

ELECTRONIC DESIGN

DEC 19 1958

DECEMBER 24, 1958



IN THIS ISSUE: ENGINEERING PASSES IN REVIEW

IF YOU DON'T MIND THE SCORE *

VITREOUS ENAMEL
POWER RESISTORS
MAY DO



The Temperature Coefficient of power wire wound resistors is a lot like golf. The higher the "score" the worse the performance. Even on special order, vitreous enamel coated PWW's are not guaranteed for a temperature coefficient of less than ± 80 p.p.m. (and they often run up duffer scores) whereas IRC Resisteg Coated Power Wire Resistors consistently average ± 25 p.p.m.

The reason is simple. Vitreous enamel units are cured at temperatures of 1200°F or over. At this temperature the turns of wire tend to loosen, shift and even short. Finer wire is therefore used to achieve wider spacing and turns are tension wound. The end result is a high tempera-



Vitreous Enamel Power Resistors best guaranteed score is at least ± 80 p.p.m. for Temperature Coefficient and then only on special order. But the par for IRC Resisteg Coated Resistors is only ± 25 p.p.m.

ture coefficient, and a substantial resistance change for any change in temperature.

On the other hand, IRC Resisteg Coated Resistors are cured at only 205°F or less, can be wound with a larger diameter wire, more closely spaced, and without extra tension. The Temperature Coefficient is about ± 25 p.p.m. after the cure or only slightly higher than that of the original wire. So why work with the high handicap resistor coating? Insist on IRC Resisteg Coated PWW's.

Write for new Power Wire Wound Resistor Bulletin C-1C.



— Wherever the Circuit Says —



INTERNATIONAL RESISTANCE COMPANY, Dept. 3313, 401 N. Broad Street, Philadelphia 8, Pa.

CIRCLE 1 ON READER-SERVICE CARD

HIGHLIGHTS OF ISSUE



Ceramic-covered rods—new capacitor element (cover). 30

Smaller ceramic capacitors are achieved through a new manufacturing process. An extremely thin ceramic film is formed on a rod, which serves as one of the capacitor's electrodes. The rods may be bundled together in a honeycomb structure to get various capacity values.

Engineering Passes in Review 5

A busy year for the electronics industry draws to a close. Miniaturization and reliability were engineered into missiles and satellites. Almost "revolutionary" developments emerged in communications, particularly in radar and its antennas. There were no "breakthroughs", but significant advances were made in instrumentation, data processing, components, microwave amplifiers, and production processes and materials.

Index of Articles, July 9 through December 24 ... 74

The reader of ELECTRONIC DESIGN can use this handy reference guide to quickly locate all articles which appeared in the magazine over the last six months.

Next Issue Design '59—A Challenge

What the design engineer should be working on in 1959 is the subject of a special report in the January 7 issue of ELECTRONIC DESIGN.

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Kennedy Introduces
a new
**low-band
duplexer**
for
**755-985 mc
range**



FEATURES:

Frequency Band.....755-985 megacycles
R-f Power.....15 Kilowatts
Pass Band.....2 megacycles
Pass Band Insertion Loss.....0.5 db over pass band
Pass Band SWR.....1.2
Xmit-Rc'Ve Separation....78 mc/s
Weight, assembled.....338.5 lbs.

HIS new Kennedy Model 803 duplexer is an isolation filter which allows the same antenna to be used for transmission and reception simultaneously without any interaction. It is particularly useful for scatter propagation.

For the most efficient operation of your antenna, let Kennedy engineers design the complete feed system.



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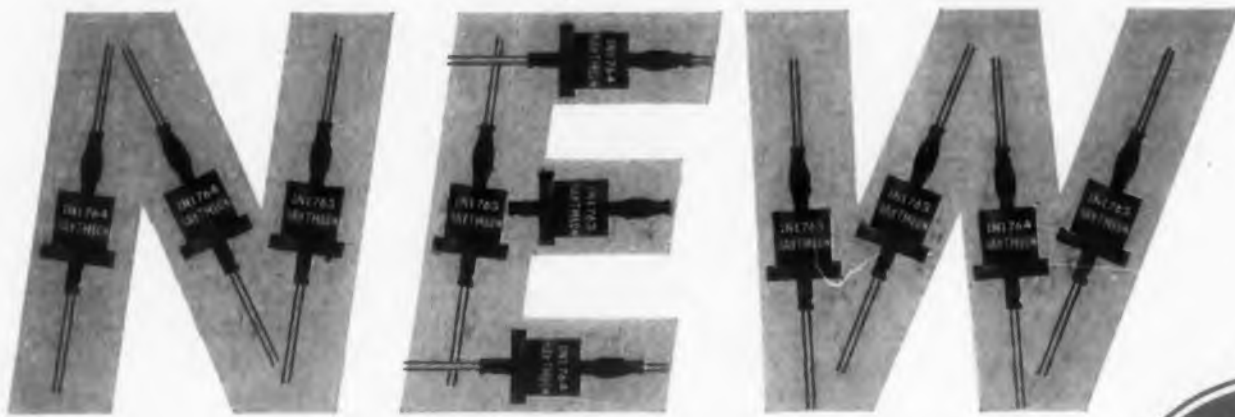
ANTENNA EQUIPMENT

D. S. KENNEDY & CO.

Evergreen 3-1200, Cohasset, Mass.



CIRCLE 2 ON READER-SERVICE CARD



1N1763 and 1N1764 DIFFUSED JUNCTION

SILICON RECTIFIERS

PRICED FOR COMMERCIAL AND INDUSTRIAL POWER SUPPLY APPLICATIONS

FEATURES:

Economical—now, silicon rectifiers at entertainment field prices.

Uniform — the Raytheon Solid State Diffusion Process permits flat junctions and assures uniform characteristics and uniformly high quality.

Hermetically Sealed — Welded

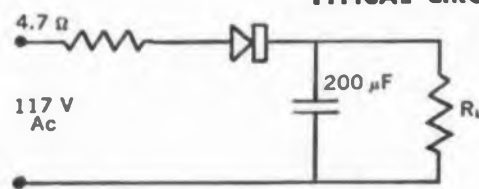
Reliable

SPECIFICATIONS:

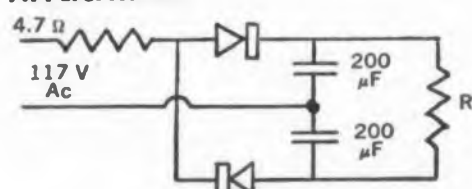
PARAMETER (25°C)	TYPE		UNITS
	1N1763*	1N1764†	
PIV	400	500	V
RMS Voltage	140	175	V
DC Load Current	500	500	mA
Surge Current for 0.1 sec	15	15	A
Max. Reverse Current at PIV	100	100	μA

*for operation direct from power line
†for operation from step-up transformer

TYPICAL CIRCUIT APPLICATIONS



Half wave rectifier, capacitive load



Full wave doubler circuit



SEMICONDUCTOR DIVISION

Needham Heights, Massachusetts

SILICON AND GERMANIUM DIODES AND TRANSISTORS • SILICON RECTIFIERS

CIRCLE 3 ON READER-SERVICE CARD

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Another year ends, one for the history books. Sputnik demonstrated Soviet scientists' superiority in propulsion techniques; Explorers' microminiaturization testified to sophistication of U.S. design concepts. Long strides were taken in radar, mobile communications, automatic testing and other fields. This review of the year's news replaces the regular Design Behind the News section.

Engineering Passes in Review



by
Ben Patrusky

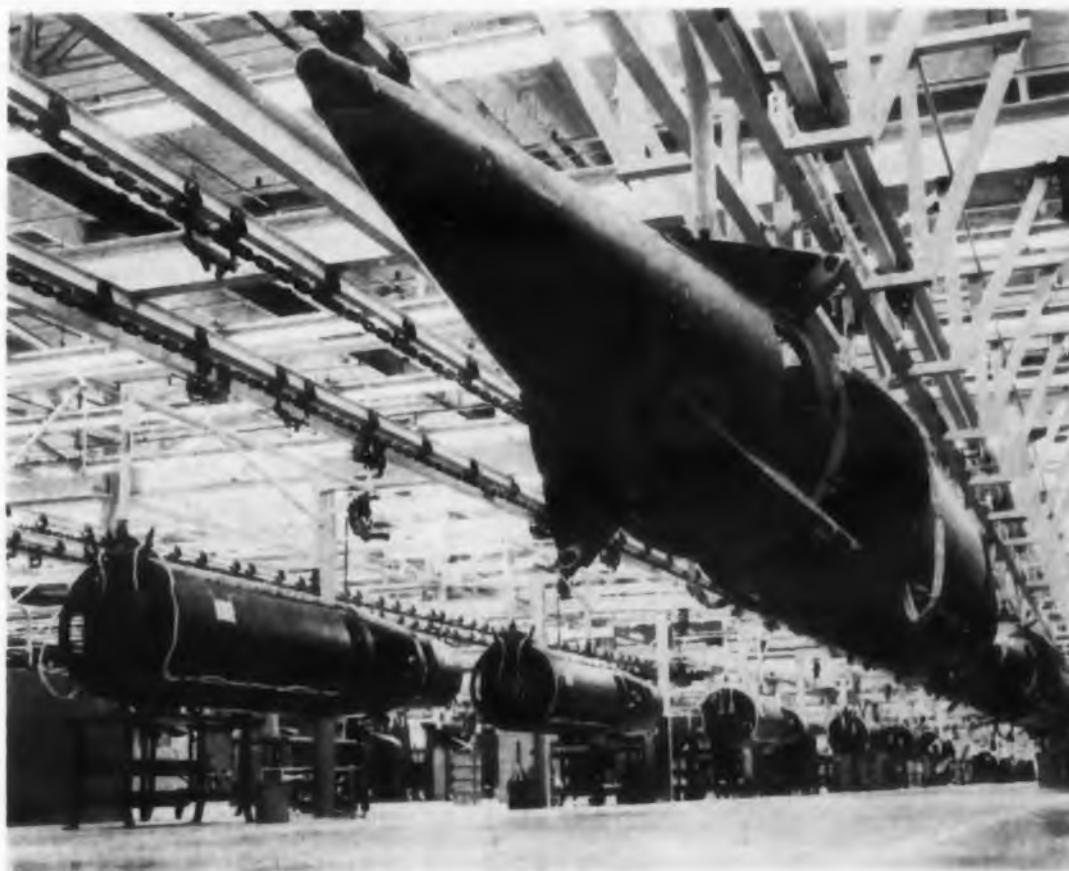
Satellite and Missile Electronics

THE RUSSIANS hurled a ton-and-a-half satellite into orbit this year, while America's heaviest weighed less than 30 pounds. Russia thus demonstrated its superiority in propulsion techniques, but it seemed likely that highly sophisticated U.S. design concepts eclipsed many the Soviets had developed. For lacking advanced propulsion capabilities, American engineers had been obliged to microminiaturize—to get as close as possible to designing instrumentation which occupies no space and is weightless.

Explorer I measured 80 in. and weighed 29.87 lbs. This is what it contained:

- A Geiger-Mueller cosmic ray counting tube and associated circuitry to count primary cosmic radiation. The apparatus was designed and built by the State University of Iowa. It also designed the miniature tape recorder which collected radiation information and played it back.
- Two micrometeorite detectors developed at the Air Force Cambridge Research Center. One was a set of 12 grids mounted as a parallel resistance network on the aft end of the fourth stage rocket motor. Variations in electrical resistance denoted micrometeorites collisions. The second was a microphone to record impacts of micrometeorites upon the exterior.

(Continued on following page)



Army Nike-Hercules is in production (top). Here it goes through final assembly at Douglas Aircraft Co. (Right) Convair's Atlas test fired at Cape Canaveral by Air Force.



Creative Microwave Technology

Vol. 1

No. 1

Published by MICROWAVE and POWER TUBE DIVISION
RAYTHEON MANUFACTURING COMPANY, WALTHAM 54, MASSACHUSETTS

NEW DEVELOPMENTS IN ELECTRONIC TUBES AND CERAMICS

Where abnormal conditions of vibration (25 to 2000 cps at 10G) are encountered, such as in advanced airborne applications, this pulsed-type X-band (9245 \pm 40 Mc) air-cooled RK6967A/QK366A magnetron oscillator maintains exceptional frequency stability and operational reliability. Optimum performance is assured by a double-end supported cathode and aluminum-clad integral magnets. Nominal peak



power output is 100 kw at typical pulse conditions of 0.5 μ sec. (.001 duty cycle). The tube operates at a peak anode voltage and current of 15 kv and 13.5 amp. respectively.

CIRCLE 110
Reader Service Card

* * *

Integrally insulated semi-conductors can now be produced by using high-alumina ceramic stem assemblies. Heat dissipating ceramic wafer (arrow) in the base insulates up to 2000 volts dc and withstands soldering temperatures as high as



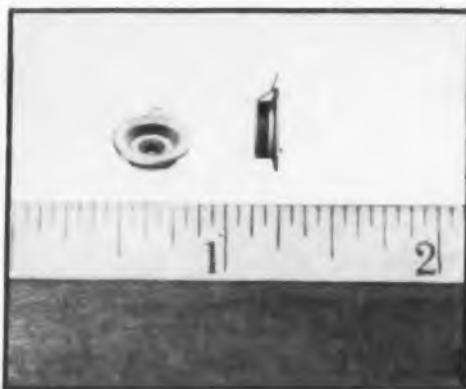
1100C. Bases can be directly mounted to chassis or cold plates. Stems are available to all semi-conductor manufacturers.

CIRCLE 111
Reader Service Card

* * *

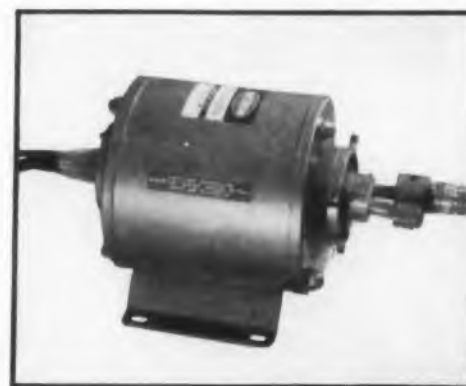
Miniature gyro feed-throughs provide take-off points from gas-filled gimbal housings. These high-alumina, vacuum-tight, R-95 ceramic assemblies can be soldered to housings at temperatures up to 1000C. They also assure positive electrical insulation with leakage less than one micro-ampere per 500 volts dc.

CIRCLE 112
Reader Service Card



Designed for voltage tunable CW or pulsed operation over the Government X-band (8500 to 9600 Mc), the QK-684 integral magnet backward wave oscillator delivers 10 to 50 mW over delay-line voltages ranging from 215 to 325 vdc. Regulation of a special control grid facilitates pulsed or amplitude modulation to meet power and frequency requirements. Models available for coupling to standard, type "N" connectors.

CIRCLE 113
Reader Service Card



* * *

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

CIRCLE 114
Reader Service Card



Instrumentation package of Air Force Lunar Probe is joined to terminal rocket engine.

■ Four temperature gages, to read temperature at three different locations on the outer shell and the interior. These were designed by Jet Propulsion Laboratory.

■ Two radio beacons, to transmit data back to ground receiving stations. Two silicon-transistor transmitters used mercury battery power supplies. The higher power transmitter radiated 60 mw continuously at 108.03 mc for about two weeks. It weighed 2 lbs with its four telemetering oscillators.

The lower-power phase-modulated transmitter radiated 10 mw at 108.00 mc. This unit telemetered continuously much the same information as did the high-power unit. It transmitted for two months. The frequency-determining quartz crystal was mounted on a spin axis transistors next, and power supply batteries were symmetrically arranged outside. The entire package was potted in plastic and tested to withstand 100-g steady acceleration and 15-g rms vibration acceleration.

Explorer II, which did not orbit, also contained the miniature tape recorder. The 1/2 lb 2.25 in.-diam memory device was designed to monitor cosmic particle impacts from all directions in space. Each second of recording time, a ratchet gear advances the 0.16 in.-wide magnetic tape about 0.005. As this 36-in.-long bronze tape is advanced the return spring is wound. Playback is completed in 5 sec, the speed being damped by an eddy-current brake. The recorder then resets itself.

A Leader in Creative Microwave Technology



Transducers installed in Explorer III carried out the experiments intended for Explorer II. However, in the transmitting system, the turnstile antenna wires were eliminated. Instead, the stainless steel instrument case and motor case were wired and tuned to the higher-power transmitter. Thus they served as a dipole radiating antenna.

Similarly the nose cone and instrument case served as dipole radiators for the lower-power transmitter. Telemetered data included satellite external and internal temperatures, micrometeorite impacts, and cosmic ray counts, much the same as its predecessor had been designed to do.

Explorer IV contains 18.26 lbs of instrumentation, all devoted to radiation studies.

The security lid is shut tighter than ever on the biggest and costliest earth satellite project to date. Lockheed Aircraft is the prime contractor for this project, the "Pied Piper."

Vanguard II's launching was "scratched" for 1958. But when the program is resumed, the Navy satellite will contain a two-way radio about the size of a loaf of bread. Known as DOVAP (Doppler, Velocity and Position), it was produced by International Telephone and Telegraph Corp. The 10 lb radio will send back data on the trajectory and velocity of the first and second stage of the Vanguard missiles.

Pioneer I, the first lunar probe, fell short of its goal by 66 per cent because of a 3.5 deg error in the gyroscope. Scientifically, however, the rocket was a huge success. The radiation detectors and telemeters worked well. The communications link also seemed to work well. The 400 mw transmitter appeared to be unaffected by distance, shock or environment.

The activity in missiles has been confusing, and it is not always clear which service and which contractor is doing what. Here is a brief listing of the number of missiles now under development or in production.

Air-to-Air missiles—7

Air-to-Surface missiles—7

Anti-Submarine—5

Surface-to-Surface—18

Surface-to-Air—10

Labs across the country meanwhile are groping with the instrumentation problems accompanying man's space travel. In addition to medical man-in-space studies, there's been considerable activity in new propulsion techniques.

One of the most promising is magnetohydrodynamics (MHD). GE is busily engaged in R & D work in this area. It recently described a laboratory model of an MHD device, called, the "pulsed plasma accelerator," which can change space vehicle direction in flight. Electric and magnetic fields exert a force upon an ionized fluid much like rotor reaction in a motor. ■ ■



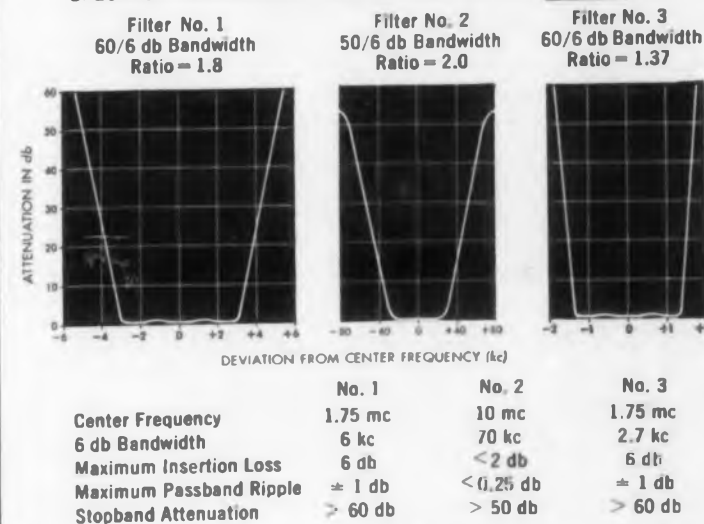
new performance levels set by Hughes precision crystal filters

Hughes Products now offers high performance crystal filters previously available only for special military developmental contracts and Hughes-built systems. Utilizing unique design and advanced manufacturing techniques, these Hughes crystal filters provide a degree of performance previously unattainable.

With center frequencies of 30 kc to 30 mc and fractional bandwidths of 0.01% to 6%, these crystal filters have seven distinct advantages:

1. High frequency filtering
2. High selectivity
3. Low passband ripple
4. Low insertion loss
5. Small size and weight
6. Excellent temperature stability
7. Excellent shock and vibration stability

SPECIFIC PERFORMANCE CHARACTERISTICS FOR TYPICAL FILTERS



For further information please write HUGHES PRODUCTS, Crystal Filters, International Airport Station, Los Angeles 45, Calif.

Creating a new world with *ELECTRONICS*

HUGHES PRODUCTS

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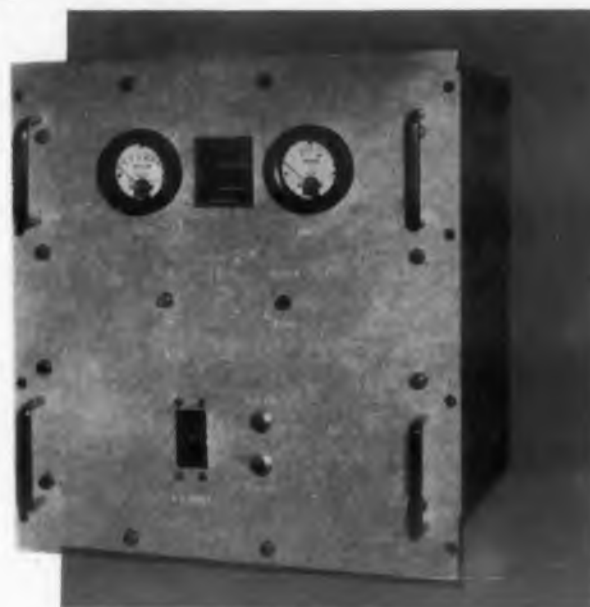
PERKIN

FOR THE FIRST TIME... 28V AT 100 AMPERE

transistorized, virtually transient-free
DC POWER SUPPLY

A MAJOR BREAK THROUGH IN DC POWER!!

Realizing a definite need for dynamically regulated D.C. Power in high current capacities, Perkin Engineering has pioneered the development of a line of units headed by 100 ampere, completely transistorized, power supply, with excellent transient regulation which is a "must" when powering voltage sensitive equipment such as transistorized inverters, converters, etc. This unit suppresses line and load transients to a very low level virtually eliminating voltage "overshoot" and "undershoot" common with more conventional supplies.



MODEL MTR28-100

UNIQUE FEATURES OF MODEL MTR28-100

- COMPLETELY TRANSISTORIZED
- EXCELLENT DYNAMIC (TRANSIENT) REGULATION
- LOW RIPPLE
- SHORT CIRCUIT PROOF
- AUTOMATIC CURRENT LIMITING
- SILICON POWER RECTIFIERS
- FAST RESPONSE TIME
- REMOTE SENSING
- SILICON ZENER DIODE REFERENCE ELEMENT



MODEL MTR060-5



MODEL MTR28-10

SPECIFICATIONS ON MTR28-100

AC INPUT: 208/230 OR 460 V. \pm 10%
3 PHASE, 60 CPS
D.C. OUTPUT: 24-32 V @ 100 A
REGULATION:
STATIC: \pm 0.1% LINE; \pm 0.1% LOAD
DYNAMIC: \pm 0.5% LINE; \pm 2 V. LOAD
RIPPLE: 20 MV RMS MAX.
DYNAMIC
IMPEDANCE: 0.025 OHMS MAX.
RESPONSE
TIME: 1 MILLISECOND MAX.

OTHER UNITS AVAILABLE WITH COMPARABLE SPECIFICATIONS

MODEL NO.	D. C. OUTPUT VOLTS	AMPS
MTR060-1	0-60	1
MTR060-5	0-60	5
MTR636-15	6-36	15
MTR636-30	6-36	30
MTR28-2	24-32	2
MTR28-10	24-32	10
MTR28-30	24-32	30

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Sales offices in principal cities throughout the country.



PERKIN

CIRCLE 6 ON READER-SERVICE CARD

Engineering Passes in Review



Communications

NARY a week went by during '58 that saw a "revolutionary" development in communications didn't break into print. It was an exciting year with significant progress made in radar, mobile communications, and broadcasting.

Radar

Perhaps one of the most interesting announcements was Hughes Aircraft's "3-D" radar. Dubbed Frescanar, the radar simultaneously computes distance, bearing and altitude of airborne targets. Scanning is done electronically. The antenna rotates but does not move vertically. By supplying a succession of frequencies to the antenna, Frescanar achieves what is, in effect, vertical scan.

All available energy is concentrated in sharp pencil beams of energy, flashing on and off a fan-shaped array to pinpoint targets with extreme accuracy. Data are transmitted electronically to missile battery processing centers to direct missiles to targets more rapidly. The Army states the new radar has 25-50 per cent better range than radars with similar missions. The Navy installed similar radars on test ships.

Early in the year, a highly classified pulse radar system was announced which permits extremely fast scanning and faster pulse repetition rates. Resolution and range losses are minimized. Developed by W. L. Maxson Corp., details still remain secret. FASTAR also scans electronically in elevation or azimuth, or both.

By applying the technique of space or frequency diversity—common in communication



RCA's experimental Megacoder for high speed selective calling.



MAXIMUM TELEMETERED RESPONSE THROUGH FLAT AMPLITUDE AND CONSTANT DELAY

In keeping with its reputation as a pioneer in the field of toroids, filters and related networks, Burnell & Co. now offers a complete line of low pass and band pass constant delay filters for standard RDB telemetering channels. These Burnell constant delay filters combine accurate amplitude and phase to effectively limit intelligence distortion and false transients to a minimum. Telemetered signals from off course missiles or those in distant or terminal flight are no longer blocked by attenuation and noise.

Amplitude and Phase Necessary

For maximum performance of telemetering systems, it is recognized that filtering of sampled data requires both linear phase and flat amplitude in the pass band. However, until recently a combination of the two in one unit had not been available.

Combination Achieved

Existing sub carrier discriminators afford no better than a choice of flat amplitude pass band with *non-linear* phase in one filter or a constant time delay filter with *distorted amplitude*. In contrast, Burnell constant delay filters combine both—are flat within 3 db over the pass band—1½ db for the low pass filters—and possess a time delay constant within 5%.

Write for Bulletin CD 051 Dept. D13.

TECHNICAL DATA

FOR ± 7½% PASS BAND

- 1 Flat within 3 db over pass band
- 2 21 db at ± 15% of center freq.
- 3 40 db at ± 22% of center freq.
- 4 Time delay over the pass band, constant to ± 5%

FOR ± 15% PASS BAND

- 1 Flat to 3 db over pass band
- 2 23 db at ± 30% of center freq.
- 3 40 db at ± 44% of center freq.
- 4 Time delay over pass band constant to ± 7%

Input impedance — 500 ohms

*Output impedance — 500 ohms and high impedance for operation to a grid

*optional impedance available on special order.

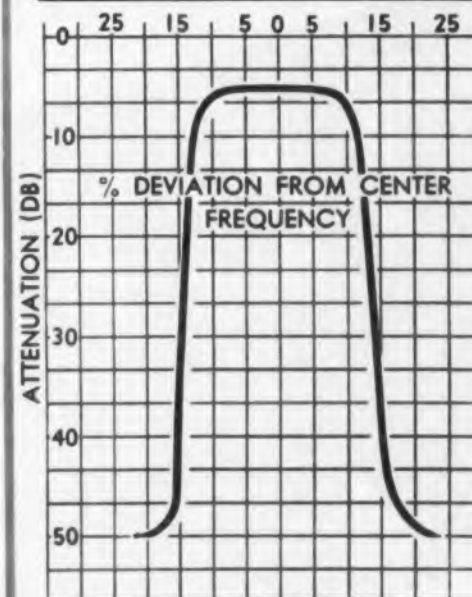
CONSTANT DELAY BAND PASS

Channel	Frequency	Part #	Delay in ms.	Δ/W
1	.4 KC	S-60051	34.00	15%
2	.56 KC	S-60052	24.30	15%
3	.73 KC	S-60053	18.60	15%
4	.96 KC	S-60054	14.20	15%
5	1.3 KC	S-60055	10.50	15%
6	1.7 KC	S-60056	8.00	15%
7	2.3 KC	S-60057	5.93	15%
8	3.0 KC	S-60058	4.40	15%
9	3.9 KC	S-60059	3.38	15%
10	5.4 KC	S-60060	2.44	15%
11	7.35 KC	S-60061	1.80	15%
12	10.5 KC	S-60062	1.26	15%
13	14.5 KC	S-60063	0.91	15%
14	22. KC	S-60064	0.60	15%
15	30. KC	S-60065	0.44	15%
16	40. KC	S-60066	0.33	15%
17	52.5 KC	S-60067	0.252	15%
18	70. KC	S-60068	0.189	15%
A	22. KC	S-60069	.305	30%
B	30. KC	S-60070	.224	30%
C	40. KC	S-60071	.168	30%
D	52.5 KC	S-60072	.128	30%
E	70. KC	S-60073	.096	30%

CASE SIZE—2" x 3½" x 4½"

* INPUT IMPEDANCE = 500 ohms

* OUTPUT IMPEDANCE = 500 ohms and to grid



Burnell & Co., Inc.

PIONEERS IN TOROIDS, FILTERS AND RELATED NETWORKS

EASTERN DIVISION
10 PELHAM PARKWAY
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TWX PELHAM 3633



PACIFIC DIVISION
720 MISSION ST.
SOUTH PASADENA, CALIFORNIA
RYAN 1-2841
TWX PASCAL 7578

CIRCLE 7 ON READER-SERVICE CARD

(Continued on following page)

er and dual speakers on a regular a-m
least band. The single side band system,
is still "years" from commercial pack-

radar system the same RCA demonstration, a high speed,
Instrum capacity ultracompact miniature decoding
quipm ent was unveiled. The Megacoder permits
ground t ive coding of any one of more than a mil-
of all veh radio receivers from a common transmitter.
Idlew idl consists of a microminiature array of capsule
system. its that can be set positively or negatively
onverted m a code. The device, only one cu in. in
iond Ant me, acts as a gate barring receipt of any but
ersion des single correct signal. The system can operate
h are ill eeds of 5000 or more codes per min.

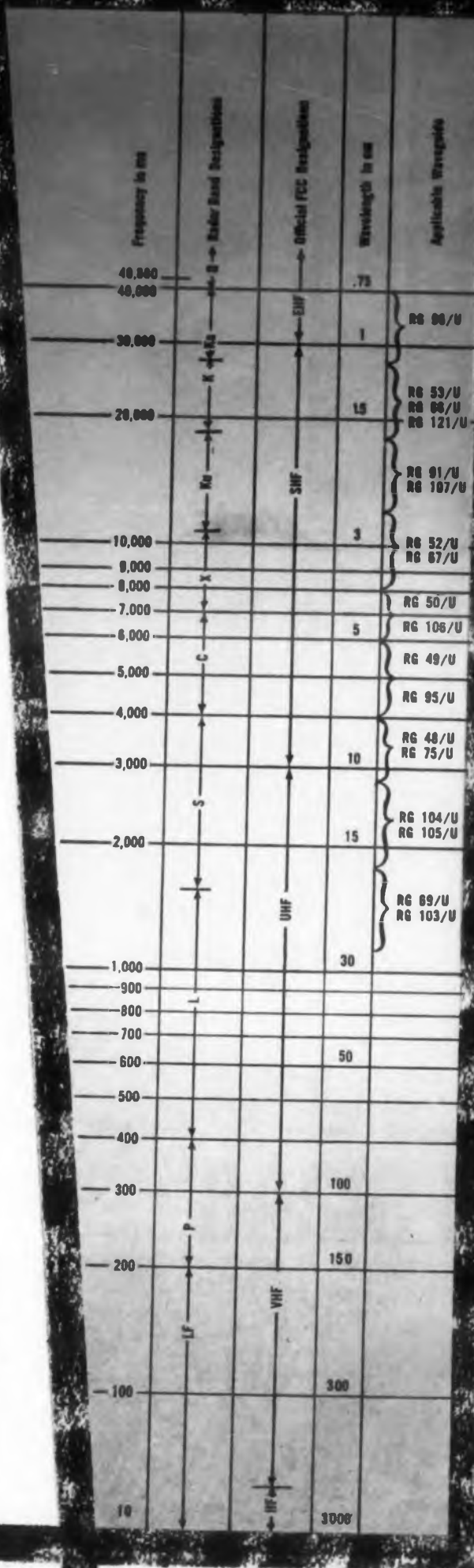
wave enc tivity in single side band has been dynamic,
oming wa the Army announcing that at least half
These w ts communications setup will go to SSB
i corres in five years. The Marine Corps has also
ey came ed up its study of SSB. Collins Radio Co.,
rance of tern Electric and Federal Electric have sup-
he scree d equipments for the Army tests being held
ould em e strategic communications center in Puerto
least sim Avco Mfg. Co. finalized designs on a fully
s shown storized one-man portable radio with sev-
s equip y has also awarded contracts to Collins, RCA
ick up b Westinghouse for SSB equipment.

multiple Motorola developed and successfully tested a
type SSB radio for the Army. Called AN/
d porta C-66 communications central system, it pro-
ealed be e a military commander with mobile "wire-
erated f telephone" service to include switching and
e labora tive calling to distances of 10 miles with
using th per cent coverage. Seven kc is used for a
control ce channel compared to the 100 kc per chan-
lbs. It ned in standard mobile communications
ions. Equipm ent. The system operates in the 132-165
mera t range.

or mon T&T early this year announced a multi-chan-
SSB radio system which operates in the 900
hibited region. Although designed primarily for line-
blacka ight transmissions, the SSB equipment is
sistors aptable to over-the-horizon microwave radio
rovide ough the use of bigger antennas and larger
from e ver amplifiers. Development plans will push
io mar e operating frequency to 2000 or more mc. The
gem accommodates up to 120 telephone chan-
l by RC s within a 500 kc bandwidth, allotting about
ransmit e per channel. Total power required to oper-
section e both transmitter and receiver is about 65
racteri tts.

terms. Another interesting development was Motor-
tribut s in roduction of a two-way radio with a fully
is. Ga nistorized receiver. Dubbed Motrac, it uses
tra sistors and weighs 25 lbs. The unit was
One st dnu d for the 25-54 and 144-174 mc bands.
just be p ver supply is also transistorized. Printed
n wh euit is used. The transmitter requires five
h a sig es.

Engineers: Tear out for your notebook



NEW! MULTI-BAND MICROWAVE ANALYZER

Complete frequency coverage 10 mc to 40,880 mc all in one unit

Extremely broad frequency range in a single unit makes Polarad Model SA-84 Spectrum Analyzer a general, all-purpose instrument for visual microwave analysis. It displays pulse modulation components, small frequency differences, attenuation and bandwidth characteristics, r-f energy leakage, radiation and interference signals, and VSWR information.



Model SA-84
Multi-Band
Spectrum
Analyzer

FEATURES:

- 10 mc to 40,880 mc frequency range in a single tuning unit.
- Unique band selector shows only the band in operation, eliminating operator error.
- Expanded direct reading slide rule dial.
- Internal r-f attenuation from 10 mc to 12,400 mc.
- Direct waveguide inputs in addition to Type N.
- Stable local oscillators covering more than one octave reduce required number of frequency bands.
- Expanded frequency marker with graduations every 200 kc permits measurements of very small frequency differences.
- Provisions for multi-pulse spectrum decoder.
- Rugged construction meets government equipment specifications, including shock, environment, vibration and interference.

SPECIFICATIONS: Frequency Range: 10 mc — 40,880 mc

Band 1.....	10 — 410 mc	Band 5.....	4,200 — 8,900 mc
Band 2.....	250 — 980 mc	Band 6.....	6,300 — 13,500 mc
Band 3.....	700 — 2,120 mc	Band 7.....	12,800 — 27,200 mc
Band 4.....	2,000 — 4,400 mc	Band 8.....	19,250 — 40,880 mc

Power input requirements: 103 to 127 volts ac
50 to 1,000 cps
380 watts power consumption

Resolution bandwidth (at the 3 db points) 25 kc at all frequencies

Frequency dispersion 10 mc to 55 mc 500 kc to 5 mc, adjustable
85 mc to 40,880 mc 500 kc to 25 mc, adjustable

Spectrum calibrator frequency 160 mc center frequency with a tuning range of ± 12.5 mc

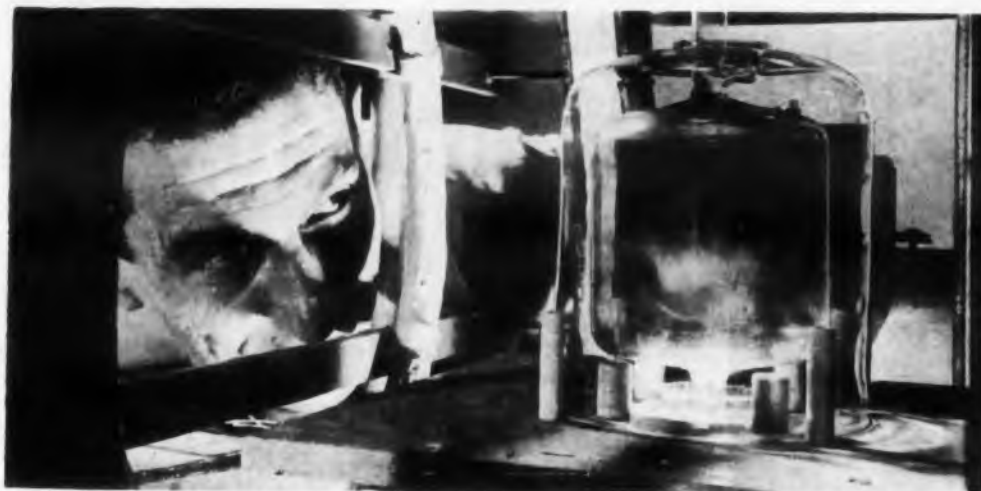
Frequency Dial accuracy ± 1% of the fundamental local oscillator frequency

R-F attenuation From 10 mc to 12,400 mc 100 db, uncalibrated, continuously variable
I-F attenuation 0 - 60 db, step-variable in nominal 6 db increments

Operating temperature range 0°C (32°F) to 55°C (131°F)

FREE LIFETIME SERVICE ON ALL POLARAD INSTRUMENTS
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Representatives in principal cities. See your Yellow Pages.



A look at IT & T's portable atomic clock. An atomic gas cell is surrounded by magnetic shielding.

Instrumentation

PERHAPS the most pronounced progress in instrumentation came in the way of automatic test equipment. Equipment has been built or is being built for virtually every operation from missile guidance (at audio and ultrasonic ranges) to navigation-doppler radar (at K band). Missile and aircraft checkout equipment was the most publicized. But there was also a wide array of odds-and-ends equipment built covering a multitude of applications.

Sperry Runs RACE

Sperry Microwave Electronics concentrated on RACE (Rapid Automatic Checkout Equipment) for complete checkout of weapon systems. Currently several kinds of RACE systems are under development or in production for a number of weapon systems and associated component systems. Many of the modular components in RACE are being standardized so as to be applicable to several types of weapon systems.

Sperry recently earned praise from Convair for a RACE system to check out the B-58 Hustler navigation and guidance bombing systems. Thirty minutes are required to check out these systems. All testing and fault location is directed by punched tape. Output is of "go, no-go" variety.

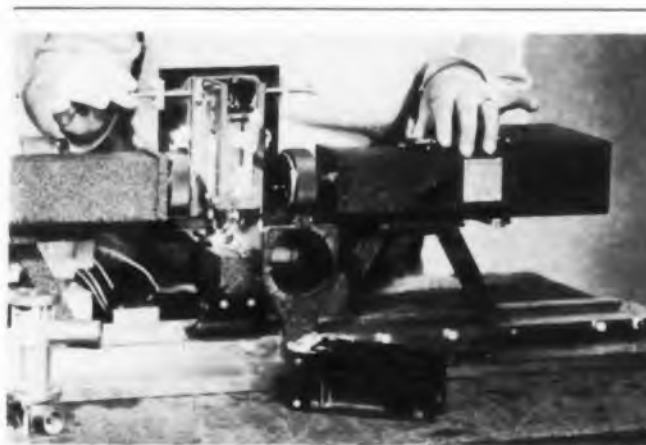
Taylor Packages SPAM

All-around checkout of any aircraft or missile package is possible with SPAM (Selective Programmed Automatic Maintenance). Taylor Engineering Co., Baltimore, Md., built it. This too is

punch tape controlled. The tape tells voltage check points, and what voltages should be. Lights indicate whether the voltage levels are right, too low or too high. SPAM also includes a 5-in. scope for display. A filmed image of the correct voltage waveforms is superimposed on the scope for pictorial comparison.

Bell Rings with ASCAT

Electrical, hydraulic and pneumatic systems of guided missiles and airplanes can be checked with Bell Aircraft's ASCAT (Analog Self-Checking, Automatic Tester). Only two minutes are required by a single technician to check out a number of operations which previously required



Ultrasonic Light Modulator—Fairchild's—gives high revolution and dynamic range in radar recording.

10 men for more than an hour. ASCAT is a voltage of "go, no-go" measuring unit.

Missile-laneous

Nike missile-men and other anti-aircraft crews are being trained in enemy interception and destruction, through electronic simulation of an actual attack. IT&T developed the simulator.

Under the direction of a control officer, various combat problems are simulated with the device, exactly as they might occur in actual attack—including the first identification of an enemy plane, "jamming" of signals by the enemy, tracking of the aircraft, "firing" of a missile and "destruction" of the enemy plane. The device can inject six synthetic aircraft targets into the control radars, with each of the simulated targets having the characteristics of extremely fast, maneuverable planes. Target speeds of up to 2300 mph with a maximum target range of more than 100 miles can be simulated. It can also simulate target altitudes up to 80,000 ft.; maneuvers, including climb rates up to 40,000 fpm and dive rates up to 80,000 fpm.

Several atomic clocks hit the scene. IT&T said its clock could be used to guide space travelers. It is not a wall fixture. It is small and light weight. Tests indicate the clock varies one second in 100 years. This error factor is expected to improve as the project continues.

The gas cell device uses optical pumping and optical detection. Atoms in vapor form—cesium and sodium—are acted on in a chamber by light and radio energy. The light comes from a vapor lamp using the same atoms as those in the chamber.

A Time Signal Generator is being used by Army Electronic Proving Ground personnel at Fort Huachuca, Ariz., to provide timing signals with an accuracy of 6-thousandths of a second per day. Timing signals record the time of day on magnetic tape, to provide event markers on special strip chart recorders. Coded time-of-day signals operate neon lamp drivers in remotely located instrumentation equipment. The generator was built by Electronics Engineering Co., Santa Ana, Calif.

A Look Across The Board

Here's a brief across-the-board look at some other developments.

An ultrasonic light modulator has overcome the shortcomings of crt displays—limited resolution and low dynamic range. Operation is based on the diffraction of light at ultrasonic wavefronts. Fairchild Camera and Instruments made it. Though applications remain classified some were suggested. The modulator may be used to obtain extremely high resolution and dynamic range in radar and video recording. It may also

is de use as a high speed shutter. Here it would we a speed of about 1/10 μ sec. It might also ve a correlator or analyzer in computer stem.

Westinghouse designed a "light chopper" to mechanically chop light beams into "pieces" only billionth of a second in length. The chopper can be useful in studying "on-off" phenomena. Also under investigation is its use in picture scanning and in high-speed photography.

A new machine is automatically testing transistors to a degree of accuracy previously unknown. The Stromberg-Carlson equipment processes any type of transistor through seven successive steps, at rates up to 430 transistors per hour. Transistors which fail any one of the tests are ejected at the station which they fail. Thus the machine sorts rejected transistors according to their defects. Accuracy is said to be within 2 per cent of the range.

Assistance to production line inspection of transistors is being offered by a traveling wave oscilloscope made by Edgerton, Germeshausen & Grier, Inc. Boston, Mass. Waveforms of a high speed switching transistor (2N501) made by Mansdale Tube Co. are being examined over a closed-circuit TV system with the aid of the scope.

Magnetic forces originating inside the earth and in outer space may now be measured far more precisely than was before possible. The Department of Commerce technique uses light absorption. A beam of light is sent through a tube containing a small quantity of vaporized cesium. The manner in which the light is absorbed indicates the strength of magnetic fields. According to Commerce Dept. officials, the instruments embodying the principle will be simple, lightly miniaturized and capable of measuring very small magnetic fields—"perhaps one billionth of the force developed by the motor which runs an apartment elevator."

A unique development in digital voltmeters is a six-digit device developed by Non-Linear Systems, Inc. Voltages from 0.0001 v to 100 v may be measured automatically at approximately 100 readings per min. Numerical readout is on the front panel. The voltmeter was built for the National Bureau of Standards and is not slated for production.

During this busy year now ending, Tenney Engineering and Westinghouse were just two of many manufacturers who came up with a huge array of environmental test chambers.

RC developed a noteworthy testing device. The Compressed Air Loudspeaker generates the world's loudest controlled noise to test sensitive electronic gear. Noise levels of 160 db can be generated in the plywood box measuring 5 x 5 x 2 3/4 ft. ■ ■



Scale model "Redstone" missile, courtesy U.S. Army

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Such exhaustive procedures of continuous inspection and quality control are unequalled in the wire industry.

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The ability of Hitemp Wires, Inc. products to exceed the exceptionally high requirements of the military in virtually all key missiles—guarantees wire, cable and tubing users in other fields the highest order of *basic reliability*.

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NEW

DESIGN PERFORMANCE APPLICATION

Relay Test Set

Semi-automatic, of modular construction, to verify the satisfactory operation of any relay by testing for:

Relay Chatter

Range: 10 - 590 microseconds in increments of 10 microseconds

Accuracy: $\pm 1\%$ or ± 4 microseconds, whichever is larger

Dry Circuit Conditions

Range: 250 - 800 ohms

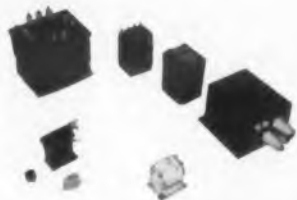
Accuracy: $\pm 20\%$

Pull-in and Drop-out Voltage

Meter voltage range: 10, 25, 75, and 150 volts dc or ac

Accuracy: $\pm 3\%$ of full scale for dc scales
 $\pm 4\%$ of full scale for ac scales

Regulated power supply included as modular unit.



Magnetic Devices

Transformers Reactors
Saturable Reactors
Magnetic Amplifiers
Pulse Transformers

Custom designed and engineered to specific electrical, mechanical, and environmental requirements.

X-Band Signal Generator

For use in the alignment and test of any radar or microwave system in the X-Band region.

Frequency Accuracy (Direct Reading): ± 1 mc

Power Output: 15 mw max. at Type "N"

Attenuator Range: 3 - 70 db ± 1 db over complete frequency range



100 Watt Power Amplifier

Completely transistorized Class B Power Amplifier.

Output: 100 watts at 140° F ambient temperature

Efficiency: 55% at 100 watts

Distortion: Less than 1% at 100 watts, 400 cycle output into resistive load

Feedback: 54 db at 400 cycles

Weight: 12 pounds

Temperature Probe Transducer

Probe is made from Carpenter No. 20 stainless steel without welds, for reliable operation in corrosive fluids.

Designed to exceed requirements of MIL-E-5272

Thermal Time Constant: 0.4 sec. typical



For further information contact:



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Los Angeles 48, California

Engineering Passes in Review



Pictorial information (below) is processed at National Bureau of Standards, BS and Bell Labs also working on TV and S search with computers.



Data Processing

IT WOULD take a pretty active computer to process information on developments in data processing this year. There are computers everywhere doing just about everything—and more. A complete machine tool line has been automated. A computer corrects its errors. There's even a machine that thinks.

Perception is the thinker. The Office of Naval Research unveiled plans for this machine, which perceives, recognizes and identifies its surroundings without human control or training. It has demonstrated its ability to perform what no machine previously has done—conceive an original idea. Perceptron generates a spontaneous concept based on its observations of visual forms and attaches meaningful symbols to things which it senses. A pilot model is now being built. The original demonstration used the IBM 704 to simulate the Perceptron concept. The first model will probably use a TV-like device to "see" with. Perceptron was developed at Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y. No practical applications are expected in "the immediate future." However, applications of Perceptron as automatic landing systems, missile and space vehicle guidance systems, library research, and scientific data gathering seem clearly indicated.

The first Semi-Automatic Ground Environment (SAGE) center went into operation at McGuire Air Force Base, N.J. More than 30

SAGE sites will be made operational within the next few years. SAGE will be a vast, interconnected network of air defense direction centers which will receive information from many sources, process the information rapidly on high-speed digital computers, and generate battle orders to jet interceptors and other weapons in the air defense system.

Hughes Aircraft revealed its completely automatic punch tape control of a machine tool line. It's the first. Machines can work on a series of successive operations and make a variety of parts at the same time with the Digitape system. Changes in operations may be introduced or production may be started on new parts by changing tapes without stopping the machines. The system makes available mass-production techniques for small-lot production.

