ELECTRONIC DESIGN

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If design for manufacturing is your responsibility, you qualify for subscription without charge provided you send us the following information on your company's letter head: your name and title; your company's name, address, and main product. Electronic, research, development, project, electrical, and chief engineers are typical qualifying titles.

If you have a design responsibility not indicated by your title, describe those responsibilities. Job changes require requalification.

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ELECTRONIC DESIGN

Contents

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January 15, 1957

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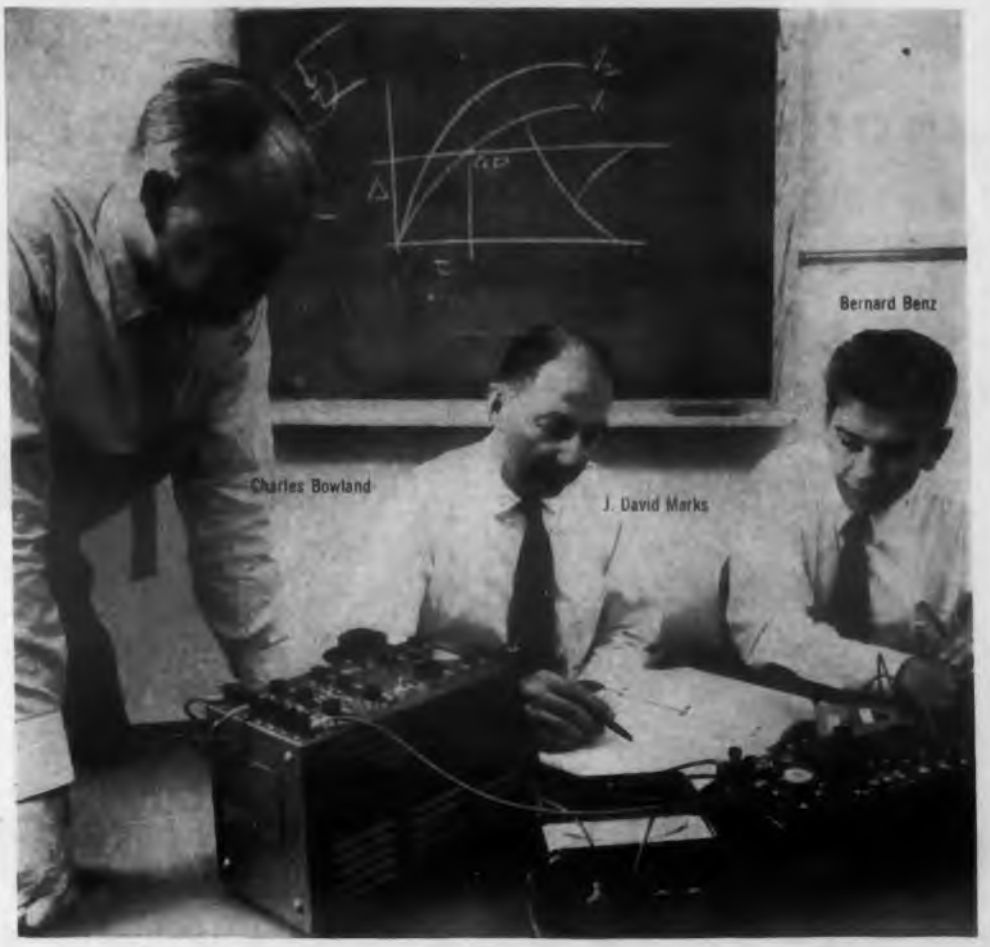

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CIRCLE 2 ON READER-SERVICE CARD FOR MORE INFORMATION

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 occurences 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.

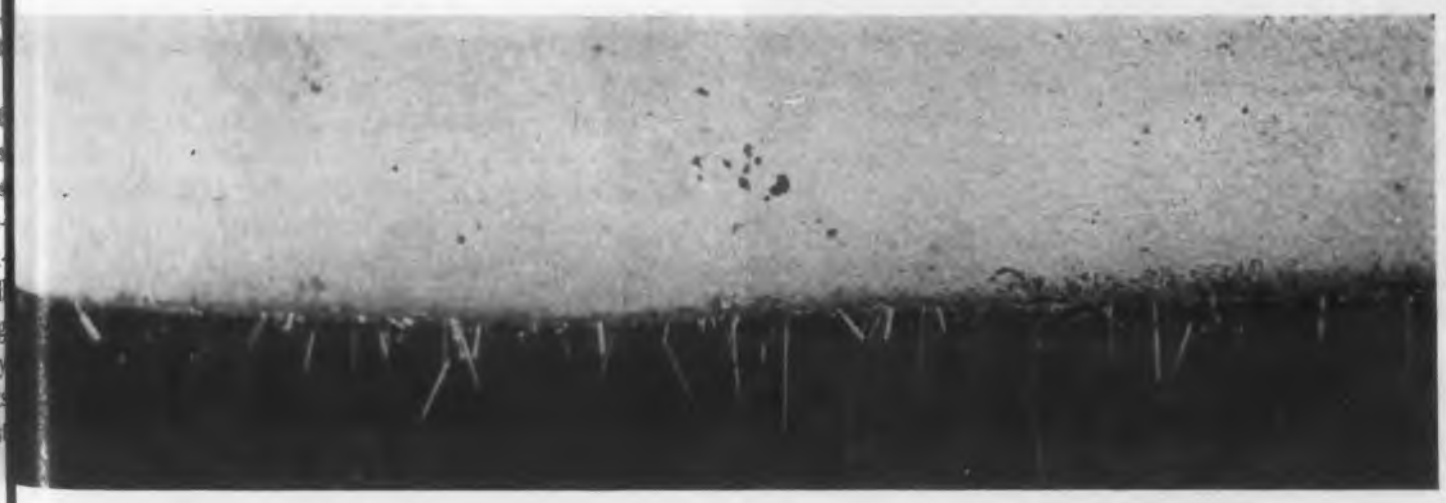
Some time ago samples of tin were placed in the reactor at the Brookhaven National Laboratory and removed a month later. Examined recently after a year of "cooling off," the irradiated samples were found to have grown more "whiskers" than identical ones not exposed to radiation.

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.

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 lathers 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."

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.

ELECTRONIC DESIGN ADDS ANOTHER SERVICE FOR READERS

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)

Name and Title (Print or type all information)

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	301	311	321	331	341	351	361	371	381	391
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205	215	225	235	245	255	265	275	285	295	505	515	525	535	545	555	565	575	585	595
206	216	226	236	246	256	266	276	286	296	506	516	526	536	546	556	566	576	586	596
207	217	227	237	247	257	267	277	287	297	507	517	527	537	547	557	567	577	587	597
208	218	228	238	248	258	268	278	288	298	508	518	528	538	548	558	568	578	588	598
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For Personnel Ads Only (Nos. 550-569)

HOME ADDRESS City Zone State

LOOK FOR THE JOB OPPORTUNITIES LISTED IN ELECTRONIC DESIGN'S "CAREERS SECTION"

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 as 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.

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 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 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.

ile Tester

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

When trouble exists, RACE (Rapid Automatic eckout Equipment) pinpoints the faulty compo- nt, flashes its location and replacement time on a nsole screen, and immediately delivers a com- ter punch card spotting the plug-in replacement technicians.

According to the Sperry Gyroscope Co., Great ck, N.Y., the tester precludes false answers by ecking itself continuously during the missile eckout and confirming all answers at the master nsole. If trouble does occur within RACE, it rns the operator immediately, naming exact k, drawer, and chassis location of its own faulty ug-in component for immediate replacement.

ergency Lighting

centralized emergency lighting system that con- ntly supervises itself has been tested and ap- oved by Underwriters Laboratories.

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

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

The emergency lighting system made by The andard Electric Time Co., Springfield, Mass., has en especially designed for new hospitals, schools, ffice and industrial buildings.

yroscopes To Test Gyroscopes

eriodically, fire-control gyros must be removed om the aircraft and checked for accuracy. A spe- al turntable for field testing the gyroscopes used airplanes aboard aircraft carriers is being devel- ped by the Westinghouse Electric Corporation's ir Arm Division, Baltimore, Md.

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

100% Reliability Necessary

Reliability was stressed by pan members discussing new devel ments in electronics at the annual i dustrial preparedness meeting of th American Ordnance Association. Dan iel E. Noble, leader of the panel sai "until we equip our military force with apparatus that functions succes fully without the attentions of caref maintenance men, or corps of equip ment nursemaid scientists, we are no ready for technological warfare." Th importance of 100% reliability wa further emphasized by Col. Meye who pointed out that a failure of on single component in a missile coul be disastrous. A misfire could destro New York City. Other members of th panel were, Rear Admiral Rawso Bennett, Chief of Naval Research, D William G. Pietempol, Director Development, Bell Telephone Lab and Col. G. Gould, U.S.A.F.

Human Engineering

Radio Corporation of America wi present a course in human enginee ing to its engineers engaged in desig and development activities. Th course will be administered by th Applied Psychological Services, Villa nova, Pa., and represents a furthe attempt on the part of RCA to includ human factor considerations in the de sign of man-machine systems.

Rotor Position Indicator

An electronic instrument that continu ously measures the clearance betwee the rotating and stationary blades in side a steam turbine has been devel oped by the National Bureau o Standards. The detecting element o the system is a mutual-inductanc micrometer probe.

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

◀ CIRCLE 9 ON READER-SERVICE CARD

...dbag Transistor Receiver

...led along the lines of a handbag ...th a snap-open case, Sylvania is ...oducing a seven-transistor receiver ... be marketed early this year. These ...eivers employ only transistorized ...cuits. Market research studies indi... a favorable response to the new ...les.

...e of Computers in Medicine

...esent day advanced computer tech...logy holds promise of opening vast ...w frontiers for medical research. ...is statement emanated from the ... Research and Development Com...nd (ARDC) sponsored symposium ... the "Use of Computers in Medi...ne," held recently at the Argonne ...ncer Research Hospital, University ... Chicago. The symposium was de...gned to fashion a "meeting of the ...inds" between leaders in the com...ter and medical research fields.

ARDC is currently engaged in re...arch on computers and their appli...ion in the development of aircraft. ... an effort to give the nation full ...nefit of the basic research and tech...ological advances which have been ...ade they have entered into the med...l application of computers.

...entive Award of 25 Kilobucks

...ongratulations to Dr. William B. ...cLean, Technical Director of the ...val Ordnance Test Station, China ...ke, California. His $25,000 is the ...ighest monetary award ever made by ...e government in recognition of an ...ployee's superior accomplishment. ...he record-breaking award required ...e approval of the Secretary of the ...avy, the Secretary of Defense and, ...ally, the Chairman of the Civil ...rvice Commission.

Rear Admiral F. S. Withington, ...hief of the Navy's Bureau of Ord...nce, stated that Dr. McLean's ...orts in the development of the Side...inder missile have saved the Gov...nment an estimated $46,000,000 the ...st year. This figure is based on com...arison of costs with other air-to-air ...id...d missile systems.

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 devel opmental 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.

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

Letters to the Editor

Semiconductor Designations

Dear Sir:

Congratulations to Mr. R. B. Hurley for his art on Semiconductor Designation (ELECTRONIC DES September 1, 1956, page 26). I've wished for same thing for months, though my idea extend only to diodes and transistors. Perhaps it was complexity of trying to include power and quency ratings which discouraged me from pu ing it further. Mr. Hurley has covered the sub admirably for a first proposal; I heartily "sec the motion." Now let's have discussion and act to bring it about.

Lansing E. Tryon
Research Division
Raytheon Manufacturing

Standards

Dear Sir:

A statement in the article by C. H. Zierdt in Oct. 15 issue of ELECTRONIC DESIGN requires cl fication. In the first paragraph under "Interchan ability," the work of the Joint Electron Tube E gineering Council is mentioned and we wo point out that this work never involves agreeme by manufacturers. Standards proposals are for lated and submitted to the standardization p cedures of the parent Associations, RETMA NEMA. The resulting standards are binding on one and can be followed or not followed in acco ance with the individual decisions of each mem of the industry.

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

Derivations

Dear Sir:

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

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

G. H. Cohen
Research Engineer
Taylor Instrument

Filing Articles

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

S. Fine
T. Stahre
Philips Laboratories

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

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

e welcome all suggestions for improving our
ce to readers. Wherever possible, these sug-
ion will be taken into consideration in laying
dep artments. Of course, there are involved pro-
ion considerations which sometimes prevent
fol owing the most desirable arrangement.

Washington Report

Herbert H. Rosen

Electronic Modules

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

MIL-E-19600 is the forerunner of a whole se of detailed specs in the Navy's program aimed the standardization of equipment used in airc The Navy strongly points out that it is not tryin standardize the initiative out of the design engin Its primary concern remains performance, relia ity, and certain size and weight considerations.

Consensus of Navy and industry opinion is t the electronic module goes a long way to achiev equipment flexibility combined with ease of m tenance. The program was conceived through efforts of Douglas Aircraft, Collins Radio, and engineers in BuAer's Avionics Division. Copie the MIL-E-19600 General Specification for El tronic Modules may be obtained from H. Thoman, Technical Support Branch, Avionics Di sion, Navy Bureau of Aeronautics, Washington D.C.

FCC Rules Change

The FCC has issued a public notice affecting co munications between amateur stations and transm sion of third-party traffic with amateurs in ot countries. As of December 5, the following co tries have notified the FCC that their adminis tion does not condone third-party traffic: Cambod Indonesia, Iran, Korea, and Viet Nam. Third-pa communications, however, are allowed betw United States and the following: Canada, Ch Costa Rica, Cuba, Ecuador, Liberia, Nicarag Panama, and Peru.

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

Meetings

...n. 21-25: *Annual AIEE Winter ...neral Meeting*

...te Statler, Sheraton McAlpin New York, N.Y. ...eal...er will be F. R. Kappel, president of AT&T. ...e entire field of electrical engineering will be the ...bject of the meeting. For further information ...ntact the American Institute of Electrical Engi...ers, 33 W. 39th St., New York, N.Y.

...n. 23-25: *Very Low ...equency Symposium*

...BS Boulder Laboratories, Boulder, Colo. Co...onsored by the Denver-Boulder chapter of the ...E PGAP and the Boulder Laboratories, National ...reau of Standards. The program is titled "Theo...ical and Experimental Results in the Propagation ...d Radiation of Very-Low-Frequency Electro...gnetic Waves (less than about 100 kc)." Authors ...e being requested to submit summaries for ap...isal as soon as possible to Dr. J. R. Wait, Chair...n, Denver-Boulder PGAP Chapter, National Bu...u of Standards, Boulder, Colo. For further in...rmation, contact U. S. Dept. of Commerce, NBS, ...ulder Laboratories, Boulder, Colo.

...b. 5-7: *Twelfth Reinforced ...stics Division Conference*

...gewater Beach Hotel, Chicago, Ill. Latest de...opments in both technical and practical aspects ... reinforced plastics. Subject matter will range ...m reports on research and testing, product de..., production methods, to marketing techniques. ...complete program, listing papers and speakers, ...istration forms for the three day conference and ...el reservation blanks are now available. Those ...erested should write to The Society of the Plas... Industry, Inc., 250 Park Ave., New York 17, N.Y.

...b. 7: *Operations Research Symposium*

...iversity Museum Lecture Hall, University of ...nsylvania. Sponsored jointly by the Professional ...roup on Engineering Management of the Phila...lphia Section of IRE and the Society of Indus...ial and Applied Mathematics. Major theme will ... Mathematical Models in Management Decision ...aking. Contact Haydn Ringer, 1303 Highland ...e., Palmyra, N. J.

...b. 7-8: *Special Conference ...Nucleonics In Industry*

...otel Statler, New York, N. Y. Principal subjects for ...cussion will be the present and prospective ...profitability of atomic investment. Sessions will ...ver industrial applications as the use of nuclear ...erg... for processing purposes, development of ...ili...y power, and the uses of isotopes. Conducted ...th... American Management Association, 1515 ...adway, New York, N. Y.

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 ➤

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.

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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.

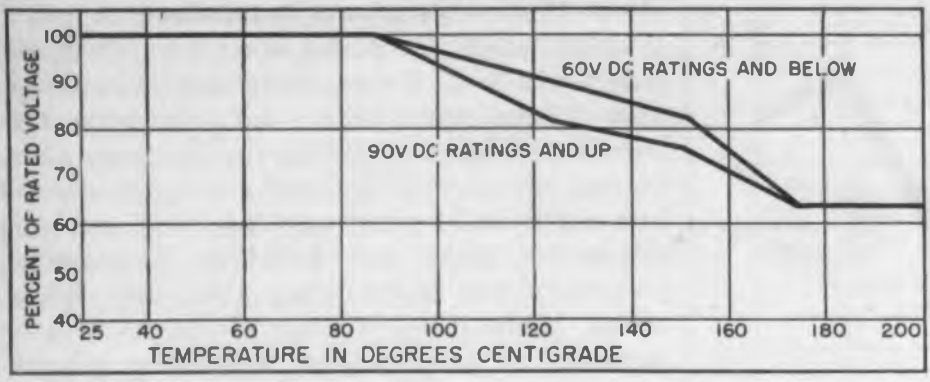
May 1-3: Electronic Components Conference

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.

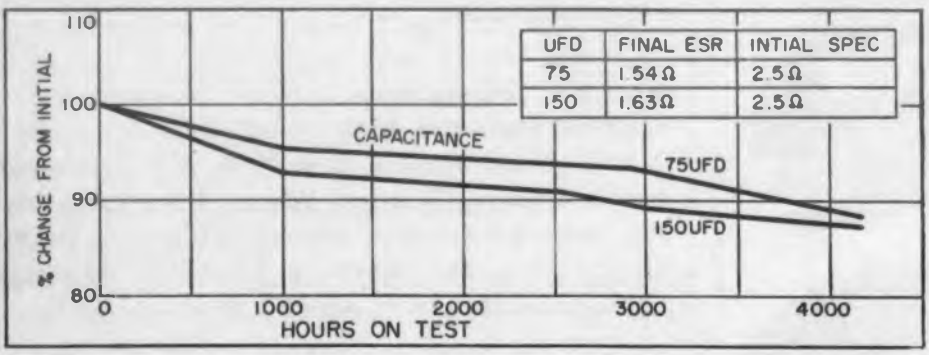


Fig. 2. Life tests for capacitors operating at 20 v dc and 175 C. Capacitors rated at 30 v. Upper curve (75 µfd) is average of 4 units. Lower curve (150 µfd) is average of 2 units.

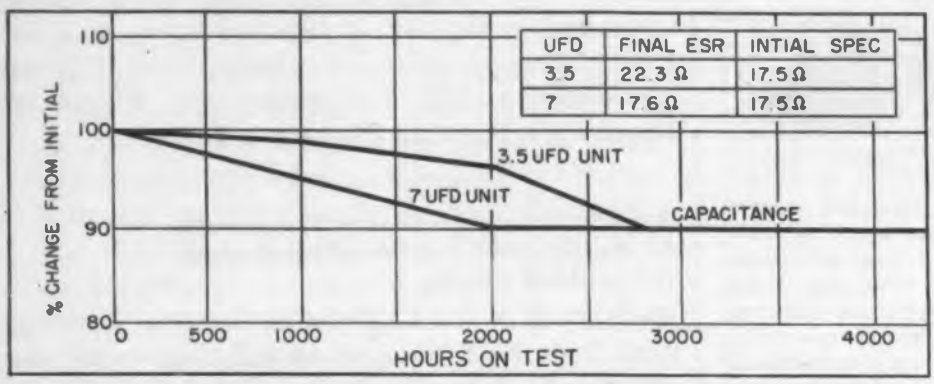


Fig. 3. Life tests for capacitors operating at 420 v dc and 175 C. Capacitors rated at 630 v. Upper curve 3.5 µfd unit. Lower curve 7 µfd unit. Both curves are average of 2 units.

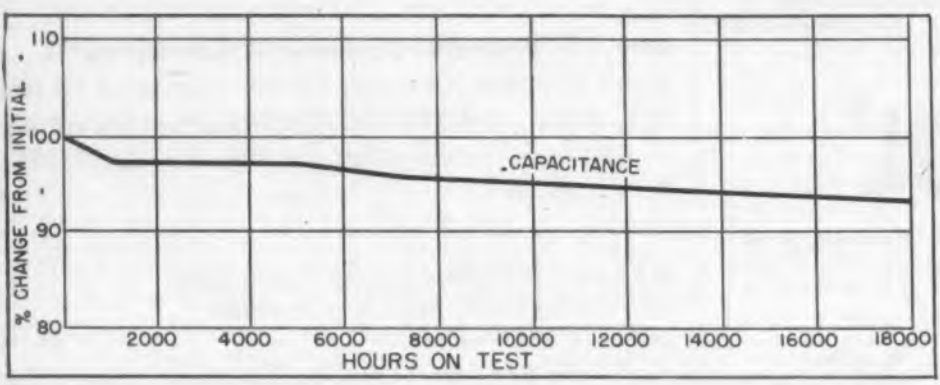


Fig. 4. Two-year life test for 125 C. Capacitor was 40 µfd rated at 60 v. Operating voltage was 50 v dc. Curve is average of 4 units. Final ESR is 1.93 ohms, initial spec calls for 2.5 ohms. Dc leakage current after 11,000 hours is less than 1 µamp at 60 v.

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 contaminates 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

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 630 v dc.

