

ELECTRONIC DESIGN

JANUARY 1957

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Flat Selenium Rectifiers page 48



NEW
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Superior Power Resistor Features in a Low Cost 5-Watt Unit

The new IRC PW-5 Wire Wound Resistor now opens up new possibilities for miniaturization and cost savings in resistance capacitance filters, radio and TV circuits, bridge circuits, attenuator networks, and many other circuits. With this new 5-watt resistor, you can now obtain the superior insulating and high temperature characteristics as

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LOOK AT THESE FEATURES

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Wherever the Circuit Says



CIRCLE 1 ON READER-SERVICE CARD FOR MORE INFORMATION

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ELECTRONIC DESIGN

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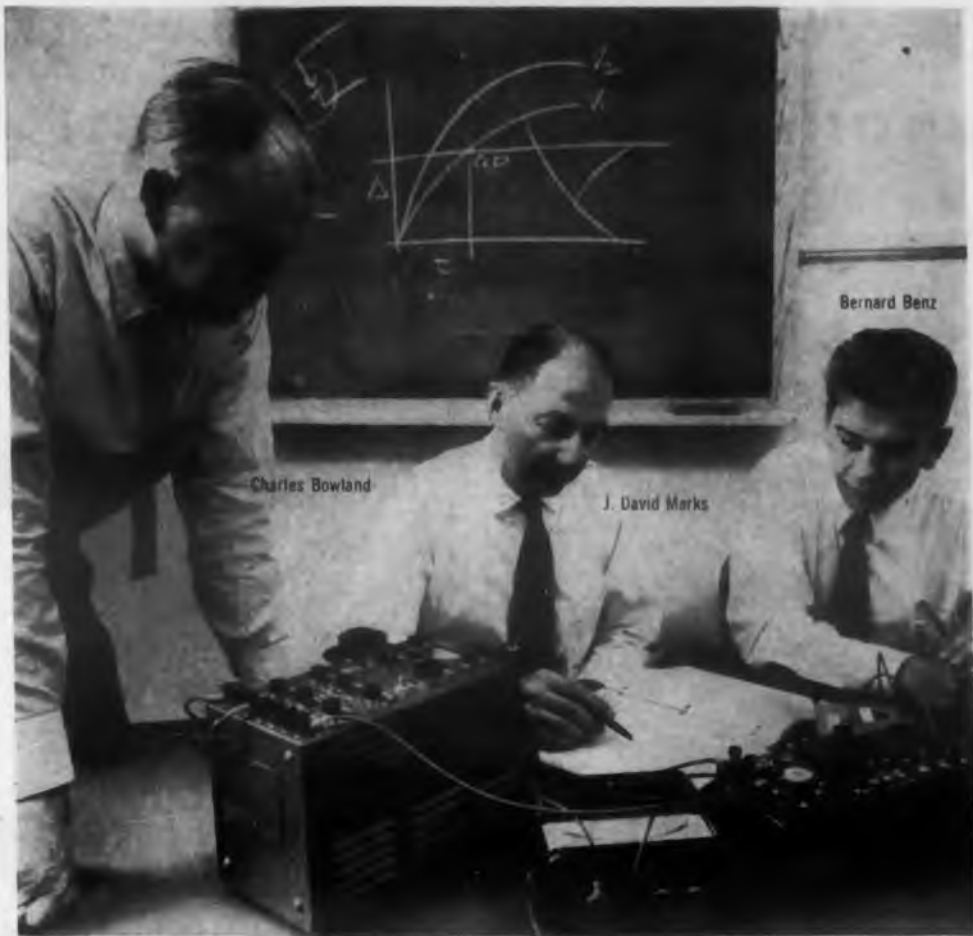
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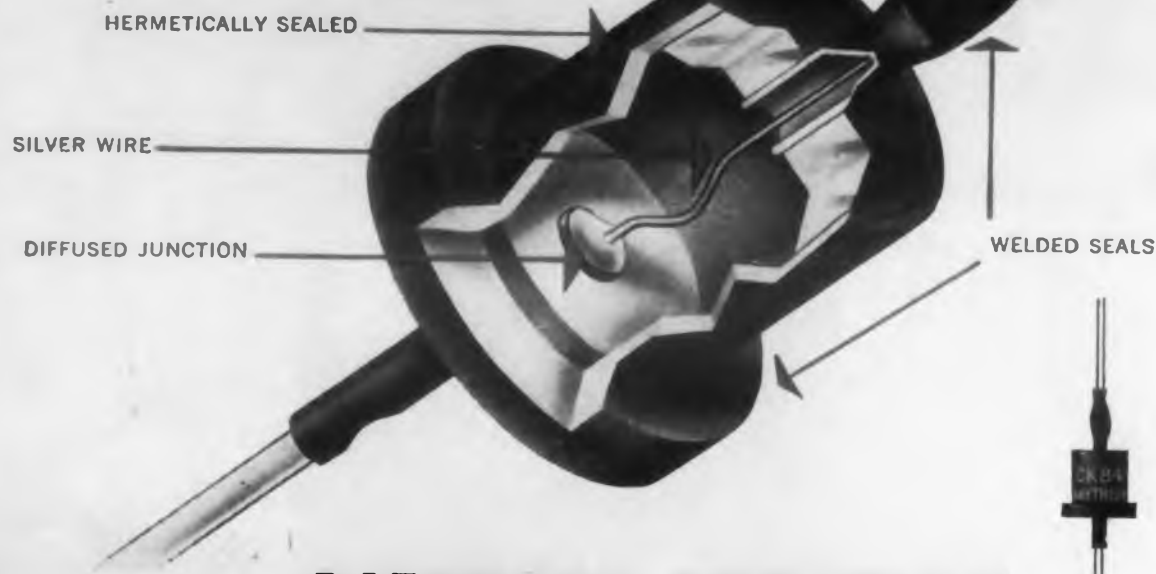


CIRCLE 2 ON READER-SERVICE CARD FOR MORE INFORMATION

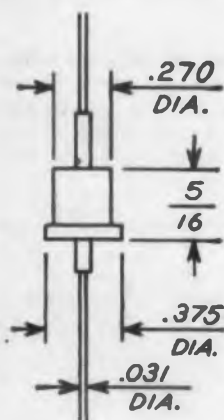
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Type	Peak Inverse Volts*	Forward Current** milliamperes		Forward Volts*** at 350 mA 100°C	Reverse Current*** (max.) mA at rms volts 100°C
		100°C	150°C		
CK840	100	350	100	0.75	0.2 at 70
CK841	200	350	100	0.75	0.2 at 140
CK842	300	350	100	0.75	0.2 at 210
CK843	400	350	100	0.75	0.2 at 280
CK844	500	350	100	0.75	0.2 at 350
CK845	600	350	100	0.75	0.2 at 420

*PIV ratings apply from -65°C to +150°C

**Into inductive or resistive load

***Averaged over one complete cycle



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CIRCLE 3 ON READER-SERVICE CARD FOR MORE INFORMATION

Editorial

Printed Circuits Ground Planes

Automatic flight control has practically eliminated the need for pilots. Yet a fatigued pilot with a few loose "nuts" and "screws" can do a better job of keeping a plane in the air than an automatic pilot with a loose connection. Vibration may simply annoy a pilot; it can "fatigue" soldered joints and flake a printed circuit. So much so that a circuit will open up. It will open at least for a time. Evidence is accumulating that shows that plated-through holes, of some vendor's products, sporadically become broken circuits. Electrical discontinuity occurs even though visually the circuit is perfect. A few unpredictable occurrences are enough to ground every wing that uses so and so's circuit boards. According to reports we are getting, this is happening.

Although the trend is definitely towards use of more and more printed circuits, some engineers, in desperation, are anticipating reverting to hook up wire. According to the disillusioned, no simple test has been devised to predict the reliability of a printed circuit. Lack of standards, even lack of data on what should be a standard, and lack of test equipment to predict product reliability literally has the design engineer flying by the seat of the pants when it comes to specifying printed circuits. This is intolerable to the military and certainly not good enough in a society becoming more and more dependent on machines operating on an ever-increasing duty cycle. Although much has been written on the excellent reliability of plated-through holes, either the word has not gotten to all users, or not all manufacturers are making reliable boards.

What should be done? Encouraging is the fact that the printed circuit industry is facing up to its responsibilities. An association of manufacturers is now being set up to evolve standards. An announcement of this group's formulation and plans are expected within a month. Establishing standards will be no easy job, as new developments in making printed circuits are constantly taking place. They must be evaluated. Users' needs and requirements must be made known to manufacturers in the first place. All can help.—JAL

Engineering Review

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

"Whiskers" Cause Short Circuit

Atomic radiation spurs the growth of hairlike metallic strands—called "whiskers"—on metal. More than five years ago, Bell Telephone Laboratory scientists found that microscopic metal "whiskers" had literally grown on some types of telephone equipment and had caused short circuits.

Recently small, needle-shaped synthetic crystals of germanium and silicon have been grown. These and other whiskerlike crystals have been demonstrated to possess great strength.

Some time ago samples of tin were placed in the reactor at the Brookhaven National Laboratory and removed a month later. Examined recently after a year of "cooling off," the irradiated samples were found to have grown more "whiskers" than identical ones not exposed to radiation.

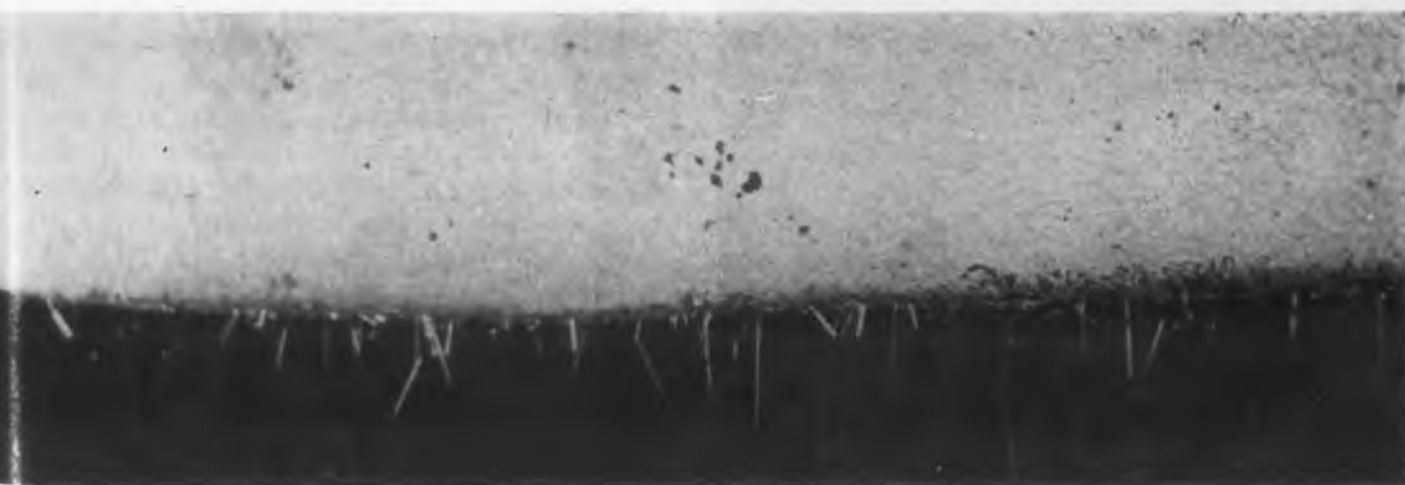
While whisker growth is a new field of research, there have already been tangible results in the form of recommendations concerning the use of some metals. Whisker-proof plating metals are used in the

metal "can" assembly of the transistor. Bell Lab. scientists found whisker growth on platings of zinc, tin and cadmium used as finishes in telephone apparatus. In extensive tests, gold was found to be whisker-free under operating conditions.

Whisker research really began with a specific case of trouble-shooting on a long distance telephone circuit. The culprit was found to be a device called a "wave-filter," important in making possible dozens of conversations simultaneously over a single telephone circuit.

One of the filter's components, a capacitor, had developed an unexplained "ground." An alert engineer scrutinized the capacitor in a strong light with a magnifier. Something glinted. What looked like lint, but much finer, connected a "hot" terminal of the capacitor to a nearby mounting bracket 3/16 of an inch away, which was "grounded."

The tiny strand had conducted to "ground" the electricity that was intended to carry voices. Investigation showed that the zinc-coated bracket had grown electrically conductive whiskers.



Ordinary tin-plated metal with whiskers as it appears through a microscope. The whiskers, which are single crystals of tin, range up to 3/16 of an inch in length and 80 millionths of an inch in diameter.



Memory Handles Millions of Items: A tiny perforated plate (insert upper left) is the heart of a new electronic memory system. It will enable electronic computers to store a million bits of information in a space no larger than a shoe box and to recall any or all of them in millionths of a second. Dr. Rajchman, Radio Corporation of America, the inventor, is shown holding a sample 2560 bit memory unit of the new type.

The device lends itself to extremely simple molding production techniques. This development should permit the design and construction of larger and more versatile electronic computers and data processing systems. It will at the same time provide a compact and economical type of memory for relatively small computing equipment.

The new aperture plate memory stores information in the form of magnetic fields. One of the two values is represented by a magnetic flux in one direction around a hole in the platter, while the other value is represented by a magnetic flux in the opposite direction.

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CIRCLE 4 ON READER-SERVICE CARD FOR MORE INFORMATION

Punched-Card Control Lathe

It is now possible for manufacturers to speed production cycles by going directly from process drawings to finished pieces.

Experiments conducted by the Sundstrand Machine Tool Co. show that application of the recently-developed General Electric numerical positioning control to a production lathe has made it practical to punch control cards directly from process drawings. Once the cards are punched, direct production operations are then possible.

The rapid changeover capable with this set up is especially significant on small lot jobs. When a changeover in cutting a different piece or cutting an entirely new piece is made on an ordinary lathe, the change may require many minutes. Change time for a comparable job on the Sundstrand Model 14 is only the time required to change the deck of cards.

Tests have shown that one man can efficiently operate as many as five punched-card-controlled lathes simultaneously, depending upon the cutting cycle. Moreover, the operator can adjust the lathes for a wide variety of pre-programmed jobs merely by changing the control cards which direct the machine's operation.

Safe Seeing—Pleasant Lighting

"How much light is required to see objects effectively, safely and comfortably?"

Finding an answer to this question was a primary objective of a symposium on "Light, Seeing and Living" conducted by the Illuminating Engineering Research Institute recently at Cornell University, Ithaca, N.Y. It continues to be the basis for more than a dozen research projects now being sponsored by the Institute.

Among the speakers was Dr. Sylvester Guth of the General Electrical Company, Cleveland, who reported on tests which showed that persons in the middle-age bracket require more light for comfortable and effective seeing than do young people.

"A person approaching the 45-year age level requires a sharp increase in light to do with equal efficiency and safety the same job he did 10 or 15 years earlier," Dr. Guth said. He also established that discomfort glare depended upon the field brightness to which the subject was adapted, the brightness of the glare source, the size of the source and its position in the field of view.

Using this formula, he reviewed a proposed glare evaluation formula developed for use in evaluating interior lighting and establishing the "maximum glare index" that may be accumulated from a series of light sources without creating a "discomfort glare."

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Color TV for Surgery: To eliminate interference with surgery or demonstrations, RCA's medical TV camera (TK-45) is designed for horizontal installation in overhead fixture which supports both camera and surgical lamp. Camera peers into mirror which reflects optical path downward through opening in surgical lamp. Remotely controlled, mirror can be panned and tilted to change viewing field without moving camera or lamp. If lamp is moved, camera's optical path automatically moves to coincide with change in lighting path.

Sylvania Joins Corning

Sylvania Electric Products Inc. and Corning Glass Works have formed a jointly-owned company for the purpose of expanded research, development, and production activities in the atomic energy field.

The new organization, to be known as the "Sylvania-Corning Nuclear Corporation," will be incorporated in Delaware and Sylvania and Corning will each own one-half of the company's stock. Atomic energy business of both companies will be taken over by the new organization.

Except for Sylvania's Hicksville facility, which will continue in operation as a part of the new organization, research, development, and production activities of the new company will be located in extensive new facilities to be constructed in the near future at one of several sites now under consideration in the Northeast. More than 50 sites have been investigated, from which the final selection will be made shortly.



Lesson from a bee...

The cell structure of a honeycomb inspired this ingenious klystron grid-making technique. Pioneered and perfected by Varian as a mass production process performed chiefly under microscopes, it consists of forming a bundle of fine copper-plated aluminum wires into a solid, honeycomb-like structure . . . then etching out the aluminum.

The end product is a pure copper grid having extremely low microphonics, high power handling capacity and great rigidity . . . essential requirements for airborne klystrons.

Of all known methods, this has proven the *only* one that assures optimum grid performance and reliability under conditions of extreme shock and vibration. Painstaking techniques like this typify Varian's manufacture of more than 60 different klystrons for every application.



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CIRCLE 5 ON READER-SERVICE CARD FOR MORE INFORMATION

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NEW "HOME REPLY FORM" BECOMES PART OF READER SERVICE CARD

Inquiries relating to employment can now be routed directly to your home. ELECTRONIC DESIGN'S new Reader Service Card carries a special "Home Reply Form" with space for your home or non-business address. If you wish to reply to any of the employment opportunities listed in ELECTRONIC DESIGN'S "CAREERS SECTION", simply circle the appropriate number in the gray area of the card . . . then fill in your home address in the space provided at the bottom of the card. The privacy of your inquiry is protected, while still offering you the speed and efficiency of ELECTRONIC DESIGN'S reader service card system.

Jan. 15th, 1957

ELECTRONIC DESIGN

(Use before Feb. 28th, 1957)

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Company

Company Address City Zone State

For Change of Address: Old Company Name

Old Company Address City Zone State

	10	20	30	40	50	60	70	80	90	300	310	320	330	340	350	360	370	380	390
1	11	21	31	41	51	61	71	81	91	400	410	420	430	440	450	460	470	480	490
2	12	22	32	42	52	62	72	82	92	500	510	520	530	540	550	560	570	580	590
3	13	23	33	43	53	63	73	83	93	600	610	620	630	640	650	660	670	680	690
4	14	24	34	44	54	64	74	84	94	700	710	720	730	740	750	760	770	780	790
5	15	25	35	45	55	65	75	85	95	800	810	820	830	840	850	860	870	880	890
6	16	26	36	46	56	66	76	86	96	900	910	920	930	940	950	960	970	980	990
7	17	27	37	47	57	67	77	87	97	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090
8	18	28	38	48	58	68	78	88	98	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
9	19	29	39	49	59	69	79	89	99	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290
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101	111	121	131	141	151	161	171	181	191	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490
102	112	122	132	142	152	162	172	182	192	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
103	113	123	133	143	153	163	173	183	193	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690
104	114	124	134	144	154	164	174	184	194	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
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107	117	127	137	147	157	167	177	187	197	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090
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109	119	129	139	149	159	169	179	189	199	2200	2210	2220	2230	2240	2250	2260	2270	2280	2290
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202	212	222	232	242	252	262	272	282	292	2500	2510	2520	2530	2540	2550	2560	2570	2580	2590
203	213	223	233	243	253	263	273	283	293	2600	2610	2620	2630	2640	2650	2660	2670	2680	2690
204	214	224	234	244	254	264	274	284	294	2700	2710	2720	2730	2740	2750	2760	2770	2780	2790
205	215	225	235	245	255	265	275	285	295	2800	2810	2820	2830	2840	2850	2860	2870	2880	2890
206	216	226	236	246	256	266	276	286	296	2900	2910	2920	2930	2940	2950	2960	2970	2980	2990
207	217	227	237	247	257	267	277	287	297	3000	3010	3020	3030	3040	3050	3060	3070	3080	3090
208	218	228	238	248	258	268	278	288	298	3100	3110	3120	3130	3140	3150	3160	3170	3180	3190
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Begins on page 110 this issue

Hayden Publishing Company, Inc.

IBM Machines For Sale

In accord with an anti-trust ruling, effective January 1, 1957, IBM must now offer for sale machines formerly available solely on a rental basis. Renters of IBM machines will have the chance to put their rental fees towards the sale price, should they decide to buy. The judgment also noted that the company will have to furnish training in the repair and maintenance of the machines for five years.

Rhenium Research

A two-year research program on the use of rhenium in electron tubes has been initiated at Battelle Institute, Columbus, Ohio.

The objectives of the program sponsored by the Air Force Cambridge Research Center, Cambridge, Mass., are to provide fundamental information about rhenium and to establish the extent to which rhenium may be used as electron-tube construction material. Some of the important facts about rhenium for electronic use are: it is highly resistant to the water cycle; it is ductile after elevated temperature cycling; and it does not form a carbide, even at elevated temperatures.

The good ductility rhenium exhibits after temperature cycling is in marked contrast to the brittleness of tungsten, which is commonly used as a heater material for electron tubes. As part of the current investigation, technologists at Battelle will evaluate rhenium's vibration resistance as a heater element when subjected to repeated temperature cycling.

110 Degree Picture Tube

A TV picture tube which is 20 per cent lighter than conventional tubes and has a 110 degree magnetic deflection will be available commercially before the end of 1956. Especially practical in portable TV sets, the tube is available in 14, 17 and 21 in. sizes. The 14 inch version, for example, weighs 6-1/2 lbs compared to 8-1/2 lbs for a 90 degree tube.

Shorter back-to-front length, as a result of the 110 degree deflection, permits more compact cabinets according to Sylvania Electric Corp., the manufacturer.

Basic design for the new light-weight line includes a 600 ma heater, aluminized screen, electrostatic focus, small (1-1/8 in.) neck diameter, ion trap, and external conductive coating. Optional variations available include a 450 ma heater, magnetic focusing is preferred, and versions in which the ion trap has been eliminated thus further shortening the tube and removing any necessity for an external trap magnet and its adjustment.

RCA has a 21 in. 110 degree tube which is 14-1/2 in. in depth but it has the heavier type face plate.



Type F: Miniature 12-position, 30-60° throw, can be mounted in 1-5/16" circle; phenolic, mycalex or steatite.



Type H: Standard 12-position; 1-7/8" diameter; 15-30-60° throw; phenolic, mycalex or steatite.



Types J, K, N: 1-17/64" diameter; provides for flexibility of layout; interchangeable sections, phenolic or steatite.



Type L or DL: Using dual eyelet fastening; 18-position; mounts in 2-9/32" circle; phenolic, mycalex.

Special Switches



Multiple Shafts combined to operate snap switches and potentiometers; many different section types.



Type MF: 24-position switch may be mounted in 3-5/16" circle; in phenolic insulation.



Series 20: Simple switch for tone controls, band switching, and talk-listen circuits.



For Printed Circuits: Special lug design for insertion into printed circuit boards.

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WRITE FOR your copy of the OAK Switch Catalog which covers the most popular of OAK's standard switches.

Type 160 Rotary Slider: 7/8" height allows shallow chassis; leads are readily accessible.



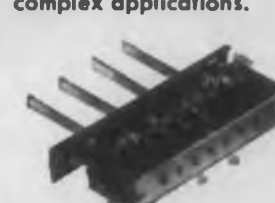
Type 120: New lower mounted version of the standard OAK rotary switch.



Type 130 Pushbutton: Available with from one to 24 buttons, 32 contacts each button.



Type 80 Pushbutton: Very adaptable. Used in communication equipment; economical for less complex applications.



CIRCLE 6 ON READER-SERVICE CARD FOR MORE INFORMATION

FINE WIRE OF DUCTILE AND NON-DUCTILE MATERIALS MEETS EVERY APPLICATION REQUIREMENT

BAKER's vast experience and research in metallurgy have made possible the development and production of fine wires of ductile and non-ductile materials to meet the expanding needs of industry. This know-how in metals has enabled BAKER to develop processes for bare drawing wire as fine as .0004". Where smaller fine wire is required, BAKER meets the need by employing the Wollaston process, when working with ductile metals, and the Taylor and Extrusion methods for non-ductile materials.

Extruded Wire of low fusing alloys can be supplied by BAKER in sizes down to .001". These have found application as protective fuses for instruments and can be supplied to fuse at any desired current. BAKER Wollaston Wire is produced with a length of bare drawn wire inserted into a close fitting tube of another metal, which is removed and dissolved by acid or other solvents before application. Both are drawn down to the desired size. BAKER Taylor Process Wire can be supplied in ductile and non-ductile materials. The metal or alloy is contained in an insulating material and both are drawn to the desired size. In this way, the metals or alloy core are not contaminated and are of exceptionally high purity. Sizes from .040" to .00004" are available. The chemical properties of BAKER precious metal Potentiometer Wire render it immune to corrosion and provide the high quality wire necessary for the delicate, precision potentiometer. Sizes as small as .0005" diameter, and enamelled to .001" diameter, can be supplied.

Write for complete catalog material and details.



PRECIOUS METAL CONTACTS resist chemical attack and effects of the electrical arc to provide long life, unvarying performance.

RHODIUM PLATING provides a hard, brilliant white, non-tarnishable surface extremely resistant to corrosive conditions.

PRECIOUS METAL RUPTURE DISCS resist corrosion and provide adequate openings to protect and relieve pressurized apparatus.

BAKER PRECIOUS METALS

BAKER & CO., INC.

113 ASTOR STREET, NEWARK 2, NEW JERSEY
NEW YORK • SAN FRANCISCO • LOS ANGELES • CHICAGO

ENGELHARD INDUSTRIES

RESEARCH MAINTAINS BAKER'S LEADERSHIP IN PRECIOUS METALS
CIRCLE 7 ON READER-SERVICE CARD FOR MORE INFORMATION

Man Friday for Project Engineer

An administrative assistant for a busy executive is not uncommon, but few businesses think of providing such an assistant to an engineering project leader. The Army's Engineering, Research, and Development Laboratories, (ERDL), Fort Belvoir, Virginia, is one of the first. A program called "Man Friday" has been under way for six months to combat manpower shortage—and squeeze more engineering work out of project engineers.

The composite Man Friday at ERDL has some technical college and enough experience to equal a degree in business administration. He may work for 8 to 14 project engineers, depending on the type of jobs and projects they control. More or less, he is a master of his actions; has the sole responsibility for budgeting his time to the satisfaction of his bosses.

More Accurate Weather Forecasts

Expected to climb to 90,000 feet, a plastic balloon was recently launched at Lowry Air Force base in Denver as part of an infrared testing program. The project, sponsored jointly by the Air Force and the University of Colorado is designed to collect information on infrared ray activity to perfect more accurate weather forecasting methods. One hundred and twenty-eight feet in diameter, the balloon carries 700 pounds of equipment aloft for 24 hours. The gear is then released by an automatic device and is parachuted to earth. Included in the experiment is the testing of an automatic constant temperature sink, a device designed to keep the sensitive instruments at a constant temperature of zero degrees centigrade.

Reps Announces Scholarship

A \$2000 annual scholarship for students of electrical engineering specializing in electronics has been announced by the Electronic Engineering Representatives.

The purpose of the scholarship is to emphasize the services that sales representation and field engineering perform in the electronic community and also to dramatize the advantages of an electronic field engineering career to young men interested in this science.

The EER scholarship is to be divided equally between a college in the territory served by the EER and a student who in the opinion of the faculty, best deserves its benefits.

The member companies, Burlingame Associates Ltd., Gawler-Knoop Company, G. Curtis Engel Assoc. Inc., RMC Associates, and I. E. Robinson Co. decided to award the scholarship in lieu of the usual Christmas gifts given to customers.

Missile Tester

RACE, an ultra-rapid missile tester enables mobile missile troops to test, troubleshoot, and service complex missile systems as they are emplaced at launching sites.

When trouble exists, RACE (Rapid Automatic Checkout Equipment) pinpoints the faulty components, flashes its location and replacement time on a console screen, and immediately delivers a computer punch card spotting the plug-in replacement to technicians.

According to the Sperry Gyroscope Co., Great Neck, N.Y., the tester precludes false answers by checking itself continuously during the missile checkout and confirming all answers at the master console. If trouble does occur within RACE, it warns the operator immediately, naming exact rack, drawer, and chassis location of its own faulty plug-in component for immediate replacement.

Emergency Lighting

A centralized emergency lighting system that constantly supervises itself has been tested and approved by Underwriters Laboratories.

The system reports, by flashing lights and buzzers, any fault—even removal of an emergency lamp from its socket. This built-in supervision makes it practically foolproof and gives full assurance that emergency lights will go on whenever regular power fails. The lights go off when power is restored.

A special 32 volt battery (which is good for 25 years) is automatically recharged and kept at full capacity by a constant trickle of charging current.

The emergency lighting system made by The Standard Electric Time Co., Springfield, Mass., has been especially designed for new hospitals, schools, office and industrial buildings.

Gyroscopes To Test Gyroscopes

Periodically, fire-control gyros must be removed from the aircraft and checked for accuracy. A special turntable for field testing the gyroscopes used in airplanes aboard aircraft carriers is being developed by the Westinghouse Electric Corporation's Air Arm Division, Baltimore, Md.

The table is gyroscopically controlled so that it holds independent of ship action. Gyroscopes to be tested are then mounted on the turntable. When the table is turned at a known rate and direction, the output of the gyroscope being tested can be checked. Maximum error in measurement is 1/170 of a degree per second. Single-degree-of-freedom gyroscopes of both rate and integrating types can be checked.



(Actual Size)
K3-SERIES

TRIPLE-POLE SWITCH

OPERATING CHARACTERISTICS

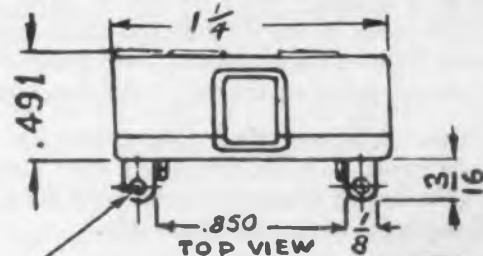
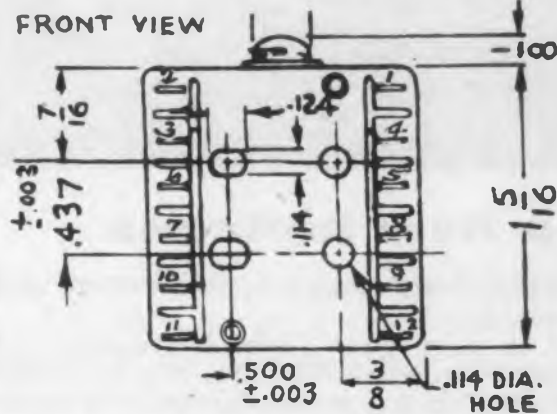
CONTACT ARRANGEMENTS:

K3-4—TRIPLE-POLE, DOUBLE THROW
K3-2—TRIPLE-POLE, NORMALLY OPEN
K3-1—TRIPLE-POLE, NORMALLY CLOSED

ELECTRICAL RATING:

15 AMP 125/250 V.A.C.
15 AMP 30 V.D.C. RESISTIVE
10 AMP 30 V.D.C. INDUCTIVE

PROBABLE MECH. LIFE.....1,000,000 OPS
PROBABLE ELEC. LIFE.....500,000 OPS
AMBIENT TEMP. RANGE.....-100° TO +275° F.*
*(-100° to +375° F. available)



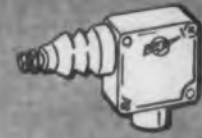
MODERN DESIGN
IN A COMPLETE LINE
OF SWITCHES



Sub-Miniature
Switch



Multi-Pole
Switches



One-Way Limit
Switch



Basic
Switch



Hermetically-Sealed
Limit Switches

CIRCLE 8 ON READER-SERVICE CARD FOR MORE INFORMATION

New **ELECTRO-SNAP** SIMULTANEOUS TRIPLE-POLE SWITCH

for interrupting 3-phase,
110 V, 400 cycle AC circuits

6-CIRCUIT CONTROL — in a small package.

Makes possible a wide variety of circuit combinations.

SIMULTANEOUS "MAKE & BREAK" ACTION

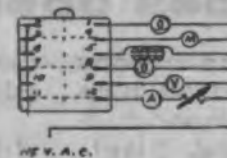
Permits unusual applications, reduces arcing, prolongs switch life and increases electrical capacity.

This completely new Electro-Snap triple-pole switch simultaneously reverses current flow through three windings of a 3-phase motor up to 1 H.P. and interrupts other types of multi-switching installations. Instantaneous snap-action of the three poles is independent of the speed of actuation — even extremely slow moving cams can be used.

The K3-Series offers designers a wide variety of 3-phase circuit hookups for servo-controls, to limit movement of machine members and as a start-and-stop switch which formerly were possible only with complicated relays or a number of separate switches. A large selection of standard actuators is available.

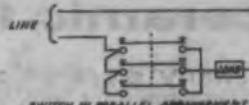
LOOK WHAT YOU CAN DO WITH IT!

Control Six Circuits
with ONE Snap

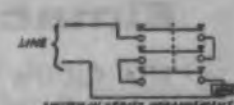


Used in motor control device switch, when actuated, turns on the red light on No. 1, the solenoid on No. 5, the voltmeter on No. 9 and turns off the motor on No. 4, the green light on No. 8 and the furnace and ammeter on No. 12.

Wire Movable Poles in Series for High Voltage
or in Parallel for High Current

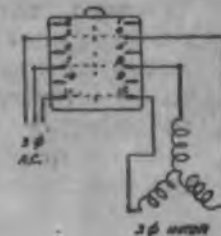


With the switch wired in parallel arrangement, the current is divided into 3 paths through the switch. This permits the switch to be used with a load rated up to 3 times the ampere rating of the switch.



In series arrangement, the current has only 1 path through the switch. The multiple breaks in the current path permits the switch to be used where the line voltage is rated up to 3 times the voltage rating of the switch; ampere rating not affected.

Start and Stop
Three-Phase Motors
Completely disconnect all current supplied to a 3-phase motor by interrupting 3 phases simultaneously with one snap.



ELECTRO-SNAP
SWITCH AND MFG. CO.

4216 West Lake Street • Chicago 24, Illinois



Eimac ceramic tubes open up new horizons

The future of many electronic applications depends on the ability of the electron tube to overcome extreme shock and temperature barriers. Anticipating this need, Eitel-McCullough has extended its leadership in transmitting tubes to the development and production of ceramic tubes in the negative grid, klystron, rectifier, and receiving tube field.

Aside from superior immunity to shock damage, ceramic permits new design concepts and optimum production techniques to be employed. The result is smaller, more reliable tubes.

In its new ceramic line, Eimac is enabling the electron tube to overcome old barriers

and establish new goals of performance and dependability.

What is your goal beyond present day horizons? With scientific certainty, you may look where you are going. But only dependable tools will enable you to go where you are looking. Make sure you have such tools. Check carefully the incomparable capabilities of performance-proved Eimac ceramic tubes.

For further information on Eimac's full line of electronic tubes, contact our Application Engineering Department and ask for the new Quick Reference Catalog.

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes



CERAMIC AMPLIFIER KLYSTRONS

3K2500SG	3K20,000LA	3K50,000LA
3K3000LQ	3K20,000LF	3K50,000LF
3KM3000LA	3K20,000LK	3K50,000LK
		3K50,000LQ
		4K50,000LQ

CERAMIC NEGATIVE GRID TUBES AND RECTIFIER

Triode	Tetrode	Rectifier
2C39B	4CX250K	2CL40A
	4CX300A	
	4X5000A	

CERAMIC RECEIVING TUBES

5C2A
33C3A2

100% Reliability Necessary

Reliability was stressed by panel members discussing new developments in electronics at the annual industrial preparedness meeting of the American Ordnance Association. Daniel E. Noble, leader of the panel said "until we equip our military forces with apparatus that functions successfully without the attentions of careful maintenance men, or corps of equipment nursemaid scientists, we are not ready for technological warfare." The importance of 100% reliability was further emphasized by Col. Meyer who pointed out that a failure of one single component in a missile could be disastrous. A misfire could destroy New York City. Other members of the panel were, Rear Admiral Rawson Bennett, Chief of Naval Research, Dr. William G. Pietempol, Director of Development, Bell Telephone Laboratories and Col. G. Gould, U.S.A.F.

Human Engineering

Radio Corporation of America will present a course in human engineering to its engineers engaged in design and development activities. The course will be administered by the Applied Psychological Services, Villanova, Pa., and represents a further attempt on the part of RCA to include human factor considerations in the design of man-machine systems.

Rotor Position Indicator

An electronic instrument that continuously measures the clearance between the rotating and stationary blades inside a steam turbine has been developed by the National Bureau of Standards. The detecting element of the system is a mutual-inductance micrometer probe.

It utilizes printed circuitry on a ceramic base that resists high-temperature steam erosion inside the turbine. Designed for the Navy Bureau of Ships by M. L. Greenough and J. Johansen of the Bureau's electronic instrumentation laboratory, this rotor position indicator will aid in the study of steam turbines under actual operating conditions.

◀ CIRCLE 9 ON READER-SERVICE CARD

Handbag Transistor Receiver

Developed along the lines of a handbag with a snap-open case, Sylvania is producing a seven-transistor receiver to be marketed early this year. These receivers employ only transistorized circuits. Market research studies indicate a favorable response to the new models.

Use of Computers in Medicine

Present day advanced computer technology holds promise of opening vast new frontiers for medical research. This statement emanated from the Research and Development Command (ARDC) sponsored symposium on the "Use of Computers in Medicine," held recently at the Argonne Cancer Research Hospital, University of Chicago. The symposium was designed to fashion a "meeting of the minds" between leaders in the computer and medical research fields.

ARDC is currently engaged in research on computers and their application in the development of aircraft. An effort to give the nation full benefit of the basic research and technological advances which have been made they have entered into the medical application of computers.

Mentive Award of 25 Kilobucks

Congratulations to Dr. William B. McLean, Technical Director of the Naval Ordnance Test Station, China Lake, California. His \$25,000 is the highest monetary award ever made by the government in recognition of an employee's superior accomplishment. The record-breaking award required the approval of the Secretary of the Navy, the Secretary of Defense and, finally, the Chairman of the Civil Service Commission.

Rear Admiral F. S. Withington, Chief of the Navy's Bureau of Ordnance, stated that Dr. McLean's efforts in the development of the Sidewinder missile have saved the Government an estimated \$46,000,000 the past year. This figure is based on comparison of costs with other air-to-air guided missile systems.



New 2½-acre Owensboro plant is fourth General Electric receiving-tube facility for serving TV manufacturers!

WELL over a million dollars in building costs have gone into General Electric's new receiving-tube factory on the outskirts of Owensboro, Ky. Another large investment is for advanced automatic machinery. Located on a 90-acre site, the plant itself is 500 feet long and 200 feet wide, with special ventilation and air-filtering to keep out dust and lint.

Here the tube needs of TV designers and builders are being met by new facilities unmatched in the industry. Here the prime targets are: still more dependable tube performance . . . even longer tube life . . . even greater values that help to keep down the curve of TV manufacturing costs.

Now, more than ever—from circuit stage through mock-up to receiver assembly—it will profit you to keep in touch with General Electric on *all* your tube requirements! *Electronic Components Division, General Electric Co., Schenectady 5, N. Y.*

Irvine D. Daniels (seated), general manager, General Electric receiving tube department, points out to three members of the G-E field commercial engineering staff—from central, western, and eastern regions—how facilities in the new plant are being systematically brought up to full production. ▼



Progress Is Our Most Important Product

GENERAL  ELECTRIC

162-1A1

CIRCLE 10 ON READER-SERVICE CARD ►

Talos Too Good: Tests Cut

At the recent American Ordnance Association meeting in New York Admiral Burke announced that developmental tests on guided missile Talos have had to be severely curtailed because of the large number of drones downed in such tests.

Curtailing of the test is an indication that direct hits are being made with remarkable regularity.

Navy Engineers Study Management

Senior engineers, scientists and training officers of the Navy Depts. in the Washington area and the Engineering School of George Washington University have worked out an evening educational 3-year program in management which leads to the degree of Master of Engineering Administration.

The student is permitted, within a specified framework, to select his own courses in the realm of human relations, communications, finance and management.

Borne wholly by the student, the present total cost is \$600, on a pay-as-you-go basis in proportion to the courses taken.

Life Test Set

An interesting solution to the problem of mass data taking is the Model 815, 1000 specimen capacity, automatically recording life test set.

It accomplishes fast, accurate mass life testing of vacuum tubes, transistors, and other electronic equipment.

The testing equipment developed by Systems Development, Inc., Binghamton, New York, provides a high degree of automation.

It will perform simultaneously many different types of tests with an automatically commanded digital readout of information about all specimens.

The total system capacity is 1000 specimens. An initial installation for 200 specimens may be increased in multiples of 200 as need arises, until full capacity is reached.

CIRCLE 11 ON READER-SERVICE CARD ►



ANODIZED COLOR CODING has been applied to the 1957 line of Rheem plug-in products including the power amplifiers, power supplies and voltage regulators. This identification increases the user's production line and maintenance efficiency.

RHEEM ELECTRONIC PRODUCTS CHOSEN FOR RUGGED RELIABILITY!



SUPERSONIC LOCKHEED X-7, shown with Marquardt powerplant installed, was recently revealed as a stratospheric test-bed for powerful new engines under test for U.S.A.F. missiles. The needle-nose X-7, which is launched from a B-29, is parachute recovered after each flight so that it may be flown again. Rheem power amplifiers form a part of the electronic control system of the X-7.

Now it can be told.

Three more top airforce weapons depend upon Rheem amplifiers and power supplies to provide dependability in a minute package. Here is electronics engineering at its best... a complete line of packaged components produced for individual or combined use in the rugged environmental conditions common to modern weapons system applications. Rheem's new electronic plant, with seasoned, experienced engineering and production personnel, is equipped to handle your individual requirements for off-the-shelf or special purpose electronic components.

A NORTHROP SNARK, inter-continental guided missile, roars from its launching cradle at a U.S.A.F. base to begin a long range test flight over the Atlantic ocean. The Snark, which couples inter-continental range with the ability to carry a first priority warhead, utilizes Rheem amplifiers for a share of the telemetering chores.



LOCKHEED'S F-104, prototype Starfighter, climbs on razor blade wings to the upper stratosphere at ground speed equaling its speed in straight and level flight. The ship is described by Hall L. Hibbard, Engineering Vice President of Lockheed, as "a masterpiece of simplification." Rheem light weight, small space, amplifier components play an important role in this simplification.

Microfilm Windows in Tab Cards

Microfilm windows in tabulating cards, used for transmitting engineering drawings are expected to save nearly half a million dollars annually in the Army Signal Corps procurement program. Positive film prints, made from original microfilm negatives, are being mounted in the cards. They will be distributed to various Signal Corps installations for reference in repair and overhaul of signal equipment and for procurement purposes. Every depot can reproduce its own paper enlargements necessary to its operations. Considerable savings in shipping costs, filing space, and time are expected.

The complete Signal Corps project calls for 18 sets of cards with duplicate 35 mm film images of all the 300,000 drawings already microfilmed. The machines used in the microfilming process are built by the Recordak Corporation. The tabulating cards have identifying data both punched in and printed, for a double check.

Another film reproduction technique for engineering drawings is discussed in "Film System for Large Drawings" elsewhere in this department.

Anglo-American Color TV

A color-TV factory opened at Enfield, Middlesex, recently is a joint Anglo-American enterprise. It aims to develop an entirely new type of color tube and to bring color TV to British viewers.

Allying British research to American production techniques, the new company has two directors—Don Mitchell, President and Chairman of Sylvania Electric Products Inc. of New York, and Jules Thorn, Chairman of Thorn Electrical Industries, Ltd., the makers of Ferguson TV and Radio.

Opening the new plant, Mr. Mitchell stated, "in many fields we in America admit that the best original research in new development is done first, and often done best, in Britain."

In this instance, he went on, it was hoped that the successful amalgamation of such research with U.S. production techniques would result in color TV for both countries cheaper and better than if either worked alone.

◀ CIRCLE 11 ON READER-SERVICE CARD

RHEEM MANUFACTURING COMPANY



ELECTRONICS LABORATORY

9236 EAST HALL ROAD • DOWNEY, CALIFORNIA

You Can Rely on

Rheem

Is a SPDT switch worth \$60.50?



Yes . . .
when it's a Brown
non-loading, electronic
Electr-O-Vane
unit

YOU'LL find this high-precision electronic switch useful in scores of applications. Less than 2 gram-inches of force actuates it. Switching action occurs with only 0.003" movement of the vane member . . . always occurs at precisely the same spot.

Use the *Electr-O-Vane* unit—
in machine tools—as a non-loading
limit switch
in automatic weighing equipment—as a
cut-off switch
in process equipment—as a no-load
safety switch
under conveyor belts—for accurate
counting without contact
—and in many other places where you
want precision switching with minimum
force.

The *Electr-O-Vane* unit has a thin metal vane which moves between a pair of coils in a stable electronic circuit. Movement of the vane starts and stops oscillation . . . actuates a load relay. No extra effort is needed at the switching point . . . no "bump" in action . . . no electrical connection to the moving member . . . no chatter.

The unit is compact, sturdy . . . mounts in any position. Its actuating arm can be set to provide switching at any point within a 260-degree arc.

ORDER NOW . . . prices from \$60.50 (even more favorable on quantity orders). Prompt quotation and delivery. MINNEAPOLIS-HONEYWELL REGULATOR Co., Industrial Division, Wayne and Windrim Avenues, Philadelphia 44, Pa. —in Canada, Toronto 17, Ontario.

SPECIFICATIONS

Force to move vane	2 gram-inches max.	Load relay rating	115 volts, 6 amp. a-c, non-inductive load
Vane motion for snap action	0.003 in.	Operating power	115 volts, 50-60 cycles. Also 230 volt model
Precision	within 0.002 in.		
Switch action	SPDT, when vane centerline approx. 41° left of vertical		

● REFERENCE DATA: Write for Specifications 911-1.
Prices and specifications subject to change without notice.

**Electronik
NULL INDICATOR**

The modern successor to the spotlight galvanometer. Ideal for lab or production testing. Immune to vibration . . . self-protecting against overloads . . . needs no leveling. Just plug into 115-volt a-c line. Sensitivity .001 microamp or 1 microvolt per division. Price: \$175.00 F.O.B. Philadelphia. Write for Data Sheet No. 10.0-12.



MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

First in Controls

Letters to the Editor

Semiconductor Designations

Dear Sir:

Congratulations to Mr. R. B. Hurley for his article on Semiconductor Designation (*ELECTRONIC DESIGN*, September 1, 1956, page 26). I've wished for the same thing for months, though my idea extended only to diodes and transistors. Perhaps it was the complexity of trying to include power and frequency ratings which discouraged me from pursuing it further. Mr. Hurley has covered the subject admirably for a first proposal; I heartily "second the motion." Now let's have discussion and action to bring it about.

Lansing E. Tryon
Research Division
Raytheon Manufacturing Co.

Standards

Dear Sir:

A statement in the article by C. H. Zierdt in the Oct. 15 issue of *ELECTRONIC DESIGN* requires clarification. In the first paragraph under "Interchangeability," the work of the Joint Electron Tube Engineering Council is mentioned and we would like to point out that this work never involves agreements by manufacturers. Standards proposals are formulated and submitted to the standardization procedures of the parent Associations, RETMA and NEMA. The resulting standards are binding on one and can be followed or not followed in accordance with the individual decisions of each member of the industry.

Virgil M. Graham, Chairman
Joint Electron Tube Eng. Council

Derivations

Dear Sir:

I am in hearty agreement with Mr. A. LaPlante (*ED—Oct. 1*) concerning the publication of derivations of equations.

The derivations show methods of attack on similar problems and bestows confidence in the reader to use the author's result.

G. H. Cohen
Research Engineer
Taylor Instrument Co.

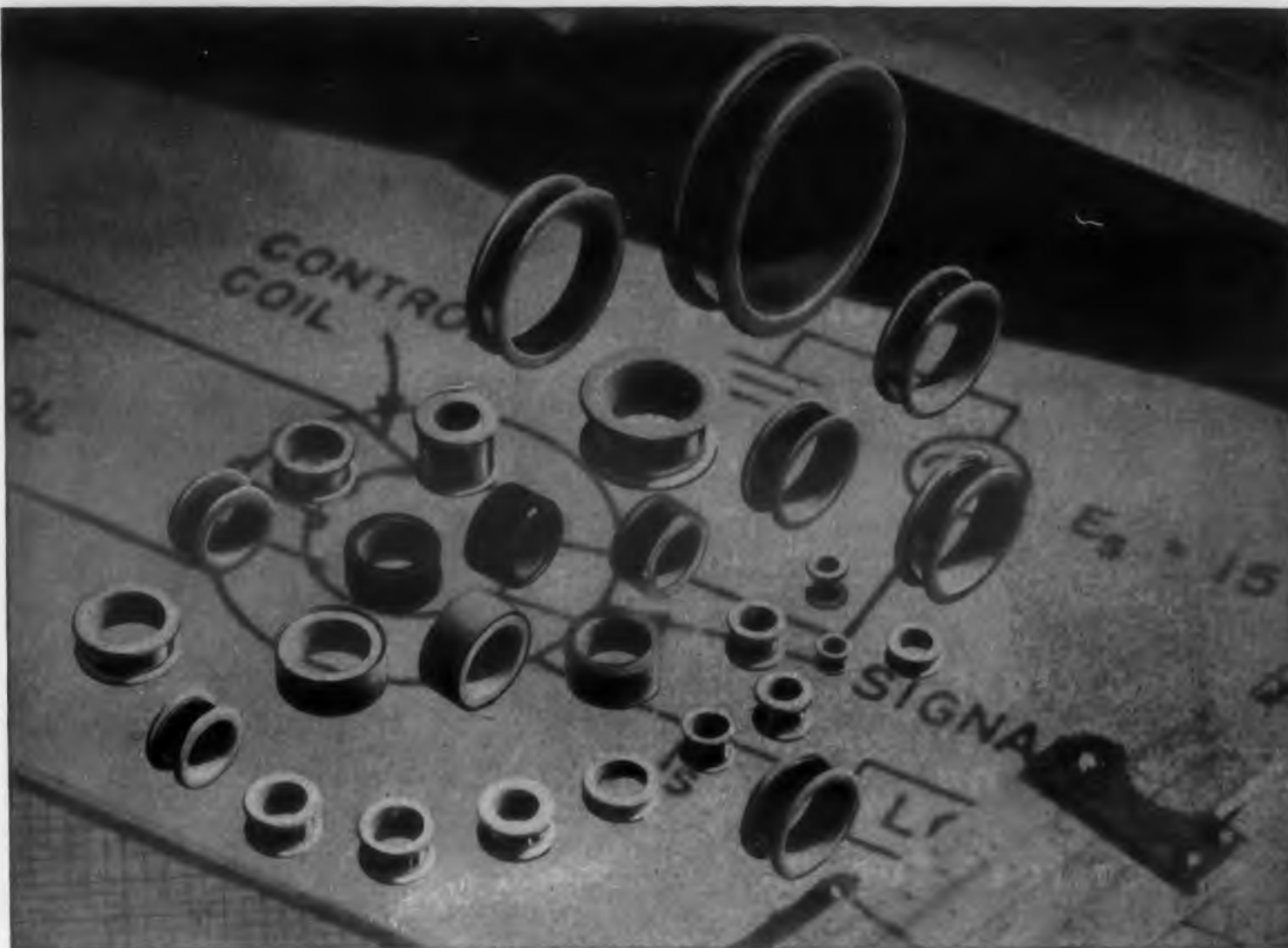


Filing Articles

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file articles from your magazine by ripping out of the issue, folding the pages in two from top to bottom. If your titles were over on the left half of the page, then when folded, it would clearly show the nature of the subject matter. We think this way of preserving what is of permanent interest to us might also interest other readers. We also truly appreciate the convenience of the service cards which save us considerable time which would otherwise be required in writing individual requests. We carefully scan each issue and find a great deal of interesting material is included.

S. Fine
T. Stahre
Philips Laboratories



In BOBBIN CORES, you need PRECISION *and precision is the word for ARNOLD*



Ultra-thin tape for bobbin cores is rolled to high precision standards for thickness and finish on our own 20-high Sendzimir cold reducing mill, beta-ray controlled.

For use in shift registers, coincident current matrix systems, pulse transformers, static magnetic memory elements, harmonic generators and similar equipment, Arnold Bobbin Cores meet the most exacting requirements.

Quality and uniformity? *You'll find them no problem*—because, as a fully integrated producer with highly modern facilities, we're able to maintain close control over every step.

Arnold Bobbin Cores are available in a wide range of sizes, tape thicknesses, widths and number of wraps depending on the ultimate use of the core. Magnetic materials usually em-

ployed are Deltamax, Permalloy and Supermalloy, in standard thicknesses of .001", .0005", and .00025". Core properties include quite rectangular hysteresis loops, relatively low coercive values and high saturation densities, plus the ability to shift in a few microseconds from negative remanence to positive saturation, and vice versa, under conditions of pulse excitation. • Let Arnold supply your requirements for Bobbin Cores—or other tape-wound cores, powder cores, permanent magnets, etc.—from the most complete line of magnetic materials in the industry. wew 8398

Write for **BULLETIN TC-108**

"TAPE-WOUND BOBBIN CORES FOR COMPUTER APPLICATIONS"

Includes essential data on applications and properties, fabrication and testing of Arnold Bobbin Cores; lists standard sizes, etc.

ADDRESS DEPT. ED-71

THE ARNOLD ENGINEERING COMPANY



Main Office & Plant: Marengo, Illinois

Repath Pacific Division Plant: 641 East 61st Street, Los Angeles, Calif.

District Sales Offices:

New York: 350 Fifth Ave. Los Angeles: 3450 Wilshire Blvd. Boston: 200 Berkeley St.

CIRCLE 14 ON READER-SERVICE CARD FOR MORE INFORMATION

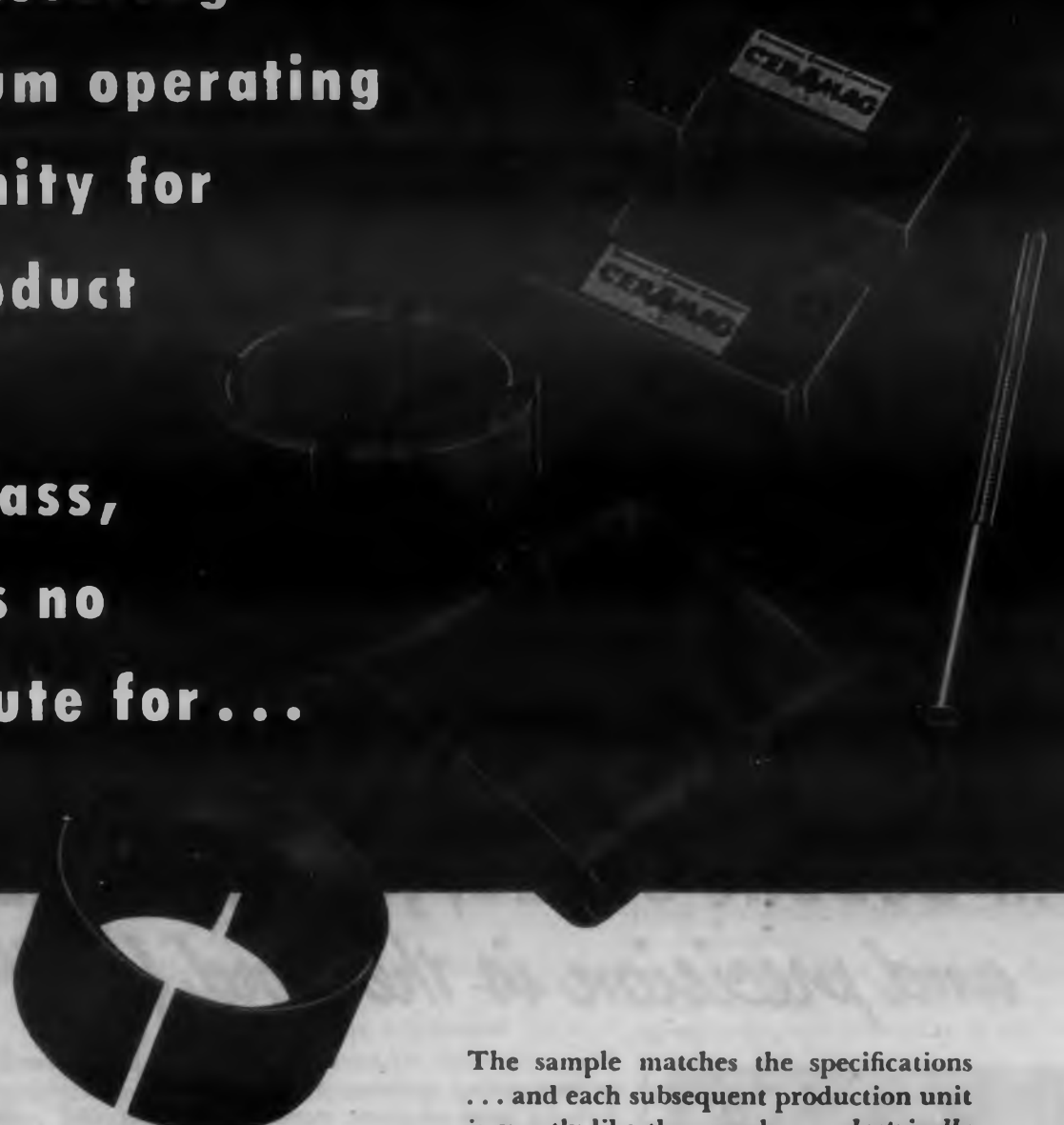
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Sir:
wish to offer a suggestion concerning your fine and greatly appreciated publication. ELECTRONIC TUBE MAGAZINE publishes many fine articles with considerable value as reference material. This is the problem. In saving back issues for reference to the design articles, the engineer eventually accumulates a stack of copies. I would like to suggest that such articles not occupy the full page, but only the two thirds (or so) of the page to the unbound edge of each sheet. This will enable the engineer simply to cut out the article with a suitable margin for mounting in his loose leaf notebook. Most engineers would appreciate this convenience. I doubt that it would detract from the advertisement. Another solution to this problem is to make reprints available.

J. Roy Smith
Code 2530
U.S. Navy Electronics Lab.

We welcome all suggestions for improving our magazine to readers. Wherever possible, these suggestions will be taken into consideration in laying out departments. Of course, there are involved production considerations which sometimes prevent following the most desirable arrangement.

for critical uses . . .
 or for assuring
 maximum operating
 uniformity for
 any product
 in any
 price class,
 there is no
 substitute for . . .



The sample matches the specifications . . . and each subsequent production unit is exactly like the sample . . . *electrically and mechanically.*



STACKPOLE

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Electronic Components Division, STACKPOLE CARBON COMPANY, St. Marys, Pa.

CIRCLE 15 ON READER-SERVICE CARD FOR MORE INFORMATION

Washington Report

Herbert H. Rosen

Electronic Modules

A Navy Bureau of Aeronautics general specification—MIL-E-19600—has recently been issued and introduces a new concept in equipment packaging. It calls for electronic modules no higher than 4 inches, no deeper than 4-1/2, 6 or 9 inches, and a reasonable length in half-inch increments. The spec also provides for: shape of the modules, type and location of the electrical connector to be used, location and form factor of the cooling connector to be used, the mounting dimensions and hardware for the modules, the electrical performance expected of the whole module, and the environmental requirements which the module must meet.

MIL-E-19600 is the forerunner of a whole series of detailed specs in the Navy's program aimed at the standardization of equipment used in aircraft. The Navy strongly points out that it is not trying to standardize the initiative out of the design engineer. Its primary concern remains performance, reliability, and certain size and weight considerations.

Consensus of Navy and industry opinion is that the electronic module goes a long way to achieving equipment flexibility combined with ease of maintenance. The program was conceived through the efforts of Douglas Aircraft, Collins Radio, and other engineers in BuAer's Avionics Division. Copies of the MIL-E-19600 General Specification for Electronic Modules may be obtained from H. J. Thoman, Technical Support Branch, Avionics Division, Navy Bureau of Aeronautics, Washington D.C.

FCC Rules Change

The FCC has issued a public notice affecting communications between amateur stations and transmission of third-party traffic with amateurs in other countries. As of December 5, the following countries have notified the FCC that their administration does not condone third-party traffic: Cambodia, Indonesia, Iran, Korea, and Viet Nam. Third-party communications, however, are allowed between the United States and the following: Canada, Chile, Costa Rica, Cuba, Ecuador, Liberia, Nicaragua, Panama, and Peru.

Exceptions to the rule are all those stations identified by prefixes KA2-KA9, inclusive.

Meetings

Jan. 21-25: Annual AIEE Winter General Meeting

Hotel Statler, Sheraton McAlpin New York, N.Y. The speaker will be F. R. Kappel, president of AT&T. The entire field of electrical engineering will be the subject of the meeting. For further information contact the American Institute of Electrical Engineers, 33 W. 39th St., New York, N.Y.

