics especially by high frequency generators. After a short explanation of the fundamentals of dielectric heating electrical and mechanical problems are discussed in the design of high frequency generators. (Germany.)

A New High Resolution Interferometer for Solar Studies, M. R. Kundu." March 1959. 9 pps. (India, in English.)

An Electronic Speech Sampler for Studying the Effect of Sample Duration on Articulation, Richard Fatehchand and Rais Ahmed. "J. ITE." March 1959. 3 pps. (India, in English.)

Tropicalization of Communication Equipment in India, S. Srinivasan. "J. ITE." March 1959. 5 pps. (India, in English.)

Production Planning and Control of Contracts for Electronic Equipment for the Armed Services, R. T. Wilkins. "Proc. AIRE." April 1959. 7 pps. In this article it is intended to examine some of the problems which confront management of the electronic industry when engaged in the production planning and control of Commonwealth contracts for electronic equipment for the Armed Services. (Australia.)

The Production of Service Electronic Equipment, H. I. Millar. "Proc. AIRE." April 1959. 6 pps. For armed service equipment manufacture, the customer has a say in planning and production procedures as well as performance of the complete equipment. Specifications are written to the Service Departments to cover their precise requirements. (Australia.)

The Reliability of Electronic Equipment, S. R. Bickerdike. "Proc. AIRE." March 1959. 5 pps. This paper draws attention to the need to improve the reliability of electronic equipment and the necessity for reliability to be considered as a design parameter in the evolution of new equipment. (Australia.)

The Practical Approach to the Improvement of the Reliability of Electronic Equipment, A. Jacoby. "Proc. AIRE." March 1959. 12 pps. During and after World War II, the increase in the amount and complexity of electronic equipment made it imperative to improve reliability. This requires careful collection of performance data, analysis of the data to obtain a precise measure of reliability, followed by appropriate action to improve the design, manufacture and maintenance of the equipment. (Australia.)

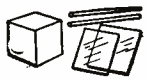
Recent Advances in Potted and Printed Circuits, H. G. Manfield. "J. Bire." May 1959. 14 pps. The various potting resins are described in relation to the variation of properties with different proportions of hardener and the effects on the parameters of the potted components. (England.)

Current and Field Stabilization of the 9-kw Electromagnet of the A.E.I. Magnet Spectrograph, R. Bailey and E. C. Fellows. "J. Bire." May 1959. 13 pps. The dc generator, which supplies power to the magnet, is converted into a low noise, high power, wideband amplifier which can be incorporated into the current stabilizing loop without excessive phase shifts. (England.)

The Temple Mills Marshalling Yard of British Railways. "Brit. C&E." July 1959. 2 pps. Modern communication facilities and Doppler radar techniques help to make Temple Mills an outstanding example of up-to-date railway operation. (England.)

Automatic Tracing for Gas Cutting Machines, J. S. Cheverton. "El Eng." June 1959. 4 pps. The equipment described in this article has been designed to obviate the need for guiding a gas cutting machine by hand or the need for expensive metal templates. (England.)

Integration for Engineers—1. "E. & R. Eng." June 1959. 4 pps. (England.)



MATERIALS

A Simple Device to Determine the Flow Resistance of Acoustically Absorbent Materials, Ludwig Muller. "Rundfunk." #3, June 1959. 4 pps. The author mentions a simple method for rapidly testing and selecting acoustically absorbent materials such methods may be based on the measurement of such material constants as have a decisive influence on the degree of absorption. The equipment used for this purpose must be easy to manipulate so that it may be used also in buliding operations. (Germany.)

A High Vacuum Laboratory for Vapor Deposition of Conductors and Dielectrics, C. R. Meissner. "Vak Teck." May 1959. 8 pps. This article describes in detail the vapour deposition plant which has been built by Bell Telephone Laboratories for their own use. (Germany.)

Electron Emission of Materials for Electron Tubes, G. A. Espersen and J. W. Rogers. "Phil. Tech." 20-9. 8 May 1959. 6 pps. Unwanted thermionic emission from electrodes other than the cathode may impair the operation of vacuum tubes. An investigation has been made into the emissive properties of various materials widely used in the construction of electron tubes. Special tubes were built for this purpose, care being taken to ensure that all parts were scrupulously clean. (Netherlands, in English.)

Panel Absorbents for Low Frequency Sound Absorption, N. K. D. Choudhury and M. V. S. S. Kanta Rao. "J. ITE." March 1959. 6 pps. Plywood panel absorbents have been designed and constructed for low frequency sound absorption. These have been tested in the laboratory and in the chamber. The resonant panels vibrating at low audio frequencies show effective absorption in the range 75-300 c./s. Peak absorption occur near the resonant frequency calculated from the theory and the chamber values are in close agreement with those obtained in the laboratory. (India, in English.)

Lead Zirconate Piezoelectric Ceramics, Alan E. Crawford. "Brit. C&E." July 1959. 4 pps. Lead zirconate titanates, modified with suitable additives, show many distinct advantages over barium titanate as a transducer material. The dielectric losses and depolarization are very much improved, and the higher Curie points enable operating temperatures to be considerably increased. These features make lead zirconate ceramics particularly suitable as the active element in acoustic generators. (England.)

MEASURE & TESTING

Initial Production Reliability of Devices, YA. A. Rips. "Avto. i Tel." June 1959. 10 pps. The paper deals with determination of initial production reliability which value is determined by the design peculiarities of the device and by production factors. Analytical relations are deduced for calculating reliability. Dependence of initial production reliability on specification factors of assurance is shown. Effect of additional control is considered. (U.S.S.R.)

Continuous Phase Comparison Between Frequencies, G. Ziro. "Alta Freq." Apr. 1959. 19 pps. The phase shift between two frequency standards gives, as it is known, good information concerning the minute-to-minute and long-term stability of quartz oscillators. For continuous phase comparison of frequency standards, an apparatus capable of accumulating the total phase shift over a period of several days with a resolution of some degrees and the possibility of sign discrimination is required. (Italy.)

Sources

The Oscillographic Recording of the Non-Linear Part of the Phase Characteristic, Lutz-Axel Wegner. "Rundfunk." #3, June 1959. 9 pps. The paper reports upon a new measuring method which makes it possible to record the so-called differential phase characteristic, that is to say, the difference between the actual and the intended linear phase characteristics as a function of the frequency. (Germany.)

A Non-Linearity Test Unit for Broadcast Music Circuits, E. A. Pavel and M. Bidingmaier. "Nach Z." May 1959. 7 pps. A test unit for the measurement of non-linear distortions and for use mainly in broadcast music circuits is described. The single tone method is used for measurements in the lower frequency range while the double tone method is used in the upper frequency range. (Germany.)

The Measurement of Balanced Impedances in the Metric and Decimetric Wavebands, H. Fricke. "Nach Z." May 1959. 6 pps. A symmetrizing network is required between the object under test and the standing wave indicator in those cases where balanced impedances have to be measured with the usual coaxial standing wave indicators. (Germany.)

The Measurement of the Statistical Distribution of the Speech Volume in Telephone Channels, K. Braun and W. Schobel. "Nach Z." June 1959. 6 pps. The paper reports on measurements of the speech volume which have been carried out by the Federal German Post Office in cooperation with Siemens & Halske AG. on a 4-wire circuit for long distance dialing from Munich to Frankfurt. (Germany.)

A Sine-Wave Generator with Periods of Hours, G. Klein and J. M. den Hertog. "El Eng." June 1959. 6 pps. By means of an "inverse-function generator" it is possible to derive a triangular voltage accurately from a sinusoidal one. By applying negative feedback the reverse can also be achieved. Making use of this possibility an ultra-low frequency sine-wave generator was designed for maximal periods of 3½ hours. (England.)

Detectors for Low Energy X-Radiation, A. Long. "J. Bire." May 1959. 15 pps. A general description of Geiger, proportional and scintillation counters is given from the viewpoint of the types useful for low energy detection. (England.)

Pulse and Square-Wave Generators. "E. & R. Eng." June 1959. 9 pps. Some basic circuits for generating rectangular pulses and square-waves are described and the performance obtainable is considered, with reference to commercially-available instruments. (England.)

RADAR, NAVIGATION

Role of British Territories in Atlantic Missile Range, Andrew Everard. "Brit C&E." July 1959. 3 pps. If any British satellite is fired from Cape Canaveral, it will largely be tracked by stations established in British islands in the Caribbean and the Atlantic. This article gives a brief description of the Range and what it is attempting to achieve. (England.)

SEMICONDUCTORS

Applications for the Storing and Switching Transistor, W. Munch and H. Salow. "Nach Z." June 1959. 10 pps. The possible applications for the storing and switching transistor are summarized. The thyratronlike input characteristic permits its use as an electronic switch or for waveform generation. (Germany.)

(*Continued on page* 146)

THE RELAY THAT FLIES

with

THE NEW NIKE

NIKE HERCULES, one of America's newest sentries of the sky, is faster and has a much greater range than the original version — Nike Ajax. Capable of carrying a nuclear warhead, NIKE HERCULES can blast an entire fleet of attacking aircraft.
Among the components selected to serve this prime defense weapon is the RX 1402-9, a special model of the WHEELOCK Series 121 tubular relay built to the customer's specification. The small size, handy shape and mounting arrangements, and wide ranges of coil resistance and sensitivity make the tubular a most attractive choice for many applications. Chances are you will find your requirements fulfilled by one of the many models available from the standard 500 milliwatt Series 120, the sensitive (85 milliwatt) Series 121 or the shorter Series 123. Technical literature on Wheelock's Tubular Relays available on request.

* 1¾" LONG, 15/32" O.D.

Wheelock SIGNALS INC.
LONG BRANCH, N. J.

Sources

Germanium Point Diode for High Switching Speeds. "El Rund." June 1959. 2 pps. After a mention of the internal process of the semiconductor the OA 186 germanium point diode for high switching speed and its curves and properties are dealt with. (Germany.)

Progress with Transistors and Semiconductor Rectifiers, H. Lennartz. "El Rund." June 1959. 7 pps. German industry is catching up on the advantage enjoyed by foreign countries, especially the USA, in the semiconductor field. The advantage is mainly with VHF, UHF and power transistors. (Germany.)

Transistor-Current-Stabilizers, G. Faini and R. Pesaresi. "Alta. Freq." Feb. 1959. 7 pps. A description is made of a transistor-equipped current-stabilizer, into which the emission current of a saturated diode is kept constant by means of a negative feed-back loop including the diode itself. The circuit has been employed in a r.f. mass-spectrometer and in a noise-figure measuring device. Theoretical treatment of the circuit is given together with extensive experimental results. (Italy.)

A Transistor Characteristic Curve Tracer, J. F. Young. "El Eng." June 1959. 7 pps. A Dekatron is used to develop a stepped voltage controlling the base current of the transistor under test. At each step a half sinusoidal voltage is applied to the transistor and the resulting collector current is plotted against voltage on an external oscilloscope. (England.)

Transistorized Pulse Amplifier, J. N. Barry and D. M. Leakey. "E. & R. Eng." June 1959. 8 pps. The article describes the design of a transistorized pulse amplifier for use with diode logic circuits. With an effective overall gain exceeding 10, the total rise- and fall-times obtainable are each better than 0.05 microsecond, although there is also a short delay between the input and output pulses. (England.)

A Review of Semiconductor Switching Devices and Associated Design Requirements, A. W. Matz. "ATE J." Jan. 1959. 22 pps. The function and design of 2-state (ON-OFF) switching elements are discussed and the many transistor-type devices that have been developed to meet these needs are reviewed. (England.)

TELEVISION

Televising Objects of Low Brightness by Means of Long Storage Times, F. Pilz and W. Habermann. "Rundfunk." #3, June 1959. 13 pps. The high efficiency of the photoelectric materials at present available makes it possible fundamentally to evaluate by television light energies that may be smaller by one order of magnitude than is necessary by photographic registration. (Germany.)

The First Results of Propagation Tests for Colour TV Transmissions in Switzerland, K. Bernath. "Nach Z." June 1959. 5 pps. Early in 1958 the Swiss Post Office has carried out transmission tests with colour pictures by means of the TV station Bantiger using the American standards. The paper describes the actual tests and the results obtained. (Germany.)

The Optical System in Television and its Transmission Characteristics, Based on its Amplitude and Phase Responses, H. Grabke and F. Below. "Rundfunk." #3, June 1959. 8 pps. A comparison is made of the electrical transmission of acoustical and optical information, and the difficulties of routine testing and measuring of optical systems are pointed out. (Germany.)

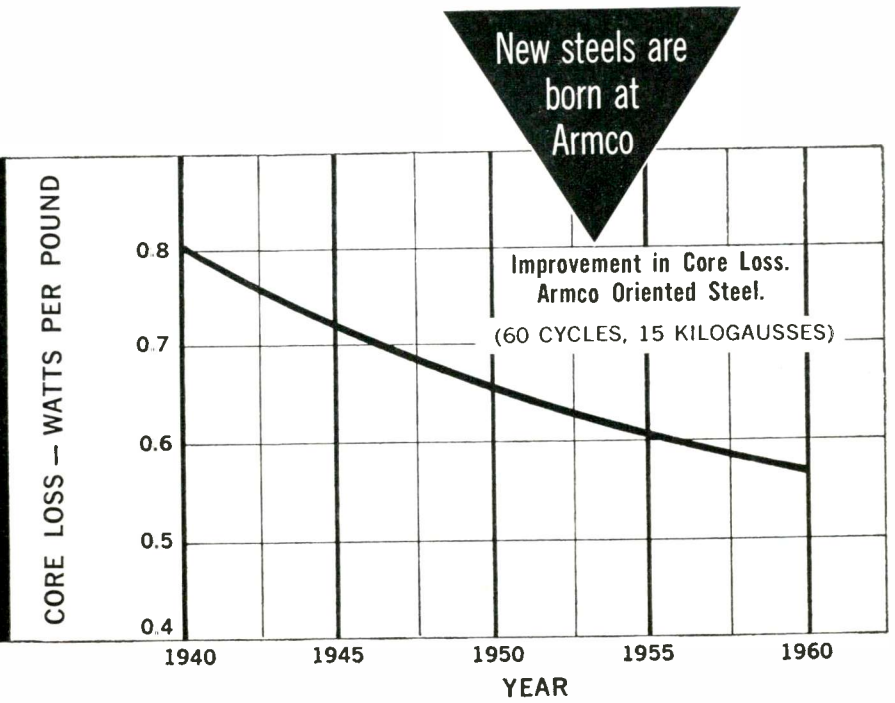
A Television Line Selector, H. Wolf. "Nach Z." May 1959. 4 pps. A line selector is described in which the delay for the selection of the desired line is produced by three

(*Continued on page* 148)

Armco Oriented M-5...

new grade of electrical steel offers lower core loss

Now in production —has maximum core loss of only .58 watts per pound—and higher permeability.



Armco's new Oriented M-5 electrical steel gives producers of distribution and high-performance wound core transformers opportunities to make substantial savings by reducing size or stepping-up operating efficiency.

Outstanding advantage of this new electrical steel is its low core loss. The limit for maximum core loss at 60 cycles and 15 kilogausses has been reduced to only .58 watts/lb. This is approximately 10% less than the guaranteed core loss for the M-6 grade. Supplementing this important improvement, Armco Oriented M-5 has materially higher permeability at high inductions than oriented silicon steels previously available.

The new Armco Electrical Steel is produced in 12-mil thickness and in coils from ⅛ to 31 inches wide. Insulations available are the natural annealing oxide or Armco's thin, high-resistivity CARLITE.

For complete information on this transformer-improving material, another Armco pioneered development in electrical steels, just fill out and mail the coupon.

ARMCO STEEL CORPORATION, 2879 Curtis Street, Middletown, Ohio
Send me complete information on your new electrical steel, Armco Oriented M-5

Name _____ Title _____
Company _____
Street _____
City _____ Zone _____ State _____

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

Sources

monostable multivibrators in series: Two are used for a coarse control and one for a fine control. (Germany.)

Flying-spot Scanning for Opaque Color Pictures, Norbert Mayer. "Rundfunk." #3, June 1959. 9 pps. The flying-spot scanning method offers a simple possibility for deriving even from opaque color pictures the color signals for red, green and blue (vitascan). For this purpose the flying spot of a scanning tube is thrown on to the picture to be transmitted and, in the simplest case, the three color-signals are produced by means of three photo-electric cells. (Germany.)

Vauxhall Motors' Industrial Television Link, R. C. T. Fishwick. "Brit. C&E." July 1959. 4 pps. This article explains some interesting and original work carried out by a team at Vauxhall Motors, on the development of a 765.5 Mc/s television link used between moving vehicles and a central laboratory. The system is principally used for car suspension testing or similar problems. The transmitter design presented several problems as commercial equipment was not available at the frequency used. (England.)

The Recording of TV Viewing and Radio Listening Statistics, E. W. P. Harris and G. D. Robinson. "Brit. C&E." July 1959. 5 pps. A new system of recording information concerning the number of homes watching television programmes is described in this article. One of the most important advantages of the system is that the information statistics are available immediately on a minute-by-minute basis. (England.)

$\Delta G = \Delta G / \epsilon n_i \mu_p \mathcal{L}$

THEORY

Device for Solving High-Order Algebraic Equations, Jiri Kryze. "Avto i Tel." June 1959. 11 pps. A device for reproducing algebraic polynomials and for solving high-order equations is described. The construction is based upon a new principle that allows its full automatization with minimum number of electronic tubes. The part of the computer where polynomials are generated has no electronic tubes at all. (U.S.S.R.)

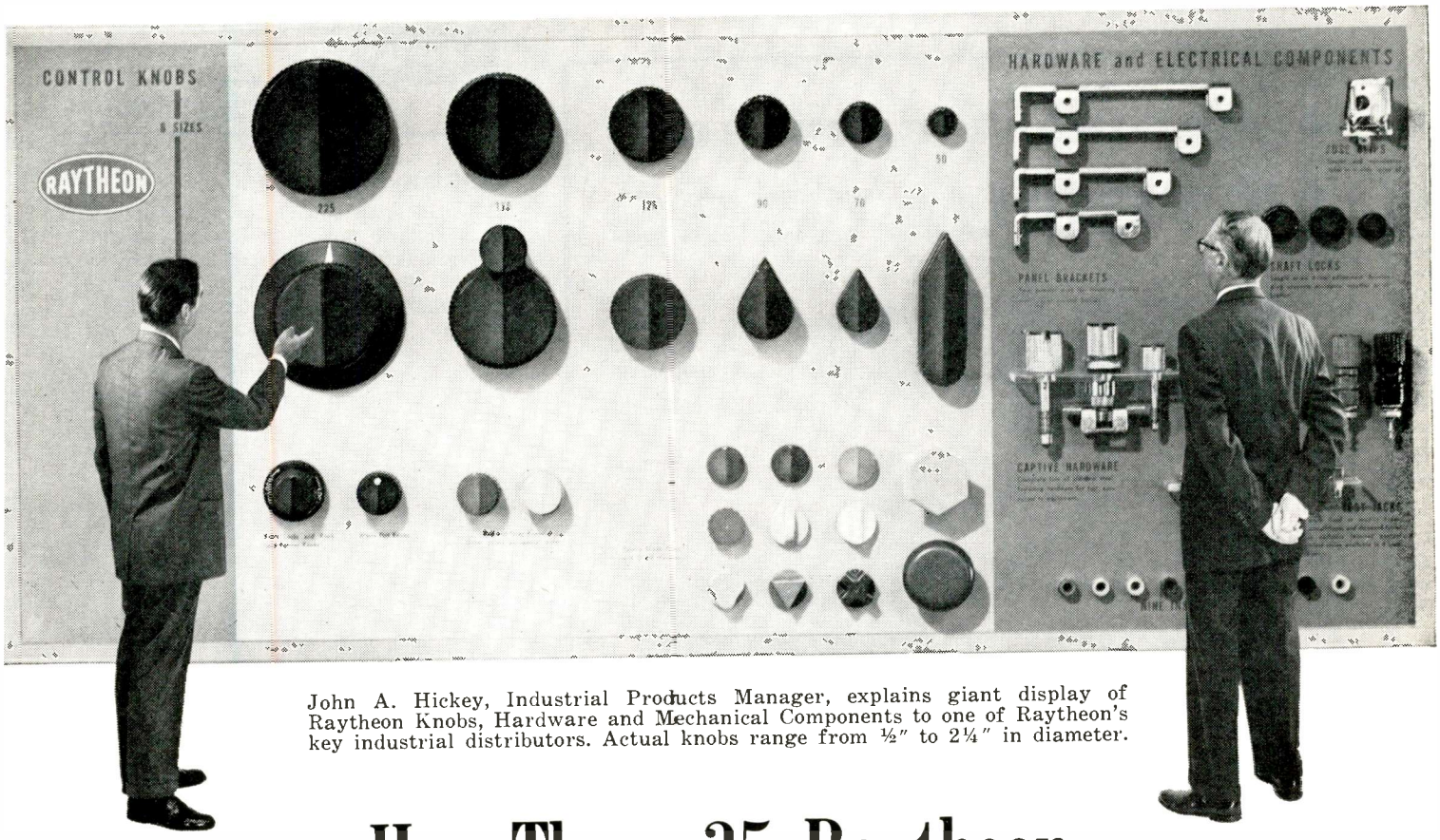
Theoretical Analysis of a Tuning System for a Bridge Piezo-Oscillator, G. Gennaro and G. C. Patrucco. "Alta. Freq." Feb. 1959. 15 pps. A new tuning system of a Meacham bridge piezo-oscillator is analyzed theoretically. The efficiency of this highly sensitive system was unknown so far. (Italy.)

The Calculation of Rational Functions by Means of the Nichols Diagram, R. A. Schraivogel. "rt." June 1959. 5 pps. The calculation of the value of a rational function for complex values of the independent variable can be simplified by the use of the Nicholls graphs. The present article deals with the development of this method and demonstrates its application on several examples. (Germany.)

TUBES

The Fine-Detail Contrast of Television Picture Tubes, Ferdinand Arp. "Rundfunk." #3, June 1959. 9 pps. The article reports on measurements of the fine-detail contrast of receiver picture tubes. (Germany.)

Distortion in Pentode Voltage Amplifiers, R. E. Aitchison, C. T. Murray, and I. S. Docherty. "Proc. AIRE." March 1959. 2 pps. (Australia.)



John A. Hickey, Industrial Products Manager, explains giant display of Raytheon Knobs, Hardware and Mechanical Components to one of Raytheon's key industrial distributors. Actual knobs range from ½" to 2¼" in diameter.

How These 35 Raytheon Knobs Solve 35 x 10^6 Control Problems

Raytheon offers the most complete line of knobs available to meet all requirements. Raytheon's knobs are handsomely styled to complement the finest electronic equipment. They are molded of Tenite II with inserts of anodized aluminum and two Allen head set screws. Raytheon knobs are designed to meet commercial and military applications. Colors are available and most knobs come in both mirror and matte finish.