Including the above voltage extremes, there are ten standard voltages and twenty standard capacitance ratings ranging from 240 μfd at 18 v to 7 μfd 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 widen 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 derated 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

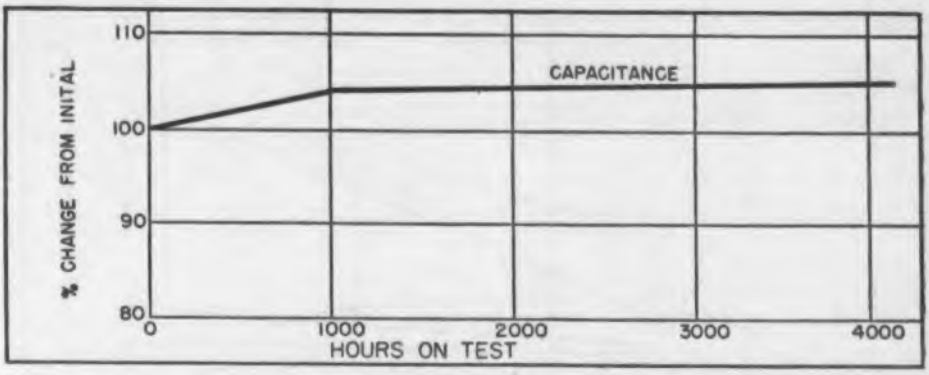


Fig. 5. Life test results of operating at below rated voltage. Here a 90 v, 50 µfd capacitor was operated at 20 v dc (at 175 C). Curve is average of 2 units. Final ESR is 1.87. Initial spec limit was 2.5 ohms.

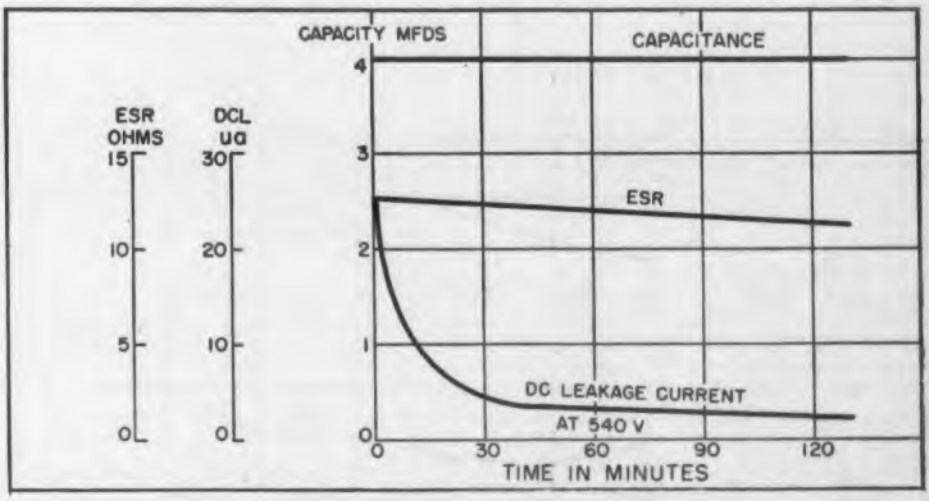


Fig. 6. Electrical measurements under continuous vibration (as per JAN-C-62, mounted vertically). Measurements made each minute.

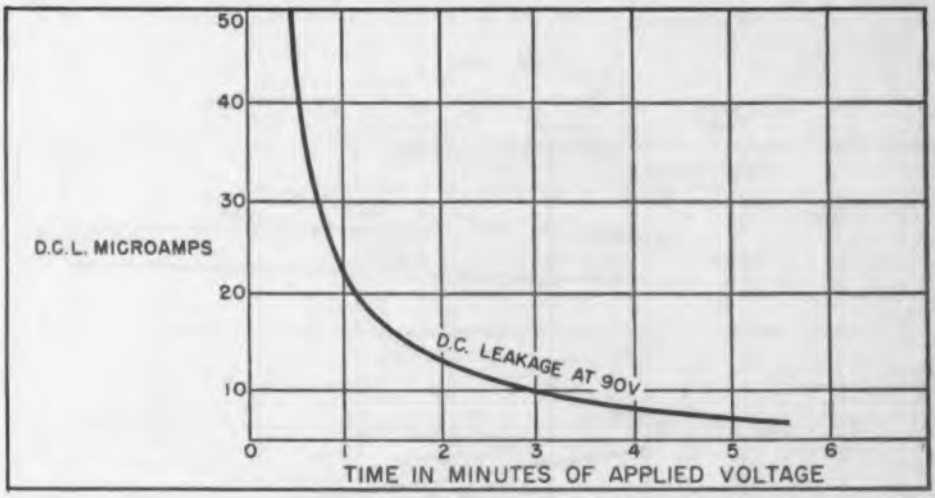


Fig. 7. Electrical measurements made after five years of idle storage at room temperature. Initial capacitance was 24.6 µfd—final 26.1 µfd. ESR changed from 1.63 ohms to 1.07 ohms.

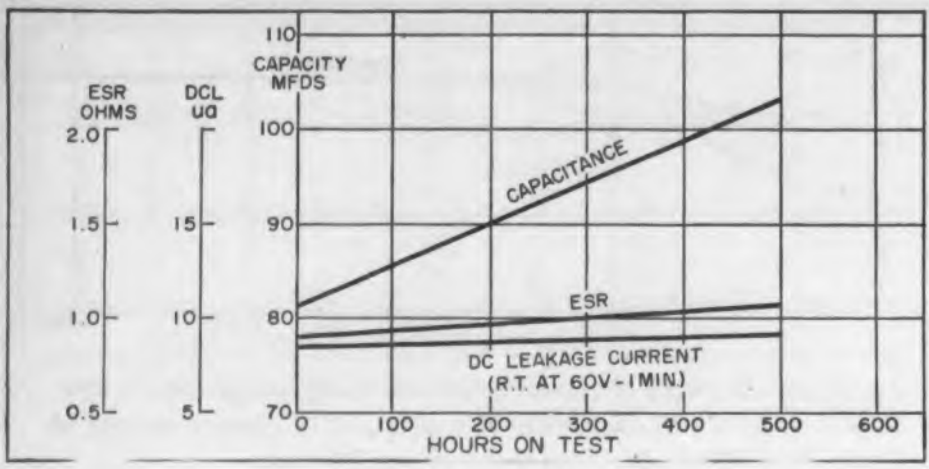


Fig. 8. Life test at 225 C. This is average of 80 μfd, 60 v units operating at 32 v dc.

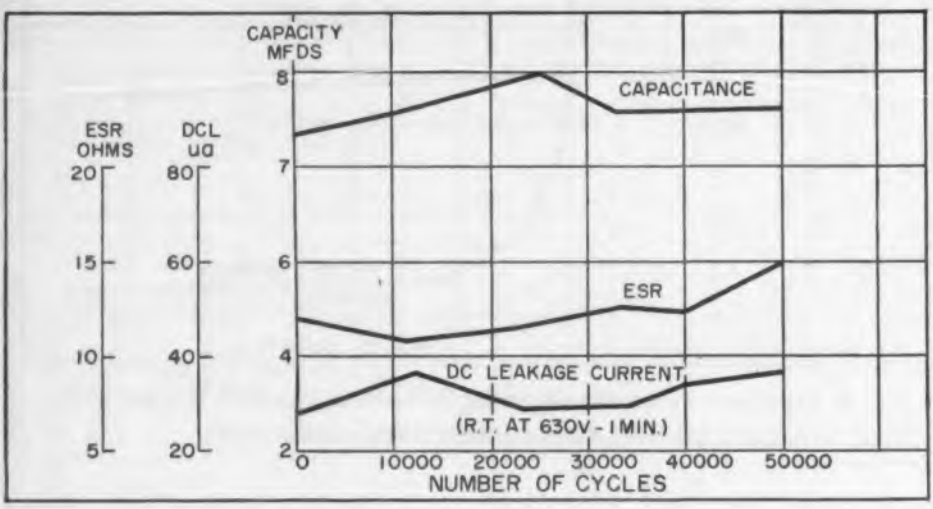


Fig. 9. Effect of charge and discharge on capacitance, effective series resistance, and d-c leakage current.

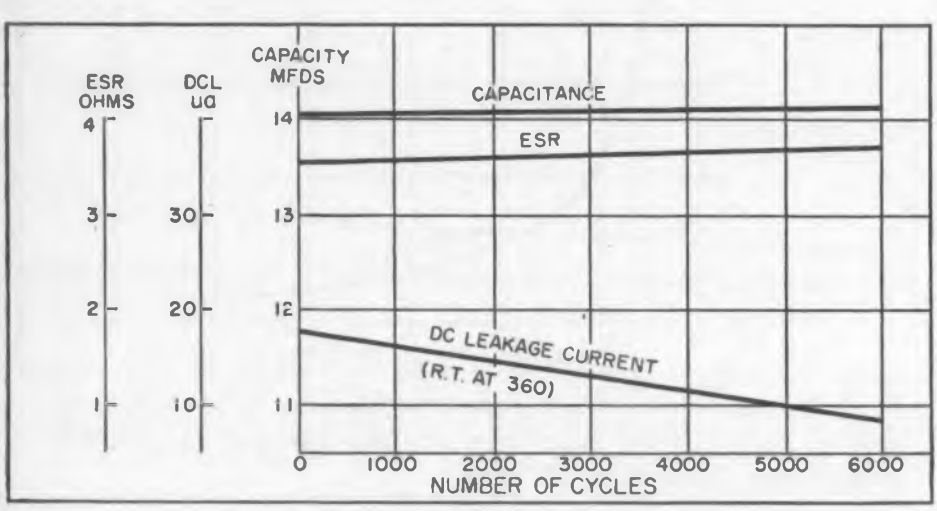


Fig. 10. Effect of cycling voltage reversal for 12 μfd, 360 v type at 85 C. Cycle consisted of 57 sec at 280 v dc and 3 sec at —5 v dc.

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 occuring. 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	XTL Series		XTH Series	
Rating	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

ten peratures encountered in the room thr ughout the year, will of course, result in higher dc leakage currents when the vol age is first applied. From tests run on cap acitors stored at +85 C, it is indicated tha dc leakage currents are approximately two and one-half times the values of similar cap acitors 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 µfd 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 µfd 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 µfd 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.

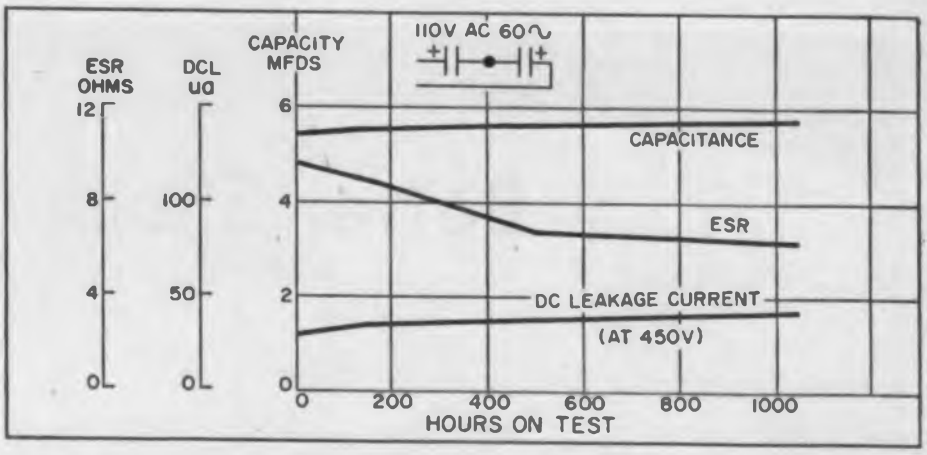


Fig. 11. Effect of pure ac voltage (100 v, 60 cps) across two 5 µfd units connected back to back. No dc bias voltage.

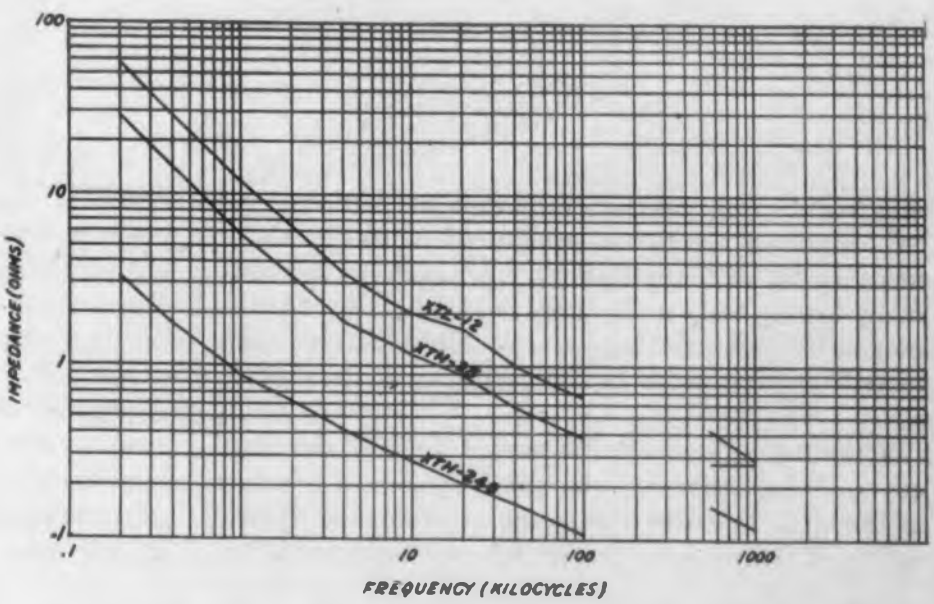
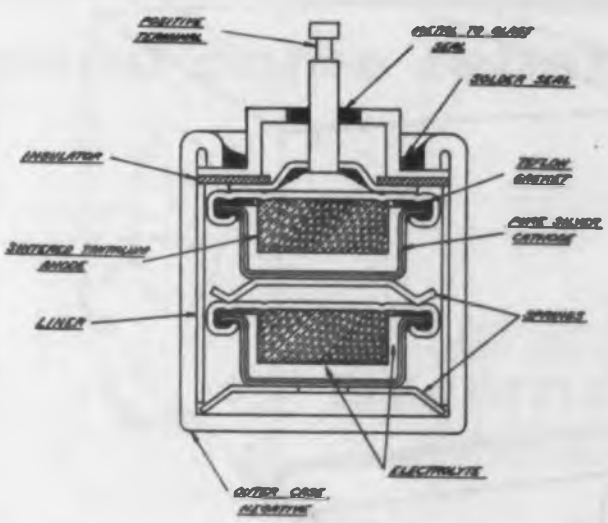


Fig. 12. Impedance versus frequency for various types. Measurements were not taken between 100 kc and 500 kc.



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
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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-

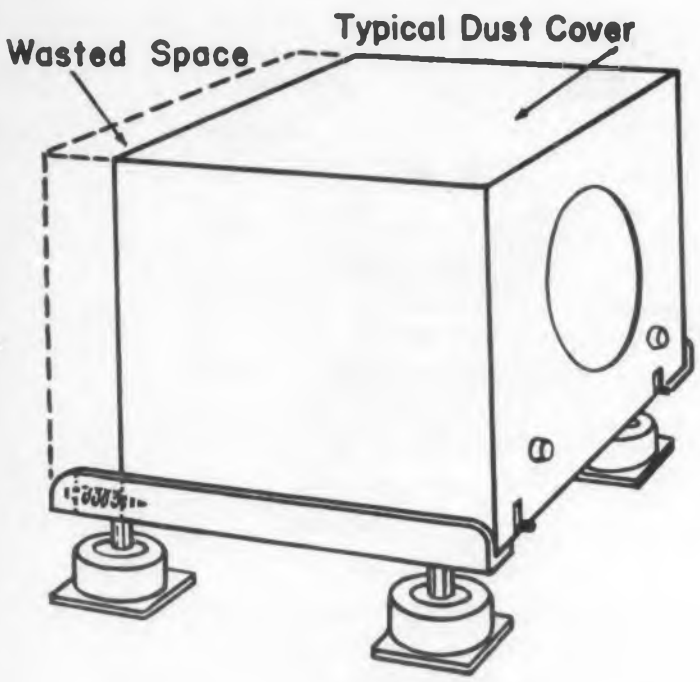

Fig. 1. Typical shock-mounted electronic unit. Space behind mounted springs (shown dotted) is usually wasted.

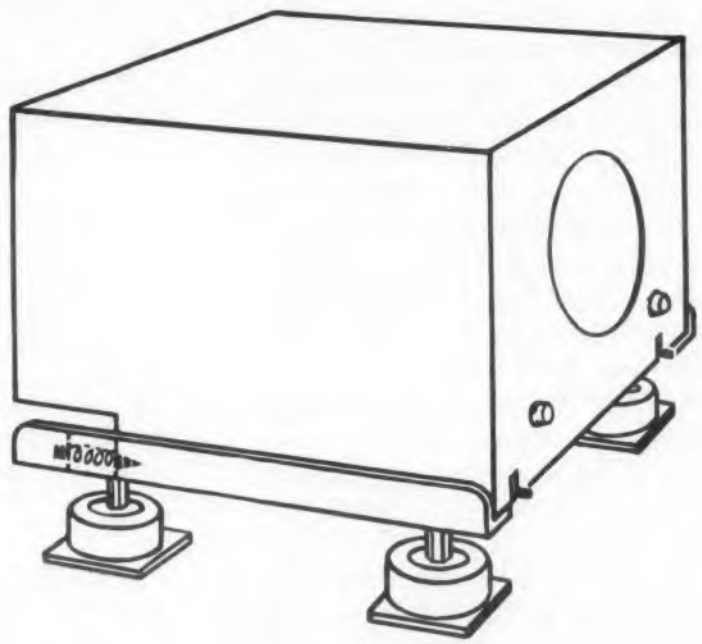

Fig. 2. New type dust-cover design to take full advantage of space at rear of shock-mount.

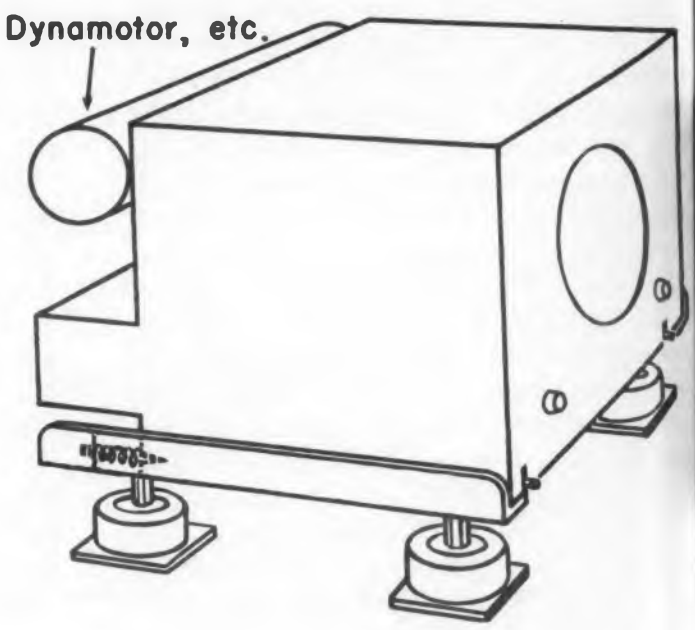

Fig. 3. Alternative design to that shown in Fig. 2, showing how different types of components can be mounted outside the dust cover to save space.

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.

lity of the unit. Structurally it is also stronger.

An alternative interesting mounting-base design is own in Fig. 5. Here a filter is installed in the base, d box-spring construction is provided at the rear for mponents and terminals.

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

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.

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_0 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_0 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 curre which provides regulation, is controlled by a factor $\beta_1 \beta_2$.

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

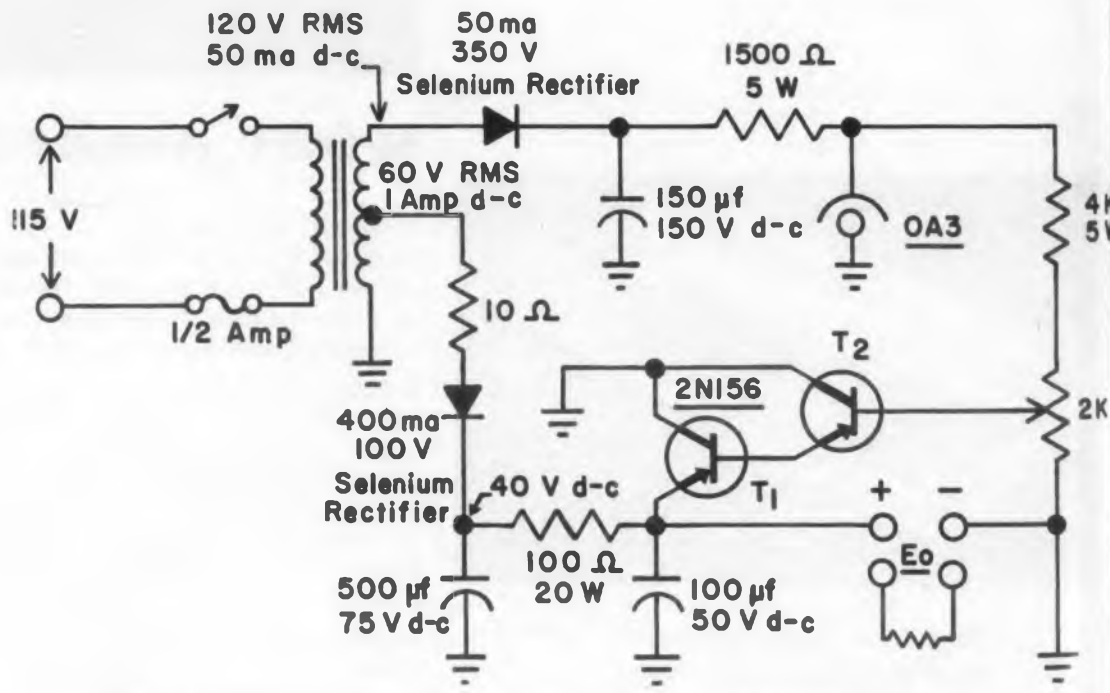

Figure 1. Circuit of transistorized regulated power supply. Regulation at 12 v output from Oto 100 ma load is better than 1 per cent.

Note: Transistors should be bolted to aluminum chassis.

qua s the source voltage E_s divided by the source re-
tar ce R_s. R_s is the collector resistance of T_1.