Jan. 23-25: Very Low Frequency Symposium

NBS Boulder Laboratories, Boulder, Colo. Co-sponsored by the Denver-Boulder chapter of the IEEE PGAP and the Boulder Laboratories, National Bureau of Standards. The program is titled "Theoretical and Experimental Results in the Propagation and Radiation of Very-Low-Frequency Electromagnetic Waves (less than about 100 kc)." Authors are being requested to submit summaries for appraisal as soon as possible to Dr. J. R. Wait, Chairman, Denver-Boulder PGAP Chapter, National Bureau of Standards, Boulder, Colo. For further information, contact U. S. Dept. of Commerce, NBS, Boulder Laboratories, Boulder, Colo.

Feb. 5-7: Twelfth Reinforced Plastics Division Conference

Seawater Beach Hotel, Chicago, Ill. Latest developments in both technical and practical aspects of reinforced plastics. Subject matter will range from reports on research and testing, product design, production methods, to marketing techniques. Complete program, listing papers and speakers, registration forms for the three day conference and hotel reservation blanks are now available. Those interested should write to The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N.Y.

Feb. 7: Operations Research Symposium

University Museum Lecture Hall, University of Pennsylvania. Sponsored jointly by the Professional Group on Engineering Management of the Philadelphia Section of IRE and the Society of Industrial and Applied Mathematics. Major theme will be Mathematical Models in Management Decision Making. Contact Haydn Ringer, 1303 Highland Ave., Palmyra, N. J.

Feb. 7-8: Special Conference Nucleonics in Industry

Hotel Statler, New York, N. Y. Principal subjects for discussion will be the present and prospective profitability of atomic investment. Sessions will cover industrial applications as the use of nuclear energy for processing purposes, development of military power, and the uses of isotopes. Conducted by the American Management Association, 1515 Broadway, New York, N. Y.

Selected MINIATURES for TRANSISTOR and PRINTED CIRCUIT APPLICATIONS

Good-All
capacitors

Design and component engineers are invited to acquaint themselves with the wide variety of miniature low voltage capacitors developed by Good-All Electric. These compact new designs are ideal companion items for use with transistors and other printed circuit components.

Many space-saving Good-All types are as useful for military as for civilian applications. This is particularly true of the molded-in-Epoxy types. It has also proven to be the case with "wrapped" mylar designs which lend themselves to use in potted subassemblies.

Mylar* dielectric is frequently selected for Good-All miniatures because of its superior electrical characteristics — high I.R., low power factor and excellent stability with life. The space-saving it offers in low voltage designs is also an attractive feature.

Good-All offers a wide selection in 50 Volt miniature designs

	REPRESENTATIVE TYPES	TYPICAL SIZE COMPARISONS		
		Cap.	Volts	Diam. Lgth.
AXIAL LEAD	600UE . . . Mylar dielectric winding molded in dense, moisture-resisting Epoxy.	.01	50	.312 x 15/16
		.1	50	.438 x 1-3/16
		.47	50	.562 x 1-15/16
RADIAL LEAD	663UW . . . Mylar dielectric winding with tough plastic film case and thermo-setting end seals.	.01	50	.188 x 11/16
		.1	50	.281 x 15/16
		.47	50	.437 x 1-15/16
UPRIGHT MOUNTING	613G . . . Mylar dielectric winding, extended foil construction, hermetically-sealed metal housing.	.01	50	.173 x 23/32
		.1	50	.313 x 27/32
		.47	50	.50 x 1-3/16
EPOXY COATED CERAMIC DISCS	600RE . . . This novel design combines features of conventional tubular capacitors and upright mounting types. The mylar dielectric winding is completely encapsulated in Epoxy. In addition to its attractive glossy red appearance the Epoxy formulation developed by Good-All yields a tough, durable coating with excellent dielectric strength.	.01	50	.250 x 11/16
		.1	50	.375 x 15/16
		.47	50	.50 x 1-3/4
EPOXY COATED CERAMIC DISCS	600UPE . . . Mylar dielectric winding molded in dense, moisture-resisting Epoxy.	.01	50	.438 x 15/16
		.1	50	.562 x 1-3/16
		.47	50	.688 x 1-15/16
EPOXY COATED CERAMIC DISCS	620UPB . . . Mylar dielectric winding with molded bakelite housing and thermo-setting plastic end seal.	.01	50	.375 x 1
		.1	50	.375 x 1-1/4
		.47	50	.625 x 1-7/8
EPOXY COATED CERAMIC DISCS	620PM . . . Mylar dielectric winding encapsulated in a plastic impregnated paper tube.	.01	50	.343 x 15/16
		.1	50	.410 x 1
		.47	50	.562 x 1-3/4

These Epoxy coated discs are ideal for use on printed circuit boards that are to be dip soldered, since no wax coating is necessary.

The available types of ceramic discs are too numerous to describe in detail. A complete brochure with specifications on each type will be mailed to you upon request.

Dimensional information is contained in the Good-All ceramic disc brochure.

*DuPont's trademark for polyester film.

Write or phone for consultation on specific design problems or to secure detailed specifications on the various capacitor types shown.



GOOD-ALL ELECTRIC MFG. CO.

OGALLALA, NEBRASKA A leading manufacturer of Tubular and Ceramic Disc Capacitors

CIRCLE 16 ON READER-SERVICE CARD FOR MORE INFORMATION

Feb. 7: Annual Symposium of the New York Section of the ISA

Garden City Hotel, Garden City, N. Y. Short papers on "Practical Accuracy of Measurement" will be presented followed by a discussion. Afternoon session will be on "Data Handling." For further information contact G. Newberg, Publicity Chairman, Fairchild Engine Division, Fairchild Engine & Airplane Corp., Deer Park, L. I., N. Y.

February 14-15: Transistor and Solid State Circuits Conference

University of Pennsylvania, Philadelphia, Pa. Sponsored by the Institute of Radio Engineers, American Institute of Electrical Engineers, and the University of Pennsylvania. For further information contact G. H. Kunstadt, Radio Corp. of America, Defense Electronic Products, Camden 2, N. J.

Feb. 25-27: Special Conference on Electronics In Action

Statler Hotel, New York, N. Y. Several major companies will show electronic data-processing equipment in action through closed-circuit television. Sponsored by the American Management Association's Finance Division, 1515 Broadway, New York, N. Y.

Feb. 26-27: Third Conference on Radio-Interference Reduction

Chicago, Ill. Sessions include equipment design techniques, instrumentation and measurement techniques, practical interference reduction methods, and special suppression components. For further information contact Armour Research Foundation of Illinois Institute of Technology, Technology Center, 10 West 35th St., Chicago 16, Ill.

Feb. 26-28: Western Joint Computer Conference

Statler Hotel, Los Angeles, Calif. The Conference is under the joint sponsorship of the IRE, AIEE, and ACM. Theme of the meetings will be "Techniques For Reliability." For further information contact S. Dean Wanlass, Aeronutronic Systems, Inc., 13729 Victory Blvd., Van Nuys, Calif.

March 18-21: The 1957 SPI Annual National Conference and Pacific Coast Plastics Exposition

Hotel Biltmore, Los Angeles, Calif., sponsored by the Society of the Plastics Industry, Inc. Sessions will cover plastics in the fields of electronics, aircraft and defense, building, and processing. Exposition will be held at the Shrine Exposition Hall. Further information may be obtained from the Society of the Plastics Industry, Inc., 250 Park Ave., New York, N. Y.

CIRCLE 17 ON READER-SERVICE CARD ►

DYNAMICS OF GROWTH



Resourceful Foot in Big Door

Half a century ago, Tung-Sol people developed the first successful electric automotive headlamp, introduced on the Stoddard-Dayton car of 1907. This was a carbon-filament lamp, crude and fragile by today's standards. But it brought business from other motor car manufacturers as well . . . and it brought *experience*, so that a year or two later, when tungsten first was used for lamp filaments, Tung-Sol was well on its way to a position of leadership among suppliers of components to a growing industry that promised to become a giant.

Find-How and Know-How



Next, in 1913, Tung-Sol developed a two-filament headlamp, "Tulite", the first to combine high and low beams in a single bulb. With it was won the business of Ford and other prodigiously growing motor car makers.

Growth put increased emphasis on research and development. First, to improve the product . . . to make the lamps themselves better and more dependable. Second, to improve the techniques of manufacturing lamps in ever-increasing quantities, to closer tolerances and more exacting standards of uniformity—and to do these things while constantly improving production economy. And today, these experiences—these assets—have been pooled with the auto lamp industry to perfect the new 4-headlamp lighting system you will see on all cars in the future.

The Capitalized Break

In the mid-1930's, Tung-Sol brought out a flashing tail-light—"Winx"—intended to signal "stop" when a motorist applied his brakes. But its flashing feature soon evolved into the familiar flasher that actuates direction signals and for which Tung-Sol is the industry's major supplier.



If you want to know the future—of this or any other company—look beyond mere size and tangible assets—into its *background*. Look for accomplishments—experience—reliability—*ability*. These are the real and vital substances that generate the drive and momentum that produce growth in a competitive and changing world.



Off the Deep End—and Up Swimming

Making lamps involves many technologies—glass—metallurgy—vacuums—skills at which Tung-Sol is master after 53 years of successful doing.

This widely recognized expertness led to Tung-Sol being literally drawn by demand into the manufacture of electron tubes beginning in the 1920's.

Once in the electronics field, Tung-Sol applied to tubes its basic company policy—"make the best that can be made."



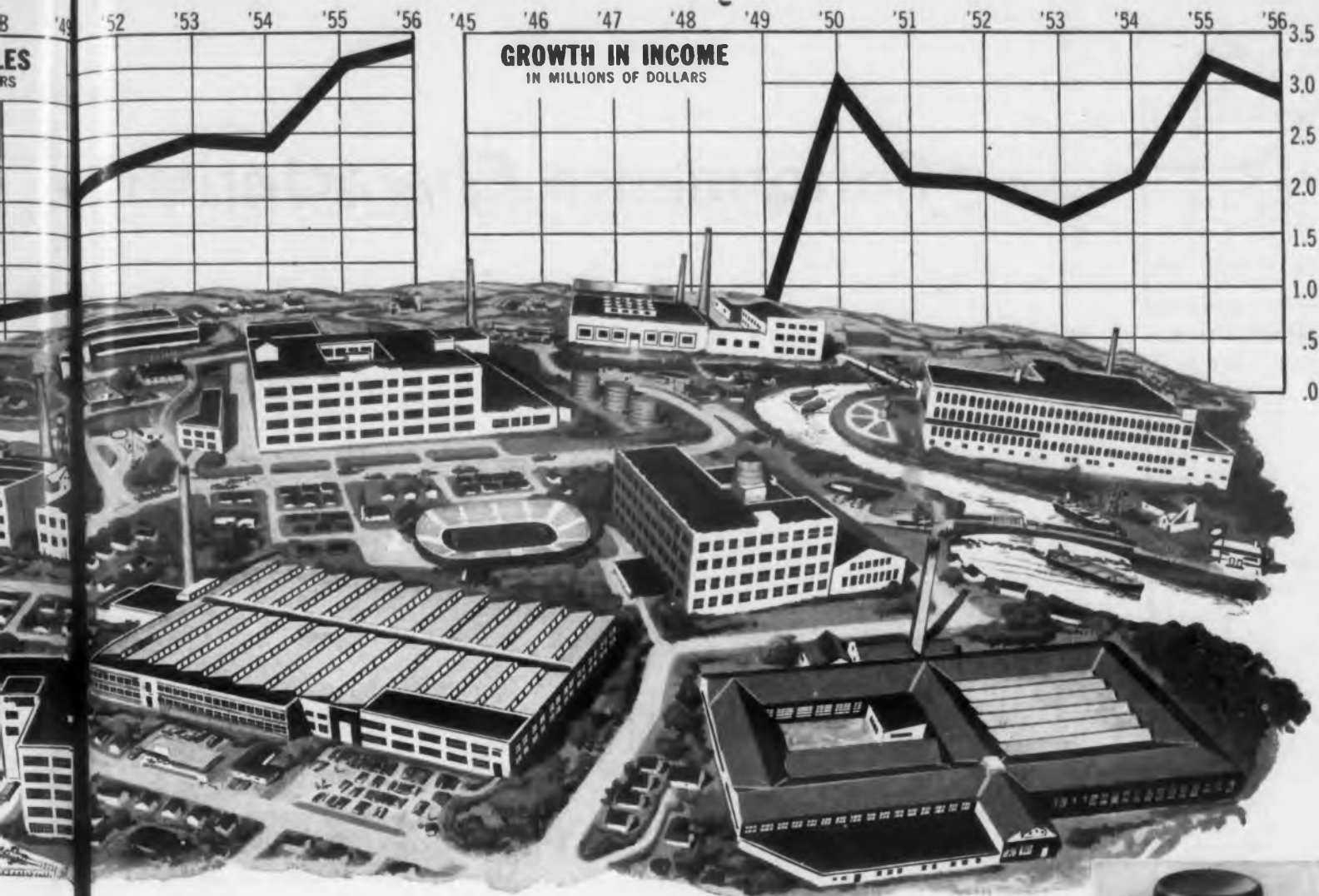
From a primitive electronics engineering nucleus has grown a research-and-development staff of the very first order—still building, both in scientific standing and in numbers, as new accomplishments serve only to present new challenges.

Pioneers in Quality Control

There is a second policy to which Tung-Sol has firmly adhered—that of making components—tubes for set and equipment manufacturers, but not the sets or equipment.

This allowed Tung-Sol to concentrate on *tube* engineering and manufacturing, with emphasis always on quantity production to standards of performance as rigid as those of a research laboratory, yet with absolute uniformity in whatever quantity and with the reliability demanded by increasingly important uses—particularly those of a nation at war.

Outstandingly important in this responsibility was the development of statistical quality control—a new kind of applied science in which Tung-Sol had early become—and still is—a recognized leader.



Sharp Sword to Profitable Plowshare

This, among other achievements under pressure, brought its rewards when World War II ended, and the marvels of electronics were turned to everyday uses—as in television and high-fidelity reproduction of music—or to striking new scientific and industrial advances—electronic computers and the automation of production machinery.

Today, Tung-Sol ranks among the largest suppliers of electron tubes—radio and TV tubes for the makers of receiving sets—for replacement by service dealers—and of many special types required by makers of the elaborate electronic devices that serve manufacturing, transportation, communication and applied science.

Transition to Transistors

Initial steps to the use of semiconductors have been through the development of so-called "hybrid" equipment designed to utilize the best characteristics of both tubes and transistors. Tung-Sol engineering produced the first successful power amplifier tube to operate directly from a 12-volt automobile battery. This tube, the 12K5, filled an enormous gap in the hybrid auto radio design. It is the first practical use of the "space charge grid" principle and has created a new tube classification extremely useful

for many low-voltage driving, switching and control applications.

In the field of "semiconductor" products, Tung-Sol research and development has been working for years, along with the rest of the industry, to perfect the design of these tiny, compact, low-current-consumption units. But more than that, Tung-Sol has been concerned with the perfection of techniques to manufacture semiconductors the way it does electron tubes: in large volume, with absolute uniformity, with unsurpassed dependability. You can confidently expect, therefore, that Tung-Sol will be as prominent a factor in the supply of transistors and related semiconductor devices for electronic equipment as it now is in the making of electron tubes.

The Tung-Sol of today is nine busy plants in seven cities, employing 6500 people and covering the nation with five divisional offices and a network of independent wholesale and retail distribution—to serve our nation's two greatest industries—automotive and electronics.

TUNG-SOL[®]

TUNG-SOL ELECTRIC INC., Newark 4 N. J. Sales Offices: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Texas; Denver, Colo.; Detroit, Mich.; Irvington, N. J.; Melrose Park, Ill.; Newark, N. J.; Philadelphia, Pa.; Seattle, Wash.; Canada: Montreal, P. Q.



MINIATURE LAMPS



SEALED BEAM HEADLAMPS



SIGNAL FLASHERS



RADIO AND TV TUBES



ALUMINIZED PICTURE TUBES



SPECIAL PURPOSE TUBES



SEMICONDUCTORS



COLOR PICTURE TUBES

March 18-21: IRE National Convention

Waldorf-Astoria Hotel and New York Coliseum, New York, N. Y. Twenty-three technical subjects such as Telemetry, Antennas and Propagation, Circuit Theory, Electron Devices and Receivers, Computers, Information Theory, Automatic Control Microwave and Instrumentation, Manufacturing Electronics, Audio and Broadcast, Aeronautical, Communication and Military Electronics, Ultrasonics, Medical and Nuclear Electronics will be presented at the convention. For further information on exhibits, contact Mr. William C. Copp, IRE Advertising Dept., 1475 Broadway, New York, N.Y. Contact the IRE, 1 East 79th St., New York, N.Y. for other information.

April 8-11: Fourth National Electrical Industries Show

71st Regiment Armory, New York, N.Y. Sponsored by the Eastern Electrical Wholesalers Association. For more information, contact William S. Orkin, Co-Producer, The American Electrical Industries Expositions, Inc., 19 W. 44th St., New York, N.Y.

April 11-13: Southwestern IRE Conference and Electronics Show

Houston, Texas. Sponsored by the Houston Section of the IRE. This conference will be augmented by the National Simulation Conference which will be sponsored by the IRE Professional Group on Electronic Computers. For information, write to Ninth Southwestern IRE Conference and Electronics Show, P. O. Box 1234, Houston 1, Texas.

April 23-25: International Symposium on the Role of Solid State Phenomena in Electrical Circuits

Auditorium of the Engineering Societies Building, New York, N. Y. Symposium will cover recent developments in application to electrical circuits on systems of unusual physical effects in solids. For information write to the Polytechnic Institute of Brooklyn, Microwave Research Institute, 55 Johnson St., Brooklyn 1, N.Y.

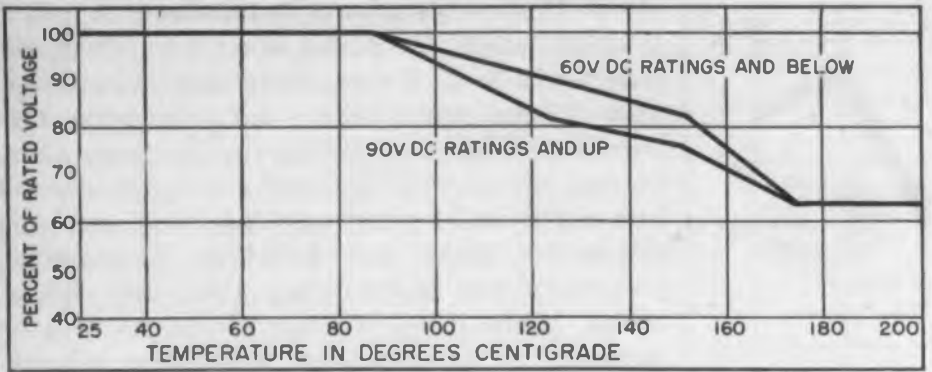
May 1-3: Electronic Components Conference

Hotel Morrison, Chicago, Illinois. Sponsored by the IRE, AIEE, and RETMA. Further information may be obtained by contacting the IRE, 1 East 79th St., New York, N.Y.

May 16-18: Eighth Annual Conference and Convention, American Institute of Industrial Engineers

New York City, Hotel Statler. For information write to AIIE, P.O. Box 8, Substation 135, The Bronx 53, New York.

◀ CIRCLE 17 ON READER-SERVICE CARD



Percent of rated voltage deviation with temperature for different types of capacitors.

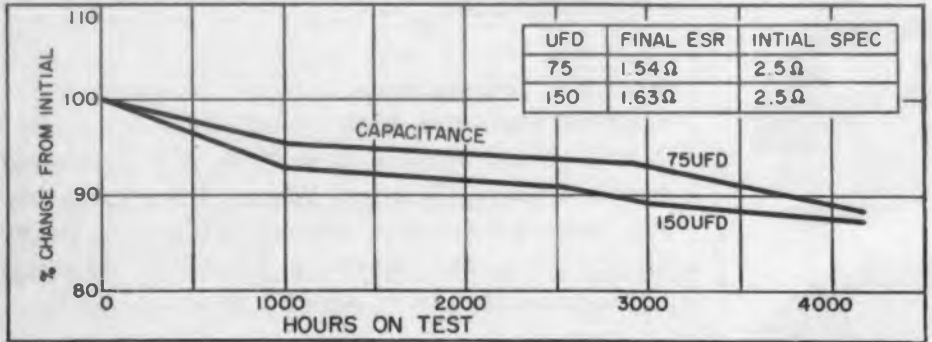


Fig. 2. Life tests for capacitors operating at 20 v dc and 175 C. Capacitors rated at 30 v. Upper curve (75 μ fd) is average of 4 units. Lower curve (150 μ fd) is average of 2 units.

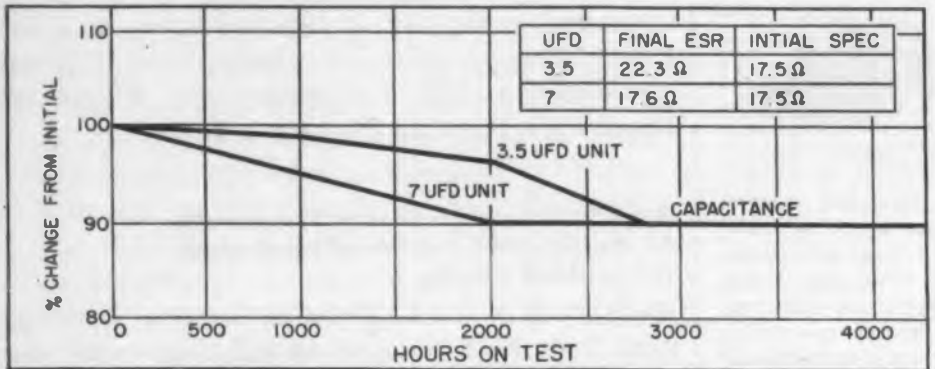


Fig. 3. Life tests for capacitors operating at 420 v dc and 175 C. Capacitors rated at 630 v. Upper curve 3.5 μ fd unit. Lower curve 7 μ fd unit. Both curves are average of 2 units.

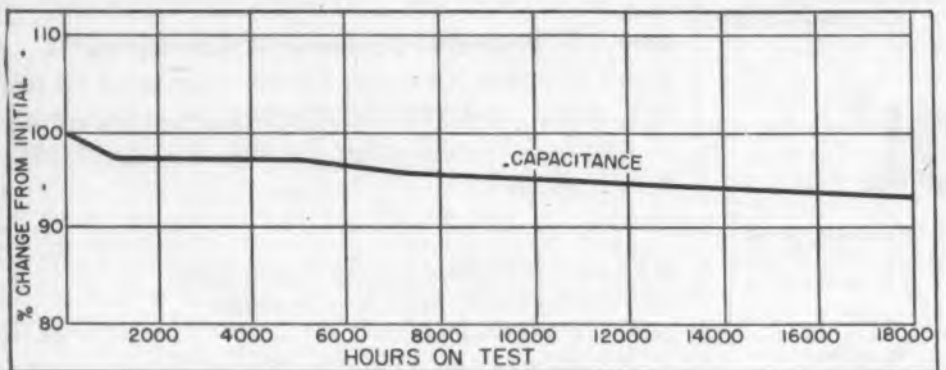


Fig. 4. Two-year life test for 125 C. Capacitor was 40 μ fd rated at 60 v. Operating voltage was 50 v dc. Curve is average of 4 units. Final ESR is 1.93 ohms, initial spec calls for 2.5 ohms. Dc leakage current after 11,000 hours is less than 1 μ amp at 60 v.

Performance Characteristics of

PERFORMANCE data accumulated through tests run on production-made tantalum capacitors designed for operation throughout the temperature range of -55 to $+175$ C are presented in this paper. Several hundred thousand of this type of capacitor have been manufactured and sold by the P. R. Mallory & Co. Inc. during the past five years. Extensive tests have been made to indicate both performance and reliability.

Tantalum Advantages

Much has already been written and published regarding the suitability of metal tantalum as the ideal element for an electrolytic capacitor. When properly processed into capacitors, this particular type of design has certain performance advantages over aluminum electrolytics such as:

1. Superior shelf life.
2. Smaller size for most equivalent ratings.
3. Better low temperature characteristics (down to -55 C).
4. Makes possible operation at 125 to 175 C, well in excess of $+100$ C—the present accepted top temperature rating for aluminum electrolytics.
5. Resists the action of certain contaminants that tend to destroy or reduce the efficiency of aluminum type electrolytics.

All of the above should result in a longer operating life for the tantalum capacitor. It should be pointed out, however, that high-quality, well-made aluminum electrolytics have demonstrated excellent life beyond 15 or more years of continuous duty. It will

take more operating time in the field under similar conditions for tantalum capacitors to obtain an exact and true comparison with their aluminum counterpart.

Ratings Available

The standardized line of capacitors was developed to present a complete coverage of voltage ratings from 18 to 630 v dc with all ratings housed in a single outer case.

Table 1
Standard Capacitance-Voltage Ratings

Type No.	Mfds	Volts
XTL-120	120	18
XTH-240	240	18
XTL-75	75	30
XTH-150	150	30
XTL-40	40	60
XTH-80	80	60
XTL-25	25	90
XTH-50	50	90
XTL-12	12	180
XTH-25	25	180
XTL-8	8	270
XTH-16	16	270
XTL-6	6	360
XTH-12	12	360
XTL-5	5	450
XTH-10	10	450
XTL-4	4	540
XTH-8	8	540
XTL-3.5	3.5	630
XTH-7	7	630

Characteristics of Tantalum Capacitors

J. W. Maxwell

Director of Engineering
Electronic Division
P. R. Mallory & Co. Inc.
Indianapolis 6, Ind.

It is unnecessary to series-connect separate capacitors to obtain voltage ratings over 150 v dc.

Including the above voltage extremes, there are ten standard voltages and twenty standard capacitance ratings ranging from 10 μ fd at 18 v to 7 μ fd at 630 v.

All case diameters are 7/8 in. with case lengths varying from 1/2 in. to 4-1/16 in. depending upon the ratings.

There are two series or types in order to broaden the scope of availability of ratings. For each voltage rating, there are *XTL* and *XTH* types with the *XTH* having twice the capacitance of the *XTL*.

De-Rating

The voltage ratings mentioned above are for operation through a temperature range of -55 to +85 C. For higher temperature operation, the applied voltage must be de-rated in accordance with the de-rating curve in Fig. 1. From this curve it is possible therefore to select the corresponding maximum working voltage for any rating up to and including +175 C ambient temperature. Voltage ratings are also published in tables for 125, 150, and 175 C operation.

The standard line is designed to operate at all temperatures up through 175 C even though the product itself is usually stamped or rated with the 85 C voltage rating. The same units will also operate satisfactorily at -200 C, the only difference being a special plating finish for +200 C operation. The +200 C operating voltages are the same as for 175 C.

Performance Data

The following data was compiled using random capacitors taken from production run lots and represents what may be expected from this product. The results do not necessarily represent the highest or lowest measure of performance but rather, a cross section. All electrolytics, both tantalum and aluminum, have rather wide limits of acceptable performance and for economic reasons this factor is taken into consideration when setting up MIL, RETMA, etc., standards. As time goes on and as the art advances, these standards will in all probability be tightened commensurate with improvements made.

The curves shown in Figs. 2 and 3 indicate life test performance of low and high voltage ratings when operated at 175 C. In order to get points on these curves as well as similar curves shown, the capacitors were removed from the life test ovens at intervals, cooled to room temperature, and their electrical characteristics measured. The maximum capacitance drops from the initial measurements are not more than 10 per cent through 2000 hours at 175 C. After 4000 hours under the same conditions, very little further drop in capacitance is noted and in all cases the final equivalent series resistance values measure very close to or under the original specification limit. Dc leakage current (not shown) is of a descending order and well within the specification limits.

Fig. 4 is a curve representing a life test at 125 C that was continued out to 18,000

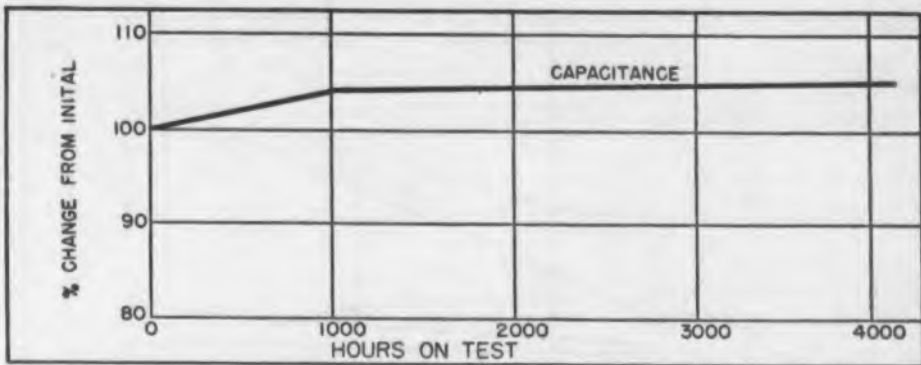


Fig. 5. Life test results of operating at below rated voltage. Here a 90 v, 50 μ fd capacitor was operated at 20 v dc (at 175 C). Curve is average of 2 units. Final ESR is 1.87. Initial spec limit was 2.5 ohms.

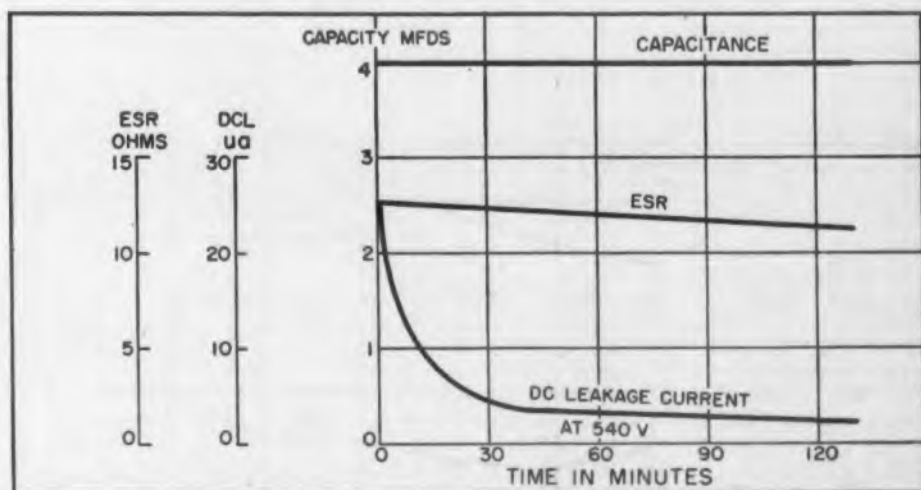


Fig. 6. Electrical measurements under continuous vibration (as per JAN-C-62, mounted vertically). Measurements made each minute.

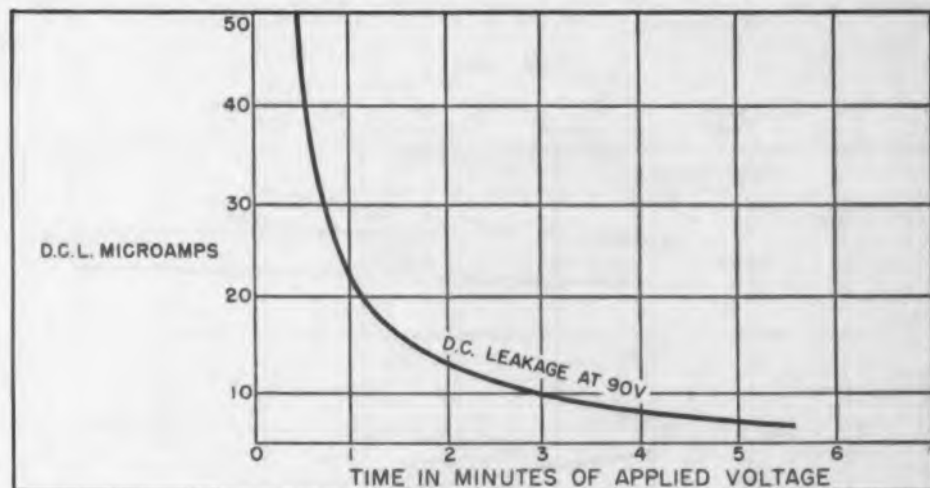


Fig. 7. Electrical measurements made after five years of idle storage at room temperature. Initial capacitance was 24.6 μ fd—final 26.1 μ fd. ESR changed from 1.63 ohms to 1.07 ohms.

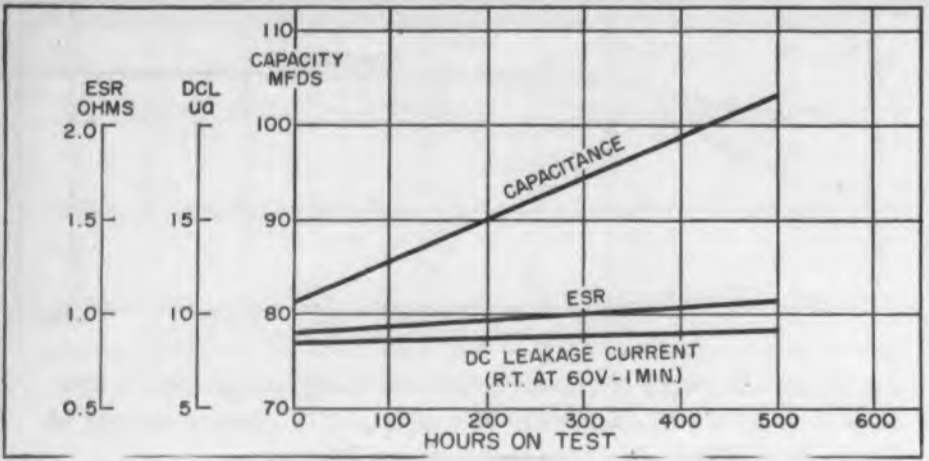


Fig. 8. Life test at 225 C. This is average of 80 μ fd, 60 v units operating at 32 v dc.

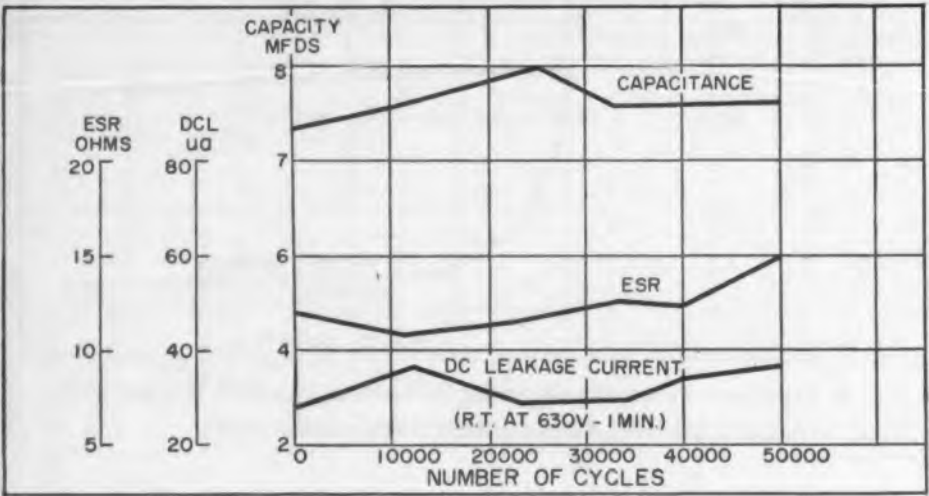


Fig. 9. Effect of charge and discharge on capacitance, effective series resistance, and d-c leakage current.

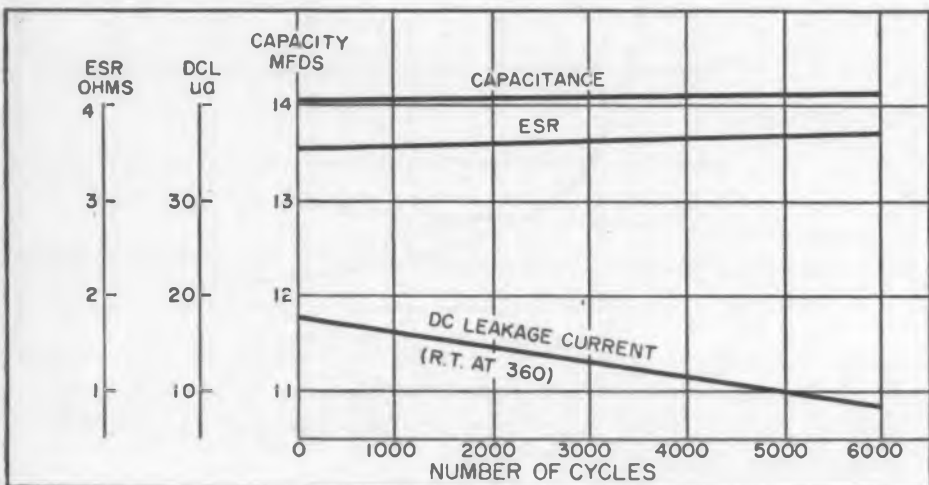


Fig. 10. Effect of cycling voltage reversal for 12 μ fd, 360 v type at 85 C. Cycle consisted of 57 sec at 280 v dc and 3 sec at -5 v dc.

hours or approximately two years at this temperature. It will be noted that the electrical characteristics of the capacitors under this long time test showed only slight deterioration. This test was subsequently continued to 23,000 hours at which point one of the units increased sharply in ESR so the entire test was terminated.

In comparing the life test data at 125 C and 175 C, it will be noted that superior life can be expected at lower temperature. Life tests at 85 C indicate still less change in capacitance and ESR than at the 125 C temperature.

Table No. 2 is a chart showing variation in capacitance at -55 C and +175 C as compared to room temperature measurements which are referred to as 100 per cent. The chart reveals that the lower voltage ratings have greater per cent capacitance changes at the temperature extremes than the higher voltage ratings. Furthermore, the temperature characteristics of the *XTL* types show somewhat less changes than those of the *XTH* types due to the fact that the cathode area per μfd is greater with the *XTL*.

A noteworthy characteristic is the relatively small capacitance change at 175 C. At 125 C, these values are roughly one-half the capacitance change that is noted at 175 C.

If the application requires an exceedingly small change in capacitance with temperature, a higher voltage rating may be used even if the actual operating voltage is considerably less than the rating.

Fig. 5 illustrates this in which a 90 v rated type was operated for 4000 hours at 175 C at 20 v dc. During this test a slight increase in capacitance occurs which levels off to a constant value of approximately 4 per cent above the initial measurement.

Vibration Effects

Most users of components for military equipment are primarily interested in the

effect of vibration on the component while it is under vibration. Fig. 6 illustrates this effect on a multi-cell 4 μfd 540 v unit. In this particular test, capacitance, ESR, and dc leakage current were monitored at one minute intervals for two hours while being subjected to the standard JAN-C-62 vibration test of 10-55 cycles.

This product may be subjected to high frequency vibrations up to 2000 cycles and 20 g's without loss of electrical performance during this test. In one particular test, units were vibrated under the above conditions in both horizontal and vertical axes for a total of two hours. During this time, capacitance and dissipation factor were continuously monitored with a no noise generation of intermittent conditions occurring. Experience in running high frequency vibration tests of this nature has shown that the mounting fixture must be so constructed to prevent its resonating during the test.

Acceleration appears to have no effect on the operation of this type of capacitor. Tests performed at 25 g's and 50 g's with electrical characteristics being monitored showed practically no change in capacity or dissipation factor.

Shelf Life

Shelf life or idle storage is extremely important to the military equipment designer for it is not possible in actual service to allow appreciable time for "reformation" or restoration of the dielectric film before the device operates. Fig. 7 gives an indication of expected performance of a capacitor after five years standing in idle storage. The important characteristic, dc leakage current, recovers quite rapidly and is well under the initial limit for newly made units. It should be pointed out that this test was performed on a capacitor made five years ago and that units made since then have been steadily improved to give still better shelf life and other characteristics. Storage under constant temperatures higher than normal

Table 2 Capacitance-Temperature Characteristics.

(Room temperature is 100% capacitance.)

Voltage Rating	XTL Series		XTH Series	
	At -55 C.	At +175 C.	At -55 C.	At +175 C.
18 V.	26% drop	12% increase	41% drop	15% increase
30 V.	15% drop	11% increase	28% drop	13% increase
60 V.	14% drop	9% increase	20% drop	11% increase
90 V. & up	10% drop	8% increase	15% drop	10% increase

temperatures encountered in the room throughout the year, will of course, result in higher dc leakage currents when the voltage is first applied. From tests run on capacitors stored at +85 C, it is indicated that dc leakage currents are approximately two and one-half times the values of similar capacitors stored at room temperature.

Other performance tests associated with MIL-STD-202 requirements such as shock, temperature and immersion, moisture resistance, salt spray and high altitude have little effect on the electrical characteristics due mainly to the rugged construction of the true metal-to-glass hermetic seal of the capacitor.

Special Conditions

In the course of working with equipment design engineers, many special application problems arise which call for investigations outside the scope of the performance requirements of MIL specifications. A few of these are presented to give the prospective user an idea of what to expect under these special conditions.

Fig. 8 shows a life test run on a standard 80 μ fd 60 v rating at +225 C with voltage de-rated to 32 v. While considerable increase in capacitance resulted after 500 hours at this extremely high temperature, it was noted that there were no failures out of 7 units tested. In this application, the increase in capacitance was acceptable.

Fig. 9 shows the effect of fairly rapid charge and discharge of these capacitors through a low impedance load. This test was conducted on a high voltage capacitor at 175 C—50,000 times with only slight changes in electrical characteristics.

Still another application called for repetitive charging at 280 v for 57 seconds and complete reversal of polarity to 5 v negative for three seconds during each cycle. Under this condition, capacitance and ESR remained constant while dc leakage current dropped. Fig. 10 indicates this test which was conducted on a 12 μ fd 360 v unit at 85 C for 6000 cycles of operation.

As stated before, this design is normally for operation as a polarized capacitor and reversed voltage should not be applied for an appreciable time. Capacitors should not be connected back-to-back for dc non-polarized operation because the one capacitor of the combination having its voltage connected in reverse can be damaged depending upon the magnitude of the voltage and time of its application.

The product, however, will operate when subjected to small values of ac voltage without the dc component. Fig. 11 shows a

test in which two 5 μ fd 450 v capacitors were connected "back-to-back" with 110 v ac 60 cycles applied across the combination. This test was conducted at room temperature for 1000 hours with little effect on the electrical characteristics of the capacitors. More tests of this nature will have to be performed in order to study the effect of ac operation under such variables as frequency, ambient temperature, single capacitor operation, etc. before broad ac voltage ratings can be established.

The effect of frequency upon impedance is shown in Fig. 12. Measurements were made through the range of 200 cycles to one megacycle. (The gap in the curve between 100 and 500 kc is due to measuring equipment for this range not being available). The sintered anode construction is not wound in a rolled up manner so there should be a minimum of inductive effect.

Reliability

As is true with most any new and radically new component, some field failures on early production made capacitors were experienced. As soon as the factors contributing to these failures were determined and brought under proper control, this difficulty was eliminated. Capacitors properly applied give satisfactory reliability.

In recent months, Mallory's Tantalum Capacitor operations were qualified by the Signal Corps on the Reduced Inspection Quality Assurance Plan (known by the industry as RIQAP). This plan guarantees consistent quality at the high level required.

Some end uses of the product require a reliability factor beyond that covered by MIL specs. Much work in this area has been done in which entire lots of capacitors are given life and environmental tests on a 100 per cent basis before shipment. Data covering the electrical measurements on each individual capacitor for all the tests is recorded, certified, and shipped to the user along with the capacitors. Since each capacitor carries its individual serial number, the user has a permanent record of each unit before it is placed into service.

Although this procedure has been used for nearly two years, there is insufficient data to make any definite conclusions regarding the reliability of capacitors given these special tests vs. those which have not. Actual field history is needed when striving for 100 per cent reliability. Each component should be returned to the manufacturer along with a statement of operating conditions at failure.

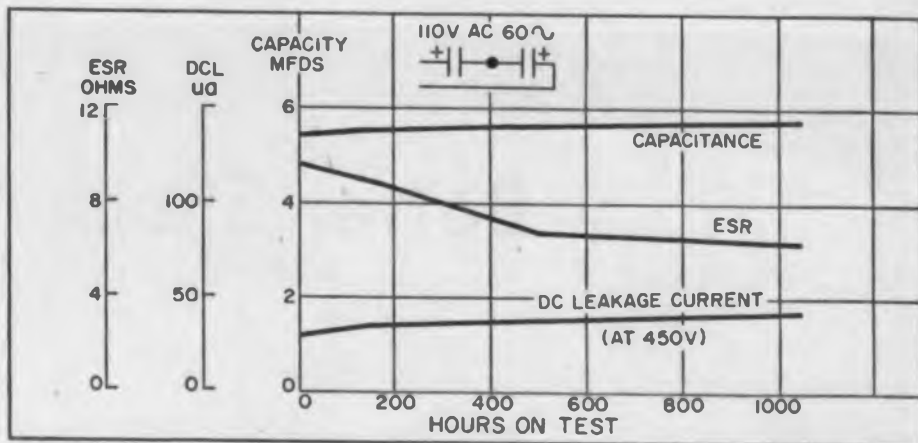


Fig. 11. Effect of pure ac voltage (110 v, 60 cps) across two 5 μ fd units connected back to back. No dc bias voltage.

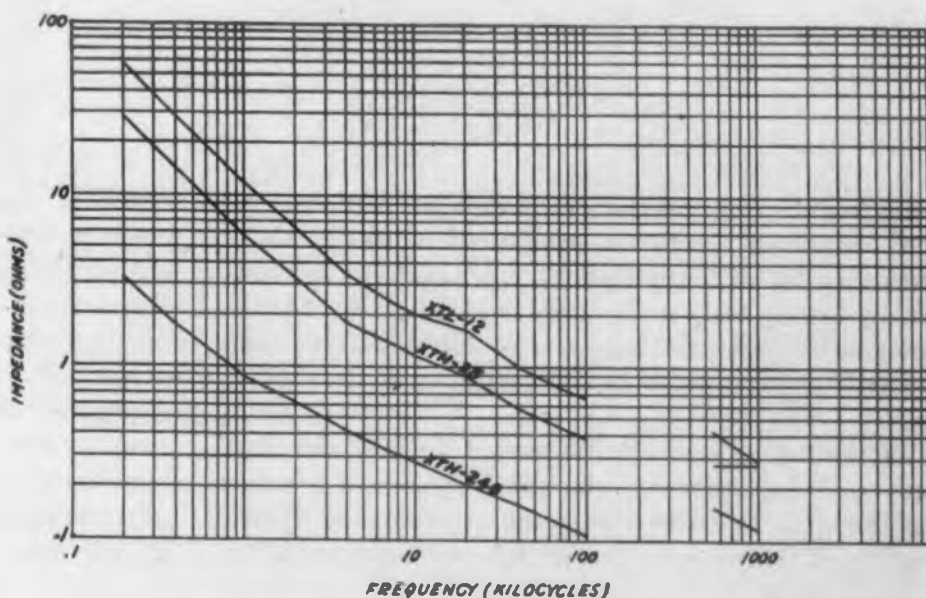
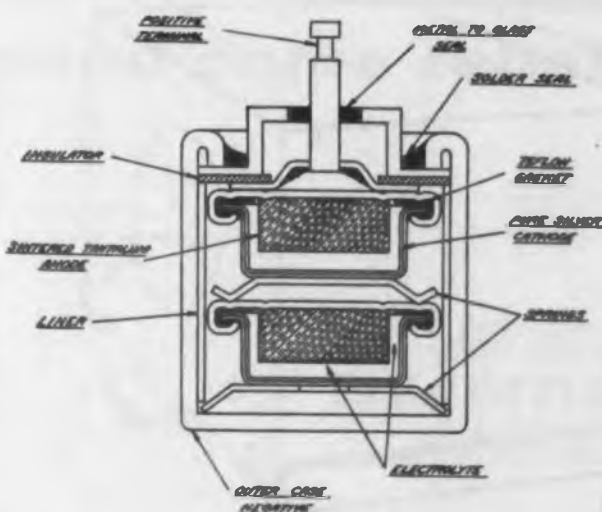


Fig. 12. Impedance versus frequency for various types. Measurements were not taken between 100 kc and 500 kc.



The cut-away view represents a 180 v rated unit (two basic cells). Anode is sintered tantalum powder electrically welded to a sheet tantalum cover. The insulating dielectric oxide is electrolytically formed on this anode. The sheet cover is crimped over the cathode silver steel cup (teflon gasket used) to seal cell. Electrolyte is primarily a sulphuric acid solution.

Better Shock-Mount Space Utilization

Robert W. Dugan
Senior Project Engineer
T. R. Finn & Co., Inc.,
Hawthorne, N.J.

SPACE is at a premium in mobile and airborne installations. Electronic equipment is usually shock mounted for such applications. The shock mounts normally use up vital space that could otherwise be employed for functional components. Described here are several approaches to better utilization of this waste space.

Some space is normally wasted behind the dust cover of shock-mounted electronic equipment because of the room taken by the mounting springs as shown in Fig. 1. There is no reason why a "back porch" or

"caboose" could not be built at the rear of the dust cover to allow room for additional components above the mounting springs as shown in Fig. 2. In some cases there might even be room for a small dynamotor, vibrator pack or other equipment as shown in Fig. 3.

Normally there is space between the mounting springs which can be used for making terminal connections to the unit. A typical terminal block could be mounted on the shock-mount as shown in Fig. 4. Connectors, plugs and relays, etc., could also be located in this area. Not only does this arrangement utilize

otherwise wasted space, but it provides the designer with extra room within the dust cover for other components.

Note also in Fig. 4 how, by a simple redesign of a type ARC-34 Mounting Base, an extra inch of height is obtained. For the base shown, this amounted to 120 cu in. of extra space. Since weight is also of prime consideration, the lightning holes in the mounting-base floor keep the weight to a minimum. Another advantage of the cradling of the unit in the mounting-base is to lower its center of gravity. This adds to the sta-

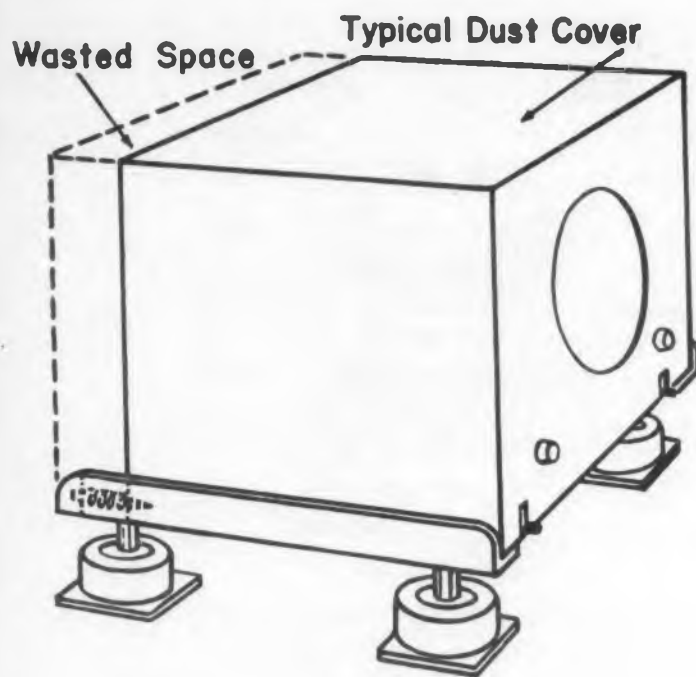


Fig. 1. Typical shock-mounted electronic unit. Space behind mounted springs (shown dotted) is usually wasted.

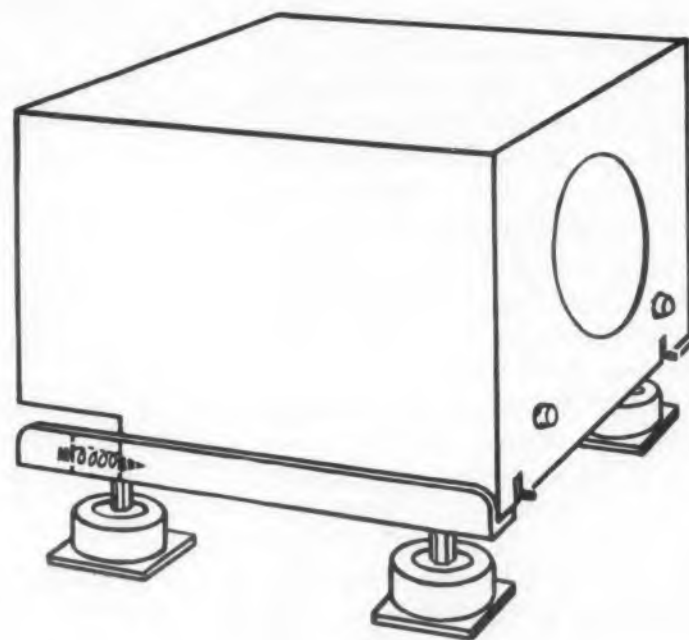


Fig. 2. New type dust-cover design to take full advantage of space at rear of shock-mount.

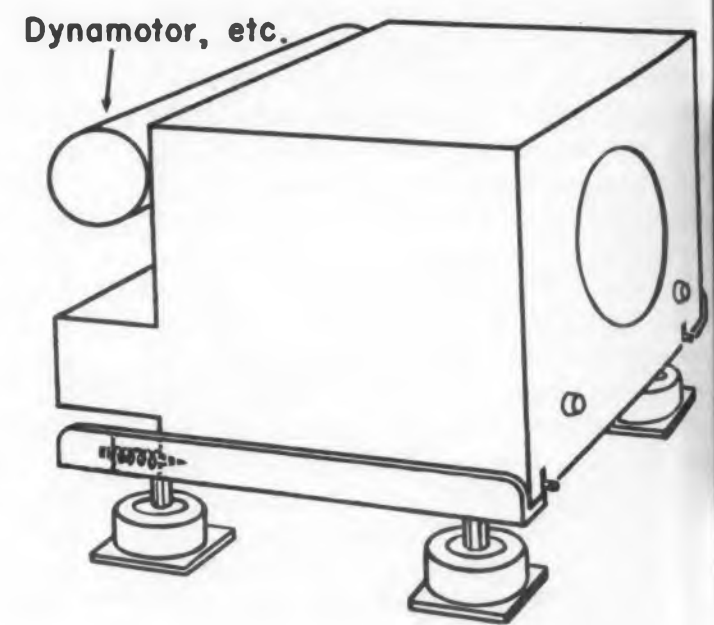


Fig. 3. Alternative design to that shown in Fig. 2, showing how different types of components can be mounted outside the dust cover to save space.



Fig. 4. Redesigned mounting base with terminal block occupying "free" space between rear mounting springs. Also, there is provision for more components between the shock-mounts by lowering the mounting-base floor as shown.



what makes tape wound cores reliable?

Reliability demands physical protection. Magnetic alloys which provide square hysteresis loop characteristics are strain sensitive. Distortion caused by coil winding will disturb precise magnetic characteristics, alter performance. So Magnetics, Inc. has devised a rigid, extra-strong aluminum core box to protect the magnetic core within from winding stresses, thus eliminating distortion.

Reliability demands electrical stability through the years. Suppose guided missiles failed to function in a future emergency because the magnetic properties of tape wound cores had changed. Cores must operate just as effectively years from now as they do today, whether or not they have been in use. Vibration, shock, and temperature changes can endanger such performance. That's why Magnetics, Inc. cushions tape windings with a special inert material in the extra-strong aluminum core box. And that's why it is especially important that our tape wound cores enclosed in aluminum boxes will withstand temperatures up to 450°F.

Reliability demands exacting standards on the part of the manufacturer. Judge a product by the company that makes it. Take a company that has pioneered a core box so advanced that it even permits vacuum impregnation. Take a company whose attention to design detail permits the offer of the *only* Performance-Guarantee in the industry. That's a real definition of reliability. Why not ask us how it will work for you? *Magnetics, Inc.*, Dept. ED-32, Butler, Pennsylvania.

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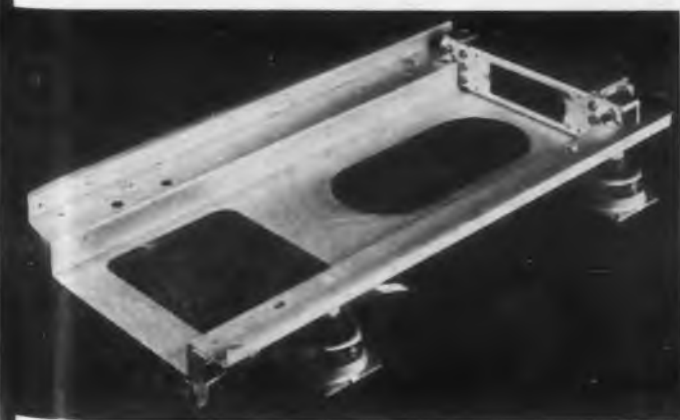


Fig. 5. A structurally rigid mounting base with an air filter mounted in the "free" space between the "runners." The box girder at the rear provides space for a terminal block and components.

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ility of the unit. Structurally it is also stronger. An alternative interesting mounting-base design is shown in Fig. 5. Here a filter is installed in the base, and box-spring construction is provided at the rear for components and terminals.

The illustrations shown are only a few of the possibilities that designers have at their disposal. However, a little ingenuity will make it possible for more equipment to fit into space allotted by military specifications and sometimes without the added expense of utilizing sub-miniature components.

Fig. 2,
can
pace.

Transistorized 25 Volt Regulated Power Supply

J. Giuffrida and W. O. Hamlin

CBS-Hytron
Danvers, Mass.

THE new junction-type power transistors, now available at low prices, are ideal for the regulating device in compact, light-weight, regulated power supplies. These transistors provide an extremely low voltage drop at high currents that is impossible to obtain from vacuum tubes. Many circuit configurations are possible consisting of two basic types, the shunt regulator and series regulator. For well-regulated voltages from about 0 to 25 v with a load current of 0 to 100 ma the circuit design shown in Fig. 1 can be employed. The advantage of this particular circuit is that low-cost commonly available parts are used. One application for this circuit is as a power supply in a test unit for 12 v automobile radio tubes

Circuit Operation

Regulation is accomplished in the circuit shown by the variable-current drain of power-junction type transistors which shunt the output voltage. The voltage is stabilized by the nearly constant current drain on the source voltage, ($I_r + I_L = C$).

Transistor T_1 functions as a variable resistance providing the shunt current which regulates the supply. The emitter-to-base voltages are in series with each other and the reference voltage which is applied to the base of T_2 . A change in the output voltage E_o results in a cascaded change in amplification of the two transistors because the base current of T_1 is the emitter current of T_2 . If E_o decreased, due to increased load, the emitter currents of T_1 and T_2 decrease, increasing collector resistances. The resulting reduction of collector current of I_1 counteracts the initial increase in load current.

The two-transistor cascaded arrangement improves the regulation over one transistor by the product of the β 's, β being the transistor's base-to-collector current amplification factor. At 12.6 v output the regulation is better than 1 per cent from no load to full load current 100 ma. Consequently, it may be seen that the

dc output resistance is less than one ohm. The reference voltage can be supplied by a Zener diode for power bulk and weight rather than the OA3 gaseous tube shown, which was used for economy.

Equivalent Circuits

The equivalent circuit of this supply is shown in Fig. 2. The following simplified equations illustrate its operation. The dc base-to-emitter resistances of the transistors are neglected since they are smaller than the resistance R_b which is in series with them. Since:

$$I_R = \frac{E_o - E_b}{R_b} \text{ and } I_2 = \beta_2 I_R = \beta_2 \frac{(E_o - E_b)}{R_b}$$

then

$$I_1 = \beta_1 I_2 = \beta_1 \beta_2 \frac{(E_o - E_b)}{R_b}$$

It can be seen from (2) that I_1 , the shunt current which provides regulation, is controlled by a factor $\beta_1 \beta_2$.

