ELECTRONIC INDUSTRIES

46th ANNUAL IRE CONVENTION

"Explorer" — And What It Means!

Strain Gages In Supersonic Aircraft

Manufacturing, Design & Operations Edition

A Chilton Publication March • 1958

When we say small . . .

.001

Maximum diameter on disc .235. Measure between leads .150. Capacities available are 800 and .001. Tolerance GMV.

.0015

Maximum diameter on disc .290. Measure between leads .250. Tolerance GMV.

we mean small

.02

Maximum diameter on disc .675. Measure between leads .375. Available +80% −20%.

.01

Maximum diameter on disc .510. Measure between leads .375. Available +80% −20% or ±20%.

.005

Maximum diameter on disc .390. Measure between leads .250. Tolerance ± 20%.

Type SM DISCAPS

RMC's Type SM DISCAP line has been expanded to include an .01 and .02 that provide the small size demanded by many applications without sacrifice of the quality, dependability and electrical characteristics built in all DISCAPS.

These DISCAPS meet or exceed the EIA RS-198 standard for Z5U ceramic capacitors.

Write on your letterhead for samples and performance data.

Booth No. 2216
I. R. E. Show

SPECIFICATIONS

POWER FACTOR: 1.5% Max. @ 1 KC (initial)

WORKING VOLTAGE: 500 V.D.C.

TEST VOLTAGE: (FLASH): 1000 V.D.C.

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

INSULATION: Durez phenolic (1/8" max. on leads)—vacuum waxed

STAMPING: RMC—Capacity—Z5U

INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms.

AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms.

DISCAP CERAMIC CAPACITORS

RMC

RADIO MATERIALS COMPANY
A DIVISION OF P. R. MALLORY & CO., INC.
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
Two RMC Plants Devoted Exclusively to Ceramic Capacitors
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Circle 1 on Inquiry Card, page 101

ELECTRONIC INDUSTRIES

Vol. 17, No. 3 **March, 1958**

FRONT COVER: The Professional Groups of the Institute of Radio Engineers now total 28, with a membership of nearly 70,000. In the past 7 years alone, some 20 new groups have been formed, and much of the industry's progress can be traced to the work of these committees. An explanation of the abbreviations can be found on page 186.

MONTHLY NEWS ROUND-UP

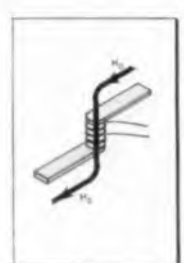
NEW PRODUCTS & TECH DATA

DEPARTMENTS

The information provided by America's first earth satellite will lead to more reliable radio communication, improved air navigation, and the first venture of manned aircraft into space.

Weldable strain gages, requiring no elevated temperature curing and providing a 13% error in sensitivity through 1200°F., appear most promising for supersonic aircraft.

Three-layer construction, of P+, Intrinsic, and N+, for silicon rectifiers promises simple and economic assembly, rugged structure, and satisfactory heat dissipation.



New approach, calculating antenna performance in terms of the magnetic field, instead of electric field, leads to significant improvement in antenna performance.

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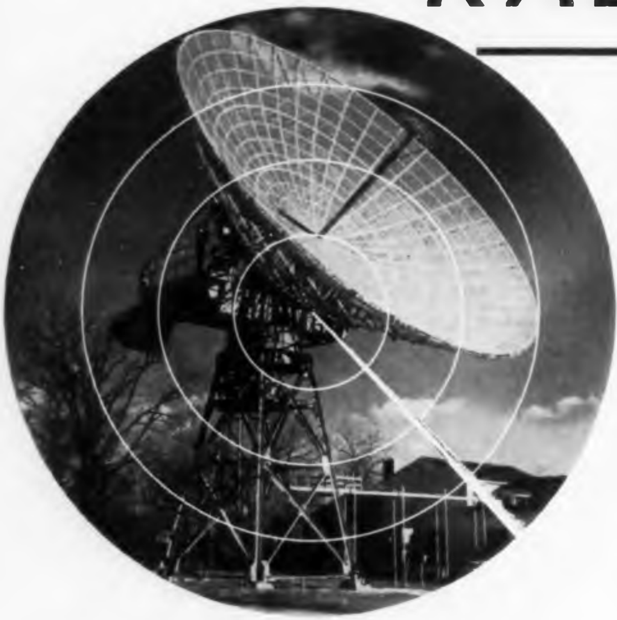
RADARSCOPE



EXPLORER TRACKER

Giant 50-ft. antenna of the Signal Corps Engineering Laboratories' famous Diana moon radar at Ft. Monmouth is being used to follow Explorer as it orbits around the world. These radars will give scientists accurate information when radio reception is poor.

THE ENGINEERING EMPLOYMENT SITUATION is taking a decided turn for the better. Indications are that the IRE show next month will see a return to the mass hiring of a few years back. Hiring halls are being set up by a great number of companies, an indication of the competition that can be expected during the show proceedings. First report from New York hotels indicate that all available space in the neighborhood of the Coliseum has been reserved.

THE GOVERNMENT is taking steps to tighten controls on the use of nickel in order to maintain a supply equal to the needs of military requirements.

THE INTERSERVICE RIVALRY which government circles are so quick to declaim is being pointed to by other scientists as one of the spurs to scientific achievement—the incentive being in the "competition." A typical case is the Thor-Jupiter race between the Army and the Air Force, and, of course, from that came the first U. S. satellite.

NOT RUSSIA ALONE but China too now begins to loom as a scientific competitor to the free world. Dr. Eric A. Walker points out that in the 6 years from 1949 to 1955 enrollment in institutions of higher education in China increased 2½ times—from 116,000 to 288,000—and of all the students enrolled nearly half are studying science and engineering.

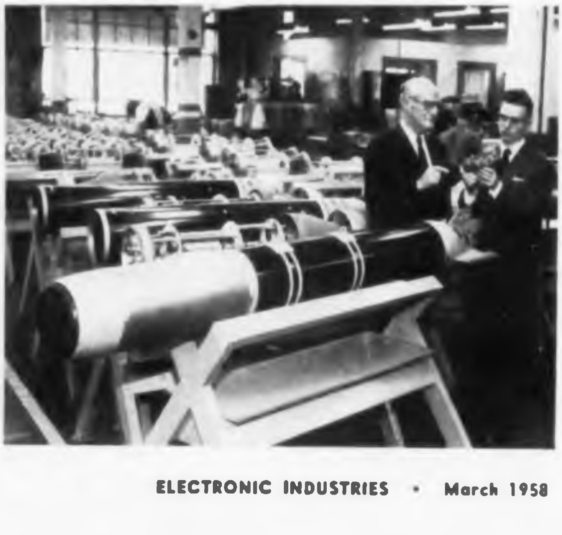
MORE PRECISE INFORMATION on the number of tape recorder sales will be available through a new agreement between the Electronic Industries Association and the Magnetic Recording Industry Association through which MRIA members will provide full and complete data on their tape recorder sales. These figures have previously been jealously guarded by the individual companies in the intensely competitive tape recorder industry. The cooperative effort is being made possible through the assurance of EIA that the information supplied by individual companies will not be let out to their competitors.

FOREIGN TECHNICAL JOURNALS will be abstracted and translated on a mass production basis by the new Foreign Technical Information Center created last month under the Department of Commerce's Office of Technical Services. The center is being established "to collect, evaluate and distribute valuable foreign scientific and technical literature for the use of American scientists and engineers."

TV AND TELEPHONE CIRCUITS are being combined in the same broadband channel in the Trans-Canada link being installed by Bell Labs and Bell Telephone Co. in Canada. It was found that two or three telephone supergroups, of 60 channels each, could be stacked in the 6 to 7 megacycle region above the television signal. The "double decking" was found to be feasible where system lengths range from about 200 to 1000 miles.

UNDERWATER GUIDED MISSILE

The Navy's new Mark 43 anti-submarine torpedo weighs only one-eighth as much as aerial torpedoes of World War II. It homes on its target by transmitting sound signals through the water and listening for an echo. A. L. W. Williams, pres. of Clevite Research Center, and T. E. Lynch, Clevite Ordnance, are checking over the units. Clevite developed and manufactured the torpedoes.



Analyzing current developments and trends throughout the electronic industries that will shape tomorrow's research, manufacturing and operation

LOOK FOR more ultrasonic equipment in the consumer field. At least one home appliance manufacturer is developing an ultrasonic dishwasher for consumer use. The New Jersey Turnpike Commission has been investigating the possibilities of using ultrasonic multiwhistles for fog dispersion along stretches of their highway. Gulton Industries has just successfully made a continuous seam welder that will weld metals to a thickness of 0.080 inches ultrasonically. Seams can be welded at a rate of 200 inches per minute.

PAY-TELEVISION is still kicking this month, but more and more feebly. From all indications in Washington, the only question remaining is just how the death blow will be delivered. Thirty members of the House Commerce Committee last month heard two weeks of pros and cons on the subject of pay-TV and the reactions were almost unanimously against approval. There is still the possibility that the Senate Commerce Committee may rescue the proposal; the word around Washington is that the public reaction against pay-TV has been so startling that, in this an election year, no lawmakers will have the inclination to crusade for the bill. The arguments heard in favor of pay-TV are not dwelling on the service that the system can provide but on the un-American attitude of strangling an industry before it has had a chance to take its case to the public.

THE FCC is being warned by the National Community Television Assoc. that the operation of low power broadcast repeater stations as proposed in FCC Docket No. 12116 will seriously jeopardize the frequency allocations plan. The association pointed out that the effect of VHF repeater devices on the single station market could result in a severe economic impact on the station which would seriously impede its attempts to perform truly local service. One consulting engineer predicted that approval of the devices would cause uncontrollable interference to all TV receiving systems such as standard individual home sets, translator receiving systems, community antenna television receiving systems, and even to the VHF repeaters themselves.

MORE THAN 40 million Americans—one-fourth of the nation—are now enrolled in formal education programs and countless others are involved in less formal education pursuits. One out of every three adults, or an estimated 50 million, participates in various educational programs.

ONE SOLUTION to the educational problem was offered by Elisha Gray II, of Whirlpool Corp., who urged the House of Representatives' Ways and Means Committee to provide a tax credit as an incentive to taxpayers to make contributions to basic scientific research in the colleges and universities.

STEREO DISKS are so eagerly awaited by the hi-fi industry that considerable pressure is being applied to standardize on any workable system compatible with the conventional monaural disks. The system presently favored—the so-called "45-45"—has two channels cut into the same groove, at 90° to each other. The same stylus reads both movements. Another system demonstrated last month by Jerry B. Minter and Electrosonic Laboratories shows possibilities. In addition to the conventional channel, another is recorded on a frequency modulated carrier in the 30 kc range. If time permits a number of other systems will probably also be suggested, but as with any new industry the advantage will be very strongly in favor of the first system adopted.

"WINDOWSCREEN" MAGNETIC MEMORY consisting of wires woven together like screen wire will greatly simplify electronic memory systems. Developed by Bell Labs it uses longitudinal magnetic wires and transverse plain copper wires. Pulses are transmitted along each of the wires to form a "bit" at the junction in the form of a permanent magnetic field.

HIGH-LIGHT

This glowing device appears to be little more than a windscreen around a candle. Actually it is the latest product of Westinghouse Lamp Division's research in electroluminescence. It is a 12-in. square of opaque fabric woven from stainless steel wire and coated with phosphors and conductive material, and formed into a cylinder. The power supplied is 250 volts at 4,000 cycles.

Circle 2 on Inquiry Card, page 101

As We Go To Press . . .

Simple cockpit display warns pilot of approaching aircraft and tells him whether to veer right or left to avoid crash.

Anti-Collision System Uses Weather Radar

An electronic collision avoidance system that will protect even the fastest jet airliners from mid-air collisions was demonstrated at the Air Transport Association meeting in Los Angeles by IT&T's Federal Telecommunication Labs.

The self-contained equipment, which requires no cooperation from the ground or other aircraft and which utilizes weather radar for its "eyes," provides sufficient warning for planes approaching at almost twice the speed of sound.

Four miniature antennas receive the radar impulses that have searched a 90-degree, pie-shaped sector extending from the nose of the plane. The impulses feed an electronic "brain" with data necessary to compute the hazard and the possibility of collision—all within 2 secs.

The computer determines the course to safety designated by a red arrow or indicator. A warning horn alerts the pilot who veers the plane in the direction indicated.

The system has a range of 8 miles.

New Professional Group

The new IRE Professional Group on Radio Interference is now in operation. In the elections for the first panel of officers H. R. Schwenk was elected chairman; A. R. Kall, secretary, and J. P. McNaul, treasurer.

The group's activities will include investigations of the origin, effect, control and measurement of radio frequency interference.

All engineers interested in joining the new group should contact I.R.E., 1 E. 79th St., N. Y. 21, N. Y.

Device Measures Missile Misses

A precision electronic device that tells anti-aircraft gunners how close their missiles come to the target has been perfected by scientists at the Naval Ordnance Lab, Silver Spring, Md.

Built to speed up the development of better anti-aircraft missiles and missile crews, the new "miss-distance indicator" is an automatic precision system that indicates the distance in feet by which the missile failed to hit the target aircraft.

The MDI is composed of 3 VHF radio units: a tiny transmitter in the missile, a receiver-recorder on board the missile launching ship, and a "transponder," or relay station, inside the target itself. When the missile is fired, its transmitter signals both the transponder in the target and the receiver on the ship. At the same time the transponder retransmits to the receiver, on a different wave length, the signal coming in to it from the missile.

The receiver compares the signal from the transponder with the signal coming direct from the missile. The difference between these two signals is recorded by a tracing that shows the distance between missile and target at the point of closest approach. Also shown is the relative speed between missile and target.

SMALLEST GYRO-COMPASS

Precision gyro-compass, believed to be the world's smallest, is 7½ in. in diameter, 9 in. high. Sperry Gyroscope Co. developed the unit specifically for small boat use.

ARMY'S OWN HELMET

The Army's helicopter pilots are getting a helmet all their own, with a built-in microphone. Adapted from Navy gear the helmet is being improved to protect against shrapnel.

Disc Stereo Channel Rides on FM Carrier

A unique form of stereo disc recording was demonstrated last month by its inventor, Jerry B. Minter, and the technical staff of Electro-Sonic Laboratories, Inc.

The stereophonic properties of the discs is obtained from a supersonic, frequency modulated carrier recorded in the groove together with the ordinary lateral microgroove recording. They are played back with a conventional monaural cartridge, in which the single stylus operates laterally only, as is customary in ordinary monaural recordings.

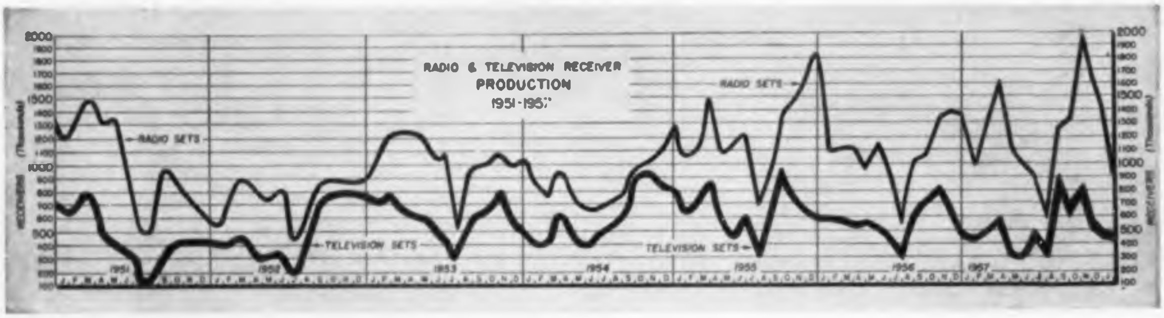
The new system achieves *double* compatibility: not only can the playback cartridge reproduce monaural discs as well as the stereo recordings, but the stereo disc, when played back with a monaural system, will reproduce the combined output of both channels—not just one channel alone. Persons without stereo equipment can enjoy these recordings exactly as they now enjoy their present single channel high quality recordings.

MORE NEWS

ON PAGE 12


STEMCO
THERMOSTATS
for electronic and avionic applications
Features to fit your special requirements for avionic and electronic applications—from standard, production-line Stemco thermostats. That's just part of the Stemco story.
Because Stevens makes the widest range of bimetal thermostats in the industry, we offer an unusual number of basic design types . . . various terminal arrangements and mounting provisions . . . different temperature ranges and performance characteristics. In addition, Stemco thermostats feature small cubage, light weight and proven reliability—at a production price.
So get the Stemco story first. Write, call or wire now while your product is in the planning stage.
*Refer to Guide 400 EO for U.L. and C.S.A. approved ratings.
TYPE A*
Semi-enclosed
Insulated, electrically independent bimetal disc gives fast response and quick, snap-action control. Operation from —10° to 400 F or higher on special order. Various mountings and terminals. Rated from 4 to 13 amps at 115 volts AC, depending on service conditions. 4 amps at 230 volts AC and 28 volts DC. Bulletin 3000.
TYPE C
Hermetically sealed
Electrically identical to semi enclosed Type C but sealed in crystal can. Also supplied as double thermostat "alarm" type. Turret terminals or wire leads. Bulletin 5000
TYPE M*
Semi-enclosed
Electrically independent bimetal disc type for appliance and electronic applications from —10 to 350 F. Rating 8 amps at 115 volts AC, 4 amps at 230 volts AC and 28 volts DC. Virtually any type terminal. Bulletin 6000
TYPE A
Hermetically sealed
Electrically identical to semi-enclosed Type A. Temperatures from —10° to 300 F. Various enclosures and mountings, including brackets, available. For appliance, electronic, apparatus applications. Bulletin 3000.
TYPE C
Semi-enclosed
Small, positive acting. Electrically independent bimetal strip for operation from —10 to 300 F. Rated at approximately 3 amps, depending on application. Terminals and mountings to customer specifications. Bulletin 5000.
STEVENS manufacturing company, inc.
Lexington and Mansfield, Ohio
STEMCO
THERMOSTATS
TYPE M
Hermetically sealed
Electrically same as semi enclosed Type M. Can be furnished with pin or solder type terminals, wire leads and various mounting brackets. Bulletin 6000.

TOTALS



TRANSISTOR SALES

	1957 Sales (units)	1957 Sales (dollars)	1956 Sales (units)
January	1,436,000	$ 4,119,000	572,000
February	1,785,300	5,172,000	618,000
March (5 wks)	1,904,000	5,321,000	708,000
April	1,774,000	4,880,000	832,000
May	2,055,000	5,636,000	898,000
June (5 wks)	2,245,000	6,121,000	1,130,000
July	1,703,000	4,216,000	885,000
August	2,709,000	6,598,000	1,315,000
September (5 wks)	3,231,000	6,993,000	1,115,000
October	3,544,000	7,075,000	1,290,000
November	3,578,700	6,989,000	1,829,000
December (5 wks)	2,773,000	6,619,000	1,608,000
TOTAL	28,738,000	$69,739,000	12,840,000

TUBE SALES

	Picture Tubes		Receiving Tubes	
	Units	$ Value	Units	$ Value
January	760,860	$ 13,594,525	37,571,000	$ 31,170,000
February	728,363	13,134,778	44,460,000	36,631,000
March (5 wks)	833,257	14,850,847	43,010,000	37,007,000
April	629,838	11,394,043	27,970,000	25,384,000
May	758,328	14,031,519	32,836,000	28,955,000
June (5 wks)	1,104,013	19,981,319	35,328,000	31,314,000
July	491,935	9,835,586	33,077,000	27,042,000
August	930,296	17,984,185	43,029,000	34,886,000
September (5 wks)	1,071,662	20,819,036	44,382,000	35,545,000
October	995,629	19,495,574	47,075,000	38,421,000
November	772,801	15,138,438	39,950,000	33,166,000
December	664,026	12,971,487	27,736,000	24,881,000
TOTAL	9,721,008	$183,231,337	456,424,000	$384,402,000

—Electronic Industries Association

ESTIMATED MILITARY ELECTRONICS SPENDING

(in millions of dollars)

Fiscal Year	Electronics Expenditures*	Total Expenditures*	Per cent
1951	$ 747	$ 4,734	16
1952	1,929	12,642	15
1953	3,042	18,535	16
1954	2,663	17,343	15
1955	2,453	14,388	17
1956	2,825	13,673	21
1957	3,506	15,335	23
1958 (est.)	3,600	15,638	23
1959 (est.)	4,000	15,828	25
TOTAL	$24,765	$128,116	19

* For Major Procurement and Production plus Research and Development by all Services. Military Functions only: Excludes Military Assistance.

—Electronic Industries Association

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in January, 1958.

Accelerometers	342,782
Amplifiers	759,844
Battery chargers	42,075
Batteries, storage	1,702,820
Cable assemblies	296,729
Circuit breakers	50,376
Computers & accessories	1,041,271
Computers, airborne	1,277,007
Connectors	72,450
Countermeasures equipment	882,933
Frequency standards	529,023
Generators, signal	630,653
Indicators	372,298
Intercom equipment	56,466
Kits, modification	79,265
Kits, radar modification	1,329,960
Meters	38,508
Meters, field	32,884
Networks	32,375
Oscillators	334,250
Radiac equipment	189,595
Radomes	91,774
Reactors	73,387
Recorders & accessories	109,495
Recorders—reproducers	1,667,329
Relays	29,800
Resistors	26,638
Semiconductor diodes	61,360
Switches	31,272
Synchro signal amplifiers	213,959
Television equipment	50,355
Test sets, meter	33,350
Transformers	32,125
Tubes, electron	3,760,691
Wire & cable	123,952

TV STATIONS

1957	Total Auth.	Licensed & Operating	CP's
Feb. 1	633	513	120
Mar. 1	638	515	123
Apr. 1	641	515	126
May 1	641	515	126
June 1	645	519	126
July 1	651	519	132
Aug. 1	654	522	132
Sept. 1	661	528	133
Oct. 1	657	531	126
Nov. 1	655	536	119
Dec. 1	656	539	117
1958			
Jan. 1	657	544	113
Feb. 1	655	548	107

—NAB

← Circle 3 on Inquiry Card, page 101

ELECTRONIC INDUSTRIES

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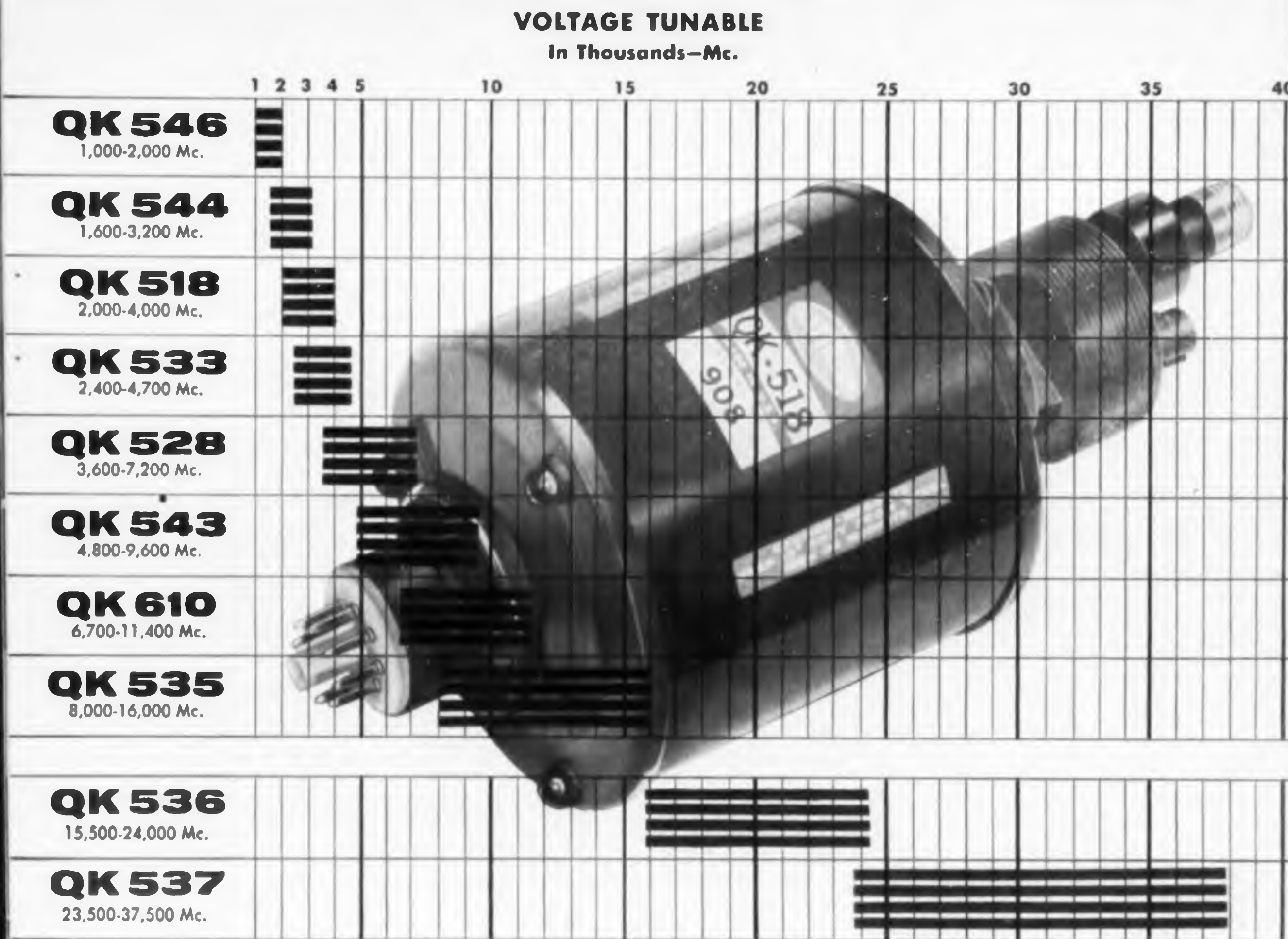


NOW — 2 New Raytheon Backward Wave Oscillators DOUBLE FREQUENCY COVERAGE

The most complete line in the industry now tunes from 1,000 to 37,500 Mc.

Specifications — QK518. Frequency: 2,000-4,000 Mc. Rapid electronic tuning by varying delay line voltage from 150-1,500 v. Power output: 0.1 to 1 w. Complete with compact permanent magnet. Approximate maximum dimensions: 10" long, 4⅜" high, 4⅞" wide.

Wide, rapid electronic tuning — 1,000 Mc. to 37,500 Mc. — is one outstanding performance advantage in Raytheon's extending line of Backward Wave Oscillators. Others are: permanent magnet focusing; high signal-to-noise ratio; operation under conditions of amplitude or pulse modulation.

Raytheon Backward Wave Oscillators are gaining wide acceptance in microwave equipment applications as local oscillators for radar receivers and as signal generators.

Our development laboratories can tailor tubes for specific requirements including narrower band, lower voltage, or higher power for primary transmitter use. Any question you may have will be answered promptly, without cost or obligation.

RAYTHEON MANUFACTURING COMPANY

Microwave and Power Tube Operations, Section PT-50, Waltham 54, Mass.

Regional Sales Offices: 9501 W. Grand Avenue, Franklin Park, Ill. • 5236 Santa Monica Blvd., Los Angeles 29, Cal.

Raytheon makes: Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Miniature and Sub-Miniature Tubes, Semiconductor Products, Ceramics and Ceramic Assemblies.

RAYTHEON

Excellence in Electronics

See Raytheon at the I.R.E.—Booths 2611-2614

Circle 5 on Inquiry Card, page 101

"We <u>want</u> these tubes for our new military circuits, but can you mass-produce them in <u>this</u> country?"

RELIABLE PREMIUM-QUALITY FRAME GRID TUBES

Amperex 5847
Broadband Amplifier Pentode

- plug-in replacement for Type 404A in existing equipment
- high figure of merit
- frame grid construction

Amperex 6688
Reliable, Ruggedized, Broadband Amplifier Pentode

- for similar applications as the 5847, but with improved base pin arrangement and higher transconductance
- figure of merit of 250 Mc as broadband amplifier
- saves entire stages in IF and video amplifiers
- improves signal-to-noise ratio
- preferred for new equipment design, particularly airborne applications
- long-life cathode
- frame grid construction

AND EXACTING INDUSTRIAL APPLICATIONS...

It's the frame grid construction that makes the difference!

Frame Grid as used in Amperex 6922

Grid-to-cathode spacing tolerance determined by carefully controlled diameter of grid support rods (centerless ground) and by frame cross-braces between these rods. Extremely fine grid wire eliminates the "island effect" usually encountered in conventional tubes with equally close grid-to-cathode spacing. Rigid support of fine wires reduces mechanical resonance and microphonics in the grid.

Conventional Grid as used in 6BQ7A tube

Grid-to-cathode spacing tolerance depends on accuracy of grid dimensions, obtained by stretching on a mandrel, and on tolerances of holes in top and bottom mica rod supports. Diameter of grid wire must be large enough to be self-supporting.

ELECTRONIC SHORTS

▶ **The USAF and the American taxpayer are saving a minimum of a million dollars a year as a result of an Aircraft Industries Assn. recommendation to have contractors conduct inventories of land, buildings, tools and equipment every 2 or 3 years, instead of annually.**

▶ Within a year the Marine Corps will possess a supply system based on electronic data processing and transmission which will serve them throughout the world. The first contract for computers has just been awarded.

▶ **Development of combat surveillance methods for the Army is provided for in a new 2-year contract awarded to the Cornell Aeronautical Laboratory. Combat surveillance is the continuous and systematic watch over a battle area under all conditions of weather by day and night, and is of direct and important aid to Army commanders.**

▶ Spying by satellite and counterespionage by satellite soon will be practicable, in the opinion of Henri G. Busignies, President of Federal Telecommunication Labs. Mr. Busignies further opined that the television transmitting satellites which would enable countries to spy on each other are "possible at the present time."

▶ **A new campaign to promote the sales of color TV has been undertaken by RCA Victor Television Div. It features greatly increased trade-in allowances, for a limited period, on black-and-white receivers. The campaign was promoted by the extraordinarily good Christmas sales, plus the company's experience that two out of three purchases of color TV sets are based on recommendations of persons who already own them.**

▶ A new ground-weather radar system which is considerably smaller, lighter, and more compact than the type of equipment now used for weather evaluation and forecasting, has been developed by the Bendix Radio Div. The new system, utilizing most of the components of the Bendix RDE-1 airborne weather radar system now in service on 17 airlines, was repackaged for ground operation. An additional unit has been provided to convert 60 cps to 400 cps power and a special plastic radome has been constructed to house the antenna, power and transmitting-receiving equipment.

▶ **An electronic system that provides automatic control of vehicles on the highway offers "the ultimate solution" to the problem of traffic accidents that now claim more than 100 lives daily. So Dr. V. K. Zworykin, Honorary VP of RCA, told the Highway Research Board at its annual meeting. Recent tests in Nebraska have confirmed the original feeling that a large measure of automatic control is technically possible.**

▶ PRODAC (Programmed Digital Automatic Control) will direct the actions of a 6000-horsepower universal reversing roughing mill designed by Westinghouse Electric Corp. Equipment makes the Jones & Laughlin Steel Corp.'s Aliquippa, Pa., Works the steel industry's first fully automated mill. It brings the goal of true "push button" steel production into reality.

▶ **Electronic equipment sales for aircraft and missile control should be one of the stronger segments of the aviation industry throughout 1958 according to Stephen F. Keating, VP in charge of Minneapolis-Honeywell's Military Products Group. Industry sales in 1957, Keating estimated, increased some $200 million over last year to about $1.7 billion and should increase as much as 15% during 1958.**

▶ A scientific phenomenon, long-known but little-used, infra-red radiation, is at the point of succeeding radar in many military applications. R. F. Wehrlin, President of Avion Div., ACF Industries, Inc., feels that it is possible by the end of 1958 that it will have replaced radar in many instances for locating targets and guiding missiles.

▶ **The large-scale electronic guidance computer used in the recent Atlas ICBM test program at Cape Canaveral, Fla., was designed, developed, and built by Burroughs Corp. at its Research Center, Paoli, Pa. The system, successfully used, is a prototype of production models which Burroughs plans to build in a Detroit plant for the USAF.**

Establish Foreign Technical Info Center

The Dept. of Commerce announced last month that they are establishing a Foreign Technical Information Center to act as a clearinghouse for all foreign scientific and technical literature. The new operation will come under the department's Office of Technical Services. An initial appropriation of $300,000 has been granted to launch the program.

Plans have been worked out for public distribution of information from such organizations as the National Science Foundation, Atomic Energy Commission, the armed services and the intelligence agencies.

The agency will distribute abstracts and translations of foreign technical articles, monographs and books to American scientists and engineers. It is estimated that these will be supplied at a rate of 50,000 abstracts and 10,000 complete translations per year.

Daylight-Bright Radar For Air Traffic Control

Air traffic controllers will direct aircraft from well lighted rooms instead of from semidarkness with new equipment that converts radar information to a brighter and more flexible daylight television type of display.

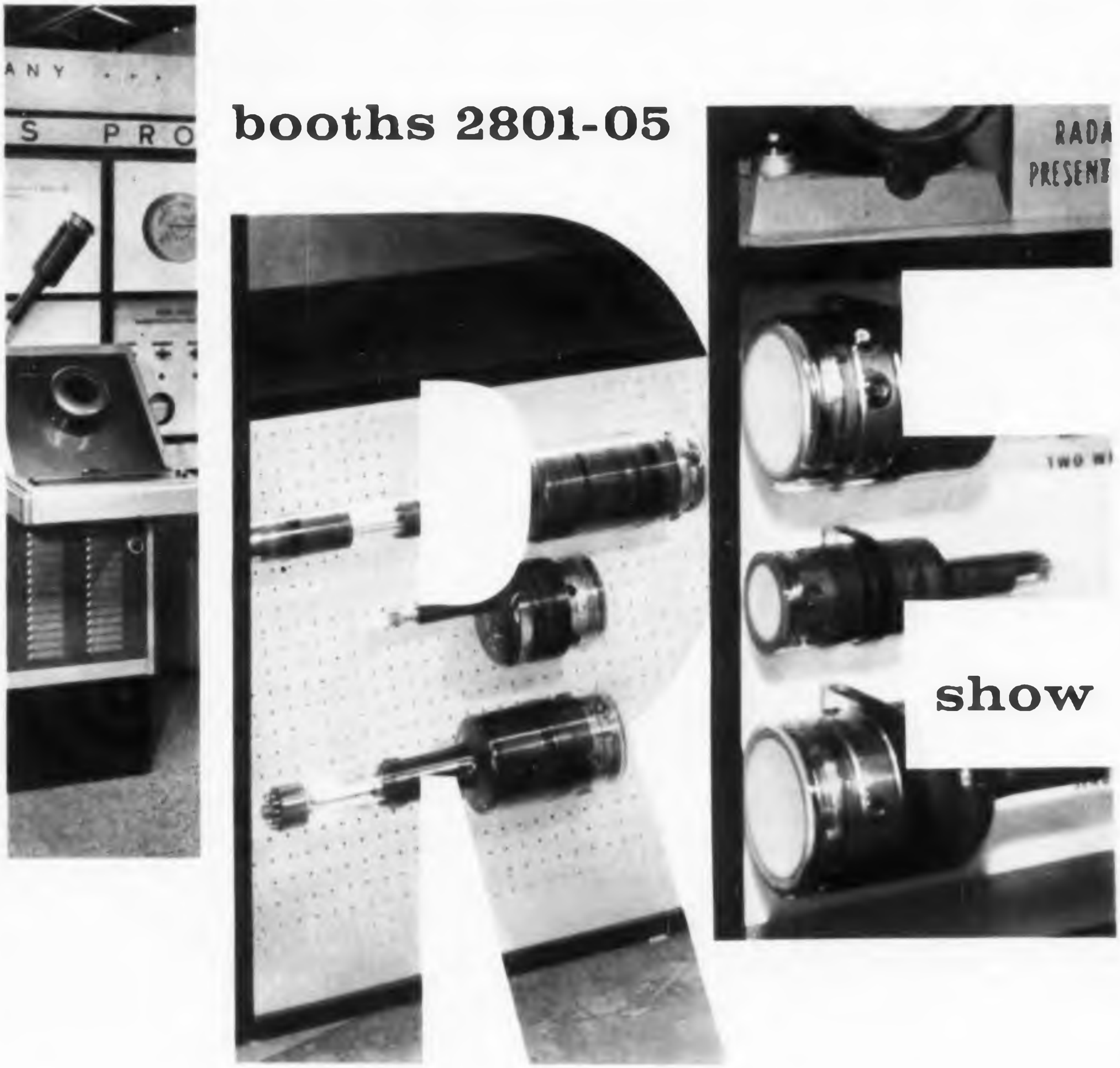
The CAA, U. S. Dept. of Commerce has ordered 13 TI 440 scan converter units from Intercontinental Electronics Corp. of Mineola, New York, at a cost of $535,-500.

Installation of the TI 440 equipment will be made at CAA operated air route traffic control centers and airport traffic control towers to be selected when delivery of the first equipment is made in approximately 60 days.

The 440 has the ability to retain radar targets on the display for up to 30 minutes and to show a trailing blip indicating previous positions of the target. The trailing blip has the advantage of keeping the controller continuously aware of the direction of the aircraft he is "working" and thus making it easier to detect possible collision courses.

More News on page 16

booths 2801-05



show

SEE THE TUBES WITH DISPLAYS THAT STAY! All Hughes direct-display cathode-ray tubes have the ability to store information for extended periods of time.

the MEMOTRON® tube will display SUCCESSIVE TRANSIENT WRITINGS until intentionally erased.

the TONOTRON* tube presents a complete spectrum of grey shades. The HIGH LIGHT OUTPUT facilitates viewing even in full daylight.

the TYPOTRON® tube is the only available CHARACTER WRITING STORAGE TUBE which displays any combination of 63 characters or symbols until intentionally erased.

For a period of years these Hughes cathode-ray tubes have been in commercial and military operation and have established an outstanding record of reliability. See these tubes actually perform in typical applications at the I.R.E. show in New York. Or, for further technical data write: Hughes Products, Electron Tubes, International Airport Station, Los Angeles 45, California.

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

*Trademark of Hughes Aircraft Co.

HOW ONE CONCEPT IN POTENTIOMETER DESIGN SOLVES THREE BASIC PROBLEMS

SPACE-SAVING SIZE AND SHAPE

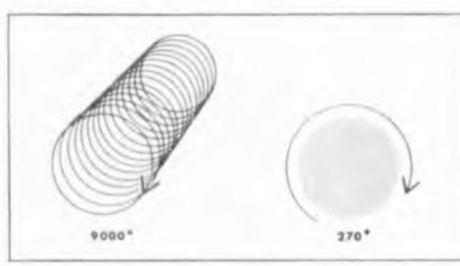
You can pack a lot of Bourns potentiometers into a small space — 12 in one square inch of panel area (or 17 TRIMPOT JR.* units!) Fit them into corners, between other components, flat against chassis or printed circuit boards. Mount them individually or in stacked assemblies.

ADJUSTMENT STABILITY

Bourns potentiometers are *self-locking* (no lock nuts required). Any adjustment *remains* stable. Shock, vibration or acceleration can't affect a setting. Bourns potentiometers are helping thousands of engineers make reliability a reality.

CIRCUIT BALANCING ACCURACY

Bourns potentiometers are 33 times as accurate as conventional single-turn rotary types – the screw-actuated mechanism provides 9000° of rotation instead of only 270°. Circuit balancing, calibration — adjustments of all types are easier, faster, more precise. And repeatability is assured.



BOURNS
Laboratories, Inc.
P. O. Box 2112 • Riverside, California

ORIGINATORS OF TRIMPOT® TRIMIT® AND POTENTIOMETER INSTRUMENTS

*Trademark

HERE ARE ADJUSTMENT POTENTIOMETERS TO MEET ALL YOUR REQUIREMENTS

high performance military potentiometers and rheostats

General Purpose Type

The original wirewound TRIMPOT® Model 200 (terminals L, S or P—see drawings below). 105°C operation. 0.25 watt. Also available as a rheostat, Model 201 TrimR® (terminal L only).

Micro-Miniature Potentiometer

The TRIMPOT JR * Model 222 is so small you can fit 17 units in one square inch of panel space. 175°C operation. One watt. Humidity proof. (Terminals L or W).

Dual Potentiometer

TWINPOT® Model 209 is two potentiometers in one. (L). 105°C operation. 0.25 watt.

High-Resistance Wirewound

Hi R® TRIMPOT Model 207 (L). Resistances to 250 K. 175°C operation. Two watts. Rheostat: Hi R TrimR Model 208. (L).

High-Resistance Deposited Carbon

An unusually significant achievement in military quality potentiometers—infinite resolution at 125°C operation. 0.25 watt. Uses the RESISTON* element, a product of 3 years of Bourns research. 20K to 1 megohm range. TRIMPOT Model 215. (L, S or P).

High-Temperature Operation

175°C operation. One watt. TRIMPOT Model 260. (L, S or P). Available as a rheostat Model 261 (L).

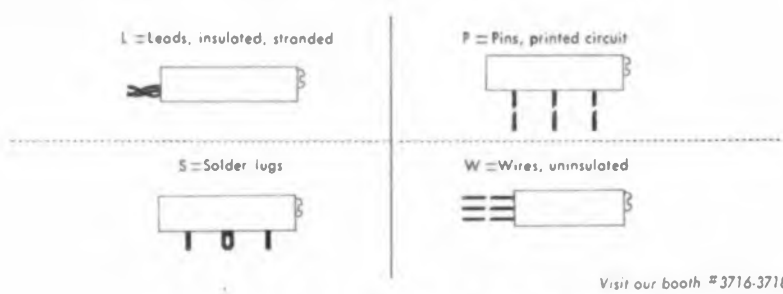
Humidity Proof, 135°C Operation

TRIMPOT Model 236. (L, S or P). 0.8 watt. Also available as a rheostat, Model 231. (L).

low-cost commercial adjustment potentiometer

TRIMIT® — an important new development for manufacturers of computers, industrial controls, communications equipment and high-quality test and measuring equipment. Provides 33 times the adjustment accuracy of single-turn rotaries, occupies only a fraction of the space, and has far greater stability of setting—at no additional cost. Wirewound Models 271 (L), 273 (S), 275 (P).
Carbon Models 272 (L), 274 (S), 276 (P).

military and commercial units available in these terminal types:



Visit our booth #3716-3718 at the I. R. E. Show

Write for detailed technical information on Bourns Potentiometers. Please specify the model or type and mention your application.

BOURNS
Laboratories, Inc.

P. O. Box 2112 • Riverside, California

ORIGINATORS OF TRIMPOT® TRIMIT® AND POTENTIOMETER INSTRUMENTS

*Trademark

Coming Events

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

Mar. 3-7: Conf. on Analytical Chemistry & Applied Spectroscopy; at Pittsburgh, Pa.

Mar. 6-7: 16th Annual SPI Canadian Section Conf., by SPI; Royal Connaught Hotel, Hamilton, Ont.

Mar. 11-13: 8th Annual Conf. on Instrumentation for the Iron & Steel Industry; at Roosevelt Hotel, Pittsburgh, Pa.

Mar. 13-14: Flight Propulsion Mtg. (Classified), by IAS; at Hotel Carter, Cleveland, Ohio.

Mar. 16-21: Nuclear Engineering & Science Conf., IRE, ASME, EJC & ANS; Chicago, Ill.

Mar. 24-27: IRE National Convention; at Waldorf-Astoria Hotel & Coliseum, New York, N. Y.

Mar. 25-28: Packaging Machinery & Materials Expos.; at Convention Hall, Atlantic City, N. J.

Mar. 26-28: American Power Conf., Illinois Inst. of Tech.; Hotel Sherman, Chicago, Ill.

Mar. 26-28: 15th Annual Pacific Coast Sect. Conf., by SPI; at El Mirador, Palm Springs, Calif.

Mar. 27-29: Electrical Industry Show; Shrine Exposition Hall, Los Angeles, Cal.

Mar. 27-29: Optical Soc. of America Spring Mtg.; at Washington, D. C.

Apr. 2-4: Conf. on Automatic Optimization, AIEE, IRE, ISA, AIChE & ASME; Univ. of Delaware, Newark, Del.

Apr. 8-10: Symp. on Electronic Waveguides, IRE & Polytechnic Inst.; Engineering Societies Bldg., New York City.

Apr. 10-12: Regional Conf. & Electronics Show, by IRE; at Municipal Audit., San Antonio, Tex.

Apr. 13-18: American Chemical Soc. National Mtg.; at San Francisco, Calif.

Apr. 14-16: Conf. on Automatic Techniques, by IRE, ASME & AIEE; at Statler Hotel, Detroit, Mich.

Apr. 14-17: 15th Annual Radio Component Show; Grosvenor House & Park Lane House, London, W. 1, England.

Apr. 14-17: Design Engineering Show, by ASME; at International Amphitheatre, Chicago, Ill.

Apr. 15-17: Annual Welding Show, by AWS; at Kiel Auditorium, St. Louis, Mo.

Apr. 16-25: Instruments, Electronics & Automation Exhibition; at Olympia Hall, London, England.

Apr. 17-18: 2nd Annual Mtg., Institute of Environmental Engineers; Hotel New Yorker, New York City.

Apr. 18-19: Spring Tech Conf. on TV and Transistors, by IRE; Engineering Soc. Bldg., Cincinnati, Ohio.

Apr. 20-24: Annual Meeting of the Scientific Apparatus Makers Ass'n; at El Mirador Hotel, Palm Springs, Calif.

Apr. 21-25: 83rd Conv., SMPTE; at Ambassador Hotel, Los Angeles, Calif.

Apr. 22-24: Electronic Components Conference, IRE, WCEMA, AIEE, & EIA; at Ambassador Hotel, Los Angeles, Calif.

Apr. 23: Annual Meeting, PACE; Governor Clinton Hotel, New York City.

Apr. 30-May 2: Tech. Conf. & Trade Show, IRE; Sacramento, Calif.

May 4-7: 4th National Flight Test Instrumentation Symp., ISA; Park Sheraton Hotel, New York City.

May 5-7: National Symp. on Microwave Theory & Techniques, IRE; at Stanford Univ., Stanford, Calif.

May 6-8: 1958 Western Joint Computer Conf., IRE, ACM & AIEE; at Ambassador Hotel, Los Angeles, Cal.

May 7-17: 2nd U. S. World Trade Fair; at New York, N. Y.

May 12-14: National Aero & Navigational Electronic Conf., IRE; at Dayton, O.

May 19-21: 1958 Electronic Parts Distributors Show; Conrad Hilton Hotel, Chicago 3, Ill.

Abbreviations:

ACM: Association for Computing Machinery
AIChe: American Institute of Chemical Engineers
AIEE: American Inst. of Electrical Engrs.
ANS: American Nuclear Society
ASME: American Society of Mechanical Engineers
EJC: Engineers Joint Council
EIA: Electronic Industries Assoc.
IAS: Inst. of Aeronautical Sciences
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
PACE: Producers of Associated Components for Electronics
WCEMA: West Coast Electronic Manufacturers Association

As We Go To Press . . .

EIA Offers Microwave Standards Package

The Electronic Industries Assoc. is offering a package of standards covering the microwave art. Included are:

Microwave Relay System Antennas and Passive Reflectors—RS-195
Microwave Relay System Towers—RS-194
Microwave Relay Systems for Communications—TR-141
Microwave Systems Generators, Emergency Stand-by Use RS-173
Microwave Housing Facilities—TR-142
Microwave Relay Applications, Transmission Lines, Mechanical Considerations—RS-158
Microwave Transmission Systems—RS-203

The complete package will be available from the EIA Engineering Office, 11 W. 42nd St., New York 36, at $4.50.

Discuss Air Traffic Control Simulator

The Airway Modernization Board has begun negotiations with Aircraft Armaments, Inc., Cockeysville, Md., for the development of an electronic air traffic control simulator.

The simulator will permit comprehensive tests of air traffic problems without the heavy expenditures required for a full flight experimentation program.

Groups Exchange Services

Joint servicing has been agreed between the Association of Missile and Rocket Industries with headquarters in Washington and the Aircraft Service Association in Los Angeles.

The missile group will handle East Coast inquiries and public relations for TASA in exchange for reciprocal services on the West Coast where hundreds of missile companies are concentrated.

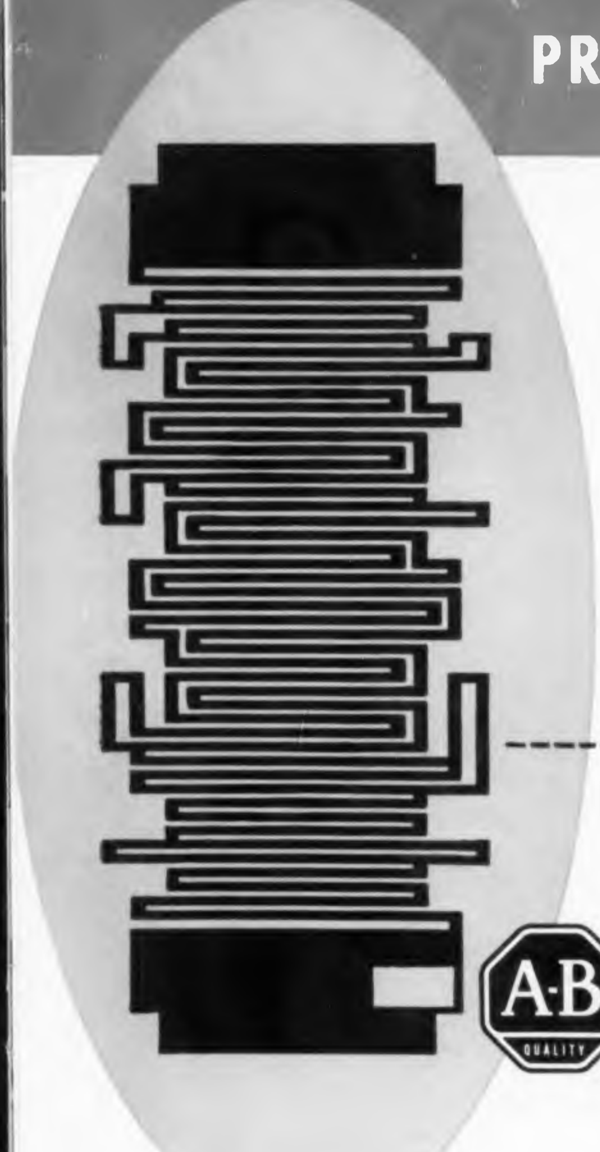
The Aircraft Service Association represents independent aircraft maintenance companies performing the majority of military aircraft contract maintenance. Its executive secretary is Thomas Wolfe.

AMRI is a trade association for all branches of the missile and space flight industry. Its executive director, Kendall K. Hoyt, is experienced in aviation writing, public relations, and organizational work.

ALLEN-BRADLEY PRESENTS...

NEW METAL GRID

¼, ½, and 1-WATT PRECISION RESISTORS



Far exceed MIL Specs for film and wire-wound resistors

Allen-Bradley's new, truly accurate, metal grid resistors are now available in ¼, ½, and 1-watt ratings, producing test results that are a substantial improvement over the MIL Specs for wire-wound and film type precision resistors. They combine remarkable stability, under load and on the shelf, with an exceptionally low temperature coefficient. Provided with gold plated leads for flawless soldering—these new metal grid resistors justly qualify under the Allen-Bradley trademark of *Quality*.

The construction of the ¼, ½, and 1-watt resistors is identical. At left is an enlarged view of the metal alloy grid, mounted on glass, that forms the resistance element. (A) Actual size of 1-watt element. (B) encapsulating epoxy resin body. (C) finished unit hermetically sealed in ceramic tube.

ALLEN-BRADLEY

ELECTRONIC COMPONENTS

QUALITY

Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

Letters

to the Editor

"Medical Electronics"

Editor, ELECTRONIC INDUSTRIES:

It is with much interest that I read in your recent article on Medical Electronics about the Entrance Requirements: ". . . the ultimate in training would be a combination E.E. and medical education." I agree that ". . . this is probably asking too much of the average professional . . ." But I think there have to be a few who fully understand the doctor's as well as the engineer's language, and who also know the needs of medicine and the possibilities of engineering from personal experience.

You may remember that I combine a doctor's degree and 10 years of medical experience with a master's degree in electrical engineering and 5 years of electronics engineering experience.

At your suggestion I first wrote to Mr. C. Berkley of R.C.A. inquiring about the possibilities of getting into the M.E. field. In the meantime I applied to many more people and/or organizations, well known names in M.E. The answers—if at all—are almost unanimous: My education and experience are appreciated but nobody knows, at least not at present, of a position where I can make use of them.

The facts I have learned so far are most discouraging. Frankly, I cannot reconcile them with the demand for more education in both fields. It almost seems as if the ultimate in training places a barrier in the way of entrance.

I just asked the PGME of the IRE to put an insertion into the next "Newsletter." I still hope to learn a different story some day.

Dr. Phil R. Amlinger
33 Kresson Rd.,
Haddonfield, N. J.

"Foreign Engineers"

Editor, ELECTRONIC INDUSTRIES:

I read the editorial of ELECTRONIC INDUSTRIES, February issue, with much interest. I think you are quite right in stating "Engineers in other foreign countries, notably France, England and W. Germany and Japan, are also producing valuable creative engineering contributions."

Unfortunately, due to the language barriers on the part of Americans, works by Japanese engineers are very little known to this country. This problem is, of course, not easy to solve. However, I modestly think I may be of help to you along this line because of my background.

(*Continued on page* 20)

Circle 9 on Inquiry Card, page 101

Letters

to the Editor

(Continued from page 19)

I was born in Tokyo, Japan, and graduated from the University of Tokyo with B.E. in 1948. I came to this country in 1952, received an M.S. degree from Cornell in 1954 and then went home. I came back to this country last summer to join RCA. This is my personal history in short.

If you wish to have my service, you can reach me at RCA. I shall be very happy to spend my spare time if I may be of help to you.

Hiroshi Amemiya
134A Haddon Hills Apts.
Haddonfield, N. J.

Ed. Note: We have contacted Mr. Amemiya and are working with him.

"Sputnik-Guide To US"

Editor, ELECTRONIC INDUSTRIES:

In your journal, ELECTRONIC INDUSTRIES I read your article: "Sputnik—Guide for the U. S. A." with great interest and fully agree with you on your conclusions as to the number of available electronic engineers in your country. Today the number of engineers graduating in U. S. A. is less than the number required by industry and these limitations may, in the long run, gradually impair the scientific and industrial progress of the nation. The recent scientific progress beyond the Iron Curtain has brought into evidence the numerical deficiency in scientific learning and your efforts in trying to get all those readers of your journal, that are still far from it, nearer to reality, are indeed praiseworthy.

I am more than sure that your article will serve as a warning for all those Americans who have the progress and the supremacy of their nation at heart.

It is not for me to suggest how to overcome that deficiency in engineers. Energetic propaganda in the American high schools aiming at acquainting the students with the economical benefits they might get when taking up such studies may, of course, remarkably shorten the distance between request and availability of engineers and physicists in U. S. A. The foundation of clubs all over the country with an aim at interesting young people in technological learning should also be profitable, and in my opinion visits to industrial plants may certainly raise their interest for such studies.

The government could exempt those young graduates from military service in order to facilitate their prompt employment in industrial life. But I

Letters to the Editor

am sure that other good results could be attained by granting foreign students who want to attend American universities the permission to reach U. S. A.

The writer of this letter, for example, is an engineer holding a diploma in Electronics of the renowned Italian Industrial Institute in Fermo. He wants to graduate as an engineer, and is inclined to come over to U. S. A. at his own expense in case any university should admit him, and some organization would help him during the first days.

Like the writer, many other young graduates would like to come over to U. S. A. to finish their studies there, if assistance could be guaranteed at least for the beginning.

Of course, once the degree has been conferred, some of these engineers would stay on in U. S. A. to take up working there and I suppose the American Government would not oppose their definite stay in U. S. A.

In Italy a committee could see to transmitting references about the Italian students to an analogous American committee which on its part could examine these references and forward them to the various universities.

Therefore, if the aim of the article published by you is also to surmount the problem of lack of engineers please make my suggestion known to the appropriate agencies or simply inform me which American Society I might contact to further pursue my idea.

Giuseppe Cirrincione
Largo S. Saturnino n° 5
Rome (Italy)

"Electronic Sources"

Editor, ELECTRONIC INDUSTRIES:

I would like to commend you for expanding the abstracting of International Electronic Sources. It is particularly helpful that you concentrate your efforts on domestic and foreign publications which are not abstracted by other well known indexing services found in most technical libraries, such as IRE Abstracts and References, Engineering Index and Industrial Arts Index.

I have been keeping your abstracts in a separate binder and they were of great service to me when searching for information. The searches could be simplified if it would be possible to issue an annotated index like the one issued by the IRE.

Dieter Lohr
Reference Engineer
Lenkurt Electric Co., Inc.
San Carlos, Calif.

(*Continued on page* 194)

Circle 11 on Inquiry Card, page 101

Electronic Industries' News Briefs

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

EAST

GULTON INDUSTRIES has established a new department for the development, production, and marketing of three special transformer types; high voltage, high current, and high temperature.

BUSH TRANSFORMER CORP. is now in production at its new plant at 707 North St., Endicott, N. Y.

SPERRY GYROSCOPE CO. has delivered its first advanced flight control systems, SP-30, for the Martin seamaster.

AUDIO DEVICES, INC., sees a great expansion in the use of double-length magnetic tape when a new tempered "Mylar" reaches quantity production.

CLEVITE TRANSISTOR PRODUCTS is now able to control the frequency response of transistors, having developed a new manufacturing technique.

RAYTHEON MFG. CO. will continue to supply TV picture tubes to distributors for the replacement market. It has discontinued production at its Quincy, Mass., plant.

ORRADIO INDUSTRIES, INC., has established two new divisions . . . Instrumentation Tape and Audio Products.

CHESTER CABLE CORP. now has available 200,000 sq. ft. of floor space, having completed their expansion at 40 Hill St., Chester, N. Y.

ERIE RESISTOR CORP. is now producing miniature pulse transformers on a custom basis through its Electro-Mechanical Div.

INTERNATIONAL BUSINESS MACHINES CORP. has acquired an option on 45 acres of land in Dayton, N. J., for its Supplies Div. A card manufacturing plant will be built there.

RADIO CORP. OF AMERICA has just taken its two billionth electron tube off the assembly line at Harrison, N. J. It was a traveling-wave tube.