The Datamatic Div. of Minneapolis-Honeywell built a system which automatically corrects errors being entered into its computer tape file. Orthotronic Control re-creates source data on a computer speeds the instant it is read into the computer. The system works with the Datamatic 1000 computer. It uses the 32nd channel on the 3-in. magnetic tape used in the computer memory system. Thirty-one channels store data.

Special adding circuitry check the tape transversely. A binary zero is written in the 32nd channel if the sum of the other 31 bits is an even

number. A one signifies the sum is odd. A weighted binary check count is inserted in each channel after every 48-bit word. If the machine detects an error in a channel, a comparison with the 32nd channel shows which bits are wrong. If an error is detected, the system inverts the binary digit. Further verification assures that corrections are authentic.

Handwritten numbers can be read by a device developed at Bell Labs. Numbers are recognized as they are being written and the device indicates the numeral by lighting up the correct digit on a numbered panel. With some modifications the equipment could be used to read handwritten letters. The size of a typewriter, the device works off a flashlight battery.

AT&T developed an aerial automatic caption writer. The Digital Data Recording Device records in code the speed, location, altitude and other pertinent data directly on the photographic film as the camera plane speeds over its target. It was made to "meet the demands of jet-age photography." The device continuously takes information from the plane's instruments and displays it on a one-in. crt in the camera's field of vision.

A lot of work is being done in speech and editorial research using computers as simulators. At Bell Labs and the National Bureau of Standards are actively engaged in this area. General-purpose digital computers are being used. The object is to understand the nature of editorial and speech information to make transmission of information more efficient.

From the University of Texas came news of an impedance computer which provides automatic determination of network characteristics. It measures impedances, admittances and transfer functions of networks rapidly. The computer contains an oscillator which provides the driving function, automatically sweeping through the desired frequency range. The devised information is obtained on a complex plane plot.

The British Broadcasting Corp. announced a new tape recorder which is said to be considerably cheaper to operate than comparable American units. Designated VERA (Vision Electronic Recording Apparatus), it uses a standard 1/2 in. magnetic tape. The comparable American make, put out by Ampex, uses 2-in. tape.

VERA records along the length of the tape as normal sound recording. The reproducing head permits pictures to be monitored while recording is taking place, a facility which is not believed to exist in other equipment. Video frequencies are separated into two bands. Each is recorded on different tracks. Sound is put on a third. The machine accommodates tape reels 1-1/2 in. in diam. for 15 min. recording. Tape speed is 200 in. per sec. ■ ■



The Human Eye, Nature's inspiration for the camera, can convert wavelengths of blue-green light measuring as little as 400 microns into visual perceptions that are truly life-size. Yet this entire human mechanism occupies space less than 1" in diameter.

Tiny New Potentiometer, shown actual size, is designed to add space-saving precision to missile and aircraft servo mechanisms. Two MPB bearings in it assure accurate, low-torque shaft rotation — a vitally important benefit in sub-miniature components.

Man With Miracles. This is Maurice Hebert, one of MPB's Sales Engineers. He'll personally help you choose the correct MPB bearing to reduce friction and increase the precision of your instruments — while keeping your operating costs low with trouble-free service.

Miracles in Miniaturization

ACTUAL SIZE OF THE MPB BEARINGS IN POTENTIOMETER SHOWN ABOVE

The Smaller The Better is often completely true. Engineers now know that miniaturization is the surest method of developing new or improved components for many of the latest developments in modern industry. But, as components become smaller, the problems of maintaining high precision and long service life become larger — and the call for MPB bearings constantly increases. MPB answers

with the most experienced engineers in the miniature bearing industry, and advanced research facilities . . . producing over 500 types and sizes of bearings from 3/8" O.D. down, with specials as required. We welcome your request for engineering advice, our catalog, or both.

Write Miniature Precision Bearings, Inc., 912 Precision Park, Keene, N.H.

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MINIATURE PRECISION

MPB
BEARINGS INC.

Helps you perform miracles
in miniaturization

If **FAST SWITCHING** is your need and available germanium types won't meet temperature and reliability requirements...

SWITCH to SILICON

MILITARY TYPES

Silicon	1N663
Computer	1N662
Diodes	1N643

A definite break-through of the inherent temperature limitations of germanium is provided by these outstanding new Silicon Diffusion Computer Diodes. They switch as fast as the best germanium types...and at temperatures to 150°C!

They combine fast switching with high conductance and high break-down voltage with high temperature operation... plus PSI "Built-in-Reliability."

These three related military types can replace all germanium diodes in computers of advanced design where high reliability performance at high temperatures must be sustained without compromise.

Look at these outstanding specifications!

EIA TYPE	Minimum Saturation Voltage (volts) @ 100 μ A	Minimum Current Forward @ +1.0v	Maximum Reverse Current (μ A)		Reverse Recovery Characteristics	
			25°C	100°C	Reverse Resistance (ohms)	Maximum Recovery Time (μ s)
1N663	100	100	5(75v)	50(75v)	200K	0.5
1N662	100	10	1(10v) 20(50v)	20(10v) 100(50v)	100K	0.5
1N643	200	10	.025(10v) 1(100v)	5(10v) 15(100v)	200K	0.3

Detailed specifications, ratings and curves available on request.

Write for full information on the entire line of PSI silicon and germanium diodes, silicon rectifiers and PSI voltage-variable capacitors (VARICAP). Production quantity delivery on all types.



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CIRCLE 13 ON READER-SERVICE CARD

Engineering Passes in Review



Components

ELECTRONIC components manufacturers broke new ground in the past year, working generally in four major areas. They improved existing components. They came up with brand new components. They reduced the size of components. And they designed components for higher operating temperatures.

To list all the companies, and their work, is impossible. The field is too big. Those mentioned have been arbitrarily selected.

Hot Stuff

There are very few components available for 200 C operation and even fewer for 500 C operation. Pressed by military needs, however, the search for components to operate at higher and higher temperatures goes on.

A thermistor which could operate continuously at about 650 C was announced by Fenwal Electronics, Inc. About 300 C was the limit for previous thermistors.

General Electric developed a vacuum tube not much larger than a shirt button which operates at ambient temperatures in the 600 C range. An interesting feature was that the cathode heating was supplied by the high ambient temperature. There was no filament in the tube. The tube is not commercially available at this time.

Using gallium arsenide, the Radio Corporation of America developed a microwave diode that will operate effectively above 572 F. The laboratory unit beats silicon rectifiers which operate at a maximum of about 392 F.

The key to high temperature components is development of materials which can stand heat. And research is essentially a slow process.

It's Little Things That Count

Everyone and his competitors, it seems, is out to make components tinier—and better.

Miniaturization sometimes has confusing results. A tiny silicon rectifier is smaller than its germanium predecessor. But the heat sink required for the silicon unit eats up the space saved.

Nevertheless, a big need for small components remains.

The Radio Corporation of America is developing micromodules. These electronic units, designed for avionic equipment, are expected to provide a 90 per cent reduction in the size and weight of components. Modules consist of 3 in. submodules. Each submodule is made from a ceramic plate and mounts one or more components with flat shapes.

Lumped constant delay lines suitable for transistor and printed circuit applications are available in 1 in. x 0.4 in. cases, manufactured by Color Instruments, Inc., Gardena, Calif.

A tantalum capacitor which measures less than 1/16 in. in diameter and a little longer than 1/8 in. in length is produced by P. R. Mallory & Co., Indianapolis, Ind. They're available in ratings of 10 μ f and 1 to 10 v.

National Cash Register developed a pin-sized memory device, a glass rod with magnetic coating, which serves as both switching and data storage element and promises to increase "thinking" speeds of future computers 10 to 20 times. Research models had switching speeds of 4 millimicrosecs. The rod lends itself to cheap mass production techniques, both in fabrication and testing.

And so the story goes. If something is small it's miniaturized. If it's miniature it's made peanut size. And if it's peanut size, it's made pea size.

Something New, Something Old

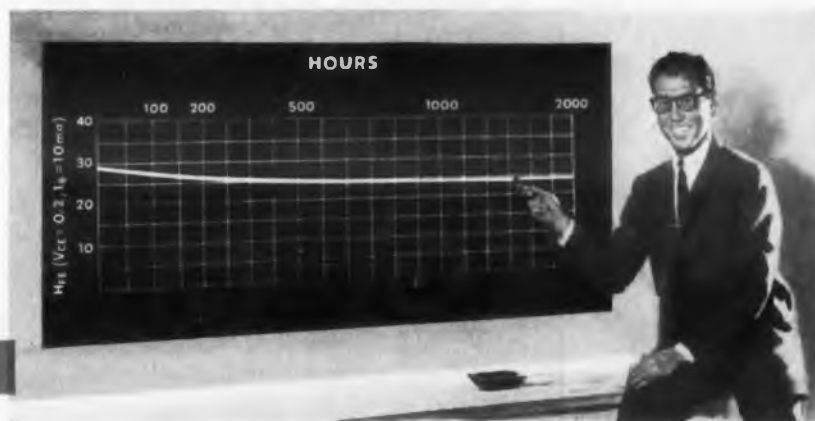
Thousands of new products were announced during the year. In general, it was a big year for solid state devices. Here are a few products that made people sit up and take notice.

The maser oscillator was put on the market by the Polytechnic Research and Development Co., Brooklyn, N.Y., for the first time. For about \$7000



tiny CR magnetic rod providing high switching speeds is inserted in a memory assembly to show ease of fabrication.

Now PNP SWITCHING TRANSISTORS from Sylvania



designed to give you this same reliability you've come to expect from Sylvania's full line of NPN types

HERE IS an important line of PNP switching transistors to complement Sylvania's line of NPN types. Manufacturing techniques developed for producing high-temperature stability in NPN types have been incorporated in these new PNP switching transistors. For designers this means the high reliability and stability synonymous with Sylvania NPN types, and permits circuit designs which take full advantage of the complementary aspects of NPN and PNP.

These transistors feature a new hermetically sealed inverted base TO-5 package which offers better heat dissipation to easily provide up to 150 mw at 25°C.

Electrical, mechanical, and environmental tests applied to these PNP transistors are in accordance with MIL-T-19500A.

TECHNICAL DATA						
Type	V _{CB} Volts	V _{EB} Volts	V _{CE} Volts	f _{ab} min mc	h _{FE} Typical	Max. Dissipation in MW
2N404	-25	-12	-24	4.0	50	120
2N425	-30	-20	-20	2.5	30	150
2N426	-30	-20	-18	3.0	40	150
2N427	-30	-20	-15	5.0	55	150
2N428	-30	-20	-12	10.0	80	150

Temperature range -65°C to +85°C



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Components (continued)

you could generate a signal at 23.8701924 kmc ± 0.0000005 kmc. Stability of the unit was better than one part in a billion.

Then there was the silicon controlled rectifier by General Electric. Sample models created a stir in the industry but they weren't available beyond sample lots until now. The solid state device acts like a thyatron and can handle up to about 60 amp.

A four-layer switch, ten times faster than most switching transistors, was made available by the General Transistor Research Laboratory. It had a switching time of from 0.03 to 0.05 μ sec. and was designed for driving memory cores.

Ohio Semiconductor, Inc. and Westinghouse experimented with an 80-year-old principle: The Hall effect. Both companies came out with devices that took advantage of this principle. The devices generated a voltage as a function of the current and a magnetic field passing through the unit. Ohio Semiconductor called theirs the Hall-tron, and Westinghouse called theirs the Hall Generator. Same thing.

Ohio Semiconductor went one step further. Using the Hall effect, they developed the Magneto-resistor. This unit changes its resistance as a function of the field passing through it.

Westinghouse also developed what they called the silicon Trinistor triode, which is a high power switch. Still in the laboratory stage in the early part of the year, these units were capable of blocking up to 200 v and carrying up to 10 amp. From the on to off time, the unit is ten times faster than that of a comparable transistor.

Another component still in the laboratory stage was the constant-current varistor. Work on it is being done by Bell Telephone Laboratories. This two-terminal passive semiconductor is applicable as a current regulator where load or supply varies from 20 to 120 v. It can be used as a coupling choke or ac switch.

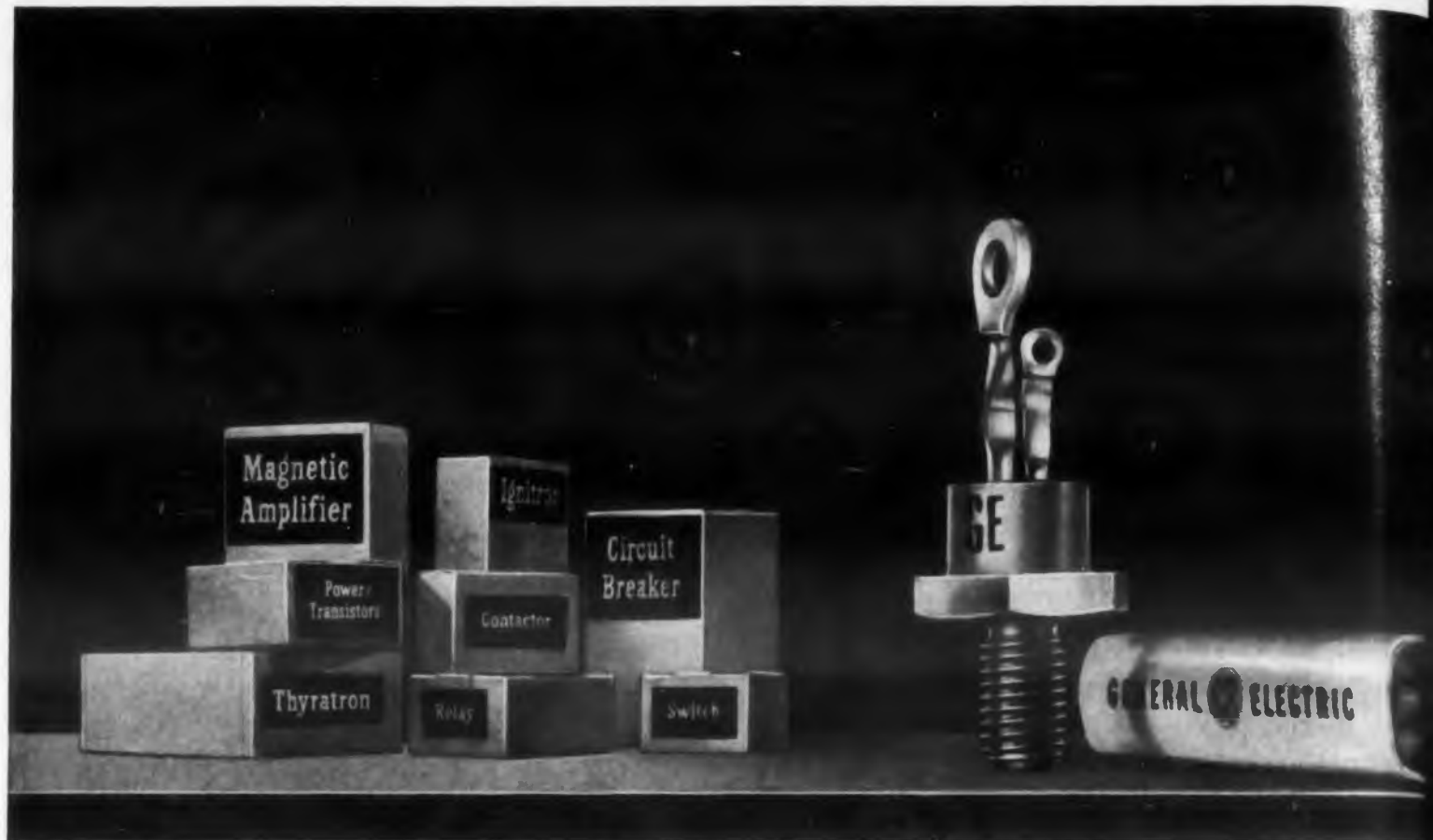
The Wamoscope, developed by Sylvania, has



Transistor-size ceramic vacuum tubes made by GE operate at 600 C.

General Electric Semiconductor News

New controlled rectifier does a



Maximum Allowable Ratings and Characteristics

(Resistive or Inductive Load)

	ZJ39A 25	ZJ39A 40	ZJ39A 75	ZJ39A 100	ZJ39A 150	ZJ39A 200	ZJ39A 250	ZJ39A 300
Continuous Peak Inverse Voltage (PIV)	25	40	75	100	150	200	250	300 V
Transient Peak Inverse Voltage (Non-recurrent > 5 millise)	35	60	100	150	225	300	350	400 V
RMS Voltage (Vrms)	17.5	28	53	70	105	140	175	210 V
Average Forward Current (I _F)	Up to 16 amperes							
Peak One-cycle Surge Current (i surge)	150 amperes							
Minimum Forward Breakover Voltage (V _{BO})	25	40	75	100	150	200	250	300 V
Maximum Forward Voltage (V _F Ave.)	0.75 Volts (Full Cycle Average)							
Maximum Reverse Current (I _R)	5 ma (Full Cycle Average)							
Maximum Gate Current To Fire (I _{GF})	25 ma							
Maximum Gate Voltage To Fire (V _{GF})	3 Volts							

Finer performance of G-E low-current silicon rectifiers now within reach for all your requirements

	MAXIMUM RATINGS AND SPECIFICATIONS								
	PIV	RMS Voltage	Cont. Reverse D-C Volt	D-C Output (150°C Amb.)	D-C Output (50°C Amb.)	One-cycle Surge Current	Full-Load Forward Voltage Drop	Leakage Current	Ambient Operating Temp.
1N536-40, 1N1095-96 series	50-600	35-420	50-600	250	750	15	0.5	0.4-0.3	165
1N440B-445B series	100-600	70-420	100-600	300-500 (100°C)	300-750	15	0.5		150-165
1N1487-92 series	100-600	70-420	100-600	250 (125°C)	750 (25°C)	15	0.55	0.3	140
1N1692-95 series	100-400	70-280	100-400	250 (100°C)	600 (50°C)	20	0.6	0.5	115
	volts	volts	volts	ma	ma	amps	volts	ma	°C

The time has come to reconsider possible applications of G.E.'s outstanding low-current silicon rectifiers in the 1N536, 1N440 Series (150°C line) . . . the 1N1487 Series (125°C line) . . . and four recently added types in the 100°C area, the new 1N1692 Series. You'll find these devices more attractive for use than ever before—both in quality and price—with equally fine values in low-current silicon stacks. Stud-mounted units are also available.

General Electric low-current silicon rectifiers are designed for maximum forward conduction at high operating temperatures. High current loads are carried without internal heat sinks. Reverse current at maximum



Microwave Amplifiers

THE LOW NOISE solid-state microwave amplifier field has been one of the most exciting news hatcheries this year. It is estimated that anywhere from 100 to 150 facilities are seriously engaged in R & D activity. And a booming dollar business is expected in three years—perhaps \$70 million dollars worth.

Applications, however, remain classified generally but certainly their use in radars, radio astronomy, telemetering, scatter and satellite communication are logical speculations.

Basically, there are two kinds of solid-state amplifiers—masers and parametric amplifiers (mavars).

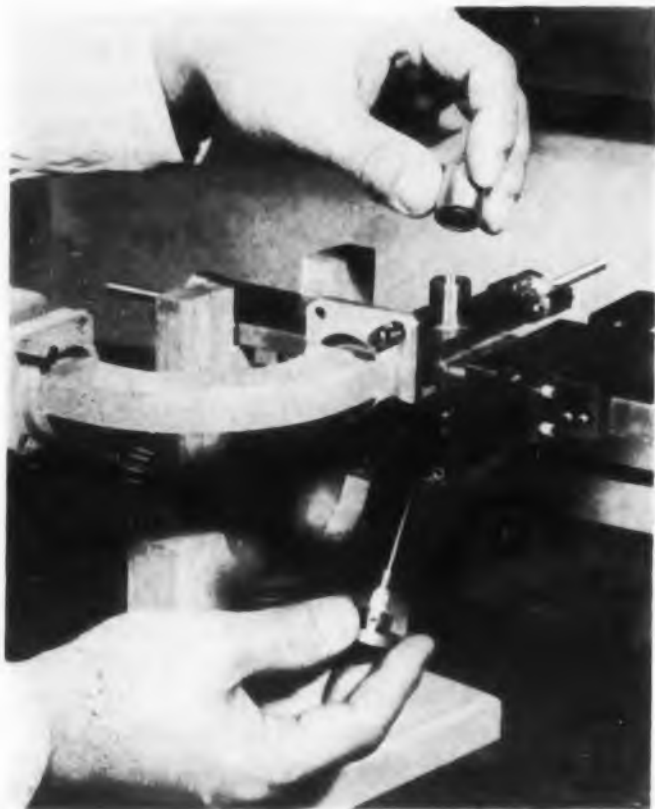
Masers are low power devices operating under cryogenic conditions at a 1 db or better noise level. Parametric amplifiers require no cooling. They offer noise levels on the order of 3 db.

To many engineers these microwave devices

are still sources of confusion. Some of their general characteristics:

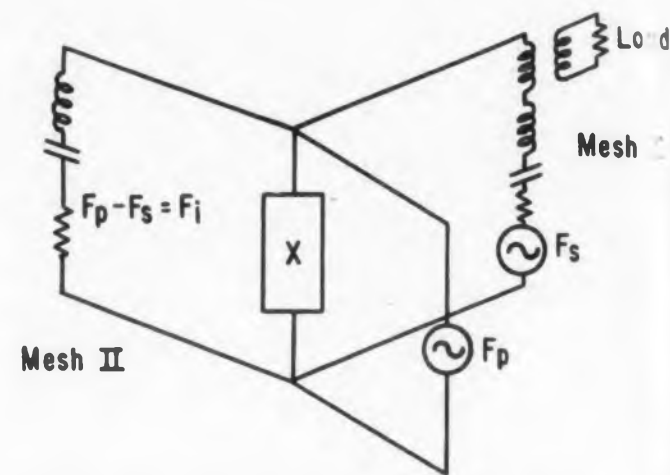
Masers: Masers depend on electron energy within individual atoms or molecules. When these electrons interact with a microwave field they can exist only at a discrete number of energy levels. At various frequencies electrons can absorb energy or emit energy by jumping to higher or lower energy levels. The trick is to put more energy out than is absorbed.

Until recently masers were operating with gases to achieve the molecular energy exchange. A short time ago, Professor N. Bloemgarden of Harvard proposed an effective technique whereby solid-state materials could be used in maser work. These solid-state masers provide much larger gain for a given bandwidth than the gas type. Another useful property is the tunabil-



IT & T's parametric amplifier (above) extends microwave links 100 miles over present 250-mi. limits. Silicon diode (inset) is heart of amplifier.

Bell Telephone Labs' parametric amplifier (left) uses semiconductor diode (varactor diode) as the non-linear capacitor.



Schematic representation of parametric amplifier.

ity obtained by using paramagnetic salts as the active material.

The frequency of these salts can be changed by varying the magnetic field strength. The salt is placed in a high Q cavity. Electrons within the structure assume various energy levels depending upon the salt used. With an increase in energy levels, the electron population of each level decreases. Most cavity-type research is with three-level devices. Westinghouse, Stanford University and the University of California are working on two-level devices. There is also activity in four-level masers by Varian and Ewen Knight.

Here's how a three-level maser works: A pumping signal with a frequency corresponding to the energy difference between the lowest and highest energy level is supplied by an external oscillator (a klystron is often used.) Electrons then jump from the lowest to the highest energy level. Electrons in the highest level jump to the intermediate level because of impurities in the crystal. This middle level then becomes over-populated compared to the lowest level. Application of an input signal corresponding to the energy level between these levels results in amplification.

In a four-level device pumping frequencies correspond to the energy differences between levels one and three and two and four. The output is the difference between levels two and three.

Work with cavity-type masers has been abandoned at Bell Telephone Labs because of development of a traveling wave maser. This slow-wave structure produces wide-amplifying bandwidth by variation of the pumping frequency and the magnetic field. The device also offers gains which are much higher than cavity-type offerings. BTL scientists report that the TWM can be tuned over a 350 mc range centered at 5.9 kmc.

Here's a capsule review of some present maser activity:

Columbia University—Developing an infrared maser to produce oscillations in infrared range. Recently, one of their solid state masers was installed in the Naval Research Labs' 50-ft telescope. This represents one of the first practical uses these devices have been put to.

AT—Trying to develop new crystals with the aid of chemists under a Signal Corps contract. Building a solid-state maser with K-band pump and X-band amplification.

AT—Working under Government sponsorship. Projects include: three-level solid-state maser at 88 kmc operation; exploring titanate crystals for maser use.

University of California—Engaged in developing a three-level two-level solid-state device using magnesium oxide; further along is a three-level ruby maser (X-band).

AT—Researching three-level solid state TWT maser; has developed molecular beam double cavity-type maser, reportedly first cavity maser to show one-way gain of molecular energy.

University of Michigan—Operated three-level maser in the S-band. Working on four-level maser. Using three-level ruby maser (K-band pump, X-band output) in noise studies on their radio telescope.

AT—Working on two-level and three-level masers in C and X band under a Wright Development Center contract.

General Electric—Recently built three-level device using pink ruby for X- and S-band operation.

Parametric Amplifiers: These devices operate admirably at room temperature and do not require the liquid helium coolant temperatures (4°K) to achieve their low noise characteristics. Where maser operation is determined by molecular or atomic energy interchange, the maser depends on energy stored in a circuit element such as a capacitor, ferrite, or inductor. Perhaps the best explanation can be achieved with the aid of a schematic of a parametric amplifier, which is shown here.

In the circuit currents from the pumping source (F_p) and from the signal (F_s) flow in the nonlinear reactance (X). The two currents mix to produce sideband currents, F_p and F_s . Mesh is tuned to the lower sideband, i.e. $F_p - F_s \approx$

Only this component of current can flow in mesh II. It adds to the current already present in the mesh. In turn this current (F_i) mixes with the source current and has a lower side band at $F_p - F_i$. For positive feedback it has been found that the current in both meshes builds up to a level determined by circuit losses and source power. Above the critical source power necessary to overcome circuit amplification is obtained.

Some of the representative developments in paramagnetic amplifiers are depicted in the accompanying picture spread. ■ ■

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Production Processes And Materials

A SLEW of new production processes and materials took prominence in the industry during the year.

Three of the newest developments in production processes have come from Bell Telephone Laboratories.

One, a floating zone method for growing single crystals of binary semiconductors, looks superior to other crystal-growing techniques. Basic experimental work was done on gallium arsenide. But the method should be applicable to a variety of compounds which are thermally unstable at their melting points. The compound, however, must have a high enough thermal conductivity to allow heating by rf induction. Also, surface tension and density of the molten material must be such as to support a molten zone during the process.

In the basic floating zone refining technique, a rod is supported vertically. A heat source (an induction coil operated at radio frequencies) is

moved relative to the rod. It melts a liquid zone as it moves. Surface tension supports this zone.

Also From Bell

In Bell's second development, downtime of equipment such as that used in the manufacture of printed circuits is eliminated by a process for continuously regenerating copper etching solutions. The process does away with the dangers inherent in changing corrosive spent etchants. It also makes it possible to salvage the etched copper.

For its third contribution, Bell conducted research which indicates that cathode metal sputtering may be useful in producing precision printed circuits. Entire circuits, including resistors, capacitors and leads, may be laid down. In this technique ionized gas molecules bombard a cathode, dislodging atoms of metal which then redeposit on nearby surfaces.

Earlier in the year, a machine which winds coils on toroidal cores almost invisible to the naked eye was designed at Stanford Research Institute. The wire forming the coil is made to pull itself through the hole or holes through which the coil is wound.

A process for electroplating copper on aluminum strips and wire was developed at Sylvania. The technique permits plating of strips in widths up to 10 in. and thicknesses of 0.008 to 0.050 in. Thickness of the copper plating ranges from flash coating of 0.002 in. per side.

An ultrasonic continuous seam welder—reportedly the first fully automated—joins any two similar or dissimilar metals. Gulton Industries was the designer. Welding is the result of a plastic flow at the interfaces of the two metals below the melting point of either. There are eight welding heads which can weld at a rate of 200 in. per min.

New Materials, New Products

Development of new materials is important for two broad reasons. First, new materials often lead to unique new products. Second, new materials are needed to meet the severe environmental stresses in military applications.

Indium antimonide is an example of a new

material which is used in a unique new product—new at least in terms of the development of suitable indium antimonide. Using this material, Westinghouse and Ohio Semiconductor, Inc., developed a solid state component based on the Hall effect. This effect, though known for 80 years, could not be turned into a commercial product until suitable materials were developed. The device manufactured by the two companies produces a voltage as a function of the current and magnetic field passing through it.

Employing gallium arsenide, a new suitable material, RCA Laboratories developed high-temperature semiconductor devices. The material is used in transistors and experimental microwave diodes and power rectifiers.

For use as a light weight free flowing filler, hollow silicate glass microspheres were produced. They look like ground sand and are manufactured by Emerson & Cuming, Inc. Dissipation factors as low as 0.008 are achieved when the microspheres are used in low-loss material. This material has a low density and low conductivity.

For molding and extrusion purposes, Teflon 100X fills the bill. It is a perfluorocarbon resin. Operating temperature limit of Teflon 100X is approximately 450 F. However, when used in injection or transfer-type molds, it may be preheated at 750 F and cooled at 400 F. It has low-loss properties and can be combined with inorganic fillers to provide rigidity and dimensional control.

Penton, manufactured by Hercules, is not affected by moisture pickup and may be used as a coating material. It is a high molecular weight-chlorinated polyether thermoplastic. Penton has a strong resistance to abrasion, excellent dimensional stability and may be easily fabricated.

In high-humidity electrical applications, Orlon filled diallyl phthalate (DAP) is an important new material. Two manufacturers are the Food Machinery and Chemical Corp. and Mesa Plastics. Among the material's features are its arc resistance, low loss and dimensional stability.

Insulating Under Stress

A silicone resin rubber tape has several good properties for insulation purposes. It can stand ozone, vibration, shock and moisture well enough to be used in big motors and generators. The tape is a product of Moxness Products, Inc.

As brought out at the recent first National Conference on the Application of Electrical Insulation, the greatest advances in recent years have been the development of the silicones and fluorocarbon materials. To meet today's ultra-high temperature requirements these substances, along with the newer plastics, are being combined successfully with the traditional insulating materials. ■ ■



Crystal growing equipment used in Bell Labs' floating zone process. Molten zone of a gallium arsenide rod is examined during crystal growing experiment.

EDITORIAL

Peace on Earth, Good Will To All Men – A Proposal

The marvels of electronics described in preceding columns have been largely designed with the aim of saving Western mankind. If Western man is kept safe, if the deterrent effects of his weapons capability staves off Armageddon, there will be "peace on earth."

History unfortunately records that most weapons developed by man have been called upon to kill. The end objective of weapons—that of maintaining the peace—never has been fully realized.

We can only hope that our arsenals will not lead to destruction, that they will remain a deterrent to all-out war. With the advent of electronic controls, the difference between a deterrent and destruction is the flick of a switch.

The precarious balance can be swung to peace if "good will towards all men" becomes operative, if it becomes more than a seasonal ideal. A great amount of good will could be given the world—given both our enemies and our friends—if we were to share those electronic marvels now saving men here, electronics for medicine.

The limited exchange of scientists and engineers between East and West already has done much to generate understanding and feelings of good will. Where "security" was at stake, however, both sides have held back. In the area of medical electronics, "security" is not a factor and there can be full giving on our part.

Nor need we concern ourselves about receiving as much or more in return. Our good will need not be confined to a few guarded overtures made from time to time by a State Department official. It can be a genuine effort, made with no thought of repayment—an effort to make the marvels of electronics available to all mankind.

International cooperation in the field of medical electronics got a start this year through the efforts of Dr. Vladimir K. Zworykin of the Rockefeller Institute's Medical Electronics Center. But there are vast problems to be surmounted before the program can go into full swing—problems of money, of labor, and, importantly, of planning. National and international committees of doctors and electronic experts, in equal partnerships, must be set up.

The engineer can participate, for example, by joining the IRE Professional Group on Medical Electronics. And to the engineer engaged in weapons development who may be pondering the meaning of his work, an avocation in medical electronics possibly could add the dimensions he seeks.

To the individuals who already have given much of their time to this work, we can appreciatively pay tribute at this season for their acts of good will to all men.

James F. Kopp

UHF-MICROWAVE TELEMETERING EQUIPMENT

by **CANOGA**

Canoga Corporation has recently developed and is now manufacturing a complete line of transmitting and receiving antennas for communication and telemetering in the 2200 mc region.

The compact blade antenna has been designed for missiles and supersonic aircraft. It is less than 1 inch high, has very low drag, an all metal leading edge, and provides an omni-directional pattern.

The 8 foot diameter horn fed paraboloid weighs only 82 pounds and provides a 4 degree pencil beam for high gain requirements. Polarization is readily changed from horizontal to vertical. The pedestal includes angle scales, a dual speed drive in azimuth and a single speed drive in elevation.

The conical scanner shown below is installed in 6, 8 or 10 foot diameter paraboloids. Optimum reception of telemetering signals even at long range is obtained by automatic tracking with the narrow beam provided. Horizontal, vertical and circular polarization are available.



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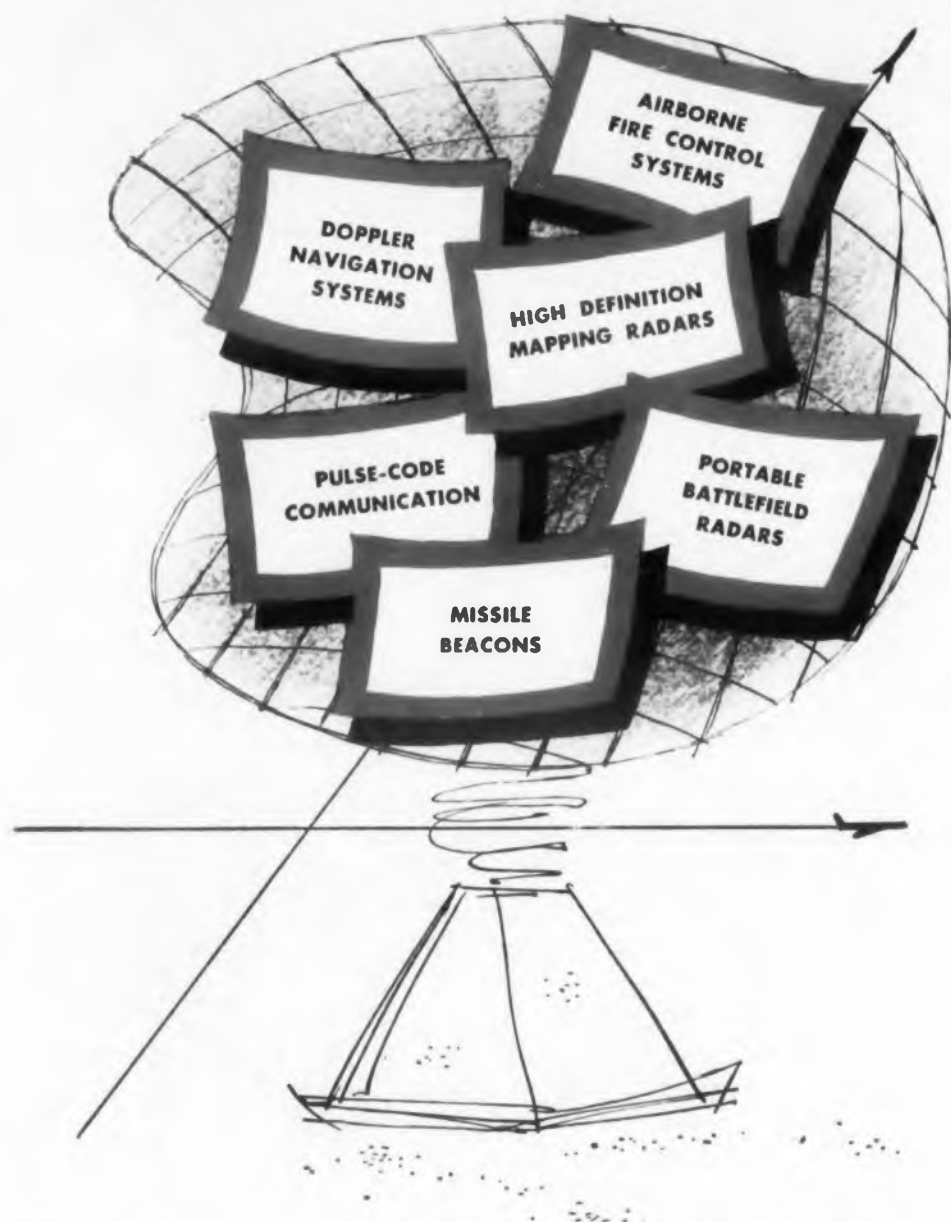
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Microwave Test Instruments

Part 2 Signal Generators

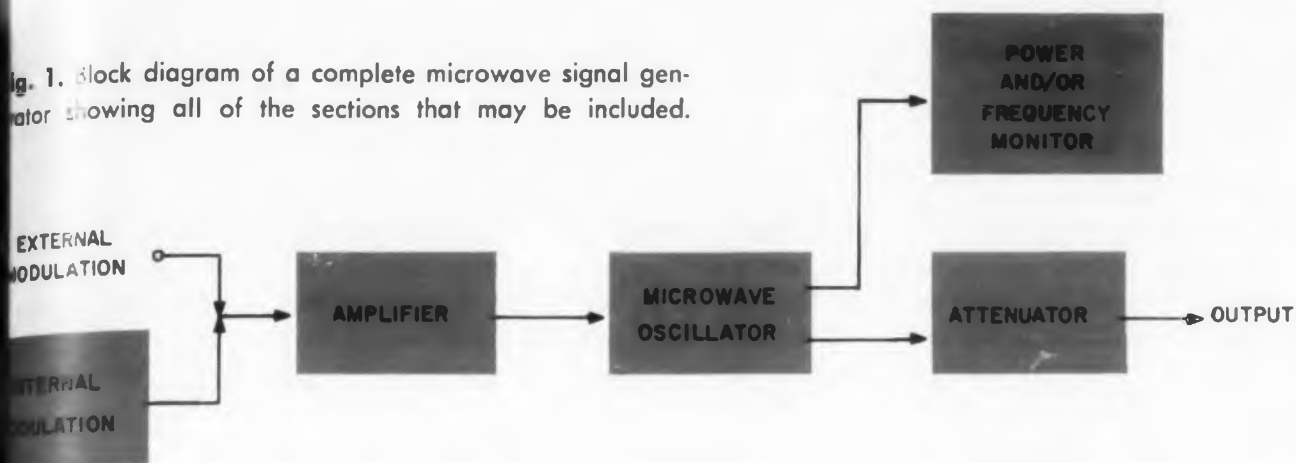
David Fidelman
Roslyn Heights, N. Y.

Different types of microwave instruments were described in the first part. It included a complete list of manufacturers of microwave instruments. In this second part, signal generators are taken up. They are classified into different types and discussed both as a source of signal power and as an accessory to supply a calibrated signal for comparison purposes.

IN ALL measurements on passive sections of a microwave system, a signal generator is required as a source of signal power for the measurement. A signal generator is normally needed when making measurements on units which produce microwave signals such as oscillators, or in making noise level measurements. But, it is often used as an accessory instrument to supply an accurately calibrated signal as a reference for comparison purposes. Measurements which require the use of a signal generator include: receiver sensitivity; selectivity or rejection, signal/noise ratio; gain-bandwidth characteristics, conversion gain; antenna gain; transmission line characteristics, filter network characteristics; for driving bridges; and slow line measurements.

A signal generator is designed to give an output of known frequency and power, with a wide range of power and as wide a range of frequency as possible. Up to frequencies of a few hundred megacycles, signal generators are relatively easy to build; frequency ranges are very wide (2:1 or more), power measurements can be made by the use of diodes as power meters, and variable power output is possible by use of resistive ladder-type attenuators up to about 100 mc, while above 100 mc the piston is used with loop or probe coupling. Microwave signal generators are more difficult to make, but there are a large number of excellent types commercially available. In all measurements the final measurement of power is by bolometer or thermistor. But a power monitor is often included to avoid the necessity of frequent calibration measurements. Tables 1 through 4 list manufacturers of K, X, S, L band signal generators.

Fig. 1. Block diagram of a complete microwave signal generator showing all of the sections that may be included.



Types of Signal Generators

Signal generators may be divided into a number of different types. The block diagram of a complete signal generator containing all the different sections that may be included in commercial units is shown in Fig. 1. It may include all of the sections shown, or in its simplest form it may consist merely of an oscillator and a tuning mechanism. Another class of signal generators, shown in one form in Fig. 2, includes a frequency meter and a power meter, which can be used for measurements of frequency and power independently of the signal generator operation. This type of unit is generally called a test set.

Low Frequency Measurements

Oscillators for use at the lower microwave frequencies generally consist of an oscillator tube in a resonant cavity, or coaxial line. A typical reflex oscillator which is suitable for use up to frequencies of about 2800 mc consists of a disc-triode in a grounded-grid oscillator circuit which uses two independently tunable concentric coaxial lines as the resonant circuit elements. The lines are tuned to one-quarter or three-quarters of a wavelength depending upon the operating frequency, and cause the unit to act as a tuned-plate tuned-grid oscillator. Feedback from plate to grid circuit is obtained through small loops or capacitive probes which

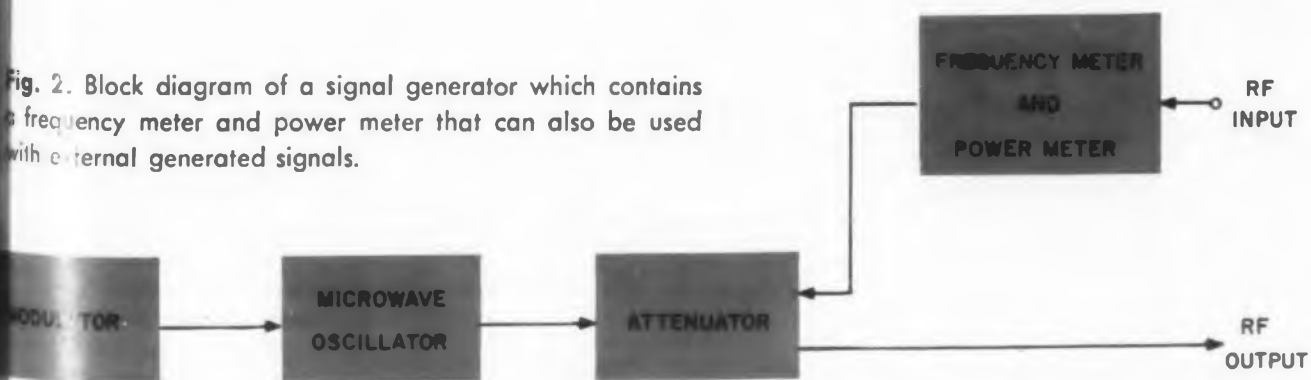
couple energy between the two cavities, and the power output is taken from a loop or capacitive probe coupled into the plate cavity. This type of oscillator can produce appreciable power, ranging from 30 watts or more at 1000 mc to 3 watts or more of cw at 2500 mc.

High Frequency Measurements

At higher frequencies the signal generator usually uses a reflex klystron oscillator, with either an external or an internal cavity. The klystron is used because it can be easily tuned over a relatively wide frequency range and can be readily frequency or amplitude modulated. In a typical reflex klystron oscillator with an external tuned cavity, the cavity is connected across the klystron resonator grids, and is tuned at the other end by changing its length by a noncontacting movable short-circuit. A coaxial cavity is preferred for broadband oscillators because its principal mode is the TEM mode, which affords a much wider frequency range than the TE or TM modes of rectangular waveguide sections.

Signal generators may also use cavities which are an integral part of the klystron tube, and can be tuned by mechanically changing the capacitive loading on the cavity; this type is inherently more narrowband than the external cavity oscillator. Output power is coupled by means of a loop extending into the cavity. In many units, the oscillator repeller voltage is

Fig. 2. Block diagram of a signal generator which contains a frequency meter and power meter that can also be used with external generated signals.



Bristol miniature pressure switch features ultra-reliable precision pressure element. Exclusive design provides outstanding resistance to shock, vibration, acceleration and overpressures.

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Write for Bulletin AV2010 on Bristol Miniature Gage and Absolute, Adjustable and Differential Switches. The Bristol Company, Aircraft Components Division, 151 Bristol Road, Waterbury 20, Conn. B-44



SPECIFICATIONS (Fixed pressure setting models)

- Normal Working Range** — 0 to 100 psi absolute, gage, or differential
- Burst Pressure** — exceeds 250% of normal working pressure
- Electrical Ratings** — 5 amp at 125 v, 60 cycle, inductive or resistive
4 amp at 30 vdc resistive
2.5 amp at 30 vdc inductive
- Dielectric Strength** — 500 v rms between terminals and from terminals to case (MIL-S-8801)
- Life at Rated Electrical Load** — 40,000 cycles at 125 vac
25,000 cycles at 28 vdc
- High Temperature Exposure & Operating** — (MIL-S-8801) 250°F
- Low Temperature Exposure & Operating** — (MIL-S-8801) -65°F
- Shock, 30 g, 3 axes** — (MIL-S-8801) no change
- Vibration** — (MIL-S-8801) no contact chatter, no switch damage
 - 300-600 cpm at 0.050" d.a. — set point change — none
operating differential change — none
 - 600-4500 cpm at 0.036" d.a. — set point change — $\frac{1}{4}$ psi
operating differential change — $\frac{1}{2}$ psi
 - 4500-30,000 cpm at 10 g — set point change — $\frac{1}{4}$ psi
operating differential change — $\frac{1}{2}$ psi
- Diameter** — 1-5/16

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made to track frequency changes automatically, thus avoiding the necessity of voltage adjustments during operation.

When extremely good frequency accuracy is required, the output frequency may be compared with the reading of a wavemeter for final settings. Some units may have built-in automatic frequency control, in which the output signal is compared with the frequency of a reference cavity, and automatically tuned by a feedback loop which causes a drift in the klystron frequency to be opposed by a feedback voltage applied to the klystron repeller to correct the frequency.

In such a unit, the klystron output is applied to a tunable reference cavity which has dual mode responses—one just below center frequency, the other just above center frequency. The outputs of these two cavities are connected through a stabilizing amplifier to the klystron repeller in such a manner that drift in the operating frequency will cause a feedback voltage which opposes the change in frequency. The discriminator cavity is made to resonate through a band of frequencies by moving a plunger within it. Tuning of the oscillator is accomplished by tuning the cavity to the desired

frequency, and then adjusting the klystron frequency until it automatically follows the cavity resonant frequency.

Modulation

Modulation in microwave signal generators can be accomplished in a number of different ways. Triode oscillators used at the lower microwave frequencies can be modulated by applying the modulation voltage in series with the plate voltage supply to the tube; since considerable power is required, power amplifier is necessary for modulation, and there is a certain amount of incidental frequency modulation. Another method, which can be used for square-wave modulation, is to insert a resistor in the grid circuit to make the oscillator unstable, and it can be triggered in and out of oscillation with relatively low power in the grid circuit.

Amplitude modulation of reflex klystrons may be accomplished by applying the modulating voltage to either the reflector electrode or the control grid. Oscillations will cease if the reflector voltage is driven out of the mode; thus, a square wave or pulse applied to the reflector will alternately turn the oscillations on and off. With control grid modulation, the electron

stream is turned off and on. Klystrons may be frequency-modulated by taking advantage of their voltage tuning characteristics, by superimposing a modulation voltage on the reflector and causing the frequency to change; however, this modulating voltage must not drive the reflector from one mode to another. Depending upon the elaborateness of their circuit, microwave signal generators may include modulation generators and amplifiers, or may simply have taps for the application of external modulating voltages.

Other Arrangements

Several different arrangements may be used in the output section of the signal generator. The simplest is to couple the output of the oscillator directly to the load. More elaborate units may include an attenuator (either calibrated or uncalibrated) between the oscillator and the load, to permit setting the output level as desired. Other units include a power monitor as well as a calibrated attenuator, and some include wavemeters for most accurate settings of frequency. Specific types of attenuators, power monitors, and wavemeters will be described in later articles dealing specifically with these devices.