In order to establish the degree of regulation provided, the equivalent circuit is revised to a current generator form shown in Fig. 3. The source generat

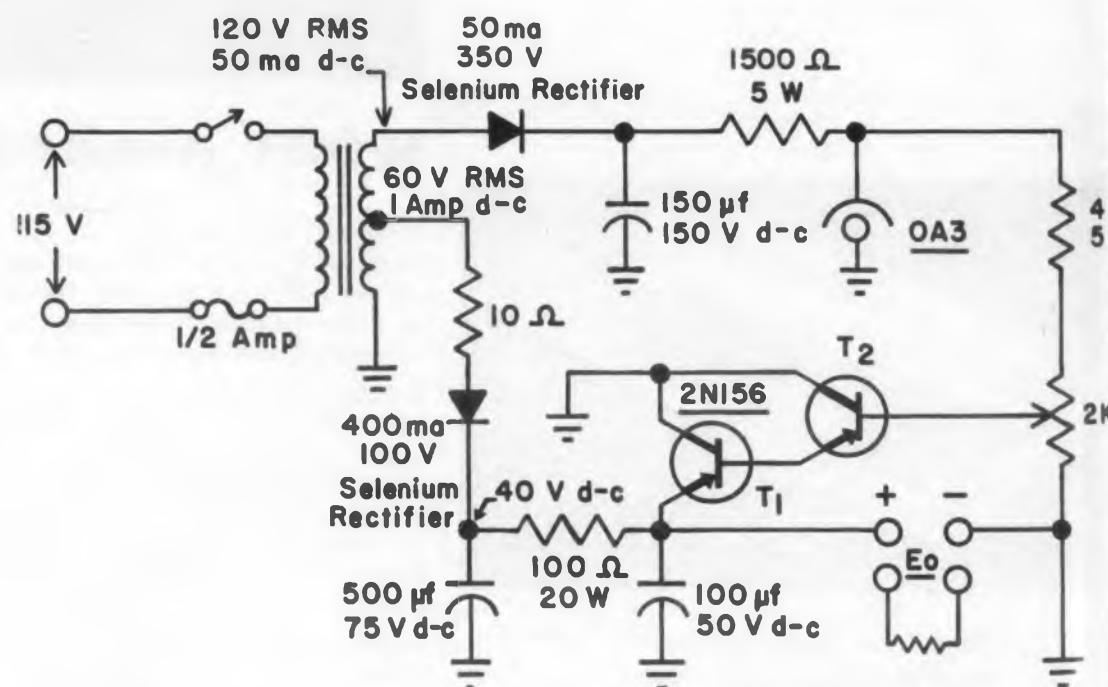


Figure 1. Circuit of transistorized regulated power supply. Regulation at 12 v output from 0 to 100 ma load is better than 1 per cent.

Note: Transistors should be bolted to aluminum chassis.

is the source voltage E_s divided by the source resistance R_s . R_c is the collector resistance of T_1 . The transistors approximate a current generator of

$$I_1 = \beta_1 \beta_2 \frac{E_s - E_b}{R_b}$$

The currents I_R and I_2 can be neglected as part of the generator since they are smaller than I_1 by factors of

$$\frac{1}{\beta_1 \beta_2} \text{ and } \frac{1}{\beta_1}$$

respectively. We have then:

$$E_o = (I_s - I_1 - I_L) K \quad (3)$$

where

$$K = \frac{R_b R_c R_s}{R_b R_c + R_c R_s + R_b R_s}$$

the paralleled resistances. This leads to:

$$E_o = \frac{\left[\frac{E_s}{R_s} + \beta_1 \beta_2 \frac{E_b}{R_b} \right]}{1 + \frac{K \beta_1 \beta_2}{R_b}} - \frac{K I_L}{1 + \frac{K \beta_1 \beta_2}{R_b}} \quad (4)$$

The first term in equation (4) represents no load voltage. The second term in (4) gives ΔE_o as a function of the degree of regulation. From the second term

$$\frac{\partial E_o}{\partial I_L} = Z_o = \frac{K}{1 + \frac{K \beta_1 \beta_2}{R_b}} \quad (5)$$

In any practical circuit it may be shown that

$$\frac{K \beta_1 \beta_2}{R_b} \gg 1$$

then from (5)

$$Z_o \approx \frac{R_b}{\beta_1 \beta_2}$$

If $Z_o \leq 1$ ohm, $R_b \leq \beta_1 \beta_2$ (6)

For the CBS transistor 2N156 conducting 0.5 amp. Beta is approximately 40; therefore R_b , the regulating resistance, will be approximately 1600. In this case E_o will approximate E_b .

In the circuit of Fig. 1 both T_1 and T_2 are transistor types 2N156. However, other transistor types may be substituted resulting in different operating characteristics. A lower-power-dissipation higher-Beta transistor can be used for T_2 with a consequent improvement in regulation. The maximum dissipation rating of T_2 can be low because its total collector current is equal to

$$\frac{E_o - E_b}{R_b}$$

In the circuit of Fig. 1, E_b is set by the 2000 ohm potentiometer having a range sufficient to establish values of E_o from almost 0 up to 25 v. The higher limit of voltage is restricted by the maximum voltage rating of the transistors and the current is limited by the maximum allowable collector dissipation. The circuit as shown will furnish 0.25 amp at 25 v without transistor T_1 overheating if it is mounted on an adequate heat sink.

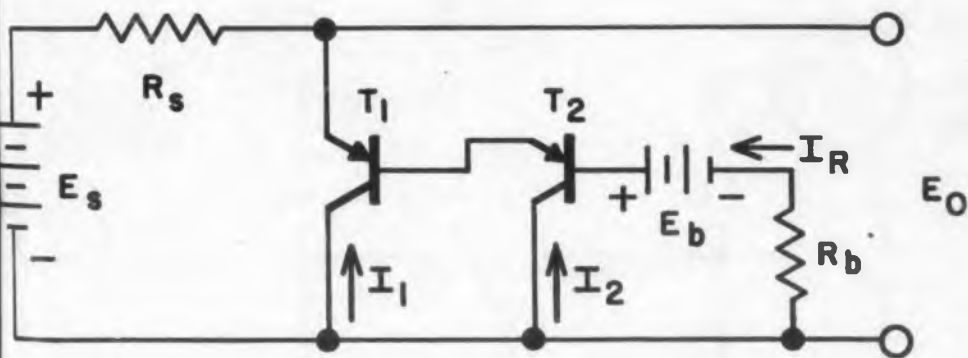


Figure 2. An equivalent circuit of the regulator circuit shown in Fig. 1. E_s —Open circuit dc supply voltage; R_s —Series resistance, either internal or external; B_1 and B_2 —Base-to-collector current amplification; E_b —Reference voltage; I_R —Regulating current; R_b —Regulating resistance; I_1 and I_2 —Collector currents.

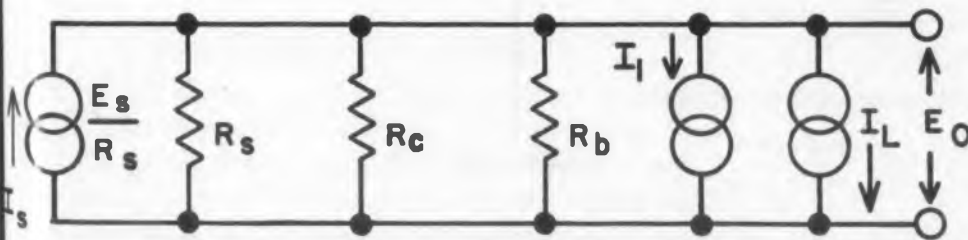


Figure 3: Current generator form of equivalent circuit for the regulator. This circuit enables calculation of the degree of regulation.

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This is a high voltage power supply for electrostatic dust collecting and air conditioning equipment. Operating on 230 volt single phase, 60 cycle, it supplies 12 KV direct current up to 30 ma. D.C. voltage is adjustable to load.

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3. Wherever possible, obtain an opinion from the various tube manufacturers that the specification is reasonable.

4. Include only those items which relate to set performance and tube dissipation limits. If there is a known field problem connected with a particular type, the specification may include an accelerated life test which has been shown to correlate with the defect under consideration. In work at Motorola, an arbitrary limit of 48 hours has been set on such tests. In addition to the above items, the specification may include a visual check on lead dress, etc.

5. Enlist the cooperation of the Purchasing Department to insure that preference will be given to the source that is most consistently meeting the specification, particularly in the case where line reject data or field failure data indicate the specification to be valid.

The above considerations serve to keep the specifications and test methods as uncomplicated as possible. However, if an additional problem arises, the specifications must be modified to include the needed controls.

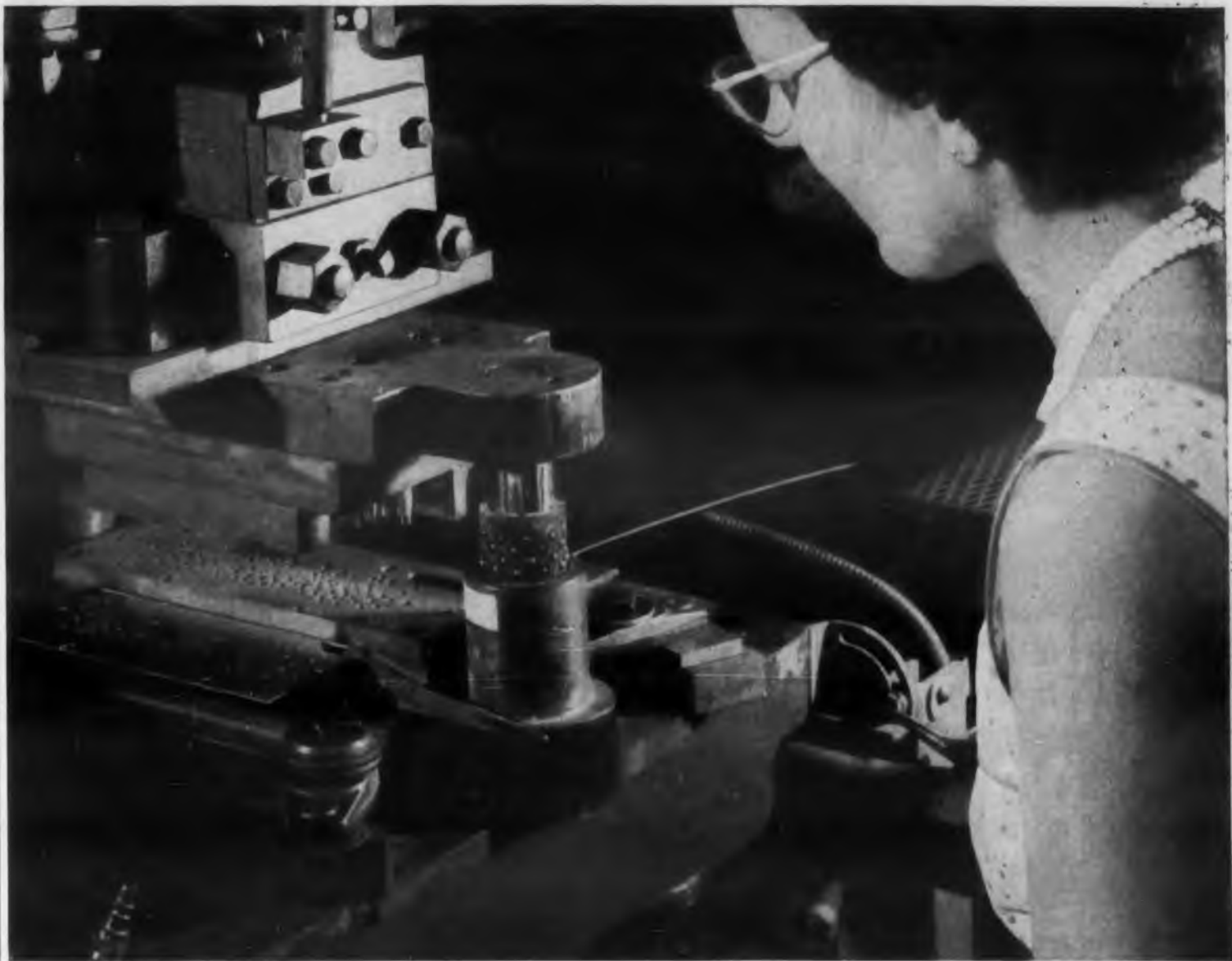
Inadequate Specifications

The following items are not adequately covered in existing acceptance specifications for receiving tubes used in Consumer Products:

1. Zero-bias plate current at maximum rated average cathode current.
2. Plate-current cutoff characteristic at maximum rated heater power.
3. Mutual conductance at maximum rated cathode current.
4. Knee location of pentode types.
5. Plate-screen ratio of pentode types.
6. Average screen current of pentode types under dynamic conditions.
7. Hum control limit.
8. Inter-element leakage control limit.
9. Inter-section leakage control limit.
10. Microphonism control limit.
11. Grid and screen emission control limits.
12. Grid current and gas current control limits.
13. Rf radiation of beam pentode types.
14. Heater-cathode insulation and heater burnout characteristics under cyclic operation.
15. Reduced heater-power mutual-conductance or plate-current drop-off characteristic.
16. Increased heater-power mutual-conductance or plate-current drop-off characteristic.

Recommended Test Methods

To test for as many of the above items as possible at one time, it was found necessary to test tubes dynamically at or above rated dissipation, voltage and current levels. It is convenient to observe a visual display of the plate and screen current waveforms. Opposition to this type of measurement is negligible today since similar test methods are used on other compo-



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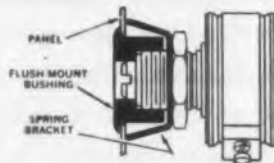
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nents. To make the test circuit as rigorous as possible without being overly complicated, the following features were adopted: (See Fig. 1.)

1. Readily available 60 cps ac was chosen for the driving voltages.
2. To provide a rough measurement of contact potential and other types of grid current, as well as to provide a check for microphonism and T-shorts, the impedance of the 60 cps grid-driving voltage was raised to several megohms by means of a series resistor.
3. For measuring the knee characteristics of pentodes, an out-of-phase, 60 cps supply voltage was added in series with the dc plate supply voltage.
4. Provision was made to apply a high voltage pulse during cutoff to check television deflection types for screen emission, leakage, etc.
5. Suitable dc supply voltages were provided in the grid, screen, and plate circuits.

With this test circuit, it is possible to operate the tube under test with the cathode current, screen dissipation and plate dissipation varied more or less independently by the proper choice of ac and dc test voltages. (See Fig. 2.)

The visual display of the above test condition is a plot of plate current or screen current vs the low impedance source of ac driving voltage. The actual plate-current waveform of the tube under test is a somewhat rounded-off square wave, the clipping re-

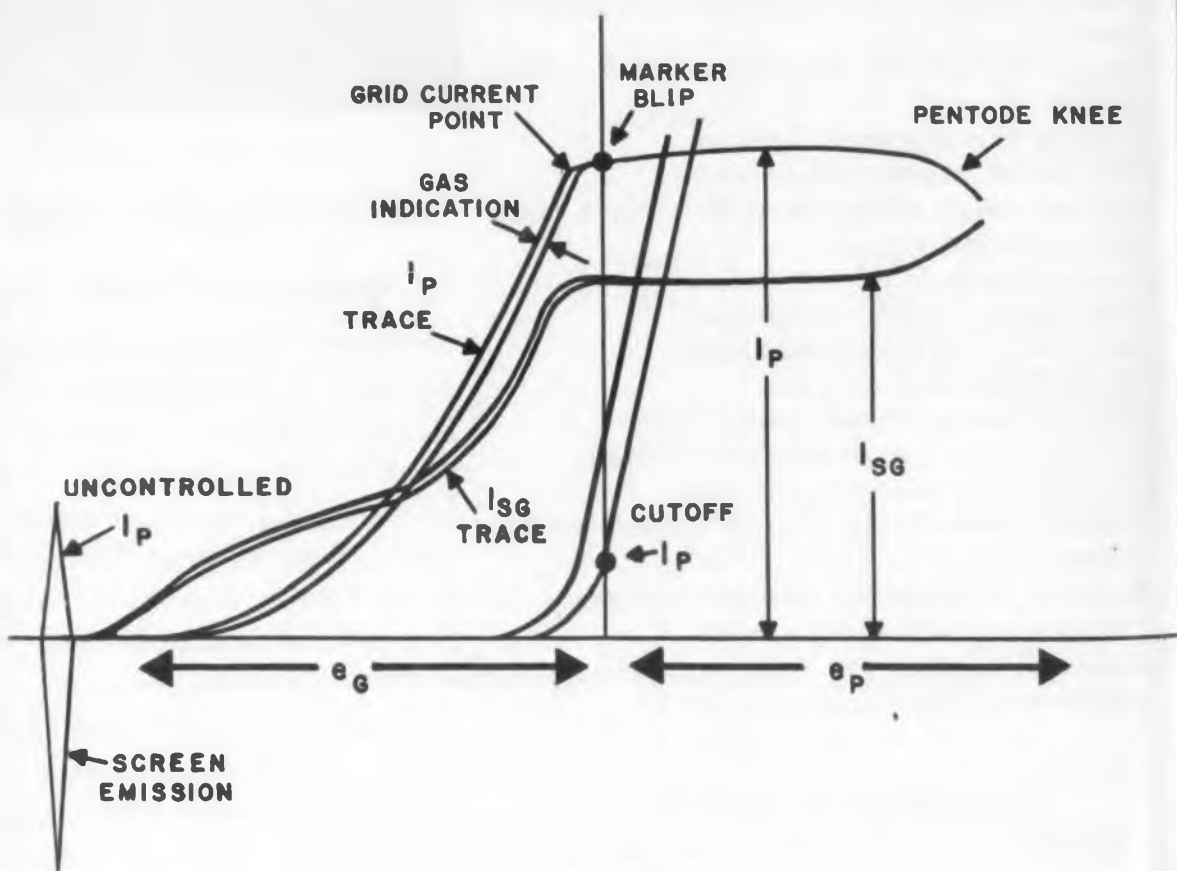


Fig. 2. Display

sulting from driving part cutoff in one direction and into grid current in the other.

The display itself resembles the transfer characteristic during the first half of trace and is flat, rounded, or sloping during the second half of trace, depending on the behavior of the tube under test when operated in the grid-current region. Since the tube under test is normally very close to zero bias during the second half of trace, the knee characteristic of pentode types may be observed during this portion of the sweep if the out-of-phase 60 cps plate-supply voltage is applied. Discontinuities in the knee region of beam pentode types are measured in terms of the amount of sudden increase in screen current and the voltage at which the increase occurs.

In order to measure the grid-current point, a blip is applied to the display device at the zero-voltage position of the low-impedance grid drive source.

The voltage and current amplifiers are stabilized and direct coupled so that the screen of the display device may be calibrated in voltage and current for measurement purposes or marked with limits for inspection purposes. With the tube operating at rated conditions in the test circuit, it is possible to simultaneously measure the grid-current value of plate current, cutoff, knee voltage, and plate-screen ratio as well as to check for tap shorts, microphonism, and the various types of grid current. Provision may be made for switching the plate-current scale factor in order to read cutoff at the microampere level. This switching may be done either manually or automatically. It has also been found desirable to switch scale factors when reading screen current. For convenience, the ratio of plate and screen scale factors should be equal to the poorest permissible plate-to-screen ratio.

Accelerated Life Testing

All of the above testing is contingent on the fact that the tubes are stable and will continue to operate in approximately the same manner throughout the warranty period. Unfortunately, there are many instances where this is not the case. In the television field, where small changes in performance are readily apparent and often necessitate costly service adjustments, there is great need for standardized, accelerated 48-hour life test to measure the change in tube characteristics under high and low line operating conditions. Tubes used for high-line testing can also be used for grid-current measurement purposes.

At present, Motorola is relying on delta mutual-conductance or zero-bias plate current checks to provide safety factor under low-line conditions and a 48-hour high-heater power, zero cathode-current life test to provide some safety factor under high-line conditions. For checking heater cathode insulation, inter-element shorts, etc., a very high heater-power, cyclic life test is being used. The object of the cyclic test is to obtain the greatest possible number of extreme temperature variations in a 48-hour period without an excessive number of heater failures.

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POWER SUPPLY: Short Time Stability (several hours), $\pm 0.005\%$ —Long Time Stability, $\pm 0.01\%$ —Output Voltage Calibration, $\pm 0.02\%$ —Output Impedance, $< 0.01\Omega$ at DC, $< 0.05\Omega$ to 200 kc—Output Hum and Noise, < 0.5 millivolt—Load Regulation Factor, $\pm 0.01\%$ —Line Regulation Factor, $\pm 0.002\%$.

METER CALIBRATOR: Same as Power Supplies with following exceptions for models which go to zero volts: Calibration Tolerance, $\pm 0.05\%$ —Hum and Noise, < 2 millivolts—Line Regulation Factor, $\pm 0.01\%$ of full scale.

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Direct Coupling Simplified by Low Shunt Capacitance Supply

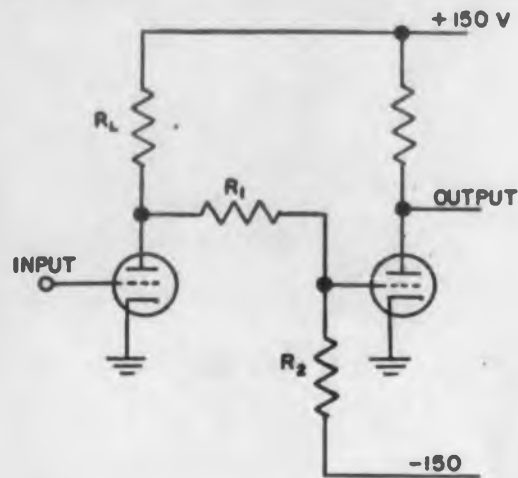


FIG. 1. VOLTAGE-DIVIDER METHOD OF DIRECT COUPLING

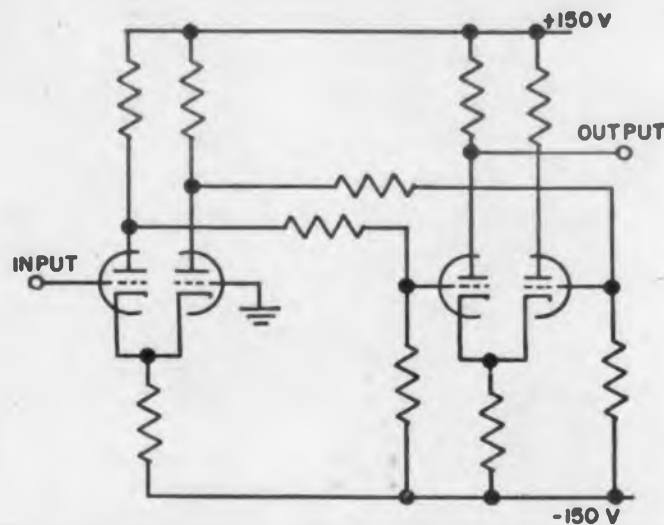


FIG. 2. VOLTAGE-DIVIDER METHOD WITH DIFFERENCE AMPLIFIER

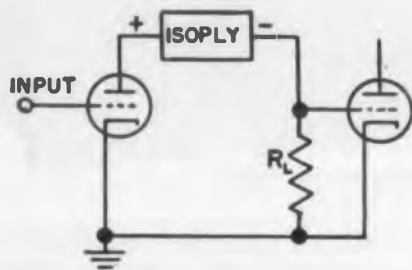


FIG. 3. ISOPLY METHOD OF DIRECT COUPLING

Note: All Isoplys shown have an output of approximately 100 v. d. c.

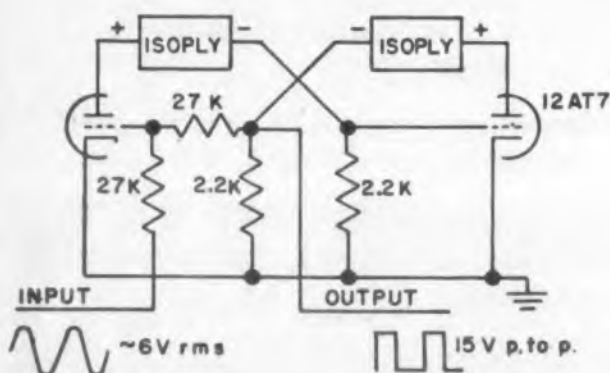


FIG. 5. RECTANGULAR-WAVE GENERATOR

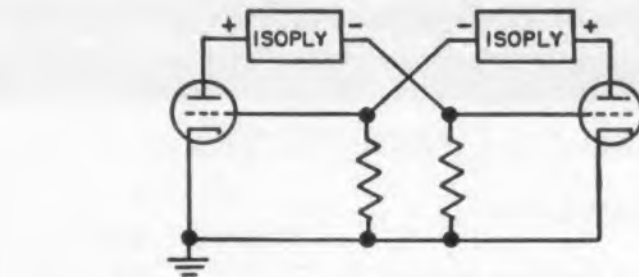


FIG. 4. BASIC FLIP-FLOP CIRCUIT USING TWO ISOPLYS

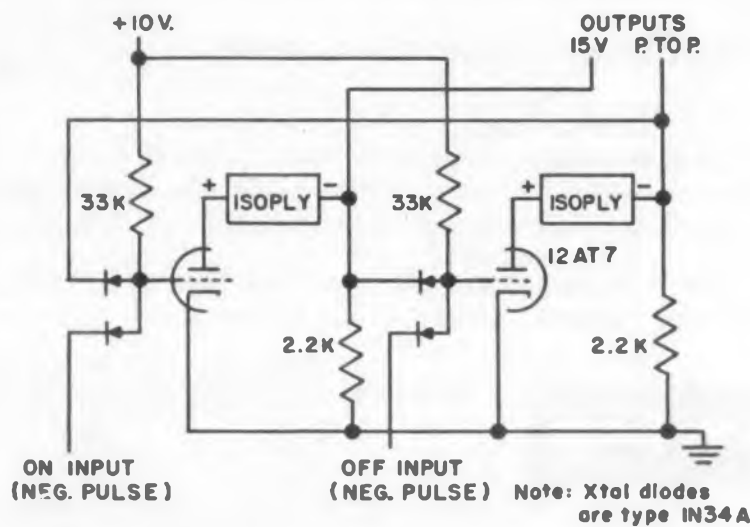


FIG. 6. FLIP-FLOP CIRCUIT WITH ON AND OFF INPUTS



This low-capacitance power supply, Model A105-15, employs four semiconductor rectifiers in a full-wave bridge circuit, and an OB2 regulator tube. Specifications are: Input, 110-125 v 60 cy; output, 105 v dc, 0-15 ma; shunt capacitance, 20 μ f; output ripple, 0.1 v at full load; regulation, NL to FL, 1%.

THIS novel power supply is designed primarily for use as a direct-coupling device in wide-band amplifiers and computer circuits. Called the Isoply because it is capacitively as well as conductively isolated from ground, it can be inserted between the plate of an amplifier tube and the load resistor without shorting out high-frequency components of the signal. When so used, the dc voltage level of the output signal is proper for direct connection to the following tube. A great simplicity in circuitry results from being able to connect the output of one tube directly to the grid of the next tube.

Special construction yields an output-circuit-to-ground capacitance of only 20 μ f in the Model A 105-15 Isoply manufactured by Elcor, Inc., of McLean, Virginia. In this model the secondary of the power transformer is separated from the core by a one-eighth inch air gap, and supported by Plexiglas pieces. The air gap is chiefly responsible for the reduction in shunt capacitance over conventional supplies. Rectifiers and filter circuit elements are also mounted on Plexiglas to further reduce the output-to-ground capacitance.

Applications

The advantages of direct coupling over rc coupling are fairly well known. Direct coupling improves low-frequency response and reduces waveform distortion. One of the most common methods of direct coupling consists of using a voltage divider network as shown in Fig. 1. In this circuit the signal amplitude is attenuated and the impedance level raised, resulting in a poorer high-frequency response. Another disadvantage is that both positive and negative supply voltages must be held constant to avoid change in the bias of the second tube.

The use of a balanced difference amplifier as illustrated in Fig. 2 reduces the sensitivity to supply voltage variations when voltage divider coupling is used. The circuit requires an extra tube and its power supply, and does not improve signal attenuation or the high-impedance of the divider network.

The Isoply permits direct coupling while overcoming these disadvantages, as shown in Fig. 3. The power supply, instead of being connected between the load resistor and ground, is connected between the tube and the load resistor. The tube's quiescent plate current, in flowing through the resistor, establishes the negative bias required for the following tube. Since the value of the load resistor is normally made low, for good high-frequency response, the dc level of the output signal is proper for direct connection to the next amplifier stage.

Although a separate power supply is required for each stage, the dimensions of the unit are only 1-5/8 x 2-1/4 x 5-5/16 in. and the cost of the supply is small enough that this design is not unduly costly.

A basic flip-flop circuit using two Isoplys is shown in Fig. 4. This flip-flop can be augmented as shown in Fig. 5 to make a sine-wave to rectangular-wave converter.

The circuit of Fig. 6 shows a flip-flop with on and off inputs formed by the use of diode gates. The circuit operates as follows: a negative pulse into either of the inputs shuts off the tube to which the output connects, causing the other tube to conduct. The conduction of the second tube produces a negative voltage which holds the first tube in its cutoff state. The input pulse and holding voltage are coupled to the grid of the first tube through diodes in a circuit that is known as an Or-gate.

The simplicity and reliability of the above circuits make the use of isolated power supplies worthwhile. The Isoply can also be used in the conventional manner with either terminal grounded or by-passed to ground. The special construction gives it the added feature of high voltage insulation, making it possible to connect many units in series to provide a high voltage source with regulated outputs in steps of 105 volts.

For more information about this product please turn to Reader's Service Card and circle 23.

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POWER OUTPUT: 2000 va three phase
 FREQUENCY: 350 to 450 cps variable
 FREQUENCY ACCURACY: 0.5% (0.2% and 0.1% available)
 INPUT: 230v 60 cps Single Phase
 OVERALL SIZE: 24" wide x 73" high x 24" deep



MODEL 751-E-1

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R-F Absorbers for 50 Mc Up

Robert F. Kolar*

Radio Corporation of America

SINCE establishment of maximum limits on undesired radiation from home radio and television receivers by FCC, more accurate radiation measurements are necessary. With a growing interest in making such measurements indoors, results of recent studies on absorbing materials at frequencies as low as 50 mc are timely.

Why Not Open-Field?

Radiation measurements, using open-field techniques are difficult to repeat, and agreement between different sites may be poor. The standard procedure is to measure the maximum signal, which occurs where the direct wave and reflected wave add in phase. This maximum signal will vary with the magnitude of the reflected wave from the earth and other objects. The amount of this reflected energy often depends upon weather conditions and can vary from 31 to 98 per cent of the transmitted signal depending on whether the earth is covered with snow or is dry. Another source of error is the change in depth of the ground plane due to a deep covering of snow. Also, at the lower frequencies, the field-strength antenna cannot be elevated enough to receive the maximum signal if the site is constructed according to existing IRE Standards.

An indoor "free-space" room with non-reflecting walls avoids the disadvantages of open-field measurements. Although electromagnetic anechoic chambers have been constructed for frequencies above 500 mc, no data has been available on such chambers for frequencies down to 50 mc.

Room Absorbers

For chambers which have been constructed to use at frequencies down to 500 mc, the material for the wall covering is made of mats of curled animal hair impregnated with a mixture of neoprene and carbon black. The commercially available curled animal-hair

base is well suited for this application inasmuch as a large surface area is presented to the wave front. Measurements made in specially-designed transmission lines and wave guides have shown that this material reflects less than 2 per cent of the normally incident energy at frequencies above 400 mc. Since existing rooms give results as good as, or better than, roof-top measurements of antenna field patterns, it is felt that a material having similar electrical characteristics at lower frequencies would be satisfactory for such rooms.

Test Results

A number of samples of absorbing material of different densities was obtained and tested to determine the best design for a room at frequencies as low as 50 mc.

The energy propagated in the "free-space" room can be reflected in three ways: 1. at the air-material interface; 2. at discontinuities within the material; and 3. by transmission through the material, reflection from the conducting end plate, and retransmission through the material. Reflections from discontinuities within the material are sometimes helpful since they may contribute to the absorbing qualities of the material by causing internal scattering and eventual absorption. The third source of reflection becomes negligible when the material thickness is such that there is no further decrease in the standing-wave ratio as the pad is made deeper. It is evident from Fig. 1 that after a particular layer of relatively low density material was made thicker than 28 in. there was little to be gained by further increasing the depth. The par-

ticular sample shown reflected a minimum of about 20 per cent of the incident power.

Electrical Taper. The reflection from the air-absorbent interface can be reduced by either geometrically or electrically tapering the section. Electrical tapering, which was accomplished by varying the resistance as a function of the depth of the material, proved to be unsatisfactory. This was because the surface reflection from the highest resistance material commercially available was far too large. Although conceivable that a satisfactory electrically tapered material could be developed, a geometrical taper would seem to be more economical.

Geometrical Taper. Having determined that the configuration to be tested should contain a geometrically tapered section to reduce the discontinuity at the air-material boundary, the next problems to be considered were: 1. the length; 2. the necessary physical constants of the material; 3. the type of taper to be used; and 4. the type of backing, if any, which must be used with the tapered section. Only a small amount of data was necessary to determine conclusively that a tapered section alone would not be satisfactory. In materials of this sort, the energy is absorbed within the materials and not on the surface. Therefore, it was necessary to use pad along with the tapered section. Although the taper could have been conical, pyramidal or exponential, a wedge was selected for experimental purposes, because it lends itself more readily to measurements in the line. A rectangular block can be cut diagonally and the two halves placed back-to-back in order to form a wedge without waste.

Resistivity Measurements. The surface reflection from wedges less than 40 in. long was too great at 50 mc to be satisfactory for use in an anechoic chamber. With a 40 in. taper, a base pad 9 in. deep was needed to keep the reflection coefficient below the required 2 per cent value. The per cent power reflected from a 40 in. wedge as a function of the d-c resistance of the

* Based on a paper "Radio Frequency Absorbers For Frequencies Above 500 Mc," presented by M. Kolar at the National Electronics Conference in Chicago, October 1-3, 1956. Methods of making measurements were also discussed.

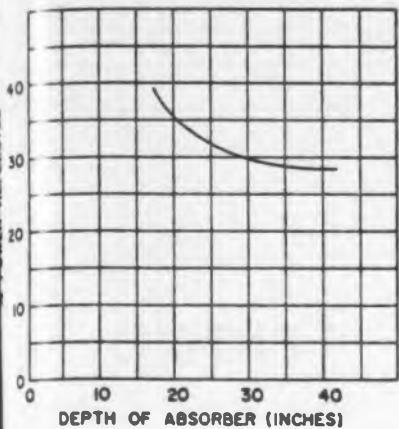


Fig. 1. Reflection coefficient of a rectangular section of an absorbing material

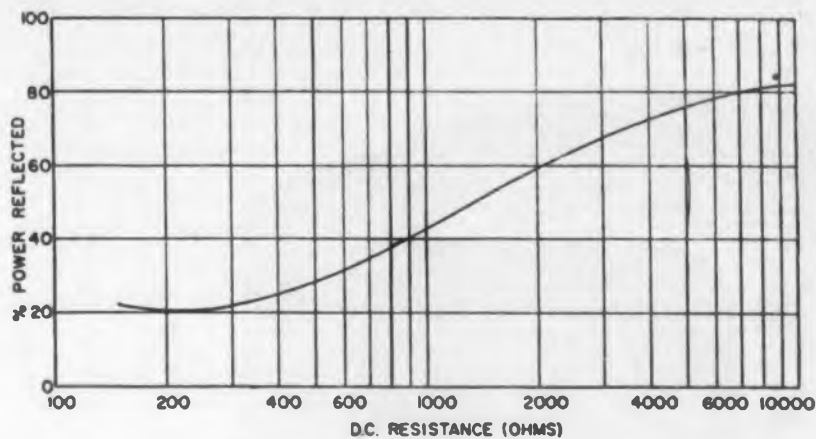


Fig. 2. Per cent power reflected vs d-c resistance of a 40 in. long wedge

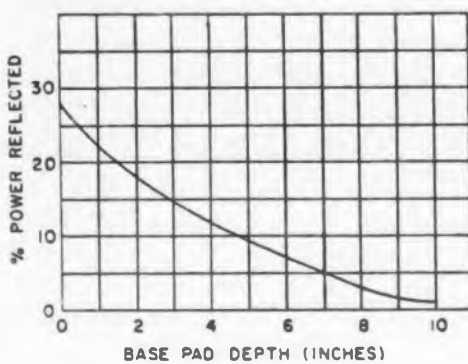


Fig. 3. Power reflection vs base pad depth

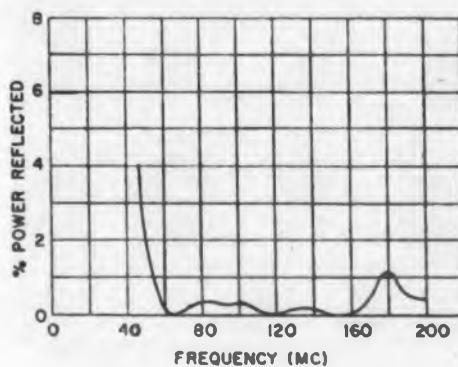


Fig. 4. Per cent power reflected vs frequency for a typical 50 mc absorber

material is shown in Fig. 2. The d-c resistance was measured between two 1/16 in. diam probes which penetrate the material to a depth of 1-3/4 in. A large number of resistance measurements were made on each sample and the average value was plotted. As the resistance of the material is decreased, the reflection coefficient decreases until an optimum value is reached. Further reduction of the resistance then results in an increasing reflection coefficient. If a 40 in. wedge of the optimum material is added to a 10 in. base pad of the same material, an absorber which reflects only 2 per cent of the normally incident energy at 50 mc, and less at higher frequencies, is obtained. It has been found that the optimum material is difficult to fabricate satisfactorily.

Material Required

Base Pad. An efficient absorber using higher resistance material can be made by using either more of the material or by providing a more efficiently absorbing base. The most effective type of base pad was

found to be one which is made up of layers of material of varying resistivity, thereby providing discontinuities between which the energy will be reflected and absorbed. In order to determine the optimum base depth, data were taken using 40 in. wedge samples of different resistivity with base pads of varying thickness and resistance. Four values of resistance were used and the optimum configuration for each total thickness was determined. The results, shown in Fig. 3, indicate that the improvement gained by using a base pad thicker than 9 in. will not be sufficient to warrant the additional expense. Any substantial reduction below this depth, however, reduces the effectiveness of the absorber.

Reflection vs Frequency. In Fig. 4 the per cent power reflected as a function of frequency is shown for a typical sample. The curve will vary slightly from sample to sample. The characteristics of the optimum material and those of a higher resistivity material with a laminated base are essentially the same for a given depth of absorber.

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The tube has a filament of the hearing-aid type and both filament and anode may be operated from the 120 v ac line. Power consumption is in the milliwatt region.

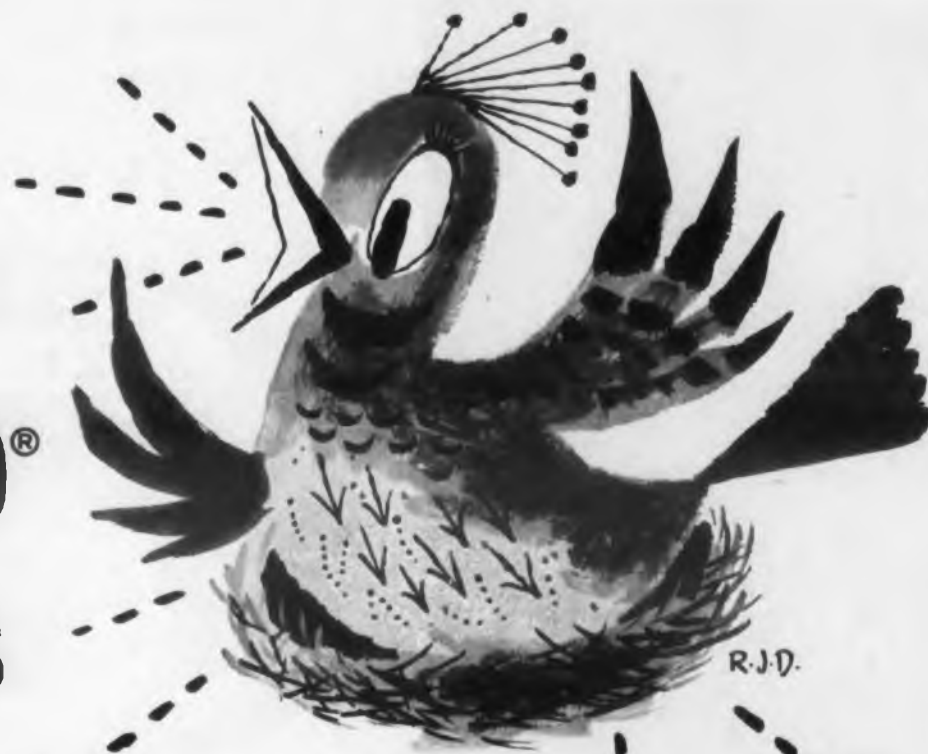
With 0 v on the grid, the tube glows, and it is extinguished with -3 v. Flying leads are provided for direct wiring into printed circuit boards.

When the tube is fired the glow may be viewed end-on or from the side of the envelope, so that the tube may be mounted in any position convenient to the circuit application. The KP-125 can find application wherever transistors require monitoring and may also be used in remote control panels for indication. Conservative ratings and design insure long life with stable characteristics.

For further information on this product fill out the Reader's Service Card and circle 27.

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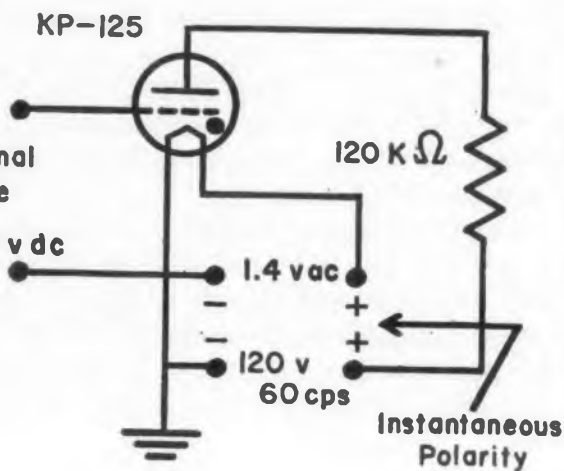
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In the circuit shown, the anode of the tube is connected through a resistor in series with the 120 v ac line. The filament is rated at 1.4 v 50 ma. A dc signal source, provided for example by the circuit to be monitored, acts as the grid supply. With -3 volts on the grid the tube is extinguished; with 0 volts the tube glows. The reference point here is the negative end of the filament when the anode is positive.

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TYPICAL CHARACTERISTICS		
	2N173	2N174
Properties (25°C)	12 Volts	28 Volts
Maximum current	12	12 amps
Maximum collector voltage	60	80 volts
Saturation voltage (12 amp.)	0.7	0.7 volts
Power gain (Class A, 10 watts)	38	38 db
Alpha cutoff frequency	0.4	0.4 Mc
Power dissipation	55	55 watts
Thermal gradient from junction to mounting base	1.2°	1.2° °C/watt
Distortion (Class A, 10 watts)	5%	5%

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Production Design

Rudolph L. Kuehn,

Chief Product Design Engineer
Electronics Division, The Ralph M. Parsons Co.,
Pasadena, Calif.

COMPENSATED attenuators occur quite frequently in test instrumentation where it is desirable to avoid frequency discrimination in the presence of signal reduction and over a reasonably wide band. Experimentally, it is quite feasible to individually adjust each attenuator section to provide the necessary relationship $R_1 C_1 = R_2 C_2$, shown in Fig. 1. In a production situation it would be highly desirable to eliminate as many adjustments as possible. It will be seen, this may be accomplished, given certain boundary conditions.

If a square wave is applied to the input terminal of the circuit in Fig. 1, when $R_1 C_1 = R_2 C_2$, then the same wave form will appear unchanged except for a change in amplitude at the output terminals. Should the above time constant relationship be violated, the output square wave may appear as indicated by the dashed line (by t

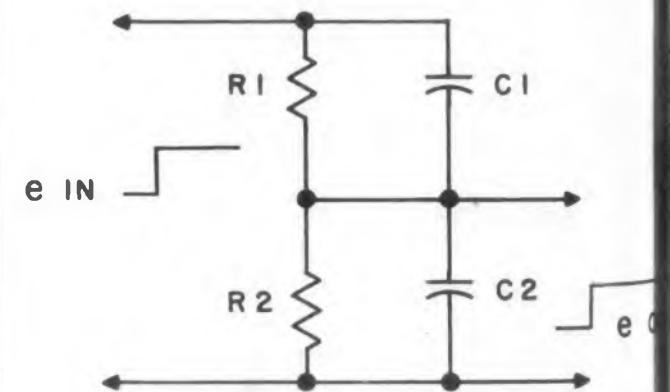


Fig. 1. Unit step function applied to compensated attenuators.

Appendix 1

Refer to Fig. 1. The equation for the output voltage in terms of Laplace transforms is given as

$$E_{out}(S) = I(S)Z_2(S) = \frac{E(S)Z_2(S)}{Z_2(S) + Z_1(S)} \quad (1a)$$

where

$$E(S) = 1/S; \quad Z_1(S) = \frac{R_1/SC_1}{R_1 + 1/SC_1} = \frac{1/C_1}{S + 1/R_1C_1}; \quad Z_2(S) = \frac{R_2/SC_2}{R_2 + 1/SC_2} = \frac{1/C_2}{S + 1/R_2C_2}$$

$$\text{Let } \alpha_1 = 1/R_1C_1 \\ \alpha_2 = 1/R_2C_2$$

Then, by substitution into Eq. 1a:

$$E_{out}(S) = \frac{\left[\frac{R_2 \alpha_2}{S + \alpha_2} \right]}{S \left[\frac{R_1 \alpha_1}{S + \alpha_1} \right] \left[\frac{R_2 \alpha_2}{S + \alpha_2} \right]} = \left[\frac{R_2 \alpha_2}{R_1 \alpha_1 + R_2 \alpha_2} \right] \frac{[S + \alpha_1]}{S \left[S + \frac{\alpha_1 \alpha_2 (R_1 + R_2)}{R_1 \alpha_1 + R_2 \alpha_2} \right]} \quad (1b)$$

The latter Laplace equation has two poles, one at $S = 0$ and the other at $S = -\frac{\alpha_1 \alpha_2 (R_1 + R_2)}{R_1 \alpha_1 + R_2 \alpha_2}$

It is now apparent that the solution of Eq. 1b is:

$$e_{out} = \frac{R_1}{R_1 + R_2} \left[1 - \left\{ 1 - \frac{\alpha_2 (R_1 + R_2)}{R_1 \alpha_1 + R_2 \alpha_2} \right\} e^{-\frac{\alpha_1 \alpha_2 (R_1 + R_2)t}{R_1 \alpha_1 + R_2 \alpha_2}} \right] \quad (2a)$$

In terms of circuit parameters, this becomes:

$$e_{out} = \frac{R_1}{R_1 + R_2} \left[1 - \left\{ 1 - \frac{(1 + R_1/R_2)}{(1 + C_2/C_1)} \right\} e^{-\frac{(1 + R_1/R_2)t}{(1 + C_2/C_1)R_1C_1}} \right] \quad (2b)$$

When $R_1C_1 = R_2C_2$ the attenuated waveform is faithfully reproduced in the output. The attenuation factor is given as: $K = (R_1 + R_2)/R_2$ (3)

Allow a tolerance of $(m \times 100)$ per cent for R_1 and R_2 , and tolerances of $(n \times 100)$ per cent for C_1 and C_2 , respectively. Now the output wave will be either a rising or falling exponential with an initial value $1/K$ times the input step function amplitude. At $t = 1/R_1C_1$ the largest deviation of the output wave, considering the allowed component tolerance is:

$$e(t_1) = \frac{R_2}{R_1 + R_2} \left\{ \left[1 - \left\{ 1 - \frac{1 + \frac{R_1(1-m)}{R_2(1+m)}}{1 + \frac{C_2(1+n_2)}{C_1(1-n_1)}} \right\} \right] e^{-\frac{1 + \frac{R_1(1-m)}{R_2(1+m)}}{\left[1 + \frac{C_2(1+n_2)}{C_1(1-n_1)} \right] (1-m)(1-n_1)}} \right\} \quad (4)$$

Since $\frac{R_1}{R_2} = \frac{C_2}{C_1} = K - 1$, the tilt is given as:

$$\frac{\Delta y}{y} = \left[1 - \frac{1 + (k-1) \left(\frac{1-m_1}{1+m_2} \right)}{1 + (k-1) \left(\frac{1+n_2}{1-n_1} \right)} \right] e^{-\frac{1 + (k-1) \left(\frac{1-m_1}{1+m_2} \right)}{\left[1 + (k-1) \left(\frac{1+n_2}{1-n_1} \right) \right] (1-m_1)(1-n_1)}} \quad (5)$$

The deviation is seen to become worse with increasing attenuation, but approaches a limit for values of $K = 100$.

$$\frac{\Delta y}{y} \Big|_{\max} = \left[1 - \frac{(1-m)(1-n_1)}{(1+m)(1+n_2)} \right] e^{-\frac{1}{(1+m)(1+n_2)}} \quad (6)$$

The exponential terms approximate to:

$$e^{-\frac{1}{(1+m)(1+n_2)}} = e^{-\frac{1}{1+m+n_2+m n_2}} \approx e^{-1+m+n_2+m n_2}$$

Compensated Attenuators

the dashed lines in Fig. 2. By definition, this deviation from flat top, known as tilt, is given as $(\Delta y/y \times 100)\%$ at the frequency $1/R_1C_1$. The problem, then, is to determine the allowable tolerances on the values of R_1, C_1, C_2 , which will maintain the tilt within a desired percentage. In the case under discussion, this tolerance is $\pm 5\%$.

Since the advent of carbon and metal film resistors with their negligible self-inductance, it is quite practical to obtain R_1 and R_2 in tolerances of $\pm 1\%$. Therefore the investigation is focused on determining the component tolerance limits on C_1 and C_2 . The analysis may be made by any of several known methods. It is, however, more expeditious to utilize the approach of a square wave function inasmuch as the condition being considered is the response of the network to a square wave (by the definition given above for tilt).

(Continued on page 42)

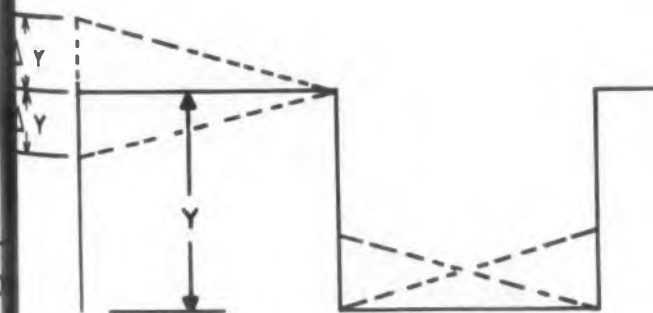


Fig. 2. Over and under compensation appearing as tilt or departure from flat-top.

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$$= \epsilon^{-1} \epsilon^{(m+n_2+m n_2)} \approx \epsilon^{-1} [1+m+n_2+m n_2] \quad (7)$$

$$= \epsilon^{-1} (1+m) (1+n_2)$$

The first term on the right hand side of Eq. 6 becomes, approximately:

$$\frac{(1+m) (1+n_2) - (1-m) (1-n_1)}{(1+m) (1+n_2)} \approx \frac{2m + n_1 + n_2}{(1+m) (1+n_2)} \quad (8)$$

The limiting case is:

$$\left. \frac{\Delta y}{y} \right|_{\max} = \frac{2m + n_1 + n_2}{(1+m) (1+n_2)} \epsilon^{-1} (1+m) (1+n_2) \quad (9a)$$

$$= 0.368 (2m + n_1 + n_2)$$

If, now, $n_1 = n_2 = n$:

$$\left. \frac{\Delta y}{y} \right|_{\max} = 0.736 (m + n) \quad (9b)$$

The detailed analysis may be obtained in Appendix I. It will be seen that if the resistance values are assigned a tolerance of $m\%$ and the capacitance values are assigned a tolerance of $n\%$, that the maximum tilt approaches a limit for attenuation ratios in excess of 100 and that it may be given as

$$\left. \frac{\Delta y}{y} \right|_{\max} = 0.736 (m + n).$$

Thus, a useful criterion is established for production variations. Since the limiting accuracy is reached at attenuator ratios equal to or in excess of 100, it is apparent that the solution of an attenuator section at this point establishes the component limits for all steps. At small values of attenuation, consideration should be given to cost reduction by the use of lower tolerance components to maintain consistent $\Delta y/y$ variations.

An interesting case is presented by the compound compensated attenuator, illustrated schematically in Fig. 3. The analysis is found in Appendix II. By the use of such a configuration, fewer components may be required for the same number of steps. Greater care must be exercised in maintaining constant impedances and time constants. Insofar as production time is concerned, fewer adjustments are necessary allowing for a more accessible switch configuration and a reduction in test time.

*The work presented was done in cooperation with Mr. Jerome Machlis when he and the author were affiliated with Hycon Electronics, Inc. Mr. Machlis is presently with Radioplane Co.

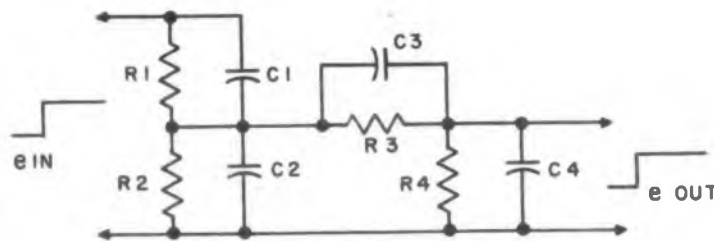


Fig. 3. Compound compensated attenuator with unit step function unit.

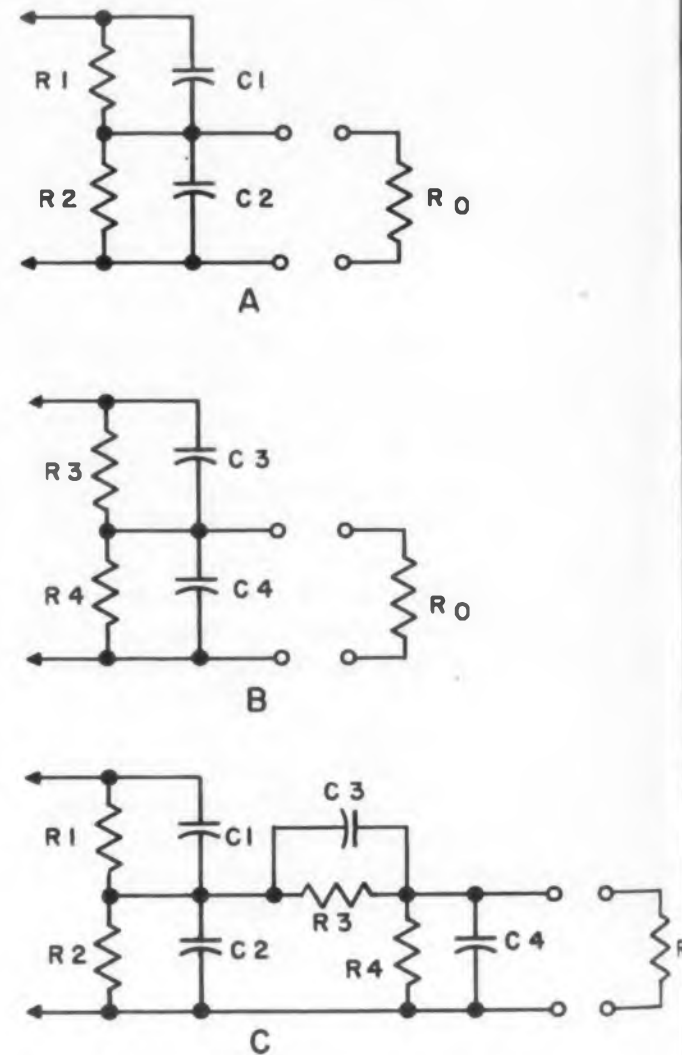


Fig. 4. Preferred configurations, a, b and c, compound attenuator. See Appendix 2.

Appendix 2

Refer to Fig. 3. If the individual sections are compensated, then $R_1C_1 = R_2C_2$ and $R_3C_3 = R_4C_4$. The output waveform in response to a unit impulse is of the form:

$$E_{out}(S) = \frac{Z_2(S) Z_4(S)}{[Z_1(S) + Z_2(S)][Z_2(S) + Z_3(S) + Z_4(S)] - Z_2^2(S)}$$

$$\left\{ \frac{Z_2(S) Z_4(S)}{[Z_1(S) + Z_2(S)][Z_2(S) + Z_3(S) + Z_4(S)] - Z_2^2(S)} \right\}$$

where $Z_n(S) = \frac{R_n \alpha_n}{S + \alpha_n}$ for $n = 1, 2, 3,$ and 4

$$\alpha_n = \frac{1}{R_n C_n} \quad (10)$$

If $R_1C_1 = R_2C_2 = R_3C_3 = R_4C_4$, then the compound attenuation factor becomes:

$$K_T = \left(\frac{R_1 + R_2}{R_2} \right) \left(\frac{R_2 + R_3 + R_4}{R_4} \right) - \frac{R_2}{R_4} \quad (11)$$

If the output response is flat. If R_2 is small compared to R_4 and can be neglected, then

$$K_T = \left(\frac{R_1 + R_2}{R_2} \right) \left(\frac{R_3 + R_4}{R_4} \right) = K_1 K_2 \quad (12)$$

A superior method of compound attenuator configuration is shown in Fig. 4.

Here the value of R_0 is:

$$R_0 = R_1 + \frac{R_0 R_2}{R_0 + R_2} = R_3 + \frac{R_0 R_4}{R_0 + R_4} \quad (13a)$$

$$= \frac{R_1}{2} + \frac{\sqrt{R_1^2 + 4R_1 R_2}}{2} = \frac{R_3}{2} + \frac{\sqrt{R_3^2 + 4R_3 R_4}}{2} \quad (13b)$$

For Fig. 4A:

$$R_1 C_1 = \frac{R_2 R_0}{R_2 + R_0} C_2 \quad (14a)$$

$$K_1 = \frac{\frac{R_2 R_0}{R_2 + R_0}}{R_1 + \frac{R_2 R_0}{R_2 + R_0}} \quad (14b)$$

For Fig. 4B:

$$R_3 C_3 = \frac{R_4 R_0}{R_4 + R_0} C_4 \quad (15a)$$

$$K_2 = \frac{\frac{R_4 R_0}{R_4 + R_0}}{R_3 + \frac{R_4 R_0}{R_4 + R_0}} \quad (15b)$$

The total attenuation of Fig. 4C if $R_1 C_1 = R_3 C_3$ is:

$$K_T = K_1 K_2 \quad (16)$$



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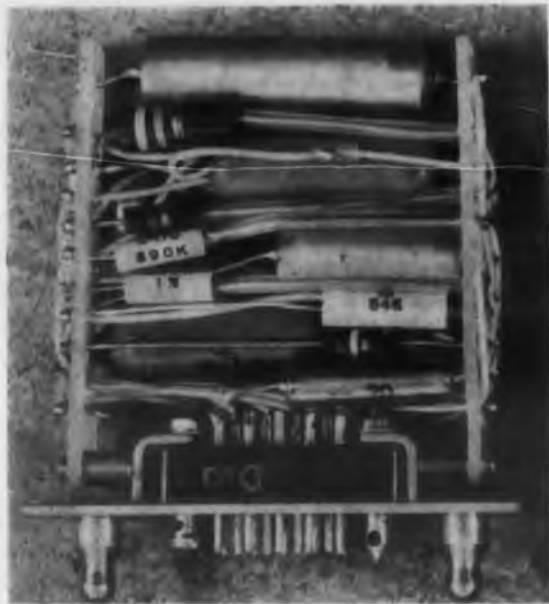


Fig. 1. (Top)—A unit prior to epoxy embedment. (Center)—After embedment. (Bottom)—Cased.

Dimensional Control of Potted Electronic Components

ONE OF the most troublesome variables confronting the designer of electronic assemblies cast in plastic materials, such as polyester and epoxy resins, is shrinkage. Many embedments must fit into a space with close tolerances, attach to a close-tolerance metal part, or perform some other function which demands close control of the dimensional tolerances of the embedded unit.

It is pointed out here that dimensional control of electronic units embedded in polyester and epoxy materials is possible, provided a thorough understanding of what is involved is known. Such control is best accomplished through the use of detailed studies which can be used as guides for proper mold design and the setting of practical tolerance limits on the finished product. There are definite limitations as to the tolerances that can be maintained with a given resin embedment or product size. Epoxy resins are generally best for embedment systems requiring minimum shrinkage. Also, if the dimensional tolerances are sufficiently broad, cast epoxy molds can be used to advantage.

One is not justified in assuming that a commercial polyester or epoxy embedment material will conform to the same tolerances as metals. It can also be very costly if product tolerances are based on an incomplete set of dimensional data. Most common errors occur when: 1. Mold design is based on limited data or on generalized data from resin suppliers; or 2. dimensional tolerances are set too close for control in the embedded product. In both cases, the usual result is that erratic dimensions occur in production—frequently, out of tolerance. At the production stage it is often very difficult to remedy the situation without waste of time and expense.