G & I DIV., PHILCO CORP., has signed a contract to build a 295-mile communications system for the USAF Eglin Gulf Test Range.

SYLVANIA ELECTRIC PRODUCTS, INC., is now in production of double-ended microwave crystal diodes in S and X bands.

GENERAL ELECTRIC CO., through its Silicone Products Dept., now makes available a room temperature vulcanizing silicone rubber compound offering good physical and electrical properties plus low shrinkage. It is designated 81726.

TAYLOR FIBRE CO. has standardized its prices for laminated plastics for all parts of the United States.

JOHNSON ELECTRONIC INC., has moved into a new, modern, air-conditioned building occupying 14,000 sq. ft. in Casselberry, Fla.

FORD INSTRUMENT CO. has been awarded $13.8-million contract by the USAF to speed the production of all-weather "robot" navigators for its strategic bombers, fighters, reconnaissance and cargo aircraft.

INTERNATIONAL RECTIFIER CORP. has opened a new district office in the Suburban Square Bldg., Ardmore, Pa. Phone: MIdway 9-1428.

MID-WEST

COLLINS RADIO CO. has been awarded a CAA contract for over $3-million. It is for microwave link installations to be used in a long range radar program.

MICRONICS DIV., ELGIN NATIONAL WATCH CO. will occupy a new 60,000 sq. ft. headquarters in early fall. The plant will be built on Illinois State Highway 53 on the Southern outskirts of Palatine, Ill., 28 miles northwest of Chicago.

MICRO SWITCH, combining the advantages of both toggle and pushbutton manual control, is now producing panel-mounted switches for computers featuring a new type snag-proof rocker-actuator designed to prevent accidental operation.

BURROUGHS CORP. has been awarded contracts totaling more than $37-million for electronic guidance computers for the USAF Atlas ICBM.

AMERICAN MACHINE & FOUNDRY CO. has contracted with the U. S. Army Ordnance Dept. to build a fully automated shell-filling line for the Joliet (Ill.) Arsenal. It will handle either 75 or 90 mm shells.

DESIGNERS FOR INDUSTRY, INC., has received a $370,000 contract to build Redstone missile check-out equipment in a crash program for the Army's Ballistic Missile Agency.

SHURE BROS., INC., now has on the market a kit to adapt tape recorders for stereophonic playback. The kit is designed for all Revere and Wollensak recorders.

P. R. MALLORY & CO., INC., is substantially reducing the price of tantalum capacitors.

TEXAS INSTRUMENTS INC. has been awarded a $4.7-million contract for airport surveillance radar systems to be installed at 14 different sites by the CAA.

FOREIGN

BENDIX RADIO DIV. reports that their DFA-70 Automatic Direction Finder Systems have been specified by the Swedish Navy for four Vertol H-44 helicopters.

SOIL ELECTRONICS MFG. CORP. (SEMCOR) is the new Puerto Rican subsidiary of Industrial Instruments, Inc., of Cedar Grove, N. J. Operations of the subsidiary company are at Hato Rey, San Juan, P. R.

LEEDS & NORTHRUP CO. has been awarded a contract for electronic recording and control instruments by Chemical Construction Corp. to be used in the expansion of a sulfuric-acid manufacturing plant in South Africa.

ADLER ELECTRONICS, INC., will supply the first 150 Watt VHF-to-VHF translater-transmitter, purchased by the Armed Forces Radio Service. This will extend the present TV coverage to American personnel and their families on Guam.

MARCONI'S WIRELESS TELEGRAPH CO. LTD has installed a VHF radio-telephone system in the Southampton Harbour Board's new Port Operation and Information Service. This system provides the maximum supervision of the very extensive shipping traffic in and around the area.

WEST

BECKMAN PROCESS INSTRUMENTS DIV. will broaden its product lines with the acquisition of Arnold O. Beckman, Inc. Many of the instruments of the latter company will be marketed by the division.

ELECTRONIC ENGINEERING CO. OF CALIF. has installed electronic flight instrumentation equipment in the first station of a high altitude tracking range for the testing of supersonic rocket aircraft. The first downrange station is located at Beatty, Nev.

HUGHES AIRCRAFT CO. has been awarded a contract for more than $21-million by the USAF for the additional production of airborne control and weapons systems for advanced all-weather jet interceptors.

HOFFMAN ELECTRONICS CORP. has effected an internal reorganization to better identify its activities. Under the new setup, Hoffman Laboratories, Inc., becomes Hoffman Laboratories Div.; Hoffman Radio Div. becomes Consumer Products Div.; Hoffman Semiconductor Div. is now Semiconductor Div.

AEROVOX CORP. combined its West Coast division facilities with Cinema Engineering Div. at 1100 Chestnut St., Burbank, Calif.

CALIFORNIA MAGNETIC CONTROL CORP. has received an order, approximately $100,000, for specialized transformers and magnetic components for use in a new version of a missile system.

NON-LINEAR SYSTEMS, INC., will produce and market a complete line of ultra-reliable Epoxy-encapsulated wire-wound, precision resistors. They will be trade named "k-OHM."

WESTERN GEAR CORP. has designed and manufactured a commercial application super-speed gear box whose gears reach rotative speeds in excess of 420 miles per hour for testing missile pumps.

KEARFOTT COMPANY, INC., Western Div., provides a substantial reduction in size and weight for microwave transmission systems as a result of its new broad band "strip-line" assembly package.

TELEMETER MAGNETICS, INC., has acquired Ferromagnetics Production Div. of International Telemeter Corp. General management will remain under Milton Rosenberg.

FILTORS, INC., recently opened a West Coast branch located at 13273 Ventura Blvd., Studio City, Calif.

UNITED ELECTRODYNAMICS is now operating a new facility called the United Testing Laboratories.

AERONUTRONIC SYSTEMS, INC., Ford Motor Company's new West Coast subsidiary, has begun construction on the first building unit at the new R & D center being established at Newport Beach, Calif.

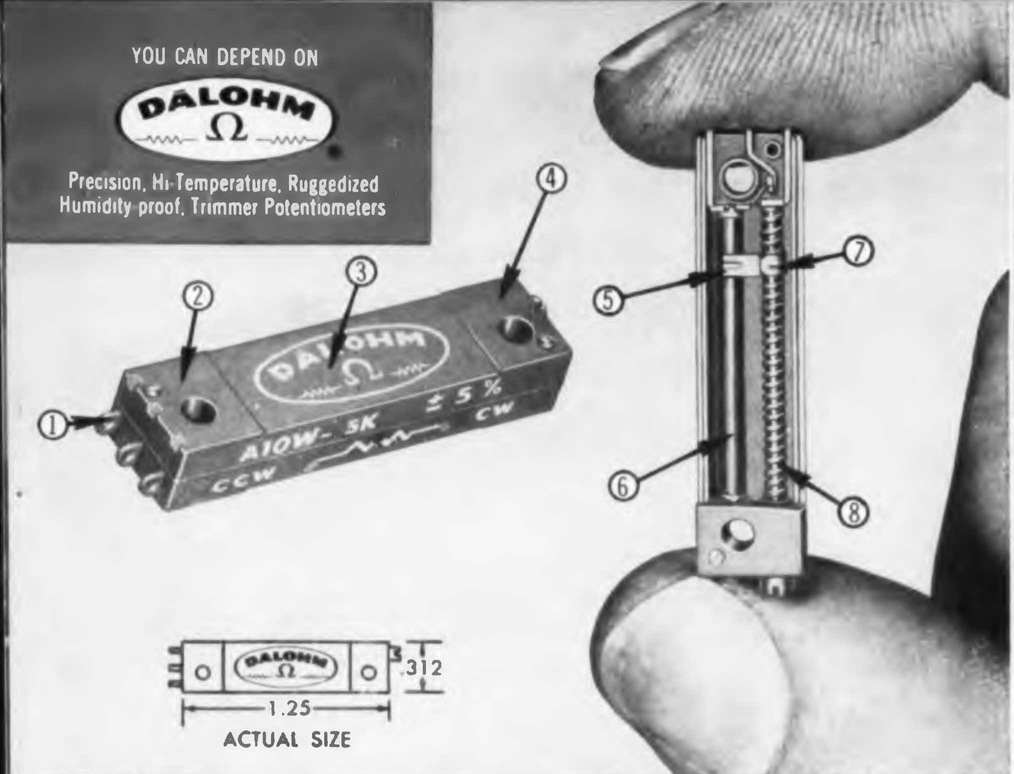
DALMO VICTOR CO. formed the Electronic Systems Div. recently. Glenn A. Walters will direct the new division as VP and manager.

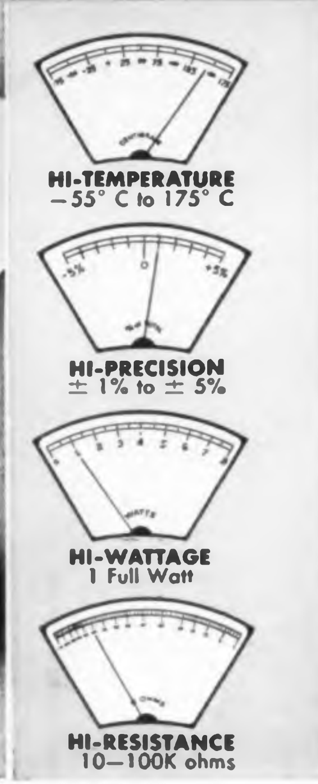
VIDEO INSTRUMENT CO., INC., moved its engineering, manufacturing and general office facilities to 3002 Pennsylvania Ave., Santa Monica, Calif.

TITANIUM METALS CORP. OF AMERICA opened a district sales office in Dallas, Tex. to serve electronic designers in the Southwest. The new office is located in the Exchange Bank Bldg.

Circle 12 on Inquiry Card, page 101

Silastic parts are used in many of the fire control electronic "packages" on Convair's new B-58 Hustler because they remain resilient at both high and low temperatures. Some of the parts touch miniature tubes that operate at 350 F. Others are subjected to oven-hot "cooling" air. All must withstand severe vibration at temperatures as low as —65 F when the equipment is not in use during high altitude flight. Designer and producer . . . Emerson Electric Manufacturing Company, St. Louis.





NEW 1958 A10-W TRIMMER ASSURES 100% RELIABILITY

1. Three precious metal, non-corrosive terminals are color coded for accuracy. New size permits easy installation in small space. Available in standard type (illustrated above), printed circuit type with 90° terminals and two types with wire leads.

2. Mounting pads, an integral part of case, provide secure mounting base on uneven surface. Mounted with two #2-56 screw holes for either stacked or multiple arrangements.

3. Case and bonding agents are high temperature materials that withstand maximum operating temperature with ease.

4. New design of case provides complete dependable sealing at all perimeters.

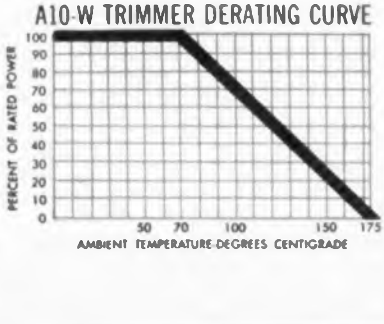
5. Excellent resolution is achieved with revised slider contact, which also assures good resistance contact at all times.

6. Precision winding by the most advanced techniques, provides dependable continuity under the most severe operating conditions.

7. Trimmer adjustment assembly, slider and excursion screw, are specially plated to allow smooth operation. This also reduces chances of small particles of metal separating due to mechanical wear and short circuiting the unit internally.

8. Trimmer adjustment screw, which can be adjusted throughout a 25 turn range, is completely insulated from circuit. Unique safety clutch prevents internal damage from over-excursion during adjustment.

A10-W TRIMMER DERATING CURVE



The 1958 DALOHM A10-W trimmer potentiometer has outstanding sub-miniature characteristics, able to operate under the most severe, demanding environmental conditions of high temperature, humidity, shock and vibration. The A10-W assures 100% reliability.

New design changes, initiated by actual field engineering experience, assure the 1958 DALOHM A10-W trimmer potentiometer of exceeding the most demanding specifications; particularly those which require high performance in moisture and vibration conditions.

- Powered at 1 watt, derated to 0 @ 175° C.
- Standard resistance range: 10 ohms to 100,000 ohms, with forty standard selections. • Standard tolerance: ± 5%.
- Special resistance values available, also lower resistance to ± 1%.
- End resistance: Not greater than 4% total maximum. • Temperature coefficient of wire: 0.00002/° C.
- Resolution: .092% to .910%. • Sub-miniature size: .220 X .312 X 1.250 inches.
- Case unit air evacuated and replaced with special silicone compound allows added protection against failure due to heat, humidity and vibration.

Exceeds trimmer potentiometer specifications as required by MIL SPECS.: JAN-R-19, MIL. STD.-202, MIL-E-5272A and MIL-R-12934.

Request bulletin R-32 for complete information.

JUST ASK US

DALOHM line includes a complete selection of precision wire wound, power and precision deposited carbon resistors. Also trimmer potentiometers, precision wire wound and deposited carbon; and collet fitting knobs. Write for free catalog.

If none of DALOHM standard line meets your need, our engineering department is ready to help solve your problem in the realm of development, engineering, design and production. Just outline your specific situation.

B11-W Trimmer Potentiometer

This is a commercial grade DALOHM trimmer potentiometer, retaining most of the desirable characteristics of the A10-W, at economical cost for application where environmental conditions are not severe.

- Powered at 1 watt, derating to 0 at 125° C.
- Standard resistance range: 10 ohms to 100K ohms, with forty standard selections.
- Standard tolerance: ± 10%.
- Sub-miniature size: .220 X .312 X 1.250 inches.

DALE PRODUCTS, INC.
1304 28th Ave.
Columbus, Nebr., U.S.A.

Circle 14 on Inquiry Card, page 101

GENERAL TRANSISTOR

PROVIDES HIGH RELIABILITY IN THE SWITCHING COMPUTER TRANSISTORS

USED IN RADIATION COUNTER LABORATORIES' 32-CHANNEL-SCALER ANALYZER

The RCLiac-32 . . . a system used for gross counting with G-M tubes through scintillation spectroscopy and pulse height analysis . . . is 95% transistorized and portable. All the transistors in this system are GT switching computer types 2N315 and 2N316, in JETEC 30 case. These transistors were developed and produced specifically to meet the rigid requirements set forth by RCL design engineers . . . high speed response, undeviating accuracy and constant reliability. Experienced engineers and trained technicians at General Transistor are fully aware of reliability important . . . and produce transistors that surpass this requirement. Here, again, is an example why **General Transistor is the fastest growing name in transistors.** Write for Computer Brochure G-140.

GENERAL TRANSISTOR
C O R P O R A T I O N

91-27 138TH PLACE. JAMAICA 35, NEW YORK

In Canada: Desser E-E Ltd., 441 St. Francis Xavier, Montreal 1, Quebec

FOR IMMEDIATE DELIVERY FROM STOCK, CONTACT YOUR NEAREST AUTHORIZED GENERAL TRANSISTOR DISTRIBUTOR OR GENERAL TRANSISTOR DISTRIBUTING CORP. 95-27 SUTPHIN BLVD. JAMAICA 35, NEW YORK

FOR EXPORT: GENERAL TRANSISTOR INTERNATIONAL CORP. 91-27 138TH PLACE JAMAICA 35, NEW YORK

Circle 15 on Inquiry Card, page 101

Here's a multiple conductor that's just loaded with the features you need—and want:

- **Light Weight • Withstands Repeated Flexing • Saves Space**
- **Matches Printed Wiring • Solderable • High Dielectric Strength**
- **Mechanical Strength • Resists Chemicals and Moisture**

Yes, *Polystrip* has *all* these features—it's a thin multiple conductor, flexible cable that comes fabricated to suit many applications. Consisting of copper wires laminated between plastic sheets, *Polystrip* occupies little volume . . . is flexible enough to fit *easily* into limited space . . . has all its conductors prepositioned in the same plane to permit automatic, simultaneous stripping, termination or dip soldering to printed wiring board or connector plugs . . . may be stripped at any position to provide terminations and soldering interconnections with other cables or wires . . . cuts costs by permitting the use of automatic tape dispensing machines and methods.

Polystrip's insulation is a special polyester capable of withstanding 85°C. continuously—has withstood temperatures greater than 100°C. for several hours without any noticeable effect! Even boiling in water for 5 hours will not damage *Polystrip.*

Polystrip's insulation and conductors can be modified in numerous ways for special applications. Write today for complete information.

Wherever the Circuit Says — IRC

INTERNATIONAL RESISTANCE COMPANY

Dept. 351, 401 N. Broad St., Philadelphia 8, Pa. • *In Canada:* International Resistance Company, Ltd., Toronto, Licensee

 Circle 16 on Inquiry Card, page 101

THERE'S NO SUBSTITUTE FOR EXPERIENCE..

YESTERDAY - TODAY - TOMORROW

JUST ONE QUALITY...THE FINEST!

KESTER SOLDER

INDUSTRY-TESTED AND PROVED FOR OVER 50 YEARS...

You hear a lot about the remarkable showing of "Johnny-come-lately" solders from that second source of supply, based only upon test samples or short production runs. But there's no real substitute for regular on-the-job applications to prove the actual merits of a product like solder. That's why Kester Solder is the preferred choice of wise solder buyers and users everywhere; they know it has over half a century of genuine experience and unqualified production approval behind every spool.
Write today for complete details.

YOUR COPY FREE! Kester's 78-page manual "SOLDER . . . ITS FUNDAMENTALS AND USAGE." Send today.

KESTER SOLDER COMPANY

4210 Wrightwood Avenue, Chicago 39, Illinois

Newark 5, New Jersey, Brantford, Canada

SILICON ZENER DIODES!

for every circuit!

VOLTAGE REGULATOR TYPES

	INT'L DIODE TYPE	ZENER VOLTAGE RANGE	I_Z MAX. ma	DYNAMIC IMPEDANCE Z_Z OHMS	DYNAMIC IMPEDANCE @ I_Z ma	NOMINAL TEMP. COEFFICIENT %/°C
500 MILLIWATT TYPES — MINIATURE STYLE M	MZ 3.9	3.6-4.3	125	1.5	25	−.04
	MZ 4.7	4.3-5.1	100	1.5	20	0
	MZ 5.6	5.1-6.2	90	2.3	17.5	+.03
	MZ 6.8	6.2-7.5	75	3	15	+.05
	MZ 8.2	7.5-9.1	60	4.5	12.5	+.06
	MZ 10	9.1-11	50	6.8	10	+.07
	MZ 12	11-13	40	12	7.5	+.075
	MZ 15	13-16	33	23	6	+.08
	MZ 18	16-20	27	45	5	+.085
	MZ 22	20-24	23	70	4.5	+.09
	MZ 27	24-30	18	90	3.5	+.095
1 WATT TYPES — STYLE S Pigtail Construction	1Z 3.9	3.6-4.3	250	1	50	−.04
	1Z 4.7	4.3-5.1	200	1	40	0
	1Z 5.6	5.1-6.2	175	1.5	35	+.03
	1Z 6.8	6.2-7.5	150	2	30	+.05
	1Z 8.2	7.5-9.1	120	3	25	+.06
	1Z 10	9.1-11	100	4.5	20	+.07
	1Z 12	11-13	80	7.5	15	+.075
	1Z 15	13-16	65	15	13	+.08
	1Z 18	16-20	55	30	10	+.085
	1Z 22	20-24	45	45	9	+.09
	1Z 27	24-30	35	60	7	+.095
3.5 WATT TYPES — STYLE T Stud Construction	3Z 3.9	3.6-4.3	850	.5	150	−.04
	3Z 4.7	4.3-5.1	700	.5	125	0
	3Z 5.6	5.1-6.2	625	.75	110	+.03
	3Z 6.8	6.2-7.5	525	1	100	+.05
	3Z 8.2	7.5-9.1	425	1.5	80	+.06
	3Z 10	9.1-11	350	2.5	70	+.07
	3Z 12	11-13	275	4	50	+.075
	3Z 15	13-16	225	7.5	40	+.08
	3Z 18	16-20	200	15	35	+.085
	3Z 22	20-24	160	22.5	30	+.09
	3Z 27	24-30	125	30	25	+.095
10 WATT TYPES — STYLE T Stud Construction	10Z 3.9	3.6-4.3	2500	.25	500	−.04
	10Z 4.7	4.3-5.1	2000	.25	400	0
	10Z 5.6	5.1-6.2	1750	.4	350	+.03
	10Z 6.8	6.2-7.5	1500	.5	300	+.05
	10Z 8.2	7.5-9.1	1200	.75	250	+.06
	10Z 10	9.1-11	1000	1.25	200	+.07
	10Z 12	11-13	850	2	170	+.075
	10Z 15	13-16	650	4	140	+.08
	10Z 18	16-20	550	7.5	110	+.085
	10Z 22	20-24	450	12	90	+.09
	10Z 27	24-30	350	15	70	+.095
DOUBLE ANODE TYPES — 350 MILLIWATT	ZZ 3.9	3.6-4.3	110	3	22	−.045
	ZZ 4.7	4.3-5.1	90	4	18	−.01
	ZZ 5.6	5.1-6.2	70	5	14	0
	ZZ 6.8	6.2-7.5	60	10	12	+.025
	ZZ 8.2	7.5-9.1	50	15	10	+.035
	ZZ 10	9.1-11	40	25	8	+.05
	ZZ 12	11-13	30	40	7.5	+.06
	ZZ 15	13-16	25	60	5	+.07
	ZZ 18	16-20	20	80	4	+.08
	ZZ 22	20-24	16	125	3.5	+.09
	ZZ 27	24-30	13	200	3	+.095
MULTIPLE JUNCTION TYPES — HIGH VOLTAGE 5 WATT	HZ 27	24- 30	200	7	40	0
	HZ 33	30- 36	150	10	30	+.03
	HZ 47	43- 51	110	20	22	+.06
	HZ 68	62- 75	75	60	14	+.075
	HZ 100	91-110	50	180	10	+.085
	HZ 150	130-160	35	370	7	+.095

REFERENCE ELEMENT TYPES

IN430	8.0-8.8	50	15	10	± .002 −55° to +100°C
IN430A	8.0-8.8	50	15	10	± .001 −55° to +100°C
IN430B	8.0-8.8	50	15	10	± .001 −55° to +150°C

International Rectifier Corp.

XY Plot of Reverse Breakdown Characteristics Supplied with Each Diode!

Here's the *versatile* zener line—a type for every application—coupled with a new service conceived to conserve engineering time! Excellent characteristics, especially in terms of low impedance values, hermetic sealing, all-welded construction and a high thermal capacity package qualify these diodes for your consideration. Receiving a plot of characteristics *with each diode* eliminates guesswork and tedious testing on your part—means more time for creative engineering. Inquire further about these diodes... and the special application services we are prepared to offer you.

SEE THE COMPLETE LINE DEMONSTRATED AT BOOTHS 3915-3917, I.R.E. SHOW

EXECUTIVE OFFICES: EL SEGUNDO, CALIFORNIA • PHONE OREGON 8-6281 • CABLE RECTUSA

NEW YORK AREA OFFICE: 132 EAST 70TH ST., PHONE TRAFALGAR 9-1330 • CHICAGO AREA OFFICE: 205 W. WACKER DR., PHONE FRANKLIN 2-3888 • NEW ENGLAND AREA OFFICE: 17 DUNSTER STREET, CAMBRIDGE, MASS., PHONE UNIVERSITY 4-6520 • PENNSYLVANIA AREA OFFICE: SUBURBAN SQUARE BUILDING, ARDMORE, PENNA., PHONE MIDWAY 9-1428

WORLD'S LARGEST SUPPLIER OF INDUSTRIAL METALLIC RECTIFIERS • SELENIUM • GERMANIUM • SILICON

Circle 18 on Inquiry Card, page 101

SKY WARRIOR WITH HIS

 Circle 501 on Opportunities Inquiry Card, page 103

Tele-Tips

TRANSISTORS seem a tremendous improvement after vacuum tubes, but what if it had been turn-about, if the transistor had come first? What adjectives would we now be using to extol the virtues of the vacuum tube? Tremendous power handling capabilities! Reproducible! Stable operation!

THERE'S A DIFFERENCE! "Made in Japan" can also be written "Imported from the Orient."

NEAR-MISSES between aircraft are being reported at a rate of four per day. Nearly 90% of the incidents occur in "controlled air space"—areas where pilots are following fixed flight patterns. Military jets are involved in about one-third of the incidents reported.

HIGHWAY OF TOMORROW envisioned by the automobile industry will have electronically controlled autos following metallic conductors embedded in the road surfaces. Automatic switching will shunt cars to other lanes in cases of emergency.

TWO JOBS or more are held by over 3.5 million persons in the U. S., according to the Bureau of the Census, Dept. of Commerce. Among professional and technical workers holding multiple jobs the majority held two jobs in the same occupation category.

TAPE RECORDING all incoming phone calls is being tried at Chicago police headquarters in the hope of cutting down crank or scare calls. It will also be a means of checking whether the two million calls received annually are handled properly.

COLOR TV sets were bought by 1 family in 250 last year. Too large a part of the public still believe that "the bugs haven't been cleaned out yet." A new selling approach is called for here.

(*Continued on page 34*)

Circle 21 on Inquiry Card, page 101

Tele-Tips

(*Continued from page 32*)

THE PAY-TV FUSS recalls similar proposals that have been made from time to time in regard to radio. Many years back one system, which earned the name "pig squeal" radio, proposed a scrambled signal and a decoding box similar to those being discussed today. Without the decoder the received signal sounded like a pig squealing, hence the name. The system was rejected.

TRANSISTOR ENGINEERS get a few words of advice from General Transistor Corp. in their new pamphlet, "How Not To Use Transistors." With tongue-in-cheek they recommend: "Forget about the I_{co}, assume it equals zero, then you'll really end up with nothing." Another point: "Check the transistor with high voltage or high current ohmmeter for continuity."

ABOUT 7.5 MILLION persons in the U. S. are now college graduates—about 2 million more than were reported in the 1950 census.

AMATEUR ROCKETEERS are being urged "not to be carried away with their experiments." Sounds like the WW II warning that went "if a victim of a direct bomb hit, don't go to pieces."

COMPUTER was brought in to total up the golf scores at the Librascope Inc. company golf tournament. Prior to the start of the tournament, the names, handicaps and rating numbers were entered on the magnetic memory drum of a Librascope LPG 30 computer. As each foursome completed play, each player's gross score was entered on the drum. When the last entry came in, it was fed into the machine and in a matter of minutes the machine compared the gross and net scores of every player, broke all ties by checking against the player's rating number, placed the contestants in correct finishing order and printed the results.

 Circle 23 on Inquiry Card, page 101

Snapshots.....of the Electronic Industries

INDUSTRIAL TV

RCA has installed the largest industrial TV system for automatizing complex railroad freight operations at Southern Railways new Inman Yard, Atlanta, Georgia.

FROZEN LIGHTNING

Scientists at Mullard Ltd., England, created this effect by building up a 4 mev charge in the block of perspex, then inducing a sudden discharge

FORWARD SCATTER TESTING

On her farm in Pharsalia, N. Y., housewife Orah Newton (left) is tending to three radio transmitters daily to help the Bell Telephone Labs check out their forward scatter link to Holmdel, 171-airline miles away. On her farm Mrs. Newton has two antennas, a 28-ft dish, and a 10-ft dish (below), and a radio building to house the equipment.

YOUTH PROGRAM

Sponsors and members of the first Boy Scout "Science Explorers" post, established in Newport Beach, Calif., by Heliport Div., Beckman Instruments, check over their new equipment.

ACCELERATION TESTING

Technician at Elgin National Watch Co.'s Micronics Division, Chatsworth, Calif., checks completed assemblies up to 1200 G's.

"ALL SHOOK UP"

Boeing's 707 jet airliner undergoes vibration tests to determine the resonant characteristics of the engine pods and engine struts.

TRANSISTOR TV

Motorola's Robert Galvin proudly displays their new 31-transistor portable TV receiver, powered by rechargeable batteries.

LIGHT MEASURING

NBS scientist checks U. S. standards of light intensity against the standards of 6 other countries. U. S. came within a few tenths of 1% of other standards.

FOREIGN VISITORS

Stromberg-Carlson's R. Sparkes and M. Soffer demonstrate new S-C equipment to 5 visiting industrial engineers from the Republic of China (Formosa).

Books

Industrial Electronics Handbook

By R. Kretzmann. Published 1957 by Philosophical Library, Inc., 15 E. 40th St. New York 16. 305 pages. Price $12.00.

The first part of this second enlarged edition describes the principles and properties of the various classes of electronic tubes, together with typical applications and circuits.

In the second part a separate chapter is devoted to each of the main types of applications, such as electronic relays, counting circuits, etc., containing a large number of practical examples, the operation of each being described in considerable detail with fully designed circuits.

Advanced Calculus

By R. Creighton Buck. Published 1956 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 423 pages. Price $8.50.

This book reviews elementary calculus with rigor, but without retracing already familiar ground. It gives a systematic and modern approach with the differential and integral calculus of functions and transformations. Analytical techniques are developed for attacking some of the typical problems which arise in applications of mathematics. The reader is introduced to modern points of view in mathematics.

Digital Computer Components and Circuits

By R. K. Richards. Published 1957 by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton N. J. 518 pages. Price $10.75.

This book provides a ready source of basic engineering approaches related to digital techniques carefully organized for practical use.

Here is information engineers need to reduce ideas about arithmetic and logic through a working machine. A reasonable familiarity with electrical and electronic fundamentals is all the background a reader needs to understand the material in this book, although the basic principles of logical functions and mechanized arithmetic such as Boolean notation and discussions of counters and adders, are included.

Engineering Properties and Applications of Plastics

By Gilbert F. Kinney. Published 1957 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 285 pages. Price $6.75.

This book is written for those who work with plastics and for those who require background information with the proper utilization or specification of these materials. The various plastics are here described separately more or less in the order of increasing complexity. A unified treatment, rather than a topical approach, permits the principles, concepts, and terminology to be established in the simpler cases, and utilized in treatment of the more complex materials.

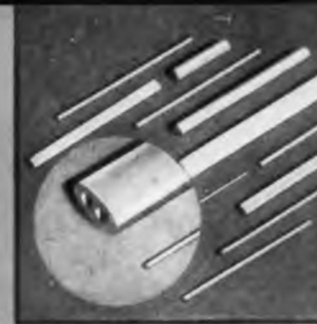
(*Continued on page 40*)

Abrasion Resistant

Sand Blast Nozzles. Spray Nozzles. Hard, homogeneous, long-lived. Suited to the most exacting uses.

ALSIMAG®

DATA FOR DESIGNERS



Precision Tolerances

Minute, yet strong tubing of AlSiMag Alumina. Parts in inset magnified three times (smaller one .013" OD); others approximate actual size.

NEW!

AlSiMag Alumina Ceramics open new fields for designers . . . permit designing to higher temperatures, higher frequencies, greater strengths.

Designers are generally familiar with the plus values of AlSiMag technical ceramics for standard industry applications. However, recent developments—particularly in new, high-strength, high-temperature AlSiMag Aluminas—have greatly enlarged their range of usefulness.

Do you need a material with such versatile characteristics as shown on this page? AlSimag technical ceramics have helped many designers solve problems . . . may help solve yours. Send blueprint with complete operating details for our recommendations.

Visit our Booths Nos. 3901, 3902, 3903 at IRE

Non-Inductive

Alignment Tool Blades. Non-metallic, for sensitive machine and instrument settings—other demanding applications.

Hard

AlSiMag Tool Tips for cutting and machining strongest alloy steels.

AMERICAN LAVA CORPORATION

CHATTANOOGA 5. TENN.
56TH YEAR OF CERAMIC LEADERSHIP

A subsidiary of Minnesota Mining and Manufacturing Company

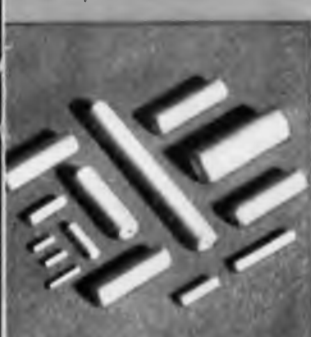
For service, contact Minnesota Mining & Manufacturing Co. Offices in these cities (see your local telephone directory): Atlanta, Ga. • Boston: Newton Center, Mass. • Buffalo, N. Y. • Chicago, Ill. • Cincinnati, O. • Cleveland, O. Dallas, Texas • Detroit, Mich. • High Point, N. C. • Los Angeles, Calif. • New York: Ridgefield, N. J. • Philadelphia, Pa. • Pittsburgh, Pa. • St. Louis, Mo. St. Paul, Minn. • So. San Francisco, Calif. • Seattle, Wash. **Canada:** Minnesota Mining & Manufacturing of Canada, Ltd., P. O. Box 757, London, Ont. **All other export:** Minnesota Mining & Manufacturing Co., International Division, 99 Park Ave., New York, N. Y.

Thin . . . Strong

Electron Tube Spacers as thin as .009" have remarkable strength. Similar parts might solve other application problems where superior insulation is needed.

Durable

Rollers for flattening inductance wire—a new application for AlSiMag.



Precision Finishes

Smooth, easily coated AlSiMag Cores for Ink, Metal Film and Carbon Deposited Resistors.

Heat Resistant

Support Rings for Heat Treating Fixtures. Welding Jigs. Hold-down Jigs for heat applications.

Acid Resistant

Rotary Seals and Plungers. Extraordinary wearing qualities. Surface finishes to most exacting specifications.

Circle 25 on Inquiry Card, page 101

Books

(*Continued from page* 38)

Transistor A. F. Amplifiers

By D. D. Jones and R. A. Hilbourne. Published 1957 by Philosophical Library, Inc., 15 E. 40th St., New York 16. 160 pages. Price $6.00.

This book deals systematically with the design of transistor audio-frequency amplifiers, and gives the circuitry and design detail of a versatile range of amplifiers, including those for high fidelity reproduction and public address systems with undistorted outputs up to 20 watts.

Ideas, Inventions, and Patents

By Robert A. Buckles. Published 1957 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 285 pages. Price $5.95.

In this concise, easy-to-read book, the author answers many questions about patent law. Carefully avoiding the legal "jargon," he discusses the principles that underlie patents in all fields of technology—mechanical, electrical, chemical, and nuclear—and then gives lucid examples of specific applications in each area. In addition, the author takes the reader step-by-step through the complete case history of a simple invention providing an unparalleled guide for readers who have had no previous experience with the patent office or with patent attorneys.

Elements of Pure and Applied Mathematics

By Harry Lass. Published 1957 by McGraw Hill Book Co., 330 W. 42nd St., New York 36. 491 pages. Price $7.50.

More extensive in its treatment of individual topics than most applied mathematics text, this work is a valuable reference book for all readers.

The text discusses more thoroughly than usual the various subjects in classical mathematics most useful to the engineer and physicist.

There is a short treatment of nonlinear mechanics and game theory, and a chapter on group theory and algebraic equations. The treatment of Vector and Tensor analysis, along with probability theory and statistics, is unusually complete. There is also a treatment of orthogonal polynomials which is unique in such a book.

Principles of Electrical Measurements

By H. Buckingham and B. M. Price. Published 1957 by Philosophical Library Inc., 15 E. 40th St., New York 16. 623 pages. Price $15.00.

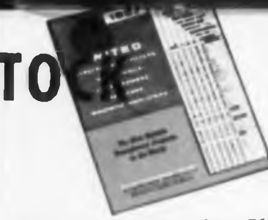
With the extension of electrical techniques to so many branches of engineering, the subject of electrical measurements is a very wide application. The chief aim of this book is to provide a knowledge of the principles employed in making such measurements and to explain the methods of applying these principles.

(*Continued on page* 44)

Circle 27 on Inquiry Card, page 101

Hi-Q Inductors .... FROM STOCK

As largest producers in this field for over two decades, UTC inductors cover virtually every need for both fixed and variable units of exceptional stability. Hermetic units have been proved to MIL-T-27A, eliminating costs and delays of initial MIL-T-27A testing.



For complete listing of our 700 stock items (300 hermetic) write for catalog.

HVC Hermetic Variable Inductors

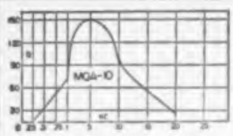
A step forward from our long established VIC series. Hermetically sealed to MIL-T-27A ... extremely compact ... wider inductance range ... higher Q ... lower and higher frequencies ... superior voltage and temperature stability. Case 25/32 x 1⅛ x 1 7/32, 2 oz.

Type No.	Min. Hys.	Mean Hys.	Max. Hys.
HVC-1	.002	.006	.02
HVC-2	.005	.015	.05
HVC-3	.011	.040	.11
HVC-4	.03	.1	.3
HVC-5	.07	.25	.7
HVC-6	.2	.6	2
HVC-7	.5	1.5	5
HVC-8	1.1	4.0	11
HVC-9	3.0	10	30
HVC-10	7.0	25	70
HVC-11	20	60	200
HVC-12	50	150	500

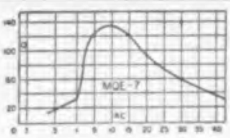
HVC

MQ drawn case structure

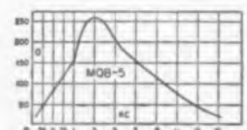
	Length	Width	Height	Oz.
MQE	1/2	1-1/16	1-7/32	1.5
MQA, MQB	11/16	1-9/32	1-23/32	4
MQB	1-5/16	2-9/16	2-13/16	14



MQA
19 stock values from 7 Mhy to 22 Hy



MQE
15 stock values from 7 Mhy to 2.8 Hy



MQB
12 stock values from 10 Mhy to 25 Hy.

MQD

New extreme stability inductors for 12KC to 130KC range. Typical Q is 170 @ 50KC. 6 stock values from 2 mhy. to 20 mhy.

MQ Series Compact Hermetic Toroid Inductors

The MQ permalloy dust toroids combine the highest Q in their class with minimum size. Stability is excellent under varying voltage, temperature, frequency and vibration conditions. High permeability case plus uniform winding affords shielding of approximately 80 db.

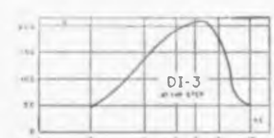
MQL Low Frequency High Q Coils

The MQL series of high Q coils employ special laminated Hipermalloy cores to provide very high Q at low frequencies with exceptional stability for changes of voltage, frequency and temperature. Two identical windings permit series, parallel, or transformer type conections. 1-13/16 dia. x 2½" H.

MQL-0	.25/1 Hys.
MQL-1	2.5/10 Hys.
MQL-2	5/20 Hys.
MQL-3	50/200 Hys.
MQL-4	100/400 Hys.
MQL-5	625/2500 Hys.

DI Inductance Decades

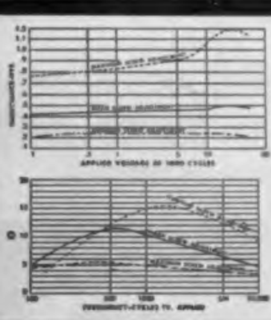
These decades set new standards of Q, stability, frequency range and convenience. Inductance values laboratory adjusted to better than 1%. Units housed in a compact die cast case with sloping panel ideal for laboratory use ... 4½ x 4⅜ x 2⅜ high.



DI-1	Ten 10 Mhy. steps.
DI-2	Ten 100 Mhy. steps.
DI-3	Ten 1 Hy. steps.
DI-4	Ten 10 Hy. steps.

VIC case structure

Length	Width	Height	Oz.
1-1/4	1-11/32	1-7/16	5-1/2



Type	Mean Hys.	Type	Mean Hys.
VIC-1	.0085	VIC-12	1.3
VIC-2	.013	VIC-13	2.2
VIC-3	.021	VIC-14	3.4
VIC-4	.034	VIC-15	5.4
VIC-5	.053	VIC-16	8.5
VIC-6	.084	VIC-17	13.
VIC-7	.13	VIC-18	21.
VIC-8	.21	VIC-19	33.
VIC-9	.34	VIC-20	52.
VIC-10	.54	VIC-21	83.
VIC-11	.85	VIC-22	130.

VIC Variable Inductors

The VIC Inductors have represented an ideal solution to the problem of tuned audio circuits. A set screw in the side of the case permits adjustment of the inductance from +85% to −45% of the mean value. Setting is positive.

Curves shown indicate effective Q and L with varying frequency and applied AC voltage.

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For precise power measurements in all bands

Microline® 123B Wattmeter Bridge. Measures average power to accuracy of 3%. Self-balancing and direct-reading, bridge operates with Microline barretter or thermistor mounts. Frequency coverage depends on mount used.

Microline 630 Peak Power Meter. New direct-reading meter measures true peak power in radars and other pulse systems. Readings, indicated continuously, are independent of width, shape, and repetition rate of pulse.

Microline Combination Test Sets. All are capable of measuring both peak and average power in radar systems. Also do the job of three or more standard test sets in measuring many other important system parameters. Special gating feature selects and identifies any pulse of a multi-pulse group for peak power measurement and spectrum observation. Available for Lp, S, C, X, K, and V band systems.

New Microline Barretter Mounts. For peak or average power measurements, these mounts are fixed-tuned and broad-banded to cover complete frequency range of their waveguide with high internal efficiency. Designed with low shunt capacity especially for peak power measurements with Microline 630 Meter. Barretters can be replaced by user. Three mounts cover all frequencies from 2.5 to 12.4 kmc.

Other Microline Barretter and Thermistor Mounts cover coaxial and waveguide lines for frequencies between 0.82 and 9.6 kmc. All Microline mounts are fixed-tuned for low VSWR over their bands.

Microline Directional Couplers. For sampling system power for measurement and test purposes. Available for coaxial and waveguide lines covering 0.96 to 40.0 kmc. Coupling ratios cover 10 to 50 db. Dual couplers are available for special comparative and ratio techniques, such as reflectometer measurements for fast production testing.

Microline Barretters and Thermistors. Precision elements for reliable power measurements as well as linear detection and probe uses. Seven types are available for special requirements of all types of power measurements, frequency bands, and bridge or meter circuits.

Now available from Sperry for immediate delivery is a complete line of Microline® equipment for measuring power in all bands. Ready to meet the growing demand for instruments capable of a high order of accuracy, Microline equipment design is based on Sperry's wide experience in developing precision test and production equipment for major weapon and defense systems. Write our Microwave Electronics Division for latest data on "Microline Power Measuring Instruments."

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Books

(*Continued from page* 40)

Books Received

Transistor Circuits

By Rufus P. Turner. Published 1957 by Gernsback Library Inc., 154 W. 14th St., New York 11. 160 pages, paper bound. Price $2.75.

A Glossary of Terms in Nuclear Science and Technology

Published 1957 by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18. 188 pages, paper bound. Price $5.00.

Neutron Cross-Sections

By Donald J. Hughes. Published 1957 by Pergamon Press, Inc., 122 E. 55th St., New York 22. 182 pages. Price $5.00.

An Introduction to Reactor Physics, Revised 2nd Ed.

By D. A. Littler and J. F. Raffle. Published 1957 by Pergamon Press Inc., 122 E. 55th St., New York 22. 208 pages. Price $5.50.

ASTM Standards on Electrical Insulating Materials

Published 1957 by American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 678 pages, paper bound. Price $6.00.

Creative Communication

By Edwin Laird Cady. Published 1956 by Reinhold Publishing Corp., 430 Park Ave., New York 22. 158 pages. Price $2.50.

Receiving Aerial Systems

By I. A. Davidson. Published 1957 by Philosophical Library Inc., 15 E. 40th St., New York 16. 152 pages. Price $4.75.

Stereophonic Sound

By Norman H. Crowhurst. Published 1957 by John F. Rider Publisher, Inc., 116 W. 14th St., New York 11. 128 pages, paper bound. Price $2.25.

Elements of Tape Recorder Circuits

By H. Burstein and H. C. Pollak. Published 1957 by Gernsback Library, Inc., 154 W. 14th St., New York 11. 224 pages, paper bound. Price $2.90.

EEI-NEMA Standards for Secondary Network Transformers

Published 1957 by Edison Electric Institute, 420 Lexington Ave., New York and National Electrical Manufacturers Assoc., 155 E. 44th St., New York. 22 pages, paper bound. Price 80¢.

The Industrial ph Handbook

Edited by Thomas J. Kehoe. Published 1957 by Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif. Price $2.00.

Annual Proceedings of the Joint Technical Advisory Committee (IRE-RETMA), Volume XIV

Publisheed by the Institute of Radio Engineers, 1 E. 79th St., New York 11. Price $5.00.

Proceedings of the 1957 Electronic Components Symposium

Published 1957 by The Institute of Radio Engineers, 1 E. 79th St., New York 11. 282 pages, paper bound. Price $5.00.

Bulletin of the Academy of Sciences of the USSR, Volume XX, Nos. 9 and 10, Physical Series

Published 1957 by Columbia Technical Translations, 5 Vermont Ave., White Plains, N. Y. Single Issues $20.00. These two issues are concerned with Cathode Electronics.

Circle 32 on Inquiry Card, page 101

Type Z817A

Type Z815B

Type Z819A

Circle 33 on Inquiry Card, page 191

Personals

Sanford H. Glassman is now Chief Engineer, Electronics Div. of the N.J.E. Corp. in Kenilworth, N. J.

Michael Giordano is now a member of the engineering staff of Filtors, Inc. He was formerly with The Nagler Helicopter Co. as consulting staff engineer.

Richard D. Peressini has been named Project Engineer for the ESC Corp. He will be engaged in the design and development of the company's line of custom-built and stock pulse transformers and pulse-forming networks.

R. D. Peressini

L. J. Torn

Lawrance J. Torn has been promoted to Chief Engineer for the Airborne Instruments Laboratory, Inc. His new work assignment calls for coordination of the company's production design activities in the field of industrial control systems involving automatic machine and process controls and electronic test equipment.

William A. Stewart has been named Chief Project Engineer for the Behlman Engineering Co., Burbank, Calif. He will be working on new product developments in the electronics, mechanics and optics fields.

Murray Kanes is now Director of Engineering of the Friez Instrument Div. of the Bendix Aviation Corp.

Gustaf A. Wallenstrom has been appointed to the newly-established position of Consulting Engineer on antenna system structures for the General Electric Company's Technical Products Dept.

Heyward A. French has been named an Executive Engineer at Federal Telecommunication Laboratories, Nutley, N. J.

Charles H. Fetter, president of the WatchMaster organization occupies a full chapter in the new Quentin Reynolds book, "Operation Success." The WatchMaster line includes ultrasonic watch and jewelry cleaners and watch demagnetizers as well as time products.

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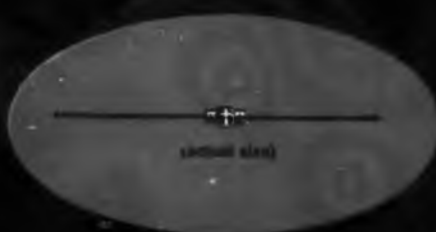
DIFFUSED JUNCTION

SILICON GLASS RECTIFIERS



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225 TO 500 PEAK INVERSE VOLTS

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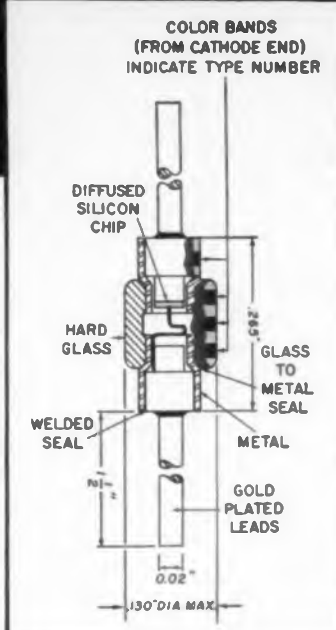
Type	Ave. Rectified Current		Peak Inverse Voltage		Reverse Current (μAdc) max. at indicated volts		
	25°C mA	150°C mA	—65° to +150°C	25°C	volts	at 25°C	at 100°C
1N645	400	150	225	275	225	0.2	15
1N646	400	150	300	360	300	0.2	15
1N647	400	150	400	480	400	0.2	20
1N648	400	150	500	600	500	0.2	20



For all types

Voltage Drop (400mA, 25°C) .... 1.0 V max.
Steady State Peak Forward Current (25°C) .... 1.25 A max.
Surge Current (1 sec. 25°C to 150°C) .... 3.0 A max.
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Circle 35 on Inquiry Card, page 101

Circle 36 on Inquiry Card, page 101

 Circle 37 on Inquiry Card, page 101

ULTRA-BROADBAND

MICROWAVE SIGNAL GENERATOR

MSG-34

one continuous control frequency

4,200-11,000 mc

Replaces 2 or more present day signal generators normally required to cover C and X bands

The new Polarad MSG-34 outperforms all existing signal generators both in frequency coverage and ease of operation. In all respects, it is the most efficient and economical instrument to generate frequencies between 4,200 and 11,000 mc at a high power level.

By means of a unique design utilizing Polarad's exclusive UNI-DIAL control, Ultra-Broadband Frequency Coverage has been achieved in one completely integrated unit. Attenuator index is automatically set throughout the entire band after calibration, thus avoiding possible error when making accurate measurements rapidly. Frequency is read directly from a 4 foot linear dial that is easy to read.

Some unusual features:

Calibrated output: 1 milliwatt

Internal pulse modulations

- .2 to 10 u sec. pulse width
- 10 to 10 000 prf
- 2 to 2 000 u sec. delay

Pulse rise and decay time 0.1 u sec.

Attenuator index independent of power set

Long life non-contacting choke in oscillator

Provision for external modulation, sine wave, pulse or multiple pulse.

POLARAD
PROVEN RELIABILITY

SPECIFICATIONS:

Frequency Range: 4,200 mc to 11,000 mc

Frequency Accuracy: ± 1%

Power Output: 1 milliwatt (0 dbm) calibrated

Attenuator Output Range: 0 dbm to −127 dbm, 0.223 volts to 0.1 microvolt, (directly calibrated).

Attenuator Output Accuracy: ± 2 db from 0 to − 127 dbm

Output Impedance: 50 ohms nominal.

Output VSWR: 2:1 maximum

Internal Pulse Modulation:
- **Width:** 0.2 to 10 microseconds.
- **Repetition Rate:** 10 to 10,000 pps
- **Delay:** 2 to 2,000 microseconds.
- **Sync:** internal, external-pulse or sine wave.
- **Rise Time:** 0.1 microsecond as measured between 10% and 90% of maximum amplitude of the initial rise.
- **Decay Time:** 0.1 microsecond as measured between 10% and 90% of maximum amplitude of the final decay.

Internal Square Wave:
- **Rate:** 10 to 10,000 pps.
- **Symmetry:** ± 5%
- **Sync:** Internal

Internal FM:
- **Type:** Linear sawtooth.
- **Frequency Deviation:** 5 mc minimum.
- **Rate:** 10 to 10,000 cps.
- **Synchronization:** Internal or external, pulse or sine wave.

External Pulse Modulation:
- **Polarity:** Positive or negative.
- **Rate:** 10 to 10,000 pps.
- **Pulse Width:** 0.2 to 100 microseconds.
- **Amplitude:** 10 to 40 volts peak.

Output Synchronization Pulses:
- **Polarity:** Positive, delayed and undelayed
- **Rate:** 10 to 10,000 pps.
- **Amplitude:** 15 volts peak minimum.
- **Rise Time:** Less than 0.25 microsecond.

External Sync:
- **Type of Input:** Positive, negative, or sine wave.
- **Amplitude:** Pulse: 5 to 50 volts peak; Sine wave: 5 to 40 volts rms.

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FIELD INTENSITY MEASUREMENTS

Absolute measurements of field intensity are possible with the Model FIM field intensity receiver system. An incoming signal, received by the calibrated antenna, is matched against the signal of an internal calibration signal source to determine absolute power. The instrument is completely shielded to prevent stray signal pickup.

RADIATED INTERFERENCE MEASUREMENTS

Over the frequency range 1000 to 10,000 mc, interference radiated from any electronic equipment can be determined and examined to meet the requirements of commercial or military specifications.

Broadband Measurements—Direct indication by peak reading slide-back V T V M and by quasi-peak meter function.

CW Measurements—Average indication of unmodulated carrier; average or peak indication of modulated carrier.

CONDUCTED INTERFERENCE MEASUREMENT

The Model FIM receiver system can be used to determine radio interference voltages operating on external power conductors, or other external system connections, by connecting the monitor unit to a line stabilization network. Both broadband and CW interference signal levels may be measured as described in "Radiated Interference Measurements" (above).

ANTENNA PATTERN MEASUREMENTS

Because of the sensitivity of the FIM receiver system, transmitter and receiver antennas can be separated by distances great enough to avoid phase errors. Minor lobes can be carefully investigated. The automatic frequency control allows the use of a relatively unstable signal source. Preselection eliminates errors that may be caused by the presence of harmonics of the signal or spurious signals.

SENSITIVE R-F VOLTMETER AND POWER METER

The Model FIM receiver system will measure carrier levels from 10 micro-microwatts to 2 watts. A multi-position coaxial step attenuator is provided to switch ranges quickly, and the effective noise bandwidth is constant for the full r-f range of the instrument. UNI-DIAL single knob tuning permits quick frequency scanning.

CALIBRATED MICROWAVE FIELD INTENSITY RECEIVER SYSTEM

absolute measurements— radiation, interference and leakage

1,000 to 10,000 mc

The new Polarad Model FIM is the only instrument approved Class A MIL SPEC MIL-I-006181C for performing radiation leakage measurements in the range 1,000 to 10,000 mc. It is a complete system including a monitor unit, 4 interchangeable tuning units covering the range 1,000 to 10,000 mc, a separate power supply, a series of antennas to match the frequency range of each tuning unit and one broadband omnidirectional antenna. The monitor unit provides meter, video, audio and recorder outputs. The power supply provides regulation of plate and filament voltages.

MODEL FIM SYSTEM
BASIC MONITOR UNIT—FIM-B
POWER UNIT—FIM-P
TUNING UNITS (interchangeable)

*FIM-L	1,000 to 2,240 mc
*FIM-S	2,140 to 4,340 mc
*FIM-M	4,200 to 7,740 mc
*FIM-X	7,360 to 10,000 mc

*U. S. PATENT NO. 2,774,243

Contact Polarad or your nearest Polarad representative for complete details.

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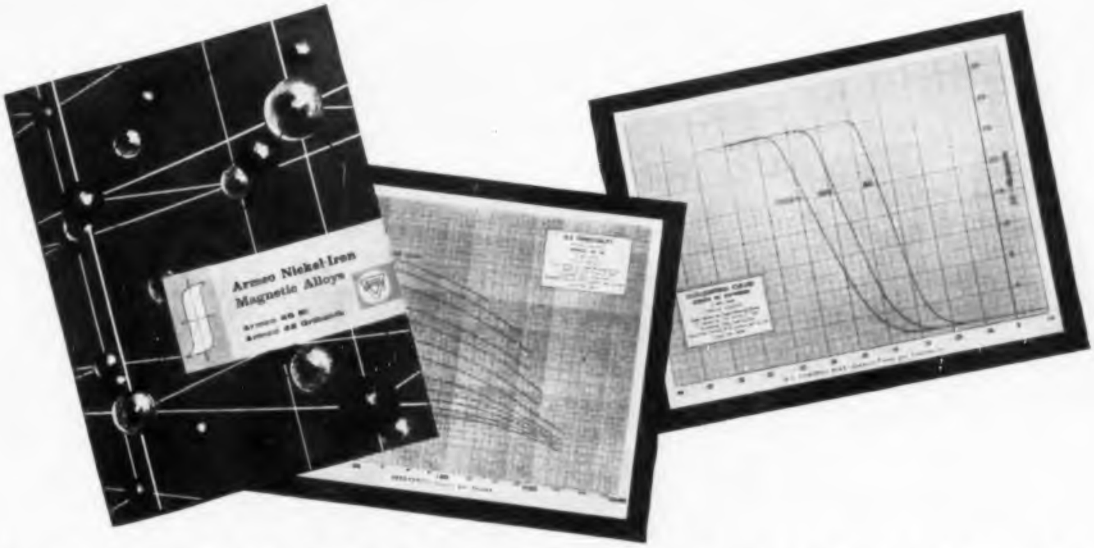
surface barrier transistors from SPRAGUE



New Manual Provides Design Data on

Armco Nickel-Iron Magnetic Alloys...

48 Ni, 48 Orthonik

Includes basic information on high permeability Armco 48 Ni and rectangular-loop Armco 48 Orthonik, plus 50 pages of graphical data on pertinent magnetic properties.

In "Armco Nickel-Iron Magnetic Alloys" you will find new and hitherto unavailable design information on the 48% nickel magnetic materials.

D-C magnetization curves, d-c hysteresis loops, flux control curves, flux-current loops, core-loss data and annealing recommendations enable you to accurately predict the performance of equipment requiring the special characteristics of these alloys. This precise data also enables you to select the grade and gage for the most effective combination of performance and economy.

Armco 48 Ni—Offers high permeability at low and moderate inductions, plus low hysteresis loss. Produced in thicknesses from 14 to 2 mils for stacked or wound cores.

Armco 48 Orthonik—Combines a rectangular hysteresis loop with high permeability at low and moderate inductions. Produced in thicknesses ranging from 1/4 to 6 mils.

Consider the multiple advantages of Armco 48 Ni and 48 Orthonik for magnetic amplifiers, high quality transformers, electronic computer and control circuits, and similar applications.

Just fill out and mail the coupon for your copy of "Armco Nickel-Iron Magnetic Alloys."

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Circle 39 on Inquiry Card, page 101

2N344/SB101
for Medium Gain Amplifiers

	Min.	Typ.	Max.
h_{fe}	11	23	83
f_{max}	30	45	—

2N345/SB102
for High Gain Amplifiers

	Min.	Typ.	Max.
h_{fe}	25	40	110
f_{max}	30	45	—

actual size

2N346/SB103
for High Frequency Oscillators

	Min.	Typ.	Max.
h_{fe}	10	—	—
f_{max}	60	90	—

2N240/SB5122
for Computer Switching

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h_{fe}	16	—
f_{max}	30	—
T_s	—	80

IN VOLUME PRODUCTION *Now!*

For general high frequency applications, and for high speed computer switching circuits, design around Sprague surface barrier transistors. They are available now in production quantities from a completely new, scrupulously clean plant, built from the ground up especially to make high quality semi-conductor products.

The four transistor types shown are the most popular. Orders for these units are shipped promptly. What's more, surface barrier transistors are reasonably priced. High quality and excellent electrical characteristics make them an economical solution to many difficult circuit requirements.