Table 1 — K band signal generators

Manufacturer	Model No.	Frequency Range	Output	Accuracy of Frequency Calibration	Frequency Drift	Modulation	Price	General Comments
Hewlett-Packard	626A	10,000-15,500 mc	+10 to -90 dbm	±1%	—	Int or Ext: Pulse, fm, square wave	\$3000	Output power continuously variable; monitored and indicated to accuracy of ±1 db
	628 A	15,000-21,000 mc	+10 to -90 dbm	±1%	—	Int or Ext: Pulse, fm, square wave	\$3000	Output power continuously variable; monitored and indicated to accuracy of ±1 db
Polarad Electronics Corp.	EHF	18,000-39,700 mc (using 7 plug-in rf units)	-10 to -90 dbm	±0.1% (using internal wavemeter)	—	Int: 1000 cps square wave Ext: pulse 100-10,000 pps, fm 50-10,000 cps	—	Output power continuously variable; monitored and indicated to accuracy of ±2 db
	SS-1218	12,400-17,500 mc	15 mw	±0.1% (using internal wavemeter)	—	Int: 1000 cps square wave Ext: Pulse, fm	—	Output power continuously variable; not monitored
	EHF Signal Source	18,000-50,000 mc (using 9 plug-in rf units)	3 mw to 10 mw (for different units)	±0.1% (using internal wavemeter)	—	Int: 1000 cps square wave Ext: Pulse, fm	—	Output power continuously variable; not monitored
Laboratory for Electronics, Inc.	814-K-1 to 814-K-21	12,000-13,800 to 15,500-17,500 mc (6 separate instruments)	20 mw to 100 m (for different units)	1 mc per division and vernier	1 part in 10 ⁶	Int: 1000 cps am, fm Ext: am, fm	\$3800 to \$3950	Ultra stable microwave oscillator, frequency stabilized by comparison with reference cavity and feedback control
Polarad Electronics Corp.	PMK	10,000-21,000 mc (using 2 plug-in rf units)	+10 to -90 dbm	+1%	—	Int: Pulse, square wave, fm Ext: Pulse, square wave, fm	\$5220 (complete)	Power unit and each tuning unit may be purchased separately; output power continuously variable and indicated to accuracy of ±2 db

Table 2 — X band signal generators

Manufacturer	Model No.	Frequency Range	Power Output	Accuracy of Frequency Calibration	Frequency Drift	Modulation	Price	General Comments
General Radio Co.	1220-A5 to 1220-A8	4240-7425 mc	80-100 mw	Uncalibrated	—	Int: 1 kc square wave Ext: Sine wave, square wave, pulse or fm	\$261.45 to \$301.45	Frequency range depends upon klystron tube used; four klystrons required to cover range; see also S-band listing
Hewlett-Packard	618 B	3800-7600 mc	0 to -127 dbm	±1%	0.02%	Int or Ext: Pulse, fm, square wave	\$2250	Output power continuously variable; monitored and indicated to accuracy of ±2 db
	620 A	7000-11,000 mc	0 to -127 dbm	±1%	0.02%	Int or Ext: Pulse, fm, square wave	\$2250	Output power continuously variable; monitored and indicated to accuracy of ±2 db
Laboratory for Electronics Inc.	814	8500-10,000 mc	80-100 mw	1 mc per division and vernier	1 part in 10 ⁶	Int: 1 kc also ext.	\$3600	Ultra-stable microwave oscillator; frequency stabilized by comparison with reference cavity and feedback control
Microwave Development Laboratories, Inc.	10 X	8500-9600 mc	10 mw	—	1 part in 10 ⁵	External	—	Stabilized oscillator using reference cavity and automatic feedback control
Polarad Electronics Corp.	MSG-34	4200-11,000 mc	0 to -127 dbm	±1%	—	Int: Square wave, pulse fm, 10-10,000 cps Ext: Pulse 10-10,000 pps	—	Output continuously variable, monitored and indicated to accuracy of ±2 db; contains internal pulse delay generator
	Model B (Band 3) (Band 4)	4450-8000 mc 7850-10,750 mc	0 to -127 dbm	±1%	±0.25%	Int: Pulse, square wave PTM, etc. (5 independent pulse channels)	—	(See Table 1)
	(See also Tables 1 and 2)							
	SSM-A	4450-8000 mc	15 to 50 mw	±1%	—	Ext: Square wave, fm	\$1180	Adjustable coupling probe may be used as uncalibrated attenuator;
	SSX-A	7850-10,750 mc	14 to 40 mw				\$1440	requires external power supply
Polytechnic Research & Development Corp.	706	3600-7300 mc	20-100 mw	±1%	—	Ext: cw, pulse, fm	\$ 950	Requires external power supply
	705	7000-11,000 mc	10-100 mw	±1%	—	Ext: cw, pulse, fm	\$ 950	Requires external power supply
Sivers Lab.	SL-5660	8200-12,400 mc	50 mw max	±0.1% (using internal wavemeter)	—	—	—	Output power continuously variable to maximum attenuation of 25 db; requires external power supply
F-R Machine Works, Inc.	C772A X772A	3950-8200 mc 7000-10,750 mc	50 mw (average)	±1%	—	Int: cw, pulse, square wave	—	Output continuously variable through level-set attenuator (uncalibrated)
Laboratory for Electronics, Inc.	814-C-1 to 814-C-5	5100-5900 mc to 7500-8500 mc	60 mw to 90 mw	1 mc per division and	1 part in 10 ⁶	Int: 1000 cps am, fm Ext: am, fm	\$3600 to	Ultra-stable microwave oscillator; frequency stabilized by comparison control
	814-C-11 to 814-C-13	5700-6300 mc to 6800-7400 mc (3 sep. instruments)	200 mw to 300 mw					
	814-X-1 to 814-X-4	8500 to 10,000 mc to 10,500-11,700 mc (4 sep. instruments)	55mw to 80 mw					
	814-X-11	8500-10,000 mc	200 mw					
	814-X-21	8500-10,000 mc	500 mw					
Polarad Electronics Corp.	PMX	4450-11,000 mc (in 2 tuning units)	0 to -120 dbm	±1%	—	Int: cw, pulse, square wave, fm Ext: Pulse	\$3710 (complete)	Power unit and each tuning unit may be purchased separately; output power monitored and indicated to accuracy of ±2 db, continuously variable

(continued on following page)

Table 3 — S band signal generators

Manufacturer	Model No.	Frequency Range	Output	Accuracy of Frequency Calibration	Frequency Drift	Modulation	Price	General Comments
Amerac, Inc.	192A	400 mc tuning range	200 w peak (pulsed) 10 mw (cw)	(counter for frequency calibration)	—	cw or pulse models (extreme modulation)	\$475	Complete series of oscillators available for frequencies in 1000-4000-mc range
B J Electronics	80	2700 - 3000 mc	10 w peak (pulsed, 1.25% max. duty cycle)	±0.03%	—	Pulsed: 200-2500 pps: 0.5-5.0 microsec pw	\$3675	Signal generator to supply high-level pulsed signals in 10 cm band
	82	2700 - 3000 mc	2.3 μv to 22.5 v	±0.1%	—	Pulsed: 1000 pps: 2.3 microsec; max duty cycle 0.23%	—	Uses Model 83 r-f oscillator; continuously variable output from -80 to +40 dbm
F-R Machine Works, Inc.	S 771B	1900 - 4000 mc	50 mw (average)	±1%	—	Int: pulse or square wave 350 to 2000 cps; cw Ext: pulse or fm	—	Output continuously variable through level-set attenuator (uncalibrated)
General Radio Co.	1220-A1 to 1220-A4	2700-4460 mc	75-100 mw	Uncalibrated	—	Int: 1 kc square wave Ext: sine wave, square wave, pulse or fm	\$254.65 to \$312.15	Frequency range depends upon klystran tube used; four klystrans required to cover range; see also x-band listing
Hewlett-Packard	616A	1800-4000 mc	0 to -127 dbm	±1%	0.01%	Int: Pulse, fm Ext: Pulse, square wave	\$1950	Output power continuously variable; monitored and indicated to accuracy ±1.5 db
Loral Electronics Corp.	MSS-2	2140-4440 mc	5 to 15 mw max; 100 db attenuator	0.3%	—	Int: 1 kc square wave Ext: 40-4000 pps	—	Output power continuously variable to ± db accuracy
New London Instrument Co.	TS-155c/ue	2700-3400 mc	-20 to -100 dbm calibrated	—	—	Int: 80-2600 pps	—	Also contains power meter for measurement of average power up to 200 mw; frequency band covered in three ranges
Polarad Electronics Corp.	MSG-2	2150-4600 mc	0 to -127 dbm	±1%	—	Int: Square wave, pulse, FM, 40-4000 cps Ext: Pulse 40-4000 pps	—	Output power monitored and continuously variable
	Model B (Band 2)	2150-4600 mc (For other frequency bands see other tables)	0 to -127 dbm	±1%	±0.25%	Int: Pulse, square wave, PTM, etc. (5 independent pulse channels)	—	
	SSS	2140-4600 mc	—	±1%	—	Ext: Square wave, fm	—	Adjustable coupling probe may be used as uncalibrated attenuator; requires external power supply
Sivers Lab	SL-5640	2500-4000 mc	50 mw	±0.1% (using internal wavemeter)	—	—	—	Requires external power supply
Transitron, Inc.	SG-153	1800-4000 mc	0 to -120 dbm	±1%	—	Int: Pulse, fm Ext: Pulse	—	Output power continuously variable; monitored and indicated to accuracy of ±2 db
Laboratory for Electronics, Inc.	814-S-1 814-S-2 814-S-3	2500-3050 mc 2950-3600 mc 4200-4800 mc	75 mw 80 mw 70 mw	1 mc per division and vernier	1 part in 10 ⁶ per 10 min.	Int: 1000 cps am, fm Ext: am, fm	\$3600	Ultra-stable microwave oscillator; frequency stabilized by comparison with reference cavity and feedback control
Marconi Instruments	1058	1700-4000 mc	-30 to -165 dbm; to 50 mw uncalibrated	±1% and vernier	0.001%	Int: 1 kc square wave Ext: Pulse	—	Output power continuously variable; indicated to accuracy of ±2 db

Table 4 — L band signal generators

Manufacturer	Model No.	Frequency Range	Output	Accuracy of Frequency Calibration	Frequency Drift	Modulation	Price	General Comments
Airborne Instruments Lab.	124B	200 - 2500 mc	2.5 - 20 watts (varies with frequency)	(Indicated by 4 - digit counter)	.005%	Int: 400 and 1000 cps sine waves Ext: Square wave or sine wave	\$2285	Frequency coverage in three ranges; power output varies with frequency; useful for applications requiring appreciable power, such as antenna design, etc.
Amerac, Inc.	192 ab and 192 b series	300 - 500 mc range (950 - 2000 mc in 4 models)	500 - 1000 mw	(Indicated by counter)	—	External	\$ 475	Coaxial line cavity using 2C 36 uhf planar triode; requires external power supply
B-J Electronics	82	1050 - 1350 mc	2.3 mv to 22.5 mv	±0.1%	—	Pulsed: 1000 pps: 2.3 μsec; max duty cycle 0.23%	—	Uses Model 84 RF oscillator; continuously variable output from -80 to ±40 dbm
F-R Machine Works, Inc.	L771B	950 - 2000 mc	50 mw (average)	±1%	—	Int: pulse or square wave 350 to 2000 cps; cw Ext: Pulse or fm	—	Output continuously variable through level-set attenuator (uncalibrated)
General Radio Co.	1021-AW	900 - 2000 mc	0.7 v max	±1%	—	Ext: Square wave 100 to 5000 cps	\$ 910	Output continuously variable; indicated by meter with ±20% or better accuracy
	1213-A	900 - 2000 mc	200 mw	±1%	0.1%	Ext: Sine wave, square wave, pulse, or fm	\$ 465	Requires external power supply; modulator must be able to carry plate current of oscillator
Hewlett-Packard	614A	800 - 2100 mc	0 to -127 dbm	±1%	0.01%	Int: Pulse, fm Ext: Pulse, square wave	\$1950	Output power continuously variable; monitored and indicated to accuracy of ±1 db
Maxson Instruments	Power Oscillator	200 - 2500 mc	2.5 to 20 watts (varies with frequency)	(Indicated by 4 - digit counter)	0.005%	Int: 400 or 1000 cps sine wave or square wave Ext: Sine wave or square wave	\$2325	Frequency coverage in three ranges; power output varies with frequency; useful for applications requiring appreciable power, such as antenna design, etc.
Northeastern Engineering, Inc.	NE 12-20-SG	900 - 2100 mc	0 to 120 dbm	±1%	0.005%	Int: 40 to 4000 pps Ext: Pulse	—	Output power continuously variable; monitored and indicated to accuracy of ±2 db
Polarad Electronics Corp.	MSG-1	950 - 2400 mc	0 to 127 dbm	±1%	—	Int: Square wave, pulse, fm 40 - 4000 cps Ext: Pulse 40 - 4000 pps	—	Output power monitored and continuously variable
	Model B (Band I)	950 - 2400 mc (For other frequencies using interchangeable r.f. heads, see other tables)	0 to -127 dbm	±1%	±0.25%	Int: Pulse, square wave PTM, etc. (has 5 independent pulse channels)	—	Output power continuously variable, monitored and indicated to accuracy of ±2 db; this unit intended as code modulated microwave signal generator; has built in oscilloscope for pulse calibration
	SSR SSL	650 - 1300 mc 1050 - 2250 mc	—	±1%	—	Ext: Square wave, fm	—	Adjustable coupling probe may be used as uncalibrated attenuator; requires external power supply
Transitron, Inc.	SG-161	900 - 2100 mc	0 to -120 dbm	±1%	—	Int: Pulse Ext: Pulse	—	Output power continuously variable; monitored and indicated to accuracy of ±2 db
Wenschel Engineering	MS-3	900 - 2000 mc	50 mw	±1%	0.1%	Int: 1000 cps square wave Ext: Sine or square wave	\$2550	When used with directional coupler and power monitor, feedback regulator amplitude stability is ±0.05 db 1 hr; without regulator ±0.1 db 1 hr

*a big step forward in
broadband RF amplification*

OCTAVE RF AMPLIFIERS 40 to 600 mcs

- low noise figure • low power drain
- high gain • broadband operation
- flat gain characteristic



Model HFW Octave RF Amplifiers feature low noise, high gain, low power drain *plus* dependability and easy maintenance. Four basic amplifiers are available, with the following frequency responses:

40 to 80 mcs • 80 to 160 mcs
160 to 320 mcs • 300 to 600 mcs

Two additional units cover the 100-400 mcs region as follows:

100 to 200 mcs • 200 to 400 mcs

Conservatively speaking, these equipments offer a practical and realistic answer to nearly all broadband amplification requirements.

TYPICAL PERFORMANCE CHARACTERISTICS Model HFW-303

Input frequency:	300-600 mcs
Input, output impedance:	50 ohms
Input, output V.S.W.R.:	Less than 1.5 in bandpass region
Noise figure (average):	7 db
Gain	30 db
Primary power requirements:	115 VAC, 60 cps
Size (L.W.H.):	19" x 12½" x 7"
Mounting dimensions:	Standard 19" relay rack

Write for further information.

Applied Research inc.

76 South Bayles Avenue, Port Washington, N. Y.

CIRCLE 20 ON READER-SERVICE CARD

Ceramic Capacitors Made SMALLER

THESE CERAMIC capacitors are smaller than those previously available. Their miniaturization was achieved through a new manufacturing process which also makes their cost reasonable. Called Cerafil, the new ceramic capacitor is compared to a paper unit in Fig. 1.

Cerafil capacitors—manufactured by Aerovox Corp., Hi-Q Div., Myrtle Beach, S.C.—were designed primarily for transistor and other sub-miniature applications. They range in size from 0.09 in. in diameter by 0.320 in. long for the 0.001 μ f unit to 0.310 in. in diameter by 0.750 in. long for the 0.1 μ f unit. These are maximum dimensions. In some cases diameters are 20 to 25

per cent smaller than guaranteed maximum diameters. These units are rated at 100 v dc with a maximum power factor of 2.5 per cent at 100 cps. Capacity varies with temperature by approximately +10%/–15% over the range of –50 to +85 C based on 25 C as the reference temperature. They are available in capacities from 10 μ f to 100,000 μ f.

These capacitors will meet or surpass all requirements of MIL-C-11015A. Extended life tests are being performed on these capacitors. They are subjected to 200 v dc in an ambient temperature of 200 C. After 3000 hours no failures were reported.



Fig. 1. A paper capacitor (top) vs a Cerafil capacitor (bottom).



Fig. 2. The photo shows 10,000 partially finished Cerafil capacitors, three finished ones, and a paper clip.

The Good and Bad of Ceramics

Ceramic dielectrics are good because they have high dielectric constant. Unfortunately, ceramics have a brittle nature. This imposes limitations on processing thin sheets of ceramic dielectrics in the conventional manner.

New Manufacturing Techniques

Aerovox Corp. circumvented the problems of ceramic sheets by employing new manufacturing techniques. The main principle consists of forming the thin film of dielectric on a substrate. The substrate is used as one of the electrodes and also serves as a support for the fragile film. With this support, extremely thin films can be processed conveniently and resulting high capacities obtained. Naturally, the voltage rating is determined by the thickness of the film employed.

The Cerafil construction consists of a single capacitor element, or a multiple of this capacitor element, depending on the capacity value required. A capacitor element is a rod of approximately 1/32 in. in diameter. Length of the rod is determined by the length of the unit desired. The bundled rods form a cylindrically shaped honeycomb structure. Surface to volume ratio increases with diminishing rod diameter.

This design and construction offers several advantages. Parallel connection to obtain the high capacities is a simple operation. Also, an element with positive temperature coefficient may be paralleled with one of a negative temperature coefficient to give a flat curve.

Ten thousand partially finished Cerafil capacitors, three finished Cerafil capacitors and a paper clip (for comparison) are shown in Fig. 2.

For more information of these miniature ceramic capacitors, turn to the Readers-Service card and circle number 109.

First family of power triodes made specifically for series regulation!



Tung-Sol/Chatham power triode family covers every series regulator need!

Now designers can specify a premium quality Tung-Sol/Chatham tube for all series regulator sockets. Tung-Sol/Chatham's family of power triodes—the first designed and produced specially for series regulator service—meets all design requirements and assures maximum reliability and life at all times.

Types include the new 100 Watters, 7241 and 7242, medium mu or low mu-high current, 12 or 26 Volt

heater versions available on most types. All embody sturdy construction features that contribute to overall ruggedness and long hours of heavy-duty operation.

Compare the ratings below against your particular application! If you desire complete data sheets . . . or you have a specific design problem, contact us today! We'll be glad to give whatever assistance we can. Just write: Tung-Sol Electric Inc., Newark 4, N. J., Commercial Engineering Offices: Bloomfield and Livingston, N. J., Culver City, Calif., Melrose Park, Ill.

TYPICAL VALUES				
	Total Plate Current	Range of Tube Voltage Drop	Minimum Tube Drop	Grid Voltage Swing
5998	200 ma	80 v	45 v	20 v
7241	400	65	70	10
7242	600	80	70	13

PERTINENT CHARACTERISTICS PER TUBE				
	Max. Plate Current	Max. Plate Voltage	MU	Gm
5998	280	275	5.5	28,000 umhos
7241	600	400	9.0	74,000 umhos
7242	900	400	9.0	111,000 umhos

TUBE TYPES BY PLATE DISSIPATION RATINGS			
Total Plate Dissipation	26 to 30 W	60 W	100 W
Low mu	6AS7G, 6082	6336A	7241
Medium mu	6080WA, 7105	6394A	
High mu	5998	6528	7242

ts TUNG-SOL

CIRCLE 21 ON READER-SERVICE CARD

new and unique!



**Eliminate
Breadboard Layout!
SPEED DESIGN OF TRANSISTOR CIRCUITS
With the SPRAGUE TRANSIMULATOR**

Bring transistor circuits to life in a matter of minutes with the Sprague LF-1 Transimulator. This new instrument lets you simulate any amplifier stage, a-c or direct-coupled, short of high power audio output; also multivibrator, switching, phasing, push-pull, Class A and B, and many others using cross-coupled Transimulators... whether the circuit is common or grounded emitter, base, or collector... whether the transistors are PNP, NPN, or Surface Barrier. You can simulate circuits stage-by-stage for cascade operation... or use a separate Transimulator for each stage to get simultaneous multi-stage operation.

Bring Circuit Diagrams To Life In Minutes

Everything you need for RC amplifier circuits is built right into the LF-1, including coupling capacitors... bias and load resistors... battery voltage supplies... Base Collector—Voltage Divider stabilization circuits... 5-way binding posts for transformer coupling and metering.

Whether you're designing audio circuits or switching circuits, you'll get a true picture of operating parameters minutes after you've drawn the circuit diagram... without wasting valuable time with breadboard and soldering gun.

Pays For Itself In A Matter Of Weeks

An ideal laboratory instrument, Transimulators are inexpensive enough to justify several on every bench. You can even use the LF-1 to test transistors *in the circuit*... the only real proof of design parameters. And a complete step-by-step instruction manual makes operation fast, simple, and easy.

FEATURES OF THE LF-1 TRANSIMULATOR

- TRANSISTORS—PNP and NPN Junction, and Surface Barrier.
- CIRCUITS—Common or Grounded Emitter, Base, Collector.
- RANGE—Audio, up to 100 kc.
- TRANSISTOR POWER—Through medium power audio output.
- BATTERY SUPPLY—Separate bias and load. 1.5, 3, 4.5, 6 volts d-c. Polarity Reversing Switch.
- COUPLING—2 μ f and 20 μ f Direct, and Ext. C. posts, on both Input and Output.
- BIAS RESISTANCE—Up to 555,000 ohms continuously variable.
- LOAD RESISTANCE—Up to 277,500 ohms continuously variable.
- EMITTER RESISTANCE—Up to 2,500 ohms variable. Series resistor and bypass capacitor can be added.
- BASE COLLECTOR STABILITY—Up to 250,000 ohms variable. Series resistor and bypass capacitor can be added.
- VOLTAGE DIVIDER STABILITY—Up to 50,000 ohms variable.
- 5-WAY BINDING POSTS—For motors, transformer coupling, external supply voltage, degeneration, bypass, coupling, signal input and output, almost any connection required.

**only \$7950
NET**



SPRAGUE PRODUCTS COMPANY, NORTH ADAMS, MASSACHUSETTS

DESIGN FORUM

**Smaller, Lighter
Power Supply**

EIGHTY-TWO per cent smaller, seventy-five per cent lighter, and much cheaper. That's an achievement for an airborne power supply. Without sacrificing required performance, Westinghouse substituted one chassis for three and maintained reliability and ease of maintenance.

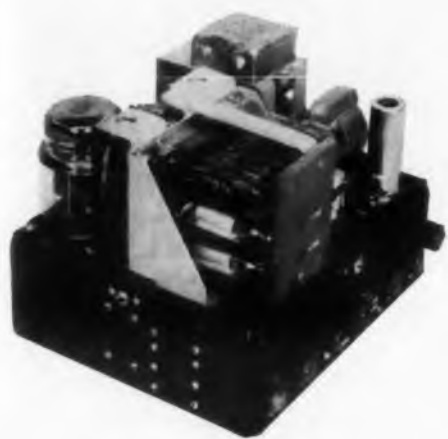
To do this, modern miniaturization techniques were put to work by M. L. Feistman and R. W. Lieske of Westinghouse Electric's Air Arm Division in Baltimore, Md. Here are some of the techniques they used.

"Cold plate" transformers are used to reduce size and weight. With their better means of conducting heat away from the core, and with better core materials, they can chop volume about 50 per cent without affecting electrical characteristics.

For high voltage rectification, a bridge of eight silicon diodes replaces a two-thyratron full-wave rectifier. This reduces size further and obviates



PREVIOUS UNITS



Subminiature tubes, silicon diodes, and the "cold plate" transformer in the rear helped shrink this airborne power supply.

Cheaper Too

generous filament supply. As a bonus, the silicon diodes take vibration and shock better than the thyratrons. A 6336A series regulator tube replaces two 630's.

Further shrinkage results from the use of subminiature tubes and potentiometers and printed circuitry. The diodes and subminiature components lend themselves well to mounting on printed circuit cards. The cards, identical for positive and negative supplies, help trouble shooting.

Perhaps most significant is the introduction of the zener diode as a precision regulator. A small, simple zener circuit with a few components replaces older circuitry with many components.

Simpler circuitry and fewer components throughout enhance the reliability of the power supply. ■ ■



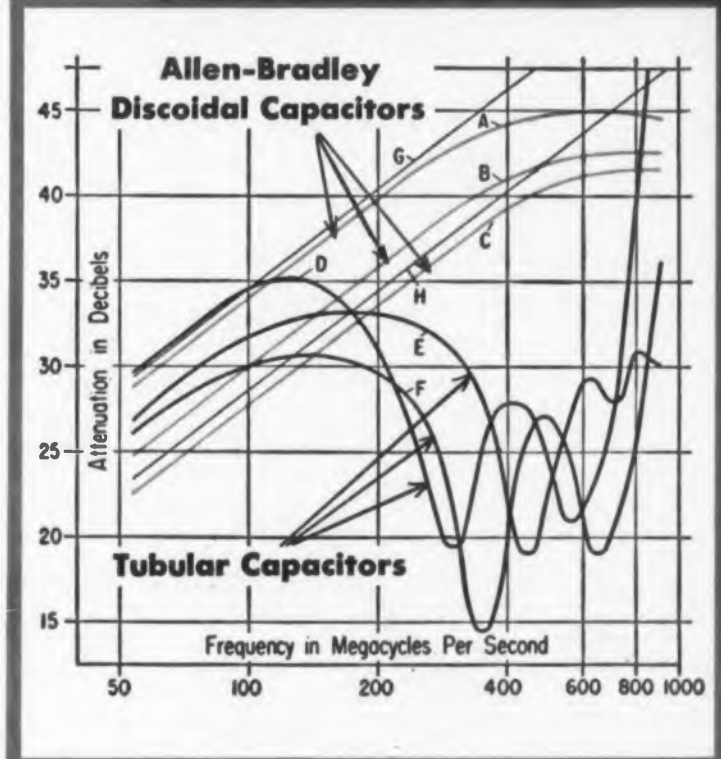
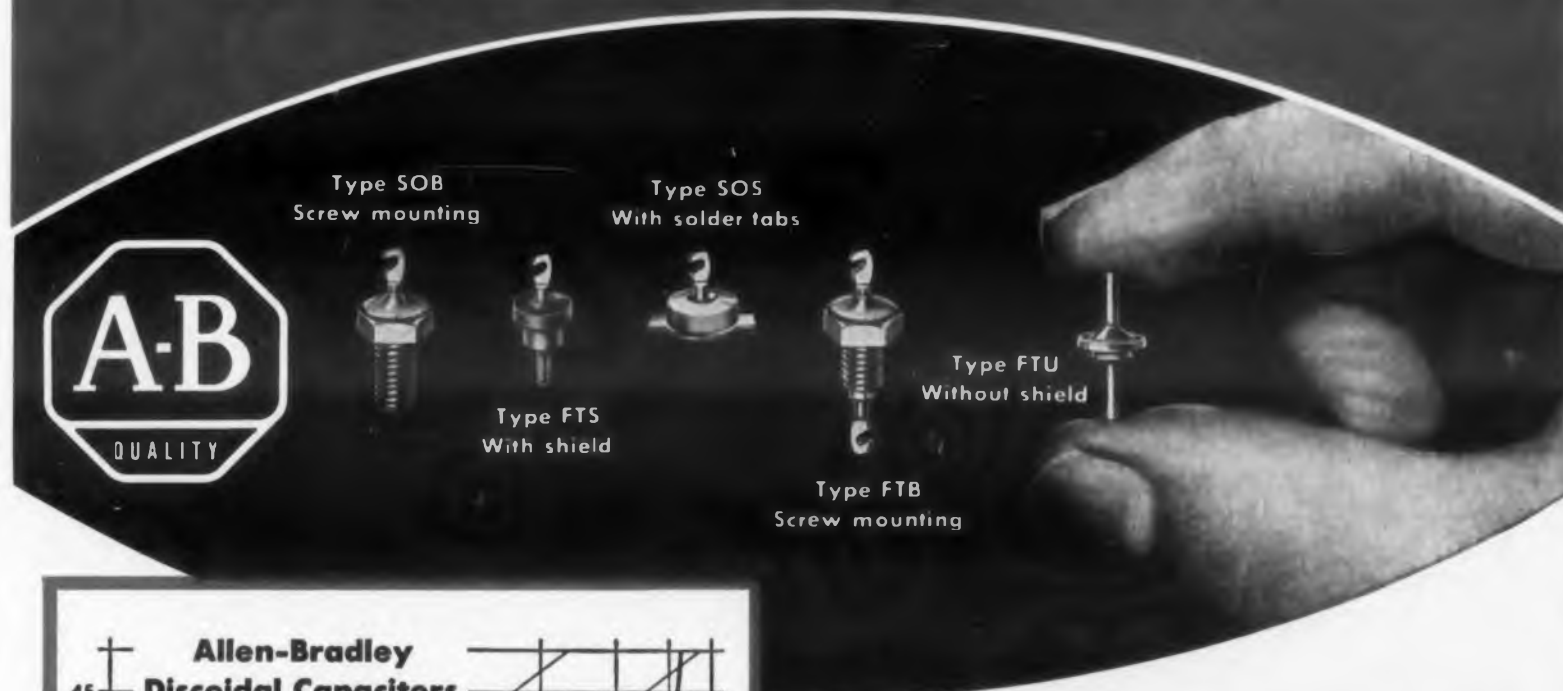
Airborne power supply on the right is 82 per cent smaller, 75 per cent lighter than earlier three-chassis model.

NEW UNIT

NO PARALLEL RESONANCE

(UP TO 1000 MEGACYCLES)

WITH ALLEN-BRADLEY DISCOIDAL FEED-THRU AND STAND-OFF CAPACITORS



Discoidal vs. Tubular Feed-Thru Ceramic Capacitors

Allen-Bradley Discoidal Type.....	Curve A—1000 MMF at 1 KC Actual
	Curve B—1150 MMF at 1 KC Actual
	Curve C—800 MMF at 1 KC Actual
Representative Tubular Type.....	Curve D—2000 MMF at 1 KC Actual
	Curve E—1500 MMF at 1 KC Actual
	Curve F—1400 MMF at 1 KC Actual
The "Ideal" Capacitor.....	Curve G—2000 MMF
	Curve H—1000 MMF

AVOID RADIATION INTERFERENCE FOR VHF AND UHF RECEIVERS

Their unique discoidal design eliminates ALL parallel resonance effects which are normally encountered with tubular type capacitors in the VHF and UHF frequency ranges. With this complete absence of self-resonance, as shown in the graph at left, you can use far greater nominal capacitance values to obtain lower coupling impedances . . . and superior filtering.

The rugged construction of Allen-Bradley discoidal capacitors minimizes breakage during assembly or from thermal shock incurred during soldering. And, these capacitors have gold plated terminals to insure faultless soldering every time . . . even after long periods in storage.

Both feed-thru and stand-off capacitors are available in standard nominal capacitance values from 5 mmf to 1,000 mmf.

For suppression of stray radiation at frequencies to 1,000 megacycles, you cannot equal Allen-Bradley discoidal capacitors. Send for Technical Bulletin 5409.

ALLEN-BRADLEY

ELECTRONIC COMPONENTS

QUALITY

Allen-Bradley Co., 1344 S. Second St., Milwaukee 4, Wis. In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

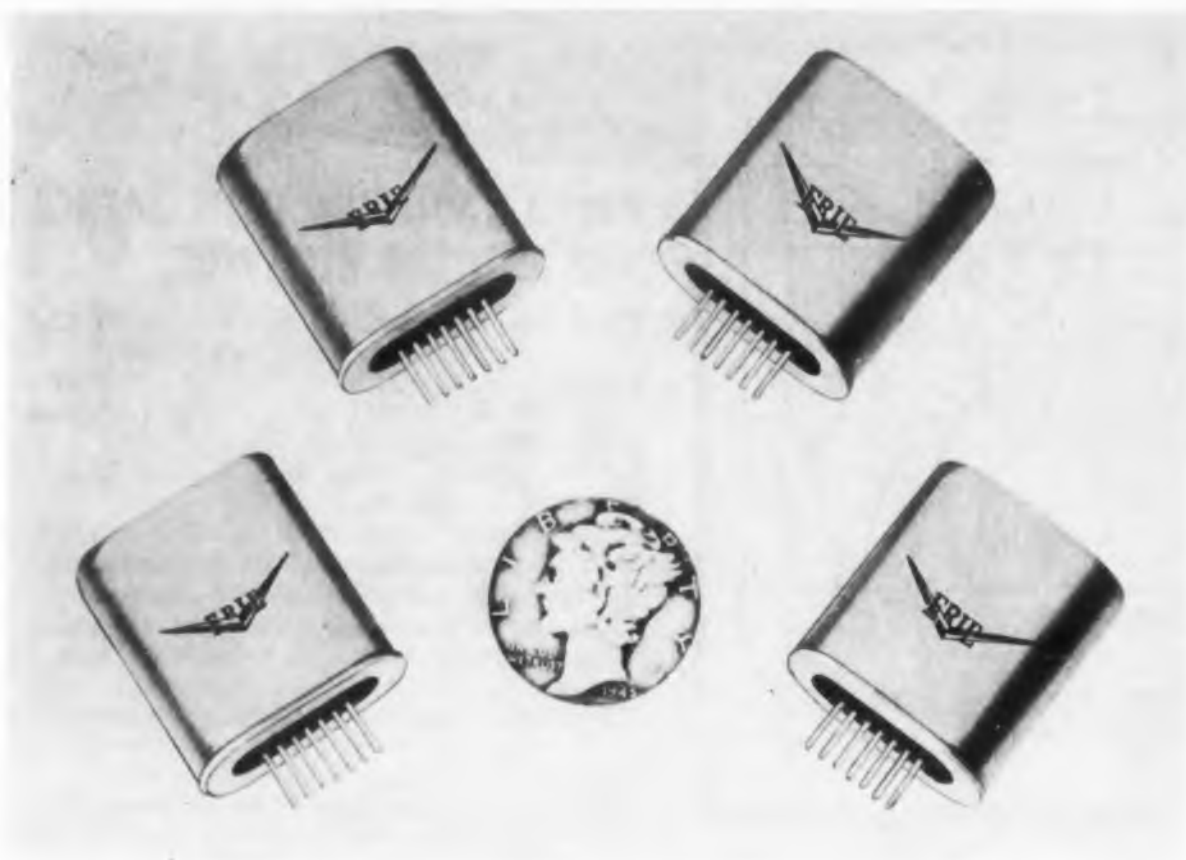
CIRCLE 23 ON READER-SERVICE CARD

NEW PRODUCTS

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

MODULAR UNITS

Small units which plug into a system, or are connected easily, have grown in popularity. They've become popular because they can be easily taken out of a system and quickly replaced if defective. Here are some modular units which have just hit the market.



LOGIC CIRCUITS

These transistorized plug-in modules for digital equipment are based primarily upon the NOR logic. The module is designed to fit a standard 7 pin inline subminiature tube socket. Up to 144 units mount on a 3-1/2 x 19 in. rack panel. Module measurements are 0.75 x 0.687 x 0.297 in. The standard unit contains four inputs.

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

CIRCLE 24 ON READER-SERVICE CARD



TRANSISTOR AMPLIFIER

Model 2620 transistor amplifier amplifies and converts charge to voltage. This design eliminates high input impedances normally required for low frequency response. Transducer and amplifier may be separated by 300 ft without signal loss. Two continuously variable gain ranges are provided: 0.8 to 12, and 4 to 15 (based on a 500 μf source). Having a relatively low input impedance, the unit is sealed against dust and humidity. Temperature range is -65 to $+185$ F.

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

CIRCLE 25 ON READER-SERVICE CARD

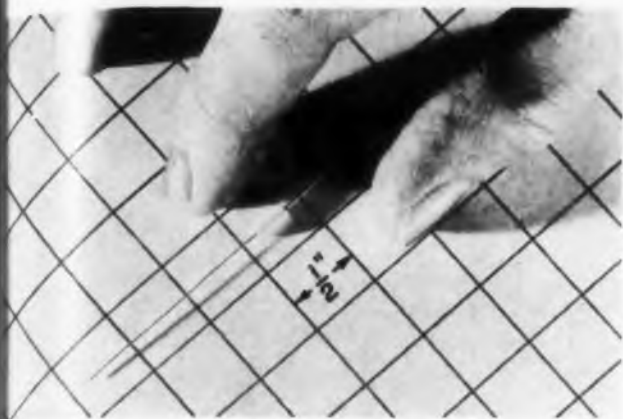


TELEMETRY KEYER

Having an input impedance of 5 megohms shunted by 68 μf , this keyer was designed for use in missile or other telemetry systems. It converts an amplitude modulated pulse sequence to a pulse series of constant amplitude and variable width. Output is suited for modulating a subcarrier oscillator or rf transmitter. Linearity error is less than 1%. Output amplitude is 5 v peak-to-peak max.

Rotary Devices Corp., Dept. ED, 30 Jay St., Englewood, N.J.

CIRCLE 26 ON READER-SERVICE CARD

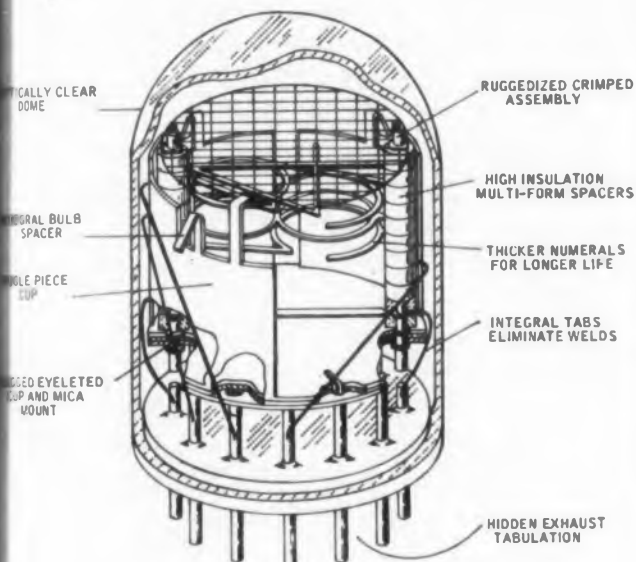


RESISTORS

Engineered to handle 1/10 w, the DCH-1/10 resistors measure 7/64 x 1/4 in. They are hermetically sealed deposited carbon resistors housed in a ceramic shell and come in a resistance range of 100 ohms to 100 K. Their tolerance is $\pm 1\%$. Operating temperature range is -55 to $+150$ C. The 1/10 w rating is at 70 C, and they must be rated to 0 w at 150 C.

Dale Products, Inc., Dept. ED, Box 136, Columbus, Nebr.

CIRCLE 27 ON READER-SERVICE CARD



ELECTRONIC INDICATOR TUBES

These Nixie all-electronic indicator tubes have had their life characteristics extended. The regular miniature Type 7009 (BD-200-S) requires a minimum of 170 v and has an average dynamic life of from 3000 to 5000 hr. Type B-4032 has an average dynamic life of more than 10,000 hr and requires a minimum of 170 v. Type B-4021 (BD-214) is designed for transistor operation and requires a 120 v supply. It has provisions for prebiasing for 45 v operation. All tubes operate with less than 1 ma on approximately 1/8 w of power. Visible up to 20 ft.

Burroughs Corp., Electronic Tube Div., Dept. ED, Plainfield, N.J.

CIRCLE 28 ON READER-SERVICE CARD



MODEL DL1010
(ACTUAL SIZE)

NEW FROM DELAY LINES

An outstanding new component series in the JFD tradition of uncompromising quality.



MODEL DL1010
(ACTUAL SIZE)

Now . . . after extensive laboratory research — JFD distributed constant Delay Lines to meet today's challenging reliability demands!

Designed for applications calling for short delay intervals, the new lines offer a high ratio of delay to pulse rise time, in minimum space. Available for printed circuit assembly or for conventional mounting, JFD Delay Lines meet all military requirements. They can also be modified or custom-designed to meet your most rigid specifications.

Call or write today for Bulletin 213 providing complete electrical and mechanical data. Better yet, tell us your delay network problem — distributed or lumped constant. Our engineering staff will promptly recommend the solution with detailed specifications for your particular application.

Characteristics:

- Precise pulse fidelity
- Operating temperature range of -55°C to $+125^{\circ}\text{C}$
- Excellent temperature stability
- Rugged encapsulated construction resists environmental moisture, humidity, shock and vibration
- Linear phase shift
- 0.1 inch grid spacing for printed board types
- Attenuation of approximately 1 db per μ sec.



JFD Canada Ltd.
51 McCormack St.
Toronto, Ontario, Canada

Pioneers in electronics since 1929

ELECTRONICS CORPORATION

1462 62nd Street, Brooklyn, New York

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New York, New York

PHONE DEWEY 1-1000

CIRCLE 29 ON READER-SERVICE CARD

SERIES (3)

radar relay switch noise problem

solved by
ASTRON
custom engineered
26
r. f. filter networks

The filters pictured were specifically developed to suppress radiated and conducted noise pulses generated from a coaxial relay switch. In this particular case Astron found it necessary to filter each contact of the switching network individually. The result was a single compact unit housing 26 different filters. A twelve-terminal line filter was also required to absorb residual noise. Both filters were hermetically sealed and compliance with all applicable military and environmental requirements was achieved.

These particular filters are one example of many custom built by Astron . . . We bring them to your attention not to demonstrate an unusual filter problem, but rather to demonstrate a very usual result of Astron's engineering skill.

Regardless of the complexity of your filter applications . . . the severity of the existent environmental conditions . . . Astron will design and produce RF noise suppression filters to your exact requirements.

IF YOU HAVE A FILTER PROBLEM - WRITE TODAY FOR ASTRON'S
"FILTER SPECIFICATION CHECK LIST"



ASTRON

C O R P O R A T I O N

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SOLVING YOUR FILTER REQUIREMENTS FROM THE PROBLEM TO THE PRODUCT.
CIRCLE 30 ON READER-SERVICE CARD

NEW PRODUCTS

Oscilloscope Kit 0 to 4.5 mc vertical response



Professional oscilloscope kit OP-1 has coupled amplifiers and a dc coupled crt unblinding. The triggered sweep circuit operates internal or external signals and may be ac or coupled. The polarity of the triggering signal may be selected, and a triggering level control can start the sweep at any point on the waveform. The sweep frequencies are provided by switch-selected base rates of 2 and 0.2 mc and 20, 2, and 1 μ sec per cm in conjunction with the continuously variable 10 to 1 multiplier. Sweep frequencies are calibrated to within 10% at all control settings. Vertical frequency response is within 1 db from dc to 2.2 mc, and within 6 db from dc to 4.5 mc. Rise time under 0.1 μ sec. Horizontal frequency response is within 1 db from dc to 450 kc, and within 6 db from dc to 900 kc.

Heath Co., Dept. ED, Benton Harbor, Mich.
CIRCLE 31 ON READER-SERVICE CARD

Solderless Terminals For high voltage



Rated 12, 25, and 35 kv at 5 amp, type LC solderless terminals are designed for high temperature, high altitude use. The leads, made of silicone rubber insulated wire, come in a length which is a multiple of 3 in. The terminals are epoxy and glass fibre or ceramic.

Amp Inc., Capiton Div., Dept. ED, Elizabethtown, Pa.

CIRCLE 32 ON READER-SERVICE CARD

Resistance Welder

Uses stored energy



A precision resistance welder, model DC 30A has a stored energy panel of 80 w-sec capacity. It welds copper, silver, tungsten, molybdenum, and other difficult materials without discoloration or metallurgical change. It also joins dissimilar metals of widely different thickness.

Federal Tool Engineering Co., Dept. ED, Cedar Grove, N.J.

CIRCLE 33 ON READER-SERVICE CARD

Multichannel Sampling Switch

For amplifier drift stabilization

Model 108A is a high-speed sampling switch which stabilizes the sequential drift of 83 high gain dc amplifiers. It has two poles, each with 70 contacts or 85 nonshorting channels. The plug-in unit is 10 x 10.38 x 6.31 in.

General Devices, Inc., Dept. ED, P.O. Box 53, Princeton, N.J.

CIRCLE 34 ON READER-SERVICE CARD



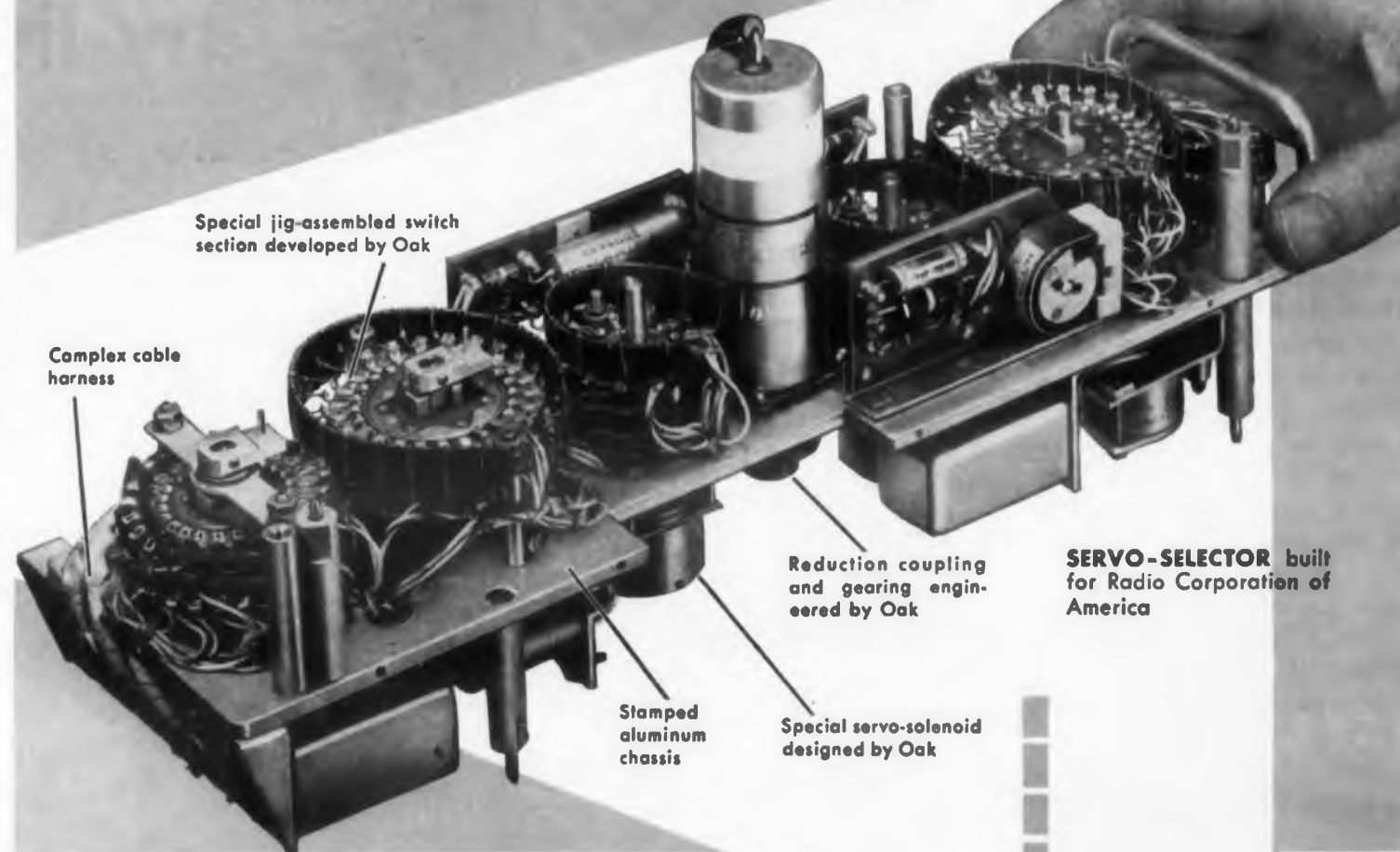
Vacuum Pumping System

For silicon and germanium deposition

A 3 in. vacuum pumping system, model D-40V was designed primarily for vacuum metallizing and silicon and germanium deposition. It provides an ultimate pressure of 5×10^{-6} mm Hg and operates during reloading. The chamber is 12.5 in. in diameter and 12 in. high. Bor-De Electronic Labs, Inc., Dept. ED, Danvers, Mass.

CIRCLE 35 ON READER-SERVICE CARD

OAK can engineer and manufacture your special **SUBASSEMBLIES**



Special jig-assembled switch section developed by Oak

Complex cable harness

Reduction coupling and gearing engineered by Oak

SERVO-SELECTOR built for Radio Corporation of America

Stamped aluminum chassis

Special servo-solenoid designed by Oak


one responsibility for the design and production of your electromechanical requirements . . .

In the servo-selector, shown above, Oak engineers solved three different design problems. They developed (1) an ingenious jig-assembly for fastening the clips to the switch sections, giving exceptional accuracy in placement and retention; (2) lower speed operation through special reduction coupling and gears; and (3) special solenoids for positive clutching.