The transistors approximate a current generator of

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

he currents I_R and I_2 can be neglected as part of the
ner ator since they are smaller than I_1 by factors of

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

spectively.

e have then:

$$E_o = (I_s - I_1 - I_L)\,K \tag{3}$$

here

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

e paralleled resistances.

his leads to:

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

he first term in equation (4) represents no load volt-
ge. The second term in (4) gives ΔE_o as a function of
or the degree of regulation. From the second term
en

$$\frac{\partial E_o}{\partial I_L} = Z_o = \frac{K}{1 + \frac{K\,\beta_1\beta_2}{R_b}} \tag{5}$$

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 $$Z_o \leq 1 \text{ ohm}, \quad R_b \leq \beta_1\beta_2 \tag{6}$$

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.

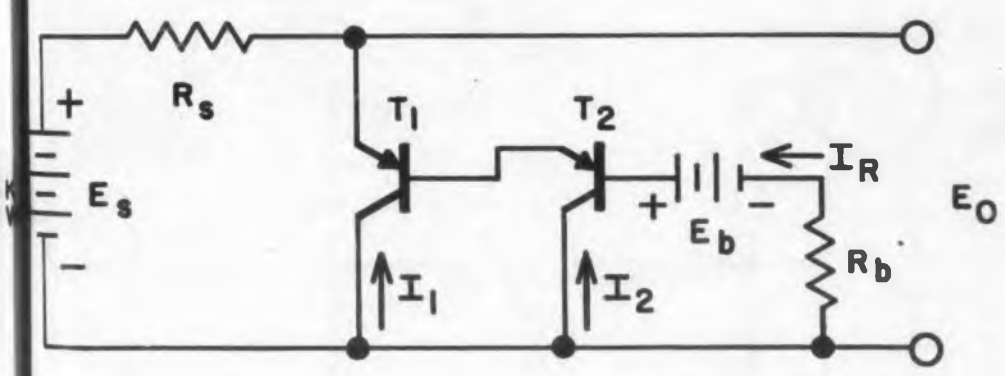

Figure 2. An equivalent circuit of the regulator circuit shown in Fig. 1. E_s—Open circuit dc supply voltage; R_s—Series resistance, either internal or external; B_1 and B_2—Base-to-collector current amplification; E_b—Reference voltage; I_R—Regulating current; R_b—Regulating resistance; I_1 and I_2—Collector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

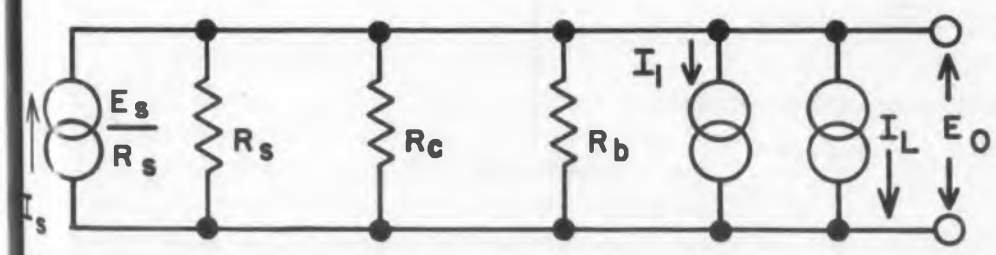

Figure 3: Current generator form of equiva'ent circuit for the regulator. This circu't enables calculation of the degree of regulation.

Receiving Tube Specifications*

Richard O'Fallon
Motorola, Inc.

REALISTIC acceptance specifications are needed on receiving tubes used in the Consumer Products field because of the highly competitive market condition which forces equipment designers to use the most simplified and efficient circuitry possible. Quite often these circuits involve tube characteristics not rigidly controlled by the tube manufacturer. This article details areas where additional controls and limits are needed, both in characteristic testing and in life testing. Such controls and limits should result in designs having maximum reliability and performance.

Equipment designers in the Consumer Products field are very reluctant to add additional parts or tubes in order to use an uncontrolled distribution of tube characteristics from each individual source plus a variation in "bogey" from one source to another. The variation in "bogey" is of great importance in this field because of the large number of new tube types and the desire of most tube manufacturers to make all types used by the major receiver manufacturers.

Test Requirements

Since the problem of setting limits on the design characteristics of tubes is likely to be a continuing one, as well as one which must be resolved between the buyer and vendor on an individual basis, there is a very real need for standardized test methods on receiving tubes which fulfill the following requirements:

1. The methods must be applicable to mass production.
2. To be economically feasible, the methods must test for the greatest possible number of characteristics at once.
3. The methods must require a minimum amount of calculation on the part of the test operator.
4. The methods must be applicable to both attributes and variables—two types of quality control.
5. The methods must use equipment readily available.
6. The methods must operate the tube under test at or above all ratings, simultaneously, wherever possible.
7. The methods must produce repeatable results.

"Characteristics" In Specifications

In writing up the acceptance specifications for a particular tube type, the Components Engineer is always faced with the problem of determining which characteristics must be included in the specification and which may be left on an Engineering "Design Check" basis. The following points need be considered in arriving at the final specification:

1. Include only those items which can be checked in Incoming Inspection.
2. Enlist cooperation of the Incoming Inspection Dept to insure items in the specification will be checked.

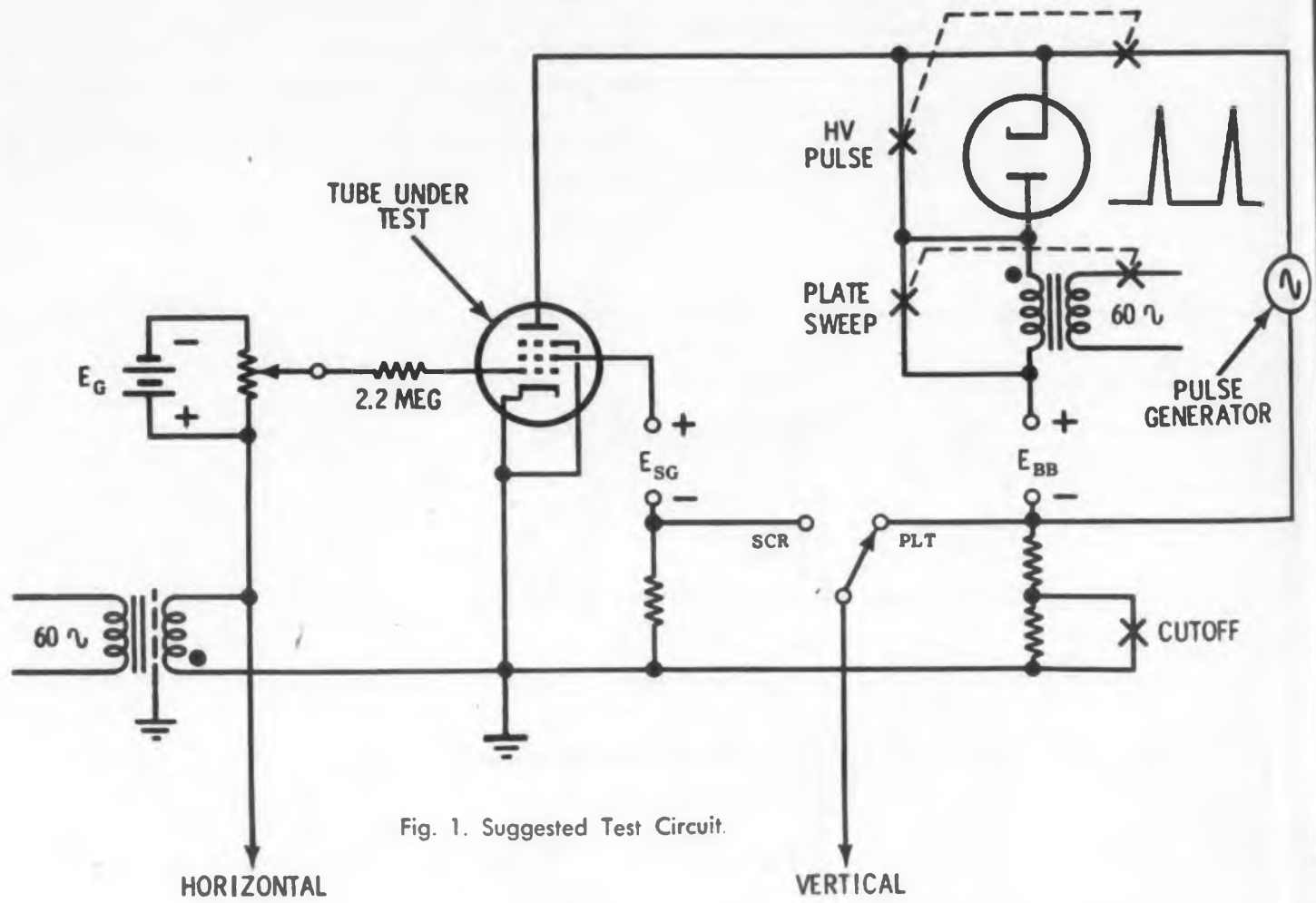

Fig. 1. Suggested Test Circuit.

* Based on a paper presented by Mr. O'Fallon at the National Electronics Conference in Chicago, October 1-3, 1956.

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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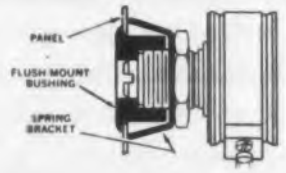

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nents. To make the test circuit as rigorous as possible without being overly complicated, the following features were adopted: (See Fig. 1.)

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-

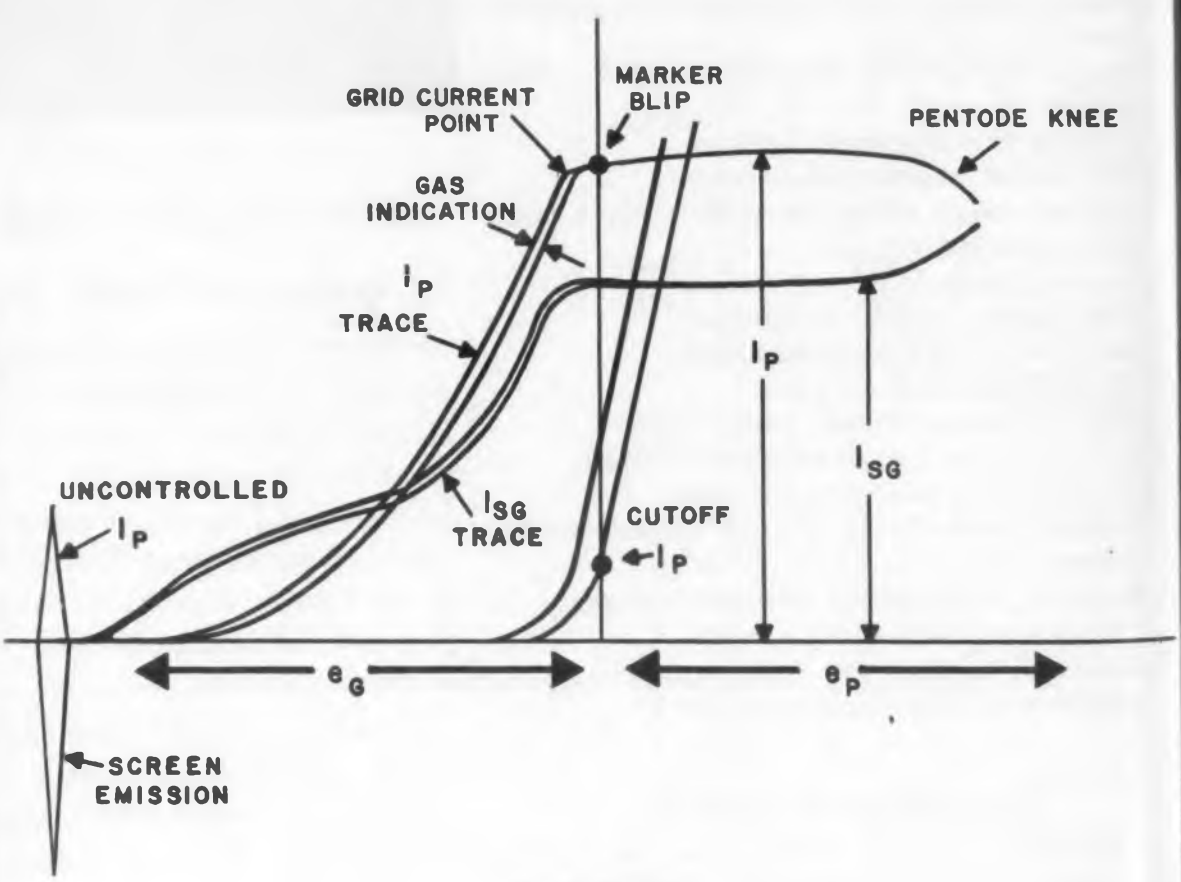

Fig. 2. Display

sul ng from driving part cutoff in one direction and int 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, is 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 warrantee 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.

Direct Coupling Simplified by

Low Shunt Capacitance Supply

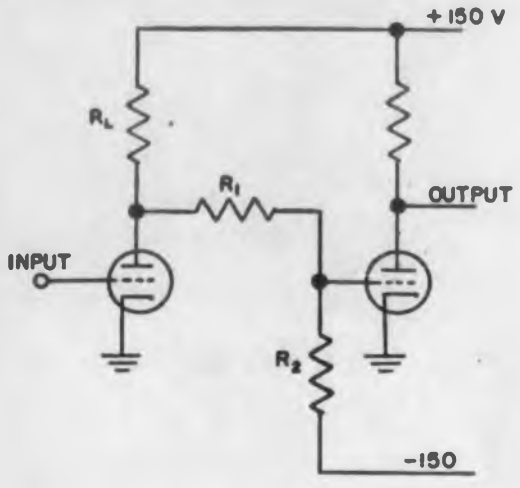

FIG. 1 VOLTAGE-DIVIDER METHOD OF DIRECT COUPLING

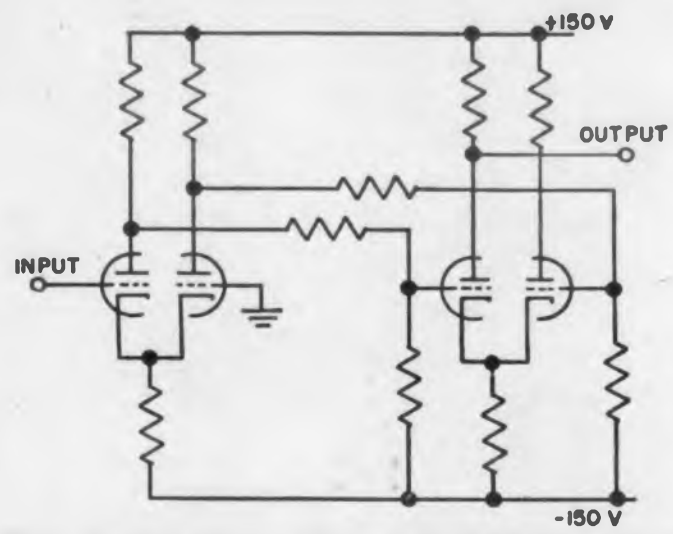

FIG. 2. VOLTAGE-DIVIDER METHOD WITH DIFFERENCE AMPLIFIER

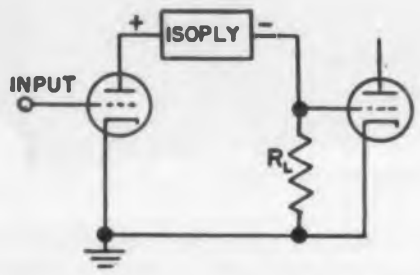

FIG. 3. ISOPLY METHOD OF DIRECT COUPLING

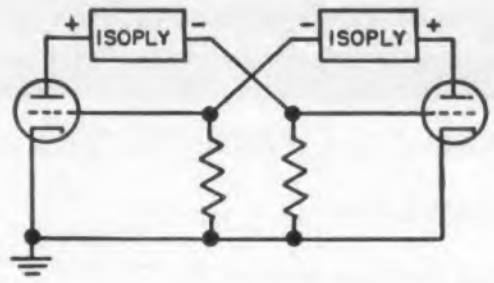

FIG. 4. BASIC FLIP-FLOP CIRCUIT USING TWO ISOPLYS

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

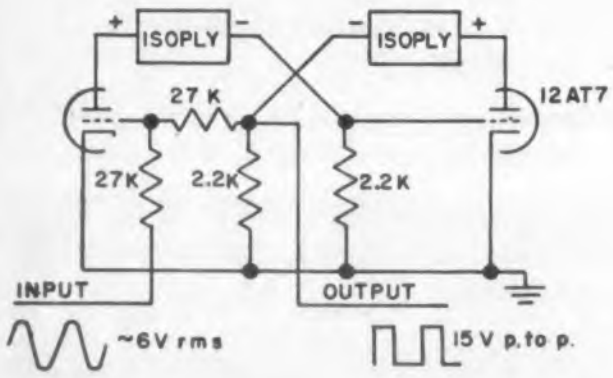

FIG. 5 RECTANGULAR-WAVE GENERATOR

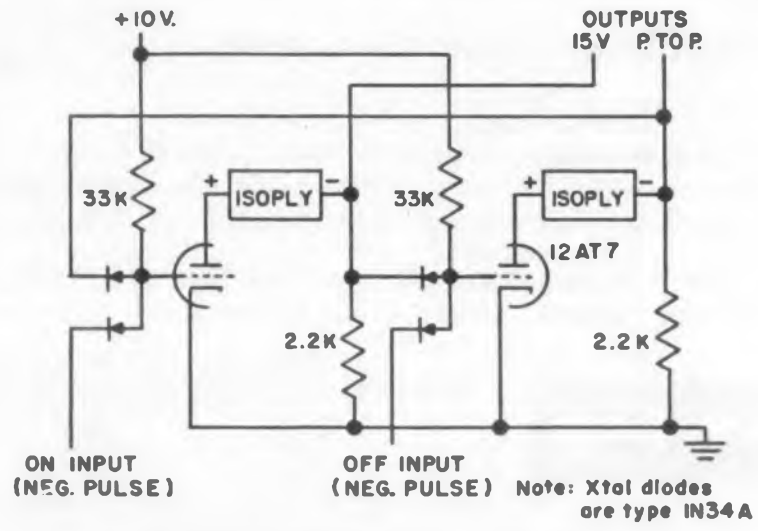

FIG. 6. FLIP-FLOP CIRCUIT WITH ON AND OFF INPUTS

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 μμf; 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 μμf 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 input connects, causing the other tube to conduct. The conduction of the second tube produces a negative voltage which holds the first tube in its cut-off 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.

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 particular sample shown reflected a minimum of about 2 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 5 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

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* 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.

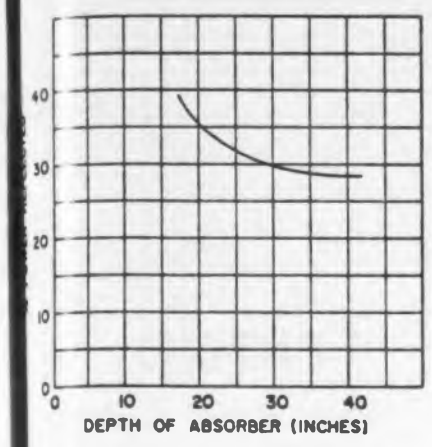


Fig. 1. Reflection coefficient of a rectangular section of an absorbing material

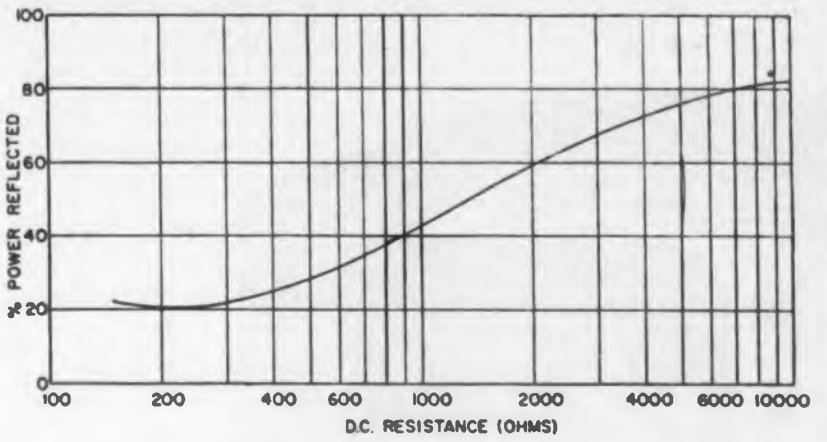


Fig. 2. Per cent power reflected vs d-c resistance of a 40 in. long wedge

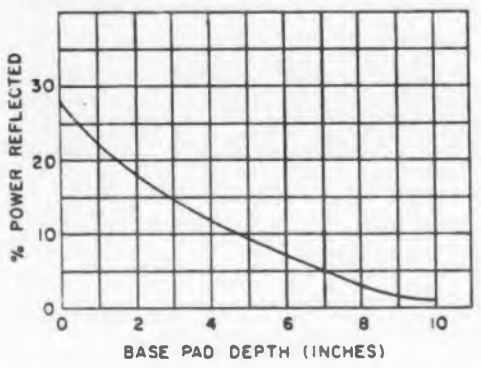


Fig. 3. Power reflection vs base pad depth

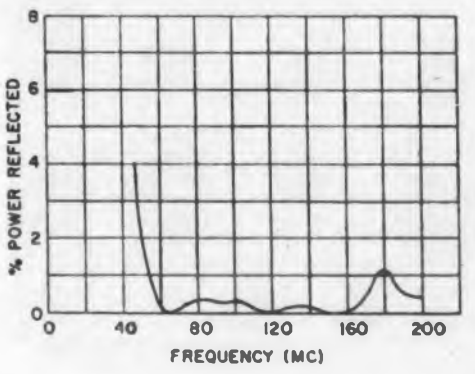


Fig. 4. Per cent power reflected vs frequency for a typical 50 mc absorber

terial is shown in Fig. 2. The d-c resistance was easured between two 1/16 in. diam probes which netrate the material to a depth of 1-3/4 in. A large mber of resistance measurements were made on ch sample and the average value was plotted. As the istance of the material is decreased, the reflection efficient decreases until an optimum value is ched. Further reduction of the resistance then reits in an increasing reflection coefficient. If a 40 in. dge of the optimum material is added to a 10 in. e pad of the same material, an absorber which rets only 2 per cent of the normally incident energy 50 mc, and less at higher frequencies, is obtained. has been found that the optimum material is difult to fabricate satisfactorily.