A typical embedment is shown in Fig. 1. Typical components embedded in this manner are resistors, capacitors, transformers, diodes, subminiature tubes and mechanical assembly devices. Various mechanical layouts of these components were investigated; yet, no shrinkage differences were observed which could be attributed to the different internal structures.

Both polyester and epoxy compounds were studied, formulated from typical resins available commercially.

The polyester compound was catalyzed with an organic hydroperoxide and cobalt naphthenate, and the epoxy compound was polymerized with an amine type hardener. The polyester embedment was cured for twenty-four hours at room temperature, followed

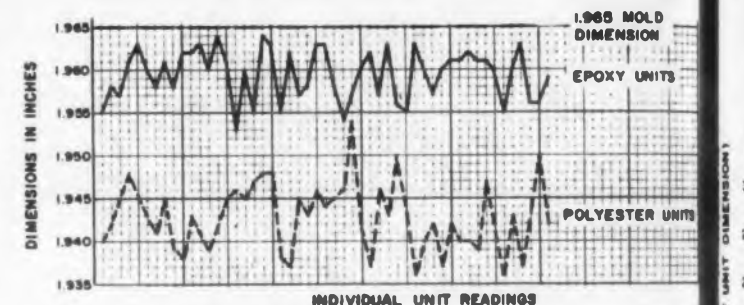


Fig. 2. Dimensional variations of polyester and epoxy embedments. Note the irregularities between samples and the greater variation with polyester resins.

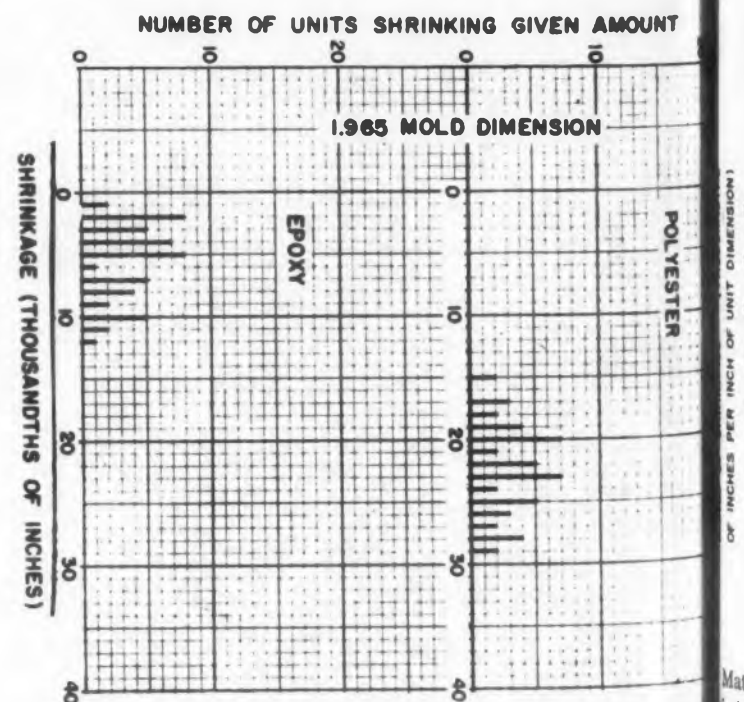


Fig. 3. Distribution of shrinkage for polyester and epoxy embedded units.

Charles A. Harper*

Westinghouse Electric Corporation

... three hours at 60 C; the epoxy embedment was cured for four hours at 65 C. The product made from both materials was subjected to four thermal cycles, each cycle consisting of two hours at 85 C, immediately followed by two hours at -65 C. The molds

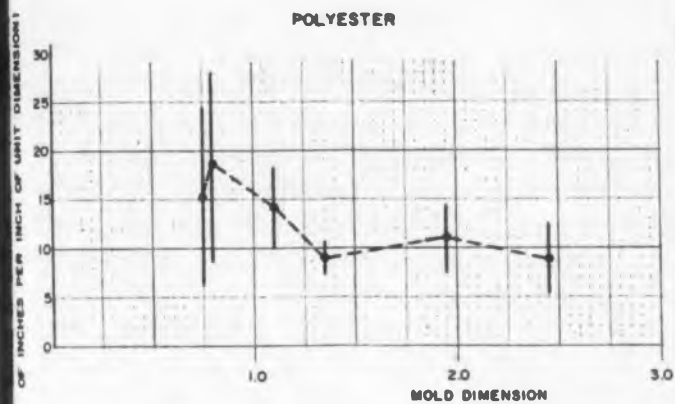
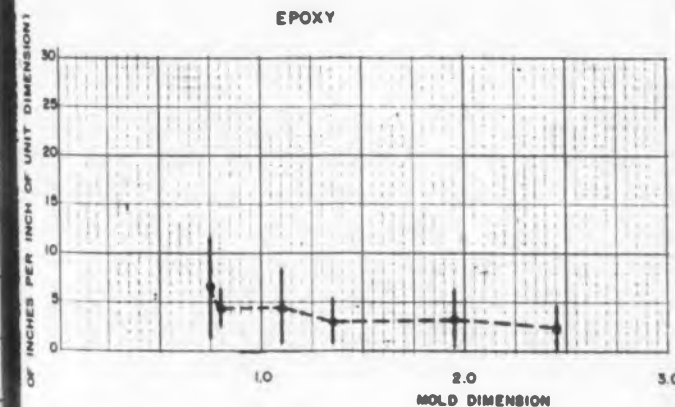


Fig. 4. Range of shrinkage encountered as a function of mold dimensions. Polyester above, epoxy below.



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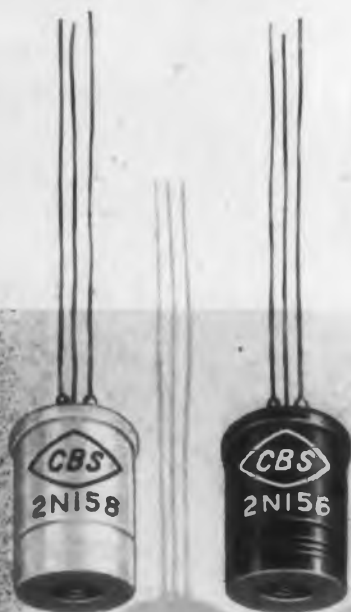
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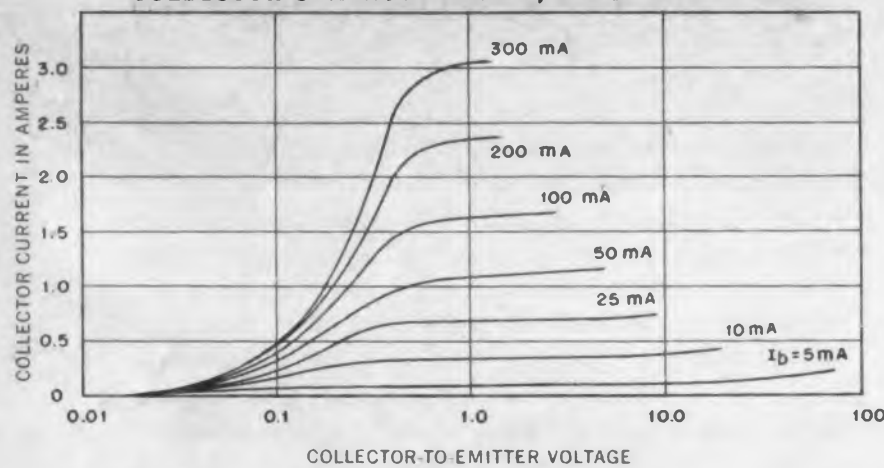
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used were made of the same formulation as the epoxy embedment material.

Shrinkage

Dimensional variations observed are shown in Fig. 2 for a typical mold. Note the inconsistency of shrinkage from specimen to specimen and the variation from the nominal mold dimension. Unit dimensions are closer to the basic mold dimensions when epoxies are used instead of polyesters. This was expected since epoxies are known to shrink less than polyesters upon polymerization. Thus, epoxies should be used for embedding components where minimum shrinkage is a requirement.

Shrinkage Variation

Shrinkage variation is generally less for epoxies than for polyesters. Thus, better dimensional control is possible in epoxy embedded units; and this should be a consideration if close dimensional control is important. Dimensional control, but somewhat less rigid, is also possible with polyesters so long as the tolerances are not too tight.

The epoxy units were observed to rarely shrink more than 0.010 in., and this only in the largest units. For the polyester embedments, shrinkage of 0.010 to 0.020 in. is common, with even higher shrinkage for the largest unit, making it impossible to maintain $\pm 1/64$ in. tolerance. Epoxy embedments, on the other hand, can be held to $\pm 1/64$ in. if needed, and closer in some cases. Due to their lower shrinkage range, the distribution of epoxy dimensions is less scattered. Shrinkage for both embedment materials seems to increase as the unit size increases, which is in agreement with a knowledge of these materials in that many characteristics of polymerizable materials are functions of mass.

Shrinkage distribution graphs are shown in Fig. 3 to help in determining the percentage of units that can be expected to fall into the various portions of the shrinkage range. As expected, the epoxy material is within closer tolerances; also, a higher percentage of unit readings fall in the center of the tolerance range.

Based on the theory that shrinkage of polymerizable materials in a function of resin mass, Fig. 4 was drawn to determine whether a linear relationship exists. The graph shows shrinkage in inches per inch of mold dimension for six different sized molds. The vertical lines, for all cases, represent the range of shrinkage. The dashed line merely connects the midpoints for easier visual observation of the trends. A definite trend is observed which might be assumed empirically linear over a given range. This is helpful as a starting point for more precise investigations. Note again that the degree of shrinkage changes less with size for epoxy than for polyester resins. Also, the shrinkage per inch of dimension becomes smaller as the embedded unit size increases.

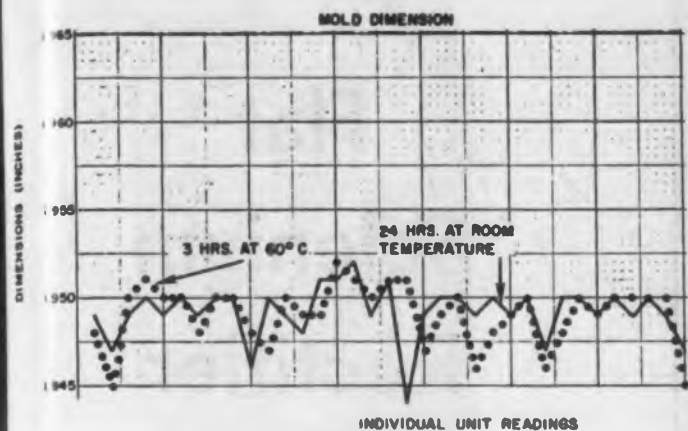


Fig. 5. Shrinkage of polyester compound as a function of the degree of cure.

Shrinkage Time

Shrinkage of a polymerizable material continues, to an extent, until the material is theoretically cured or polymerized to completion. However, the stage at which polymerization is completed is difficult to determine. This is particularly true in the case of materials which are cured in more than one stage. Multi-staged curing is often employed to minimize internal stresses which might result if a rapid, higher curing temperature were used. The polyester material used in this study is typical of standard commercial polyesters and is cured for twenty-four hours at room temperature, followed by three hours at 60 C, as previously explained. Fig. 5 shows the degree of shrinkage which occurs in each of these curing stages.

Nearly all of the shrinkage seems to occur during the room temperature stage of cure. In some cases it is questionable whether measurable additional shrinkage occurs, or whether the data merely represents measuring deviations. The fact that so much of the shrinkage occurs in the first stage should indicate that polymerization was essentially completed in this stage. Yet, the hardness increase during the second stage of curing was quite measurable, indicating that polymerization was not complete in the first stage. Hence, shrinkage must occur to a maximum extent during one stage of the polymerization. This maximum shrinkage probably occurs either during gelation or immediately following.

The Molds

The molds used for making the embedded units described were made of epoxy material. The epoxy material is cast around an aluminum pattern, and then separated from the pattern to give a mold. Epoxy molds are possible because of the low shrinkage of these materials. While shrinkage is low, there are some cases of shrinkage up to 0.008 in. This is clearly not as good as machined metal molds; however, where the dimensional tolerance of the end product is sufficiently wide, cast epoxy molds can be used with considerable economic advantage.

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SERIES: PR Heavy Duty.

CONTACTS: Max. DPDT. 5/16" dia. silver, 13 amps. at 115 V., 60 cycle, non-inductive. 6.5 amps. at 230 V. 60 cycle, non-inductive.

VOLTAGE RANGE: 6 to 110 V. DC. 6 to 230 V. AC.

COIL RESISTANCE: 63800 ohm max. DC.

TEMPERATURE RANGE: DC, -45° to 85° C. AC, -45° to 55° C.

PULL-IN: DC, 75% nominal. AC, 78% nominal.

TERMINALS: Heavy duty screw type. Adaptable for printed circuits or plug-in.

BASE: Molded phenolic or metal.

MOUNTING: (2) 3/16" dia. holes on 1 7/8" centers.

DIMENSIONS: 2 1/2" W. x 3 3/8" L. x 2 1/2" H.

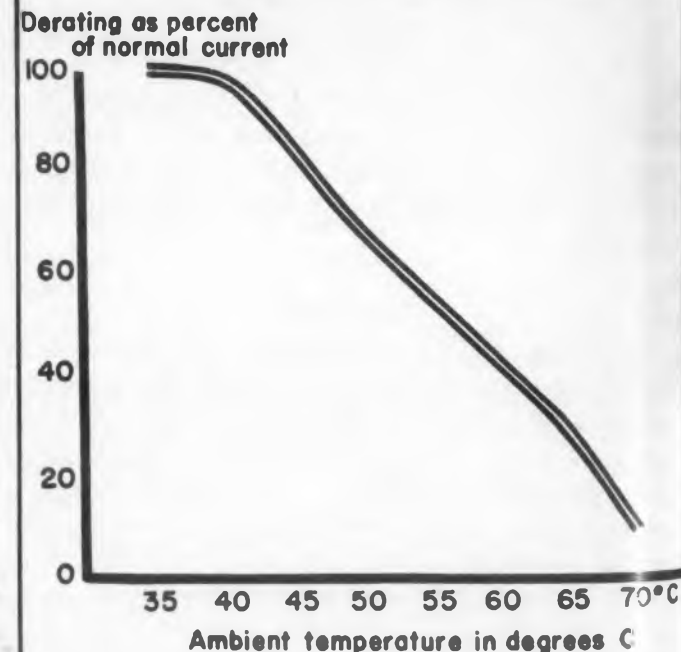
Flat Selenium Rectifier

SMALLER and lighter than comparable stacked rectifiers, these units hold a promise for more compactly designed electronic circuits. No ventilation is required for the rectifiers. They are mounted directly on the chassis and use the heat sink principle for cooling.

Manufactured by the Siemens Company of West Germany, the units are now being distributed in this country for the first time by Radio Receptor Co. Inc., Brooklyn, N.Y. The rectifiers are intended to be mounted with their rear side in thermal contact with the chassis. Heat conduction will then be able to provide effective cooling. With this method for cooling it is necessary to avoid mounting too near to other components which heat up the chassis.

Current ratings on all units are for an ambient temperature of 35 C. Higher currents applied for short periods of time, will not result in destruction.

CURRENT DERATING WITH TEMPERATURE

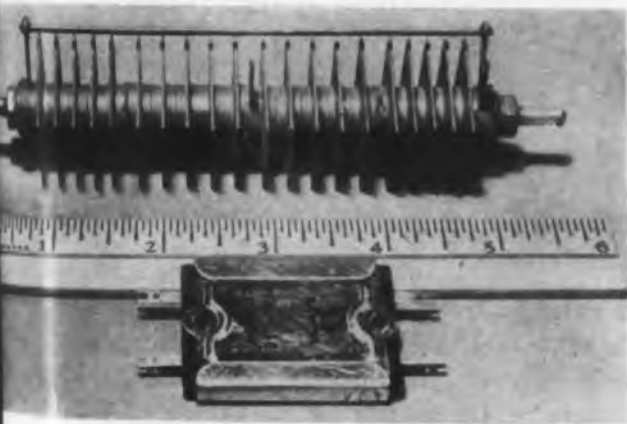




the rectifier. For continuous operation at higher temperatures, lower values of current must be used. The graph shows the per cent of current derating necessary as temperature increases. Voltage rating remains the same at all temperatures.

Because of the low development of heat, effective cooling of all the wafers, and their low sensitivity to heat, the rectifiers do not deteriorate more than 10 per cent after 10,000 hours of service under normal load.

Half-wave and bridge flat rectifiers both are being supported. They range in size from 1/2 x 5/8 x 3/8 in. to 3-1/2 x 1-1/2 x 1/4 in. The half-waves range in ratings from 15 v at 300 to 1800 ma to 600 v at 15 ma. Bridge flat rectifiers are from 30 v and 200 ma to 600 v at 70 and 130 ma. The units are competitively priced. For additional information on this, fill out the Reader's Service Card and circle 36.



Conventional stack assembly (top) and flat selenium rectifier shown with it are rated at 125 v ac input and 160 ma dc output capacitive load. The flat rectifier measures 1-13/16 x 3/16 x 1-3/8 in. and weighs half an ounce. The stack is 4 x 1 x 1 inches and weighs 3-3/4 oz.

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Silicone News

FOR DESIGN ENGINEERS

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Capitalizing on the inherent physical and chemical stability of Dow Corning 200 Fluid, Ten Bosch has designed an accelerometer weighing a mere 2½ ounces that retains a sensitivity of plus or minus .006 G at up to 6 Gravities. The time constant of the unit is only .0002, yet it has absolutely no undamped natural frequency.

Dow Corning 200 Fluid was selected as the "integrating fluid" for this unit after tests on dozens of other materials including motor oil, kerosene, mineral oil, water and air failed to meet Ten Bosch's requirements. Non-corrosive, non-conducting and non-gumming, the 200 Fluid permits the accelerometer to retain all of its original alertness and sensitivity over a wide temperature span in aircraft, missiles, and gyroscope direction service. **No. 110**



Silicone Insulation Eliminates Power Bottlenecks

When the Ohio Valley Electric Corporation designed its new Clifty Creek and Kyger Creek Plants to supply power for the AEC's new Portsmouth (Ohio) Area Project, it specified a 50 C (122 F) ambient and a 70 C (158 F) rise for its twenty-two 1500 hp fan motors. But OVEC also specified that the motors be silicone (Class H) insulated.

When the two plants were put on the line in January 1955, it became evident that their actual generating capacity exceeded design estimates. Ordinarily nothing could be done to take advantage of the extra capacity because plant auxiliaries, such as these fan motors, are restricted to design ratings.

But because the motors are silicone insulated, they easily withstand a boost in operating temperatures from the specified 120 C up to 160 C. This enables OVEC to raise their output from 1500 to 2060 hp. An OVEC engineer made this typical comment, "Silicone insulation helps us obtain maximum output from every plant." **No. 113**

Pump Life Tripled with Silicone Lubricant for Plastic and Rubber

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All New — 1957 Guide to Dow Corning Silicones is a twelve page, fact-filled catalog which briefly describes the silicone products of interest to most industries. Containing latest data and information, the guide is designed expressly to help you enjoy the advantages, profits, and savings made possible through imaginative use of these unique engineering materials. **No. 112**

Becher produces a positive-flow chemical pump incorporating a nylon planetary roller plus a vinyl guard and tube. The pump is designed to carry chemical slurries, liquids or gases without danger of contamination or reaction.

By sealing the pump with Dow Corning 3, thus lubricating both plastic parts and sleeve bearing, Becher engineers tripled the unit's service life while reducing power requirements by 50%. They further report that introduction of the silicone compound so drastically reduced starting torque that they now employ a 1/25 hp, 1720 rpm shaded pole motor to do the work that previously required a more costly 1/12 hp split phase motor.

Dow Corning 3 Compound dissipates heat so effectively the pump remains cool even when pumping dry. No decrease in capacity or pressure has been noted after 3000 hours' operation at 1750 rpm. **No. 111**

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High Sensitivity Phototube

Very Low Dark Current



Developed specifically for instrumentation work, a new high sensitivity vacuum phototube, the CE-75V, has a maximum dark current rating of 5.0×10^{-11} amperes. All the internal parts are electropolished to reduce dark current to the lowest possible value. Peak sensitivity of the S1 surface occurs at 8000 \AA . Both tube and base have been silicone treated to reduce external leakage. This new phototube, because of its extremely low dark current rating, may prove useful not only in instrumentation, but in other applications also.

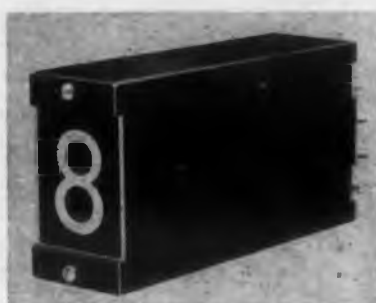
Continental Electric Co.,

Dept. ED, 6 N. Michigan Ave., Chicago 2, Ill.

CIRCLE 39 ON READER-SERVICE CARD FOR MORE INFORMATION

One-Plane Digital Display

Readability Is Featured



A one-plane presentation display has just been announced, featuring readability. All numbers and characters appear on the front surface of the unit, in the same plane. They are of

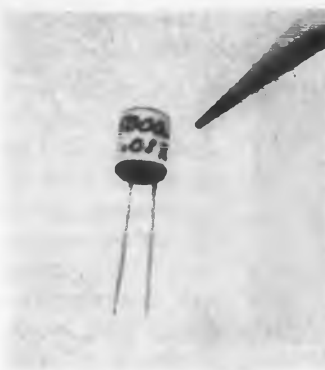
uniform size and intensity. The digits are 1-1/4 in. high and include a shifting decimal point, ac and dc, and polarity signs. Lamps used are operated at 3 to 7.5 v ac, and their life is rated at 3000 to 10,000 hours, according to the voltage used. Lamps and all wiring are accessible at the rear of the unit.

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

CIRCLE 40 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Miniature Resistor

Accuracy 0.01 %



With an accuracy of 0.01 per cent or better, 0.005 per cent in values above 1000 ohms, and a power dissipation of 0.2 w, a new wire wound resistor Type 287, has physical dimensions of 5/16 in. diameter and 7/16 in. length. Special winding and encapsulat-

ing techniques were developed for its manufacture. Temperature coefficient is 10 ppm; resistance stability is 0.003 per cent. Epoxy resin is used for encapsulation. The resistor conforms to applicable requirements of MIL-R-93A, Amendment No. 3.

Consolidated Resistance Co. of America, Inc., Dept. ED, 44 Prospect St., Yonkers, N. Y.

CIRCLE 41 ON READER-SERVICE CARD FOR MORE INFORMATION

Plug-in Precision Pots

For Printed Circuits



Simplifying installation in miniaturized assemblies that use printed-circuit techniques, the Model APP-1/2 precision potentiometer is pro-

vided with a 3-prong base that fits standard 3-circuit microphone sockets. The plug-in connection afforded by this unit is also advantageous in automated assemblies where precise positioning and rapid installation are essential. The plug-in precision potentiometer is available in resistance ranges of 10 ohms to 100,000 ohms, with standard accuracy of 5 per cent below 50 k and 2 per cent above 50 k.

Waters Mfg. Inc., Dept. ED, P. O. Box 368, South Sudbury, Mass.

CIRCLE 42 ON READER-SERVICE CARD FOR MORE INFORMATION

Printed Circuit Sockets

Multiple Units



For use in conjunction with printed circuits, a new multiple right-angle socket mounting can be constructed

to order for two, three or four, etc., sockets either of the same size or of varying sizes; and for mounting such other electronic components as resistors and capacitors. The mounting has high structural rigidity, based on patented supplementary buttress ribs and can withstand great pressure, shock and vibration. The company designs and manufactures printed circuits for existing or new products.

Cleveland Metal Specialties Co., Dept. ED, 1789 East 21st St., Cleveland 14, Ohio.

CIRCLE 43 ON READER-SERVICE CARD FOR MORE INFORMATION

Photoengraving Resist Thinner Regularly Stocked

A diluent for use with Kodak photo resist in spray-coating operations is now available as a regular order product.

Formerly available only on special order under the name of "Kodak Photosensitive Lacquer Thinner," the new thinner is used in the manufacture of printed circuits and photoengraved printing plates. Kodak photo resist also serves as an acid and alkali-resist in other manufacturing operations such as the production of nameplates. Eastman Kodak Co., Dept. ED, Rochester 4, N.Y.

CIRCLE 44 ON READER-SERVICE CARD

Teflon Hook-Up Wire 600 and 1000 Volt Types

Teflon insulated hook-up wire is available in sizes 16 to 28 with covering of Teflon insulation in thicknesses of 0.010 in. to 0.015 in. This wire of silver-plated copper is covered by the extrusion of a controlled thickness of Teflon. Method assures a pinhole free coating for full utilization of the product's excellent dielectric properties. Hook-up wire meets National Air Force Standards and Government Specification MIL-W-16878-B, both Type E (600 v) and Type EE (1000 v). It can be supplied for coding in any one of 16 colors. Spiral striping in various colors can also be supplied to meet customer requirements.

Electrical properties of Teflon coated wire are outstanding. It has a low power factor, low dielectric constant, high volume and surface resistivity, good dielectric strength—all constant over a wide range of frequencies and temperatures.

Teflon wire is also capable of continuous service to 260 C. It is flexible and tough over a wide range of temperatures, even down to -265 C. Wire conforms well to odd shapes and sharp corners because of good elongation. It is inert to all chemicals and solvents and is unaffected by weathering.

Have Industries Inc., Dept. ED, 100 Greenbank Rd., Wilmington 8, Del.

CIRCLE 45 ON READER-SERVICE CARD

CIRCLE 46 ON READER-SERVICE CARD

CASE history
number 6



PISTON CAPACITORS AT WORK



trimmers achieve maximum measurement, accuracy and stability in BERKELEY frequency meters



PROBLEM: To combine functions of precision wide-range frequency meter and universal counter and timer in one compact instrument—to measure frequency from 0 to 42 megacycles with an accuracy of ± 1 cps or greater and elapsed time from 1 microsecond to 10 million seconds with a maximum accuracy of ± 1 microsecond.

SOLUTION: Berkeley engineers specified 22 model VC11RGA JFD Trimmer Piston Capacitors in the 0-42 mc. harmonic frequency turret to assure precise repeatable selection of reference frequencies. The reasons JFD Variable Trimmer Capacitors were selected? . . . Because an ultra-stable compact, trimmer capacitor was needed to afford rapid and accurate tuning capacity in the reference oscillator circuit.

RESULT: Performance so outstanding that Berkeley, division of Beckman Instruments, Inc., has continued to specify JFD Piston Capacitors in their model 5571 Frequency Meters for 3½ years.

MORAL: If you are seeking stability, shock-resistance, ultra-linear tuning and wide operating temperature range in a trimmer capacitor, you'll find the best answer at JFD.

Why don't you take advantage of JFD Piston Capacitors in solving your circuit tuning problems?

*One of the miniature and subminiature JFD Piston Capacitors now serving in printed and conventional electronic circuits. Write for literature.



ELECTRONICS CORPORATION, 1462-62 STREET, BROOKLYN 19, N. Y.

Go Forward with JFD Engineering!

FANSTEEL

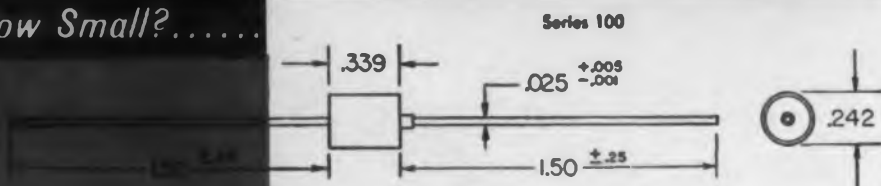
S.T.A. Capacitors

SOLID TANTALUM

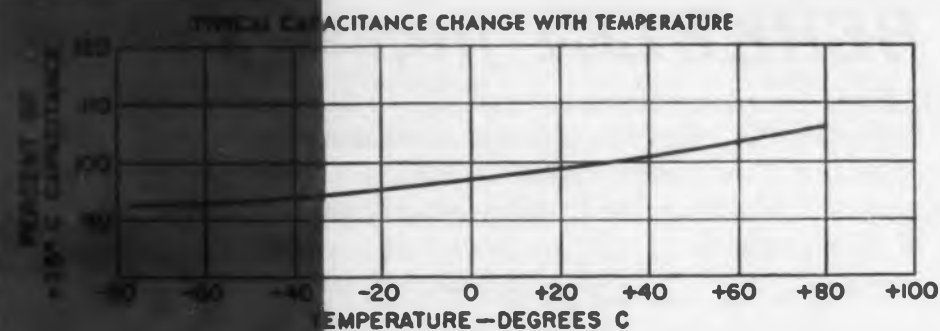


Small[®]
 Stable[™]
 Large Capacity^{***}

* How Small?.....



** How Stable?.....



*** How Large?.....

Series 100	1 mfd at 35 volts
Series 200	5 mfd at 35 volts
Series 300	20 mfd at 35 volts

NOW AVAILABLE IN PRODUCTION QUANTITIES

(Write for bulletin 6.112)


FANSTEEL METALLURGICAL CORPORATION
 North Chicago, Illinois, U.S.A.



TANTALUM CAPACITORS DEPENDABLE SINCE 1930

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

Coincidence Thyatron For Triple Control



The KP-80 pentode thyatron may be used in circuits where the coincidence of two or three signals should fire the tube. It can also be used as a single signal pulse thyatron, or where negative signals should cause conduction. Operating on the ion deflection principle, the tube has two symmetrical control grids, plus a third control electrode. A signal on only one grid up to and exceeding 40 v will not fire the tube, but a 4.5 v simultaneous signal on both grids will cause conduction.

The KP-80 has a 6.3 v 150 ma heater cathode, with an anode operating voltage of 150 v. Its subminiature equivalent, the KP-106, is also available. The tubes may find application in computers, coding or programming devices, automation, or wherever a coincidence function is to be performed with a minimum of circuit components.

Kip Electronics Corp., Dept. ED, 29 Holly Place, Stamford, Connecticut.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

Local Mounted Temperature Control Has Dual Switch

Type B27A local mounted temperature control is a dual switch control that can often substitute for two separate single-switch controls. The immersion element (bellows housing) is placed directly into the medium that is to be controlled. Variations in the temperature of the medium are converted to a force that causes the bellows plunger to operate the two switches.

The control head is enclosed by a cast aluminum case with a black wrinkle finish. It has an external range adjustment with a calibrated scale, and temperature settings are made by rotating a single-turn knob and pointer to the desired point on the scale. Models with range spans of 50 or 100 F between limits of 30 and 400 F are available.

In addition to allowing a savings in space and cost, the control provides extreme flexibility of switching arrangement, permits control of two independent circuits, and also permits switch action above and below the set point. An internal adjustment screw on each switch makes it possible to adjust for a maximum span of approximately 20 F between switch settings. This span is constantly maintained throughout the control range. Spans greater than 20 F are available upon specification.

United Electric Controls Co., Dept. ED, 85 School St., Watertown, Mass.

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION



Fresh, sound thinking on new uses for screws can open up for your company broad, new areas of savings achieved through faster assembly and less waste.

Southern Screw Company is eager to show you how precision-built fasteners can produce precision-built profits.



Phone or wire—or write
Southern Screw Company
Box 1360-ED,
Statesville, North Carolina.

Wood Screws • Machine Screws & Nuts
A&B Tapping Screws • Wood & Type
Drive Screws • Dowel Screws • Stove Bolts
Roll Thread Carriage Bolts • Hanger Bolts

Warehouses:

NEW YORK • CHICAGO • DALLAS • LOS ANGELES
CIRCLE 51 ON READER-SERVICE CARD

for longer
life... higher
voltage...

Illustrated above—
Johnson's nylon insu-
lated tip plug and
companion tip jack
and insulating sleeve.

Solderless Nylon Connectors

(Available in 11 bright colors)

- Shock-proof nylon sleeves—won't chip or crack with the hardest usage.
- Excellent for high voltage applications.
- Highly resistant to extremes of heat, cold and moisture.
- Tip and banana plugs designed for simplified solderless connection of up to 16 gauge stranded wire. Jacks require soldered connection.
- Economical—simple, functional design gives you top quality at low cost.

SPECIFICATIONS

BANANA PLUG—Nickel-plated brass construction with nickel-silver springs. Spring plug is .175" diameter, fits all standard banana jacks.

TIP PLUG—Recessed metal head is fully insulated. Metal parts are brass, nickel-plated. Pin is .081" diameter—fits all standard tip jacks.

NYLON TIP JACK AND INSULATING SLEEVE—Complete assembly includes standard nylon tip jack with threaded nylon insulating sleeve. Ideal for patch cords or for panel mounting where an insulated rear connection is desired.

Write for samples, prices and further information.

Pilot Lights



Available in a wide variety of types, Johnson Pilot Lights are stocked by parts distributors throughout the country. Available types include: continuous indication neon types; models for high and low voltage incandescent bulbs; standard or wide angle glass and lucite jewels in clear, red, green, amber, blue, or opal lenses. Specials, including those meeting military specifications are also available in production quantities. For full information, write to:

E. F. Johnson Company

3408 SECOND AVE. S.W. • WASECA, MINN.

CIRCLE 53 ON READER-SERVICE CARD

Telemetry Commutator

10 to 30 Rps



A two-pole telementering commutator, operating at pole speeds of 10 to 30 w, and hermetically sealed against adverse operating environments, measures 2-1/2 in. in diameter by

5-3/4 in. in length. Each pole provides 27 BBM contacts plus one master contact. The duty cycle can be made from 30 per cent ON to 70 per cent ON. It is powered by a 400 cy, 115 v, two-phase motor, and requires 7 w for 10 rps pole speeds up to 15 w for 30 rps. Poles are dynamically balanced metallic alloys mounted on jewel-pivoted bearings with low spring rates, milled to phasing accuracies of 0.2 milliseconds at 30 rps. Contact resistances are less than 0.25 ohms, contact impedances more than 100 megohms, and these values are maintained for the life of the instrument. Life expectancy exceeds 500 hours without servicing. Tested units have withstood more than 1000 hours at 10 rps; and have survived vibration frequencies of 2000 cps at 16g amplitude.

Instrument Development Laboratories, Inc., Dept. ED, 67 Mechanic St., Attleboro, Mass.

CIRCLE 54 ON READER-SERVICE CARD FOR MORE INFORMATION

Fuse and Fuseholder

Signals Blown Fuse



New fuseholder in combination with indicating fuse flashes a light, rings a bell, trips a relay or gives other signals, to

tell you when or where a fuse blows. Fuseholder and fuse can be used where it is desirable to have a visible or audible signal to indicate trouble on the circuit. Possible applications include many types of testing equipment, control circuits, control panels, switchboards and calculating or computing machines.

Specifications: BUSS Type HKA Fuseholder is panel mounted. Takes 1/4 x 1-1/4 in. BUSS GLD indicating fuse. Indicating pin in fuse pops out when fuse is blown and activates signal or alarm. Indicating lamp shows through transparent knob of holder.

Bussmann Mfg. Co., Dept. ED, University at Jefferson, St. Louis 7, Mo.

CIRCLE 55 ON READER-SERVICE CARD FOR MORE INFORMATION

FANSTEEL SILICON RECTIFIERS

Small*

Wide Range**

High Performance***



**How Small?.....*



***How Wide?.....*

Available in both
single voltage ratings from
20 through 350 volts

****How High?.....*

Rated at 500 milliamperes
without heat sink

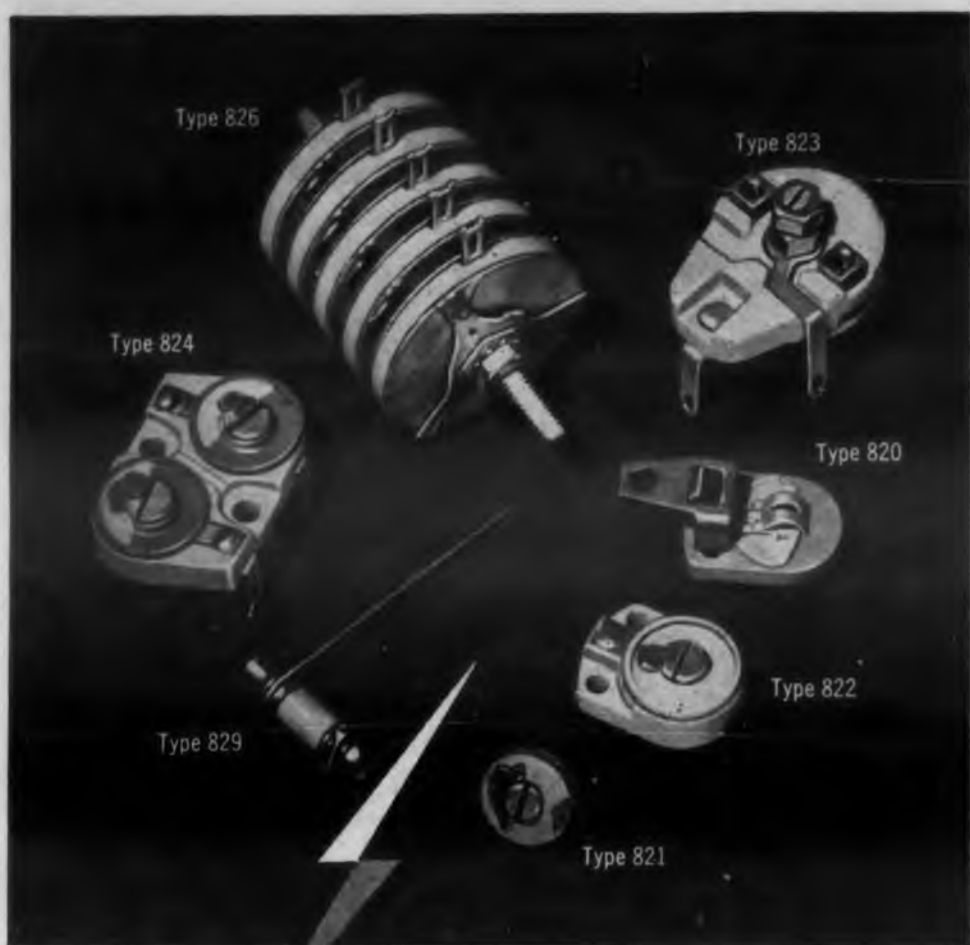
Write us about your application



FANSTEEL METALLURGICAL CORPORATION
North Chicago, Illinois, U S A

DEPENDABLE RECTIFIERS SINCE 1924

CIRCLE 56 ON READER-SERVICE CARD FOR MORE INFORMATION



The most complete line of Ceramic Trimmer Capacitors




Eight standard types. Special designs engineered to specifications.

*All units rated
600 V. D. C. W.,
1500 V. D. C. test*

*Capacity range from
.5 to 125 mmf.*

Small size—light weight

*Power factor less than
0.2% at one megacycle*

-  Rotors and stators ground optically flat, to insure dependability and accurate retrace.
-  Lightweight rotors always in balance and under heavy spring pressure. Provide excellent stability under vibration without special locking device.
-  All units easily adjusted. Full capacity range is obtained with 180° rotation. Equal stability is maintained at any position from minimum to maximum.

*For further information,
write for Technical Bulletin 42-101R1.*

Centralab

D-2356

A DIVISION OF GLOBE-UNION INC.

960A East Keefe Avenue • Milwaukee 1, Wisconsin
In Canada: 804 Mt. Pleasant Road, Toronto, Ontario



CIRCLE 59 ON READER-SERVICE CARD FOR MORE INFORMATION

Polarized Plug

50 Amp, 250 V



A new 3-wire, 50 amp, 250 v polarized 90 degree angle cap is made of rubber for flush or surface outlets. Designed for heavy duty applications this polarized device

will not break or crack, even when subjected to extremely severe usage.

This 90 degree angle rubber cap will prove especially popular for use with industrial portable welding equipment, assembly line portable tools and other electrical equipment requiring 50 amp, 250 v service which is expected to stand up under rigorous use.

A 1.062 in. cord hole is standard with this 3-wire angle cap, which has 2-screw contacts. If desired, the cap will be supplied with a 1.218 in. cord hole. Optional ground straps permit grounding of a fourth wire.

The Arrow-Hart & Hegeman Electric Co., Dept. ED, Hartford, Conn.

CIRCLE 60 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniaturized Accelerometer

Ranges to 35 G's



Already in use on target drones and in missile systems, a miniaturized accelerometer, now released by its maker for general use, weighs only 3 ounces and measures without connector, only 1.5 in. high. Typical ranges are $-10g$, $\pm 5g$, $\pm 15g$ to $\pm 35g$. Shock resistance is rated at

40g; vibration resistance from 0 to 2000 cps to 10g; linearity 0.5 to 1.5 per cent; hysteresis at 0.2 to 1.0 per cent; friction at 0.15 to 1.0 per cent; natural frequency at 50 cps ($\pm 15g$); temperature rating -15 C to $+100\text{ C}$; resolution to 0.3 per cent, pick-off potentiometer 500 to 10,000 ohms. Design of the device is simple and rugged. It is supplied in a pressure-sealed case, with either connector or solder terminals as preferred.

Humphrey, Inc., Dept. ED, 2805 Canon St., San Diego 6, Calif.

CIRCLE 61 ON READER-SERVICE CARD FOR MORE INFORMATION

Reliable Sensitive Relays

Now available for quick delivery



the electronics division of IRON FIREMAN

is now mass-producing its new 400 series sensitive relay. This new relay possesses high sensitivity and reliability even under extremely severe environmental conditions. Many leading manufacturers with prime military contracts for electronic systems are using these 400 series Iron Fireman sensitive relays.

A 60-page Certified Qualification Report*

showing compliance of this relay to military specifications is now in the hands of the Iron Fireman Electronics representatives listed here. They will be pleased to go over this report with you.

M. B. Gilbert Co.
6214 W. Manchester Ave.
Los Angeles 45, California

Julius J. Bressler Co.
4808 Bergenline Ave.
Union City, New Jersey

Massay Associates
529 Brookhurst Ave.
Norwalk, Pennsylvania

Massay Associates
1 Thomas Circle N. W.
Washington, D. C.

Sealtronics, Inc.
911 Western Ave.
Seattle 4, Washington

*Qualified to MIL-R-5757B



Send today for "Sensitive Relay Data File" containing specification sheets, operational charts, temperature conversion charts, and other helpful information.

IRON FIREMAN Sensitive Relays

2810 S. E. Ninth Avenue, Portland 2, Oregon

CIRCLE 62 ON READER-SERVICE CARD

NEW!

**ORBITRAN
MODEL 1000-A**

**AN EXTERNALLY
TRIGGERED**

precision digital

**PULSE DELAY
GENERATOR**



**1 - 1000 μ sec.
0.1 μ sec. steps**

ACCURATE

$\pm 0.01\%$ OR 0.05 μ SEC.

STABLE

LESS THAN 0.005 μ SEC. JITTER
LESS THAN 0.005% CHANGE
IN DELAY WITH CHANGE IN PRF

VERSATILE

EXTERNAL OR INTERNAL TRIGGER
SINGLE OR PAIRED PULSE OUTPUT
DELAYED SCOPE TRIGGER IN
ADVANCE OF DELAYED PULSE
BUILT IN CALIBRATOR

Send for complete specifications

ORBITRAN COMPANY
LAKE SIDE CALIFORNIA

CIRCLE 65 ON READER-SERVICE CARD

Stand-Off Capacitors

Ceramic Dielectric



A rugged new series of stand-off capacitors with ceramic dielectric, Series X2122, available in a group of values, are general rf bypass capacitors for

use in high-quality electronic equipment.

The encapsulating resin provides exceptional rigidity and durability under extreme conditions of shock, vibration and humidity. A design feature minimizes breakage of the dielectric ceramic due to flexing of the chassis and mounting surfaces.

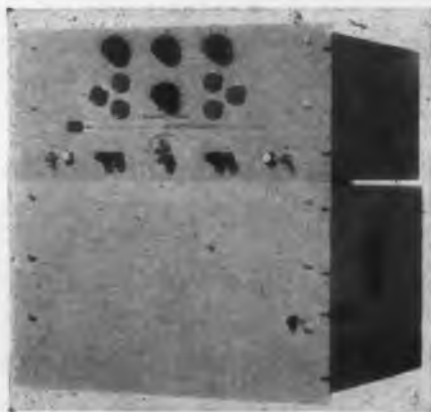
The capacitors mount by a single 6-32 threaded stud, 1/4 in. long. The over-all height when mounted is less than 3/8 in. The mounting stud is 5/16 in. hexagonal brass that has been gold-flashed. The solder terminal is also gold-flashed brass.

Cambridge Thermionic Corp., Dept. ED, Cambridge, Mass.

CIRCLE 66 ON READER-SERVICE CARD FOR MORE INFORMATION

DC Meter Calibrator

High Accuracy 0-1000 V



A new improved Model M100A-20 meter calibrator which provides dc from 0 to 1000 v at 0 to 200 ma with 0.01 per cent long time stability. 0.01 per cent line and load regulation, 0.2 μ sec response

time, 0.05 per cent calibration tolerance, less than 2 mv hum and noise, and less than 0.01 ohm output impedance.

This instrument employs high gain chopper amplifiers to constantly compare the output voltage with an internal standard cell, providing high accuracy and stability regardless of line or load variations. Direct reading calibrated dials permit instant selection of the desired output voltage. Outputs are provided for both regulated voltage and current. The M100A-20 is ideal for laboratory and production meter calibration, standards laboratories computer facilities, nuclear research and other applications.

Kay Lab., Dept. ED, 5725 Kearny Villa Road, San Diego 11, Calif.

CIRCLE 67 ON READER-SERVICE CARD FOR MORE INFORMATION



ELECTRONS, INCORPORATED

127 SUSSEX AVENUE

NEWARK 3, N. J.

*Fairchild's Oscillo-Record Camera relies on the
EL C1B thyatron for precise electronic speed
control.*

CIRCLE 68 ON READER-SERVICE CARD FOR MORE INFORMATION

Corrosion-Resistant Coating

In Mobile Unit

A new concept in corrosion-resistant coating, a mobile, dual-purpose unit that provides both spray and dip or fluidized coating, has been introduced. Known as the Mark III, the mobile unit consists of a 15 in. dia metal reservoir hopper, a 24 in. deep powder bed, an overall height of 33-1/2 in., and a maximum width dimension of 20 in.

In operation, the Mark III is rolled by one man to its point of use. Connections are easily attachable to compressed air outlets. The unit can be used for both fluidizing (dip coating), and spray coating of finely divided polyethylene powders to metal targets. In addition, the fluidizing process offers even greater flexibility since, in addition to polyethylene, nylon and fluorocarbons can be utilized.

The Mark III rides on 6 in. rubber-tired ball bearing wheels. The unit comes complete with 15 ft. of air and powder feed hose together with an aluminum spray gun equipped with needle and control valves.

American Agile Corp., Dept. ED, P.O. Box 168, Bedford, Ohio.

CIRCLE 71 ON READER-SERVICE CARD FOR INFORMATION

Vinyl Film Adhesives

Fire-proof

Three newly developed adhesives for combining vinyl chloride films have been announced. These adhesives are based on new copolymer. Being free from dangerous solvents, there is no fire hazard or problem of toxic fumes.

Resyn emulsion 33-8020 is a general purpose emulsion for adhering vinyl film to cloth, paper and paperboard. It is a smooth, white, fluid emulsion containing approximately 54 per cent solids with a viscosity of 1000-1500 cps. It may be applied by a reverse roll coater, gravure or air knife. The preferred coating weight for vinyl to cloth is 1/2 to 1-1/2 oz of dry adhesive per square yard. For vinyl to paper, 8 lbs per ream of dry adhesive is desirable. From 200-250 F is required for drying. The coated fabric or paper can then be combined at a nip temperature of 275-300 F, depending upon machine speed.

Resyn emulsion 33-8010 has similar properties to Resyn 33-8020, but its viscosity of 5000 cps. is heavier and it is preferred for knife coating. It is also excellent for the lamination of vinyl film to latex saturated paper.

National Adhesives, Div. National Starch Products Inc., Dept. ED, 270 Madison Ave., New York 16, N.Y.

CIRCLE 72 ON READER-SERVICE CARD FOR INFORMATION

PHELPS DODGE THERMALEZE®

A PROVEN CLASS "B" FILM WIRE!



- Dielectric twist performance establishes Thermaleze as Class "B".
- Suitable for Class "B" insulation system designs.
- Over seven years' practical experience in coils, motors, and transformers.
- Essential balance of mechanical, chemical and electrical properties.

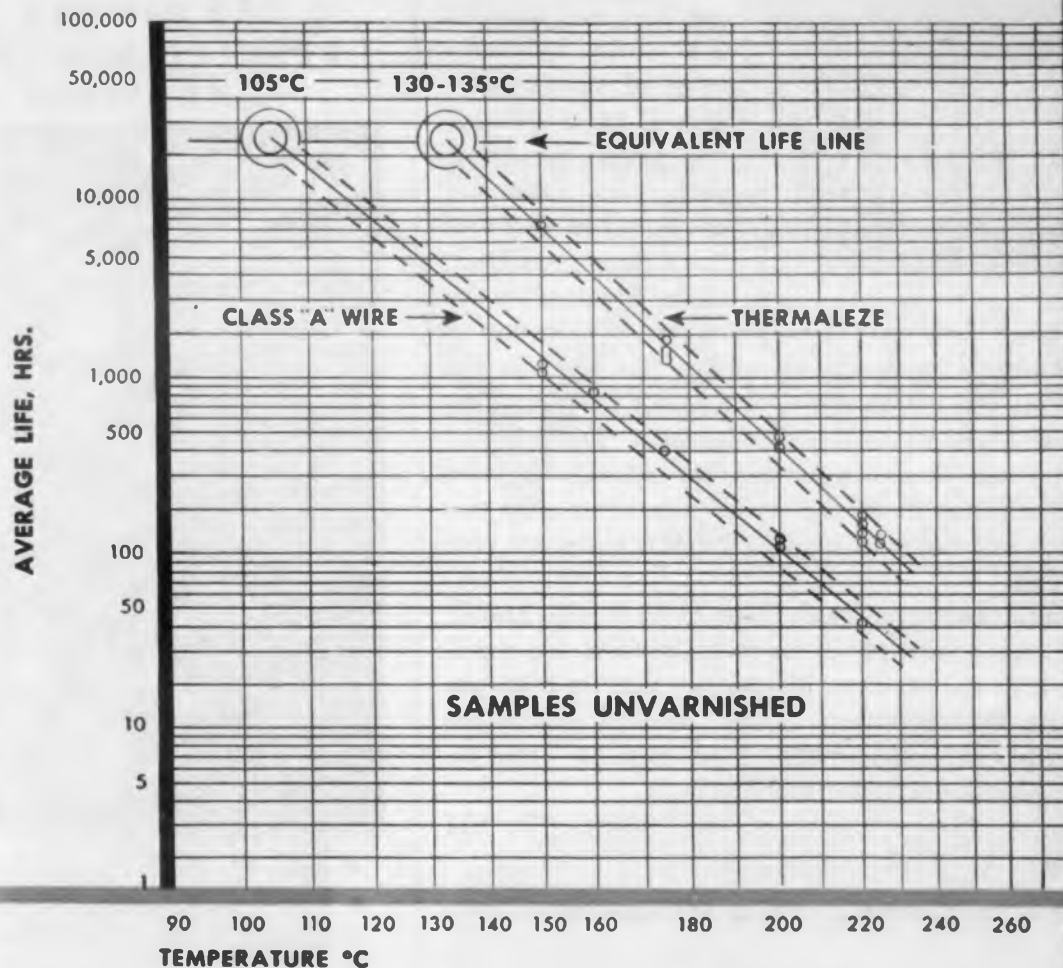
Any time magnet wire is your problem, consult Phelps Dodge for the quickest, easiest answer!

FIRST FOR LASTING QUALITY—FROM MINE TO MARKET!

CIRCLE 73 ON READER-SERVICE CARD FOR MORE INFORMATION

AGED DIELECTRIC TWISTS

Thermaleze vs. Conventional Class "A" Wire
AIEE Procedure



NEMA twist samples aged in oven at various temperatures following AIEE aging procedures

PHELPS DODGE COPPER PRODUCTS
CORPORATION

INCA MANUFACTURING DIVISION
FORT WAYNE, INDIANA

CIRCLE 73 ON READER-SERVICE CARD FOR MORE INFORMATION

Copper-Clad Phenolic

Meets Government Specs

Cirprint basically is a new vastly-improved XXP grade which additionally meets MIL Spec 3115 B for type PBE-P, and fulfills the requirements of 90 per cent of the printed-circuit-producing industry. Cirprint meets UL requirements.

Heading a list of vastly improved qualities over previous XXP grades are high insulation resistance, better cold-punching qualities and lower moisture absorption. Cirprint is translucent and is water-marked for easy identification. Specifically, cirprint offers the following major qualities: 250,000 megohms insulation resistance after 96 hours at 35 C and 90 per cent relative humidity, cold punching up to and including 1/16 in., 0.80 per cent moisture absorption in a 1 x 3 x 1/16 in. sample after 24 hours immersion.

Cirprint's translucency offers two useful properties, in that (1) it allows a visual check on the register of a circuit printed on one side with that on another, and (2) it presents a visual check on quality which, at a glance, shows the homogeneous structure, and lack of voids, blisters or other impurities which might dissipate the electrical insulating properties of the sheet.

Formica Corp., Dept. ED, 4408 Spring Grove Ave., Cincinnati 32, Ohio.

CIRCLE 75 ON READER-SERVICE CARD FOR INFORMATION

Triode-Tetrode Converter

For 40 Mc I-F Circuits

The 6CQ8 is a 9-pin miniature tube containing a medium-mu triode and a sharp-cutoff tetrode and may be used in a wide variety of applications in black-and-white and color television receivers. It is especially useful as a combined oscillator and mixer tube in tuners of TV receivers that utilize an intermediate frequency in the order of 40 mc. The triode unit of this tube is not only useful as a vhf oscillator but also as an r-f amplifier, phase splitter, sync clipper and sync separator. The tetrode unit is also useful as a sound or video intermediate-frequency amplifier tube.

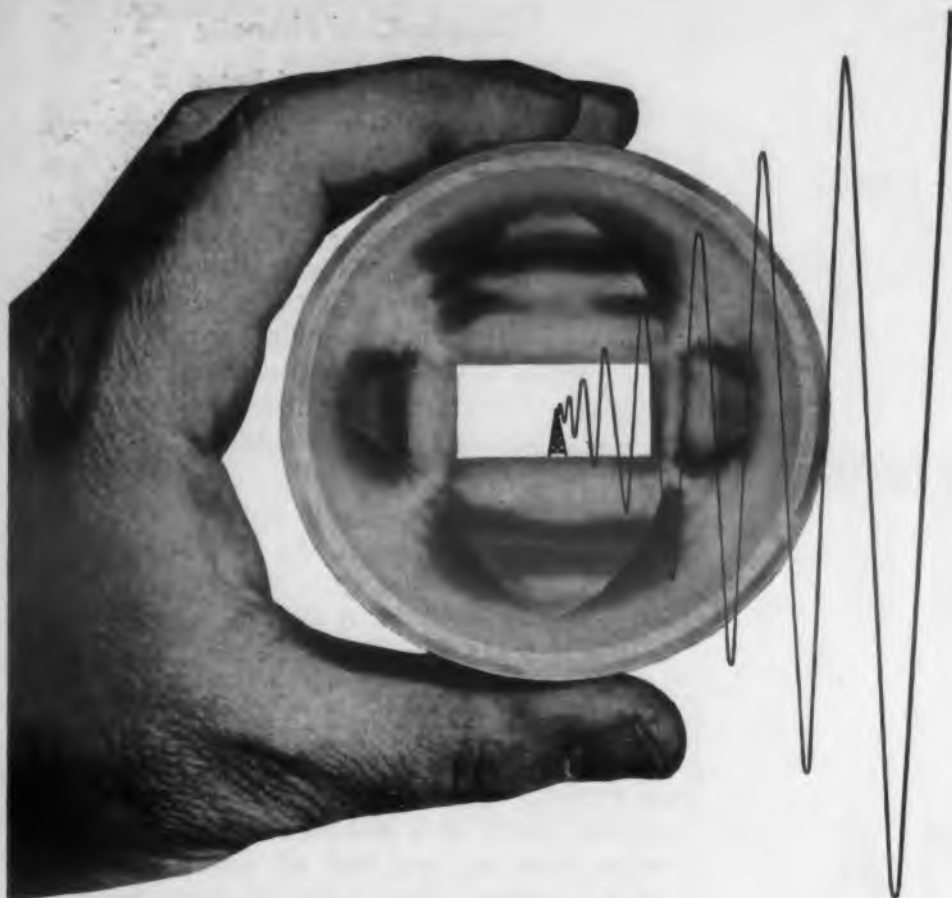
The 6CQ8 has a 450 ma heater with a controlled warm-up time to minimize voltage unbalance during starting in TV receivers utilizing series heater-string arrangement.

The tetrode mixer unit of the 6CQ8 features a plate-current characteristic with a sharp knee at relatively low plate voltages. As a result of this favorable characteristic, mixer operation with good linearity can be obtained.

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

CIRCLE 76 ON READER-SERVICE CARD FOR INFORMATION





for your waveguides • transitions • couplers

look into **GAR-FORMING** from a microwave point of view

You'll see this unique part-forming process gives you the fine surface finish and absolute accuracy that keeps transition losses low and gives identical characteristics, part for part.

Gar-forming is an advanced electroforming process. It produces intricate internal shapes with an inside precision and finish unobtainable with any other method. For the first time, it makes it possible to produce a wide variety of solid and thin-wall parts in configuration and materials that are particularly suitable for microwave components. The price of Gar-forming is equally low for experimental, prototype, or production runs. Send us your specifications — we'll be glad to demonstrate the advantages of Gar-forming in your particular application.



Send today for full information

GAR PRECISION PARTS, INC.
5 LUDLOW STREET, STAMFORD, CONNECTICUT

CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION

Strip Chart Recorder Self-Balancing



The G-11 self-balancing strip-chart recorder records within a limit of error of 1 per cent and provides full scale balancing time of one second. The G-11 is suitable for panel mounting, relay rack mounting or portable use and has features enabling wide adaptability by

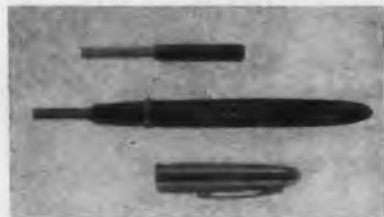
the user. Measuring circuit is unitized. Selection of appropriate input chassis adapts the G-11 in the field for the job at hand. A number of measuring circuit types are under development. The potentiometer model now available has behind-the-panel span adjustment to any value from 9 to 100 mv. Source resistance as high as 100,000 ohms are permissible.

Rectilinear strip chart is 5 in. in 85 ft rolls. Single, dual and quadruple chart-speed models are available with speeds from 1/8 in. per hour to 8 in. per minute. Weight is only 15 lbs. Over-all dimensions are 8-5/8 in. wide by 10-3/8 in. high by 7-3/4 in. deep (5-1/4 in. behind panel).

Varian Asso., Instrument Div., Dept. ED, 611 Hansen Way, Palo Alto, Calif.

CIRCLE 79 ON READER-SERVICE CARD FOR MORE INFORMATION

Plastic-Cased Burnisher For Relay Contacts



A 3-in. burnisher with a plastic handle is designed for use where relay contacts are almost completely hidden and hard to reach. The

No. 162 burnisher includes a long basic element in the burnisher itself, which provides large polishing area and accessibility, and a spare 1-1/2 in. blade which fits into the original case. The burnisher elements give a micro-fine polish without pitting or scratching. A series of knife-like edges polish contacts smoothly. Residual oil film, carbonaceous deposits, grit, dirt and contact filings are eliminated. The pen-type case, made of an insulating plastic, permits use on energized contacts without danger of shock. The handle for the 3-in. burnisher is also of an insulating material.

ADRE, Dept. ED, 8980 W. Hawthorne Lane, Hales Corners, Wisc.

CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

Malco IS YOUR BEST SOURCE FOR SOLDERING LUGS TERMINALS PRINTED CIRCUIT HARDWARE



HERE'S WHY:

- Specialized high production techniques afford lowest possible unit cost.
- Precision tooling, rigid quality control assure tolerances to critical specifications.
- Ample stocks of over 1000 different parts permit prompt delivery.
- Malco specializes in a complete line of small stampings for Radio-TV, electrical/electronic and automotive industries.
- Our line includes terminals and printed circuit hardware in loose or in chain form for automatic insertion.

Let Malco show you how you can save on production time and costs. Contact us today.



Request handy reference catalog containing specifications on standard and custom-made lugs, terminals, corona rings, pins, contacts and similar stampings.