Oak then produced the assembly . . . stamping the aluminum chassis . . . manufacturing screw machine parts . . . making the complicated cable harnesses, switches, and solenoids . . . assembling all parts . . . then running vibration, cold (-55°C), humidity, and life tests.

Why not contact Oak engineers about your own requirements? But, do it early in the design stage . . . take full advantage of Oak's 25 years of experience in solving electromechanical problems.

Phone or Write Our Mr. Howard Olson, Today, on Any Aspect of Your Subassembly Projects

OAK MFG. CO. 

1260 Clybourn Ave., Dept. D, Chicago, Illinois
Phone: MOhawk 4-2222



CHANNEL SELECTOR switch built for Sylvania Electric Products Inc.



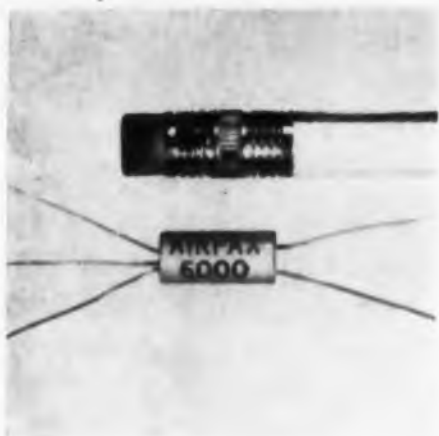
CAPACITOR SWITCH built for Radio Corporation of America

SWITCHES • ROTARY SOLENOIDS • CHOPPERS • SPECIAL ASSEMBLIES • VIBRATORS • TUNERS

CIRCLE 36 ON READER-SERVICE CARD

Transistorized Choppers

Handle signals from 0 to 100 kc



Shock and vibration resistant, these 1 gram transistorized choppers handle 0 to 100 kc signals. They may be driven by a sine or square wave with 1 to 18 v peak to peak amplitude. Type 6000 operates from -40 to $+60$ C and handles input signals from less than 1 mv to 5 v. For type 6010, the upper limits are extended to 85 C and 10 v.

Airpax Products Co., Cambridge Div., Dept. ED, Jacktown Rd., Cambridge, Md.

CIRCLE 38 ON READER-SERVICE CARD

Elapsed Time Indicator

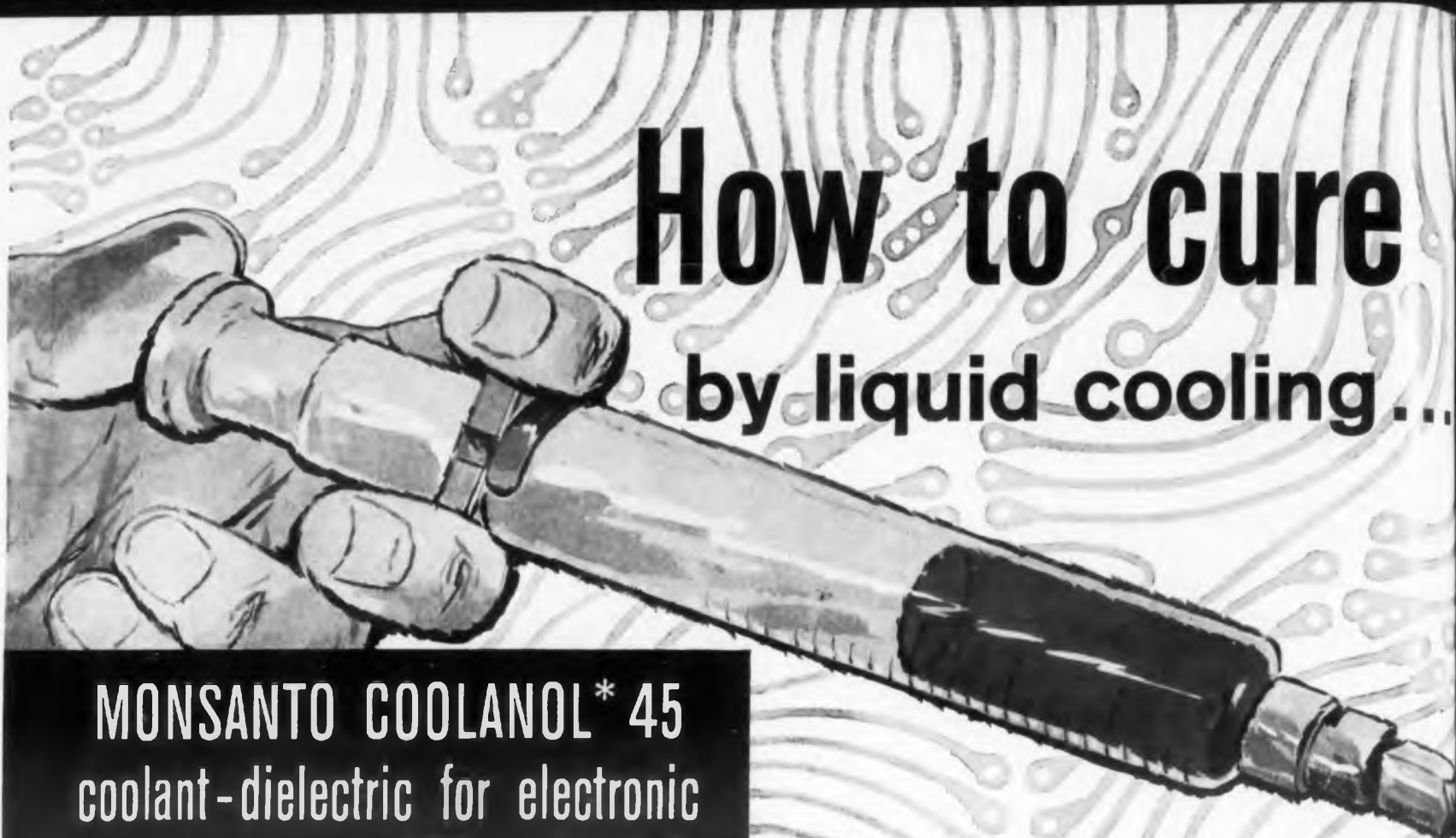
2 inches long



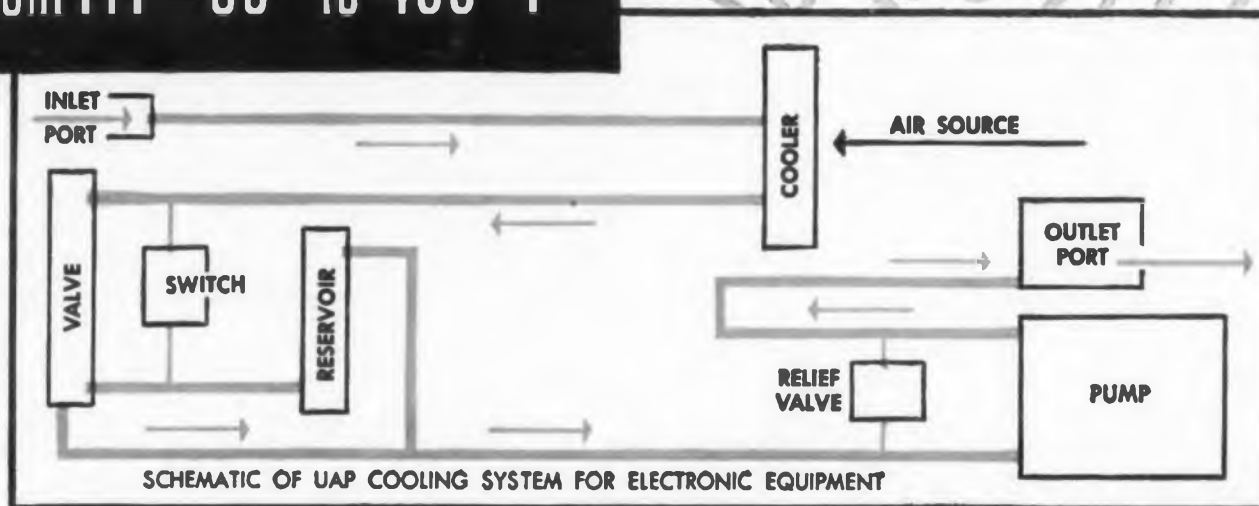
Recording up to 10,000 hr, the WT-1 elapsed time indicator keeps track of the time electrically powered equipment is in use. It is 1 in. in diameter, 2 in. long, and weighs 3 oz. Designed to operate from 115 v, 60 or 400 cps, it attains synchronous speed almost as soon as power is applied. In a variety of mountings, the unit is hermetically sealed and meets MIL-E-5272A specifications.

Waltham Precision Instrument Co., Dept. ED, Waltham, Mass.

CIRCLE 39 ON READER-SERVICE CARD



MONSANTO COOLANOL* 45
coolant-dielectric for electronic
equipment... -65° to 400° F



For reliable operation of electronic equipment, Monsanto COOLANOL 45 maintains desired temperature control within the range of -65° to 400° F. Pumped through jacketed components, it efficiently dissipates heat through liquid-phase heat transfer. COOLANOL 45 is an excellent fluid for the "package concept" of liquid cooling systems, such as UAP's, because it can also function as a hydraulic fluid. This makes possible a one-fluid, packaged coolant and hydraulic system.

COOLANOL 45 has extremely high purity, good dielectric qualities, excellent lubricity, low foam

tendency, and good viscosity properties over its wide temperature range. The fluid is compatible with common materials and its non-toxicity simplifies handling methods. For complete technical data, write today for Technical Bulletin AV-3 on COOLANOL 45. Address:

MONSANTO CHEMICAL COMPANY
Aviation Fluids Department AV-6
Lindbergh and Olive Street Road
St. Louis 24, Missouri

*Coolanol: Monsanto Trademark.

Present systems using Coolanol 45...

Fire Control Radar (ground and air) Guidance
Communications Navigation Bomb-Navigation
Data-Link Telemetry

Monsanto

e "electronic fever"



UAP cooling systems
for airborne electronics

UAP Cooling Systems assure safe operating temperatures for ground or airborne electronic equipment in applications such as automatic flight, weapon fire control, communication, navigation, and mobile ground support and test equipment. Typical systems consist of heat exchanger, fan and motor, pump and motor, expansion reservoir, and safety controls to protect the system and customer's equipment. The entire package is contained in an envelope of strict space and weight requirements.

U-518078-3, shown above, is 9 x 5.9 x 4.4 inches and weighs 6.75 lbs. exclusive of coolant fluid. Heat load of 275 watts is transferred from the electronic equipment to Monsanto COOLANOL 45. The pump circulates 1¼ to 3½ gpm through the

cooling system. Forced air through the heat exchanger maintains fluid outlet temperatures that vary between the extreme design points of 192° F. at sea level (air-in temperature 160° F.) and 220° F. at 70,000 ft. altitude (air-in temperature 36.5° F.).

Get complete information on UAP electronic cooling systems . . . or submit your application problem today for UAP design study! Call the nearest UAP Contractual Engineering Office: Burbank, California VI-9-4236; New York, N. Y. MU-7-1283; Dayton, Ohio BA-4-3841; Montreal, Canada ME-1-4396.

UNITED AIRCRAFT PRODUCTS, INC.
1116 Bolander Avenue, Dayton, Ohio



Custom designed UAP electronic equipment cooling packages incorporate mechanical, and expendable refrigerant systems; cold plates, gas-air and liquid-air heat exchangers.

Dry Batteries

High voltage



Dynox dry batteries come in four sizes: 0.14, 1.15, 1.57, and 2.87 cu in. Respectively, the units have 95, 190, 380, and 950 v potential.

Universal Winding Co., Patterson, Moos Div., Dept. ED, 90-28 Van Wyck Expressway, Jamaica, N.Y.

CIRCLE 41 ON READER-SERVICE CARD

Terminal Blocks

Time saving design



RH terminal blocks are delivered open and ready for wire insertion. To save searching time for dropped or lost screws, each terminal has a spring clip to retain backed out screws. Rated at 750 v, 50 amp, the blocks have 1 to 20 terminals. They accept 8 to 18 AWG wire.

Curtis Development & Mfg. Co., Dept. ED, 3250 N. 33rd St., Milwaukee 16, Wis.

CIRCLE 42 ON READER-SERVICE CARD

Missing Ace

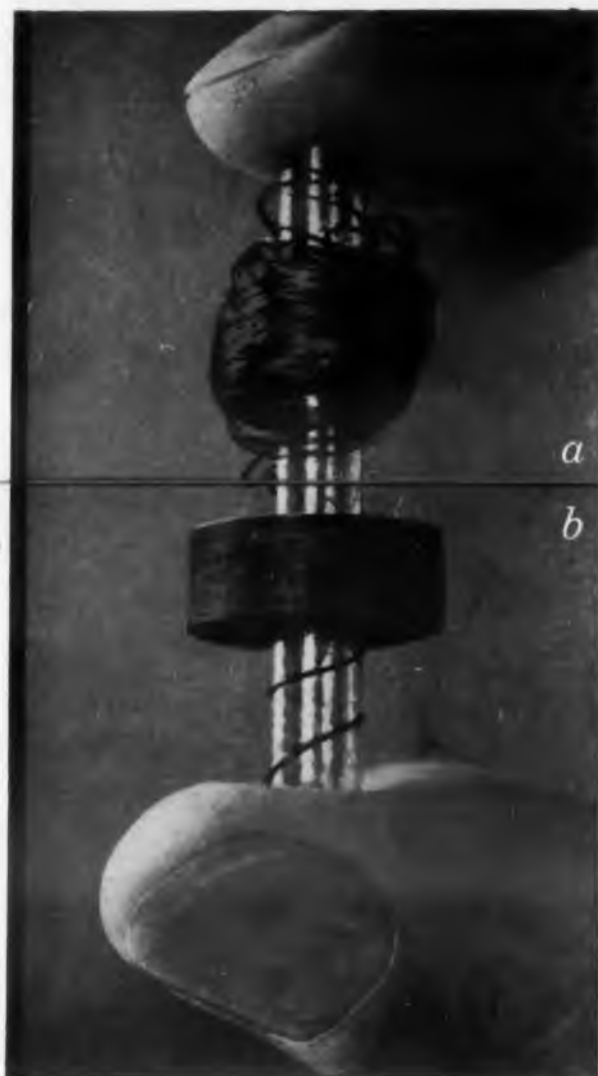
Change-Quick potentiometers, announced on p 85 of ELECTRONIC DESIGN, Nov. 12, are made by Ace Electronics Associates, Inc. Inadvertently, we dropped the Ace and credited them to Electronics Associates, Inc.

CIRCLE 40 ON READER-SERVICE CARD

If you have this problem, investigate

GRIP-EZE®

—an example of Phelps Dodge's
realistic approach
to Magnet Wire research



THE PROBLEM: To develop a solderable film-coated wire without fabric for winding universal lattice-wound coils without adhesive application.

THE SOLUTION: Phelps Dodge Grip-eze—a solderable film wire with controlled surface friction for lattice-wound coils that provides mechanical gripping between turns and keeps wire in place.

EXAMPLE: Coils wound with (a) conventional film wire; (b) Grip-eze. Note clean pattern of Grip-eze as compared to fall-down of conventional film wire.

Any time magnet wire is your problem, consult Phelps Dodge for the quickest, easiest answer!

FIRST FOR
LASTING QUALITY
— FROM MINE
TO MARKET!



**PHELPS DODGE COPPER PRODUCTS
CORPORATION**

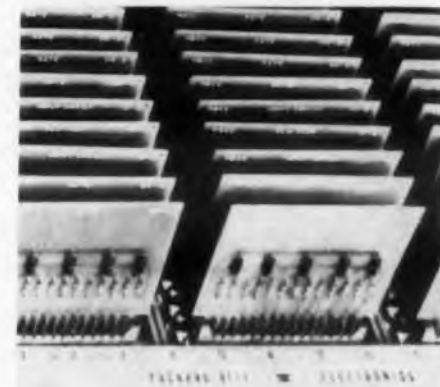
**INCA MANUFACTURING DIVISION
FORT WAYNE, INDIANA**

CIRCLE 44 ON READER-SERVICE CARD

NEW PRODUCTS

Digital Logic Packages

For data handling equipment



These solid state digital logic packages can be combined to build registers, counters, computers and other data handling equipment. They include flip-flops, inverters, gates, drivers, clock generators, and so forth. Low cost plug-in modules, they are easily replaced and can be built into systems of any size. High reliability is achieved through the elimination of both eyelets and printed circuit connectors. Shown are modules in an input buffering system.

Packard-Bell Computer Corp., Dept. ED, 190 S. Armacost Ave., Los Angeles 25, Calif.

CIRCLE 45 ON READER-SERVICE CARD

Plastic Rods and Sheets

10¹⁶ ohm-cm resistance



In rods and sheets of various shapes and sizes, Eccostock HT 0003 is a thermosetting plastic that withstands 500 F and exhibits almost no cold flow. From 10² to 10¹⁰ cps, dielectric constant is 2.2 and dissipation factor is below 0.0003. Insulation resistance is 10¹⁶ ohm-cm. The material can be used for coaxial insulation, antenna windows, and sundry dielectric machine parts.

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

CIRCLE 46 ON READER-SERVICE CARD

CIRCLE 47 ON READER-SERVICE CARD

ELECTRONIC DESIGN • December 24, 1958

ALCOA ALUMINUM TEAMS NATURALLY WITH ELECTRICITY



—first step to better coil design

Manufacturers of electromagnetic equipment can reduce material and production costs *now*—by switching to ALCOA® Aluminum strip windings. Equipment designed with ALCOA strip is more compact, lighter in weight, and better able to dissipate heat than conventional wire. For information about recent ALCOA developments in this field and how they benefit you—please turn the page.

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CARD
1958

NEW DESIGN CONCEPTS WITH ALUMINUM STRIP

by Robert R. Cope, Aluminum Company of America, Pittsburgh, Pa.

Light weight, better space factor, better heat dissipation, low voltage between turns, less point-to-point contact . . . these characteristics of aluminum strip have long intrigued designers of electrical windings. Today, this aluminum application is a practical reality.

Intensive research and testing by ALCOA have contributed to important technical breakthroughs. New techniques are solving problems relating to edge effect, joining and insulation.

Recently, ALCOA purchased the transformer division of Automation Instruments, Inc., to perfect winding techniques and to produce prototype coils for customers' evaluation. With this added facility, the electrical windings division of ALCOA Research Laboratories is equipped to wind coils from small solenoids up to distribution transformer sizes for testing by manufacturers—an important, new service for the electrical industry.

ALUMINUM'S NATURAL ADVANTAGES

Aluminum weighs less. In general, an aluminum strip winding weighs only half as much as an equivalent winding of copper. Based on equal current-carrying capacity, 0.48 pounds of aluminum replaces one pound of copper. (Figures are for 61.0 per cent conductivity aluminum, 97 per cent conductivity hard-drawn copper.) ALCOA No. 3 EC alloy has been developed expressly for electrical windings. Space factor of aluminum strip can be 90 per cent and higher; for copper wire, 55 per cent to 65 per cent is typical. Thus, although an aluminum strip requires more conductor volume than a conventional wire winding, the total space occupied by each is about the same. Variations in space factor will depend on the strip-to-insulation thickness ratio.

Aluminum strip windings permit higher current densities because each turn has an outside radiating edge that provides effective heat dissipation. Layer-to-layer temperatures are constant; hot spots are virtually eliminated. The inner turns of a wire-wound coil cannot radiate heat as efficiently as the outer turns.

In most cases, aluminum strip windings can be manufactured at lower cost than equivalent wire windings. Aluminum strip lends itself to automation; new high-speed winding techniques have reduced fabrication costs by eliminating much of the hand labor necessary with wire.

Conventional wire windings require heavier insulations to withstand (1) abrasion during winding, (2) abrasion from point-to-point contact between turns, (3) layer-to-layer voltage, which may be many times the turn-to-turn voltage. Aluminum strip insulation needs to withstand only turn-to-

turn voltage because a single turn occupies the entire width of the coil. Thus, thinner and less abrasion-resistant insulations can be used, such as interleaved sheets of Mylar or Kraft paper . . . coatings of varnish, lacquer or epoxy . . . anodized films or vitreous enamel.

ALCOA has tested every known method of joining aluminum. Some techniques proved impractical or costly. But successful joining has been accomplished with ultrasonic welding, high temperature soldering, shielded inert arc welding, cold pressure welding, resistance welding and mechanical joining. Cold pressure welding is quite practical; joints have high strength and conductivity. Ultrasonic welding requires no heat, precleaning or flux; joints are made quickly between parts of different thicknesses, or of multiple thicknesses—and the weld can be made through many types of insulation.

Where is the best application for aluminum strip windings? In power devices or electronic equipment, the economics of aluminum strip windings are indicated when customary wire sizes are 24 gage or larger. However, in many aircraft and missile applications, where weight is a critical factor, aluminum strip is a natural application regardless of size.

Here, at a glance, are the main areas of comparison:

PROPERTY	HARD-DRAWN COPPER WIRE	ALUMINUM STRIP No. 3 EC
Weight (lb/cu in.)	0.321	0.098
Specific gravity	8.89	2.70
Coefficient of linear expansion (°C)	0.000017	0.000023
Thermal conductivity at 20°C ($\frac{\text{watts/sq in.}}{\text{in.}^\circ\text{C}}$)	9.7	6.0
Electrical conductivity at 20°C, per cent IACS	97	61.0
Electrical resistance at 20°C (microhms/sq in./ft)	8.40	13.14
Temperature coefficient of electrical resistance at 20°C (°C)	0.00381	0.00409
Modulus of elasticity	17 x 10 ⁶	10 x 10 ⁶

ALCOA Aluminum Electrical Windings will reduce your costs and improve your product. We'd like to prove it. Send your specifications to us and we will wind sample coils. Then make your own test.

ALUMINUM COMPANY OF AMERICA, 2263-M Alcoa Building, Pittsburgh 19, Pennsylvania.



Interleaving sheet-type insulation with aluminum strip.



Specially designed equipment for winding smaller coils.



Preliminary testing of foil-wound transformer.



Send for Alcoa's new *Conductor Selector Chart*, a convenient slide rule for converting standard wire sizes to equivalent strip conductor.



Production Coil Tester

Checks for shorts, opens, and grounds

At a rate of 600 an hour, this coil tester checks armature windings for shorts, opens, and grounds. It automatically ejects acceptable parts into a support cradle. Rejected parts light a red lamp and stay clamped to the machine until a button is pushed to release them.

Cen-Tec Corp., Dept. ED, 38903 Schoolcraft Rd., Livonia, Mich.

CIRCLE 48 ON READER-SERVICE CARD

Permanent Magnet Motors

Miniature



Diameters of these permanent magnet dc motors are 1-1/2 in. Types BD and BL are respectively 1/16 and 2-15/16 in. long and rated at 1/45 and 1/30 hp continuous duty at 10,000 rpm.

Globe Industries, Inc., Dept. ED, 54 Stanley Ave., Dayton 4, Ohio.

CIRCLE 49 ON READER-SERVICE CARD

Transient Protector

Transistorized

Model N210 transistorized transient protector is for use on a 28 v. line. It passes up to 30 amp with an input to output voltage drop of 1.5 v. The clipping level of the input voltage is 35 v. The unit is 2 1/2 x 3.5 in.

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

CIRCLE 50 ON READER-SERVICE CARD

CIRCLE 47 ON READER-SERVICE CARD

CIRCLE 51 ON READER-SERVICE CARD



for: MISSILE, ELECTRONIC
and INDUSTRIAL CONTROLS

NEW



modular mounting

lighted push-button panel switch

Simplifies Control Panels; Saves Space, Cuts Cost.

May be used singly or in "stacked" arrangement.

3 UNITS IN 1 COMPACT MOUNTING



NAME-PLATE + PILOT-LIGHTS + PUSH-BUTTON SWITCH UNIT

In one compact assembly, this unit provides new space and cost economy whether used individually or in "stacked" arrangement. You get quality appearance with "thumb-size" operation.

TWO-PIECE, PLASTIC NAME-PLATE PROVIDES EASY COLOR-CODING; SIMPLIFIES OPERATION IDENTIFICATION



Virtually any operating condition can be identified with this push-button name-plate arrangement. The snap-in button is easily removed for insertion of slip-in name-plate. Use of various colored button bases, or various colored lamps, permits wide range of codings and monitoring.

This new Electro-Snap push-button panel switch efficiently combines a name plate, pilot light assembly and a switching unit in one compact modular assembly. The trim, streamlined design permits easy "stacking" on control panels or consoles. It eliminates congestion by replacing three individual units (nameplate, pilot light assembly and switch unit). You can achieve greater operating efficiency and quality appearance while making substantial savings in space and cost. A wide variety of configurations is available in:

- colored lights for color monitoring
- circuit arrangements of switch and pilot lights
- colored buttons for color coding

- Snap-in button permits easy lamp replacement from front of panel
- Barrier can be color-anodized to your specification

The operating and indicating combinations possible through the variation of arrangements provides almost unlimited applications for sequencing, movement-limit, start-and-stop, position-indicating and similar control operations.

Check the design and construction advantages of this significant advance in panel switches for your own applications. For further details contact your local representative or write to:

ELECTROSNAP CORPORATION

4216 W. Lake St. • Chicago 24, Ill.
VA 6-3100 TWX #CG-1400

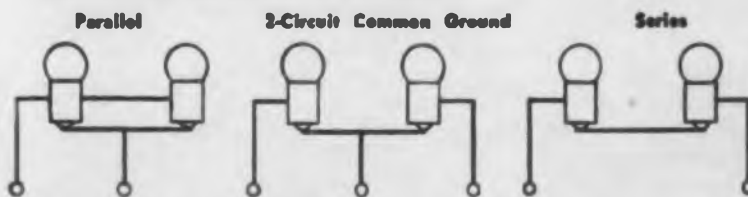
- Snap-in button permits easy lamp replacement from front of panel
- Barrier can be color-anodized to your specification



The lighted push-button switch assembly is also available without the switch unit for use where only pilot light duty is required.

VARIETY OF CIRCUIT ARRANGEMENTS PERMITS WIDE RANGE OF INDICATING AND SWITCHING COMBINATIONS

- Lamp circuit can be wired independently of switch circuit—or through switch unit.
- Since two lamps are provided, independent external circuits can be indicated on single unit with different lamp colors and white push-button.
- Complete push-button switch unit or pilot-light assembly can be supplied in any of the three following circuit arrangements.



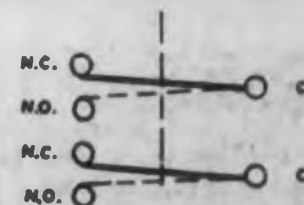
• 6V. or 28V. lamps may be used (solder terminals on lamp assembly)

Switch terminals available

- Solder
- Turret
- Double Turret
- AMP quick-disconnect

Switching Circuits to Meet Your Needs

The double-pole, double-throw switching unit may be wired normally-open or normally-closed.

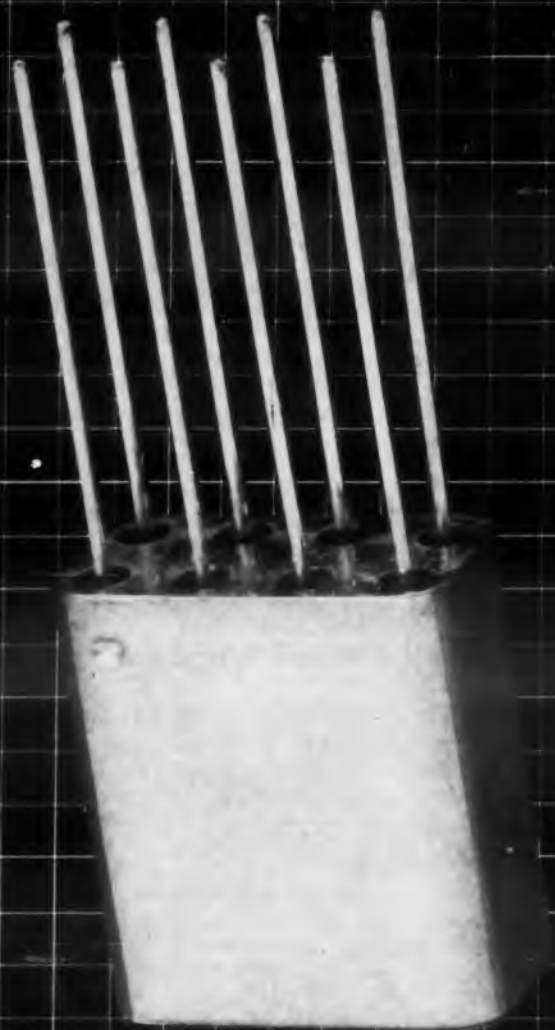


a standard
ELECTRO-SNAP UNIT

- Compact
- Space Saving
- Precision-Engineered
- Low Cost



MINIATURIZED SEALED RELAYS



Relay shown is 2½ times actual size.

PERFORMANCE TESTS PROVE CAPABILITY

New G-E grid-spaced relay

Lab test reports now confirm the outstanding performance capabilities of General Electric's new Type GS micro-miniature relay. Here are data on two tests:

7,000,000 operations plus—Type GS relays switched 360 ma at 30 v DC in an ambient of +125C. Maximum contact resistance reading was .024 ohms during and after test.

3,000,000 operations plus—Here, relays switched dry-circuit loads of 1 micro-amp at 300 mv in an ambient continuously cycled from -65C to +125C. A 1000 ohm contact resistance failure point was set. No failures occurred.

New G-E grid-spaced relay terminals match standard spacing for printed circuits. The relay excels in missile and aircraft applications. Quality control tests assure that relay will meet applicable portions of MIL-R-5757C, and MIL-R-25018 specifications.

Specifications include:

Shock: 50G's per MIL-R-5757C, and MIL-R-25018.

Vibration: 20G's from 55-2000 cps.

Operating Time: 4.5 ms nominal.

Release Time: 3.5 ms nominal.

For details, call your G-E Apparatus Sales Engineer. Or, send for the G-E Sealed Relay Catalog, Specialty Control Dept., Waynesboro, Va.

GET YOUR 1958-59 G-E SEALED RELAY CATALOG

General Electric Co., Sect. C792-10
Schenectady 5, N. Y.

Please send me a copy of GEA-6628,
1958-59 Sealed Relay Catalog.

Name _____

Company _____

Address _____

City _____ State _____

GENERAL  ELECTRIC

NEW PRODUCTS

Miniature Relay

Has heavy-duty socket

For industrial and instrument use, this sealed electromagnetic relay has a 14 terminal header mated with a heavy-duty socket. The 4pdt unit has a minimum creepage of 1/4 in. At reduced contact loads, it survives up to 100 million operations. In ratings to 5 amp at 28 v dc or 120 v ac, it measures 1.5 x 1.6 x 2 in.

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

CIRCLE 53 ON READER-SERVICE CARD

Magnetic Core Memory System

Modular



Made from transistorized plug-in packages, the 3C-Memory magnetic core memory system is designed to handle core matrix driving and sensing circuits. Its modular construction permits random access memories with capacities to 4096 words and 40-bit word lengths.

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

CIRCLE 54 ON READER-SERVICE CARD

DC Power Supply

Two continuously adjustable outputs

Type D-10-10-100KS4 power supply has two continuously variable outputs: 6 to 10 v, 50 amp and 6 to

CIRCLE 52 ON READER-SERVICE CARD

10 v 10 amp. Power may be drawn from them separately or simultaneously. Regulation is $\pm 0.5\%$; ripple is 60 mv peak to peak; recovery time is 0.2 sec. For missile ground support, the unit meets MIL-E-4970 specifications.

Christie Electric Corp., Dept. ED, 3410 W. 67th St., Los Angeles 43, Calif.

CIRCLE 55 ON READER-SERVICE CARD

Preamplifiers

Low noise



These miniature broadband preamplifiers give low noise and cover the 50 to 500 mc range. A typical unit accepts everything from 50 to 300 mc and has a noise figure of 5 to 8 db and a dynamic range of 60 db.

The Singer Mfg. Co., Military Products Div., Dept. ED, 149 Broadway, New York 6, N.Y.

CIRCLE 56 ON READER-SERVICE CARD

Strip Chart Recorder

Offers continuous integration

This strip chart recorder measures, records, and continuously totals any linear variable with respect to time. Quantitative integration is read on a 6 digit counter at speeds to 1000 counts per minute. Analog equivalent is recorded on a chart by a dual pipping pen at rates to 500 strokes per minute. The unit is $\pm 1\%$ accurate.

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

CIRCLE 57 ON READER-SERVICE CARD

CIRCLE 58 ON READER-SERVICE CARD



Special aptitude test for metals

This man is vaporizing a test sample from an incoming metals shipment in a spectrograph to determine its composition. And spectral readings, accurate to .001%, will show whether or not it meets Varian's high quality standards. Copper for components, nickel alloy for cathodes, glass sealing alloys, all are critically checked and controlled before and during manufacture to guarantee that the completed Varian Tubes will perform as specified.

This is the kind of quality control that has made Varian Tubes "Standard" for all microwave installations. Over 100 of these tubes are described and pictured in our latest catalog. Write for your copy today.

THE
MARK OF
LEADERSHIP



VARIAN associates

PALO ALTO 21 CALIFORNIA

Representatives throughout the world

KLYSTRONS, TRAVELING WAVE TUBES, BACKWARD WAVE OSCILLATORS,
LINEAR ACCELERATORS, MICROWAVE SYSTEM COMPONENTS, R. F. SPECTROMETERS, MAGNETS,
MAGNETOMETERS, STALUS, POWER AMPLIFIERS, GRAPHIC RECORDERS, RESEARCH AND DEVELOPMENT SERVICES

NEW PRODUCTS

Miniature Relays

Control one to six circuits

In 1 to 6 pdt arrangements, series DC miniature relays have snap-action, heavy duty contacts rated at 2 or 5 amp. They have 400 cps ac coils or high resistance coils for plate circuit operation. Available in various mounting brackets, the units are provided with potted leads of any specified size or length.

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

CIRCLE 59 ON READER-SERVICE CARD

Electro-magnetic Brake

40 oz-in. torque



Industrial Miniature-B-125 brake has a minimum torque of 40 oz-in. and weighs 6 oz. Unit's backlash is 0 deg, and power consumption is 5 w. Designed for operation on 28 v dc, its response is 30 msec.

Autotronics Inc., Dept. ED, Box 208, Florissant, Mo.

CIRCLE 60 ON READER-SERVICE CARD

Power Supply

For strain gage excitation

Designed for strain gage excitation, model SR-1000 solid-state dc power supply provides a floating output. Voltage is adjustable from 5 to 30 v; maximum output current is 1 amp; and ripple is under 1 mv. Line regulation from 95 to 135 v is 0.1%.

Video Instruments Co., Inc., Dept. ED, 3002 Pennsylvania Ave., Santa Monica, Calif.

CIRCLE 61 ON READER-SERVICE CARD

Transitron announces

5 NEW TYPES OF SILICON TRANSISTORS

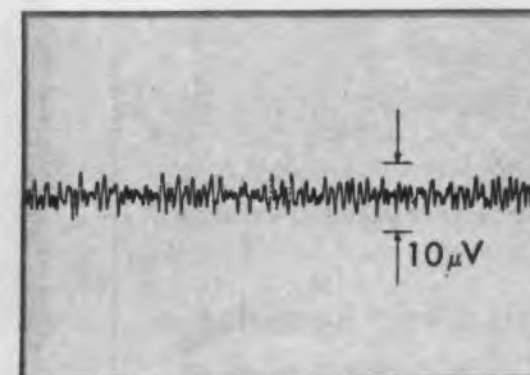
LOW NOISE type... lowest noise figure yet achieved



in the critical range from one cycle per second to audio frequencies. The ST1050 offers improved equipment stability down to a fraction of a cycle per second. Use it for all low level amplification problems having an input source impedance of 50 Kohms or less... strain gages, thermocouples, accelerometers.

TYPE	ST1050	
Equivalent Input Noise Voltage (0.8 to 50 cps)	2.5	μ V RMS
DC Beta @ $I_c = 20 \mu$ A	20	—
Collector Cutoff Current (25°C, -3V)	.002	μ A
Collector Cutoff Current (100°C, -3V)	0.2	μ A

Complete data in bulletin TE-1353



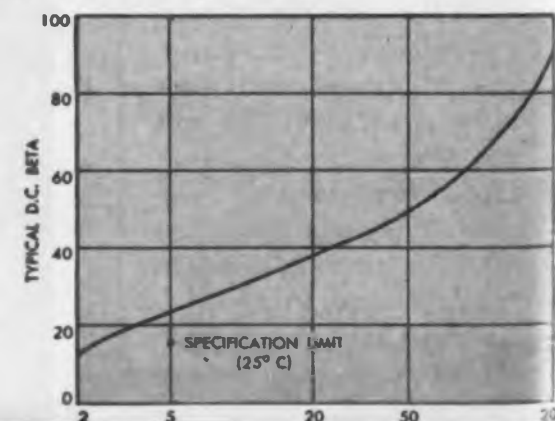
LOW LEVEL INPUT type... extremely low drift



over the recommended operating range of 2-200 μ A collector current. With typical drift of only 1.0 milli-microamps per degree C and 5 milli-microamps per day, ST1026 may be used in circuits with high impedance sources... phototubes, G-M tubes, infra red tubes and ionization gages. Many new low current applications are opened up by the high beta and extremely low I_{CO} .

TYPE	ST1026	
Minimum DC Beta @ 5μ A	15	—
Maximum Collector Cutoff Current (25°C, -3V)	.005	μ A
Typical Collector Cutoff Current (100°C, -3V)	0.2	μ A

Complete data in bulletin TE-1353



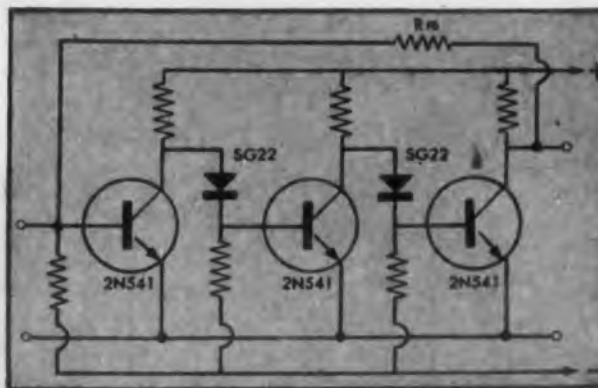
HIGH BETA types... current gain of 80 minimum



the highest level yet achieved in the industry. A useful end-of-life beta is maintained at temperatures down to -65°C , even at reduced collector current levels. The high gain of these transistors reduces the number of stages required in amplifier applications. A greater degree of degenerative feedback may be used to obtain much greater gain stability and uniformity, resulting in reliable amplifier operation.

TYPES	2N543	2N542	2N541	
Minimum Common Emitter Current Gain @ 1 Kc	80	80	80	—
Typical Common Emitter Current Gain @ 1 Mc	15	15	15	—
Maximum Collector Voltage	45	30	15	Volts
Maximum Collector Cutoff Current (25°C @ V_c Max.)	.5	.5	.5	μA

Complete data in bulletin TE-1353



HIGH V_{EB} /SMALL SIGNAL types

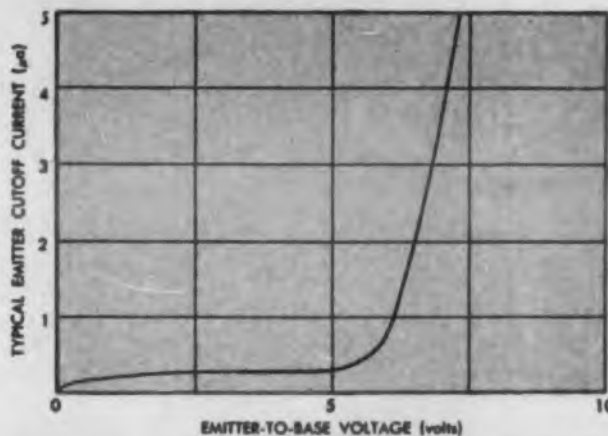
... V_{EB} of 5 Volts minimum



eliminates the need for series diodes in many applications and protects against transients in pulse and digital circuitry. This improvement in emitter-to-base voltage is available in Transitron's entire line of small signal transistors, at no sacrifice of other characteristics.

TYPES	2N543A	2N480A	2N475A	
Maximum Emitter-to-Base Voltage	5	5	5	Volts
Maximum Collector Voltage	45	45	45	Volts
Minimum Common Emitter Current Gain	80	40	20	—
Maximum Collector Cutoff Current (@ $V_c = 45$ Volts)	.5	.5	.5	μA

Complete data in bulletin TE-1353



HIGH BETA/MEDIUM POWER types

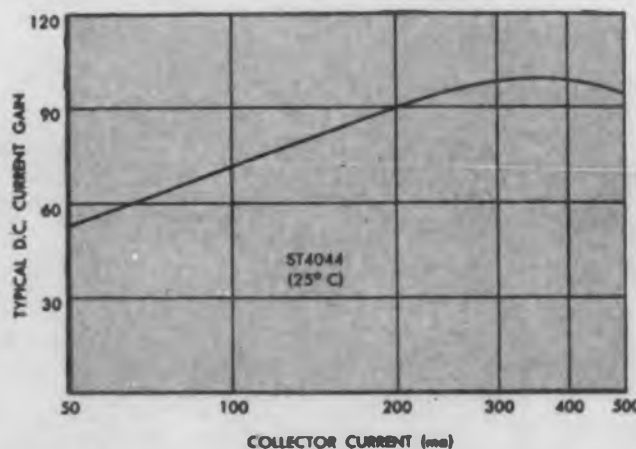
... current gain of 40 minimum



at 500 milliamps. Typical power gain of 1000 into a 100 ohm load significantly reduces drive power requirements. When used in conjunction with small signal high gain types, these transistors reduce the number of components needed in a system and, hence, the overall weight and volume. I_{CO} is measured at maximum rated collector voltage at 150°C .

TYPES	ST4044	ST4045	
Minimum DC Beta = 40 at I_c	500	200	ma
Maximum Collector Voltage	60	60	Volts
Power Dissipation (100°C , free air)	6	.6	Watt
Power Dissipation (100°C , stud heat sink mounting)	5	5	Watts
Typical Collector Saturation Voltage (@ specified current)	3	1.5	Volts

Complete data in bulletin TE-1355



HEAT SINK MOUNTINGS... higher power ratings

for medium power transistors in Transitron's TO-5 Outline package. These factory-fitted heat sink mountings make possible a realistic 5 watt rating at 100°C case temperature for the first time. The stud type offers the con-

venience of single-hole mounting, the same as for our JAN rectifiers in the $\frac{1}{16}$ " hex package. No clip is needed... insulation and mounting hardware are supplied. Complete data in bulletin TE-1355.

Transitron

electronic corporation • wakefield, massachusetts



Transistors



Diodes



Regulators



Rectifiers



Proximity Pickups

Waterproof

Designed for complete water and oil resistance, these proximity pickups have a 10 ft cable that is potted in place. In model 4913-WPN, the cable ends with a 3-pin connector; in the 4913-WPL, with terminal lugs. The units can detect ferrous and nonferrous metal parts with diameters of less than 0.1 in., and they can be excited by gear teeth of 10 diametral pitch. When connected to a proximity control unit, they can detect moving metal pieces passing at a rate of 60,000 per min. Operating clearances for metal pieces over $\frac{3}{8}$ in. in diameter are up to $\frac{1}{4}$ in. The units have a $\frac{5}{16}$ in. diameter sensing face and are $1\frac{21}{32}$ in. long. They operate from extremely low temperatures to 200°F .

Electro Products Labs, Dept. ED, 4500 N. Ravenswood Ave., Chicago 40, Ill.

CIRCLE 62 ON READER-SERVICE CARD

Counting-Dividing Units

Speed of 100,000 counts per sec



For scaling, computing, and control, Incremag counting and dividing units have a maximum count rate of 100,000 per sec. They accept random or uniform pulses. From a 1 kc input, one form can deliver four outputs from 1 to 1000 cps.

General Time Corp., Dept. ED, 109 Lafayette St., New York 13, N.Y.

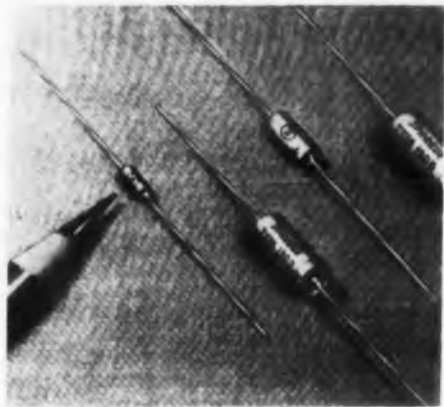
CIRCLE 63 ON READER-SERVICE CARD

CIRCLE 64 ON READER-SERVICE CARD

NEW PRODUCTS

Solid Tantalum Capacitors

Operate to 125 C



Maximum capacitances of type 150D solid-electrolyte tantalum capacitors now range up to 330 μf at 6 v, 220 μf at 10 v, 150 μf at 15 v, 100 μf at 20 v, and 47 μf at 35 v. The units may be operated at 125 C with appropriate voltage derating. They withstand severe shock and high frequency vibration.

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

CIRCLE 65 ON READER-SERVICE CARD



Broadband Load Isolators

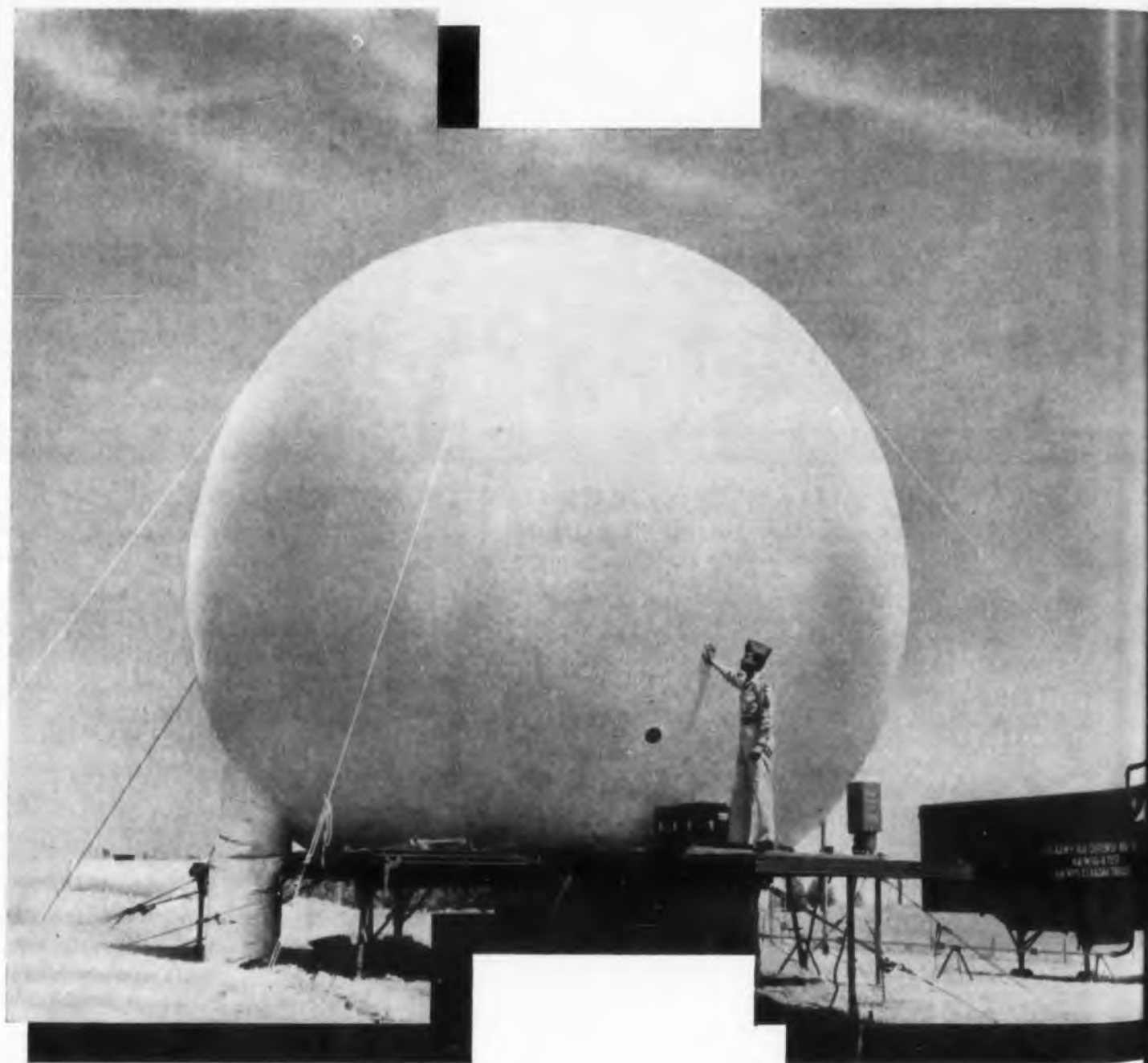
Low power

Handling 10 w in the forward direction and 2 w in the reverse, these broadband ferrite load isolators have 1 db maximum insertion loss. Input vswr into a flat load is 1.15 maximum. Models X-12.29 and X-12.25 cover 8.2 to 12.4 kmc with 30 and 40 db minimum isolation, respectively. With the same respective isolations, models XL-12.10 and XL-12.7 cover 7 to 10 kmc, and models J-12.70 and J-12.65 cover 5.85 to 8.2 kmc.