One Source—These knobs plus a complete line of hardware and mechanical components are offered by Raytheon Industrial Distributors. In addition, Raytheon distributors offer complete availability on industrial tubes, voltage regulators, transistors and diodes, receiving tubes and cathode ray tubes. Whatever electronic components you need, your local Raytheon Industrial Products Distributor can supply them. You pay no penalty in price, and get faster service from complete local stocks on *all* Raytheon products they sell. If you don't know your nearest Raytheon Distributor, write to John Hickey, Industrial Products Manager, at the address below.

RAYTHEON COMPANY • DISTRIBUTOR PRODUCTS DIVISION

RAYTHEON

Raytheon Distributors Serving Key Markets Include:

Baltimore, Md.
Wholesale Radio Parts Company
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DeMambro Radio Supply Company
Burbank, Cal.
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Chicago, Ill.
Newark Electric Company
Cleveland, Ohio
Main Line Cleveland, Inc.
Pioneer Electronic Supply Corporation
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Ward Terry & Company
Detroit, Mich.
Ferguson Electronic Supply Company
Inglewood, Cal.
Newark Electric Company
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Burstein-Applebee Company
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Milwaukee, Wis.
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Arrow Electronics, Inc.
H. L. Dalis, Inc.
Milo Electronics Corporation
Oakland, Cal.
Elmar Electronics
Philadelphia, Pa.
Almo Radio Company
Phoenix, Ariz.
Radio Specialties & Appliance Corporation
Portland, Ore.
Lou Johnson Company
Tampa, Fla.
Thurow Distributors
Tulsa, Okla.
S & S Radio Supply
Washington, D. C.
Electronic Wholesalers, Inc.

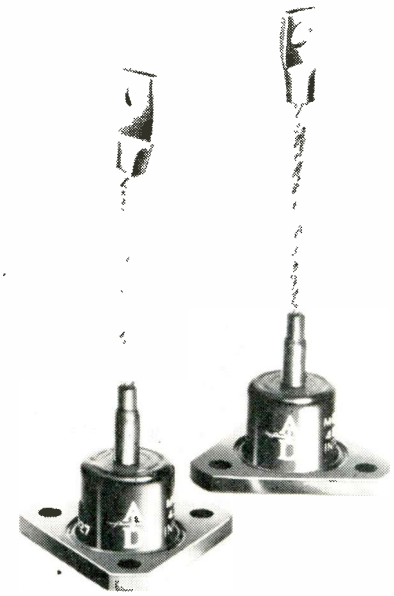
This is a partial listing only. Names of other Raytheon Industrial Distributors on request from John Hickey, Raytheon Distributor Products Division, 55 Chapel St., Newton 58, Mass.

Circle 87 on Inquiry Card

New Products

SILICON RECTIFIERS

Rectification efficiencies up to 99% at standard power frequencies are claimed for this series of improved-design 50-400 PIV K-M type 25-35 miniaturized silicon rectifiers. Units

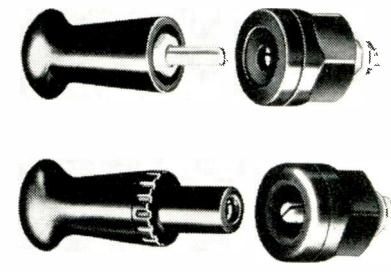


are available with positive and negative bases, and are designed to replace selenium rectifiers in similar performance ranges. Typical applications include battery chargers, welding equipment, plating equipment and medium power industrial power supplies. Rated junction temps. to 190°C. Rectifier Div., Audio Devices, Inc., 620 E. Dyer Rd. Santa Ana, Calif.

Circle 168 on Inquiry Card

CONNECTORS

Single-conductor plugs and receptacles, Supercon electrical connectors, in 50 and 100 a ratings for use in power and distribution panels. They feature a functional positive-grip plug, quick assembly; wide range of colors. Current carrying parts are of gold-plated brass. Plastic parts are



molded of durable nylon for high dielectric strength and excellent resistance to corrosive chemicals, oil and grease, abrasion and impact, chipping and cracking. The Superior Electric Co., Dept. PR, Briston, Conn.

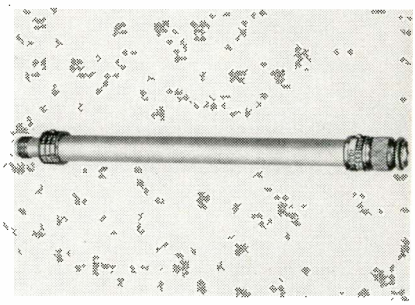
Circle 169 on Inquiry Card

Circle 88 on Inquiry Card

New Products

COAXIAL ATTENUATORS

Fixed Coaxial Attenuators are now available with Type TNC connectors (male/female, double male or double female). Specifications include: frequency range, 1 to 12.4 KMC; attenua-

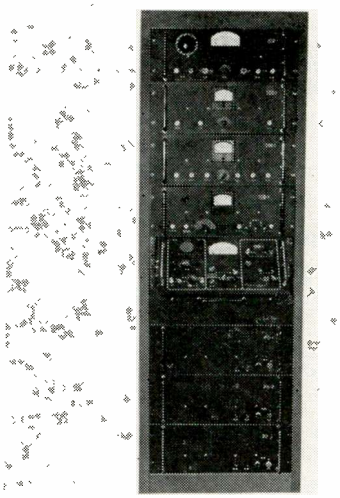


tion range, 1 to 20 db; impedance, 50 ohms; model numbers, Model 633—1 male, 1 female connector; Model 634—2 female connectors; Model 635—2 male connectors. Weinschel Engineering, 10503 Metropolitan Ave., Kensington, Maryland.

Circle 170 on Inquiry Card

SSB ADAPTER SYSTEM

Model SSB-58-1A adapter system permits standard high frequency, high level AM transmitters to be converted to SSB operations without engineering modifications. Advantages over conventional high power linear SSB systems are: 2 to 1 or more reduction, in equipment costs, greater undesired sideband rejection, lower tube costs, and less sensitivity to over-loads and



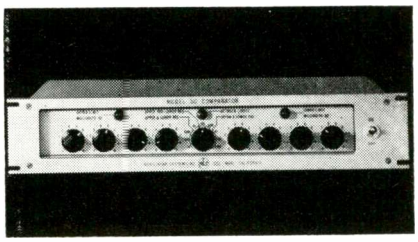
tuning errors. It is specifically tailored to high frequency voice, facsimile and multi channel FSK operation from 10 kw to 1 mw. Kahn Research Laboratories Inc., 22 Pine St., Freeport, L. I., N. Y.

Circle 171 on Inquiry Card

New Products

VOLTAGE COMPARATOR

The NLS 50, compact transistorized voltage comparator, for instant go/no-go indication of voltage tolerance determines whether or not an input voltage is within prescribed limits. It

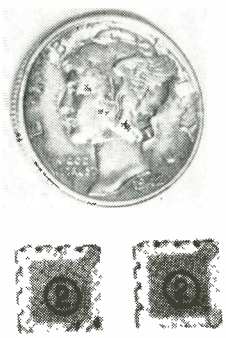


will check any voltage from ±0.001 to ±999.9 v. It has a detection threshold of 500 uv, a sensitivity of 0.005% and its limit settings are precise to ±0.01%. In addition to indicating voltage tolerances for the operation, it gives a go/no-go command to such devices as cut-off relays, sorting chutes, data printers, tape or card punches, and audible warning equipment. Non-Linear Systems, Inc., Del Mar, Calif.

Circle 172 on Inquiry Card

MICROMODULE CAPACITORS

Developed for use in the Signal Corp-RCA Micromodule Electronic Super-Miniaturization Project, these 0.3 in. sq. wafers are typical of multilayer Monolythic ceramic capacitors. Capacitor at the left is 10 mils thick and has 4 active dielectrics. Capacitor at the right is 35 mils thick, has 10 active dielectrics. Ceramic bodies with various dielectric constants and



temperature coefficients are used to achieve desired capacitances and performance characteristics. The max. made so far is a 0.3 μf, 25 v capacitor. Sprague Electric Co., N. Adams, Mass.

Circle 173 on Inquiry Card

New Products

MINIATURE TRANSFORMERS

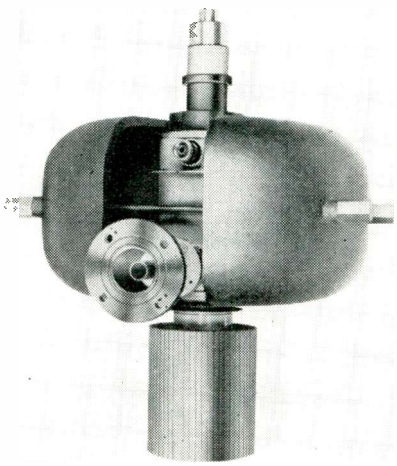
A new line of Veri-miniature transistor transformers in hermetically sealed construction to MIL-T-27A, Grade 4, Class R, 10,000 hour life. Size is 0.600 inches diameter by 13/16

inches high. Weight is 0.32 oz. Designed for clamp mounting, they may also be obtained with 4-40 stud. Units have glass seal turret terminals. Microtran Company, Incorporated, 145 E. Mineola Avenue, Valley Stream, New York.

Circle 174 on Inquiry Card

AMPLIFIER KLYSTRON

VA-802 amplifier klystron delivers 1000 w min. of CW power over the 1700-2400 MC band. It is an air cooled, high-gain, 4-cavity amplifier with internal cavities tunable over the specified range. It is designed for wide-band tropospheric forward scatter communications and other CW applications. With an integral permanent magnet, it is adapted to transport-

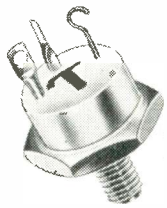


able service. Characteristics permit amplification of frequency, amplitude, or phase modulated signals at power gains in excess of 40 db. Varian Assoc., 611 Hansen Way, Palo Alto, Calif.

Circle 175 on Inquiry Card

SILICON TRANSISTOR

High power silicon transistor line, the 2N1208, 2N1209, and 2N1212, features low thermal resistance, good beta linearity and switching characteristics, good high frequency beta,

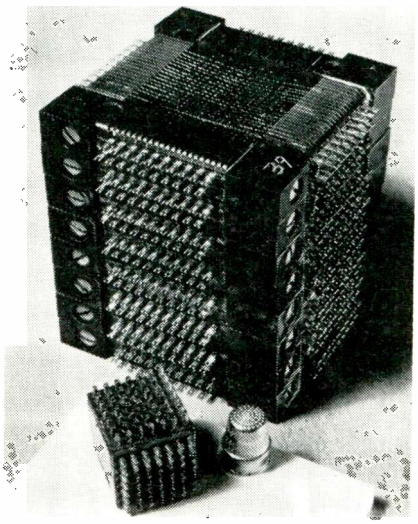


high temperature reliability and low saturation voltage. For application in regulated power supplies, high current switching, and high frequency power amplification. Transitron Electronic Corporation, 168 Albion Street, Wakefield, Massachusetts.

Circle 176 on Inquiry Card

MEMORY STACK

Miniaturized memory stack for coincident current systems, whose physical volume is 1/50th of the conventional stack. Prototype stacks consist of 2,048 cores in a unit measuring only 1 x 1.4 x 1.4 in. The new stack offers increased reliability, shortens lead lengths, and enhances the useful-

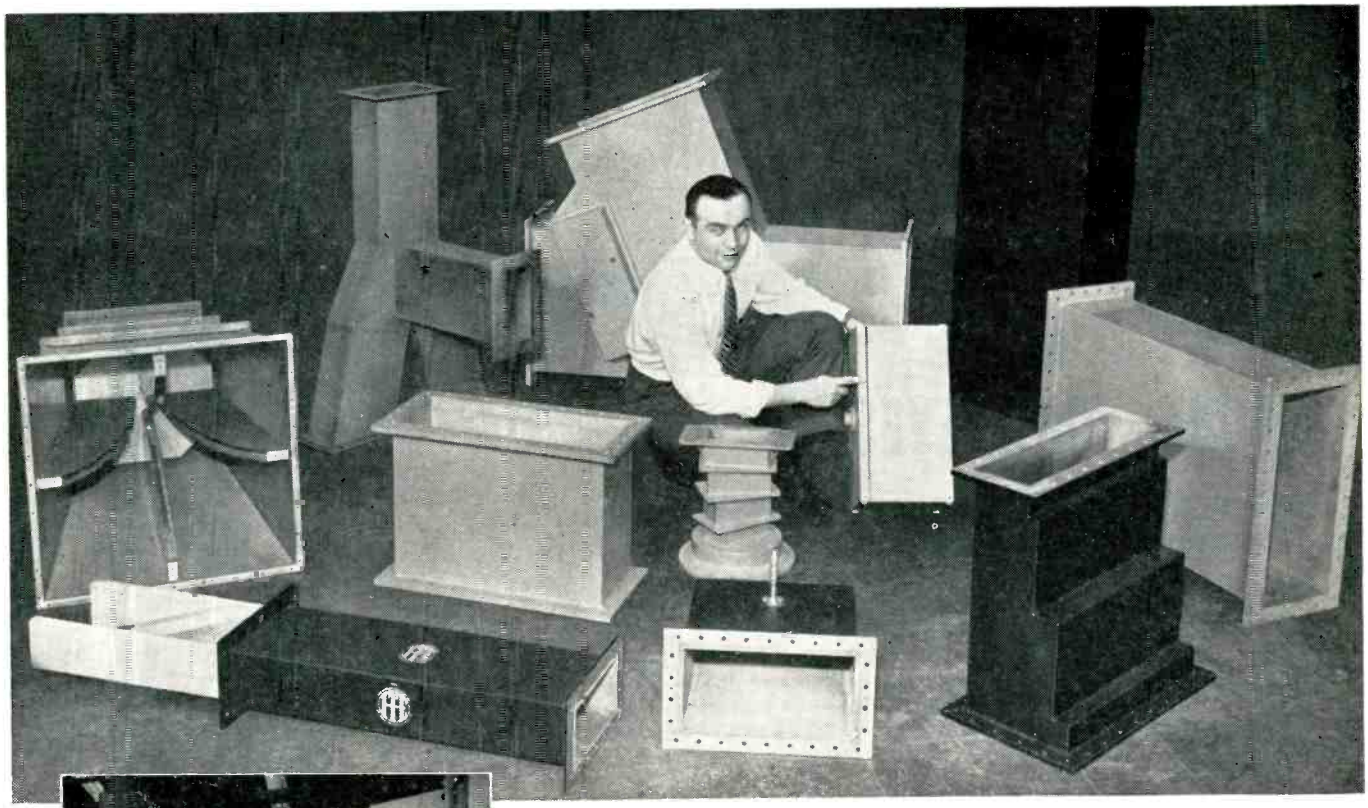


ness and economy of ferrite core arrays. The stack, which has as low a noise ratio as conventional stacks, is made up to 0.050 in. memory cores. Applied Logics Div., General Ceramics Corp., Keasbey, N. J.

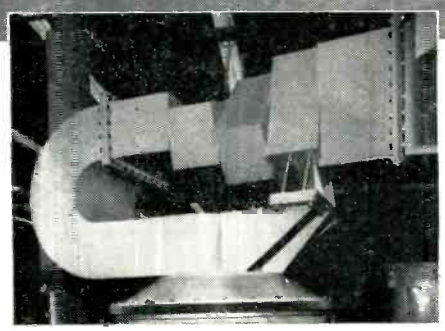
Circle 177 on Inquiry Card

NEED LARGE WAVEGUIDE?

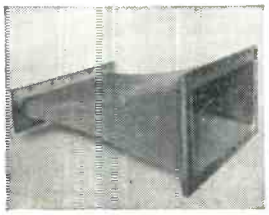
Look to I-T-E to meet all your needs: conventional types or special designs



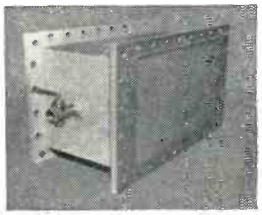
A complete large waveguide service. These units reflect I-T-E's design and production capabilities with large waveguide. Noncontacting short circuit section shown is available with servo-controlled motor drive. For proper electrical continuity, all waveguide flanges are held to 0.001 in. flatness (total indication) . . . are perpendicular within 0.030 (for two flanges, total indication). Available in sizes WR770 through WR2300.



Rotary joint and step twist. High-power rotary joint designed for low VSWR. Binomial stepped 90° twist has 1.02:1 VSWR over wide band.



Waveguide transformer features low VSWR, high power, economy.



Gas barrier utilizes Rexolite window for maximum RF transmission.

I-T-E is staffed and equipped to meet your requirements for large waveguide used in multimegawatt radar and scatter communications systems. For conventional needs, I-T-E manufactures an extensive line of standard configurations. And where special problems exist, depend on I-T-E waveguide engineers to originate special designs exactly suited to your wants and at reasonable cost.

Productionwise, I-T-E can provide faster deliveries, thanks to its fully equipped waveguide shop. Custom-designed tools and fixtures assure both flaw-free fabrication and production-line efficiency. Every step—from the initial sheet metal work to final finishing—is performed under one roof . . . under one responsibility. You benefit from lower VSWR, plus maximum strength with lightness and economy.

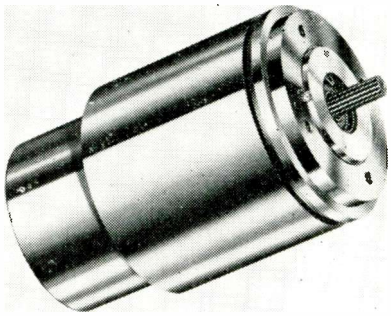
Let I-T-E's broad design experience and unique production facilities work to solve your waveguide problems. Address your inquiries to I-T-E's Special Products Division. And ask for your copy of free-space vs. guide wave lengths conversion tables for large waveguide.

I-T-E CIRCUIT BREAKER COMPANY
Special Products Division • 601 E. Erie Avenue • Philadelphia 34, Pa.

New Products

SERVOMOTOR

Size 18 inertia-damped servomotor provides upper corner frequency of 27 CPS. Model 18 IM 460 operates from a 115 v., 400 CPS source to deliver 2.35 oz.-in. of torque at stall. No-load

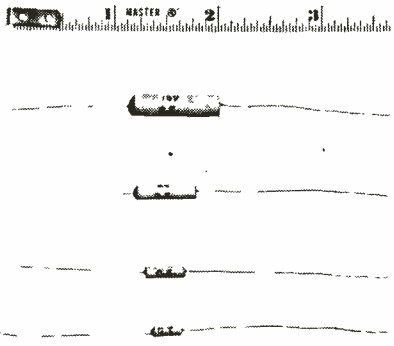


speed is 4,700 RPM, rotor inertia 7.5 gm. cm.^{2} and acceleration at stall 22,200 rad/sec.^{2} Flywheel damping factor of 940 dyne cm.sec/rad is provided by the viscous friction introduced by the magnetic coupling of a low inertia drag cup to a freely rotating magnet flywheel. Withstands 20G's vibration up to 500 CPS, 200°C total unit temp. and meets MIL-E-5272A. Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif.

Circle 178 on Inquiry Card

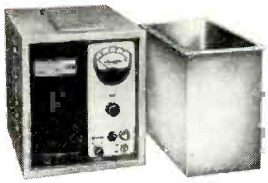
TANTALUM CAPACITORS

"Wet slug" tantalum electrolytic capacitors come in 4 case sizes ranging from 0.115 to 0.225 in. in dia., 0.312 to 0.875 in. long, are used chiefly in military and other applications requiring very small size and high reliability. Ratings are from 2 to 325 μf, 6 to 60 vdc. The capacitors meet MIL-C-3965B, except for impedance



at lowest temperature ranges. They are capable of at least 2,000 hrs. of continuous operation from −55°C to +85°C, and will sustain vibration up to 15 g's at 2,000 CPS. General Electric Co., Schenectady 5, N. Y.

Circle 179 on Inquiry Card

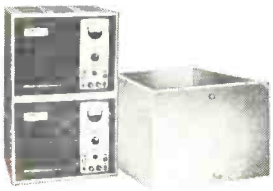


Model BC60
Capacity 1¼ gal. **$350**

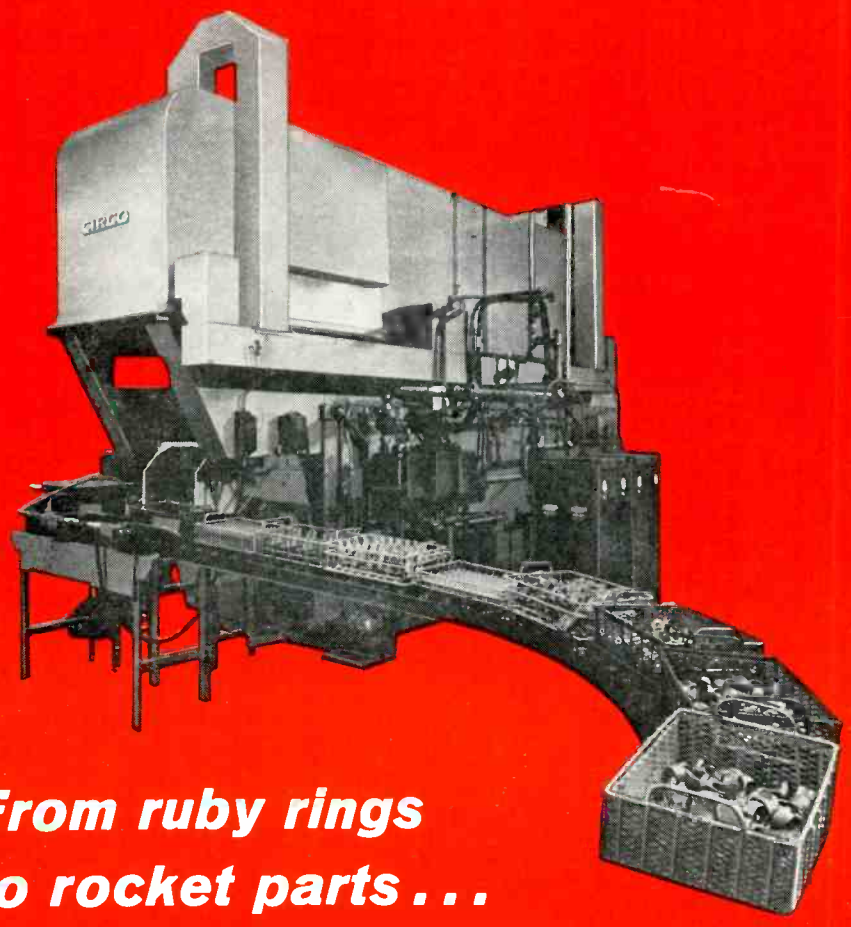
Model BC125
Capacity 2 gal. **$575**

Model BC250
Capacity 5 gal. **$750**

Model BC500
Capacity 12 gal. **$1375**



Model BC1000
Capacity 25 gal. **$2750**



From ruby rings to rocket parts . . . CIRCO ultrasonic cleaning units achieve precision cleaning . . . in seconds!