Sprague surface barrier transistors are fully licensed under Philco patents. All Sprague and Philco transistors having the same type number are manufactured to the same specifications and are fully interchangeable. You have *two* sources of supply when you use surface barrier transistors!

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ELECTRONIC INDUSTRIES

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

IRE—Growth and Future

ON the front cover this month we are calling attention to the forthcoming 46th annual IRE National Convention to be held in the New York Coliseum and in the Waldorf-Astoria Hotel, March 24-27. The attendance this year is expected to exceed 55,000 and more than $10 million worth of electronic equipment will be on display.

Most significant about this cover design is the fact that it shows how the interest among Institute of Radio Engineers members has become specialized into Professional Groups. There are now 28 specialized groups with total membership of close to 70,000. (See page 186 in this issue for a breakdown of PG titles.) The growth pattern here has been truly phenomenal! The Professional Group program was started in 1948. By 1951 eight groups had been formed with a total membership of 2,087. Thus, the growth of some twenty new groups to 1958, with a total membership increase of nearly 58,000, was accomplished in about seven years.

We are citing this great growth pattern because we believe that the professional groups that have been formed are indicative of the principal areas in which we can expect new developments for both consumer and industrial applications. All of us should realize that more than 50% of the industry output involves designs and equipment for the military and government.

Recently there has been considerable discussion of tax reductions to stimulate business. In our industry a tax reduction, which might be reflected in reduced government spending, would be extremely serious to most electronic producers. As individuals, we are wholeheartedly in favor of tax reductions! As an industry, however, the current high level of government support is a momentary blessing.

What is needed now is a concerted effort to develop new and practical consumer and industrial electronic products. This in turn should reflect in the overall national product output to reduce military and government percentages to lower and lower values. If IRE Professional Groups were to adopt programs that would promote new product suggestions, we could be taking a major forward step toward increased stability and security within our industry. Along these lines, one suggestion which reached us recently was entitled . . .

Electronic Simulators

AIRLINES have considerable money invested in FLIGHT SIMULATORS but the dividends in the form of results and reduced costs make such investment worthwhile. Bombardiers, during World War II, seated at a table on the ground and watching the trace on a cathode-ray oscilloscope while manipulating the control "stick" of a guided missile system, gained the "feel" and other valuable experience in the training so necessary before they could effectively drop guided bombs on the enemy. A small, electronic simulator, costing $3,000, gave them the equivalent of many practice hours in the air in bringing their radio-controlled bombs on the target.

We should extend the principle of SIMULATION into more fields, utilizing this low-cost, convenient electronic means to get correct answers, obtain practice in and solve many of our problems.

New examples come to light from day to day. For instance: The control of a model radio-controlled ship to instruct sailors in the effect in navigation of rudder, speed, currents, etc. A remunerative field is that of sports. For instance, skeet shooting, carried on (even in the living room) with electronic aids would not only save costs in ammunition but should train the marksman rapidly because he could see just where his "misses" missed. As a teacher of automobile driving a real, electronic simulator, not the crude type found in penny arcades, should find acceptance. Devices of this general type would greatly simplify the selection, by personnel departments, of prospective employees for jobs where certain reflexes and inherent skills are demanded.

"EXPLORER"

—And What It Means!

The information being telemetered from America's first Earth satellite will lead to more reliable radio communication and improved air navigation, and set the stage for the first manned aircraft to invade space.

Satellite is assembled at Redstone Arsenal

FOUR months of national humiliation and frustration finally came to an end on Jan. 31, 1958, at Cape Canaveral, Fla., as the Army's Jupiter-C missile soared into the night sky carrying the first U. S. earth satellite, the Explorer, into its space orbit.

The long-awaited U. S. space vehicle was neither as big, nor as heavy as Sputniks I and II, but it was well-instrumented and its orbit was carrying it much further into space than its Russian counterparts. Also it was supplying a wealth of information to the U. S. and other IGY countries who were given the key to the telemetering code being transmitted.

Explorer is shaped not like the Navy's ill-fated Vanguard but in the form of a rifle shell. It weighs 30.8 lbs., is 6 in. in diameter and 80 in. long. Before launching the unit was spin-stabilized—set whirling at 700 rpm.

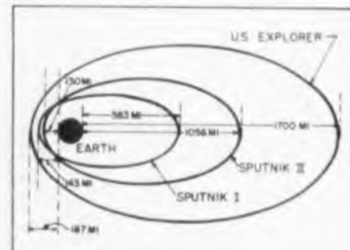
Of the 30.8 lbs., 18.13 lbs. represents the satellite package. The empty rocket case at the rear weighs 12.67 lbs. The weight of the instruments in the satellite is 11 lbs.

The instruments carried by Explorer include: an interior temperature probe, an exterior temperature probe, a cosmic ray measuring device, including Geiger-Mueller tube, a matrix of wire grids to measure the bombardment by micrometeorites, a microphone to pick up the sounds of micrometeorite impacts, a device to measure the erosion caused by the impact of micrometeorites, and two radios, a 6 milliwatt transmitter expected to transmit for approximately three months, and a 1 milliwatt transmitter which cut out after 12 days. Transmissions are being heard on 108 MC.

The first stage of the 4-stage space vehicle was the Army's Redstone missile, developed by the Army Ballistic Missile Agency, Huntsville, Ala., under Maj. Gen. John B. Medaris and Dr. Wernher von Braun. It develops 78,000 lbs. of thrust, and lifted the 65,000 lb. missile assembly to an altitude of

Army's Jupiter-C roars from launching pad carrying Explorer to its earth-circling orbit

Explorer's orbit is carrying it much farther into space than either Sputnik I or II



53 miles before burning out and dropping off.

Propulsion for the upper stages was provided by clusters of the Army's Sergeant solid-propellent rockets. The fourth stage — the satellite itself — carried one Sergeant.

The path of the Explorer is at elliptical path around the earth. At its peak, or apogee, it is estimated to be 1,700 miles from the earth, and at its closest point, or perigee, around 200 miles. Sputnik I had an apogee of 560 miles, and a perigee of 145 miles, while Sputnik II's is 1,056 miles and 104 miles.

The path of the Explorer is at an angle of 33° to the equator, reaching as far north and south on the globe as 33° latitude. The path is approximately at right angles to that of the Russians' Sputnik II.

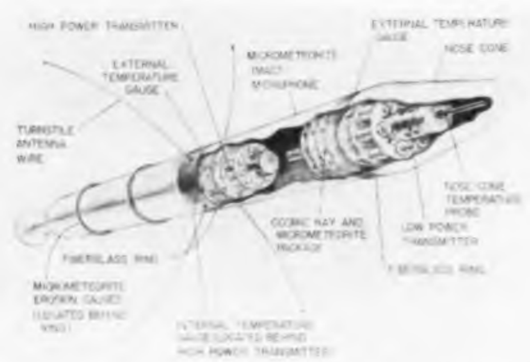
Fuel for the Redstone was a "rather exotic" combination based on hydrazine. Spokesmen for North American Aviation, Inc., manufacturers of the rocket motor, said that the new fuel increased the power and range of the Redstone by 12 per cent.

The rocket motor and fuel used in Redstone is still far less powerful than that used in Sputnik II. On the basis of the weight of Sputnik II, U. S. scientists estimate that the Russian power plant generated close to 250,000 lbs. of thrust—almost four times as much as Redstone.

Speed of Explorer was estimated at approximately 18,000 mph. The time for one complete revolution of the earth was 118 minutes.

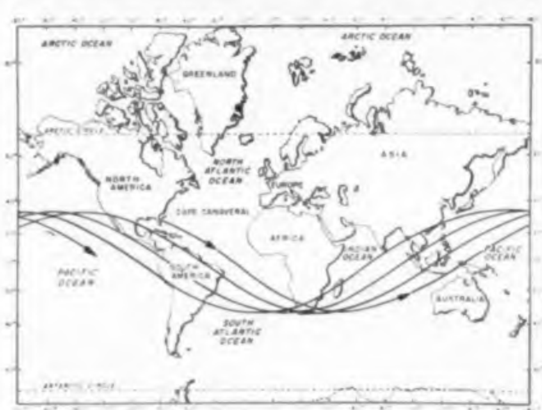
In light of its value to the In-

(Continued on page 126)



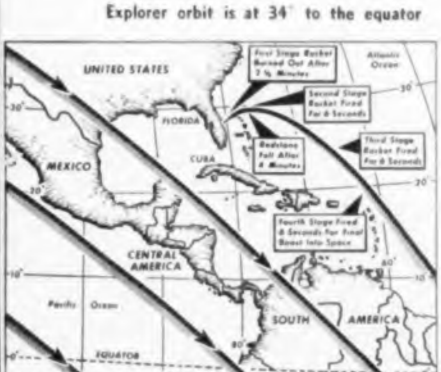
Explorer instruments measure cosmic rays, meteorite bombardment and temperature of nose cone and space

Satellite instruments are placed in "lattice sleeve" at Cal Tech's Jet Propulsion Laboratory



First four passes of Explorer. Orbit is between 35th latitudes, North and South

Explorer orbit is at 34° to the equator



Satellite prototype (right) is examined by key project officers: seated — E. Rees, Maj. Gen. J. B. Medaris, Dr. W. von Braun, Dr. E. Stuhlinger; standing — W. A. Mrazek, Dr. W. Haeussermann

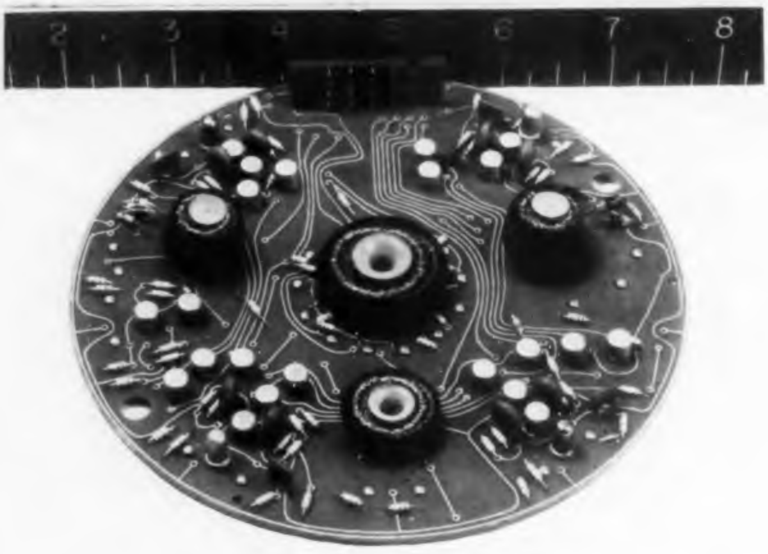


Fig. 1: Miniature telemeter encoder used in American satellites.

Telemetering from Explorer

The American satellite instrumentation package is a marvel of miniaturization. The multi-channel telemetering encoder described here operates on only 4 ma at 2.7 volts—weighs only 3.2 ounces.

THE American Explorer satellite is sending a stream of information about space to technical centers throughout the world. The telemetering system has been widely publicized, and any country can record and decode the satellite signals.

In preparing Explorer, one of the Vanguard telemetery packages was used, with some modifications. The following is a description of the telemetering principles of the basic Vanguard instrumentation package.*

One major, new problem introduced into the telemetry system requirements for the earth satellite scientific program was that of memory devices. Inclination to the plane of the earth's equator for the orbit of the satellite is such that it passes over nearly two thirds of the earth's surface. Provision of an adequate number of ground stations to receive and record telemetered data over all of this area was not feasible. With any practical number of ground stations, the very nature of many of the scientific phenomena to be studied is such that there is little statistical likelihood of obtaining significant data during the recording intervals.

Satellite Requirements

The very listing of the requirements for the earth satellite telemetering system calls to mind the prime attributes of one or more of the recent advances in magnetic devices. Weight and power efficiency coupled with a high degree of reliability have characterized magnetic amplifiers since the introduction of modern magnetic materials. More recent advances using a combination of square hysteresis loop magnetic cores with switching transistors have made available a new and flexible instrumentation technique. Use of magnetic techniques for storage of information is commonplace. Thus a magnetic telemetry encoding system is used in the earth satellite.

The Explorer satellite uses the Minitrack radio tracking system for determination of time-position information. Amplitude modulation of the Minitrack transmitter in the satellite is the radio link for transmission of data to the recording sites. A telemetry encoder using magnetic techniques scans the various input information channels and modulates the Minitrack transmitter with a signal from which the input data from scientific instruments in the satellite can be extracted.

Basic Principles

The telemetry encoder uses square hysteresis loop core materials to establish a series of time intervals proportional to a series of input parameters from satellite instruments. Consider a hysteresis loop of

* As described by AIEE member Whitney Matthews, Head, Applications Group, Solid State Division, Naval Research Laboratory.

the general character shown in Fig. 2 with the flux level at positive saturated remanance point A. A voltage of proper polarity applied to a winding on such a core will cause the flux to approach point B as shown by Arrow 1. Since the voltage induced in the winding, due to this change of flux, must equal the applied voltage in an ideal case, the rate of change of flux must be a linear function of the applied voltage and the current flowing in the winding will be limited to the value, I_M. In other words, such a core is capable of absorbing a fixed number of integrated volt-seconds in changing its flux level from point A to point B, or the time required to change the flux between these points is inversely proportional to the applied voltage.

When the flux level reaches point B, radical changes take place in the core characteristics. Currents are no longer limited to I_M and any practical circuit cannot provide the large currents necessary to maintain the rate of change of flux required to have the induced voltage equal to the applied voltage. These characteristics at saturation are thus able to supply current and voltage signals to actuate switching transistors which change the core from one operating mode to another.

Interaction of switching effects between the core and transistor provides a cumulative action to provide very rapid transitions between operating modes. Switching transistors are used to remove the applied voltage which provided the flux change from A to B and permit operating conditions to return to C. This same switching signal is used to apply a second (or the same) voltage of reversed polarity to repeat the above process in carrying the flux as shown by Arrow 2 to its original condition at point A via point D. The above discussion has been based upon a voltage source as a signal input, but minor changes permit use of variable resistances or currents as input signals.

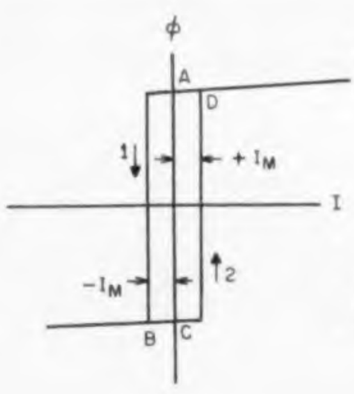


Fig. 2 (l): Idealized flux - current curve in a square hysteresis loop material.

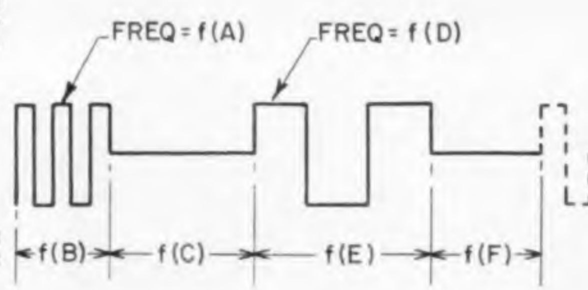


Fig. 3 (r): Typical basic telemetering presentation.

Output

An output winding placed on such a core has an induced voltage proportional to the input signal, polarity a function of the direction of traversal of the hysteresis loop, and a time interval between reversal of output polarities inversely proportional to the integrated average of the signal input over that time interval. In the satellite telemetering system, this latter characteristic is used to present the useful data, thus eliminating stringent linearity requirements on the data transmission system and also permitting all data to be derived from a measurement of time, which can be done with precision.

These basic characteristics are used in two ways in the earth satellite telemetry encoder system. In the "high-frequency" channels, the same input signal is used to carry the flux level around the entire hysteresis loop. Switching transistors are used at each saturation polarity to reverse the magnetomotive force applied by the input signal and return the core to its saturated flux level in the opposite direction at a rate proportional to the same input signal. For a fixed input signal, this circuitry generates a symmetrical square wave whose frequency is a function of the input signal. For a variable input signal, an unsymmetrical square wave of continuously variable time intervals between polarity reversals is generated, each such interval representing the integrated average of the signal level during the interval. Relationships between signal levels and volt-second capacities of the magnetic circuit are so adjusted as to provide flux reversals at a rate which is orders of magnitude more rapid than the second usage described below. For this reason, high-frequency channels are used for all rapidly varying inputs requiring good time resolution in their measurement.

The second type of information presentation is in the "time-interval" channels. This circuitry differs from the high-frequency channels described above in that the switching pulse at saturation is used to transfer magnetic circuit inputs from one input device to another. Thus, the time required to go from positive to negative saturation is a function of one input, while the succeeding time interval is established by a second input carrying the flux level back from negative to positive saturation. Still a third input would be used in establishing the next flux

(*Continued on page* 124)

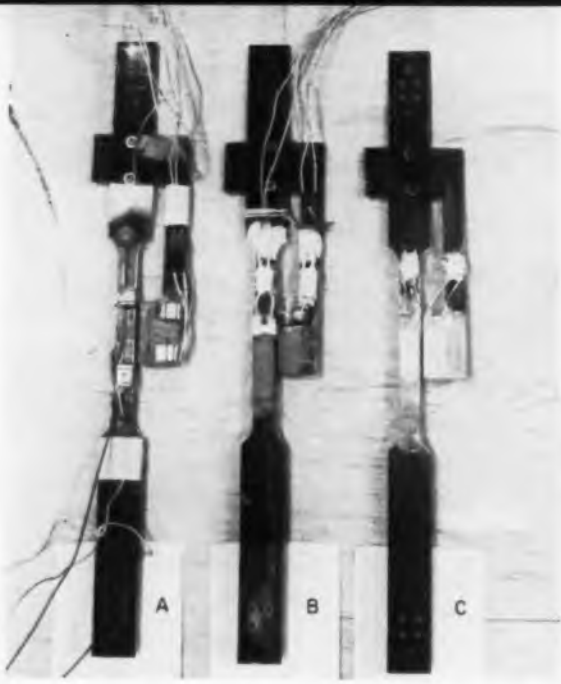


Fig. 1: Strain gage tensile specimens: (A) Micro-test weldable strain gages; (B) Baldwin Nichrome foil gages and Allen P-1 cement; and, (C) Baldwin foil gages and General Electric. L.P. 28-39 cement.

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Weldable strain gages, requiring no elevated temperature curing and providing a 13% error in sensitivity through 1200° F, appear most promising for supersonic aircraft study.

An Evaluation . . .

Strain Gages In Supersonic Aircraft

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Based on a paper presented at the Symposium on Elevated Temperature Strain Gages, Philadelphia, Pa., December 5, 1957.

THE emphasis on elevated temperatures, precipitated by the aerodynamic heating phenomena on fighter aircraft, traveling at supersonic speeds in a dense atmosphere, is increasing. This and the lack of data dealing with the properties of structural materials at elevated temperatures, aroused an acute interest in strain measurements. As a result, an investigation in this field was undertaken.

To date, the work has included consideration of the foil type gage, the two strain—wire type gage, and the wire grid type gage, as well as the weldable strain gages. The amount of manufacturer's data made available with these strain gages was almost nil.

A program of development was established rather than simply a program of evaluation. The aims of the ensuing investigations were easily set forth. We intended to become familiar with the available types of elevated temperature strain gages to the extent of making these devices as usable at elevated temperatures as the ordinary strain gages are at room temperature. The task at hand was soon fully appreciated.

Environmental Testing

A means of providing environmental conditions to check our efforts was undertaken. Our initial work led to the building of a jig for strain gage testing. A bending beam was devised for simultaneously checking gages in tension and compression.

The entire jig was designed to be placed within a heat-treat furnace with load application being accomplished from outside the heated cavity. This proved satisfactory at relatively low temperatures, 300°F. However, due to excessive heat transfer and specimen deflection, it was not considered feasible for the 1200°F temperature range which was fixed as a goal.

For this higher range, a tensile specimen, Fig. 1, was chosen and load was applied by adapting a Dillon Dynamometer. An air-cooled, radiant heat furnace

Fig. 2: "Dillon Dynamometer" adapted for elevated temperature testing, with controls and recording equipment. Note the radiant heat sources — two vertically mounted tungsten filament quartz tubes in air-cooled reflectors

was attached to the vertical supports of the machine to supply the high test temperatures, Fig. 2.

Special end fittings of A-286 stainless steel were fabricated. Extension arms were devised for reaching beyond the heated area while holding a specimen and dummy strip, upon which a four-arm strain gage installation was mounted.

Data Recording

It was felt desirable to obtain a plot of Load vs. Strain at stable increments of temperature by using an X-Y Recorder. Load was sensed from a strain gaged load link, positioned between the loading screw and the end fitting. Loading of the specimen was accomplished manually by a crank.

The radiant heat source was two vertically mounted General Electric, tungsten filament quartz tubes mounted in air-cooled reflectors. Specimen temperature regulation was obtained by controlling the input to the quartz tubes with a Variac. The specimen temperature was sensed from four thermocouples welded directly to the specimen, and the temperature was indicated by a Lewis Potentiometer.

The loading rate could be varied by the operator, but a rate of 100 lb./sec. was found convenient to maintain. The heating rate between load applications was about 50°F/min.

It was apparent from successive trials that the performance of the foil and grid gages was limited by the ceramic that is used to mount them. All of the ceramics that were tried were found relatively poor for strain gage use, Fig. 3. It was extremely difficult to obtain and maintain a workable strain gage installation.

With the weldable strain gages, it was found that an error of 13% in sensitivity, through 1200°F, was possible. Repeatability was a function of mounting technique and temperature history, and not more than 20% accuracy could be assigned to a new installation.

It was concluded from these studies that the weldable gage holds the most promise for development, at the present time, to suit our needs. Attachment of the gage was easily accomplished compared with the ceramic cement, foil, or wire grid combinations. Also, no elevated temperature curing process is necessary with the weldable strain gage, which is one of the most limiting factors of the remaining high temperature gages.

Lead Wire Attachment

In the process of development, swaged lead wire attachment was tried in favor of a welded joint. A hole was drilled in a small section of Nichrome wire. The lead wires were inserted in each end of the resulting tube, and the tube was pressed closed, clamping the wires. This manner of swaging worked well, but it was a delicate operation and welding proved more convenient.

Attachment of ribbon lead wires insulated with glass sleeving proved bothersome, and the insulation was difficult to maintain during temperature cycling. Ceramic, "stand-offs" for the lead wires were clumsy. To overcome this, MgO insulated stainless steel sheathed wire was tried and appeared to offer a better solution. The wire could easily be tack welded to the specimen with a Unitek Welder. The cost of this wire, however, is a very limiting factor.

With the advent of a satisfactory ceramic for use with the foil and the wire grid type gages, many of the present problems with these gages will undoubtedly be overcome. Our investigations with the weldable gages and the ceramics are continuing, and as new types become available and better techniques are developed, they are being included in our work.

Fig. 3: Foil gage and ceramic cement installation after thermal shock. Foil and grid gages were limited by ceramic used to mount them.

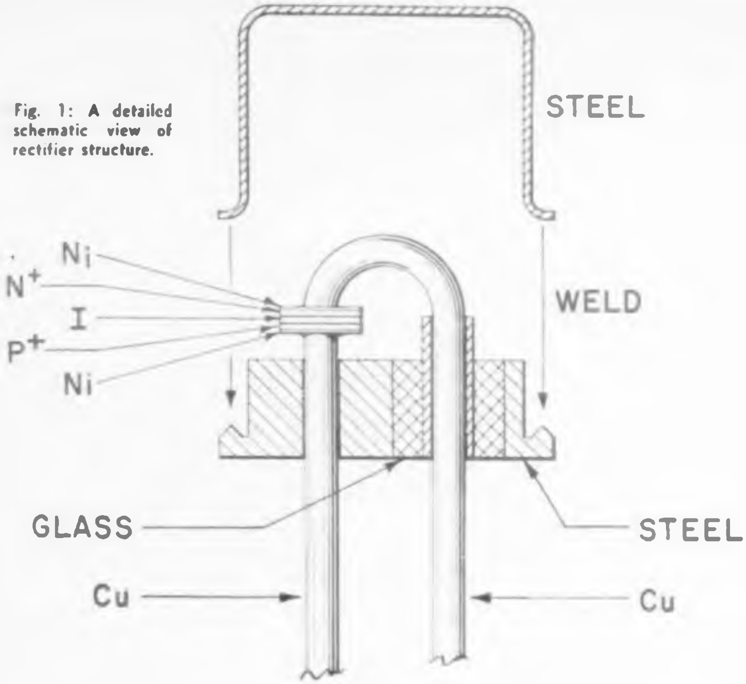

Fig. 1: A detailed schematic view of rectifier structure.

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P-I-N Type Structures as

Medium Power Silicon Rectifiers

A new design consisting of 3 layers,—P^+, Intrinsic, N^+—for silicon power rectifiers promises simple and economical assembly, rugged structure, and satisfactory heat dissipation for the low and medium power ranges.

THE literature reports that diodes with a wide range of power capabilities, designed to be amenable to easy assembly with minimum cost can be prepared either with alloyed junctions[1] or with diffused junctions.[2] It was apparent that many advantages lay in the diffused junction processes. Mainly because large areas can be prepared and subsequently cut to the size required for the desired rating.


Dr. E. L. Steele


Dr. R. J. Andres

Preparation

The schematic in Fig. 1 shows an enlarged picture of the PIN diode structure which has been developed; for maximum ease in assembly and etching of the junction surface, a single-ended structure was chosen.

A high resistivity N-type die containing the two diffused surfaces, one a P^+ layer and one an N^+ layer, was nickel-plated on the faces for ease in soldering. The solder connected the two nickel-plated faces to the copper leads which in themselves provided a means for the conduction of electric current as well as heat.

After assembly, cleanup and protection of the silicon surface with a silicone varnish, the unit was sealed by means of welding a steel cover to the base. The resulting structure was hermetically sealed and mechanically rugged so that it easily passed most requirements for resistance to moisture and shock.

The rectifying junction is formed by the preparation of a PIN structure within a wafer of silicon by a two-stage diffusion. Silicon wafers lapped to a thickness of .010 in. were degreased, washed and placed in a heated zone of a globar heated furnace.

Since it has been found in our laboratories that a slightly oxidizing atmosphere was necessary* to provide the required silicon dioxide surface on the wafer, the wafer was treated with air purified by a charcoal filter before the diffusion was started. After this pretreatment the furnace was flushed with nitrogen containing a small percentage of oxygen and the diffusion started.

Phosphorous pentoxide was placed in a boat which was moved to the pre-heater section of the furnace and left in this pre-heater area for several minutes. It was then removed and the diffusion continued for several hours; nitrogen carrier gas flowed throughout.

After the phosphorous diffusion, the wafers were removed from the furnace which had been cooled below 600°C and the silicon die was lapped on one side to remove the N-type material from one face. The other was protected by waxing to a glass plate. Any scratching of the unlapped surface by the abrasive destroyed its effectiveness as a mask during the subsequent diffusion of boron.

The lapped wafers were replaced in the furnace which was then heated to temperatures exceeding 1200°C and the process described for phosphorous diffusion was repeated using boric acid as the source for boron. Diffusion continued for several hours to place the junction approximately .001 in. below the surface of the silicon.

Forming

In Fig. 2 the mechanical procedure of forming the junction is described. Stage 1 is that of the wafer covered by the silicon dioxide layer.

In Stage 2 the condition of the wafer after the phosphorous deposition and the first stage of the diffusion is shown. Note that the surface is a phospho-silicate glass and below this is a doped layer where elemental phosphorous is diffused part way below the silicon-glass interface. This figure also indicates that the phospho-silicate glass and the partially diffused layer has been lapped away from one side leaving exposed the high resistivity silicon.

Stage 3 shows the final state of the diffused wafer where boron has been deposited on the lapped surface and both boron and phosphorous have diffused from their respective faces to give the PIN structure.

It is interesting to note that the phospho-silicate layer remains N-type despite the subsequent deposition of boron and diffusion. It is thought that the boron oxide might be insoluble in the phospho-silicate layer since a slight scratching of the surface has been shown to permit neutralization of the layer by boron. Further study is in progress to determine whether this is the mechanism of masking or whether the phosphorous, being present in greater concentration in the N-doped side throughout the diffusion, determines the type of doping under the phospho-silicate layer.

* If oxygen was absent or if hydrogen was present to provide a reducing atmosphere, a brown layer deposited on the exit end of the furnace and a white, water-insoluble deposit was found on the wafers. These deposits were shown by chemical analysis to contain phosphorous and silicon and it is thought that they were an amorphous form of phospho-silicate glasses containing some elemental phosphorous. No junction could be detected by staining nor could rectification be obtained from these wafers.

Fabrication

The double-diffused wafers are next plated with nickel to provide soldering surfaces for the leads.

This plating was done with an "electroless" nickel solution. By this process a matte surface was obtained. These wafers can be cut into dice by ultrasonic cutting or by gang sawing using a silicon carbide abrasive without destroying the plated contact.

After cutting the dice by one of the methods suggested, they were ready for assembly in the header. In Fig. 3, the essential parts for the assembly are shown in an exploded drawing. One of the leads, preferably the hook lead, must be fixed to the header before assembly of the unit. An oriented die or several dice, if series units are required, were wrapped in a strip of solder, fluxed, and placed in position.

Solder rings were then dropped on each lead and the unit, held in an assembly jig, passed through a soldering furnace where the atmosphere consisted of nitrogen from which all oxygen had been removed. A lead-tin solder was chosen for two reasons. 1. The solder has a high enough melting point to permit a full power dissipation rating of the unit with the limitation only on the properties of the silicon itself. 2. The high lead content offers good resistance to the nitric-hydrofluoric acid etch used for final etch on the assembled unit.

Before chemical etching, the header, leads and all parts of the assembly that may come in contact with the etch solution were coated with Apiezon wax dissolved in a solvent such as trichloroethylene to adjust

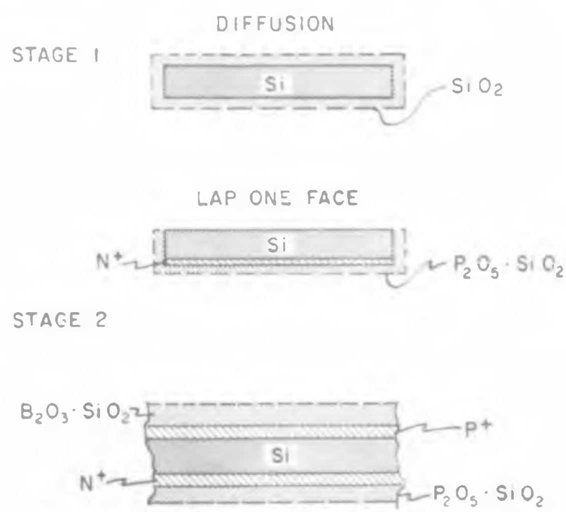


Fig. 2: Wafer cross-section at various diffusion stages.

the viscosity. The edge of the silicon die was, of course, kept free of wax.

After etching, the etch solution was diluted with an overflow rinse and the units washed in an ultrasonic cone with demineralized water. The wax mask was then removed, the unit washed several times in demineralized water, and vacuum baked.

To protect the surface of the silicon during the welding closure, it was found necessary to coat the silicon die with a silicone varnish. This varnish was

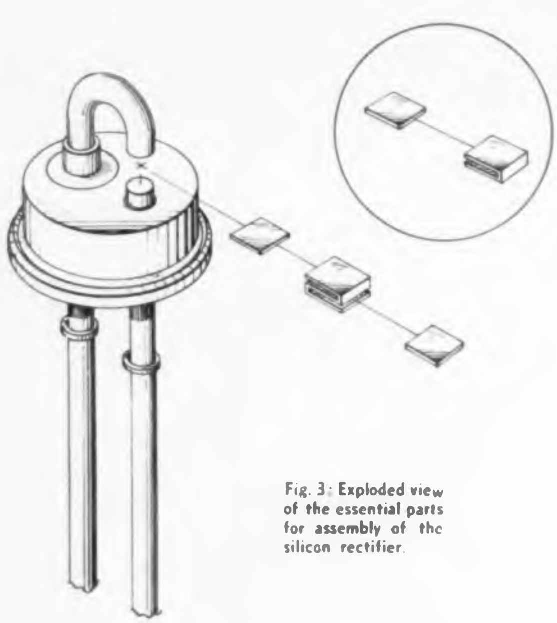


Fig. 3: Exploded view of the essential parts for assembly of the silicon rectifier.

Silicon Rectifiers

(Concluded)

applied and cured by baking the units after varnishing. The steel cover was then welded to the base by use of a capacitance discharge welder.

Since the units were hermetically sealed, it was practical to plate the overall assembly with nickel or gold or to paint the entire assembly for corrosion resistance to suit the end use.

Electrical Characteristics

Note in Fig. 5 the small change in potential drop across a diffused junction diode of the MN-14 type between 0.75 and 3.0 amp. This small change contrasts with a considerably larger change observed in most of the alloyed junction units reported in various manufacturers specifications.

The second point to note is the marked uniformity from unit to unit. Out of a group of 20 samples, it was typical to observe a range of only 2 to 3 mv at 1 amp.

The third point to note in the forward characteristic of this structure is that the resistance drops with increase in temperature, as expected. The properties of the diffused junction rectifiers offer many advantages in practical applications. Easy matching for parallel operation and minimum heat generation at the junction with a given current output are two.

In Fig. 6, the mean breakdown voltage of diffused junction diodes is plotted vs. the resistivity of the starting material in ohm-cm. The junction depth on all these units was approximately 2.5×10^{-3} cm. That the relationship for units made from P-type and from N-type material closely approximated a straight line is noteworthy. In the case of P-type material, the range of resistivities was from 4 ohm-cm to 300 ohm-cm while in N-type the range was from 10 ohm-cm to 100 ohm-cm. From this curve it is possible to predict the minimum resistivity required to obtain a good yield of diodes with breakdown voltage in the range required. It was reported by Veloric[4] that resistivity in this range gave unpredictable breakdown.**

Considerable attention was given to material parameters and to their influence on the performance of the material in diodes. No correlation was noted between resistivity or lifetime and the forward characteristic. However, crystals in which there was impurity segregation would give erratic forward resistance which in some cases were very high.

For predicting the mean breakdown voltage of units obtained from a given crystal, resistivity was a consistent and important parameter as indicated in the previous figure. Lifetime of minority carriers seemed to be of no influence if it was in the order of 20 µsec or better before diffusion. No correlation was observed between etch pit density and mean breakdown voltage. For example, the P-type crystal which gave a mean breakdown voltage of 500 v. had a much higher etch pit density than many of the crystals which gave lower mean breakdown voltages.

Up until now, the discussion has considered a steady state operation of the rectifier. For reliable operation in a practical circuit, however, ability to handle surges at a switch or cyclical surge caused by distortion of the wave form imposed some limitation to the rating of the device. When capacitive filters are used, the start-up surges and repetitive surges are usually maximum. For this reason, reliability and life of the units were studied for the most part in capacitive filtered circuits.

It was shown that the unit was reliable and would withstand the typical peak surges met on unregulated alternating current supplies at ambient temperatures up to 100°C with dc current output up to 0.5 amps. Tests are continuing in order to determine the maximum current at which the unit will operate reliably with the present dimensions. It is obvious that for ratings beyond the capability of the present steel base and dice size, heat sinks of copper will be required. Experimental models of the structures allowing higher dissipation are now being evaluated.

Returning to the basic design in utilizing a steel header, a hook lead and a single-ended configuration, a number of cover cases can be designed to enclose the unit and provide desirable mounting arrangements for electrical circuitry. Two things were considered in these designs: (1) the position of the leads; (2) provision of a stud for mounting to a heat sink. For applications where double-ended configuration was desirable, a lead can be brazed to the cover can before welding to the base and after assembly the lead shorted to the header base can be clipped off. For additional heat dissipation, a stud can be mounted to the cover or made an integral part of the cover.

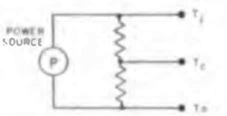
Measurements of the thermo-dissipation of the various structures indicated that the derating curves

** For both n- and p-type $V_B \propto \rho^{0.38}$ which is in close agreement with the results of Veloric where the exponent of ρ ranged from 0.36 to 0.39.

shown in Fig. 7 can be used as a guide for steady state operation.

In determining the derating curves, the following equations and electrical analog, Fig. 4, describing the heat flow were used:

The junction temperature, T_j, the heat sink or rectifier case temperature, T_c, and the ambient air temperature, T_a, are related to thermal resistances by the following equation:



$$T_j - T_c = P \times R_{T1}$$
$$T_c - T_a = P \times R_{T2}$$
$$T_j - T_a = P\,(R_{T1} + R_{T2})$$

Fig. 4: Electrical analog

The thermal resistance, R_{T1}, is between the P-N junction and the case or heat sink and the second thermal resistance R_{T2} is between the heat sink and the ambient air. The thermal power generated in the rectifier is defined by P. For the stud mounted unit, the heat sink temperature might differ from the case temperature; in this instance, the temperature of the heat sink was used instead of the case temperature.

Since the reverse current of the MN-14 even at 100°C is typically less than 500 μamps, the only power of consequence is dissipated when the rectifier is conducting in the forward direction. The power dissipation, then is equal roughly to one volt multiplied by whatever forward current is required and hence a derating curve may be drawn relating the forward current to the temperature.

R_{T1} was found to be approximately 20°C/watt indicating the temperature drop from junction to case. R_{T2} is determined by the case area and varies with the structure and with the mounting system.

For the single-ended unit operating in air, the temperature difference between the case and the atmosphere was about 55°C/watt. In the stud mounted unit where the area is larger and the wall thickness is greater, the heat must flow through a longer path to reach the heat sink area from the junction itself. It was found with the stud mountings that a difference of 25°C/watt was typical. The heat differential existing between the case and the ambient air is determined by the area of the heat sink and the air velocity across this sink. As an example, a 4 x 4 in. aluminum heat sink can reduce the temperature gradient between the stud and ambient air to 6°C/watt.

Other reliability studies of this group of structures indicate that the lead assembly and the mounting of the die provide a physically rugged structure. Military specifications for vibration, shock, and centrifugal force were met.

References

1 Hall, R. N., and Dunlap, W. C., "P-N Junctions Prepared by Impurity Diffusion," *Physical Review*, 80, 467 (1950).

2 Prince, M. B., "Diffused P-N Junction Silicon Rectifiers," *Bell System Technical Journal*, 35, 661-84 (1956).

3 Sullivan, M. V., and Eigler, J. H., "Electroless Nickel Plating for Making Ohmic Contacts to Silicon," Electrochemical Society, 104, 226-30 (1957).

4 Veloric, H. S., Prince, M. B., and Eder, M. J., "Avalanche Breakdown Voltage in Silicon Diffuser P-N Junctions as a Function of Impurity Gradient," *J. Applied Physics*, 27, 895-9 (1956).

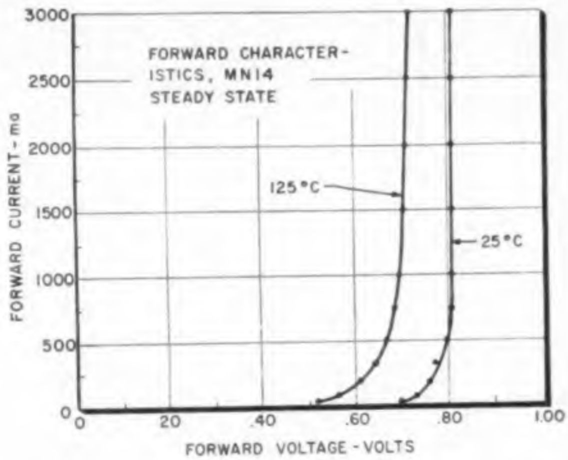


Fig. 5 (above): Note the small change in potential drop between 0.75 and 3.0 amp across the MN-14 type diffused junction diode.

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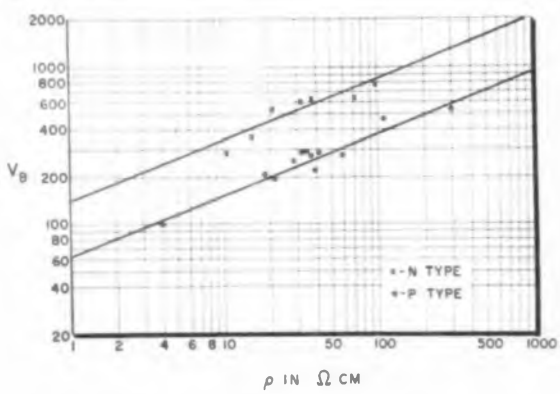
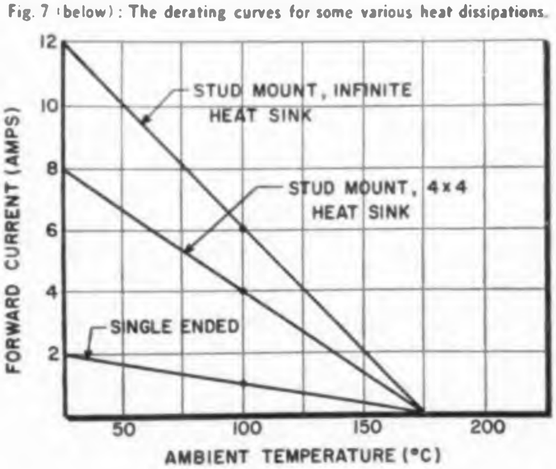


Fig. 6 (above): From this curve, minimum resistivity required to obtain a good yield of proper breakdown voltage diodes can be predicted.

Fig. 7 (below): The derating curves for some various heat dissipations.



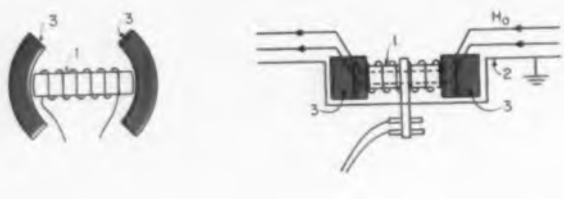


Fig. 1: Flushmounting antenna uses magnetic deflecting bars.

A new approach to propagation gives us the

Magnetic Field Antenna

Completely new shapes and forms of antenna can be designed from the magnetic point of view. Most conventional theory is based on the electric field—neglecting the magnetic component. The magnetic field theory is especially important for new missile and aircraft antennas, collectors, deflectors, and perhaps radar-invisible skins.

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ALL present-day theories and computations are based on the electric force of radiation. Since the early days of vertical antennas, the measures of field strength were devised on the assumption of a potential gradient of the wave front which can be measured in terms of volts per centi or microvolts per meter and knowing the effective height of an antenna one can easily obtain the product of $E\,h_{eff} = V$ voltage developed on the antenna.

Although Hertz in his early experiment used magnetic pick-up devices (loop), the present-day derivation of efficiency of the artificial loop antenna is based upon a concept of electric force acting on two vertical antennas a small distance apart and connected together to form a "frame aerial" by means of two horizontal conductors. The traveling wave collected on two verticals creates a phase difference in potential dependent upon the velocity of propagation, V_0. A number of such antennas connected in series constitute a rectangular coil of a frame antenna or loop antenna whose efficiency, as compared with a vertical antenna, may be expressed as effective height.

$$h_{eff} = \frac{2 \lambda N A}{\lambda} \cos \theta \text{ where } A \text{ is the area,}$$

equally applicable to other than rectangular forms. N is number of turns, and λ is wavelength V_0/f.

$\cos \theta$ symbolizes the directive properties of such antennas, the well known "figure eight" patterns having two null points when $\cos \theta$ is zero. This corresponds to the position of the frame's plane perpendicular to the direction of the traveling wave.

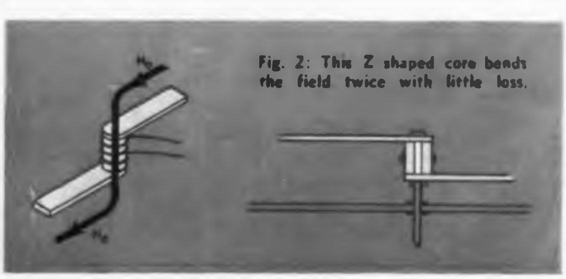


Fig. 2: This Z shaped core bends the field twice with little loss.

Maxwell's Equation

In accordance with Maxwell's equation of velocity of propagation, $V_0 = \frac{1}{\sqrt{k\mu}}$ the velocity should be reduced when a dielectric of high K or magnetic body of high permeability, μ, is interposed between the verticals of a frame aerial, thus slowing the propagation and increasing potential difference between the verticals. A great number of experiments failed to show this increase in efficiency when dielectric is inserted. However, the insertion of magnetic materials show, definite increase in h_{eff} and experimental findings indicate the increase is equal to μ_{eff} rather than that expected from Maxwell's formula $\sqrt{\mu_{eff}}$.

Effective "Mu"

Because of the finite length of a magnetic mass in the form of a "core" inside a round loop antenna, its effective permeability μ_{eff} is the material permeability μ reduced by demagnetization effects so that

$$\mu_{eff} = \frac{\mu}{1 + D(\mu - 1)} \text{ or when } \mu >> 1 \quad \mu_{eff} = \frac{\mu}{1 + D\mu}$$

where D is demagnetization factor of a core depending on the ratio length to effective diameter of the core (rod). A large choice of demagnetization coefficients is offered by different investigators, as tabulated by Sanford (Magnetic Testing N.B.S. Cir. c-456), but I have conducted such investigations at high frequency, and I prefer the curves by Thompson, published in 1913. Elementary theory shows that flux density in the core $B = \mu H = \frac{\mu H_o}{1 + D(\mu - 1)}$ where H is the field strength in the core and H_o same outside the core; hence we may designate

$$\mu_{eff} = \frac{\mu}{1 + D(\mu - 1)}$$

from which it follows that $B = \mu_{eff} H_o$.

New Approach

Another direct approach is to consider the loop antenna as a strictly electromagnetic device operating on the magnetic component of radiations. This component always coexists with the electric component, both being related in free space as $E/cm = 300\ H_o/cm^2$

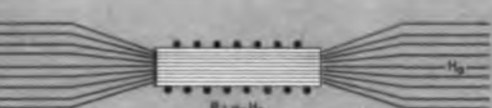


Fig. 3: The electric field component vanishes as the wave enters the rod.

the first in volts and second in gauss, noting that in air $B = H_o$. A coil with or without a magnetic core having N turns and area A being subjected to an alternating field of B gauss at a frequency f will develop a voltage

$$V = 2\pi N A B f (10^{-8}) \text{ volts}$$

and for an air cored loop $B = H_o$; when core is added, $B = \mu_{eff} H_o$ in accordance with which the gain in voltage due to the core is numerically equal to μ_{eff} which is substantially confirmed by experiment and actual practice.

Theoretical investigations by several writers agree with the general principle of treating a ferromagnetic loop as a magnetic device. It is interesting to note here that in an air cored loop where $B = H_o$, one can replace H_o by an equivalent E and the frequency by the corresponding wave length in which case the equation yields

$$V = \frac{2\pi A N E}{\lambda}, \text{ but } V \text{ is also equal to } h_{eff} E.$$

Thus, for an air cored loop we arrive at precisely the same value for h_{eff} as derived artificially from electric force. Here, however, the analogy ends. As soon as we insert a magnetic core a large discrepancy appears.

Core Effects

Very substantial gains are realized with properly designed elongated cores. Using a material of $\mu = 100$, such as recommended for frequencies around 1 MC, in the form of a rod having a length to diameter ratio of 10, one may get a gain of 40 as compared with an air cored loop of the same area. At very low frequencies such as used in submarine loops μ can be increased to 1000 and the elongation radio to 20 times, in which case realizable gain is of the order of a hundred. One must remember, however, that insertion of the core increases the inductance by the same amount of μ_{eff} and it becomes necessary to reduce the number of turns.

Applications

One outstanding property of magnetic material with regard to radiated magnetic lines of force is its ability to attract, collect and direct said lines into magnetic circuits which may include a loop proper. One example of such application is shown in Fig. 1 which describes a loop antenna(1) mounted flush with the reflecting metallic surfaces(2) which may be the skin of an aircraft. Thanks to stationary magnetic members(3) around the loop antenna the incoming wave, which normally would be deflected by the adjoining surfaces, is attracted into the members and passed through the loop antenna proper without any sacrifice in efficiency. Further developments of this principle emphasize the "bending" of the lines by winding the loop coil vertically (for vertical polarization) on a cylinder of ferrite, in which position the loop ceases to act as a collector. Addition of two ferrite "directors" in the form of horizontal bars, one on top, the other at the bottom of the cylinder as shown in Fig. 2 restores the functioning of the loop. Its directional properties are then obtained solely by rotation of the magnetic structure. The pick up coil is stationary, thus eliminating problems of commutation. In such a Z-shaped structure, the magnetic lines are bent twice at right angles without any noticeable loss in efficiency, and upon emergence continue their initial course. Now, in the case of a single horizontal bar, on top or bottom of the cylinder, the structure becomes a horizontal "L" and the antenna operates quite well, considering the reduction of the magnetic circuit. This indicates that magnetic lines pass through the coil vertically and emerge from the material at a right angle to their original direction, but will eventually align themselves with the initial direction of propagation.

These three examples sufficiently illustrate collecting, directing, and deflecting (bending) of magnetic lines of force in the presence of magnetic mass.

Magnetic Field Antenna

(Concluded)

Further consideration of the increased efficiency due to a core in a loop, leads one to believe that the lines are drawn from the space not only in the immediate area of the coil, but from the adjoining region as well, causing lines to bend on their entry as well as upon their emergence from the core. Field radiated in the space has a certain energy per cubic centimeter; which energy, in the form of lines of force, enters an air cored loop through its opening area (at maximum position) to utilize that energy in the coil. Since the energy in an iron cored loop is increased by amount of μ_{eff} it is logical to conclude that a much greater element of space contributes, by an attraction of the lines into the loop. Thus we may visualize, in Fig. 3, a conically shaped bunch of magnetic lines entering into a magnetic body and a similar conical bunch upon the emergence from the body gradually resuming the linear path afterwards. This and the previously described bending of magnetic lines have a very important bearing upon new applications. While the wave travels through space, two forces, electric and magnetic, simultaneously exist mutually at right angle. Their relative values are fixed by the "intrinsic impedance" of space (120 Ω). When entering into the magnetic mass this impedance suddenly changes, causing a vanishing of electric force (while the energy product remains the same). Upon emergence from the mass the electric force is restored again at a right angle to the magnetic lines. Obviously at that moment the electric lines are also bent from their initial direction in the free space.

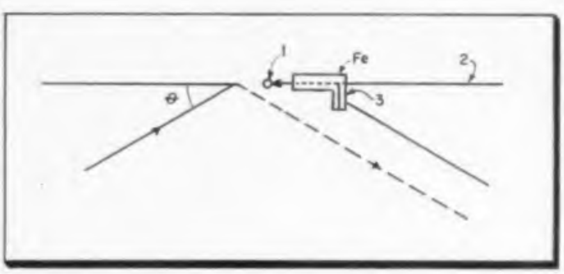


Fig. 4.: Ferrite rods can be used to bend and redirect the wave.

Bending

Therefore, a collector of electrical energy, say in the form of a dipole, may under certain conditions, register this bending. In Fig. 4 this effect becomes evident when a dipole(1) is in the vicinity of reflecting surface. There the reception is at its maximum when the incoming wave is normal to the surface. But when the path is oblique to the surface the wave is reflected, causing the skipping of a line beyond the collector at an angle θ. Interposition of a magnetic mass(3) on the reflecting surface close to the collector, by bending the magnetic and accompanying electric force upon emergence, restores the reception. This example clearly demonstrates the effect of "bending," no matter what physical interpretation is chosen. One may be temped to consider the magnetic element as a secondary radiator, but the extremely high resistivity of the material, as compared with the highly conductive reflecting surface, precludes this interpretation.

Thus, besides their direct application in magnetic collectors the magnetic non-conducting materials such as ferrites may also be utilized for directing part of the electric forces or the wave as a whole, providing the dimensions of both the wave and the material are of the same order. In the above example of a dipole, a plate of ferrite in front of the dipole may re-direct the entire wave to the extent of completely blanking reception.

We have shown the bending of magnetic lines up to a right angle; in the above dipole experiment we succeeded in diverting the wave in the vicinity of dipole by 15°, using a very small quantity of magnetic material. No doubt it could be considerably improved. So far in this investigation, at the frequencies from 100 KC to 1 KMC, we have encountered no indication of any loss occurring when a wave passes through a magnetic material of very high resistivity, if very high-μ materials were employed.

The direct treatment of electric collectors (monopoles, dipoles and their equivalent) by placing the material all around the wire-collector produces no other result than a mere increase in inductance and consequent change in natural resonance, without however, increasing its effectiveness.

Redirection

But now we have a new process of collecting, bending, re-directing the wave front by means of an electromagnetic mass. We may therefore collect the magnetic component into a magnetic mass and in its simplest application, using a straight bar near an electric collector, utilize the deflection of lines so that new electric lines (perpendicular to magnetic lines) strike the collector at a favorable angle. This is particularly useful when the collector is near the reflecting (conducting) surfaces which at a certain oblique angle to the incoming wave may completely obscure reception. What actually happens is the modification of reflecting properties by a magnetic mass. Theory will show that if an entire metallic sheet is covered by a magnetic material of the thickness approaching $\lambda/4$ the entire wave will be redirected along the magnetic mass and there will be no reflection. One must always remember that the wave length will shorten itself by the amount equal to $\sqrt{\mu}$ so that at microwaves this critical thickness is not in the realm of fantasy. A much lesser amount of material will be needed to re-direct the reflected wave by a few degrees. To get a complete "blanking" of reflecting properties one does not need to treat the entire surface. A plurality of magnetic elements of dimensions $\lambda/4$ and spaced a half wave length apart will do as well.

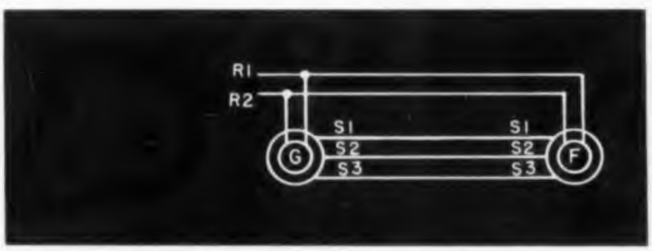
New Vistas

I believe this new technique, especially at very high frequencies, opens a new chapter of application of magnetic materials as collectors and deflectors of electromagnetic waves. Entirely new shapes and forms of collectors of radiated energy are possible.

Synchro Trouble Shooting

Shortcuts for locating external wiring problems are listed in an easy to follow tabular form.

By **JOHN E. HICKEY, JR.**
Assistant Editor
ELECTRONIC INDUSTRIES



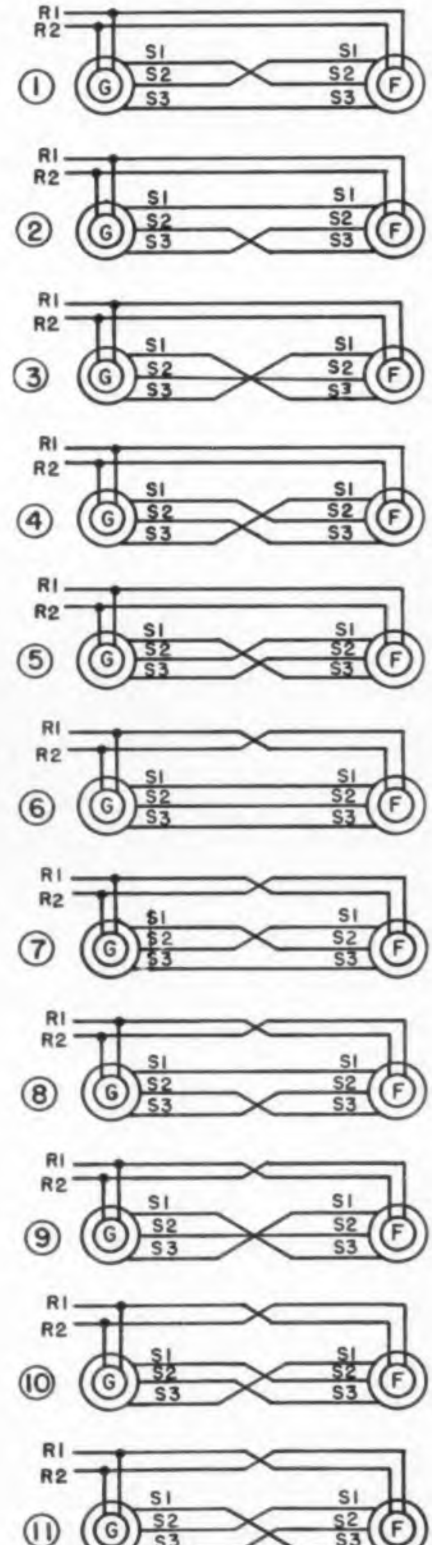
A synchro generator properly wired to a synchro follower.

QUITE often when various units containing synchros are interconnected and energized, erroneous readings are obtained or rotation is reversed. Assuming that the synchros are zero-ed,[1] this means that the troubles are caused by external wiring. The table below is intended to aid the engineer in rapidly locating the misplaced leads.

The table below applies provided, that along with the synchros being electrically at zero and not defective, there is normal torque and no heating or overload.

1. Philip L. Hillman and Francis J. Galvin, "Procedures for Electrically Zeroing Synchros," *Electronic Industries*, December 1957.

Follower rotation in respect to Generator is:	With Generator on zero, Follower reads:	Cause is:	Refer to drawing:
Opposite	240°	S1-S2 Reversed	1
Opposite	120°	S2-S3 Reversed	2
Opposite	0°	S1-S3 Reversed	3
Same	120°	S1 to S2, S2 to S3, S3 to S1	4
Same	240°	S1 to S3, S2 to S1, S3 to S2	5
Same	180°	R1-R2 Reversed	6
Opposite	60°	S1-S2 Reversed, R1-R2 Reversed	7
Opposite	300°	S2-S3 Reversed, R1-R2 Reversed	8
Opposite	180°	S1-S3 Reversed, R1-R2 Reversed	9
Same	300°	S1 to S2, S2 to S3, S3 to S1 and R1-R2 Reversed	10
Same	60°	S1 to S3, S2 to S1, S3 to S2 and R1-R2 Reversed	11



Drawings are referred to in the table at left.