Cascade Research, Div. of Monogram Precision Industries, Inc., Dept. ED, Los Gatos, Calif.

CIRCLE 66 ON READER-SERVICE CARD

The strange shape



ap of defense

This plastic balloon, resting on a mobile trailer bed like a golf ball on a tee, protects the new Hughes three-dimensional radar antenna.

Frescanar, the exclusive system combining high-speed data processors and a frequency scan radar antenna, has been developed by Hughes engineers in Fullerton, California.

Sensitive to the inadequacies of conventional radar, these Hughes Fullerton engineers have devised a radar antenna whose pointing direction is made sensitive to the frequency of the electromagnetic energy applied to the antenna. This frequency sensitivity results in the radar beam being radiated from the antenna at different angles, depending on the frequency of the energy supplied. With the supply of a succession of frequencies, the antenna beam can be moved through a succession of positions. Utilizing this advanced technique, range, bearing and altitude can be detected... on a single antenna.

This Hughes-developed radar system has been combined with compact, high-speed Hughes data processors to provide a completely self-sufficient, mobile radar defense system.

Other Hughes projects provide similarly stimulating outlets for creative engineering talents. Current areas of Research and Development include Advanced Airborne Electronics Systems, Space Vehicles, Nuclear Electronics, Subsurface Electronics, Ballistic Missiles... and many more. Hughes Products, the commercial activity of Hughes, has assignments for imaginative engineers for research in semiconductor materials and microwave tubes.

The diversity and advanced nature of Hughes projects provides an ideal environment for the engineer or physicist interested in advancing his professional status.

An immediate need now exists for engineers in the following areas:

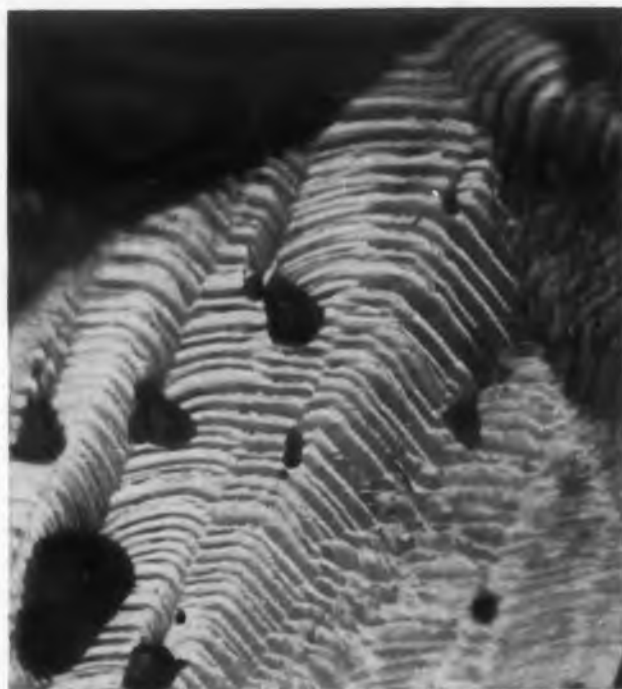
Microwave & Storage Tubes	Reliability Engineering
Field Engineering	Systems Analysis
Quality Control	Circuit Design
Semiconductors	Communications
Digital Computer Engineering	Radar

*Write in confidence, to Mr. Phil N. Scheid,
Hughes General Offices, Bldg. 6-E-2, Culver City, California.*

© 1958. HUGHES AIRCRAFT COMPANY



The Hughes Communications Laboratories have as one objective the development of systems capable of deflecting their signals from meteors, artificial satellites and even the moon.



This photomicrograph of an etched silicon sphere is used in basic studies of semiconductor materials at Hughes Products, the commercial activity of Hughes.

The West's leader in advanced ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY
Culver City, El Segundo,
Fullerton and Los Angeles, California
Tucson, Arizona

Conductive Cement

For printed circuit repair



Hysol 6250 is a conductive cement based on epoxy resins. Its volume resistivity is 0.01 ohm-cm at 25 C. For repairing printed circuits or bonding electrical components, it cures in 24 hours at room temperature, or in two hours at 140 F.

Houghton Labs, Inc., Dept. ED, Olean, N.Y.

CIRCLE 67 ON READER-SERVICE CARD

Silicon Transistor Chopper

Operates from -55 to +130C



Encapsulated in epoxy resin, model 70 silicon transistor chopper withstands 500 g shock for 11 msec, 30 g vibration from 0 to 2000 cps, and 700 g acceleration. Operating from -55 to +130 C, it has a chopping frequency of dc to 100 kc. The driving voltage is square wave, 5 to 10 v peak to peak. Both driving source and input resistances are 600 ohms. Input voltage can range from less than 1 mv to over 10 v, and output voltage equals chopped input voltage. The unit may be used as a modulator or demodulator and is suited for low level voltage measurements, dc amplifier stabilization, high speed servomechanisms, thermocouple instrumentation, and low level switching. It is 5/16 in. in diameter and 1-1/8 in. long.

Solid State Electronics Co., Dept. ED, 8158 Orion Ave., Van Nuys, Calif.

CIRCLE 68 ON READER-SERVICE CARD

NEW PRODUCTS



DC to DC Converter
300 v dc output

Solid state model PP 12/300 converter has an output of 300 v dc at 100 ma for a 12 v dc input. In a commercial case or hermetically sealed, it can serve as a plate supply for all types of communication and telemetering equipment.

Polytron Engineering Inc., Dept. ED, 32 W. Biddle St., Baltimore 1, Md.

CIRCLE 69 ON READER-SERVICE CARD

Power Supply

Has continuously variable output

Transistorized type PS-T-LV12 power supply provides 6 to 18 v at 2 amp, continuously variable. Load regulation is 0.3% no load to full load, and line regulation is 1% for a 105 to 130 v input.

The Reflectone Corp., Dept. ED, Stamford, Conn.

CIRCLE 70 ON READER-SERVICE CARD

Time Sequence Control

Operates on 3 channels



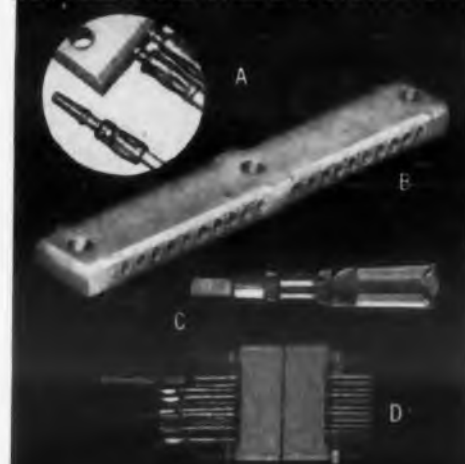
Fully automatic, this time sequence control operates on three channels and handles any time up to 130 sec on the selected channels. Of sturdy construction, the unit is suited for production as well as laboratory testing.

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

CIRCLE 71 ON READER-SERVICE CARD

FOR BETTER WIRE TERMINATING

AMP TAPER TECHNIQUE



(A) A-MP "53" SERIES TAPER PINS... insulated solid, screw machined or uninsulated formed pins to mate with tapered receptacles. Both types provide noise-free, low resistance electrical characteristics.

(B) A-MP "53" SERIES TAPER BLOCKS... are available in either solid blocks or two piece blocks... 10 or 20 cavity series... single or dual insert.

(C) A-MP TAPER TAB RECEPTACLES... accommodate flat tabs employing the taper key principle... feature standardized tapered section to fit relays, stepping switches, multiple connectors and other electronic components.

(D) A-MP MINIATURE TAPER PIN RECEPTACLES... eliminate tedious and costly operations of soldering leads to miniature connectors... use A-MP "37" Series Pins.

Bulletin Number 77

CIRCLE 102 ON READER-SERVICE CARD

AMP PATCHBOARD TECHNIQUE



A-MP PATCHCORD PROGRAMMING SYSTEMS AND PANELS offer tremendous versatility and flexibility. Exclusive feature of A-MP Systems is wiping action of pins against springs for clean contacts. A-MP Universal Patchcord Programming Systems and Panels are excellent for digital computers, data processing equipment and automatic test equipment. A-MP Shielded Patchcord Programming Systems and Panels are excellent for analog computers, telemetering equipment, test equipment and other low level applications where reliable shielding is required. Patchcords are made in a complete series for all programming requirements.

A-MP "240" SYSTEMS... offer complete reprogramming in seconds in airborne applications. The compact "240" System weighs 3¼ pounds and features 240 patchcord receptacles for maximum program combinations. It, too, features the exclusive wiping action to assure optimum electrical contact at all times.

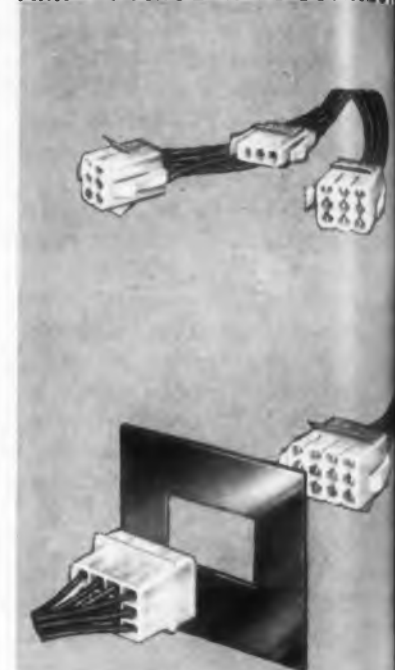
Bulletin Number 58

CIRCLE 103 ON READER-SERVICE CARD

Information concerning any termination problem will be forwarded on request. For literature on the above products, write, giving bulletin numbers desired, to:

AMP

AMP-Lok MULTIPLE CONNECTOR



AMP-LOK CONNECTORS... are available in 3, 6, 9, or 12 circuit units... the most versatile multiple connectors available to the electronics industry. Self anchoring units require no extra mounting parts for through-panel applications. All contacts are identical and self cleaning... recessed for safety. Finger grip engagement and disengagement of housing which is polarized to eliminate circuit error. AMP-lok will accommodate a wide range of panel thicknesses... may be color coded. AMP-lok may also be used with complete safety as a free hanging multiple connector.

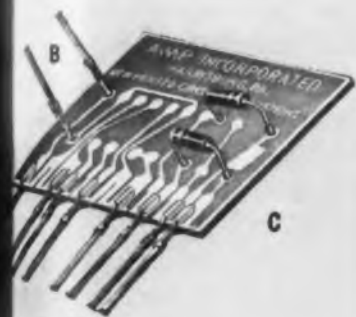
Bulletin Number 45

CIRCLE 104 ON READER-SERVICE CARD

AMP INCORPORATED
GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

TECHNIQUES . . . SPECIFY **A-M-P**

PRINTED CIRCUIT TECHNIQUE



AMP-EDGE TERMINALS . . . provide excellent electrical contact with minimum grippage and positive wiping action . . . apply easily to any section of the perimeter of the printed circuit board . . . reduce cost of application of wire conductor and to board.

AMP-IN TERMINALS . . . eliminate the need for leads during solder-dip operation . . . promote good capillary action during solder dipping . . . accommodate solid or stranded conductors . . . are self-retaining and self-aligning.

AMP COMPONENT TIPS . . . prevent movement of components during the solder dipping cycle . . . permit bridging of components . . . protect conductor leads from solder dip heat . . . eliminate need for eyelets through-plating on two-sided boards, excellent solder wicking characteristics and uniform solder deposit.
Bulletin Number 81

CIRCLE 105 ON READER-SERVICE CARD

SHIELDED WIRE PRODUCTS



(A) **TERMASHIELD SHIELDED WIRE FERRULES . . .** assure positive grounding of wire shield . . . eliminate solder, danger of burning insulation and uncertain attachment . . . feature one-piece construction . . . accommodate one or more grounding wires.

(B) **TERMASHIELD SHIELDED WIRE SPLICES . . .** join sections of shielded wire so that both the inner conductors and outer shields are firmly spliced, with the two effectively insulated. They eliminate multi-stage assembly or soldering . . . color coded for matching with application tooling and wire sizes.

(C) **TERMASHIELD 7MM SHIELDED CABLE FERRULES . . .** permanently ground shielded high tension cables . . . prevent wire damage during attachment . . . won't loosen or vibrate to cause poor ground or rf noise . . . remove danger of sparking . . . offer easy four-step attachment . . . seat precisely into applicable joints.
Bulletin Number 24

CIRCLE 106 ON READER-SERVICE CARD

TERMINALS AND SPLICES



(A) **STRATO-THERM TERMINALS AND SPLICES . . .** for high temperature and heat resistant requirements . . . accommodate a wide range of wire sizes either solid or stranded or both . . . with or without fully circumferential wire insulation support as desired.

(B) **CERTI-SEAL MOISTURE PROOF WINDOW SPLICES . . .** seal out vapors and fluids even at altitude to assure dry splice . . . accommodate over 100 insulation thicknesses . . . resist heavy vibration and shock.

(C) **OTHER A-M-P TERMINALS AND SPLICES . . .** designed for the most diverse circuitry requirements . . . stringently tested for corrosion resistance, vibration resistance, conductivity and long life . . . ideal for all types of electronic equipment.
Bulletin Number 37

CIRCLE 107 ON READER-SERVICE CARD

Temperature Control

Noncontacting

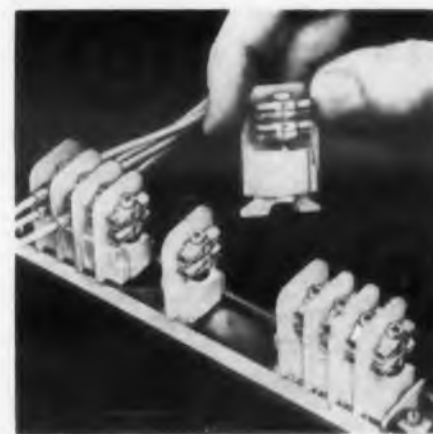
A noncontacting monitor and control, the Pyrotrol senses the temperature of objects 6 inches or many feet distant. Insensitive to flame, it reacts only to infrared radiation. Operating range is 950 to 2000 F, and repeat accuracy is within 0.5% of scale.

Mason Instrument Co., Dept. ED, 29 Elm Ave., Mt. Vernon, N.Y.

CIRCLE 72 ON READER-SERVICE CARD

Terminal Block

Snaps together



The Modulok terminal block consists of modules that snap together and fit into a steel track where they are held in place by end locks. Holding up to 30 modules per foot, the tracks come in lengths to 32 in. The modules have either two or four tier spring-loaded plated sockets which may be set for quick-disconnect or made into permanent connections with a screwdriver. The block accommodates wire sizes 22 through 12.

Burndy Corp., Omaton Div., Dept. ED, Norwalk, Conn.

CIRCLE 73 ON READER-SERVICE CARD

Motor Alternators

Provide 420 cps current

PA-40 and SA-40 motor alternators will operate computers, synchros, servo mechanisms, and other control equipment. They can be provided with outputs of 115 or 230 v, single, two, or three phase, at 420 cps. Inputs may be supplied at 230 or 460 v, 50 cps, three phase; 220 or 440 v, 60 cps, three phase; or 220 v, 60 cps, single phase.

Electric Motors and Specialties, Inc., Dept. ED, King and Hamsher Sts., Garrett, Ind.

CIRCLE 74 ON READER-SERVICE CARD

A-M-P products and engineering assistance are available through wholly-owned subsidiaries in: Canada • England • France • Holland • Japan

THOMAS A.

EDISON

**Time Delay Relay assures
sharp, clear aerial photos...
automatically**



The F8U-1P Crusader recently set new coast to coast speed record. CAI camera control system with Edison Time Delay Relay was used to automatically provide sharp, clear aerial photographs of the entire flight.

HERE'S WHAT A CUSTOMER SAYS ABOUT EDISON TIME DELAY RELAY...

"The CAX-12 servo power unit is a very vital part of the intricate 'brain' of the automatic camera control system, and naturally, we must have absolute reliability in all components. Therefore, as you know, we have relied on Edison Thermal Time Delay Relays since the original design of this CAX-12 and similar units. Since space for this type of equipment is at a premium, the compact size was a most important factor in original selection, but our units must also withstand severe environmental testing, involving vibration, moisture, shock, pressure fluctuation and extremes of temperature. Needless to say, the Edison Relay met all of these exacting requirements in our laboratories, and we've been specifying Edison ever since!"

(The above letter was received from Chicago Aerial Industries)



Edison's Thermal Time Delay Relay being inserted in the CAX-12 servo power unit.

Chicago Aerial Industries has developed a camera control system that allows one jet pilot to do the job of ten expert aerial photographers... automatically.

Heart of this new unit is the CAX-12 servo power unit. It accurately synchronizes film speed with speed of the jet—changes lens openings in response to electronic signals—regulates shutter speed and controls driving motor on cameras.

Because this power unit is vital to the camera control system component reliability is a must. That's why CAI relies on

Edison Thermal Time Relays exclusively for CAX-12.

Edison's line of miniature time delay relays are available for a wide range of electronic applications. They are light, small, rugged and offer these advantages:

- Designed to withstand vibration frequencies to 500 CPS
- Exceptionally high rate of contact closure
- Permanent calibration and hermetic seal
- Extremely rigid mechanical structure using high-strength, high-expansion alloys.

Thomas A. Edison Industries INSTRUMENT DIVISION

55 LAKESIDE AVENUE, WEST ORANGE, N. J.

EDISON FACTORY OFFICES ARE LOCATED IN: EVANSTON, ILLINOIS; DALLAS, TEXAS; DAYTON, OHIO; SHERMAN OAKS, CALIFORNIA



NEW PRODUCTS

Servo Motor

Velocity damped

Servo motor model 8 VM 420 is velocity damped by the magnetic coupling of a low inertia drag cup to the fixed field of two parallel magnets. The field intensity can be varied to provide added damping up to 100 dyne-cm-sec per radian. The size of the velocity-damped motor has an oversized rotor with 0.24 gm cm² inertia. Stall torque is 0.25 oz-in and acceleration at stall is 73,000 rad/sec.² The unit is 1.395 in. long.

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

CIRCLE 76 ON READER-SERVICE CARD

Microwave Relay System

For 120 to 240 channel operation

Operating in the 5925 to 8500 Mc band, model MCR-1000 microwave relay system accommodates 120 to 240 channels. It has linear 100 db base-band response and 1 w post-detection output.

Raytheon Mfg. Co., Dept. ED, Waltham 54, Mass.

CIRCLE 77 ON READER-SERVICE CARD

Emitter Follower

Designed for missiles



For use in aircraft and missiles, emitter follower model 5000 operates from -65 to +185 F and tolerates high noise and shock conditions. It permits measurements from 10 cps to 100 kc and handles signals

CIRCLE 75 ON READER-SERVICE CARD

in the low millivolt range. Current gain is 50,000 and voltage gain is 0.99.

Columbia Research Labs, Dept. ED, MacDade Blvd. and Bullens Lane, Woodlyn, Pa.

CIRCLE 78 ON READER-SERVICE CARD

Primary Phase Standard

± 0.01 degree accuracy



Self-calibrating type 7000-B audio primary phase standard has an ultimate accuracy of ± 0.01 degree. It supplies two sinusoidal voltage signals whose phase relationship, continuously variable from 0 to 360 deg, is known to ± 0.05 deg. The two signals have the same frequency set at one selection from 30 cps to 20 kc.

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

CIRCLE 79 ON READER-SERVICE CARD

Differential Transformer

Has large bore

Model 1000XS-N variable differential transformer has a large bore which suits it for flow meter and other applications where a tube must separate core and transformer. With a linear range of 1 in. either way from null, the unit provides a stepless output with less than 1% deviation from a straight line.

Schaevitz Engineering, Dept. ED, Route 130 and Schaevitz Blvd., Pennsauken, N.J.

CIRCLE 80 ON READER-SERVICE CARD

CIRCLE 81 ON READER-SERVICE CARD

10 CPS

SO WIDE IN RANGE...

8.0 MC

SO SMALL



IN SIZE

ESC WIDE BAND VIDEO TRANSFORMERS have been engineered and developed to offer . . . subminiature units of unusually wide bandwidth (10 CPS to 8.0 MC). They are used to replace bulkier and more costly components, thereby creating greater economy, and increasing equipment efficiency. There are 14 catalog units available from stock, cased or uncased.

ESC ELECTRONIC COMPONENTS DIVISION specializes in

the design and development of Wide Band Video Transformers to meet your particular applications. Each transformer prototype is accompanied by a comprehensive laboratory report, which includes submitted electrical requirements, photo-oscillograms (which indicate input and output pulse shape and output rise-time), the test equipment used, and evaluation of the electrical characteristics of the prototype.

Transformers Are Supplied With Solder Terminals

Meet All Applicable Mil-Specs

Complete catalog data on request



electronic components division

ESC

CORPORATION • 534 BERGEN BOULEVARD • PALISADES PARK, NEW JERSEY

exceptional employment opportunities for engineers experienced in pulse techniques



Pulse transformers • Medium and low-power transformers • Filters of all types • Pulse-forming networks • Shift registers • Miniature plug-in encapsulated circuit assemblies • Distributed constant delay lines • Lumped constant delay lines • Variable delay networks • Continuously variable delay lines • Pushbutton decade delay lines



Just published — bobbin core guaranteed performance limits!

We have just published new data which will light the way to ease, sureness and accuracy for the designer who works with tape wound bobbin cores.

First—and this is a “first”—we have published *guaranteed* maximum and minimum performance limits for all of our bobbin cores. Computer-type designers who would like open-circuit characteristics, guaranteed core flux and guaranteed squareness will find them all here.

Second—and this too is a “first”—we have published the first fundamental data on characteristics of bobbin cores for circuit designers. Need core total flux characteristics as related to core material? Want switching time vs drive levels? How about typical spreads of core characteristics? It's all yours.

Third—and this too is a “first”—we automatically give you test data for prototype orders. With your prototype cores come open-circuit outputs, total flux, and squareness data. You get a basic understanding of the core's characteristics under specific test conditions. More important, when you re-order production quantities, you will be able to duplicate the core around which you designed your circuit.

Last—but still a “first”—to show that we manufacture as well as publish, we have designed the first bobbin core protective cap which will permit normal potting procedures for all sizes of steel and ceramic bobbins. Our “Poly Caps” have virtually no effect on dimensions—and will not soften or deform under manufacturing or operational temperatures. We'd like to show you samples.

At what stage do you want to start? Whether it's design data, prototype data and cores, or production quantities of our “Performance-Guaranteed” bobbin cores—you can get what you need by writing Magnetics, Inc., Department ED-48, Butler, Pennsylvania.



CIRCLE 82 ON READER-SERVICE CARD

NEW PRODUCTS

RF Signal Generators

Permit remote tuning



For the S through K_a bands, these tuneable magnetron rf supplies consist of a modulator, an rf source, and an optional remote control unit. Pulse rates of 1000 pps and pulse widths of 1 μ sec are standard. Typical rf sources are the 2J51, tuneable from 8500 to 9600 mc with 35 kw peak power, and the 2J66, tuneable from 2840 to 2905 mc with 15 kw peak power.

California Technical Industries, Div. of Telectron, Inc., Dept. ED, 1421 Old County Rd., Belmont, Calif.

CIRCLE 83 ON READER-SERVICE CARD

Low Pass Filters

Sharp cutoff



Compact type 4 low pass filters have sharp cutoff characteristics. They cover a frequency range from 100 to 2000 mc and are supplied with TNC, BNC, and N connectors. Insertion loss is 0.4 to 0.8 db ripple in the pass band; vswr is 1.5 maximum in the pass band. Rejection slope is 40 db minimum at $1.25 \times f_c$; second harmonic is 60 db minimum; and spurious responses are 40 db minimum greater than $2 \times f_c$. Nominal impedance is 50 ohms and power handling is 15 or 50 w cw. The units weigh between 0.19 and 0.58 lb.

Maury & Associates, Dept. ED, 10373 Milliken Ave., Montclair, Calif.

CIRCLE 84 ON READER-SERVICE CARD



Grid Dip Meter

400 kc to 250 mc
range

Supplied complete or as a kit, the 710 grid dip meter covers 400 kc to 250 mc in seven overlapping ranges. Its meter movement is 500 μ a. The unit may be used to align traps and filters, as a signal or marker generator. It comes with rewound plug-in coils calibrated to $\pm 0.5\%$ accuracy.

Electronic Instrument Co., Inc., Dept. ED,
100 Northern Blvd., Long Island City, 1, N.Y.

CIRCLE 85 ON READER-SERVICE CARD

Contact Meter and Controller

Work together or apart

The C'trol combination contact meter and controller continuously limits or controls any electrical variable. The self-contained transistorized device uses no locking coils or magnetic contacts. Reset is automatic. The modular panel-mounted meter and chassis-mounted controller may be plugged together or separated.

Waters Mfg., Inc., Dept. ED, Wayland, Mass.

CIRCLE 86 ON READER-SERVICE CARD

Regulated Power Supply

Has two outputs



With 0.01% regulation and stability, model SC-32 1.5 transistorized power supply delivers two independent outputs of 0 to 32 v, 0 to 1.5 amp. Ripple is under 1 mv rms; recovery time, 0.01 sec; output impedance, 0.01 ohm.

Kepler Labs, Inc., Dept. ED, 131-38 Sanford Ave., Flushing 55, N.Y.

CIRCLE 87 ON READER-SERVICE CARD

GENERAL TRANSISTOR



QUALITY PRODUCT
FROM GENERAL TRANSISTOR.



ACTUAL SIZE

new
complete line of

GERMANIUM
GOLD BONDED DIODES

GENERAL TRANSISTOR IS NOW MAKING
GERMANIUM SUBMINIATURE GOLD
BONDED DIODES

You may be assured that this new product line has the same high quality and reliability that has made General Transistor the Fastest Growing Name in Transistors. Experienced design engineers, quality materials, proven production techniques, and strictly enforced quality controls are your guarantees.

These diodes have been designed for computer, industrial and military applications where high reliability is of prime importance. They are hermetically sealed in a glass case with tinned leads. Their rugged construction makes them resistant to humidity, shock and vibration, and impervious to extreme environmental conditions.

Write today for Bulletin GD-10 showing complete specifications, diagrams and other engineering data.



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In Canada: Desser E-E Ltd., 441 St. Francis Xavier, Montreal 1, Quebec
FOR IMMEDIATE DELIVERY FROM STOCK, CONTACT YOUR NEAREST AUTHORIZED GENERAL TRANSISTOR DISTRIBUTOR OR
GENERAL TRANSISTOR DISTRIBUTING CORP., 95-27 SUTPHIN BLVD., JAMAICA 35, NEW YORK FOR EXPORT: GENERAL
TRANSISTOR INTERNATIONAL CORP., 91-27 138TH PLACE JAMAICA 35, NEW YORK

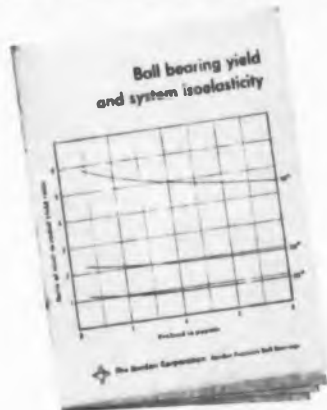
CIRCLE 88 ON READER-SERVICE CARD

91-27 138th Place
Jamaica 35, N. Y.



Barden Precision Z148 bearings specially designed for a gyro rotor

BARDEN engineers work with you creatively from design to application



Write for the Barden booklet, "Ball Bearing Yield and System Isoelasticity." An aid to application of precision instrument bearings, it offers background data on axial and radial play, axial take-up, preloading, isoelectric bearings and achievement of system isoelectricity.

To achieve system isoelectricity and minimize moment errors, gyro rotors need bearings that provide rotational accuracy, exact positioning and controlled axial and radial yield rates.

All standard *Barden Precision* bearings have the extreme accuracy required for precise radial and axial positioning. In addition, the special purpose Z148 has these important features:

Closely controlled contact angles—essential for bearing or system isoelectricity

Inner ring raceways ground in shaft—to simplify rotor design . . . reduce mating part errors . . . improve bearing alignment

One of hundreds of Barden "specials," the Z148 is an example of the results that stem from working creatively with Barden engineers from the earliest design stage.

Like all *Barden Precision* bearings, standard or special purpose, the Z148 is planned for *performance* from research and design, through quality controlled production, functional testing and application engineering.

Your product needs *Barden Precision* if it has critical requirements for accuracy, low torque or low vibration . . . if it operates at extreme temperatures or high speed.

THE BARDEN CORPORATION

47 E. Franklin St., Danbury, Connecticut • Western office: 3850 Wilshire Blvd., Los Angeles 5, California

NEW PRODUCTS

Piezoelectric Accelerometers

Ungrounded

Series AXT ungrounded piezoelectric accelerometers may be directional or tridirectional. They operate from -100 to $+525$ F with $\pm 5\%$ accuracy and $\pm 1\%$ linearity. Standard housings are titanium, aluminum can be provided.

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

CIRCLE 90 ON READER-SERVICE CARD

Filter Set

Octave band



Model 530P filter set, when attached to the company's GR150 sound level meter, permits measurements in octave bands between cps and 10 kc. The unit has built-in transistorized amplifier measuring noise to 36 db below overall noise level. A switch of the filter in and out so that set need not be disconnected from the sound level meter at any time.

Allison Labs, Dept. ED, 140 Skyline Dr., La Puente, Calif.

CIRCLE 91 ON READER-SERVICE CARD

Transistorized Power Supply

± 5 mv long term stability

Output of this transistorized power supply is 0 to 30 v at 0

CIRCLE 89 ON READER-SERVICE CARD

SPECIFY BARDEN PRECISION BALL BEARINGS FOR: INSTRUMENTS • COMPUTERS AND RECORDERS • AIRCRAFT ACCESSORIES • MACHINE TOOL AND TEXTILE SPINDLES • OTHER PRECISION APPLICATIONS



LECTROFILM* -B CAPACITORS



For Computer Applications, General Electric Announces . . .

New Lectrofilm*-B Capacitors With a Design Life of 44,000 Hrs.

Over 3,000,000 unit-hours of life test data in accordance with G-E Specification MTC-3 indicate a probability of survival in excess of 0.99 for 44,000 hour life, under rated voltage at 85 C. At 125 C, indicated probability of survival is in excess of 0.98 . . . and low unit cost means the highest order of reliability per dollar invested.

LOW FAILURE RATE AND LONG LIFE of these inexpensive G-E capacitors result from using only the highest quality materials and the closest of process controls . . . units are precision wound with high-purity aluminum foil and capacitor-grade Mylar† film dielectric. No solder is used, and introduction of contaminants through impregnation is eliminated.

SMALL, LIGHTWEIGHT ENCLOSURE consists of tape wrapped around the compact roll and sealed with epoxy resin, forming a rugged case which resists humidity, vibration and shock.

TO MEET YOUR APPLICATION REQUIREMENTS, 14 case sizes are available in five ratings—100-, 200-, 300-, 400-, and 600-volt. Capacitance range within each rating is: 0.015 to 0.68 uf in 100 volts; 0.010 to 0.47 uf in 200 volts; 0.0047 to 0.22 uf in 300 volts; 0.0033 to 0.15 uf in 400 volts; and 0.0010 to 0.10 uf in 600 volts.

GET A QUOTATION TODAY ON NEW LECTROFILM-B CAPACITORS by contacting your General Electric representative. Ask for your copy of life-test data and G-E Specification MTC-3. Or, write to Section 447-5, General Electric Co., Schenectady, N. Y.

* Trade-mark of General Electric Co.

† Registered trade-mark of DuPont Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC

amp. Long term stability is ± 5 mv; line and load regulation is ± 6 mv; and ripple is under 200 μ v. At dc, output impedance is under 0.002 ohm. At 1 mc, it is 0.1 ohm. Invar Electronics Co., Dept. ED, 1749 N. Eastern Ave., Los Angeles 32, Calif.

CIRCLE 92 ON READER-SERVICE CARD

Environment Chambers

For military and commercial equipment

For military and commercial testing, TempLine environment chambers feature high and low temperatures, and controlled humidity and altitude ranges. Work space dimensions are 15 x 21 x 15 in.; 24 x 30 x 23 in.; or 35 x 36 x 41 in.

International Test Equipment Mfg. Co., Inc., Dept. ED, 4 Manhasset Ave., Port Washington, N.Y.

CIRCLE 93 ON READER-SERVICE CARD

Static Inverter

± 2 cps frequency regulation

Model W-1348 static inverter supplies 800 cps power from nominal 28 v sources. It delivers 150 va of continuous 115 v power, amplitude regulated to 2% under all MIL-E-5272A conditions. Frequency regulation is ± 2 cps.

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

CIRCLE 94 ON READER-SERVICE CARD

RF Filter

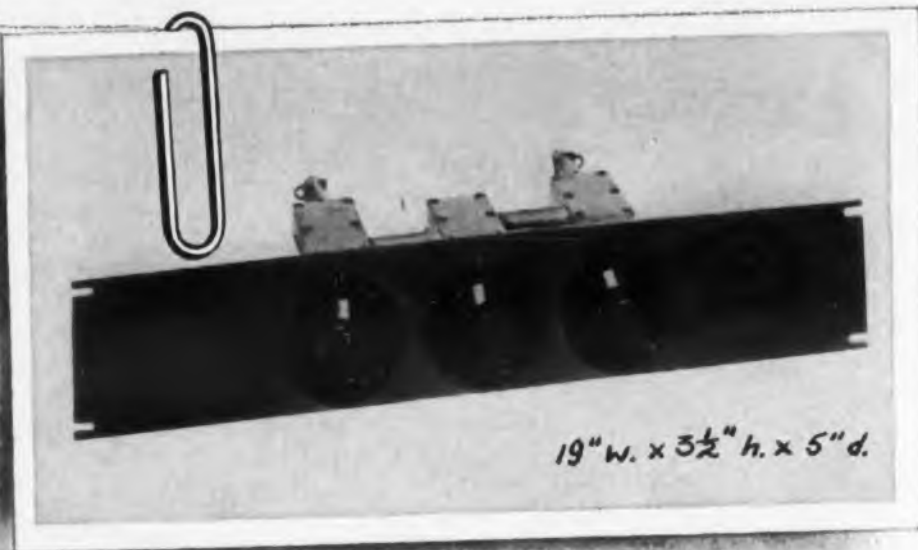
Low pass

Designed to protect uhf or vhf communication systems, model 700 low pass rf filter has a 700 mc cut-off and handles 300 w cw. Insertion loss is 0.3 db below 420 mc and 60 db from 750 to 4000 mc. Vswr is 1.3 below 420 mc in a 50 ohm system. The unit is 15 in. long; 2.5 in. in diameter.

Adams-Russell Co., Inc., Dept. ED, 292 Main St., Cambridge, Mass.

CIRCLE 95 ON READER-SERVICE CARD

CIRCLE 96 ON READER-SERVICE CARD >



Variable RF Attenuators... from DC to 500 MC

Rotary adjustable—available individually unmounted or in combinations on rack mounted panels—every production unit completely tested for insertion loss and voltage standing wave ratio—guaranteed for two years.

Read these specs!

Type	V6	V7	V8
No. Steps	5	11	11
DB/Step	10	1	0.1
Specification	0 - 50db	0 - 11db	0 - 1.1db
Freq. Range	0 - 500MC	0 - 500 MC	0 - 500MC
Overall Accuracy	.5 db at 500MC	.25 db at 500MC	.1 db at 500MC
Impedance*	50 Ω	50 Ω	50 Ω
SWR - 100 MC	1.02	1.02	1.02
SWR - 500 MC	1.2	1.2	1.2
Max. Insertion Loss DC	0	0	0
Max. Insertion Loss 100 MC	<.1db	<.1db	<.1db
Power Dissipation**	1/2 watt	1/2 watt	1/2 watt

**Note: power rating means actual power dissipated in the attenuator and varies with power input and attenuation setting.

*75 ohm units also available.

Write for complete information.

Ortho Filter Corp.

196 Albion Avenue
Paterson 2, New Jersey
MULberry 4-5858

CIRCLE 97 ON READER-SERVICE CARD

NEW PRODUCTS

Electronic Delay Timer

Plug-in



Complete in a 2 x 2-1/4 x 3-1/8 in. can, this delay timer employs a unique circuit to control the breakdown of gas tubes and provide 0.001 to 300 sec delays. Unaffected by line voltage variations, the timer needs no warmup and consumes under 2 w. It has an octal radio type plug and can be provided with an spdt or 3pdt relay. It can also be supplied to operate an external relay. The unit recycles instantly. Any number of these timers can be connected to provide a sequence of controlled intervals.

G. C. Wilson & Co., Dept. ED, Huntington, W. Va.

CIRCLE 98 ON READER-SERVICE CARD



Volt-Ohm-Milliammeter
Highly sensitive

Volt-ohm-milliammeter model 980 is an analyzer with 20 K per v dc and 1 K per v ac sensitivity. Its accuracy is 2% full scale dc, 3% ac. The unit has seven dc ranges to 4000 v, six ac ranges to 1600 v; six db ranges from -15 to +54 db; and six dc ranges to 8 amp.

Weston Instruments, Div. of Daystrom, Inc., Dept. ED, Newark 12, N.J.

CIRCLE 99 ON READER-SERVICE CARD

Transistorized Power Supply

2 amp output



This power supply has a 2 amp output over a voltage range of 0.5 to 36 v dc. Designated model 62-124, it operates continuously in temperatures up to 50 C. Regulation is 0.05% for line voltage change from 105 to 125 v, and 0.05% from no load to full load. Unit is short circuit proof and free from line transients in its output. Dressen-Barnes Corp., Dept. ED, 250 N. Vineo Ave., Pasadena, Calif.

CIRCLE 115 ON READER-SERVICE CARD

Power Converter

Output of 200 amp, 28 v

From a three phase, 400 cps, 115 or 200 v source, the W-1328 transistorized converter delivers 200 amp of 28 v rectified power. It weighs 7 lb, has a 50,000 hr life expectancy, and meets MIL-E-5272A specifications.

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

CIRCLE 116 ON READER-SERVICE CARD

Multitester

Pocket size



Furnished semi-assembled, the TK-10 pocket size multitester has five dc and five ac voltage ranges from 0 to 1000; three resistance ranges from 10 K to 1 meg; three dc current ranges from 0.5 to 250 ma; and two db ranges. Sensitivity is 20 K per v on dc and 10 K per v on ac. Lafayette Radio, Dept. ED, 165-08 Liberty Ave., Jamaica 33, N.Y.

CIRCLE 117 ON READER-SERVICE CARD

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General Instrument for Silicon



AUTOMATIC SILICON POWER RECTIFIERS



RADIO RECEPTOR SILICON DIODES

General Instrument for Germanium



RADIO RECEPTOR GERMANIUM DIODES

General Instrument for Selenium



RADIO RECEPTOR HIGH CURRENT DENSITY SELENIUM RECTIFIERS

Complete reliability, long life—along with dependable delivery and competitive prices! The General Instrument trademark assures you that these claims are valid.

Whether your requirements are for silicon power rectifiers, germanium or silicon signal diodes or selenium rectifiers, General Instrument is the *only* supplier that can meet all of your needs from a single source. Because of this, General Instrument can afford to be objective in making recommendations and you can be certain that your application will be reviewed in an unbiased manner—And that the device best suited for your needs will be offered.

The General Instrument team of semiconductor experts and its many years of production know-how assure you of superior products at competitive prices with on-time deliveries.

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AUTOMATIC MANUFACTURING DIVISION, 65 GOUVERNEUR STREET NEWARK, NEW JERSEY TELEPHONE: HUMBOLDT 5-2100

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



RADIO RECEPTOR COMPANY, INC. 240 WYTHE AVENUE BROOKLYN 11, NEW YORK TELEPHONE: EVERGREEN 8-6000

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 Francisco: Pacific Wholesale Co. • Seattle: Seattle Radio Supply • Tulsa: Oil Capitol Electronics

CIRCLE 118 ON READER-SERVICE CARD

NEW PRODUCTS

Photoheads

For electronic counters

These photoheads permit Count-Pak electronic counters to operate up to 30 in. away from a light source. They can be assembled so that jarring will not knock them out of focus.

Veeder-Root Inc., Dept. ED, 70 Sargeant St., Hartford 2, Conn.

CIRCLE 119 ON READER-SERVICE CARD

Transistorized Power Supplies

$\pm 0.25\%$ regulation

This transistorized power supply line includes plug-in units for ac to dc power supplies, dc to dc converters, dc to ac inverters, and rack-mounted and bench top dc supplies. Standard regulation is up to $\pm 0.25\%$ with a 0.05% ripple content.

Consolidated Avionics Corp., Dept. ED, Westbury, N.Y.

CIRCLE 120 ON READER-SERVICE CARD

Potentiometers

In 25 to 500 K values

Internal redesign has raised the rating of model 3 Radiohm variable resistors from 1/4 to 1/2 w. The miniature units come in values from 25 to 500 K and meet MIL-R-94B requirements.

Centralab, Div. of Globe-Union, Inc., Dept. ED, 900 E. Keefe Ave., Milwaukee 1, Wis.

CIRCLE 121 ON READER-SERVICE CARD

Input Transformers

Plug-in

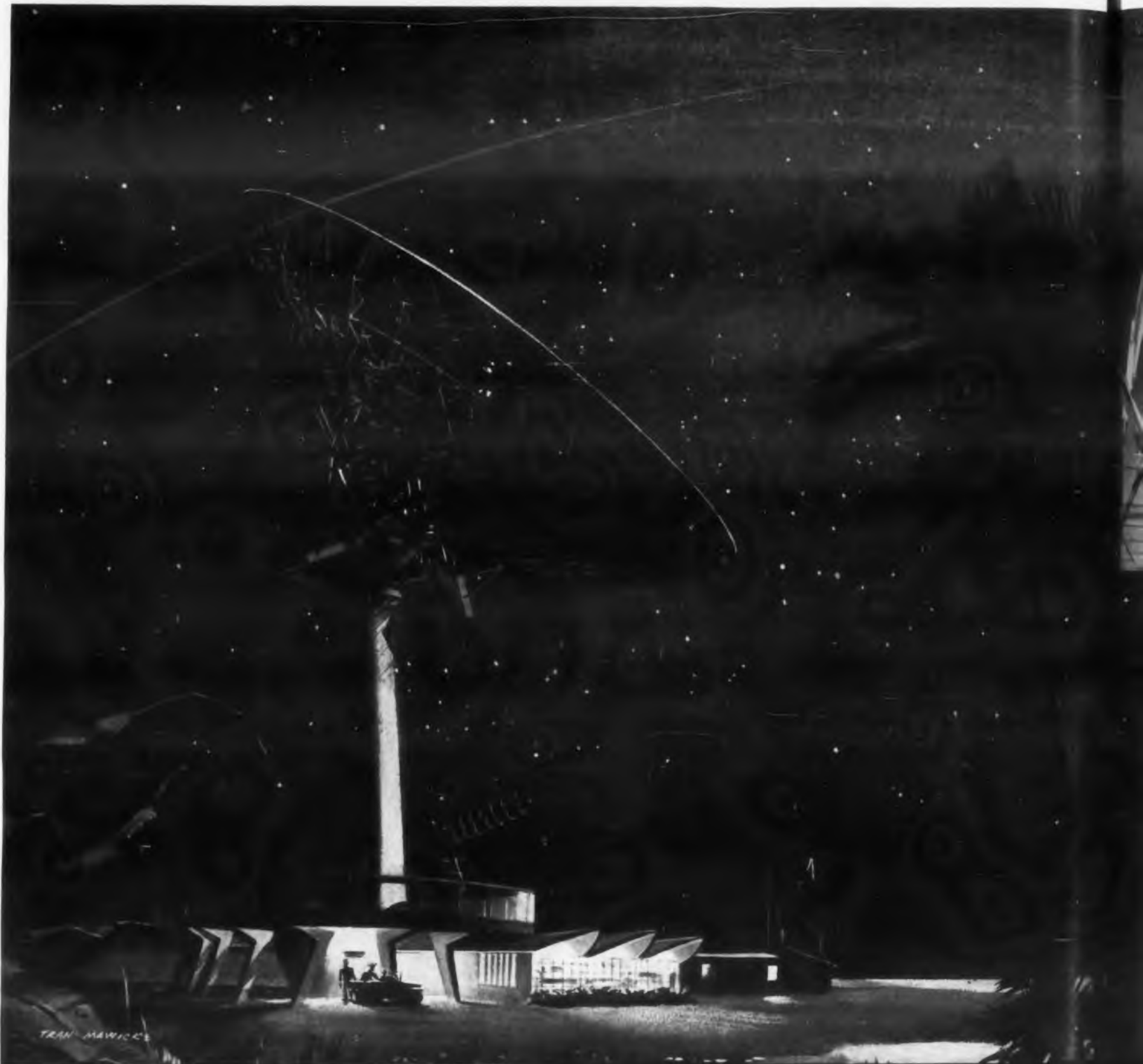
Designed to match the impedance of a microphone, pickup, or line to a high impedance amplifier, these input transformers have a frequency response of 20 cps to 20 kc ± 2 db. The plug-in units have double mu metal shielding.

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

CIRCLE 122 ON READER-SERVICE CARD

READY FOR TOMORROW'S CIRCUITS-

Only tubes can perform many difficult jobs of tomorrow's advanced systems and still give the performance, flexibility, and reliability you require. The significance of these tube advantages is increasing through General Electric's program to improve constantly such 5-Star qualities as known, predictable reliability.



GENERAL ELECTRIC 5-STAR TUBES!

ELECTRONIC TUBES are, and will remain, superior in these areas of performance:

- Proved reliability.
- VHF and UHF capability, and flexibility at these frequencies.
- One third the number of devices.
- Economy.
- Stable under ambient-temperature variations. Tolerate high temperatures.
- Low noise in wide-band RF circuits.
- High-voltage capability.
- Uniform product, with predictable performance to ratings.

This margin of superiority grows as General Electric's active program of im-

provement makes 5-Star Tubes still more efficient and reliable. Design; manufacture; test; application—every product stage from development to final use in circuits shows progress in materials, methods, or both, as illustrated and described below.

14,000 tubes, using various cathodes and cathode coatings, make up one of many tests by General Electric to help determine the specifications for future 5-Star Tubes having even better performance. Equipment designers can be sure that General Electric leadership in high-reliability tubes is being maintained and strengthened; that 5-Star types will continue to meet the challenges of advanced electronic circuitry.



PROGRESS IN DESIGN. New cathodes for G-E 5-Star Tubes reduce interface and degradation of characteristics throughout life, mean built-in reliability. 100% tube stabilizing—used only by General Electric—adds to cathode and tube dependability and long life. New glass technology gives G-E tubes greater resistance to heat.



PROGRESS IN MANUFACTURE. Ultrasonic cleaning now is used for critical tube parts. This further extends General Electric's famed SNOW WHITE technique for excluding impurities of all kinds—notably dust and lint—during 5-Star Tube manufacture...A new direct-flow coating method for tube heaters accurately centers the wire, and provides an even coating, for more uniform insulating properties.



PROGRESS IN TESTING. General Electric's new impulse test, with vibrational output measured both in peak and integrated values, promotes lower-noise tubes where shock and vibration occur. Interface life tests; 100% DC testing for shorts and opens: these are among the many checks that make 5-Star tubes constantly more reliable.

For further information, phone nearest office of the G-E Receiving Tube Department below:

EASTERN REGION
200 Main Avenue, Clifton, New Jersey
Phones: (Clifton) GRegory 3-6387
(N.Y.C.) Wlconsin 7-4065, 6, 7, 8

CENTRAL REGION
3800 North Milwaukee Avenue
Chicago 41, Illinois
Phone: SPring 7-1600

WESTERN REGION
11840 West Olympic Boulevard
Los Angeles 64, California
Phones: GRanite 9-7765; BRadshaw 2-8566

Progress Is Our Most Important Product

GENERAL  ELECTRIC

12-11-207

Beam Power Tubes

250 w plate dissipation

Capable of dissipating 250 w in the plate, these small beam power tubes are forced air cooled and designed with ceramic-metal seals. They can be operated with full ratings to 500 mc. Model 7203/4CX250B has a 6 v, 2.6 amp heater; model 7204/4X250F has a 26.5 v, 0.58 amp heater.