Malco TOOL and MANUFACTURING CO.
4027 W. Lake St., Chicago 24, Ill.

CIRCLE 81 ON READER-SERVICE CARD
CIRCLE 82 ON READER-SERVICE CARD

*The most important announcement
in modern oscillograph history...*

the dramatic new **Honeywell** direct-recording

VISICORDER[®]

All at once you can record and read the record of the Visicorder. Using a completely new direct-recording principle, the Visicorder puts six channels on a direct-reading record at sensitivities comparable to photographic oscillographs, and at frequencies from DC to 2000 cps!



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CARD
1957



THE NEW VISICORDER, perfected after years of research by the Heiland Division of Honeywell, combines the high frequency and high sensitivity characteristics of photographic oscillographs with the convenience of a direct-recording instrument.

By means of a completely new type of recording paper, light source, and optical system, the Visicorder makes use of mirror-type galvanometers to record phenomena from DC through 2000 cps *without* peaked amplifiers or other external compensation.

The record requires no liquids, vapors, powder magazines, or other processing materials. Development is accomplished by external light only as the record emerges from the oscillograph.

The Visicorder records are stable and require no further processing under normal conditions. They may be subjected to room light for extended periods without fading, and are permanent indefinitely when protected from light. Should it be necessary to subject the records to direct sunlight, they may be chemically "fixed" (in room light) using conventional photographic practices.

Visicorder records are reproducible by several methods using commercially available equipment.

Since the Visicorder operates on light-beam galvanometers, traces may deflect the full 6" width of the chart, peak to peak, and their deflection is not limited by adjacent channels.

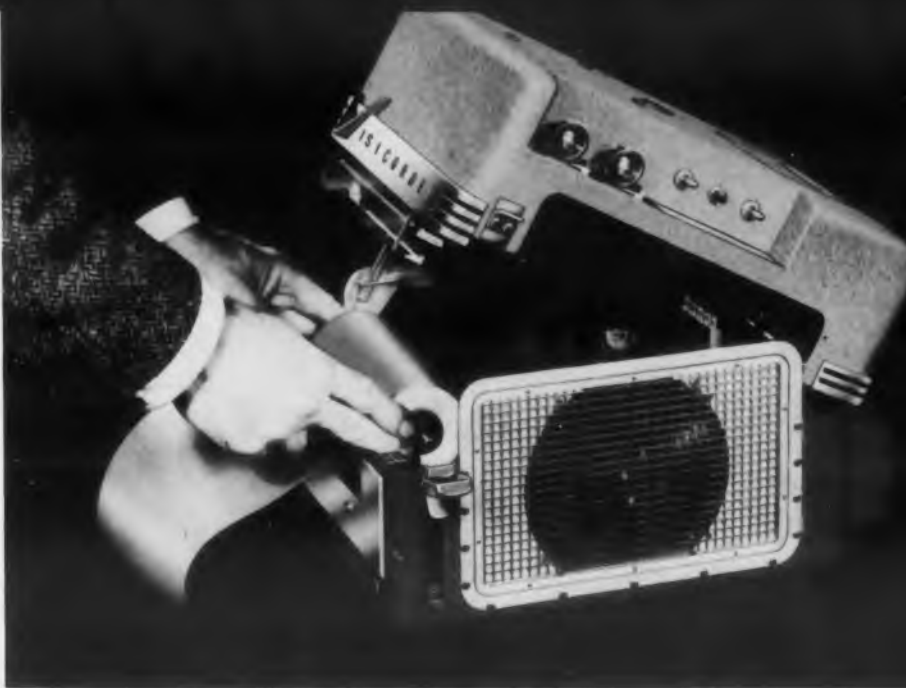
The remarkable exclusive features of the Visicorder make it the ideal recording oscillograph for applications where readable, permanent analog records are required and for additional uses where the measured phenomena need to be monitored or where immediate recorded results are desirable.

GENERAL FEATURES

FREQUENCIES	From DC to 2000 cps without peaked amplifiers or other compensation of any kind.
SENSITIVITIES	Comparable to photographic-type oscillographs.
RECORDING METHODS	Records directly on paper which requires no powder magazines, liquids, vapors, or other processing. Records are immediately visible and usable. Daylight loading. Accommodates recording paper 100 feet in length. Indicator shows unused recording paper available.
NO. OF CHANNELS	6 channels on 6" wide paper plus provisions for two timing traces.
DEFLECTION	Full 6" peak to peak. Traces may overlap; not limited by adjacent channels.
RECORD SPEEDS	0.2, 1, 5, and 25 inches per second, minute, or hour.
GALVANOMETERS	D'Arsonval-movement mirror galvanometers with choice of natural frequencies to suit individual requirements.
AMPLIFICATION	None required for most applications.
POWER	115 volt 60 cycle AC operation. 4 amperes.
DIMENSIONS	10" height; 15" depth; 10" width.
WEIGHT	37 pounds, complete and ready to operate.
PRICE	\$2,500.00, less galvanometers. Galvanometers \$150.00 each.

Deliveries starting January, 1957

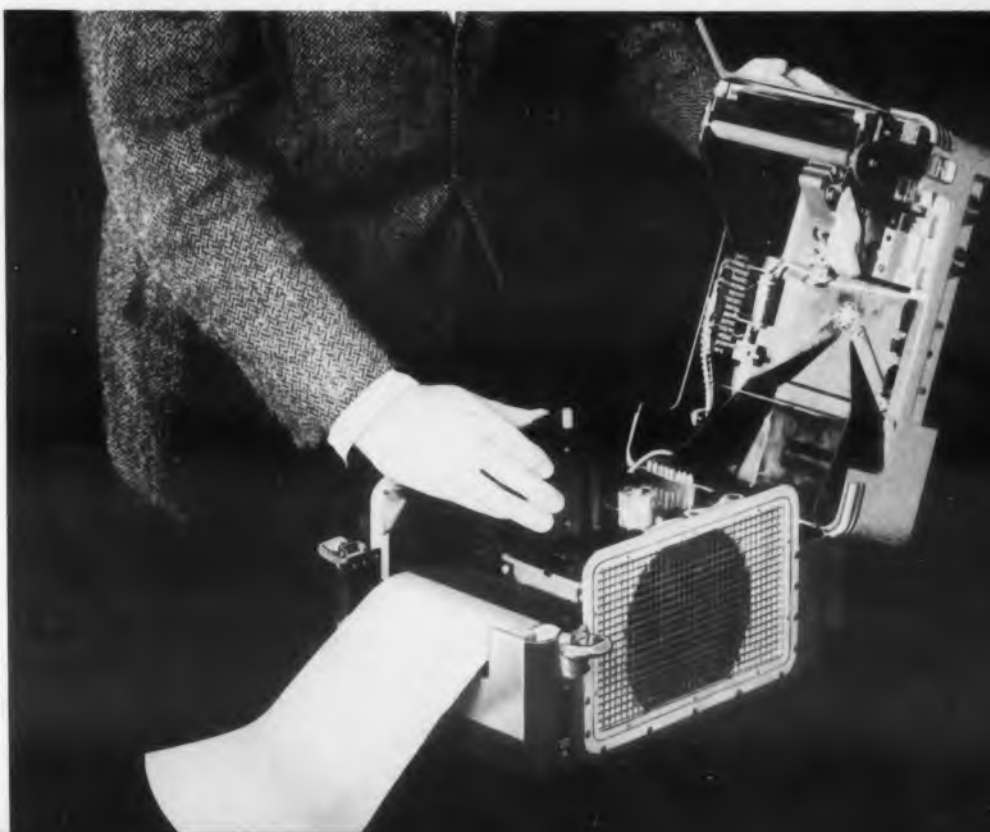
① **THE VISICORDER** is the first and only photographic-type oscillograph that can be loaded with recording paper in daylight. The paper speeds can be selected while the instrument is in operation. The light spots from the galvanometers are *visible from the exterior* at their point of contact with the paper; thus phenomena can be monitored simultaneously with their recording.



② GALVANOMETER ADJUSTMENTS

may be made through a panel-covered opening in the back of the instrument. Other operating controls—power on-off, lamp switch, paper drive and paper speed—are located on one convenient panel. Galvanometers are of the familiar Heiland solid-frame type: high sensitivity, accurate balance, high stability, low drift, in a versatile range of frequencies and sensitivities.

③ **SERVICE** on the Visicorder is extremely easy, since the instrument opens completely as shown. All components—galvanometers, recording lamp, transmission—are completely accessible.



VISICORDER[®] APPLICATIONS

The versatile Visicorder will fit almost unlimited applications because of its high frequency and sensitivity characteristics, and because of its ease of operation.

In any application where instantaneous monitoring is needed, whether or not a record is desired, the Visicorder is ideal.

- ★ In **CONTROL** applications the Visicorder will continually monitor and record reference and error signals, and present an immediately available recording of information.
- ★ In **NUCLEAR** applications, the Visicorder will monitor and record temperatures, pressures, and all other phenomena needed.
- ★ In **PRODUCTION TEST** applications, the Visicorder will provide a final dynamic inspection of electrical and mechanical devices such as motors, relays, generators, governors, solenoid valves, etc., where high frequency response has been required, but unavailable in the past.
- ★ In **COMPUTING** applications, the Visicorder will provide immediately-readable analog recordings representing dynamic solutions at much higher frequencies than have ever been available via pen-and-ink-type recorders previously used for this work.
- ★ In **PILOT and COMPONENT TESTING**, the Visicorder will accomplish more rapid evaluation of design and prototypes than any other direct-writing oscillograph available.
- ★ In **MEDICAL** applications the Visicorder is useful for dynamic blood pressures, electrocardiograms, EEG, and other physiological measurements.
- ★ In **all TEST** applications the direct-recording features of the Visicorder are invaluable. Where complex tests involve the assembly of considerable equipment and the gathering of personnel, the immediate Visicorder record will prove the success of the test at once before the test equipment is dispersed.

For further information about the Visicorder, contact the Minneapolis-Honeywell Industrial Division Sales Office nearest you. Sales-service facilities in over 130 principal cities throughout the world.

700-C Series Recording Oscillographs
Galvanometers
Bridge Balance Units
Amplifier Systems
HEILAND Photo-Flash Equipment

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HEILAND INSTRUMENTS
5200 E. EVANS AVENUE • DENVER 22, COLORADO

announcing the new

recti/riter

first truly
RECTILINEAR
GALVANOMETRIC
RECORDER



**READ WITH
A RULER...**

exclusive *recti/riter* trigonometric link-inscribes the true signal form on standard rectilinear chart. You have total access for all controls and making notations . . . $\pm 1\%$ accuracy over 4 1/2-inch scale; sensitivity—0.45-inch/microamperes; pen speed at a quarter-second over full 4 1/2-inch deflection. ac or dc drive, spring drive, or internal drive . . . with 10 optional speeds.

For complete information on the modern and versatile *recti/riter* — write for Bulletin R-501.



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LABORATORIES**

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HOUSTON 6, TEXAS

instrumentation subsidiary of

TEXAS INSTRUMENTS INCORPORATED

CIRCLE 83 ON READER-SERVICE CARD 6477

CIRCLE 82 ON READER-SERVICE CARD

ELECTRONIC DESIGN • January 15, 1957

Torque-Brake Units

Have Wide Range



Developed are three compact torque-brake units giving a wide range of speed-torque characteristics. Designed to provide continuous tension, these motors are especially applicable to wire winding and can be made to customer specifications.

The B. A. Wesche Electric Co., Dept. ED,

1622 Vine St., Cincinnati 10, Ohio.

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION

Cabinet Cooling Fan

Yields 300 Cfm



Announced is the production of a new low cost fan suitable for a wide variety of electronic cooling applications. The new Model 1E65 may be used in any position and will give air delivery of 300

cfm at zero pressure. Dimensions are 6-1/2 in. fan diameter and 8-1/2 in. OD. Motor is totally enclosed 115 v, 60 cps, 300 rpm. Case is gray hammertone finish with mounting holes located 72 degrees apart, 4-3/4 in. deep. Available in other sizes and modifications and with air flow push or pull over motor.

McLean Engineering Labs., Dept. ED, P.O. Box 228, Princeton, N.J.

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION

Concentric Shaft Pots

Simplify Panel Layout



Two potentiometers can be single-hole mounted for control by a dual knob, by reason of a new concentric-shaft design. Standard 1/8 and 1/4 in. shafts are used. The assembly

is mounted with the usual 3/8 in. threaded bushing; however, it is also available with servo-style mounting. A wide variety of resistance ranges can be furnished in many combinations; either or both elements can be supplied for continuous rotation, or with stops.

Waters Manufacturing, Inc., Dept. ED, P. O. Box 368, South Sudbury, Mass.

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

Resinite EP-93

Vinyl Sleeving
for MIL-I-7444A(1)

**FLEXIBLE
AT -90°F!**

Cold brittle tests prove Resinite EP-93 flexible at -90°F , yet this Specification Vinyl Insulation Sleeving will withstand 185°F continuous operation, unusual for an L-T tubing. EP-93 also offers exceptional flame, fungus and corrosion resistance — plus the many exclusive advantages of the Resinite Soft-Wound packaging system.

One order will show you why more Resinite Specification Vinyl Sleeving than all others is used by the aircraft and electronics industries.



New label provides Positive Test No. Identification on every spool



Comes in all 3 Specification size ranges. #20 AWG thru $2\frac{1}{2}$ " ID in all standard wall thicknesses.

Cross section of "Soft-Wound" spool



Cross section of ordinary spool



Exclusive Resinite "Soft-Wound" spools deliver sleeving full round

PROPERTY	MIL-I-7444A(1)	EP-93
Brittle Point	-90°F Max.	-90°F Max.
Inflammability	15 Sec. Max.	6 Sec. Avg. 14 Sec. Max.
Corrosion	Shall not accelerate metal corrosion	Pass
Oil Aging	Shall not deform or lose flexibility	Pass
Fungus Resistance	Shall not support Fungus. No Mercury	Pass
Dry Dielectric Strength	200 Volts/Mil./Min.	390 V/M/Avg. 280 v/M/Min.
Wet Dielectric Strength	200 Volts/Mil./Min.	335 V/M/Avg. 250 V/M/Min.

Resinite

THE Borden COMPANY

CHEMICAL DIVISION • RESINITE DEPT. • BOX 1589 SANTA BARBARA, CALIFORNIA



SPECIALISTS IN VINYL SLEEVING AND TUBING FOR THE AIRCRAFT, ELECTRONICS, ELECTRICAL AND PHARMACEUTICAL FIELDS

CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION

**RCA INSTRUMENTS OF
LABORATORY PRECISION**



**Precision
engineered
to do
a more
versatile
job**

**RCA PRECISION IMPEDANCE BRIDGE
TYPE LB-52 \$585.***
Also ask about a utility bridge.

**IMMEDIATE
AVAILABILITY**

THIS PRECISION IMPEDANCE BRIDGE has a combination of advanced features which you'll respect more and more as you put it to work! Most versatile bridge in its price class, it provides an internal metered source of voltage and current; AC detection for all measurements, including DC, via "magic eye" null indicator; provision for use of external standards. It measures resistance, capacity, inductance, dissipation factor and "Q"... facilitates measurement of incremental inductance and electrolytic capacitors.

RESISTANCE:

0.01 ohm to 10 megohms.
Accuracy:
± 1% from 0.1 ohms to
1 megohm.
± 2% outside these limits.

CAPACITANCE:

1 μf to 100 μf .
Accuracy:
± 1% from 100 μf to 10 μf
± 2% or ± 0.2 μf , which-
ever is greater, outside
these limits.

INDUCTANCE:

10 μH to 1,000 H.
Accuracy:
± 2% from 100 μH to 50 H.
± 3% from 50 H to 1,000
H. somewhat less accurate
from 10 μH to 100 μH .
Q:
0 to 12.
Accuracy: ± 5% of
reading or ± 0.005 for
values less than 0.1.

DISSIPATION FACTOR:

0 to 0.12.
Accuracy: ± 5%.
DC COMPONENT:
Adjustable between the
following limits:
Current: 0 to 100 ma. ± 3%.
Voltage: 0 to 50 V,
0 to 500 V.

BRIDGE EXCITATION:

Internal: 1,000 cps ± 2%,
power line frequency or DC.
External: 50 to 10,000 cps.

For complete information on the above and other instruments in the
RCA line write to RCA, Dept. NC-292, Bldg. 18-1, Camden, N.J.

Instrument Engineering Representatives in Principal Cities

*Price in U.S.A., f.o.b. Camden, N.J. Subject to change without notice.

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OF AMERICA**

CAMDEN, N.J.

**COMMERCIAL
ELECTRONIC
PRODUCTS**

In Canada: RCA VICTOR Company Ltd., Montreal

CIRCLE 88 ON READER-SERVICE CARD FOR MORE INFORMATION

Remote Position Control

Linear or Rotary Motion

Intended for remote or automatic control of manipulation in radioactive or other hazardous locations, for

power plant and other controls in aircraft, for valve, throttle or fuel mixture activities, and the like, this remote positioning system can control either linear or rotary motion. It consists of a transmitter, amplifier and receiver. The amplifier needs 115 v, 400 cps ac, but the motor at the receiving end may be operated by practically any power available. Input-output ratio can be 1:1 or any other ratio desired. Accuracy is independent of load, since full voltage is applied to the motor in the receiver whenever any error signal is initiated, and this can be as low as 0.2 per cent of scale. Override, inching and interlock features are optionally available.

The Bristol Company, Dept. ED, Waterbury 20, Conn.

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION

Sub-Miniature Potentiometer

Available to 150,000 Ohms

The resistance range of sub-miniature precision wire-wound potentiometer trimmers has been increased to cover from 10 to 150,000 ohms, with a standard linearity of ± 3 per cent. Ultra compact, only 1/2 in. and weighing but a 1/4 oz, they offer outstanding performance characteristics and dependability in the tiniest possible size. Specifications include: good resolution; high torque as required; ambient temperature -55 to 125 C; power rating 2 w for 60 C rise.

Case is one-piece precision machined aluminum for maximum heat dissipation. All units meet JAN-MIL specs, are antifungus treated and completely sealed against sand, dust or other foreign matter to avoid abrasive action between moving parts. Available in threaded bushing, servo or flush mounting, or ganged units.

Ace Electronics Associates, Inc., Dept. ED, 103 Dover St., Somerville 44, Mass.

CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION



P. R. MALLORY & CO. Inc. MALLORY

—pioneered the mercury battery—known for its constant voltage discharge rate.

—developed the smallest sub-miniature capacitors—in the broadest ranges of voltage ratings and capacitances available anywhere.

—can best supply your mercury battery and subminiature capacitor needs for miniaturized transistor circuit design and production.

Write or ask for complete technical data on Mallory mercury batteries and types TAP, TAW and TNT (tantalum) capacitors.

P. R. MALLORY & CO. INC.
Indianapolis 6, Indiana

P. R. MALLORY & CO. Inc. MALLORY

CIRCLE 91 ON READER-SERVICE CARD

Tape-Recorder Reproducer

14 To 28 Channels



Designed specifically for recording and reproducing data from telemetering channels, Model TR-150-14 is a rack mounted 14-channel 3-speed tape recorder and reproducer. Data are recorded on and reproduced from a 2400 ft magnetic tape moving at 15 ips, 30 ips or 60 ips.

The frequency response of the Model TR-150-14 is: 200 to 20 kc ± 3 db at 15 ips, 200 to 40 kc ± 3 db at 30 ips, 200 to 80 kc ± 3 db at 60 ips. Rewind time is less than one minute for a full reel of tape.

The Model TR-150-14 is supplied as 5 separate units, each suitable for mounting in a standard relay rack. The separate units comprise a low and high voltage power supply; filament and bias supply, recording amplifiers, playback and amplifiers and tape transport mechanism.

Model TR-150-14 features unique applications of a 3-speed motor, and specially designed circuitry for changing speeds and automatically accomplishing compensation.

The unit can be supplied to record data from as many as 28 channels.

Telectro Industries Corp., Dept. ED, 35-18 37th St., Long Island City 1, N.Y.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION

Dc Voltage Ratio Tester

For Fast Readings



Wherever voltage or resistance ratios are more important than absolute values a new ratio tester provides quick, accurate measurements. It measures dc voltage ratios for such devices as potentiometers, etc. Its own self-contained mercury cells and standard cells provide voltage in two ranges, 1 v and 10 v. Switching permits using

either these internal sources, or an external source. Accuracy is 0.05 per cent.

Allegany Instrument Company, Inc., Dept. ED, 1091 Willis Mountain, Cumberland, Md.

CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION

GRAY CODE



BINARY



BINARY
CODED DECIMAL



LIBRASCOPE

SHAFT POSITION-TO-DIGITAL

CONVERTERS

Equipped with ANTI-AMBIGUITY
DOUBLE BRUSH PICKOFFS

Useful in a wide variety of applications, including digital aircraft and missile controls, machine tool controls, digital readout from strip chart recorders, and as the modulator and de-modulator in pulse-code modulated radio links.

GRAY CODE MODEL - Capacity of 8 binary digits (single brush pickoff),

BINARY MODEL - Capacity of 7 to 19 binary digits.

BINARY CODED DECIMAL MODEL. Capacity range from 0-1999 to 0-35,999.

Units for special codes or capacities are built to meet specific requirements.

SHOCK ENDURANCE.....20g

TEMPERATURE RANGE...-50° to 83°C min.

CODE DISCS.....Rhodium plated phenolic

PICKOFFS.....Multiple wire brush.
Two pickoffs/channel

ROTATION.....Continuous, either direction.

**RUGGED-NON-MAGNETIC-LONG LIFE
MAY BE READ WHILE IN MOTION**

**SPECIAL CONVERTERS DESIGNED TO MEET
YOUR INDIVIDUAL PROBLEMS**

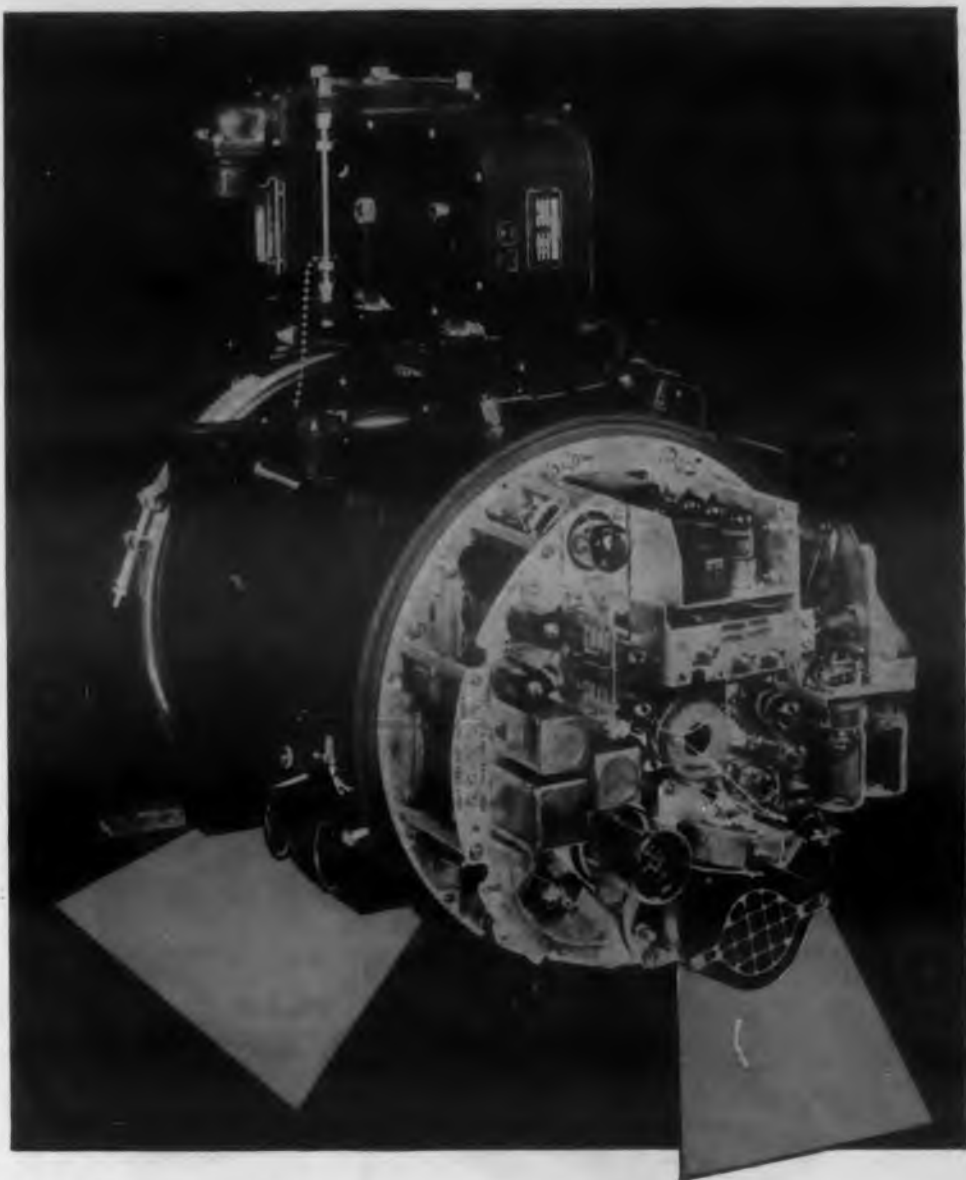
Send for illustrated brochure

LIBRASCOPE

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100 W. Stern Avenue • Glendale, California

CIRCLE 93 ON READER-SERVICE CARD



Joy Fans **HELP LICK HIGH VOLTAGE ARC-OVER IN AIR-BORNE RADAR UNIT**

WHEN MOTOROLA designed this 10 inch air-borne radar indicator to operate at 60,000 ft. they eliminated high voltage arc-over by pressurizing the unit. But this created excessive heat.

TO DISSIPATE HEAT an air-to-air heat exchanger, using three Joy Axivane fans was built in. Two external fans blow outside air between two plates separated by aluminum tubing. Another Joy fan, sealed *inside* the pressurized radar unit circulates hot inside air thru this tubing.

THESE JOY FANS must operate in the wide temperature range of -55°C to $+125^{\circ}\text{C}$. . . tough treatment.

Joy has over 250 models and 1300 designs of these high performance fans ready to solve your toughest air-moving problem . . . be it electronic cooling, de-icing and defogging or ventilation. Write *Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.* In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Write for **FREE Bulletin 145-57**

JOY . . . **EQUIPMENT FOR AVIATION . . . FOR ALL INDUSTRY**

WSW 16415-143



Ground
Power Units



Portable
Lighting



Electrical
Connectors



Vaneaxial
Fans

CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION

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Stressed Panel Fastener
 problems...

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SPF®

**HIGH STRENGTH
 ROTARY
 FASTENER**



SPF eliminates shortcomings of other methods of securing removable structural panels...

- gives all the advantages of a thread plus continuous thread engagement
- overcomes cross-threading and stripping
- fastens and unfastens in less than a full turn
- compensates for "warpage" or "spring-back" of panels
- saves on structural weight and maintenance time
- provides positive clamping force of a bolt
- prevents deflection under loads



Get a quick answer to your stressed panel fastening problems. Write for Catalog No. SPF 56 today!

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"Specialists in fasteners for Industry"

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61 Spring Valley Road, Paramus, N. J.

WEST COAST OFFICE: 5410 WILSHIRE BLVD., LOS ANGELES, CAL.

CIRCLE 98 ON READER-SERVICE CARD FOR MORE INFORMATION

VHF Band Rejection Filter

Flexible Bandpass Shape



Model DBR is a vhf band rejection filter which achieves extreme stability and flexibility by means of

separately tuneable high Q rejection sections. It is especially useful in eliminating adjacent broadband interference or multiple spurious signals and is particularly well suited for use in removing interference to color TV signals.

This unit has a nominal 0.5 db insertion loss and ± 0.5 db passband response. Twelve superimposed asymmetrical notches permit a great variety of precision response shapes to be easily achievable. Typical adjustments provide a rejection band 600 kc wide with minimum attenuation of 90 db, 1 mc wide with 75 db attenuation or 6 mc wide and 25 db minimum attenuation. It can be adjusted to afford the equivalent of a bandpass response in the neighborhood of a passband.

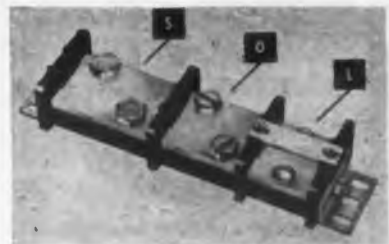
As a bandpass filter it will provide 60 db attenuation approximately 1 mc outside the passband with 35 db attenuation 6 mc outside the passband. This unit mounts in a 19 in. relay rack and is available with various types of connectors, matched to maintain minimum VSWR. Current model (DBR-26) is tuneable in the range of 50 mc to 100 mc.

Entron, Inc., Dept. ED, 4902 Lawrence St., Bladensburg, Md.

CIRCLE 99 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Terminal Blocks

100-225 Amperes



Three new terminal blocks are designed for relatively high voltage, high current power connections. Designated types S, O and L they can be supplied

in any desired combination either with each other, or with terminal sections such as H, BT and BS. Consequently, both control and power terminals can be assembled in one block.

All three new terminals are rated 750 v; type L is rated at 100 amp; type O at 125 amp, and type S at 225 amp, with screws for No. 1 wire lugs, No. 1/0 wire lugs and No. 4/0 wire lugs, respectively. Steel mounting brackets are plated with zinc dichromate.

Curtis Development and Mfg. Co., Dept. ED, 3250 N. 33rd Street, Milwaukee 16, Wisc.

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION

TELESYN[®] 400 CYCLE RESOLVERS

from FORD INSTRUMENT



FORD INSTRUMENT COMPANY

Division of Sperry Rand Corporation
31-10 Thomson Ave.
Long Island City 1, N. Y.

Ford Instrument's standard components



- STANDARD RESOLVERS in Sizes 15 and 23.
- RESOLVER SYSTEMS incorporating size 23 resolvers, network box and amplifier.
- and SPECIALS designed to the particular application.

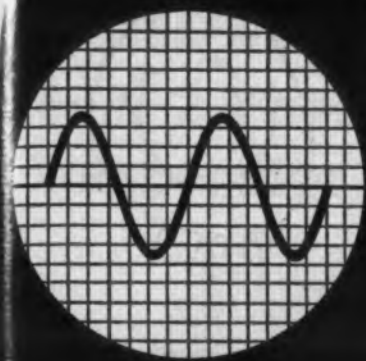
Ford Instrument's *Telesyn* Resolvers — precision-built for the extreme efficiency and accuracy of the Company's computers and control systems — are available to meet your own quality requirements.

FREE — Fully illustrated data bulletin gives specifications and performance information. Please address Dept. E.D.



69A

CIRCLE 101 ON READER-SERVICE CARD



*you'll check
waveshapes
much faster
with a*
SWEEP-SYNC



new automatic sweep generator eliminates manual oscilloscope adjustments

This instrument frees you from the tedious, time-consuming job of manipulating controls. Hooked up to your cathode-ray oscilloscope, it adjusts automatically every time you change signal frequency. Change it 10... 50... 500 times an hour—the display comes up unaltered, and with the preset number of cycles. You never lose the display. Hence all the time you now spend setting and resetting dials is put to productive use. You get more work done, with less distraction.

Trigger input — any waveshape 5 cps to 100,000 cps. Output is sawtooth, approximately 10 V.P.P. The SWEEP-SYNC saves time in circuit development, production testing, and waveshape monitoring... makes many visual techniques practical. Occupies only 4" of front panel width. Write for literature.



**CHADWICK
HELMUTH
COMPANY**

472 East Duarte Road
Monrovia, California

CIRCLE 103 ON READER-SERVICE CARD

**Frequency Monitor
And Voltages Indicator**



A fail-safe voltage and/or frequency monitor, can be adjusted to usual military and commercial specifications or is adaptable to special requirements. This

over/under voltage/frequency monitor incorporates a Regohm regulator. A typical monitor, for example, could be used to actuate an aural or visual warning signal when the line is 5 per cent off nominal voltage or frequency and disconnect or turn off equipment at the 10 per cent limit. Percent Off points are precisely adjustable, and monitoring functions of any degree of complexity can be performed.

Electric Regulator Corp., Dept. ED, Norwalk, Conn.

CIRCLE 104 ON READER-SERVICE CARD FOR MORE INFORMATION

**Rf Sweep Generator Kit
High Accuracy, Low Cost**



The rf sweep generator kit provides high accuracy and reliability at low cost. The unit has an electro-mechanical wobblator system which provides good sweep linearity. Frequency range

is 300 kc to 250 mc on four fundamental ranges and sweep is fully variable from 0 to 13 mc on any frequency within this range.

The sweep system used in this instrument is adjusted by means of a panel-mounted control to insure high linearity even with changes in temperature and humidity. An automatic gain control circuit keeps the output voltage constant within 1 db throughout its entire range.

A built-in crystal-controlled marker accommodating any two crystals is included. An input to permit use with an external marker is also provided.

A switch for selection of marker crystals is located on the front panel. Rf sweep output is in excess of 0.15 v and is adjustable by means of step-type and continuously variable output attenuators.

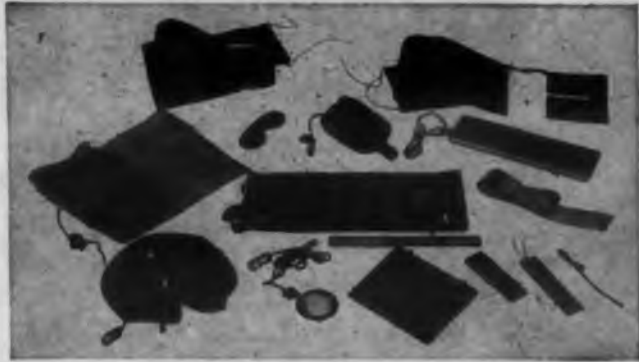
An external marker may be mixed with the crystal marker and controls are also provided for marker amplitude and phase shift. A convenient 5 v rms, 60 cy sine wave horizontal sweep voltage is available from the front panel for scope synchronization. Also included is a horizontal retrace blanking circuit.

Allied Radio Corp., Dept. ED, 100 N. Western Ave., Chicago 80, Ill.

CIRCLE 105 ON READER-SERVICE CARD FOR MORE INFORMATION



THERMAL CONDITIONING OF ROCKETS AND GUIDED MISSILES



HEATING OPTICAL, ELECTRONIC, OR HYDRAULIC AIRBORNE EQUIPMENT

WHERE CAN YOU USE G-E SPECIALTY HEATING EQUIPMENT?

Whenever your equipment requires thermal conditioning, General Electric specialty heating equipment can help.

G.E. has had extensive design and manufacturing experience in providing controlled heating for a wide variety of applications. These applications range from giant guided missile blankets to tiny one-inch-long accelerometer heaters. Problems of intricate shape, large or small size, unusual environmental conditions, and amount of heat required have all been solved.

LET US ANALYSE YOUR HEATING PROBLEM; a General Electric specialty heating expert is available and a prompt answer is assured.

FOR MORE INFORMATION contact your General Electric Aviation and Defense Industries Sales Office or send coupon.

General Electric Company
Section AA220-10A, Schenectady 5, N. Y.

Please send me new bulletin GEA-6285,
G-E Specialty Heating Equipment.

- for immediate project
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Position

Company

City..... State.....

Progress Is Our Most Important Product

GENERAL  ELECTRIC

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION



for Teflon* wire

From advanced know-how and industrial chemistry . . . came "Teflon." Through unique applications of "Teflon" on wire and cable . . . Hitemp Wires, Inc. has opened new horizons for the electronic and electrical industries.

With "Teflon" insulated wire, tubing, multi-conductor cables, lacing cord, tape and sewing thread, miniaturized electronic and electrical components are now possible . . . with the amazing working temperature range of -90°C to $+250^{\circ}\text{C}$.

"Teflon" insulated products offer this unexcelled combination of properties: low loss factor, low dielectric constant, high volume resistivity, nonflammable, low coefficient of friction, unaffected by moisture, tough . . . yet flexible, and completely inert to all known commercial solvents.

For better products . . . for lower production costs, call the leading specialist in high temperature insulations . . . your nearest Hitemp Wire, Inc. sales engineer.



HITEMP WIRES INC.

26 WINDSOR AVE., MINEOLA, NEW YORK

NATIONAL REPRESENTATIVES

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*DuPont's Trade Name for PDLTFE TFEALFLODDETRYLENE

CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply For Oscilloscope



The Type 126 power supply supplies the required voltages and currents necessary to power one Tektronix Type 360 indicator or any one of the Type 160 series waveform generators. The Type 126 mounts beneath the unit to be powered, and includes a cabinet to house both the Type 126 and the powered unit. A Type 126 power supply combined

with a Type 360 Indicator makes a practical, compact slave unit for any tektronix oscilloscope. Output voltages: +300 v dc, unregulated; +225 v dc, regulated, 45 ma; +150 v dc, regulated, 5 ma; -170 v dc, regulated, 30 ma; 6.3 v ac, unregulated, 4 amps. Weight 10-1/2 lbs.

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

CIRCLE 109 ON READER-SERVICE CARD FOR MORE INFORMATION

Sector Potentiometers For Control Systems



A new and complete line of sector potentiometers has been especially engineered for control systems and instrumentations in aircraft and missile

systems. The Models CP01-0103-1, CP01-0207-1 and CP01-0204-1 precision potentiometers are designed to measure angles from zero to a maximum of 90 degrees of shaft rotation. Accuracy is achieved to 0.5 per cent, and resolution to 0.10 degrees.

The instruments are of rugged, all-metal construction with high temperature insulation, capable of withstanding up to 300 F. They are particularly qualified for explosion-proof requirements; severe environmental conditions, vibration, shock and temperature.

All three models are available with shaft extension from either or both sides; also with terminals or with integral cable; and singly or in dual gang units.

Humphrey Inc., Dept. ED, 2805 Canon St., San Diego 6, Calif.

CIRCLE 110 ON READER-SERVICE CARD FOR MORE INFORMATION



if you're feeling very well



or if you're feeling queerly



if it's living you want most



have a checkup yearly

Many cancers can be cured if detected in time. That's why it's important for you to have a thorough checkup, including a chest x-ray for men and a pelvic examination for women, each and every year... no matter how well you may feel.



AMERICAN CANCER SOCIETY

SANDERS

Model 2 Phase Comparator



**...can be used as a
modulator,
demodulator
or switch**

This compact, rugged comparator is hermetically sealed in an inert gas and packaged for mounting in a standard octal socket. Two full-wave bridge rectifiers are used to obtain a high degree of stability and balance.

As phase sensitive comparators, these units can be used to measure the amplitude or phase of an input signal with respect to a reference signal. As demodulators, DC output can be obtained either single-ended or push-pull with respect to ground. Suitable for all military applications.

SPECIFICATIONS

Frequency Response: 0 to 5000 CPS;
Max. Reference Voltage: 120V. RMS;
Max. Output Voltage: \pm 50V. DC;
Dynamic Range: 46 db; **Load:** Max. 200K ohms, — Min. 20K ohms; **Input Impedance:** Approx. 200K ohms with 200K ohms load and 1:1 transformer.
Size: 1" dia. x 3"; **Weight:** 2 ozs.

Write for data sheets to Dept. ED-1



CIRCLE 113 ON READER-SERVICE CARD

No-Contact Proximity Control

Uses HF Energy



The MEK-3030 electronic proximity control detects the presence of an insulator or conductor at the detecting point without making contact with the surface. It can be used as a limit switch which does not require physical contact with the controlling surface, or as a level control of such materials as

soap, coal, oil, etc. It can also be used as an interface control between two dissimilar fluids. Proximity Control has voltage regulation, plug-in relay, visible contacts. Specifications: input voltage 115 v, 60 cy; line consumption 25 va; relay capacity 5 a, 115 v; contact available spdt.

The unit operates on a principle of high frequency energy. The presence of the material close to the detecting element is reflected into the electronic circuit as an increase in loading. This loading is detected and amplified to operate the relay. Several different types of detecting elements are offered to handle the large number of requirements encountered in the industrial electronic field.

Machinery Electrification, Inc., Dept. ED, Northboro, Mass.

CIRCLE 114 ON READER-SERVICE CARD FOR MORE INFORMATION

Rotary Test Head

For Synchros, Resolvers



Potentiometers, synchros, resolvers, and the like can be tested to high degrees of accuracy by a Rotary Test Head which consists of a precision gear, shaft and chuck. The wheel can be positioned in half-degree steps through a

rack engagement; a micrometer advance on the rack mechanism permits fine phasing to within one-half minute. Settings are repeatable to within one part in 200,000. The test fixture is supplied with a set of standard potentiometer pilot diameters. Adapters for special components are also available.

Millitest Company, Dept. ED, 88 Madison Ave., Hempstead, L. I., N. Y.

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION

TRY THIS TEST ON YOUR PRODUCTS LABEL

PERSIANE
ECONOMICAL
EFFICIENT



A hand is shown using a coin to scratch a label on a product. The label has some text on it, including 'Sho' and 'GARN'. The background is dark, and the lighting highlights the hand and the coin.

GARN

MODEL N
FOR USE

MAX CO

USE

PE

Coin test equals years of normal wear

Scrape a coin briskly over your product's name plate or decal. Chances are it will scratch the name plate or tear the decal right off. Not so with Metal-Cal.

Even under extreme conditions of temperature and abrasion, Metal-Cals remain bright and easy to read for years. Metal-Cal, the original aluminum foil applique, is made of .003 inch aluminum, backed with an amazing adhesive requiring no screws, pins, rivets or heat for normal application.

And the eye appeal of Metal-Cal's shiny or matte aluminum finish plus a choice of deep, rich colors... anodized, dyed and etched right into the metal, is a real sales tool in itself.

Metal-Cal

Try the coin test today. See if your present label measures up to the permanent, long wearing beauty of a low cost Metal-Cal.



Send this coupon
for free sample
and brochure today!

METAL-CAL manufactured by C & H Supply Company
415 E. Beach Ave., Inglewood 3, California Dept. ED

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

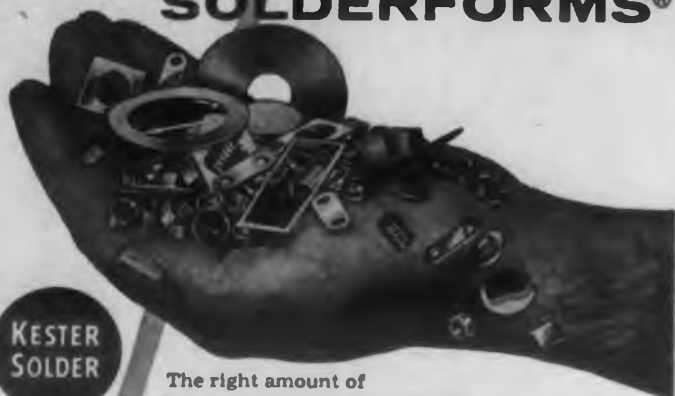
Pat. Pending

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION

no limit on shape versatility... economy!

when you use

KESTER SOLDERFORMS®



KESTER
SOLDER

The right amount of solder every time when you use Kester Solderforms in your assembly operation. Produce better looking and more efficient products as well as greatly increase speed of manufacturing.

WHERE TO USE KESTER SOLDERFORMS

Capacitors • Switches • Resistors • Transformers
Relays • TV and Radio Tuners • Gauges • Small
Metal Assemblies and Controls ... many, many others.

WRITE TODAY for free samples and complete information

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CIRCLE 118 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC RESEARCH ENGINEERS

for

SYLVANIA'S

Applied Research Laboratory

If you are an electronic research engineer qualified to assume major project responsibility, there are excellent opportunities at Sylvania's new Applied Research Laboratory. We are presently forming groups to carry out theoretical and experimental research to establish system requirements for future aircraft ECM systems and airborne radars; devise and evaluate counter-countermeasures techniques; study low altitude clutter rejection problems; and investigate passive detection system requirements.

If your interest is in one of these fields, you will find stimulating associates and unlimited opportunities to contribute and gain recognition at Sylvania.

For further information send resume to:

Dr. L. S. Sheingold,
Manager
Applied Research Laboratory

SYLVANIA
SYLVANIA ELECTRIC PRODUCTS INC.

Waltham Laboratories
100-J6 First Avenue
Waltham, Massachusetts

CIRCLE 119 ON READER-SERVICE CARD FOR MORE INFORMATION

Alignment Instrument

10 to 145 Mc



The Radaligner Model V is a complete alignment instrument designed for the 10 to 145 mc range. The new instrument includes a sweep-

ing oscillator, calibrated variable-frequency marker and fixed crystal-controlled markers.

The fundamental-frequency sweeping oscillator is continuously variable in six overlapping bands accurately calibrated on a direct-reading dial. Sweep widths are provided variable to 60 per cent of center frequency below 50 mc, 30 mc above 50 mc. Rf output voltage is 1.0 v rms into 70 ohms, agc'd for ± 0.5 db flatness over widest sweep and tuning range.

The variable marker is a birdie "pip" marker generated by a separate cw oscillator continuously variable from 5 to 170 mc in six overlapping bands and calibrated to ± 1 per cent on a separate direct-reading dial. Eleven individually-switched, crystal-controlled pulse-type markers at customer-specified frequencies are provided for both separate and simultaneous operation.

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

CIRCLE 120 ON READER-SERVICE CARD FOR MORE INFORMATION

1-Band 5-5000 Cps Oscillator

Needs No Zero Setting



An adaptation of the rm oscillator design, the new DY-2000 sweep oscillator requires no zero setting, and covers the frequency range 5 to 5000 cps in one continuous band. Range changing, switching transients and dial discontinuities are eliminated. The dial is large for easy reading, and between 50 and

5000 cps is calibrated in a true log scale.

Mechanical sweep and other auxiliary components can be attached to the tuning shaft, which extends beyond the rear of the compact and portable cabinet. The instrument is also available in a standard rack-mounting panel.

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

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION

AQ*

CUTS SHORT RUN STAMPING COSTS-----



PROBLEM:

Relay Support Bracket with

9 holes—two different sizes

Tolerance—hole dia. + .002/- .001; location $\pm .003$

Blank size (developed)—1 1/4" x 3"

Material—.062 C. R. Strip Steel

RELAY BRACKET HOLE PUNCHING ANALYSIS

CONVENTIONAL	Single Hole "Short Run" jig punching Tools and first 1,000 pieces \$125.00 Subsequent re-runs 1,000 pieces \$102.00
CONVENTIONAL	"Permanent Gang Die" Punching Tools and first 1,000 pieces \$266.00 Subsequent re-runs 1,000 pieces \$11.00
FEDERAL	"Multiple Hole Process" Punching Tools and first 1,000 pieces \$70.00 Subsequent re-runs 1,000 pieces \$41.00

In analyzing the problem it was found that only through Federal's multiple hole-punching process could stamping costs be cut and still hold to rigid tolerances. Let Federal quote on your next problem piece and save!

Send your print, sketch or piece for our . . .



Analyzed Quotation

Federal TOOL & MFG. CO.

Quality Stampings in
Small Quantities

3650 Alabama Ave., Minneapolis 16, Minn.

CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION



New miniature disc cathodes . . .

... REDUCE HEAT, WEIGHT AND SIZE IN PORTABLE TV SETS

They save up to 50% of required heater power, in contrast with most disc cathodes—hence less heat inside the cabinet. 25% smaller size makes possible a shorter picture tube with a narrower neck . . . a smaller deflection yoke . . . and smaller overall cabinet size. If you are designing picture tubes for portable TV, and if you plan to use either 450 or 300 ma. heaters, get complete information on these new Superior ED-1-7 miniature disc cathodes. Write Superior Tube Company, 2050 Germantown Ave., Norristown, Pa.

Superior Tube

The big name in small tubing
NORRISTOWN, PA.

Johnson & Hoffman Mfg. Corp., Mineola, N.Y.—an affiliated company making precision metal stampings and deep-drawn parts such as those used in the electron guns that glow with this new cathode.

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistance Thermometers

Deliver 5 V at 20 Ma

Without amplification this new line of stainless steel bulb resistance thermometers deliver outputs up to 5 volts at 20 ma. They are available in various ranges from -300 to

1800 F. The temperature interval over which their 100 ohm resistance change will occur may be as low as 100 F. Detachable leads can be exposed to temperatures up to 600 F, and the bulbs can be furnished for installation in corrosive liquids or gases. Time constant in agitated water is less than 5 seconds. The thermometers withstand extreme environmental conditions, including 60 g shock in any direction.

Trans-Sonics, Inc., Dept. ED, Box 328 Lexington, Mass.

CIRCLE 125 ON READER-SERVICE CARD FOR MORE INFORMATION

Self-Locking Clinch Nuts

Ferrous or Non-Ferrous

The range of clinch nuts employing the Nylok self-locking principle has been enlarged to include sizes down to Number 0. They are available in a wide range of ferrous and

non-ferrous materials. The self-locking principle of Nylok fasteners eliminates the need for lock washers, lock wires and other forms of safety fastening. They meet the torque requirements of AN-N and Signal Corps clinch nut requirements.

A rough resilient pellet of duPont "Zytel" nylon is permanently imbedded in the body of each Nylok nut. The pellet projects beyond the threads, and, when engaged, is compressed into the threads. This spring-like wedging action grips threads tightly, setting up a counter-thrust and creating a strong metal-to-metal contact of mating threads. The locking action is positive, whether the mating screw is seated or not. A unique advantage of Nylok clinch nuts is that the screw can be inserted from either side.

Nylok Corp., Dept. ED, 611 Industrial Ave., Paramus, N. J.

CIRCLE 26 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 15, 1957



Rugged and stable under high temperature conditions, these Corning S-Type resistors provide savings in space and cost.

Now you can have resistors with all these advantages . . .

1. 120° C. operation with 100% power, derating to 200° C.
2. Same size as deposited carbons
3. Wide resistance range
4. Economical cost

To help you solve the problem of small space and high ambient temperature Corning has developed these Type S resistors.

These are not ordinary film-type resistors. They are integral units made by bonding a metallic oxide to a PYREX glass rod at red heat. They're non-inductive and completely impervious to moisture.

Three sizes are now available in production quantities:

S-20—½-watt at 120° C. (or 1-watt at 40° C.). Range from 10 ohms to 100,000 ohms.

S-25—1-watt at 120° C. (or 2-watts at 40° C.). Resistance range from 10 ohms to 400,000 ohms.

S-30—2-watts at 120° C. (or 4-watts at 40° C.). Resistance range from 30

ohms to 1 megohm.

Corning Type S resistors have an average change in resistance of less than 1.5% after 1,000 hours at rated power.

Tolerances of 1%, 2%, 5% and 10% are available to meet your exact applications.

And how does a volume price of 25¢ each for the S-20 ± 1% tolerance sound to you?

Write for detailed descriptive bulletin.

Ask for information on these other Corning resistors:

Type LP—Low-cost, low-power. In 3-, 4-, 5-, and 7-watt sizes.

Type R—Power resistor to MIL-R-11804B. Tolerances of 2% or 5%, 7 to 115 watts. Range: 10 to 1,000,000 ohms.

Type H—High-frequency 2% or 5% tolerance. Standard ranges from 10 to 1,000,000 ohms and ratings from 7 to 140 watts.

Type HP—High-power resistors. 17, 30, 70, and 150 watts. Tolerances of 2% or 5%. 20 to 500,000 ohms.

Type WC-5—Water-cooled. Range—35 to 300 ohms. Versatile and adaptable.

Type N—Accurate grade. Made to meet all requirements of MIL-R-10509B.

Other products for Electronics by Corning Components Department: Fixed Glass Capacitors*, Transmitting Capacitors, Canned High-Capacitance Capacitors, Subminiature Tab-Lead Capacitors, Special Combination Capacitors, Direct-Traverse and Midget-Rotary Capacitors*, Metallized Glass Inductances, Attenuator Plates.

*Distributed by Erie Resistor Corporation



CORNING GLASS WORKS, 97-1 Crystal Street, CORNING, N. Y.

Corning means research in Glass

CIRCLE 127 ON READER-SERVICE CARD FOR MORE INFORMATION



FOR HIGH TEMPERATURE APPLICATIONS such as mobile radios, G-E Vac-u-Sel rectifiers have given outstanding service. Unlike ordinary rectifiers limited to 75C, the G-E Vac-u-Sel rectifier will operate dependably at full rating up to 130C ambient . . . and at no price premium.



DESIGNED FOR HIGH-TEMPERATURE OPERATION . . .

G-E *Vac-u-Sel** Stacks Rectify at 130C; Cost No More Than Ordinary Rectifiers

Where temperatures are soaring and conditions rugged, General Electric Vac-u-Sel rectifiers continue to deliver dependable operation.

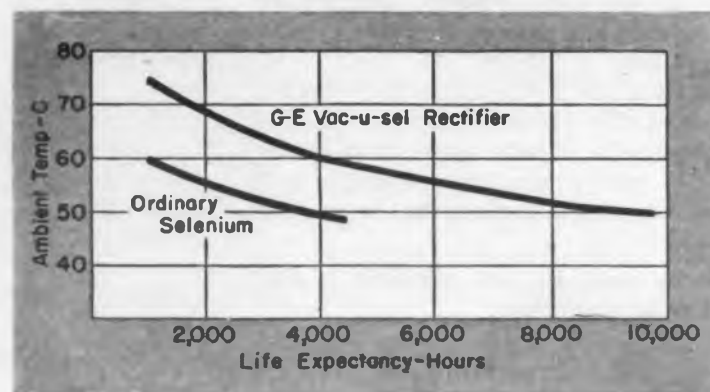
DEPENDABLE OPERATION IN HIGH AMBIENTS is a characteristic of Vac-u-Sel rectifiers made possible by the exclusive manufacturing process described below. This process results in a rectifier that operates successfully at 130C ambient at full voltage and current . . . **without derating**. To operate under these conditions, ordinary selenium rectifiers must be derated. This high-temperature characteristic is available in Vac-u-Sel rectifiers at no extra cost.

WHEN DESIGN SPACE IS AT A PREMIUM, the high-temperature 45-volt Vac-u-Sel stack is your best buy. Its higher voltage rating means that fewer cells can be used than with lower-rated cells. The 45-volt stack will operate at 110C ambient at full voltage and current with a life expectancy of over 1000 hours.

For further information, contact your nearest G-E Apparatus Sales Office, or write for bulletin GEA-6273 to: Section 461-43, General Electric Co., Schenectady 5, N. Y.

*Vac-u-Sel is the trade-mark of the General Electric Co. It designates top-quality selenium rectifiers manufactured by an exclusive sphere-type vacuum-evaporation process by

the Rectifier Department, headquarters for silicon, germanium, selenium, and copper-oxide component rectifiers.



These curves show how a G-E Vac-u-Sel rectifier which is operating at twice normal current, will outlast an ordinary selenium stack operating at only normal current. This explains how a smaller, less expensive G-E rectifier can be used to match performance of ordinary rectifiers.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

Fast High Vacuum Pumps

Rotary-Piston Type

A new line of fast, roots-type vacuum pumps is available in six standard sizes, covering maximum speed ranges from 92 to 4900 cf per minute.

Basic mechanism of these pumps is a pair of figure-eight-shaped rotors which counter-rotate in the pump chamber. These finely machined rotary pistons never touch one another or the pump casing. Consequently, no oil sealing in the pump chamber is required which would contaminate the vacuum system with backstreaming vapors.

Featuring quiet, vibration-free operation and low power consumption, these pumps have motors which operate within the vacuum, eliminating need for shaft seals, which are frequently sources of leakage. Roughing is done directly through the pump without by-passing or valving.

The pumps are reported to be extremely fast mechanical pumps in the 10^{-1} to 10^{-5} mm Hg range. For example, the 39 in. x 20 in. x 22 in. size has a throughput of 10,400 micron-cubic feet per minute at 10 microns. This permits the pump to handle sudden gas bursts encountered with certain metals when the pump is used with a vacuum furnace.

Rochester Div., Consolidated Electrodynamics Corp., Dept. ED, 1775 Mt. Read Blvd, Rochester 3, N.Y.

CIRCLE 131 ON READER-SERVICE CARD

Super Power Klystron

1 Megawatt Pulse

A giant, super power klystron, the largest electron tube ever developed, has been announced. This new tube, the X626, is capable of generating 100,000 w of average radio frequency power and more than 1,000,000 w of peak pulse power. It will be used in radar and linear accelerator operations.

The king-size tube, 10 feet-5 inches long, is the first of a series of super power Eimas klystron tubes.

Eitel-McCullough, Inc., Dept. ED, San Bruno, Calif.

CIRCLE 132 ON READER-SERVICE CARD

◀ CIRCLE 130 ON READER-SERVICE CARD

Spring-Loaded Thermocouple

For Sub-Surface Work

A spring-loaded thermocouple, type is designed specifically for sub-surface temperature measurements where it is essential for contact to be maintained. In this thermocouple line the spring (made of Inconel-X) holds the couple tip firmly against the work surface, assuring constant contact and accurate measurement. It is especially suited for temperature measurement of plastic extrusion machines, generator bearings and dynamo end plates; all typical of applications where the measured part may tend to break contact with the thermocouple.

The thermocouple is available as a straight or 90 degree angle type. It also comes optionally equipped with a bayonet adapter allowing easy removal and reinsertion for inspection.

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

CIRCLE 135 ON READER-SERVICE CARD

Lead Filled Thermoplastic

Used for Radioactive Shielding

Leadolene is an especially formulated polyethylene lead filled thermoplastic compound that produces an homogeneous casting suitable for use in radioactive shielding, or as a high density molding compound. Leadolene, composed of 95 per cent lead by weight and 5 per cent polyethylene by weight, has a specific gravity of 7 grams per cc, approximately. The specific gravity of the final compound can be controlled by changing the ratio of lead and polyethylene in accordance with specific requirements.

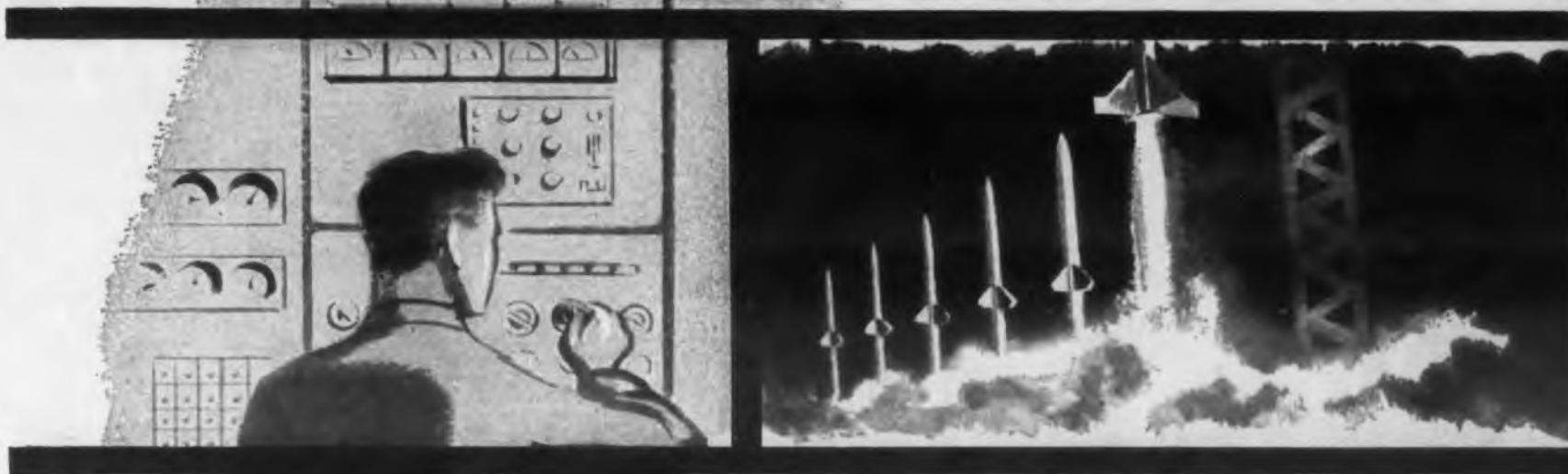
Leadolene melts at a temperature of 220 F into a low viscosity liquid. At the melting temperature and at temperatures of 300 F the compound can be poured into the forms and used for simple castings. The surface of leadolene is smooth, and resistant to oxidation. Cast pieces can be remelted and cast again with no loss of materials due to oxidation.

Electro Industries Corp., Dept. ED, 35-18 37th Street, Long Island City, N.Y.

CIRCLE 136 ON READER-SERVICE CARD

CIRCLE 137 ON READER-SERVICE CARD

WHERE DEPENDABILITY IS VITAL



DAVEN

ROTARY SWITCHES

ARE SPECIFIED

Here's why: Positive solutions to critical rotary switch requirements can be found within the thousands of combinations of poles, positions and decks available from DAVEN's complete line of precision rotary switches.