Whenever *absolute* product cleanliness is a critical factor . . . whenever cleaning is a production bottleneck . . . CIRCO ultrasonics offer you the widest range of precision engineered ultrasonic cleaning units available anywhere.

CIRCO ultrasonics blast dirt loose, yet never harm your products . . . ideal for removing solder flux, fingerprints, lint, waxes, polishing compounds and other contaminants. Ultrasonic cleaning reduces solution consumption and eliminates laborious hand operations.

Whether you need a bench model or a huge custom-designed conveyerized system, CIRCO engineers can recommend the specific CIRCOSONIC unit to solve your problem. Write for your free copy of "Tips on Ultrasonic Cleaning".

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"See you at the National Metal Show, booth #1537."

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51 Terminal Ave., Clark, New Jersey • FUlton 8-8600

Automated Machine Tools

Applying numerical control techniques to machine tool processes turned up some interesting discoveries for one old line machine tool company. The control equipment, they found, was relatively uncomplicated—in fact a number of versions of tape controlled equipment were available—but the company found that despite their many years of experience in machine tool construction, they had never analyzed the precise role of the operator and this, it turned out, involved remarkably complicated equipment for duplication. This seems to support the opinion heard many times over the past few years—that in industries requiring skilled personnel the incentive for automation must come from the machine manufacturers themselves.

Cutting Costs of Highways

Stereoscopic surveys of highways and terrain, made by feeding 2-dimensional photo information into a computer for storage in electronic memory device, could save billions in highway construction costs. The new photogrammetric method, developed at MIT, and called Digital Terrain Model System, uses 3-dimensional photos of survey area projected in red and blue light by a unit whose operator wears 2-color stereo spectacles. The recorded measurements are fed into a computer, reducing the time needed for the survey from weeks or months to a matter of minutes or hours.

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stock or specification solders ultra-high purity—99.999% and commercial grade metals and alloys

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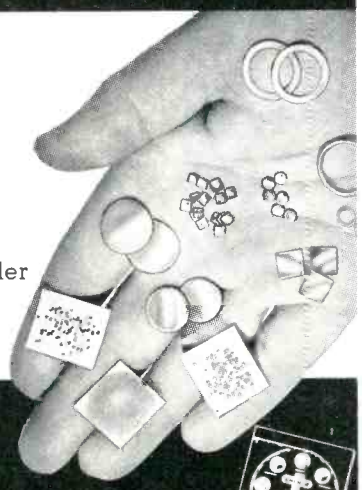
first to pioneer the development of solder metals and alloys for the semiconductor field

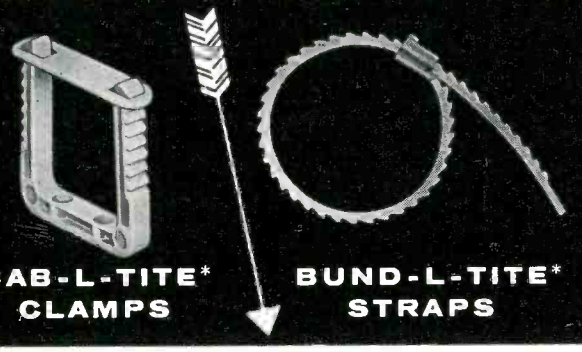


Send today for free manual on HOW TO SELECT MICROFORMS FOR ALL SEMI-CONDUCTOR NEEDS. Our engineers will be more than happy to lend further assistance on specific problems.

ANCHOR METAL COMPANY, INC.
966 Meeker Ave. Dept. E-9
Brooklyn 22, N. Y. • N. Y. Phone: STagg 2-7090

Circle 102 on Inquiry Card

DAKOTA



The lightest, fastest, most reliable way to

SECURE WIRES & WIRE BUNDLES!

Made from high strength DuPont Zytel, compact Dakota fastening devices provide positive holding power under extreme loading and shock. Unaffected by vibration. Comprehensive range of sizes and accessories.

If you're not acquainted with advanced Dakota securing products, write today for complete details! State application for engineering recommendations.

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4317 SEPULVEDA BLVD. • CULVER CITY, CALIFORNIA

Circle 103 on Inquiry Card

NEW GIANT narda SONBLASTER

Generator G-5001
500 watts output

Transducerized Tank NT-5001
Capacity: 10 gallons
Dimensions: 20" L x 11½" W x 10" D

Generator features tank selector and load selector switches on front panel to operate one or two NT-5001 tanks alternately. Other combinations of tanks and submersible transducers available from stock; larger tanks available on special order.

$1325

For mass-production cleaning and high capacity chemical processing!

Here's a new Narda SonBlaster ultrasonic cleaner with tremendous cavitation activity and generating capacity! Featuring full 500 watts output, this SonBlaster is available with a fully transducerized giant 10-gallon capacity tank. In addition, it will operate from six to 10 Model NT-605 high energy submersible transducers, at any one time, in any arrangement in any shape tank you need up to 70-gallon volume.

Install this new Narda SonBlaster, and immediately you'll start chalking up savings over costly solvent, vapor or alkaline degreasing methods! You'll save on chemicals and solvents, cut maintenance and downtime, eliminate expensive installations, save on floor space, and release labor for other work. But perhaps most important, you'll clean faster, cut rejects, and eliminate bottlenecks.

Whether you're interested in mass-production cleaning or degreasing of mechanical, electronic, optical, or horological parts or assemblies ...rapid, quantity cleaning of "hot-lab" apparatus, medical instruments, ceramic materials, electrical components or optical and technical glassware...or in speeding up metal finishing and chemical processing of all types—you'll find this new SonBlaster will do your work faster, better and cheaper. Write for more details now, and we'll include a free questionnaire to help determine the precise model you need. Address: Dept. EI-20.

Consult with Narda for all your ultrasonic requirements. The SonBlaster catalog line of ultrasonic cleaning equipment ranges from 35 watts to 2.5 KW, and includes transducerized tanks as well as immersible transducers which can be adapted to any size or shape tank you may now be using. If ultrasonics can be applied to help improve your process, Narda will recommend the finest, most dependable equipment available for immediate delivery from stock—and at the lowest price in the industry ($175 up)!

For custom-designed cleaning systems, write to our Industrial Process Division; for information on Chemical processing applications, write to our Chemical and Physical Process Division; both at the address below.

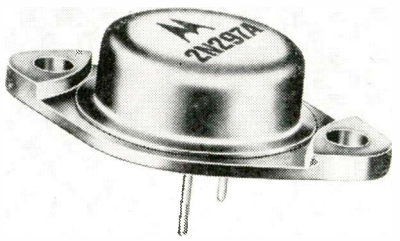
the narda ultrasonics corporation
625 MAIN STREET, WESTBURY, L. I., N. Y.
Subsidiary of The Narda Microwave Corporation

Circle 104 on Inquiry Card

New Products

POWER TRANSISTOR

The 2N297A germanium pnp power transistor for both military and commercial use, is designed to meet military mechanical, environmental and electrical tests. Units meeting Signal

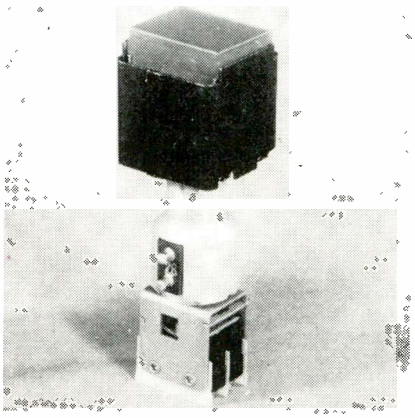


Corp specification MIL-T-19500A/36 are currently available. Ratings on the 2N297A are V_{CB}—60 vdc, V_{EB}—40 vdc; operating temp. range —65°C to +95°C; and P_c (at 75°C)—10 w. Semiconductor Products Div., Motorola, Inc., Dept. MPT, 5005 E. McDowell Rd., Phoenix, Ariz.

Circle 180 on Inquiry Card

PANEL SWITCH

Solenoid-held lighted push-button panel switch designed for control panels which require an electrical interlock system such as used for sequence operation. It also may be used in remote control, applications to monitor the operation of equipment which the switch controls. The solenoid feature cannot actuate the switch; it may be used only to hold the circuit after the switch is actuated. The unit may be wired with or without the



solenoid circuit as part of the switch circuitry. If the solenoid is not energized the switch functions as a momentary action control. Electro-snap Corp., 4218 W. Lake St., Chicago 24, Ill.

Circle 181 on Inquiry Card

Now! get complete data on

MINIATURE AGASTAT®
time/delay/relays

This free folder contains complete specs on 24 models of the miniature AGASTAT Time Delay Relay for missile, aircraft, computer, electronic and industrial applications. They're small as 1-13/16" x 4-7/16" x 1½", with adjustable timing ranges starting at .030 and as high as 120 seconds.

The folder gives operating and environmental specs, coil data, contact capacities, dimensions, diagrams of contact and wiring arrangements. *Write:* Dept. A-33-932.

AGA DIVISION **ELASTIC STOP NUT CORPORATION OF AMERICA**
Elizabeth, New Jersey

Circle 55 on Inquiry Card

Increased Insulation
BETTER CONNECTIONS
JONES BARRIER TERMINAL STRIPS

Leakage path is increased — direct shorts from frayed terminal wires prevented by bakelite barriers placed between terminals. Binder screws and terminals brass, nickel-plated. Insulation, BM 120 molded bakelite. Finest construction. Add much to equipment's effect.

Jones Means Proven Quality

Illustrated: Screw Terminals—Screw and Solder Terminals—Screw Terminal above Panel with Solder Terminal below. Every type of connection.

Six series meet every requirement. No. 140, 5-40 screws; No. 141, 6-32 screws; No. 142, T-32 screws; No. 150, 10-32 screws; No. 151, 12-32 screws; No. 152, ¼-28 screws.

Catalog No. 22 lists complete line of Barrier strips, and other Jones Electrical Connecting Devices. Send for your copy.

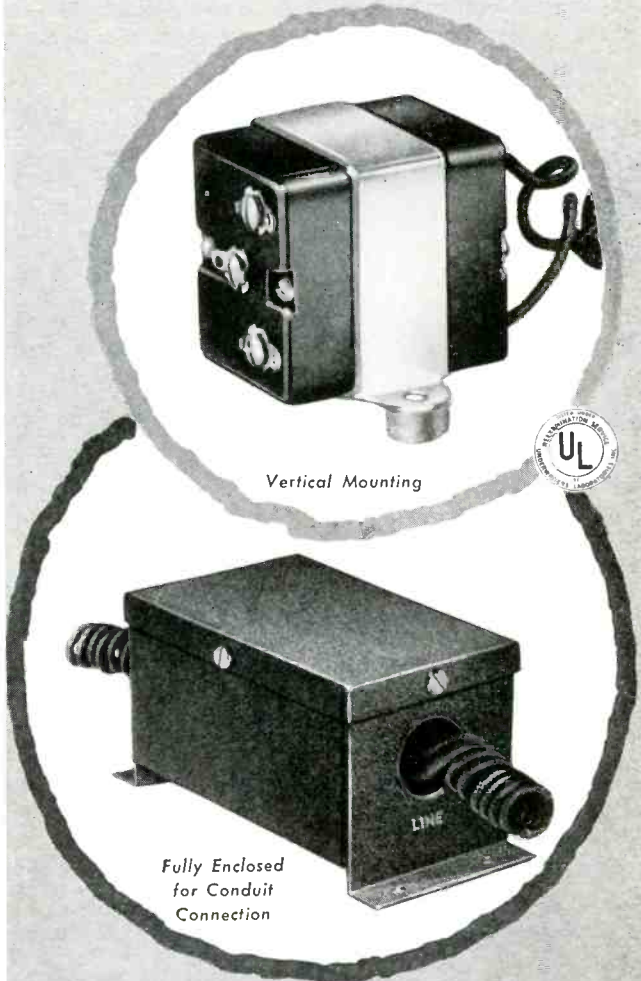
Jones **HOWARD B. JONES DIVISION**
CINCH MANUFACTURING COMPANY
CHICAGO 24, ILLINOIS
DIVISION OF UNITED-CARR FASTENER CORP.

Circle 68 on Inquiry Card

TRANSFORMERS
Step-Down
Class II

This new line of low power transformers is designed for remote control and signal circuits. An entirely new concept in construction includes the following features:

- **Windings insulated from core with nylon plastic**
- **High temperature plastic and metal shells**
- **Screw terminals molded in plastic case**
- **Moisture proof • Noise free • Underwriters appr.**
- **Low cost • Low heat rise • Small size**



Units are available with various mounting arrangements and connection facilities. Two power ratings of 10VA and 25VA in five outputs from 6 volts to 24 volts are standard.

Write for descriptive literature. Samples for test promptly supplied.

SOLENOIDS • COILS • ELECTRICAL COMPONENTS

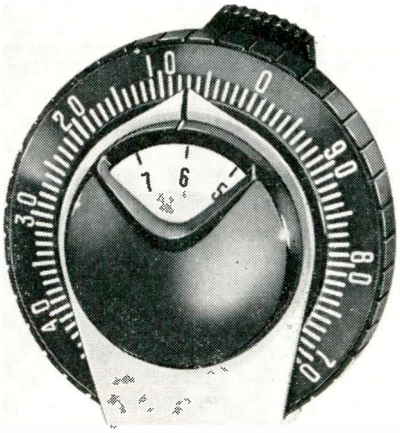
anderson controls, inc.
General Offices: 9959 Pacific Avenue • Franklin Park, Ill.
Factories: Des Plaines, Ill., Woodstock, Ill., Franklin Park, Ill.
Phone: Gladstone 1-1210

Circle 69 on Inquiry Card

New Products

MICRODIALS

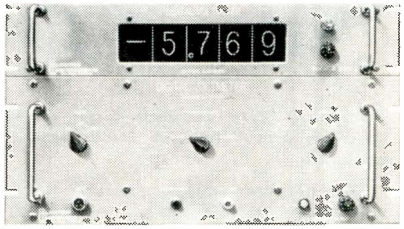
A new series of multi-turn counting dials designed to add new style to modern control panels. The dials are presently available in 5 variations of red, gray and black colors. Mechanical features such as smoothness of operation, absence of noise, no jumping or step-action and lack of ambiguities in reading have been retained. A contour lever brake arm locks settings in place yet does not interfere with dial adjustment. Borg Equipment Div., Amphenol-Borg Electronics Corp., 120 S. Main St., Janesville, Wisconsin.



Circle 182 on Inquiry Card

CONVERTERS

Series of totally transistorized, high speed, all-electronic, analog-to-digital converters are capable of making up to 1,000 conversions per second. Instruments in the new 7,000 Series feature 0.01% sensitivity and resolution, automatic polarity, three or four digit in-line display and transistorized logic circuits. Voltage state BCD outputs are developed for data recorder entry. Electro Instruments, Incorporated, 3540 Aero Court, San Diego, California.



Circle 183 on Inquiry Card

New Products

SERVO INDICATOR

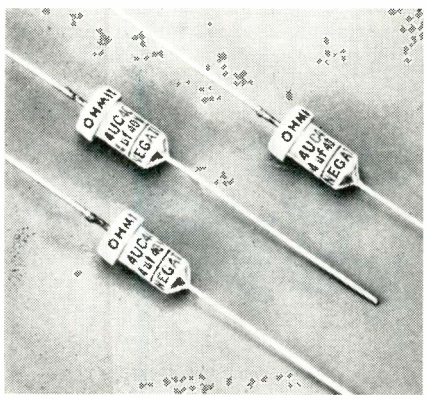
A compact, easy-to-read dual servo indicator consists of two independent position servos with digital counter readout. Static accuracy of the indicator systems is 0.1% of full scale

and resolution is infinite. The high slewing rate permits full scale excursion in 40 sec. Counter indications are registered smoothly and with a complete absence of jitter. The damping ratio is adjustable between 0.6 and 0.9. Typical input signals to the servos are 0 to 3 v rms at 400 CPS. General Controls Co., 1320 S. Flower St., Burbank, Calif.

Circle 184 on Inquiry Card

TANTALUM SLUG CAPACITOR

A high temperature type of tantalum slug electrolytic capacitor, Style UC is rated for operation at ambient of 125°C. It retains the "hat shape" construction but utilizes materials capable of withstanding considerably higher temperatures. Characteristics of slug capacitors are,



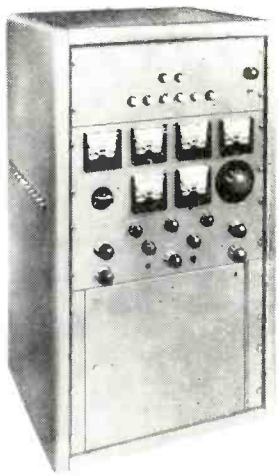
lowest power factor and leakage current, best temperature coefficient and very small size for its capacity range and level of quality. Ohmite Manufacturing Company, 3638 Howard Street, Skokie, Illinois.

Circle 185 on Inquiry Card

New Products

MICROWAVE MODULATOR

High-power microwave modulator, Model 10001, for magnetrons covering the range from 3200 MC to 35,000 MC with peak outputs from 6 kw to 120 kw. The modulator is a source of high

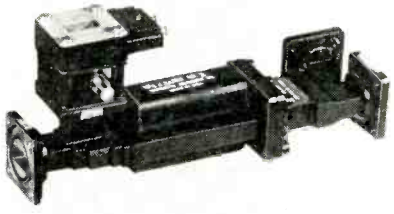


peak power microwave energy when used in conjunction with any compatible magnetron. High-voltage power supply is 0 to 4 kw at 100 ma; magnetron filament supply is 0 to 13 v. at 3a; repetition rate generator frequency range is 180 to 300 pps; all continuously variable. Normal pulse width is 1 μsec at 70% points, rise time 0.15 μsec, max. slope 5%, other pulse widths are available. Narda Microwave Corp., Mineola, N. Y.

Circle 186 on Inquiry Card

FERRITE DUPLEXER

The MA122TS is a light-weight ferrite duplexer developed for high power radars in the 16 to 17 KMC frequency range. It exhibits the inherent fast recovery, low insertion advantages of a non-reciprocal differential phase shaft ferrite circulator. Features are: frequency range, 16-17



KMC; power peak, 150 kw; average, 150 w; receiver duplexer loss 1.2 db max.; transmit duplexer loss, 0.3 db max.; VSWR, 1.15 max.; recovery time, 2μsec. Microwave Associates, Inc., Burlington, Mass.

Circle 187 on Inquiry Card

UTC NEW EXPANDED DO-T AND DI-T SERIES

Revolutionary transistor transformers hermetically sealed to MIL-T-27A Specifications.

UTC DO-T and DI-T transistor transformers provide unprecedented power handling capacity and reliability coupled with extremely small size. Comparative performance with other available products of similar size are shown in the curves (based on setting output power at 1 KC, then maintaining same input level over frequency range). The new expanded series of units cover virtually every transistor application.

DO-T

ACTUAL SIZE

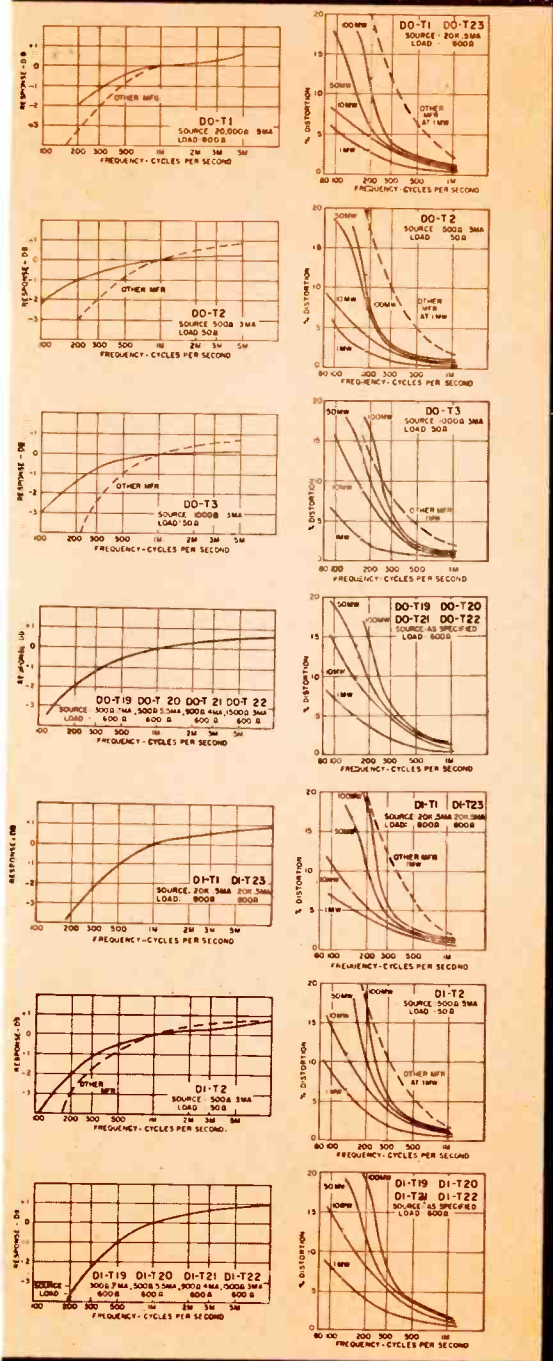
5/16 Dia. x 13/32, 1/10 Oz.

- **High Power Rating** . . . up to 100 times greater.
- **Excellent Response** . . . twice as good at low end.
- **Low Distortion** . . . reduced 80%.
- **High Efficiency** . . . up to 30% better.
- **Moisture Proof** . . . hermetically sealed to MIL-T-27A.
- **Rugged** . . . completely cased.
- **Anchored Leads** . . . withstand 10 pound pull test.
- **Printed Circuit Use**...plastic insulated leads.

DI-T

ACTUAL SIZE

5/16 Dia. x 1/4, 1/20 Oz.