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

CIRCLE 470 ON READER-SERVICE CARD

Power Supplies

Provide B+, B-, bias voltages



Operating from a 400 cps power line, these miniature power supplies provide various B+, B- or bias voltages. They are sealed in an octal plug-in base.

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

CIRCLE 124 ON READER-SERVICE CARD

Impact Switch

Works in 90 μ sec

For missile and kindred speed measurement requirements, this single action impact switch has a controllable time limit range of 90 to 200 μ sec. It may be supplied in 95% nonmetallic materials. Vibration and shock resistant, it operates from -80 to +185 F.

Servonics Engineering Services Co., Inc., Dept. ED, 4645 Van Nuy Blvd., Sherman Oaks, Calif.

CIRCLE 125 ON READER-SERVICE CARD

← CIRCLE 123 ON READER-SERVICE CARD

VICTOR DIGIT-MATIC PRINTERS

Proved by over 16,000,000 printings without repairing, adjusting or cleaning!

The adding machine in the Digit-Matic has been tested with over 16,000,000 continuous printings, with no failure, no service other than periodic oiling. Forty years of experience in producing 1,500,000 adding machines—as well as precision instruments such as the Norden Bombsight—has given Victor Adding Machine Co. outstanding qualifications for producing rugged and reliable digital printers.

CHECK THESE 4 VICTOR ADVANTAGES

Reliability: Examine the rugged construction of a Victor machine. Each part is conservatively designed to provide extended life and reliability. Wearing surfaces heat treated, cyanide hardened to stand up under constant use. All steel parts cadmium plated to prevent rusting.

Immediate Service: Factory-trained servicemen (and parts) are on call in more than 725 cities coast to coast.

Flexibility: At least 500,000 different combinations available, with speeds up to 33 characters per second. With Victor Digit-Matics you have your choice of listers, accumulators, or calculators plus an almost infinite number of other variations ranging from electrical noise filters to upside-down printing.

Fast Delivery, Low Price: Because of Victor's continuous high volume of adding machine production, we can ship almost any quantity of Digit-Matics—built specifically to your order—within 30 days. Victor Digit-Matics, from only \$425.00, are the value buy in the digital printer field.



VICTOR SERIAL ENTRY DIGIT-MATIC PRINTER

10 Digit solenoids. Digits are entered in sequence with most significant digit first. Accepts digits at a rate up to 20 per second. Print cycle: listers 0.27 seconds; accumulators 0.35 seconds. Available in up to 11 column entry capacity.

COIL DATA

Voltage	21-28VDC	42-54VDC	125-160VDC
Resistance, ohms			
Digit solenoid	25.5	75.0	490.
+ or - Print solenoid	25.5	75.0	450.
Minimum on time, seconds	.02	.02	.02
Maximum on time, seconds (continuous printing)	.05	.05	.05

Minimum off time between digits—all serial entry machines—.025 seconds.



VICTOR PARALLEL ENTRY DIGIT-MATIC PRINTER

All digits 1 through 9 of each column equipped with solenoids. Digit and print command solenoids may be simultaneously energized. Print cycle:—listers 0.30 seconds; accumulators 0.35 seconds. Available in up to 10 columns entry capacity.

COIL DATA

Voltage	20-28VDC	35-56VDC	125-160VDC	105-125VAC
Resistance, ohms				
Digit solenoid	17.6	53.0	700.	125.
+ Print solenoid	17.6	89.0	375.	125.
- Print solenoid	17.6	53.0	375.	125.
Minimum on time, seconds	.020	.020	.015	.025
Maximum on time, seconds (continuous printing)	.050	.050	.035	.050

COVER REMOVED

A few popular model variations:—columnar spacing; right side of machine accumulating and left side listing data identification; Non-Add printing; Non-printing adding; MIL-I-17623 Electrical Motor Noise elimination; Induction Motors; Manual Keys over the solenoids; "digit key depressed" switch (serial entry Digit-Matics); tag and label printing; and all kinds of alphabetic and special types.



CIRCLE 126 ON READER-SERVICE CARD

Write today! Victor's electronics-trained staff will gladly help you solve any digital printing or calculating problem.

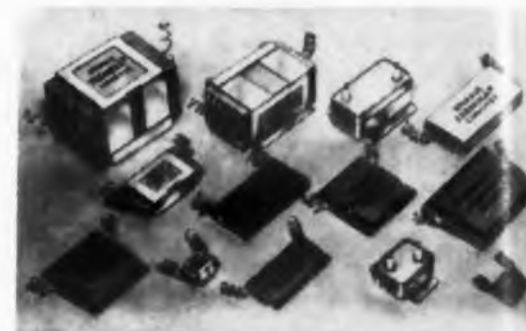
Write for technical manual No. D 12-71.

Electronics Division
VICTOR ADDING MACHINE CO.
 3900 N. Rockwell Street, Chicago 18, Ill.

NEW PRODUCTS

Stacked-Foil Capacitors

Standard ratings to 260 C



Stacked-foil Fabmika capacitors can be used in jet ignition systems, missile controls, atomic reactors, and high voltage dc power supplies. A dielectric of silicone-bonded mica paper permits them to function effectively at high temperatures. Standard units have ranges from - to +125, +165, +200, or +260 C. Special units can operate at 310 C. Radiation resistant, the capacitors are available uncased, uncased and clamped, in cast epoxy housings, or in drawn metal cases.

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

CIRCLE 127 ON READER-SERVICE CARD

Reference Resistors

Accurate within 1%



Certified accurate within 1% at a given room temperature and humidity, these improved reference resistors are available in values of 100, 10,000, 100,000, 1 million, and 10 million ohms. Designed to plug directly into any of the company's megatrometers, the instruments are supplied in a Faraday box, utilizing Teflon insulators which are encompassed by grounded guard rings. Surface leakage is virtually eliminated by silicone treatment.

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

CIRCLE 128 ON READER-SERVICE CARD

Size 8 Servo Motor

Velocity damped

Designed to replace motor generators in servo systems, model 8 VM 460 is a size 8 velocity-damped servo motor for 115 v operation. It performs damping up to 85 dyne-cm-sec per radian. It has a 0.34 gm cm² rotor inertia and 0.33 oz-in. torque produce an acceleration of 68,000 per sec². The unit has a no load speed of 100 rpm and a 3.3 w power input. It passes MIL-E-5272A tests and stands 100 g shock and 100 g vibration at 2000 cps in all major axes. Its operating range is -55 to +130 C.

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

CIRCLE 129 ON READER-SERVICE CARD



Snap Action Switch

Has safety lock

This snap action switch has a safeguard to prevent it from being moved by accident. It will not move from neutral unless the toggle handle is raised or pulled out. Particularly suited for aircraft instrument panels, the dpdt unit comes in four switching combinations: momentary, neutral, maintained; maintained, neutral, momentary; momentary, neutral, momentary; and maintained, neutral, maintained. Any or all parts of these combinations can be supplied with the lock-out feature.

Milli-Switch Corp., Dept. ED, Frankfort, Ind.

CIRCLE 130 ON READER-SERVICE CARD

Power Supply

Protected against spikes

Model 6073 transistorized power supply has built-in protection against spikes and transients. It is used for communication and navigation applications, is 3.5 in. in diameter and 6.25 in. long. It produces 70 and 100 v from 27 v dc input and operates from -40 to +80 C with 87% efficiency. Universal Transistor Products Corp., Dept. D, 17 Brooklyn Ave., Westbury, N.Y.

CIRCLE 131 ON READER-SERVICE CARD

HIGH TEMPERATURE CAPACITORS BY BENDIX

DESIGN FEATURES

Temperature Range . . . -55° to +315°C. Capacitance . . . 0.05 to 4.0 uf at 600 VDC. Voltage Range . . . 600 V to 3000 V per section. No Voltage Derating, Low Capacitance and Power Factor Variation, Environmental Resistant, Hermetically Sealed, Rugged Construction, Nonstrategic Materials, Minimum Size and Weight, High Altitude Operation.

The E-315 capacitor offers proven stability of operation over the temperature range of -55° to +315° Centigrade* with no voltage derating and low capacitance variation. Of rugged hermetically sealed construction and nonstrategic materials, this capacitor is built for high altitude and severe environmental operation.

This nonpolarized capacitor is available in a variety of sizes in a capacity range of from 0.05 to 4.0 microfarads at 600 VDC. It is also available in higher voltage ratings. Performance data and operating characteristics are given in Technical Bulletin SL-61 which is supplied upon request.

*Confirmed by qualification test of 1000 hours at 100% rated voltage over ambient temperature range of -55° to +315° C.

Now Available in Production Quantity

E-315



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

Scintilla Division

Sidney, New York

CIRCLE 132 ON READER-SERVICE CARD



new
miniature
DC RELAY
with full size contacts
TYPE Z

AVAILABLE WITH PRINTED CIRCUIT TABS

Ideal for applications requiring compactness, sensitivity, easy mounting and economy. Features full-size contacts. Can be supplied with tabs for printed circuit use. Send for details.

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CIRCLE 133 ON READER-SERVICE CARD

New ESNA CLINCH NUT HANDBOOK



Here's a brand new design manual giving full information on ESNA's line of self-locking clinch type Elastic Stop® nuts. The manual covers such points as:

- Applications
- Design Features
- New Flush mounting Types
- Insertion methods
- Correct part selection
- Plus: Materials, finishes and complete dimensional data

SEND TODAY for your copy. Write Dept. 917 Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, New Jersey.

This new flush mounting, miniature ESNA Clinch nut is easily installed by a simple flaring operation—becomes a permanent fastener.



ELASTIC STOP NUT CORPORATION OF AMERICA

CIRCLE 134 ON READER-SERVICE CARD



EVERYTHING
UNDER CONTROL
WITH THE GUARDIAN
ON-OFF
LATCHING RELAY



Design Engineers are highly enthusiastic about the positive impulse control performance of this ON-OFF Latching Relay by Guardian. It is ideally suited to positioning devices, T-V remote controls, appliances, lighting controls and applications requiring positive ON-OFF impulse control. Special armature toggle spring reverses position of cam actuator either to open, close, or transfer the snap-action switch. Unit utilizes power only on impulse or coil energization. Replaces costlier ratchet relays, conserves power, saves space, cuts costs, increases the salability of your product.

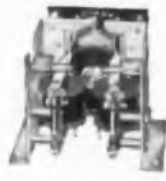
Thousands of Variations
in Guardian's Complete Stepper Line



P.E.R.
ELECTRICAL RESET
STEPPER



P.C.
CONTINUOUS ROTATION
STEPPER



R.A.S.
ADD AND SUBTRACT
STEPPER

write for details on Guardian's ON-OFF Relay
and for Stepper Bulletin P-84

GUARDIAN ELECTRIC

1622-P W. WALNUT STREET

CHICAGO 12, ILLINOIS

CIRCLE 135 ON READER-SERVICE CARD

NEW PRODUCTS

ROTARY DIAZO PRINTERS.—Blu-Ray 1959 models have improved paper feed. Cases can be quickly removed with snap fasteners.

Reproduction Engineering Corp., Dept. ED, Ivoryton, Conn.

CIRCLE 136 ON READER-SERVICE CARD

UNIVERSAL TRANSISTOR TESTER.—Model TT-1 tests npn and pnp low, medium, and high power types. Has both socket and external leads. Needs no external power connection.

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

CIRCLE 137 ON READER-SERVICE CARD

WIRING DUCT CORNER STRIP.—In 5 ft lengths easily cut to any height. Makes corners for any of the company's plastic ducts.

Panduit Corp., Dept. ED, 14461 Waverly Ave., Midlothian, Ill.

CIRCLE 138 ON READER-SERVICE CARD

TELEMETERING PRESSURE GAGE.—Single coil variable inductance gages 7/8 in. diam. and 1.3 or 1.6 in. long. Absolute, gage, and differential units in ranges from 5 to 5000 psi for use from 1.3 to 70 kc and -85 to +250 F.

Travis Instruments, Inc., Dept. ED, 1901 E. Walnut St., Pasadena, Calif.

CIRCLE 139 ON READER-SERVICE CARD

INDUSTRIAL SERVO MOTOR.—Model A Selsyn transmitter-receiver features rugged, waterproof construction. Operates from 115 v, 50 to 60 cps. Maximum torque is 2.75 oz-in.; maximum speed, 500 rpm.

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

CIRCLE 140 ON READER-SERVICE CARD

HEAVY-DUTY INDUSTRIAL THERMOCOUPLE.—PermaKouple consists of heavy protecting tube with two no. 8 B & S gage wires completely embedded in solid ceramic. Remains rigid indefinitely in temperatures to 2200 F. In standard pipe diameters of 1/2, 3/4, and 1 in.

E. C. Smith Mfg. Co., Dept. ED, Forrest and Hector Sts., Conshohocken, Pa.

CIRCLE 141 ON READER-SERVICE CARD

12 INCH CATHODE RAY TUBE.—Type SC-2558 uses electrostatic deflection, post deflection acceleration, and an aluminized P7 screen. For medical, radar, and other oscilloscope equipment.

Sylvania Electric Products Inc., Dept. ED, Seneca Falls, N.Y.

CIRCLE 142 ON READER-SERVICE CARD

RIGID VINYL WIRING DUCT.—Type O has slots instead of holes to speed installation of large lugged wires on control panels. Eliminates harness lacing or lug attachment after assembly. Snap-on cover holds all wires in place.

Taylor Electric, Inc., Dept. ED, 15400 Dale, Detroit 23, Mich.

CIRCLE 143 ON READER-SERVICE CARD

NEW from
SYSTRON!



**RMS to DC
CONVERTER**

Model 1240

Now, for the first time, laboratory standard accuracy readings of AC voltages (from 20 millivolts to 300 volts) are achieved without sluggishness, excessive loading, and non-linear scales. Model 1240 provides a precision DC output directly proportional to the TRUE RMS of an applied AC voltage regardless of the waveform of the input. Linear DC output has low impedance for meter, analog recorder, data processing system. Combined with DC digital voltmeter operates as precision AC digital voltmeter.

- True RMS regardless of waveform
- $\pm 0.1\%$ (of Reading) Accuracy
- Linear DC output
- 50 CPS to 10,000 CPS frequency response
- 0.5 second time response
- Low output impedance
- High input impedance

Price \$1,150.00

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CIRCLE 144 ON READER-SERVICE CARD



Typical
FARR-AIR
filters
now in use by
major
electronic
manufacturers

HOW MUCH AIR?
WHAT PRESSURE LOSS?
WHAT TYPE OF FILTER?
WHAT SIZE FILTER?
HOW MANY FILTERS?

How Are You Going To Solve
Your Electronic Equipment
Ventilation Problems?

Smaller components, critical heat and effective dirt removal make proper ventilation of electronic equipment most important. FARR COMPANY offers a new line of air filters for electronic components that can be specially designed to meet your needs in any size, shape, material or capacity.

More Important, Farr Engineers who are among the country's leading authorities on air filtration, offer you expert assistance in your ventilation design problems.

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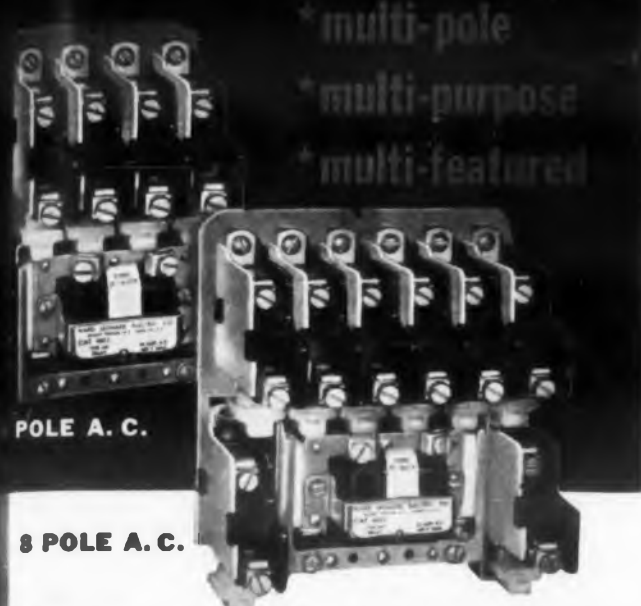
Manufacturing: Stamford, Conn. • Sales: New York, N.Y. • The City Engineering Co. Inc., New York, N.Y. • Sylvania Electric Products Inc., Seneca Falls, N.Y. • Westinghouse Electric Corp., Pittsburgh, Pa.

Originators of FARR-AIR Certified Filter Service

CIRCLE 145 ON READER-SERVICE CARD

ELECTRONIC DESIGN • December 24, 1959

HIGH-RELIABILITY RELAYS



and new, Type HR solenoid relays are Result-Engineered to function as the "heart" of any control system. Type HR is designed as a multi-pole relay for pilot-machine and process control components where long life and hi-speed operation are mandatory.

Wiping action contacts insure high electrical reliability. Nylon movable contact carriers and armature guides minimize operating friction.

Simple, fast, easy installation speeds assembly into your equipment, saves time, cuts cost. Accessible front connected coil and contact terminals equipped with pressure connectors . . . no lead lugging needed!

Four basic models, up to eight unitized poles, convertible N.O. or N.C. contacts, completely enclosed, make the HR an unusually versatile relay line.

Write for Ward Leonard Bulletin 4470. Ward Leonard Electric Co., 77 South Street, Mount Vernon, New York. (Canada: Ward Leonard of Canada Ltd., Toronto.)

ENGINEERING DATA

CONTACT RATINGS: A.C.—10 amps., 600 V. max.; D.C.—6 amps., 120 V., 1 amp., 230 V.

VOLTAGES: A.C. 110, 208-220, 440, or 550 V., 50-60 cps. D.C. for 115 or 240 V. Others on special order.

POLES: 2 to 8, in all combinations of N.O. and N.C. Contacts convertible from N.O. to N.C. and vice versa.

DIMENSIONS: Maximum, 4 pole—3 3/8" W, 5 3/4" H, 3 3/8" D. 8 pole—5 1/2" W, 5 3/4" H, 3 3/8" D. Mounting centers for all models identical.

LIVE BETTER...Electrically

WARD LEONARD ELECTRIC CO.

Result-Engineered Controls Since 1892

HISTORIC - RHEOSTATS - RELAYS - CONTROLS - DIMMERS



CIRCLE 146 ON READER-SERVICE CARD

ELECTRICAL CONTACTS.—Type 710, cold-headed directly from sintered silver-cadmium oxide wire. Conductivity of the material is 84 to 88% IACS, 6 to 12% above that of oxidized type and 15% above that of pressed and sintered type.

Judson L. Thomson Mfg. Co., Electrical Contacts Div., Dept. ED, Waltham, Mass.

CIRCLE 147 ON READER-SERVICE CARD

DUAL VOICE COIL WOOFER.—Model C-12SW, a 12 in. unit for monophonic or stereophonic use, has 1.5 lb Alnico 5 Gold Dot magnet and built-in response limiter adjustable for 700, 2500, and 5000 cps cutoff. Response: 40 to 6000 cps.

University Loudspeakers, Inc., Dept. ED, 80 S. Kensico Ave., White Plains, N.Y.

CIRCLE 148 ON READER-SERVICE CARD

AIR DRYER AND RECEIVER.—Purifies and dries air to zero dewpoint quality, then stores and delivers it. Prevents fouling, corroding, and freezing of instruments. Capacities to 8000 scfm and 6000 psig.

Van Products Co., Dept. ED, 5825 Swanville Rd., Erie, Pa.

CIRCLE 149 ON READER-SERVICE CARD

REFRIGERATED BLOWERS.—Model BR-6 holds cabinet temperature at 70 F or any preset value between 60 and 100 F. Panel-mounted unit fits standard 19 in. rack. Capacity of 6000 BTU.

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

CIRCLE 150 ON READER-SERVICE CARD

SEALED METERS.—Ruggedized, 1.5 in. square metal-cased units for electronic and aircraft equipment.

WacLine, Inc., Dept. ED, 35 S. Clair St., Dayton 2, Ohio.

CIRCLE 151 ON READER-SERVICE CARD

AUTOMATIC BATTERY CHARGERS.—Check batteries every hour; charge those that need it, disconnecting them when fully charged. For inputs to 600 v, 60 cps and 6 to 32 v batteries. Charging rate of 6 amp.

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

CIRCLE 152 ON READER-SERVICE CARD

POTENTIOMETER TESTER.—Model PC-15 uses 10-turn master potentiometer to check 1, 3, 10, and 15-turn units with respective accuracies of 0.01, 0.005, 0.002, and 0.003%.

Analogue Controls, Inc., Dept. ED, 39 Roselle St., Mineola, N.Y.

CIRCLE 153 ON READER-SERVICE CARD

BROADBAND VHF ANTENNA.—CV-3 system has eight vertically polarized corner reflector elements placed two wide and four high. Uses tropo scatter propagation; covers 90 to 160 mc range without adjustment. Gain of 19 to 21 db.

All Products Co., Dept. ED, Box 110, Mineral Wells, Tex.

CIRCLE 154 ON READER-SERVICE CARD

put your finger on

PROFIT



This magnified minuscule electrical part is another Advance Stamping which saved production costs.

Yes—bigger profits from smaller parts are very possible when you engineer in Stampings—especially *Advance Stampings*. As Specialists in Small Stampings, Advance has been helping metal working industries of various kinds attain higher production at lower cost for over 35 years.



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12023 Dixie Ave., Detroit 39, Michigan

CIRCLE 155 ON READER-SERVICE CARD

OVER 100 DIFFERENT COAXIAL CABLES TO CHOOSE FROM!

Many approved types
... many in stock

Also... TEFLON MINIATURE
COMMUNITY TV
AND METALLIC SHEATH

RG TYPE COAXIAL CABLE Teflon* Dielectric														
Military Number RG-u	Plastoid Part Number	V.P. %	Cap. Mmfd. /ft.	Max. Oper. Volts	Nom. Imp. Ohms	Armor O.D.	Jacket		Teflon Tape		Shields		Dielect. O.D.	Center Cond.
							Outer	Inner	Outer	Inner	Outer	Inner		
87A	4690													
RG TYPE COAXIAL CABLE - Polyethylene Dielectric														
Military Number RG-u	Plastoid Part Number	V.P. %	Cap. Mmfd. /ft.	Max. Oper. Volts RMS	Nominal Imp. Ohms	Armor O.D.	Jacket O.D.	Type Jacket	Shields		Dielect. O.D.	Center Cond.	Applicable Spec.	
									Outer	Inner				
54A	4640	65.9	26.5	3000	58.0		.250	III		TC	.178	7x .0152C	JAN-C-17A	
55	4641	65.9	28.5	1900	53.5		.206	III	TC	TC	.116	1x .0320C	JAN-C-17A	
55A	4684	65.9	30.5	1900	50.0		.216	IIa	SC	SC	.116	1x .0355C	MIL -C-17B	
58	4644	65.9	28.5	1900	53.5		.195	I		TC	.116	1x .0320C	JAN-C-17A	
58A	4645	65.9	28.5	1900	52.0		.195	I		TC	.116	19x .0066TC	JAN-C-17A	
58B	4646	65.9	28.5	1900	53.5		.195	IIa		TC	.116	1x .0320C	MIL -C-17B	
58C	4647	65.9	30.5	1900	50.0		.195	IIa		TC	.116	19x .0071TC	MIL -C-17B	
59	423	65.9	21.0	2300	73.0		.242	I		C				
59A	4649	65.9	20.5	2300	75.0		.242	IIa		C				
62	4650	84.0	13.5	750	93.0		.242	I		C				
62A	4651	84.0	13.5	750	93.0		.242	IIa		C				
63	4652	84.0	10.0	1000	125.0		.405	I		C				
63B	4653	84.0	10.0	1000	125.0		.405	IIa		C				
71	4654	84.0	13.5	750	93.0									

For years we have been meeting the requirements of U. S. government agencies for both defense and peacetime needs, as well as supplying major aircraft, missile, electronic controls, computer manufacturers and the communication field.

These vital industries rely on Synkote to supply sure-performing, long-lasting, high quality wire and cable of every type and description and meeting the most rigid specifications. Our varied coaxial constructions are an indication of our versatility.

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SPECIFY *Synkote* FOR SURE PERFORMANCE

CIRCLE 156 ON READER-SERVICE CARD

NEW PRODUCTS

INERTIA DAMPED SERVO MOTOR.—Standard model 8 IM 460 permits use of a rotor with as little as 0.34 gm cm² inertia. Flywheel damping is 52 dyne-cm-sec/rad. Power input. 3.3 w per phase. No load speed: 6000 rpm.

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

CIRCLE 157 ON READER-SERVICE CARD

POTENTIOMETER.—Improved model 215 Resistor carbon Trimpot is rated 0.25 w at 70 C, stands 1 1/4 x 5/16 x 1-1/4 in. and meets MIL-STD-202 specifications. Mean diameter.

Bourns Labs, Inc., Dept. ED, P.O. Box 220, Riverside, Calif.

CIRCLE 158 ON READER-SERVICE CARD

TV I-F PENTODES.—Sharp cut-off units with 100 umho transconductance. Types 3DK6 and 4DK6 are 3 and 4 v versions heater warmup controlled series-string operation. Type 6DK6 is for parallel operation.

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

CIRCLE 159 ON READER-SERVICE CARD

INDUSTRIAL HANDLES.—Round wire type adaptable to any electronic chassis, relay rack, or cabinet. Series 600 have female thread and bushing; series 700 have male thread.

Grant Pulley & Hardware Corp., Dept. ED, 100 St., West Nyack, N.Y.

CIRCLE 160 ON READER-SERVICE CARD

PLUG AND JACK.—Combination 2317 allows patch backing of patch work panels and additional patching. Mates with the company's 2201-2 plug. For terminal boards from 0.087 to 0.214 in. thick.

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

CIRCLE 161 ON READER-SERVICE CARD

LIGHT SOURCES AND PHOTOUNITS.—Miniature electric eyes designed for use with the company's IRC-5 control relay.

ESS Instrument Co., Dept. ED, 96 S. Washington Ave., Bergenfield, N.J.

CIRCLE 162 ON READER-SERVICE CARD

TIME DELAY RELAY.—Type TDS provides delay from 0.2 sec. Coil resistance for 26.5 v dc operation is 425 ohms. Dpdt contacts rated 5 amp at 26.5 v or 115 v ac. Weighs 5 oz.

E. V. Naybor Labs, Inc., Dept. ED, 26 Manhattan Blvd., Port Washington, N.Y.

CIRCLE 163 ON READER-SERVICE CARD

PRESSURE-SENSITIVE TAPES AND SYMBOLS.—For printed circuit master layouts. Tapes are 1/2 to 2 in. wide ±0.002 in. Symbols are precision cut.

Chart-Pak, Inc., Dept. ED, 1 River Rd., Lee, Mass.

CIRCLE 164 ON READER-SERVICE CARD

PRESSURE CONTROL.—Model PE-103 for wind tunnel applications. Acts like 30pst switch: cuts off 30 pressure lines in one position; connects 30 input lines to 30 output lines in the other. For any pressure to 125 psig.

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

CIRCLE 165 ON READER-SERVICE CARD

STEPPING SWITCHES.—Plug-in base with removable cover has been added to type 11 spring driven switches. Bases have three 16 or 36-pin Amphenol plugs, or two 54-pin Elco plugs.

C. P. Clare & Co., Dept. ED, 3101 Pratt Blvd., Chicago 45, Ill.

CIRCLE 166 ON READER-SERVICE CARD

PRESS-ON NAMEPLATES.—Furnished in any commercial metal from 0.003 to 0.006 in. thick. Suited for panel and dial facings. Wide choice of colors, sizes, and shapes.

The Dickey-Grabler Co., Dept. ED, 10302 Madison Ave., Cleveland 2, Ohio.

CIRCLE 167 ON READER-SERVICE CARD

RECTANGULAR CATHODE RAY TUBE.—Improved 3 in. type 3XP has 20% more distortion free usable screen area. Available with P1, P2, P5, P7, and P11 phosphors.

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

CIRCLE 168 ON READER-SERVICE CARD

PHENOLIC INSULATOR.—Impact-resistant type BI-1000 has Bakelite insulator body and steel cadmium plated base which may be obtained separately. Meets MIL-P-14B-Type CFG requirements.

Electric Machinery Mfg. Co., Mullenbach Div., Dept. ED, 2100 E. 27th St., Los Angeles 58, Calif.

CIRCLE 169 ON READER-SERVICE CARD

JACK.—Model 2515 for tight patch work. Compression spring used with floating key provides permanent gripping power. For plugs with 0.062 in. pin diameter and panels from 1/32 to 3/16 in. Has solder terminal.

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

CIRCLE 170 ON READER-SERVICE CARD

PULSE DELAY UNIT.—Step variable delays of 5, 10, 15, 25, 50, and 100 msec. For matched use in pulse systems using RG 63/U cable. Characteristic impedance of 125 ohms.

Electrical and Physical Instrument Corp., Dept. ED, 42-19 27th St., Long Island City 1, N.Y.

CIRCLE 171 ON READER-SERVICE CARD

AUTOMATIC IMPEDANCE PLOTTER.—Portable or rack-mounted units present continuous data on unknown rf impedance. Trace 60 points per sec on a Smith chart. Frequency ranges: 2.5 to 250 mc, 30 to 400 mc, 180 to 1100 mc.

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

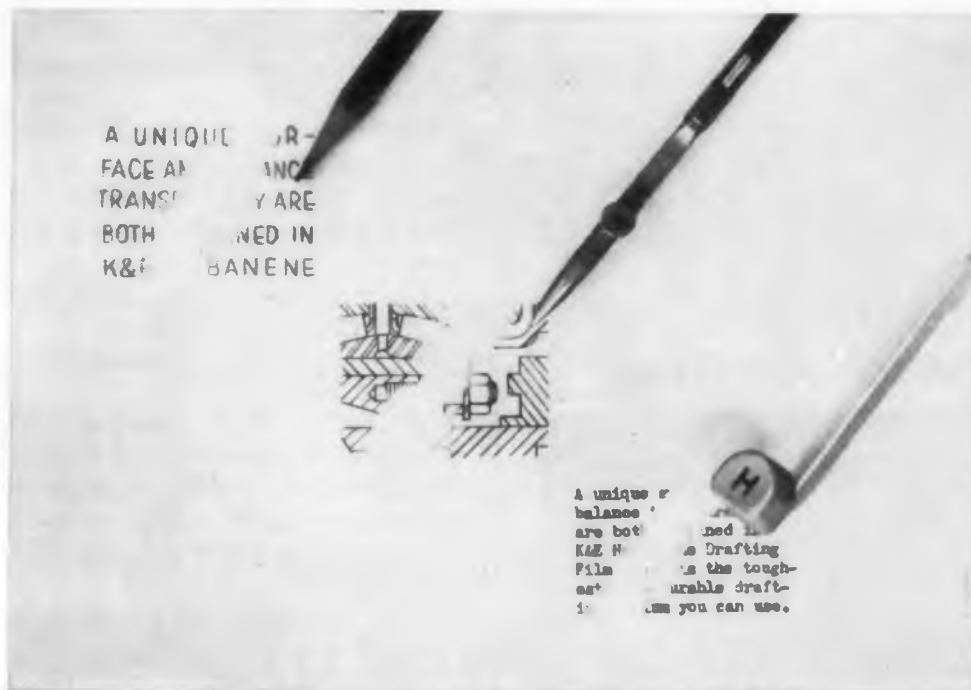
CIRCLE 172 ON READER-SERVICE CARD

Some Ideas

for your file of practical information on drafting and reproduction

from

KEUFFEL & ESSER CO.



Now you see it . . . now you don't. Pencil, ink and typing all register sharply, erase completely on the K&E "engineered surface."

The K&E "Engineered Surface"

All K&E paper, cloth and film has one extremely individual characteristic. It's what K&E calls its "engineered surface" . . . a unique surface designed and applied by K&E, right in its own plant, to every roll and sheet of prepared tracing paper, cloth and film. It means controlled drafting qualities far beyond anything the base material alone can normally provide, with a surface tooth that's exactly right and uniform. Whatever's penciled, inked or typed onto it goes on crisply and sharply . . . shows up clearly and stays that way. Furthermore, the "engineered surface" lets you erase if you want to, easily and quickly and without any of those leftover ghost lines that drive you crazy when they show up in reproductions. And remember, only with K&E do you get all the advantages of an "engineered surface," no matter which paper, cloth or film you're interested in.

About HERCULENE (TM)

The Newest of Films

Frankly, we think K&E Herculene Drafting Film is a real discovery. It has all the properties of the K&E "engineered surface" . . . exceptional "take," adhesion and erasability . . . plus the toughness and durability of its Mylar® base. What's the latter? It's a polyester film, developed by DuPont, that's uncommonly strong and virtually indestructible . . . waterproof and almost immune to the effects of age, heat, ultraviolet exposure and handling. With our K&E "engineered surface" added, it becomes K&E Herculene Drafting Film . . .

the toughest, most durable drafting medium yet to reach the drafting room. And the surface will last indefinitely, without flaking off or chipping off.

Some Points About Paper . . .

K&E Albanene® Tracing Paper is the largest selling tracing paper in the world today. Why? Because Albanene is the *only* prepared tracing paper which has an "engineered surface." All other brands depend for their pencil tooth solely on the natural surface texture of the paper itself, which varies from fine to coarse . . . often on the same sheet.

Albanene invariably gives you sharp, clear pencil lines, superb reproductions. It has a solid transparentizer that is chemically stable and can't leak out, ever. This permanent transparentizing means that you'll never get white, opaque spots, even from contact with drafting tape. Try the drafting tape test yourself.

. . . and its package

And now, all Albanene paper in rolls is packaged in the new square carton for better protection and easier storage. Your rolls stay neat and clean while in use, and the cartons will do double duty in helping you to store finished tracings. In fact, some companies are rearranging their filing systems by using Albanene cartons, which hold large numbers of rolled-up drawings and stack simply and neatly.

Some Facts About Cloth

When you want cloth, think first of K&E Phoenix® Tracing Cloth. Besides the K&E "engineered surface" with the superb "take", adhesion and erasability for pencil, ink or typing, K&E Phoenix has all the advantages of a water-resistant, chemically-inert coating that won't soften even under high heat and won't discolor, become brittle or flake off the base. You can even clean both sides with a damp cloth, without worrying about moisture stains.

And Some Tips On Erasing

All K&E drafting media give you excellent erasability, but there's a right way to erase on each one. On cloth and film, harsh, gritty erasers can destroy the surface. You'll get the best results with plastic erasers, such as the Richard Best "Tad" and the Eberhard Faber "Race Kleen." Moisten them for removing ink and stubborn typing; use them as they are for removing pencil lines. Large areas of ink can be removed completely without damage by using a moist cloth and Bon Ami cleanser. On Albanene, electric erasing machines are fine if used with a soft eraser.

The Choice Is Up To You

When it comes to selecting K&E paper, cloth or film for the job at hand, we have to leave the choice to you. We're not being indecisive . . . it's just that you're the only one who knows the particular problem you have and which product solves it best. But remember . . . K&E has a *complete* line of paper, cloth and film . . . and only K&E puts a special "engineered surface" on all three media to provide a well-balanced, uniform surface suited to the base material.

KEUFFEL & ESSER CO., Dept. ED-12, Hoboken, N. J.

Please send me more information and samples on the following:

K&E Herculene K&E Albanene K&E Phoenix

Name & Title _____

Company & Address _____

CIRCLE 173 ON READER-SERVICE CARD

NEW . . . FROM **api** THE PANEL METER WITH THE BUILT-IN



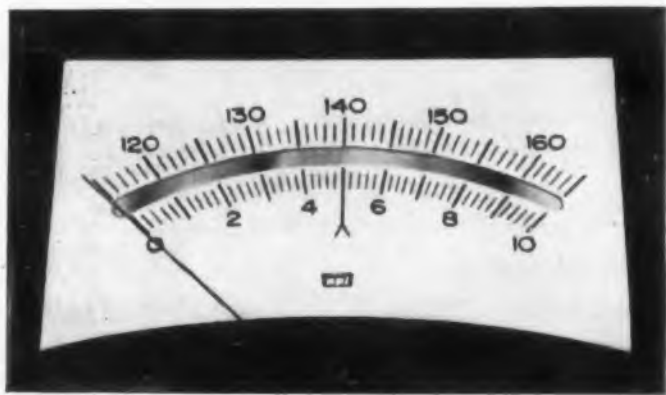
NATURAL READING ANGLE



Here is the newest, freshest meter styling idea in years: The A.P.I. Model 561 . . . the slim, trim panel meter with the longer, larger dial you read like a book. Subtly recessed and correctly sloped at the natural reading angle, this meter gives you 30% more dial area in 15% less panel space. Back-of-panel mounting neatly conceals the meter movement; only the clean, crisp façade of the dial is exposed, a clear picture window.

Installation is easier done than said. The 5" x 2 7/8" case frame is self-trimming, requires a simple panel cutout—no holes to drill, no stud alignment troubles. A window in the meter case provides for dial illumination; you can save a bit of work (and panel space) by using the dial light as a pilot.

For the man who needs a smaller meter, there's the Model 361, an identical but diminutive companion to the Model 561. It measures just 3 1/2" x 2". Both models are molded of satin-finish Bakelite, and both can be had in ranges of 0-5 microamperes to 0-50 amperes or 0-5 millivolts to 0-500 volts.



MORE INFORMATION? SEND FOR DATA SHEET 10-A



ASSEMBLY PRODUCTS, INC.
Chesterland 16, Ohio

CIRCLE 174 ON READER-SERVICE CARD

S.A. 1857

NEW PRODUCTS

SPECIALIZED AIR CONDITIONER.—Model BOMO controls temperature and humidity in mobile vans that house electronic systems used to compute aircraft flight paths. Suspends beneath van floor.

Ellis and Watts Products, Inc., Dept. ED, Cincinnati 36, Ohio.

CIRCLE 175 ON READER-SERVICE CARD

PRECISION GEAR HEADS.—Size 11 units for use with standard BuOrd MK 14 Mod. 2 servo motors. Can be provided with adapters for use with other than size 11 motors and systems. Pass MIL-E-5272A tests.

Fae Instrument Corp., Dept. ED, 42-61 Hunter St., Long Island City 1, N.Y.

CIRCLE 176 ON READER-SERVICE CARD

ELECTRIC COUNTER.—Model CE-800 for dc or any standard voltage to 230 v ac, 25, 40, or 60 cps. Available with six digits, knob or key reset. Rated at 1000 counts per minute.

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

CIRCLE 177 ON READER-SERVICE CARD

FOOT, KNEE, OR ELBOW SWITCH.—Actuates electric counters, production equipment, and other electrically operated mechanisms. Switches 3/4 hp loads at 115 v ac.

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

CIRCLE 178 ON READER-SERVICE CARD

CERAMIC COIL FORM.—Type 2500, for printed circuitry, has independently tunable primary and secondary windings. Threaded to accept tuning cores supplied for four ranges between 1 and 150 mc.

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

CIRCLE 179 ON READER-SERVICE CARD

BATTERY CHARGER POWER UNITS.—Provide economical power; can deliver current peaks up to 10 times rated capacity of the batteries. Built-in charger keeps batteries fully charged at all times.

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

CIRCLE 180 ON READER-SERVICE CARD

VARIABLE SPEED DRIVE.—Servotran drive for automatic control systems now has accurately calibrated dial for precision manual speed adjustment. Calibrations may be for 180 deg rotation forward and reverse, or for 360 deg in one direction.

Humphrey, Inc., Humphrey Products Div., Dept. ED, 3794 Rosecrans St., San Diego 10, Calif.

CIRCLE 181 ON READER-SERVICE CARD

NEON PILOT LIGHT.—Extends less than 7/8 in. behind panel, mounts in single 1/2 in. hole. U/L and CSA approved.

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

CIRCLE 182 ON READER-SERVICE CARD



TEST
INSTRUMENTS
for

LABORATORY/PRODUCTION
FIELD TESTING

measure
microwave power
directly, quickly,
accurately



TRANSISTORIZED POWER BRIDGE

The AIL Type 50 R-F Power Bridge applies the most advanced transistor circuitry techniques to power measurements in the 10-40,000 MC range. Full scale ranges of 1.0 and 10 milliwatts and plus and minus 10dbm are provided. Accuracy within 0.5 db.

Compact—battery operated—weighs less than 4 pounds—hand held—ideal for field applications.

Each Type 50 is carefully checked and tested under the rigid AIL quality control system assuring highest reliability for a variety of applications in:

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FORCED CONVECTION CABINET OVENS.—Cyclo-Flow series OH horizontal flow and OV vertical flow units with ranges to 500, 650, 850, and 1000 F.

L & L Mfg. Co., Dept. ED, 136 Eighth St., Upland, Delaware Co., Pa.

CIRCLE 183 ON READER-SERVICE CARD

KLYSTRON TRANSMITTER.—Model 50T operates over 225 to 400 mc band, produces 18 kw of cw power and 50 kw of peak power at maximum duty cycle of 0.4. Uses Eimac X590 klystron with 40 db power gain.

Levinthal Electronic Products, Inc., Dept. ED, Stanford Industrial Park, Palo Alto, Calif.

CIRCLE 184 ON READER-SERVICE CARD

PNEUMATIC PRESSURE SWITCH.—Miniature model 610 for gage pressure, 617 for differential. Operate from 0 to 30 psi, —55 to +160 F. Units are 1.5 in. in diameter, 2 in. long.

Meletron Corp., Dept. ED, 950 N. Highland Ave., Los Angeles 38, Calif.

CIRCLE 185 ON READER-SERVICE CARD

PRECISION PRESSURE SWITCH.—Consists of a contactor manometer and a relay-power supply package. Has make or break control sensitivity of 0.005 in. of water. Senses pressure increments of 0.003 oz per sq in.

Meriam Instrument Co., Dept. ED, 10768 Madison Ave., Cleveland 2, Ohio.

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PRECISION THERMOSTATS.—Klixon M201 fixed setting, snap acting temperature controls in several ac and dc ratings. Units are 5/8 in. diam, weigh 4 g. Shock and vibration resistant.

Metals & Controls Corp., Spencer Thermostat Div., Dept. ED, Attleboro, Mass.

CIRCLE 187 ON READER-SERVICE CARD

HIGH TEMPERATURE RESISTOR RIBBON—26A Thermal-Ribbon for temperature measurement and control applications to 260 C. Measures 0.02 x 0.5 x 1/4 in. Sticks to irregular surfaces.

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

CIRCLE 188 ON READER-SERVICE CARD

POWER RELAY.—Type R310 for switching high currents. Rated 10 amp, 125 or 250 v ac, 30 v dc, inductive. Nominal coil resistance for 26.5 v dc; 300 ohms. Weight: 3 oz.

E. V. Naybor Labs, Inc., Dept. ED, 26 Manorhaven Blvd., Port Washington, N.Y.

CIRCLE 189 ON READER-SERVICE CARD

MAGNETIC TAPE HEAD.—Stereophonic model TLD-L records and reproduces frequencies from 10 cps to 15 kc at tape speed of 3.75 in. per sec. Has laminated pole pieces. In four impedances from 100 to 1 h.

The Nortronics Co., Inc., Dept. ED, 1015 S. Sixth St., Minneapolis 4, Minn.

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NEW 400 cycle DEVR

eliminates distortion



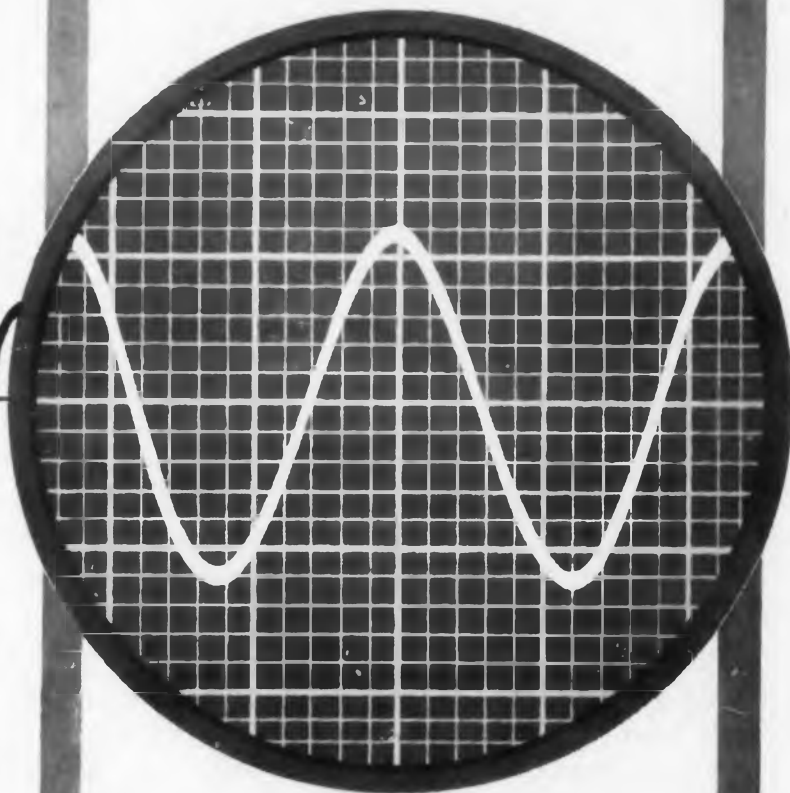
regulates voltage

Distortion Eliminating Voltage Regulator responds to transient surges and harmonics, as well as to normal variations caused by line and load changes. The Curtiss-Wright Model 104 DEVR corrects for any deviations of up to 20% from pure sine wave, regardless of their nature, in less than 125 microseconds.

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The DEVR is also available in 60 cps model.



SIMULTANEOUSLY AVAILABLE

- 1.4 KVA regulation $\pm 1\%$ electronically
response 125 microseconds
distortion elimination to less than 0.3%
- 4 KVA regulation $\pm 1\%$ electro-mechanically
response 20 V/sec

ELECTRONICS DIVISION

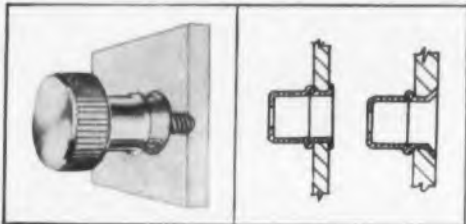
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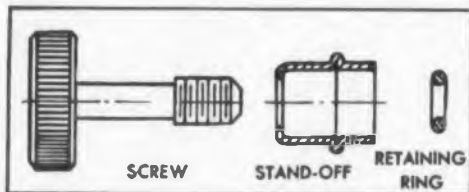
SELECT CLOSURE HARDWARE TO IMPROVE UTILITY, APPEARANCE, AND TO LOWER COST

QUICKLY INSTALLED SOUTHCO CAPTIVE PANEL SCREWS END MISALIGNMENT PROBLEM . . .



Simplicity of design contributes to clean, distinctive appearance and fast, low-cost installation. Stand-off is slipped into panel hole and secured by flaring. Screw is passed through stand-off and made captive by vinyl o-ring.

"Floating" screw design eliminates costly close tolerance manufacture and permits easy engagement regardless of panel distortion encountered under adverse use conditions.



SPECIFICATIONS

Material: Screw is brass, chrome plated; can be supplied in stainless steel. O-ring is vinyl plastic.
Overall length of screw: 1 3/16"
Depth of screw head: 1/4"

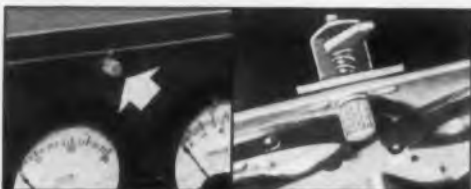
Sizes:

SCREW HEAD DIAMETER	THREAD SIZE
3/4"	1/4-20
5/8"	1/4-20, 12-24
3/8"	10-24, 10-32

Length of thread: 3/8"

Screw head is supplied plain, as shown, or slotted for screw driver.

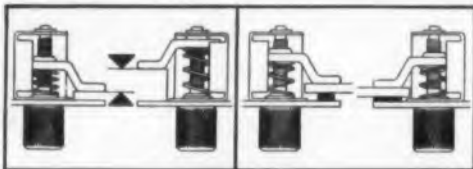
PRE-ASSEMBLED PAWL ADJUSTS TO DESIRED THICKNESS AND PRESSURE



This neat, compact Southco panel and door fastener is supplied assembled, requires but two rivets or bolts for low cost installation. It is available in three models—large, intermediate and midget.

The unique feature of Southco Pawl Fasteners is the fact that, by merely turning the knob, the pawl is adjusted to a wide range of frame thicknesses. This assures a tight grip without precision setting regardless of variations in frame or door dimensions or changes that are produced by wear or warping of sheets.