Material Required

Base Pad. An efficient absorber using higher resisnce material can be made by using either more of e ma erial or by providing a more efficiently absorbg ba e. 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.

Triode Glow Tube

SMALL signal operation and negligible curre drain enable a new subminiature grid-controlle electron tube to serve as an indicator for transist circuits.

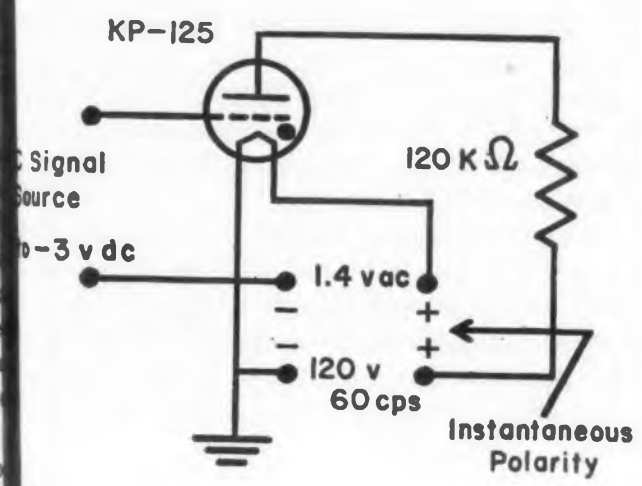
The KP-125, manufactured by Kip Electroni Corp., Stamford, Conn., is a gas-filled triode of t glow-discharge type which provides a readi viewed neon type of glow when signalled. Th visual indication is obtained with signals as low 3 v. The low currents involved do not load the te circuit, so that the tube can monitor computer tra istor circuits and act as an indicator of current co ditions.

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

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

When the tube is fired the glow may be viewe end-on or from the side of the envelope, so that th tube may be mounted in any position convenie to the circuit application. The KP-125 can find a plication wherever transistors require monitorin and may also be used in remote control panels f indication. Conservative ratings and design insu long life with stable characteristics.

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



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.

Productio
Desig
om
tte

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

COMPENSATED attenuators occur quite quently in test instrumentation where it is sirable to avoid frequency discrimination in the ess of signal reduction and over a reasonably band. Experimentally, it is quite feasible to ind ually adjust each attenuator section to provide necessary relationship $R_1 C_1 = R_2 C_2$, shown in 1. In a production situation it would be highly d able to eliminate as many adjustments as possible will be seen, this may be accomplished, given cer boundary conditions.

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

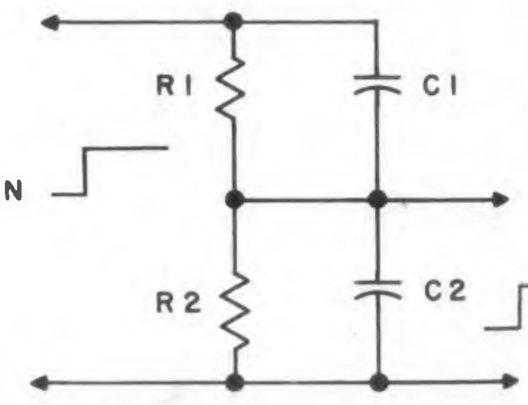


Fig. 1. Unit step function applied to compensated attenuators.

ompensated

ttenuators

ite the dashed lines in Fig. 2. By definition, this de-
t is ture from flat top, known as tilt, is given as
ne p y x 100) % at the frequency $1/R_1 C_1$. The problem,
ly w , is to determine the allowable tolerances on
indi R_1, C_1, C_2 which will maintain the tilt within a de-
vide d percentage. In the case under discussion, this
n in e is ±5%.
ly d nce the advent of carbon and metal film resistors
sible egligibly low self-inductance, it is quite practical
n cer btain R_1 and R_2 in tolerances of ±1%. Therefore
investigation is focused on determining the ca-
ermi ance limits on C_1 and C_2. The analysis may be
then e by any of several known methods. It is, how-
cept r, more expeditious to utilize the approach of a
ne ab function inasmuch as the condition being con-
e ou led is the response of the network to a square
e do e (by the definition given above for tilt).

(*Continued on page 42*)

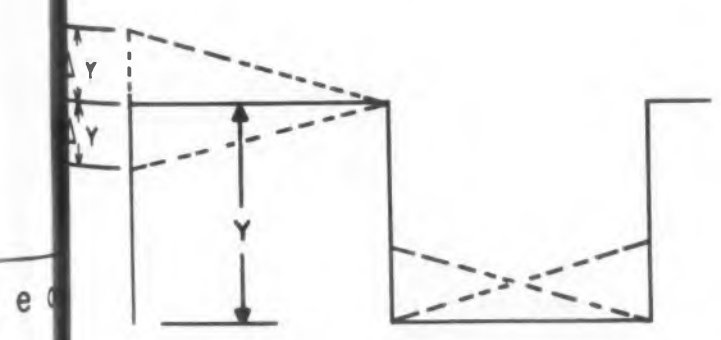


Fig. 2. Over and under compensation appearing as tilt or departure from flat-top.

Appendix 1

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

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

where

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

Let $\alpha_1 = 1/R_1C_1$, $\alpha_2 = 1/R_2C_2$

Then, by substitution into Eq. 1a:

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

The latter Laplace equation has two poles, one at $S = O$ 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:

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

In terms of circuit parameters, this becomes:

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

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 x 100) per cent for R_1 and R_2, and tolerances of (n x 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:

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

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

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

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

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

The exponential terms approximate to:

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

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

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.

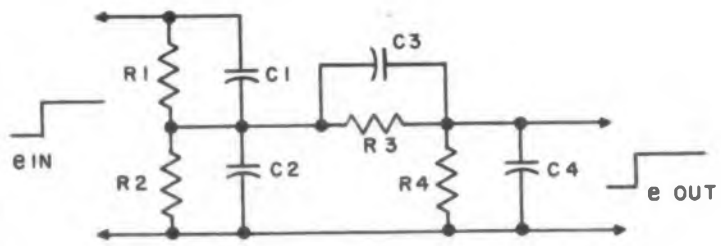


Fig. 3. Compound compensated attenuator with unit step function unit.

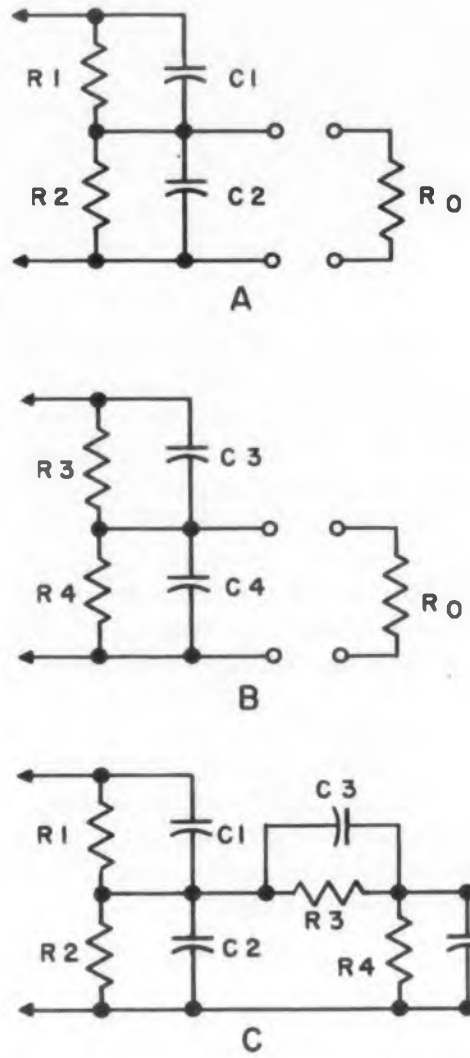


Fig. 4. Preferred configurations, *a*, *b* and *c*, compound attenuator. See Appendix 2.

Appendix 2

efer to Fig. 3. If the individual sections are compen-ted, then $R_1C_1 = R_2C_2$ and $R_3C_3 = R_4C_4$. The out-t w:veform in response to a unit impulse is of the rm:

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

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

$$\alpha_n = \frac{1}{R_nC_n} \tag{10}$$

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

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

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

$$K_T = \left(\frac{R_1 + R_2}{R_2}\right)\left(\frac{R_3 + R_4}{R_4}\right) = K_1K_2 \tag{12}$$

superior method of compound attenuator configura-n is shown in Fig. 4.

ere the value of R_o is:

$$R_o = R_1 + \frac{R_oR_2}{R_o + R_2} = R_3 + \frac{R_oR_4}{R_o + R_4} \tag{13a}$$

$$= \frac{R_1}{2} + \frac{\sqrt{R_1^2 + 4R_1R_2}}{2} = \frac{R_3}{2} + \frac{\sqrt{R_3^2 + 4R_3R_4}}{2} \tag{13b}$$

r Fig. 4A:

$$R_1C_1 = \frac{R_2R_o}{R_2 + R_o}\,C_2 \tag{14a}$$

$$K_1 = \frac{\dfrac{R_2R_o}{R_2 + R_o}}{R_1 + \dfrac{R_2R_o}{R_2 + R_o}} \tag{14b}$$

r Fig. 4B:

$$R_3C_3 = \frac{R_4R_o}{R_4 + R_o}\,C_1 \tag{15a}$$

$$K_2 = \frac{\dfrac{R_4R_o}{R_4 + R_o}}{R_3 + \dfrac{R_4R_o}{R_4 + R_o}} \tag{15b}$$

e tot l attenuation of Fig. 4C if $R_1C_1 = R_3C_3$ is:

$$K_T = K_1K_2 \tag{16}$$

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

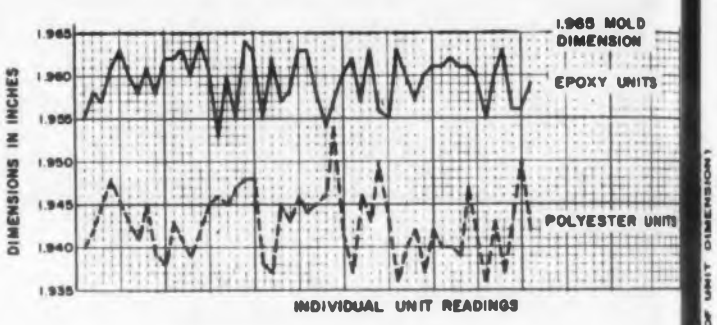


Fig. 2. Dimensional variations of polyester and epoxy embedments. Note the irregularities between samples and the greater variation with polyester resins.

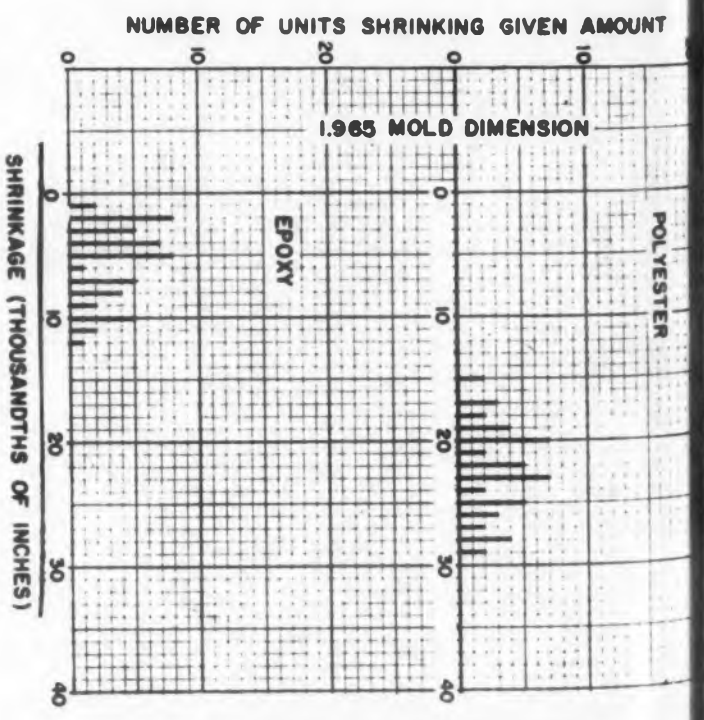


Fig. 3. Distribution of shrinkage for polyester and epoxy embedded units.

Charles A. Harper*
Westinghouse Electric Corporation

three hours at 60 C; the epoxy embedment was red for four hours at 65 C. The product made from th materials was subjected to four thermal cycles, ch cycle consisting of two hours at 85 C, immedi- ely followed by two hours at —65 C. The molds

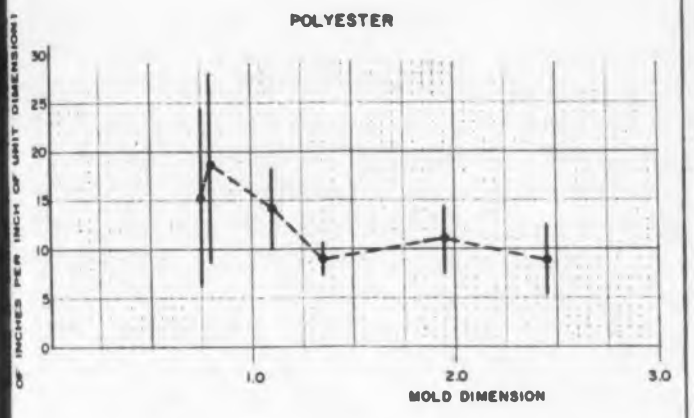
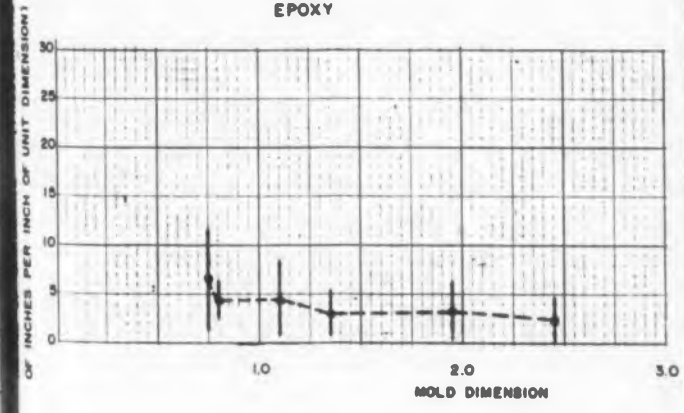


Fig. 4. Range of shrinkage encountered as a function of mold dimensions. Polyester above, epoxy below.



Materials and Standards Engineer
Air Arm Division
Baltimore, Maryland

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 ±1/64 in. tolerance. Epoxy embedments, on the other hand, can be held to ±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.

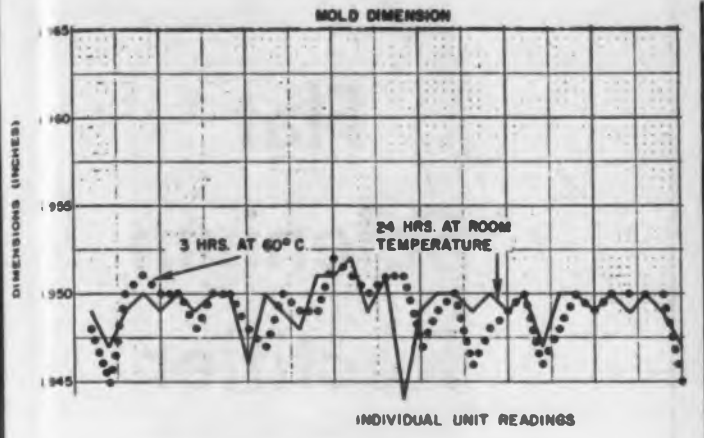


Fig. 5. Shrinkage of polyester compound as a function of the degree of cure.

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.

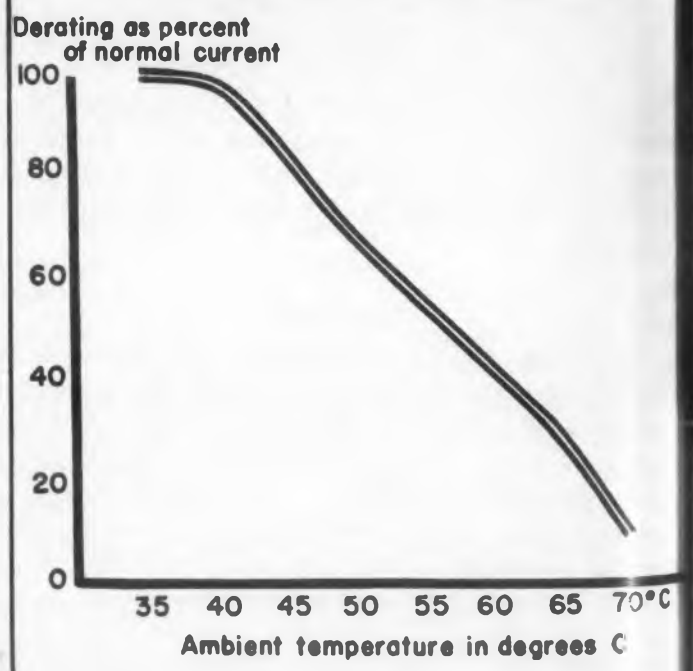
Flat Selenium Rectifier

SMALLER and lighter than comparable stac rectifiers, these units hold a promise for mor compactly designed electronic circuits. No ventila tion is required for the rectifiers. They are mounte directly on the chassis and use the heat sink prin ciple for cooling.

Manufactured by the Siemens Company of We Germany, the units are now being distributed i this country for the first time by Radio Recepto Co. Inc., Brooklyn, N.Y. The rectifiers are intende to be mounted with their rear side in thermal co tact with the chassis. Heat conduction will then b able to provide effective cooling. With this metho for cooling it is necessary to avoid mounting te near to other components which heat up the chassi

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

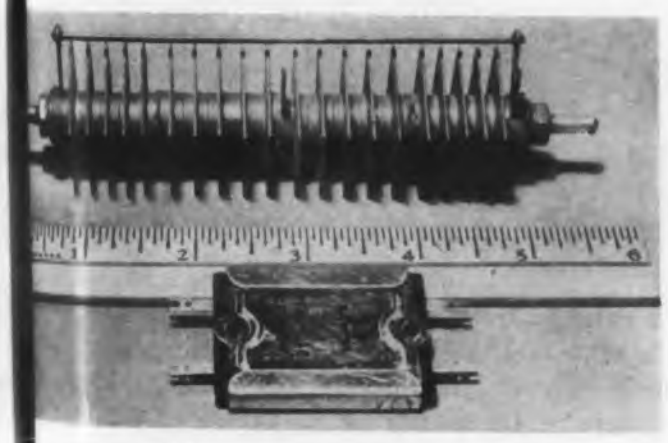
CURRENT DERATING WITH TEMPERATURE



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 imported. They range in size from 1/2 x 5/8 x 3/8 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 5 ma. Bridge flat rectifiers are from 30 v and 200 to 1200 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.

New Products

Miniaturized Thermostat Switch

Ranges From 50-275 F

Available in various mountings which range up to 5/8 in. O. D., a line of thermostat switches features a model measuring only 1/4 in. x 1 in., outside dimensions. Capacity of these switches is 1 amp. at 110 volts, ac; and operating ranges available are 50-175, 150-275 and 250-275 F. In a suitably designed and balanced heat system the switch can operate on a difference of 1/8 degree between make setting and break setting.

Scaico Controls, Inc., Dept. ED, Palmyra, N. J.

CIRCLE 38 ON READER-SERVICE CARD FOR MORE INFORMATION

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 x 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 A°. 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 encapsulating 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

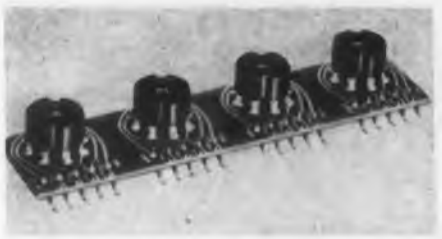
Simplifying installation in miniaturized assemblies that use printed - circuit techniques, the Model APP-1/2 precision potentiometer is provided with a 3-prong base that fits standard 3-circuit microphone sockets. The plug-in connection afforded by this unit is also advantageous in automated assemblies 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, So. 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, 1783 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 Aircraft Standards and Government Specification MIL-W-16878-B, both Type E (600 v) and Type EE (1000 v). 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 insulated 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.

Haveg Industries Inc., Dept. ED, 900 Greenbank Rd., Wilmington 8, Del.

CIRCLE 45 ON READER-SERVICE CARD

CIRCLE 46 ON READER-SERVICE CARD ➤

FANSTEEL

S-T-A Capacitors

SOLID TANTALUM

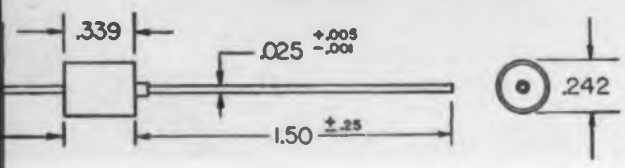
Small*

Stable**

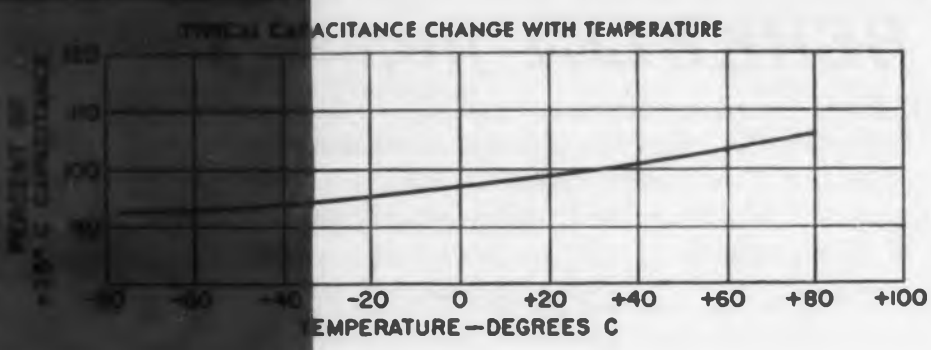
Large Capacity***

*How Small?.....