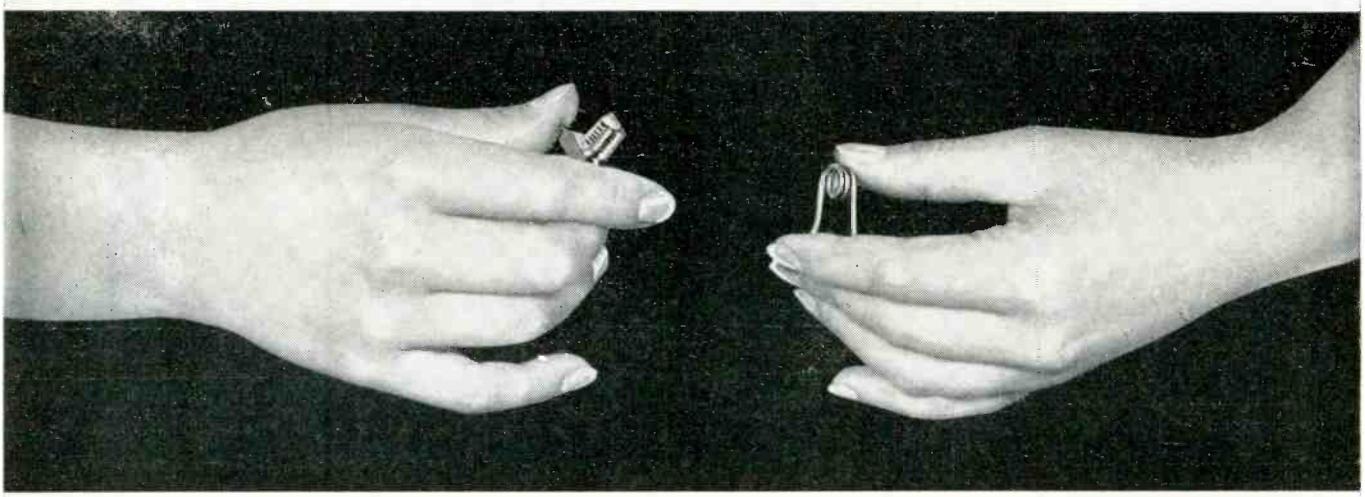
DO-T No.	MIL Type	Application	Pri. Imp.	D.C. Ma.‡ in Pri.	Sec. Imp.	Pri. Res. DO-T	Pri. Res. DI-T	Level Mw.	DI-T No.
DO-T1	TF4RX13YY	Interstage	20,000 30,000	.5 .5	800 1200	850	815	50	DI-T1
DO-T2	TF4RX17YY	Output	500 600	3 3	50 60	60	65	100	DI-T2
DO-T3	TF4RX13YY	Output	1000 1200	3 3	50 60	115	110	100	DI-T3
DO-T4	TF4RX17YY	Output	600	3	3.2	60		100	
DO-T5	TF4RX13YY	Output	1200	2	3.2	115	110	100	DI-T5
DO-T6	TF4RX13YY	Output	10,000	1	3.2	790		100	
DO-T7	TF4RX16YY	Input	200,000	0	1000	8500		25	
DO-T8	TF4RX20YY	Reactor 3.5 Hys. @ 2 Ma. DC, 1 Hy. @ 5 Ma. DC				630			
	TF4RX20YY	Reactor 2.5 Hys. @ 2 Ma. DC, .9 Hy. @ 4 Ma. DC					630		DI-T8
DO-T9	TF4RX13YY	Output or driver	10,000 12,000	1 1	500 CT 600 CT	800	870	100	DI-T9
DO-T10	TF4RX13YY	Driver	10,000 12,000	1 1	1200 CT 1500 CT	800	870	100	DI-T10
DO-T11	TF4RX13YY	Driver	10,000 12,000	1 1	2000 CT 2500 CT	800	870	100	DI-T11
DO-T12	TF4RX17YY	Single or PP output	150 CT 200 CT	10 10	12 16	11		500	
DO-T13	TF4RX17YY	Single or PP output	300 CT 400 CT	7 7	12 16	20		500	
DO-T14	TF4RX17YY	Single or PP output	600 CT 800 CT	5 5	12 16	43		500	
DO-T15	TF4RX17YY	Single or PP output	800 CT 1070 CT	4 4	12 16	51		500	
DO-T16	TF4RX13YY	Single or PP output	1000 CT 1330 CT	3.5 3.5	12 16	71		500	
DO-T17	TF4RX13YY	Single or PP output	1500 CT 2000 CT	3 3	12 16	108		500	
DO-T18	TF4RX13YY	Single or PP output	7500 CT 10,000 CT	1 1	12 16	505		500	
DO-T19	TF4RX17YY	Output to line	300 CT	7	600	19	20	500	DI-T19
DO-T20	TF4RX17YY	Output or line to line	500 CT	5.5	600	31	32	500	DI-T20
DO-T21	TF4RX17YY	Output to line	900 CT	4	600	53	53	500	DI-T21
DO-T22	TF4RX13YY	Output to line	1500 CT	3	600	86	87	500	DI-T22
DO-T23	TF4RX13YY	Interstage	20,000 CT 30,000 CT	.5 .5	800 CT 1200 CT	850	815	100	DI-T23
DO-T24	TF4RX16YY	Input (usable for chopper service)	200,000 CT	0	1000 CT	8500		25	
DO-T25	TF4RX13YY	Interstage	10,000 CT 12,000 CT	1 1	1500 CT 1800 CT	800	870	100	DI-T25
DO-T26	TF4RX20YY	Reactor 6 Hy. @ 2 Ma. DC, 1.5 Hy. @ 5 Ma. DC				2100			
	TF4RX20YY	Reactor 4.5 Hy. @ 2 Ma. DC, 1.2 Hy. @ 4 Ma. DC					2300		DI-T26
DO-T27	TF4RX20YY	Reactor 1.25 Hy. @ 2 Ma. DC, .5 Hy. @ 11 Ma. DC				100			
	TF4RX20YY	Reactor .9 Hy. @ 2 Ma. DC, .5 Hy. @ 6 Ma. DC					105		DI-T27
DO-T28	TF4RX20YY	Reactor .3 Hy. @ 4 Ma. DC, .15 Hy. @ 20 Ma. DC				25			
	TF4RX20YY	Reactor .1 Hy. @ 4 Ma. DC, .08 Hy. @ 10 Ma. DC					25		DI-T28
DO-T29	TF4RX17YY	Single or PP output	120 CT 150 CT	10 10	3.2 4	10		500	
DO-T30	TF4RX17YY	Single or PP output	320 CT 400 CT	7 7	3.2 4	20		500	
DO-T31	TF4RX17YY	Single or PP output	640 CT 800 CT	5 5	3.2 4	43		500	
DO-T32	TF4RX17YY	Single or PP output	800 CT 1,000 CT	4 4	3.2 4	51		500	
DO-T33	TF4RX13YY	Single or PP output	1,060 CT 1,330 CT	3.5 3.5	3.2 4	71		500	
DO-T34	TF4RX13YY	Single or PP output	1,600 CT 2,000 CT	3 3	3.2 4	109		500	
DO-T35	TF4RX13YY	Single or PP output	8,000 CT 10,000 CT	1 1	3.2 4	505		500	
DO-T36	TF4RX13YY	Isol. or interstage	10,000 CT	1	10000 CT	950	970	500	DI-T36

DO-TSH Drawn Hipermalloy shield and cover for DO-T's, provides 25 to 30 db shielding, for DI-T's **DI-TSH**
‡DCMA shown is for single ended useage (under 5% distortion—100MW—1KC) . . . for push pull, DCMA can be any balanced value taken by .5W transistors (under 5% distortion—500MW—1KC)
*DO-T units have been designed for transistor application only . . . not for vacuum tube service. Pats. Pend.

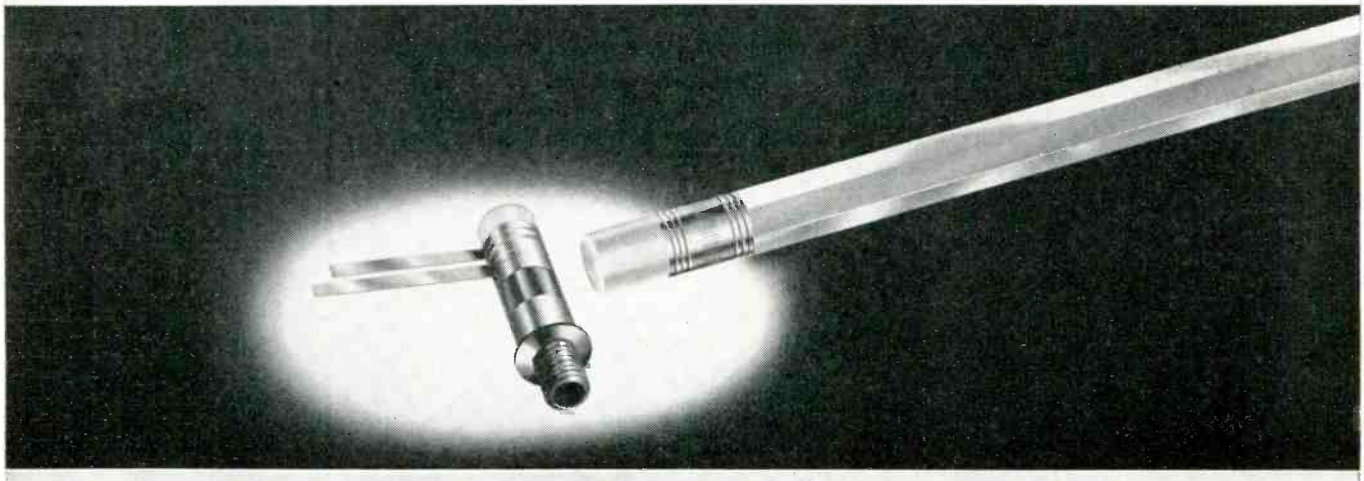
And Special Units to Your Specifications

UNITED TRANSFORMER CORPORATION
150 Varick Street, New York 13, N. Y.
PACIFIC MFG. DIVISION: 4008 W. JEFFERSON BLVD., LOS ANGELES 16, CALIF.
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"

WHY USE TWO?



WHEN ONE JFD LC TUNER WILL DO!



The versatile new JFD LC Tuner combines the characteristics of a precision variable capacitor and a metallized inductor. Its unique miniaturized construction helps effect compact electronic packaging to meet space challenging demands . . . affords higher reliability, faster assembly, and greater economy in prototype design or production.

A wide selection of 12 LC Tuners (in panel and printed circuit mounting types), each offering a large range of resonating frequencies, meet most circuitry requirements. If our standard line does not meet your needs, our engineering staff will be glad to design LC Tuners that suit your individual circuit specifications.

Typical LC Tuners Now Available

Model	Self Resonating Frequency Range	Length Above Panel	Diameter
LC303	450–700 MC	.635	5/16"
LC304	300–500 MC	.845	5/16"
LC306	200–450 MC	1.104	5/16"
LC309	125–200 MC	1.691	5/16"

Write for Bulletin 216 for further facts. Include your current design or performance problems for specific recommendations.

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CIRCLE THE NUMBERS OPPOSITE THE NAMES OF THE

132 Allegheny Electronic Chemicals Co. — Silicon crystal slices
76 Allen-Bradley Co.—Ceramic capacitors, adjustable fixed resistor
81 Allied Chemical Corp., General Chemical Div.—"Electronic grade" hydrofluoric acid
108 Allied Control Company, Inc.—Relays
109 American Electrical Heater Company—Soldering irons, temperature regulating stands
79 American Time Products, Inc. — Frequency standards
17 Amperex Electronic Corporation—Twin-tetrode tube
91 Amperite Co., Inc.—Thermostatic delay relays & ballast regulators
29 AMP Incorporated—Coaxial cable disconnect
119 Amplifier Corp. of America — Flutter meter
102 Anchor Metal Company, Inc.—Metals and alloys
69 Anderson Controls, Inc. — Step-down transformers
100 Andrew Corporation — Antenna equipment
85 Armco Steel Corporation — Electrical steel
45 Arnold Engineering Company, The — Pulse transformer
59 Astron Corporation—Subminiature electrolytic capacitors
40 Audio Devices, Inc.—Magnetic tape
113 Auto-Lite General Products Group, Wire & Cable Div.—Hook-up wire
49 Beckman/Berkeley Division A Div. of Beckman Instruments, Inc.—10 Mc Counter
7 Belden Mfg. Corp.—Electronic wire and cable
84 Bendix Aviation Corporation, Red Bank Div.—15 amp power transistors
138 Bliley Electric Company—Transistorized control oven for crystals & components
78 Borg Equipment Div., Amphenol-Borg Electronics Corp.—Miniature potentiometers
13 Bourns Laboratories, Inc.—Trimmer potentiometers
147 Bruno-New York Industries Corp. — "Pig-tailoring" machine
24 Brush Instruments Division of Clevite Corp.—Engineered chart paper
11 Burnell & Co., Inc.—Toroidal inductor
32 Burroughs Corporation, Electronic Tube Div.—Numerical readout tube
82 Bussmann Mfg. Div. McGraw-Edison Co. —Fuses and fuseholders
16 Cannon Electric Co.—RF coaxial plugs
37 CBS Electronics, A Div. of CBS, Inc.—Secondary-emission tube
54 Cinch Manufacturing Company Div. of United-Carr Fastener Corp. — Plugs and sockets
97 Circo Ultrasonic Corporation—Cleaning units
30 Cleveland Container Co., The—Fly-back coil forms, phenolic tubing
9 Clevite Transistor Products Div. of Clevite Corp.—Silicon rectifiers
61 Conrac, Inc.—Monitors, audio-video receivers
124 Cutler-Hammer Inc.—Transistorized relays
43 Clare & Co., C. P.—Relays
103 Dakota Engineering Inc.—Wire & cable securing devices
33 Dale Products, Inc.—Trimmer potentiometer
15 Delco Radio Division of General Motors —Germanium PNP transistors
34 Deutsch Company, The—Miniature connectors
96 Dit-MCo, Inc., Electronics Div.—Circuit analyzer
46 Eitel-McCullough, Inc. — Internal-anode tetrodes
55 Elastic Stop Nut Corp. of America, AGA Div.—Miniature time delay relays
47 Electra Manufacturing Company—Metal film resistor
123 Electronic Instrument Co., Inc. EICO—Power & bias supply
143 Film Capacitors, Inc.—Precision capacitors
148 Freed Transformer Co., Inc. — Variable inductors, pulse transformers
21 Fusite Corporation, The—Glass-to-steel hermetic terminal
131 General Electric Co., Defense Industries Sales—Component packaging
72 General Instrument Corp., Semiconductor Div.—Silicon power rectifiers
65 General Products Corporation—Terminal boards
23 General Transistor Corporation — Germanium diodes
130 Gertsch Products, Inc.—AC/DC ratio standard
144 Graphic Systems—Visual control board
92 Gulton Industries, Inc.—Nickel cadmium battery
2 G-V Controls Inc.—Thermal relay
18 Hoffman Electronics Corp., Semiconductor Div.—Zener reference element
62 Houston Fearless Corp. — TV camera pedestal
90 Howard Industries, Inc.—Fractional hp gear motor
4 Hughes Products, Hughes Aircraft Co.—Computer switching transistors
5 Hughes Products, Hughes Aircraft Co.—Backward-wave amplifiers
6 Hughes Products, Hughes Aircraft Co.—Crystal filter
36 Indiana Steel Products Co., The—Permanent magnets
127 Industrial Electronic Engineers, Inc.—Rear-projection type digital display
110 Industrial Test Equipment Co.—Impedance comparators
38 International Electronic Research Corp. —Electron tube shields
95 I-T-E Circuit Breaker Company—Large waveguides
117 Itemco Inc.—Humidity chamber
14 International Resistance Co.—Resistance strips, Disc resistors
145 Jennings Radio Manufacturing Corp.—Vacuum coaxial relays
112 JFD Electronics Corp.—LC tuner
136 Johnson Co., E. F.—Capacitor
68 Jones Division, Howard B., Cinch Manufacturing Co.—Barrier terminal strips
89 J-V-M Microwave Co.—Triode cavities
135 Kay Electric Co.—Noise generator
86 Kearfott Co., Inc., A Subsidiary of Precision Equipment Corp.—Ferrite isolators
94 Keithley Instruments, Inc. — Milliohmmeter
128 Kelvin Electric Co.—Toroid inductors
35 Kemet Company Division of Union Carbide Corp.—Tantalum capacitors
134 Kester Solder Company—Flux-core solder
73 Klein & Sons, Mathias—Midget pliers
77 Kleinschmidt Division of Smith-Corona Marchant Inc.—Teleprinted systems
122 Lepel High Frequency Laboratories, Inc. —Floating zone unit
60 Lockheed Electronics & Avionics Div.—Video telemetering system
50 Magnavox Co., The, Government & Industrial Div.—Anti-submarine warfare equipment
42 Magnetics Inc.—Powder core
129 Marconi Instruments—FM signal generator
139 Marconi Instruments — FM deviation meter
26 Markite Products Corp.—Potentiometers
141 Measurements A McGraw-Edison Division—Signal generator
56 Methode Manufacturing Corp.—Flexible multi-conductor wiring
74 Micro Switch A Division of Honeywell—Subminiature switch
121 Miller Company, J. W.—R. F. coils
28 Minnesota Mining and Manufacturing Co.—Magnetic tapes
115 Motorola Communications & Electronics, Inc.—AC voltmeter
19 Muirhead & Co. Limited—Control instruments, synchros, catalogue
104 Narda Ultrasonics Corporation, The—Cleaning equipment
48 National Ultrasonic Corp. — Cleaning equipment

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ADVERTISERS FROM WHOM YOU DESIRE FURTHER INFORMATION

101 Newbury Industries, Inc.—Plastic injection molding machines
44 Nothelfer Winding Laboratories, Inc.—DC power supply
64 Onan & Sons, Inc., D. W.—Auxiliary electric power plant
105 Osborne Electronic Sales Corp.—Ratio transformer, deviation meter

PROFESSIONAL ENGINEERING OPPORTUNITIES

Circle number of company on card at right from whom you desire further information.

509 American Machine & Foundry Co.
512 Bendix Aviation Corp., Kansas City Div.
507 Garrett Corporation, The
506 General Electric Co., Light Military Electronics Dept.
510 General Electric Co., Defense Systems Dept.
513 General Electric Co., Heavy Military Electronics Dept.
511 Melpar, Inc.
501 Raytheon Co., Government Equipment Div.
508 Sylvania Semiconductor Division
505 System Development Corporation
503 Texas Instruments Incorporated
502 Westinghouse Electric Corp.

116 Pennwood Numechron Co.—Digital clock movements
10 Philco Lansdale Tube Company Division—Micro alloy diffused-base transistors
20 Polarad Electronics Corp.—Field intensity receiver, tube tester, transistorized power meter
52 Potter & Brumfield Division of American Machine & Foundry Co.—Telephone type relay
107 Pyramid Electric Co.—Capacitors
1 Radio Materials Company—Subminiature ceramic capacitors
146 Raytheon Co., Industrial Tube Division—Tubes
87 Raytheon Co., Distributor Products Div.—Control knobs
58 Reeves Instrument Corporation — Gyro and gyro system test equipment
63 Rohn Manufacturing Co., Inc.—Communication tower
57 Sangamo Electric Company — Inductive component engineering
98 Scala Radio Company — Parabolic reflector
27 Scintilla Division Bendix Aviation Corp.—Cable assemblies
106 Scopes Company Inc., The—Portable oscilloscopes
22 Sealectro Corporation — TEFLON terminals
66 Shoe Form Co., Inc.—Plastic boxes
70 Shure Brothers, Incorporated—Communications microphone
80 Sonotone Tube Division—Tubes
3 Sprague Electric Company—Wirewound resistors
39 Stackpole Carbon Company—Fixed composition resistors
114 Stanpat Co.—Adhesive back drafting aids
8 Stevens Manufacturing Co., Inc — Thermostats
93 Stromberg-Carlson A Div. of General Dynamics—Relays
75 Sylvania Electric Products, Inc., Special Tube Operations—Magnetrons
25 Sylvania Electric Products, Inc., Semiconductor Division — NPN & PNP switching transistors
125 Syntronic Instruments, Inc.—Deflection yokes
53 Superior Electric Company—Connectors
99 Tamar Electronics, Inc.—Cable connector
118 Technical Appliance Corp. TACO—Communication antennas
142 Technical Appliance Corp. TACO—Airborne antennas
12 Tektronix, Inc.—Dual-beam oscilloscope
31 Telechrome Mfg. Corp.—Special effects generator
41 Texas Instruments Incorporated — Germanium power transistor
51 Transitron Electronic Corporation — Zener diodes
67 Tung-Sol Electric Inc. — Twin power triode
111 United Transformer Corporation — Transistor transformers
71 Varian Associates, Instrument Division—Potentiometer recorder
120 Walsco Electronics Mfg. Co. Division of Textron Inc.—Chassis punches
88 Waveline Inc.—Attenuation devices
83 Wheelock Signals, Inc.—Tubular relay
137 White Industrial Division, S. S.—Air abrasive unit

Employment—Use the handy card below to get more information on the engineering positions described in the "Professional Opportunities" Section which begins on page 185 of this issue.

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502	507	512	517	522
503	508	513	518	523
504	509	514	519	524
505	510	515	520	525

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NEW PRODUCTS—SEPTEMBER '59

167 Adapters, current test — Vector Electronic Co.
236 Amplifiers—Reeves Instrument Corp.
225 Analyzer, wave—Quan-Tech Labs., Inc.
219 Antenna, radar — Underwood Corp., Canoga Div.
170 Attenuators, coaxial — Weinschel Engineering Co.
239 Attenuators, step—Empire Devices Products Corp.
249 Camera, CCTV — Packard-Bell Electronics Corp.
185 Capacitor, tantalum slug—Ohmite Manufacturing Co.
229 Capacitors, ceramic—Vitramon, Inc.
173 Capacitors, micromodule—Sprague Electric Co.
179 Capacitors, tantalum — General Electric Co.
226 Changer, gain—John Oster Mfg. Co.
201 Cleaner, ultrasonic—National Ultrasonic Corp.
172 Comparator, voltage—Non-Linear Systems, Inc.
169 Connectors—The Superior Electric Co.
183 Converters—Electro Instruments, Inc.
235 Counter and printer—American Data Div., American Electronics, Inc.
231 Delayline, lumped—Technitrol Engineering Co.
223 Diode, parametric—International Telephone and Telegraph Corp.
187 Duplexer, ferrite—Microwave Associates, Inc.
222 Generator, time-delay — General Radio Co.
221 Housing, CCTV—General Electric Co., Technical Products Dept.
247 Image orthicon—Radio Corp. of Amer., Electron Tube Div.
184 Indicator, servo—General Controls Co.
205 Inductors, toroidal—Burrnell & Co.
175 Klystron, amplifier—Varian Associates
182 Microdials—Borg Equipment Div., Amphenol-Borg Electronics Corp.
248 Microphone, cardioid — Electro-Voice, Inc.
186 Modulator, microwave — Narda Microwave Corp.
220 Oven, bench-model — American Instrument Co., Inc.
233 Plugs, environmental—Cannon Electric Co.
230 Preamplifier, plug-in—Tektronix, Inc.
202 Ratio standard, ac/dc—Gertsch Products, Inc.
203 Receptacles, card—Methode Manufacturing Corp.
250 Recorder, tape—Midwestern Instruments, Inc., Magnecord Div.
168 Rectifiers, silicon—Audio Devices, Inc., Rectifier Div.
246 References, silicon — Transitron Electronics Corp.
240 Relays—Electronic Div., Elgin National Watch Co.
237 Relay, vacuum transfer—Jennings Radio Mfg. Corp.
178 Servometer—Beckmen Instruments, Inc.
166 Socket, UHF—Jettron Products, Inc.
177 Stack, memory—General Ceramics Corp., Applied Logics Div.
224 Switch, accelerometer—Humphrey, Inc.
181 Switch, panel—Electrosnap Corp.
234 Switch, toggle—Hetherington, Inc.
171 System, SSB adapter—Kahn Research Laboratories, Inc.
227 System, switching—Kin Tel Div. Cohu Electronics, Inc.
232 Terminal, feed-thru—Sealectro Corp.
238 Transistor, germanium—Tung-Sol Electric, Inc.
180 Transistor, power—Motorola, Inc., Semiconductor Products Div.
176 Transistor, silicon — Transitron Electronic Corp.
174 Tranformers, miniature—Microtran Co., Inc.
204 Triode—Raytheon Co.
228 Tube, TV picture—Westinghouse Electric Co.