Pressure exerted by the pawl on the frame is controlled in the same way, by merely turning the knob. Against gasketed frames, pressure can be easily applied to compress the gasket.



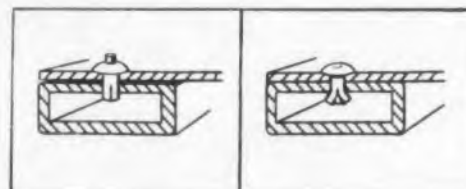
SPECIFICATIONS

Knob: Cadmium or chromium plated steel.

Head Styles: Protruding ribbed or knurled knob; flush screw driver slotted for large size only.

	LARGE	INTERMEDIATE	MIDGET
Knob diameter	7/8"	3/4"	1 1/2"
Total width	2 1/2"	1 3/4"	1 1/2"
Total height	1 3/8"	7/8"	3 3/4"
Back of panel depth	1 3/32"	1 1/4"	7/8"
Knob length	1 1/8"	1 3/16"	3/2"

FAST, HAMMER- DRIVEN BLIND RIVETS CUT INSTALLATION TIME



You "hit-the-pin" and the rivet's in. No special tools to limit production or require maintenance, no bucking, no finishing. For blind or open applications, Southco Drive Rivets save time, reduce costs.

Automatic "pull-up" action assures uniform, tight grip.

Southco Rivets are made of aluminum or cadmium plated steel with cadmium plated or stainless steel pins. Diameters are from 1/8" to 1/4", grip range is from 1/16" to 3/8".

Increased widespread use is due to low installed cost and elimination of down time and maintenance associated with fasteners requiring special tools.

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IDEAS FOR DESIGN



Engineer-teacher E. W. Berry uses the Contour Portable photocopier to make copies directly from bound volume.

Contour Following Photocopier Rides On Air

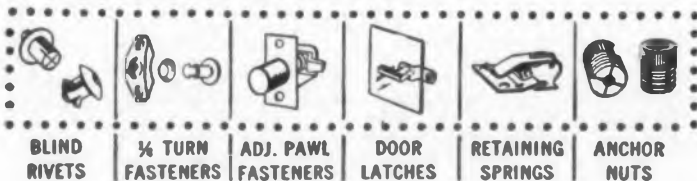
This portable photocopier can make direct copies of pages from books or magazines right to the margin—and without harming the binding. It follows the contour of a page in a volume by virtue of its inflatable plastic air cushion. The copier, placed face down on a page, makes copy in 30 seconds.

Manufactured by F. G. Ludwig, Inc., 28 Coulter St., Old Saybrook, Conn., the Contour Portable copies anything written, printed, drawn in any color. It makes crisp black and white copies.

Good, clean copies can even be made of overlays and paste-up jobs without showing Scotch tape marks.

Transistorized Driver for Medium and High Impedance Crystals

We needed a single oscillator to drive crystals in the 300 to 500 kc range and in the 1000 to 1600 kc range. Crystal characteristics dictated the use of CT or DT cut crystals for the lower frequency operation and AT cut crystals for the higher frequencies. Series-resonance crystals were chosen for the desired high frequency stability. With oven control, our final circuit

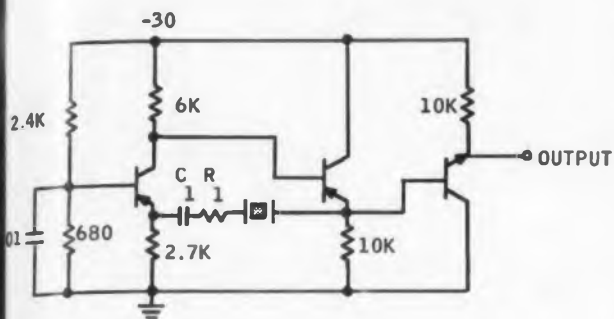


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LION

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transistorized crystal driver works with medium high impedance crystals.

provided a stability of 0.0005 per cent over a deg C temperature variation.

We found the best circuit for the job was a transistorized Butler oscillator. It has a common collector amplifier driving the series-resonance crystals, and a common base amplifier to provide the voltage gain necessary for the unity loop gain required for oscillation.

Since there is no Miller effect in either stage, one can operate in the megacycle region without high frequency transistors. Since the common collector stage has a low output impedance and the common base stage has low input impedance, a constant current drive results, since the crystal impedance is much higher than the common base input impedance.

A resistor in series with the crystal keeps internal heating down and increases stability. Its value is determined experimentally as different crystal impedances are used in the circuit.

The output frequency can be trimmed by changing the value of C_1 . In the case of AT cut crystals, a variation of several hundred cycles can be achieved.

Max Liang, Electronics Engineer, Consolidated Electrodynamics Corp., Pasadena, Calif.

Battery Saver

Some people drive to work early in the morning, then leave their lights on in the parking lot. (Not a technical problem, but a very practical one.)

The solution to this problem is a simple one. Put a small warning light in series with a diode between the taillight contact and the ignition wire in such a way that the bulb will light when lights are on and the key off, but not vice versa. The small current through the bulb does not interfere with normal operation of either circuit. The same circuit without the diode would also warn you to turn lights on at nightfall.

Robert W. Blanchard, Sr. Engineer, Federal Telecommunication Labs., Nutley, N. J.

GLOBE SPECIAL ACTUATORS / FROM STOCK PARTS

Globe Industries designs and builds rotary and linear actuators to your specifications . . . custom units can be in your hands quickly. Moreover, if required, Globe can deliver the correct precision motor and planetary gear reducer in 2 weeks if you want to breadboard the actuator first.

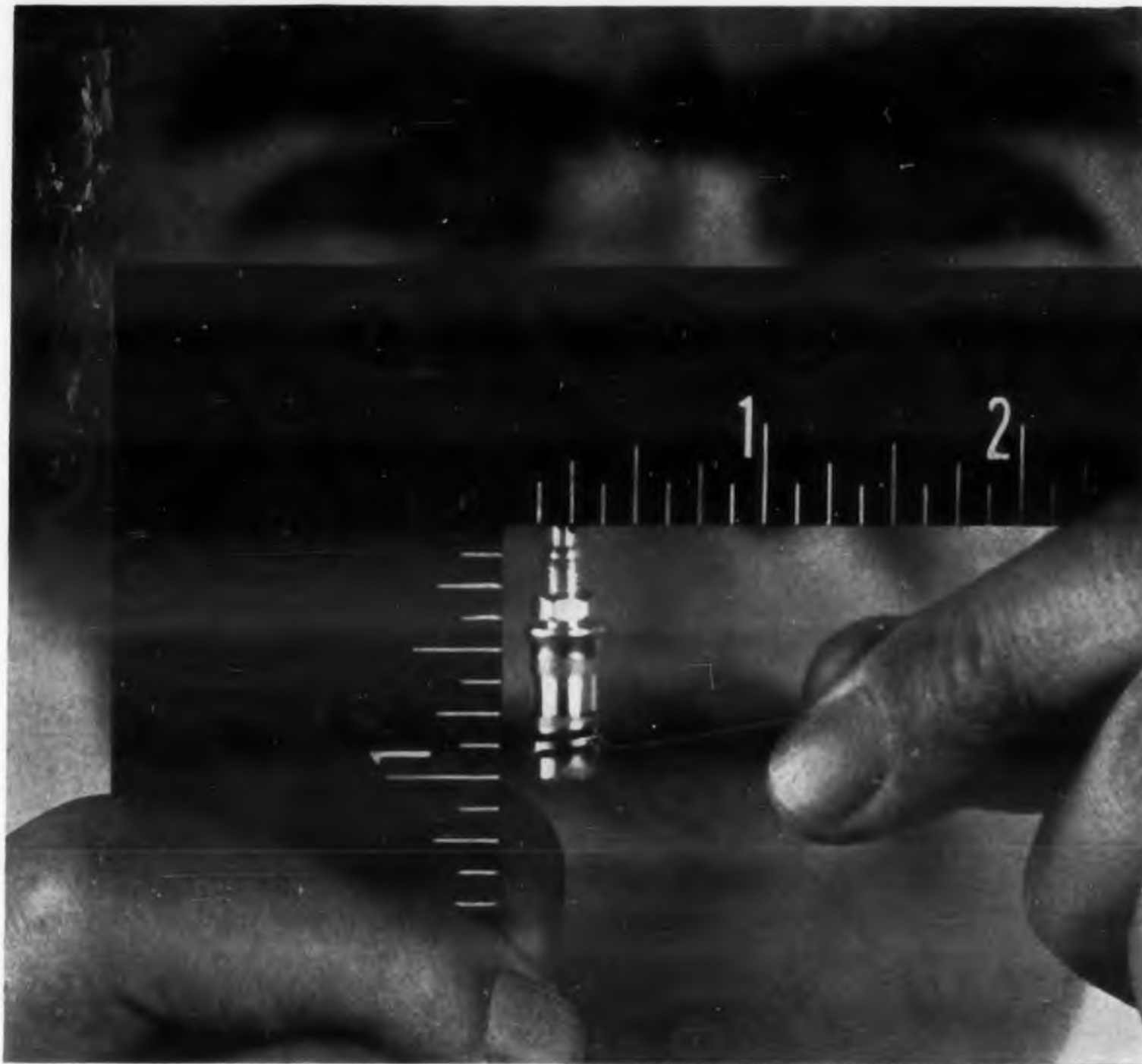
Specific reason for fast delivery and low cost—Globe builds actuators in many standard sizes; into the protective housing can go any of 10 different frame size motors with literally hundreds of standard windings. Hundreds of gear reducers are stocked or readily available, as are components for governors, switches, relays, potentiometers and other take-off and control elements. Our special engineering group quickly puts these standard components together to meet your prototype requirements. Intermittent torques to 2500 in. oz. (150 in. lb.)

Write for Bulletin 2000. Please outline your actuator needs for an engineering recommendation. Globe also makes precision timers, gyros, stepper motors, blowers and fans, servos, clutches and motorized devices. GLOBE INDUSTRIES, INC., 1784 Stanley Avenue, Dayton 4, Ohio.



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Another new miniature from Corning...

1 to 8 ufd direct traverse trimmer capacitor

Small but still precise, this new Corning direct traverse type trimmer capacitor meets military as well as civilian requirements.

Other features besides its size:

Silver plated hardware takes the noise out of tuning and protects the unit from corrosion even under extreme environments.

Mechanical stops at both ends of capacitance adjustment, with self-contained adjusting shaft.

Linear tuning with fine resolution. About 0.50 uufd capacitance change per turn.

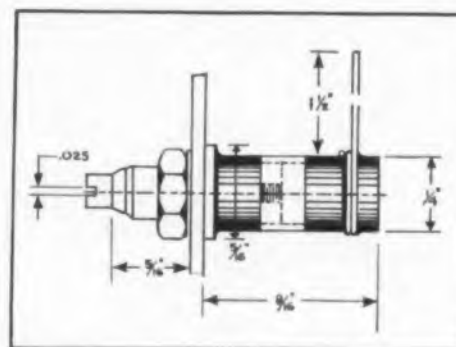
No capacitance reversals.

Glass-Invar construction.

Bushing and shaft assembly is coaxial for low inductance, high frequency applications.

Shock, vibration, and thermal shock resistance all excellent.

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Electronic Components Department

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IDEAS FOR DESIGN

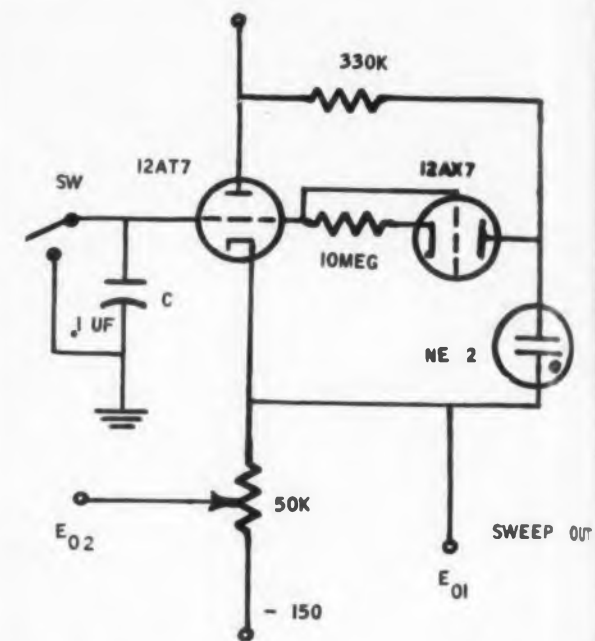


Fig. 1. The neon lamp (or a zener diode) helps bootstrap sweep from zero to 200 v in 3 sec with better than 10 per cent linearity.

Long Linear Sweeps

Here's a way to get very long duration sweeps with good linearity.

A neon lamp, or zener diode, is used in bootstrap circuit to make the bootstrapping action effective all the way down to dc. The linearity of the sweep depends on the change of grid bias of the cathode follower as the sweep runs from zero to a maximum of 200 volts or more.

Linearities of better than 10 per cent can be achieved with the circuit of Fig. 1. Linearity is defined as per cent change of charging current from the beginning to the end of the sweep.

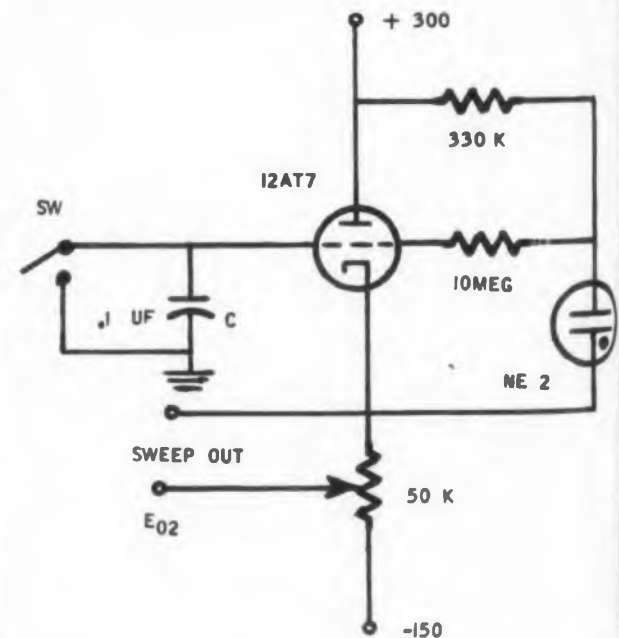


Fig. 2. This bootstrap includes a constant current generator. It sweeps 60 times slower than that in Fig. 1.

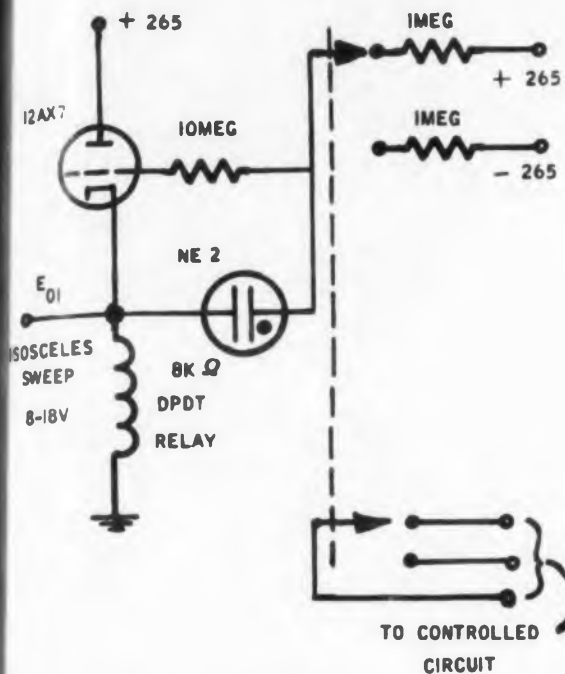


Fig. 3. This circuit can provide an isosceles sweep, 10 seconds long.

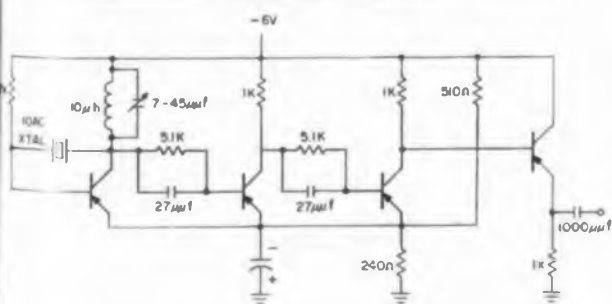
...tubes with a large "μ" should be used for best linearity.

To achieve a 100-fold improvement in both linearity and duration of sweep-time we can use "constant current" generator instead of a resistor, as shown in Fig. 2. Using $R = 10$ meg and $C = 0.1$ μf, sweep times of 3 seconds/200 volts were obtained with the circuit in Fig. 1, and 3 minutes/200 volts with the circuit in Fig. 2. An improvement of only 60 times is obtained instead of "μ" times ($\mu = 100$) because μ decreases at very low plate currents.

The center tap of the filaments of both tubes should be tied to the cathode follower output to reduce hum pick-up and leakage currents.

The sweep can be made repetitive by using a thyatron or other discharge device indicated by "SW." The firing point can be controlled by E_{o2} . Fig. 3 shows a circuit used to provide a 10-second isosceles sweep voltage for on-off cycling of certain equipment.

S. Bernstein-Bervery, Tarrytown, N. Y.



Time calibrator for oscilloscopes. It's small and portable, and it checks the most popular oscilloscope time base—0.1 μs/cm.

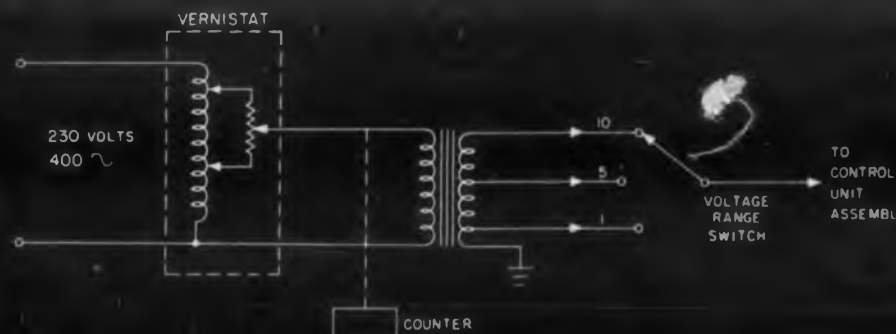
Donald A. Purland, Design Engineer, Philco Corp., Govt. and Ind. Div., Philadelphia, Pa.

Eclipse-Pioneer designs test set for B-58 Hustler autopilot system...



An automatic flight control system that "thinks ahead" of the pilot is a "must" for the Air Force's Convair B-58 Hustler — world's fastest bomber. "Brain" of this system — developed by Eclipse Pioneer Division of Bendix Aviation Corporation — is a compact control unit assembly in which all flight factors are continuously and instantly translated into commands to control surfaces. To check out this assembly quickly and conveniently, a mobile test set has also been designed — and Vernistat is there as an accurate source of test voltages in simulating a number of signals and commands.

...and Vernistat* is there!



Vernistat a.c. potentiometers were selected for several of the test panels because of their unique combination — in one component — of reliability, low output impedance, low phase shift, and high linearity. In the typical application above, Vernistat is mechanically geared to a counter to provide an output voltage that can be accurately set to the required value. Low phase shift from input to output is maintained by the Vernistat's inherent design. And need for an isolation amplifier — with its added cost and disadvantages — is eliminated.

Doesn't Vernistat thinking belong in your system design too?

In this application, Vernistat thinking by Eclipse-Pioneer engineers helped solve a design problem with reduced equipment cost, system complexity, and design time. Cost was only a quarter of that of an alternative method utilizing conventional potentiometer, isolation amplifier, and d.c. power. Use of fewer components reduced system complexity, increased accuracy and reliability, and saved valuable

design engineering man-hours.

In servo systems, analog computers, and similar uses, you too can obtain such results with Vernistat a.c. potentiometers. With this new concept in relating shaft position to voltage, you get low output impedance (as low as 45 ohms) with high input impedance (as high as 200,000 ohms), plus high resolution (to 0.004%), low phase shift (as low as 0.2 minutes), and high

linearity (to 0.01%).

In addition to precision a.c. potentiometers, Vernistat products include function generators (adjustable non-linear potentiometers), and variable ratio transformers. Military specifications are met by the wide selection of models available.

Write today for complete details and specifications on Vernistat precision products.

*vernistat® — a new design concept that unites in one compact device the best of both the precision autotransformer and the multiturn potentiometer.

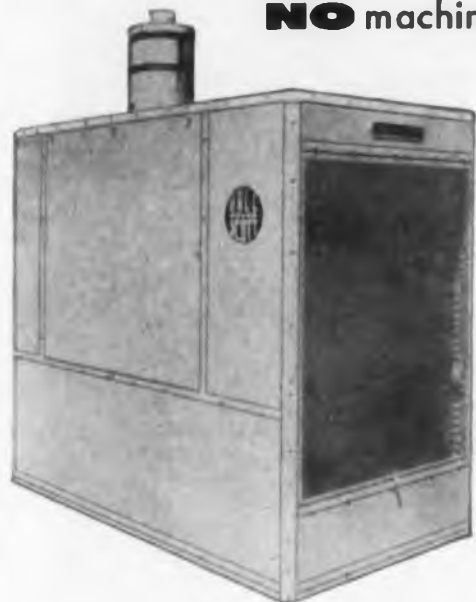
Perkin-Elmer Corporation

vernistat

765 Main Avenue, Norwalk, Conn.

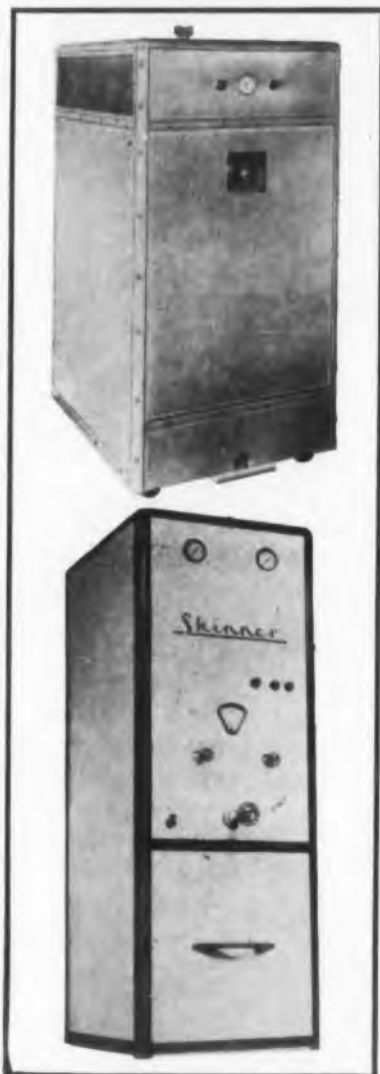
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NO new tools needed!
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Readily adaptable, die-drawn Lindsay Structure components make it easy to prefabricate enclosures for instruments, testing machines, radio and radar equipment . . . and housings for processing, large towers, industrial equipment, and shielding (electromagnetic shielding through the entire radio frequency spectrum).*

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Whether you are planning 1 or 1,000 units . . . with Lindsay Structure you save the cost of expensive dies and "tooling" up.

You can begin production immediately . . . your assembly can be handled by workers without special training . . . and you are assured of complete uniformity in your finished units, when you use die-drawn, die-cut Lindsay components of exact size requirements.

Make use of Lindsay Structure components for your housing, enclosure, building or equipment requirements. Write for information, descriptive folder, or send single-line drawing for cost estimate.

* Lindsay Structure shielded enclosures supplied by Ace Engineering and Machine Company, Huntingdon Valley, Pennsylvania.



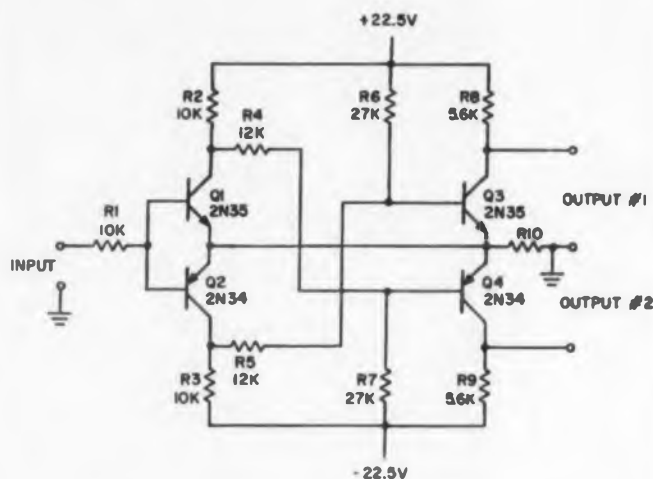
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IDEAS FOR DESIGN



A Polarity Sensitive Trigger Circuit

In designing a Schmitt trigger to change states when the input goes through zero, two approaches can be used. These are (1) use of an input stage to change the level of the input signal, (2) use of both positive and negative supply voltages to bring the firing level of the Schmitt to zero volts. Because the firing level and hysteresis are subject to changes with age and supply voltage variations, use of the standard Schmitt circuit dictates that for accurate sensing of polarity, caution be taken to insure stability.

The circuit shown here was developed primarily to detect polarity changes. Because of the balanced design and use of complementary symmetry the circuit is stable with temperature and aging. The transistors are operated at either cutoff or saturation and the loop gain is quite high. As a result, the firing points remain relatively drift free. The amount of hysteresis is varied by changing the common emitter resistor R_{10} and remains balanced about zero. Typical values of hysteresis are ± 0.1 v for R_{10} set at 100 ohms, to ± 0.5 v for R_{10} equal to 500 ohms.

Circuit constants are selected so the transistors operate in either the cutoff or saturation regions. When the input pnp and output npn units are at cutoff the input npn and output pnp units are in saturation. Because the collector current in the output stage is approximately twice that in the input stage, the polarity of the voltage across R_{10} is determined by the conducting output transistor. This polarity is opposite the input signal and its magnitude determines the hysteresis of the circuit.

Transition from one state to the other occurs when the input approaches the emitter voltage sufficiently to reduce the collector current in the conducting input transistor. The change in collector voltage resulting from the reduction of collector current is transferred to the conducting



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I say it's Venus!
I say it's Mars!



Thomas & Skinner says: This is a helluva way to run a space ship!

But we're not blaming the space crew—just the engineer who designed the highly complex astral navigation equipment. He didn't know about T & S's new, exclusive *three-phase* laminations . . . which offer *balanced voltages* in all three phases and *completely eliminate third harmonics*.

These compact laminations are now available in standard production sizes . . . for 400-cycle applications, 4 mil thicknesses with leg widths from 1/4 to 7/8 inches . . . for 60-cycle applications, 14 and 18.5 mil thicknesses with leg widths from 1.2 to 3.6 inches.

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output transistor. The signal appearing at the output transistor is transferred to the input transistor through the common emitter resistor, reappearing at the collector of the input transistor with the same polarity as the original change.

When the loop gain exceeds unity regeneration takes place, causing the circuit to switch states. The action is identical with the operation of the Schmitt trigger and the relationship between loop gain and hysteresis hold for both circuits. This is discussed more fully in Millman and Taub's "Pulse and Digital Circuits."

The circuit can be used as a Schmitt trigger, a squaring circuit or a flip-flop. It has proven quite useful in detecting the polarity of random pulses. It operates over wide temperature ranges and its stability at high temperature can be improved by shunting R_4 and R_5 with back biased germanium diodes to supply I_{co} to the output transistors.

As a sine wave phase comparator it can provide 1 degree accuracy with 3 v rms input. It requires no amplification for most input waveforms.

James E. Curry, Tasker Instruments Corp., Hollywood, Calif.

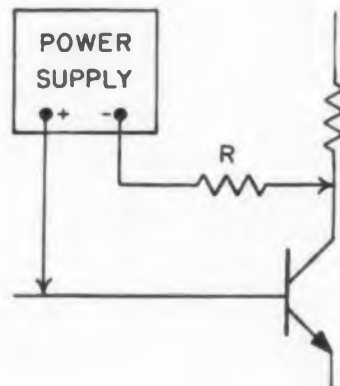
Simple Test For Temperature Effects On Transistors

With germanium transistors, the effect of changes in collector cutoff current (I_{co}) with temperature is very important. Here is a simple and rapid means of evaluating this effect.

The diagram shows how additional I_{co} is injected into the transistor. The series resistor R must be very large compared with the collector and base circuit impedances. The amount of current used is determined by the proposed rise in I_{co} over the temperature range.

Typical values are 150 v through 1 meg. This simulates an I_{co} change of 150 μ a. Voltage polarity must be reversed for pnp transistors.

J. R. Siconolfi, Engineer, I. T. & T. Labs., Fort Wayne, Ind.



I_{co} injector simulates temperature changes.

NEW BENDIX SILICON RECTIFIERS

feature rugged performance



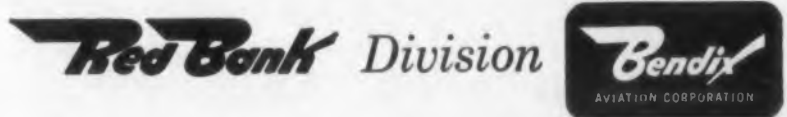
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50	35	1N1434	30 Adc	1N1612	5 Adc	1N536	250 mAdc
100	70	1N1435	30 Adc	1N1613	5 Adc	1N537	250 mAdc
200	140	1N1436	30 Adc	1N1614	5 Adc	1N538	250 mAdc
400	280	1N1437	30 Adc	1N1615	5 Adc	1N540	250 mAdc
600	420	1N1438	30 Adc	1N1616	5 Adc	1N547	250 mAdc
Maximum reverse current at rated peak inverse voltage		5.0 mAdc at 150°C		1.0 mAdc at 150°C		500 μ Adc at 150°C	
Forward voltage drop at 25°C		1.2 Vdc at 60 Adc		1.5 Vdc at 10 Adc		1.1 Vdc at 0.5 Adc	
Peak recurrent current		90 amperes		15 amperes			

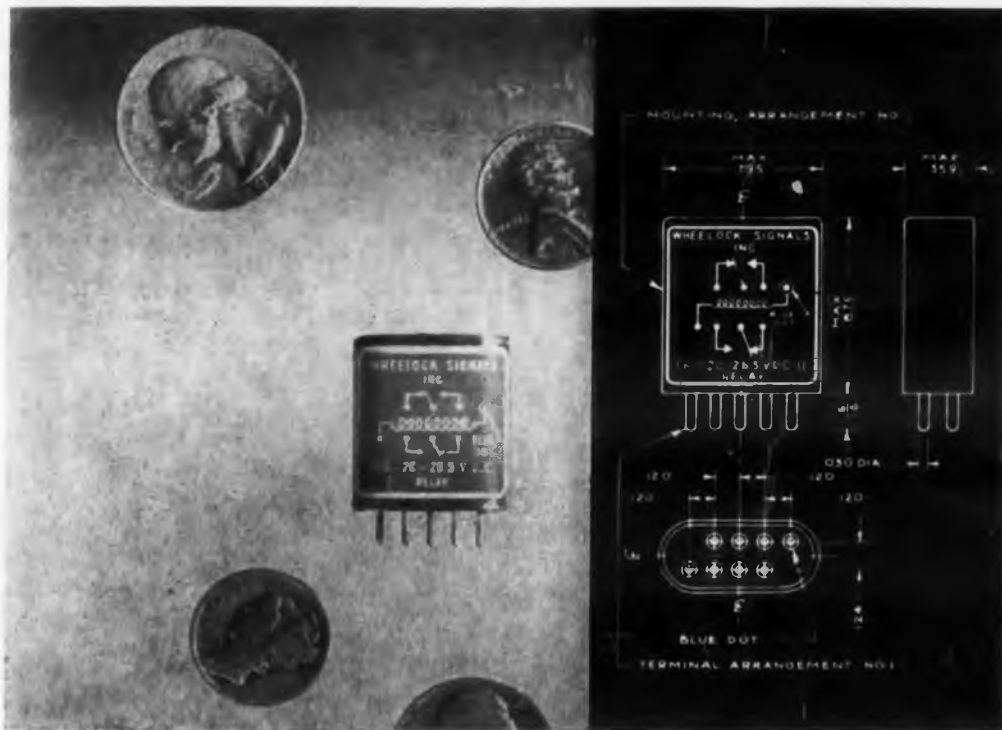
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CIRCLE 199 ON READER-SERVICE CARD



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and excessive vibrations . . . 2000 cps at 20 g

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inherent in design and
performance

SPECIFICATIONS

TEMPERATURE	—65° to 125° C
DIELECTRIC	1000 VRMS; 750 VRMS across contact gaps
INSULATION RESISTANCE	10,000 megohms at 25° C; 100 megohms at 125° C
CONTACT ARRANGEMENT	SPDT—2PDT
CONTACT RATING	2 amps resistive at 28 VDC or 115 VAC
CONTACT LIFE	100,000 operations
CONTACT RESISTANCE	.05 ohms
SHOCK	JAN-S-44 Test in excess of 100 g all planes — no opening
VIBRATION	10-55 cps at 1/8" excursion and 0-2000 cps at 20 g acceleration
ENCLOSURE	Hermetically sealed dry nitrogen filled
TERMINAL & MOUNTING	Mounting arrangements to your specs
PICKUP TIME	5 milliseconds approx.
DROP-OUT TIME	1.45 milliseconds approx.
WEIGHT	.35 oz.
COIL POWER	350 milliwatts
COIL RESISTANCE	up to 6000 ohms
SIZE	.359 in. x .797 in. x .875 in.

Wheelock SIGNALS
RELAYS LONG BRANCH, N. J.

CIRCLE 210 ON READER-SERVICE CARD

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ABS	Abstract
DF	Design Forum
ED	Engineering Data
GA	German Abstract
ID	Ideas for Design
PF	Product Feature
RT	Russian Translation

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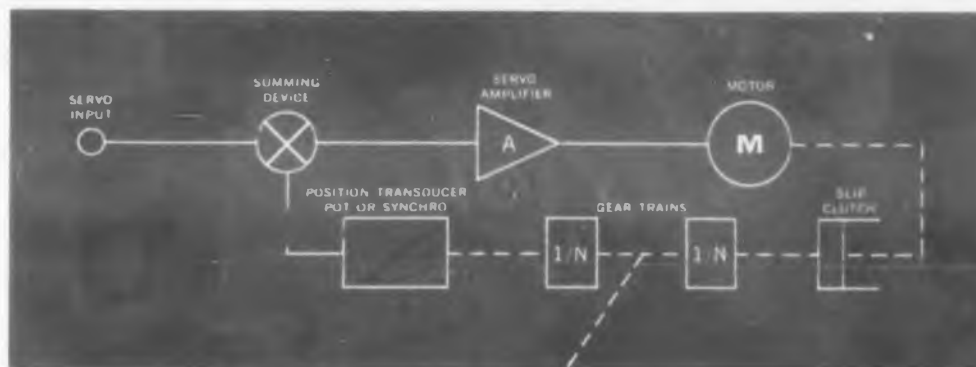
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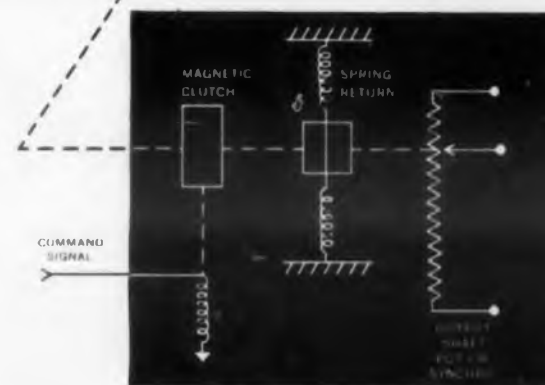
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PROBLEM: To provide an output Potentiometer-Transducer which can be readily engaged with a minimum angular error to a servomechanisms gear train when energized by an external command signal. The transducer must accurately return to a specified null position when the command signal is removed.



A SOLUTION:

Provide an electro-magnetic clutch, spring return mechanism and rotary potentiometer. Assemble these parts into the required package with the resultant difficulties brought about by the mounting and coupling problems with a consequent increase in cost.



THE OPTIMUM SOLUTION:

Technology Instrument Corporation's west coast engineering facilities developed and offer a unitized package consisting of an electro-magnetic clutch, spring return mechanism and rotary potentiometer as one compact assembly. The clutch will transmit high torque without slippage and has negligible angular engagement error. TIC's unique spring return mechanism will accurately return the output transducer to the desired null, yet requires low driving torque. TIC's unitized assembly replaces three (3) individual components with their inherent assembly difficulties.



TIC
unitized
package

GENERAL INFORMATION:

Shaft Position Transducers can be linear or nonlinear potentiometers, synchros, linear transformers or digitizers. Spring return mechanism can be supplied designed to return to any desired point. A built-in slip clutch can also be furnished if the input torque can exceed the rating of the clutch.

TIC UNITIZED PACKAGE HAS MANY APPLICATIONS,

SUCH AS: Auto pilots, altitude controllers, machine controllers, measurement and control problems, speed control, process control of temperature and flow, differential measurement, expanded scale servos, or any other problem requiring an output, commencing at some specified servo position determined by an external command signal.



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... a paired trigger generator with fixed and delayed pulses. Combination of counters and digital dial provides direct reading delay to 9,999.99 microseconds accurate to better than 0.01 microsecond. Note that this instrument is a full size module of the TLI Modular Instrumentation System.

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- D-C AMPLIFIER (0 to 2 cps band)
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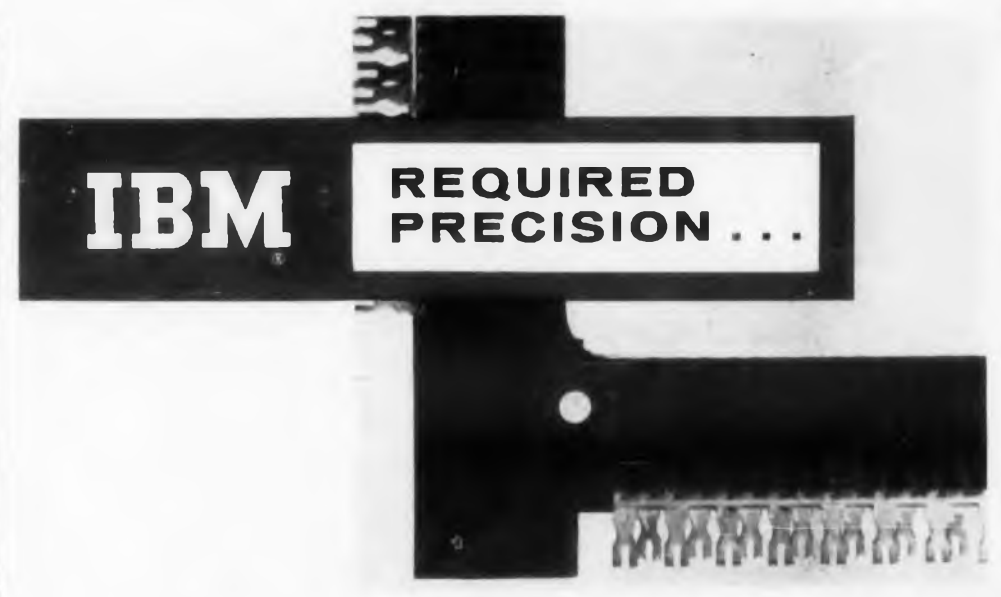
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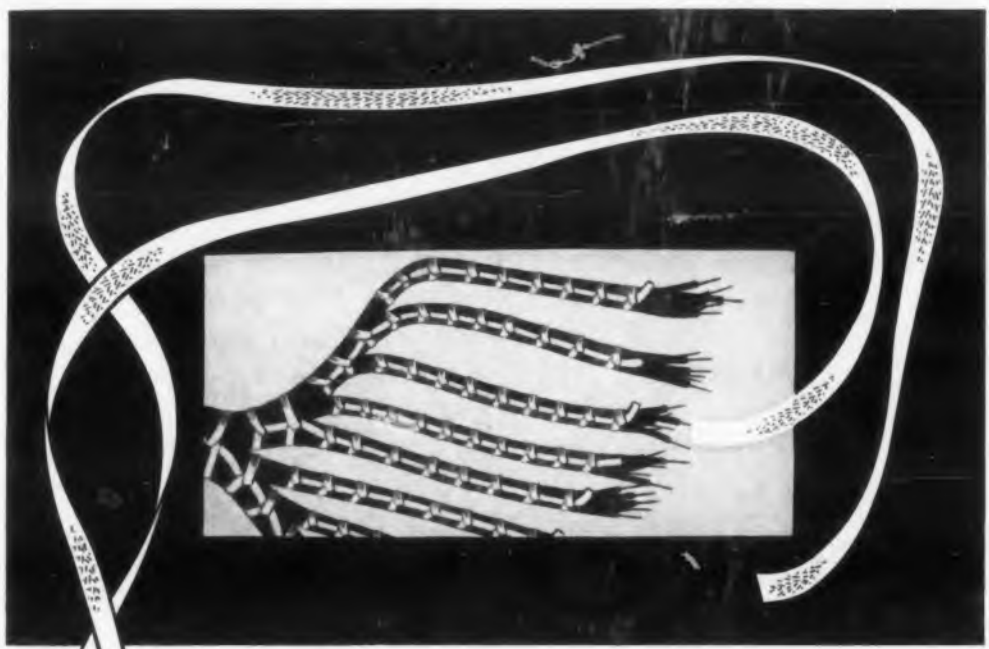
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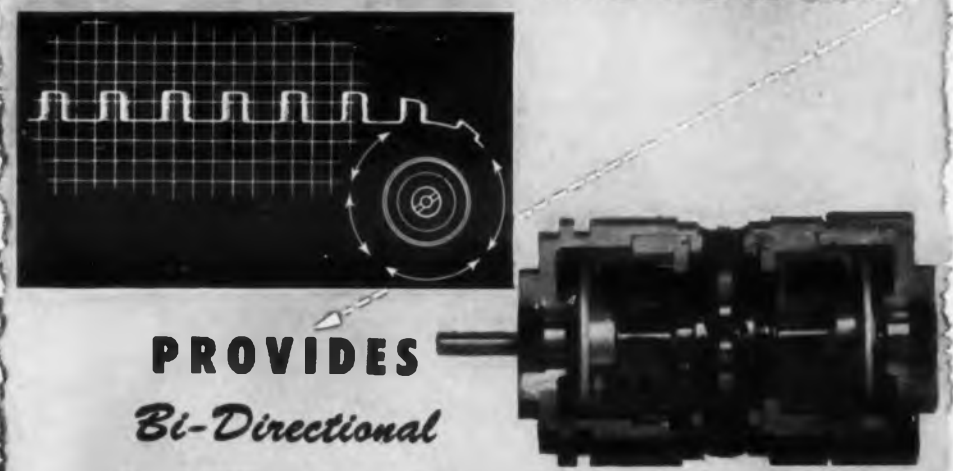
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RUSSIAN TRANSLATIONS

Nonlinear and Phenomena Radiation

Part 8

A. A. Kharkevich

(Translated by J. George Adashko)

Chapter 1

Nonlinear Circuits Nonlinear

10. FM and PM Detection

In this section we discuss the general principles of detection, used for modulation other than a-m, particularly frequency modulation (f-m) and certain forms of pulse modulation (p-m).

FM Detection

The usual manner of detecting frequency modulated oscillations consists of first converting the f-m oscillations into a-m oscillations, then detecting them as described in Sec. 9. The f-m is converted into a-m with a so-called frequency detector.

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Meet applicable requirements for military apparatus.

Operate in a plate circuit of an amplifier presenting an effective generator impedance of 47,000 ohms and to drive the grid circuit of the following amplifier stage.

Operate at signal level as low as 10 microvolts.

Must be well shielded against external fields.

Passband ripple not to exceed 1 db. from 25 KC to 26 KC.

Minimum rejection shall be 35 db. at 28 KC and 40 db. at 23 KC.

The phase shift, from one production filter to another, shall not vary more than 5° at any point in the 25 KC to 26 KC bandpass.

The phase shift and attenuation

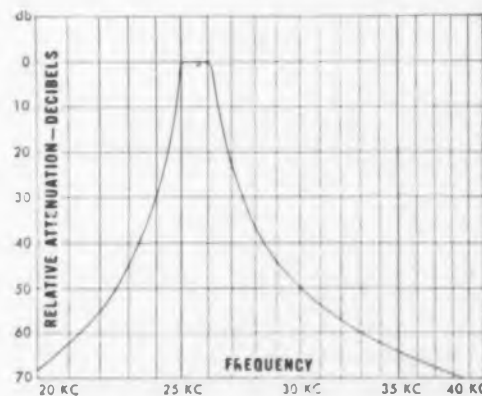
characteristics must be reproducible over a long period of years to insure properly functioning spare parts.

Temperature range 0° to 85°C.

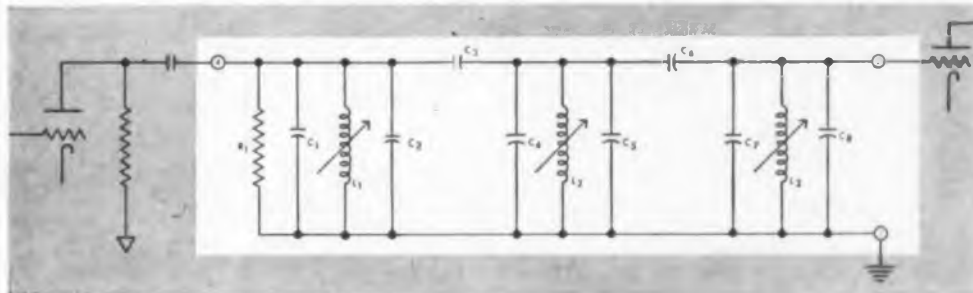
SANGAMO SOLUTION TO PROBLEM

The above requirements were met by using three parallel tuned circuits properly coupled by capacitors. Selection of the L-C ratios, coupling, and circuit Qs were made in order to fulfill the overall response requirements and at the same time present the proper load to the driving amplifier stage. Stability requirements were obtained by using Sangamo silvered mica capacitors. Negative temperature coefficient capacitors were inserted in parallel with the tuned circuits to correct for the positive temperature coefficient of the inductors. A phase shift variation of 2.5° maximum from 25 KC to 26 KC has been consistently maintained during eight years of production on these units. The

universal wound coils are enclosed in powdered iron cups with moveable slugs for precise adjustment of the response and the phase shift. These inductors manufactured by Sangamo have uniform distributed capacity and Q. The cup-enclosed inductance coils are in turn housed in a die-cast aluminum enclosure. This housing lends physical rigidity to the coupled structure and assists in minimizing magnetic interaction between the enclosed inductors. The entire filter assembly is enclosed in a hermetically sealed drawn steel case. The terminals are of the extremely rugged compression glass type.



Relative response curve of this Sangamo bandpass filter.