Page from an Engineer's Notebook

#42—Calculating Noise In Electrical Resistors

Johnson noise for a given amplifier can be quickly determined given the value of input resistance and the ambient temperature of operation

By A. E. MAINE

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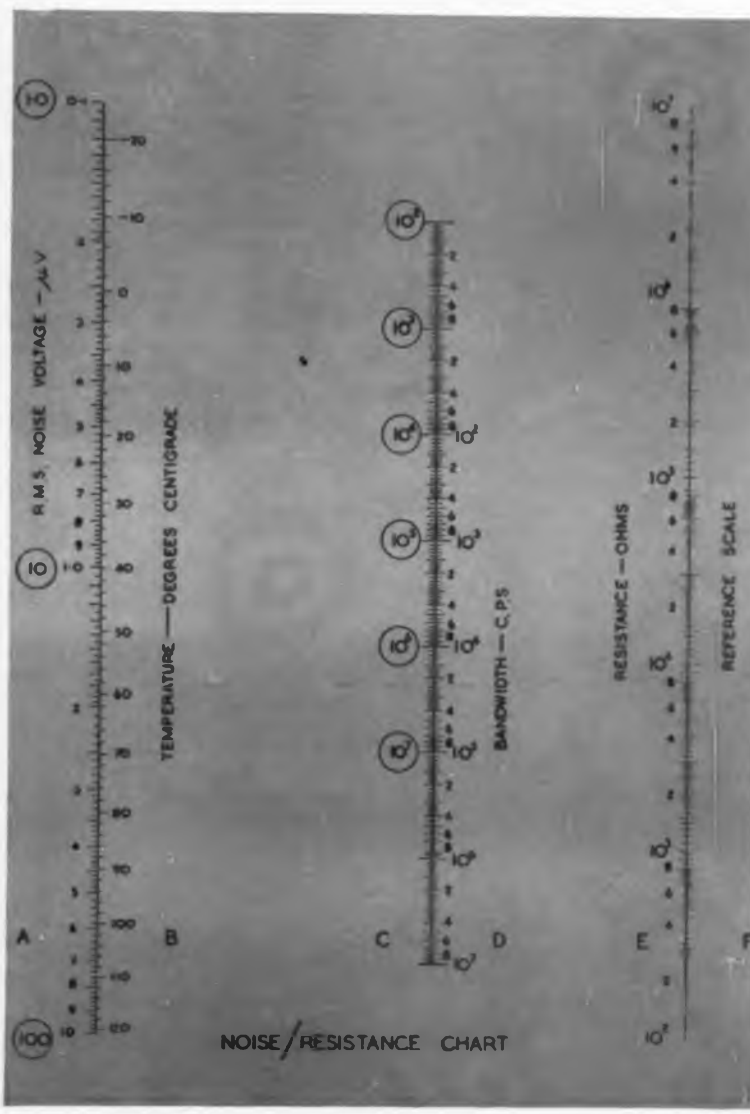

THERMALLY produced electrical noise applicable to any linear conductor is given by the well-known equation set out below:

$$E_{RMS} = 2 \cdot \sqrt{RKT\Delta_f}$$

where,

E = generated RMS noise voltage

R = resistance

K = Baltzman's Constant = 1.38×10^{-23}

T = Absolute temperature °C.

Δf = Bandwidth in c/s.

The accompanying nomogram solves this equation over a range of values wide enough for most practical purposes. The range may be extended by using the circled calibrations on scales (A) and (C).

An amplifier with a voltage gain of 1000 has an input resistance of 470 KΩ and a bandwidth of 2 Kc/s. Find the value of the output noise level due to the input resistance when the amplifier operates at an ambient temperature of 100°C.

Set a straight-edge between "100°C." on scale (B) and "470 KΩ" on scale (E). Note an intersection with the reference line (F). From this point, re-position the straight-edge to align with "2 Kc/s" on scale (D). The noise voltage generated by the resistance is read off at the intersection with scale (A), and is, 4.4 μv. Since the amplifier gain is 1000, the equivalent output noise becomes 4.4 mv.

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Transistors and Diodes in Strong Magnetic Fields

What happens when semiconductors are operated in a very strong magnetic field? Some show parameter change, some show orientation sensitivity, and some show no detectable change—but all show superior performance over vacuum tubes.

By **HENRY A. KAMPF**
Argonne National Laboratory
Lemont, Illinois

FREQUENTLY, the designer of electronic equipment is faced with the problem of extraneous signal pickup for stray dc and ac magnetic fields existing around chokes and transformers. An even more serious situation exists when active electronic circuits are required to be in locations of high magnetic field intensity.

Unwanted Signals

When semi-conductors are used in magnetic fields, unwanted signals arise from several sources. One is the signal caused by a conductor loop enclosing a changing magnetic field. This is a steady state effect for ac fields and a transient effect for dc fields. This is the effect most of us are familiar with. However, when we place a semiconductor in a magnetic field, two additional mechanisms combine to give extraneous signals. These are *magneto-resistive* and *Hall* effects of the semiconductor. They are steady state effects for both ac and dc magnetic fields. (See references.)

Fig. 1: Tests were run at fields as high as 10 kilogauss with this giant electromagnet. Semiconductors proved superior to tubes.

Several applications of transistors and semiconductor diodes are proposed for the proton-synchrotron at Argonne National Laboratory. These involve operation in rather strong pulsating dc magnetic fields. Because of this, we have studied the magnitude of these effects. Our tests included NPN silicon transistors, NPN and PNP germanium transistors, silicon junction Zener regulator diodes, germanium junction diodes, and point contact germanium diodes.

We also checked two typical vacuum tubes, 12AT7 and 12BY7A, in the dc field. The effect of the magnetic field upon the vacuum tubes was very pronounced and position sensitive, as we had expected. However, even with the position of minimum magnetic effect, their G_m was reduced to zero by 5,000 gauss.

Tubes

Fig. 4 shows these dc field effects graphically. The video amplifier pentode 12BY7A exhibits a very sharp cut off at about 200 gauss, while the 12AT7 triode has a relatively slow cut off rate. These curves were taken with an axial magnetic field, that is, perpendicular to the electron flow. Sharp magnetic cut-off characteristics such as the 12BY7A exhibits could be further enhanced by special tube design for possible applications of dynamic and static magnetic field measurements. These curves likewise indicate that normal operation in fields of the order of several kilogauss is impossible with vacuum tubes.

Transistors

The magnetic effects upon transistor parameters were quite small. The variation of parameter values was in no case over 25% at fields of 10 kilogauss, and in many instances the variation was so small as to be undetectable. We used transistor sockets in these tests. Special adapters kept the transistors with large steel cases (2N167 and 2N137) from being pulled out of their sockets by the magnetic attraction.

Orientation

The largest magnetic effect upon the transistor parameters occurs when the field is parallel to the leads. In this position, the magnetic field is approximately perpendicular to the hole and electron current. These effects can be reduced ⅓ by orienting the transistor so that the field is most nearly parallel to the electron and hole current. However, the sense of the effect is the same.

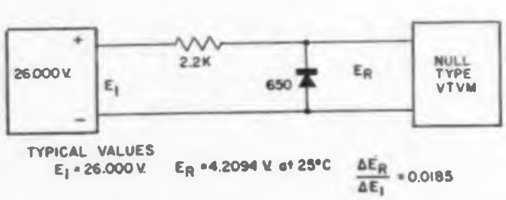

Fig. 3: Test circuit used for Zener regulator diodes

The magnetic field effects were approximately the same amplitude and sense for both NPN and PNP germanium transistor types. However, NPN silicon transistors exhibited very little parameter changes due to magnetic fields.

Comparison

The results of the β and I_{co} tests are shown in Tables 1 and 2. In all cases except 2N337, β was reduced by the field. The field had no measurable effect upon the 2N337. The 2N114 and the 2N167 have the least change in β of all the germanium transistors, probably because their active base region is very narrow and their currents, therefore, have a smaller length of magnetic field to traverse. These two transistors are high frequency triode types. All silicon transistors showed less change than the best germanium transistors. The I_{co} tests again demonstrated superior performance by silicon transistors. The I_{co} for germanium types decreased by as much as 10% with the application of a magnetic field, while silicon types showed no effect.

Fig. 2: Transistors, diodes, and tubes were tested in the field of this electromagnet

Variation

Many units of each type were tested and an average unit of each type was selected and listed in the tables. The magnetic effects varied from transistor to transistor of the same type, about as much as the variation between types. This is shown in Table 3 for a typical Germanium junction transistor, and a 2N337 Silicon transistor. While the amount of the variation of transistor characteristic was quite different from transistor to transistor, the sense of the variation was always the same. The largest percentage effect measured in all cases was β, and the largest change in β was 23% for a 2N35.

Diodes

We also tested the following diodes in a magnetic field:

650—Silicon junction, Zener regulator.
1N220—Silicon junction, high inverse voltage.
1N92—Germanium junction, high current.
1N127—Germanium point contact, high inverse voltage.

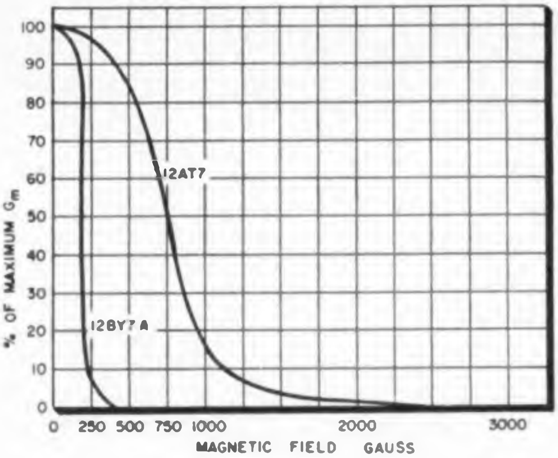

Fig. 4: Two typical tubes were tested in an axial magnetic field.

The 650 regulator diode is normally used with a back bias and we tested it in this manner, with about 10 ma current flowing through it. The circuit is shown in Fig. 3. The regulated voltage E_r was unchanged by the application of a magnetic field of 10 kilogauss of any orientation. We measured the regulated voltage with an accuracy of about one part in 50,000. Variations of E_r, due to normal temperature changes, are much more than this, usually about .03%/°C.

The apparent internal resistance of the diode was also unchanged since the ΔE_r was the same for conditions of zero field as for 10 kilogauss ΔE_r.

We also checked the three other diode types for forward and reverse current. The results are tabulated in Tables 4 and 5. In each case where the magnetic field had an effect, the effect was to reduce the current.

The 1N220 showed magnetic effects which were not position sensitive, while both the germanium diode effects were most prominent when the field was perpendicular to the leads.

Conclusion

These tests have shown that transistors and semiconductor diodes can be expected to give much better performance in a magnetic field environment than vacuum tubes; and for most applications the magnetic effects can be effectively reduced to zero by choosing a good silicon device instead of germanium.

References

C. Kittel, "Introduction to Solid State Physics," John Wiley & Sons, Inc., New York, 1953.
F. Seitz, D. Turnbull, "Solid State Physics," Academic Press, Inc., New York, 1957.

Table 1

Number	Type	Change in Beta Zero Field	10 Kilogauss	Change
2N34	Ge. PNP	64	50	−22%
2N35	Ge. NPN	35	29	−17%
2N114	Ge. PNP	43	37	−14%
2N137	Ge. PNP	135	105	−22%
2N167	Ge. NPN	43	40	− 7%
2N175	Ge. PNP	52	42	−19%
2N185	Ge. PNP	175	140	−20%
2N337	Si. NPN	45	45	− 0
953	Si. NPN	16.8	16.0	− 5%

Table 2

Number	Type	Change in I_{co} Zero Field	10 Kilogauss	Change
2N34	Ge. PNP	7.20μa	6.60μa	− 8%
2N35	Ge. NPN	1.40	1.35	−3.5%
2N114	Ge. PNP	.70	.675	−4.5%
2N137	Ge. PNP	1.18	1.12	− 5%
2N167	Ge. NPN	.586	.580	− 1%
2N175	Ge. PNP	4.65	4.30	−7.5%
2N185	Ge. PNP	5.65	5.55	− 2%
2N337	Si. NPN	.041	.041	0
953	Si. NPN	.031	.031	0

Table 3

β, I_{co}, and Common Base h Parameter Variations in a Magnetic Field

Typical Germanium, 2N35

	Zero Field	10 Kilogauss	Change
I_{co}	1.40μa	1.34μa	− 4%
β, h_{fe}	35	29	−17%
h_{11}, h_{ib}	33Ω	36Ω	+10%
h_{12}, h_{rb}	1.50 x 10^{-4}	1.58 x 10^{-4}	+ 5%
h_{22}, h_{ob}	1.4 x 10^{-6}mho	1.5 x 10^{-6}mho	+ 6%

Silicon, 2N337

	Zero Field	10 Kilogauss	Change
I_{co}	.041μa	.041μa	0
β, h_{fe}	45	45	0
h_{11}, h_{ib}	60Ω	60Ω	0
h_{12}, h_{rb}	4.4 x 10^{-4}	4.4 x 10^{-4}	0
h_{22}, h_{ob}	1.35 x 10^{-6}mho	1.35 x 10^{-6}mho	0

Table 4

Forward Current in Milli-amperes

	Zero Field	10 Kilogauss	% Change
1N220	10.000	9.990	−0.1
1N92	100.00	100.00	0
1N127	10.000	9.986	−0.14

Table 5

Reverse Current in Micro-amperes

	Zero Field	10 Kilogauss	% Change
1N220 @ 300V	1.61	1.60	−0.6
1N92 @ 100V	90	85	−5.6
1N127 @ 100V	335	335	0

For Indicating VSWR . . .

A Phase-Sensitive Detector

Carrier amplitude is measured by extracting with a probe the impressed a-f modulation on an r-f wave travelling down a guide. A phase sensitive probe pulsed at modulation frequency, permits use down to fractions of a microvolt.

By KENNETH G. BEAUCHAMP

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ONE method of measuring the relative amplitudes of an r-f wave travelling down a waveguide is to modulate the wave at some audio-frequency and extract this modulation by means of a silicon diode probe inserted into the guide. The magnitude of this detected wave will then provide a measure of the carrier amplitude.

To measure signals well below the noise level of the detector (fractions of a microvolt) it is necessary to reduce the bandwidth of the amplifier channel. The limitation is then set by the time taken to make a single measurement.

V.S.W.R. detector. Signals of 1 microvolt are readily detectable.

Using a tuned frequency-selective amplifier and a narrow detector bandwidth of about 1 cps, signals of the order of 0.01 µv are readily detectable.

A schematic for the equipment is given in Fig. 1. A phase-sensitive detector, pulsed at modulation frequency, enables the instrument to be used down to the very low signal levels required.

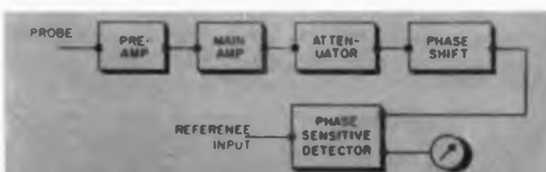


Fig. 1: The V.S.W.R. detector shown in block diagram form. Phase-sensitive detector, pulsed at modulation frequency, enables use down to the very low signal levels required.

Low-Noise Pre-Amplifier

To reduce the noise pick-up at the amplifier input, a screened pre-amplifier is mounted on the travelling carriage of the probe unit. As the pre-amplifier is subject to movement when the probe carriage is adjusted, it is necessary to reduce microphony to a minimum.

These considerations led to the development of the cascode circuit shown in Fig. 2. The heaters are fed from rectified ac and grid leak bias used for V_2 to avoid critical setting of the grid potential.

The probe diode is connected in shunt with the input terminals and provides the return path for the input grid circuit. Resilient mounting for the tube and use of local feedback assists in reducing microphony to small proportions.

A gain of 36 db was secured with this arrangement and equivalent input noise of 4 μv at a bandwidth of 250 KC.

The measured plate current was 2.2 ma and the shot noise equivalent resistance $R \simeq \frac{3}{G_m} = 1{,}360\ \Omega$ at this value of current.

Thermal noise is given by—

$$E^2 = 4kTR\,(f_2 - f_1)$$

where,

k = Boltzman's constant = 1.38×10^{-23} Joules/°K.

T = Ambient temperature in °K.

$f_2 - f_1$ = Bandwidth in cps.

Taking T as 300°K and $f_2 - f_1$ as 250 KC, this gives a theoretical noise input figure of 2.38 μv.

The ratio of measured to theoretical noise, 1.7, represents a fairly good agreement at this level.

Main Tuned Amplifier

In order to provide at least 1 v rms of signal at the phase detector input, a gain of 10^4 was required in the main amplifier.

Various types of selective amplifier circuits are available. Initially a symmetrical twin-T network in a negative feedback circuit was considered. Calculation showed that if a reasonable range of modulation frequencies, 2 to 5 KC, were to be covered without adjustment, at least 3 separate stagger-tuned amplifier stages would be required. Even then, very poor selectivity would be secured.

A tunable amplifier was therefore necessary, having constant gain over the modulation frequency range. The possibilities of using a twin-T circuit by varying only one element were investigated and discarded on the grounds of variation of selectivity and loss of stability.

An alternative network, Fig. 3, was investigated and found to be more easily adjustable over a wider range of frequencies by use of only one variable.

This network is due to Sulzer.[1] A simple description is given on the basis of the vector diagrams shown in Fig. 4. Considering the simple phase-shift circuit of Fig. 4a, a constant (all-pass) network is obtained where the locus of the E_o vector follows a semi-circular path as the frequency is varied.

If the input voltages, E_a and E_b, are given a phase difference of 90° as in Fig. 4b, then the semi-circle tracing the locus of the $E_c - E_r$ junction passes through the origin and E_o experiences a null at one particular frequency. A practical network is shown in Fig. 4c where the 90° phase shift is obtained from a network C_1R_1 and a potentiometer R_3R_4 to keep the amplitudes of vectors E_a and E_b approximately the same.

The null in this case is not a true one since the phase shift of E_b is slightly less than 90°. In the following application this is an advantage as some stabilizing feedback is obtained at the balance frequency.

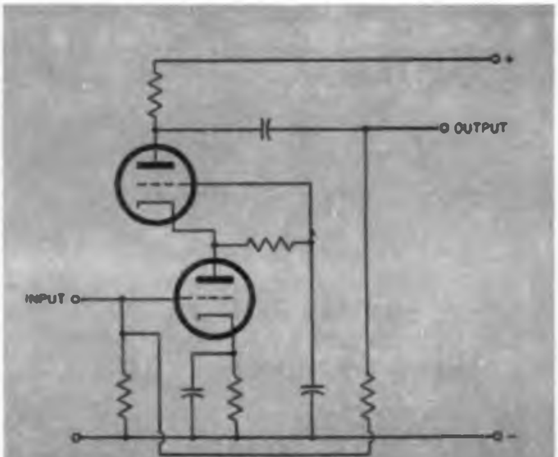


Fig. 2 (above): The cascode pre-amplifier. Note that critical setting of grid potential is avoided by feeding heaters from rectified ac and using grid leak bias for V_1.

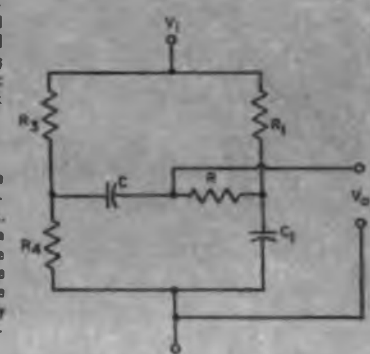
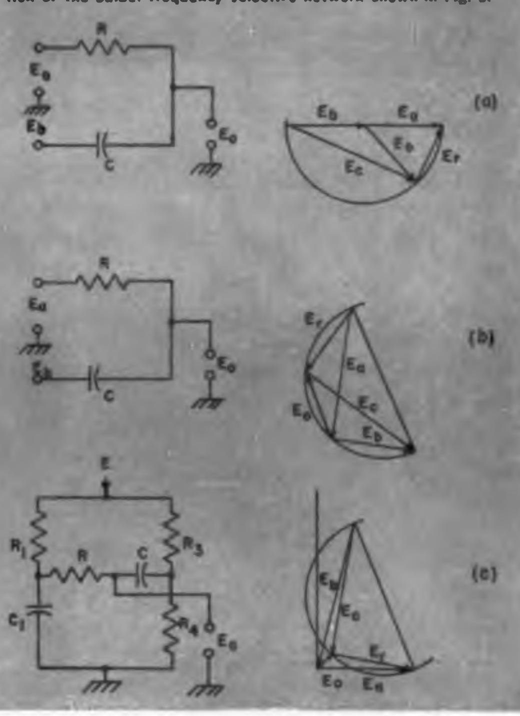


Fig. 3 (right): The Sulzer frequency-selective network. It was finally chosen because it is more easily adjustable over a wider range of frequencies by use of only one variable.

Fig. 4 (below): The vector diagrams give a simple description of the Sulzer frequency-selective network shown in Fig. 3.



VSWR

(Continued)

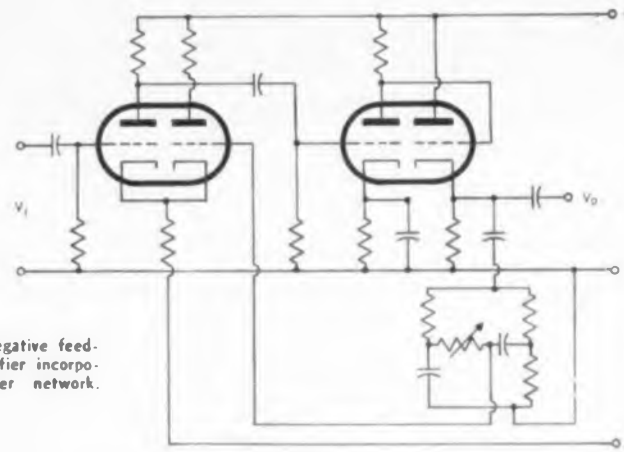


Fig. 5: Negative feedback amplifier incorporates Sulzer network.

The Sulzer network is a form of asymmetrical twin-T network and a number of design criteria can be derived from it.

The balance frequency is

$$f_o = \frac{1}{2\pi\sqrt{\gamma_1 \gamma \alpha}} \quad \cdots \cdots (i)$$

where;—

γ = time constant CR

γ_1 = time constant C_1R

α = a reduction factor $\frac{R_4}{R_3 + R_4}$

The Q-factor of the network is derived as

$$Q = \frac{R}{R + R_1 + R_2} \cdot \sqrt{\frac{\gamma_1}{\gamma \alpha}} \quad \cdots \cdots (ii)$$

The circuit was used in the negative feedback circuit of Fig. 5. This is a two-stage amplifier providing the necessary conditions of low input impedance and high output impedance for the selective network and allowing the input signal to be applied without loading the network.

A stage gain of 43db was secured and a Q-factor of 6. The feedback factor at resonance was β = 0.0067. The gain is fairly independent of variations of high potential and tube deterioration. Two stages of amplification are used, both networks being simultaneously controlled by a ganged potentiometer.

Phase-sensitive Detector

A large square wave at the reference frequency was available from the klystron modulator, consequently, it was considered that the detection process could best be accomplished by a switching circuit.

The balanced system described by Chance[2] was used. This is shown in Fig. 6 and consists of differential amplifier V_2 and V_3 into which the signal is applied in push-pull.

The reference square-wave signal is applied to a cathode follower V_1, whose purpose is to modulate the common cathode of V_2 and V_3.

It can be shown that the output signal is given by

$$V_o = V_{a_2} - V_{a_3} = \left\{ V_x + V_s \sin(\omega_1 t + \theta) \right\} \frac{4}{\pi} \sum_{n=1}^{n=\infty} \frac{\sin(2n-1)}{(2n-1)} \omega_1 t \quad \cdots \cdots (1)$$

where,

$V_x + V_s \sin(\omega_1 t + \theta)$ represents the input signal of amplitude V_s and phase shift relative to the reference signal of θ radians. (V_x is the standing potential at the tube plates).

The summation term is that for a square wave of unit amplitude and frequency $\frac{\omega_1}{2\pi}$.

Expansion of Eq. 1 gives

$$V_o = V_s (\sin \omega_1 t \cos \theta) \left\{ 4/\pi \left(\sin \omega_1 t + 1/3 \sin 3\omega_1 t + 1/5 \sin 5\omega_1 t + \cdots \right) \right\}$$
$$+ V_s (\cos \omega_1 t \sin \theta) \left\{ 4/\pi \left(\sin \omega_1 t + 1/3 \sin 3\omega_1 t + 1/5 \sin 5\omega_1 t + \cdots \right) \right\}$$
$$+ V_x \left\{ 4/\pi \cdot (\sin \omega_1 t + 1/3 \sin 3\omega_1 t + 1/5 \sin 5\omega_1 t + \cdots) \right\} \cdot (2)$$

This output voltage is passed through a low-pass filter, having a cut-off frequency much lower than $\frac{\omega_1}{2\pi}$. This will average V_o for times longer than $\frac{2\pi}{\omega_1}$ and the only term not reduced to zero will be

$$4/\pi \cdot \sin^2 \omega_1 t \cos \theta$$

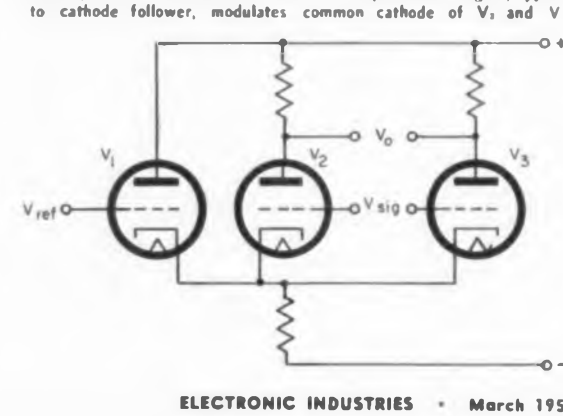
giving an average value for V_o as

$$V_o' = \frac{2}{\pi} \cdot V_s \cdot \cos \theta \quad \cdots \cdots (3)$$

If θ is arranged to be zero, than the output is a dc potential directly proportional to the input signal.

To ensure that this zero phase shift is maintained, the signal is passed through the phase shifting circuit V_7 shown in Fig. 7 before being applied to the phase detector. The zero phase shift between signal

Fig. 6: Signal is applied in push-pull to differential amplifier of balanced phase-sensitive detector. Reference square-wave signal, applied to cathode follower, modulates common cathode of V_2 and V



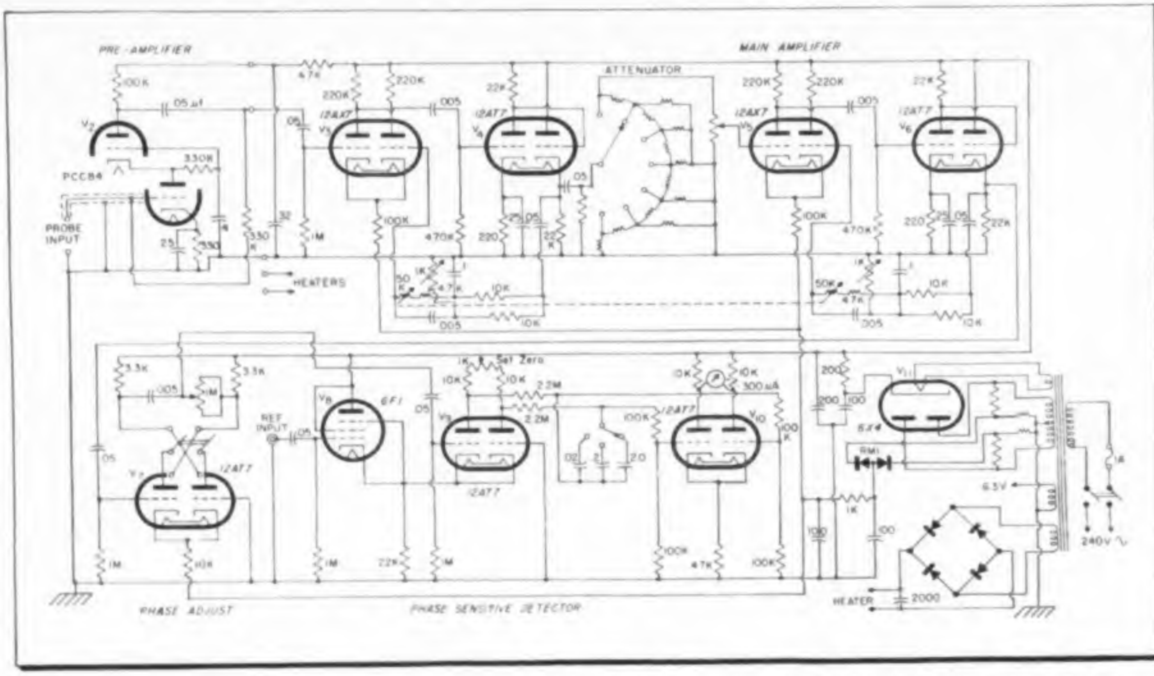


Fig. 7: A complete circuit diagram of the V.S.W.R. detector. The linearity of the instrument is within 1% with this accuracy, it was found useful in operation to scale the meter in V.S.W.R., as well as in linear dimensions, to facilitate rapid matching measurements.

and reference can be adjusted by varying R to give a maximum output before a reading is taken. Ganged with this potentiometer is a reversal switch which automatically ensures that the phase of the signal is such as to give a positive indication at the output meter.

Performance

A complete circuit diagram is given in Fig. 7. The total gain from input to the grid of V_7 measured 1.17×10^6 giving a full-scale-deflection sensitivity of 0.5 μv rms.

A minimum square-wave reference signal of 12 v p-p is required. The breakthrough of this to the amplifier section being comparable to the noise level at the detector input.

Three time-constants were provided in the phase-sensitive detector, namely, 0.1, 1.0, and 10 sec., giving an effective bandwidth to noise of 2.5, 0.25, and 0.025 cps, respectively.

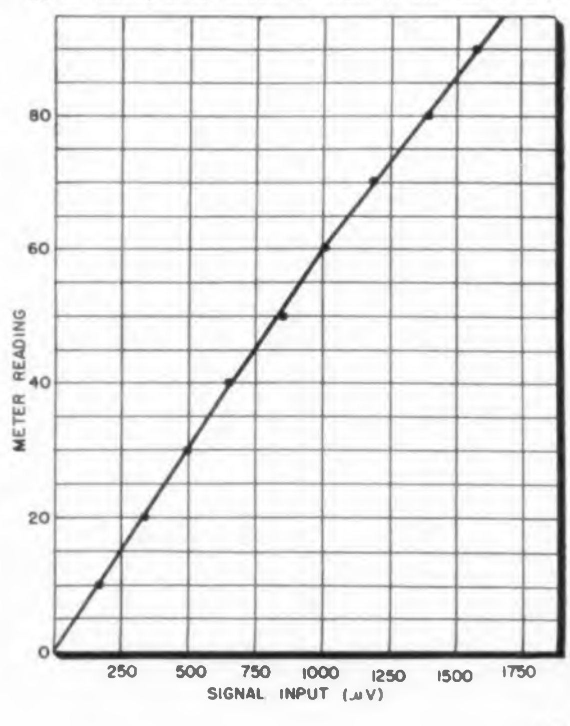
Some dc drift was experienced in the meter amplifying circuit. This was reduced to 1 part in 200 per hour by use of high-stability resistors, considerably under-rated, and reducing the heater potential for this tube.

It was found useful in operation to scale the meter in VSWR as well as in linear dimensions to facilitate rapid matching measurements. The linearity of the instrument permitted this as the accuracy, as shown in Fig. 8, is within 1% over most of the scale.

References

1. Sulzer, "Single-band Audio Generator," *Electronics*, Jan. 1952, p. 95.
2. Chance, "Waveforms," M.I.T. series, Vol. 19, p. 515.

Fig. 8: Linearity of the detector is within 1% over most of range.



What's New . . .

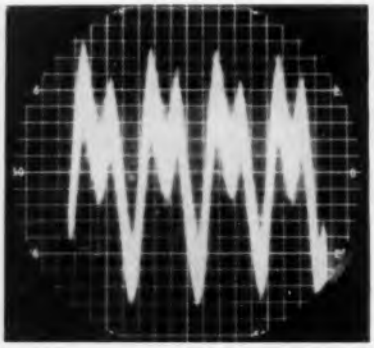


Fig. 1: This oscillogram shows the sound pressure vs. time relationships at the exhaust of an old-style tool.

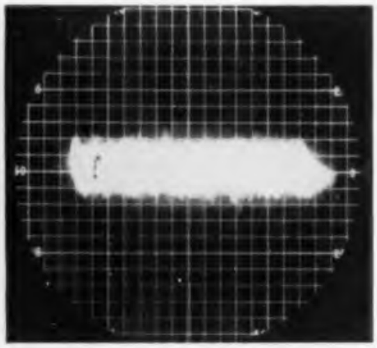


Fig. 2: Lower peaks, and more uniform pressure are shown in this oscillogram of sound pressure from redesigned tool.

Oscilloscope Shows Way To Silence

HERE is an excellent example of the use of electronic equipment to redesign industrial tools. An oscilloscope analysis of air motor exhausts by the Aro Equipment Corp. of Bryon, Ohio, showed high sound-pressure peaks. A simple fixture was designed for the exhaust port, and the exhaust rerouted in the tool, to produce what Aro now calls their "Golden Silence" tool line.

★ ★ ★

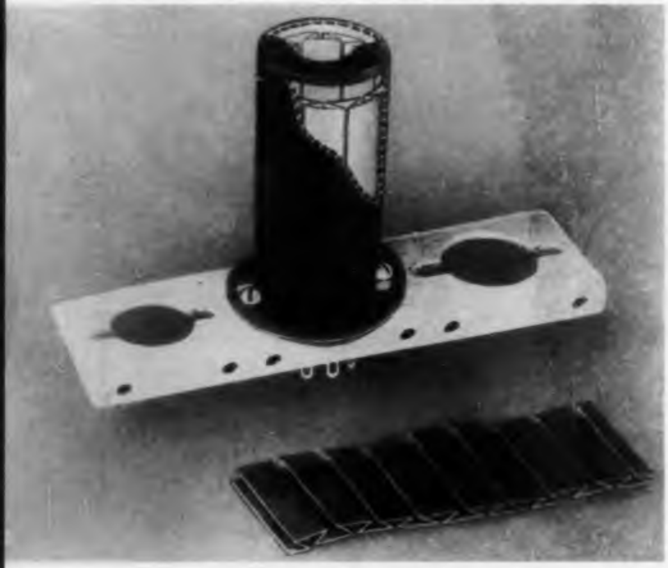
The Tecnetron

DR. A. V. J. MARTIN, at Carnegie Institute of Technology in Pittsburgh, reports to us that a completely new semiconductor amplifier has been invented by Mr. Teszner at the French Post Office Labs (CNET). Considerable development work has been done by CNET, and about twenty units a day are being produced.

The amazing simplicity of the device is shown in Fig. 3, which represents the Tecnetron and associated circuitry. A small rod of germanium carries two ohmic end contacts, the cathode and the anode. In between, a deep groove has been cut in the germanium and receives an indium contact. Despite its physical size, the Tecnetron bears no relation to any previous device.

New Liner For Tube Shields

Fig. 3: Cutaway view of the new Atlas tube shield and liner (Pat. Pend.)



HEAT'S the big killer of vacuum tubes. Tube shields are supposed to help dissipate the heat, but there are three stumbling blocks in the path of heat removal by a shield. First there is the jump from the glass tube to the shield. Second is the joint between the shield can and the shield base. And then we have the connection between the shield base and the chassis.

It's no secret that the JAN TS shields committed wholesale mayhem on tubes by setting up a dead air space between tube and shield

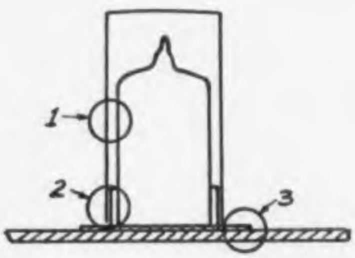


Fig. 2 (right): Thermal barrier points: 1, tube-to-shield air space; 2, can to base contact; 3, base to chassis contact.

. . . a simple new semiconductor

Fig. 1: The Tecnetron is made of a small germanium cylinder, 2 mm long, .5 mm in diameter, with a groove which acts like a tube grid.

The middle contact is not fundamentally used as a junction. Actually, it is a clever trick to produce a high field intensity, sufficient to cut-off the flow of current between cathode and anode. In other words, the Tecnetron uses the field effect,

Fig. 2: Encased, Tecnetron looks like a transistor; characteristics, however, are more like those of a pentode tube.

which takes us back to Lilienfeld in 1928, and not the transistor effect.

The parallel is obvious between the middle contact or throat and the grid of a vacuum tube.

Characteristics

The three electrodes, cathode, "grid," and anode, can not but recall the triode, and all the more so when it is seen (Fig. 3) that the "grid" receives a negative bias of a few volts and the anode a positive voltage of the order of 40 to 50 volts.

The curves of anode current versus anode voltage, for different groove voltages, are given in Fig. 4. It is immediately apparent that if the device is to be compared to any vacuum tube, it must be to a pentode.

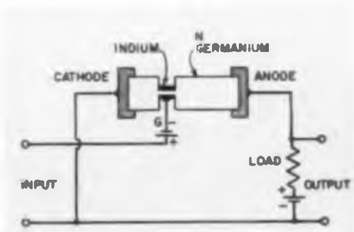


Fig 3: Tecnetron circuitry is simple—resembles familiar vacuum tube circuits.

Moreover, the input impedance is of the order of several megohms, and the output impedance is of the order of 1 megohm.

The most remarkable fact, however, is evidenced by the curve of the slope or mutual conductance S versus frequency (Fig. 5). The slope *increases* with frequency, since the control element is in fact a capacitance. More precisely, the equivalent circuit exhibits variable capacitance and resistance, and its analysis agrees with the experimental facts.

More What's New on Page 86

Performances

For the Tecnetrons presently produced on a pilot run, at the rate of 20 units a day approximately,

(*Continued on page* 118)

—a major heat barrier. About a year ago the Navy Electronics Laboratory came out with a corrugated shield insert which contacted half the tube surface and half the shield inner wall. This cut tube temperatures by as much as 50°C or more.

Now, Atlas E-E Corp. has come up with an even better shield and insert combination. The new insert contacts about 98% of the major tube surface. Soldering the shield can and base together further lowered the resistance to heat flow. The net result is a further lowering of tube temperatures by another 50°C.

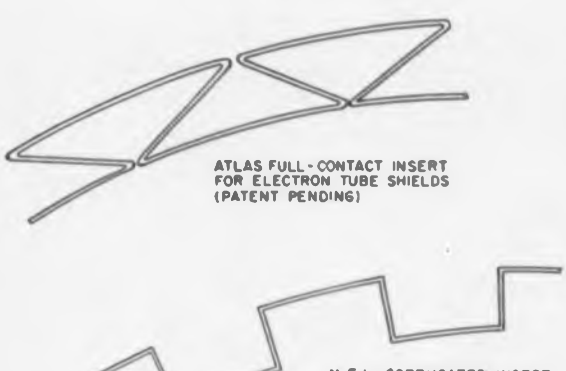


Fig. 3 (left): Comparison of the Atlas Full-Contact insert, and the NEL corrugated insert. New Atlas insert gives up to 98% contact with major tube surface.

Systems Engineering a PDM*/FM Telemetry System

A basic application of information theory leads to basic principles of PDM/FM system design.

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IN a PDM/FM telemetry system, voltage data from various transducers is sequentially sampled by a commutator. The dwell time of the sampling element (the rotating wiper for example) on each channel is equal to $1/nf$, where n = number of channels or segments, and f = rps.

Primary Pulses

The output of the commutator is a train of amplitude modulated pulses of constant width (i.e., $1/nf$ seconds). These pulses are transmitted to a keying device which transforms the variable amplitude —constant width pulses into pulses of constant amplitude — varying width. Fig. 1 illustrates the pulse input and pulse output of the keyer unit. T_s is equal to a unit sample time 1/900 second, and T is the guard time to reduce interchannel crosstalk. In addition to the data pulses, the keyer also provides standard amplitude pulses whose duration is a linear measure of the amplitude of the sampled data source.

This last statement is particularly significant because by providing such pulses, it is possible to calibrate the system against itself, thereby permitting errors in data input to be "zeroed" out.

Keyer Output

The output of the keyer is used to frequency shift an FM transmitter over a nominal deviation range of + or — 35 KC. Deviation of the transmitter should be restricted to permit all significant sidebands to pass through the available bandwidth. Since the entire telemeter, from the point of conversion of amplitude to time is time-dependent only, a PDM system is almost completely free from effects of noise or amplitude non-linearity. Signal-to-noise ratios as low as unity will not appreciably affect the system performance.

The basic principles involved in transmitting data by sampling techniques have been developed as a result of information theory investigations. The prime theorem provided by information theory states that a complex waveform containing no frequency components above f_{max} can be completely reproduced by sampling at a frequency of twice f_{max} or higher. This theorem may be explained by reference to Fig. 2a. A sinusoidal signal f_i is sampled at a frequency of f_s. This wave form consists of a pulse train, amplitude modulated by the intelligence. Thus each of the harmonics of the pulse train is associated with two sidebands separated from the harmonic by the intelligence frequency as shown in Fig. 2b. Since the pulse train has only one polarity, a component at the intelligence frequency is also present. If the intelligence frequency exceeds $f_s/2$, the intelligence component and the lower sideband at the sampling frequency overlap and cannot be separated by a low pass filter.

Failure to exclude dynamic inputs above system frequency capabilities results in spurious low frequency components which may reach considerable proportions. The problem of filtering these inputs is difficult in the common case where a high input impedance is desired.

Limits

In a practical physical system,

* Pulse Duration Modulation.

the intelligence spectrum is rarely sharply defined by a limiting frequency. Most systems will provide an attenuation of the intelligence inversely proportional to some exponent of the frequency. Under these conditions it becomes necessary to evaluate the consequences of failure to comply with the requirements of the sampling theorem. Bosch & Mallinckrodt have analyzed this problem, and have published their results in "Data Smoothing Techniques," Final Report, Department of the Air Force, Edwards AFB, Report No. 1026-F1. A summary of results of their analysis is shown in Fig. 3 in which contours of constant RMS percentage error relate the attenuation slope of intelligence spectrum and the required sampling rate.

Error Sources

It is important to realize that noise or data of no interest is just as capable of producing errors as any other signal source, and that the process is irreversible. The error in question appears as a lower sideband of the sampling rate and is indistinguishable from intelligence. The inputs to a sampled system can be filtered to reduce these errors to an acceptable proportion, but this technique is difficult for high input impedance and low cut-off frequency. Impedance transformations with active elements to permit filtering introduce drift problems and thus eliminate a prime asset of sampled systems.

Linearity

The linearity of a PDM system is unaffected by narrow band transmission. A. Westneat, Jr. in a paper entitled "PW Data Multiplexing of an FM/FM Subcarrier" has described a system which has provided an input to output linearity curve (for the overall system including the r-f link and ground demodulating equipment) which deviated by .4% of full scale, or ±.2% from the line of best fit. Linearity in a PDM system is a direct measure of overall accuracy since the data transmitted is a ratio of percentage, rather than a measure of absolute value. It should also be noted that carrier drift has no effect on system performance since only time intervals are measured. When intentional shifts in a test system were made of ±10% in full scale and zero voltages, or in the keyer parameters, the system linearity was maintained to better than ±0.5%. System linearity is determined by the transfer characteristics of the keyer, from volts to pulse duration.

Crosstalk

The only source of crosstalk in PDM aside from such things as improper shielding of individual channels, coupling of individual channels via the power supply, etc., is overlapping of the pulses. Crosstalk may be expressed in terms of the fraction, $1/a$, of the allotted time of each channel used for modulation, and the bandwidth, F_c, written as $F_c = knF$. A discussion of the derivation of bandwidth considerations is given in "Radio Telemetry," Nichols and Rauch, Second Edition, Wiley. The authors conclude that for approximately constant r-f bandwidth, and for a given crosstalk suppression, there is a value of the video bandwidth of the r-f link (F_c) for which the wide band gain of a data channel is a maximum. The reason for this is that constant r-f bandwidth still permits adjustment of the deviation ratio to give an optimum balance between FM noise improvement and video noise improvement.

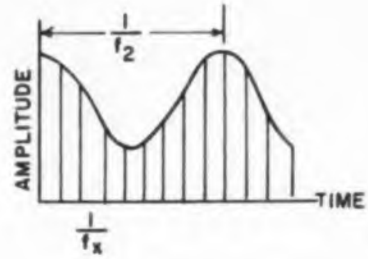


Fig. 2a: Wave to be reproduced.

Since adjacent channel crosstalk will degrade the overall system performance, it is important to think in terms of the system requirements which state that the time interval between the leading edges of successive pulses within a frame should be uniform, and should have a nominal period equal to the reciprocal of the total sampling rate. The maximum crosstalk has been shown (see "Radio Telemetry," p. 245) to be equal to $.023a^2/k^2$ $(a - 1)$. For crosstalk 60 db below full modulation, it can be shown that k (where k is the ratio of video bandwidth to total samples) is approximately 7. Thus a video bandwith of approximately 15 KC is indicated.

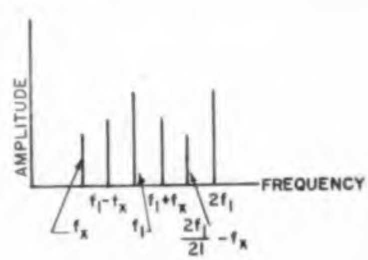


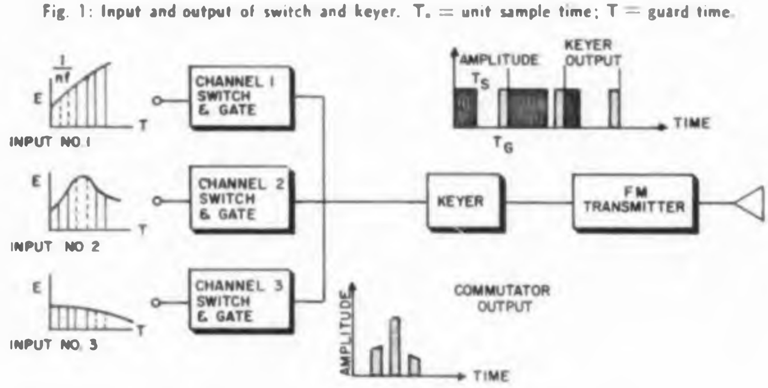
Fig. 2b: Frequency spectrum of sample

Noise Improvement

The noise improvement of a wide-band communication link may be expressed as the ratio of the full modulation output signal-to-noise ratio of the wide-band link to the full modulation output signal-to-noise ratio of a comparison AM link with the same received

(*Continued on page* 126)

Fig. 1: Input and output of switch and keyer. T_s = unit sample time; T = guard time.



Design Analysis of the Low-Q Circuit

The successful design of a low-Q circuit must take into account six distinct resonant frequencies. Here they are defined and derived, and results of the analysis given in tables and useful design curves.

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Part 2 of Two Parts

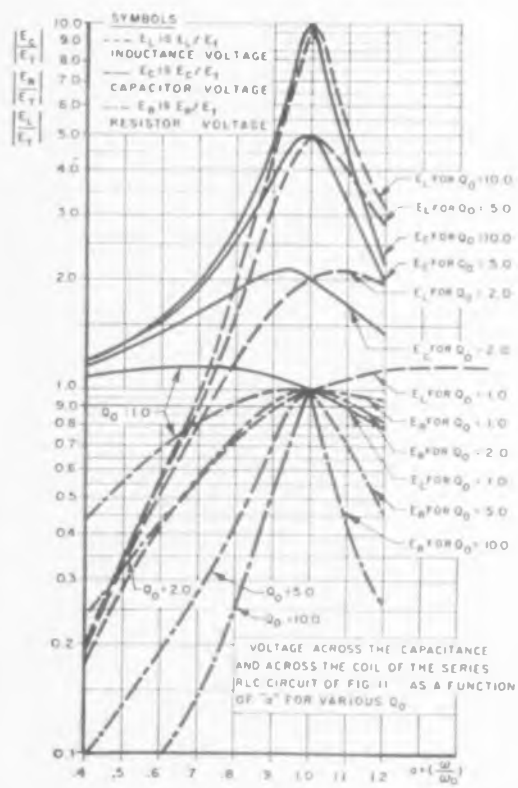
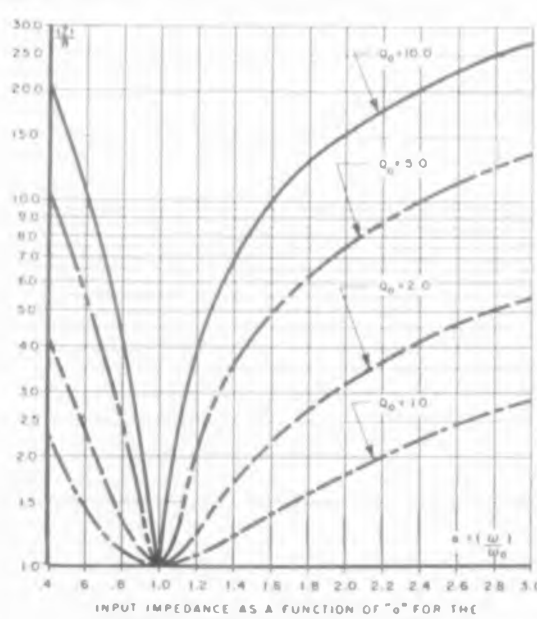


Fig. 9 (left): Voltage across the elements of series RLC circuit.

Fig. 10 (below): Variation of the input impedance with frequency.



Current Ratios

The variation of the current ratios through the capacitive and inductive branches with frequency around ω_0 may be obtained from Fig. 9. This is due to the reciprocity relationship between the RLC series and the RLC parallel circuits. If both circuits have the same parameters, R, L and C, then I_C/I_T of the parallel RLC circuit equals E_L/E_T of the series RLC circuit, where E_L is the voltage across R and L. Also, I_L/I_T of the parallel RLC circuit equals E_C/E_T of the series RLC circuit. Then, from these relationships, $|I_L/I_T|$ and $|I_C/I_T|$ may be obtained from Fig. 9. Fig. 9 is rather crowded so this method is used to introduce the extra symbolism needed. It should be pointed out here, that two of the three parameters, R, L and C are arbitrary for this analysis. The third is fixed by the desired performance of the circuit.

The Series RLC Circuit

If the Q of the circuit given in Fig. 11 is high ($Q_0 > 10$), then its resonant frequency is given by $\omega_0 = \frac{1}{\sqrt{LC}}$. At this frequency when the circuit is sinusoidally excited, the following is true: (a) The input impedance of the circuit is a minimum. (b) The circuit operates at unity power factor. (c) The ratio of voltage across the inductive branch to the total input voltage is a maximum. (d) The ratio of voltage across the capacitive branch to the total input voltage is a maximum. (e) Also, if the circuit is energized by a DC pulse, the resulting frequencies of oscillation in the loop of the circuit formed through the voltage source is essentially ω_0. The analyses for the high Q and low Q series circuits are the same as that for the high Q and low Q parallel RLC circuits.

Again, for the low Q circuit, there are five resonant frequencies besides ω_0 or *a total of six resonant frequencies*. It only remains to define symbols for these frequencies and to give procedures for finding these frequencies at any given Q_0. These frequencies are defined in Table III, together with detailed derivations of these frequencies in terms of Q_0 and ω_0 are given in Table IV.

The essential ideas in these deviations are reviewed here as was done for the parallel RLC circuit. ω_m is the resonant angular frequency for minimum input impedance. This calls for the minimizing of the input impedance with respect to the frequency. This means that $\frac{\partial |Z|}{\partial \omega}$ is set equal to zero. From this, the resonant frequency ω_m, is found in terms of ω_0 and Q_0. The derivative is then tested to verify that the result gives a minimum. ω_{EL} is the resonant angular frequency for maximum ratio of voltage across the inductive branch to the total input voltage of the circuit. ω_{EC} is the resonant angular frequency for maximum ratio of voltage across the capacitive branch to the total input voltage of the circuit.

Each of these resonant frequencies calls for the maximizing of the ratio, E_L/E_T, and the ratio, E_C/E_T, respectively, with respect to the frequency. This means that $\frac{\partial |E_L/E_T|}{\partial \omega}$ and $\frac{\partial |E_C/E_T|}{\partial \omega}$ each, is set equal to zero. From this, the respective resonant frequencies are found in terms of ω_0 and Q_0. The derivatives are, then, tested to verify that the results give maxima. ω_c, again, is the resonant angular frequency for unity power factor. ω_c is found in terms of ω_0 and Q_0 by equating the imaginary part of Z equal to zero. ω_d is the resonant angular frequency at which the circuit oscillates through the voltage source when energized by a DC pulse.

Design Curves

Here, again, advantage is taken of the linear relationships between each of the resonant frequencies and ω_0 by using the reduced frequency, "a". The advantage of the reduced frequency "a", is illustrated by Fig. 12, where the current variation through both high and low Q series RLC circuits can be compared for any ω_0. Each resonant reduced frequency is only a function of Q_0.

This result might be expected, though, if thought is given to the reciprocal parameter relationship of the two circuits. Fig. 3 is just as important for the series RLC circuit case. Fig. 9 shows the voltage ratio variation across each of the circuit parameters with frequency variation for varied Q_0. Fig. 9 is useful in finding how the maximum voltage ratios vary around ω_0 as Q_0 is made smaller. Fig. 10 shows the variation of input impedance with frequency for various Q_0. It is interesting to note that the minimum input impedance is constant with Q_0 variations.

Design Procedure

It must be remembered that since these curves are rather universal in their application, only the essential ideas of a general design

TABLE 3

SYMBOLS FOR THE TYPE OF RESONANT FREQUENCY	PHYSICAL DEFINITION OF SYMBOLS	DEFINITION OF THE REDUCED RESONANT FREQUENCY "a"	FORMULA FOR "a" IN TERMS OF Q_0 ($Q_0 = \frac{\omega_0 L}{R}$)	FORMULA FOR Z (INPUT IMPEDANCE) IN TERMS OF Q_0 AT RESONANT CONDITION
ω_m	ANGULAR FREQUENCY FOR MAXIMUM INPUT IMPEDANCE INTO THE CIRCUIT	$a_m = \frac{\omega_m}{\omega_0}$	$a_m = 1$	$\frac{Z_m}{R} = 1$
ω_c	ANGULAR FREQUENCY FOR UNITY POWER FACTOR INPUT INTO THE CIRCUIT	$a_c = \frac{\omega_c}{\omega_0}$	$a_c = 1$	$\frac{Z_c}{R} = 1$
ω_{EC}	ANGULAR FREQUENCY FOR MAXIMUM VOLTAGE RATIO ACROSS THE CAPTIVE BRANCH	$a_{EC} = \frac{\omega_{EC}}{\omega_0}$	$a_{EC} = \sqrt{1 - 1/2Q_0^2}$	$\frac{Z_{EC}}{R} = 1 + j\frac{1}{2\sqrt{Q_0^2 - \frac{1}{4}}}$
ω_{EL}	ANGULAR FREQUENCY FOR MAXIMUM VOLTAGE RATIO ACROSS THE INDUCTIVE BRANCH	$a_{EL} = \frac{\omega_{EL}}{\omega_0}$	$a_{EL} = \sqrt{\frac{1}{2}(\sqrt{1 + 2/Q_0^2} + 1)}$	$\frac{Z_{EL}}{R} = 1 + j\frac{Q_0(\sqrt{1 + \frac{2}{Q_0^2}} - 1)}{2\sqrt{\frac{1}{2}(\sqrt{1 + \frac{2}{Q_0^2}} + 1)}}$
ω_d	ANGULAR FREQUENCY FOR THE NATURAL DAMPED FREQUENCY THROUGH THE LOOP FORMED BY THE VOLTAGE SOURCE	$a_d = \frac{\omega_d}{\omega_0}$	$a_d = \sqrt{1 - \frac{1}{4Q_0^2}}$	$\frac{Z_d}{R} = 1 - j\frac{1}{4Q_0\sqrt{1 - \frac{1}{4Q_0^2}}}$
ω_0	ANGULAR FREQUENCY COMMONLY ACCEPTED AS THE CIRCUIT'S RESONANT FREQUENCY	$a_0 = 1 = \frac{\omega_0}{\omega_0}$	$a_0 = 1;\ \omega_0 = 1/\sqrt{LC}$	$\frac{Z_0}{R} = 1$

Low-Q *(Continued)*

procedure are given and, because of the lack of space, the individual steps are not given. Again, for a given application, a listing in their order of importance is made of the types of resonant frequencies. If Q_0 is specified, then the resonant frequencies are read from Fig. 3 or obtained with the aid of Table III formulas. Then, the input impedances are checked at each of the resonant frequencies by using Table III relationships. Next, the variation of input impedance and the voltages across three parameters as functions of frequency around ω_0 are checked on Figs. 9 and 10 for the Q_0 of interest. As was true for the parallel RLC circuit, two of the three parameters, R, L and C, are arbitrary. The third is fixed by the desired performance of the circuit.