NEW TECH DATA

189 Bio-Assays—Controls for Radiation, Inc.
210 Catalog, sealed relay—General Electric
190 Chambers, temperature—Missimers, Inc.
244 Choppers, coaxial — James Vibrapower
206 Clamps, servo—Sterling Precision Corp., Instrument Div.
243 Cleaning, ultrasonic — Circo Ultrasonic Corp.
188 Conversion factors — Precision Equipment Co.
196 Fastener, plastic—Richco Plastic Co.
194 Glass-Ceramic—Corning Glass Works
197 Guide, bidder's—Blonder-Tongue Labs.,
218 Krypton 85—Air Reduction Co., Inc.
211 Lamps, miniature—Tung-Sol Electric Co.
215 Oscillator—Tele-Dynamics, Inc.
199 Potentiometer, AC — Vernistat Div., Perkin-Elmer Corp.
192 Power supplies—Mideastern Electronics, Inc.
242 Power supplies—Matthew Labs., Inc.
193 Preamplifiers—The Victoreen Instrument Co.
200 Publication, computer—Donner Scientific Co.
198 Radio, FM—Monitoradio Div., I.D.E.A., Inc.
214 Regulators, missile—Linde Co., Div. of Union Carbide Corp.
191 Relay, mercury—Mack Electronic Devices, Inc.
207 Relay, time delay—AGA Div., Elastic Stop Nut Corp.
212 Resistor, wire-wound — Dale Products, Inc.
195 Service, antenna—D. S. Kennedy & Co.
251 Shields, magnetic—Perfection Mica Co.
209 Switch, rotary—Couch Ordnance, Inc.
216 System, measuring — Consolidated Electrodynamics Corp.
217 System, Video—Cohu Electronics
208 Terminal, PC — Litton Industries, USECO Div.
213 Testing, synchro — Theta Instrument
241 Transformer—Arnold Magnetics Corp.
245 Transistors, tetrode — General Electric Co., Semiconductor Products Dept.

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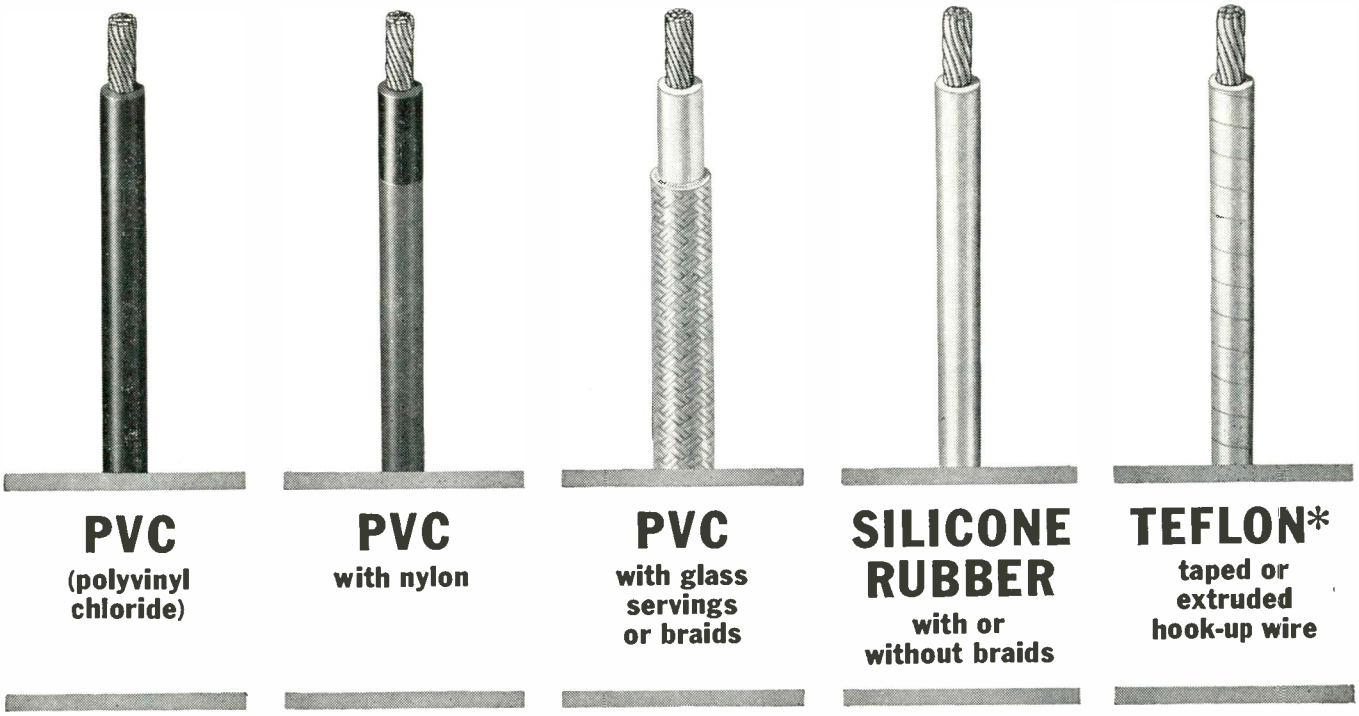

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X-band radar antenna, Model 8340, designed for mobile use as a portion of a tactical weapons system. Characteristics include operation over 8750 to 10,500 MC with a power handling

capability of 300 kw peak power if operated unpressurized. Standard polarization of the antenna feed is linear and adjustable to any orientation; Circular polarization also available. The unit can accommodate reflectors up to 3 ft. in dia., providing approx. 37 db gain at mid-band frequencies. Underwood Corp., Canoga Div., 15330 Oxnard St., Van Nuys, Calif.

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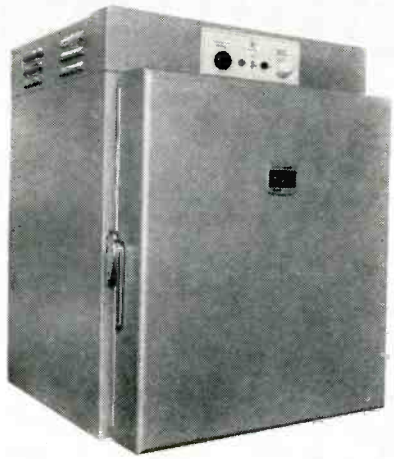
BENCH-MODEL OVEN

High-temp, bench-model oven offers constancy and uniformity values at temp. from 125°F to 1000°F. A simultaneous temp. recording of 8 thermocouples suspended 2 in. from the corners shows a uniformity of ±4°F. at 1000°F. A thermocouple suspended in the center of the oven for approx. 4 hrs. showed a constancy of ±0.5°F. at 150°F., 500°F., and 1000°F. The oven's electric resistance heaters are



located in all 6 walls and are thermally weighted to produce max. temp. uniformity. American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.

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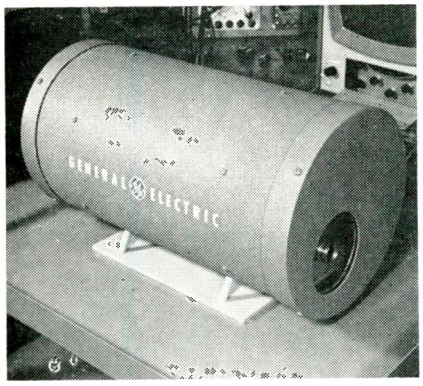
New Products

CCTV HOUSING

Anti-magnetic housing for closed-circuit television cameras is designed to protect TV cameras against interference from magnetic fields produced by high ac or dc currents. Applica-

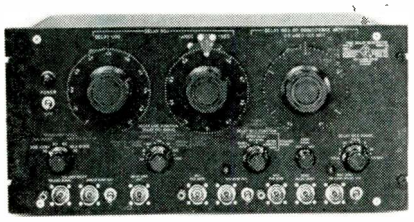


tions include observation of metallurgical furnaces or wherever camera operation would be affected by high-capacity power lines. Combinations of metals provide protection against ac and dc fields. Protection is assured against 40 gausses in a dc field and 80 in ac. General Electric, Technical Products Dept., Electronics Park, Syracuse, N. Y.

Circle 221 on Inquiry Card

TIME-DELAY GENERATOR

Type 1392-A, analog generator, produces accurately known and continuously adjustable time delays. An external signal voltage of almost any waveshape will set the PRF. Two delay circuits provide delays relative to the 0.1 sec direct synchronizing reference pulse of from 0 to 1.1 sec. Delay No. 1 is initiated by the direct synchronizing pulse. Delay No. 2 can be



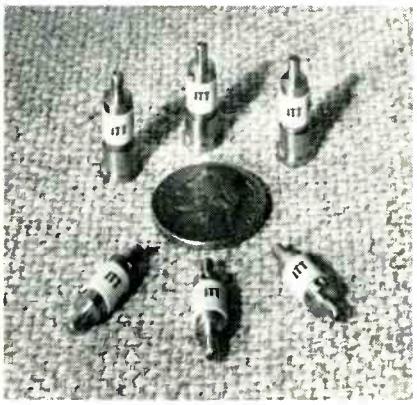
initiated by either the direct synchronizing pulse or the Delay No. 1 synchronizing pulses. General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Circle 222 on Inquiry Card

New Products

PARAMETRIC DIODE

Parametric diode with applications where high cut-off frequency is required has been successfully tested in low-noise amplifiers used for extending the range of missile tracking and in over-the-horizon communication



equipment. The diode also can be employed in such electronic devices as harmonic generators, frequency converters and voltage tuned circuits. Developmental types include diodes with cut-off frequencies ranging up to 150 KMC, with zero bias capacitance as low as 0.4 $\mu\mu$f. International Telephone and Telegraph Corp., Components Div., Clifton, N. J.

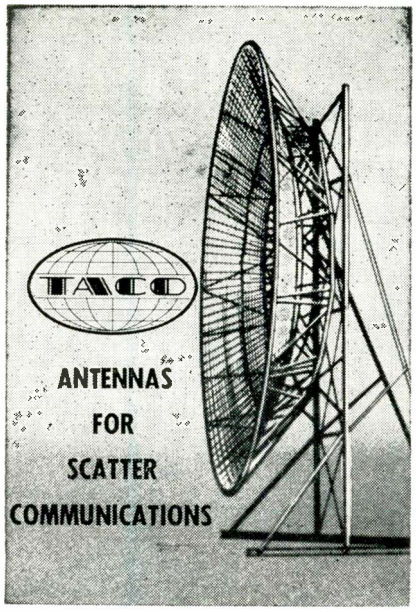
Circle 223 on Inquiry Card

ACCELEROMETER SWITCH

High-performance acceleration switch, the AS-13 Series, has single-pole, double-throw, normally-open contacts. It can be furnished with a built-in relay to provide more complex switching contacts. There is only one moving part in the AS-13 accelera-

tion switch. The new instrument weighs less than four ounces, and is expected to find widespread use in applications calling for precision inertia-operated switches. Humphrey, Inc., 2305 Canon St., San Diego, Calif.

Circle 224 on Inquiry Card



Parabolic reflectors up to 32′ diameters, complete with feed systems to meet specific needs, including dual polarization. Taco is one of the world's largest suppliers of parabolic antennas to the military and commercial markets.

Write for complete technical data...

TACO

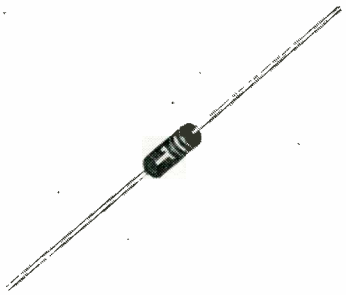
TECHNICAL APPLIANCE CORPORATION
SHERBURNE, NEW YORK

Circle 118 on Inquiry Card

New Products

SILICON REFERENCES

Line of subminiature silicon voltage references IN821-IN827 Series, combine features of lower dynamic resistance and voltage stability exceeding that of a standard cell. Single-piece construction affords ideal thermal connection between "zener" diode and the compensating stabistor, assuring that the junctions operate at

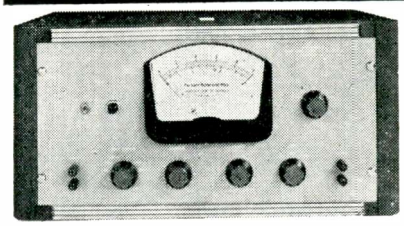


the same temp., eliminating warm-up transients. Also available as symmetrical double anode types, they offer temp. coefficients as low as 0.001%/°C. Transitron Electronic Corp., 168 Albion St., Wakefield, Mass.

Circle 246 on Inquiry Card

New Accurate and Sensitive

FLUTTER METER



Complies with standards set by the Institute of Radio Engineers. With Built-in 3 kc Oscillator, High-Gain Preamplifier, Limiter, and Filter. Ranges: 0.5 to 6 cps; 0.5 to 250 cps; 5 to 250 cps. Designed for rapid visual indication of flutter and wow produced by magnetic tape recorders and playback equipment, disc recorders and reproducers (all speeds), sound film mechanisms and film recorders.

Flutter and wow readings can be separated by a high-pass and low-pass filter. Large, sensitive 7 inch meter has three scales: 0.3%, 1.0%, and 3.0%, calibrated for flutter and wow readings. Accuracy within 2% of full scale value, independent of wave-form, amplitude variation, hum, noise, switching surges and other extraneous transients.

CONDENSED SPECIFICATIONS

Input Voltage	0.001 to 100 Volts
Ranges	0.01 to 3%
Limiter Range	20 db
Oscillator (Built-in)	3,000 Cycles
Net Price	$495.00

Write for complete specifications to Dept. EI:

AMPLIFIER CORP. of AMERICA
398 Broadway, New York 13, N. Y.

Circle 119 on Inquiry Card

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SQUARE

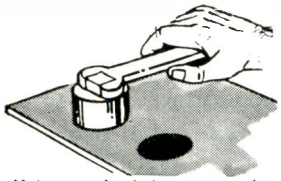
KEY

"D"

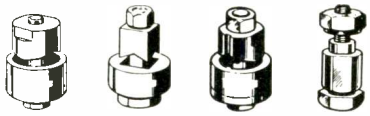
Cut Holes In Less Than 90 Seconds!

with Walsco

CHASSIS PUNCHES



Make any size hole you want for sockets, plugs, meters, others... do it faster with less effort with famous Walsco L.T.* Chassis Punches. Easy to use... last a lifetime. Send postcard for free literature.



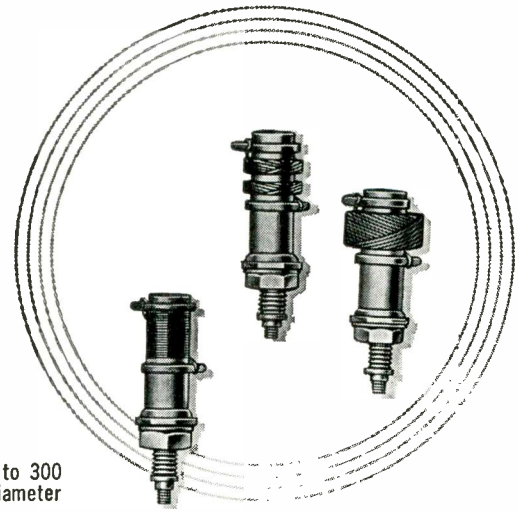
(*L.T. is Walsco's exclusive "Low-Torque" design)

WALSCO ELECTRONICS MFG. CO.
Division of Textron Inc.
Western Plant: Los Angeles 18, California
Main Plant: ROCKFORD, ILLINOIS, U.S.A.

Circle 120 on Inquiry Card

MILLER small, adjustable R. F. COILS

—built with top quality materials, impregnated with moisture-resistant varnish, and 100% tested to exacting specifications.



SUB-MINIATURE RANGE:
—15 items, with inductances from .17 to 300 microhenries. Form dimensions: 3/16″ diameter x 5/8″ long. Mounting hole: 11/64″.

MINIATURE RANGE:
—15 items, from .4 to 800 microhenries. Form dimensions: 1/4″ diameter x 7/8″ long. Mounting hole: 3/16″.

STANDARD RANGE:
—13 items, from .9 to 2100 microhenries. Form dimensions: 3/8″ diameter x 1-1/16″ long. Mounting hole: 1/4″.

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MILLER QUALITY PRODUCTS

J. W. MILLER COMPANY
5917 S. Main St., Los Angeles 3, Calif.

Circle 121 on Inquiry Card

Circle 122 on Inquiry Card

New Products

WAVE ANALYZER

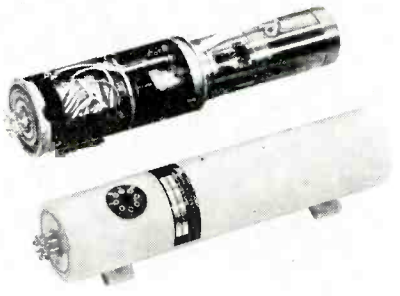
Wave and noise spectrum analyzer, Model 303, is an all-transistorized unit with flat-topped bandpass. It covers frequencies from 30 cycles to 100 KC. A switch selects any of the 4 constant

bandwidths from −3 db at 10 and 30 cycles round top, and 100 cycles and 1 KC flat top. Its voltage range is 100 μv. to 300 v. full scale. Input impedance is 100k ohms and 1 megohm. The meter output and a voltage proportional to the dial setting provide a graphic display on oscilloscopes and X-Y recorders. Quan-Tech Labs., Morristown, N. J.

Circle 225 on Inquiry Card

GAIN CHANGER

Gain Changer contains 7 components in a single package 6 in. long (less terminal lugs) and 1.375 in. in dia. and weighing 18 oz. Type 9805-12 consists of a 115 v.; 400 cycle synchronous motor with phase shifting capacitor coupled thru a 24,000:1 ratio gear train, magnetic clutch with associated dc power supply and spring reset mechanism for driving a 2-



gang potentiometer. Operating temperature range is −62°C to +100°C. Unit meets MIL-E-5272B. John Oster Mfg. Co., Avionic Div., 1 Main St., Racine, Wis.

Circle 226 on Inquiry Card

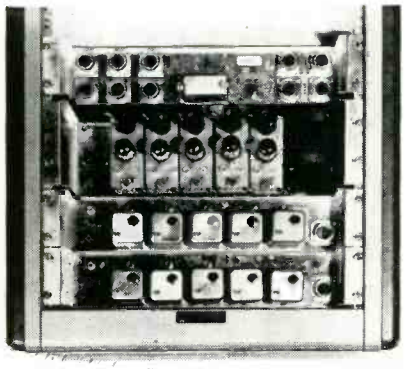
Circle 123 on Inquiry Card

Circle 127 on Inquiry Card

New Products

SWITCHING SYSTEM

A master switching and distribution system for closed circuit TV, designated as Model AVS-X, is capable of switching the signals from any number of TV cameras to any number

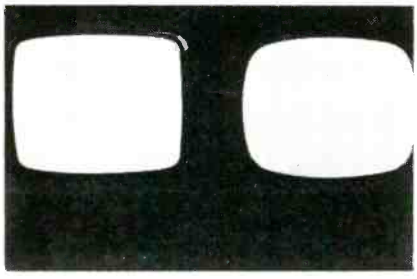


of viewing monitors. The entire network can be operated by a simple selector-switch panel located at a central control station or, if desired, at each monitor. There is no limit to the number of cameras and monitors that can be tied into one system. KIN TEL Div., Cohu Electronics, 5725 Kearny Villa Road, San Diego 12, Calif.

Circle 227 on Inquiry Card

TV PICTURE TUBE

A 110-degree television cathode ray tube (Type 23BP4) with the safety panel sealed to the tube by epoxy resin. The double faceplate construction eliminates the implosion glass used on conventional television receivers. The 23BP4 has 20 square inches more viewing surface when compared to the conventional 21 inch picture tube. This increase was ob-



tained by increasing the height and width of the screen and by making the corners of the faceplate nearly rectangular. Westinghouse Electric Corp., Box 2278, Pittsburgh, Pa.

Circle 228 on Inquiry Card

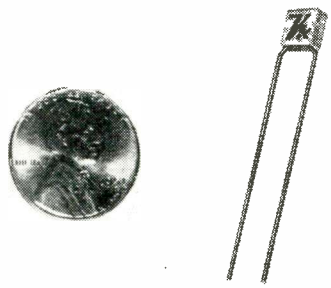
Circle 124 on Inquiry Card

Circle 125 on Inquiry Card

New Products

CERAMIC CAPACITORS

Ceramic capacitor series, VK, combines miniature size, high operation and reliability. It is built to operate from −55°C to 150°C at 200 vdc without derating in a capacitance

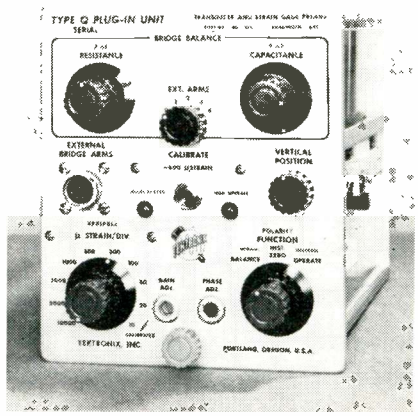


range from 47 to 10,000 μμf. The series can withstand a potential of 800 vdc applied for 10 sec. at 25°C. Insulation resistance is of the order of 10,000 ohmfarads (10^{12} ohms) at 25°C and 35 ohmfarads (10^{10} ohms) at 150°C. Capacitance change through the entire temp. range is typically ±10% with a max. excursion of ±15%. Vitramon Inc., Box 544, Bridgeport 1, Conn.