Series 100



**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 Thyratron
For Triple Control

The KP-80 pentode thyratron 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 thyratron, 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

Telemetering Commutator

10 to 30 Rps

A two-pole telemetering 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 peak
reverse voltage ratings from
50 through 1200 volts

***How High?.....

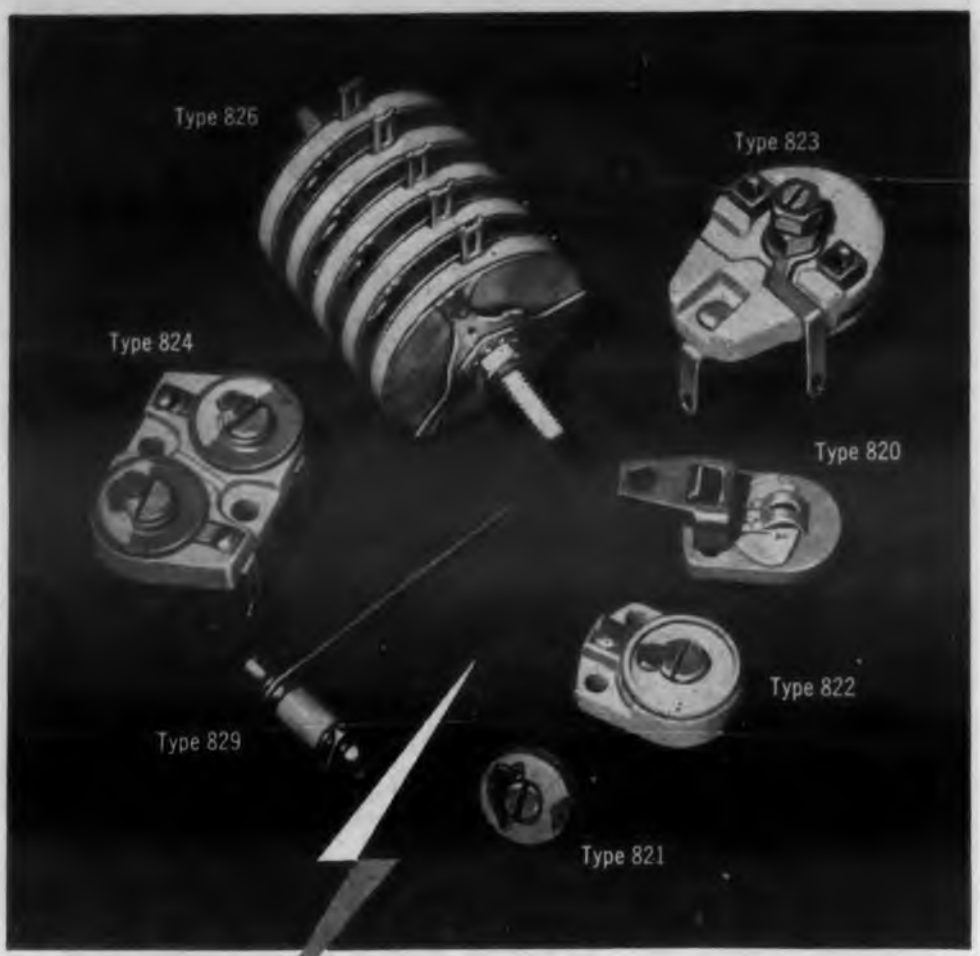
Rated at 500 milliamperes
without heat sink

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

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

Eight standard types. Special designs engineered to specifications.

- 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

A DIVISION OF GLOBE-UNION INC.

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

D-2356

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, ±5g, ±15g to ±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 (±15g); temperature rating —15 C to +100 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

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.

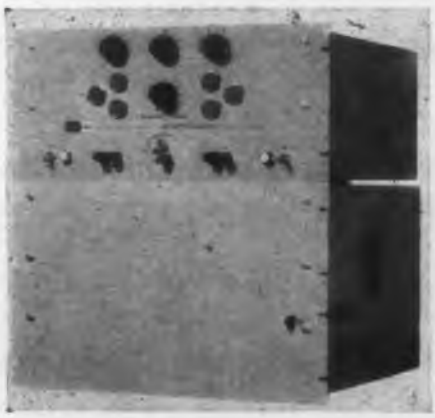
The capacitors mount by a single 6-32 threaded stud, 1/4 in. long. The over-all height when mounted is less than 3/8 in. The mounting stud is 5/16 in. hexagonal brass that has been gold-flashed. The solder terminal is also gold-flashed brass.

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 μsec 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

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 fluorcarbons 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

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

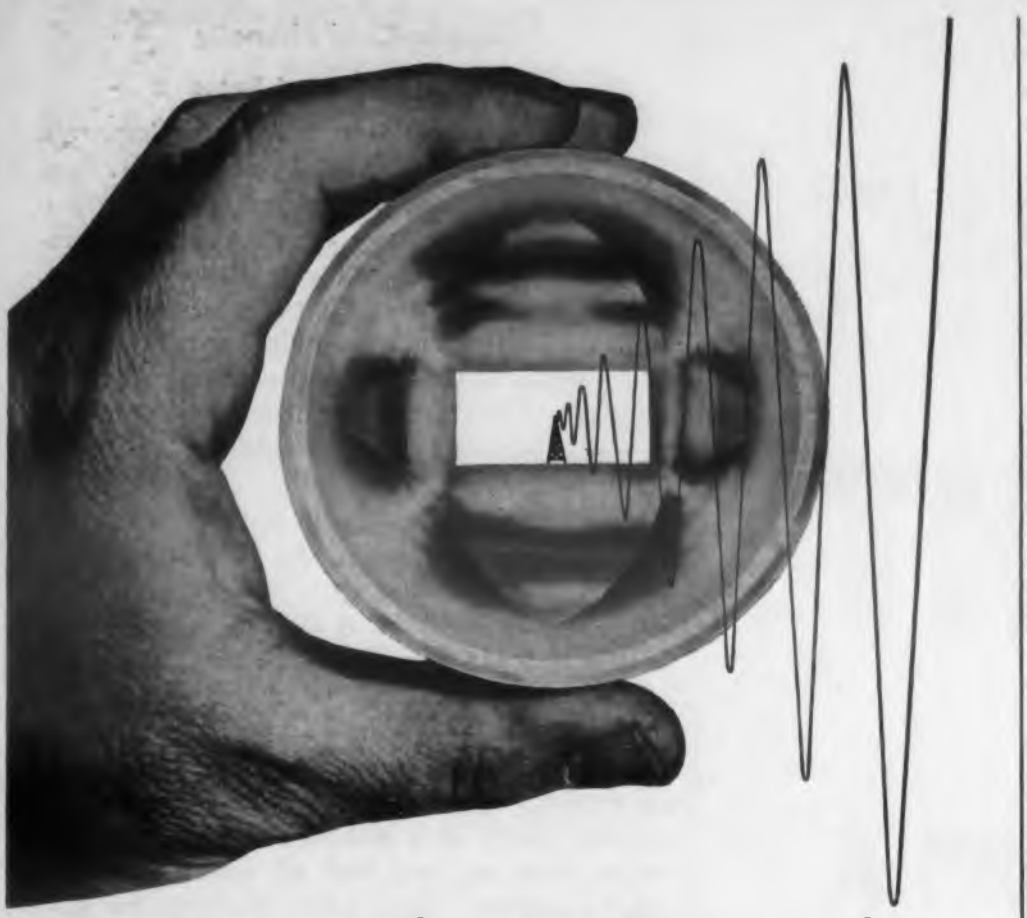
The *6CQ8* is a 9-pin miniature tube containing a medium-mu triode and a sharp-cutoff tetrode and may be used in a wide variety of applications in black-and-white and color television receivers. It is especially useful as a combined oscillator and mixer tube in tuners of TV receivers that utilize an 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.

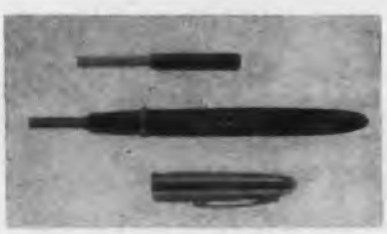
Rectilinear strip chart is 5 in. in 85 ft rolls. Single, dual and quadruple chart-speed models are available with speeds from 1/8 in. per hour to 8 in. per minute. Weight is only 15 lbs. Over-all dimensions are 8-5/8 in. wide by 10-3/8 in. high by 7-3/4 in. deep (5-1/4 in. behind panel).

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

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!

HONEYWELL

HONEYWELL

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.

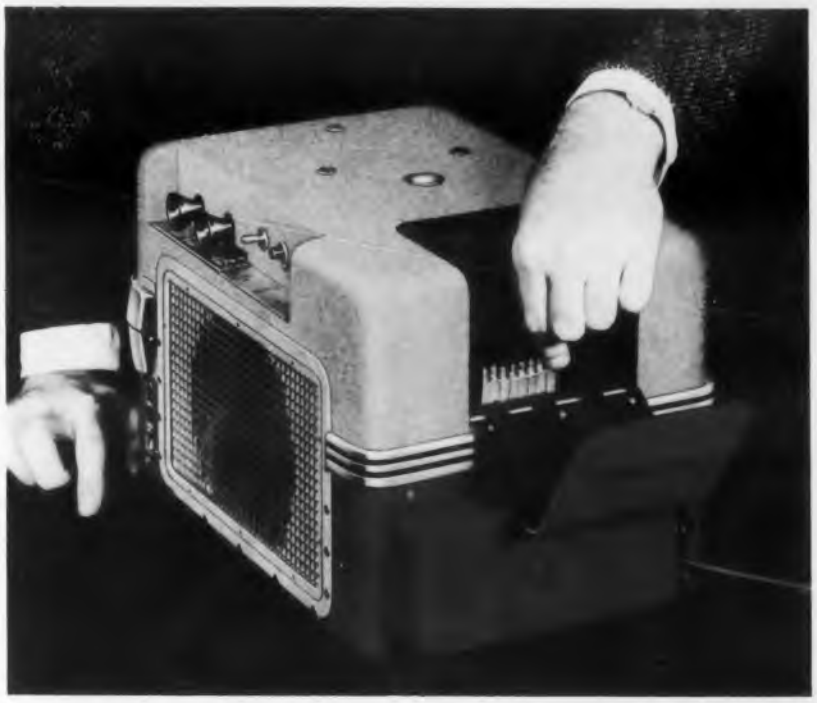
The remarkable exclusive features of the Visicorder make it the ideal recording oscillograph for applications where readable, permanent analog records are required and for additional uses where the measured phenomena need to be monitored or where immediate recorded results are desirable.

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.**

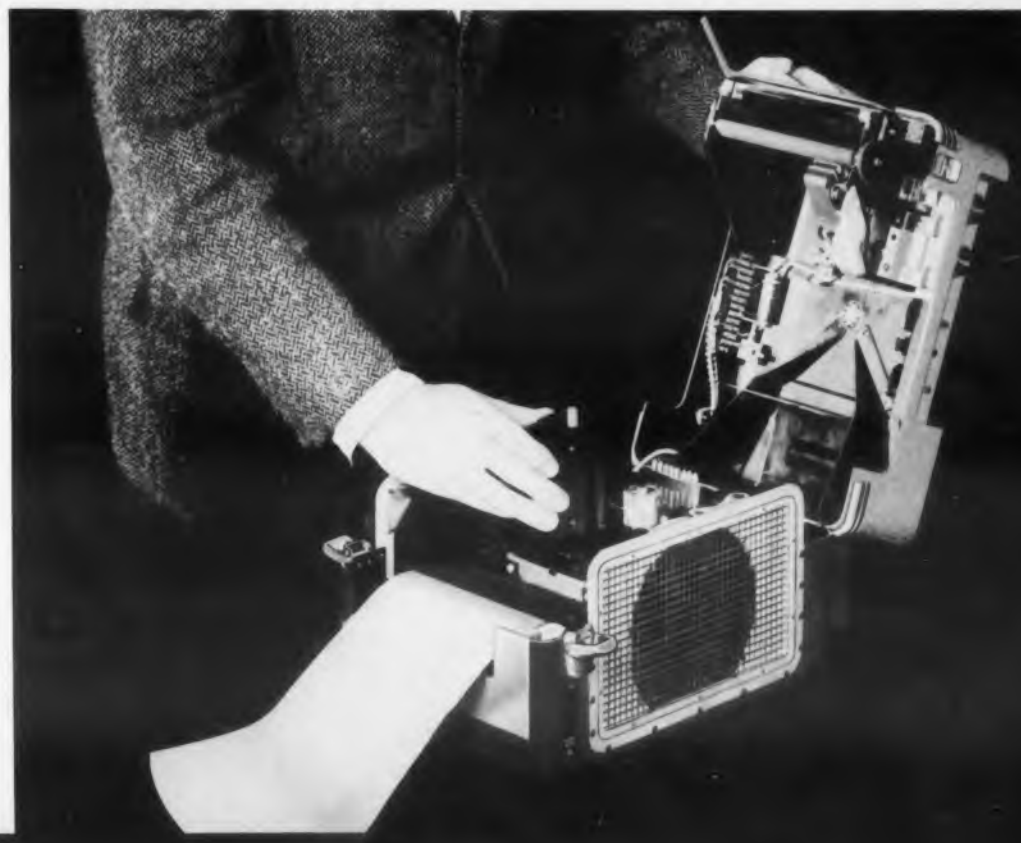
Deliveries starting January, 1957

❶ *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.



❷ *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.

❸ *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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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 concetric-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 2½" 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.

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CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION

Remote Position Control

Linear or Rotary Motion

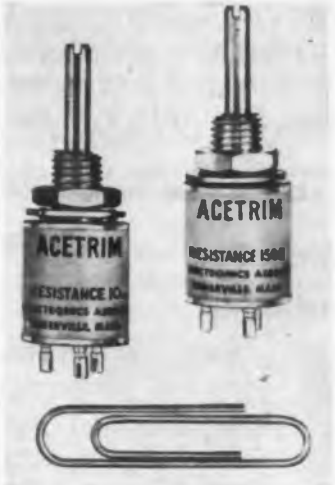
Intended for remote or automatic control of manipulation in radioactive or other hazardous locations, for power plant and other controls in aircraft, for valve, throttle or fuel mixture activities, and the like, this remote positioning system can control either linear or rotary motion. It consists of 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 subminiature 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

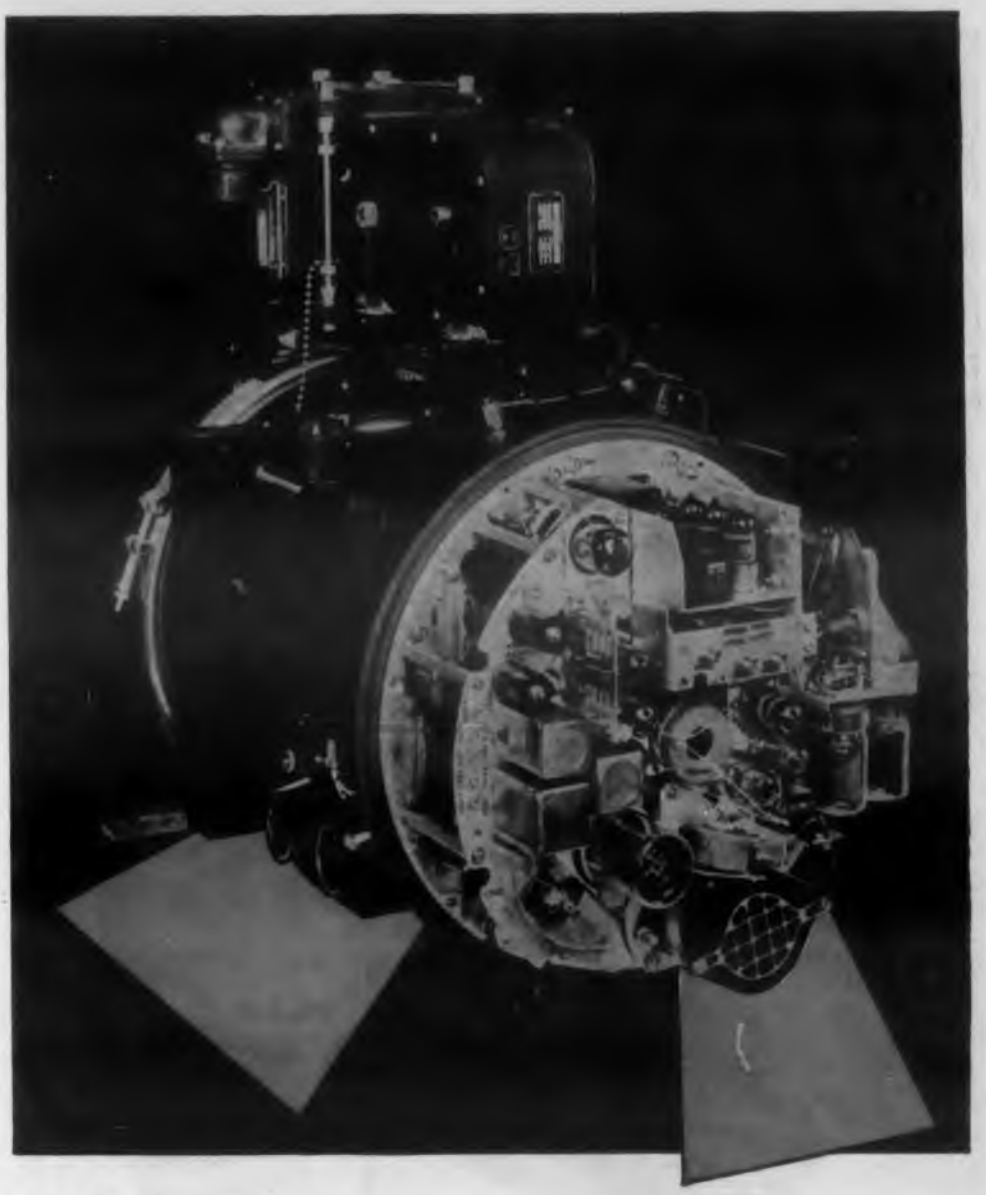
Dc Voltage Ratio Tester

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



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°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

WSW I 6415-143

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

Ground Power Units

Portable Lighting

Electrical Connectors

Vaneaxial Fans

CIRCLE 96 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 assymetrical 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.

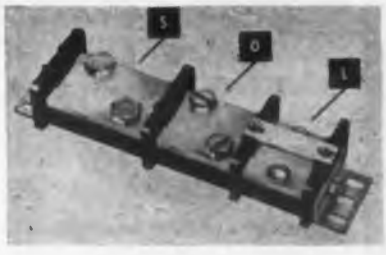
As a bandpass filter it will provide 60 db attenuation approximately 1 mc outside the passband with 35 db attenuation 6 mc outside the passband. This unit mounts in a 19 in. relay rack and is available with various types of connectors, matched to maintain minimum VSWR. Current model (DBR-26) is tuneable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

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 wobbulator 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.

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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°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.

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*DuPont's Trade Name for POLYTETRAFLUOROETHYLENE

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

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.

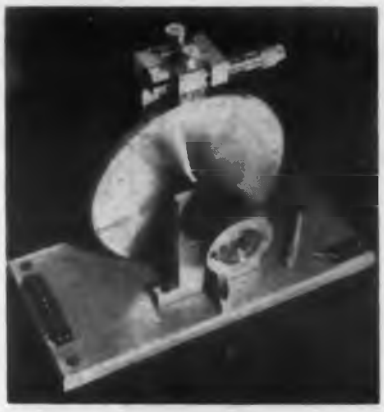
The unit operates on a principle of high frequency energy. The presence of the material close to the detecting element is reflected into the electronic circuit as an increase in loading. This loading is detected and amplified to operate the relay. Several different types of detecting elements are offered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

YOUR

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

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 sweeping 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

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 73, 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 nonferrous 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-5 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. Its 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

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

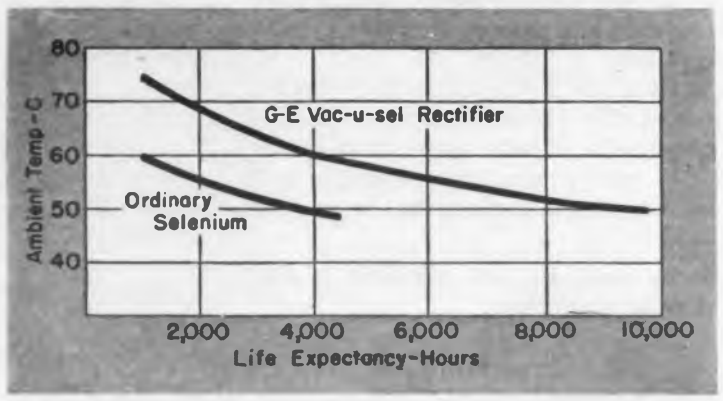
Where temperatures are soaring and conditions rugged, General Electric Vac-u-Sel rectifiers continue to deliver dependable operation.

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 ectifier 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 J, 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.