TABLE 4

DERIVATIONS OF THE VARIOUS TYPES OF RESONANT FREQUENCIES THAT OCCUR IN A SERIES RLC CIRCUIT

$Z = R + j(\omega L - \frac{1}{\omega C}) = R[1 + j(aQ_0 - \frac{Q_0}{a})]$ WHERE $\omega_0 = \frac{1}{\sqrt{LC}}$, $a = \frac{\omega}{\omega_0}$, $Q_0 = \frac{\omega_0 L}{R} = \frac{1}{\omega_0 RC}$

THE FOLLOWING DEFINED NOTATION HELPS SIMPLIFY THE DERIVATIONS OF THE RESONANT FREQUENCIES

$D(a) = 1 + a^2Q_0^2$; $G(a) = a^2 + Q_0^2(a^2-1)^2$

DERIVATION OF a_m	DERIVATION OF a_c	DERIVATION OF a_{E_L}	DERIVATION OF a_{E_C}	DERIVATION OF a_d
$\lvert Z\rvert = R\sqrt{1+Q_0^2(a-\frac{1}{a})^2} = R\sqrt{\frac{G(a)}{a^2}}$; $\frac{d\lvert Z\rvert}{da} = $ [illegible] $\frac{d}{da}\left(\frac{G(a)}{a^2}\right)$; SET $\frac{d\lvert Z\rvert}{da} = 0$; SINCE $\lvert Z\rvert$ CAN BE SHOWN TO BE FINITE FOR REAL "a", THEN $\frac{d}{da}\left(\frac{G(a)}{a^2}\right) = 0$ OR $0 = Q_0^2\,2(a-\frac{1}{a})(1+\frac{1}{a^2})$; SINCE "a" IS A REAL NUMBER, THEN $a - \frac{1}{a} = 0$ OR $a_m = a = 1$ (FROM THE EQUATION FOR $\lvert Z\rvert$ IT CAN BE SEEN THAT $a = 1$ PRODUCES A MINIMUM $\lvert Z\rvert$, AND THIS RESULT COULD HAVE BEEN OBTAINED BY INSPECTION)	FOR UNITY POWER FACTOR, Z MUST BE RESISTIVE ONLY SINCE $Z = R[1 + jQ_0(a - \frac{1}{a})]$; THEN THE IMAGINARY PART MUST EQUAL ZERO, OR THAT $0 = Q_0(a - \frac{1}{a})$; THEN $a_c = a = 1$	$\frac{E_L}{j\omega L} = \frac{E_T}{Z}$; $\frac{E_L}{E_T} = \frac{jaQ_0}{1+j(aQ_0 - \frac{Q_0}{a})}$; $\left\lvert\frac{E_L}{E_T}\right\rvert = \sqrt{\frac{a^2Q_0^2}{1+(aQ_0-\frac{Q_0}{a})^2}} = \sqrt{\frac{a^2D(a)}{G(a)}}$; $\frac{d\lvert E_L/E_T\rvert}{da} = $ [illegible] ; SET $\frac{d\lvert E_L/E_T\rvert}{da} = 0$; SINCE $\lvert E_L/E_T\rvert$ CAN BE SHOWN TO BE FINITE FOR REAL "a", THEN $\frac{d}{da}\left(\frac{a^2D(a)}{G(a)}\right) = 0$ OR [illegible] OR THEN $a_{E_L} = $ [illegible]	$\frac{E_C}{\frac{1}{j\omega C}} = \frac{E_T}{Z}$; $\frac{E_C}{E_T} = \frac{1}{(1-a^2)+j\frac{a}{Q_0}}$; $\left\lvert\frac{E_C}{E_T}\right\rvert = \frac{1}{\sqrt{(1-a^2)^2+(\frac{a}{Q_0})^2}} = \sqrt{\frac{Q_0^2}{G(a)}}$; $\frac{d\lvert E_C/E_T\rvert}{da} = $ [illegible] ; SET $\frac{d\lvert E_C/E_T\rvert}{da} = 0$; SINCE $\lvert E_C/E_T\rvert$ CAN BE SHOWN TO BE FINITE FOR REAL "a", THEN $\frac{d}{da}\left(\frac{Q_0^2}{G(a)}\right) = 0$ OR [illegible] OR $0 = a^2(2Q_0^2)(1-2Q_0^2)$ [illegible] OR THEN $a_{E_C} = a = \sqrt{1-\frac{1}{2Q_0^2}}$	A PROOF FOR THE EXISTENCE OF "a_d" MAY START WITH THE [illegible] EQUATION [illegible] THE LOOP FORMED THROUGH THE VOLTAGE SOURCE [illegible] THE THREE COMPONENTS OF THE RLC CIRCUIT; [illegible] HERE IT IS ASSUMED THAT THE [illegible] ACTION OF THE [illegible] PULSE IS TO CHARGE C; SO A TRANSIENT ANALYSIS IS [illegible] TO FIND "a_d". THE DIFFERENTIAL EQUATION IS $0 = L\frac{di}{dt} + Ri + \frac{1}{C}\int i\,dt$; THE CHARACTERISTIC EQUATION IS $0 = Lp^2 + Rp + \frac{1}{C}$ OR $p = -\frac{R}{2L} \pm \sqrt{\frac{R^2}{4L^2} - \frac{1}{LC}}$ OR $p = -\frac{R}{2L} \pm j\omega_0\sqrt{1-\frac{1}{4Q_0^2}}$ SO THAT $i = e^{-\frac{R}{2L}t}[Ae^{j\omega_d t} + Be^{-j\omega_d t}]$ WHERE $\omega_d = \omega_0\sqrt{1-\frac{1}{4Q_0^2}}$ OR $a_d = \sqrt{1-\frac{1}{4Q_0^2}}$

Examples

A video amplifier is an example of a circuit where use is made of a low Q parallel RLC circuit to extend the frequency range at the high end of the amplifier. In two terminal coupling between stages of a video amplifier, the output capacitance of the first stage together with the input capacitance of the second stage and wiring capacitance and any padding capacitance short out frequencies above a certain critical value determined by the sum of these capacitances.

In such an amplifier it is possible to extend the range of the amplifier by adding a small inductor in series with the coupling resistor. If "high frequency peaking" is not to occur, then the coupling resistance has to be made relatively large. Therefore, the resulting coupling network at the high frequency end of the amplifier is a low Q parallel circuit consisting of the output capacitance, and any padding capacitance in parallel with the coupling resistance and the introduced inductance. Here the input impedance of the coupling network is raised at the upper end of the amplifier by addition of the inductance. This impedance is kept from peaking here by the relatively large coupling resistance.

A transformer coupled amplifier is an example of a circuit where use is made of a low Q series RLC circuit to extend the range of the amplifier at the high frequency end of the amplifier. In a transformer coupled amplifier the input capacitance of the second stage and wiring capacitance and distributed capacitance of the transformer effectively short out frequencies above a given critical frequency determined by the sum of these capacitances. For frequencies just lower than this upper limit, the above capacitances resonate with the total leakage inductance of the transformer giving

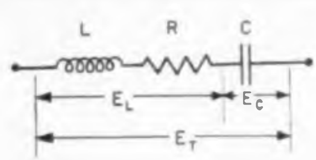


Fig. 11: Important series RLC values.

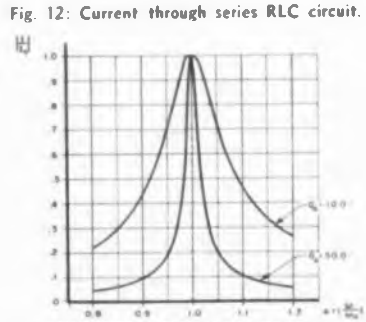
"high frequency peaking," if the Q of the series circuit formed by the primary and secondary resistances of the transformer plus the plate resistance of the first stage in series with the leakage inductance of the transformer and the capacitance mentioned above is high. In this series circuit it is desirable to keep the voltage across the capacitance nearly uniform as frequency changes giving uniform gain with frequency. Therefore, if "high frequency peaking" occurs, it may be overcome by adding the proper amount of resistance in series in the circuit.

In both the video amplifier and the transformer coupled amplifier, it has been shown which resonant frequency is the most important and what the behavior of the circuit should be in the vicinity of that resonant frequency. Therefore, it is now a simple matter to check the graphs to find the proper Q_0 of operation of each circuit.

Servos

Another application is in AC servos. If a shaping network is going to be made so that a selected amplitude ratio is to be symmetric about a relatively low frequency point and also if the components are to be kept in reasonable size, then a low Q circuit should be used if it is to be a simple three element circuit.

Fig. 12: Current through series RLC circuit.



CURRENT THROUGH THE SERIES RLC CIRCUIT OF FIG 11 AS A FUNCTION OF "a" FOR HIGH AND LOW Q ("a" IS THE RATIO OF THE APPLIED FREQUENCY TO THE COMMON RESONANT FREQUENCY, $1/\sqrt{LC}$)

Circle 41 on Inquiry Card, page 101

What's New . . .

Fig. 1: A complete Bi-Tran system has been set up and demonstrated to interested engineers at the Blonder-Tongue Labs in Newark, N. J.

Compatible TV Multiplexing System

A COMPLETELY compatible system of multiplexing TV signals would be a big help on our crowded VHF TV band. Such a system would double the available number of channels, and open up new revenue possibilities to TV broadcasters. The Blonder-Tongue Labs, in Newark, N. J., feel they may have come up with the answer. They are now showing a working model of their "Bi-Tran" system. This system makes it possible to add a second video signal which is invisible and non interfering to ordinary receivers. A simple converter (present model is 5 tubes) enables any TV receiver to select either signal at will, blanking out the unwanted signal. Thus, the Bi-Tran system is completely compatible with present equipment and would not interfere with existing channels. It is readily adaptable to educational, industrial, or pay TV applications—with no need for new frequency allotments or interference with existing channel utilization.

The accompanying diagrams illustrate the basic principles used to code the second signal for multiplexing, and the method by which the receiver selects one signal or the other. For this illustration, the two signals are called "standard program *a*"—the signal normally received by a standard receiver—and "private program *b*"—the added signal which would not be seen on the screen of any ordinary receiver. Program *b* is normally self-cancelling, but may be selected by converter circuits in place of program *a*.

Now look at the system itself. In the transmitter, two signals are mixed. One is the ordinary *a* video. The second is a coded *b* signal. Signal *b* is passed through gated alternate paths, one of which contains a phase inverter. Many variations are possible for the gating code, but the present demonstration equipment uses a simple gating code which reverses the phase of the *b* signal for each successive scan of any given line. Thus, considering any one line, successive traces will each display the *a* signal, alternately mixed with positive and inverted *b* signals. The new result is a cancellation of *b* and a display of *a* alone. This is the case shown in Fig. 4.

To receive the *b* picture and cancel the *a*, a converter, synchronized with gating circuits in the transmitter, passes alternate traces of any given line first unmodified, then with phase inverted. The receiving

Fig. 2: Two signals are mixed at the transmitter. One is a plain video signal, the other is coded by alternate phase reversals.

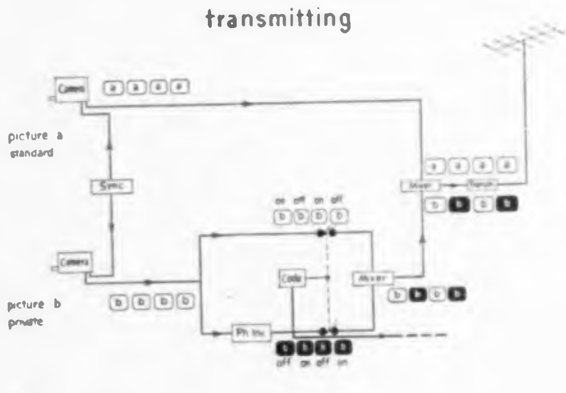
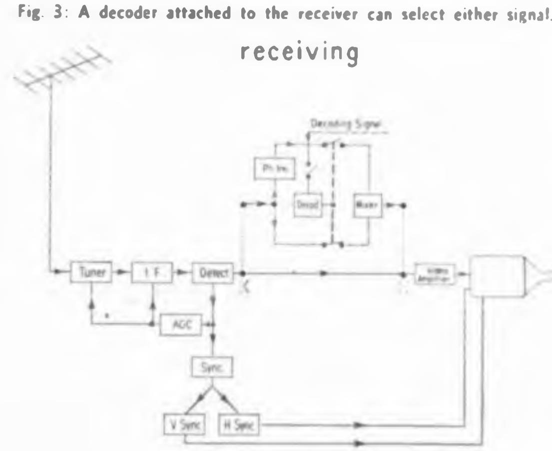


Fig. 3: A decoder attached to the receiver can select either signal.



converter is synchronized so that it inverts each incoming signal containing an inverted *b* signal, and passes unmodified those parts of the signal containing normal *b* components. The net effect is to display constantly positive *b* signals, alternately mixed with positive and inverted *a* signals. Thus, *b* is now visible, and *a* has become self-cancelling.

From this description it is evident that some sort of synchronizing link is necessary between the transmitting coder and receiving decoders. Many means can be used, including some portion of the TV signal, a separate radio channel, or a wire. According to Blonder-Tongue engineers, synchronizing frequencies can range from low audio to 20 KC or beyond, thus making possible use of wire lines of a variety of characteristics. In the present working demonstration at Blonder-Tongue Labs, the synchronizing signal is sent to the decoder by wire.

Industrial TV

Several probable uses of Bi-Tran are envisaged by the Labs. Television time could be bought by companies for "B" channel use, just as the advertisers on commercial television buy time to produce shows and to sell their products. Product demonstrations for company officials, sales personnel, and dealers located in widely dispersed areas is an example of such use. A given plant with nationwide facilities could televise new processes and techniques to key personnel across the country is another example. For the consumer, product demonstrations, stockholder meetings and similar functions become available.

Educational TV

Educational TV, one of the stepchildren of the medium, has been virtually confined to UHF or relegated to the undesirable hours on VHF. Now, with the development of Bi-Tran, educational TV will be capable of providing the service long denied both the educators and the public.

Primarily, Bi-Tran could be used by educational institutions to present those courses on a high school or college level to meet the demands of this complex age of rockets, missiles, moons and nuclear weapons. If we recognize that deficiencies exist in the area of science education—deficiencies created by the lack of qualified teaching personnel, by the inadequacy of our physical plants, and by the spurning of science courses by our youth, then we must look earnestly and speedily for solutions.

The Bi-Tran development would serve to accelerate the strengthening of our educational program. Educators would be able to present the best teachers before the greatest number of students for each classroom session. Adults who desire to embark on or finish high school or college educations would find it convenient to do so without the need to attend classroom sessions at the institutions. This is an important advantage for working people and parents who do not have the time to travel and who are confined to the home. Payment for these programs would be possible by means of a Bi-Tran decoding system.

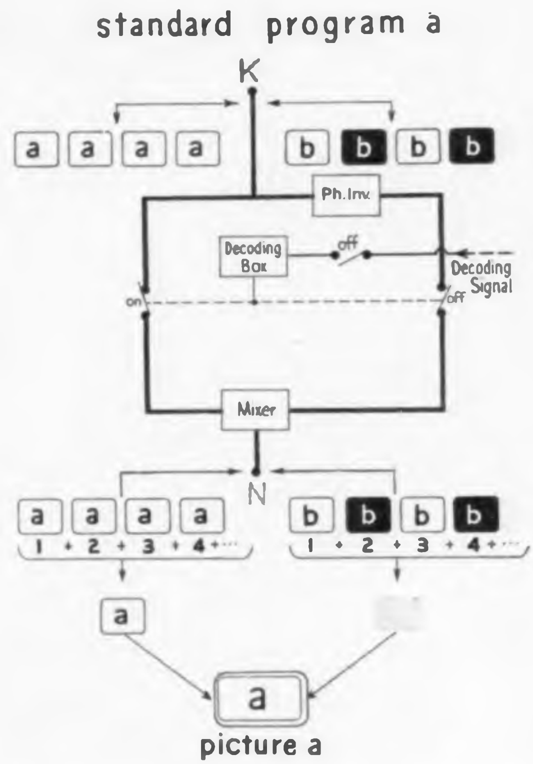
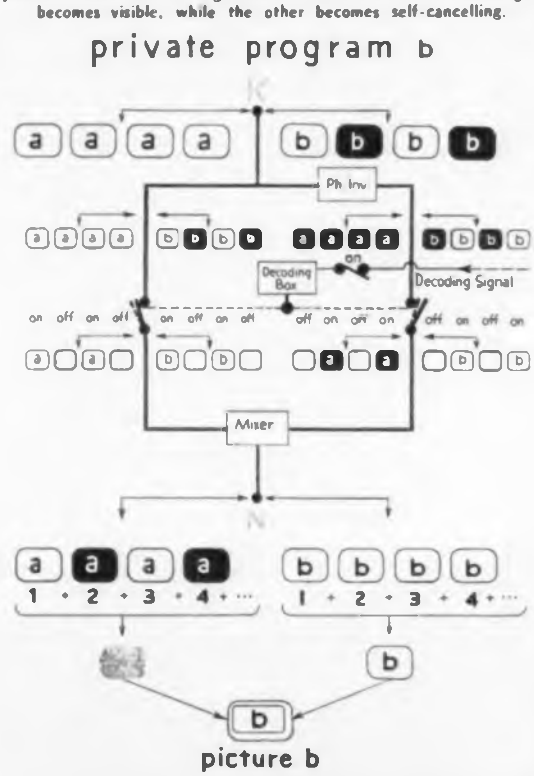


Fig. 4: In a normal receiver, the coded signal is self-cancelling.

Fig. 5: A synchronized decoder can, however, alternately reverse phase so that the two signals are reversed and the coded signal becomes visible, while the other becomes self-cancelling.



See how the facts speak for themselves

hcd* RADIO RECEPTOR Petti-Sel SELENIUM RECTIFIERS

are revolutionizing the field!

* high current density

► 100,000 hours estimated life ► Lower voltage drop
► Higher current density ► Less reverse leakage
► Smaller size

Standard rectifier

RRco. Petti-Sel rectifier

Both rectifiers are rated at 26V, 8 amps, but notice the significant space saving in the compact Petti-Sel unit.

compare the size . . .

compare the specs . . .

STANDARD SELENIUM RECTIFIERS								
NOMINAL CELL SIZE (INCHES)		RRco. CELL CODE	Continuous DC Amperes at 35° C Ambient					
			SINGLE PHASE			THREE PHASE		
Vert	Horiz		Half Wave	Center Tap	Bridge	Half Wave	Center Tap	Bridge
1.0	1.0	M	.11	.22	.22	.29	.40	.33
1 3/16	1 3/16	P	.23	.45	.45	.60	.81	.67
1.5	1.5	Q	.45	.90	.90	1.2	1.6	1.3
2	2	S	.70	1.4	1.4	1.8	2.5	2.1
3	3	U	1.6	3.2	3.2	4.2	5.8	4.8
3 3/8	3 3/8	V	2.0	4.0	4.0	5.3	7.2	6.0
4	4	W	3.0	6.0	6.0	8.0	10.8	9.0
4.5	5	G	3.75	7.5	7.5	10.0	13.5	11.2
4 1/4	6	T	4.2	8.5	8.5	11.0	15.0	12.5
5	6	H	5.0	10.0	10.0	13.3	18.0	15.0
6	7 1/4	L	7.5	15.0	15.0	20.0	27.0	22.5

RRco. PETTI-SEL SELENIUM RECTIFIERS								
NOMINAL CELL SIZE (INCHES)		RRco. CELL CODE	Continuous DC Amperes at 35° C Ambient					
			SINGLE PHASE			THREE PHASE		
Vert	Horiz		Half Wave	Center Tap	Bridge	Half Wave	Center Tap	Bridge
1.0	1.0	6	0.2	0.4	0.4	0.6	1.0	0.6
1.3	1.3	11	0.5	1.0	1.0	1.5	2.5	1.5
1.6	1.6	16	0.75	1.5	1.5	2.25	3.75	2.25
2	2	25	1.25	2.5	2.5	3.75	6.25	3.75
2.6	2.6	44	2.25	4.5	4.5	6.75	11.25	6.75
4	4	100	4	8	8	12	20	12
4	8	200	8	16	16	24	40	24
4	12	300	12	24	24	36	60	36
8	8	402	16	32	32	48	80	48
8	12	600	22.5	45.0	45.0	67.5	112.5	67.5
8	16	800	30.0	60.0	60.0	90	150	90

In case you haven't noticed, the yellow and gray areas denote actual comparative sizes of the two rectifier types.

and compare the prices! HCD Petti-Sel rectifiers, developed in Western Germany by Siemens and now made in the U.S. by Radio Receptor, offer many important electrical advantages over standard types plus economic advantages.

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See these Products at IRE

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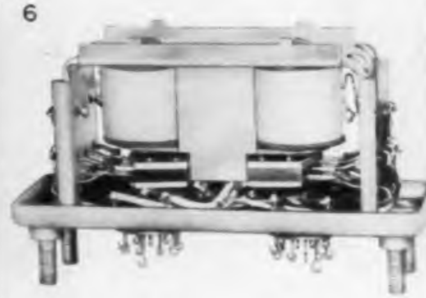

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1—Frequency Counter

Type 350 counts the number of input events for the duration of the crystal controlled time base. Automatic recycling is provided. Dynapar Corp. **Booth 3118.**

Circle 160 on Inquiry Card, page 101

2—Variable Gain AC Preamp

Model 110, a stable 2 stage feedback amplifier preceded by a set of impedance converting circuits, is self-powered and transistorized. Burr-Brown Research Corp. **Booth 3052.**

Circle 161 on Inquiry Card, page 101

3—Phase Meter

Phase Meter Model 200AB features high sensitivity, and high input impedance for the reference input as well as signal input. Industrial Test Equip. Co. **Booth 3229.**

Circle 162 on Inquiry Card, page 101

4—Connector

With improved end bell design, the series CT offers 5-15% reduction in weight and up to 25% reduction in length than with earlier MS-E designs. Cannon Electric Co. **Booth 2733.**

Circle 163 on Inquiry Card, page 101

5—Miniature Relay

A new miniature relay, which fulfills the Class C, Type II, Grade 3 requirements of Specification MIL-R-25018, MS-24114-9, has been developed. Union Switch & Signal. **Booth 2122.**

Circle 164 on Inquiry Card, page 101

6—High Current Relay

The dual coil magnetic latching KG relay meets military shock and vibration specs and was modified to switch loads up to 30 a. at 30 vdc. Potter & Brumfield, Inc. **Booth 3904.**

Circle 165 on Inquiry Card, page 101

7—Precision Phase Shifter

Type 208 consists of resistant-capacitance phase shifter networks, an electron-tube phase inverter, and an output cathode follower. Advance Electronics Lab., Inc. **Booth 3606.**

Circle 166 on Inquiry Card, page 101

8—Atlas Missile Computer

Various electronic components from the USAF Atlas Ballistic Missile Guidance Computer will be shown along with a model of the complete unit. Burroughs Corp. **Booth 1718.**

Circle 167 on Inquiry Card, page 101

9—Liquid-Filled Pots

Potentiometer gives up to 20-million shaft revolutions with little noise, high heat dissipation, high dielectric strength and operation under water. Helipot Corp. **Booth 2602.**

Circle 168 on Inquiry Card, page 101

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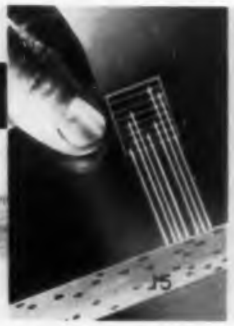

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See these Products at IRE

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10—Wire Wound Trimmer Pot

A10-W Trimmer Pot. provides good electrical characteristics while maintaining precision sub-miniature design. Available in 40 resistance values. Dale Products, Inc. **Booth 2742.**
Circle 169 on Inquiry Card, page 101

11—DC to AC Static Inverters

A complete range of transistorized static inverters are available for battery operation of equipment requiring ac power. Universal Transistor Products Corp. **Booth 3937.**
Circle 170 on Inquiry Card, page 101

12—Terminal Strips

Zip Terminals speed up and simplify component wiring by providing 2 pairs of toothed gripper-jaws at right angles to firmly retain wires. Vector Electronic Co. **Booth 4050.**
Circle 171 on Inquiry Card, page 101

13—Microminiature Relay

Relay is of ruggedized construction for high resistance to shock, vibration and temperature required in missile systems. Magnecraft Electric Co. **Booth 2342.**
Circle 172 on Inquiry Card, page 101

14—Ceramic Coil Forms

Designed for both military and commercial applications, the ceramic coil forms are comprised of 5 standard sizes. National Company, Inc., **Both 1403.**
Circle 173 on Inquiry Card, page 101

15—Silicon Photo-Voltage Cells

They have a response time of less than 20 microseconds, and a lifetime expectancy of over 10,000 years and are low-cost. Hoffman Electronics Corp. **Booth 3830.**
Circle 174 on Inquiry Card, page 101

16—Phonograph Cartridge

The new cartridge, which for stereo reproduction contains a single stylus or "needle" and two high fidelity ceramic elements is available. Electro-Voice. **Booth 1915.**
Circle 175 on Inquiry Card, page 101

17—Glass Silicon Rectifiers

Tiny glass silicon rectifiers are all rated at 400 ma forward current. Four types have PIV ratings from 225 to 500 volts. Raytheon Manufacturing Co. **Booth 2611.**
Circle 176 on Inquiry Card, page 101

18—Speech Input Console

The 8 channel speech input system that will fit a modest budget and allow future expansion is equally adaptable to radio or television studio control. Gates Radio Co. **Booth 1306.**
Circle 177 on Inquiry Card, page 101

19—P-C Test Block Connector

Right angle pins are designed for dip soldering to a printed circuit board. Choice of 6 or 16 contacts available for easy insertion of a test probe. DeJur-Amsco Corp. **Booth 3911.**
Circle 178 on Inquiry Card, page 101

20—Tape Recorder-Reproducer

Aerotape, a new miniature magnetic tape recorder-reproducer is a modular airborne package permitting record, erase and playback in a single unit. Packard-Bell. **Booth 1313.**
Circle 179 on Inquiry Card, page 101

21—Frequency Meter

The FM-6 measures and generates frequencies from 20 to 1000 MC with better than 0.0001% accuracy. It is direct reading and portable. Gertsch Products, Inc. **Booth 3701.**
Circle 180 on Inquiry Card, page 101

22—Geiger-Muller Tube

The Genalex-Type GM41B is a new Geiger-Muller tube with low background count. Tube is capable of detecting minute amounts of beta radiation. British Industries Corp. **Booth 2921.**
Circle 181 on Inquiry Card, page 101

23—1 MC Decade Counter

DC-105 is of modular construction with a magnetron beam switching tube and a Nixie numerical indicator tube. It can reset in less than 1 μsec. Burroughs Corp. **Booth 1724.**
Circle 182 on Inquiry Card, page 101

24—Miniature Chopper

A new low noise miniature Syncroverter chopper features low thermal construction. It is particularly useful in chopper stabilized dc amplifiers. The Bristol Co. **Booth 2932.**
Circle 183 on Inquiry Card, page 101

25—Differential DC Amplifier

The 114A is a true differential dc amplifier. The input and output are both floating and are completely isolated from each other. It's transistorized. Kin Tel. **Booth 3401.**
Circle 184 on Inquiry Card, page 101

26—Magnetic Core Inspection

Completely automatic magnetic memory core classifier grades cores on the basis of switching time and integrated flux from change. Rixon Electronics, Inc. **Booth 1317.**
Circle 185 on Inquiry Card, page 101

27—Miniature Soldering Iron

The T-1232 tip-element is designed for soldering jobs of the more precise nature. It is only slightly larger than an ordinary kitchen match. American Electrical Heater Co. **Booth 4033.**
Circle 186 on Inquiry Card, page 101

28—Electronic Voltmeter

Model 300D precision, laboratory electronic ac voltmeter is designed to operate for extended periods of time without recalibration or servicing. Ballantine Labs. **Booth 3402.**
Circle 187 on Inquiry Card, page 101

29—Drift Transistor

Diffused base transistor has a good feature in that it operates at high speeds. It enables a computer to complete its calculations more rapidly. General Transistor Corp. **Booth 3828.**
Circle 188 on Inquiry Card, page 101


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Automatic silicon power rectifiers

STUD MOUNT TYPES

MILITARY TYPES — JAN SERIES 1N253, 1N254, 1N255 AND 1N256

This series meets all the rigid electrical, mechanical and environmental requirements of MIL-E-1 specification. You are assured of highest quality and reliable performance.
Peak inverse voltages of 100 to 600 are available with DC ouput currents of 200 ma to 1 amp.

GENERAL PURPOSE TYPES — 1N550 THROUGH 1N555 SERIES

This series is suitable for all magnetic amplifier, power supply and DC blocking applications requiring 500 MA average rectified current over the range of 100 through 600 volts peak inverse.

HIGH VOLTAGE TYPES — 1N562 AND 1N563

These rectifiers cover the range of 800 to 1000 volts peak inverse with a DC output current of 400 MA. They are **single junction devices** offering the lowest possible forward voltage drop for high voltage service.

PIGTAIL TYPES

MILITARY TYPES — USAF SERIES 1N538, 1N540 AND 1N547

Peak inverse voltages of 200 to 600 are available with DC output currents of 250 ma at 150°C ambients. Meets all rigid requirements of MIL-E-1 specifications.

MAGNETIC AMPLIFIER TYPES — 1N440 THROUGH 1N445 SERIES

This series of rectifiers incorporate the most rigid electrical specifications currently being offered and has set the standard for the industry regarding quality for magnetic amplifier applications. Available with peak inverse voltages of 100 to 600 and DC output current of 300 MA.

POWER SUPPLY TYPES — 1N530 THROUGH 1N535 SERIES

Widely accepted for power supply applications, this series of rectifiers, which is available with peak inverse voltages of 100 to 600 and an average reotified current of 300 MA, has been used successfully in a multitude of military and commercial equipments.

GENERAL PURPOSE TYPES — IN1100 THROUGH IN1105 SERIES

This series of rectifiers, which is available with peak inverse voltages of 100 to 600 and an average rectified current of 250 MA at ambient temperatures of 150°C, is useful for all applications requiring a high quality rectifier. When used at lower ambient temperatures, rectifiers in this series can be operated at significantly higher DC output currents, namely, 750 MA at 25°C.

GERMANIUM REPLACEMENT TYPES — S-91 THROUGH S-93 SERIES

This series of rectifiers is designed to replace germanium types 1N91, 1N92 and 1N93. The advantages of silicon are offered at prices comparable to germanium, thus making this series admirably suited for use in commercial equipments where component cost is a factor.

HIGH POWER TYPES

5 AMPERE TYPES — AM0505 THROUGH AM3505 SERIES

This series of rectifiers covers the range of 50 to 350 volts with an average rectified current of 5 amperes at a case temperature of 135°C. Low leakage current makes high rectification efficiencies possible. These devices are very useful for the construction of various types of high power rectifier assemblies where a minimum of space is available and high operating temperatures encountered.

10 AMPERE TYPES — AM0510 THROUGH AM3510 SERIES

This series of rectifiers covers the range of 50 to 350 volts with an average rectified current of 10 amperes at a case temperature of 135°C. Low leakage current makes high rectification efficiencies possible. These devices are very usefui for the construction of various types of high power rectifier assemblies where a minimum of space is available and high operating temperatures encountered.

20 AMPERE TYPES — AM0502 THROUGH AM3520 SERIES

This series of rectifiers covers the range of 50 to 350 volts with an average rectified current of 20 amperes at a case temperature of 135°C. Low leakage current makes high rectification efficiencies possible. These devices are very useful for the construction of various types of high power rectifier assemblies where a minimum of space is available and high operating temperatures encountered.

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MASS PRODUCERS OF ELECTRONIC COMPONENTS

Donald G. Fink, Pres., IRE

IRE Show

Opens March 24 in N. Y. C.

More than 55,000 engineers, scientists and other industry personnel are expected to attend the 4-day show and convention at New York's Coliseum. Technical sessions will feature the presentation of more than 275 technical papers, at 55 technical sessions.

THE largest technical event in the world, the 1958 IRE National Convention, will commence on March 24 and run for four days, in New York City. Centers of activity will again be the Waldorf-Astoria Hotel and the New York Coliseum.

Providing an unparalleled opportunity for engineers to meet and see thousands of brand-new items of electronic equipment, an attendance in excess of 55,000 is expected.

There will be a total of 850 exhibits covering all four floors of the Coliseum. Not only will the newest, most advanced products of developments in electronics be displayed, but all booths will be manned by the men who made them possible. This will help to give the engineer accurate, intelligent, and first-hand information.

For the convenience of visitors, the exhibits will be grouped with systems on the first floor, component parts on the second, instruments and components on the third, and production and services on the fourth.

No convention is complete with only technical attractions. Consequently, two outstanding social events have been scheduled—a cocktail party on the evening of the 24th and the annual banquet on the evening of the 26th. Both will be held in the Grand Ballroom of the Waldorf-Astoria Hotel.

Newly appointed Fellows and winners of the annual IRE awards will be honored during the banquet. Guest speaker will be Robert C. Sprague, Chairman of the Board, Sprague Electric Co. His subject will be "The Federal Reserve and the Electronic Industry."

On the opening morning of the convention, the Annual Meeting will convene. Ernst Weber, President, Polytechnic Institute of Brooklyn and IRE Director, will be the principal speaker. His subject will be "The Broad Spectrum."

On the distaff side, a program appealing to visitor and native alike has been arranged. Broadway shows, radio and TV programs, fashion talks, a visit to U. N. Headquarters, and unusual guided tours are only a few of the many activities.

All registrations for the convention and show will take place on arrival either at the Waldorf-Astoria

C. E. Granqvist, Vice-Pres., IRE

Haraden Pratt, Secy., IRE

Dr. W. R. G. Baker, Treas., IRE

or the Coliseum. Registration fees are $1.00 for each IRE member, and $3.00 for each non-member. Payment of the fee entitles registrants to attend all sessions and exhibits.

IRE Technical Sessions

A COMPREHENSIVE program of 55 technical sessions is expected to attract at least 55,000 radio engineers and scientists. Thirty-three sessions are scheduled for the Waldorf-Astoria Hotel and 22 at the Coliseum. Approximately 275 papers will be presented at these sessions.

A total of 850 exhibits will cover all four floors of the Coliseum

One of the opening sessions on Monday afternoon will discuss new developments in the packaging and integrating of Auto-Sembled transistorized printed circuits. The paper "Circuit Packaging and Integrating of Transistor Assemblies" is being presented by H. H. Hagens, U. S. Army Signal Eng. Labs, Ft. Monmouth, N. J. The increasing use of transistors should make this session very interesting.

A new IRE professional group—Engineering Writing and Speech—has a series of papers scheduled for Monday afternoon at the Coliseum. The papers, "Road Blocks in Technical Writing," "Non-Technical Help for Engineer-Writers," "Preparation of Auto-Abstracts," and "We Are What We Say," should prove invaluable to people in this field.

The recording industry will be interested in the paper being presented Tuesday morning by C. C. Davis and J. G. Frayne, Westrex Corp., entitled "The Westrex Stereo Disc System,"—a must. This paper describes a stereo disc recorder which records two stereophonic channels in a single groove with a single stylus. The axis of the two recordings are 90° to one another, each being at 45° with horizontal plane of the record. Design features and performance of the reproducer are also described.

TV broadcasters should place the Tuesday morning sessions—"Broadcast Transmission Systems"—on the top of their list. Some of the papers to be presented at these sessions are "Video Modulation Limiter," "Color TV Recording on Magnetic Tape," and "An Automatic TV Level Control Using Vertical Interval Test Signals." A. C. Goodnall, WBC, is presenting a paper "A Novel System for Feeding a Signal Tower AM-FM and TV Signals." This paper is expected to raise high interest.

With reliability the keynote of today, "A Tube That Tells Time," being presented Tuesday afternoon by W. T. Eriksen and E. J. Handley, Raytheon Mfg. Co., Newton, Mass., should prove valuable. A novel subminiature tube type for measuring the total number of hours of operation of any electrical equipment or component is described. The results are particularly applicable when the tube is used to obtain reliability data so that lifetime use of components and modules can be predicted and replacements made before equipment failure occurs.

With the advent of the "Space Age" the sessions Tuesday evening at the Waldorf-Astoria, Starlight Roof, entitled "Electronics in Space," should prove to be a "sell-out." This panel discussion will include such things as "Propulsion and Interplanetary Travel, Navigation and Control Count, Man in the Space Environment, Communications and Telemetering, and Terminal Environment." Wernher von Braun, U. S. Army Ballistic Missile Agency, and the key scientist responsible for the launching of the U. S. Army satellite, the "Explorer," will take part in this panel discussion.

Engineers concerned with microwave equipment should find the paper "A New Microwave Rotary Joint" by W. E. Fromm, E. G. Fubini, and H. S. Keen, Airborne Instruments Lab., Inc. of great interest. At this session on Wednesday morning, a novel annular microwave rotary joint will be described. This rotary joint is characterized by very low loss, SWR

(Continued on page 124)

TECHNICAL PROGRAM

Detection Theory and its Applications

Monday, March 24
2:30-5:00 P.M.
Starlight Roof—Waldorf-Astoria
Chairman: David Slepian
Bell Telephone Labs.

Detection as a Statistical Decision Problem—D. Van Meter
Some Communications Applications of Detection Theory—W. B. Davenport, Jr.
Some Applications of Detection Theory to Radar—Wm. McC. Siebert
Human Factors in Detection and Speech Communications—J. P. Egan

Vehicular Communications

Monday, March 24
2:30-5:00 P.M.
Astor Gallery—Waldorf Astoria
Chairman: Angus A. MacDonald
Motorola, Inc.

Direct Despatch Service—A. J. Dinnin
A Unique Radio System Designed for Flood Forecasting—W. C. Wray
A New Approach to Broadband Vehicular Antennas—H. Brueckmann
Mobilization of Transistors—R. J. Hansen
Vehicular Noise Problems in Modern Land Mobile Systems—S. F. Meyer

Telemetry and Remote Control

Monday, March 24
2:30-5:00 P.M.
Jade Room—Waldorf Astoria
Chairman: Kenneth T. Larkin
Lockheed Missile Systems Division

The RCA Flight Data System—C. N. Batsel, Jr., R. E. Montijo, Jr. and E. J. Smuckler
A Pulse Position Telemetry System—L. Weisman and E. S. Teltscher

(Continued on page 182)

IRE's 1958 Fellows Predict . . .

Exclusive statements from the nation's leading electronic engineers summarize the future for the electronic industries.

ACOUSTICS

Arnold Peterson, General Radio Co.—". . . advances in measuring radiated acoustic power and the acoustic characteristics of rooms are needed for more effective control of sound. They may result from new techniques of measurement, some of which are now being explored. The considerable effort applied to the measurement and control of high-intensity sound should also result in new instrumentation and techniques for this specialized but important field."

A. Peterson

R. H. Tanner

R. H. Tanner, Northern Electric Co.—"In the Audio field, interest continues to grow and widen in high quality transmission and reproduction of sound, as well as in the related arts of Music and Drama. Meanwhile, there is a spreading awareness of the importance of the acoustical conditions under which sounds, whether live or reproduced, are heard. On the other hand, methods are being devised to control and reduce the increasing problem of noise, the hidden fatigue factor in so many of our modern activities."

ANTENNAS

F. E. Brooks, Jr.

H. L. Brueckmann

F. E. Brooks, Jr., Collins Radio Company—"The antenna is that important link between the electronic equipment and the propagation waves of the radio communication system. With present trends toward miniaturization of all radio equipment, there are demands for smaller, more efficient antenna systems, yet retaining directional qualities of their larger counterparts. There is a need for new ideas and techniques in antenna systems to satisfy these demands."

Helmut L. Brueckmann, Army Signal Engineering Lab. — "Since further progress in transmitter and receiver design will be increasingly difficult to come by, good antennas will be appreciated more than they have been in the past. I hope that project engineers will stop thinking of antennas as an accessory to the main equipment which can be taken care of in last-minute superficial studies by inexperienced engineers."

Henry Jasik, Jasik Laboratories—"The trend in antenna systems is toward larger sizes. The near future will see a number of steerable radio telescopes of 60 foot and 85 foot diameter in operation in the United States with still larger sizes being planned. The tremendous capital cost of these systems makes it essential that the maximum in electrical performance be derived from these antenna systems. It is expected that methods of obtaining considerable improvements in the radiation properties of large paraboloids will be found in the coming year."

M. W. Scheldorf

H. Jasik

M. W. Scheldorf, Andrew Corporation—"The proper radiation of electromagnetic energy will continue to be an important factor for consideration in a large proportion of our electronic systems. It will become more and more necessary to restrict our antenna beams to regions where the signal is needed, in order to communicate at higher levels and in order to reduce the difficulties with interference."

COMMUNICATION SYSTEMS

A. C. Beck, Bell Telephone Labs.—"Theory and experiment have shown the validity and some of the requirements of long distance waveguide transmission. This can open vast new frequency areas, perhaps many times larger than the whole radio spectrum, for communication purposes. Like most new things, there are problems and difficulties to be overcome, and advances in the waveguide art and in all of the associated microwave technology are necessary."

A. C. Beck

H. Costa

Brigadier Helio Costa, Brazilian Air Force—"The safety and efficiency of air operation after the introduction of high speed and high altitude flying aircrafts in a near future, depend upon the effectiveness of the communication and electronic systems used to orient, control and protect those aircrafts. Present status of such systems in Brazil as in many other countries interested in the progress of civil aviation, calls for a great combined effort of the Government, Airlines and Industries resources, in order to plan, build and install the equipments and services required for safe air operation."

(Continued on page 98)

IRE Fellows Predict

Wilbur B. Davenport, Jr., Lincoln Lab., MIT—"The beginning of the space age forecasts greater and greater demands on our systems of information processing and information transmission than ever before. The great distances involved and the complexity of the operations required pose new and difficult problems. However, recent applications of statistical methods and concepts to similarly difficult problems have resulted in significant practical advances. We have every reason to expect comparable advances in the future."

W. B. Davenport, Jr.

H. E. Dinger

Harold E. Dinger, Naval Research Lab.—"Under an accelerated program within the IGY, a large amount of data will be obtained that most certainly will lead to interesting and useful new theories concerning the magneto-ionic conditions surrounding the earth. These will result in a considerable advance in our knowledge of wave propagation, and will enable more effective use of the radio spectrum to be made."

Irvin H. Gerks, Collins Radio Co.—"We can hope in coming years to acquire much more reliable knowledge of such phenomena as turbulent scattering in the troposphere and the ionosphere, and scattering from meteor trails, auroral ionization, the lunar surface, and perhaps various forms of man-made scatterers. Intrusion of man into the outer reaches of the atmosphere and into planetary space will provide challenging new problems in the maintenance of communication."

I. H. Gerks

J. W. Herbstreit

Jack W. Herbstreit, N.B.S. Boulder Labs.—"Research in the field of tropospheric propagation is opening the doors to a better understanding of the effects of our atmosphere on the propagation of radio waves. Recent studies have indicated that the accuracy with which we know the direction of arrival of radio signals from outer space is limited by atmospheric irregularities. Our future frontiers of knowledge in the field of radio communication and the conquest of outer space are greatly dependent upon our further advances in research in these fields."

W. M. Sharpless, Bell Telephone Labs.—"As we progress toward the use of higher and higher frequencies, extremely broad bands become available. In exploiting this new extremely high frequency band it will become necessary to develop new types of equipment capable of handling millimicrosecond pulses; this will result in the extensive use of point contact rectifiers for fast acting switches and detectors."

W. M. Sharpless

R. M. Soria

Dr. R. M. Soria, Amphenol Electronics Corp.—"The great strides that have been made already to increase the operational range of transmission systems will be further accelerated with the availability of many new and improved materials. These materials will permit novel manufacturing techniques, automation where applicable, and unique designs that will result in components meeting the requirements of reliability, performance, packaging, and environmental extremes."

R. R. Stoddart

E. Toth

Richard R. Stoddart, Stoddart Aircraft Radio Co.—"Recent happenings in the missile field emphasize the importance of radio interference control as never before. I predict that government contractors who now have the facilities and engineers to design noise-free products, will find increased sales and profits by selling their noise-free products to the public, and as off the shelf items to the government. Non-Government contractors will fall in line with the result that radio interference levels will be reduced to acceptable limits."

Emerick Toth, Naval Research Lab.—"The present high degree of vulnerability of receiving equipment to strong-signal and noise interference must be reduced to a degree which will permit receiver weak-signal selectivity to become the determining factor in adjacent channel assignment. Much more remains to be done to substantially improve the reliability and effectiveness of what we have so far achieved; new discoveries and inventions will increase both our difficulties and our opportunities."

BROADCAST

Jay W. Wright, Radio Service Corp. of Utah—". . . broadcasters will develop technical plant systems and components which will be more easily operated and require fewer highly trained engineers. Automation of various kinds will come into much wider use. Technical operations will be more closely integrated with program production operations."

J. W. Wright

I. L. Auerbach

COMPUTERS

Isaac L. Auerbach, Auerbach Electronics Corp.—"Electronic information processors will be capable of routine management decisions and the ability to recognize patterns to read. Along the way, we will achieve automatic machine translation of languages, complete computer control of complex industrial processes, and the acceptance of real time computers to control airways. The future applications of information processing systems and computer techniques to industrial requirements will dwarf their present scientific and business uses."

Professor J. Millman, Columbia University—"Pulse and digital circuits will not only be of importance in computers, but will penetrate ever

(Continued on page 106)

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Radio Receptor silicon diodes

IN ANY COMBINATION OF CHARACTERISTICS INCLUDING...

high speed high conductance high temperature high voltage high back resistance

General Instrument semiconductor engineering has made possible these new silicon diodes with a range of characteristics never before available to the industry. **Particularly outstanding is the all-purpose type 1N658 which offers uniform excellence in all parameters.** The RRco. diodes shown here are just a small sampling of the line — the complete list will be sent you upon request to Section IN-3.

Code No.	Max. Fwd. Voltage Drop @ Indicated DC Current	Max. Rev. DC Cur. @ Test V. 25° C.	Max. Rev. DC Cur. @ Test V. 150° C.	Test Voltage	Min. Break-down Voltage*	Reverse Recovery
1N658	1 @ 100 mA	.05 µA	25 µA	50V	120V	80KΩ in 0.3 µsec†
1N457	1 @ 20 mA	.025 µA	5 µA	60V	70V	
1N458	1 @ 7 mA	.025 µA	5 µA	125V	150V	
1N459	1 @ 3 mA	.025 µA	5 µA	175V	200V	
DR668	1 @ 200 mA	.025 µA	5 µA	60V	80V	
DR669	1 @ 200 mA	.025 µA	5 µA	125V	150V	
DR670	1 @ 200 mA	.025 µA	5 µA	175V	200V	
			100° C.			
1N625	1.5 @ 4 mA	1 µA	—	10V	30V	15KΩ in 0.15 µsec‡
	—	10 µA	50 µA	20V	—	----
1N627	1.5 @ 4 mA	20 µA	100 µA	75V	100V	400KΩ in 1.0 µsec†
1N629	1.5 @ 4 mA	20 µA	100 µA	175V	200V	400KΩ in 1.0 µsec†
DR677	1 @ 100 mA	0.5 µA	25 µA	20V	30V	15KΩ in 0.15 µsec‡
DR673	1 @ 100 mA	0.5 µA	10 µA	75V	100V	400KΩ in 1.0 µsec†
DR675	1 @ 100 mA	0.5 µA	10 µA	175V	200V	400KΩ in 1.0 µsec†

*Reverse voltage at which a reverse current of 100 µA flows.
†When switching from 5 mA to −40V.
‡When switching from 5 mA to −20V.

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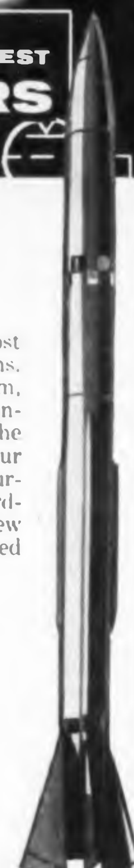
Circle 45 on Inquiry Card, page 101



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VC9G Trimmer series (lug & lead type for printed circuits)

Model	Capacitance Range (MMF) Min.	Max.
VC9G	0.8	8.5
VC10G	0.8	4.5
VC31G	0.8	12
VC32G	0.8	18
VC42G	1	21
VC43G	0.8	30

VC9GW Trimmer series (4 wire type for printed wiring boards)

Model	Capacitance Range (MMF) Min.	Max.
VC9GW	0.8	8.5
VC10GW	0.8	4.5
VC31GW	0.8	12
VC32GW	0.8	18
VC42GW	1	21
VC43GW	0.8	30

VC20G Trimmer series (panel type)

Model	Capacitance Range (MMF) Min.	Max.
VC20G	0.8	8.5
VC21G	0.8	4.5
VC22G	0.7	12
VC23G	0.8	18
VC24G	1	30

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Toronto, Ontario, Canada

JFD International
15 Moore Street
New York, New York

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502	507	512	517	522
503	508	513	518	523
504	509	514	519	524
505	510	515	520	525

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221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300

YOUR NAME ....TITLE..............

FIRM ....

FIRM ADDRESS ....

CITY or TOWN ....ZONE.........STATE..........

New Products and Technical Data—March '58

NEW TECHNICAL DATA

FIRST CLASS
PERMIT NO. 36
NEW YORK, N. Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

ELECTRONIC INDUSTRIES

P. O. BOX 73, VILLAGE STATION
NEW YORK 14, N. Y.

FIRST CLASS
PERMIT NO. 36
PHILA., PA.

BUSINESS REPLY CARD
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CHESTNUT & 56th STS.,
PHILADELPHIA 39, PA.

Chilton Company

FIRST CLASS
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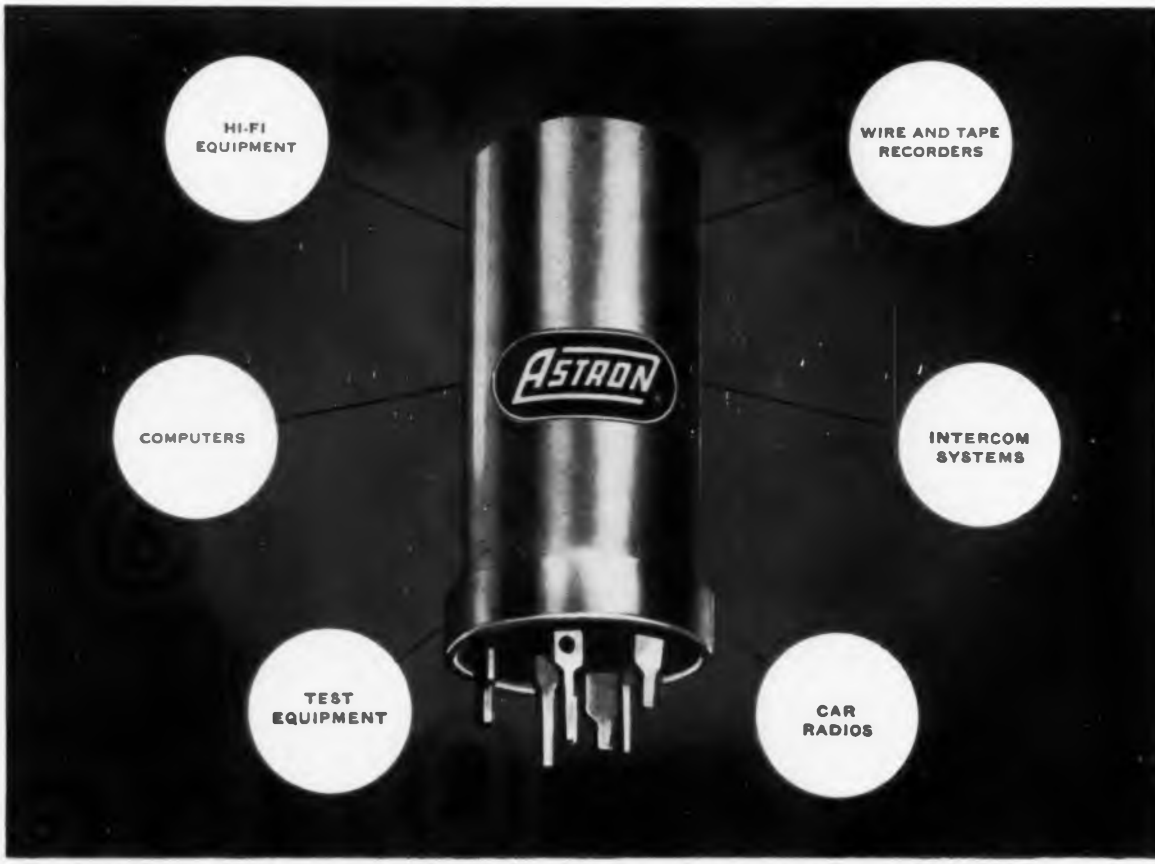

ASTRON "SAFETY MARGIN"*

ELECTROLYTIC CAPACITORS

for transistorized and printed circuits

IMPORTANT DESIGN ADVANTAGES OF ASTRON EZ AND EX ELECTROLYTICS

- MINIATURIZED SIZE—LIGHT IN WEIGHT
- DESIGNED FOR MINIMUM LOSSES—LOW DRAIN
- LONG "SHELF" AND OPERATING LIFE
- HERMETICALLY SEALED
- RUGGEDLY CONSTRUCTED

PRINTED CIRCUIT MOUNTING STYLE—EZ

STANDARD TWIST PRONG MOUNTING STYLE—EX

Today's low-voltage transistorized and printed circuits demand capacitors with absolute minimum leakage and impedance. To meet these exacting needs, Astron Engineers developed new miniaturized EZ and EX Electrolytics for ambient operation up to 85° C.

99.99% pure aluminum foil is specially anodized by an exclusive process . . . power drain is cut to a minimum. They are constructed to withstand extreme temperature changes and give reliable operation after periods of "long idleness."

Each electrolyte formula is scientifically compounded of special chemicals, selected for their high purity. Assembly steps are kept meticulously clean . . . the result: Safety Margin Construction, famous for its ability to withstand ripple currents, vibration, shock and wide temperature fluctuations. These hermetically sealed units are available in a broad selection of capacitance and voltage ratings.

Send today for further technical information . . . **please describe your application; it helps us offer proper assistance to you . . . when special conditions require, we will design a prototype to meet your specifications.**

ASTRON CORPORATION
255 GRANT AVENUE EAST NEWARK, N. J.

SKOTTIE ELECTRONICS CORPORATION • A Wholly-owned subsidiary of ASTRON CORPORATION
PECKVILLE, PENNSYLVANIA

*Trade-Mark

WEST COAST WAREHOUSE: 9041 WEST PICO BLVD., LOS ANGELES—EXPORT DIVISION: ROCKE INTERNATIONAL CORP., 13 EAST 40TH ST., N. Y., N. Y.—IN CANADA: CHARLES W. POINTON, 6 ALCINA AVE., TORONTO, ONTARIO

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teachers. In turn, we should subsidize team effort in technological progress. Richard C. Webb, Colorado Research

IRE Fellows Predict

(*Continued from page 98*)

more deeply into almost all branches of electrical engineering, such as instrumentation, control, communications, data processing, telemetering, etc."

J. Millman

N. Rochester

Nathaniel Rochester, IBM — "During the next decade, high-powered information handling machines will probably obey spoken as well as written or punched instructions. These instructions will be more general in nature and easier for people. I expect the machines to be more resourceful and to manage kinds of problems that are beyond present machines."

COMPONENTS

H. V. Noble, Wright Air Development Center—"We can expect a phasing out of evolutionary improvements and an acceleration of revolutionary concepts and advancements. Lumped circuit type of components will be replaced by composite circuit functions, first by compact subassemblies and later by integrated circuit functions utilizing the fundamental molecular atomic and nuclear properties of matter."

H. V. Noble

W. H. Kohl

ELECTRON DEVICES

Dr. Walter H. Kohl, Stanford University—"For operation at high temperatures (500°C), and in the presence of shock, vibration, and nuclear radiation, the ceramic envelope tube is further advanced than any other circuit component. This development will have an important impact on the formerly unreliable receiving tube, even for civilian use where critical environments are not ordinarily encountered but a better product is nevertheless appreciated."

Peter G. Sulzer, Consulting Engineer—"I can foresee that recent improvements in transistors, crystal units and circuit design will permit the production of rugged, highly portable frequency-control equipment with unprecedented reliability and frequency stability. The use of such equipment should lead to the construction of simplified but improved navigation and communication systems, and will save space in the frequency spectrum as well as in the airplane or missile."

P. G. Sulzer

P. M. Honnell

EDUCATION

Professor Pierre M. Honnell, Washington University—"Without question, the most important single activity of the nation, and upon which its future depends in a very real sense, is that of education in all its phases. We in engineering education are particularly conscious of our immediate role in the physical security of the nation. The immediate needs however, must not be placed out of proportion to the requirements of the nation for the future. These considerations bear heavily upon all of us who are revising engineering curricula, and explains their present state of flux, from which will emerge educational improvements as far-reaching as the more obvious advances in the electronic art."

George L. Van Deusen, RCA Institutes—"A significant phase of the current shortage of engineering personnel is the growing need for high grade technicians to assist the professional engineer in the details of his work. This area of education has been surveyed recently by outstanding industrial, educational and governmental bodies. It remains to implement their conclusions by drafting definite employment specifications for the appropriate technician grades, outlining courses of instruction conforming thereto and, most important, by conducting a nation-wide publicity campaign to popularize the technician as a vital and respected member of the engineering team."

G. L. Van Deusen

D. L. Waidelich

Professor Donald L. Waidelich, University of Missouri—"Here is probably the most urgent and far-reaching problem facing engineering education at the present time. The raw material for the engineering courses given in the universities is largely the basic research done in the past by engineers in industry and the universities. With the great amount of applied research sponsored by industry and government in the universities and with the greatly increased teaching loads that are looming over the university faculties, how can the seed corn of basic research be stimulated for increased growth in the universities?"

MANAGEMENT

Charles F. Horne, Convair—Pomona—"Although there are many problems that will confront us in the electronics-guided missiles field in the future, there is one that is paramount. Our profession is only as strong as the people we have in it. We may be able to buy facilities and equipment off the shelf or with short lead times. But we cannot purchase competent brainpower unless it already exists. It is now in very short supply. Creation and training of brainpower takes a long time. I believe that our first

C. F. Horne

R. C. Raymond

order of business is to strengthen the bonds between industry and education. We must spend time, money and effort to assist all levels of our educational system. We must help lead the schools away from mass mediocrity. In our profession we need high quality engineers. We will have this standard only if the schools are strong enough to produce an effective end product. I know we can achieve this goal. We must make education aware of our real engineering needs—the need for quality. We must assist education by lecture-demonstrations on the fascination of science and engineering at the junior high school level; by assisting the counselors in the senior high schools; by financial assistance at the college and university level. We should consider lending our top engineers to colleges as lecturers and teachers. In turn, we should subsidize faculty members to spend sabbatical leaves with us in industry. In all of our endeavors we need to stress the spirit of industry-education cooperation. Only in this way can we take the quick, long strides toward more high quality brainpower which our country and our industry so greatly need."

Dr. Richard C. Raymond, General Electric Co. — "Dominant technical problems of the future include mainly those associated with fuels and energy conversion, materials, and communications. Imaginative work in all three areas is needed badly to prevent war and to make it possible for all of us on Earth to have a better life."

E. H. Schulz

D. E. Sunstein

Dr. E. H. Schulz, Armour Research Foundation—"Over the past period of rapid growth of industrial research, we have seen a gradual shift of emphasis from testing to higher and higher levels of problem-solving activity. Attention to this highly-important activity can be accelerated by those of us in the research field making known the profitability and necessity of such research and dispelling the popular notion that basic research is not profitable."