Circle 229 on Inquiry Card

PLUG-IN PREAMPLIFIER

The Type Q unit equips Tektronix oscilloscopes for use with strain gages and other transducers. It achieves the equivalent of dc amplification by amplitude modulating a 25 KC carrier voltage. Characteristics are: Carrier frequency 25 KC, frequency response dc to 6 KC, risetime approximately 60 μsec, strain sensitivity 10 microstrain (μin per in.) per major graticule div. to 10,000 microstrain per div.



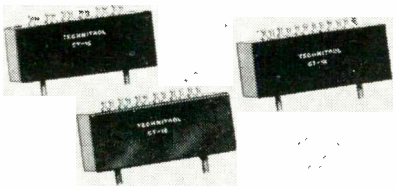
continuously variable. Max. sensitivity with 4 active arms and a gage factor of 2 is 2.5 microstrain per div. Tektronix, Inc., P. O. Box 831, Portland, Ore.

Circle 230 on Inquiry Card

New Products

LUMPED DELAY LINE

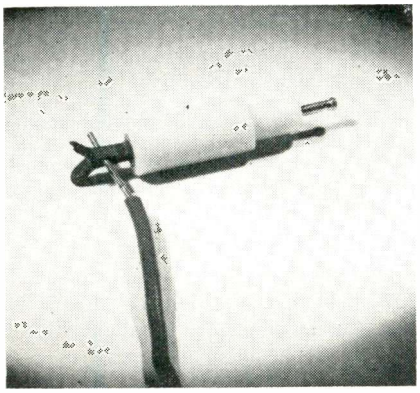
Lumped-constant Delay Line CT-18 has 10 separate taps of 0.05 μsec each providing a max. total delay of 0.5 μsec. Impedance is 550 ohms and max. rise time figure is 0.1 μsec. Attenuation is 1.0 db max. and temp. range is −25 to +85°C. It is 2½ in. long, 1 in. wide and approx. 1½ in. high including threaded mounting studs on the underside of the case. Applications include: trimmer for a long delay line, variable pulse generator and a variable pulse forming network. Technitrol Engineering Co., 1952 E. Allegheny Ave., Philadelphia, Pa.



Circle 231 on Inquiry Card

FEED-THRU TERMINAL

External connections are readily made and broken with the Type FT-2010 ML "Press-Fit" terminals. The beryllium-copper clip end grips wire ends or other conductors securely for the duration of a test, after which the connections are simply pulled away. Voltage breakdown rating is 11,000 vdc at sea level. One-piece terminal simply presses into the given hole without need of screws, nuts, washers, lockwashers or other hardware, for a trouble-free installation. Sealectro Corp., 139 Hoyt St., Mamaroneck, N. Y.

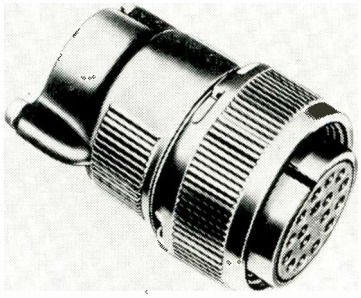


Circle 232 on Inquiry Card

New Products

ENVIRONMENTAL PLUGS

The Class "R" environmental resistant plug is a new addition to the MS plug family. These MS-R plugs are described in a new "D" revision to MIL-C-5015. According to the spec, Class "R" plugs supersede the MS-E



types currently in use, which may be used in existing equipment, but not be incorporated in new designs. The new plugs use a moisture sealing grommet at the exit of the wires which seals each wire individually and also supports the cable. Advantages are a 30% saving in plug length and a 25% saving in weight as compared with the older MS-E. Cannon Electric Co., P. O. Box 3765, Terminal Annex, Los Angeles 54, Calif.

Circle 233 on Inquiry Card

TOGGLE SWITCH

Midget SPST toggle switch, T4201, has applications where space, weight and durability are vital factors. The toggle may be capped with a gray silicone rubber boot for added protection against moisture. Switch is rated

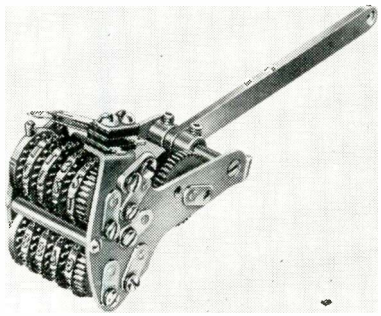
for 1 a @ 28 vdc resistive load at sea level. Overall length is 57/64 in. and case dia. is 21/64 in. Recommended panel mounting hole is ¼ in. Hetherington Inc., 1420 Delmar Drive, Folcroft, Pennsylvania.

Circle 234 on Inquiry Card

New Products

COUNTER AND PRINTER

Direct read-out Swinging Head Counter continuously prints digital data ranging from + through 0 to — numbers. Other symbols such as North (N) or South (S) may be substituted. Unit requires no interpola-

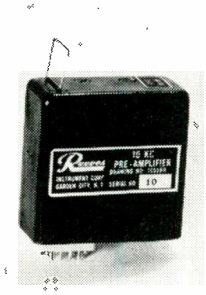


tion of data. True numerical values and symbols are printed out directly in a parallel line on tape, card, or any other print output. The counter employs 2 sets of 4-digit print wheels, both the positive and negative set printing out digits ranging from 0001 to 9999 respectively. Fundamentally a shaft-driven device, but pulse inputs of 720 per min. can be accommodated. American Data Div., American Electronics, Inc., 75 Front St., Bklyn. 1, N. Y.

Circle 235 on Inquiry Card

AMPLIFIERS

Line of subminiature transistorized amplifier assemblies feature modular design allowing for ready assembly. Operating temp. range is —55°C to +90°C. They withstand up to 10g vibration to 2000 cps, and shock as high as 15g along any axis. Fifteen



different amplifier types are currently available, including units for summing, isolation, AGC, relay, servo and pulse applications. Reeves Instrument Corp., Roosevelt Field, Garden City, N. Y.

Circle 236 on Inquiry Card

New Products

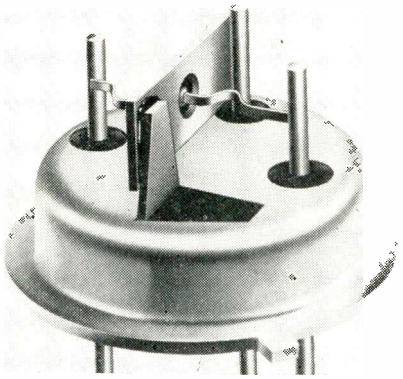
VACUUM TRANSFER RELAY

RE6B vacuum transfer relay is for high voltage used in limited space applications very often found in antenna switching, pulse forming networks and similar r-f and dc circuits. The relay has a 60 cycle or dc operating voltage rating of 25 kv and a peak test voltage of 35 kv. The relay will carry continuous currents of 25 a at 60 cycle or 9 a at 16 MC. It has a continuous dc interrupting rating of 20 kw (not to exceed steady state currents of 5 amps). It employs a 26.5 vdc actuating coil with a 125°C operating ambient temp. Jennings Radio Mfg. Corp., P. O. Box 1278, San Jose, Calif.

Circle 237 on Inquiry Card

GERMANIUM TRANSISTOR

PNP germanium alloy junction transistor, 2N1313, for high current, high speed, computer switching applications. It withstands 20,000 g centrifuge, exceeds MIL specs for shock, vibration, resistance to salt spray and moisture, and shows excellent current gain linearity. It's thermal resistance derating is the lowest for electrically insulated devices (0.350°C/mW, typical). Other features: stress-relieved collector and emitter connectors, a double-anchored junction tab, mated seal header, and TO-5 index tab. Tung-Sol Electric Inc., 1 Summer Ave., Newark 4, N. J.

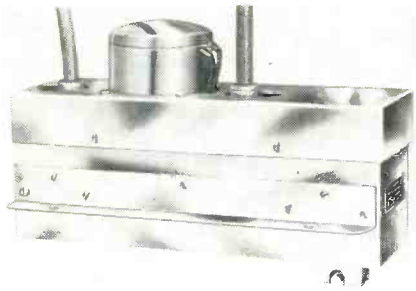


Circle 238 on Inquiry Card

New Products

STEP ATTENUATORS

Designed for use where manual operation of attenuators is not practical, a new line of 6 or 12-position automatic step attenuators, Empower, is powered by a motor-operated driving mechanism. Actuation of a simple



rotary switch, or of push buttons causes the mechanism to produce, automatically, the rotary and linear movements required to insert the desired attenuation value. Standard attenuation values are from 0.1 db to 60 db, and can handle 1 or 4 watts of r-f power. Frequency range is from dc to 4 KMC, and standard units operate from a 28 vdc power source. Empire Devices Products Corp., Amsterdam, N. Y.

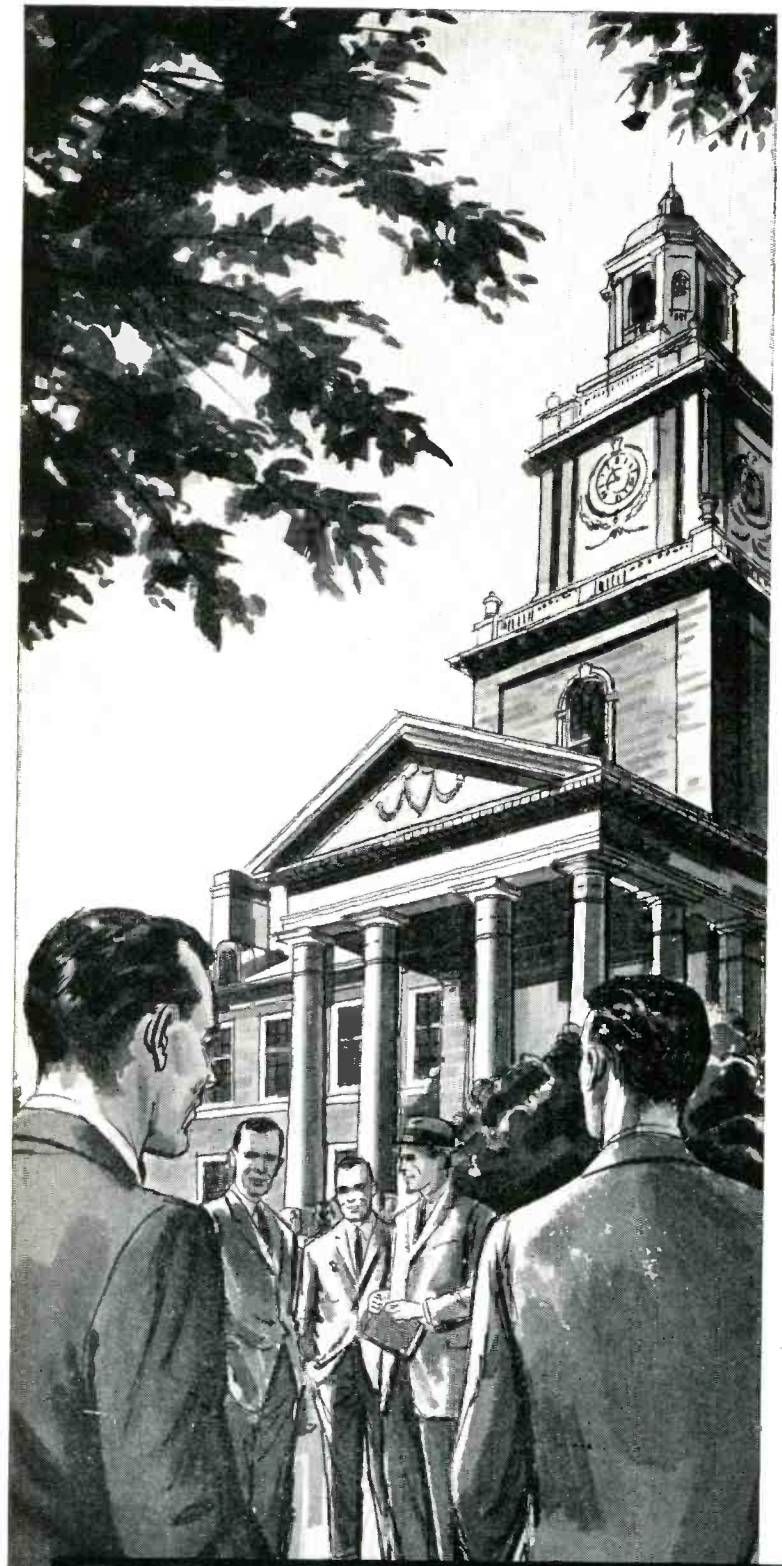
Circle 239 on Inquiry Card

RELAYS

Three new types of Elgin-Advance relays feature high sensitivity — of 250, 100 and 50 mw—in a crystal can size with 0.2 in. grid spacing. Nominal operating voltages range from 1 to 110 v., with coil resistances from 35 to 10,000 ohms. Relays are rated up to 3 a resistive at 28 vdc or 115 vac. They operate under vibration as high as 30 g's to 2000 CPS, with shock ratings of 50 to 100 g's. The temp. range

extends from −65° to +125°C. Designated MQA, MQB and MQC, the relays are hermetically sealed and meet mil. specs. Electronic Div., Elgin National Watch Co., 2435 No. Naomi St., Burbank, Calif.

Circle 240 on Inquiry Card



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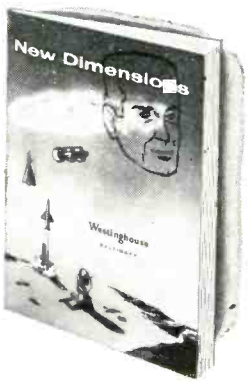
- Ferret Reconnaissance
- Electronics Instructors
- Communications Circuitry
- Field Engineering
- Technical Writing
- Electronic Packaging
- Experimental Psychologists
- Other positions open for Electrical & Mechanical Engineers and Physicists



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BALTIMORE

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Engineering Enrollment Dips, Further Cuts Seen

In the face of ever increasing challenges and opportunities for trained engineers, freshmen engineering enrollment declined last Fall for the first time in eight years. The final count—institutions with ECPD accredited curricula: 59,164 (down 11.8%); all others: 10,865 (down 7%): total: 70,029 (down 11.1%).

Most disturbing is the possibility of further declines in 1959; and the causes of the decline (while all college freshman enrollment increased by 7%). A special study by Engineering Manpower Comm., in cooperation with the American Society for Engineering Education, revealed that although 45% of the Deans of Engineering anticipate increased 1959 enrollment, 20% are expecting further declines—particularly in the East and Southcentral.

The reasons given by Deans for the decline concern the reduced number of applications received. These may be summarized as follows: (1) Because of a false appraisal of the long-range engineering career opportunities by counsellors, students and parents, based on reports in the general press on lay-off and reduction of company engineering complements during the 1957-58 recession period. (2) Because of increased concern about rigors of engineering curriculum. (3) Because of increased interest by potential engineering students in other scientific fields resulting in diversion of students to other educational pursuits.

Three-quarters of the Engineering Deans and Presidents were convinced that improper counselling by guidance officials in secondary schools, based primarily on reports of diminishing opportunities in engineering which, in fact, were transitory.

GOLD-PLATED TERMINALS

To meet rigid torque tests IBM gold plates brass resistor-board lugs. Plating prevents embrittlement, while protecting against corrosion. Here operator completes assembly of board provided by Taylor Fibre Co. into SAGE computer unit.

Teacher Income Up 13.5%

The teaching salaries and other professional income of engineering teachers rose from $8,862 in 1956 to $9,598 in 1958 (8.3%).

Average teaching salaries rose $894 (13.5%), but outside income declined 7%. Consulting opportunities apparently declined sharply during the 1957-58 recession period.

These details are spelled out in a study by Engineering Manpower Commission. Copies may be obtained at a cost of 25¢ from Engineering Manpower Comm., 29 West 39th St., New York 18.

A more serious problem discussed by the Deans concerns the increased rate of attrition of undergraduate engineering students. This trend was reported by 35% of the institutions. It appears that estimates of numbers of degrees in engineering for the next three years will have to be revised downward.

Survey To Assess U. S. Needs For Scientists

The National Science Foundation is launching a survey to determine how many scientists and technicians the U. S. has now and how many will be needed in the future.

The goal of the program is to gather timely information on the "supply, demand and utilization of scientists and technical personnel."

Three projects have been labled "most urgent": the identification of scientific and technical occupations; a periodic survey of scientific and technical personnel; and a periodic study of the demand outlook for various kinds of scientific and technical personnel in each major activity.

More Graduates Go Back For Advanced Courses

More of this year's crop of graduating engineers are going back to school for advanced work than did last year's, reports Engineers Joint Council.

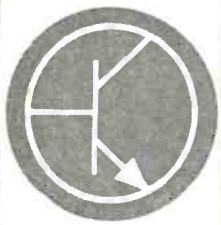
Where 9.8% of the 1958 graduating engineers returned for graduate work, 10.9% of the 1959 class will be returning.

The availability of employment seems to have little to do with their decision. The survey of 100 colleges shows that 63.3% of the graduating class have already accepted employment, compared with 59.0% last year.

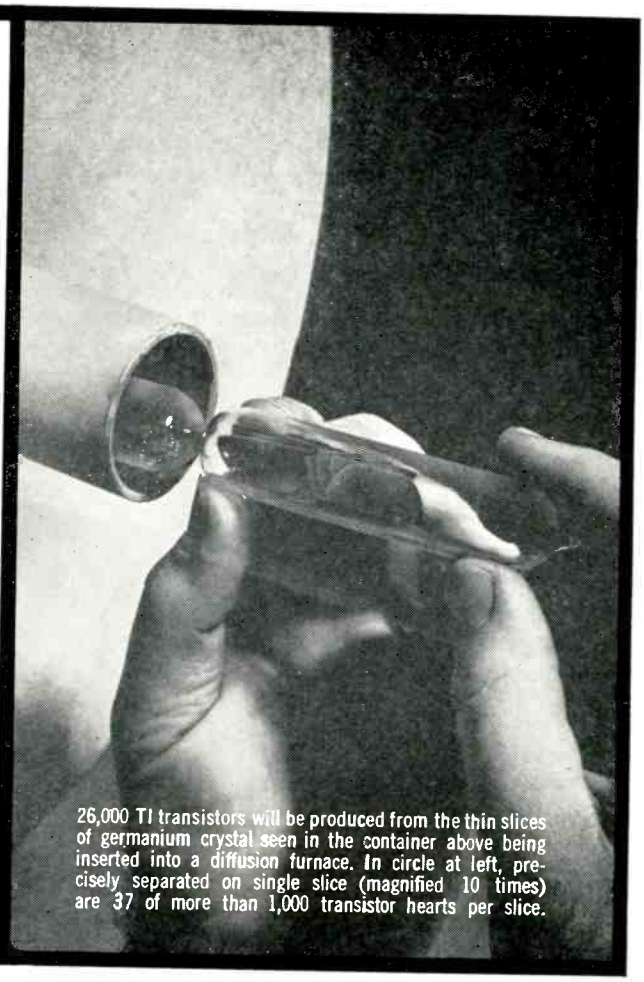
Approximately 8% of the graduating engineers are going directly into the armed services. This is considerably lower than last year.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 169.

CAREER OPPORTUNITIES AT TI



DEVICE DEVELOPMENT ENGINEER



26,000 TI transistors will be produced from the thin slices of germanium crystal seen in the container above being inserted into a diffusion furnace. In circle at left, precisely separated on single slice (magnified 10 times) are 37 of more than 1,000 transistor hearts per slice.

your future: a challenging opportunity with an industry leader

Now take advantage of maximum professional growth at Texas Instruments by participating in development of the most advanced semiconductor-component devices. Working with the newest facilities, take part in:

- **DEVICE DEVELOPMENT** Development of new devices by studies in solid-state diffusion, alloying of metals and semiconductors, vacuum deposition of metals, surface chemistry, and solid state physical measurements.
- **SURFACE STUDIES** Surface reactions and surface energy phenomena on silicon and germanium.
- **ADVANCED COMPONENT DESIGN** Development of new components by studies of deposition of thin films, electrolytic studies such as anodic oxidation rates and film structures.
- **NUCLEAR RADIATION** experiments on semiconductor materials and devices.

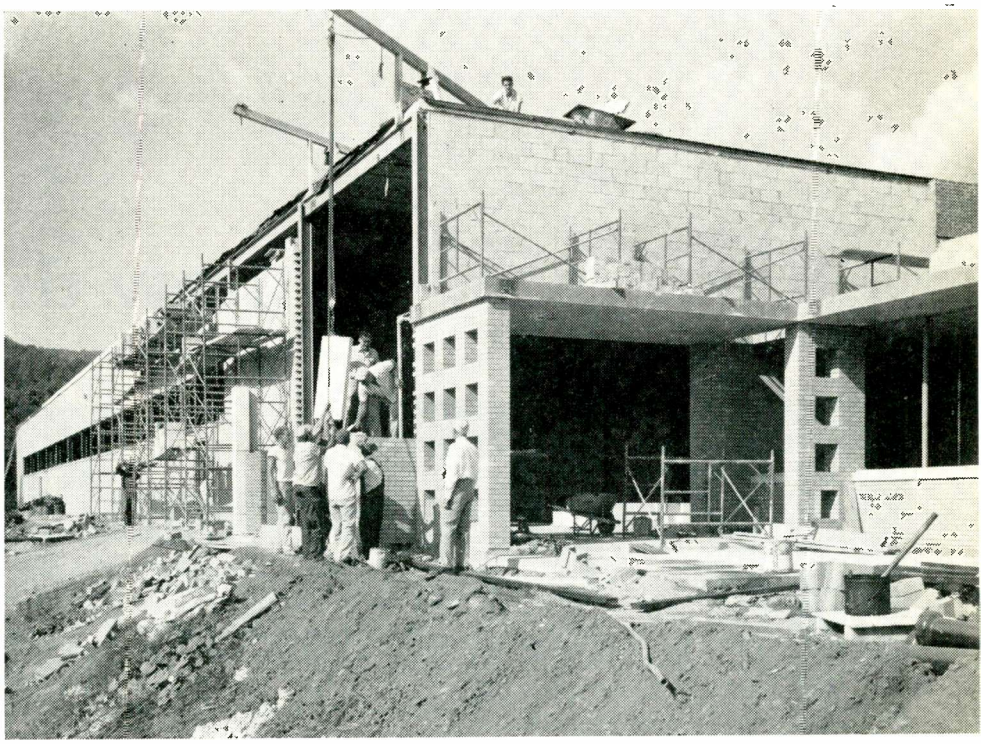
With TI . . . receive liberal company-paid benefits, including profit sharing *(last year 15% of base salary)* . . . enjoy premium living in a moderate climate with excellent neighborhoods, schools and shopping facilities . . . work in a plant selected as one of the 10 outstanding U. S. industrial buildings of 1958.

Interviews will be held in your area soon. If you have an Electrical Engineering, Physical Chemistry or Physics degree and experience in semiconductor or related development areas, please send a resume to:

C. A. Besio, Dept. 201

For immediate Eastern appointment, contact H. C. Laur Dept. 201-E 1141 E. Jersey St. Elizabeth, N. J.