- *Patented knee-action rotor*—ensures low and uniform contact resistance. It also provides tamper-proof and trouble-free operation over the life of the switch.
- *One-piece combination contact and solder lug*—solid-silver alloy contacts, gold plated to resist corrosion.
- *Turret-type solder lugs* for excellent mechanical and electrical connections.
- *Roller-type detent* gives positive indexing action.
- As many as *Eight poles* available on each deck—where minimum space is a factor.

Write for complete data, catalog and engineering information.

Action	Type	Maximum Number of Positions Per Pole	Number of Poles/Deck	Size
Shorting	11-BM	24	one	1 3/8 Dia. x 1 1/4 Depth
Shorting	12-CM	32	one	1 3/8 Dia. x 1 1/4 Depth
Shorting	25-EM	48	two	2 3/8 Dia. x 1 1/4 Depth
Non-shorting	85-EB	6	eight	2 3/8 Dia. x 1 1/4 Depth
Shorting	45-DM	23	four	2 1/4 Dia. x 1 1/4 Depth



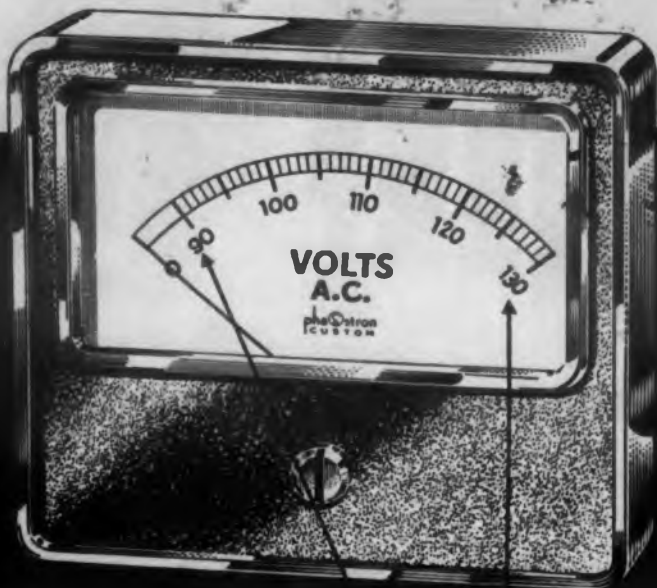
THE **DAVEN** CO.

524 West Mt. Pleasant Avenue
Route 10, Livingston, New Jersey

TODAY. MORE THAN EVER. THE DAVEN  STANDS FOR DEPENDABILITY!

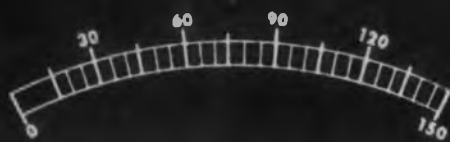


NEW PHAOSTRON EXPANDED SCALE AC Voltmeter



Available now from distributors in 90V to 130V Range. AC Rectifier Type in all custom styles and sizes.

3 1/2" and 4 1/2" rectangular meter



NOW!... all the time-tested proven Phaestron features... PLUS UP TO TEN TIMES GREATER READABILITY for greatly increased accuracy!

Phaestron has squeezed down that under 90V portion of the scale, where you don't need it, and expanded the section where you need it most—between 90 and 130V. Precisely calibrated 1 volt scale increments provide greater reading accuracy. Wide frequency range—linearity—true rms reading and Phaestron craftsman construction.

Phaestron Custom Panel Meters, with expanded scale, 90V to 130V AC rms, are available in nine types at your Parts Distributor. For special requirements, write to the Product Development Department for practical recommendations.



2 1/2" or 3 1/2" square meter



6" rectangular meter



2 1/2" or 3 1/2" round meter

PHAOSTRON

PHAOSTRON INSTRUMENT & ELECTRONIC CO., 151 PASADENA AVE., SOUTH PASADENA, CALIF.

CIRCLE 138 ON READER-SERVICE CARD FOR MORE INFORMATION

Temperature Sensing Control

-103 to +572 F



This temperature sensing and control unit plugs into a 115 or 230 v ac line. It senses and/or controls temperatures from -103 to +572F, and

can be set for either automatic on-off or locking operation. In the first, the control acts as a thermostat, monitoring and maintaining temperature. If set for locking operation the unit turns off heat when a predetermined temperature is reached and keeps it off until an operator intervenes. It is sensitive to 0.075 F. The sensing element can be located as far as 200 feet from the instrument without loss of accuracy.

Models are available in a number of specific temperature ranges. One is intended for use in hospitals to warn of even a 0.075 degree change in patient's body temperature. Construction is that of a bridge circuit with a thermistor as one arm of the bridge, and a meter-relay controller.

Assembly Products, Inc., Dept ED, Wilson Mills Road, Chesterland, Ohio.

CIRCLE 139 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultrasonic Thickness Tester

Reads on CR Tube



The Vidigage Model 14 ultrasonic thickness tester with automation converter and recorder scans the wall thickness of a 6 in. od, 2 in. id steel tube. The small probe makes contact with only the outside of the

tube. Thickness is indicated instantaneously on the cathode ray tube of the instrument. Green and red lights on the automation converter show whether or not the wall thickness is within predetermined limits. The output of the automation converter is placed on a strip chart recorder, which indicates thickness variations as small as 1/20 per cent. The Vidigage can measure thickness on direct-reading scales from 0.005 in. to 2.7 in. It is also used extensively for determining bonding between materials, and the detection of defects in brazed sections.

Branson Ultrasonic Corp., Dept. ED, Stamford, Conn.

CIRCLE 140 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW

magnetically
-controlled

COUNTER -DIVIDER

magnivide



Using a "ladle-bucket" principle, magnetic cores in the unique Magnivide circuit set a new high of reliability and ruggedness wherever counting, scaling or frequency division is required.

Self-contained Magnivide plug-ins are ideal for your new equipment designs. Compared to conventional four-tube counters, one-tube Magnividers offer

- one-third the size
- 50% less power drain
- twice the reliability
- compatible scales of 9-10-11
- counting rates from 0 to 50 Kc.
- both low and high impedance outputs
- direct cascading without buffers

Magnividers have a wide range of applications

- Random counting
- Preset counting
- Cycle counting
- Frequency division
- Timing chains
- Synchronizing circuits
- Accumulators

Write for our Technical Bulletin to obtain complete information and specifications.



Dept. ED-10

MAGNETICS RESEARCH COMPANY

255 GROVE STREET
WHITE PLAINS, N. Y.

CIRCLE 141 ON READER-SERVICE CARD

450 Ma TV Tubes For Series-String Use

Fifteen new receiving tubes included for use in television receivers utilizing 450 ma series-heater strings. These heaters with the same controlled warm-up time to minimize voltage unbalance during starting. In addition, these types have heater-cathode voltage ratings sufficiently high to insure dependable performance in series-stringing circuitry. Except for items involved in the changes of heater design, these new types correspond electrically and mechanically to the prototypes 6AU6, 6CB6, 6DT6, 6BQ7-A, 6M8, 6AQ5, 6AT8, 6CG8, 6U8, 6W8-A, 6CG7, 6CM7, 6AX4-GT, 6Q6-GTB/6CU6, and 6DQ6-A.

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

CIRCLE 143 ON READER-SERVICE CARD

St/St Round Spacer Posts Tap Holes At Both Ends

A complete line of round spacer posts in 3 diameters: 1/8, 3/16 and 1/4 in. and in lengths ranging from 1/4 to 3 in. have tap holes at both ends and flats milled on sides for holding with a wrench while locking. The material is #303 stainless steel with a clear passivate finish.

PIC Design Corp., Div. Benrus Watch Co. Inc., Dept. ED, 477 Atlantic Ave., East Rockaway, L.I., N.Y.

CIRCLE 144 ON READER-SERVICE CARD

Drafting Ellipse Templates Flexible In Use

A set consisting of four templates, 30, 45 and 60 degree projection, and also available individually, is announced. Each template has a range of 2 to 6 in. major diameter, in increments of 1/8 in. The ellipses are tapered, allowing the use of a tubular drafting pen when placed face down. Made of 0.060 in. plastic and green tinted for easy vision, all cut outs are precision smooth and have pencil alignment for absolute accuracy.

Mapidesign, Inc., Dept. ED, Box 100, Glendale, Calif.

CIRCLE 145 ON READER-SERVICE CARD

CIRCLE 146 ON READER-SERVICE CARD

THE INSIDE STORY



PNP Germanium Type—T 1041

PHILCO® POWER TRANSISTOR


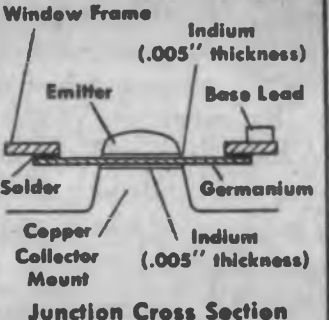

THERMAL DROP 1½° C PER WATT TYPICAL

The advanced design of Philco Power Transistors gives a new high in reliability. Superior thermal drop is achieved by placing the collector junction in intimate contact with the copper base—and the copper mount is assured maximum dissipator contact by "knee action" of the aluminum mounting clamp. The Philco exclusive cold weld gives freedom from contamination—for long

life! Long, flexible, insulated leads assure optimum electrical connection in printed circuitry—without disturbing the hermetic seal. Available in production quantities and specifically built for the audio output stage of auto radios, Philco Power Transistors are ideally suited to high power amplifiers, servo-amplifiers, power converters and low-speed switches.

FEATURES

High beta at high currents • 100° C storage temperature • Improved alpha cut-off • Absolute hermetic seal
Low surface leakage currents • Superior thermal drop • Low distortion • Low saturation resistance

 <p>Actual Size</p>	 <p>Window Frame Indium (.005" thickness) Emitter Base Lead Solder Germanium Copper Collector Mount Indium (.005" thickness) Junction Cross Section</p>	 <p>Aluminum Clamp Copper Cap Complete Transistor Assembly</p>	Specifications Power Gain (5W—Class A) 35 db (typical) D. C. Current Gain ($I_c = -1a, V_c = -1.5V$) 40—150 Sat. Voltage ($I_c = 1a$) 0.8V Max.
			Maximum Ratings Collector Dissip. @ 75° C Ambient 10W. Collector Voltage 40V.

Make Philco your prime source of information for Power Transistor applications.
Write to Dept. ED, Lansdale Tube Company, Lansdale, Pa.

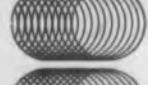
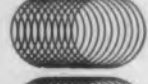
PHILCO CORPORATION
LANSDALE TUBE COMPANY DIVISION
LANSDALE, PENNSYLVANIA



Write today for your free copy of this technical paper



ask for data file 125



Measurement and Correction of Phase Shift in Copper-Mandrel Precision Potentiometers

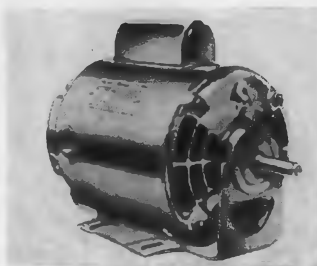
BY STANLEY SCHNEIDER,
FRED HIRAOKA
AND CLARENCE GAULDIN
Research and Engineering Division,
Helipot Corporation

Beckman Helipot Corp., Newport Beach, Calif.
a division of Beckman Instruments, Inc.

898

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION

Fractional Horsepower Motors Smaller and Lighter



Capacitor-start and split-phase motors in rigid and resilient base models are now available in NEMA 48 frame size. Through use of smaller, lightweight, precision-machined steel frames and cast aluminum endplates, weights of 1/8, 1/4 and 1/3 hp ratings have been reduced from 3 to 8 lbs, making the new motors easier to handle, stock and install.

A new lubrication system permits mounting sleeve bearing motors at any angle with positive protective lubrication in every position. The bearings, lined with high tin babbitt, have superior antiseizure and nonscoring characteristics, and high corrosion resistance, and provide smooth performance with low temperature rise.

High dielectric strength, moisture resistance and thermal stability resulting in longer motor life, have been obtained through the use of laminated slot insulation. A dependable trouble-free quick-break switch and an easily accessible terminal board are other features of the new designs.

Wagner Electric Corp., Dept. ED, 6400 Plymouth Ave., St. Louis 14, Mo.

CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION

KU-Band Ferrite Isolation Yields 10 Db Isolation



Utilizing the resonance absorption characteristics of ferrites, a new load resistor designated Model U90, is designed to provide a simple and compact solution to magnetron loading problems caused either by excessive VSWR or by lengthy transmission lines. It provides a minimum of 10 db isolation over the bandwidth of 16,300 to 16,700 mcs at 90 kw peak power and 90 watts average power. Maximum insertion loss is 0.7 db and maximum input VSWR is 1.05.

A cover totally encloses the magnet, preventing disturbance of its field or alteration of its electrical characteristics. Operating characteristics are guaranteed under vibration spec MIL-E-5272A and over temperatures ranging from -55 C to plus 100 C. The Model U90 is designed for rugged operating conditions.

Litton Industries, Components Division, Dept. ED, 5873 Rodeo Road, Los Angeles 26, Calif.

CIRCLE 150 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW

series 7000 sub-miniature rotary switch

OFFERING
UP TO TWELVE
POSITIONS
PER DECK
AND THREE DECKS



Maximum versatility, 1 to 3 decks, wide range of contact arrangements. Specially impregnated glass melamine wafer. Solder type lugs. Positive indexing.

Write FOR ENGINEERING DATA SHEETS ON ROTARY SWITCH AND:

1 1/2" Ruggedized Meters; 1" and 1 1/2" Panel Meters; 1 1/2" VU, Db and Illuminated Meters; Miniature Multitesters; and Side Indicators.



international instruments, inc.

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Cable "INTERINST"

CIRCLE 151 ON READER-SERVICE CARD FOR MORE INFORMATION

Type 1 for steel Type 23 for die castings

FREE!
TEST OFFER PROVES
NO TAPPING WITH
SHAKEPROOF
T. M. REG. U. S. PAT. OFF.

THREAD-CUTTING SCREWS

They actually cut their own mating thread in metal or plastic... just drill and drive! Because each screw remains in its own self-cut thread... tighter, stronger fastenings are certain!

SEND FOR
FREE TEST KIT OF TYPE 1
OR TYPE 23 AND 25 NOW!

Type 25 for plastics

SHAKEPROOF
"Fastening Headquarters"
St. Charles Road, Elgin, Illinois

SHAKEPROOF FASTEX DIVISIONS OF ILLINOIS TOOL WORKS

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION

USING LACING CORDS OR TAPES? Consider the advantages of **NYLON**

HEMINWAY & BARTLETT

NYLON FLAT BRAIDED TAPES and NYLON LACING CORDS

- Fungus-proof
- Stronger—ties easier, faster, tighter
- Knots will not slip

MEETS NEW GOVT. SPEC. MIL-T-713A
Tapes are available in both Nylon and Dacron and in wax, wax-free and resin-coated finishes.

New **TEFLON COATED FIBERGLASS TAPES WITHSTAND TEMPERATURES UP TO 600°**

FREE! Write today for free samples of tapes and cords

The Heminway & Bartlett Mfg. Co. ELECTRONICS DIVISION, 500 5th Ave. N. Y. 36 Sales Offices: Chicago, Philadelphia, Boston, Cincinnati, San Francisco, Los Angeles, Detroit, Charlotte, N. C., Gloversville, N. Y., Lynchburg, Va. Foreign Agent Turner, Halsey Co., Inc., 40 Worth St., N. Y.

CIRCLE 152 ON READER-SERVICE CARD FOR MORE INFORMATION

flexible couplings with ZERO BACKLASH



Series #1
Actual Size

For exacting requirements, you're sure of best results with precision-made Renbrandt Flexible Servo-Couplings. They have zero backlash and low inertia... and they do not introduce velocity variations between driving and driven shafts. Available in a variety of sizes for 1/16" through 1/2" shafts in all combinations. Widely used for servo-mechanisms, computers, and for all precision applications.

Specify Renbrandt Flexible Couplings. Fast delivery on prototype or production orders. Send for complete catalog.

Renbrandt, Inc.
98B Kirkland Street
Cambridge 38, Mass.

Tel.: TRowbridge 6-6560

Renbrandt



TinyMite Coupling
Actual Size

Low cost for general application. Thousands of uses. 1/2" dia. x 1 1/16" long. For 1/4" and/or 3/16" shafts. No backlash. Insulated.

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

specify standard



FLEXLOC SELF-LOCKING NUTS

FLEXLOC DESIGN FEATURES

one-piece, all-metal construction
millient locking action
controlled locking requires
lock and stop nut in one
every thread carries its share of load

DO YOU KNOW? FLEXLOCS do not have to be seated to lock. They lock anywhere on a bolt as soon as the locking threads are fully engaged. And FLEXLOCS are stocked by authorized industrial distributors in a full range of sizes from #0 to 2". Write for Bulletin 866. STANDARD PRESSED STEEL Co., Jenkintown 12, Pa.

STANDARD PRESSED STEEL CO.

FLEXLOC LOCKNUT DIVISION

SPS

JENKINTOWN PENNSYLVANIA

CIRCLE 155 ON READER-SERVICE CARD FOR MORE INFORMATION

Transducer Amplifier

Provides 8 Kc Excitation



The Model 400A differential transformer amplifier is a highly stable carrier amplifier for use with differential transformer transducers in dynamic and static measurement of motion, force, weight, pressure, acceleration, and similar

quantities. The demodulated output signal is suitable for cathode ray oscilloscopes, null-balance recorders, galvanometer oscillograph amplifiers, VTVM's, and similar devices. An internal 8 kc oscillator provides transducer excitation. Frequency response extends from zero to 1000 cps. Maximum sensitivity is 500 mv/.001 in. using a typical transducer.

Combined noise level and uncorrected zero drift is equivalent to 10 μ n. per hr at maximum gain. Zero set and gain controls are provided on the front panel. Available in portable or rack mounted styles. Weight is 13 lbs.

Daytronic Corp., Dept. ED, 216 S. Main St., Dayton, Ohio.

CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION

VHF-UHF Sweep Generator

Wide Band



The Model SG-132 combines the features of a standard cw and am signal generator and a wide band sweep generator. Among its many applications are testing

and aligning vhf-uhf communication receivers, measuring sensitivity, selectivity, image rejection and gain of receivers, if amplifiers, broadband amplifiers, TV, and other equipment. It offers a very wide sweep width—40 per cent of the center frequency, from 15 to 400 mc, with a dial accuracy 0.01 per cent, crystal corrected. The output, which is entirely fundamental (not beat-frequency oscillators), is calibrated from 0.1 to 150,000 μ v throughout the frequency range. An unusual feature is the constancy of this output which varies less than ± 0.2 db over the entire range. The equipment also has an integral dc coupled oscilloscope.

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

CIRCLE 157 ON READER-SERVICE CARD FOR MORE INFORMATION

SCIENTIFIC ENCLOSURES QUICKLY ASSEMBLED!

The *Widney-DORLEG*

Cabinet Component System

of pre-fabricated dural die-cast corners, extruded sections and parts... assemble into modern fully-radiused cabinets to any dimensions, with NO SPECIAL TOOLS, DIES OR JIGS.

Used in Electronic applications, such as Control and Analysis, Computers, Mining, Spraying, Refining, Food Processing, etc. Also in many Government-approved installations.

For prices & data sheets write Dept. YA-887

BRITISH INDUSTRIES CORP., Port Washington, N. Y.

CIRCLE 158 ON READER-SERVICE CARD FOR MORE INFORMATION



New BRADY Aluminum Foil Wire Markers —Give Permanent Identification

Stick and stay in elevated temperatures, oils, most solvents

New Brady Aluminum Foil Wire Markers show which wire goes where at a glance. Permanently identify machine tool electrical systems, motor leads, control circuits, etc.

Only 3 mils thin. Self-Sticking Markers wrap around

wire fast. Legends imbedded in the foil stay permanently legible. Markers stay on wire under oily conditions — won't discolor at temperatures to 350°F.

NEMA and NMTBA Markers in stock for immediate delivery. Specials made to your order. Write today for free working samples, prices, and name of local distributor

W. H. **BRADY** CO.
Est. 1914

783 W. Glendale Ave.
Milwaukee 9, Wis.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW, a complete line of insulating tapes with improved Thermosetting Adhesive!



These "SCOTCH" Brand Tapes have thermosetting adhesives:

- "SCOTCH" Polyester Film Tapes
- "SCOTCH" Acetate Tapes
- "SCOTCH" Glass Cloth Tape
- "SCOTCH" Paper Tapes
- "SCOTCH" Cotton Cloth Tapes

There's a big difference between pressure-sensitive insulating tapes with true "thermosetting" adhesives, and tapes with "heat-resistant" adhesives. The difference is *holding power*. Improved 3M Thermosetting Adhesive holds under extreme operating heat without softening . . . has high bond strength for anchoring leads . . . bakes dry to prevent throw-out . . . resists action of solvents, waxes, varnishes. The only tapes combining *all four* of these advantages are "SCOTCH" Brand Tapes with 3M Thermosetting Adhesives.

GREATER ADHESION • GREATER SOLVENT RESISTANCE • 50% MORE TACK • LONGER SHELF LIFE

The first true thermosetting adhesive . . .
still the industry standard . . .



SEND FOR FREE BOOKLET illustrating and describing "SCOTCH" Brand Thermosetting Electrical Tapes. Just write on your letterhead to 3M Co., St. Paul 6, Minn., Dept. ON-17.

REG. U.S. PAT. OFF.
SCOTCH
BRAND
Electrical Products

The term "SCOTCH" and "3M" are registered trademarks of Minnesota Mining and Manufacturing Co., St. Paul 6, Minn. Export Sales Office: 99 Park Ave., New York 16, N.Y. In Canada: P.O. Box 757, London, Ontario.

CIRCLE 161 ON READER-SERVICE CARD FOR MORE INFORMATION



Variable Delay Network For Computers, Triggers



Variable, stable time delay, with no jitter, intended for computers, triggering systems and other precision applications is provided by Type 801 variable delay network. Incremental time delay may be less than 0.08 millisecond and total time delay up to 1 millisecond. A unit of these networks consists of one continuously variable delay line and three step-variable delay lines. Four models are available with different total delays ranging from 55.55 to 1111 μ secs. In all models input impedance is 500 ohms, output impedance 1000 ohms. Accuracy, attained by use of correction curves, can be maintained within 0.1 per cent. The panel measures 5 1/4 x 19 in., and is adapted for standard rack mounting.

Advance Electronic Lab., Inc., Dept. ED, 451 Highland Ave., Passaic, N. J.

CIRCLE 162 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse-Analog Converter 2 Degrees Per Pulse



The Model 8915 rotor stepper, an electro-mechanical shaft positioning device which provides controlled incremental shaft rotation of one 2 degree step per dc pulse. Rotation is unlimited clockwise or

counter-clockwise, and stepping speed is as rapid as 60 steps per second with torque output as high as 14 oz in. Between pulses, shaft position is locked in an accurate shaft angle by a spring detent. Nominal input of 1 amp at 28 v dc for a pulse duration as short as 10 μ sec will accomplish one 2 degree step.

Optional control mechanisms available on standard models provide homing to a fixed reference position, automatic continuous stepping with the application of a steady dc voltage, and/or potentiometer output proportional to shaft position.

Designed for use in computer equipment, the rotor stepper finds a wide variety of applications in sequence switching, algebraic counting, or any system requiring reliable, accurate, shaft positioning.

G. M. Giannini & Co., Inc. Dept. ED, 918 East Green St., Pasadena 1, Calif.

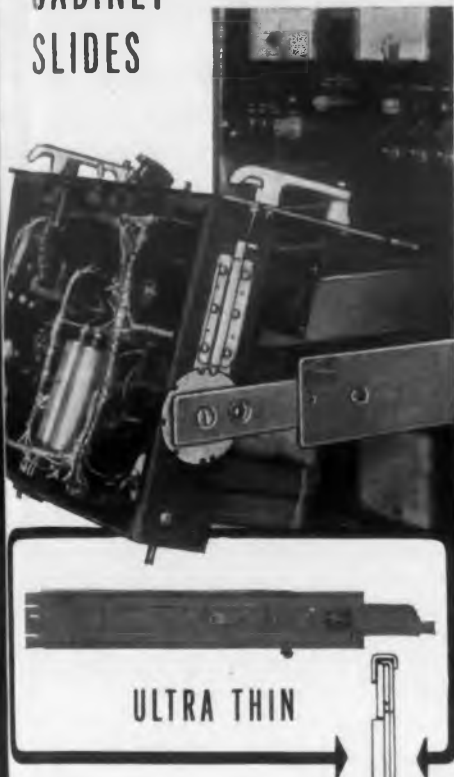
CIRCLE 163 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 15, 1957

SPECIFY

Chassis-Trak

ROLLER BEARING
CABINET
SLIDES



New Chassis-Trak roller bearing slides make your electronic equipment more accessible . . . faster and easier to service. Chassis Trak's ultra thin design, wider bearing rollers support up to 175 lbs. with chassis extended. Rollers assure permanent, smooth slide operation.

PLUS:

- Ultra thin slide design (.350") for maximum use of cabinet interior
- Permanent, dust-repellent, dry lubricant finish
- High corrosion resistance
- Easy installation
- 8 stock lengths, standard width
- Push button emergency chassis removal

WRITE: DEPT. 2ED

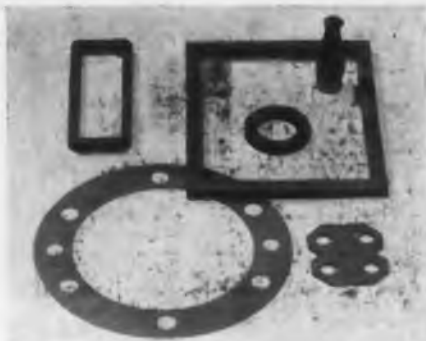
Chassis-Trak, Inc.

525 S. WEBSTER AVENUE
INDIANAPOLIS 19, IND.

CIRCLE 165 ON READER-SERVICE CARD

Silicone Rubber

Low Durometer



A new, very low durometer silicone rubber stock has been developed which has compressibility in the range of silicone sponge rubber. Designated COHrlastic R-

11568, the new stock is moldable in 1/16 to 1 in. sections, 1/16 to 1/2 in. sheets and extrudable in 10 ft lengths. Its moldability and its very low compression set, in particular, recommend it for applications where a soft sealing material is desired in thick or thin section, in simple or complicated shapes. While slightly softer than this new (solid) compound, silicone sponge rubber is not readily moldable.

Cohrlastic R-11568 has a -100 to +500 F temperature range, is immune to ozone and weathering, is odorless, tasteless, noncorrosive, noncontaminating. Initially, it is available in custom-made sheets, moldings and extrusions.

The Connecticut Hard Rubber Co., Dept. ED, 407 East St., New Haven 9, Conn.

CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION

WWV Standards Receiver

Has Crystal Control



Tube model SR-7 receiver is designed for the specific purpose of receiving radio transmissions from the Nation-

al Bureau of Standards through stations WWV or WWVH. It utilizes crystal control for fixed frequency selection. Dual conversion is used to accomplish image rejection, selectivity and gain. Speaker and S meter located on panel.

Less than 2 μ v of signal is required to produce a signal-to-noise ratio of 10 db on all operating frequencies. Frequency coverage is 2.5, 5, 10, 15 and 20 mc, crystal controlled. Selectivity is 6.5 kc at 20 db down. If frequencies are 1990 kc and 175 kc, and output is 250 mw into 10,000 ohm load. It has a series type noise limiter. Antenna inputs are 52 ohm and high impedance. The receiver is available for either bench use or rack mounting.

Specific Products, Dept. ED, 14515 Dickens St., Sherman Oaks 2, Calif.

CIRCLE 167 ON READER-SERVICE CARD FOR MORE INFORMATION

DOUGLAS ROESCH

Custom ELECTRONIC CABLES

extend your design possibilities



THE PLANETARY CABLER and other Roesch-developed, exclusive equipment allow D-R to fabricate cable to your individual needs.

Electronic system design and performance no longer need to be compromised because of lack of adequate electrical connections between system elements. Environments including critical temperatures (-85° to $+410^{\circ}$ F)... High G... metal burning velocities... extreme vibration... pressure or vacuum... abrasion... flexing... or severe electrical loads. D-R Cables spell performance, durability, stability... wholly new design horizons.



ROUND OR FLAT, lozenge, elliptical shape or any combination in a single length of cable available at D-R.



Write for complete facilities brochure... let us help you system engineer your complete layout.

A D-R Custom Cable can meet your most critical missile, airframe or automation electronic system requirements.

Engineers, investigate your future with Douglas Roesch



CABLES CAN BE CUSTOMIZED with electronic conductors, steel, nylon or teflon for strength; elastic shock cord, pneumatic or hydraulic hoses.

Douglas Roesch 2950 NO. ONTARIO ST.
BURBANK, CALIFORNIA

a DIVISION of **HALL-SCOTT** HALL-SCOTT, Inc.

CIRCLE 168 ON READER-SERVICE CARD FOR MORE INFORMATION



another
product surprise
from

Beckman[®] Magnetic Clutches

Feather-light, acorn-small, our two new magnetic clutches run free as a breeze (no slippings here), require little torque to turn them. They're for electrical control of rotary mechanical functions or for controlled loads or stops. And they've got zero backlash!

BECKMAN dry-disc, solenoid-operated magnetic clutches, designed for high cycling rates, may be operated in any position. Standard units (with or without brakes) are available for operation at 24 and 48 volts. All come furnished with stainless steel input gears. Special input gears other than those shown below are available.

Here are some facts:

Model	BP-543	BP-583
Max. Speed	3,600 rpm	7,200 rpm
Total Torque (clutch + brake)	35 oz. in. max.	8 oz. in. max.
Time for Full Engagement	0.005-0.020 sec.	0.015-0.025 sec.
Dissipation (continuous)	6 watts	2.5 watts
Output Inertia (gm. cm. ²)	10.974	6.76
Input Gear Pitch	48	48
Number of Teeth	66	50

→ Want more? Write for data file 155

Beckman[®] / **Hellpot Corp.**, Newport Beach, Calif.,
a division of Beckman Instruments, Inc.
Engineering representatives in principal cities.

CIRCLE 170 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW CONTACT CATALOG

Shows You How to
Cut Contact Costs!



Your design engineers, quality control, production and purchasing departments will all save valuable time and money by utilizing this new easy-to-use Deringer catalog which lists 300 standard flat and radius faced contacts available in a wide range of metals—fine silver, gold, platinum, palladium, precious metal alloys, brass, steel, aluminum, etc. A wide variety of contacts in special sizes and shapes is also shown.

Included are three handy contact selector sheets which contain design and order information on other contacts and cold-headed specialties.

DERINGER METALLURGICAL CORPORATION

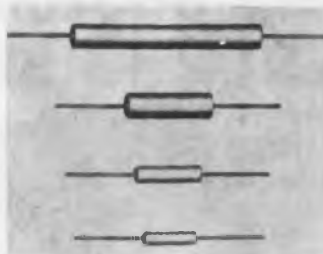
8127 Monticello Avenue, Skokie, Illinois
Please send a copy of your new catalog
"300 Standard Contacts and Rivets."

Name _____ Title _____
Company _____
Street Address _____
City _____ State _____
Type of business _____

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION

Carbon Film Resistors

Ceramic Encased



This type precision resistor construction features a layer of pure carbon deposited on a ceramic rod. Silver plated end-caps are expansion fitted for positive contact and the unit

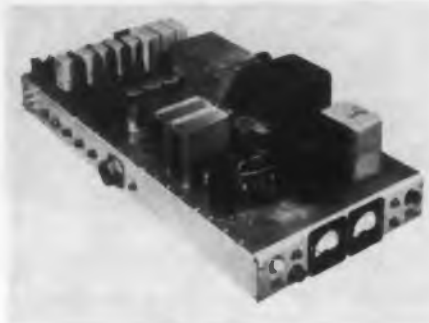
is encased in a non-hygroscopic ceramic tube and hermetically sealed with high temperature solder for improved stability characteristics. The resistors conform to MIL-R-10509B specifications and are furnished in standard tolerance of ± 1 per cent. Tolerances of ± 2 per cent and ± 5 per cent are available. These resistors are furnished in 1/4, 1/2, 1 and 2 w sizes.

Continental Carbon, Dept. ED, Div. of Wirt Co.,
13900 Lorain Ave., Cleveland 11, Ohio.

CIRCLE 172 ON READER-SERVICE CARD FOR MORE INFORMATION

Radar Mark Generator

Simulates Radar Pulses



This radar mark generator simulates both range timing pulses and 10 degree and 30 degree azimuth pulses. Designed for use in personnel training

as well as radar equipment design, the unit is completely self-contained in a portable case or relay rack-mount and has its own power supply. It provides one-microsecond pulses for 10 mile and 50 mile markers, and a main trigger every 350 miles. 10 millisecond azimuth pulses are generated from a 36 speed synchro every 10 degrees regulated to emphasize the signal every 30 degrees. All outputs have independently adjustable amplitude controls, variable from 0 to 25 v across a 72 ohm terminated line. Range marks are generated from a crystal oscillator with extreme accuracy (frequency instability less than one part in 10,000) and negligible phase jitter. Azimuth marks are generated with less than 0.5 degree variable error.

High quality JAN-type components and computer-type circuitry are used throughout. In addition, a marginal checking feature permits raising and lowering all voltages to locate marginal components before actual failure can occur.

Advanced Electronics Mfg. Corp., Dept. ED,
2025 Pontius Ave., Los Angeles 25, Calif.

CIRCLE 173 ON READER-SERVICE CARD FOR MORE INFORMATION



Type 1604-B
Comparison
Bridge
\$450.

Rapid, Accurate Testing of Audio Components in the Lab or on the Production Line

This Comparison Bridge is a versatile instrument for extremely quick measuring of resistances, inductances and capacitances by comparison with an external standard. It is completely self-contained and consists of a bridge circuit, an oscillator operating at 400 c, 1000 c, or 5 kc, and a sensitive cathode-ray tube as a visual null indicator.

With this bridge, rapid production testing of 1/4% or 1% components is simple. It will measure impedances from pure resistive to pure reactive at any arbitrary phase angle from 0 to $\pm 90^\circ$. Accuracy is $\pm 0.1\%$.

Write for Complete Data

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

Broad Avenue at Linden, Ridgefield, N. J. NEW YORK AREA 920 S. Michigan Ave. CHICAGO 5

1150 York Road, Abington, Pa. PHILADELPHIA

8055 13th St., Silver Spring, Md. WASHINGTON, D. C. 1000 N. Seward St. LOS ANGELES 38

CIRCLE 174 ON READER-SERVICE CARD FOR MORE INFORMATION



HEAT-CONTROL PROBLEMS
IN YOUR INDUSTRY,
MR. DESIGNER?

BEST ANSWER USUALLY COMPACT, TOUGH,
ACCURATE FENWAL THERMOSWITCH.®

WE HAVE PROVED THAT TO DESIGNERS
IN ALMOST EVERY INDUSTRY,
INCLUDING, PROBABLY, YOURS.

VERY ADAPTABLE — 24,000 VARIATIONS
AVAILABLE ON BASIC THERMOSWITCH IDEA.

Designers — Write Fenwal Inc.,
171 Pleasant St., Ashland, Mass.,
for THERMOSWITCH Folder.

Fenwal

Controls Temperature
... Precisely

CIRCLE 175 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 15, 1957

**NEW
VARO
400 CPS
FREQUENCY
METER**



**DESIGNED FOR GREATER
ACCURACY AND VERSATILITY
IN LABORATORY USE**

This is a compact precision 400 cps frequency standard and frequency meter with center scale accuracy of .02%. An output terminal is provided for external use of the 400 cps signal, as well as one for a recorder for permanent record. Write for details.

**SPECIFICATIONS
VARO 6501 FREQUENCY METER**

Center Frequency.....	400 cps
Full Scale Accuracy (395-405).....	0.1%
Full Scale Accuracy (350-450).....	1.0%
Reference Frequency Accuracy.....	.02%
Input Signal Range.....	2.0 to 250 volts
Power Requirement.....	105-125 volts 60 cycle AC
Dimensions.....	8-5/16 in. high, 5 1/2 in. wide, 6 1/8 in. deep

VARO Mfg. Co., Inc.
2201 Walnut Street, Garland, Texas

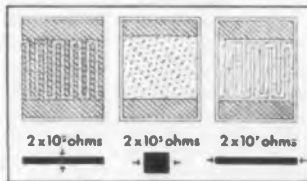
CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION

**Kodak
Ektron
Detector...**



A unique lead sulfide photosensitive resistor with the following characteristics:

- Response extends from 0.25 microns to 3.5 microns with maximum sensitivity at 2.2 microns in the infrared
- High signal-to-noise ratio in infrared
- Signal response is almost independent of size of sensitive area
- Unaffected by vibration, small in size
- Available in complex and exact arrays and mosaics



For a booklet giving detailed information on Kodak Ektron Detectors, write Military and Special Products Sales,

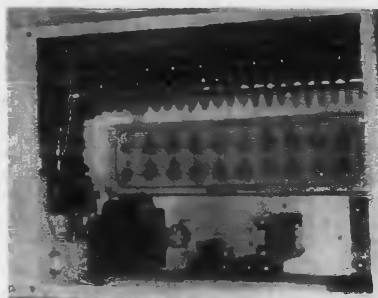
EASTMAN KODAK COMPANY
Rochester 4, N. Y.

Kodak

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION

Automation Timing Device

0.01% Revolution Accuracy



Accurate to one ten-thousandth part of one complete revolution, and with a repetition rate up to twenty operations in one revolution, the Dietz timed operations preselector is intended for, and has been used in, automation. It is built in units. Each unit can handle a maximum of twenty time intervals or operations. Time ranges can be built in to meet customers' requirements, the shortest interval obtainable being 1/10th second. Operating power is 115 v, 60 cps ac. Switch contacts can control up to 15 amps., 120-125 v ac.

The time of any operation can be preselected without affecting any other operation. Operations can be added, dropped out or modified without affecting any other operation. Sequence of operations can be altered; any number of operations can be performed by ganging standard units; a pre-selected sequence can be repeated indefinitely. Pre-set sequences can be initiated by remote control. The device is versatile. It is currently in use to provide automatic control of coke quenching operations in the steel industry, for automation of industrial laundry equipment, and control of equipment that tests hydraulic appliances, etc. Essentially a synchronizable sequence controller, the instrument can control practically any series of operations.

Henry G. Dietz Co., Dept. ED, 12-16 Astoria Boulevard, Long Island City 2, N. Y.

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION

**Transistorized Charger
For Dosimeter Pens**



A family of lightweight dosimeter pens ranging from 200 milliroentgens to 100 roentgens is offered with a compact, transistorized dosimeter charger. The pens are direct reading self-contained electrometers designed especially for the protection against radioactive material.

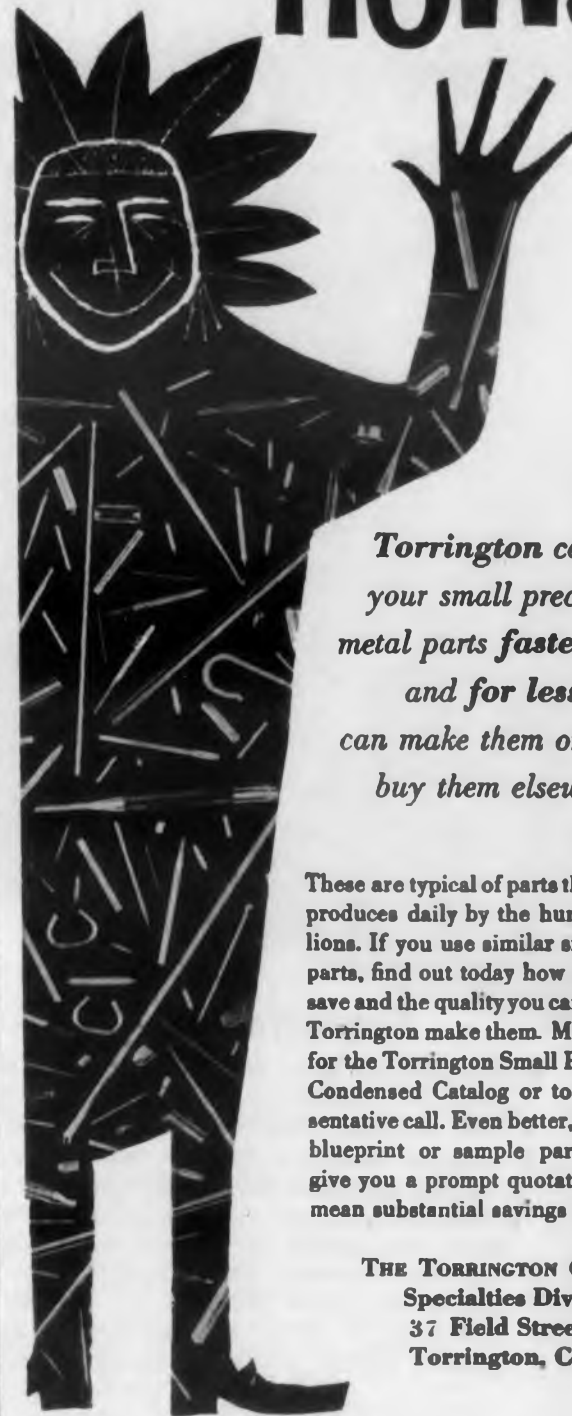
The charger, Model No. 44, utilizes a high efficiency encapsulated transistorized power supply; and has no neon regulators. It operates from a single standard flashlight cell and weighs less than a pound.

Universal Atomics Corp., Dept. ED, 143 E. 49 St., New York 17, N.Y.

Universal Atomics Corp., Dept. ED, 143 E. 49 St., New York 17, N.Y.

CIRCLE 180 ON READER-SERVICE CARD FOR MORE INFORMATION

HOW...



*Torrington can make
your small precision
metal parts faster, better
and for less than you
can make them or
buy them elsewhere*

These are typical of parts that Torrington produces daily by the hundreds or millions. If you use similar small precision parts, find out today how much you can save and the quality you can get by letting Torrington make them. Mail the coupon for the Torrington Small Precision Parts Condensed Catalog or to have a representative call. Even better, send a sketch, blueprint or sample part and we will give you a prompt quotation which will mean substantial savings to you.

**THE TORRINGTON COMPANY
Specialties Division
37 Field Street
Torrington, Conn.**

**TORRINGTON
SPECIAL METAL PARTS**
Makers of Torrington Needle Bearings



The Torrington Company - Specialties Division
37 Field Street, Torrington, Conn.

- Please send the Torrington Small Precision Parts Condensed Catalog.
- Please have representative call.
- Please send a quotation on enclosed sketch, blueprint, part.

Name _____ Title _____

Company _____

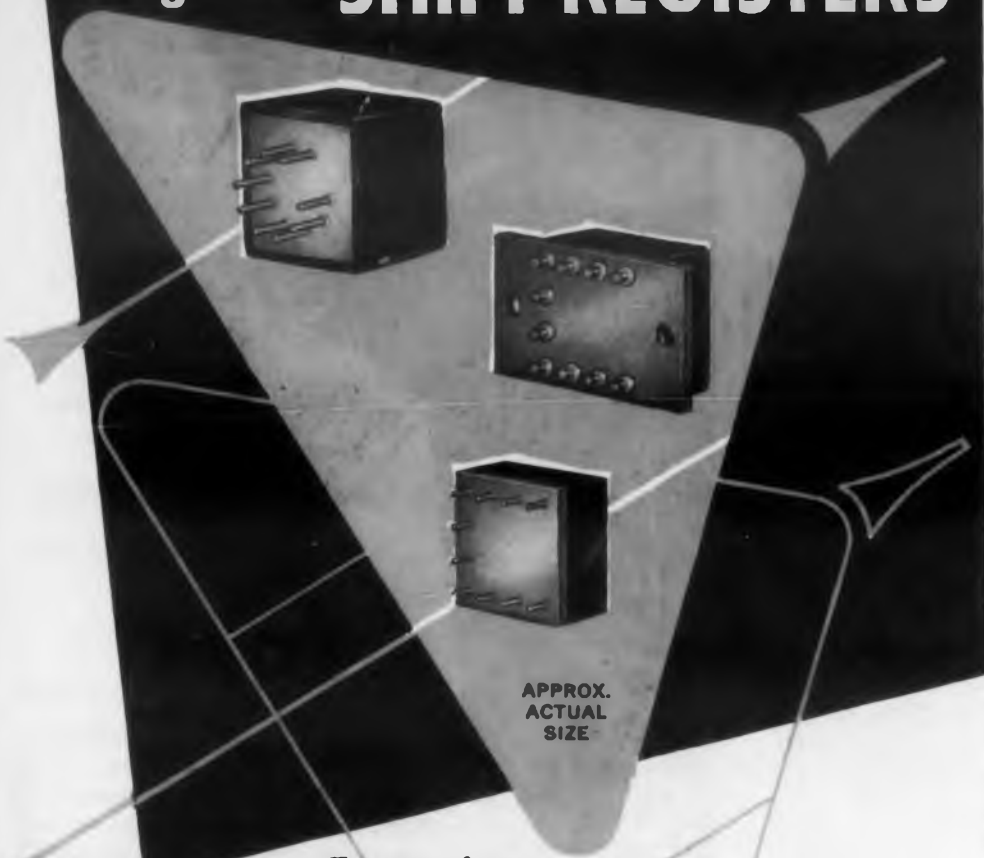
Address _____

City _____ Zone _____ State _____

CIRCLE 181 ON READER-SERVICE CARD FOR MORE INFORMATION

Epsco

HIGH-PERFORMANCE MINIATURIZED Magnetic SHIFT REGISTERS



APPROX.
ACTUAL
SIZE

Featuring...

- ▶ **Extremely low power consumption** —less than 0.25 watt peak power for 3 kc rate; 0.6 watt peak power for 100 kc rate
- ▶ **Wide operating tolerances** —pulse width may vary ± 50 percent
- ▶ **Minimum space requirement** —below $\frac{1}{4}$ cu. in. per binary unit
- ▶ **Surpass applicable MIL specifications**
- ▶ **Standard packages** — 9-pin miniature base, dip-solder terminals for printed circuits, and solder-lug panel with mounting ears; standard Epoxy resin cases, hermetically sealed corrosion-resistant container, or custom packaging to your specifications. Package sizes range from $\frac{3}{4}$ " long x $\frac{3}{4}$ " wide x $\frac{3}{8}$ " high to 1-7/32" long x 1-1/64" wide x 11/32" high. Semi-conductor diodes may be encapsulated with the storage element.

SHIFT PULSE	Pulse Rate — kc	0-3	0-10	0-100	0-200
Nominal current (ma)		40	60	100	300
Pulse width (50% avg.) in μ sec		19	12	2.0	1.0
Rise time (10% to 90%) in μ sec		4.0	1.0	0.6	0.3
Fall time (90% to 10%) in μ sec		1.0	1.0	0.2	0.2
Max. voltage drop (volts)		6.0	6.0	6.0	6.0
Peak pulse power (watts)		0.24	0.36	0.6	1.8
INPUT PULSE					
Recommended current (ma)		3	3	5	10
Recommended duration (μ sec)		10	10	10	10
OUTPUT PULSE					
Minimum signal voltage		10	10	18	10
Signal-to-noise ratio		8:1	8:1	8:1	8:1
Minimum load impedance (ohms)		1,000	1,000	1,500	2,500
RECOMMENDED DIODE					
Transitron type number		1N279	1N279	15G	1N279

We will cooperate in your design or application problems. Engineering brochure describing Epsco Magnetic Shift Register available on request.

Check these specifications with your requirements in data processing, telemetering, computation, and related fields.

Epsco also produces a complete series of pulse transformers and lumped-constant delay lines.

Epsco

incorporated

588 COMMONWEALTH AVE.,

BOSTON 15, MASSACHUSETTS

CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Amplifiers

1 to 50 Watts



Amplifiers for both 60 and 400 cps servo motors, ranging in shaft power from 1 to 50 watts, have been designed with flexible input circuits and universal characteristics.

Circuit techniques range from vacuum tube to transistor-magnetic, and all the most widely used servo motors are covered. Hermetically sealed, plug in and quick disconnect packages are offered. Input networks are arranged for single speed synchro and pot data, two speed synchro data, and dc data. Most amplifiers operate directly from power lines. All are designed to meet applicable military specifications and industrial usage requirements.

Industrial Control Company, Dept. ED, Wyandanch, Long Island, N. Y.

CIRCLE 184 ON READER-SERVICE CARD FOR MORE INFORMATION

Package Controls

Sensory-Director



These controls are called directors because they direct machines to perform various sequences of simultaneous functions to form complete cycles of operation. Devices are em-

ployed in connection with the director to continually check on the performance of the functions, and if the performance is not correct, the director either stops the operation or corrects it. To achieve the utmost in compactness, the directors are built in hinged multi-deck form which at once makes all connections and components available for inspection and service.

The systems are available for full automatic control of many types of machine tools and manufacturing processes. They are furnished as completely wired plug-in packages with wiring harnesses and terminals ready for connection to the machine motor controls and switches by any industrial electrician. Actual size of a package control is 11 in. x 6 in. x 7 in. deep, when closed and sealed.

Sensory Inc., Dept. ED, 504-95 Pleasantville Rd., New Vernon, N.J.

CIRCLE 185 ON READER-SERVICE CARD FOR MORE INFORMATION

DC REFERENCE
VOLTAGE
THAT'S

CONSTANT!

- ▶ from -55° to $+100^{\circ}\text{C}$
- ▶ thru 10 G's vibration
- ▶ over 1000 hours continuous operation



1/2-Volt Standard*

TUBELESS CONSTANT VOLTAGE SOURCE

- Replaces VR tubes and chemical cells
- For airborne, mobile and laboratory instrumentation

Designed to provide dependable DC reference voltage wherever specifications demand long-term stability in the presence of environmental extremes. Uses no tubes or moving parts... conforms to shock, vibration and acceleration requirements of MIL-E-5272A. Negligible temperature coefficient, plus freedom from hysteresis and switching effects, make it readily applicable to the most critical measurement and control circuits. Weighs less than 3 ounces; requires less than 1.8 watts. Other features:

- Small size: $1\frac{1}{4}$ " x $1\frac{1}{4}$ " dia.
- Life expectancy: more than 10,000 hours
- Base: miniature 7-pin
- Case: hermetically sealed
- Random drift: less than 0.1% over 1000 hrs.

Models to meet wide range of application requirements: Inputs from 26.5V DC, or 115V AC, 60 or 400 cycles. DC output 6.2V at 1 ma or 10 ma, 1V at 1 ma. Modified types can be developed to meet your particular needs. For complete specifications and performance data, write for Bulletin (ED-115), Avien, Inc., 58-15 Northern Blvd., Woodside 77, N. Y.


*Trade Mark
Precision Instruments and Control Systems

CIRCLE 186 ON READER-SERVICE CARD

Longer
Tube
Life



With G-E Inductrol* Voltage Regulators

Overvoltage can destroy gas-filled tubes in minutes, dangerously overheat vacuum tubes. As little as 5% overvoltage can cut tube life in half.

Economical Inductrol voltage regulators precisely control (within $\pm 1\%$) voltage, help assure proper tube operation. This means longer tube life, less downtime, more efficient operation.

For more information, write Section 5-5, General Electric Co., Schenectady, N. Y., or call your nearest General Electric sales office or agent.

General Electric Trade-mark for induction voltage regulators.

Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 188 ON READER-SERVICE CARD

Improved Magnetostriction Filter

Construction Simplified



Simpler in construction than earlier models, a new magnetostriction frequency filter is stamped out of a single piece of special alloy (Ni-Span "C"), instead of being assembled out of spool-like disks mounted on a brass base, as were earlier models. Size, cost and operation all are improved. The

new filter consists of a row of six or seven rectangles approximately $1/2 \times 1/4$ in. in dimensions and connected with each other by strips of the same material $1/2$ in. long; the exact dimensions to the frequency to be passed and are made to equal one-fourth of the desired wavelength. All other frequencies are damped or reduced to negligible values by the time they reach the end of the filter, thus permitting only the desired frequency to operate within the equipment.

Federal Telecommunications Laboratories, Dept. ED, 500 Washington Ave., Nutley 10, N.J.

CIRCLE 189 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Amplifier

For Servomotor



A new blue line premium amplifier, model D-4, is designed to deliver 4 w, half wave, 400 cps to the BuOrd MK14 servomotor or equivalent. All units have silicon diodes and use heavy formvar magnetic wire. The Model D-4 has control windings for both transistor and vacuum tube

preamplifiers.

Specifications are: input impedance to control winding (transistor), 100 ohms; input impedance to control winding (tube), 14 K ohms; voltage gain (tube) 4; response, one cycle or less of supply frequency; zero drift, less than 5 per cent of full-load voltage; temperature range, 65 to 125 C; power required, 115 v, 400 cps; connections, hermetically sealed soldering header; packaging, potted in epoxy resin and sealed in a metal case.

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

CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION

Epsco

Lumped-constant Precision DELAY LINES

Featuring...

Extremely long delay accurate to $\pm 1\%$, low attenuation, and excellent phase linearity from 1% to 80% of cut-off frequency, are important features of these standard Epsco precision audio delay lines.

Delay μ sec	Rise Time μ sec	No. of Taps	Z ohms	Attenuation	Cut-off Freq.	Size-In. Rack Mtg.	Catalog No.
1000	40	50	600	3 db @ 9 kc 6 db @ 13 kc	20 kc	19x3 $\frac{1}{2}$ x9	0600-200/50
5000	100	125	1000		0.5 kc	19x5 $\frac{1}{4}$ x9	1000-400/125
5000	100	125	600	3 db @ 3 kc 6 db @ 6 kc	9.5 kc	19x5 $\frac{1}{4}$ x9	0600-400/125
5000	100	125	510		9.5 kc	19x5 $\frac{1}{4}$ x9	0510-400/125

Epsco will design and build special delay lines to your performance requirements. Characteristics of typical custom-engineered units are given below.

Delay μ sec	Rise Time μ sec	No. of Taps	Z ohms	Attenu. db	Temp. range °C	Dimensions inches	Catalog No.	Features
1.5	.06	45	600	.3	-45 + 85	8x3 $\frac{1}{2}$ x $\frac{1}{2}$	0300-0033/45	Low attenuation
18.0	.65	60	1000	1.8	-55 + 105	7x4x1	1000-03/60	Low attenuation
20.3	0.62	84	1000	4.0	-55 + 125	2.3x2.3x3.3	1000-0242/84	Miniature size
23.76	.75	83	180	3.0	-95 + 105	8x2x4	0180-029/83	Low attenuation
24.0	0.65	120	100	5.0	-45 + 85	1 $\frac{1}{4}$ x1 $\frac{1}{4}$ x2 $\frac{1}{2}$	0100-02/120	Form factor
36.0	0.85	120	600	4.0	-55 + 85	13 $\frac{1}{2}$ x2x1 $\frac{1}{2}$	0800-03/120	Low attenuation
200	5	100	300	13	-65 + 150	7 $\frac{1}{2}$ x4 $\frac{3}{4}$ x1 $\frac{1}{2}$	0390-20/100	Temp. coefficient less than 10 PPM/°C

An engineering bulletin giving useful data on delay lines and their application is available on request.

Epsco also produces a complete line of pulse transformers and magnetic shift registers

Epsco

incorporated

588 COMMONWEALTH AVE.,

BOSTON 15, MASSACHUSETTS

CIRCLE 191 ON READER-SERVICE CARD FOR MORE INFORMATION

ELCO SCREWS ARE GOOD SCREWS
Ask a man who has used them



SMALL SCREWS Special equipment and special engineering and tooling experience enable us to offer a broad line of screws of various types in the smallest sizes for which dimensions are standardized. These include body diameters as small as No. 0 and lengths as short as 1/8". They can be made in any of our standard and special materials, and with any of our regular finishes. Engineering or design assistance is available whenever needed. Stock is carried in many sizes — write for our Small Screw Stock List and free samples. *Send your prints for prompt quotation!*

WOOD SCREWS	THREAD-CUTTING SCREWS	STOVE BOLTS
MACHINE SCREWS	PHILLIPS AND SEMS SCREWS	CAP SCREWS
MACHINE SCREW NUTS	PIPE PLUGS	LAG SCREWS
TAPPING SCREWS	COLD HEADED PRODUCTS	DRIVE SCREWS
		SPECIAL SCREWS

REMEMBER



WE ALSO SPECIALIZE IN MAKING ANY OF OUR PRODUCTS OF THE FOLLOWING MATERIALS

Stainless Steel	Copper	Monel
Bronze	Silicon Bronze	Aluminum
Brass	Ambroc	Special Analysis

ELCO TOOL AND SCREW CORPORATION
1948 BROADWAY • ROCKFORD, ILLINOIS

CIRCLE 193 ON READER-SERVICE CARD FOR MORE INFORMATION

Sweep Generator Kit For FM-TV Range



The sweep generator Model 368 range is 3-216 mc in 5 overlapping fundamental bands, and the sweep width is continuously variable from 0-3 mc lowest maximum deviation to 0-30 mc highest maximum deviation. The variable market generator range is from 2-75 mc in 3 fundamental bands plus a calibrated harmonic band (60-225 mc). The variable marker is calibrated with an internal crystal marker generator; the 4.5 mc crystal is included with the kit. Other features are provision for external marker, double pi line filter, output impedance of 50 ohms.

EICO, Dept. ED, 84 Withers St., Brooklyn 11, N.Y.

CIRCLE 194 ON READER-SERVICE CARD FOR MORE INFORMATION

Rocket Flight Simulator Acceleration Test System



The simulator is an automatic test system that subjects acceleration-sensitive devices to the entire range of acceleration and deceleration forces encountered during rocket and missile flights. The system duplicates any two stage flight during each test.

Essentially it consists of acceleration - deceleration, program, and data recording units. The acceleration-deceleration unit contains a vector seeking specimen mount which eliminates virtually all undesirable side accelerations. An acoustic specimen cavity and special microphone permits audio data sensing so

that hermetically sealed units can be tested. This standard system contains two energy storing flywheels which can accelerate a device from 2 up to 125 g's in 200 milliseconds. Minimum braking time is 100 milliseconds. Maximum flight time is 55 sec.

The program-unit controls the acceleration-deceleration cycle through adjustable cam operated switches which control magnetic clutches and brakes. The standard data recording unit is a four-channel oscillograph recorder.

The Magnavox Co., Dept. ED, Dept. N.P., Fort Wayne 4, Ind.

CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION

For Small Spaces, High Temperatures



GAMEWELL
RVG SERIES
Miniature **PRECISION**
POTENTIOMETERS

These Gamewell pots — 1/4", 1/8" and 1/16" — provide superior characteristics in miniature size... ideal for high temperatures and other environmental extremes. All have anodized aluminum bodies, stainless steel shafts, excellent linearity and meet MIL-E-5272A specs as they apply. RVG-17XS has a specialized arrangement which produces sine-cosine functions with unique precision and smoothness.

For dependable performance under rugged environmental conditions and severe space restrictions, specify one of these RVG Precision Potentiometers. Many special features and modifications are also available to meet your specific need. Write or call for details.

THE GAMEWELL COMPANY, NEWTON UPPER FALLS 64, MASS.



PRECISION
POTENTIOMETERS
SPECIAL! Send for New catalog with data on complete line.

CIRCLE 196 ON READER-SERVICE CARD FOR MORE INFORMATION

FRONT LOADING MULTIPLE HEADER BOBBIN WINDER Adjustable Length

Up to 4 heads easily handled by operator without shifting position. Each head winds random wound Bobbin Coils, Solenoids, Repeater Coils or Resistors up to 2 1/2" long and up to 4" OD. Each head individually motorized and easily portable.



Note extreme compactness

Write for new
62-page catalog

Exclusive time-saving convenient front loading — spindle faces operator. Winding traverse infinitely adjustable — no cam changing.

Up to 7000 RPM winding speed. Exclusive features: 1) Slow start eliminates wire breakage. 2) Extra economy positive stopping magnetic brake. 3) Instant automatic brake release.

Other time-saving features: 1) Instant re-setting automatic counter. 2) Faster gear changing — gear box handily located on top of head. 3) One motion by operator re-sets counter and starts machine — starting switch located directly opposite counter re-set lever. 4) No oiling necessary — all parts automatically lubricated. 5) Tension conveniently mounted below spindle.

Increase production, lower costs, lessen down time with Model 314-AM.

GEO. STEVENS MANUFACTURING CO., INC.
Pulaski Rd. at Peterson, Chicago 30, Ill.