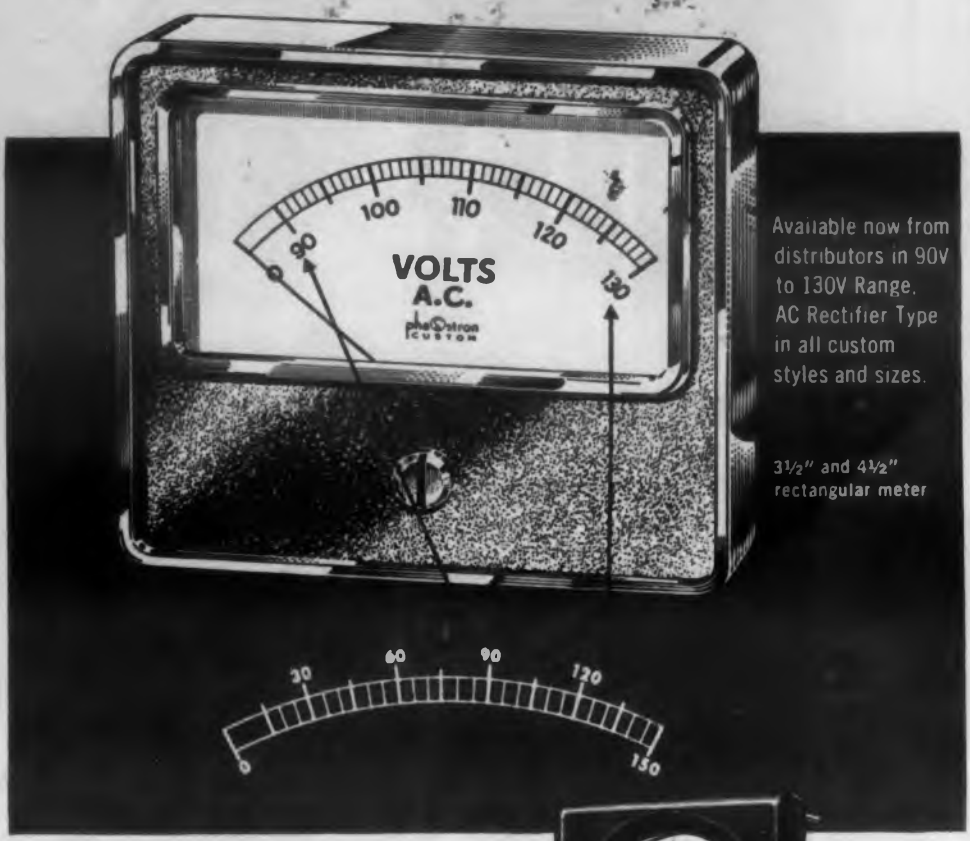
Leadolene melts at a temperature of 220 F into a low viscosity liquid. At the melting temperature and at temperatures of 300 F the compound can be poured into the forms and used for simple castings. The surface of Leadolene is smooth, and resistant to oxidation. Cast pieces can be remelted and cast again with no loss of materials due to oxidation.

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

CIRCLE 136 ON READER-SERVICE CARD

CIRCLE 137 ON READER-SERVICE CARD ➤

NEW PHAOSTRON
EXPANDED SCALE AC Voltmeter



Available now from distributors in 90V to 130V Range. AC Rectifier Type in all custom styles and sizes.

3½" and 4½" rectangular meter

NOW!... all the time-tested proven Phaostron features... PLUS UP TO TEN TIMES GREATER READABILITY for greatly increased accuracy!

Phaostron 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 Phaostron craftsman construction.

Phaostron 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.

2½" or 3½" square meter

6" rectangular meter

2½" or 3½" 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

450 Ma TV Tubes
For Series-String Use

Fifteen new receiving tubes intended for use in television receivers utilizing 450 ma series-heater strings have 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-string 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, 6Q8-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

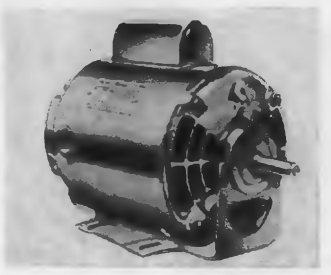
A set consisting of four templates, 15, 30, 45 and 60 degree projection, sold also available individually, is announced. Each template has a range from 2 to 6 in. major diameter, in increments of 1/8 in. The ellipses are taper cut, allowing the use of a tubular drafting pen when placed face down. Made of 0.060 in. plastic and green tinted for easy vision, all cut outs are precision smooth and have pencil allowance for absolute accuracy.
Rapidesign, Inc., Dept. ED, Box 642, Glendale, Calif.

CIRCLE 145 ON READER-SERVICE CARD

CIRCLE 146 ON READER-SERVICE CARD ➤

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 1/6, 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

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

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.

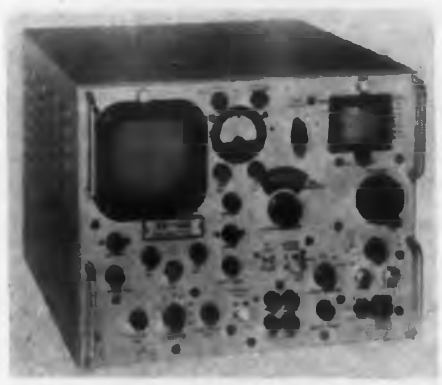
Combined noise level and uncorrected zero drift is equivalent to 10 μin. per hr at maximum gain. Zero set and gain controls are provided on the front panel. Available in portable or rack mounted styles. Weight is 13 lbs.

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 μv 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

CIRCLE 158 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 159 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 millimicrosec 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 μsecs. 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 rotostepper, an electromechanical 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 μsec 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.

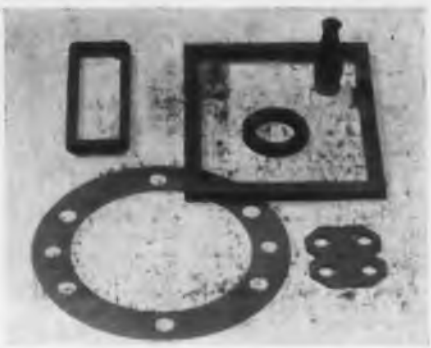
Designed for use in computer equipment, the rotostepper finds a wide variety of applications in sequence switching, algebraic counting, or any system requiring reliable, accurate, shaft positioning.

G. M. Giannini & Co., Inc. Dept. ED, 918 East Green St., Pasadena 1, Calif.

CIRCLE 163 ON READER-SERVICE CARD FOR MORE INFORMATION

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 National 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 μv 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.

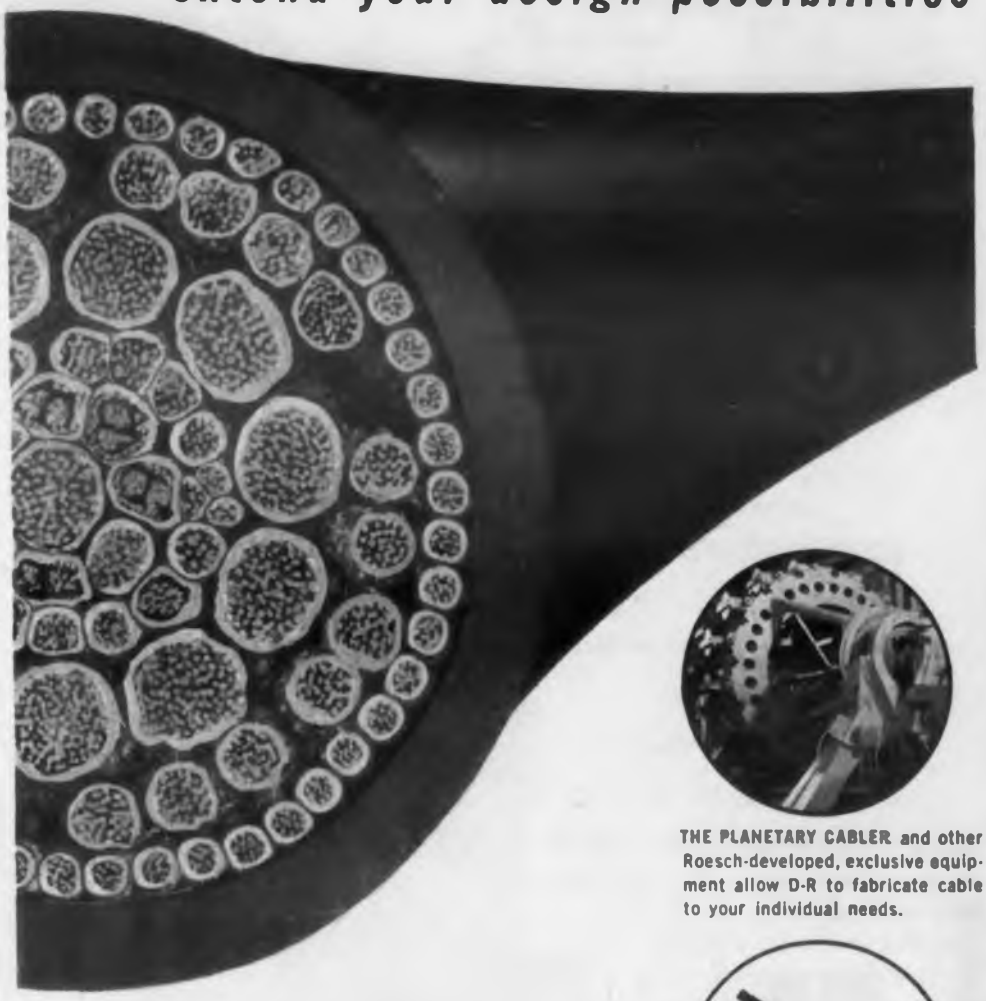
Specific Products, Dept. ED, 14515 Dickens St., Sherman Oaks 2, Calif.

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° 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.

CABLES CAN BE CUSTOMIZED with electronic conductors, steel, nylon or teflon for strength; elastic shock cord, pneumatic or hydraulic hoses.

Engineers, investigate your future with Douglas Roesch

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

Beckman® Magnetic Clutches

Feather-light, acorn-small, our two new magnetic clutches run free as a breeze (no sliprings 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® / Helipot *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

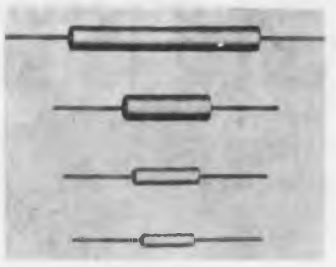
Please send a copy of your new catalog "300 Standard Contacts and Rivets."

Name_____ Title_____
Company_____
Street Adrress_____
City_____ State_____
Type of business_____

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION

Carbon Film Resistors

Ceramic Encased



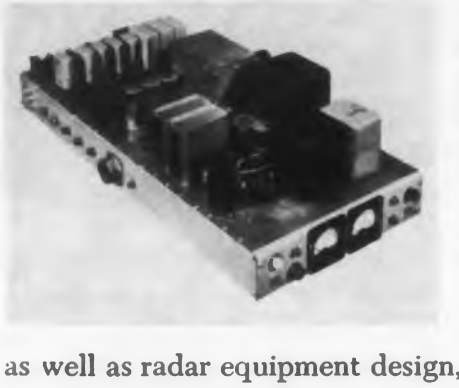
This type precision resistor construction features a layer of pure carbon deposited on a ceramic rod. Silver plated end-caps are expansion fitted for positive contact and the unit is encased in a non-hydroscopic ceramic tube and hermetically sealed with high temperature solder for improved stability 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

GR®
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 ¼% or 1% components is simple. It will measure impedances from pure resistive to pure reactive at any arbitrary phase angle from 0 to ±90°. Accuracy is ±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.

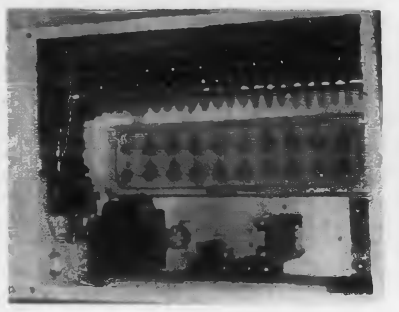
Designers — Write Fenwal Inc., 171 Pleasant St., Ashland, Mass., for THERMOSWITCH Folder.

Fenwal

Controls Temperature ... *Precisely*

CIRCLE 175 ON READER-SERVICE CARD FOR MORE INFORMATION

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 preselected sequence can be repeated indefinitely. Preset 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.

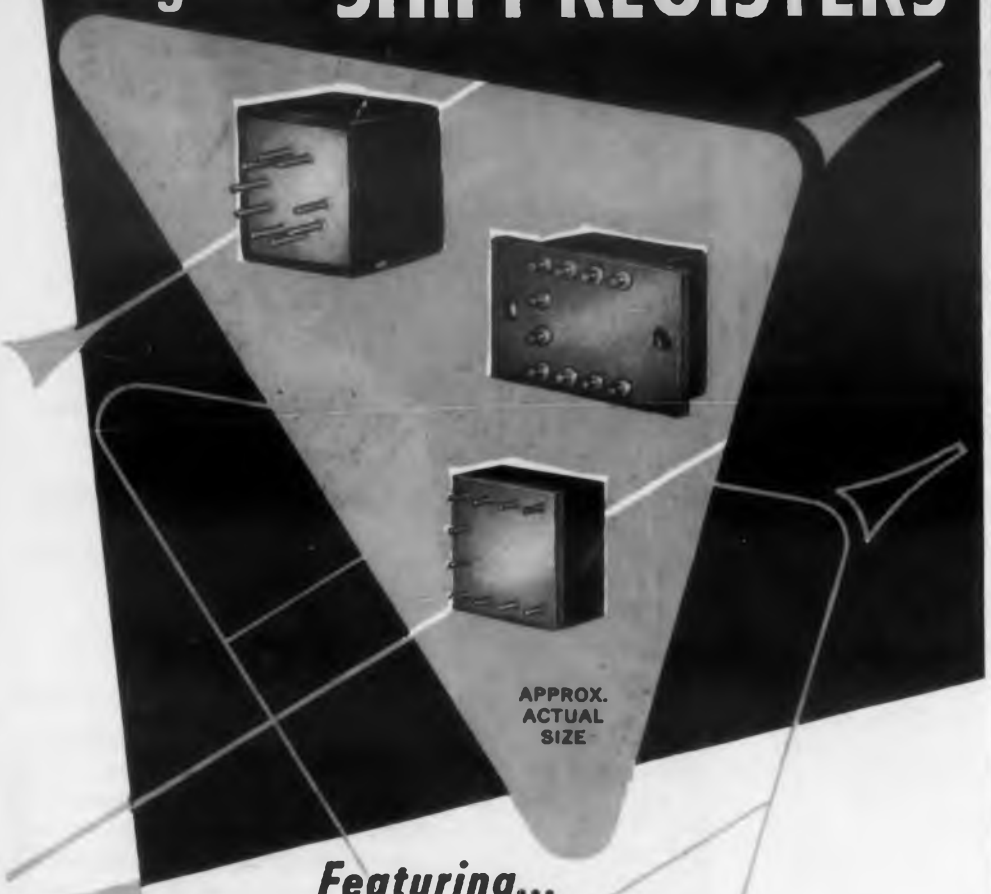
The charger, Model No. 44, utilizes a high efficiency encapsulated transistorized power supply; and has no neon regulators. It operates from a single standard flashlight cell and weighs less than a pound.

Universal Atomics Corp., Dept. ED, 143 E. 49 St., New York 17, N.Y.

CIRCLE 180 ON READER-SERVICE CARD FOR MORE INFORMATION

Epsco

HIGH-PERFORMANCE MINIATURIZED Magnetic SHIFT REGISTERS



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 ¼ 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 ¾" long x ¾" wide x ⅜" 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% ampl.) in μsec	15	12	2.0	1.0
Rise time (10% to 90%) in μsec	6.0	6.0	0.5	0.3
Fall time (90% to 10%) in μsec	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 (μsec)	10	10	10	10
OUTPUT PULSE				
Minimum signal voltage	10	10	10	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	1N278	1N278	TSG	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 employed 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

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 x 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 ±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 μsec	Rise Time μsec	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	19x3½x9	0600-200/50
5000	100	125	1000		9.5 kc	19x5¼x9	1000-400/125
5000	100	125	600	3 db @ 3 kc 6 db @ 6 kc	9.5 kc	19x5¼x9	0600-400/125
5000	100	125	510		9.5 kc	19x5¼x9	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 μsec	Rise Time μsec	No. of Taps	Z ohms	Attns. db.	Temp. range °C	Dimensions inches	Catalog No.	Feature
1.5	.08	45	600	.3	−45+85	6x3½x½	0300-0033/45	Low attenuation
18.0	.65	60	1000	1.8	−55+105	7x4x1	1000-03/60	Low attenuation
20.3	0.82	84	1000	4.0	−55+125	2.3x2.3x3.3	1000-0242/84	Miniature size
23.76	.75	83	180	3.0	−55+105	8x2x4	0180-029/83	Low attenuation
24.0	0.65	120	100	5.0	−45+85	1¼x1½x27½	0100-02/120	Form factor
36.0	0.85	120	600	4.0	−55+85	13½x3x1½	0600-03/120	Low attenuation
200	6	100	390	13	−66+150	7½x4¾x1½	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

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.

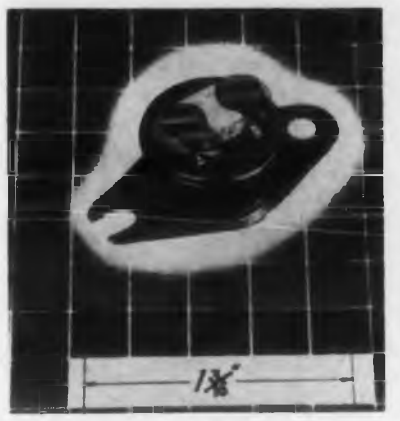
The program-unit controls the acceleration-deceleration cycle through adjustable cam operated switches which control magnetic clutches and brakes. The standard data recording unit is a four-channel oscillograph recorder.

The Magnavox Co., Dept. ED, Dept. N.P., Fort Wayne 4, Ind.

CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermostat for Aircraft

Weighs 4 Grams



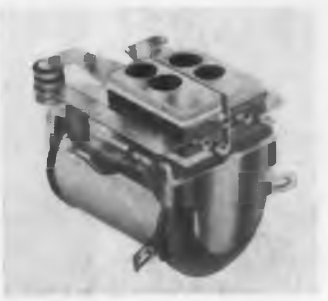
Weighing only four grams, the Klixon M1 thermostat is manufactured to conform with Military Specification MIL-E-5272A (Environmental Testing, Aeronautical and Associated Equipment, General Specifications for), and MIL-T-5574A (Thermostat, Aircraft, General Specifications for). The device is currently 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

Pulse Amplifier

Single Channel Analyzer

This stable, non overload pulse am plifier together wit a precision singl channel analyzer, o one standard size chassis, can be use for scintillation spectroscopy, single compone monitoring and proportional counter pulse analys

The Model N-302 amplifier, which employs dela line clipping and long-tailed pair stages with fee back, has good stability, short rise-time, and exce lent overload characteristics. Overloads as large a factor of 100 are handled easily. The pulse heig selector is of advanced design and provides sho time resolution, high base line and window stabili and low rate dependence.

Hamner Electronics Co., Inc., Dept. ED, P. Box 531, Princeton, N. J.

CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATI

Power Pickup

for Speed Controls

A new power pic up serves as a s generating pow source for operati directly over and u der speed contr or warning devic The Model 30 pickup provides s ficient power to operate low voltage electrical d vices without the use of an amplifier. The pow output is high with an optimum load of 1000 oh and 750 mh average pickup inductance. At actu ing surface speeds of 250 or more inches per seco the 3040 provides sufficient power to operate rel having 100 mw sensitivity. When using two g manium diodes in a voltage doubler circuit, it v operate a conventional 2500 ohm vacuum tube pl circuit relay.

Power output can be substantially increased any low speed by placing enough capacity acr the pickup, causing it to resonate at the freque generated for the desired speed. Measuring 2- in. overall length (exclusive of the mating con tor) and 3/4 in. in diameter, the new pickup wei only two oz.

Other features are a sleeve-protected coil sect which extends 5/16 in. from the end of the threa portion of the mounting shell, and an enlarged di eter pole piece made flush with the end of the c Temperature limit is 200 F.

Electro Products Lab. Dept. ED, 4501 Rave wood Ave., Chicago 40, Ill.

CIRCLE 207 ON READER-SERVICE CARD FOR MORE INFORMAT

Tape-on Surface Resistor

For Temperature Telemetering

A new line of tape-on surface temperature resistors for temperature telemetering 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 telemetering 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 transducers without any further circuitry modification. These resistors are available in various ranges from -300 F to +400 F and are furnished with two 6 in. long fiberglas-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 73, 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 counters, shaft synchronization, register control, and the like. It is most useful in operations where the operate 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., 115 v a.c.

Farmer Electric Products Co., Inc., Dept. ED, 30 Washington St., Newton Lower Falls, Mass.

CIRCLE 211 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

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:	±2%

PRICE $1450.

Immediate Delivery

Watch for further announcements by —— Wayne Kerr —— *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

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 ⅞"-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 21

Magnetic tape recording and playba system for recording stress, pressure, te perature and vibration is described in Bu letin No. 1561 B now available. The syste provides direct amplitude modulation, wid band frequency modulation, RDB fr quency modulation and pulse duratio modulation as well as compound modul tion.

The standard recorder accommodates op eration both on air and on the ground, a entire recording system is operable fr single phase 115 v, 50/60/400 cycle pow source. Also featured are a record amp fier, signal modulators, and automatic ca brator permitting "in-flight" calibratio with negligible data loss. Consolidat Electrodynamics Corp., 300 N. Sie Madre Villa, Pasadena, Calif.

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. Thecabinet 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.

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 wtih 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 23

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., 11-11 131st St., College Point 56, N. Y.

Silicone Lubricants 23

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.

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.