TEXAS INSTRUMENTS
INCORPORATED
SEMICONDUCTOR – COMPONENTS DIVISION
POST OFFICE BOX 312 • DALLAS, TEXAS



The new large addition to Kearfott's Asheville plant is shown under construction. Addition was built by R. S. Noonan, Inc.

By **JOHN E. HICKEY, Jr.**
Associate Editor
"Electronic Industries"

One Solution to Plant Expansion

The need for greater plant space is a problem at one time or another to all manufacturers. Here is one possible solution— it worked for a synchro manufacturer. It takes a minimum of capital and offers significant tax benefits.

IN our fast growing field of electronics, many companies, large and small, are faced with a need for expansion. When this happens the company has the problem of whether to rent, buy or build a new plant, or build an addition to an existing plant. Secondly if they decide to build a new plant, where shall it be located?

The present synchro manufacturing plant of Kearfott, Inc., in Asheville, N. C. is a good illustration of the problems faced by an expanding company as it seeks additional manufacturing space.

We discussed this problem with them at the Asheville plant. With fourteen plants employing nearly 6,000 persons in northern New Jersey, California and North Carolina, Kearfott has experienced nearly all of the expansion problems of the fast growing electronic industry. Perhaps other Companies wishing to expand may learn something from Kearfott's North Carolina operation.

To understand just how Kearfott arrived at the decision to build in Asheville, it is first necessary to go back four years when their synchro operation began to outgrow their plants in northern New Jersey.

When Kearfott required more manufacturing space, they had first to decide in what geographical area to build. Management agreed that the new production facility would be more competitive if located out of the north Jersey area so that a completely self-sustaining large volume semi-automatic production operation could be developed. They then organized two teams to look into potential industrial building locations,

1—to investigate the New England area, and

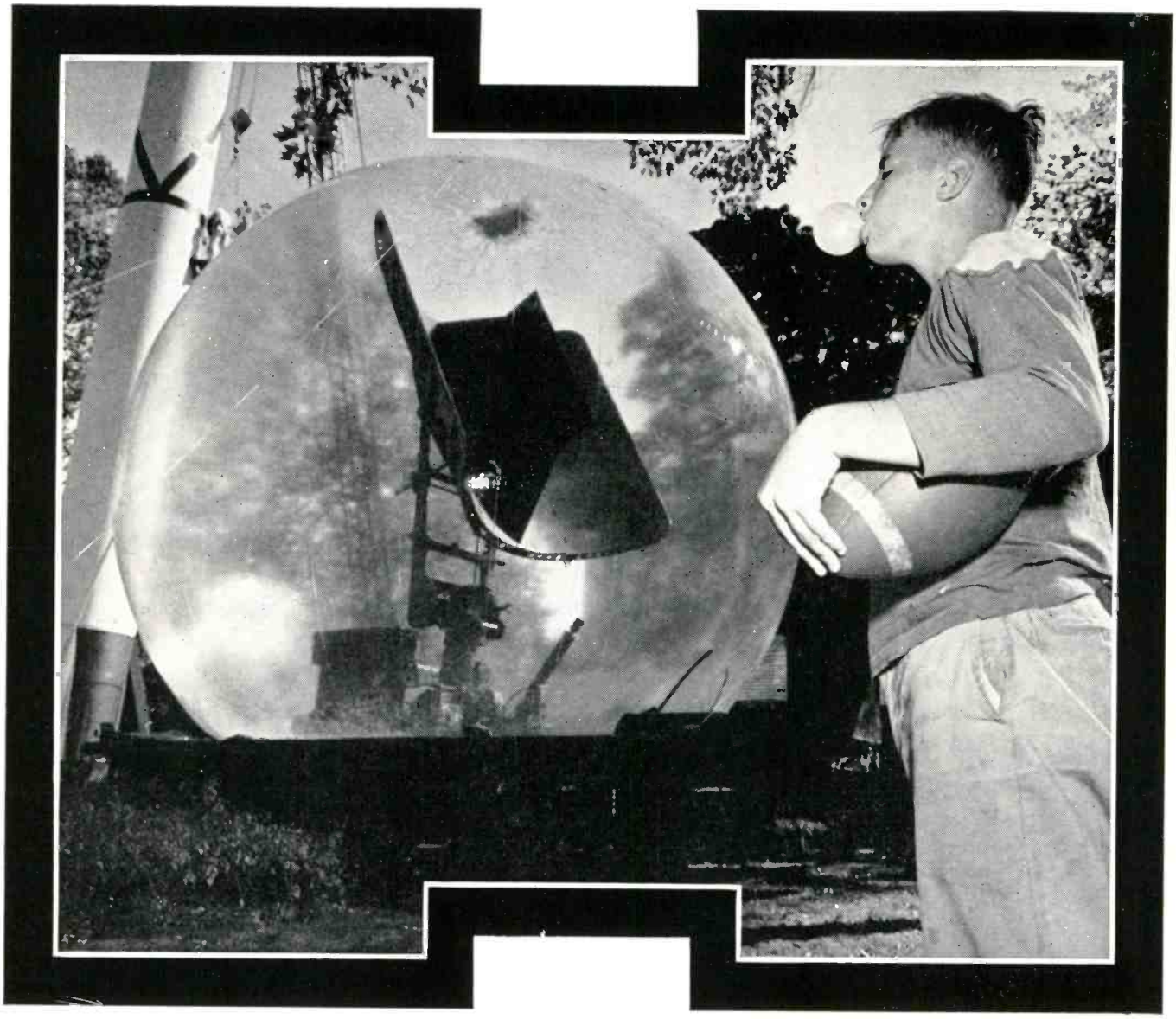
2—the South Eastern area

These two teams worked very closely with the state development commissions and Chambers of Commerce of many sections in both areas. Some states and towns offered special inducements to obtain plant location in their section. However, the site chosen by Kearfott near Asheville, N. C., was not motivated by any special inducements by the local Chamber of Commerce. For other reasons the area simply met their needs and had the desired potentials.

We would like to add here that in many cases plant relocation is no real problem to the electronic industries as far as transportation

(*Continued on page* 192)

A new dimension in



bubble blowing

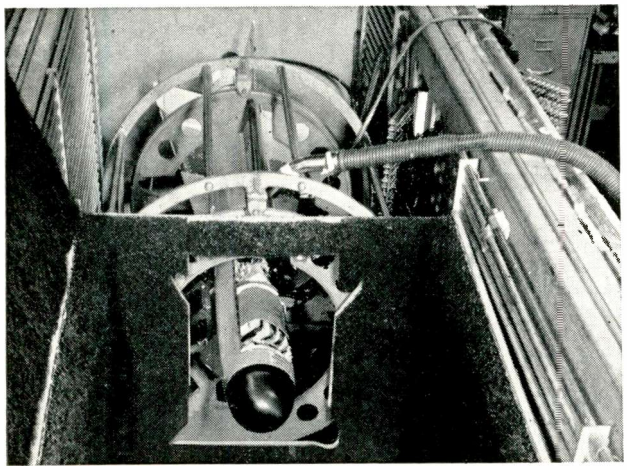
This plastic bubble protects the antenna of a radically new aerial three-dimensional radar defense system.

Sensitive to the inadequacies of conventional radar systems, engineers at Hughes in Fullerton devised a radar antenna whose pointing direction is made sensitive to the frequency of the electromagnetic energy applied to the antenna. This advanced technique allows simultaneous detection of range, bearing and altitude...with a single antenna.

Hughes engineers combined this radar antenna with "vest-pocket sized" data processors to co-ordinate antiaircraft missile firing. These unique data processing systems provide:

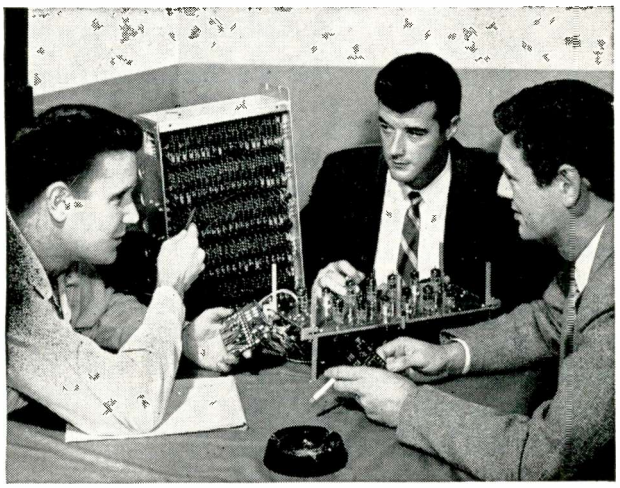
1. Speed—Complex electronic missile firing data was designed to travel through the system in milliseconds, assuring "up-to-date" pinpoint positioning of hostile aircraft.
2. Mobility—Hughes engineers "ruggedized" and miniaturized the system so that it could be mounted into standard army trucks which could be deployed to meet almost any combat problem—even in rugged terrain.
3. Reliability – By using digital data transmission techniques, Hughes engineers have greatly reduced any possibility of error.

Result: the most advanced electronics defense system in operation!



Falcon air-to-air guided missiles, shown in an environmental strato chamber are being developed and manufactured by Hughes engineers in Tucson, Arizona.

Reliability of the advanced Hughes systems can be insured only with the equally advanced test equipment designed by Hughes El Segundo engineers.



Other Hughes projects provide similarly stimulating outlets for creative talents. Current areas of Research and Development include advanced airborne electronics systems, advanced data processing systems, electronic display systems, molecular electronics, space vehicles, nuclear electronics, electroluminescence, ballistic missiles...and many more. Hughes Products, the commercial activity of Hughes, has assignments open for imaginative engineers to perform research in semiconductor materials and electron tubes.

Whatever your field of interest, you'll find Hughes diversity of advanced projects makes Hughes an ideal place for you to grow...both professionally and personally.

Newly instituted programs at Hughes have created immediate openings for engineers experienced in the following areas:

Infrared	Thin Films
Plasma Physics	Microwave Tubes
Digital Computers	Circuit Design & Evaluation
Field Engineering	Systems Design & Analysis
Quartz Crystal Filters	Logical Design
Communications	Semiconductor Circuit Des.

Write in confidence to Mr. Mike Welds
Hughes General Offices, Bldg. 6-E9, Culver City, Calif.

HUGHES

The West's leader in advanced ELECTRONICS

HUGHES AIRCRAFT COMPANY
Culver City, El Segundo, Fullerton, Newport Beach, Malibu and Los Angeles, California
Tucson, Arizona

Electronic Engineers Are On The Move!

A look at our subscription lists shows that distance means little to the electronic engineer looking for opportunity and challenge.

Each year during the past decade, one in five Americans moved, a United States Department of Commerce survey shows. Two-thirds (66 1/3 per cent) of the movers changed residence within the same county. The other one-third (33 1/3 per cent) moved from one county to another, with this group divided about half and half between intrastate and interstate moves.

Electronic Industries decided to see if movement among its electronic engineering subscribers was comparable to government statistics. They were not. The electronic engineer is moving farther than his fellow citizen. Specifically 42.1 per cent of the moves tabulated over a four-month period were interstate; 44.9 per cent were intrastate; and only 10.8 per cent were within the same county. The remaining 2.2 per cent were moves from and to the United States, plus changes in Canada.

A further analysis of these engineer moves showed that 69.8 per cent changed from one company to another.

The five states who gained the most in the interstate moves in the order of their importance were California, New Jersey, New York, Virginia and Maryland. Regional changes are shown in the following chart.

"EI SUBSCRIBER MOVEMENT"

March-May, 1959

Inter-State Moves

From	To New England	To Middle Atlantic	To East North Central	To West North Central	To South Atlantic	To East South Central	To West South Central	To Mountain	To Pacific	TOTAL
New England	1	6	—	—	6	—	1	—	2	16
Middle Atlantic	8	24	11	3	19	—	1	—	16	82
East North Central	4	2	9	1	2	—	—	5	4	27
West North Central	—	—	2	—	2	—	—	—	—	4
South Atlantic	4	13	2	1	9	1	2	3	6	41
East South Central	1	—	—	—	—	—	—	—	—	1
West South Central	—	2	1	—	2	—	1	1	3	10
Mountain	3	3	—	—	—	1	—	1	8	16
Pacific	1	7	3	1	1	—	—	1	2	16
TOTAL	22	57	28	6	41	2	5	11	41	213

* See separate listing for gain by state.

NEW ENGLAND: New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut

MIDDLE ATLANTIC: New York, New Jersey, Pennsylvania

EAST NO. CENTRAL: Ohio, Indiana, Illinois, Michigan, Wisconsin

WEST NO. CENTRAL: Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas

MOUNTAIN: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada

PACIFIC: Washington, Oregon, California, Alaska

SOUTH ATLANTIC: Delaware, Maryland, Dist. of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida

EAST SO. CENTRAL: Kentucky, Tennessee, Alabama, Mississippi

WEST SO. CENTRAL: Arkansas, Louisiana, Oklahoma, Texas

Re-locations To . . .

Alabama	2	Iowa	3	Nevada	0	S. Dakota	0
Arizona	7	Kansas	1	New Hampshire	5	Tennessee	0
Arkansas	0	Kentucky	0	New Jersey	25	Texas	5
California	36	Louisiana	0	New Mexico	1	Utah	0
Colorado	3	Maine	0	New York	23	Vermont	0
Connecticut	7	Maryland	12	N. Carolina	2	Virginia	13
Delaware	0	Massachusetts	9	N. Dakota	0	Washington	5
Dist. of Col.	4	Michigan	5	Ohio	7	West Virginia	0
Florida	10	Minnesota	0	Oklahoma	0	Wisconsin	7
Georgia	0	Mississippi	0	Oregon	0	Wyoming	0
Idaho	0	Missouri	1	Pennsylvania	10	Canada	0
Illinois	4	Montana	0	Rhode Island	1		
Indiana	5	Nebraska	0	S. Carolina	0	TOTALS	213

INTRA-STATE MOVES 228

INTRA-CITY MOVES 55

Other:

Canada to Us	2
U. S. to Israel	1
U. S. to APO	1
U. S. to Canada	2
U. S. to Hawaii	1
Lebanon to U. S.	1
Intra-Canada	3
GRAND TOTAL	507

354 of 507 changed company.

"AT SOME POINT IN HIS CAREER, every engineer critically evaluates himself in terms of his professional growth and progress. If your evaluation indicates that you have developed a depth of appreciation for the major problem areas in large complex electronic systems and the technical competence to contribute to the solution of such problems, you should seriously consider the next step in your professional career and explore the challenging opportunities the System Development Corporation has to offer.

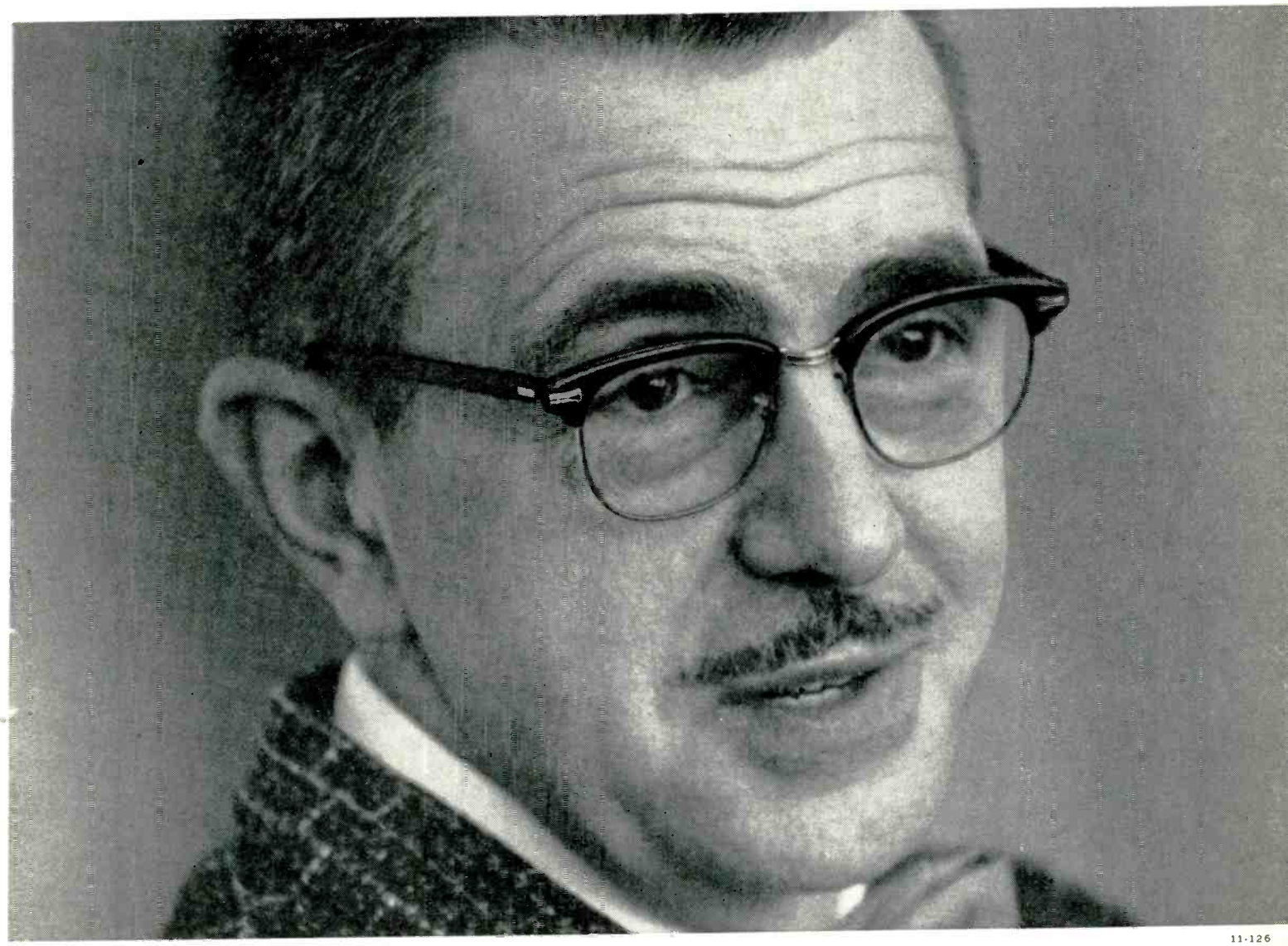
"SDC has assumed major responsibilities for development and sustaining engineering and the implementation of engineering advances in the state of the art associated with the SAGE Air Defense System, the world-wide SAC Control System, and other major system development projects. Therefore, at SDC engineering is system-oriented and requires personnel with broad backgrounds and extensive experience in design, development and system engineering.

"The experience gained through intimate association with all of the elements of these large-scale systems and subsystems they control provides a most unusual opportunity for engineers to grow in technical competence and professional stature.

"I invite you to explore the opportunities offered by SDC at Santa Monica, California and Lodi, New Jersey, by writing or telephoning Mr. R. A. Frank, 2428 Colorado Avenue, Santa Monica, California, EXbrook 3-9411, or Mr. R. L. Obrey, Box 2651, Grand Central Station, New York 17, N.Y., ELdorado 5-2686, regarding our division at Lodi, New Jersey. Your correspondence will receive preferential treatment and its content will be handled in strict confidence."

V. J. Braun

V. J. BRAUN, ASSISTANT DIRECTOR FOR PLANNING, ENGINEERING DIRECTORATE



V. J. BRAUN

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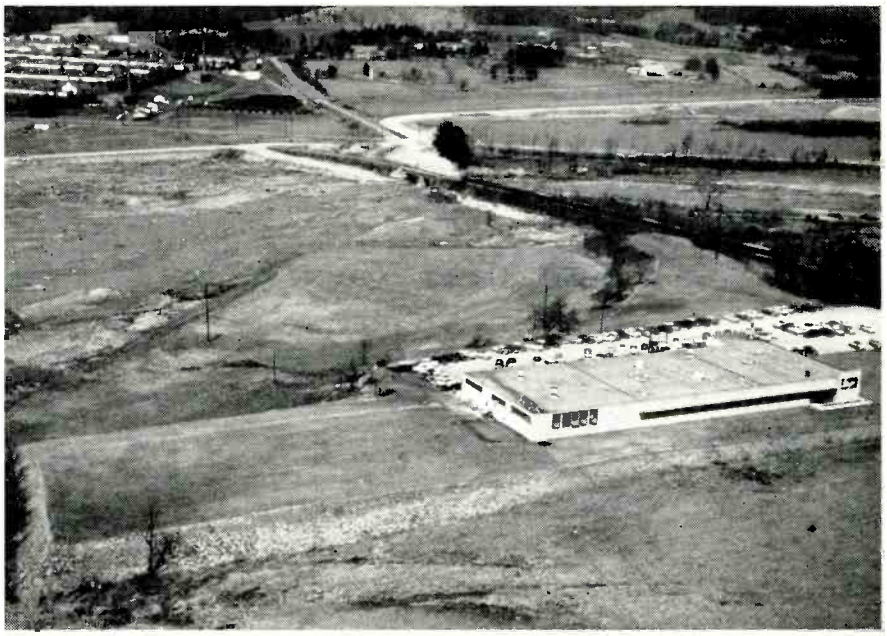
SDC

SYSTEM DEVELOPMENT CORPORATION

SANTA MONICA, CALIFORNIA • LODI, NEW JERSEY



Kearfott's Asheville plant is shown before larger addition was built. This plant had 26,000 sq. ft.

Plant Expansion

(*Continued from page* 187)

is concerned. Most of the electronic parts and materials are of a very light nature and may be quite readily trucked in and out. For this reason electronic plants do not have to locate close to their suppliers.

The land in the Asheville area was cheaper in price and the rate of wages was a little lower. This area had a surplus of labor. There was also the fringe benefit of a nice area to live, work and play. The climate there is pretty temperate throughout the year and the area has a resort-type of air to it.

With a 22 acre site picked, Kearfott proceeded to construct a 26,000 sq. ft. building designed and equipped for manufacturing synchros. While there was a surplus of very willing, but unskilled labor, there was a definite shortage of personnel trained in the skills required by most electronic assembly operations. With these conditions in mind, Kearfott designed its production operation with the maximum amount of automation for semi-skilled operators. Then a training program with the assistance of the State Employment Division, was initiated to train the help, primarily female labor, in the specific skills required. This took many months, but resulted in a group of skilled and willing personnel, many of whom were made group leaders as the work force was expanded.

After training and placing the plant in operation, Kearfott found that the employees were both extremely loyal and productive. So much so, that when Kearfott found four years later that they required still more space, they expanded at this site. This expansion was finished just a few months ago and the plant now has 82,500 sq. ft.

They maintain only 5 engineers at this plant which has approximately 750 employees. Most of the engineering is still done at the main plant in New Jersey. The engineers at Asheville handle primarily production problems. If any major or special problems arise, they can get specific engineering solutions via a direct telephone line to their main engineering division in New Jersey. The Kearfott plant works two shifts in this area.