The most complete line of coil winding equipment made
CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

FREE
DATA FILE
#110

"ELECTRONIC
DESIGN
WITH
FERRISTORS*"

Describes how ultra-reliable, compact FERRISTORS* can be used to perform many vacuum tube functions. Gives elementary FERRISTOR* circuitry and basic data, plus complete diagrams for 14 useful circuits (amplifiers, oscillators, gating, ring counter, etc.). FERRISTOR* technical data, literature and price lists included. Write today for your free copy; please address Dept. D-1.

TRADEMARK

Berkeley

division

115

BECKMAN INSTRUMENTS INC.

2200 Wright Avenue • Richmond 3, Calif.

CIRCLE 199 ON READER-SERVICE CARD FOR MORE INFORMATION

Send for this Free SAMPLE FOLDER...



Contains 25 different test samples of high-dielectric Insulating Tubing & Sleeving.

Includes samples and descriptions of:
Varglas Silicone • Permafil-Impregnated
Varglas Tubing • Varglas Tubing and
Sleeving • Varglas Non-Fray Sleeving •
Varflo Tubing and Sleeving • Varflex
Cotton Tubing and Sleeving • Syntholvar
Extruded Tubing

Write today!

VARFLEX CORPORATION

14 West Court St.

Rome, N. Y.

CIRCLE 200 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 15, 1957

Thermostat for Aircraft

Weights 4 Grams



Weighing only four grams, the Klix-on M1 thermostat is manufactured to conform with Military Specification MIL-E-5272A (Environmental Testing, Aeronautical and Associated Equipment, General Specifications for), and

MIL-T-5574A (Thermostat, Aircraft, General Specifications for). The device is currently used in guided missile and aircraft applications. It is hermetically sealed, vibration resistant, with factory preset, non-adjustable temperature ratings ranging from -65 to 400 F. Electrical ratings available are 250 v ac, 3 amp, 125 v ac, 6 amp, or 30 v dc, 7 amperes. The devices are made either to open on temperature rise or to close on temperature rise. Insulation resistance is rated at one minute for 1250 v ac, 60 cps. Mounting terminals available may be either flattened, pierced or right angle, top bracket or bottom bracket, or the thermostat can be supplied without terminals. The device weighs only four grams; the right angle terminal bracket measures only 1/2 in. Available finishes are cadmium, copper-nickel and black chromate.

Metals and Controls Corp., Spencer Thermostat Division, Dept. ED, Attleboro, Mass.

CIRCLE 201 ON READER-SERVICE CARD FOR MORE INFORMATION

Sensitive Relays
Single or Double Wound

This relay, type 4-C is designed expressly for applications permitting only minimum size but requiring maximum sensitivity, long life, and low power consumption. Standard Phillips Type 4 contact spring assembly is used.



A choice of type 4 coils are available including single or double wound, time delay slugs, and special windings for high temperature and/or high humidity. Armature of the type 4-C is fixed to a precision ground stainless steel pin, which turns in a reamed-bronze yoke extending the full width of the relay. The armature backstop is stainless steel for maximum strength and rigidity.

Phillips Control Corp., Dept. ED, Joliet, Ill.

CIRCLE 202 ON READER-SERVICE CARD FOR MORE INFORMATION



DO YOU
WANT TO...



GENERATE PULSES



DELAY PULSES



WIDEN PULSES



REGISTER PULSES



COUNT PULSES



SUM PULSES



DO BINARY LOGIC



DRIVE TRANSISTOR CIRCUITS

You can do all of these functions with the new integrated line of NAVCOR transistorized pulse programming equipment . . . available in miniaturized building blocks.

WRITE FOR COMPLETE DATA FOLDER!



NAVIGATION COMPUTER CORP.

1621 SNYDER AVE., PHILADELPHIA 45, PENNA. / HOward 5-7700

CIRCLE 203 ON READER-SERVICE CARD FOR MORE INFORMATION

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1956

789
pages
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612
955

again... the greatest advertising page gain

In 1956 *ELECTRONIC DESIGN* gained 789 advertising pages, continuing its position of leadership among all publications—business or consumer.

In four years of publishing, *ELECTRONIC DESIGN* has carried a total of 4,013 advertising pages—a growth history unequaled among business papers.

This enthusiastic support is one more evidence of the values *ELECTRONIC DESIGN* offers its readers, as well as its advertisers. Timely editorial, complete technical coverage, informed reporting, reader service, The Continuing Audit of Brand Recognition, Mail Readership Measurement, inquiry evaluation, merchandising aids, and new in 1957, the "CAREERS SECTION", with Home Reply Form, for employment opportunities.



Hayden Publishing Company, Inc.

YOUR ELECTRONICS ADVERTISING WILL
BE READ IN *ELECTRONIC DESIGN*

Pulse Amplifier Single Channel Analyzer



This stable, non-overload pulse amplifier together with a precision single channel analyzer, of one standard size chassis, can be used

for scintillation spectroscopy, single component monitoring and proportional counter pulse analysis.

The Model N-302 amplifier, which employs delay line clipping and long-tailed pair stages with feedback, has good stability, short rise-time, and excellent overload characteristics. Overloads as large as a factor of 100 are handled easily. The pulse height selector is of advanced design and provides short time resolution, high base line and window stability and low rate dependence.

Hamner Electronics Co., Inc., Dept. ED, P.O. Box 531, Princeton, N. J.

CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Pickup for Speed Controls



A new power pickup serves as a self-generating power source for operating directly over and under speed controls or warning devices. The Model 304 pickup provides sufficient

power to operate low voltage electrical devices without the use of an amplifier. The power output is high with an optimum load of 1000 ohms and 750 mh average pickup inductance. At actual surface speeds of 250 or more inches per second the 3040 provides sufficient power to operate relays having 100 mw sensitivity. When using two germanium diodes in a voltage doubler circuit, it will operate a conventional 2500 ohm vacuum tube pickup circuit relay.

Power output can be substantially increased at any low speed by placing enough capacity across the pickup, causing it to resonate at the frequency generated for the desired speed. Measuring 2-1/2 in. overall length (exclusive of the mating connector) and 3/4 in. in diameter, the new pickup weighs only two oz.

Other features are a sleeve-protected coil section which extends 5/16 in. from the end of the threaded portion of the mounting shell, and an enlarged diameter pole piece made flush with the end of the coil. Temperature limit is 200 F.

Electro Products Lab. Dept. ED, 4501 Ravenswood Ave., Chicago 40, Ill.

CIRCLE 207 ON READER-SERVICE CARD FOR MORE INFORMATION

Tape-on Surface Resistor For Temperature Telemetry



A new line of tape-on surface temperature resistors for temperature telemetry can be rapidly applied to any surface. The sensing element is applied to the surface by merely pressing the thumb over a small piece of mylar tape. Having an output up to 5 v without amplification, these resistors can be used directly in a commutation circuit to modulate standard telemetry transmitters. Since the resistance change over the specified temperature range is 100 ohms, the Type 1371 tape-on surface temperature resistor may be added to an installation using other Trans-Sonics temperature transmitters without any further circuitry modification. These resistors are available in various ranges from -300 F to +400 F and are furnished with two 6 ft long fiberglass-covered constantan leads. Specifications are: Size 1/4 in. x 5/16 in.; Accuracy ± 2 per cent of full scale range; Precision ± 0.5 per cent of full scale range; Maximum continuous current 20 ma rms (averaged over 1 second); Environmental operation conditions: Vibration 1 in. double amplitude, 0 to 22 cps ± 25 g, 22 to 2000 cps; shock 100 g in any direction per para. 4.15.1 of MIL-E-5272A (10 milliseconds shock).

Trans-Sonics Inc., Dept. ED, Box 328, Lexington, Mass.

CIRCLE 210 ON READER-SERVICE CARD FOR MORE INFORMATION

Automatic Rotary Timer Switch Has Fine and Coarse Settings



Equipped with coarse and fine adjustments, this Model 3 rototimer is used for such applications as automatic control of punch press operations, automatic actuation of magnetic

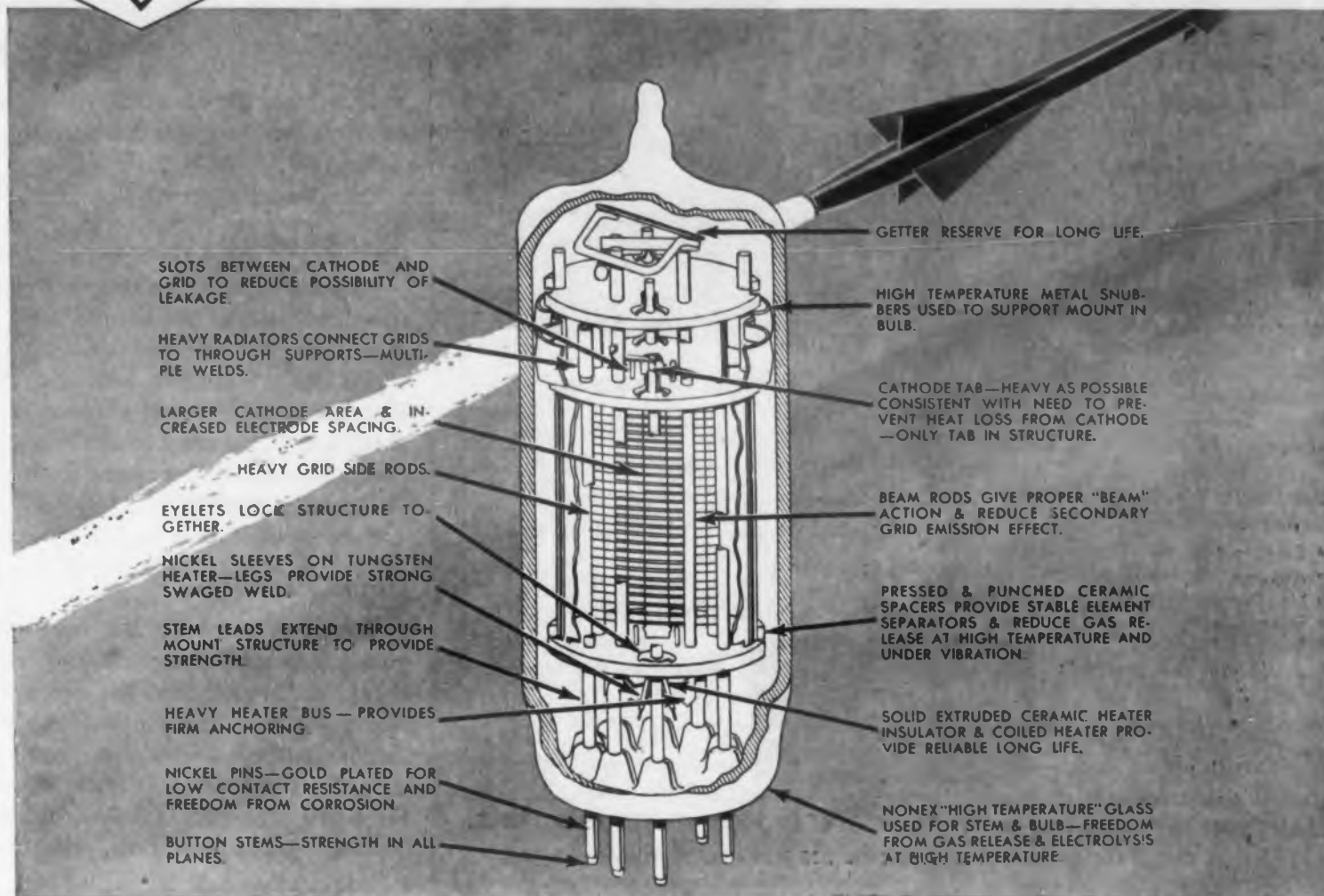
timers, shaft synchronization, register control, and the like. It is most useful in operations where the set point is set carefully and changed seldom. Coarse adjustment is effected in 5-degree steps; fine adjustment is stepless. Four types of interchangeable cams are available to vary switching functions. Contacts are non-inductive, rated 1 amp., 5 v ac.

Farmer Electric Products Co., Inc., Dept. ED, 100 Washington St., Newton Lower Falls, Mass.

CIRCLE 211 ON READER-SERVICE CARD FOR MORE INFORMATION

1957 ELECTRONIC DESIGN • January 15, 1957

HY-G-300 ELECTRON TUBES FOR SURVIVAL



WHY BENDIX* HY-G-300 ELECTRON TUBES ARE BEST FOR EXTREME SHOCK, VIBRATION AND TEMPERATURES!

From the standpoint of design features (see above), these reliable hard glass tubes offer the superior quality needed to survive today's severe environmental demands.

Specifically, Bendix HY-G-300's are designed to withstand the following environmental conditions—bulb temperatures up to 300° C; vibration up to 20G's over the range of 5-2000 cycles; and shock of 200G's having 20-millisecond duration.

For full information about the HY-G-300 line . . . the surest answer to electron tube applications in jet aircraft, missiles and rockets . . . write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

West Coast Sales and Service: 117 E. Providencia, Burbank, Calif. • Export Sales and Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y. • Canadian Affiliate: Aviation Electric, Ltd., P. O. Box 6102, Montreal, Que.

HY-G-300						
TUBES ARE AVAILABLE FROM STOCK						
Bulb Size	Dbt. Triodes Volt Amp.	R. F. Pentodes	Gate Pentodes	Rectifiers FullWave	Beam Power	Power Triodes Passing
T-12	—	—	—	—	—	6080WB 6082A
T-11	—	—	—	—	6384 6889	—
T-9	—	—	—	6853	—	—
T-6½	6851 6854 6900	6582A	6486A	6754	81194	6877 6900
Retma Type No.	Retrofit For	Generic Type	E _f	I _f	Bulb	Bendix Type No.
6080WB	6080 6080WA	6080	6.3	2.5	T-12	TE-46
6094	—	6AQ5- 6005	6.3	0.6	T-6½	TE-18
6853	6106 5Y3	5Y3	5.0	1.7	T-9	TE-45
6384	6AR6 6098	6AR6	6.3	0.9	T-11	TE-27
6854	6385	2C51 5670	6.3	0.5	T-6½	TE-47
6486A	6486	6AS6	6.3	0.25	T-6½	TE-43
6582A	6582	6AK5	6.3	0.25	T-6½	TE-44
6754	412A	—	6.3	1.0	T-6½	TE-36
6851	5751	—	6.3	0.5	T-6½	TE-42
6877	—	Half of 6080	6.3	0.8	T-6½	TE-48
6900	5687	5687	6.3	0.9	T-6½	TE-54
6889	—	—	6.3	0.9	T-11	TE-52
6082A	6082	6082	26.5	0.6	T-12	TE-55

Red Bank Division



CIRCLE 212 ON READER-SERVICE CARD FOR MORE INFORMATION

A New Technique by Wayne Kerr

Measurement of X Band power now becomes accurate and quick with the Wayne Kerr torque operated Wattmeter. Standards room and production line both benefit from its high accuracy and ease of operation.

SUPERIOR TO CALORIMETERS because:

- Easy to operate
- Absorbs negligible power
- Needs no warming up or pre-calibration
- Extremely accurate. Calibration is stable
- Suitable for rapid production measurements

Watch for further
announcements by



Specialists in
RF Measurement

Exclusive Sales & Service in U.S.A.

MARCONI Instruments • 44 NEW STREET • NEW YORK 4, N. Y.

CIRCLE 214 ON READER-SERVICE CARD FOR MORE INFORMATION



BRIEF SPECIFICATION:

Frequency range: 8690-9840 Mc
VSWR: better than 1.1:1
Insertion loss: 0.1 db
Power range: 10-200 watts, mean.
Accuracy: $\pm 2\%$

PRICE \$1450.

Immediate Delivery



Metal Case
(Type 908)

Fairchild now gives you a choice of metal or phenolic case 10-turn precision potentiometers. The rigidity of metal case construction provides *maximum* life and sustained accuracy. The phenolic case units offer the high accuracy and reliability needed to meet normal life requirements at a lower cost. To select the best unit for your application, write for more information on both metal and phenolic case potentiometers today.

TWO NEW 7/8", TEN-TURN POTENTIOMETERS

Fairchild Type 907 Phenolic and Type 908 Metal Case Precision Potentiometers are 7/8"-diameter units with 3600° electrical rotation. Type 907 has a linearity range of 0.1% to 0.50%; Type 908 has a linearity range of 0.05% to 0.25%. Both are rated at 2 watts at 40°C. Standard units rated to +85°C; higher temperature requirements can be obtained on special order. Resistance ranges from 100 to 100K ohms.



Phenolic
Case
(Type 907)

Write: Dept 140-79N1, Fairchild Controls Corp., Components Division, 225 Park Avenue, Hicksville, Long Island, New York. West Coast: 6111 E. Washington Blvd., Los Angeles, California.

FAIRCHILD
PRECISION POTENTIOMETERS
and COMPONENTS

CIRCLE 215 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Speed Reducers

216

Bulletin No. 98 describes a line of small speed reducers. These reducers have a maximum power output of 0.1 hp at the low speed shaft. Standard units and units with an anti-backlash feature are described. Each kind is available in over 400 fixed ratios. Metron Instrument Co., 432 Lincoln St., Denver 3, Colo.

Liquid Rosin Flux

217

A 2-page brochure has been published giving a complete description, uses, properties and methods of application of No. 346 liquid rosin flux (activated). Included in the bulletin is a graph showing the concentration-density relationship of No. 346 flux and No. 446 flux thinner. Alpha Metals, Inc., 56 Water St., Jersey City, N.J.

Data Tape Recorders

218

Magnetic tape recording and playback system for recording stress, pressure, temperature and vibration is described in Bulletin No. 1561 B now available. The system provides direct amplitude modulation, wide band frequency modulation, RDB frequency modulation and pulse duration modulation as well as compound modulation.

The standard recorder accommodates operation both on air and on the ground, and the entire recording system is operable from a single phase 115 v, 50/60/400 cycle power source. Also featured are a record amplifier, signal modulators, and automatic calibrator permitting "in-flight" calibration with negligible data loss. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

**Portable...
Versatile...
Temperature
Test Chamber**

For ambient temperature tests in the **LABORATORY** or on the **PRODUCTION LINE**, the Model TC-2 Temperature Test Chamber is ideal. Interchangeable extra test trays may be ordered to eliminate loading delays in continuous production tests, or for convenience in special test work.

Range: -65° to + 350° F.
Heater: Electric strip heater
Coolant: Dry ice, 15 lbs. capacity
Control: Adjustable thermostat & selectable heat inputs
Load Capacity: 600 cubic inches of test materials
Power: 115V, 5 amp. 50-60 cycle
Overall Size: 48" x 16½" x 12"
Weight: 62½ lbs.



\$550.00
F.O.B. LOS ANGELES

**MODEL TC-2
TEMPERATURE
TEST CHAMBER**

**STATHAM
DEVELOPMENT
CORPORATION**
12411 W. Olympic Blvd.
Los Angeles 64, Calif.

CIRCLE 219 ON READER-SERVICE CARD FOR MORE INFORMATION

Research Reactors

226

Bulletin No. 6326-B describing three research reactors, is now available. Featured are the swimming-pool reactor which consists essentially of a lattice of fuel elements immersed in a large pool of water in which high flexibility permits simultaneous experiments; heavy-water reactor which offers highest neutron flux potential and nuclear test reactor which is especially suited for precise experiments.

The 12-page bulletin describes by words and pictures, specific uses, design characteristics, safety features and experimental facilities. General Electric Co., Apparatus Sales Div., Schenectady 5, N. Y.

Recording Oscillograph

227

Bulletin 1536B stresses the 5-119 recording oscillograph, its performance, operation, application and specifications.

The 12-page illustrated booklet also covers the series 7-300 galvanometers, carrier amplifiers, bridge balances, an oscillogram processor, and other equipment. Consolidated Electrodynamics Corp., 300 Sierra Madre Villa, Pasadena, Calif.

Automatic Measurement

228

A four-page pamphlet describing standard instruments and components for automatic measurements is available.

Featured among the instruments are a deviation bridge indicator, sorting bridge, sorting mechanisms, chopper and data recorder.

The catalog which is illustrated gives specifications, descriptions and uses of each instrument. Barnes Development Company, 213 W. Baltimore Pike, Lansdowne, Pa.

Atmosphere Control Cabinet

229

An illustrated page explains an atmosphere control cabinet for testing all types of materials. The cabinet may be used with -20 to +200 F temperatures and with 18 per cent to slightly under 100 per cent relative humidity for all temperatures above 50 F.

The bulletin tells how the cabinet works and cites its advantages. Two accompanying sheets give brief descriptions of 4 models and list a choice of controls and temperature and humidity ranges. Atmosphere Control Co., Inc., 5315 Chester Ave., Philadelphia 43, Pa.



D I O D E S

- Non-coated tungsten filament
- Temperature sensitive

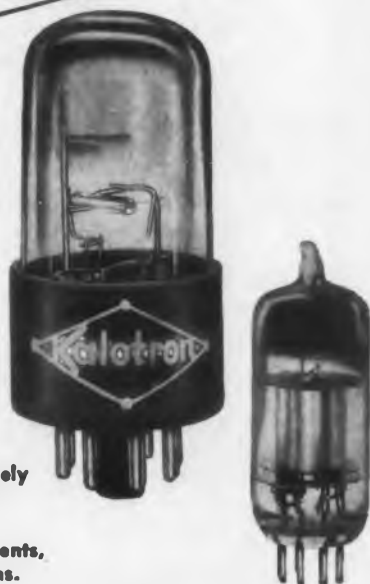
TYPICAL APPLICATIONS

- Manufacturing accuracy makes these diodes ideal for voltage and current reference applications.
- Can be used to make highly sensitive and accurate voltmeters out of low cost instruments.
- Available in T9 and T5½ sizes.

DEVELOPMENT AND MANUFACTURE — We are adequately staffed and equipped to handle development work and manufacture to your specifications.

We are large enough to meet your production requirements, yet small enough to take a real interest in your problems. Inquiries will receive prompt attention.

Write for literature describing types available from stock.



THERMOSEN, INC., 361 West Main St., Stamford Conn., U.S.A.

CIRCLE 230 ON READER-SERVICE CARD FOR MORE INFORMATION

If it's
PLASTICS
we're
interested!

Yes, at Standard Plastics we are interested in trying to solve any problem in the molded plastics field. Small, medium or large, wherever close tolerances are needed, plus high speed production in all materials, both thermoplastic and thermosetting.

Pilot runs in small quantities can be produced economically.

Your inquiries will have our prompt and interested attention.



STANDARD PLASTICS CO., Inc.

62 WATER ST., ATTLEBORO, MASS., Tel. AT. 1-1940 • N. Y. OFFICE: 303 FIFTH AVE., Tel. MU 9-1910

CUSTOM MOLDERS OF THE UNUSUAL

CIRCLE 231 ON READER-SERVICE CARD FOR MORE INFORMATION

**NEW DRESSEN-BARNES
DUAL POWER SUPPLY**

**doubly useful
-yet compact**

You can combine the DC outputs on this unit by switching. No need to hook up two power supplies. Merely turn a dial to series or parallel connections, and you get double the voltage or double the current, instantly. Cabinet is only 8¾" high, 19" wide, and 17" deep.

Model D5-200 C

8-output Versatility

1. 30-500 VDC @ 200 MA — single output
2. 30-500 VDC @ 200 MA — single output
3. 60-500 VDC @ 400 MA — parallel connection
4. 30-1000 VDC @ 200 MA — series connection
5. 6.3 VAC @ 10 Amps — single output
6. 6.3 VAC @ 10 Amps — single output
7. 6.3 VAC @ 20 Amps — parallel connection
8. 12.6 VAC @ 10 Amps — series connection



All outputs are floating, and either the positive or negative of any combination may be grounded. Regulation for all DC outputs is 0.15% for a 10% change in line voltage; 75 MV change no-load to full-load. Ripple is less than 2 MV RMS when full load is applied. Model D5-200 C is priced low Write for literature

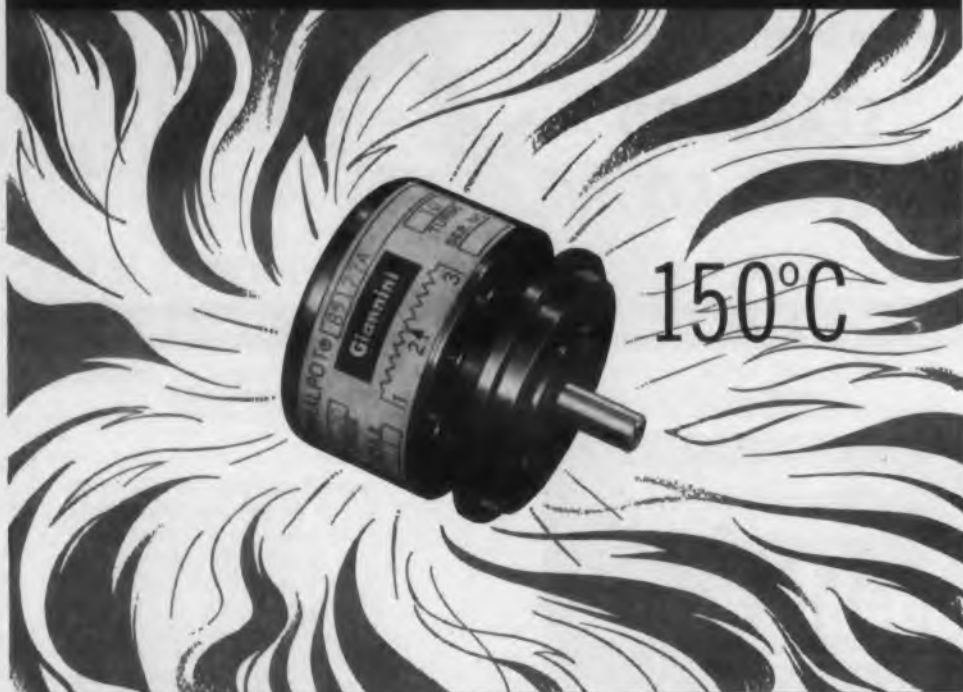
dressen-barnes

DRESSEN-BARNES CORP., 250 N. VINEY AVE., PASADENA 8, CALIF.

CIRCLE 232 ON READER-SERVICE CARD FOR MORE INFORMATION

THE NEWEST AND HOTTEST SPIRALPOT YET

by Giannini



A NEW HIGH TEMPERATURE addition to the famous SPIRALPOT family of infinite resolution potentiometers... rated to deliver full power in temperature environments of 150°C. The use of special materials and alloys has increased the temperature range of earlier SPIRALPOT models by 80°C with no decrease in power rating.

Designed for use in high resolution servo systems, the Model 85177 HI-TEMP SPIRALPOT finds applications in installations requiring a potentiometer of infinite resolution and excellent linearity at elevated temperatures.

SPECIFICATIONS

POWER .15 watt per turn throughout operating temperature range.
TURNS—1 to 10
TEMP. RANGE —55°C to +150°C.
INFINITE RESOLUTION
RESISTANCE—up to 250 Ω/turn
HIGH LINEARITIES

Write for Data
Bulletin No. 85177

Giannini

PRECISION
INSTRUMENTS
& CONTROLS

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

CIRCLE 235 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrical Test Equipment 236

Electrical test equipment is listed in Catalog No. 21, now available. It lists electronic measuring and control equipment for use in laboratory and on the production line. Included in the catalog are automatic component testers, cable and arc resistance testers, voltage breakdown testers, capacitance and resistance decades, decade potentiometers, limit and wheatstone bridges, ohmmeters and megohmmeters, switches and test fixtures.

Complete technical specifications, schematic diagrams, and photographs of each unit are included with comprehensive charts and tables. Industrial Instruments Inc., 89 Commerce Rd., Cedar Grove, Essex County, N.J.

Thermostats 237

Bulletin No. 5000 describing hermetically sealed and semi-enclosed type thermostats is announced. The bulletin features operating principles, dimensional data, ratings, materials of construction. Terminal and mounting arrangements are illustrated with photographs. Stevens Mfg. Co., Inc., Lexington & Mansfield, Ohio.

Regulated Power Supplies 238

Catalog 57 covers a complete line of regulated power supplies. The series listed and described include portable, bench and rack models, heavy duty component power supplies for original equipment, and models for fixed voltages. Specifications and prices are given throughout. The many illustrations include dimensional outline drawings and a labeled photograph showing the construction and special features of the 150 MA Series. Lambda Electronics Corp., 11-131st St., College Point 56, N. Y.

Silicone Lubricants

The properties and performance of various silicone oils, greases and compounds are discussed in an 8-page brochure. Many typical applications are listed and illustrated. Technical data is clearly set forth in tables and graphs. Coded No. 6-101, the booklet gives special attention to high speed, high temperature ball bearing problems. The relative influence of such considerations as bearing load, speed, metal combinations and fit-up are also explained. Dow Corning Corp., Midland, Mich.



BIRTCHER TOP-TAINERS

**FOR THE MILITARY-APPROVED
METHOD OF SECURING TUBES
AND COMPONENTS AGAINST
SEVERE SHOCK AND VIBRATION**

Even severe shock and vibration can't loosen the new stainless steel Birtcher TOP-TAINERS, yet they can be removed for maintenance with a slight upward pull on the locking tab. Available in a wide range of single and double post modifications for all tubes and cylindrical components ranging from 7/8" to 2-5/16" in diameter, and in post heights from 2-1/2" to 4-5/8". Write for catalog and specifications.

Write
for
catalog



THE BIRTCHER CORPORATION

INDUSTRIAL DIVISION	4371 Valley Blvd., Los Angeles 32, Calif.
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CIRCLE 240 ON READER-SERVICE CARD FOR MORE INFORMATION

Terminal Blocks

243

Catalog-folder No. SB-173, describing the medium duty series 200 and 300 terminal blocks is now available. Each type is illustrated and complete descriptions are given, as well as their applications.

Four features of these blocks are: increased strength, increased insulation, circuit identification and increased creepage. Marathon Electric Mfg. Corp., Wausau, Wis.

Galvanometers

244

The 7-300 series galvanometers for recording oscillographs are given detailed treatment in Bulletin 1528. Sections are devoted to operation principle, quality control, construction features, and application circuitry. There are also specification tables and a page discussing selection of the proper galvanometer for a given purpose. In addition, accessory equipment is briefly described.

The 12-page booklet is generously illustrated with graphs, photos and diagrams. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

High Temperature

245

The results of a symposium on high temperature is included in a volume containing papers by a number of recognized authorities on this subject. The proceedings included discussions on three major subjects covering "Methods for Reaching High Temperatures," "Materials for Containing High Temperature" and "Processes Occurring at High Temperatures."

The fundamentals of temperature and the keynote address on Aeronautical Research and Development were among the topics interpreted at the conference. Stanford Research Institute, Menlo Pk., Calif.

Silicone Rubber

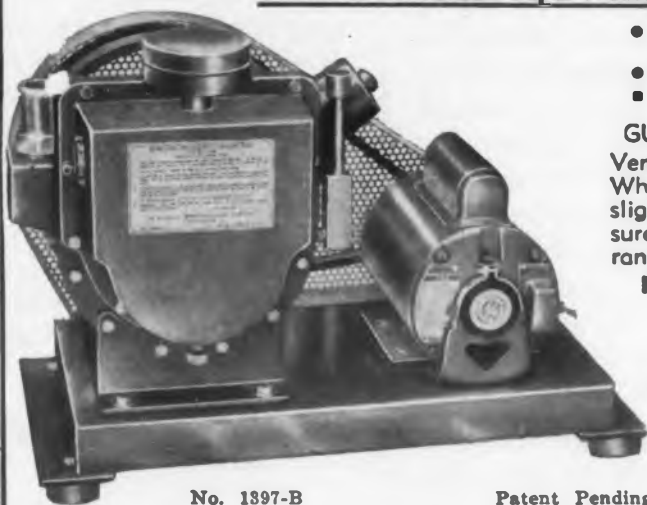
246

W-96 silicone rubber gum stock for gaskets, O-rings and sundry molded parts used in electronics is the topic of a recent booklet. The 28 pages incorporate a compounding study and detailed information and instructions for manufacturers and product designers.

Numerous charts and tables are added to the text. Union Carbide and Carbon Corp., Silicones Div., 30 E. 42nd St., New York 17, N. Y.

VERY LARGE CAPACITY — HIGH VACUUM TWO-STAGE DUO-SEAL® VACUUM PUMP TWO-STAGE CONSTRUCTION WITH VENTED - EXHAUST PATENT PENDING

eliminates Condensed Vapor Problems



- Eliminates oil filters and separators
- Reduces pumpdown time
- Fewer oil changes

GUARANTEED VACUUM

Vent closed, 0.1 micron. When the vent is open, only slightly higher ultimate pressures result—usually in the range of 1 micron.

FREE AIR CAPACITY

375 Liters
Per Minute

Illustration shows
1397-B Duo-Seal
Pump equipped
with Vented Ex-
haust.

No. 1397-B

1397-B. DUO-SEAL VACUUM PUMP, Motor Driven. For 115 Volts, 60 Cycles A.C. Each, \$625.00

1397-C. DUO-SEAL VACUUM PUMP, Motor Driven. For 230 Volts, 60 Cycles, A.C. Each, \$625.00

Patent Pending

1397-D. DUO-SEAL VACUUM PUMP, Motor Driven. For 115 Volts, D.C. Each, \$695.00

4 belt guard is included with the mounted pumps. 1397. DUO-SEAL VACUUM PUMP, Un-mounted. With pulley, but without motor, belt or base. Each, \$525.00

Vented Exhaust is available on all Two-Stage Duo-Seal® Pumps

W. M. WELCH SCIENTIFIC COMPANY

DIVISION OF W. M. WELCH MANUFACTURING COMPANY

ESTABLISHED 1880

1515 Sedgwick Street, Dept ED, Chicago 10, Illinois, U. S. A.

CIRCLE 247 ON READER-SERVICE CARD FOR MORE INFORMATION

The Vacuum Switch Goes to Work SWITCHING TRANSMITTER ANTENNAS



No longer is it necessary to manually switch high voltage rf circuits. No longer is it necessary to fight problems of changing contact resistance or rectification due to the oxides that form on contacts in air.

Jennings vacuum switches have solved these problems. Their clean contacts stay clean since contamination is impossible in a vacuum. And in addition the high dielectric strength of a vacuum makes possible small solenoid actuated relays that can interrupt high voltage circuits with contacts that have to move only a fraction of an inch.

Turn therefore to Jennings with all of your rf switching problems. "Hot" or "cold" rf circuits can be remotely operated at any power level and at any transmission line frequency. Jennings vacuum switches can be used to switch antennas from transmit to receive, from the final amplifier to the driver stage, or from a main transmitter to a standby transmitter. They can be used to isolate a transmitter from its antenna, to switch to one of several antennas or to switch from an antenna to a dummy load. They can also be used for tap changing on rf coils or for switching antenna tuning coils.

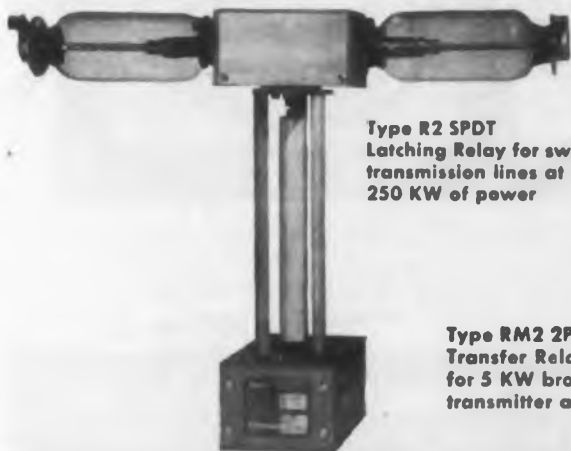
We can suggest a relay for many difficult rf, dc, or 60 cycle switching problems if you will send us your circuit conditions.



Type JGF-RE2
Transfer Relay for
switching aircraft
antennas



SPDT Coaxial Relay
for 3 inch,
50 ohm line—
VSWR less than 1.1
at 325 mc.



Type R2 SPDT
Latching Relay for switching
transmission lines at up to
250 KW of power



Type RM2 2PDT
Transfer Relay suitable
for 5 KW broadcast
transmitter antennas

**JENNINGS RADIO MANUFACTURING CORPORATION • 970 McLAUGHLIN AVE.
P.O. BOX 1278 • SAN JOSE 8, CALIFORNIA**

CIRCLE 248 ON READER-SERVICE CARD FOR MORE INFORMATION

CALL *Pacific Automation Products* for your *Systems* *Cable Requirements*

The multi-conductor cables shown below are only a very few of the many varieties of **neoprene jacketed cables** that Pacific Automation Products processes every day for systems applications.

These cables are designed to perform under extreme environmental conditions and adhere to existing military specifications.



Co-axial conductor breakout



Special rack and panel connector molded to cable



Cable with umbilical connectors.



Molded 90° backshell



Multi-breakout harness assembly



Rack and panel connectors with molded 90° cable attachment

Whatever your requirements for system engineered cable— for military or commercial uses— Pacific Automation Products is your best bet. Call, wire or write today.

Write for Bulletin 156



Pacific Automation Products, Inc.

1000 AIR WAY, GLENDALE 1, CALIFORNIA
CHapman 5-6871 • TWX: GLN 7371

137 Walnut Hill Village, Dallas, Texas
Fleetwood 2-5806

CIRCLE 251 ON READER-SERVICE CARD FOR MORE INFORMATION

X-rays in Atomic Research

252

An article entitled "X-rays Pierce Problems in Atomic Research" has been reprinted. With illustrations, the 4-page text covers problems solved with X-rays. Subjects include barium impurities in zirconium, water molecules in uranyl sulphate, aluminum corrosion products, and quality control of stainless steels, aluminum and silver-platinum alloys, solders and brasses. The article also takes up quantitative determinations of uranium in thorium base alloys. The aqueous solution technique for handling specimens is treated in detail. Information is given on work that involves atomic radiation effects on metals, graphite and certain ceramics. Single crystal and preferred orientation studies on copper, aluminum, uranium, thorium and titanium are also discussed. North American Philips Co., Inc., 750 S. Fulton Ave., Mt. Vernon, N.Y.

Signal Generator

253

An 8-page illustrated folder about the company's signal generator and control system has just been published. The pamphlet contains a description of the instrument and its applications along with detailed specifications and some information on selecting cabinets. Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Powdered Metal Parts

254

Comprehensive two color 12-page brochure on powdered metal parts has been issued which contains many illustrations and detailed case histories.

Included in brochure is a general guide for performance of such operations as brazing, welding, soldering, peening, riveting and machining on powdered metal parts. Special finishes, the storing of impregnated parts and reiling are also discussed. A chart for design engineers which outlines various standards, specifications and references for powdered metal parts is also included. Lux Clock Mfg. Co., Powdered Metal Parts Div., 100 Johnson St., Waterbury, Conn.

Hydraulic-Magnetic Circuit Breakers

255

General purpose hydraulic-magnetic circuit breakers are covered in 20-page Bulletin 3411. Illustrated and revised, the booklet details the hydraulic-magnetic principle, design, operation, and application of the circuit breaker. Schematic diagrams, time-delay curves, and other engineering information are included. Tables and graphs give data on basic design considerations, voltage drop curves and interrupting capacities. Superimposed wiring diagrams on dimensional drawings give a graphic representation of all special circuit forms. Heine-mann Electric Co., 449 Plum St., Trenton 2, N.J.



Beckman®

Servomotor- Rate Generator

Snug as two bugs in their unitized stainless steel housing, motor and generator work hand-in-hand on the same shaft . . . to improve response characteristics of suffering servo systems.

Where the trouble is in the dynamics of your system components, watch this purposeful pair roll up their sleeves and go to work. The high torque-to-inertia motor, for instance, responds quickly and accurately to error signals . . . with acceleration at stall up to 100,000 radians/sec.². Signal-to-noise ratio of the linear generator is 25:1 or better. Aiding and abetting each other in their dedicated mission, they'll operate continuously at stall and at total unit temperature from -55°C to 200°C.

Right now, our corrosion-resistant, completely encapsulated Servomotor-Rate Generators are available in sizes 11, 15 and 18. (We'll soon add size 8; eventually, other sizes.) We've got descriptive literature available too. It's data file 135.

Beckman® Helipot

Corporation
Newport Beach, California
a division of Beckman Instruments, Inc.
Engineering representatives
in principal cities

889

CIRCLE 256 ON READER-SERVICE CARD

5

Helpful Heart Facts



1 Some forms of heart disease can be prevented . . . a few can be cured.

2 All heart cases can be cared for best if diagnosed early.



3 Almost every heart condition can be helped by proper treatment.

4 Most heart patients can keep on working—very often at the same job.



5 Your "symptoms" may or may not mean heart disease. Don't guess—don't worry. See your doctor and be sure.

FIGHT FEAR WITH FACTS

Help
Your
Heart
Fund



Help
Your
Heart

Dial Set Time Delay Relays

262

Two bulletins containing details on the function of three motor-operated dial adjustable time delay relays along with catalog part numbers for standard ranges and voltages in ac, dc and 400 cycle are now available. TD 404 describes the surface mounting type and TD 405 the flush mounting type for panel installation, both of which are used where frequent change in time setting is necessary. Clutch holding contacts are available for both models.

The sheets are clearly blocked out and illustrations include photos of models, diagrams of overall and mounting dimensions, and charts for selection of desired unit according to voltage and time delay ranges. A. W. Haydon Co., Waterbury, Conn.

Hermetically Sealed Components

263

For electronic component manufacturers who use glass to metal vacuum seals, a 12-page catalog featuring the use of the Duro-Vac process has been issued. Added to the descriptions, charts, and cross-sectional drawings are photographs of multi-headers, feed-thrus, stand-offs, seals, AN connectors and transistor and diode terminals. Glasseal Products Co., Inc., 1111 E. Elizabeth Ave., Linden, N.J.

Thermal Image Device

264

A brochure on a direct thermal imaging device has been announced. Bulletin RD 515 describes this instrument as being used for locating and monitoring either hot or cold spots. Specific applications illustrated include use of device for test bonds and laminations, process equipment, and determinations of cooling efficiency in certain types of electronic assemblies. Also noted are applications in temperature evaluation of aircraft power plants and detection of hazardous area "hotspots" by remote monitoring.

This comprehensive booklet deals with principles of operation, radiation measurement theory, temperature measurement methods and related information. Schematics, curves and engineering drawings are used throughout the booklet. Baird Associates-Atomic Instrument Co., 33 University Rd., Cambridge 38, Mass.

X-Band Calibrated Load

265

A leaflet released recently illustrates and describes the CTI Model 128A X-Band calibrated load, an adjustable mismatch load which is calibrated at three frequencies and at four VSWR's. Specifications included in the sheet cover the standard calibration frequencies and VSWR's, the accuracy, type of waveguide fitting, dimensions, and price. Listing is made of the availability of special calibrations where required. Color Television Inc., 1070 E. San Carlos Ave., San Carlos, Calif.

Proven Outstanding in its Class . . .

ULTRA STABLE OSCILLATOR

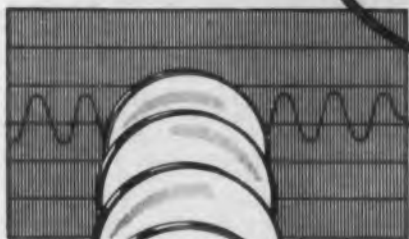


MODEL 101C

HYCON EASTERN

Hycon Eastern's new Ultra Stable Oscillator is a one megacycle signal source of exceptional stability. It is useful wherever precise time measurements or frequency control are required, as in reinsertion of carrier in suppressed carrier systems, telemetry, astronomical measurements, navigation systems, geophysics or other critical applications.

Write for Ultra Stable Oscillator Bulletin



STABILITY: 1 PART IN 10^9

- **FREQUENCY STABILITY:** DRIFT RATE LESS THAN 1 PART IN 10^9 PER DAY AFTER ONE MONTH'S OPERATION.
- **FREQUENCY:** 1 MEGACYCLE, VARIABLE OVER A RANGE OF 1 CYCLE. AVAILABLE AT OTHER FREQUENCIES ON SPECIAL ORDER.
- **CRYSTAL OVEN:** STABILIZED TO BETTER THAN 0.01°C BY TEMPERATURE-SENSITIVE RESISTANCE BRIDGE. OVEN CONTAINS NO MOVING PARTS.
- **DISSIPATION IN OSCILLATOR CRYSTAL:** STABILIZED AT A POWER LEVEL LESS THAN ONE MICROWATT.
- **2 OUTPUTS:** SINE WAVE—4 VOLTS RMS; PULSE—1 VOLT.
- **OUTPUT IMPEDANCE:** APPROXIMATELY 250 OHMS.
- **POWER REQUIRED:** 150 VOLTS, 100 MA, REGULATED DC, AND 6.3 VOLTS, 3 AMPERES, AC OR DC. (Matching Power Supply available)

HYCON EASTERN, INC.

75 Cambridge Parkway Dept. F-1 Cambridge 42, Mass.
Affiliated with HYCON MFG. COMPANY, Pasadena, California

CIRCLE 266 ON READER-SERVICE CARD FOR MORE INFORMATION

Packing for a journey into space?



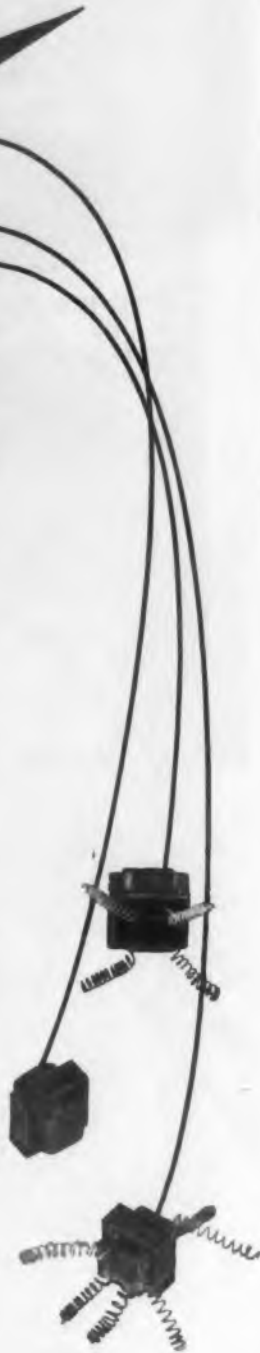
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SAVING with Wheeler's new
CAST EPOXY wound components**

Yes, Wheeler now offers the latest engineering, manufacturing and test facilities for Epoxy resin casting of electronic wound components, including inductors, transformers and subminiature assemblies of tuned circuit elements.

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Exhaustive tests, and many thousands of units produced to date, have proved the exceptional quality of these new Wheeler facilities . . . another important addition to the custom engineering and production services Wheeler now offers in the following classifications. Consult us.

Electronic transformers to 1 kva.
Precision wound coils and components.
Custom electro-mechanical assemblies.
Custom electronic and power supply assemblies.
Custom electrical harness assemblies.



THE WHEELER

INSULATED WIRE COMPANY, INC.
Division of Sperry Rand Corporation
1131 East Aurora Street, Waterbury 20, Connecticut

CIRCLE 271 ON READER-SERVICE CARD FOR MORE INFORMATION

TW142

Magnetic Laminations

272

A 4-page supplement to Magnetic Laminations Catalog ML-201 has been issued. It gives physical lamination constants and core stack design factors for four high permeability laminations.

Designated DU-1, DU-37, UI-312, and F-21, the shapes are illustrated with diagrams. All are available in both 48 Alloy and Hy Mu 80.

A revised index may be obtained with the supplement. Magnetics, Inc., Butler, Pa.

Rotary Converters

273

Bulletin 1156A describes the 750 w dc to ac converter which is specially engineered for Marine and Industrial service.

It features pole shoes and field rings which are cast in a single unit to eliminate electrical loss and simplify construction.

Dimensions are 13-7/8 in. long x 6-3/4 in. wide x 7-1/4 in. high, and it weighs 58 pounds.

Complete information is included as well as performance charts. Carter Motor Co., 2711 W. George St., Chicago 18, Ill.

Graphite Tube Furnace

274

Bulletin CT-1156 on graphite tube furnaces for temperatures to 5000 F has just been released.

The illustrated bulletin describes the operating limitations of graphite tubular element research and production furnaces and indicates the auxiliary and control equipment normally used.

It also includes table of specifications and dimensions of 17 standard models. Harper Electric Furnace Corp., Buffalo, N.Y.

Mechanical Alignment Testing

275

"Alignment Testing" by K. J. Hume is the third in a series of technical papers published for the advancement of metrology. Several instruments, including the auto-collimator, the micro-alignment telescope and various levels and clinometers are depicted and described.

With diagrams, the 8-page article explains the operation principles of these devices and a number of testing methods to which they are applied. Engis Equipment Co., 431 S. Dearborn St., Chicago 5, Ill.

COMMUNICATIONS SYSTEMS ENGINEERS

The expanding scope of advanced communications projects has created several unique positions in fields related to VHF, UHF, microwave transmission and reception, forward scatter and single sideband applications at Hoffman. Electronics engineers with appropriate backgrounds will find these new assignments professionally stimulating and financially rewarding. Please address Vice President of Engineering:

Hoffman LABORATORIES, INC.

A SUBSIDIARY OF HOFFMAN ELECTRONICS CORP.
3761 South Hill St., Los Angeles 7, Calif.
Telephone: RIchmond 9-4831.

CIRCLE 276 ON READER-SERVICE CARD FOR MORE INFORMATION

A complete line of industrial compacting presses is described in a 24-page comprehensive catalog, No. 816 just issued. It includes tiny ferrite rings and other sub-miniature electronic parts to large ceramic parts such as grinding wheels and brake linings, as well as catalysts and other chemical preparations, carbon brushes, bi-metallic contacts, plastics preforms bearings and bearings and other powdered metal parts, and pharmaceutical products. Models range from simple hand-operated machines of 1-1/2 ton capacity to automatic 10 ton hydraulic presses; with production rates ranging from 5 or 6 pieces per min. to 100 per min. F. J. Stokes Corp., Tableting Dept., 5500 Tabor Rd., Philadelphia 20, Pa.

Temperature Conversion Chart 280

A pocket temperature conversion chart measuring 8-1/2 by 3-1/2 in. is now available. The easy-to-read tables of Fahrenheit and Centigrade temperature equivalents would be a valuable time saver. Moeller Instrument Co., Richmond Hill 18, N.Y.

Brochure No. 1021 on temperature and pressure recorders is now available. It describes the workings and advantages of the filled tube system recorders and lists six types of pens.

In addition, illustrations of recorders as well as blueprints showing make-up, installation and operation, is included. The booklet gives complete information on bulbs, sockets for gas-filled (Class III) thermal systems, and symbol numbers, materials and tube dimensions. Burgess-Manning Co., Penn Instruments Div., 4110 Haverford Ave., Philadelphia 4, Pa.

Potentiometer Pyrometer 282

A portable potentiometer pyrometer with interchangeable direct-reading scales is presented in Bulletin 9B. The 8-page text explains the advantages and operation of the instrument and cites its uses and specifications. The illustrations include labeled photographs to show construction. Technique Assoc., 211 E. South St., Indianapolis 25, Ind.

Brew Delay Lines meet exacting specifications

Whatever your delay line requirements, from prototype to large scale manufacture of production units, Brew offers you the design-engineering experience and complete facilities to supply your most exacting specifications.

Brew Delay Lines are custom made to your requirements and are available covering an extremely wide range of characteristics. A Laboratory Report accompanies every prototype showing your specifications and the characteristics of the prototype.

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Richard D. Brew and Company, Inc.

Concord, New Hampshire

design

development

manufacture

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0 CPS to **1** MC!
DIRECT READING



new
Computer-Measurements Model 226A

UNIVERSAL COUNTER-TIMER

OUTSTANDING FEATURES:

- ★ Three independent, adjustable trigger level controls permitting full rated sensitivity at any voltage level between 300 and 300 volts.
- ★ Small voltage increments ordinarily masked by attenuators are easily selected.
- ★ Simplified color-coded controls and direct read-out in kc, mc, sec, or millisecc, with automatic decimal point indication.
- ★ Oscilloscope marker signals facilitate start and stop trigger level adjustment for time interval measurement of complex waveforms.

A brand new multi-purpose instrument provides precision measurement of frequency, frequency ratio, period (1 frequency) and time interval. Pressure, velocity, acceleration displacement, flow, RPS, RPM, etc., may also be measured with suitable transducers. The 226A may be used as a secondary frequency standard.

price: **\$1,100.00**

Long Term: 3 parts per million per week
Display Time: Automatic: Continuously variable 0.1 to 10 seconds
 Manual: Until reset
Input Impedance: 1 megohm and 50 mmf
Trigger Level: Continuously adjustable from -300 to +300 volts
Accuracy: ± 1 count ± stability
Secondary Frequency Standard: 1 mc; 100, 10, 1 kc; 100, 10, and 1 cps
Dimensions: 17" W x 8¾" H x 13½" D approx.
Weight: 50 lbs. approx.



MODEL 225A 0 cps-100 kc
UNIVERSAL COUNTER-TIMER

Similar to the 226A in design. Featuring Oscilloscope Trigger Level Marker Signals; Three Direct-Coupled Inputs of 70 mv sensitivity; Direct Reading, Automatic Illuminated Decimal Point. Easily portable. Price: **\$840.00**

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Write for complete specifications on the new 226A and the 225A models and the complete CMC line of electronic counting and controlling equipment.

Computer-Measurements Corporation

5528 Vineland Avenue, North Hollywood, Calif. Dept. 76A

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FREQUENCY

SPECIFICATIONS:

FREQUENCY MEASUREMENT

Frequency Range: 0-1,000,000 cycles per second
Input Sensitivity: 0.2 volt rms. Direct-coupled input
Time Bases: 0.00001, 0.0001, 0.001, 0.01, 0.1, 1 and 10 seconds. Also can use external 0-1 mc standard

PERIOD MEASUREMENT

Period Range: 10 microseconds to 1,000,000 seconds
Frequency Range: 0.000001 cps to 100 kc
Input Sensitivity: 0.2 volts rms. Direct-coupled input

Gate Times: 1 and 10 cycles of unknown frequency
Standard Frequency Counted: 1 mc; 100, 10, 1 kc; 100, 10, 1 cps; external 0-1 mc.

TIME INTERVAL MEASUREMENT

Range: 3 microseconds to 1,000,000 seconds
Start and Stop: Two independent or common channels. Positive or negative slope
Input Sensitivity: 0.2 volts rms. Direct-coupled input
Standard Frequency Counted: 1 mc; 100, 10, 1 kc; 100, 10, 1 cps; external 0-1 mc.

GENERAL

Stability: Short Term: 1 part in 1,000,000 (temperature-regulated crystal)

FREQUENCY • PERIOD • TIME INTERVAL • FREQUENCY

PERIOD • TIME INTERVAL • FREQUENCY • PERIOD • TIME INTERVAL • FREQUENCY

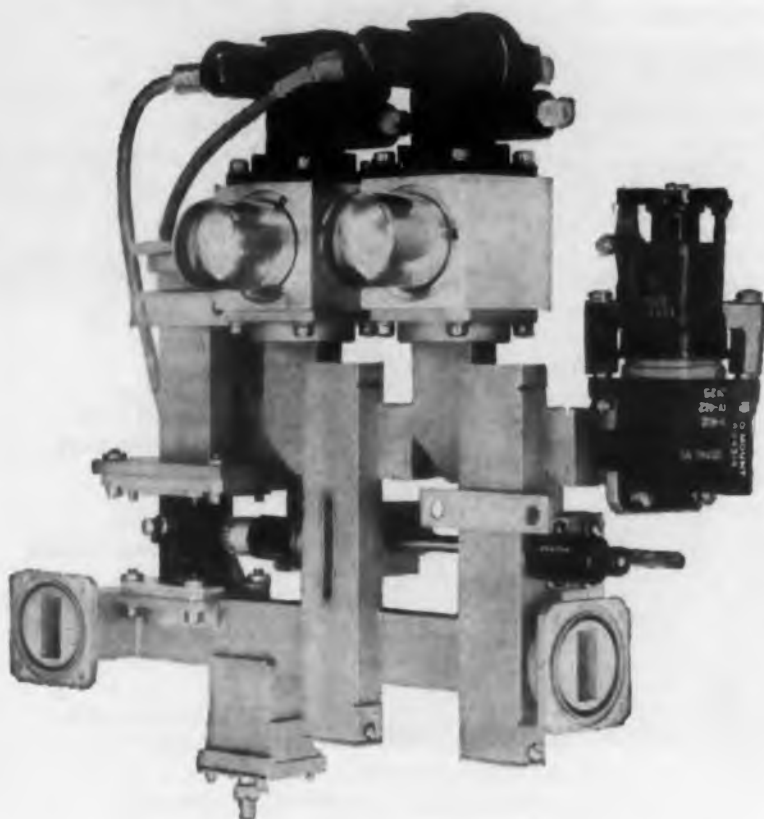


CC-30

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- ① Exclusive new casting process now produces waveguide assemblies without machining and brazing.
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RF HEAD (cast section shown unpainted)

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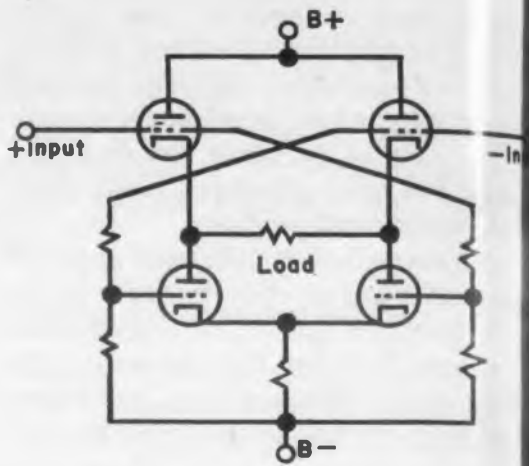
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Patents

Dark Trace Cathode-Ray Tube and Method of Manufacture

Patent No. 2,755,404, *Gustave Levy*. (Assigned to *National Union Elec. Corp.*)

This patent covers a cathode ray tube similar to the usual type except that the electron beam produces a dark trace on a light background. The electron beam impinges on a screen which contains a layer of scotophor material which develops opacity centers. A lamp illuminates the screen from behind, and maintains a light screen except where the opacity centers have been produced. A thin aluminum layer between the beam source and the screen serves to erase the opacity centers soon after they have been formed. The aluminum layer is thin enough so that the electron beam is undisturbed but the aluminum is able to absorb infra-red radiation and produce heat which will destroy the opacity centers. The



infra-red generator is located within the tube and is designed to produce considerable radiation at wavelengths less than 25×10^{-4} cm.



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For long spring life and reduced spring cost

I-S Beryllium Copper compression springs are hardened after forming to a tensile strength of 185,000 to 220,000 psi. The resultant springs offer you many advantages...

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- ✓ close tolerances
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al Response Amplifier

ent No. 2,758,161. Stuart P. Jackson. (Assigned to General Electric Company, New York.)

balanced, direct coupled amplifier circuit for supplying power to a load in response to a balanced input signal. A schematic diagram of the output stage of the amplifier is shown. The four output triodes are driven in push-pull with the lower tubes driving approximately half of the signal and the upper tubes driving the other half.

Printing System

ent No. 2,757,605. Arnold I. Dumey. (Assigned to Potter Instrument Co., Inc., New York, N. Y.)

line by line printing system utilizing a printing wheel with at least two identical faces of type face, and as many printing hammers as there are characters in a line. The characters to be printed is stored in an electrical memory circuit which in turn actuates the printing hammers when the desired character is opposite the appropriate line position. The system is thus capable of printing at least one line for every revolution of the printing wheel.

AEC Patents

The following patent was recently released by the Atomic Energy Commission.

Method and Apparatus for Measuring Electrical Current.

Patent No. 2,760,158. Q. A. Kerns. (Assigned to U. S. Atomic Energy Commission.)

A method is outlined for measuring both an alternating current and unidirectional current flowing in the same wire when it is not desirable or feasible to insert by direct connection a measuring device into the circuit carrying the current.

The ac component is measured by transformer type inductance cores and windings placed about the conductor.

The unidirectional component is measured by a combination of a radio frequency generator to form a magnetic flux opposing that which is about the conductor and a wheatstone bridge circuit to establish a null when the flux of the conductor is counteracted.

The two signals are integrated in a voltmeter to give an indication that is a function of both component of the unknown current.

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...**MORE** sizes...in

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WING NUTS

GRC offers the widest range to choose from—hundreds of stock sizes—thousands of thread and blank combinations. All have clean accurate threads . . . a bright, corrosion-resistant, rustproof finish, that can be used "as is" or plated in any commercial finish . . . a smarter appearance with their exclusive finger-grip wings!

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**ALL Eimac Air
System Sockets are
Thermo-Electrically
Designed for
Optimum Cooling**

To perform a specific function in a specific manner calls for custom design. To cool a tube efficiently, keeping airflow and circuit losses at a minimum, calls for a thermo-electrically designed air socket.

Eimac's line of 16 air sockets provides these advantages for nearly all Eimac multi-grid and klystron tube types.