David E. Sunstein, General Atronics Corp. — "To insure expansion and health of our national economy, the technically creative personnel of the country will be faced with the problem of coming up about once every 10 or 20 years with a major new commercial product for domestic consumption, about which a new industry can be built."

H. W. Welch, Jr.

L. J. Giacoletto

H. W. Welch, Jr., Motorola Inc.—"Solid state device and microwave tube development exemplify the requirement for scientific engineering team effort in technological progress. We have made much progress but with improvement in team management substantially accelerated progress can be made in the future."

THEORY

L. J. Giacoletto, Ford Motor Co.—"Non-linear effects, particularly as found in solid-state devices, will in coming years be exploited rather than avoided at all cost as has been done in the past. There are many unusual and useful non-linear effects which have not been exploited because of complexities in analysis. Improved analysis techniques and better measurement equipment will be employed in the study and application of non-linear effects."

Dr. Harold Lyons, Hughes Aircraft Co.—"The development and application of quantum phenomena to military and industrial problems will continue at an increased pace. This will result in a kind of quantum electronics using atomic circuit elements, as exemplified by maser amplifiers and ultra-stable or coherent oscillators. The physics of the solid state will continue to be intensely studied with more advances in application of the resonances, internal fields and ferromagnetic and ferroelectric properties. The study of the solid state at very low temperatures will increase. All these techniques give new depth and flexibility to electronics, giving speed or frequency ranges comparable to what has been associated with beams or streams of electrons but without shot noise; thus greater sensitivities will be achieved through noise reduction by this means and the use of low temperatures. Quantum electronics also offers potential for advances in the millimeter wave region."

H. Lyons

L. A. Pipes

Professor Louis A. Pipes, University of California—"Currently, the trend in the analysis of nonlinear electric circuits is to arrive at a closer correspondence between mathematics, mathematical physics, and engineering inventive ability. Perhaps in time this activity will enable the circuit analyst to understand nonlinear circuits and systems to the degree that linear circuits are understood at present."

Richard C. Webb, Colorado Research Corp.—"What I see as the most significant advance in the electronic industry during the next few years, and it is already well under way, is the development of a unified system design philosophy based upon concepts that have come to us recently from the fields of communication and information theory and from the vast realm of computer logic and technique; these new ideas contain principles almost as important to the design engineer as mathematics itself."

R. C. Webb

D. F. Winter

David F. Winter, Maloney Electric Co.—"Some of the more fruitful areas yet to be developed include the application of principals developed in the communications field to such problems as the control of industrial processes, the substitution of electronics for impaired body communications and functions and the implementation of computer control power systems."

Professor L. A. Zadeh, Columbia University—"We are witnessing now a shift of interest from classical network theory to more general theories such as system theory and signal theory. Furthermore, the theory of discrete devices and automata is rapidly gaining in importance, while the classical theories of continuous systems of linear and nonlinear types are getting into doldrums. I think that in a few years from now most of our theoretical work will be concerned with the analysis and synthesis of discrete probabilistic systems."

L. A. Zadeh

C. M. Crain

MICROWAVE

Cullen M. Crain, The Rand Corp.—"Increasing knowledge of the structure of the atmosphere through which radio waves are propagated will continue to give a better understanding

(Continued on page 110)

Separate

THE EXPENSE FROM THE EXPENDABLE . . .

Investigate

CHARACTER DISPLAY VIA CATHODE-RAY TUBES

No longer is it necessary to put all your eggs in one basket when it comes to character read-out displays. Now you can do it better, and more economically, with Du Mont cathode-ray display tubes in one of several commonly-known systems. Such a system permits the replacement of the display unit *alone*, eliminating the very expensive replacement of integrated tube and generator, and at the same time, provides these outstanding PLUS FEATURES . . .

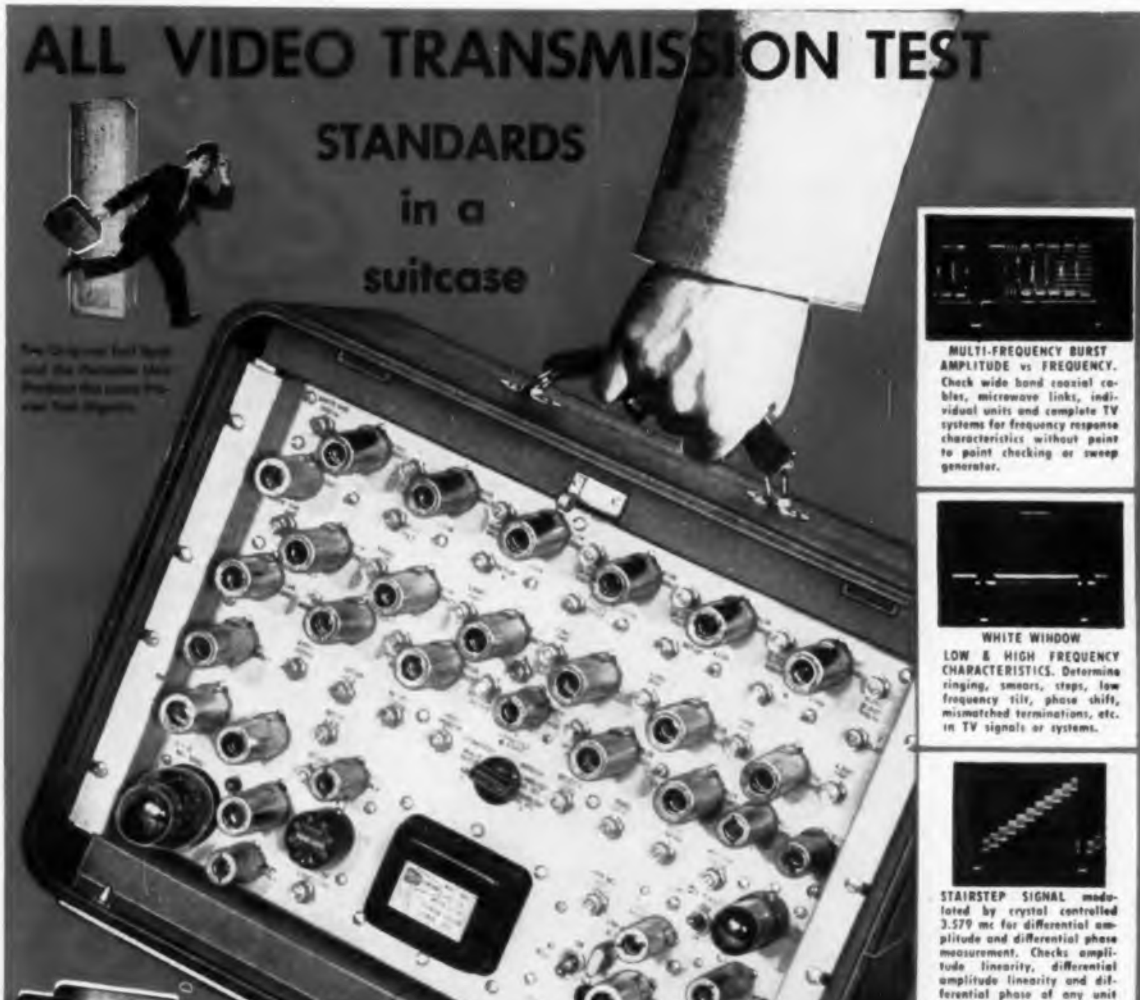
- **Bright, flickerless display** — permits read-outs under high ambient light conditions. No annoying, low-frequency flicker.
- **Space-saving** — greatest screen diameter-to-length ratio. Du Mont display tubes are available in 5, 12, 15, and 19-inch screen diameters.
- **Versatility**—variable size characters, positioned anywhere on screen.
- **Low replacement cost** — the generator is completely divorced from the CRT. For replacement, only the cost of a moderately-priced tube.
- **Speed** — electrostatically-formed and electromagnetically-positioned characters for greatest speed and accuracy.

If you use, or are considering the use of character display read-out—investigate display by cathode-ray tubes — *WRITE FOR COMPLETE DETAILS . . .*

DU MONT®

INDUSTRIAL TUBE SALES, ALLEN B. DU MONT LABORATORIES, INC., 2 MAIN AVE., PASSAIC, N. J.

BE SURE TO VISIT DU MONT AT THE IRE SHOW IN NEW YORK. BOOTHS 3705, 3707



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11-30

(*Continued from page 107*)

of the performance of radio systems for missile guidance, beyond-the-horizon microwave propagation, and numerous other uses of radio waves. Our knowledge of the nature of the propagation medium should be extended by making direct measurements of such things as the microstructure of the stratosphere up to at least 150,000 feet."

Anthony B. Giordano, Polytechnic Institute of Brooklyn—". . . major efforts are now in progress to broaden the microwave spectra and to develop efficient microwave transmission systems. Since these advances will strongly rely upon measurements, basically new approaches in microwave measurements are envisioned as well as renewed interest in extending and refining proven techniques."

A. B. Giordano

S. E. Miller

S. E. Miller, Bell Telephone Labs.—"As the radio spectrum becomes filled and as the communication needs of our country increase, millimeter waves and circular-electric waveguides should become of practical importance in our communication network."

Professor Joseph Weber, University of Maryland—"Progress continues to be rapid on low noise microwave amplifiers. The ferromagnetic parametric amplifier of Suhl and Weiss appears capable of giving lower noise performance at room temperature. The parametric amplifier principle is being applied to electron beams by Quate, and Louisell and also by Wade and Heffner, in a way which indicates that lower noise figure microwave electron tubes will be developed also. The coming year will see a more complete development of solid state Masers and the range of usefulness of the different approaches to low noise amplification should be better understood."

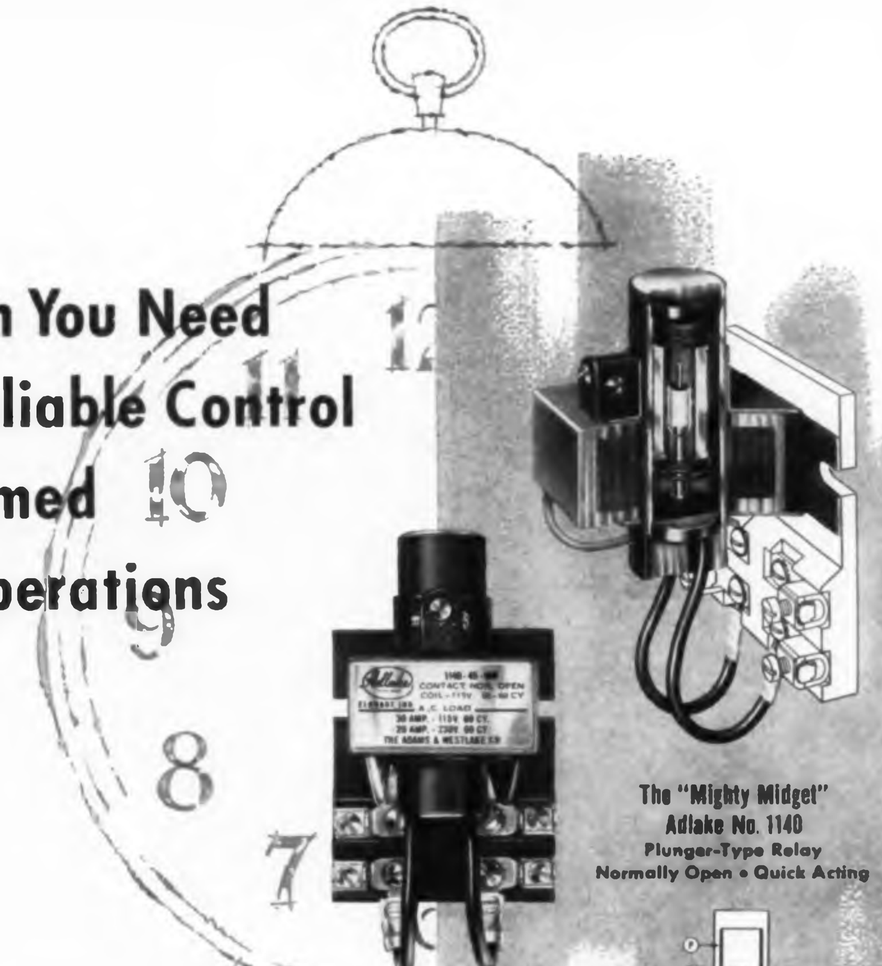
J. Weber

R. W. Peter

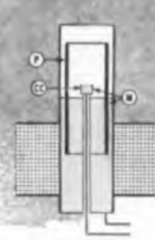
Rolf W. Peter, RCA Labs.—"With space travel and outer-space naviga-

(*Continued on page 134*)

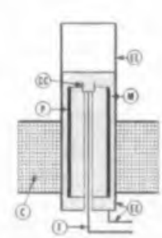
When You Need Reliable Control Of Timed Operations



The "Mighty Midget"
Adlake No. 1140
Plunger-Type Relay
Normally Open • Quick Acting



DE-ENERGIZED
Plunger P is floating in mercury M. External circuit is open because main body of mercury M is below lip of ceramic cup CC.



ENERGIZED
Coil C pulls plunger P down into mercury M. Mercury thus displaced completely covers ceramic cup CC filled with mercury. This establishes mercury-to-mercury contact between electrodes E and EE.

You Need

Adlake

mercury-to-mercury relays

List what you like and don't like in a switch, then see how Adlake meets your need:

- **Immune to vibration**
- **Perfect snap-action—no burning, pitting or sticking**
- **No intrusion of dust, dirt or moisture—hermetically sealed at the factory**
- **Time delay characteristics fixed and non-adjustable**
- **Quiet. Chatterless. Require no maintenance whatever.**

Our engineers will gladly help you with your control problems. No obligation. Just write the original and largest maker of plunger-type relays—THE ADAMS & WESTLAKE COMPANY, 1182 N. Michigan, Elkhart, Ind. • New York • Chicago

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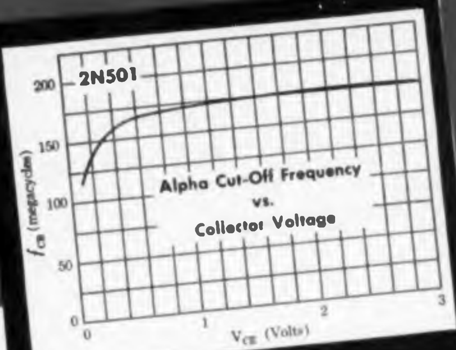
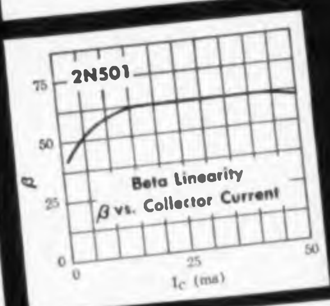
Circle 52 on Inquiry Card, page 101

Circle 53 on Inquiry Card, page 101 →

VHF Transistors! First From PHILCO





New family of Micro Alloy Diffused-base Transistors (MADT)*

- Rise, Storage, Fall Time in Low $m\mu$sec Range
- High Oscillator efficiency at 200 mcs
- Amplifier gains of 10 db at 200 mcs

MADT FAMILY APPLICATIONS DATA

TYPE*	f_{max}	Power Gain	Oscillator Efficiency	Class of Use
2N499	250 mcs (min)	10 db at 100 mcs	25% at 100 mcs (min)	oscillator and amplifier to 100 mcs
2N500			25% at 200 mcs (min)	oscillator to 400 mcs
2N501	Ultra high-speed switch typical $t_r = 12$ $m\mu$sec; (18 max.); $t_s = 7$ $m\mu$sec; (12 max.); $t_f = 4$ $m\mu$sec; (10 max.). In circuit with current gain of 10 and voltage turnoff.			
2N502†	500 mcs	10 db at 200 mcs		amplifier to 250 mcs
2N503†		11 db at 100 mcs(min.)		amplifier to 100 mcs
2N504	50 mcs	46 db at 455 KC		high gain IF amplifier

*Available in voltage ratings up to 35V and dissipation ratings to 100 mw.
†In JETEC TO-5 Case (widely known as JETEC 30 Case).

Here is a major breakthrough in the frequency barrier . . . a new family of *field-flow* Micro Alloy Diffused-base Transistors. Philco MADT's extend the range of high gain, high frequency amplifiers; high speed computers; high gain, wideband amplifiers and other critical high frequency circuitry.

MADT's are available to various voltage and frequency specifications for design of high performance transistorized equipment through the entire VHF and part of the UHF spectrum. These transistors range in f_{max} from 250 mc to as high as 1000 mc. MADT gains are typically 10 db at 200 mc and greater than 16 db at 100 mc. A low cost general purpose unit is available which will deliver typically 18 db at 50 mc and 32 db at 10 mc.

Make Philco your prime source of information for high frequency transistor applications.

Write to Lansdale Tube Company, Division of Philco Corporation, Lansdale, Pa., Dept. EI-358

*Trademark Philco Corporation for Micro Alloy Diffused-base Transistor

PHILCO CORPORATION
LANSDALE TUBE COMPANY DIVISION
LANSDALE, PENNSYLVANIA

TRANSISTOR CENTER U.S.A.

P-C CONNECTOR

To insure perfect alignment between printed circuit board and connector, the receptacle is furnished with floating bobbins which compensate for any misalignment. Available in 10, 15, 22 and 28 single row

contacts and 30 and 44 double row contacts. The self-alignment floating bobbins feature is optional. Even after 1,000 board insertions, the contacts exhibit good electrical characteristics. The contacts are located on 5/32 in. centers and will accommodate a 1/16 in. board. Viking Industries, Inc., 21343 Roscoe Blvd., Canoga Park 2, Calif.

Circle 227 on Inquiry Card, page 101

COUPLINGS

Metro-Flex Couplings allow new designs over a wide range of laboratory, military, and original equipment market applications. They will handle: angular misalignment of driving and driven shafts up to 5°; paral-

lel offset to as much as 0.010 in. and axial end play up to 0.090 in. They provide constant rotational velocity, transmit high torques up to 150 oz.-in., permit high speeds to 10,000 RPM, minimize backlash, provide high torsional rigidity and operate over a wide temperature range of −10°F to +250 F. Metron Instrument Co., 432 Lincoln St., Denver 3, Colo.

Circle 229 on Inquiry Card, page 101

ELECTROLYTICS

Type EC aluminum-foil electrolytic capacitors were specifically designed for transistor and "low-B" tube applications where compactness is an important design factor. The smallest case size is 0.187 in. in di-

ameter and ½ in. long, the largest size is 0.375 x 1½ in. They are available in ratings from 3 to 75 vdc working, and in capacitance from 1.0 to 250 mfd., depending on voltage ratings. Operating temperature range is —20°C to +65 C. They are housed in special tubular ceramic cases. Cornell-Dubilier Electric Corp., South Plainfield, N. J.

Circle 231 on Inquiry Card, page 101

VOM

The new volt-ohm-milliameters are available. Models 630-P1 and 630-AP1 stress easier reading and feature a clear, unbreakable, shadowless front for instant accurate vision. Other features include 5 to 500,000 cps response on ac; continuous reading from 0.1 ohms to 100 megohms; polarity reversing switch; single switch to select both circuit and range; volt-

age scales reading by 10's (2.5-10-50-250-1000-5000). Model 630-AP1 incorporates ½% resistors and a more accurate movement with a mirrored scale. Triplett Electrical Instrument Co., Bluffton, O.

Circle 228 on Inquiry Card, page 101

COMPUTER SWITCHES

The switches feature new type snag-proof rocker-actuators to prevent accidental operation. They are available in two key designs. Series "TP1" is flush mounted and has removable translucent plastic keys. Series "TP4" is mounted above flush and has removable transparent plastic keys. They feature integral terminal construction, coupled with a step-

design case for ease of wiring. Under a 30 vdc, resistive load, the single-pole "1TP" is rated at 30 a., the 2 pole "2TP" at 30 a. and the 4-pole "4TP" at 20 a. Micro Switch, Freeport, Ill.

Circle 230 on Inquiry Card, page 101

SERVO MOTOR

This tiny, low inertia servo motor has just been developed. It measures ½ in. in diameter by 1 19/64 in. long. It consists of a squirrel-cage rotor mounted on precision ball bearings, a two-phase stator and a stainless steel housing. While the motor illustrated incorporates a tapered shaft, similar units can be supplied with shafts designed for specific ap-

plications. Some characteristics of the motor include: size, 5 frame; weight, 0.94 oz.; fixed phase and control phase voltage, 26 v.; frequency, 400 cps. Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.

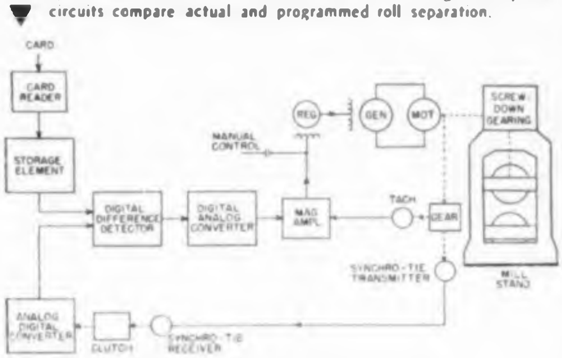
Circle 232 on Inquiry Card, page 101

Computer Controls Steel Mill

▲ In the Aliquippa Works of the Jones and Laughlin Steel Corp., a single IBM card controls all necessary variables in rolling a steel slab or strip. The Westinghouse automatic control system gives uniform production at the highest possible rate.

▲ Prepared beforehand, IBM cards are available for nearly every slab and strip size, and for each grade of steel.

Roll separation "screwdown," information is read from the punched card by the IBM card reader and transferred into storage. Computer circuits compare actual and programmed roll separation. ▼



In the background of the mill motor room are the memory and decision making portions of Westinghouse's Prodac (Programmed digital automatic control). Here, a Westinghouse engineer checks Prodac. ▼

An employee at the new 44-inch semi-continuous hot strip rolling mill marks identification on a coil of strip steel after it emerges from the down coilers. High uniformity results from automation. ▼

First fully automatic programmed reversing rougher is shown in operation at the Jones & Laughlin Aliquippa, Pa., works. Operator initiates each sequence, can regain manual control any time. ▼

Models S-10H and S-10L 2-Way System Consolettes

For use where space is most restricted. Only 25" x 14" x 14½" deep; removable base adds 1½". The new C-12HC 12" high compliance, low resonance woofer is employed with special UL/HC wide-angle tweeter (2500 cps crossover) and matched-level crossover network with high frequency balance adjustment. Takes power input of 25-60 clean watts. 8 ohms impedance. Extra-dense ¾" thick double-braced construction; beautiful natural grain, hand-rubbed finish. S-10H is upright model; S-10L, lowboy. User net: Mahogany—$139, Blond—$143, Walnut—$147.

MODEL S-10H

INCREDIBLE BUT TRUE!...

Here at last is luxurious "big system" performance from handsome, convenient-to-place enclosures that are *fully 40 to 80% smaller* than previously available systems of similar performance standards!

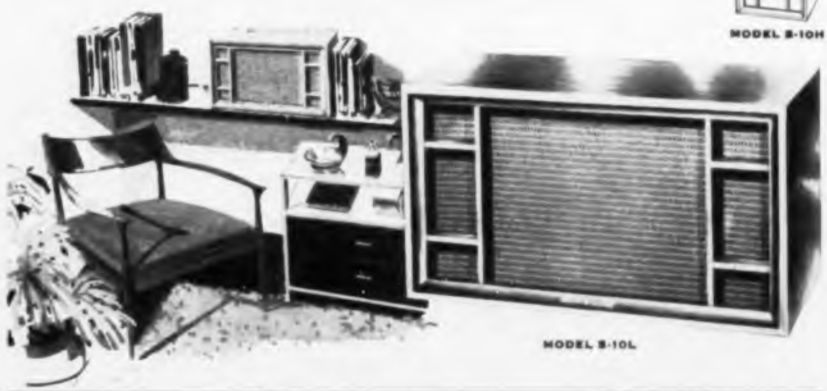
Here at last from a small-space system comes *authentic, distortion-free* bass reproduction that's effective at *low* volume as well as at higher levels.

Do NOT confuse University ultra linear response systems with other small units that offer an acoustic compromise. The S-10 2-way systems and S-11 3-way systems employ newly designed, specially high-compliant woofers, free from artificial resonances that "mask" bass deficiency. Mid-range and treble performance is balanced to assure completely flat response to beyond audibility

Though you will need about 20-25 clean watts to drive them, the S-10 and S-11 eliminate excessive power demands, especially on transient peaks. Hence, you get *cleaner* performance from them than from other similar type systems.

Yes, here is the "impossible" brought to miraculous tonal reality . . . small systems that leave *nothing* to be desired in musical performance . . . so faithful that you can listen hour after hour, relaxed, and without "ear fatigue."

Hear these systems now . . . at your dealer . . . and learn that finally there is a genuine answer to the problem of obtaining "big sound" in small space!



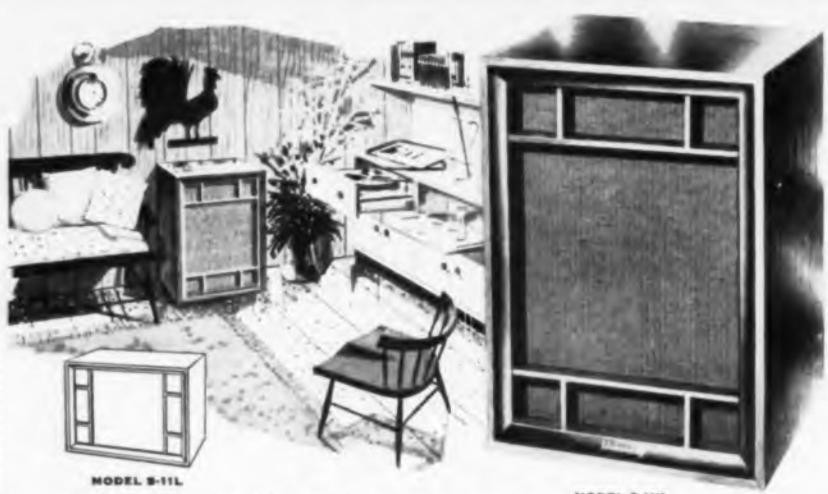
MODEL S-10L

NEW! *University*

ULTRA LINEAR RESPONSE SYSTEMS

Models S-10 and S-11

Protected by Patent Nos. 2,641,329; 2,690,231 and other patents pending

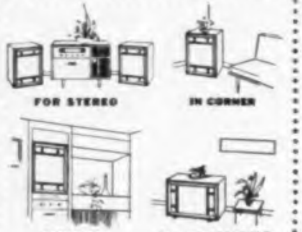


MODEL S-11L

MODEL S-11H

Models S-11H and S-11L 3-Way System Consolettes

Unusually small size is achieved by coupling University's new ducted annular relief enclosure to the new heavy duty high compliance 15" C-15HC woofer. Special HC-3 matched-level network with "Presence" and "Brilliance" balance controls integrates the Diffusicone-8 in its own compression chamber for mid-range (500 cps crossover) with special UL/HC Hypersonic Tweeter (2500 cps crossover) for response to beyond the limits of hearing range. Takes power input of 20-60 clean watts. 8 ohms impedance. Extra-dense ¾" thick double-braced construction, fine-furniture finish and styling. 26⅞" x 19½" x 17½" deep; removable base adds 2". S-11H is upright model; S-11L, lowboy. User net: Mahogany—$245, Blond—$249, Walnut—$253.



For complete technical story on the S-10 and S-11 ultra linear response systems as reprinted from Radio & TV News, write Desk P-6-2.

LISTEN *University sounds better*

UNIVERSITY LOUDSPEAKERS, INC., 80 SOUTH KENSICO AVENUE, WHITE PLAINS, N. Y.

SHIELDING

engineers largest rf shielding enclosures ever built......

AN INSIDE VIEW DURING CONSTRUCTION OF A VERTICAL TEST CELL USED BY THE MARTIN COMPANY DENVER DIVISION FOR MISSILE TESTING.

TYPICAL SHIELDING "UNIVERSAL" RF SHIELDING ENCLOSURE

Shielding, Inc. has just completed the engineering of what is believed to be some of the largest RF enclosures ever built. These giant, many stories high shielding rooms incorporate vertical test cells for testing some of America's most strategic missiles in an area free of RF interference. Shielding, as a major contractor and erection supervisor for this project, worked in close conjunction with some of the leading industrial construction firms.

Shielding, Inc. was awarded this contract because Shielding's engineers have specialized in the design and construction of RF shielding enclosures for the electronic and avionic industries for over a decade . . . and has the experience and know-how to fill any RF shielding requirement from the smallest to the largest. A typical Shielding enclosure is shown at left which offers the highest shielding effectiveness and incorporates the latest in mechanical and electrical design features.

If you are faced with RF interference problems, Shielding can solve them. Write for Brochure #581 which outlines Shielding's capabilities.

SEE US AT BOOTHS 1114-1115 IRE SHOW

SHIELDING, INC.

63 N. READE AVE., RIVERTON, N. J.

CHICAGO — R. EDWARD STEMM • DENVER — WILLIAMS & ASSOCIATES • LOS ANGELES — CARL A. STONE ASSOCIATES, INC.
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Circle 54 on Inquiry Card, page 101

Tecnetron

(*Continued from page 79*)

the following performances are representative.

At a frequency of 110 MC, the gain reaches 22 db for a bandwidth of 1.7 MC.

At a frequency of 200 MC, the gain reaches 16 db for a bandwidth of 6 MC.

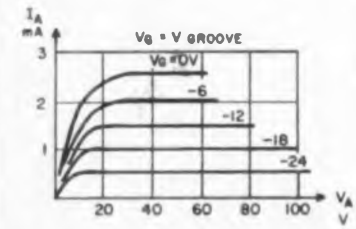


Fig. 4: The anode characteristics of the Tecnetron resemble those of pentode tubes.

At a frequency of 430 MC, the gain reaches 9 db for a bandwidth of 30 MC.

The dissipated power is 125 mw, and the output power is 30 mw in class A.

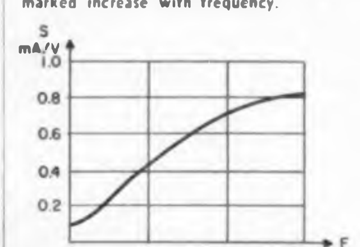
Development is being pushed, and samples have already been produced which provide at 500 MC a gain of 9 db over a bandwidth of 30 MC.

Immediate future possibilities are working frequencies of the order of 1,000 MC and powers of several watts.

Production

For the time being, the Tecnetron is machined by ultrasonics. Mass production will probably use a multiple hole matrix to provide the bodies. Then the cylinders will be cut, and the groove will be obtained by electrolytic etching followed by indium deposition, in a process somewhat akin to surface barrier transistor production methods.

Fig. 5: Amazingly, mutual conductance shows marked increase with frequency.



Circle 56 on Inquiry Card, page 101

WASHINGTON

News Letter

RADIO'S IMPORTANCE TO NATION—"Radio is in use and affects the most commonplace occurrence in everyone's life," FCC Chairman John C. Doerfer told the House Interstate Commerce Committee's legislative oversight subcommittee recently. The FCC chieftain stressed to the Congressional body that, "although publicity spotlights the broadcasting (television) portion of our work, by far the greatest number of our licensees serve the public in indirect and unseen ways." He reported to the House subcommittee that the FCC at present has outstanding around 380,000 authorizations covering the use of about 1,170,000 radio transmitters in the United States. Around 65,000 of these transmitters are for marine use, about 63,000 for aviation, more than 300,000 used by railroads, buses, taxicabs, trucks, and other land vehicles, over 325,000 by petroleum, electric power and other industrial stations, more than 240,000 by police and fire departments, highway maintenance, forestry conservation, etc., around 160,000 by amateurs, and broadcasting (AM-FM and TV) about 5,000 transmitters.

GOVERNMENT-CIVILIAN USE — The spectrum is divided about 50-50 between government and civilian radio services, FCC Commissioner T. A. M. Craven informed the House Subcommittee. The engineer FCC Commissioner brought out that the Commission in its negotiations and relations with the government agencies, particularly the military services and the Civil Aeronautics Administration, demanded information that the military and CAA radio requirements be justified as "absolutely essential" so as not to take away any spectrum assignments made to non-government (civilian) services. The FCC deals with the other government agencies through top-level officials of the Office of Defense Mobilization, he cited.

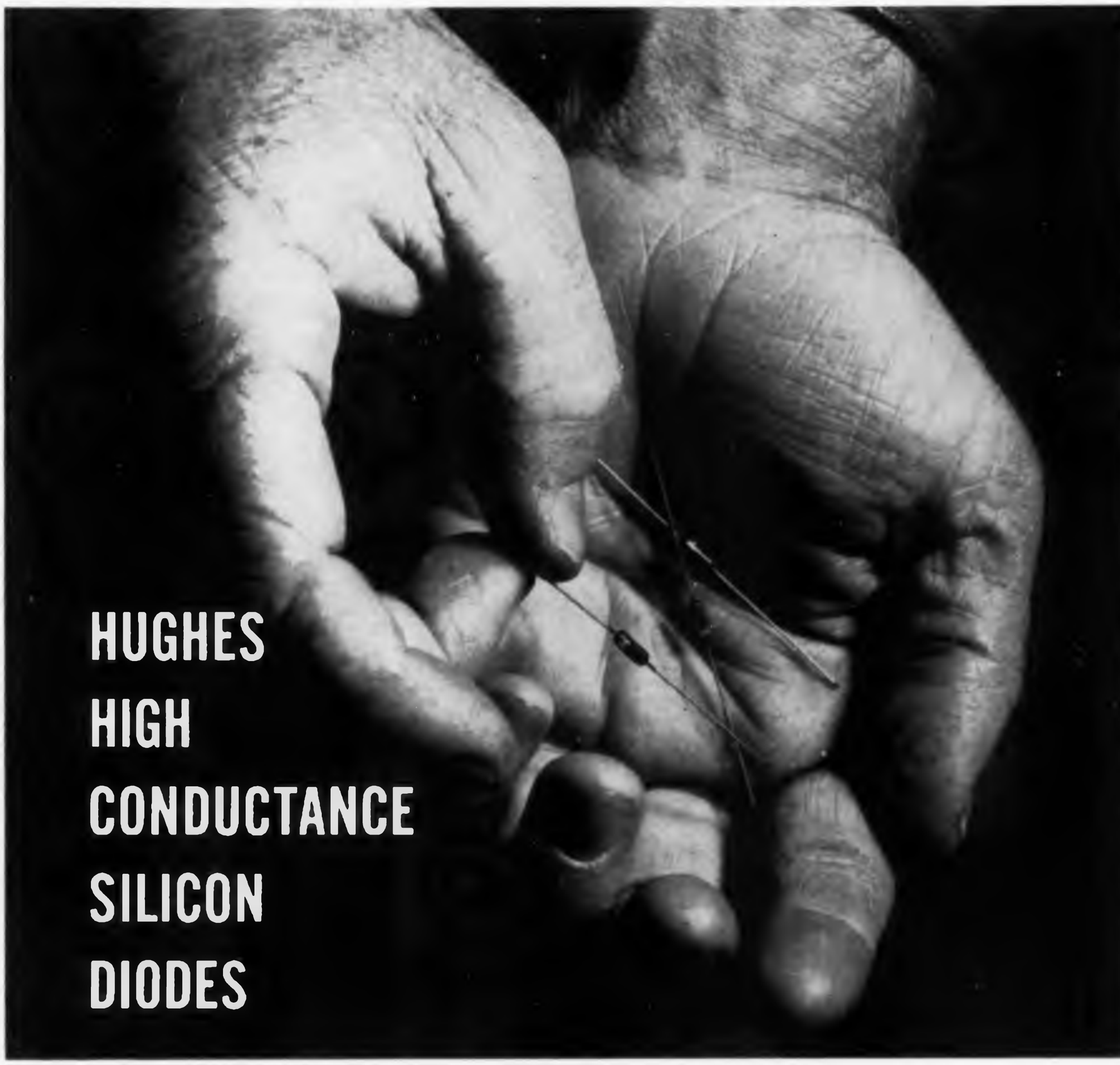
DEFENSE EXPENDITURES—Of the 2.41 billion in new obligational authority asked for the Defense Department in the fiscal 1959 budget—plus the supplemental $207 million for all 1958 fiscal procurement which has been approved by Congress last month for all procurement other than aircraft, missiles and ships—around half of the combined funds are for electronics and communications equipment. Included in the new defense fund requirements are "new and vastly more powerful equipment for the new ballistic missile detection system now under accelerated development, and equipment for the further improvement and extension of the existing continental air defense warning systems—SAGE, Missile Master, and the newly-developed frequency diversity radars." The budget message, which compares the 1959 fiscal year with 1955, brought out that expenditures for missiles, which requiring large quantities of communications and electronic items, will be 360% higher.

CONGRESS AND PAY TV—Because of the rising tide of opposition to subscription television, Congress was slated to throw up a road block against the FCC's pay-TV program tests plan. Both the Senate and House Interstate Commerce committees which handle FCC legislative matters had preponderant majorities against the test proposal as not in the best interest for television's future. It was anticipated that there would be no legislation by Congress against the pay-TV test plan, but the Senate and House committees would enunciate their viewpoints that this should not be launched by the Commission at the present time.

MINOR FCC EXPANSION—With a request for $8,950,000 in the fiscal 1959 budget, started July 1, as compared with $8.3 million being spent in the current fiscal year, the FCC will have some increases in all its activities provided Congress approves its appropriations program for its broadcasting—television work, the 1959 budget calls for $1,730,463 as compared with the current appropriation of $1,638,-373. Safety and special services requested $992,437 against this year's fund of $889,966, and to maintain its key assignment of preventing interference the FCC field engineering and monitoring division requested a $300,000 increase with the 1959 fiscal of $2,870,139 as compared with the current $2,576,853 appropriation. It is generally felt that Congress will approve, despite the current economy tide, the increased FCC funds in recognition of the Commission's important work in these fields.

AIR NAVIGATION BOOST—The fiscal 1959 budget for the Civil Aeronautics Administration calls for $175,000,000 for establishment of air navigation facilities against $124,603,525 appropriated for the current 1958 fiscal year. The program lists $38,320,000 for VORTAC; $4,200,000 for instrument landing systems; and under enroute traffic control aids $25,623,-000 for long range radar; $21,854,000 for air route traffic control centers; $6,181,000 for air traffic communications stations; $1,889,000 for international air traffic communication stations; and $16,833,000 for terminal air radar. With jet flying "around the corner," it is anticipated that CAA is likely to gain Congressional approval for this improved air navigation plan.

National Press Building — *ROLAND C. DAVIES*
Washington 4 — *Washington Editor*



Hughes, many years a leader in the semiconductor industry, has added another series to its expanding line. These new units can withstand temperatures as high as 200 C while sustaining all the important features your circuits demand:

- high forward conductance
- high reverse voltage
- low dynamic forward resistance
- high back resistance at high temperatures and/or high voltages

They are quality diodes, rugged and reliable like all Hughes diodes. And each is packaged in Hughes' famous glass envelope, designed for complete protection from contamination and moisture penetration. Maximum body dimensions: .107" x .265".

Special types are available, too. Perhaps you have a design with unique requirements and can't find the right diode for the job. If so, ask for a call from one of our sales engineers or visit our booth at the IRE show this month. Either way, we would be pleased to discuss your requirements.

Type Number*	Max. Forward Current @ +1 Volt	Max. Rated Average Forward Current @ 25°C	Max. Rated Average Forward Current @ 150°C	Max. Inverse Current @ 25°C	Max. Inverse Current @ 150°C	Max. Inverse Current Test Voltage	Max. Rated Inverse Operating Voltage
1N482B	100mA	200mA	50mA	025μA	5μA	30V	36V
1N483B	100mA	200mA	50mA	025μA	5μA	60V	70V
1N484B	100mA	200mA	50mA	025μA	5μA	125V	130V
1N485B	100mA	200mA	50mA	025μA	5μA	175V	180V
1N486A	100mA	200mA	50mA	050μA	25μA	225V	225V
1N487A	100mA	200mA	50mA	.100μA	25μA	300V	300V
(*Lettered and unlettered versions not listed are available.)							
Hughes has related types with higher forward currents. Here are three of the many which could be listed:							
HD6764	200mA	200mA	50mA	.025μA	5μA	60V	70V
HD6768	200mA	200mA	50mA	.025μA	5μA	175V	180V
HD6773	200mA	200mA	50mA	.025μA	5μA	300V	300V

For printed literature, please write: Semiconductor Division, HUGHES PRODUCTS, International Airport Station, Los Angeles 45, California

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

HUGHES SEMICONDUCTORS

 Circle 57 on Inquiry Card, page 101

A NEW, SOUND, LOGICAL CONCEPT

IN A DIRECTORY

*A Directory **Plus** Engineering Reference Material*

That's the editorial concept built into the new EI annual directory now being prepared. The 16th edition of the Electronic Industries Directory to be published in June will contain extensive engineering reference material in addition to the regular product listings. It's being designed for constant reader recall and reference.

So plan now for a multiple page ad in the June issue! Your catalog ad will sell twice as hard in the next 12 months because readers will be using the Electronic Industries Directory not only for product information, but also for the important electronic engineering reference material that this issue contains.

Write, wire, or phone your space reservations now! EI's Annual Directory is published as a *regular monthly issue* and earned space rates apply.

CLOSING DATE MAY 1st 1958

EI has more electronic O.E.M. circulation than any other publication

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Telemetering

(*Continued from page 59*)

transition from saturation to saturation, etc.

With these basic functions, the general techniques of the earth satellite telemetry system may now be described in terms of a six-channel telemetry system. Output signals after electrical clipping to provide uniform pulse heights are as shown in Fig. 3 for one "frame" or scan of all channels. Upon completion of each frame, a subsequent frame is presented, differing from the previous frame only as required to reflect changes in the input parameters. Such a system carries two information channels in the form of high-frequency bursts, two information channels in the time intervals during which these bursts appear, and the remaining two channels in the intervals between bursts, as shown. The switching signals from the time-interval channels gate the high-frequency channels and switch from one input to the next by means of switching transistors.

IRE Show

(*Continued from page 95*)

and "wow," and has wide band performance.

On Wednesday afternoon the paper "A Solid State Analog-to-Digital Conversion Device" presented by M. Palevsky of Packard-Bell Computer Corp. should be of interest to all computer engineers. A high speed completely solid state analog-to-digital conversion device that is accurate to 0.01% is described. This device employs a new switching scheme.

Both ultrasonic equipment manufacturers and users should find the panel discussion, "Problems in Power Measurement," on Thursday afternoon a must. Many problems arise in the measurement of power radiated by the ultrasonic transducers. Knowledge of the acoustic energy present in the sound field is important to both groups. As an example, one current problem is the determination of the intensity of the ultrasound in a confined vessel such as a cleaning tank. Such problems and their possible solutions will be discussed.

Explorer

(*Continued from page 57*)

ternational Geophysical Year program, Explorer was proving of immensely more value than the Russians' satellites. Within hours of the launching all countries participating in the IGY were furnished with codes to decipher the telemetering messages being transmitted by the satellite. A strong, clear signal was being transmitted on 108 MC furnishing information on temperatures, cosmic ray radiation and meteorite impacts to tracking stations.

Estimates of the satellite's life varied considerably. IGY officials said they expected "a relatively long life." Army scientists predicted a life span of at least several months.

PDM/FM

(*Continued from page 81*)

carrier power (excluding the side-band power) and the same noise per unit bandwidth in the carrier channel. This ratio is called the wide-band gain and devoted by R_w.

In a PDM/FM system, R_w is proportional to the square root of the video bandwidth if the carrier deviation is held constant. However, the carrier threshold is also proportional to the square root of the video bandwidth. Thus, any improvement of the wide-band gain is accomplished at the expense of an increased threshold level.

Bandwidth

It can be shown that the video bandwidth which maximizes the wide-band gain, subject to 60 db crosstalk suppression, is equal to $13nf$, or 11.7 KC.

The ability of a system which uses narrow passbands for data transmission to reliably measure time intervals down to microseconds is based upon a fundamental concept. The bandwidth necessary to transmit a video pulse is determined by the rise and decay time of the pulse. This bandwidth is approximately given by $BW = 1/2t$, where t is the rise or decay time of the pulse.

(*Continued on page 128*)

NEW

OHMITE®

HIGH STABILITY
FOR —55°C to + 85°C OPERATION
HIGH CAPACITANCE
SUBMINIATURE SIZES
LONG SHELF LIFE

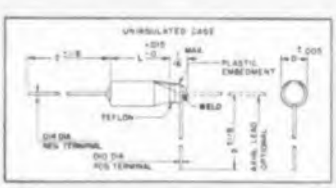
"TAN-O-MITE®" TANTALUM CAPACITORS

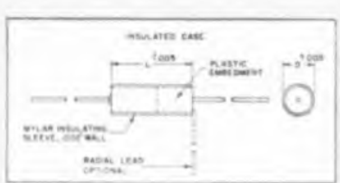
SERIES TW WIRE-TYPE TANTALUM CAPACITORS

These new subminiature, wire-type units feature greater capacitance per unit volume, lower leakage current and power factor, and small capacitance drop at extremely low temperatures as compared to other types of electrolytics. Ultrasmall for low-voltage DC transistorized electronic equipment, these new tantalum capacitors have *high stability, high capacitance, long shelf life, and excellent performance* under temperature extremes of —55°C to + 85°C. Available in eight subminiature sizes; 0.1 to 80 mfd. over-all capacitance range.

	UNINSULATED		INSULATED	
SIZE	D (Inches)	L (Inches)	D	L
*T	.075 (5/64)	.156 (5/32)	.082	.203
*S	.075 (5/64)	.187 (3/16)	.082	.234
*M	.095 (3/32)	.172 (11/64)	.100	.218
*A	.095 (3/32)	.250 (1/4)	.100	.312
*B	.125 (1/8)	.312 (5/16)	.134	.375
C	.125 (1/8)	.500 (1/2)	.134	.562
D	.125 (1/8)	.625 (5/8)	.134	.687
E	.125 (1/8)	.750 (3/4)	.134	.812

Smallest size is .075 (5/64) x .156 (5/32) inches; the largest is .125 (1/8) x .750 (3/4) inches. Five stock sizes (*) are available in a wide range of capacitances and voltages. Units insulated with a tough Mylar® plastic sleeve can be furnished. *Write on company letterhead for Bulletin 148B.*





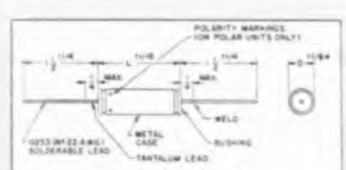
SERIES TF FOIL-TYPE

These capacitors are tantalum foil, electrolytic units designed for low voltage AC and DC applications where small size, top performance, and stability of electrical characteristics are required. Units feature unusually long shelf and operating life.

CASE SIZE	D*	L*
J	3/16"	1 1/16"
K	9/32"	7/8"
L	3/8"	1 7/16"

**Add 1/16" to L and 1/32" to D when insulating sleeve is used.*

Three sizes now available; .25 to 140 mfd. over-all capacitance range. Standard tolerance is ±20%. Working voltage up to 150 volts. Polar and nonpolar units are available. *Bulletin 152.* Design and construction meet military specification MIL-C-3965, paragraph 3.3.



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VARIABLE TRANSFORMERS

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3662 Howard Street, Skokie, Illinois

Circle 63 on Inquiry Card page 101

(*Continued from page 126*)

It is apparent that if true pulse fidelity were required, the narrow bandwidths available would be completely unsuitable. Since reference pulses are transmitted through the telemetry system which are an accurate comparison for the 0 and 5 volt data input limits, these pulses will be degraded by the bandpass limitations in identically the same fashion that pulses from the data channels which will have random amplitudes within the 0-5 volt range will be degraded. The absolute value of width of pulse is used to indicate the ratio of the width of the data pulse to the width of the known reference pulses occurring in the same frame of data.

Since each frame will require approximately 1/900 second, any slowly changing system error will have little effect on any one frame, and in any event, can be calibrated out. Rapid, transient changes occurring substantially less than one frame time are those changes which will introduce random errors and adversely affect the system accuracy. Past experience has shown that rise and fall times as poor as 100 μsec were tolerable, and at the same time maintaining system accuracy of ±2 μsec. The restricted bandwidth will limit the minimum pulse width that the system may pass. The minimum pulse duration (for zero level data) will be 90 ± 30 μsec.

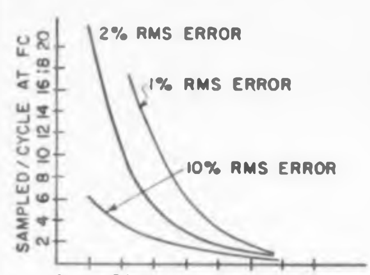

Fig. 3: Summary of sampling error data.

It has been found from actual operating tests that there is a distinct and rapid performance deterioration when the rise time is greater than approximately 70% of the shortest pulse transmitted through the system.

SENSITIVITY:

100 μVOLTS

PER SCALE DIVISION

(without pre-amplification)

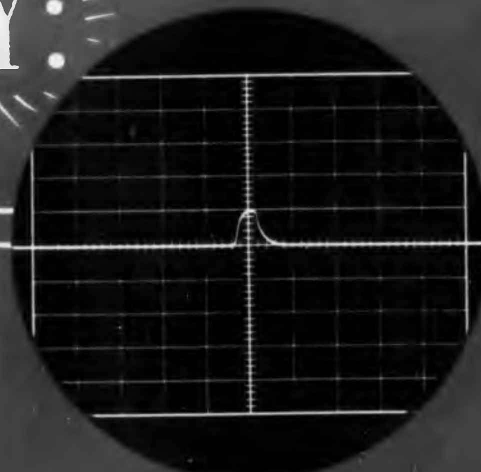

PHOTO REDUCED 33%

DU MONT 403

The Du Mont 403 is the most sensitive oscilloscope commercially available. This outstanding sensitivity permits direct measurements from low output transducers such as strain gages, pressure pickups, accelerometers, heart monitoring equipment, and others that normally require pre-amplification.

The 403, when used as a direct-reading voltmeter, offers full scale amplitude measurements from 1 millivolt to 500 volts, continuously variable in 17 steps. At maximum sensitivity, the 403 allows resolution of signals in the region of 20 microvolts.

Stability, commensurate with this outstanding sensitivity, is another feature of the 403.

The 403 is another in the Du Mont 400 Series Instruments. It is designed for fast, easy, and accurate measurements, along with complete accessibility and reliability.

One of the 400 Series

FEATURING

AMPLIFIERS: Direct coupled amplifiers. Single-ended or balanced Y-input.
EXTREME SENSITIVITY: 1 millivolt to 500 volts full scale, continuously variable.
FREQUENCY RANGE: DC to 300 KC.
Y AMPLIFIER CALIBRATION: 5%.
SWEEPS: 19 calibrated linear sweeps, 0.5 sec/cm to 0.5 μsec/cm. Calibrating accuracy, 5%.
EXPANDED SWEEP: Any 10 cm portion of 50 cm sweep may be expanded 4 times and positioned on screen.

$580

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DU MONT®

INSTRUMENT DIVISION
Allen B. Du Mont Laboratories, Inc., Clifton, N. J., U.S.A.

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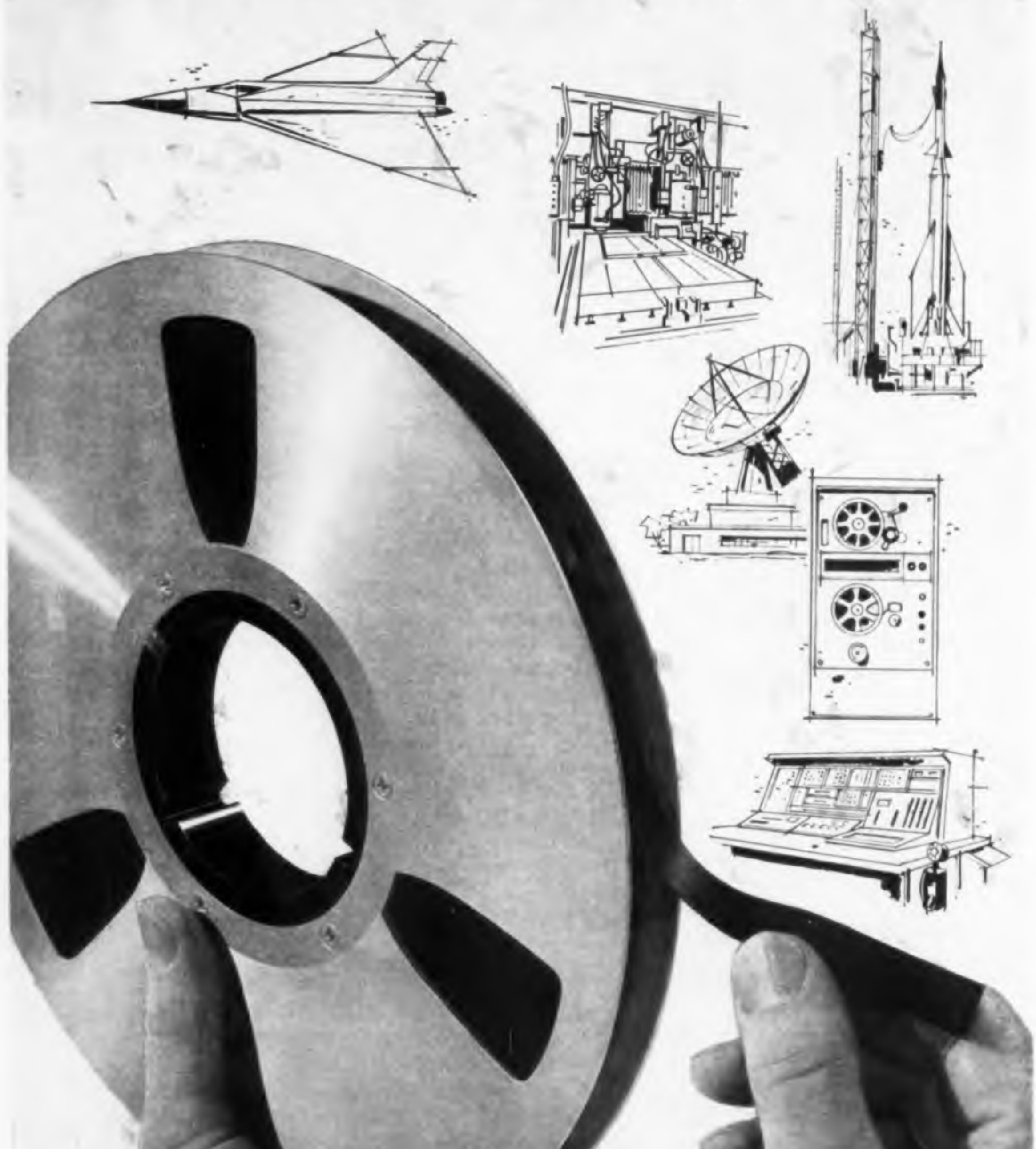
TAPES YOU CAN



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Instrumentation Tapes assure absolute dependability inch after inch . . . reel after reel

You can't afford to compromise with accuracy, reliability and uniformity in critical recording work – instrumentation, computers, machine tool control and other technical applications. You need a magnetic tape of *proven* instrumentation quality, "SCOTCH" Brand Magnetic Tape.

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PHYSICAL AND MAGNETIC PROPERTIES OF "SCOTCH" BRAND MAGNETIC TAPES — INSTRUMENTATION QUALITY




Tape Number	108	109	128	159
Description	Standard Instrumentation	Standard Instrumentation	Hi-Output Instrumentation	Extra Play Instrumentation
Physical Properties				
Backing Material	Polyester	Acetate	Polyester	Polyester
Thickness in mils				
Backing	1.45	1.42	1.45	.92
Coating	.55	.55	.65	.35
Ultimate Tensile Strength ¼" Wide — Room Conditions	9#	5.8#	9#	7#
Yield Strength 5% Stretch in ¼" Width	5.4#	4.5#	5.4#	3.8#
Elongation at Break	100%	25%	100%	100%
Coefficient of Friction	0.33	0.33	0.30	0.33
Residual Elongation	0.5%	1.5%	0.5%	0.5%
Slitting Tolerances	+.000 ins. —.004 ins.	+0.0% —0.8%	+.000 ins. —.004 ins.	+.000 ins. —.004 ins.
Toughness				
Tear — grams	26	3	26	12
Impact — Kc — cms	100	20	100	70
Coefficient of Expansion* Humidity (units per % RH change)	1.1×10^{-5}	15×10^{-5}	1.1×10^{-5}	1.1×10^{-5}
Temperature (units per °F.)	2×10^{-5}	3×10^{-5}	2×10^{-5}	2×10^{-5}
Temperature Limits for Safe Use				
Low	—40°F.	—40°F.	—40°F.	—40°F.
High	+140°F.	+140°F.	+185°F.	+140°F.
†Relative Wear Ability	100%	100%	250%	100%
Magnetic Properties				
Intrinsic Coercivity (Hci) Oersteds	250	250	240	240
Retentivity (Brs). Gauss	700	700	1100	1100
Remanence (Flux lines/ ¼" tape)	0.6	0.6	1.2	0.6
Relative Output in db at 1% distortion** 15 mil Wave Length	0	0	+6	0
Relative Sensitivity in db**				
15 Mil Wave Length	0	0	+3.5	+1.5
1 Mil Wave Length	0	0	0	+3.5
Erasing Field	1000	1000	900	800
Uniformity at 15 Mil Wave Length				
Within a Roll	±3%	±3%	±3%	±3%
Roll to Roll	±10%	±10%	±10%	±10%
Dropout Count*** Errors/1 Roll	1	1	1	1

*These coefficients are unitless and represent the change per % RH or degree Fahrenheit over the following ranges:
Humidity 20% RH to 80% HR
Temperature –30°F to +130°F

**At optimum bias for each tape type

***Measured by recording 200 non-return pulses per inch on a 0.035" track. A reduction to less than 50% normal signal amplitude constitutes a signal error. Zero errors are measured by saturating the tape undirectionally. Each spurious signal greater than 10% of normal signal amplitude constitutes a zero error. Errors per roll based on recording 7 tracks on rolls ¼" x 2500'.

†Relative wear ability is considered as 100% for 109 Tape. Relative output is established by 100 which is designated as zero. All other tapes are expressed as gradations from this reference point.

FREE BOOKLET! Get all the facts about America's most complete line of instrumentation quality tapes. Mail this coupon for your free specification catalogue.

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Circle 66 on Inquiry Card, page 101

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J. B. Russell, General Electric Co.—

TELEMETRY

NOW!