Kearfott owned the original section of this plant. However, when they decided to construct a new and much larger addition to this plant, they made a change of policy which is quite interesting. Instead of tying up capital with a new addition, they obtained financing from insurance companies. These insurance companies bought both the original building and land and then supplied funds for the new addition. Kearfott in turn signed a lease for 25 years with three ten-

year renewal options.

This interesting financing step is available to almost any electronic company wishing to expand. By a leasing arrangement, companies may obtain some very good advantages. Some of these advantages are listed here.

(a) They can have a building that is constructed to fit their exact needs.

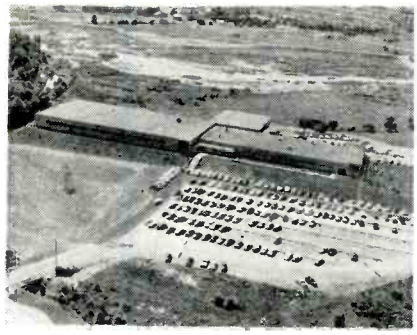
(b) It frees dollars tied up in real property for additional working capital. Depending upon the nature of the business, this capital can be turned over from 2½ to five times each year.

(c) The amount paid by the tenant as rent under the lease is completely deductible for tax purposes, whereas under ownership the business could only deduct a nominal depreciation each year plus interest paid on existing mortgages.

(d) Leasing removes a fixed asset from the books and improves the ratio of current assets to current liabilities by the additional working capital available.

(e) Growth industry, such as Kearfott, can expand more rapidly under leasing than by waiting for an accumulation of reserves before making much needed expansion.

Some companies in the electronic field may feel that expansion presents tremendous problems in



The Asheville plant of Kearfott Company, with their new addition, now has 82,500 square feet of space available for manufacturing their line of synchros.

obtaining financing, designing new plant layouts and finding a new site. This is not actually a real problem. There are a few construction companies, such as the one used by Kearfott, who will handle almost every detail at competitive construction prices.

R. S. Noonan, Inc. of York, Pa., who built the new large Kearfott

(*Continued on page* 194)

Plant Expansion

(*Continued from page* 193)

addition, and other similar specialized construction companies are prepared to offer a real service to companies wishing to expand. These specialized construction companies building industrial buildings such as Noonan are "geared" to handle all the services of following through, from obtaining financing to completion. They can offer these services at today's highly competitive prices or costs. This type of construction company is very flexible. For instance — Noonan & Company maintains their own twin-engine airplane and full time pilot so that they may quickly move men back and forth on their jobs.

With services like this available from construction firms, companies that wish to expand have a real burden lifted from their shoulders. While construction firms will offer or suggest sites that they know are available, the companies may select their own sites and purchase them. However, this service is available to them if they desire.

Earn Advanced Degrees In On-The-Job Program

The first engineers to enter Bell Laboratories' unique educational program run in cooperation with New York Univ. won their master's degrees last month.

The 97 men in the class were awarded their diplomas for completing the 2-year advanced study program at the N.Y.U.-Bell Labs graduate center at the Labs' campus-like location in Murray Hill, N. J.

The graduate center was opened in the fall of 1957. It is staffed by faculty members from N.Y.U.'s College of Engineering and is financed entirely by the Laboratories. The young men in the program receive full salary from the Laboratories while studying and working part-time in the technical departments.

The men take courses designed to develop a strong background for engineers embarking on careers in creative work in the field of communications. Their studies lead to N.Y.U. master's degrees in electrical or mechanical engineering or engineering mechanics.

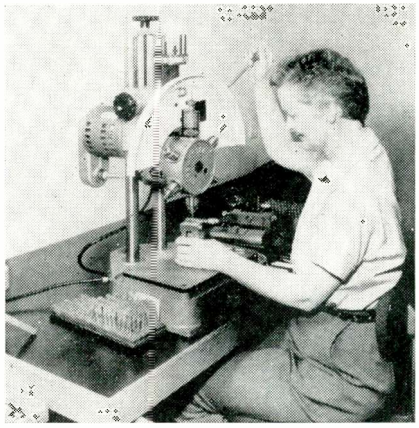
Air Force Sole Agent For Military Tubes

The Air Force has been selected by the Dept. of Defense as the single procurement agent for common electron tubes used by the three military departments.

During fiscal 1959 the military departments procured more than $48 million worth of electron tubes. The Air Force alone accounted for over 50% of the total procurement.

This assignment is to be fully implemented by March 31, 1960, in accordance with a phased schedule which will be developed by the Air Force in coordination with the Army and the Navy.

PRECISION DRILLING



Problem of machining precision holes of different diameters in electronic parts is simplified by this 6-spindle turret drill by Burgmaster Corp., Gardena, Calif.

"What Will This Job Or Career Pay Me?"

Correct, up-to-the-minute answers to this eternal question plus concise, complete descriptions of each career including type of work, educational requirements, fields of employment and other valuable information are found quickly and easily in the new book "What You Can Earn In 250 Different Careers" by Ben Puchaski, published by Chilton Co.

Based on extensive research by Career Research Associates, this book not only gives the complete story on starting earnings, but also earnings after five to ten years working experience. It also tells how earnings vary across the United States.

Electronic Larynx

(*Continued from page* 83)

A third transistor acts as a single-ended power output stage that amplifies the pulses applied to it from the relaxation oscillator. A diode serves to isolate the multivibrator from the power amplifier input impedance during the period between pulses, and is necessary for stable operation. Because a large pulse is required for sufficient acoustic power output at low frequencies, the relaxation oscillator drive circuit has heavy current requirements.

Two 5.2-volt mercury cells in series provide the power necessary to operate the artificial larynx continuously for a period of approximately 12 hours. These batteries have a 250-ma-hour rating with a maximum permissible current drain of 25 ma. With push-to-talk operation such as the laryngectomized patient requires, 12 hours of continuous operation should be equivalent to several days or even weeks of normal talking.

An alternative to using the self-contained mercury cells for powering the artificial larynx is a small a-c power supply which can be fed from a normal wall outlet at home or in the office. When the artificial larynx is plugged into the power supply, its batteries are disconnected from the circuit.

"Value Engineering" Meet

The increasing appearance of Value Engineering requirements in military contracts makes particularly significant the Conference on Value Engineering which will be held at the Univ. of Pennsylvania on October 6, 7.

Sponsored by Electronic Industries Assoc., and planned by an outstanding committee headed by Adm. R. S. Mandelkorn (Ret.) of Lansdale Tube Co. this conference will cover both the industry and military aspects of Value Engineering (VE).

Value Engineering "systematically analyzes functions and costs to assure the achievement of essential function for the lowest total cost."

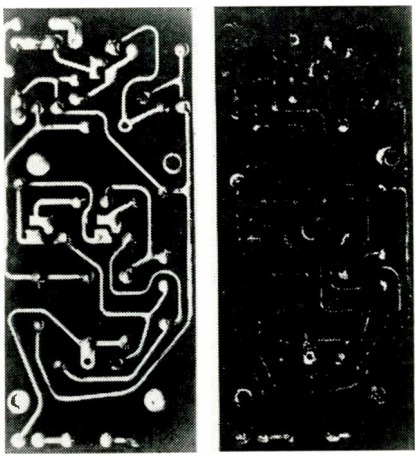
The technical sessions will consist of 16 papers, including "application of VE Techniques," "Cost Reduction," "Value Assurance vs. Improvement," and "Organizing for VE."

"Black Light"

(*Continued from page 76*)

nary light. Among these soils are solder flux, brazing flux, welding slag, and certain hydrocarbons, lints, resins, & salts.

Other contaminants that are used in industrial processes such as highly refined cutting oils, silicone greases, & coolants, while non-fluorescent or only slightly fluorescent, may have one of the additives available from the Black



(Left) Apparently clean printed circuit under white light. (Right) Residual solder flux fluorescing under ultraviolet rays.

Light Eastern Corp. mixed with them so that their complete removal in the final cleaning processes may be readily ascertained.

The units are compact, portable, sturdy, meet all UL requirements, and are completely harmless to skin and eyes.

For production line inspection, they are normally used next to the cleaning apparatus so that the operator can quickly check the cleaned parts for residual contamination and return them to the cleaner if necessary.

Patent Adviser (Navy)

The U. S. Civil Service Commission has announced an examination for "Patent Adviser." Pay is $5,430 to $8,810 per year (grades GS-7 through GS-12) depending on education and experience. To apply: write to The Executive Secretary, Board of U. S. Civil Service Examiners, Dept. of the Navy, Main Navy Bldg., Washington 25. D. C.

Industry News

Emmet Cameron has been promoted to Executive Vice President and General Manager at Varian Associates. He had been Vice President and General Manager.

Dexter S. Marcum has been appointed Manager of the General Electric Co.'s Heavy Military Electronics Dept. Sales District in Red Bank.

DeForest E. Sanford has been appointed Manager of Industrial and Defense Manufacturing for the Bulova Watch Co. For the past 2 yrs., he has been Director of planning for the Bulova Research and Development Labs., Inc.

McLean Engineering Labs., Inc., Princeton, N. J., has appointed **James G. Robinson** as Technical Assistant to the President and Company Procurement Director.

J. Robinson

H. Hills

Horace B. Hills has been appointed Vice President of Sales Organization and Programming of the Alden Systems Co., Westboro, Mass. He was formerly Manager of the Consumer Products Div. of the Farrington Mfg. Co.

Richard L. Lawrence has been appointed Manager of Advertising and Sales Promotion for the Semiconductor Div. of Hughes Aircraft Co. He previously was Advertising Manager of Giannini Controls Corp.

Robert E. Bard, General Radio Co., has been elected Chairman of the Chicago section of the Institute of Radio Engineers.

John G. Beamish, Manager of Hughes Aircraft Co.'s Research and Development Material Dept. has been appointed National Chairman of the Electronic Industries Buyers Group of the National Assoc. of Purchasing Agents.

Roy J. Sandstrom is now Assistant General Manager of the Bendix Systems Div. He was formerly Vice President in Charge of Engineering of the Bell Aircraft Corp.

(*Continued on page* 199)

Industry News

Promotion of **Linwood C. Huff** to Manager of Commercial Engineering of Clevite Transistor Products. Waltham, Mass., has been announced.

Thomas McLaughlin, Vice President, has been appointed Director of Planning and Engineering of Loral Electronics Corp. He joined the company in 1948 as Chief Engineer.

Robert V. McLaughlin is now President and a Director of Tensolite Insulated Wire Co., Inc., and its Pacific subsidiary.

R. McLaughlin

J. Johnson

John E. Johnson has been elected as Vice President and Marketing Manager, Electronic Data Div., Radio Corp. of America. He was formerly Marketing Vice President of the Datamatic Div. of the Minneapolis-Honeywell Regulator Co.

Election of 2 executives by the Board of Directors of International Telephone & Telegraph Corp. has been announced. **William T. Marx** has been named Sr. Vice President, Planning and Organization and Industrial Relations, and **Harry G. Beggs,** Vice President, Manufacturing and Facilities.

Charles L. Jones, Director of American Electronics, Inc., has been elected Executive Vice President of the company.

A. William Christopher, Jr., Sylvania Electronic Systems Div. Sylvania Electric Products Inc., has been elected President of the Washington chapter of the Armed Forces Communications & Electronics Assoc.

Irving H. Young has been appointed Manager of Engineering Administration at Litton Industries' Maryland Div. **Fred E. Burnham** has been appointed Manager, Antenna and Microwave Section.

Kimball C. Cummings is now Manager of Engineering at Minneapolis-Honeywell's Beltsville, Md., Div. He had been Associate Director of Research of the Aeronautical Div.

News of Reps

REPS WANTED

Jonard International, Inc., the importers of the new Diacrom Spatulas are actively seeking manufacturer's reps covering the electronic field. The Diacrom Spatula is used to clean relays. Contact Mrs. R. Osten, Jonard International, Inc., 624 Madison Ave., New York.

Perkin Engineering Corp., Electronic Div., has named **Law Instruments**, Angola, Ind., its sales rep for Indiana.

The United Transformer Corp. has appointed **Comtronic Assoc.**, Mineola, L. I., N. Y., as its rep in the New York metropolitan area, servicing industrial accounts.

Leonard G. Evans has joined Henry Lavin Assoc., manufacturers' rep, Meriden, Conn., as Sales Engineer. He was formerly with Sandia Laboratories, Albuquerque, N. M.

Epsco Instruments and Equipment Div. has appointed **Robert L. Lang Assoc.**, Chicago, as reps for that division in Indiana and Illinois.

Four reps have been appointed by Motorola Communications and Electronics, Inc.: **Wallace and Wallace**, Los Angeles; **Saffro and Assoc.**, Chicago; **MEMO, Inc.**, Hempstead, L. I., New York, and the **Representatives Corp.**, Boston, each operating basically in its present territory.

Cozzens & Cudahy, Inc., Chicago, has been appointed sales rep for Shockley Transistor Corp. for the states of Illinois, Indiana, Iowa and Wisconsin.

Pacific Electro-Sales, Inc., La Jolla, Calif., has been appointed Industrial Sales rep for International Rectifier Corp. in the San Diego area.

A newly formed Electronic Sales Engineering Co., **The Bert Barron Co.**, 15166 Ventura Blvd., Sherman Oaks, Calif., will represent electronic component, equipment, and system manufacturers to Southern California accounts.

Michael A. Limanni Co., Salem, N. H., is rep for The Radiart Corp. and the Tobe Deutschmann Corp., Indianapolis, Ind., in Maine, New Hampshire, Vermont, Rhode Island, Connecticut and Massachusetts.

The **Jay Co.**, Arlington, Va., is now rep for Industrial Test Equipment Co.

(*Continued on page* 202)

ELECTRONIC INDUSTRIES Advertisers — September 1959

News of Reps

(*Continued from page* 200)

The following reps have been appointed by WacLine, Inc.: **Electrical Manufacturers' Service** in Maryland, Virginia, the Carolinas, Georgia, Alabama and Eastern Tennessee; **Lawrence L. Hill**, Kansas and Missouri; **Johnson Assoc.**, Florida; **Long Assoc.**, Northern California; and **Arthur J. Schubert**, Illinois and Wisconsin.

Western Gear Corp.'s Electro Products Div., Pasadena, Calif., has appointed the **L. G. White Co.**, Towson, Md., as rep for its line of rotary electrical equipment.

Ohio Semiconductors, Inc., Columbus, Ohio, has appointed the **Tyler Griffin Co.**, Devon, Pa., as sales rep for Eastern Pennsylvania, Southern New Jersey, Maryland, Delaware and the District of Columbia. **Bill Kolans & Co.**, Burlingame, Calif., is rep in Northern California, Northern Nevada, and Hawaii.

Saffro & Assoc., Chicago, Ill., is now Chicago-area sales rep for Perkin Engineering Corp. Electronic Div., El Segundo, Calif.

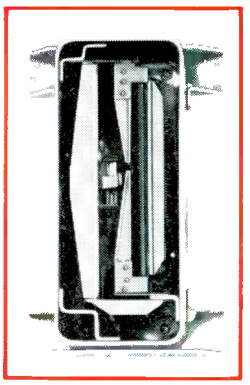
Ankofski Assoc., Detroit, Mich., is now rep for Tatnall Measuring Systems Co.

The most precise, sturdiest thermal relay ever built... best for missile applications

. . . from the leader in thermal relay design!

Now, for missile environments and for all applications where greater precision is necessary, G-V Controls offers the revolutionary new PT Thermal Relay—the most **precise** thermal relay ever built!

And the PT's **sturdiness** is unequalled in thermal relays. It withstands missile vibration and shock far better than any other thermal relay.



SPECIFICATIONS

Time Delay: 3 to 60 seconds (Factory Set)
Setting Tolerance: ±5% (±¼ sec. min.)
Temperature Compensation: Within ±5% over —65°C. to +125°C. range (±¼ sec. min.)
Heater Voltages: 6.3 to 115 v. for delays up to 12 sec.; 6.3 to 230 v. for longer delays.
Power Input: 4 watts. Rated for continuous energization at 125°C.
Contacts: SPST, normally open or normally closed. Rated 2 amps. resistive at 115 v. AC or 28 v. DC.

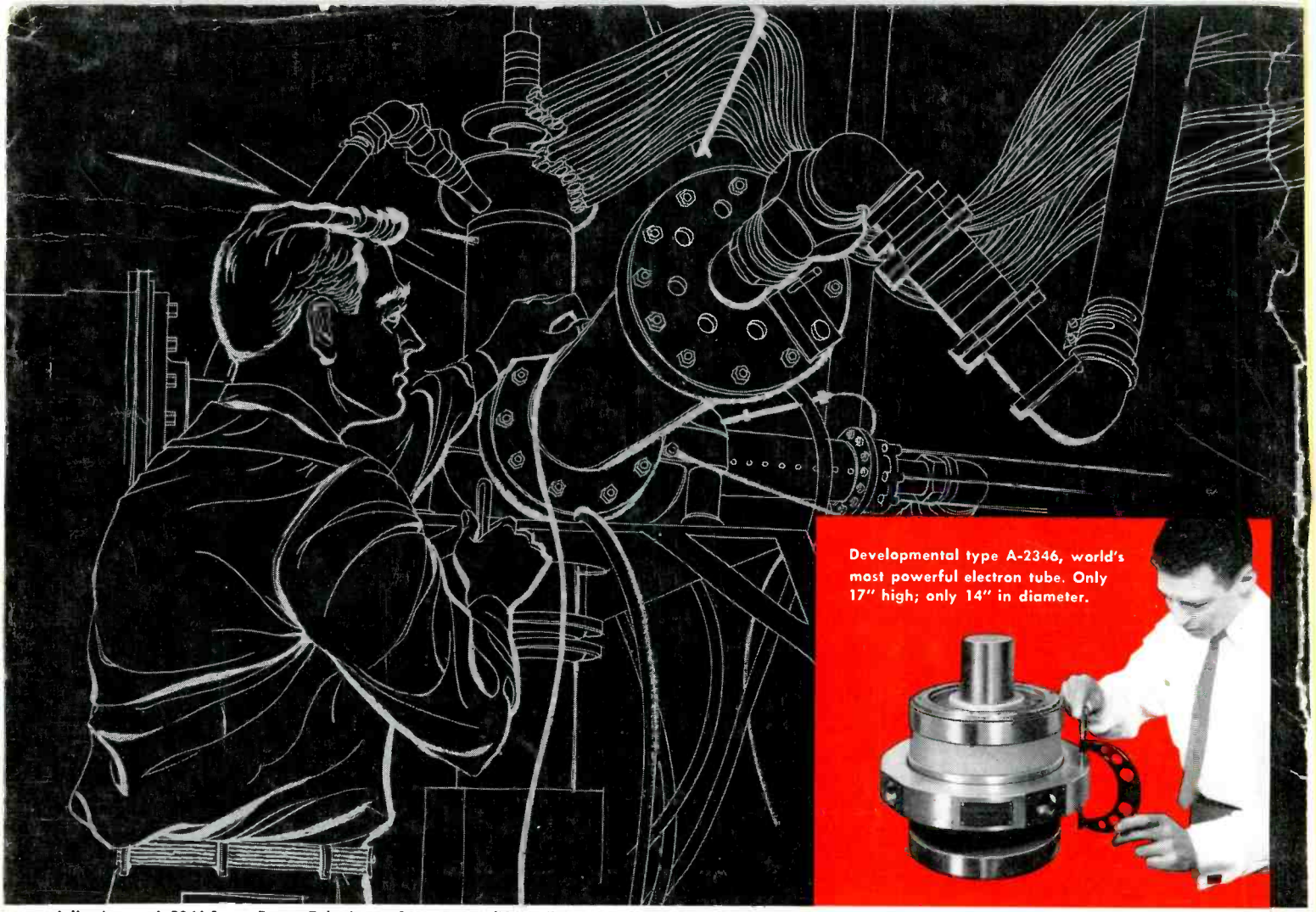
Write for Product Data Bulletin #PD-1015

Insulation Resistance: 1,000 megohms
Dielectric Strength: 1000 v. RMS at sea level. 500 v. RMS at 70,000 ft.
Vibration: Operating or non-operating, 20 g up to 2000 cps
Shock: Operating or non-operating, 50 g for 11 milliseconds
Unidirectional Acceleration: 10 g in any direction changes delay by less than 5%, 50 g by less than 10% with proper orientation.
Weight: 2 to 2¼ ounces.

G-V CONTROLS INC.
Livingston, New Jersey

G-V®

Circle 2 on Inquiry Card



Adjusting an A-2346 Super-Power Tube in an rf power amplifier utilizing experimental cavities.

5 MEGAWATTS OF LONG-PULSE POWER

—at 450 Megacycles

Revolutionary new RCA developmental Super-Power Tube delivers tremendous RF Power with a pulse duration of 2000 microseconds and a duty factor of 0.06

Innovator in super-power tube development and manufacture for almost two decades, RCA takes another bold step into high-power rf generation with the new developmental type A-2346—*the most powerful UHF electron tube on earth.*

Here, within the geometry of a single tube no bigger than a nail keg, lies the potential ability to generate the rf power it takes for outer-space communications ...scatter transmission on a global scale...super-range radar and missile guidance ...industrial rf applications on a mass-production basis.

Developmental type A-2346 is just one among a number of RCA Super-Power types now available to research, industry, and the military. RCA Super-Power Tubes have been serving in major projects and are being incorporated in other major defense projects.

For more information on both commercial and developmental types of RCA Super-Power Tubes—and application assistance—talk to your RCA Field Representative.

Typical data on RCA Super-Power Tubes in plate-pulsed service

TYPE	USEFUL POWER OUTPUT (Kw)■	DUTY FACTOR	FREQ. (Mc)	MAX. FREQ. FOR FULL INPUT (Mc)	UPPER USEFUL FREQ. (Mc)‡
RCA-2041	300 250	0.003 0.05	450 250	600 600	1500 1500
A-15049*	1100 500	0.003 0.06	500 500	1000 1000	1250 1250
RCA-2039	1500	0.06	200	200	250
RCA-6952	2000	0.0018	425	600	1000
A-2344*	5000	0.003	1000	1000	1250
A-2349*	8000	0.003	200	200	250
A-2346*	10000 5000	0.01 0.06	450 450	450 450	600 600
A-15025*	27500	0.003	425	600	600

*RCA Developmental Type ‡For Prototype Design
■At Peak of Pulse

Typical data on RCA Super-Power Tubes In hard-tube pulse-modulator service

TYPE	MAX. SWITCHED POWER (Kw)	DUTY FACTOR
A-15030*	22,000	0.05
A-15034*	11,000	0.05

*RCA Developmental Type

RADIO CORPORATION OF AMERICA
Electron Tube Division *Harrison, N. J.*

Your RCA Field Representatives are here to help you

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