Pictured above is the SK-100, for the 3K3000L-series klystrons. Below it the SK-400, for the 4-400A. Next is the SK-600, for the 4X250B. And finally the SK-300, for the 4X5000A. Each is the best for its own specific function. And each is an original Eimac custom design. There are 12 others, every one as outstanding.

Among these 12 is the SK-630. Developed for use with Eimac's 4X150A, 4X150D, 4X250B, 4X250F, and 4W300B in tropical atmospheres, it employs an encapsulated screen-to-cathode bypass capacitor which, in combination with shielded circuits, permits stable high gain operation up to the tube's highest useful frequency.

Eimac air system sockets chimneys are also available.

For further information, write our Application Engineering Department.



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The World's Largest Manufacturer of Transmitting Tubes

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NOW – PORTABLE 400 cycle power

This new frequency changer makes it possible to provide well regulated 400 cycle power conveniently and quickly. This unit, Model FCR 250, is extremely useful in a wide variety of applications including testing, production, airborne frequency control, computers, missile guidance system testing, and in practically any application where the use of 400 cycle power is advantageous.

Model FCR 250 is only one of a complete line of frequency changers available from Sorensen . . . the authority on controlled power for research and industry. Write for complete information.



ELECTRICAL CHARACTERISTICS

Input	105-125 VAC, 1 phase, 50-65 cycles
Output voltage	115 VAC, adjustable 105-125V
Output frequency	320-1000 cps in two ranges
Voltage regulation	$\pm 1\%$
Frequency regulation	$\pm 1\%$ ($\pm 0.01\%$ with auxiliary frequency standard fixed at 400 cycles)
Load range	0-250 VA

MODEL FCR 250



SORENSEN & COMPANY, INC. • STAMFORD, CONN.

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Books

The Art and Science of Protective Relaying

C. Russell Mason. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 410 pages, \$12.00.

Although this book was written for the power engineer, the electronics engineer might find something of value in the principles it discusses. The text deals with relay protection of all elements of a power system against all abnormal operating conditions, and discusses the relation of relaying to other power-system elements. It tells how to design systems and apply relays to get the optimum results, and presents material applicable to any make of relay. Complete references to basic source material have been included. This book is intended primarily for students.

Radio-Television and Basic Electronics

R. L. Oldfield. American Technical Society, 848 East 58th St., Chicago 37, Ill., 300 pages, \$4.95.

Written as a general introduction to many facets of electronics, this book devotes considerable space to the discussion of new electronics devices for home and industry. It is intended for beginners and students. Advantages and disadvantages of various types of components for high frequency systems are explored along with transmission and reception of both monochrome and color television. For reference purposes, a glossary of electronic terms, a list of basic electronic formulas, a conversion table, an alphabetical list of abbreviations and letter symbols.

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SKL Electronic Filters are used constantly in acoustic, speech and psychology laboratories to shape bands of noise over a wide spectrum for measurements of masking effect in research on annoyance threshold judgments, loudness adaptation, sonar audibility, etc.

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SKL Electronic Filters are widely used in vibration, telemetering, underwater sound and cardiography studies to eliminate interfering hash and unwanted frequencies in the outputs of all kinds of transducers such as microphones, accelerometers, hot wire anemometers, hydrophones, etc.

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Numerical Analysis, Vol. VI

Proceedings of the Sixth Symposium in Applied Mathematics of the American Mathematical Society, John H. Curtiss, Editor, Crane-Hill Book Company.

This volume contains papers presented at the sixth symposium, covering such areas as theory of computer programming, number theory, differential equations, and numerical methods. Contributors to the volume include Richard Bellman, Stefan Bergman, Bruck, D. R. Clutterham, A. H. Taub, Philip W. Fischbach, S. P. Frankel, T. S. Szkin, P. C. Rosenbloom and Olga Besky.

Oscilloscope at Work

by Ed Haas and R. W. Hallows. Philosophical Library, 15 E. 40th St., New York, N.Y. 171 pages. Price: \$10.00.

Designed to cover all possible uses of the wide-ray oscilloscope, this practical guide lays special stress on radio and television receiver applications. The more than 100 oscillograms which illustrate the book emphasize its practical value. Numerous circuit drawings and other diagrams have also

been provided to clarify the text. Although the uses of the instrument and correct interpretation of the oscillograms are its chief concern, the book also contains much valuable information on oscilloscope circuits, construction, and adjustment. A full chapter explains how the instrument can be made to diagnose its own troubles when faults develop.

Originally published in French under the authorship of Mr. Haas, the book has been partially rewritten and considerably enlarged for the English adaptation.

Reference Data for Radio Engineers (Fourth Edition)

International Telephone and Telegraph Corporation, Publication Dept., 67 Broad St., New York 4, N.Y. 1121 pages, 1000 illustrations. Price: \$6.00.

Primarily a compilation of equations, graphs, tables, and similar data that are frequently needed in radio engineering. New material has been added on modern network design, magnetic amplifiers, feedback control systems, semiconductors, transistors, scattering matrixes, digital computers, nuclear physics, information theory, and probability and statistics.

Transidyne[®] d. c. voltage changer

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long life

This transistorized unit operates for thousands of hours with no maintenance whatever—no bearings to wear out . . . no brushes to replace. Efficiency is 80% minimum—nearly double that of comparable equipment.

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Standard Model 265R changes 27 V.D.C. input to 250 V.D.C. at 200 MA.

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T W O N E W PULSE GENERATORS

pulse widths variable 1-40 usec current up to 2 amps peak



Model 5 — negative going pulses — Model 6 is similar, delivering positive going pulses

● The Reflectone Model 5 high current pulse generator delivers negative going rectangular wave current pulses of variable duration, rise time and amplitude. Model 6 is similar, delivering positive going pulses.

Each of these new pulse generators is a four stage unit — multivibrator, inverter-amplifier, cathode follower, and current amplifier. The design of the multivibrator stage permits the selection of any pulse width from 1-40 microseconds by either instrument controls or the use of two external trigger pulses.

The inverter amplifier stage provides a rise time range from .15-1.0 microseconds.

Output amplitude can be varied from 0-2 amperes. Input Requirements: Standard 0.1 microsecond pulses, negative, 13-30V.; +150V. DC, 2.03 amps; -150V. DC, .04 amps; 6.3V. AC, 10.6 amps.

Either Model 5 or Model 6 is available in a standard 19" relay rack mounting 5¼" high by 8" deep.

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A P P L I C A T I O N S

- precision measurement of core characteristics in magnetic logic circuits
- high current for memory circuit testing
- transistor testing
- high speed ferrite study
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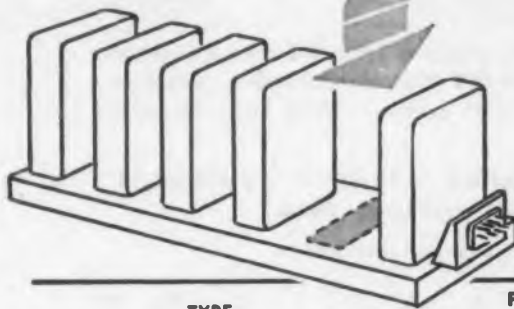
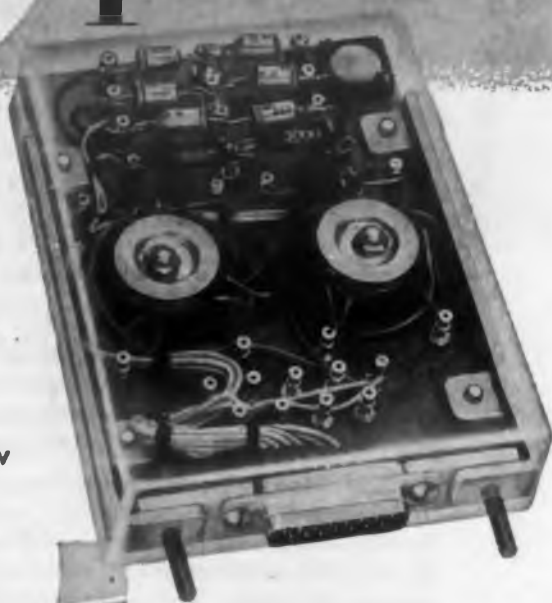
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Lightweight!

SERVO

Magnetic Amplifiers

The servo amplifiers illustrated are typical standard types. Other models, including higher power types, are available for systems engineering. The complete MA line offers the designer a choice of compact, low cost types, amplifiers featuring fast response at high gain and all-magnetic models providing highest performance.



In addition to standard types, custom designs can be produced for special applications, or complete servo and automatic control systems can be engineered to your requirements.

TYPE	SUPPLY	POWER OUTPUT	SENSI-TIVITY	RESPONSE TIME-SEC.
LIGHTWEIGHT SUB-MINIATURE MAGNETIC AMPLIFIER	115 volts 400 cps.	½, 3, 5, 10 watts	.02 volts	.003
MAGNETIC PRE-AMP + SATURABLE TRANSFORMERS	115 volts 400 cps.	3, 5, 6, 10, 18 watts	1 volt AC	.03
MAGNETIC PRE-AMP + HIGH GAIN MAGNETIC AMPLIFIER	115 volts 400 cps.	5, 10, 15, 20 watts	0.1 volt AC	.008 to .1
TRANSI-MAG*: TRANSISTOR + HIGH GAIN MAGNETIC AMPLIFIER	115 volts 400 or 60 cps.	2, 5, 10, 15, 20 watts	.08 volt AC into 10,000 ohms	.01

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West Coast Division

136 WASHINGTON ST., EL SEGUNDO, CALIF. — EAsgate 2-2056



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Fundamentals of Vibration Analysis

N.O. Myklestad. McGraw-Hill Book Company, 330 West 42nd St., New York 36, N.Y. 260 pages, price \$6.50

An understanding of vibrations from a basic point of view rather than by presenting routine methods of analysis is attempted in this book. Since the classical method of analysis is used, an effort is made to develop the material in such a way that a clear picture of the phenomena involved is brought out while numerical and routine methods of analysis are reduced to a minimum. The book contains many features of presentation such as a proof of the orthogonality condition, introduction of the concept of damped modes of free vibration, treatments of vibration instruments and balancing. Examples and problems aid the reader's understanding and demonstrate the applicability of the methods of analysis used in the text.

Handbook of Industrial Electronic Control

John Markus and Vin Zeluff. McGraw-Hill Book Co., Inc., 327 W. 41st St., New York 36, N.Y., 352 pages, \$8.75.

Designed for quick finding of circuits that merit consideration for a particular

electronic control is this book of circuit diagrams and descriptions. The more than circuits presented have been chosen particularly for their value to designers of control devices and systems.

The circuits are logically grouped in chapters according to function and emphasize automatic control throughout. Complete information on each circuit encompasses general nature, performance characteristics, operation, data on critical components, suggested applications. An entire chapter is devoted to practical transistor circuits.

Each circuit may be quickly located either by function in the Table of Contents or by one of its several names in the Index.

Picture Book of TV Troubles, Vol. 7, Sound Circuits and L-V Power Supplies

John F. Rider, Inc., 480 Canal St., New York 13, N.Y., 49 pages, \$1.50.

Reporting the results of troubleshooting a large number of TV receivers, this volume, primarily for technicians, shows the effects of faults in the sound and L-V power supply circuits by examples of incorrect waveforms at specific test points. The component at fault is identified on appropriate schematics and correct waveforms are shown.

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TO-100

- TELEMETERING MODEL FURNISHES STANDARD FM/FM FREQUENCIES FROM 400C TO 70 KC
- AUDIO MODEL FURNISHES FCC FREQUENCIES SUGGESTED FOR DISTORTION MEASUREMENTS
- SPECIAL MODELS FOR ANY 20 FREQUENCIES FROM 20 TO 100,000 CYCLES PER SECOND
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CIRCLE 296 ON READER-SERVICE CARD FOR MORE INFORMATION

Handbook of Electronic Measurements

Edited by Moe Wind. Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn, N.Y., 2 Vols., 879 pages, \$15.00.

These volumes are an attempt to fill the practical need for concise and complete sources of information in the electrical engineering field. Techniques and formulas for electronic measurements are reviewed by leading authorities. Chapter I is an introduction. Chapters II through VIII deal with the measurement of fundamental parameters—voltage and current, power, impedance, frequency, time interval, phase, and field intensity. Chapters IX through XVIII are concerned with specific techniques for the measurement of the characteristics of electronic devices—gain, bandwidth, noise figure, transient response, distortion, waveform, stability, modulation, spectrum analysis, and attenuation. Each chapter describes in detail the better known and more readily applicable techniques of electronic measurement concerning the particular quantity under consideration. Complete descriptions and illustrations of necessary equipment are given, and orders of accuracy and physical magnitudes indicated. A comprehensive bibliography is appended to each chapter.

Scatter Propagation Theory and Practice

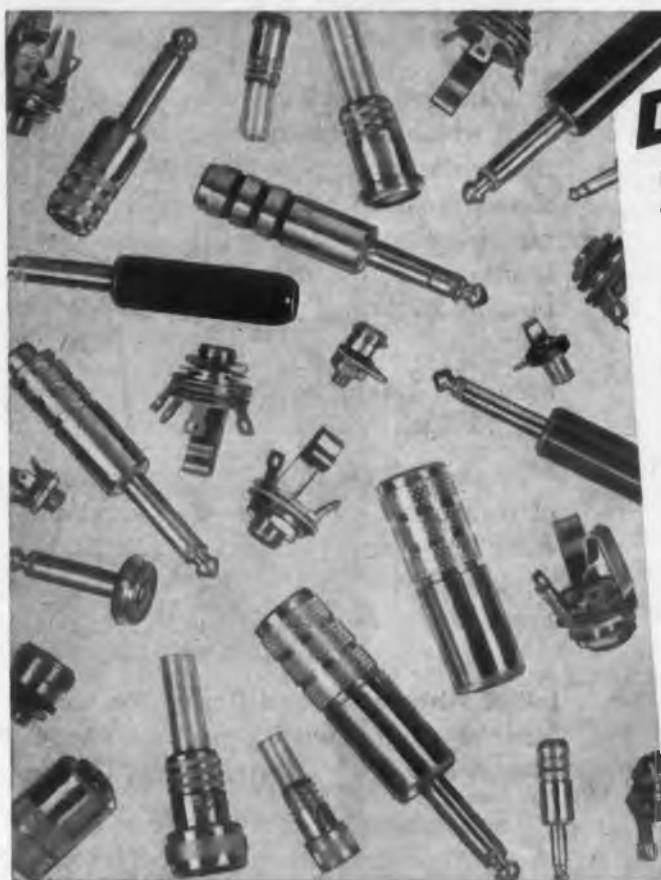
Ira Kamen and George Doundoulakis. Howard W. Sams & Co., Inc., 2201 E. 46th St., Indianapolis 5, Ind. 197 pages. Price: \$3.00.

The theory and practice of ionospheric and tropospheric propagation receive complete coverage in this paperbound book. Throughout the text there is distributed considerable original information as well as actual photographs of equipment and installations of scatter propagation systems. The book delineates such new test techniques as miniaturized design, waveguide inspection and polar measurements.

Servicing and Calibrating Test Equipment

Milton S. Kiver. Howard W. Sams & Co., Inc., 2201 E. 46th St., Indianapolis 5, Ind., 184 pages, \$2.75.

To show how test instruments can be kept in reliable working order and their operation determined is the aim of this book. It tells how to avoid erroneous indications, explains typical calibration procedures, gives a method for performance record-keeping, and covers the most frequently used equipment.



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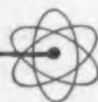
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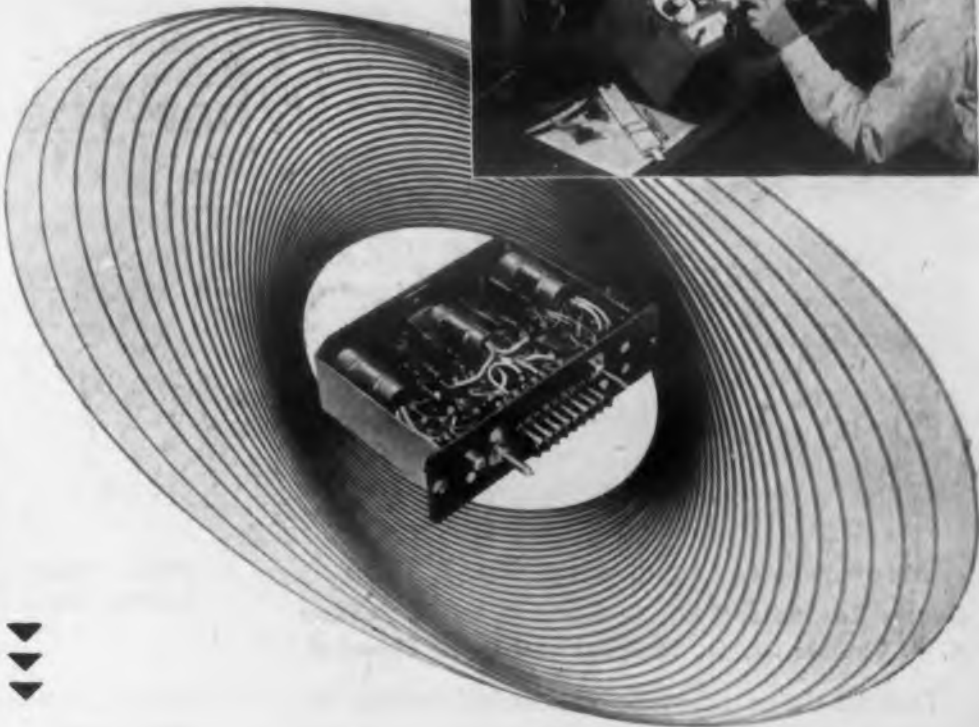
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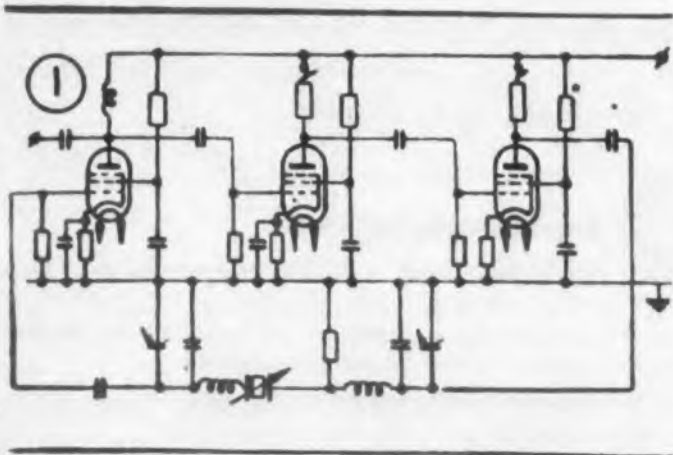
What The Russians Are Writing

J. George Adashko

Measurement Engineering, No. 3, 1956
Quartz Resonator With Q Better Than 10 Million
 A. F. Plonski, A. G. Smagin, and B. K. Shembel;

The All-Union Scientific Research Institute for Physical and Electronic Measurements has developed an evacuated quartz 500 kc quartz resonator with a Q factor better than 10,000,000, for use as a frequency standard. As far as is known from the literature, this is the highest Q attained at the present time. The resonator employs a polished quartz lens operating at the fundamental frequency. The lens is 38 mm in diameter and 3.8 mm thick at the center.

The width of the resonant curve of such a resonator is $2 \Delta f = \frac{f}{Q} < 0.05$ cycle, and to conventional method of determining Q from this width would lead to an excessive error. A more accurate method for determining the Q of high-Q resonators is by di-



rectly measuring the attenuation of the free oscillations, using the equation

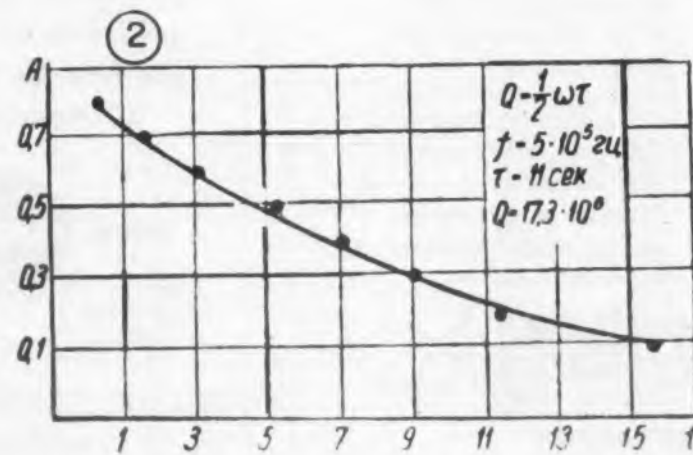
$$Q = \frac{1}{2} \omega \tau$$

where ω is the resonant angular frequency and τ the time constant of the circuit.

The accuracy of such a method increases with the Q of the resonator. The measurement circuit developed for the purpose is shown in Fig. 1. It comprises a three-tube oscillator with rather loose coupling between the resonator and the excitation circuit. The measurement is made with an oscillograph connected to the plate circuit of the first tube.

Fig. 2 shows the time variation of the damped oscillations. The fact that the experimental points fall very close to the exponential curve is proof that there are no non-linearities in the circuit.

Another evacuated 500 kc resonator with an 18 mm lens was also developed. Its Q is better than 2 million.



Contents of Avtomatika i Telemekhanika
No. 7, 1956

Electrical Simulators for the Solution of Boundary Value Problems and Algebraic, Transcendental, Integral Equations, I. M. Vitenberg, E. A. Gluzbe (11 pp, 9 figs).

Concerns principally the use of a "minimization" method with which the best analog solution satisfying certain boundary problems is determined by a successive-approximation method. (The application of the minimization method to the solution of linear algebraic equation is given by W. Adcock in the *Review of Scientific Instruments* for March 1948.)

Induction Linear Potentiometer, Ia. M. Pul'er, (11 pp, 12 figs).

Analysis of construction, performance, and error of contactless and slide-wire induction potentiometers. Refers to article by S. Davis, Induction Potentiometer as an Angular Position Indicator, *Production Engineering*, August, 1954.

Initial Parameters and Design Values for Calculation of Characteristics of Two-phase Miniature Motors and Their Determination, (11 pp, 3 figs).

The symmetrical components of the rotor current of a two-phase miniature induction motor are calculated and used for the analysis of the operating characteristics of servomotors and tachometer generators. A procedure is given for experimentally determining generalized parameters and design values for the machines.

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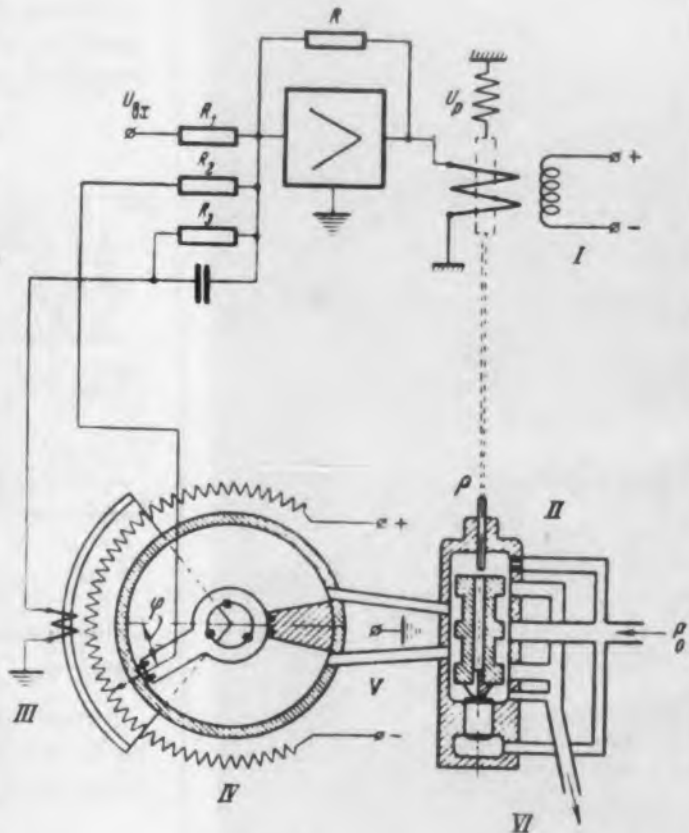
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CIRCLE 299 ON READER-SERVICE CARD

Electro-Hydraulic Converter for Use with D-C Electronic Analog Computer, V. A. Kotel'nikov, V. A. Khokhlov, (10 pp, 7 figs).

Gives simplified dynamic equations and stability analysis of the loop shown in the figure. Here I is an electromechanical transducer, II—hydraulic amplifier, III—velocity transmitter, IV—feedback potentiometer, VI—overflow.



Choice of Optimum Characteristics of Linear Servo Systems—Part II, K. I. Kurakin (16 pp, 16 figs).

This part concerns the determination of the optimum transfer function of a servo system for the case when the noise is uniformly distributed over the operating spectrum and the regulated variable is stationary random function.

Other Articles in this Issue:

"Possible General Solution to the Problem of Determining the Optimum Dynamic System," V. S. Pugachev, (5 pp); "Certain Problems in the Design of Hydraulic Jet-Type Amplifiers," B. D. Kosharsky, (9 pp, 4 figs).

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3 figs).

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Coil Voltage Pickup	3-5 V.D.C. 44 MA Max.	6-10 V.D.C. 22 MA Max.	9-15 V.D.C. 14 MA Max.	12-21 V.D.C. 10 MA Max.	18-30 V.D.C. 7 MA Max.

Duty: Continuous
Dropout: 30 to 60% of pickup
Contact Rating: .25 AMP at 28 V.D.C. resistive load
Operation Time: 4 milliseconds max. @ rated voltage
Dielectric Strength: Sea level: 500 V RMS. High altitude: 500 V RMS

Shock: Shock test: 50 G. without damage
Vibration: 10 G to 500 cps
Contact Arrangement: SPDT Form C
Ambient Temperature Range: -55°C to $+85^{\circ}\text{C}$
Life: 1,000,000 operations at rated load
Contact Resistance: .05 Ohms

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About a Sawtooth, Clamping and your Efficiency...

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CIRCLE 301 ON READER-SERVICE CARD FOR MORE INFORMATION

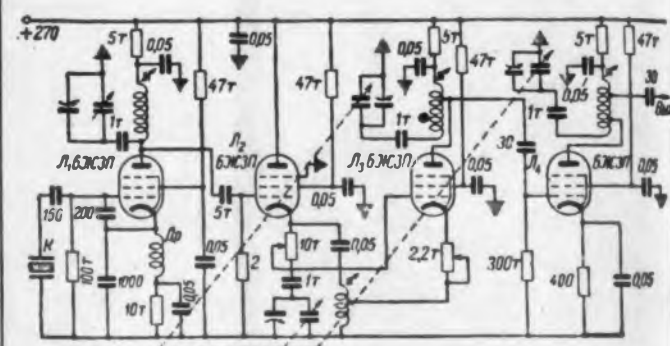
Contents of Elektrosviaz' No. 6, 1956

Negative Feedback in Semiconductor Amplifiers, A. G. Muradian, (11 pp, 10 figs).

Gives matrix equations and equivalent circuits of transistor amplifiers employing series, parallel, and mixed feedback.

New Method of Frequency Multiplication and Crystal Stabilization of Short and HUF Waves, V. Grigulevich, (5 pp, 2 figs).

The article deals with the difficulties encountered in design of stable multi-channel crystal-controlled communication circuits. An oscillator of this type is shown in the figure, and is similar in many respects to the one described by Alvin Hahnel (*IRE Proceedings*, Jan. 1953 and *Electronics* April 1955).



Color Television Systems, A. K. Kustarev, (10 pp, 6 figs).

Survey of the state of the art, based on an article by E. Schwartz in *Archiv für Elektr, Übertragung*, Vol 9, No 11, 1955.

Developments in Cable Technology During the Past Five Years (1950-1955), K. K. Sergeeva, (7 pp).

Survey covering high-frequency (symmetrical and coaxial) cables and wave-guides used in long-distance communication.

Principle of Construction of Electronic Start-Stop Regenerative Repeaters, L. N. Shchelovanov, (11 pp, 17 figs).

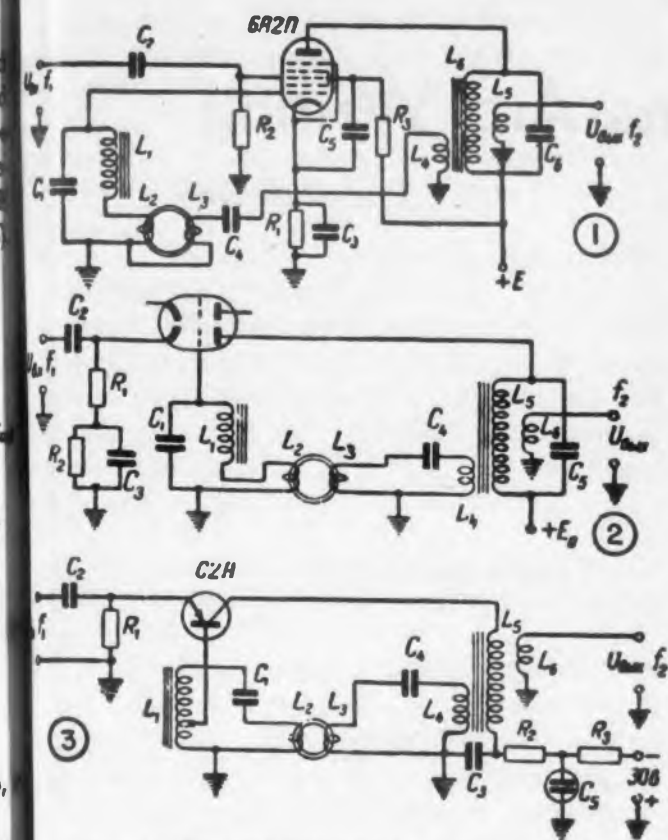
Discusses the regeneration of distorted pulses with the aid of electronic telegraph repeaters.

Use of Mutual Inductance in Electric Filters, Kh. Cherny, (11 pp, 21 figs).

Derives the conditions under which certain four-terminal networks without mutual inductance become equivalent to networks containing mutual inductance. The latter frequently simplify the design of filters by requiring fewer elements or making certain impedance values more easily realizable.

Use of Ferrite Transformers in Frequency Multiplication and Division Circuits, V. M. Rozov, (4 pp, 5 figs.)

Description of several simple experimentally-verified frequency multiplication and division circuits with toroidal transformers employing ferrite core material with rectangular hysteresis loop.



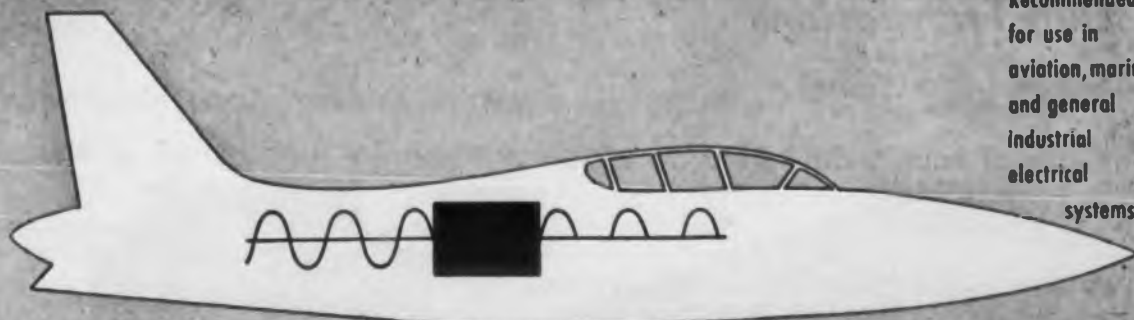
Figures 1, 2, and 3 are frequency multiplication and division circuits with toroidal ferrite transformers.

Graph-Pulse Distortion Produced in Tonal Telegraphy Channels by Pulse-Type Noise, A. M. Lagerenko, (8 pp, 6 figs.)

Statistical treatment, showing that the noise changes the duration of a transmitted pulse in a manner independent of the bandwidth of the channel. The distortion-attenuation obtained in fm transmission is 3.5 times greater than that obtained in am channels.

Interference Induced in Communication Lines by Long Power-Transmission Lines, I. G. Gertsenshtein, (7 pp, 4 figs.)

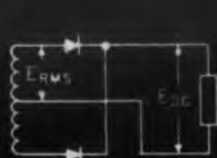
Wave-propagation theory is used to calculate the distribution of higher voltage and current harmonics in a 900-km, 400-kv line. Suggests that present inductive-coordination standards in the USSR are inadequate.



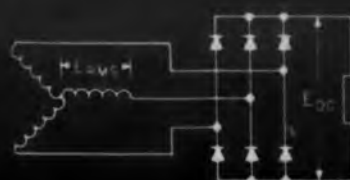
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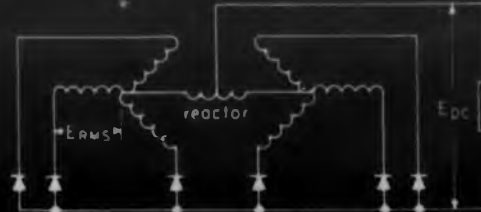
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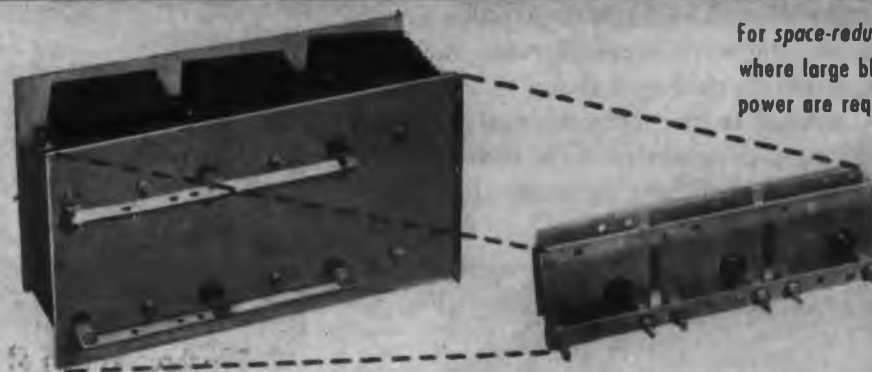
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Contents of Radiotekhnika No. 7, 1956

Design of Three-Tube RC Oscillators, S. V. Svechnikov, V. A. Kaz'menko, (4 pp, 3 figs).

RC oscillators are frequently used as master oscillators and converters. The article is devoted to circuit analysis, stability considerations, and design procedures.

Resonance in Two Coupled Low-Loss Line Sections, N. S. Kochanov, (3 pp, 2 figs).

Circuit-theoretical analysis of a filter comprising a pair of line sections and having a very narrow pass band.

"Polyphase" Multivibrator. Ia. E. Belenski, A. N. Svenson, (7 pp, 5 figs).

The "polyphase" multivibrator is a pulse generator for time-sharing multi-channel measuring and telemetering installations. Fig. 3 shows that the multivibrator is similar to the conventional rc oscillator, except that a common cathode resistor R_k is used. All the elements of the ring multivibrator are identical, and as a rule $R_a \ll R_c$.

Instead of using a common cathode resistor, it is also possible to use a common grid resistor (Fig. 5).

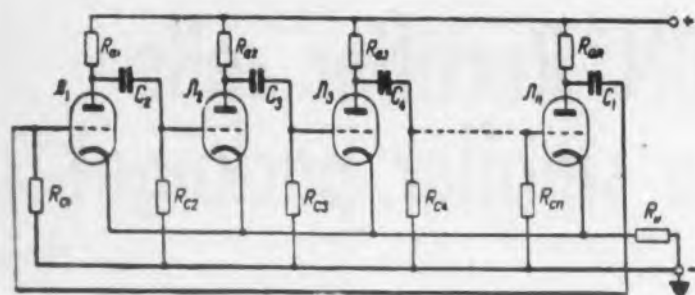


Fig. 3

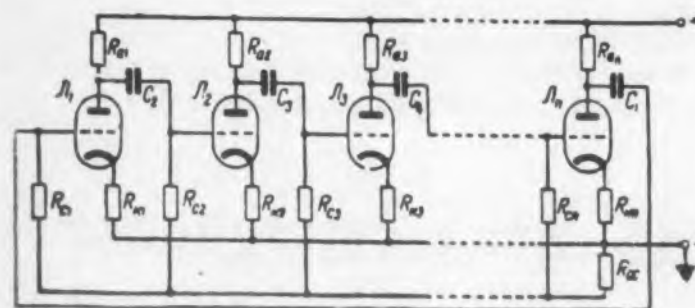


Fig. 5

Synchronization of Vacuum-Tube Oscillators with a Nearly Subharmonic Voltage, T. A. Gailit, I. I. Minakova, (7 pp, 5 figs).

Investigation of the synchronization of a nearly sinusoidal oscillator of natural frequency $\omega_0 \approx p$ excited by a driving voltage of frequency $\omega = p/n$ ($n = 2, 3, \dots, k$). The analysis is made for both relaxation and feedback oscillators.

Effective Output Circuit of a Television Transmitter, E. S. Glazman, (11 pp, 6 figs).

Analysis of the properties of filter networks is used to demonstrate that in order to suppress part of the lower sideband frequency and to increase selectivity, the output stage of a television transmitter should be designed as a selective band filter. The proposed circuit is shown. The design parameters are calculated and test results are given.

Construction and Test of Code-Pulse Comparison Apparatus, Incorporating Protection against Spurious Operation, B. V. Rybakov, (13 pp, 7 figs).

The pulse-comparison circuit operates on the anti-coincidence principle. The article contains a thorough analysis of the operation of the apparatus as well as the calculation of the basic parameters to meet the specified operating conditions.

What The Russians Are Writing

Continued

Effectiveness of Duplicate Reception in the Presence of Interference from Radio Stations at Nearby Frequencies, V. M. Rozov, (12 pp, 6 figs).

Statistical analysis of the benefits resulting from using two antennas to improve the reception of radio-telegraph signals.

On the Calculation of the Effective Area of a Surface Target Reflecting Centimeter Waves, G. Perov, (3 pp, 1 fig).

Claims that the equations derived by some authors for the effective reflecting area and efficiency of panoramic-radar airplane antenna are in error.

Design of Single-Crystal Quartz Filter, L. G. Sodin, (10 pp, 8 figs).

Derives expressions for the gain and resonance characteristics of an amplifier employing a single crystal filter. Both tuned and untuned circuits are discussed.

Other Articles in this Issue:

"The Limit of Applicability of Corrections to Telegraph Voltages for High-Frequency Insulators," G. Murav'eva, (5 pp, 1 fig. 1 table).

Contents of Elektrosviaz' No. 7, 1956

Modulation of Modulated Television Signals with Symmetrical Sidebands, A. K. Oksman, (19 pp, 17 figs).

Theoretical discussion of "linear," square-law, and phase demodulation and of the distortion inherent in each method. Refers to Goldman's "Frequency Analysis, Modulation, & Noise" (Russian translation, 1951) and to article by Colin Cherry, "The Transmission Characteristics of Asymmetrical Sideband Communication," *Proc. IEE*, part III, March 1942.

New Methods for Measuring the Characteristics of Television Channel, M. I. Kiroshchev, (9 pp, 12 figs).

Describes a method employing sine-squared pulses to test the transfer characteristics of a channel. Indicates that it is best to test a television channel directly during program transmission. By way of example, a method employing a special test line is described. Refers to "Waveform Responses of Television Links" by N. W. Lewis, *Proc. IEE*, part II, July 1954, p 258.

Design and Calculation of Electronic Bridge Circuit for Control of Gas-Filled Rectifiers, V. N. Aksenov, (11 pp, 6 figs).

The usual phase control of gas-filled rectifiers by means of induction or static phase regulators is subject to many shortcomings, foremost among which being low speed and the fact that such devices do not carry out all the required control functions—voltage regulation at any speed, high-speed protection, resetting after operation, limiting the amplitude and duration of the short-circuit current, and stabilization. An electronic circuit performing all the above functions is shown and the article is devoted to the analysis and operating characteristics of this type of circuit.

High-Frequency Wattmeter, B. N. Terent'ev, (8 pp, 9 figs).

Discussion of the principle of operation of a wide-band instrument measuring the product $EI \cos \phi$. The manner in which the individual circuit elements affect the accuracy is discussed. A model of a 15 kw 20 mc wattmeter is described.

Attenuation of Low-Pass and High-Pass m-derived Filters, K. A. Semenov, (10 pp, 6 figs).

The analysis of the dependence of the characteristic attenuation on the Q at cutoff frequency is given. The value of the critical Q, corresponding to the maximum attenuation for each value of m is given. Plots are shown for the dependence of the attenuation on Q for various values of m. The author points out that in the design of such filters it is essential to make allowances for the critical value of Q, particularly at low values of m.

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Printed Circuit Soldering

SUCCESSFUL soldering of printed circuits is based on the same fundamentals that underlie any other soldering technique. 1. There must be metallurgical affinity between the metals that are soldered. 2. These metals must be free, and remain free, from all non-metallic surface contamination. 3. There must be complete and adequate metal contact between the solder and the metal that is soldered. 4. The temperature must be adequate for efficient alloy or metal solvent action.

Solder Composition

To satisfy the time and complexity requirements of printed circuit soldering, the solder must be fluid and free-flowing to penetrate and wet the intricate recesses of the pattern, and of such metal solvent character as to provide the most rapid alloy action at the relatively reduced soldering temperature. Accordingly, the best solder alloy is close to the eutectic point. The straight tin-lead alloy, of 63/37 or 60/40 composition, is in wide use, with fairly satisfactory results.

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Highly useful in securing solder attachment to non-metallic surfaces, or in such applications as "Project Tinkertoy," are the silver solders, having a composition of approximately 3/61/36. This 3 percent silver solder requires a temperature of 478 F. instead of 361 F, to effect complete solution, and a working temperature of at least 525 F. For strict metal soldering, a silver solder is not recommended. Silver solder applications should be confined to attachments on non-metallic surfaces.

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- 10-turn potentiometers for both "slope" and "break point" give excellent resolution. Still further improvement in resolution is obtained by splitting slope adjustment into two ranges.
- 1000-division direct read-out 10-turn dials permit logging of function for fast reproduction later.
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The DFG-401 is a completely self-contained unit consisting of 5 channels of function generation, 15 DC amplifiers (with VTVM and all control circuits for monitoring and balancing), and all necessary power supplies (except relay and reference voltages). In the event that any amplifiers supplied are not needed in the problem, they can be made available in groups at the patchbay as inverters with one gain of one.

This unit is ideal for the addition of up-to-date diode function generation equipment to an existing analog computer installation.

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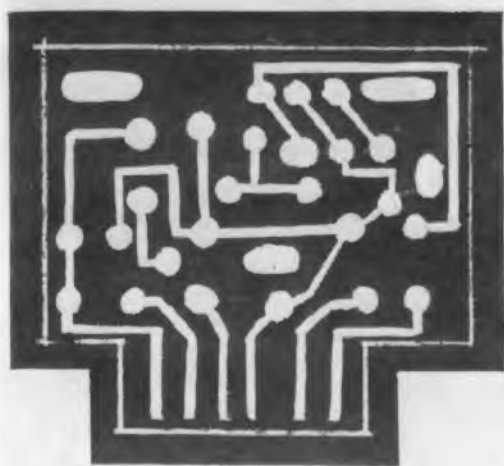
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minerals very rapidly approach the solder temperature, but the non-conductive plastic board absorbs very little heat. Accordingly, there is less damage to the plastic board when soldering at high temperatures than when soldering at a low one. Since the required time interval of soldering is about 2 to 3 seconds at 550 F rather than some 15 secs at 450 F, the board is subjected to much less total heat during the shorter interval.

Solder Segregation

The practice of periodically adding tin to the solder pot or dip container to compensate for its selective abstraction during the soldering operation ignores the facts of the case. When the molten solder boils at the close of the working day, the lead-rich crystals are the first to crystallize, leaving a tin-rich liquid portion. If this metal is now used while it is in this partly melted condition, the tin-rich portion at the top is consumed at the expense of the high-lead fraction at the bottom of the container. Solder should, then, always be completely molten and stirred before use.

Contamination of the Solder

Owing to the normal reaction of the metals, the molten solder exerts a metal solvent action on the metal being soldered. This dissolved metal slowly contaminates the solder bath. The extent of contamination differs according to the nature of the contaminant. Zinc, for example, is objectionable in even minute traces, while silver may be dissolved in appreciable amounts without undue harm. When the solder bath no longer seems to meet the desired standard of quality performance, it is wise to replace it with fresh, new solder rather than try to add a "replenisher." *Abstracted from Printed Circuit Soldering, Clifford L. Barber, Kester Solder Company, Chicago, Illinois, Paper presented at Formica Printed Circuit Forum, Netherland Hilton Hotel, Cincinnati, Ohio, Oct. 1956.*

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Report Briefs

Low Level Modulator Survey

A survey of commercially available and developmental low-level modulators. Fundamental limitations which restrict the minimal signal are the prime requisites for evaluation. Consideration is also given to transfer linearity, complexity, size, weight and power requirements. PB 121385 *Survey of Low Level Modulators*, J. H. Searcy, OTS, U.S. Dept. of Commerce, Washington 25, D.C., Feb. 1956, 87 pp. \$2.25.

3D Hyperbolic Tracking Systems

Part I is a mathematical treatment of the problem of position determination, in 3D, based on difference of arrival times of pulsed signals at separated receivers. Spherical tracking systems are compared with hyperbolic systems. Part II is an additional method of solution of the four hydrophone tracking problem, involving solution of four linear equations. *Analysis of Three Dimensional Typerbolic Tracking Systems*, D. J. Bordelon, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D.C. Part I, NAVORD 2718, Dec. 1952 PB 122022, Microfilm \$3.00, Photocopy \$6.30; Part II, NAVORD 2972, April 1955, PB 120817, Microfilm \$2.40, Photocopy \$3.30.

Microwave Gas Discharge Noise

Experimental measurements were made on noise output, electron temperature, and electron density of rare gas discharges excited by up to 300 w, cw, 1850 mc. Objective of the study was to determine what noise amplitudes and bandwidths are feasible and to determine, too, if a noise level of 1 mw/mc could be generated over a 200 mc band in the S-band region. PB 121338 *Noise Generation In High-Power Microwave Gas Discharges*, R. C. Jones, W. J. Graham, NRL Report 4808, OTS, U.S. Dept. of Commerce, Washington 25, D.C., Aug. 1956, 28 pp. \$0.75.

Basic Research in Electronics

Incorporates suggestions regarding basic areas of research in electronics which are in need of additional support. PB 121486 *Ad Hoc Working Group on Basic Research in Electronics*, W. L. Everitt, OTS, U.S. Dept. of Commerce, Washington 25, D. C., May 1956, 50 pp. \$1.25.



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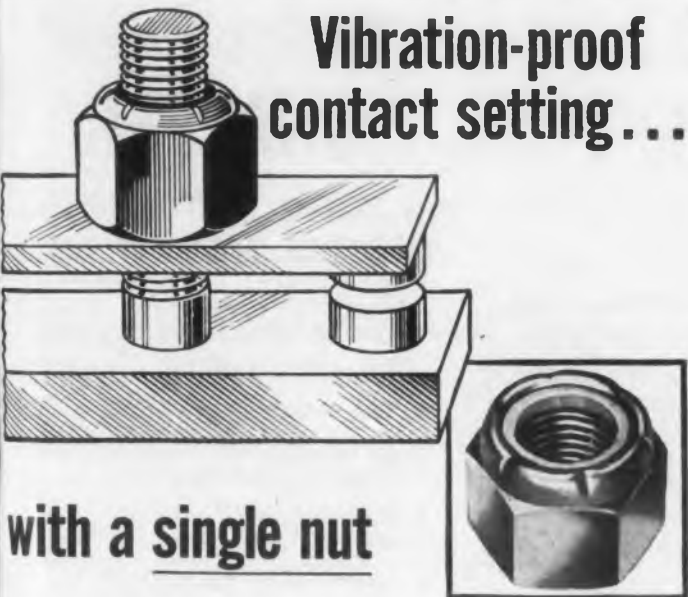
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Human Engineering Bibliography

A compilation of unclassified human engineering reports by Naval research. Topics include Learning, Training Analysis, Instructional Films, Teach-Test Devices, Television, Motor Skills, Perception, Target Detectability, Color Vision, Voice Communications, Procedures and Retention, Systems Analysis, Controls and Displays, and Research Tools. *PB 121452 Bibliography of Human Engineering Reports, NAVEXOS P-1491, Navy Special Devices Center, Port Washington, N. Y. Jan. 1956, OTS, U.S. Dept. of Commerce, Washington 25, D. C., 18 pp. \$0.75.*

Teflon Metal Lubricant

Applied as a thin film to hard substrates, the teflon coating produces a dry, chemically resistant, all-weather lubricant with excellent preservative qualities. *PB 121161 Thin Films of Polytetrafluoroethylene Resin (Teflon) As Lubricants and Preservative Coatings For Metals, FitzSimmons & Zisman, NRL, OTS, US Dept. of Commerce, June 1956, 32 pp. \$1.*

Magnetic Properties of "Non-Magnetics"

Investigation of magnetic properties measurement of feebly magnetic materials in weak fields. Studies resulted in the selection of materials for use in "non-magnetic" minesweepers. *PB 122080 Measurement of Magnetic Characteristics of "Non-Magnetic Materials," M. Pasnak and D. I. Gordon, NAVORD 2415, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D.C., May 1952, 40 pp. Microfilm \$3.00, Photocopy \$6.30.*

Detection of Infrared Radiation

A new system for the detection of infrared radiation (7000 A-20,000 A) is described. It used a lead sulfide photoconductive cell and a high gain ac amplifier. Using this new detector, infrared phosphorescence of a number of different substances was studied. Phosphorescent emission was found for a series of cadmium-sulfide zinc-sulfide phosphors up to a wavelength of 9000 A. As a result of the frequent use of solutions of fluorescent materials in scintillation counters, interest in the phenomenon of energy transfer in phosphor systems has been greatly stimulated. Ordinary spectrographic producers were employed in this study to determine the fluorescent spectra of solutions of various organic compounds. *Energy Distribution in Luminescence Spectra of Organic Compounds. PB 111872 Final Report, F.E.E. Germann, Univ. of Colorado for Naval Research. Nov. 1954. 163 pp. \$4.25.*

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Military Applications For Transistors

This compilation of 32 papers on transistors offers still-valid information, although they were presented at Yale University in Sept. 1953. The transistors under discussion were mostly fabricated by laboratory and/or pilot line techniques, which created problems of parameter variation and stability beyond that usually experienced in circuit study. *PB 111680 Symposium On The Application Of Transistors To Military Electronics Equipment, OTS, US Dept. of Commerce, Washington 25, D. C., Sept. 1953, 503 pp. \$5.00.*

Measurement in Wavelength

The method described utilizes an intermediate medium interposed between a source and receptor antenna to create an interference which provides a measure of the free-space (air) wavelength. Results were independent of the antenna patterns and Fresnel zone effects and not appreciably affected by the orientation or position of the interposed medium. Measurements accurate to 1 percent were attained, and greater accuracy is predicted with refinements of instrumentation. *PB111909 A Method of Wavelength Measurement For the Centimeter and Millimeter Wave Regions, Rapport, Ward and Balwanz, NRL, OTS, US Dept. of Commerce, Washington 25, D.C., April 1956, 16 pp. 50 cents.*

Ionospheric Propagation Studies

This report presents some results of studies of ionospheric forward-scatter propagation at frequencies exceeding normal muf in the high hf and low vhf range for investigating potential point-to-point communications. Signal levels and related characteristics are discussed. Off-path signal levels and measurement of cosmic noise are described. *PB 123211 Investigations of Scattering and Multipath Properties of Ionospheric Propagation at Radio Frequencies Exceeding the MUF, Abel, DeBettencourt, Roche and Chisholm, MIT, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., 166 pp. Microfilm \$7.80, Photostat \$25.80.*

Improving Aircraft Radio Systems

During the course of the work carried on by the Systems Operational Survey Group of NRL, a number of ideas for improving aircraft radio and electronic systems originated. *PB 120773 Some Proposals For Improving Aircraft Radio Systems, Boyd, Huntley and Shupe, NRL Report 2854, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., June 1946, 13 pp. Microfilm \$2.40. Photocopy \$3.30.*



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TECHNIC BIBLIOGRAPHY

"Electroplated Gold"; "Precious Metal Electroplating Data: Gold, Rhodium, Palladium, Platinum, Silver, Nickel"; "Electroplated Platinum"; "Electroplated Palladium"; "Electroplated Rhodium"; "Analysis of Gold & Gold Alloy Solutions".

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Govt.-Owned Patents Available

Described in this book are 1915 Government-owned inventions which are applicable to the electrical and electronic apparatus industry. Active as of Dec. 1953, for each invention the following data is provided: title, US patent number, inventor's name, Govt. agency administering the patent, and an abstract of the patent. *PB 111468, Electrical and Electronic Apparatus, Government-Owned Inventions Available For License, Patent Abstract Series No. 5, OTS, U.S. Dept. of Commerce, Washington 25, D. C., 160 pp, \$4.00.*

Dielectric Film For CRT

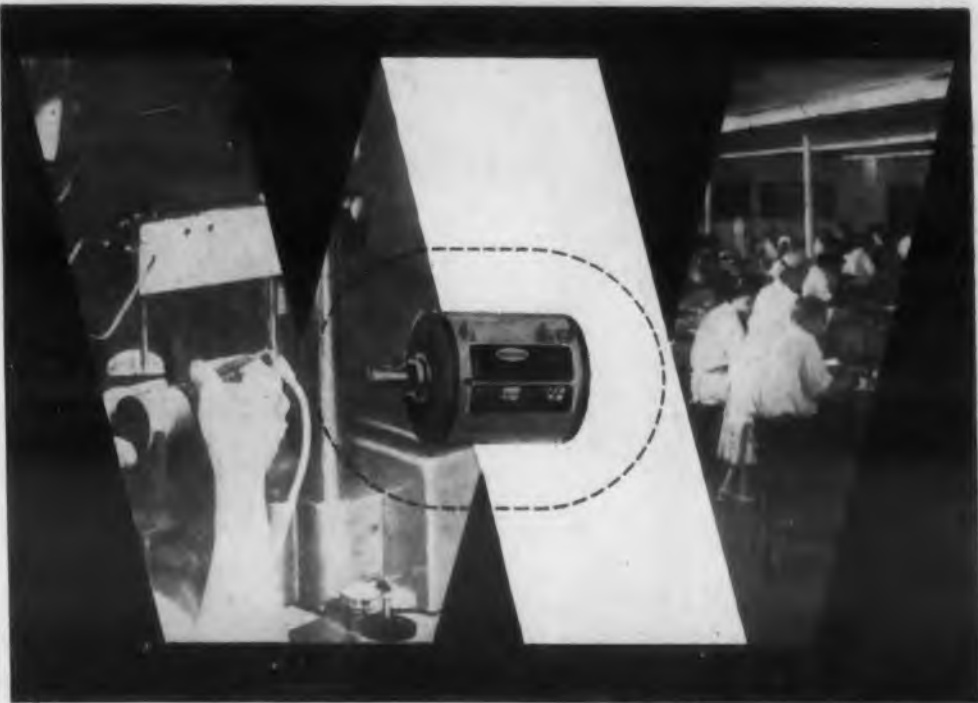
Development of thin dielectric bentonite films to bridge the openings of a fine mesh nickel screen for use in cathode-ray storage tubes and possibly in other applications are described. The films were dried onto nickel screens from a hydrosol of bentonite clay. Laboratory treatment reduced conductivity to the level of mica. Typically about 0.1 micron, and formed as thin as 20 millimicrons, the films were able to withstand a 400 C bake temperature used to outgas the tubes. *PB 121328 A Thin Dielectric Film of Bentonite Clay For Cathode-Ray Storage Tubes, F. H. Harris, NRL, OTS, U.S. Dept. of Commerce, Washington 25, D. C., July 1956, 7 pp, \$0.50.*

Gold Bonded Transistors

Stable, junction-like transistors with alpha cut-off frequencies up to 10 mc and values of alpha up to 0.95 have been produced by electrically bonding gallium doped gold wire to the opposite faces of a thin germanium crystal. A number of experiments, designed to improve previously obtainable characteristics, have been carried out; many more remain to be tried. Unfortunately, present methods of fabrication result in an extremely low yield of satisfactory units. *PB 111669 Research and Development Study of Gold Bonded Transistors, P. Toong, R. Yee. G. Knight, Jr., OTS, U.S. Dept. of Commerce, Washington 25, D. C., Aug. 1954, 44 pp, \$1.00.*

Radio Sono Buoy Redesign

This report describes the redesign of the expendable radio sono buoy AN/CRT-1B. A battery power supply, having improved storage characteristics, is one of the extensive changes suggested in the redesign. *PB 120771 Redesign of AN/CRT-1B Expendable Radio Sono Buoy, F. J. Hollweck, NRL Report 2844, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., May 1946, 13 pp, Microfilm \$2.40, Photocopy \$3.30.*



Spectrol's* problem: to join .0006" nickel wire to gold-plated brass

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First, it requires concurrent development work in a number of different technical areas such as guidance and control, aerodynamics, structures, propulsion and warhead. Each of these large areas in turn contains a wide variety of specialized technical activities. As an example, digital computer projects in the guidance and control area involve logical design, circuit design, programming, data conversion and handling, component and system reliability, input-output design, and environmental and mechanical design.

A second characteristic is frequently the requirement for important state-of-the-art advances in several of the technical areas. For instance, the supersonic airframe needed for a new missile may necessitate not only novel theoretical calculations, but also the design and performance of new kinds of experiments.

A third characteristic of missile development work is that such close interrelationships exist among the various technical areas that the entire project must be treated as a single, indivisible entity. For example, what is done in the guidance portion of the system can affect directly what must be done in the propulsion and airframe portions of the system, and vice versa.

These characteristics make it clear why such work must be organized around strong teams of scientists and engineers. Further, for such teams to realize their full potential, they must be headed by competent scientists and engineers to provide the proper technical management. And finally, all aspects of the organization and its procedures must be tailored carefully to maximize the effectiveness of the technical people.

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Standards and Specs

Sherman H. Hubelbank

This department surveys new issues, revisions and amendments, covering military and industry standards and specifications. Our sources of information include the Armed Services Electro-Standard Agency (ASESA), the cumulative indexes to Military Specifications, Vols. II, IV, American Standard Association (ASA) and other standards societies.

RETMA Standards—Revisions

The following RETMA standards proposals are being circulated for comment. Although the official comment period may have expired, you are encouraged to contact the RETMA Engineering Department, 11 West 42nd St., New York 36, N.Y. if you are vitally interested.

TR-102-B, POWER TRANSFORMERS FOR RADIO TRANSMITTERS (S.P. 510)

TR-110-B, POWER FILTER REACTORS FOR RADIO TRANSMITTERS (S.P. 511)

TR-121, AUDIO TRANSFORMERS FOR RADIO TRANSMITTERS (S.P. 512)

TR-122, AUDIO REACTORS (S.P. 513)

TR-127, IRON CORE CHARGING REACTORS (S.P. 514)

TR-129, PULSE TRANSFORMERS FOR RADAR EQUIPMENT (S.P. 515)

Shock Test

MIL-T-17113 (SHIPS), GENERAL SPECIFICATION FOR ELECTRONIC EQUIPMENT SHOCK, VIBRATION, AND INCLINATION TESTS, AMENDMENT NO. 1, 27 AUGUST 1956

The requirement that the final vibration test be made along each of the three principal axes separately has been deleted.

Terminals

MIL-T-15659A, TERMINALS; LUG, SOLDER TYPE COPPER SUPPLEMENT-1A, 23 JULY 1956

Twenty MS Standards drawings covering various types and designs of solder type copper terminal lugs have been added.

Illustrations

ASA Y15, A GUIDE FOR PREPARING TECHNICAL ILLUSTRATIONS FOR PUBLICATION AND PROJECTION

Preferred illustration planning and layout practices, factors influencing legibility of reproduction principles common to both publication and slide copy preparation of illustrations and copy for either still projections or publications, drafting practices and materials for use in illustration work are covered in this proposed standard. Copies of this 34-page standards are available from ASA for \$2.00.

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ANTENNA ENGINEERS

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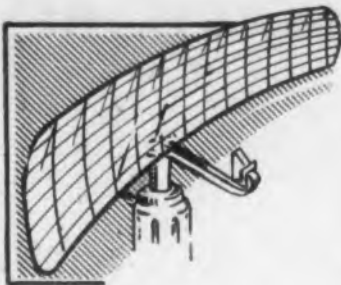
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Amplifiers and Detectors						
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Tuner Tubes			Rectifiers			
RF Amplifiers	Osc.-Mixers	High Voltage	Low Voltage	Damper Types		
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