A FULLY-ADJUSTABLE, ULTRA-SENSITIVE RELAY

WESTON'S NEW LOW-COST SENSITROL RELAY PROVIDES A WIDE RANGE OF OPERATING VALUES

Weston introduces another important 'first': an all-purpose, fully-adjustable, sensitive relay. Available from stock and at low cost, it greatly simplifies many of the problems of engineers, designers and builders of alarm or control devices.

In breadboard circuits, the new SENSITROL relay makes it unnecessary to pinpoint electrical operating values through elaborate calculations or measurements. A single, movable contact adjuster provides an almost infinite number of accurately repeatable settings. In production equipment, the SENSITROL can eliminate the need for stocking a variety of relays.

A pair of SENSITROLS connected in opposition can provide close high-low control, adjustable over a wide range. The new relay can also be used for continuous pulsing control, or in a sensing control circuit to hold variables such as temperature, voltage or light level constant within very narrow limits.

SENSITROL relays contain built-in, re-set mechanisms and feature locking magnetic contacts. They can be set to close at any value of D-C from 5 to 50 micro-amps, or a comparable millivolt span of 10 to 100 . . . and will handle 100 milliamps at 120 volts A-C without chatter.

For complete information, contact your local Weston representative, or write to Weston Instruments, Division of Daystrom, Inc., Newark 12, N. J. *In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 10, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.*

WESTON
Instruments

A DAYSTROM UNIT

IRE Fellows Predict

(*Continued from page 110*)

tion and communication becoming realities, new vistas are opening for microwave electronics. The distances to be bridged by radio signals will be increased enormously. Fortunately, however, there will be no attenuation of the radio waves due to atmospheric absorption and the background noise level in outer space is exceedingly low. These new conditions will necessitate various changes. Shorter and shorter waves will be employed, to make use of both increased antenna gains and available frequency bandwidths. The incentive will grow to bridge the gap between the shortest microwaves and far-infrared waves, ultimately with coherent infrared generators and amplifiers. Ultra-low-noise microwave amplifiers will become a prime requisite, as much or more so than higher-power transmitters. In the future many of these microwave devices will be based upon electronically active solids. Gradually, some of the functions previously performed by vacuum and gas tubes will be taken over by solid-state devices up to higher frequencies."

Dr. Dean A. Watkins, Stanford University—"I predict that the great advances required of microwave systems by the rapid development of modern weaponry will be made through great strides forward in the field of microwave electron devices of both the solid-state and vacuum variety. Improvements in receiver sensitivity of 20 db. or more will be achieved with solid-state or electron-beam devices or both. Improvements in average power of factors of ten to one-hundred can be expected from electron tubes accompanied by bandwidths and instantaneous tuning ranges measured in thousands of megacycles. Power-tube efficiency will begin to approach 100%. At the same time these devices will improve in cost, weight, size, and reliability."


D. A. Watkins


A. C. Hall

MILITARY

A. C. Hall, The Martin Co.—"We have now gained the appreciation that most weapon systems are closed loop systems and have extended feedback theory to the point that it is a large factor in all modern weapon system analysis. We can expect to see this concept continue to grow in usefulness in the future."

J. B. Russell, General Electric Co.—"One of the most promising fields is that of solid state devices. Such new devices, particularly multi-functional devices, coupled with the development of new techniques and applications may well provide the breakthrough so badly needed in military electronics in the next few years."


J. B. Russell


R. L. Garman

SEMICONDUCTORS

Dr. R. L. Garman, General Precision Equipment Corp.—"The recent strides which have been made in transistors, etc., as a result of the pioneering efforts made by Dr. William Shockley and his group at Bell Telephone Laboratories will seem minuscule in the future by comparison to the developments which are now being investigated, for the most part without government support, by our leading laboratories in the field of low signal to noise amplification at all frequencies."

TELEVISION

J. B. Epperson, Scripps-Howard Radio—"Being currently active with TASO, the Television Allocations Study Organization, through MST, the Maximum Service Telecasters—one of the TASO sponsors—I predict that the year 1958 will see a great amount of informative and useful data handed over to FCC. In fact, MST has already made available to TASO the results of two important field propagation studies giving measured comparisons between UHF and VHF field strengths, made at Wilkes-Barre, Pa., and at Baton Rouge, La."


J. B. Epperson


W. Y. Pan

Wen Yuan Pan, RCA—"The importance of television to every-day living will continue to grow, as television is now being utilized for many new services other than entertainment. Reliability and convenience appear to be the criteria of television design, particularly for the new services."

TELEMETRY

Conrad H. Hoeppner, Radiation, Inc.—"Progress in telemetry is being made on all fronts. Improved pickups, transmitters, transmitting and receiving antennas, receivers, pulse code modulation techniques, and data processing equipment will be the highlights of new advances. The use of the general purpose digital computer for the analysis and processing of data will become extremely widespread. Faster methods of plotting and printing the analyzed data are still required for the reliable transmission of data over the wire line or radio links to diversified centers of analysis. We are entering a new era to be characterized by vast quantities of precise measurements and we must meet the challenge by producing automatic equipment and techniques to do the job."


C. H. Hoeppner


J. C. Seddon

J. Carl Seddon, Naval Research Lab.—"The increasing emphasis on long-range missiles and long-life satellites will bring even greater demands for more information about the earth's outer atmosphere. The sounding rocket, both orbiting and non-orbiting, will provide benefits of both a military and non-military nature. In the latter category will be improved weather predictions and hurricane warnings."

TIME

Dr. Eduard A. Gerber, U. S. Army Signal Engineering Labs.—"Devices with frequency stabilities in the order of one part in 10^9 are already available, but I foresee in the years to come that stabilities in the order of


E. A. Gerber


W. A. Marrison

one part in 10^{11} and better will be required and obtainable through im-

(*Continued on page 180*)

Tele-Tech's ELECTRONIC OPERATIONS

The Systems Engineering Section of ELECTRONIC INDUSTRIES · March 1958

In This Issue:

Scatter Transmission At 2000 MC 02

DuMont Laboratories has constructed a 124-mi. scatter link between Cedar Grove, N. J. and Somers, Conn. to study the effects of tropospheric scatter and line-of-sight communications. Here are details on the equipment.

FM Automobile Radios? 012

There are a number of good technical reasons why FM should be difficult in autos, but actually, as these tests show, the reception, in terms of fading, frequency response and signal strength offers significant advantages over AM.

SYSTEMS—WISE . . .

FREQUENCY STANDARD

Antenna structure used by NBS Boulder Labs for experimental standard frequency broadcast at 60 MC. Five 125-ft poles support the wires of the antenna. At the center pole is located the tuning house.

Biophysicists are already looking forward to the day when electronic diagnosis of medical patients will be possible. A combination of detecting instruments and computers will be necessary.

New radar sets, forty of them, have been purchased from Raytheon to replace ancient sets in the Military Sea Transportation Service. The new Mariner's Pathfinder 1402 has a range of from 35 yards to 40 miles.

Even painting is being electrified! The latest gimmick is electrifying tiny paint droplets as they are sprayed. This creates an attraction between the droplets and the metal part being sprayed. Result is better coverage, less waste paint.

Deck officers training at the U. S. Merchant Marine Academy are receiving instruction in the use of radio teleprinters, valuable aboard ship for weather maps and other printed data.

Ham radio is in constant use keeping polar expeditions in touch with the rest of the world. Recently, expeditions in the Arctic and in the Antarctic have even communicated directly with one another.

Radio broadcasters are moving ahead with plans to use the Conelrad signal for emergency storm and flood warnings. This brings to the public a powerful new service on the part of radio broadcasting.

Five years ago, Japan had one TV station and 866 registered receivers. Now, the nation has 68 stations, and nearly 700,000 receivers.

A handy slide rule for calculating the remaining portion or final broadcast date of any time or talent contract just showed up in our mail. They are being distributed by Caldwell Ltd., 447 Jarvis St., Toronto 5, Ontario.

Mobile radio is becoming a must for almost every kind of business. Now we hear that the Dime Savings Bank of Brooklyn has begun saving time and money by installing RCA mobile radios in their field appraisers' cars.

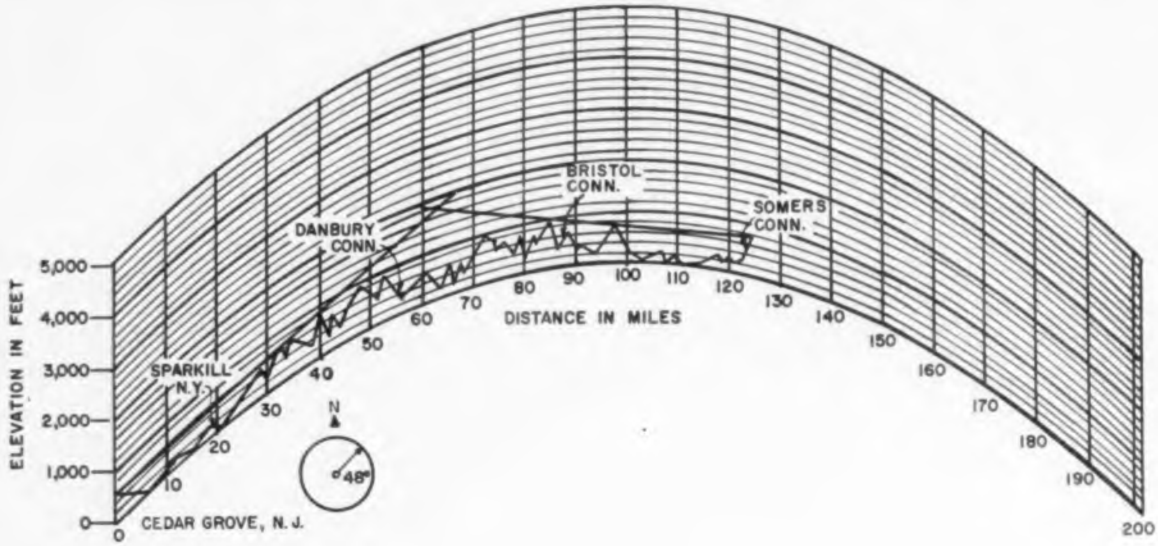


Fig. 1: Profile and field strength vs. distance for the scatter link between Cedar Grove, N. J., and Somers, Conn. The curvature is based on 4/3 earth radius.

Forward Scatter . . .

THE increasing importance of the 2,000 MC region prompted the Research & Development Div., Allen B. Du Mont Laboratories, to establish a 2180 MC communications link between Cedar Grove, N. J. and Somers, Conn. The path length is 124 miles. This program operates under the call letters KE2XSV, assigned by the FCC, and carries 72 voice channels.

The objectives are primarily to gain more knowledge of propagation, including scatter techniques, in the 2180 MC range. Different forms of modulation are being evaluated and field strength vs. time measurements made.

Secondly, experience was desired in the design and manufacture of 2,000 MC equipment for line-of-sight and tropospheric scatter communications, especially transmitters, receivers, diversity aspects of reception, antenna systems and multiplexers.

Transmitting Site

Cedar Grove was chosen as a transmitting site for the system because it offered many potential paths for the propagation investigations contemplated. From this location a parabolic reflector, mounted on a 25 ft. self-supporting tower, may be aimed at any location within an azimuth of from 40° to 130°.

Within this arc the distance to the horizon varies from approximately 15 to 35 miles. The Palisades form the horizon for a large portion of the arc, while the Atlantic Ocean provides the horizon in the Southeasterly direction.

In addition, it is possible to vary the vertical angle of the transmitting antenna over a 4° range, thus

By JOHN L. GARDNER
Research and Development Division
Allen B. Du Mont Laboratories, Inc.
East Paterson, N. J.

facilitating "scatter angle" studies.

The exact location of the transmitting site, known as the Du Mont Cedar Grove field laboratory, is as follows:

Township of Cedar Grove, N. J.
Lat. 40° 50′ 24″
Long. 74° 13′ 00″ W.

The field laboratory is located on the top of the Watchung Ridge overlooking rolling terrain to the East and more rugged land towards the West. The ground elevation is 620 ft., some 420 ft. above the highest ground elevation between the laboratory and the Hudson River. The Palisades are the exception, for they rise to heights of 500 ft., especially in the 30° to 70° sector.

From the laboratory, the southern 30 miles of the Palisades and the tops of the tall buildings on Manhattan Island, may be seen. The laboratory is 13 air miles from the Empire State Building. A convenient notch or "cut" in the Palisades Ridge effectively reduces the scatter angle, Fig. 1.

In this relatively uncrowded region, more information can be transmitted within a smaller frequency band. Radiated power is more effective from a given parabolic antenna in a given location.

Above 2000 Megacycles!

Fig. 2: The aluminum mesh parabolic reflector is 18 ft. in diameter.

Antenna Systems

The 600 lb., 18 ft. aluminum mesh parabolic reflector, Fig. 2, is held on one leg of the transmitting tower; so mounted that the main lobe can move through an arc of approx. 90° horizontally, and ±2° vertically. It was designed and manufactured by Du Mont, as was all the other equipment, specifically for this system.

By tapering the illumination from a maximum at the center of the dish to a low value at the edge, the side lobes are minimized and spill-over becomes negligible. The illumination gradient must never be too steep, however, as this results in a shortening of the effective dish diameter with a consequent broadening of the beam and a reduction in system gain.

A rectangular horn feed is being used to illuminate the dish. However, a dual polarization square horn has been developed to allow the use of cross polarization and thereby ease the diplexing problems for certain systems.

Fig. 3: Radiation pattern of the H plane of the square horn. The measurements were conducted by Lincoln Laboratories.

The radiation pattern of the H plane of the square horn, Fig. 3, is the result of measurements conducted by Lincoln Laboratories. Front-to-back ratio of this horn is about 40 db at 2180 MC. To measure radiation patterns of the various rectangular feed horns, a special measuring site was constructed on a flat roof reasonably clear of reflecting structures.

The transmitting portion of the test set-up was comprised of a motor driven rotating assembly housing, a 2180 MC signal generator and the horn under test. The VSWR of the waveguide used was also measured on the same roof site.

The Transmitter

The transmitter, Figs. 4 and 6, uses a serrasoid modulator with a temperature controlled crystal oscillator operating at 2.24 MC. The signal is then multiplied in frequency 3 times, heterodyned to 121 MC, and multiplied 18 times to the carrier frequency of 2180 MC at a power level of 8-10 w.

This signal is fed into an air cooled klystron power amplifier with a nominal power output of 1000 w. The transmitter is housed in four cabinets with plate transformers for the power amplifier in an external wire screened enclosed area.

The primary power requirements are:

1. Driver: Single phase 208 vac., 60 cps, approx. 700 va.
2. Power amplifier three phase, 4 wire, 208 vac 60 cps, approx. 5,000 va.

Fig. 4: The transmitter is housed in 4 cabinets; plate transformers for power amplifier are in an external, wire-screened enclosed area.

Forward Scatter *(Continued)*

For line-of-sight communications at 2000 MC only, the first two frames of the transmitter are used. The third frame contains the power supply for the klystron amplifier while the fourth contains the klystron itself. The power supply and the klystron frames would be changed for a 10 kw system.

A major problem in using electro-magnetically focussed klystrons of this type is the requirement for constant readjustment of the focus coil voltage. This is caused by the change in resistance as the coils heat up and by changes in the ambient temperature.

This situation was alleviated by the use of magnetic amplifier constant-current power supplies, Fig. 5. The power supply uses silicon diodes for rectifiers and magnetic amplifiers with a zener diode reference for regulation. The regulation is such that for a change in coil resistance from 14 to 18 Ω, the current change is 0.020 amps out of a nominal 2.350 amp.

Receiving Site

For the purposes of a scatter link a favorable receiving site was found near Somers, Connecticut. The exact location is as follows:

Township of Somers, Conn.
Lat. 42° 01′ 50″
Long. 72° 24′ 54″ W.

The site is located on a flat treeless hilltop some 770 ft. above mean sea level and has an excellent exposure toward the Cedar Grove laboratory. It lies at an azimuth of 48° from the laboratory. It is located some 3½ miles northeast of Somers.

The site was selected after a series of measurements made with a mobile test laboratory. A 4 ft. parabolic reflector with a dipole and reflector feed was mounted on the rear of the truck.

In the traveling position the dish was fastened securely and protruded approximately 1 ft. above the top of the vehicle; in the measurement position, the dish was raised up so that the bottom edge was 1 ft. above the truck. In this latter position it was rotatable through an arc of 90° horizontally and ±2° vertically.

The dipole fed a 4 ft. section of RG-104 waveguide which was coupled to a 2 ft. section of RG-8/U cable feeding the front end of the receiver. The 2 ft. section of co-ax cable was removed while the dish was in traveling position.

The Receiver

The large path loss of beyond the horizon communication systems makes it imperative that receivers be designed for extreme sensitivity. Consequently low noise front ends and a high degree of selectivity must be employed. The fm receivers used for both the portable equipment and semi-permanent phases of the program have a noise figure of 8 db or better. This noise figure is obtained through the use of IN21E silicon diode crystals in a balanced mixer circuit allowing its use in future broadband systems.

A preselector filter is used to provide 60 db first image rejection. The insertion loss of this filter is approx. 0.5 db. A similar resonant filter is used to suppress any spurious signals generated by the local oscillator.

The local oscillator signal is generated by a crystal controlled oscillator. The crystal is mounted in a temperature controlled oven. A frequency stability of ±0.001% in the ambient temperature range from 0°C to 45°C is obtained. The local oscillator frequency is 39.1 MC, and suitable frequency multipliers are used to drive the mixer at the desired local oscillator frequency of 2110 MC. With a carrier frequency of 2180 MC this provides an i-f of 70 MC.

Fig. 5: Magnetic amplifier constant current power supplies reduced problems encountered in using electro-magnetically focused klystrons.

A cascode 70 MC i-f preamplifier is included on the front end chassis. The noise figure of the i-f contributes to the overall receiver noise figure and therefore should be made small. The use of a cascode amplifier results in a noise figure of approx. 2 db at 70 MC.

A 70 MC selective i-f amplifier is used to provide good selectivity and a flat bandpass. A staggered quintuple amplifier is used to give a flat bandwidth of

2.5 MC and a 3 db bandwidth of 3.85 MC. The gain of this section is held to a minimum in order to prevent overloading under strong signals. Wideband limiters and discriminators are incorporated in the receivers, using the principles developed by J. Granlund[1] and L. B. Arguimbau, in order to decrease distortion caused by multipath conditions.

The limiter section contributes the major portion of the overall receiver gain. The limiting action is accomplished by pairs of biased crystal diodes in the grid circuits of the amplifiers. The biased crystal diode limiter is desirable because it has a short recovery time constant, and therefore is useful for removing the rapid amplitude fluctuation of signals received over beyond the horizon paths. The limiter bandwidth is 6 MC. The limiter output is held to $\pm \frac{1}{2}$db over a 75 db input fading range.

The discriminator characteristic is linear over approx. 6 MC. The discriminator slope is approx. 1 mv/KC.

A wideband linear baseband amplifier is used after the discriminator. The amplifier has a frequency response of $\pm$ 1 db from 300 cps to 300 KC. Its distortion is less than 0.1%.

Dual space diversity reception is employed, the two signals being combined in inverse quadratic proportion to the out-of-band noise. The combining cathode follower technique is used. The speed of response of the variable combining output impedance corresponds to a time constant of 2 msec.

The baseband output is adjustable over a 20 db range in 1 db steps. The maximum output is + 6 dbm.

An AGC controlled i-f metering circuit is incorporated for field strength measurements. Fig. 7 is a block diagram of the FM Receiver.

The reflectors, feed, and waveguide transmission systems are similar to the previously described transmitter layout, except that two 10 ft. dishes, one on each tower, are used for signal reception.

Measurement Program

A signal level quantizer was developed for two important duties: first, for instantaneous signal level indication and second, for time integration of levels exceeded.

In receiver measurements, a varying dc voltage is developed from the AGC string in the receiver. The

1 Interference in FM reception. Technical Report No. 42, Research Laboratory of Electronics, M.I.T., 1949.

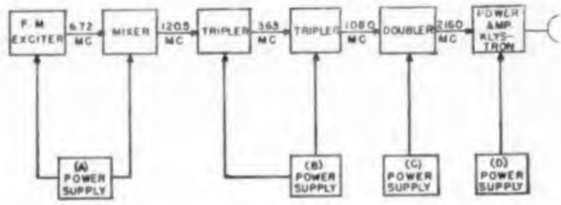


Fig. 6: Nominal output of the klystron power amplifier is 1000 w.

input is divided into 10 channels and the voltage in each channel is sampled rapidly to provide a count of the number of times a voltage in the channel exceeds a preset level for that channel. The output is a set of numbers for each channel representing the number of times, consequently percentage of total time, each channel exceeded its preset value, thus providing information for distribution curves of signal strength.

This set, or array of numbers, can be plotted on probability paper. The median signal strength and the standard deviation, on which all system designs are based, can then be quickly and easily determined.

Antenna pattern and site testing measurement were carried out using the mobile test laboratory. To gain knowledge of its side lobe amplitude and position, antenna pattern measurements were made of the 18 ft. dish.

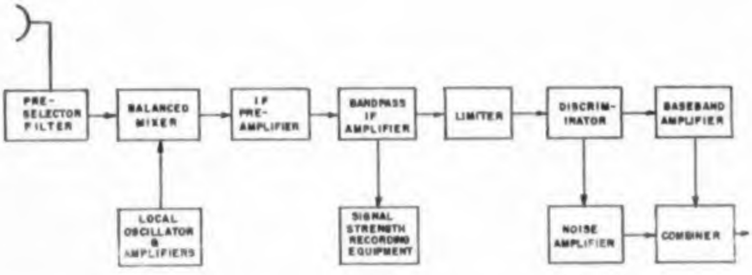
Although the Cedar Grove laboratory was thought to be ideal from a transmission standpoint, difficulties were discovered in antenna pattern measurements caused by multipath conditions. The minimum distance from the 18 ft. dish at which the antenna pattern could be measured was computed as $R = \frac{2 D^2}{\lambda}$, which, in this case, equalled 1250 ft.

The first measuring site used was at a distance of 10,000 ft. and at line-of-sight. The irregularity of the pattern indicated the probability of considerable multipath so a second site was chosen, which produced slightly better results. Site three, at a range distance of about 2000 ft., produced a considerably improved pattern which closely resembled the theoretical. Fortunately the site at Somers is almost ideal both for reception and antenna pattern measurements.

At the present time one receiver has been installed at the measuring site in Somers. Recordings include two separate 24 hr. signal strength measurements made on Esterline-Angus recorders. Instantaneous signals were recorded that reached values of the order of -24 dbm. Over the two 24 hour periods, the hourly medians ranged from 17 db above 1 μv. up to 70 db above 1 μv.

I should like to express my appreciation for the cooperation and assistance I have received from the Research and Development engineers, who developed this system.

Fig. 7: An AGC controlled i-f metering circuit in the FM receiver measures field strength.

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Measuring Dielectric Constants at UHF

This novel measuring method consists of determining the impedance of a small capacitance cell, made part of a load terminating a transmission line. It is used for the 250-900 MC range.

By DR. JOSEPH J. KYAME
Dept. of Physics, Tulane Univ. New Orleans, Louisiana

Fig. 1: The central conductor of this measuring line is supported by a metal disc at one end and the capacitance to be measured at the other.

METHODS of measuring dielectric constants, employing transmission lines, wave guides, or cavities over various frequency ranges, are described in a number of references.[1] This investigation considers the measurement of the impedance of a small capacitance cell using a transmission line method for the frequency range 250-900 MC.

Impedance Measurement

For measuring the impedance of the capacitance cell, the method developed by Chipman[2, 3] and others was used. The method consists of adjusting to resonance a length of line, shorted at one end and terminated at the other by a detector.

The impedance to be measured replaces the short, and the line length is again adjusted for resonance. From these resonant lengths and the widths of the resonance bands, the resistive and reactive components of the unknown impedance can be evaluated.

Chipman derives the equations for resonance considering multiple reflections occurring at each end of the line. If the reflection coefficient of the detector element and the attenuation losses of the measuring line are neglected, these equations may be used for calculating the impedance:

(*Continued on page* 010)

Type BK-1A Pressure Microphone—High-fidelity "Commentator" pressure microphone, non-directional in character. An ideal announce mike for speakers. It assures clear, crisp speech and is well suited for remote pickup.

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Dielectric Constants *(Continued)*

$$Z = Z_0 \frac{1 - \rho^2 - j2\rho \sin \phi}{1 + \rho^2 + 2\rho \cos \phi}, \quad (1)$$

$$\phi = \frac{4\pi}{\lambda} (l - l_s), \quad (2)$$

$$\rho = \text{antilog}\, 2 \left[\text{arc sinh} \left(\sin \frac{2\pi\delta_s}{\lambda} \right) - \text{arc sinh} \left(\sin \frac{2\pi\delta}{\lambda} \right) \right], \quad (3)$$

where $$\rho \angle \phi = \frac{Z_0 - Z}{Z_0 + Z} \quad \text{reflection} \quad (4)$$

coefficient of the unknown impedance.

l_s = resonant length with line shorted.

δ_s = change in resonant length (when shorted) necessary to reduce resonant current to 0.707 of the max. value.

l, δ = resonant length and band width when line is terminated by unknown impedance.

Z_0 = characteristic impedance of measuring line

Z = impedance terminating line.

λ = wavelength of the altering current.

The measuring line, Fig. 1, is a concentric line, 5 ft. in length, with conductors ¼ in. and 3 in. in diameter. The central conductor is supported by a metal disc closing one end of the line and at the other end by the impedance to be measured or a thin polystyrene disc.

The line length is varied by moving a shorting carriage containing the detector pickup loop. The driving mechanism consists of a screw, 5 ft. long, ¾ in. in diameter, 10 threads per inch, capable of moving the carriage approximately the length of the line. A counter attached to the screw gives directly the length of the line to 0.01 in.

The signal fed into the line by a small loop near the load, is provided by a General Radio Unit Oscillator, Type 1209-A. The line current, rectified by a Sylvania 1N34 crystal, is measured by dc microammeter or milliammeter.

Capacitance Cell

The small capacitance consists of circular plates, ¾ in. diameter, separated by approximately 2 mm. The wall of the cell is a polystyrene ring. This reduced the diameter of the cell cavity to 1.60 mm. The exact separation of the plates can be determined by knowing the plate area and measuring the amount of liquid necessary to fill the cell.

To eliminate stray external reflections and to provide shielding, the cell is made part of the central conductor of a small length of shorted line, Fig. 2.

The following procedure is used for computing the dielectric constant of the unknown. The impedance of the cell is measured when empty, filled with mercury, and filled with the unknown. Let these be

$Z_e = R_e + jX_e$ = impedance of cell empty, (5)

$Z_m = R_m + jX_m$ = impedance of cell filled with mercury, (6)

$Z = R + jX$ = impedance of cell filled with unknown. (7)

To eliminate the effects of the small line and capacitance between the cell and outer conductor the quantities

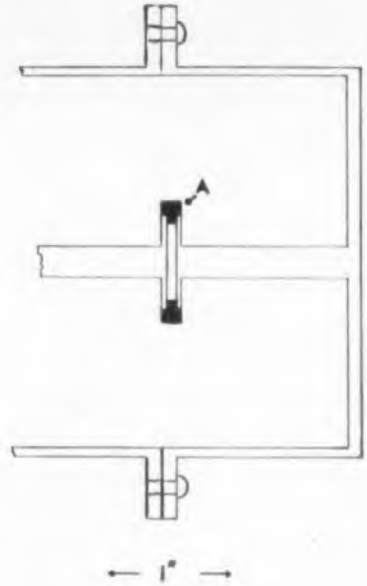

Fig. 2: Capacitance cell with supporting line attached to the measuring line. Wall of cell is a polystyrene ring (A).

$$Z' = Z_m - Z \quad (8)$$

and $$Z_e' = Z_m - Z_e \quad (9)$$

are formed. These impedances are now considered to be the reactance of a capacitance having a complex dielectric coefficient, e.g.,

$$Z' = R' + jX' = \frac{1}{j\omega C'} \quad (10)$$

Therefore $$C' = \frac{\varepsilon A}{4\pi t} = \frac{1}{j\omega Z'}, \quad (11)$$

or $$\varepsilon = \varepsilon' - j\varepsilon'' = \frac{4\pi t}{jA\omega Z'} \quad (12)$$

where ε' and ε'' are the usual real and imaginary parts of the complex dielectric constant, $\omega = 2\pi f$ and A and t are the cross section area and thickness of the cell cavity.

To minimize the effects of fringing the calculation of ε is given in terms of ε_0 (dielectric constant of free space or air) from Z' and Z_e' by

$$\varepsilon - \varepsilon_0 = \frac{4\pi t}{jA\omega} \left(\frac{1}{Z'} - \frac{1}{Z_e'} \right). \quad (13)$$

Application

As application of the method, several dielectric constants were measured. Measurements were taken at intervals of 20 MC over the range from 260 MC to 920 MC. Both the real and imaginary parts of the dielectric constant of glycerine are shown in Fig. 3 and the real part of that of polystyrene in Fig. 4. These were taken at room temperature, approx. 75° F.

For the measurement of its dielectric constant a small disc of polystyrene was fitted into the cell cavity and cemented to the wall with a polystyrene cement to eliminate air cavities. The determination of the imaginary part of the dielectric constant of polystyrene would require measurement of band widths smaller than the accuracy provided by the particular measuring line.

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Circle 73 on Inquiry Card, page 101

Fig. 1: This AM/FM radio was used for "road tests" of FM reception.

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A New Broadcast Dimension . . .

FM In The Car

By WILLIAM MARON & ANN MARON

William Maron, President, Radio Bergen, 921 Bergen Ave., Jersey City 6, N. J.

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HOW well can you receive FM broadcast stations in a car? To find out, we installed a Blaupunkt AM-FM radio in our car. Here are the main questions we were trying to answer:

1. How practical is FM broadcast reception in a car?

2. How well does a vertical antenna work for FM broadcast reception? (FM broadcast transmitters are horizontally polarized.)

3. What sort of mobile coverage do FM broadcast transmitters give in Manhattan and outlying areas?

4. What differences would we find in signal strength of FM stations in New York City, and from other nearby localities?

Here are the more important receiver data:

Sensitivity:
FM—3 μv for 20 DB quieting.
AM—6 μv.

Selectivity:
Image rejection better than 25 DB.

Response:
40—16,000 cps.

Tuning range:
FM—87 to 108 MC.
AM—520 to 1640 KC.
AM—145 to 290 KC.

Switching from FM to AM, or vice versa, is accomplished by pushing one of the FM or AM station selector buttons. The receiver is extremely stable. After a few minutes warm-up there is no drift from vibration, driving over rough roads, or temperature changes.

Ed.: FM auto radios and tuners are made in the U. S. by Franklin Electronics, Bridgeport, Pa., and Gonset, Burbank, Calif. The German Blaupunkt is imported by Robert Bosch Corp., Long Island City, N. Y.

Installation

Fig. 1 shows the receiver mounted in the dash of the car. We added the small meter below the set for precise tuning and measuring signal strengths *qualitatively*. It is a 0-100 microampere dc meter, with a 100,000 ohm resistor in series, converting it to a 0-10 volt meter. It is connected across the ratio detector of the receiver.

The antenna is not mounted on the car roof, as a height of 30 inches above the roof would interfere with garaging and servicing. Instead, it is mounted on the lid of the trunk (Fig. 2).

The antenna, cut for the center of the FM band (98 MC), is made of ½-inch copper tubing, silver plated, and treated to prevent oxidation. A sturdy ceramic insulator is used for the base support. It is connected to the input terminal of the receiver with RG-8/U co-axial cable. The cable is run through the hollow, longitudinal, chassis member of the car for additional shielding and mechanical protection.

As the antenna is vertical, its characteristic is omni-directional. There may be a very slight reduction in gain toward the front of the car, making the pattern somewhat cardioid, but this is only a surmise and did not show up in our measurements.

We gave careful attention to suppressing electrical noise from the ignition, battery charging, and regulating systems. A 10,000 ohm resistor is connected between the ignition coil high voltage terminal and the common terminal of the

(*Continued on page* 025)

Fig. 2: FM reception in a car was tested at the points marked on the map above. There was no noticeable difference between reception when standing still and when in motion.

Qualitative Comparison of Signal Strengths of FM Broadcast Stations in New York City and Other Nearby Cities at 10 Locations

Frequency (MC)	Call Letters	Station Location	Meter Reading At Point On Map A	B	C	D	E	F	G	H	I	J
90.7	WFUV	Bronx, N. Y.	5.0	4.7	3.9	1.9	3.7	4.1	4.4	4.9	1.5	1.5
92.3	WHOM	New York, N. Y.	5.1	5.3	4.7	2.8	5.0	4.9	4.7	4.9	1.6	xxx
93.1	WPAT	Paterson, N. J.	5.0	5.8	4.9	2.9	4.2	2.2	1.8	1.6	xxx	xxx
*93.5	WNRC	New Rochelle, N. Y.	4.1	3.3	xxx	xxx	2.1	xxx	4.9	5.5	1.7	xxx
93.9	WNYC	New York, N. Y.	4.8	4.7	4.9	2.4	4.9	5.3	4.7	4.8	1.6	xxx
*94.3	WJLK	Asbury Park, N. J.	xxx	xxx	1.7	5.3	xxx	xxx	1.5	xxx	xxx	xxx
94.7	WAAT	Newark, N. J.	4.4	4.8	4.5	2.6	3.4	2.8	2.1	2.0	xxx	xxx
95.5	WABC	New York, N. Y.	5.2	5.0	4.6	2.4	5.0	5.1	5.0	4.9	1.9	1.7
96.3	WQXR	New York, N. Y.	4.9	5.1	4.5	2.7	5.1	4.7	4.9	4.7	1.6	1.8
*96.7	WSTC	Stamford, Conn.	xxx	xxx	xxx	xxx	xxx	xxx	3.8	4.9	1.3	xxx
97.1	WRCA	New York, N. Y.	5.1	5.2	4.7	2.1	5.1	5.2	5.1	5.0	2.0	1.9
97.5	WALK	Patchogue, N. Y.	2.7	xxx	3.0	2.2	3.3	xxx	3.3	3.4	xxx	xxx
97.9	WEVD	New York, N. Y.	4.7	4.7	4.1	2.3	5.0	4.9	4.7	4.4	xxx	1.7
98.3	WHLI	Hempstead, N. Y.	1.9	xxx	2.2	2.3	3.1	xxx	3.8	4.1	xxx	xxx
98.7	WOR	New York, N. Y.	5.2	5.4	4.5	2.6	4.8	5.2	5.1	5.0	1.8	1.6
99.5	WBAI	New York, N. Y.	5.3	5.1	4.9	2.7	5.3	5.1	5.0	5.1	2.0	1.9
101.1	WCBS	New York, N. Y.	5.1	5.1	4.9	2.9	5.4	5.2	5.3	5.0	2.1	1.7
101.9	WBFM	New York, N. Y.	5.2	5.2	4.8	2.8	5.2	5.4	5.4	4.9	2.2	1.9
*103.9	WFAS	White Plains, N. Y.	3.0	xxx	xxx	xxx	2.7	xxx	3.9	4.6	1.6	1.5
104.3	WFMX	New York, N. Y.	4.7	4.6	4.1	2.1	4.8	4.9	4.6	4.7	1.7	xxx
105.1	WWRL	Woodside, N. Y.	4.1	4.0	3.7	2.7	5.6	4.4	4.9	5.0	xxx	xxx

*—Class A Station, 1000 watts ERP maximum. xxx—Too weak to read at these locations.

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Analyzing Interference in FM Communications Systems

FM interference is caused by performance limitations of the receivers and the transmitters. The author discusses the kinds and causes of interference, describes measuring techniques, and presents a powerful method of analyzing the results.

By N. H. SHEPHERD
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WHEN a communication system is operated at or near maximum system gain it is susceptible to several types of interference from radio transmitters which produce strong signals at the system's receiver input terminal. Interference decreases the system gain by reducing the effective receiver sensitivity. Before a system can be properly designed for minimum interference it is necessary to know the interference characteristics of the receivers in the system and that of any transmitters producing strong signals. The following is a method of determining and applying patterns obtained by measuring typical VHF FM transmitters and receivers. Only one half of each transmitter or receiver pattern is described since the other half of each pattern may be treated in the same manner. The techniques applied to VHF FM transmitters and receivers can also be applied to other types of modulation and frequency bands by utilizing similar standard procedures.

Fig. 1: FM receiver interference rejection pattern. Operating frequency f..: 160 MC. Reference sensitivity: .5 µv for 12 db sinad.

Types Of Interference

The several types of interference that will reduce the effective sensitivity of a receiver, operating in a system and being interfered with by one or more undesired transmitters, may be divided into the two following categories:

Category 1

Interference caused by limited performance of the receiver.

1. Intermodulation.
2. Modulation splatter.
3. Signal Desensitization.
4. Spurious and image response.

Category 2

Interference caused by extra band radiation of the interfering transmitter.

1. Intermodulation.
2. Modulation splatter.
3. Broadband noise radiation (transmitter noise)
4. Spurious and harmonic radiation.

Four types of interference are listed in each cate-

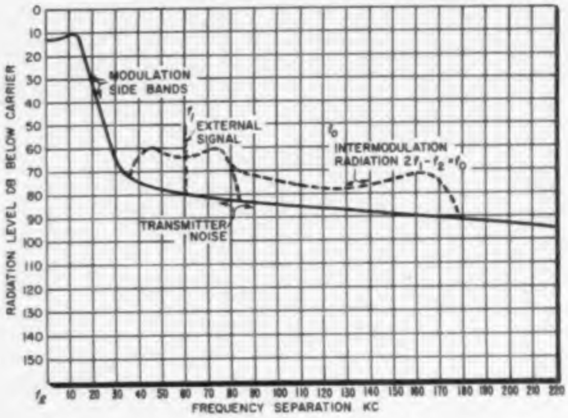


Fig. 2: FM transmitter radiation pattern. Operating frequency f_2: near 160 MC. Modulation: ± 15 KC simulated voice.

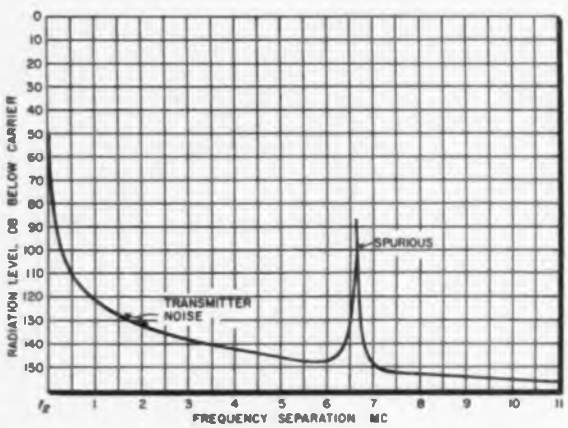
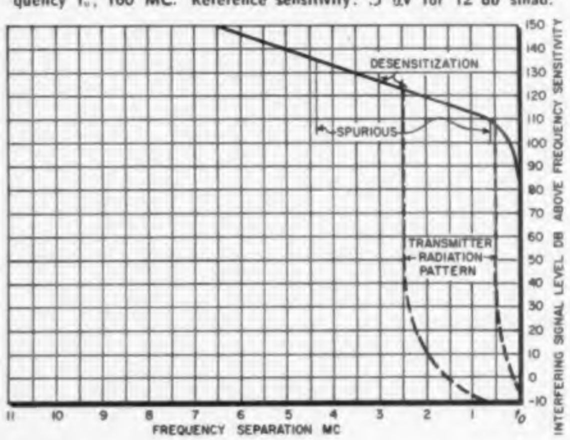


Fig. 3: FM transmitter radiation pattern. Operating frequency f_2: 150 MC to 160 MC. Modulation: ± 15 KC simulated voice.

Fig. 4: FM receiver interference rejection pattern. Operating frequency f_0: 160 MC. Reference sensitivity: .5 uv for 12 db sinad.



Interference *(Continued)*

gory. Observation and experience indicate that corresponding numbered types of interference in each category will produce similar effects in reducing the effective sensitivity of a receiver. Only the most careful interference evaluation can determine whether the receiver or transmitter is at fault. Although certain of the above listed types of interference have been discussed in other papers, they are included here again for completeness and review.

Intermodulation

Intermodulation occurs when two signals combine in a nonlinear circuit to produce a multitude of product signals. Since nonlinear circuits are found in both receivers and transmitters, intermodulation will occur in both. When one of the intermodulation products is created on the desired frequency of a receiver, and in the presence of a desired signal, interference will result. Figure 1 illustrates a typical example of the required levels of two undesired frequencies f_1 and f_2 which, when combined in a receiver, produce interference on the desired frequency f_0 if:

$$2f_1 - f_2 = f_0$$

This type of intermodulation interference, commonly referred to as third-order intermodulation, occurs most frequently in VHF and UHF receivers. Second-order and higher than third-order intermodulation may also cause interference in VHF and UHF receivers but their occurrence is less frequent. The signals f_1 and f_2 at a level of 70 db above the receiver's sensitivity, combine to produce a third-order signal which is of a magnitude 6 db below the sensitivity of the receiver. By holding f_1 constant in frequency and amplitude, then f_2 could be adjusted to follow the dotted curve in frequency and amplitude to maintain the same level of interference. If f_2 were held constant then f_1 could similarly follow its dotted curve to produce the same reference interference. The amount that f_1 can vary from the reference frequency is half the variation for the frequency f_2, since the frequency of the third-order product varies as two times the frequency f_1.

The third-order intermodulation frequencies generated on frequency f_0 when an external frequency f_1 is introduced into a transmitter on frequency f_2 is illustrated in Fig. 2. The dotted line in the region of frequency f_0 represents the modulation side bands of the signal being radiated, from the transmitter on frequency f_2, when both signals f_1 and f_2 are being modulated to ±15 KC deviation. In the example shown the maximum output at frequency f_0 is about 62 db below the transmitter carrier f_2 when the external signal f_1 is introduced at a level of 50 db below the carrier f_2. Comparing the receiver intermodulation frequency rejection pattern, Fig. 1, with the transmitter radiation pattern, Fig. 2, it can be seen that the third-order intermodulation signal radiated from the transmitter on frequency f_0 is about 14 db stronger than the third-order intermodulation signal generated in the receiver by the same two transmitters on frequencies f_1 and f_2. Such a comparison must be made by assuming the levels of frequencies f_1 and f_2 are the same and at the level of f_2 in relation with f_o when arriving at the receiver. Another example could be given to illustrate the case of a stronger third-order product being generated in the receiver then in the transmitter. In such a case the external signal frequency f_1 would necessarily be attenuated by an additional 15 db before entering the transmitter on frequency f_2. Various other examples would further illustrate the importance of comparing the receiver interference rejection pattern with the transmitter radiation pattern to establish the source of intermodulation interference in a system.

Modulation Splatter

Modulation splatter is produced by certain modulation products of an adjacent channel transmitter appearing in the low i-f of a receiver and being demodulated to cause interference in the presence of a desired signal. Modulation splatter interference can be caused by limited performance of the receiver or by extra band radiation from the transmitter. The greatest contributor to modulation splatter can be determined by comparing the receiver interference rejection pattern with the transmitter radiation pattern.

Fig. 2 illustrates the extra band radiation of the modulation products. Starting at a frequency of about 16 KC separation from f_2, the radiation pattern of the voice modulated transmitter, falls off at the rate of about 3.5 db/KC until it reaches a point about 70 db down where the slope changes. (Beyond this change of slope other types of interference occur. These will be discussed later.) The slope of the modulation radiation pattern is typical of FM transmitters being modulated at ±15 KC deviation with a single voice channel. Other types of modulation will produce similar patterns with different slopes. The most significant part of the modulation radiation pattern is the slope since it determines the optimum i-f selectivity of the adjacent channel receiver.

The portion of the receiver interference rejection pattern, illustrated in Fig. 1 that is pertinent to modulation splatter interference starts at f_o and continues to a point at about 35 KC separation. Beyond 35 KC separation the slope changes and also the type of interference. The average slope of the i-f rejection portion of the receiver pattern between 15 KC separation and 35 KC separation is about 4 db/KC. Near the receiver i-f rejection pattern is reproduced a portion of the transmitter radiation pattern taken from Fig. 2. The center of the transmitter radiation pattern is located at a frequency separation of 45 KC, which is equivalent to an adjacent channel operation on 45 KC channel spacings. The adjacent channel signal level is located at a point 69 db above the receiver sensitivity. Interference can be shown to occur at the nose of the receiver i-f rejection pattern, when the receiver and transmitter patterns are fitted together, as in Fig. 1. Interference is noted at the point the two patterns first touch, which in this case is at the nose of the receiver pattern near f_o. Such a system is operating with a 69 db adjacent channel interference protection. Only one point of contact of the two patterns will be noted because the receiver i-f rejection pattern maintains a greater slope for all frequency separations than the corresponding slope of the transmitter radiation pattern.

If the receiver i-f rejection slope were less than 3.5 db/KC, as for a second typical example, the transmitter and receiver patterns would first touch at some point down the receiver i-f slope and result in a reduction in the adjacent channel interference protection. The interference as noted in the receivers would have a close resemblance to the first example, however, it would be due to inadequate receiver i-f selectivity. Thus it is important to fit the transmitter radiation pattern to the receiver interference rejection pattern to make a proper evaluation of the cause of interference.

For the first example of modulation splatter interference, the receiver i-f selectivity has exceeded the point of optimum slope. Any further increase in the i-f selectivity would have little or no effect on adjacent channel interference. Such a condition is sometimes not recognized in receiver specifications. Frequently specifications are written requiring the greatest receiver selectivity within the state of the art without due consideration for the adjacent channel transmitter radiation pattern with the result that possible inherent degradation of some of the desired signal performance characteristics. I-f Selectivity, greater than the optimum slope may cause degradation of performance due to increased phase distortion or impulse noise response.

Transmitter Noise

One of the most important, yet least considered, parts of the transmitter radiation pattern is the region between the modulation sidebands and spurious outputs, as shown in Figs. 2 and 3. This region is occupied by a noise spectrum which is generated in the oscillator, multiplier, and power amplifier stages in a transmitter. In the case of SSB transmitters, noise is also generated in converters. The type of interference produced by the transmitter noise is not easily recognized because it does not produce any characteristic audio output in a receiver being interfered with, thus it frequently is mistaken for other types of interference. As illustrated in Fig. 2, the transmitter noise starts at a point near 35 KC separation and continues to decrease slowly until the first spurious output is reached. Fig. 3 shows a longer frequency spectrum of transmitter noise including the first spurious output. The noise near the spurious output as shown rises very sharply on both sides of the spurious. It should be noted that the noise near the spurious is attenuated only a few db below the amplitude of the spurious, thus the spurious takes on the form of a very noisy carrier.

Signal desensitization interference of a receiver is caused by the carrier of the interfering signal reducing the r-f or i-f gain of the receiver. When the gain of a receiver is reduced, the desired signal performance is affected by a loss of sensitivity. If the interfering signal is amplitude modulated, the desensitiza-

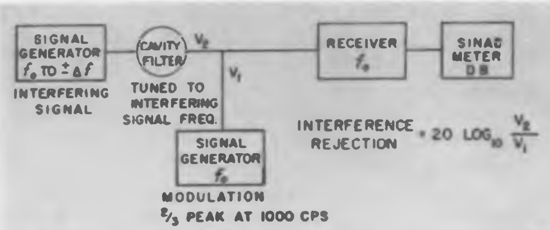


Fig. 5: Method for measuring receiver interference rejection pattern: i-f rejection, desensitization, and spurious response.

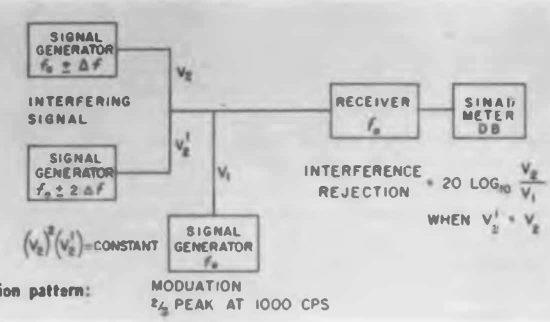


Fig. 6: Method for measuring receiver interference rejection pattern: intermodulation.

Interference *(Continued)*

tion takes on the form of cross-modulation interference in an AM receiver. Amplitude modulation on an interfering signal causes very little cross-modulation in an FM receiver since the resulting frequency modulation is slight. Fig. 1 shows the desensitization pattern of a receiver starting at a point near 40 KC frequency separation and continuing to larger frequency separations. Fig. 4 is a continuation of the same desensitization pattern. A portion of the transmitter radiation pattern, starting at a frequency separation of 180 KC, is included in Fig. 1 as a typical case of interference analysis. The level of the carrier of the transmitter radiation is 86 db above the receiver's referenced sensitivity. At this level the transmitter carrier is not strong enough to cause desensitization since it does not touch the receiver's interference rejection pattern. The transmitter pattern does touch at the receiver's i-f nose near frequency f_o thus interference is being produced at the nose of the receiver by transmitter noise.

Two more typical examples are illustrated in Fig. 4 for frequency separations of .5 MC and 2.5 MC. At a separation of .5 MC the transmitter radiation pattern touches the receiver interference rejection pattern at two points. One point is in the desensitization region while the other point is near the nose of the receiver, thus producing interference which is a combination of desensitization and transmitter noise. The third example of interference for 2.5 MC separation results in only one point of contact in the desensitization region. Starting at the lowest frequency spacing and retracing through the three examples of interference it is seen that the interference is first produced by transmitter noise, then a combination of transmitter noise and desensitization, and lastly desensitization alone.

The three examples of interference due to transmitter noise, desensitization, and combinations of both further show the importance of pattern fitting in interference analysis.

Spurious

Spurious responses of receivers and spurious radiation of transmitters have received wide treatment in the literature, thus requiring only slight comment here. The techniques of evaluating and controlling spurious have advanced far beyond the other types of interference listed above, however, interference due to spurious should be included in interference patterns to provide a complete interference analysis. Figs. 1 and 4 show typical receiver spurious patterns and Fig. 3 shows a typical transmitter spurious. Of all the types of interference mentioned here, these are the rarest and do not merit any further discussion with the state of the art as it is today.

Pattern Measurement

Pattern measurement procedures as described in this paper are based on certain arbitrary standards of desired signal and interference levels to produce 6 db reduction in a 12 db $S + N + D/N + D$ ratio (abbreviated to read 12 db sinad ratio). If desired, these same techniques may be applied to patterns for higher desired signal and interference levels. The desired signal level to produce 12 db sinad ratio was chosen because it represents a round figure near the point of 100% intelligibility for a single voice channel, 300 to 3000 cps. Intelligibility falls off very rapidly below the 12 db sinad ratio point.

(Continued on page 028)

Fig. 7: Method for measuring transmitter interference pattern: modulation side bands, noise, and near spurious.

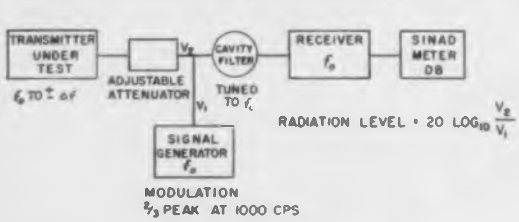
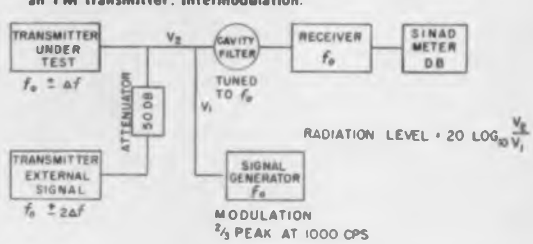
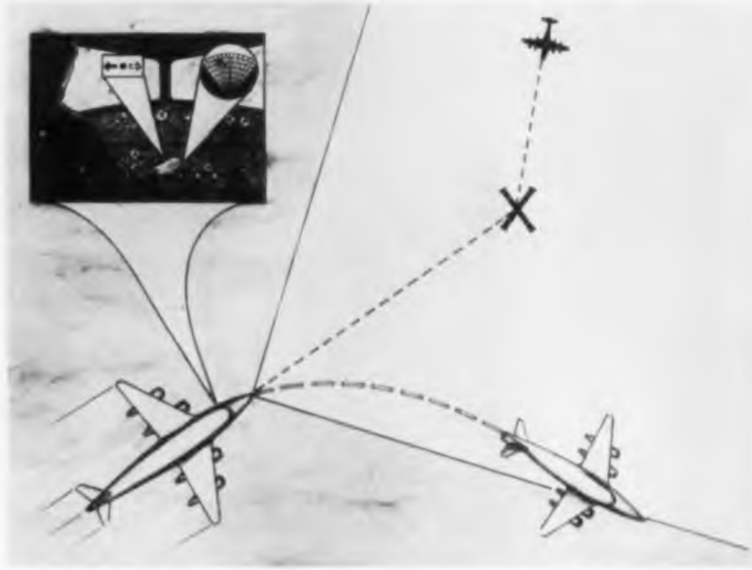


Fig. 8: A method for measuring the interference pattern of an FM transmitter: intermodulation.



What's New . . .

New Pilot Warning System



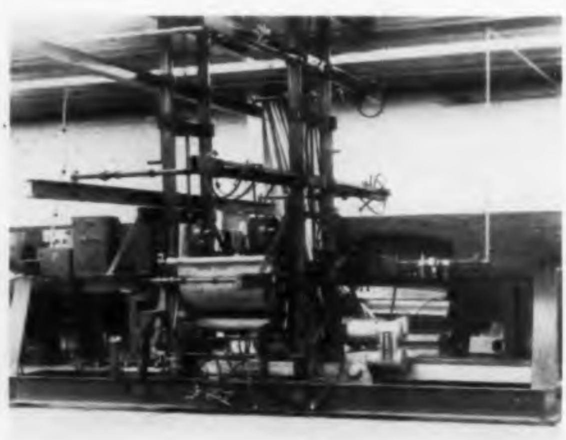
A NEW collision avoidance system has been announced by Federal Telecommunication Laboratories of IT&T. The new system gives warning and avoidance instructions to the pilot and covers a forward sector only. Equipment weighs only sixty-three pounds and is integrated into existing radar system.

Ultrasonic Welder

WHAT is believed to be the first automated, continuous seam, ultrasonic welder has been produced by Gulton Industries, Inc., Metuchen, N. J. It was developed as a result of a research contract and built to exact specifications to be used in a classified project.

The continuous seam, ultrasonic welder joins two dissimilar or similar metals, through high frequency sound alone. Two pieces of metal are joined as a result of a molecular transference or plastic flow at the interfaces of the two metals and below the melting point of either metal.

The prototype welder was designed to weld corrugated sheets to long curved aluminum extrusion. Its operation is completely automatic including feed. Although the machine can be made to weld flat sheets, this particular one was specifically constructed for the welding of semi-circular sheets. It is capable of welding eleven different radii without any modification.



This ultrasonic welder stands 13 feet high, is 12 feet long and 10 feet wide. The three-ton machine is powered by two 2-kw generators.

Sellevision

Slides or movie strips can be continuously displayed by this Siegler Corp. "Selevision" system. Mirrors and a projector within the cabinet present a continuous selling message or other material on the screen.

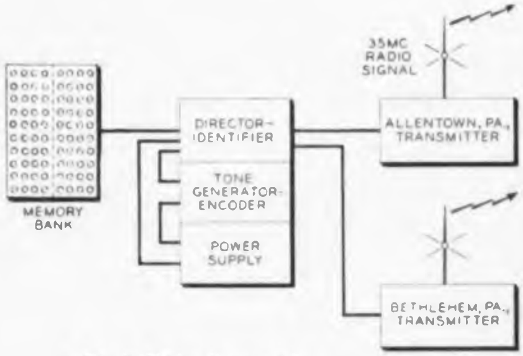


Fig. 1: Block diagram of coding system.

Wireless Phone Bell

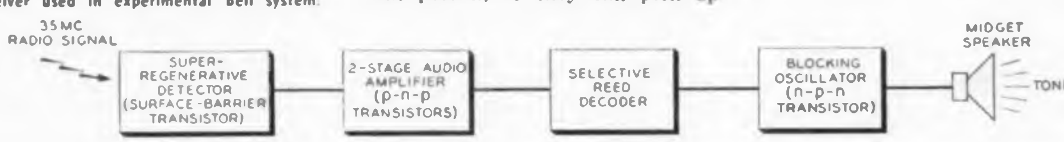
Fig. 2: Signal strengths are checked with mobile equipment.

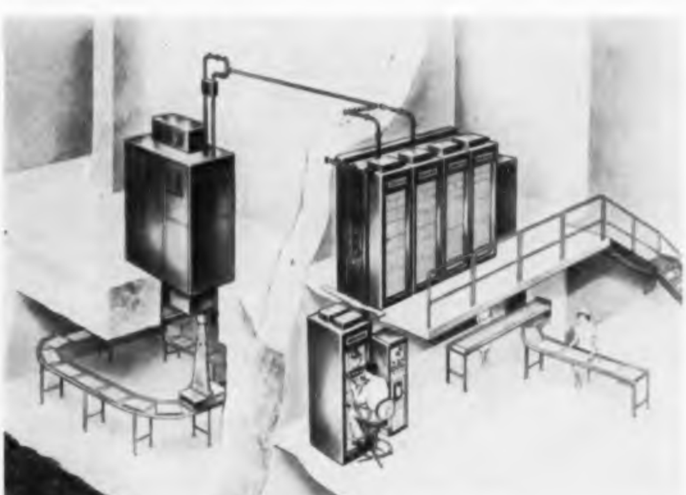
Fig. 3: Tiny receiver carried to give personal signaling of incoming phone calls.

Fig. 4: Block diagram of miniature signal receiver used in experimental Bell system.

PROFESSIONAL people around Allentown and Bethlehem, Pa. are trying out Bell Labs' "Pocket-Radio Signaling" system. When you need to phone one of the area's doctors, salesmen, or others not near a phone all the time, you call a special signaling-service operator, give her the number, and she sends a coded pulse out over the air. This trips a signal in the pocket radio signal set carried by that person, so they can pick up the nearest phone and complete the call. The codes use four out of a possible nine audio tones.

These preliminary tests use two 250-watt AM transmitters and a series of miniature receivers manufactured by the Stromberg-Carlson Company. Stromberg-Carlson has just placed on the market its "Pagemaster" selective calling system, including receivers, transmitters, and encoding equipment.