C₁, C₄, C₇—Temperature Compensators
C₂, C₃, C₅, C₆, C₈—Sangamo Silvered Mica Capacitors



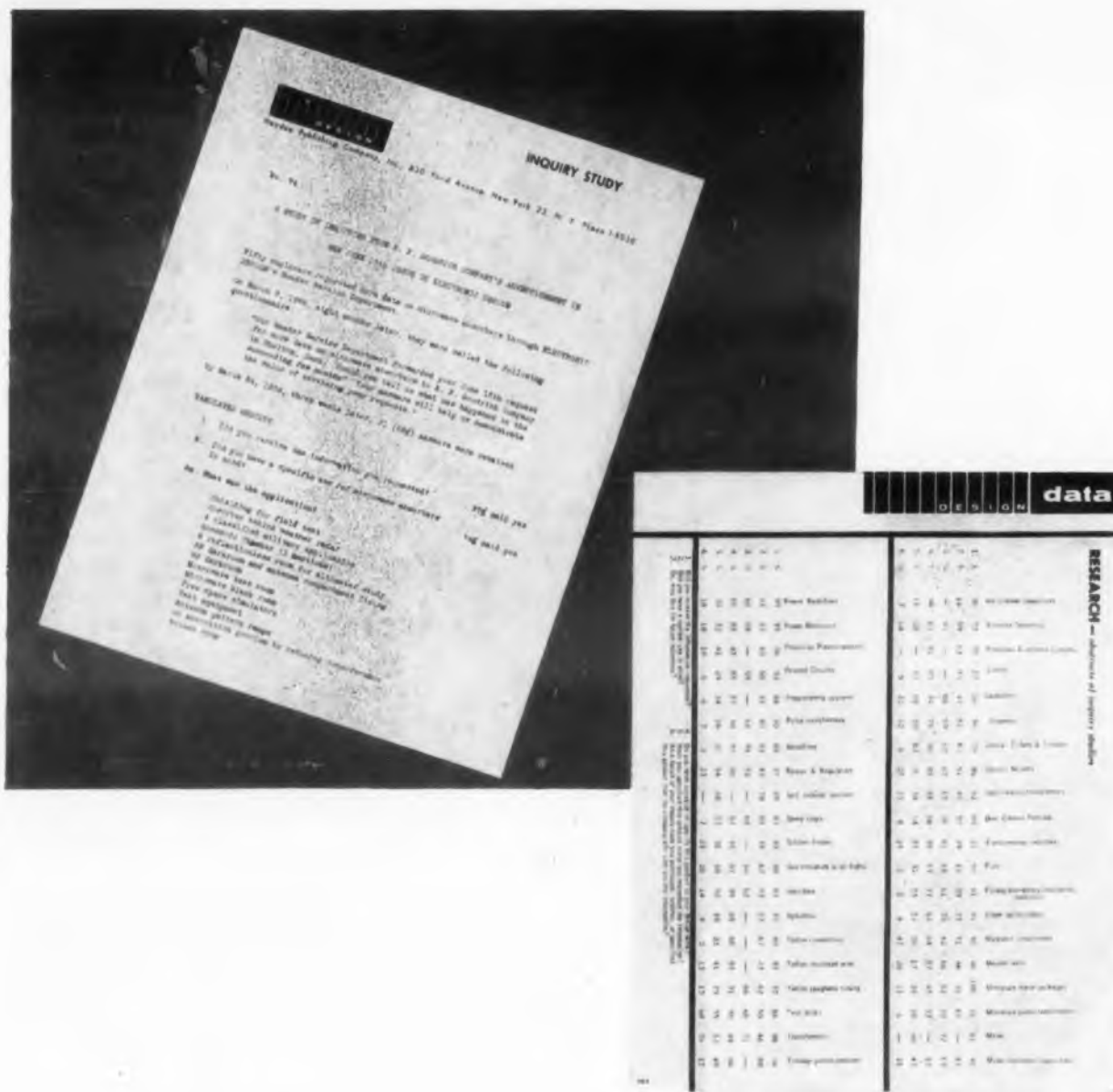
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RUSSIAN TRANSLATIONS

to detect and filter it in the usual manner. The basis circuit for f-m detection is shown in Fig. 34.

Modern practice calls for better frequency detectors. The point is that to avoid nonlinear distortion, the characteristic of the frequency detector must be linear. In other words, the derivative of the characteristic, given by the derivative $dI_m/d\omega$ must be constant within the operating range. For broadband f-m, it is difficult to satisfy this requirement with a simple circuit, and therefore employs symmetrical circuits, which have more favorable characteristics.

An example of such a circuit is shown in Fig. 34. Here the two tank circuits are usually tuned to the extreme values of the frequency, i.e., $\omega_0 + \Delta\omega$ and $\omega_0 - \Delta\omega$. Each of these tanks converts f-m into a-m. The a-m oscillations are detected by the respective halves of the diode.

The RC combinations serve as filters. The frequency voltages of U_1 and U_2 across R_1 and R_2 are proportional to the ordinates of the resonance curves of circuit 1 and 2 respectively. But these voltages across R_1 and R_2 are opposite in sign (see arrow showing the directions of the currents on the diagram), the output of the circuit is the difference between the voltages U_1 and U_2 .

The characteristic of the frequency detector, i.e., the dependence of the output voltage on f-m frequency at the input, is obtained by subtracting the two resonance curves, as shown in Fig. 35. Frequency detectors of this type are called discriminators.

PM Detection

Let us turn now to pulse modulation. The principal forms of pulse modulation are (1) modulation of pulses by amplitude—(PAM), (2) modulation of pulses by repetition frequency—(PFM), (3) modulation of pulses by duration—(PDM), and (4) modulation of pulses by phase—(PPM).

Detection of a PAM signal does not differ essentially from detection of an ordinary amplitude-modulated oscillation. The difference is only in the contents of the high frequency portion of the spectrum, which must be filtered out anyway.

The same pertains to PDM, although it is not obvious at first glance. It must be taken into account, however, that the low-frequency component, after the usual detection of the pulse-modulated signal, is proportional to the area under the pulse. Consequently, it makes no difference what changes in the envelope of the pulse duration modulation, the amplitude or the duration. The

usual detector circuit is suitable for the de-
on of PAM and PFM.

atters are different with pulse-phase modu-
n. In the case of PPM, as is known, the area
he pulse remains constant. The modulation
ists merely of shifting the pulse relative to
reference point. It is therefore necessary, in
detection of PPM, first to convert the PPM
PAM or PDM, or in general to a form in
h the pulse area changes. To convert PPM

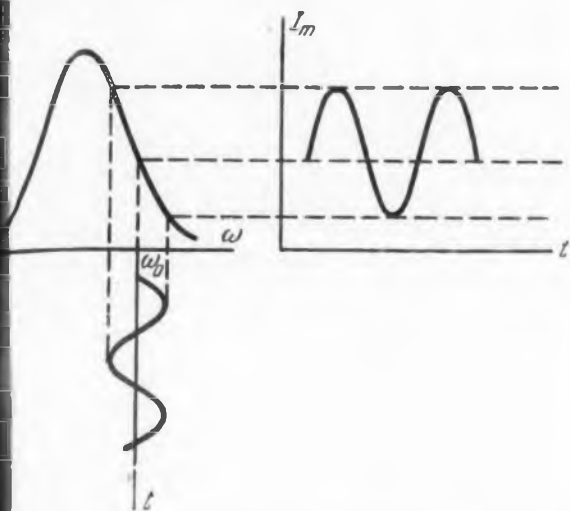


Fig. 32. The simplest frequency detector
is tuned to a lower-than-carrier frequency.

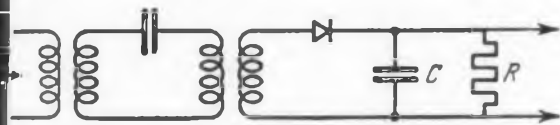


Fig. 33. The simplest type of f-m detector.

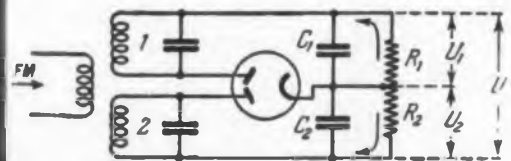


Fig. 34. The discriminator gives more linear
m detection than the simple circuit of Fig. 33.

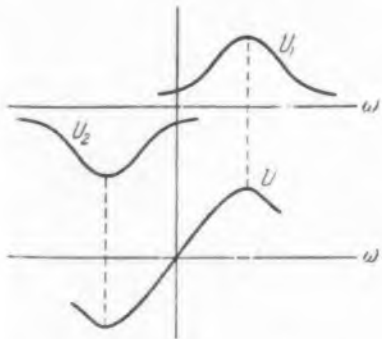


Fig. 35. The discriminator provides more linear
over a broader frequency range by
making the difference between the two input
pulse resonance curves.

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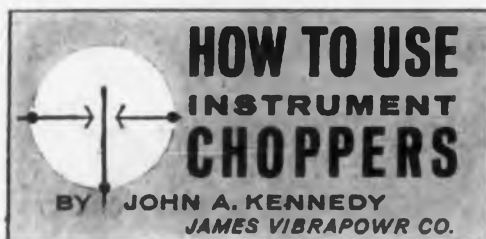
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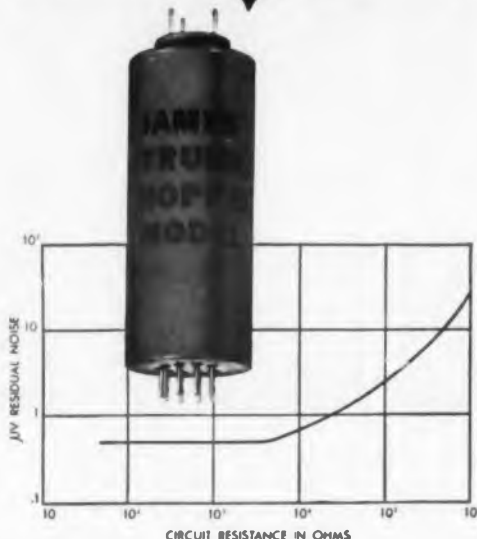
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RUSSIAN TRANSLATIONS

into PDM one can employ, for example, a circuit containing an electronic relay energized by the in-phase pulses (or vice versa), as shown in Fig. 36.

Topics connected with detection of pulse-code modulation, being more specialized will not be considered here.

11. Modulation

The purpose of modulation is to shift the spectrum of the transmitted (low-frequency) signal into the high-frequency region. This makes the signal suitable for transmission by radio. Such a shift is necessary because effective radiation can be obtained only at high radio frequencies.

Modulation is produced when the signal modifies the high-frequency oscillations yet remains "imprinted" in the variations of one of the parameters. The high frequency, so to speak, carries the signal with it, retaining all the signal properties. The signal can thus be again separated on the receiving end.

Modulation is essentially a linear process realized in a linear system with variable parameters.

We shall first explain the mechanism of amplitude modulation, using as an example an extremely simple circuit, used at one time in low power telephone transmitters. The circuit is shown in Fig. 37. The high-frequency oscillator is coupled inductively to the antenna. Connected in series with the antenna is an ordinary carbon microphone. The sound causes the membrane of the microphone to vibrate and compress the carbon powder contained in the microphone, thus changing its admittance.

Let us assume that the microphone is strictly linear, i.e., that its admittance is a linear function of the sound pressure. We then obtain for the admittance of the antenna circuit

$$Y = Y_0 + kP$$

Let the sound pressure be sinusoidal

$$P = P_m \sin \Omega t.$$

We can then write for the admittance

$$Y = Y_0 + kP_m \sin \Omega t = Y_0 + Y_1 \sin \Omega t = Y_0 (1 + m \sin \Omega t),$$

where $m = Y_1/Y_0$ as the coefficient of modulation of the admittance. Furthermore, let the electromotive force induced by the oscillator in the antenna be

$$E = E_m \sin \omega_0 t,$$



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where ω_0 is the high (carrier) frequency. The antenna current is the product of this emf and the admittance.

$$I = EY = E_m Y_0 (1 + m \sin \Omega t) \sin \omega_0 t.$$

We have derived the usual expression for an oscillation, amplitude modulated sinusoidally at a frequency Ω .

This is a linear circuit with variable parameter. The variable parameter is the admittance.

Returning to the expression for the amplitude-modulated oscillation, let us rewrite it in a more general form.

$$I = I_m [1 + m f(t)] \sin \omega_0 t.$$

where $f(t)$ is an arbitrary transmitted signal and it is assumed here that $|f(t)| < 1$.

We see that the modulation process consists of multiplying two functions of time, $1 + mf(t)$ and $I_m \sin \omega_0 t$. Consequently, the modulator should act in principle as a multiplying device, i.e., a device with two inputs and one output.

If the inputs are, say $x(t)$ and $X_0(t)$, the output is

$$y(t) = x(t) X_0(t)$$

Multiplication by a given function $X_0(t)$ is a linear operation, as can be seen from the following relationship

$$y(t) = [x_1(t) + x_2(t)] X_0(t) = x_1(t) X_0(t) + x_2(t) X_0(t) = y_1(t) + y_2(t)$$

Devices that multiply two functions of time

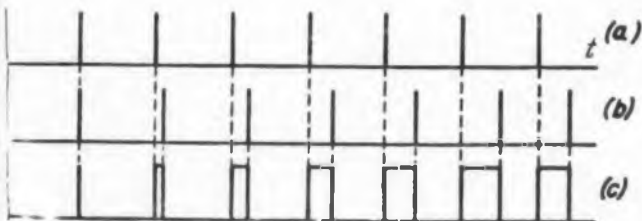


Fig. 36. An electronic relay can convert PPM to PDM. The in phase "on" pulse are shown at (a), the PPM "off" pulses at (b), and the pulses at the output of the electronic relay at (c).

and are used for modulation and frequency conversion are usually called mixers. This is a poor term, for it does not describe the nature of the process. We shall call a device that multiplies two functions a multiplier.

Thus, to obtain ordinary amplitude modulation it is necessary to take a multiplier with inputs $x(t) = 1 + m f(t)$ and $X_0(t) = I_m \sin \omega_0 t$. The multiplication will yield the modulated oscillation.

(Continued on following page)

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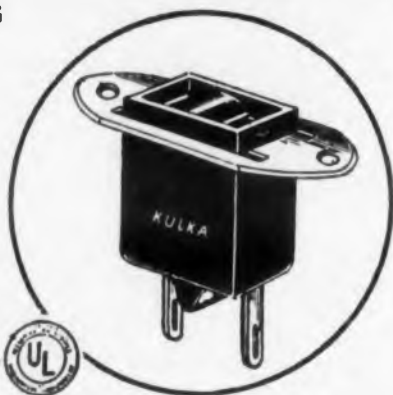
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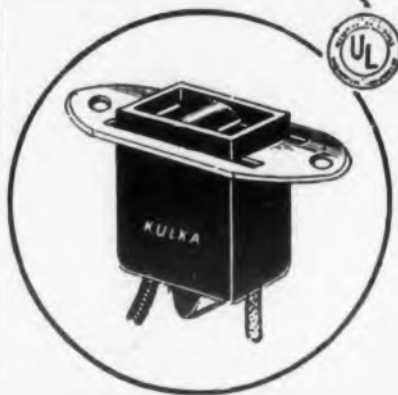
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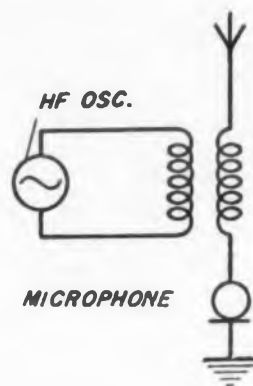


Fig. 37. A simple modulation scheme, once used in low power telephone transmitters.

Let us note that this expression can be written

$$I = I_m \sin \omega_0 t + m I_m f(t) \sin \omega_0 t.$$

The first term is the carrier-frequency current. Expansion of the second terms gives the sideband frequencies of the modulation spectrum. Along with ordinary a-m, one also employs transmission without the carrier frequency, obtained with the aid of so-called balanced modulation.

To obtain amplitude modulation without a carrier frequency, using a multiplier, it is merely necessary to eliminate the dc component of the modulating function, i.e., use only $x(t) = f(t)$. This results in a multiplier output

$$y(t) = x(t) X_0(t) = I_m f(t) \sin \omega_0 t.$$

The spectrum of this oscillation does not contain the carrier frequency; the spectrum consists of only the two sideband frequencies.

Any two-port network with adjustable transfer function can be used as a linear multiplier. Thus, if we have, in general,

$$y(t) = k x(t)$$

and if we can vary the transfer function k in accordance with an arbitrary law $k = k(t)$, we indeed obtain a multiplier, whose operation is described by

$$y(t) = k(t) x(t)$$

By way of an example, let us examine how a multigrad tube (specifically, a heptode) operates as a multiplier. In such a tube, as is known, the transconductance with respect to the third (so-called "signal") grid depends on the voltage on the first ("heterodyne") grid. In the ideal case, the dependence of the transconductance on the

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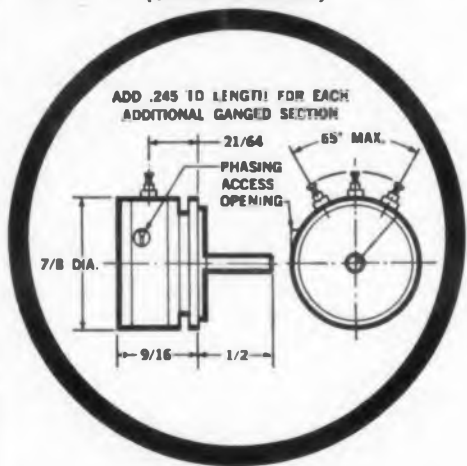
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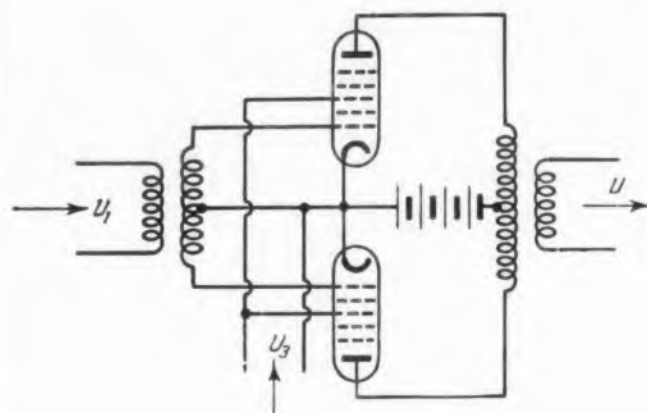


Fig. 38. This balanced multiplier gives U , the product of U_1 and U_3 .

potential of the first grid would be linear, i.e.,

$$S_3 = b_0 + b_1 U_1.$$

Applying the two multiplicand voltages $U_1(t)$ and $U_3(t)$ to the first and third grids, we would obtain in the plate circuit the following current

$$I_p = U_3 U_3 = U_3 (b_0 + b_1 U_1) \\ = b_0 U_3 + b_1 U_1 U_3.$$

We see that we would not obtain pure multiplication, owing to the presence of a dc component in the transconductance as given by

$$S_3 = b_0 + b_1 U_1.$$

But the effect of this component can be eliminated by using a symmetrical (balanced) circuit with two tubes, as shown in Fig. 38 (for simplicity the connections to the auxiliary grids are not shown). The voltage U_3 is applied to the third grids of both tubes with like polarity (i.e., in phase), while the voltage U_1 is applied to the first grids with opposite polarity (i.e., out of phase). The output voltage U , by virtue of the bucking connection of the coils in the plate circuits, is proportional to the difference in the plate currents, i.e., to the quantity

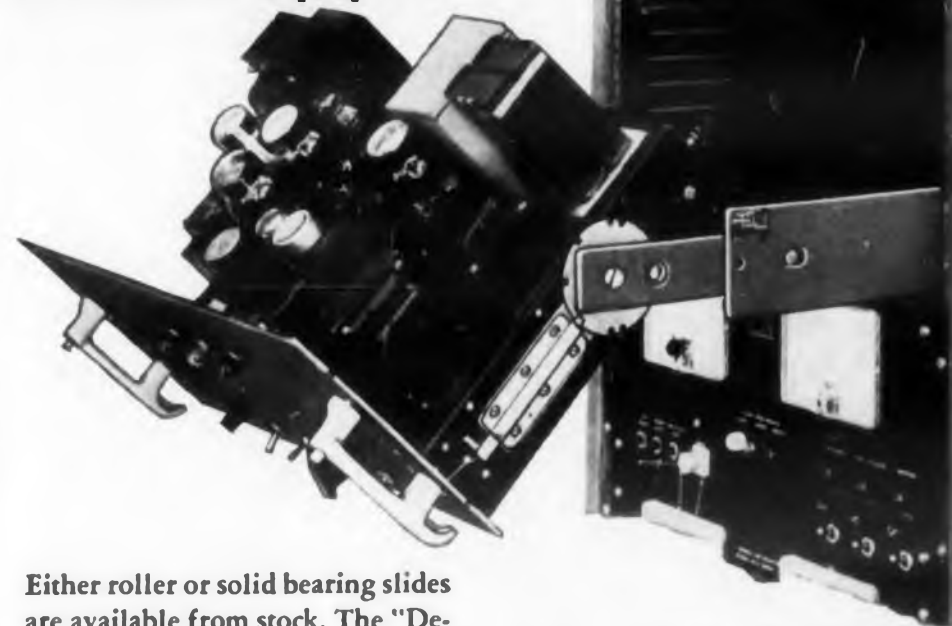
$$(b_0 U_3 + b_1 U_1 U_3) - (b_0 U_3 - b_1 U_1 U_3) = 2b_1 U_1 U_3.$$

Thus, if the transconductance varies linearly with the voltage, the circuit of Fig. 38 operates as an ideal linear multiplier. Actually, the expression $S_3 = b_0 + b_1 U_1$, is satisfied only approximately, and over a small voltage range at that. Nevertheless, under these conditions, the balanced circuit of Fig. 38 gives a better result than the simpler (one-tube) circuit.

(To be continued)

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Detent	CTRD			X	X	X	X	X	X	X	X	175
Cradle Track	CTEZ				X	X	X	X	X	X	X	125
Heavy Duty Basic	CTHRB				X	X	X	X	X	X	X	275
Heavy Duty Detent	CTHRD				X	X	X	X	X	X	X	275

SOLID BEARING SLIDES	MODEL	SLIDE LENGTH										LBS MAX LOAD
		10	11	12	14	16	18	20	22	24		
Basic	CTB	X	X	X	X	X	X	X	X	X	X	175
Detent	CTD			X	X	X	X	X	X	X	X	175
Light Weight	CTL				X	X	X	X	X	X	X	100
Heavy Duty Basic	CTHB				X	X	X	X	X	X	X	250
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RUSSIAN TRANSLATIONS

What the Russians Are Writing



J. George Adashko

CIRCUITS

Low Frequency Power Amplifier with Distortion Compensation by G. Ya. Gurovich. RE, 8/58, pp 50-53, 1 fig.

Analysis of the new circuit described here (patented by the author in 1951) shows that it is possible in principle to cancel out completely frequency, non-linear, amplitude, phase, background, and all other distortions in a low-frequency power amplifier without reducing its gain.

Use of Phase Frequency Synchronization by A. D. Artym. RE, 8/58, pp 37-46.

The use of phase synchronized frequency control in band pass filters was treated by J. Jelonek et al (*Proceedings IEE*, Part 4, February 1945). The author discusses the use of such a system in frequency modulators or phase detectors and determines the response of such a system to frequency modulated signals. See Fig. 1.

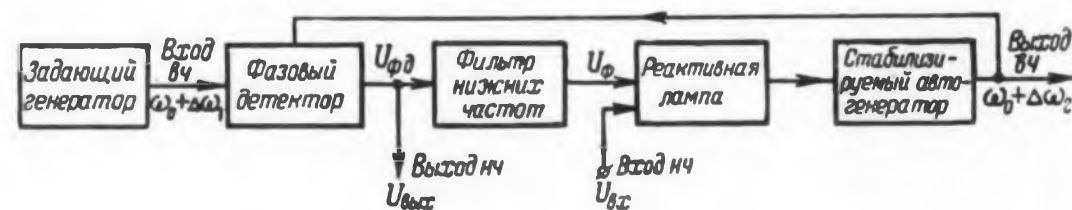


Fig. 1. The circuit consists of two stages: the first includes tube T_1 , output transformer Tr_1 and resistance R_1 . The second comprises elements T_2 , Tr_2 , and R_2 . Both stages are fed from a common plate voltage and have a common self-bias and deliver power to a common load R_{II} . The input is applied to grid of T_1 . The voltage applied to T_2 is obtained from potentiometer R_1 . It is the same value as the input voltage. If distortion is produced in the circuit, the two grid voltages become unequal. This difference, amplified in the tubes, is used as the feedback voltage.

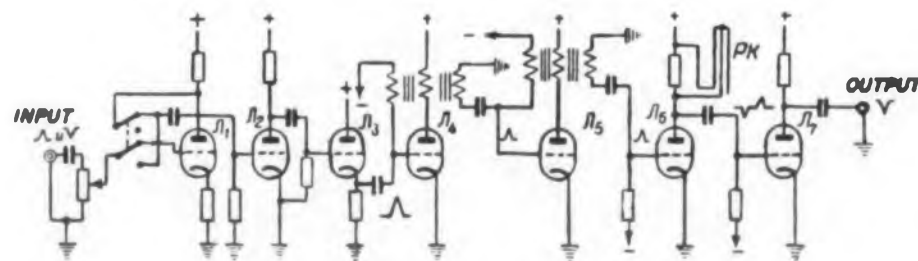


Fig. 2. Basic circuit.

Generator for Triangular Video Pulses by Yu. N. Prozorovskiy. RE, 8/58, pp 47-49.

Triangular video pulses are generated with the aid of a shaping two-terminal network, such as line segment, having a signal time delay that is shorter than the duration of the front of the voltage or current applied to the generator. See Figs. 2 and 3.

TELEMETRY

New Principles for Synthesis of Telemetering Systems with Pulse-Time and Pulse-Width Modulation by V. A. Il'in and A. I. Novikov. AT, 8/58, pp 757-761, 5 figs.

In most telemetering systems, the measurement error depends on the stability of the transfer functions of the system as a whole and of its individual elements. This is why precision of the various converters and transducers used (modulators, demodulators, etc.) in such systems is of primary importance.

This article shows that the use of new type high-stability time-pulse and width-pulse converters or transducers (which the authors call "exponential") makes the telemetering system less sensitive to changes in such external influences as ambient temperature or line voltage. See Figs. 4, 5 and 6.

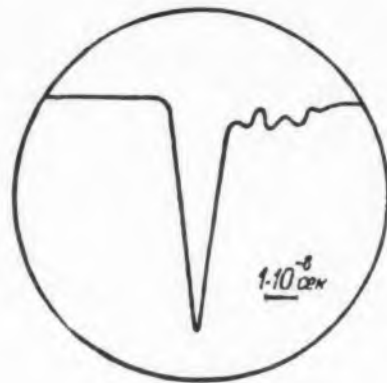


Fig. 3. Pulse produced along with a 1×10^{-6} second time marker.

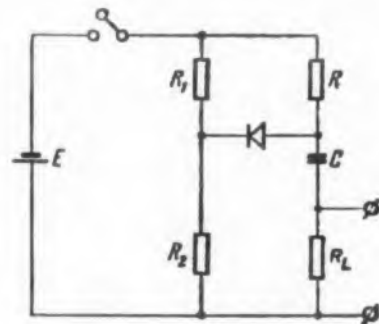


Fig. 4. Prototype of exponential pulse-width converter.

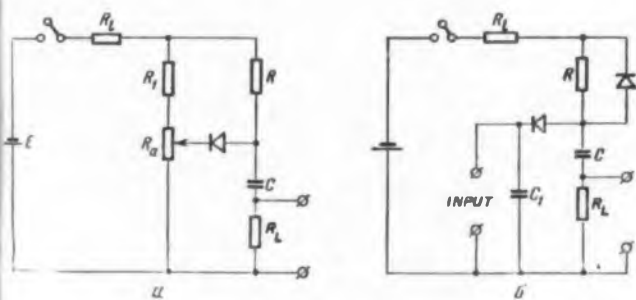


Fig. 5. Two exponential converters modified to accommodate pickups with low resistance.

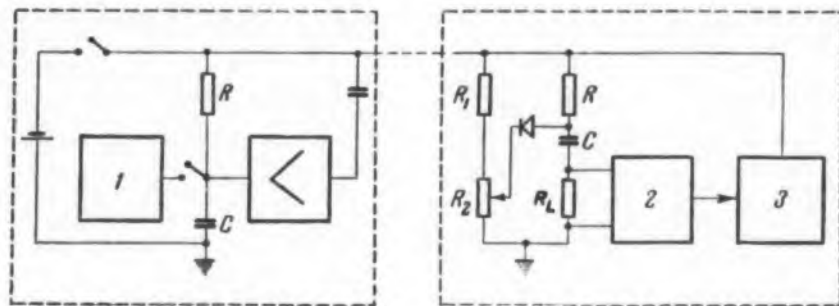


Fig. 6. Telemetering system with exponential converter. 1—indicator; 2—electronic relay; 3—audio generator. The electronic relay operates at the instant t_c and turns on the audio generator until the primary pulse is complete. The receiver is tuned to the audio frequency. The amplified signal causes the relay to operate at the instant t_c . The transmitter and receiver RC cells have equal time constants, thus ensuring a linear relation between the measured parameters and the reading of the output meter. The error is less than 1 per cent for ambient variation from -50° to $+50^\circ$ and for supply line variations of ± 15 per cent.

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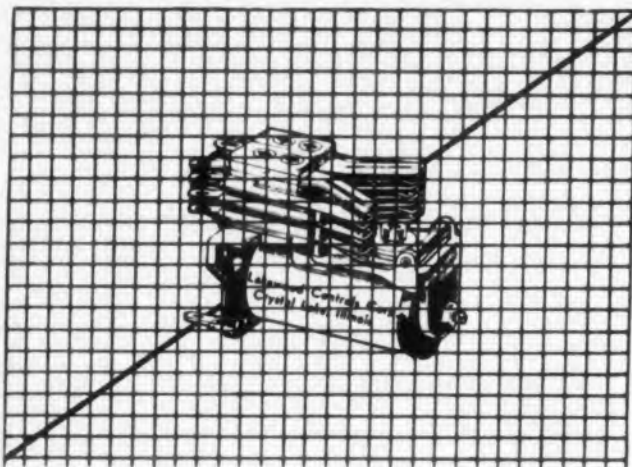
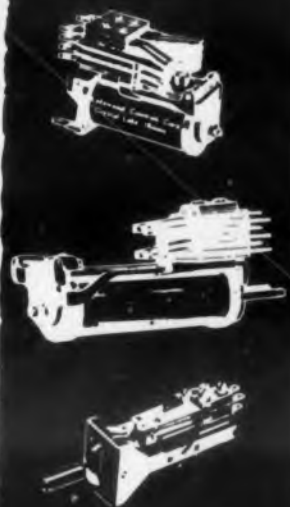
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RUSSIAN TRANSLATIONS

TELEVISION

Investigation of a Television Synchronization Flywheel System by Yu. N. Bakayev. REE 2/58, pp 227-236, 9 figs.

Generalized equations are derived for synchronization by pulse signals. A detailed investigation is made of a sawtooth and sinusoidal generator. The author also considers synchronization of a sinusoidal generator by discrete signals, and proposes a procedure for its design. Reference is made to work by W. G. Gruen, Theory of AFC Synchronization, *Proceedings IRE*, 1953, 8, 1043-1047, and T. S. George Synchronizing Systems for Dot-Interlaced Color Television, *Proceedings IRE*, 1951, 2, 124-131.

Operation of Television Sets in 1957 by A. Kanayeva. R 2/58, pp 32-35, 1 fig, 2 tables.

Lists all the television sets produced in the USSR and gives some statistical data on operating failures and repairs necessitated in three most popular sets, as well the causes of these failures.

ANTENNA

Disk and Cone Antenna by V. Batayev. R, 8/58, pp 34, 4 figs.

Description of an umbrella type antenna for 144-146 Mc, having a circular pattern in the horizontal plane and a vertical pattern. The disk is made of 1.5 mm duraluminum 370 mm in diameter. Eight ribs are used, each made of aluminum tubing 8 mm in diameter and 74 cm long. A coaxial cable (II) is used to feed the antenna.

PROPAGATION

General Formulas for the Field Produced by a Dipole with Arbitrary Orientation, Located over Plane Homogeneous Earth by L. S. Tartakovskiy. RE 4/58, pp 36-44, 1 fig.

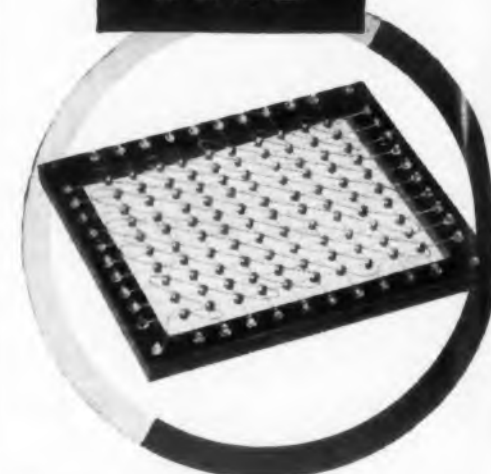
The author gives and analyzes general field formulas in the radiation zone produced by the vertical and horizontal electrical dipoles located over a plane homogeneous earth. The features of the propagation of radio waves over a region with a surface deposit of iron ore are indicated.

Stability of the Field Intensity over Sections of Radio Relay Lines by A. I. Kalinin. RE 1/58, pp 22-28, 8 figs.

The author plots curves for the stability of the field intensity on sections of radio relay lines. He uses the known dependence between the attenuation factor on the vertical gradient of the dielectric constant of air and on the statistical

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distribution of the values of this gradient in the region where the given section of the line is located. Equations are derived for the curves of optimum stability of field intensity. Numerical results are given for the climatic conditions of the middle zone of European portion of the USSR.

Secondary Diffraction Electromagnetic Waves by a Disc by P. Ya. Ufimtsev. JTP 3/58, pp 583-597, 6 figs.

The diffraction produced by a disc is analyzed with account of the interaction of the edge currents. Expressions are obtained for the fields scattered by the disc in the form of spherical waves from two points on the rim of the disc. The way each wave is rediffracted on the disc is examined.

Radiation of a Hertz Dipole on the Urge of an Ideally-Conducting Wedge by A. I. Potekhin and L. B. Tartakovskii. REE 5/58, pp 592-602, 8 figs.

The method proposed in the preceding article in the same issue is used to find a closed-form solution for the components of the field vectors and current density on the phases of an ideally-conducting wedge excited by a Hertz dipole located on the edge of the wedge. It is shown that if the wedge has a sharp angle, an "edge wave" propagates along the edge of the wedge. This wave is pronounced most clearly in the case of a half plane.

Calculation of the Equivalent Parameters of an Inhomogeneous Ground with Allowance for the Surface Effect by P. G. Gorodetskiy. EC 4/58, pp 59-62, 2 figs.

Formulas are derived for the calculation of the equivalent resistance and inductance of the earth as the return lead for an axially-symmetrical system for the transmission of electromagnetic signals, with allowance for the surface effect. The irregularities of the ground are taken into account conditionally by assuming it to contain two inhomogeneous coaxial layers. The calculation formulas are simplified for the cases of low and high frequencies.

Contribution to the Theory of a Double Block of Slot Resonators by M. F. Stel'makh. RE, 8/58, pp 30-36, 4 figs.

The propagation of waves in a double block of slot resonators was treated by Pierce "Traveling Wave Tubes" and Brillouin's "Waveguides for Slow Waves," (*Journal of Applied Physics*, Vol. 19, No. 4, 1948). It was found that both symmetric and anti-symmetric waves can propagate in such a system. In the former case the frequency band in which slow waves exist is

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broader than in the latter case, but the longitudinal electric field vanishes in the space between the blocks in the case of anti-symmetric waves for all spatial harmonics, while for the harmonics of the symmetrical waves this field is nonvanishing.

A longitudinal shift of one block relative to the other produces a field structure that is more suitable for the odd harmonics of the anti-symmetric waves, from the point of view of interaction with the electron beam. The results can be used for the design of traveling wave tubes and backward wave tubes in which the interaction between the electric electron beam and the odd-harmonic field is used.

Contribution to the Determination of Losses of Magneto-Dielectric Materials at Microwave Frequencies by V. N. Aksenov. REE 1/58, pp 156-157.

The author derives approximate formulas for the total losses of magneto-dielectric materials when these losses are small, using the results of only one short-circuit measurement (or only one open-circuit measurement). This makes it possible to select a specimen thickness to insure sufficient accurate measurement of the SWVR in the slotted line.

MISCELLANEOUS

List of References on Magnetic Amplifiers and Contactless Magnetic Elements by G. V. Subbotina. AT 4/58, pp 379-388.

Extensive survey of the literature, published mostly in 1956-1957, on magnetic materials, design of nonlinear magnetic circuits, magnetic amplifiers, magnetic contactless elements, and descriptions of commercial devices.

Radio Receiver "Voskhod" (east) by Ye. Dryzgo and Ya. Leven. R, 5/58, pp 23-24, 3 figs.

This all-transistor radio is designed for un-electrified rural communities and apparently no portability or miniaturization was intended. It measures 222 x 282 x 158 mm and weighs 3.5 kg. It is supplied by four 1 1/2-volt dry batteries.

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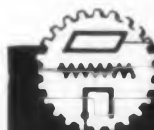
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power and 110 ma at maximum power. The service life of the batteries is about 80 hours. Provision is made also for a phonograph pickup with a sensitivity of approximately 100 mv.

Aerial Defense Radar Techniques by K. Trofimov. R 2/58, pp 27-31, 11 figs.

Popular articles showing various types of radar equipment for the detection of incoming enemy planes and various techniques for tracking and destroying the incoming targets.

Certain Properties of Optical Converters in Radio Engineering by S. I. Borovitskiy. REE 2/58, pp 237-243, 3 figs.

Although the use of optical devices in radio engineering is quite common (recording of electric oscillations, generation of oscillations of specified waveform with light modulated in some manner, etc.), such devices seldom offer outstanding advantages. In many cases they can be replaced by mechanical or magnetic devices. Recent efforts, however, in the direction of employing optical devices for statistical and communication analysis (Kretzmer, *Bell System Technical Journal*, 1952, 31, 7, 751; Schreiber, *Convention Record IRE*, 1953, 4, 35; Oliver, *Bell System Technical Journal*, 1952, 31, 7, 724) use of optical converters for simultaneous analysis of signals using various features (such as the aggregate of spectral components of the signal, the aggregate of the delays of a signal of specific form, or the aggregate of signals of different forms). The author discusses several optical devices from this point of view.

KEY

The sources of the Russian articles and their dates of issue follow the authors' names. Here is the key to the names of the journals in which the articles originally appeared.

- AJ** Acoustic Journal (*Akusticheskiy Zhurnal*)
- AT** Automation and Telematics (*Avtomatika i Telemekhanika*)
- CJ** Communications Journal (*Vestnik Svyazi*)
- EC** Electrical Communications (*Elektrosvyaz*)
- IET** Instruments and Experimental Techniques (*Pribori i Tekhnika Eksperimenta*)
- JTP** Journal of Technical Physics (*Zhurnal Tekhnicheskoy Fiziki*)
- ME** Measurement Engineering (*Izmeritel'naya Tekhnika*)
- RE** Radio
- R** Radio Engineering (*Radiotekhnika*)
- REE** Radio Engineering and Electronics (*Radiotekhnika i Elektronika*)



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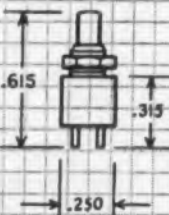
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MEETINGS

Calendar of Events

December

26-31 Annual Meeting American Assoc. for Advancement of Science, Washington, D.C.

January

12-14 5th National Symposium on Reliability and Quality Control, Philadelphia, Pa.*

26-29 27th Annual Meeting Institute of Aeronautical Sciences, New York, N.Y.

27-30 15th Annual Technical Conference (SPE), New York N.Y.

28-29 1st International Symposium on Nuclear Fuel Elements, New York, N.Y.

29-30 Long Distance Transmission by Waveguides (IRE), London

February

1-6 AIEE Winter General Meeting, New York, N.Y.

2-6 ASTM Committee Week, Pittsburgh, Pa.

3-5 14th Annual Technical and Management Conference, Chicago, Ill.

8-14 National Electrical Week, New York, N.Y.

12-13 Transistor and Solid State Circuits Conference, Philadelphia, Pa.

17-20 6th Annual Western Convention, Audio Engineering Society, Los Angeles, Calif.

March

3-4 Western Joint Computer Conference, San Francisco, Calif.

5-6 Flight Propulsion Meeting, Cleveland, Ohio.

5-7 Second Western Space Age Conference and Exhibit, Los Angeles, Calif.

16-20 National Meeting American Inst. Chemical Engineers, Atlantic City, N.J.

17-21 8th Electrical Engineers' Exhibition, London

23-26 IRE National Convention, New York, N.Y.

26 15th Annual Quality Control Clinic, Rochester, N.Y.

30- April 1 Electrical Industry Show, Chicago, Ill.

31-

April 2 21st American Power Conference, Chicago, Ill.

31-

April 2 Symposium on Millimeter Waves, New York, N.Y.

April

5-10 5th Nuclear Congress, Cleveland, Ohio

6-8 3rd Annual Astronautics Symposium, Washington, D.C.

6-9 16th Annual British Radio and Electronic Component Show, London

8-10 AIEE Southern District Meeting, Atlanta, Ga.

14-15 Electric Heating Conference (AIEE), Philadelphia, Pa.

16-18 Southwestern IRE Regional Conference and Electronics Show, Dallas, Tex.

*Indicates meetings herewith described.

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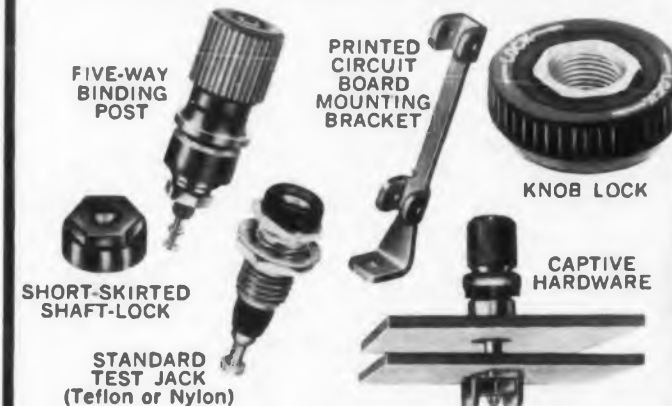
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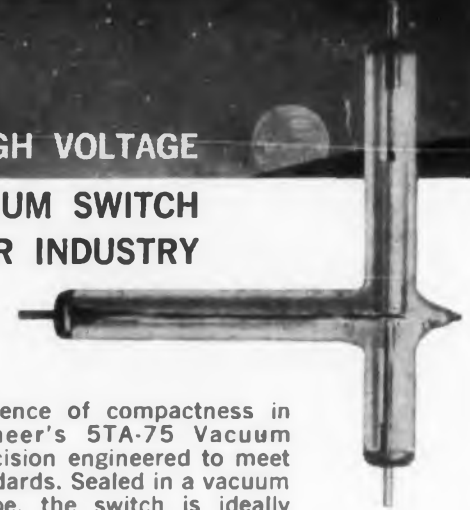
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CIRCLE 258 ON READER-SERVICE CARD

5th National Symposium on Reliability and Quality Control, Jan. 12-14

Bellevue-Stratford Hotel, Philadelphia, Pa. The program this year attempts to show the transition of experience in the reliability art. Highlighted are new design techniques and the greater use of transistors; cost considerations, and management's part in a reliability program; quality control techniques, measurement of reliability; quantitative treatment with progress in the mathematical theory of reliability; and field reliability and maintainability. The program is listed here.

Mon. a.m., Jan. 12

Reliability of Transistorized Equipment

- Transac S-2000—A Case History
R. J. Segal, Philco Corporation
- Reliability Evaluation of Silicon Transistors
K. W. Davidson, Texas Instruments, Incorporated
- An Approach to Transistorized Equipment Design
O. Golubjatnikov, General Electric Company

Cost of Reliability

- Support Costs vs Reliability and Maintainability
H. D. Voegtlen, RCA Service Company
- A Reliability-Cost Optimization Procedure
P. R. Gyllenhaal, Radio Corporation of America
- Experiments to Expose Marginal Reliability Designs
W. R. Kuzmin, Minneapolis-Honeywell Regulator Co.

Mon. p.m., Jan. 12

Military/Industry Reports

- Putting the R & D Reliability Dollar to Work
G. N. Beaton, Hughes Aircraft Company
- Minuteman Missile Reliability Requirements
S. C. Morrison, Ramo-Wooldridge Corporation
- Reliability Program for an Analog Computer
H. M. Davis, Sperry Gyroscope Company
- AN/ARC-58 Reliability Program Case History
R. L. Vander Hamm, Collins Radio Company

Mathematical Theory

- Methods for Evaluating Reliability Growth
M. H. Saltz, Hughes Aircraft Company
- Reliability Starts with the Design
Dr. I. R. Whiteman, General Analysis Corporation
- Significance Tests of Effects of Wearout Failures
Dr. J. H. Smith, Vitro Laboratories
- Acceptance Sampling with New Life Test Objectives
Dr. M. Sobel, Bell Telephone Laboratories

(Continued on following page)

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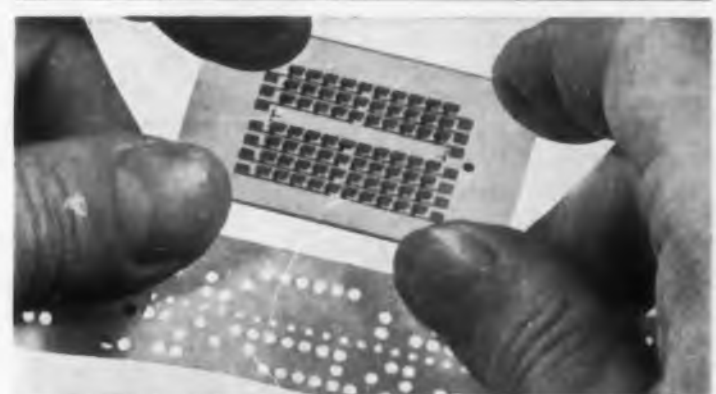
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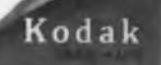


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MEETINGS

Reliability Definitions Panel

C. M. Ryerson, Radio Corporation of America, Moderator

Tues. a.m., Jan. 13

Reliability Training and Education

System Operational Effectiveness
H. G. Friddell, Boeing Airplane Company
Reliability Education in Academic Curricula
G. A. Henderson, Army Rocket & Guided Missile Agency
The ASQC-IRE Reliability Course
F. M. Gryna, Jr., ASQC-IRE (The Martin Company)
Reliability Design Tools for Engineers
J. J. Kaufman, Boeing Airplane Company

Quality Control Techniques

A Critique of the Defect Classification Technique
C. J. Brzezinsky, Ofc. Ass't. Sec. of Def., (S & L)
Determining AQL by Linear Programming
G. H. Sandler, Raytheon Manufacturing Company
Experimental Design for a System Error Analysis
L. H. Chapin, Minneapolis-Honeywell Regulator Company
Economically Optimum Receiving Inspection
M. Goetz, Westinghouse Electric Corporation

Tues. p.m., Jan. 13

Techniques for Reliable Design

Mechanical Design Review—A Tool for Reliability
H. I. Dwyer, Bendix Aviation Corporation
Radio Frequency Compatibility Affects Reliability
L. W. Thomas, BuShips, U. S. Navy
Reliability Through Adequate Specification
A. R. Park, Westinghouse Electric Corporation
Reliable Valves & Performance in Service Equipment
K. Hopkinson, British Ministry of Supply

Field Reliability and Maintainability

Predicting Electronic Equipment Availability
J. W. Thomas, Vitro Laboratories
Cost, Reliability, and Replacement Analysis
Dr. E. L. Welker, ARINC Research Corporation
Selection of Spare Parts Using Part Failure Data
Dr. G. Black, Sylvania Electric Products Inc.
An Analysis of the Operator-Equipment Relationship
R. C. Horne, Jr., ARINC Research Corporation

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Symposium Reception

Capt. David R. Hull (USN, Ret.)
"Is Your Customer Satisfied?"

Wed. a.m., Jan. 14

Reliability Tests & Measurements

Accelerated Life Test for Composition Resistors
B. C. Spradlin, Battelle Memorial Institute
Economical Methods for Life Testing Parts
L. Knight, British Tabulating Machine Co., Ltd.
Designing Combined Environmental Tests-to-Failure
V. L. Grose, Boeing Airplane Company
Prediction, Test, & Field vs Lab Reliability
R. G. Stokes, Vitro Laboratories

Reliability Management

Bullpup Reliability & The Project Team Concept
G. R. Eagle, The Martin Company
Organizing Dynamically for Reliability
W. R. Kuzmin, Minneapolis-Honeywell Regulator Company
Measurements Engineering—A Key Reliability Tool
J. A. Connor, Hughes Aircraft Co.
Time Phasing of a Reliability Program
G. Ashendorf, Radio Corporation of America

Mon. p.m., Jan. 12

Tutorial Session on the Fundamentals of Reliability

Basic Reliability Considerations
M. P. Feyerherm, Radio Corporation of America
Statistics for Prediction and Analysis
Dr. G. R. Herd, Booz Allen Applied Research, Inc.
Effective Reliability Management
M. M. Tall, Radio Corporation of America
Data Collection and Evaluation
D. W. Sharp, ARINC Research Corporation
Panel Discussion—A review of the session by the Moderator and Speakers, with audience participation.

Solid State Circuits Conference, Feb. 12-13

Hotel Sheraton, Philadelphia, Pa. Sponsored by IRE, AIEE, and Univ. of Pennsylvania. Devoted to transistor circuit technology, applications, and circuit techniques of a variety of solid state devices.

Paper Deadlines

Jan. 15: Deadline date for submission of titles to be presented at the 1959 National Telemetry Conference, May 25-27, in Denver, Colo. Final manuscript deadline is March 19. Further information from L. Scott Bailey, American Rocket Society, Inc., 500 Fifth Ave., New York 36, N.Y.



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