The Vacuum Switch Goes to Work

SWITCHING TRANSMITTER ANTENNAS

Jennings RADIO
VACUUM ELECTRONIC COMPONENTS

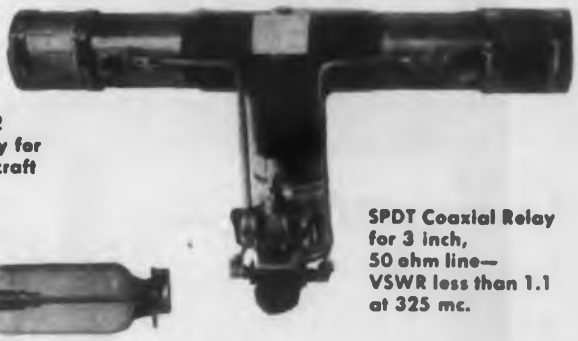
No longer is it necessary to manually switch high voltage rf circuits. No longer is it necessary to fight problems of changing contact resistance or rectification due to the oxides that form on contacts in air.

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.

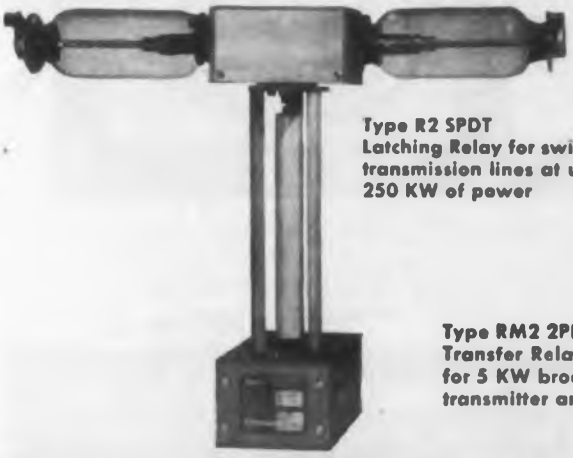
Turn therefore to Jennings with all of your rf switching problems. "Hot" or "cold" rf circuits can be remotely operated at any power level and at any transmission line frequency. Jennings vacuum switches can be used to switch antennas from transmit to receive, from the final amplifier to the driver stage, 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

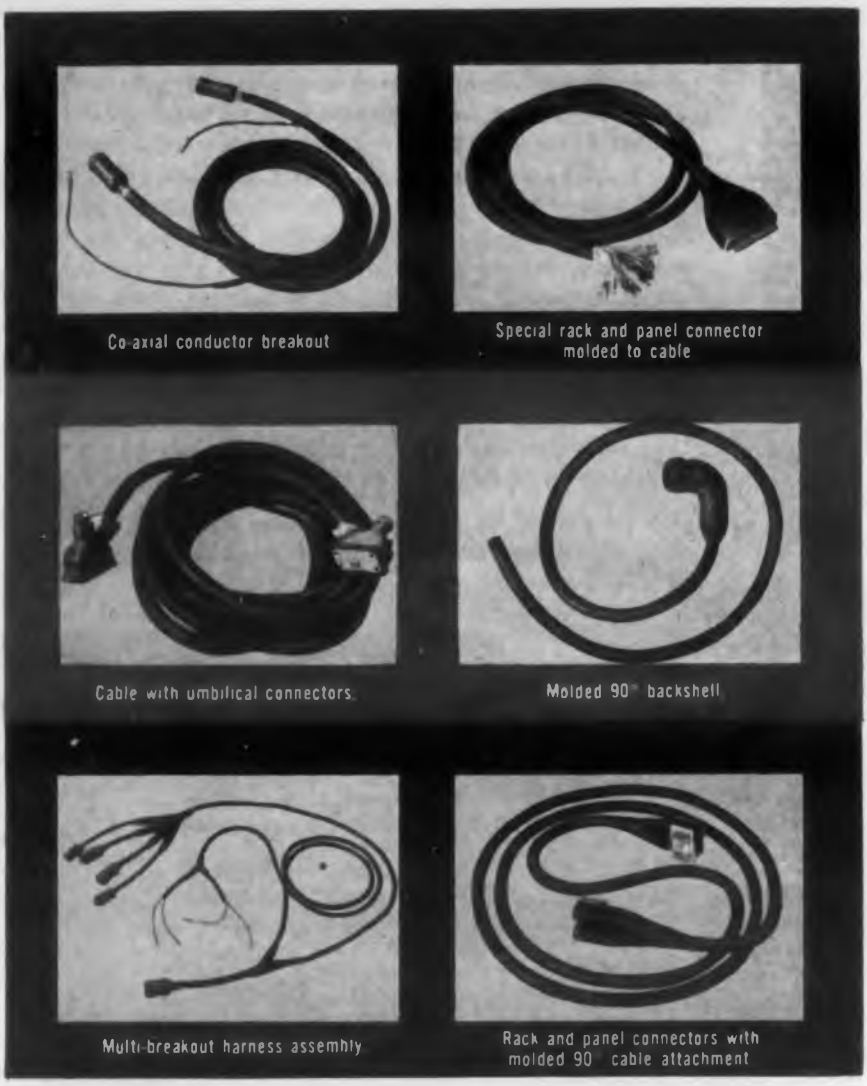
JENNINGS RADIO MANUFACTURING CORPORATION • 970 McLAUGHLIN AVE.
P.O. BOX 1278 • SAN JOSE 8, CALIFORNIA

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 quatitative 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.

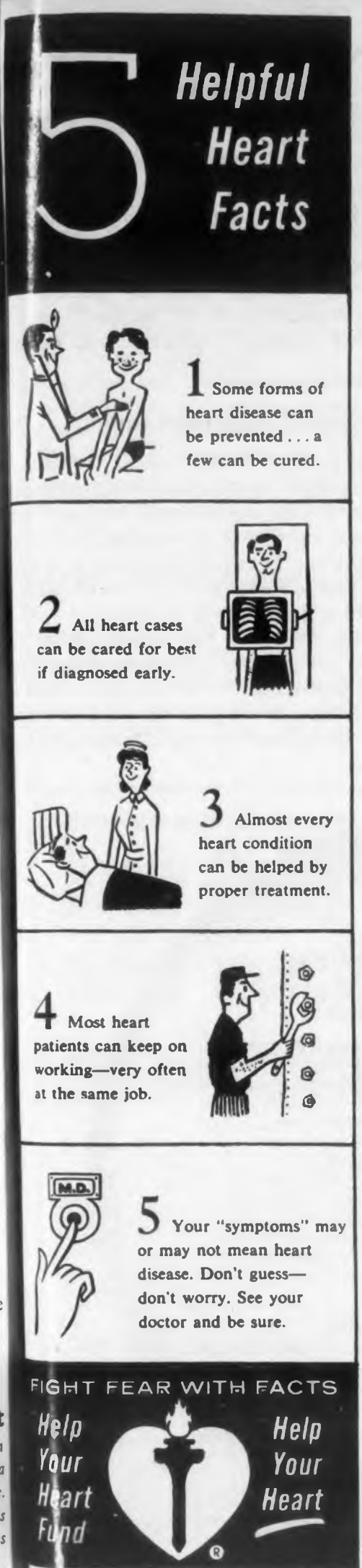
Powdered Metal Parts 254

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 reoiling 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. Heinemann Electric Co., 449 Plum St., Trenton 2, N.J.



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

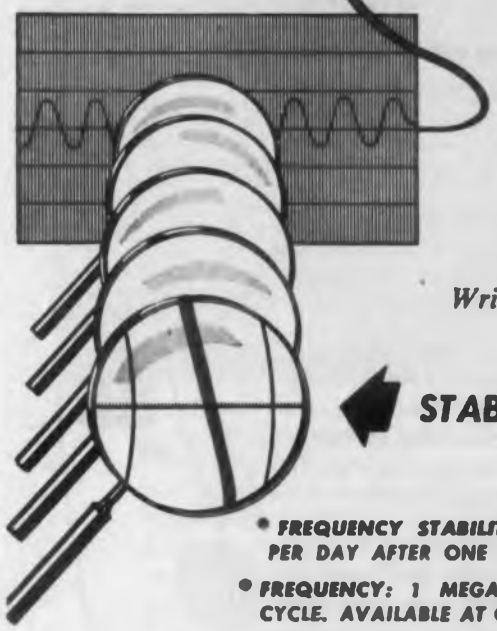
A brochure on a direct thermal imaging device has been announced. Bulletin RD 515 describes this instrument as being used for locating and monitoring either hot or cold spots. Specific applications illustrated include use of device for test bonds and laminations, process equipment, and determinations 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 . . .



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?

better check 30% SPACE 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.

Use of this new encapsulating process permits a space saving of up to 30% compared with hermetically sealed canning, while at the same time producing finished components highly resistant to conditions of humidity and thermal shock and capable of meeting the rigid requirements of Government Specification MIL-T-27-A.

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

TW1452

CIRCLE 271 ON READER-SERVICE CARD FOR MORE INFORMATION

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 autocollimator, 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.

mpacting Presses 279

A complete line of industrial compacting sses is described in a 24-page compre- sive catalog, No. 816 just issued. It in- des tiny ferrite rings and other sub- iature electronic parts to large ceramic s such as grinding wheels and brake in- s, as well as catalysts and other chemical parations, carbon brushes, bi-metallic tacts, plastics preforms bearings and hings and other powdered metal parts, pharmaceutical products.

Models range from simple hand-operated hines of 1-1/2 ton capacity to automatic ton hydraulic presses; with production s ranging from 5 or 6 pieces per min. to 0 per min. F. J. Stokes Corp., Tabletting ., 5500 Tabor Rd., Philadelphia 20, Pa.

mperature Conversion Chart 280

A pocket temperature conversion chart suring 8-1/2 by 3-1/2 in. is now avail- . The easy-to-read tables of Fahrenheit Centigrade temperature equivalents uld be a valuable time saver. Moeller rument Co., Richmond Hill 18, N.Y.

Temperature Recorders 281

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.

0 CPS to 1 MC!
DIRECT READING

new

Computer-Measurements Model 226A

UNIVERSAL COUNTER-TIMER

FREQUENCY • PERIOD • TIME INTERVAL • FREQUENCY • PERIOD • TIME INTERVAL • FREQUENCY • PERIOD • TIME INTERVAL • FREQUENCY

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 millisec, 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

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)

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**

Data Subject to Change Without Notice — Prices F.O.B. Factory

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

LC-30

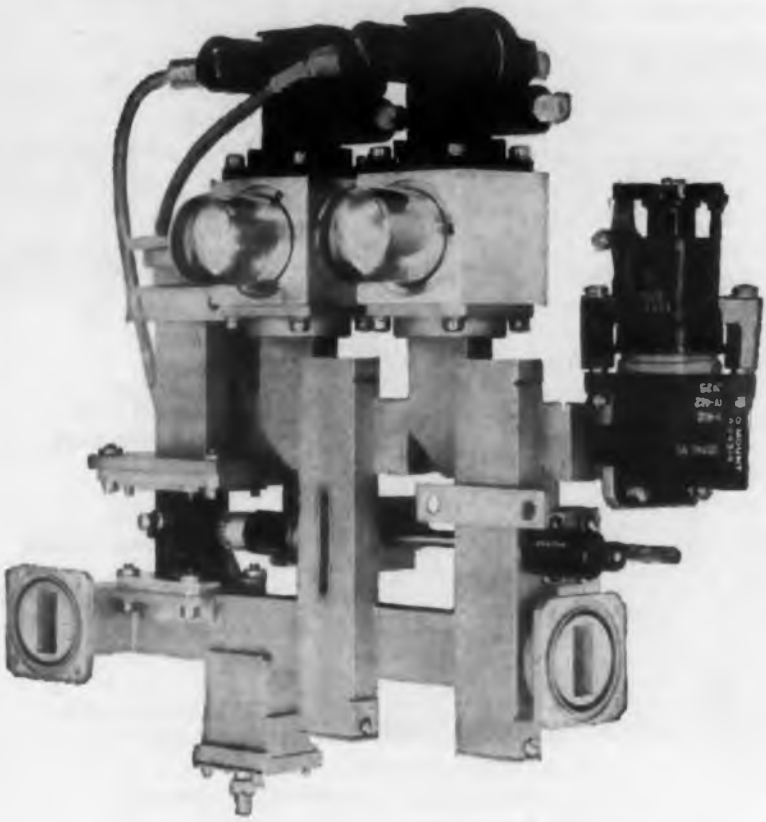
CIRCLE 284 ON READER-SERVICE CARD FOR MORE INFORMATION

BUDD • STANLEY

offers two outstanding services in microwave transmission components!

(1) Exclusive new casting process now produces waveguide assemblies without machining and brazing.

(2) RF heads complete with electron tubes and all accessories fully tested to your specifications and ready for installation in your system.



RF HEAD (cast section shown unpainted)

You can depend on Budd•Stanley engineering know-how, manufacturing methods and experience to produce microwave transmission equipment to your specific requirements.

Write to Dept. D-1 for booklet "Additional Facts about the Budd•Stanley Casting Process".

BUDD • STANLEY CO. INC.

43-01 22nd St., Long Island City 1, N. Y.
Phone STillwell 6-1706
Cable Address "BUDDSTAN"

Quality • Economy • Dependability

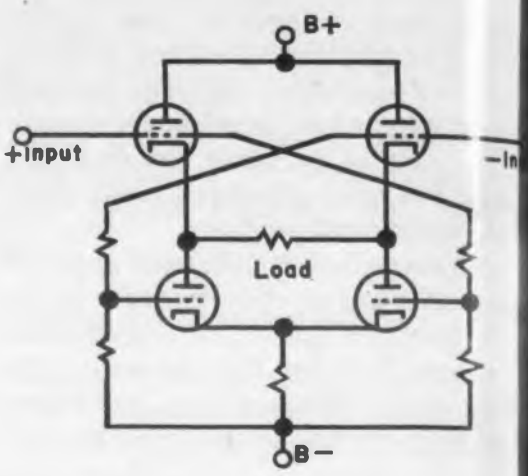
CIRCLE 287 ON READER-SERVICE CARD FOR MORE INFORMATION

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 tube and is designed to produce consi able radiation at wavelengths less t 25×10^{-4} cm.

al Response Amplifier

nt No. 2,758,161. Stuart P. Jackson. igned to General Electric Company, Y rk.)

ba nced, direct coupled amplifier cir- for supplying power to a load in re- se to a balanced input signal. A sche- ic diagram of the output stage of the lifier is shown. The four output triodes driven in push-pull with the lower tubes iving approximately half of the signal ge that is applied to the upper tubes.

Printing System

nt No. 2,757,605. Arnold I. Dumey. igned to Potter Instrument Co., Inc., Neck, N. Y.)

line by line printing system utilizing a ting wheel with at least two identical of type face, and as many printing ham- s as there are characters in a line. The to be printed is stored in an electrical mory circuit which in turn actuates the ting hammers when the desired char- r is opposite the appropriate line posi- The system is thus capable of printing ast one line for every revolution of the 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.

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.

Eimac

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

The World's Largest Manufacturer of Transmitting Tubes

CIRCLE 290 ON READER-SERVICE CARD FOR MORE INFORMATION

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	±1%
Frequency regulation	±1% (±0.01% with auxiliary frequency standard fixed at 400 cycles)
Load range	0-250 VA

MODEL FCR 250

Sorensen

SORENSEN & COMPANY, INC. • STAMFORD, CONN.

CIRCLE 291 ON READER-SERVICE CARD FOR MORE INFORMATION

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 Electron

R. L. Oldfield. American Technical Socie 848 East 58th St., Chicago 37, Ill., 3 pages, $4.95.

Written as a general introduction to many facets of electronics, this book votes considerable space to the discuss of new electronics devices for home and dustry. It is intended for beginners and dents. Advantages and disadvantages various types of components for high fi ity systems are explored along with tr mission and reception of both monochro and color television. For reference p poses, a glossary of electronic terms, a of basic electronic formulas, a conver table, an alphabetical list of abbreviati and letter symbols.

erical Analysis, Vol. VI

eedings of the Sixth Symposium in Applied Mathematics of the American Mathematical Society, John H. Curtiss, Editor, Graw-Hill Book Company.

is volume contains papers presented at ixth symposium, covering such areas as y of computer programming, number ry, differential equations, and numerimethods. Contributors to the volume in- Richard Bellman, Stefan Bergman, Bruck, D. R. Clutterham, A. H. Taub, h W. Fischbach, S. P. Frankel, T. S. kin, P. C. Rosenbloom and Olga sky.

Oscilloscope at Work

d Haas and R. W. Hallows. Philosical Library, 15 E. 40th St., New York Y. 171 pages. Price: $10.00.

ended to cover all possible uses of the de-ray oscilloscope, this practical lays special stress on radio and tele- receiver applications. The more than oscillograms which illustrate the book to its practical value. Numerous cirdrawings 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.

TWO NEW 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.

Write today for complete details!

APPLICATIONS

- **precision measurement of core characteristics in magnetic logic circuits**
- **transistor testing**
- **high current for memory circuit testing**
- **high speed ferrite study**
- **switch core investigation**

OTHER REFLECTONE PRODUCTS: integrators • differentials • couplings • power supplies • simulators • procedure trainers

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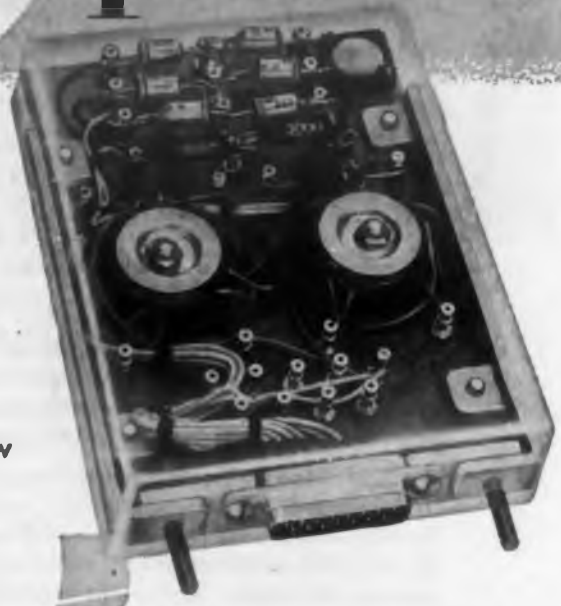

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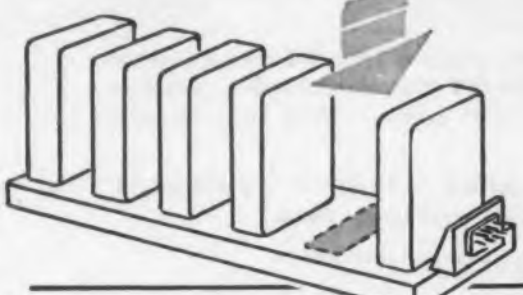

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MAGNETIC PRE-AMP + HIGH GAIN MAGNETIC AMPLIFIER	115 volts 400 cps.	5, 10, 15, 20 watts	0.1 volt AC	.008 to .1
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CIRCLE 295 ON READER-SERVICE CARD FOR MORE INFORMATION

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 d grams and descriptions. The more than circuits presented have been chosen p ticularly for their value to designers of c trol devices and systems.

The circuits are logically grouped chapters according to function and emp size automatic control throughout. Con information on each circuit encompa general nature, performance characteris operation, data on critical components, suggested applications. An entire chapt devoted to practical transistor circuits.

Each circuit may be quickly loc either by function in the Table of Cont or by one of its several names in the In

Picture Book of TV Troubles, Vol. 7, So Circuits and L-V Power Supplies

John F. Rider, Inc., 480 Canal St., New 13, N.Y., 49 pages, $1.50.

Reporting the results of troublesho a large number of TV receivers, this ume, primarily for technicians, shows effects of faults in the sound and L-V po supply circuits by examples of inco waveforms at specific test points. The ponent at fault is identified on appro schematics and correct waveforms shown.

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 critical 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.

To the engineer capable of original thinking...

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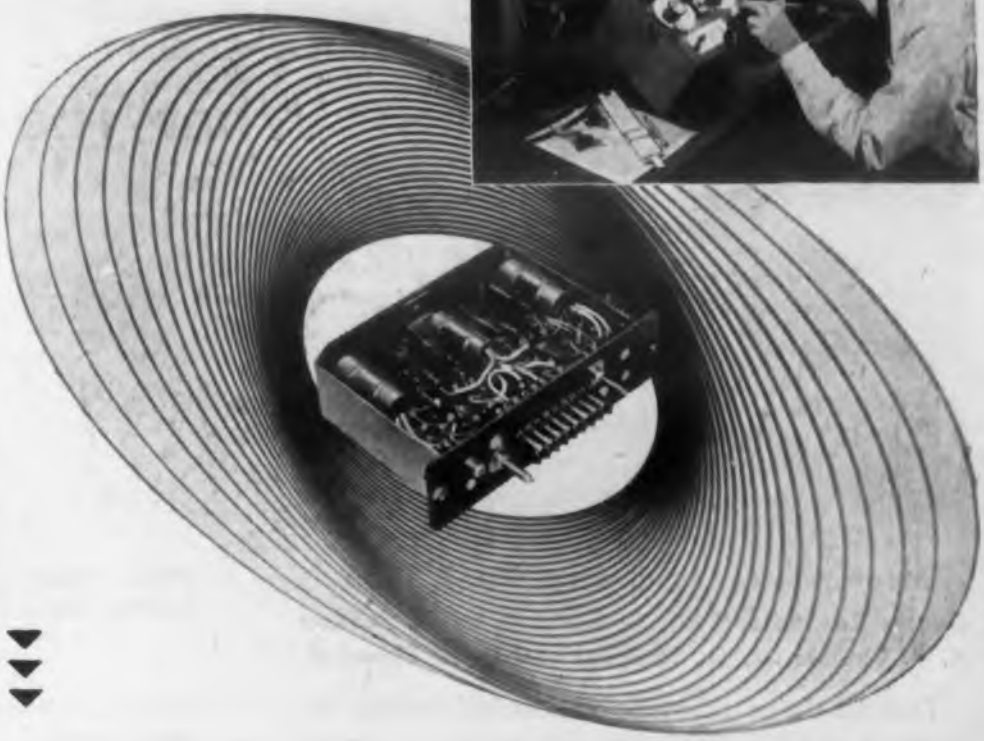

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CIRCLE 298 ON READER-SERVICE CARD FOR MORE INFORMATION

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 directly measuring the attenuation of the free oscillations, using the equation

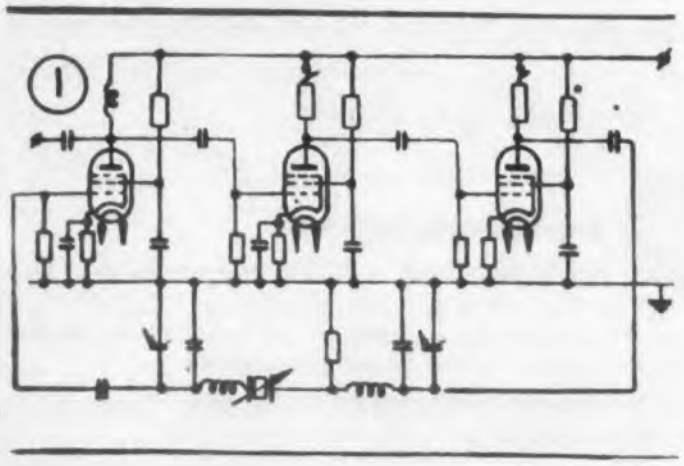
$$Q = \frac{1}{2}\omega\tau$$

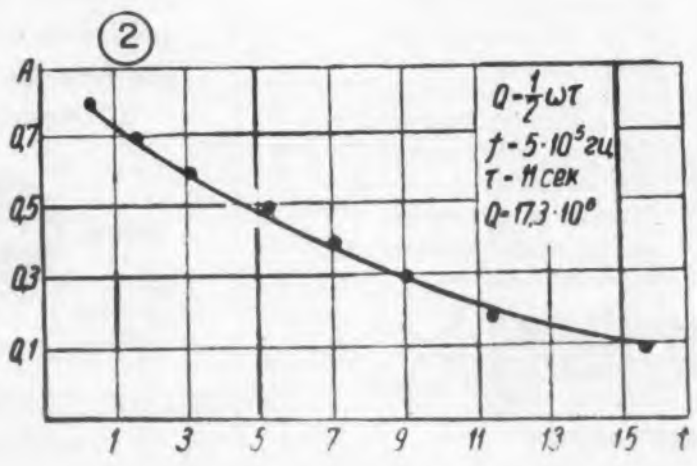
where ω is the resonant angular frequency and τ the time constant of the circuit.

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. Gluzberg (11 pp, 9 figs).

Concerns principally the use of a "minimiz... with which the best analog solution satisfying c... tain boundary problems is determined by a succ... sive-approximation method. (The application of t... minimization method to the solution of linear al... braic equation is given by W. Adcock in the I... *view of Scientific Instruments* for March 1948.)

Induction Linear Potentiometer, Ia. M. Pul'er, (... pp, 12 figs).

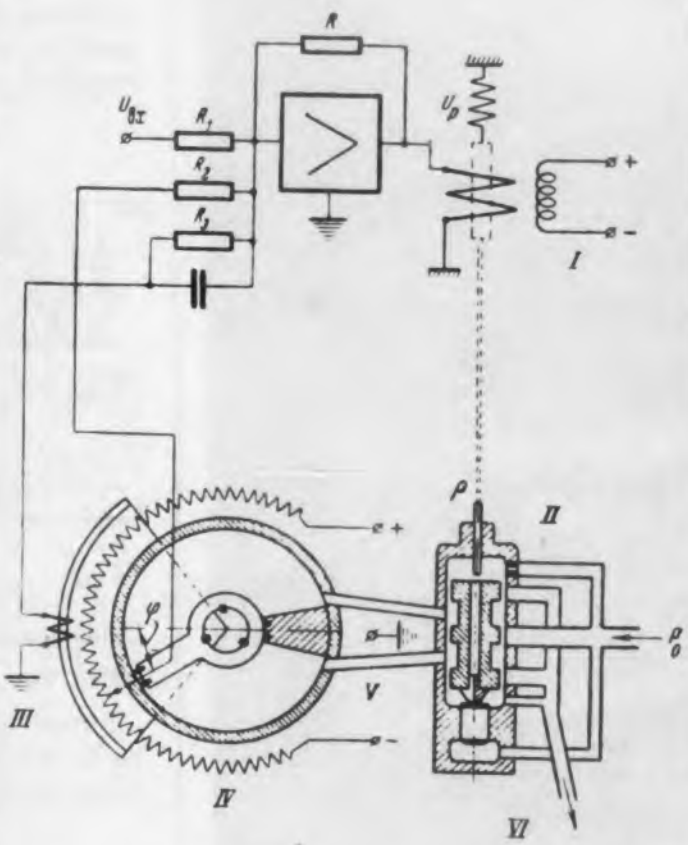
Analysis of construction, performance, and err... of contactless and slide-wire induction potentio... eters. Refers to article by S. Davis, Induction Pote... tiometer as an Angular Position Indicator, *Prod... Engineering*, August, 1954.

Initial Parameters and Design Values for Calcul... tion of Characteristics of Two-phase Miniatu... Motors and Their Determination, (11 pp, 3 figs).

The symmetrical components of the rotor curre... of a two-phase miniature induction motor are c... culated and used for the analysis of the operati... characteristics of servomotors and tachometer ge... erators. A procedure is given for experimenta... determining generalized parameters and desi... values for the machines.

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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Coil Voltage	3-5 V.D.C.	6-10 V.D.C.	9-15 V.D.C.	12-21 V.D.C.	18-30 V.D.C.
Pickup	44 MA Max.	22 MA Max.	14 MA Max.	10 MA Max.	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°C
- **Life:** 1,000,000 operations at rated load
- **Contact Resistance:** .05 Ohms

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CIRCLE 300 ON READER-SERVICE CARD FOR MORE INFORMATION

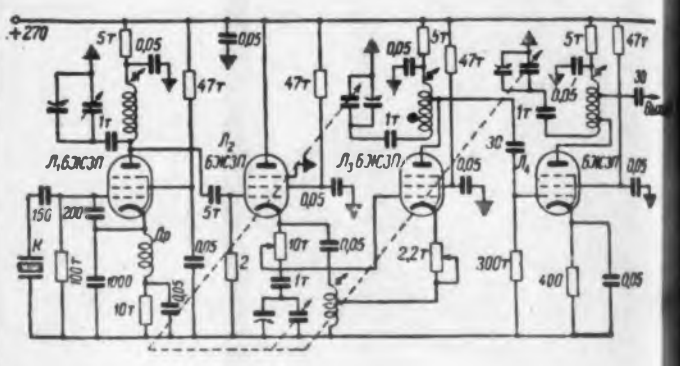
Contents of Elektrosviaz' No. 6, 1956

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. I. 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, figs).

Survey of the state of the art, based on an article by E. Schwartz in *Archiv für Elektr, Ubertragung*, 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, (7 pp, 17 figs).

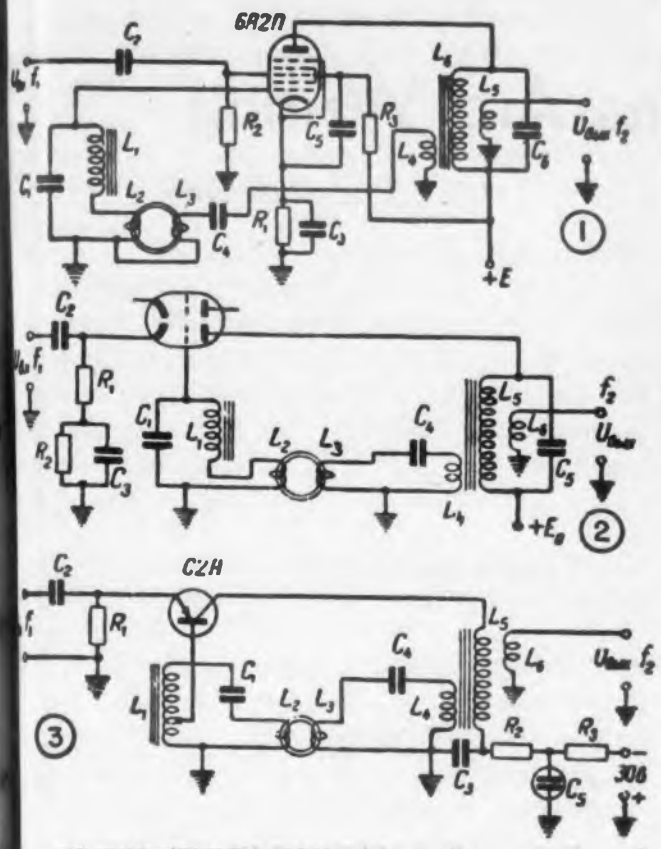
Discusses the regeneration of distorted pulses with the aid of electronic telegraph repeaters.

Use of Mutual Inductance in Electric Filters, Kh. Cherne, (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.

...e of Ferrite Transformers in Frequency Multipli-...ion and Division Circuits, V. M. Rozov, (4 pp, 5 ...gs).

D...scription of several simple experimentally-veri-...d frequency multiplication and division circuits ...th toroidal transformers employing ferrite core ...terial with rectangular hysteresis loop.



Figures 1, 2, and 3 are frequency multiplication and division circuits with toroidal ferrite transformers.

...legraph-Pulse Distortion Produced in Tonal-...legraphy Channels by Pulse-Type Noise, A. M. ...ngerenko, (8 pp, 6 figs).

Statistical treatment, showing that the noise ...anges the duration of a transmitted pulse in a ...nner independent of the bandwidth of the chan-...l. The distortion-attenuation obtained in fm ...nsmission is 3.5 times greater than that obtained ... am channels.

...terference Induced in Communication Lines by ...ng Power-Transmission Lines, I. G. Gertsen-...leyn, (7 pp, 4 figs).

Wa...e-propagation theory is used to calculate ...e distribution of higher voltage and current har-...onic... in a 900-km, 400-kv line. Suggests that ...sen...t inductive-coordination standards in the ...SSR are inadequate.

What The Russians Are Writing

Continued

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).

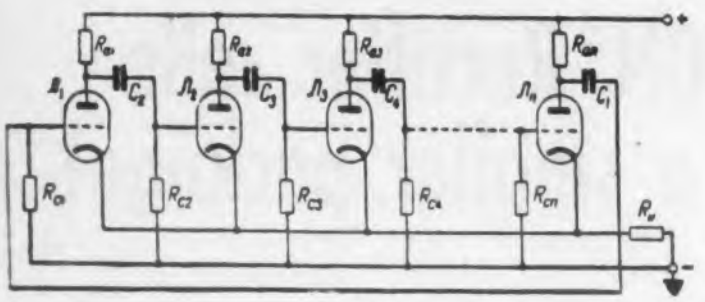


Fig. 3

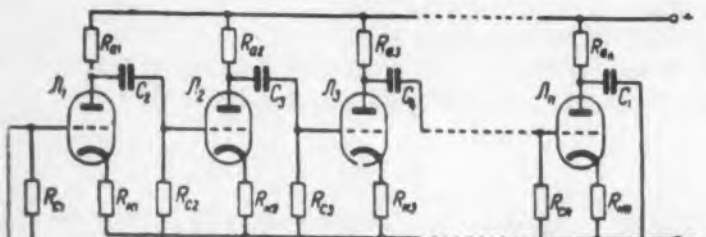


Fig. 5

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 $\omega = p/n$ ($n = 2, 3, \ldots k$). 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.

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. Sodi (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 Test Voltages for High-Frequency Insulators," G. I. Murav'eva, (5 pp, 1 fig. 1 table).

Contents of Elektrosviaz' No. 7, 1956

em dulation of Modulated Television Signals with ymmetrical Sidebands, A. K. Oksman, (19 pp, 17 gs).

Theoretical discussion of "linear," square-law, and -phase demodulation and of the distortion inerent 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 ideband Communication," *Proc. IEE*, part III, March 1942.

ew Methods for Measuring the Characteristics of Television Channel, M. I. Kirosheev, (9 pp, 12 gs).

Describes a method employing sine-squared ulses to test the transfer characteristics of a chanel. Indicates that it is best to test a television chanel directly during program transmission. By way example, a method employing a special test line described. Refers to "Waveform Responses of elevision Links" by N. W. Lewis, *Proc. IEE*, part II, July 1954, p 258.

esign and Calculation of Electronic Bridge Circuit r Control of Gas-Filled Rectifiers, V. N. Aksenov, l pp, 6 figs).

The usual phase control of gas-filled rectifiers by eans of induction or static phase regulators is bject to many shortcomings, foremost among hich being low speed and the fact that such deces do not carry out all the required control funcons—voltage regulation at any speed, high-speed otection, resetting after operation, limiting the mplitude and duration of the short-circuit current, d stabilization. An electronic circuit performing l the above functions is shown and the article is evoted to the analysis and operating characteristics this type of circuit.

igh-Frequency Wattmeter, B. N. Terent'ev, (8 pp, 9 gs).

Discussion of the principle of operation of a wideand instrument measuring the product EI cos φ. he manner in which the individual circuit elements ect the accuracy is discussed. A model of a 15 kw 20 mc wattmeter is described.

tenuation of Low-Pass and High-Pass m-derived lters, K. A. Semenov, (10 pp, 6 figs).

The analysis of the dependence of the characteris- attenuation on the Q at cutoff frequency is given. he value of the critical Q, corresponding to the aximum attenuation for each value of m is given. ots are shown for the dependence of the attenuaon on Q for various values of m. The author points t that in the design of such filters it is essential to ake allowances for the critical value of Q, particularly at low values of m.

Printed Circuit Soldering

SUCCESSFUL soldering of printed circuits based on the same fundamentals that underlie a other soldering technique. *1.* There must be met lurgical affinity between the metals that are s dered. *2.* These metals must be free, and rema free, from all non-metallic surface contaminatio *3.* There must be complete and adequate metal contact between the solder and the metal that is s dered. *4.* The temperature must be adequate f efficient alloy or metal solvent action.

Solder Composition

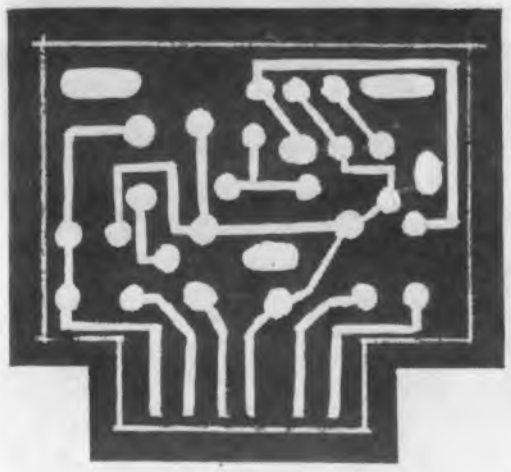
To satisfy the time and complexity requireme of printed circuit soldering, the solder must be flu and free-flowing to penetrate and wet the intric recesses of the pattern, and of such metal solv character as to provide the most rapid alloy acti at the relatively reduced soldering temperatur Accordingly, the best solder alloy is close to t eutectic point. The straight tin-lead alloy, of 63/ or 60/40 composition, is in wide use, with fai satisfactory results.

Silver Solder

Highly useful in securing solder attachment non-metallic surfaces, or in such applications "Project Tinkertoy," are the silver solders, havin composition of approximately 3/61/36. This 3 p cent silver solder requires a temperature of 47 instead of 361 F, to effect complete solution, an working temperature of at least 525 F. For stric metal soldering, a silver solder is not recommend Silver solder applications should be confined to tachments on non-metallic surfaces.

Temperature vs. Heat

Whether a plastic board warps or is damaged pends not upon the solder temperature but on thermal absorption of the material. When an sembled board is placed on hot solder, the m



minals very rapidly approach the solder tempera-
e, but the non-conductive plastic board absorbs
y little heat. Accordingly, there is less damage
the plastic board when soldering at high tempera-
es than when soldering at a low one. Since the
uired time interval of soldering is about 2 to 3
s at 550 F rather than some 15 secs at 450 F, the
rd is subjected to much less total heat during
shorter interval.

Solder Segregation

The practice of periodically adding tin to the sol-
pot or dip container to compensate for its selec-
e abstraction during the soldering operation
ores the facts of the case. When the molten solder
ls at the close of the working day, the lead-rich
stals are the first to crystallize, leaving a tin-rich
uid portion. If this metal is now used while it is
this partly melted condition, the tin-rich portion
the top is consumed at the expense of the high-
d fraction at the bottom of the container. Solder
uld, then, always be completely molten and
red before use.

Contamination of the Solder

Owing to the normal reaction of the metals, the
lten solder exerts a metal solvent action on the
tal being soldered. This dissolved metal slowly
ntaminates the solder bath. The extent of con-
mination differs according to the nature of the
ntaminant. Zinc, for example, is objectionable in
en minute traces, while silver may be dissolved in
preciable amounts without undue harm. When
e solder bath no longer seems to meet the desired
ndard of quality performance, it is wise to re-
ce it with fresh, new solder rather than try to add
"replenisher." *Abstracted from Printed Circuit*
dering, Clifford L. Barber, Kester Solder Com-
y, Chicago, Illinois, Paper presented at Formica
nted Circuit Forum, Netherland Hilton Hotel,
cinnati, Ohio, Oct. 1956.

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 1, NAVORD 2718, Dec. 1952 PB 122022, Microfilm $3.00, Photocopy $6.30; Part II, NAVORD 3972, 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.*

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 spectographic 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.*

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

and how a weldmatic solved it

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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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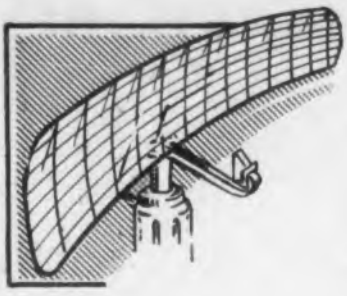

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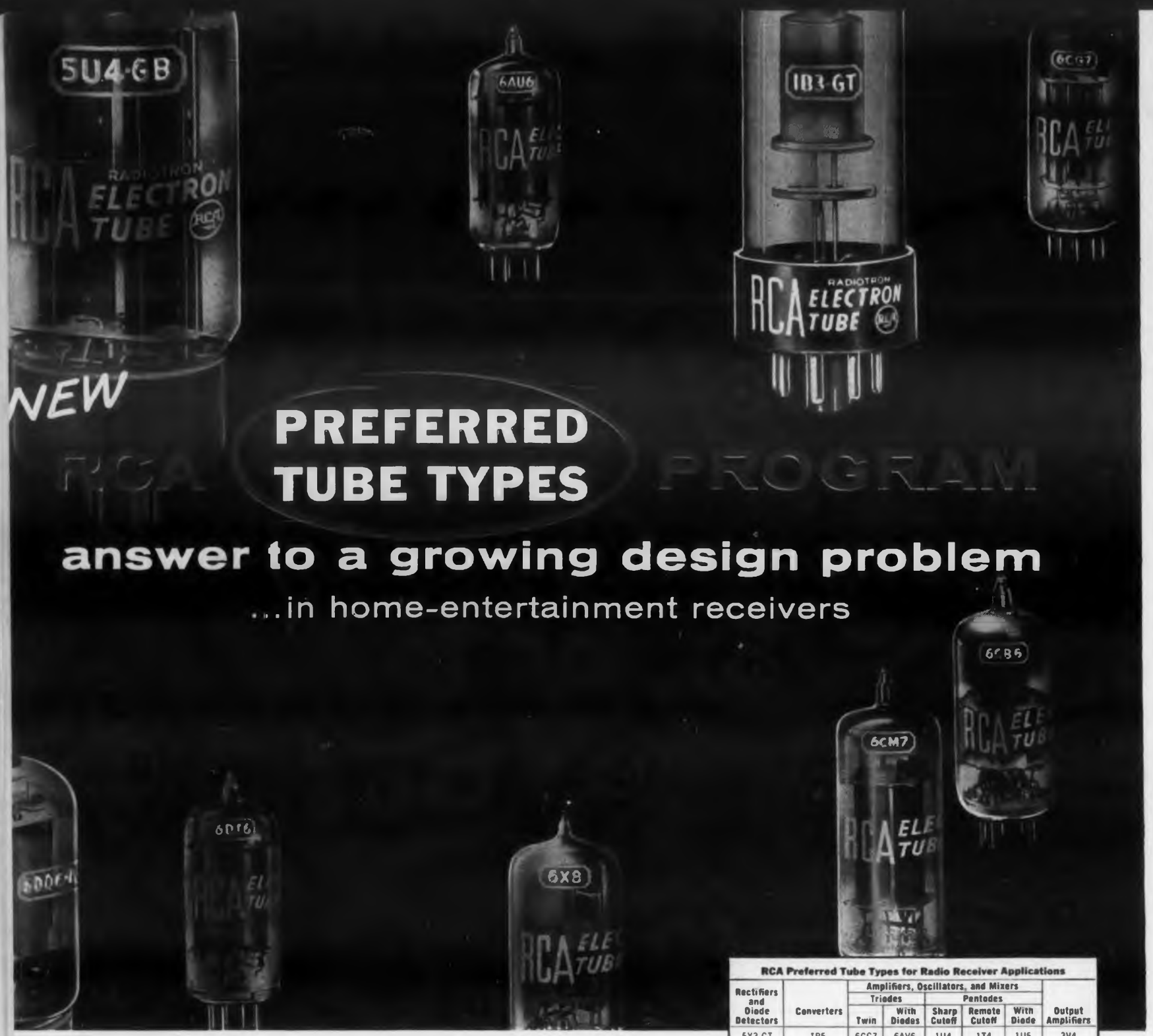

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