Van de Graaff Sterilizer

THIS installation uses a two million volt accelerator to irradiate surgical sutures, "catgut." Sterilization by irradiation at Ethicon, Inc., Somerville, N. J., eliminates the damage done by ordinary heat methods.

CUES

for Broadcasters

More On Testing Tape Speed

GEOFFREY A. GASS, Ch. Engr.
KSRV, Ontario, Oregon

Byron Parrish's suggestion in the January issue of ELECTRONIC INDUSTRIES is interesting, but the closest approximation of tape speed obtainable by his method over a 100 sec. test period (without "expensive equipment") is about 1%.

One hundred seconds is a long time to sit around counting beeps when a lineup must be done in a short time. Add to this the fact that a tape loop necessarily cannot reflect the effect of the takeup- and feed-reel tensions on tape speed, it is obvious that even if sufficiently accurate (which it would be if used over a period of, say, 15 min.) it would not necessarily reflect recorder performance under operating conditions.

The following method is used at KSRV with completely satisfactory results, and accuracy within 0.1 of 1%:

(1) A reference tape is made from a machine of known accuracy. The tape consists of one- to two-minute recordings of 60-cps line frequency, spaced at different points in a reel of tape.

(2) The tape is played back on the machine to be tested, and beat with the line frequency, obtained from a permanent 60-cps patch on the main patch panel. The signal source is from a filament supply, suitably attenuated and isolated with resistors. The speed discrepancy is measured by the number of beats in 17 sec. The number of beats in that space of time is the speed discrepancy in tenths of 1%. The direction of the discrepancy can be determined by manually slowing the recorder and noting the difference in beat-reading. The procedure is repeated for the test recordings made at different points in the reel of tape, to measure the effect of feed-reel tension at different points in the tape.

A discrepancy of 1% is easily noticeable on the air, and all machines should be adjusted to agree within 0.5 of 1% of each other. The actual tape speed is not so important here as close agreement between machines.

Manufacturers of recorders make various allowances for slippage in their machines, with the result that very little trust can be put in a machine just because it is new or because it runs faster than the others. The best policy is to obtain a recording of 60-cps line frequency tone from the most reliable machine available and take it as a standard.

If a large number of tapes from some outside source are used, it's probably a good idea to have them make you a test tape to set your own timing by. It would certainly do you no good to have your own machines running at exactly 7.5000 in./sec., if half your programming was recorded at 7.40 in./sec.!

While speed regulation is not the greatest problem confronting radio stations and tape producers nowadays, it is certainly one of the most noticeable defects, and requires the closest degree of accurate measurement and adjustment to provide quality reproduction of tape material.

Perhaps with a completely reliable method of maintaining speed regulation, this problem may be dismissed and a little more attention paid to frequency response, noise, and distortion in recordings.

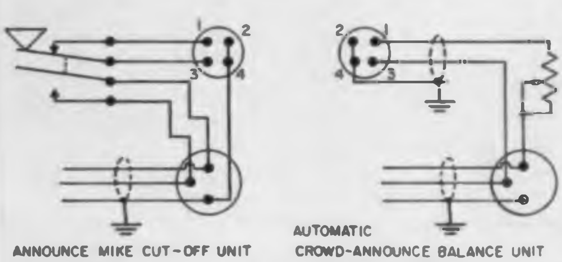
Balancing

MEL HAAS, Engr. in Charge
WOI, Iowa State College
Ames, Iowa

The simplest source of crowd (background) noise for atmosphere at a sportscast is the normal pickup of the sportscaster's mike directly into the remote mixer amplifier. Variations from this go to the extreme of a separate mike in a parabolic reflector which is continuously directed toward the point of interest.

We at WOI (Iowa State College) like to furnish our announcer with a mike cut-off push button switch, but if we depend on his mike for crowd noise, pushing this button causes an objectionable silence. In the past we have used the supplement of hanging a separate crowd mike as a separate feed into our remote mixer amplifier. This still presented a noticeable crowd noise level drop when the announcer would push his cut-off button, but the results were much better.

To improve on this set-up, we added another unit, one which makes the feed from the crowd mike adjustable. It consists of a 200 Ω variable resistor across our 50 Ω mike line, which is basicly adjusted to reduce the output of the crowd mike by the amount picked up on the announcer's mike. Interconnection from this unit is made back to the cut-off control switch, to a pair of contacts that are normally closed. As a result, when the cut-off button is pushed, this variable resistance is removed. The crowd mike level is automatically increased by the amount reduced. The object is to maintain a uniform crowd noise level.



Three prong sockets are for mikes. Four prongs interconnect. Variable resistance reduces crowd mike output by amount of crowd noise picked up by announce mike. Cut-off button shorts announce mike, removes crowd mike reduction, and thereby maintains crowd noise level.

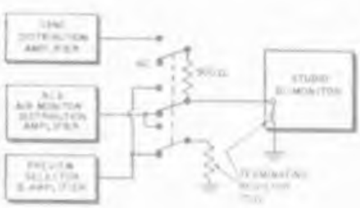
We chose to use a different type of connector on the interconnection between the automatic crowd-announcer balance unit and the announcer cut-off unit than we use on our mikes to reduce confusion. Obviously the cut-off unit must be close to the announcer, but we usually keep the balance unit near the remote mixer, and plan cord lengths according to our remote broadcast needs. The only equipment needed to construct this unit is the necessary plugs, sockets, a 200 Ω potentiometer, and a switch with one set of contacts normally open and another set normally closed.

CUES for Broadcasters

Bi-Monitor

STAN BLITZ & ED ROOS, Engrs.
WEAT, West Palm Beach, Fla.

One of the many problems encountered in a small compact TV station is the need for versatile equipment. A dual purpose studio monitor used either as an AIR



When switched to preview, sync is automatically added before feeding to monitor.

monitor or a PREVIEW monitor is a typical example.

Our studio monitor is fed a composite signal from an RCA distribution amplifier, which feeds all our AIR monitors. Our preview monitor is fed a non-composite signal by push-button selections. It was necessary to add sync to our preview signal before feeding it to our studio monitor, as well as keeping a consistent termination for the video signals.

Parts Required: 1 Minibox, 5 x $2\frac{1}{4}$ x $2\frac{1}{4}$ in. 4 Amphenol chassis mounts, coax. 1 3 PDT switch. 1 75 Ω, 5 per cent terminating resistor. 1 500 Ω resistor.

Heat-treating Metals

JOSEPH ZELLE, Tech. Staff
WERE, Cleveland, O.

Often enough, experimenters and constructors in the course of assembling, are confronted with bending or forming stiff metals or tubing. This is particularly unpleasant when working with hard drawn aluminum or copper in the cold state or in cold surroundings. However, even the softer varieties of metal will be easier to work with and present neater and a more finished appearance, if the metal is brought to a warm pliability before and during machining.

Applying heat with a torch or burner is not recommended for the occasional worker. First of all, the heat cannot be controlled easily, and the metal may become tarnished. Secondly, there is the danger of making the metal brittle, which is bad for bending and hammering. Moreover, where durability is needed, the crystallized metal may be questionable for service and application.

For ordinary work, the metal should be thoroughly impregnated with gentle heat. This will loosen up all the molecules and atoms. While they will not melt like butter out of the refrigerator, the sheet or tube will become quite pliable. The tools, such as vise, hammer, pliers, and saw should also be warm to keep the metal workable during the entire time it is being machined.

In summer the metal might be placed in the sun to get it thoroughly warm. If the metal can be made black, so much the better, since it will absorb the heat so much better. In winter time, the metal can be placed near the furnace or heat-radiator, over the hot-air grating, or even in the kitchen oven. However, the heat should be low and allowed to soak through the metal slowly and thoroughly.

Name Plate Hazard

LLOYD H. LUTZ, Engr.
WMOP, Ocala, Fla.

It is interesting to note how a manufacturer of electronic equipment will save a few cents each by cementing on metal name plates.

Such practice caused a recent failure of the high-voltage power supply in the remote controlled transmitter at this station. After nearly four years of operation, a voltage resistor unit for the extension plate voltmeter shed an aluminum identification plate which fell against the grounded cabinet interior and a high potential terminal.

Operators who maintain such equipment may avoid trouble by investigating "pasted-on" metal parts and secure same by a better method.

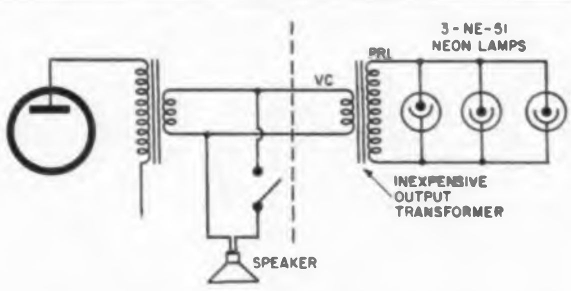
Modulation Indicator

NORMAN BOWMAN, Ch. Engr.
KBTM, Jonesboro, Ark.

Stations operating with remote control usually have an AVC operated relay alarm to give an indication of carrier failure. With a simple inexpensive addition you can have an indicator to show modulation as well as carrier failure.

We mounted three NE-51 neon lights in a cluster next to our Western Union clock. As the announcers are time conscious, they will notice them in this position more readily.

Set to give a good flash with modulation, but low enough not to indicate when no modulation is present, lamps will fail to operate when carrier or modulation fails.



Set the volume control on the receiver to give a good flash with modulation but, low enough as not to indicate when no modulation is present. Then when either carrier or modulation fails, the lights will fail to operate.

More Cues on Page 012

Recording In The Small Station

Radio stations of less than 10,000 watts are permitted to operate with less technical personnel. A simplified recording system considering this is treated.

By HOWARD SHEETS
Chief Engineer, WNOR
Norfolk 7, Virginia

MANY of the smaller broadcasting stations are operating with a limited engineering staff under current FCC regulations. It is advantageous to design the studio and recording equipment of such a station for operation by non-technical personnel.

This recording system was designed and has been used for several years by WNOR. It utilizes a minimum of switches and seldom requires more than one patch cord; none for program air checks or normal tape playback.

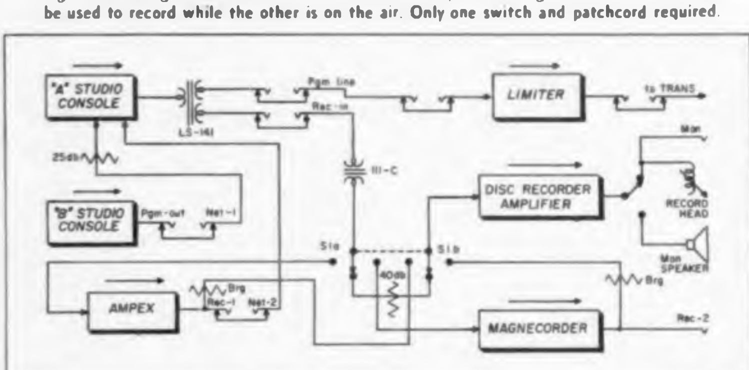
The design is based on a two-studio operation with "A" Studio serving as master control (it may be, and quite often is, unattended). "B" Studio operates as an adjunct of "A" Studio, or separately, as desired. Recording can be done from either studio, while the alternate studio is on the air, and recording facilities are available while playing back programs from either tape recorder.

A single telephone-type switch, S1, Fig. 1, permits selection of either of two tape recorders or a disc recorder for recording, and switches the disc recorder amplifier across the output of either tape recorder for monitoring or "dubbing."

A switch at the disc recorder amplifier output permits selection of either the monitor speaker or the cutting head. Fig. 2 shows details of S1 and its associated circuitry.

Referring to Fig. 1, it is seen that the output of the "A" Studio program amplifier is fed to a hybrid coil (UTC LS-141 or equivalent). One of the two outputs provided by the hybrid coil feeds the limiting amplifier and transmitter. The other output normally feeds the selector switch S1 through a line transformer (W.E. 111-C or equivalent). In the right or left-hand positions, switch section S1a selects the desired tape recorder while

Fig. 1: This diagram shows how either of two studios, one serving as master control, can be used to record while the other is on the air. Only one switch and patchcord required.



S1b bridges the output of that recorder. The center position feeds program directly through the switch and a level pad to the disc recorder amplifier.

A single patch cord from "B" Studio Pgm-out to Pgm-line will permit recording from "A" Studio or a single patch cord from "B" Studio Pgm-out to Rec-in will permit recording from "B" Studio.

The output of the Ampex recorder, Rec-1, feeds the "A" Studio console through the Net-2 input key. It may be patched to the "B" Studio console by patching Rec-1 out to any "B" Studio console remote-line input-jack. Similarly, the output of the Magnecorder, Rec-2, may be patched to either studio.

The Ampex recorder is remotely controlled from either studio, providing a "one-man" recording/playback operation.

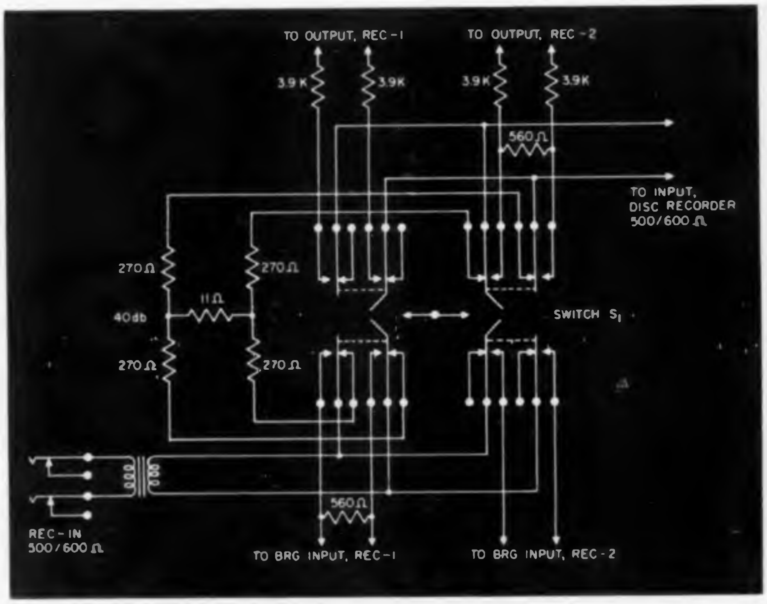


Fig. 2: Details of switch S1, Fig. 1. Upper half is equivalent to section S1a which selects the desired tape recorder; lower to S1b which bridges the output of that recorder.

FM in the Car

(*Continued from page 013*)

distributor. 0.05 mfd. capacitors are connected from the following points to automotive ground; hot terminal of generator armature; battery side of ignition coil; battery side of voltage regulator. A short piece of heavy, tinned-copper, braid is connected between the engine and secured under the stud holding the power supply unit bracket to the fire wall. This braid provides additional bonding between the body and the engine.

General Results

Reception of FM broadcasting in a car is astounding. It is a unique experience to drive over hill and dale, under bridges, through short tunnels, on the streets of New York among the tall buildings, under trees and beside power lines and *all the time have the program volume remain at a constant level.*

There is none of the "drop-out" experienced with AM. There is no noise in passing a neon sign or a high tension line. Although the signal strength varies, as indicated by the meter, the listener is totally unaware of this. Furthermore, each station has approximately the same volume for the same volume control setting.

The center of the vertical antenna is only 55 inches above the ground. It is extremely effective for receiving FM stations. We received signals from WNHC-FM, New Haven, Connecticut, and WALK-FM, Patchogue, L. I., New York, in the vicinity of Point A (see map), the distances being about 70 miles or so by air.

Local Results

With the car parked within a block from the antenna of a 10 KW (ERP) FM station the meter reads 6. A meter reading of 1½ gives program volume of acceptable quality.

The table and map give qualitative signal strengths of various stations at locations in New York City and other locations. Although we parked the car to tune in each station and take the meter reading, the same readings prevail when the car is moving. The speed of the car has no effect on the signal. We made observations on the New Jersey Turnpike and the Garden State Parkway (N. J.) at the maximum legal speed limit, 60 mph.

First Conclusions

It is proven that FM broadcast reception in an automobile is not only feasible, but superior to reception of AM broadcast stations.

While all FM broadcast stations use horizontal polarization, a vertical antenna provides excellent reception. There is the added advantage of being virtually nondirectional.

Reception is excellent in Metropolitan New York and to a radius of 40 to 50 miles from the transmitter. Especially startling is the constant volume level of the program material in the presence of man-made structures and natural obstructions that tend to shield and degrade AM signals. Although there are differences in carrier level from various stations this has no effect on the program volume level.

Some engineers have expressed the opinion that the carrier frequency, rather than the fact that frequency modulation is used, accounts for the superior reception.

(*Continued on page 026*)

FM in the Car

Fig. 3: The Blaupunkt radio used in this series of tests is one of several makes available in this country for auto installation.

(*Continued from page* 025)
Putting it another way, they say if the FM stations were to use amplitude modulation, the results will be the same.

Nothing can be further from the truth. Tests performed in the 144-148 MC band using AM transmitters and receivers reveals the same reception deficiencies experienced in the AM broadcast band.

It is the frequency modulated carrier, not the carrier frequency, which gives the superior reception.

Touring

We made a 1500 mile trip to observe FM broadcast reception on an automobile receiver at localities away from New York City. The route was from New York over the New York Thruway to Buffalo. From there via the Queen Elizabeth Way to Toronto, Ontario. King's Highway 2 from Toronto was followed to Kingston, Ontario, the Gateway to the Thousand Islands, then over the Thousand Island International Bridge back to the United States.

From Alexandria Bay on Route 12, through the mountains to Utica, New York, then to Albany. At the Massachusetts line the recently opened Massachusetts Turnpike provided easy driving through the Berkshire Mountains to Boston and Gloucester.

The return route to New York was the Turnpike to Lee, then Stockbridge and Great Barrington, Mass. Then to the Taconic State Parkway in New York to Route 301 and 9D to the Bear Mountain Bridge. From that point the Palisade Interstate Parkway led to the George Washington Bridge.

About three-quarters of the trip was made through mountainous regions, with many peaks over 2000 feet. Rugged terrain is supposedly detrimental to VHF progation. However, all along the route we listened to FM broadcast stations.

Reception enroute will now be discussed in detail. In most cases, more information is obtained by staying tuned to one station and observing the effect on the signal strength as the distance from the transmitter increases. Obstructions, especially mountains, cause the signal to fluctuate as the road dips into valleys and winds along the slopes. Differences in signal strength is only apparent by the variation in meter reading and not the volume level. All reception is with the car in motion, unless otherwise stated. Stations mentioned are FM stations. Nearly all FM stations broadcast the same program as the affiliated AM station.

From time to time the receiver was switched to the AM broadcast band for comparison of reception with FM. The results on AM are so poor that no comment will be made. The receiver performs better on AM than many home-type AM receivers, within the limitations of AM reception. While driving in Buffalo, at three o'clock in the morning, AM stations from Boston, Mass. and Richmond, Va. were heard with good volume. Of course, the usual fading and other reception defects were present, too.

On leaving New York WCBS was tuned in. The meter reading being 5. By the time the Harriman exit on the Thruway was reached the signal was down to about 1. The program was no longer understandable and the background noise high.

Afterward, WPIK, Poughkeepsie, N. Y., provided program for about 70 miles. Some 30 miles south of Albany two stations were checked — WGFM (Schenectady) and WFLY (Troy). The signal from both stations read about 3 at that point.

The following stations were tuned in while going West on the Thruway:

WRUN	Utica, N. Y.	4.0
WODS	Syracuse, N. Y.	3.0
WSYR	Syracuse, N. Y.	3.8
WRNY	Rochester, N. Y.	2.5

Numerous other stations were heard, but time did not permit identifying them, as at a speed of 60 miles, distance is covered quickly, and some stations give their call letters every half hour.

About 50 miles from Buffalo WBEN and WBNY came booming in. Signal strength being about 2 to start and increasing to over 5 on the outskirts of Buffalo.

Continuing into Canada several stations were heard with good signal strength. The Toronto FM stations have signals over 5 in all parts of the city.

Leaving Toronto, going East toward Kingston, both WBEN and WBNY have 2.5 signals in Coburg, Ontario, about 80 air miles from Buffalo. At Colburne, Ontario, WHCU (Ithaca, N. Y.) has a 2 signal. The distance is 115 miles over rough terrain and Lake Ontario.

Returning to the United States and heading toward Boston from Albany on the Massachusetts Turnpike WFLY (Troy) was monitored. This station put in an acceptable signal to a point 36 miles from the beginning of the Turnpike, an airline distance of about 60 miles from Troy, with many intervening mountain peaks.

On the Turnpike beyond Springfield, Mass. the following stations were logged:

WMAS	Springfield, Mass.	3.00
WMMW	Meriden, Conn.	1.75
WNHC	New Haven, Conn. (88 miles)	2.00

Approaching Boston the dial was alive with FM stations. In Belmont, a suburb of Boston, a few stations were checked for signal strength, as tabulated below:

WCOP		4.6
WCRB		4.0
WEEI		4.2
WLLH	(LOWELL)	3.5
WNAC		4.2

On the return trip, leaving Boston, WXHR was monitored. The signal dropped below 1.5 at Sturbridge, which is about 60 miles.

Fig. 4: The FM antenna, made by Antenna Co. of America, mounts on the trunk lid.

In Great Barrington, Mass., a check showed that WGFM (Schenectady) and WFLY (Troy) have a 3 and a 2.5 signal respectively. On Route 9D, leaving Cold Springs, New York, WBAI was tuned in all the way to New York. The signal was over 5 near the George Washington Bridge.

The reception obtained with FM during this trip conclusively indicates that it is a highly desirable means of receiving programs in a car—with the same quality as obtained with FM receivers in the home.

* * *

Interference

(*Continued from page* 018)

Receiver Pattern

The test equipment as arranged in the block diagram, Fig. 5, can be used to measure the complete receiver interference rejection pattern except for the portion produced by intermodulation interference. The receiver under test is tuned to frequency f_o and the audio output is connected to a distortion analyzer adjusted to read sinad ratio in db. (Sinad ratio is a measurement of distortion expressed in db instead of percent.) The desired signal, modulated with ⅔ of rated deviation at 1000 cps, is adjusted in level to produce a 12 db sinad ratio at the receivers' audio output in the absence of interference. Two thirds of rated deviation is equivalent to ±10 KC deviation for the type of equipment under discussion. The voltage V_r required to produce the 12 db sinad ratio is recorded as the receivers sensitivity and is used as a basis of comparison with the level, V_x, of the interfering signal to calculated values of interference signal levels in db. The frequency of the interfering signal is adjusted from f_o to plus or minus the required frequency separation to obtain a complete receiver interference rejection pattern. The cavity filter is adjusted to the interfering signal frequency to attenuate extra band radiation from the interfering signal generator. (Care must be taken to insure that the interfering generator is highly stable and produces a minimum of extra band noise radiation.) Extra band noise radiation from the interfering signal generator operating at frequency separations between 40 KC and 100 KC may require further attenuation to obtain accurate pattern measurements. In such cases a second or third cavity may be added in series to obtain the highest possible interference signal level. The interfering signal generator is adjusted in level to reduce the previously established 12 db sinad ratio to 6 db for each frequency setting. For a frequency setting of f_o the level of the interfering signal generator is normally about 6 db below the receiver's sensitivity. This point which is about 6 db below the receiver sensitivity is referred to as the nose of the receiver in Figs. 1 and 4. The voltage, V_x, required from the interfering signal generator to reduce the 12 db sinad ratio by 6 db is divided by the reference voltage V_r. The resulting ratio is converted to db to locate points on the receiver pattern corresponding to the frequency separation.

Receiver intermodulation patterns when measured in accordance with the block diagram of Fig. 6 require only a slight modification of the above described test procedure. The desired signal is adjusted to produce the standard 12 db sinad ratio. Two separate interfering signal generators are also connected to the receiver under test and are adjusted in frequency to produce third-order intermodulation on the desired signal frequency f_o. No additional filtering of the interfering signals such as the cavity filter used in Fig. 5 is required since third-order intermodulation signal level produced in a receiver is normally larger than that produced in the interfering signal generators. Some care must be taken to maintain the voltages V'_i and V''_i within about 20 db of each other to prevent other types of interference in the receiver. To measure the complete intermodulation pattern V'_i and V''_i are adjusted at an equal level to produce 6 db reduction in the 12 db sinad ratio with the third-order on frequency f_o. While one interfering signal generator is held constant, the second is varied in level and frequency to maintain the established interference. The same procedure is repeated with the second interfering signal generator held constant. As shown on Fig. 1, the near frequency signal generator interference pattern is reduced in frequency variations by 2 to 1. The interference signal level is calculated in db from the ratio V'_i/V_r or V''_i/V_r.

Transmitter Pattern

The transmitter pattern is measured using block diagram Fig. 7 for arranging the test equipment. The receiver as measured in accordance with the above described test procedure is used as a unit of test equipment to make the transmitter pattern measurement. A cavity filter tuned to frequency f_o provides protection to the receiver from interference due to limitations of its own interference rejection pattern. The most critical region, in the transmitter pattern from a measurement standpoint, is for a frequency separation between 15 KC and 30 KC. To obtain correlation of results in this region, the modulation side bands must be produced by some standard modulating signal which can closely simulate average voice[2]. In taking the transmitter pattern, the same procedure is used as described for Fig. 5. The radiation level in db is calculated from the ratio of V_2/V_1. The values in db are used together with the frequency separation to draw the transmitter pattern by using the nose of the receiver to locate the points on the pattern. Once the transmitter pattern is complete it can be used for comparison with any other *FM* receiver pattern of comparable bandwidth. Transmitter patterns for comparison with receivers designed to receive other types of modulation, or transmitter patterns for comparison with receivers of other band widths must be taken with the type of receiver they are to be compared with.

The transmitter intermodulation portion of the transmitter pattern is taken in a similar manner. An external signal as shown in Fig. 8 is introduced into the transmitter under test through an attenuator for different values. The cavity filter tuned to frequency f_o is used to prevent intermodulation in the receiver and to provide an improved receiver pattern. The 50 db attenuator value was chosen to obtain a typical intermodulation pattern representative of transmitter operating with closely spaced antennas. One or both transmitters may be modulated or unmodulated to obtain patterns for all possible conditions. The radiation level in db is calculated from the ratio V_2/V_1. An adjustable attenuator, not shown, would normally be required between the transmitter under test and the receiver tuned to frequency f_o to facilitate adjusting the level of the third-order product to produce a 6 db reduction in the 12 db sinad ratio. The 12 db sinad ratio is provided by the voltage V, when the interference is turned off.

Conclusions

The most important factor in the reduction of interference in a system is to determine the type and cause. Some systematic method of interference analysis must be applied since it is not easily determined whether the interfering transmitter or the receiver being interfered with is at fault in the production of interference. It has been shown that bi-dimensional patterns formed according to standard rules can be a powerful tool in determining the type of interference and establishing the cause.

References

1. R. Engels and J. Augusting, "UHF Interference" Proc. of the Second Conference on Radio Interference Reduction, 1956.
2. Neal H. Shepherd, "Sinad Interference Evaluation by Vosim," I. R. E. Convention Record, P. G. V. C. March 1957.

RCA POWER TUBES give "WORKHORSE" Service

at Sherwin-Williams

Radio "covers the yard" with a big assist from dependable RCA Power Tubes.

Yard management for this world-famous paint manufacturer has credited its two-way radio installation with a two-for-one increase in overall materials-handling efficiency. At the heart of this vital communications system, RCA Power Tubes are proving out their famed "proved-in" performance—another good reason why more and more mobile communications systems in many industrial activities incorporate long-life, reliable RCA Power Tubes.

Your RCA Industrial Tube Distributor stands ready to serve and supply you with RCA Power Tubes for your radio communications requirements.

The best mobile communications systems rely on the best in power tubes . . . RCA.

RADIO CORPORATION OF AMERICA
Electron Tube Division — *Harrison, N. J.*

Circle 80 on Inquiry Card, page 101

New Products

MOBILE RADIO

New 60 or 30 w. transistor-powered mobile radios in low band (25-54 MC), 25 or 50 w. in high band (144-174 MC) and 15 w. in Citizens' Band (450-470 MC) are available. Transistorized

power supplies in the new units are associated with both the transmitter and receiver. Mounted externally on the front of the mobile combination is a grille-like "heat sink" for fast heat dissipation. They may be used with either positive or negative ground 12 vdc systems. General Electric, Communication Products Department, Electronics Park, Syracuse, New York.

Circle 233 on Inquiry Card, page 101

TWO-WAY RADIO

Equipment to operate in the 890 to 960 MC. UHF range, providing point-to-point radio circuits for remote control and other purposes is available. Available in either upright

indoor or weatherproof outdoor cabinets, are completely functional units, including transmitter, receiver, power supply, termination and metering facilities. The control station is provided with loudspeaker and other audio termination equipment. Can also be supplied for point-to-point multiple channel communications. Motorola Inc., 4501 W. Augusta Blvd., Chicago 51, Ill.

Circle 234 on Inquiry Card, page 101

. . . for Communications

FM SIGNAL GENERATOR

Model 1064/2 covers all mobile radio r-f bands and most i-f's in one portable instrument weighing 26 lbs. Frequency ranges are 450-470MC, 118-185MC, 30-50MC, 290KC-16MC. FM deviation is ± 3.5 KC and ± 10 KC, or to order. Output is calibrated 0.025 μv to 5 mv, up to 100 mv uncalibrated. A new design approach has given it good stability and very short warm-

up time. Attenuator reaction and leakage are negligible. Marconi Instruments, 111 Cedar Lane, Englewood, N. J.

Circle 235 on Inquiry Card, page 101

COLOR TV MONITOR

Engineered for the ultra-high quality, stability, and uniformity required in color-broadcast and closed-circuit operations, the 21 in. monitor reproduces all information contained in a compatible color picture. It presents the scene exactly as the camera sees it, and facilitates pin-pointing elements of the overall TV system which may need adjustment. The TM-21

monitor provides precision checks. Designed for ultra-simple initial adjustment without an oscilloscope. Radio Corp. of America, Camden 2, N. J.

Circle 237 on Inquiry Card, page 101

SSB ADAPTER

The compatible single - sideband transmitter adapter is offered to the radio broadcast and HF communications industry. The system has been designed to convert any standard high-level, low-level, or Doherty type AM transmitter to a new and improved type of single-sideband operation. Transmitters can be adapted without engineering modifications,

and reception is completely compatible on all existing AM receivers. Kahn Research Labs., Inc., 22 Pine St., Freeport, N. Y.

Circle 238 on Inquiry Card, page 101

MAGNETIC TAPE

Another new number, "Fortified" Double-Play Tape, is being introduced for tape recorders. The No. 400 reduces the problem of stretching because it is made on Du Pont's Mylar

polyester base, in this case 60-gauge Mylar, specially reinforced for sinewy strength. It will withstand a pull of 3 lbs. without distortion. It has the same long playing features as the No. 724 Double-Play. One 7 in. reel, carrying 2400 ft., at 3¾ ips will take a two-hour recording on single track or four hours on dual track. ORRadio Industries, Inc., Shamrock Circle, Opelika, Ala.

Circle 236 on Inquiry Card, page 101

Circle 79 on Inquiry Card, page 101

Dielectric Constants

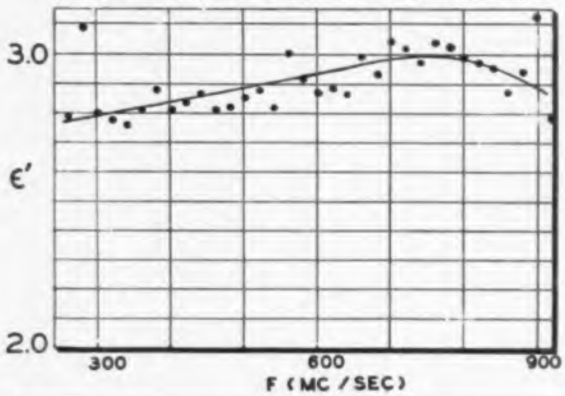
(*Cont. from page* 010)

Measurement of the dielectric constant of water over this range gives a mean value of approx. 71. However, there is considerable fluctuation in this value. This is believed due to the accuracy limitation of the measuring line for there is not an appreciable difference in the resonant lengths of the lines when the cell is filled with water and when filled with mercury, particularly at high frequencies.

The accuracy of the dielectric constants obtained here is limited by the measurements of the resonant lengths and band widths. A more precisely threaded screw would considerably improve these measurements. It should be noted that the losses in the measuring line must be considered when dielectrics of very low loss are studied and Eq. 3 must be modified accordingly.

The author wishes to thank Prof. J. A. Cronvich, Electrical Engineering Dept., Tulane Univ. for the use of the measuring line.

Fig. 3: Dielectric constant of glycerine as function of freq.



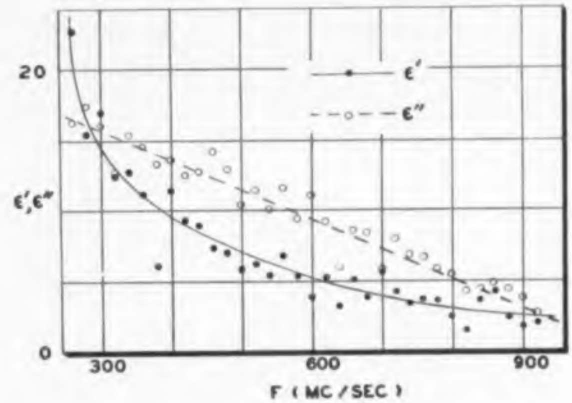


Fig. 4: The real part of polystyrene as a function of frequency.

References

1 For example, see: C. G. Montgomery, *Techniques of Microwave Measurements.* McGraw-Hill Book Co., Inc., New York, 1947.
2 Chipman, R. A.: Resonance Curves Method for the Absolute Measurement of Impedances at Frequencies of the order of 300 Mc/sec. J. Appl. Phys., 1939, 10, 27.
3 Hartshorn, L.: *Radio Frequency Measurements by Bridge and Resonance Methods.* John Wiley & Sons, New York, 1943.

New Tech Data for Engineers

Frequency Standard

A 12-page technical bulletin issued by Marconi, 111 Cedar Lane, Englewood, N. J. describes in brief detail their quartz servo frequency standard type RD 101. Two-color booklet contains complete technical data along with drawings and sketches.

Circle 190 on Inquiry Card, page 101

Laminated Plastics

The Taylor Fibre Co., Norristown, Pa. has issued a 2-color, 8-page booklet describing their laminated plastics and vulcanized fibres. The brochure is complete with descriptions, photographs, and tables giving general data and engineering data.

Circle 191 on Inquiry Card, page 101

Industrial Colorado

Two brochures have been issued by the Grand Junction Chamber of Commerce, 127 N. 4th St., Grand Junction, Colo. describing the growth and advantages of the Western Colorado area for industry. Brochures are complete with tables and maps.

Circle 192 on Inquiry Card, page 101

Tape Cable

A folder containing 8 engineering bulletins has been issued by the Tape Cable Corp., 790 Linden Ave., Rochester 10, N. Y., describing completely their tape cable, its uses and benefits derived from its use. Complete specifications are included.

Circle 193 on Inquiry Card, page 101

Transformers and Inductors

A 14-page, 2-color brochure has been issued by Pulse Engineering, 2657 Spring St., Redwood City, Calif. describing their complete line of toroidal inductors and transformers, wave filters, magnetic amplifiers, saturable reactors, and speciality transformers, along with pulse components. Brochure is complete with photographs, electrical and mechanical specifications, charts and graphs.

Circle 194 on Inquiry Card, page 101

Molded Plastics

A 12-page, 2-color booklet issued by The Richardson Co., 2700 Lake St., Melrose Park, Ill., contains pictures and descriptions of molded and laminated plastic applications. Laminated applications include printed circuits, industrial gears, bearings, and aviation cable guards. Booklet also shows production scenes at the company's general offices.

Circle 195 on Inquiry Card, page 101

Radar Calculator

Radar calculator provides a jamming figure of merit for radar system engineers. The hand calculator with its simplified scale settings eliminates slide rule calculations formerly required to determine the distance at which signal energy received at the radar is large enough to show through the jamming noise. Available to radar engineers from Electronics Research Lab., AVCO Research and Development Div., 750 Commonwealth Ave., Boston, Mass.

Circle 196 on Inquiry Card, page 101

High Frequency Transistor

General Transistor Corp., 91-27 138th Place, Jamaica 35, N. Y., has issued a 12-page brochure describing their high frequency transistors. Brochure gives maximum ratings, cut-off and small signal characteristics, and charts showing the common emitter output static characteristics.

Circle 197 on Inquiry Card, page 101

Transistor Plug-ins

Engineered Electronics Co., 506 E. 1st St., Santa Ana, Calif., has issued a 2-color bulletin describing their new silicon transistor plug-ins. These transistor plug-ins are a complete circuit such as flip-flops, one shots, linear amplifiers, blocking oscillators, etc. Complete specifications are included.

Circle 198 on Inquiry Card, page 101

Weldable Strain Gages

A 4-page, 2-color brochure has been issued by Micro-Test, Inc., 657 N. Spaulding Ave., Los Angeles 36, Calif. describing their weldable strain gages. Brochure is complete with photographs, tables, and graphs.

Circle 199 on Inquiry Card, page 101

TV Distribution Handbook

Entron, Inc., P. O. Box 287, Bladensburg, Md., has issued a 24-page booklet describing their complete line of community TV equipment and accessories. The booklet contains complete electrical and mechanical specifications along with photographs, tables, and graphs.

Circle 200 on Inquiry Card, page 101

Variable Transformers

Bulletin 151 issued by the Ohmite Mfg. Co., 3668 Howard St., Skokie, Ill., describes their line of "V.T." variable transformers. Bulletin is complete with photographs, outline drawings, charts, and specifications along with prices.

Circle 201 on Inquiry Card, page 101

Saturable Reactors

Control, a division of Magnetics, Inc., Butler, Pa., has issued Bulletin CO15 describing their proportion reactors, transductors and switching reactors. This 2-color, 4-page brochure describes both physical and electrical properties, dimensional container outlines and complete tables.

Circle 202 on Inquiry Card, page 101

Airborne Tape Recorder

A 16-page brochure on Ampex 800 mobile and airborne magnetic tape recorder is available from the Ampex Corp., 934 Charter St., Redwood City, Calif. Brochure gives complete equipment description, detailed specifications, photos of typical applications and a tabular presentation of the various data requirements served.

Circle 203 on Inquiry Card, page 101

Teflon Terminals

Up-to-the-minute data on Teflon terminals and connectors are provided by "Terminology," a bi-monthly news bulletin available from the Sealectro Corp., 610 Fayette Ave., Mamaroneck, N. Y.

Circle 204 on Inquiry Card, page 101

Silicon Rectifier

Bulletin No. 5 issued by Audio Devices, Inc., 620 E. Dyer Rd., Santa Ana, Calif., describes their Model A-200 silicon rectifier. Complete mechanical and electrical specifications are given along with graphs and typical installations circuits. Rectifiers are all welded and hermetically sealed and are threaded at both ends.

Circle 205 on Inquiry Card, page 101

Servomotor

A new size 11 inertia-damped servomotor, manufactured by Helipot Corp., Newport Beach, Calif., is graphically introduced in Data Sheet 915. Complete electrical and mechanical specifications are given along with photographs.

Circle 206 on Inquiry Card, page 101

Printed Circuit Receptacle

A 2-color bulletin issued by Cannon Electric Co., 3208 Humboldt St., Los Angeles 31, Calif., describes their new MS type printed circuit receptacle designed to mate with 1 to 4 printed circuit boards. Complete information is included in the bulletin.

Circle 207 on Inquiry Card, page 101

New Products ... for the Electronic Industries

PRODUCTION CALENDAR

A king size, 25 year, reminder-type, wall calendar with changeable monthly calendar cards having big date spaces for eraseable notes is available. Called "SKED-U-CAL," it is approximately 2 ft. sq. It has a

rigidly constructed and colorfully lacquered backboard of processed wood (masonite) designed to hold a complete set of monthly calendar cards and to serve as a channel for sliding the cards to left or right, as desired. Cards can be inserted or removed from the front as well as from the sides. Price is $28.50 FOB. L. D. Blehart Co., Lucas Bldg., 10 Fiske Pl., Mt. Vernon, N. Y.

Circle 239 on Inquiry Card, page 101

AC VOLTAGE REGULATOR

The Model APR1010, a tubeless all-purpose ac voltage regulator, can solve nearly all regulator problems found in the laboratory or on the production line. It can be used to regulate average and peak voltages as

well as RMS, independent of input waveform. By turning a switch, the regulator output can be matched to special requirements of the load. It also provides 5 sensing arrangements: internal (normal ac regulation); external ac (any ac voltage); remote (115 vac at a remote location); constant current, and dc. Sorensen & Co., Inc., Richards Ave., S. Norwalk, Conn.

Circle 241 on Inquiry Card, page 101

FREQUENCY METER

Direct-reading frequency meter, Type 590-A, allows quick determination and easy reading of frequencies in waveguide systems operating between 5100 and 5900 MC. It consists of a TE_{011} mode cavity resonator

tuned by a non-contacting plunger. The calibration spiralled around a drum dial indicates frequency directly in MC. Cavity is coupled to a section of waveguide fitted at both ends with cover flanges, enabling the units to be inserted directly into any line of matching waveguide size. Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y.

Circle 243 on Inquiry Card, page 101

MYLAR ZIPPERTUBING

Designed specifically for use in the electronic circuits of missiles and aircraft, a new Mylar Zippertubing is now being manufactured. Used as a protection for existing installed wires, cable or tubing, or as a cable jacket or shield. By laminating Mylar Zippertubing with aluminum, it is now possible to quickly construct shielded

cable without the use of any additional equipment. Available in sizes from ⅜ in. to 4 in., in ⅛ in. increments (I.D.). The Zippertubing Co., 752 S. San Pedro St., Los Angeles 14, Calif.

Circle 240 on Inquiry Card, page 101

BLOCKING TRANSFORMERS

Design of blocking oscillators is greatly simplified by this kit of transformers. The transformers are specifically designed for use in preferred blocking oscillator circuits. Kit consists of 8 oscillator units with turns ratios of 1:1:1 and open-circuit primary inductances from 0.08 to 159 mh. and 2 interstage units with turns

ratios of 5:1:1. These 10 Pulsite transformers are packed in a convenient plastic box for laboratory use. All units plug into 7-pin miniature tube socket. Airpax Products Co., Middle River, Baltimore 20, Md.

Circle 242 on Inquiry Card, page 101

HEATED ANTENNA

The Model GPC-150 ground plane antenna has a 24 v. heating system for complete weather proofing and safe year round operation under the most severe icing and weather conditions. Heaters are located in all radial elements as well as the driven element. The safe, low voltage system can be operated from either a 115

vac or 230 vac line. Thermostatically controlled heaters operate only during freezing temperatures. Frequency range is 40 to 170 MC. Scala Radio Co., 2814 19th St., San Francisco, Calif.

Circle 244 on Inquiry Card, page 101

Wherever you require high power, consider

DELCO HIGH POWER TRANSISTORS

Thousands of Delco high power germanium transistors are produced daily as engineers find new applications for them. In switching, regulation, or power supplies—in almost any circuit that requires high power—Delco transistors are adding new meaning to compactness, long life and reliability.

All Delco transistors are 13-ampere types and, as a family, they offer a collector voltage range from 40 to 100 volts. Each is characterized by uniformly low saturation resistance and high gain at high current levels. Normalizing insures their fine performance and uniformity regardless of age. Also important—all Delco transistors are in volume production and readily available at moderate cost.

For complete data contact us at Kokomo, Indiana or at one of our conveniently located offices in Newark, New Jersey or Santa Monica, California. Engineering and application assistance is yours for the asking.

DELCO RADIO DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA

BOOTH 1619 AT THE I.R.E. SHOW

Circle 109 on Inquiry Card, page 101

you freedom of choice

signals. Electrically controlled chart drive transmissions permit instantaneous switching on the spot or by remote control.

New functionally designed control panels are clean, legible, easy to understand. All components are readily accessible for fast inspection and simple adjustment. The most comprehensive operating manuals in the industry are included with every Brush product.

Call your nearest Brush factory branch or representative for complete assistance in making your logical choice. If you prefer, write Brush about your requirements.

brush INSTRUMENTS

DIVISION OF CLEVITE CORPORATION

3405 PERKINS AVENUE CLEVELAND 14, OHIO

Circle 110 on Inquiry Card, page 101

New Tech Data for Engineers

(*Continued from page 137*)

Positioning Control

Bulletin GET-2676, 14 pages, describes functions of numerical positional control, gives a detailed breakdown of the three major elements—data input, director, and servo drive—provides data accumulated from particular applications on a variety of machines using this type of control. General Electric Co., Schenectady 5, N. Y.

Circle 208 on Inquiry Card, page 101

Micro Tips

This "How Others Do It" publication is a showcase of ideas submitted by plant engineers. Illustrated by drawings and photographs, this issue covers 6 new methods which can save man hours. Micro Switch, Freeport, Ill.

Circle 209 on Inquiry Card, page 101

Digital Voltmeter

A 4-page bulletin, No. 19-2, describes the new Model 401 DC digital voltmeter. Bulletin is complete with photographs, specifications, and block diagrams. Kin Tel, 5725 Kearny Villa Rd., San Diego 12, Calif.

Circle 210 on Inquiry Card, page 101

Electrical Tapes

Application information and specifications for a complete line of pressure sensitive electrical tapes and epoxy resins for electrical insulations are listed in a new 32-page guide book and catalog available from Minnesota Mining & Mfg. Co., 900 Bush St., St. Paul 6, Minn.

Circle 211 on Inquiry Card, page 101

Ultrasonic Cleaners

The Narda Ultrasonics Corp., 160 Herricks Rd., Mineola, L. I., N. Y., has issued a 2-color bulletin describing their Series 600 ultrasonic cleaners. Bulletin is complete with tables, photographs, specifications, and price list.

Circle 212 on Inquiry Card, page 101

Broadcast Transmitters

A 28-page, 2-color booklet issued by Collins Radio Co., Cedar Rapids, Iowa, describes, in complete detail, their various broadcast transmitters and accessories. The booklet contains price list, photographs with descriptions of each section of the various transmitters, schematics, block diagrams, drawings, signal path flows, and other specifications.

Circle 213 on Inquiry Card, page 101

Laboratory Instruments

The Allen B. Du Mont Laboratories, Inc., Clifton, N. J., have issued a 2-color, short form catalog which gives some quick facts on their line of laboratory instruments.

Circle 214 on Inquiry Card, page 101

Crystal-Video Receivers

Granger Associates, 966 Commercial St., Palo Alto, Calif., has issued Technical Bulletin No. 1 which describes the characteristics of crystal-video receivers employing r-f preamplification.

Circle 215 on Inquiry Card, page 101

Springs and Wire Forms

The Newcomb Spring Corp., 77 E. Hawthorne Ave., Valley Stream, L. I., N. Y., has issued a 12-page, 2-color booklet describing their line of springs. The brochure is complete with hints and tips on springs, tables, photographs, and drawings.

Circle 216 on Inquiry Card, page 101

Electrical Controls

Bulletin 106, 2-color, 12-pages, describes a complete line of all-purpose electrical controls for thickness, torque, current, voltage, radiation, pressure, viscosity, pH, light, speed, and load. Complete electrical and mechanical specifications are included along with photographs. Assembly Products, Inc., 75 Wilson Mills Rd., Chesterland, Ohio.

Circle 217 on Inquiry Card, page 101

Slip Rings

"Design Considerations for Miniature Slip Ring and Brush Assemblies" is a booklet issued by the Poly-Scientific Corp., Blacksburg, Va. Booklet contains interesting information on miniature slip rings and brush assemblies.

Circle 218 on Inquiry Card, page 101

Transformers and Chokes

Catalog No. 102, 2-color, 28-page, has just been issued by Hermetic Seal Transformer Co., 555 N. 5th St., Garland, Tex. Listed, illustrated and described are 390 stock and many special-application audio transformers, chokes, filters, geophysical transformers, high-temperature transformers and reactors, magnetic amplifiers, miniature transformers, power transformers, pulse transformers, reactors, space-save audio units, toroids, and transistor transformers.

Circle 219 on Inquiry Card, page 101

Transistor Chart

Industro Transistor Corp., 35-10 36th Ave., Long Island City 6, N. Y., has announced the availability of a newly revised transistor specification chart which covers the germanium alloy-junction transistors that the company is now manufacturing. Chart also contains an interchangeability guide covering transistors of all manufacturers for computer, entertainment and industrial applications.

Circle 220 on Inquiry Card, page 101

Replacement Guide

A new crystal diode replacement guide is available from Sylvania Electric Products Inc., 100 Sylvan Rd., Woburn, Mass. The new guide contains special data on Sylvania's miniature diodes plus complete listings for all general purpose diodes in the industry.

Circle 221 on Inquiry Card, page 101

Copper Plating Process

Sel-Rex Corporation, Nutley 10, N. J., has just issued an 8-page bulletin describing the new CuSol acid copper plating process. Various features of the process are discussed along with such topics as preparation and maintenance of copper sulphate and copper fluoroborate baths.

Circle 222 on Inquiry Card, page 101

Selenium Rectifiers

Radio Receptor Co., Inc., 240 Wythe Ave., Brooklyn 11, N. Y. has issued a new bulletin No. 248A, giving ratings and dimensions for new high current density Petti-Sel industrial type selenium rectifiers. The bulletin also has data on uprating the rectifiers when cooled by forced air.

Circle 223 on Inquiry Card, page 101

Telemetery and Communications

Tele-Dynamics Inc., 5000 Parkside Ave., Philadelphia 31, Pa., has issued a 20-page booklet which describes in detail their research and development facilities. Booklet contains many photographs showing various equipment and facilities.

Circle 224 on Inquiry Card, page 101

Offset Printing

A 4-page booklet issued by Jas. H. Matthews & Co., 3717 Forbes St., Pittsburgh 13, Pa., describes the function and specifications of 5 different offset printing units for a wide range of industrial printing applications such as steel, plastic, aluminum and other surfaces.

Circle 225 on Inquiry Card, page 101

Eimac
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MADE IN U.S.A.
EIMAC FIRST
Covering the spectrum
with reliable ceramic tubes
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Ceramic Tubes
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2C39B
2C39WA
3CX100A5
3CPN10A5
4CX300A
4CX250B
4CX250K
4CX250M
4CX1000A
4CX5000A
X629
X635
X656
X685C
X693
X694
UHF
Ceramic Tubes
2C39B
2C39WA
3CX100A5
3CPN10A5
3K2500LX
3K2500SG
3K3000LQ
3K50,000LA
3K50,000LF
3K50,000LQ
3KM2500LT
3KM3000LA
3KM50,000PA

4CX300A
4CX250B
4CX250K
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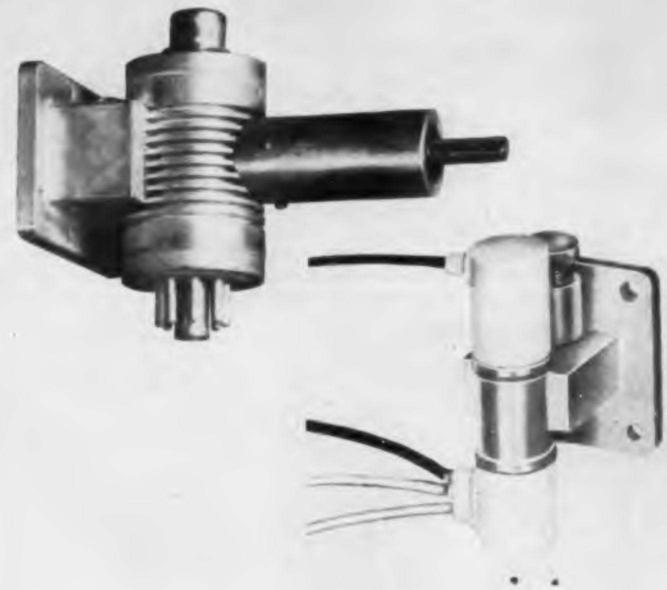

From audio into super high frequencies, Eimac covers the RF spectrum with modern ceramic tubes. This incomparable ceramic electron tube family — more than one-third of the Eimac line — includes reflex and amplifier klystrons, negative grid tubes, rectifiers, pulse modulators, and receiving tubes. The tubes illustrated are typical of more than 40 Eimac ceramic tube types that are being selected by leading equipment manufacturers for use in all types of applications — from tropo-scatter to industrial heating, from single sideband to pulse.

The advantages of reliable Eimac ceramic tubes include: resistance to damage by impact, vibration, and heat; smaller size; and better processing techniques.

Do it yourself — subject an operating Eimac ceramic tube to impact at our unique display, booths 2409-2412, during the New York IRE Show, March 24-27.

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***Eimac First* with ceramic tubes that can take it**

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Ceramic Tubes

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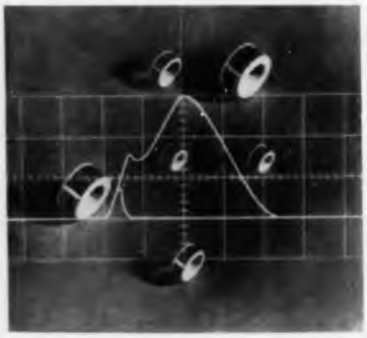
1K20XS
1K20XK
1K20XD

1K20KA
X563
X639
X686

New Products ...for the Design Engineer

MAGNETIC BOBBIN CORES

Magnetic bobbin cores that are consistently uniform for digital data processing systems, small pulse transformers and high frequency magnetic amplifiers are now available. The



precision-made cores are available in either of 2 materials, 4-79 Molybdenum Permalloy and Orthnoik, containing 50% nickel and 50% iron. They are either the highest quality ceramic or stainless steel. Cores are subjected to rigid quality control tests. A complete range of bobbin sizes are available. G-L Electronics, 2921 Admiral Wilson Blvd., Camden 5, N. J.

Circle 245 on Inquiry Card, page 101

VINYL TUBING

Color-coded wiring and printed numbers are easily read through a new, "crystal clear" vinyl tubing. Called "Irvington" brand No. 3022 clear vinyl electrical tubing, the new fungus resistant, flame retardant, low temperature tubing is "clear." It meets the requirements of Mil-I-7444 with its latest revisions. Available in tubing size ranges I, II and III and has a low temperature ASTM brittle point of —100°F with a max. operat-

ing temp. of 185°F. Available in standard coil lengths from number 24 through 3 in. inside dia. Irvington Div., Minnesota Mining and Mfg. Co., Irvington, N. J.

Circle 246 on Inquiry Card, page 101

AIRCRAFT SPEAKER

A new dynamic loudspeaker designed especially to provide high quality sound reproduction in aircraft installations is available. The RC-26 is an 8 in. permanent magnet type. It

measures 2 15/16 in. in depth (front to back) and weighs 1 lb. 7 oz. The cone has special moisture-resisting treatment. Speaker will handle 10 w. of program material. It has a frequency response of 60 to 8500 cps; sensitivity is 88 db; impedance 8 ohms. Is easily mounted by 8 equally spaced holes on 7⅝ in. diameter bolt circle. Stromberg-Carlson, Rochester 3, N. Y.

Circle 247 on Inquiry Card, page 101

PRECISION POTS

A pair of Precision Potentiometers to actuate the hydraulic servo valve in the nose wheel steering system of the new Convair Supersonic B-58 Bomber has been developed. The custom designed Pots consist of a nonlinear control transmitter utilizing a 10:1 gearing system at the shaft input and generating a nonlinear steering curve having a slope ratio of 80:1, either side of center. The position transmitter utilizes 3

parallel linear elements and supplies a feedback signal proportional to nose wheel position. Technology Instrument Corp. of Calif., 7229 Atoll Ave., N. Hollywood, Calif.

Circle 248 on Inquiry Card, page 101

MINIATURE CONNECTORS

Field serviceable subminiature r-f connectors have been added to the line of Subminax components. Besides miniature sizes, features include easy assembly (no special tools), an-

chored center contact (to prevent possible contact recession) and an improved cable clamp mechanism. Plugs, jacks, bulkhead jacks and right-angle plugs are available in screw-on and push-on coupling designs. They have a nominal impedance of 50 ohms, and are for use with miniature RG-196 U Teflon coaxial cable. Amphenol Electronics Corp., 1830 S. 54th Ave., Chicago 50, Ill.

Circle 249 on Inquiry Card, page 101

INDICATOR

A new indicating version of the Dynamaster self-balancing electronic potentiometer or bridge has just been announced. This new indicator is designed for use when legibility of the indicating scale from greater distances is an important factor. It has the same 32 in. long scale and the same pointer as the standard round-chart recorder Dynamaster. There is no recording mechanism, the instrument indicates only. It can be used

for measurements of such variables as temperature, speed, pressure, smoke density, pH, and electrical values. The Bristol Company, Waterbury 20, Conn.

Circle 250 on Inquiry Card, page 101

Design Shortcut for Holding Magnets

Richard A. Scholten, Senior Design Engineer, The Indiana Steel Products Company, describes a fast design method that eliminates complex math. Magnet dimensions are obtained by a simple, three-step procedure using basic performance data.

In this unique method for designing holding magnets, all the hard work is done with graphs. It requires mathematics no more difficult than cubing a number, then taking its square root.

A comparison of configurations is the key to the method. In most cases any magnet design can be used to predict the performance of any other magnet of the same material and geometric shape—regardless of size.

Only three factors are needed for design: desired pull, air gap and geometric shape. If air gap and each magnet dimension are multiplied by the same factor K, the new system will be geometrically similar and the pull force will vary directly as the area of the magnet pole face.

Material to be used must be considered first. For a discussion of magnet material selection, see *Applied Magnetics*, October-December, 1957. Information on four of the 24 designs analyzed is shown here: Design 5, using an Indox I ceramic magnet; Design 10, using Indox V; and Designs 13 and 20, using cast Alnico V magnets. The four designs are illustrated in Fig. 1.

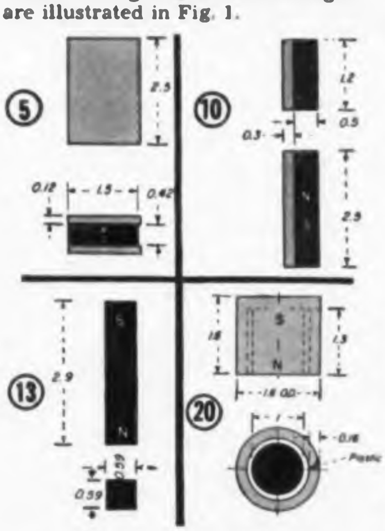


FIG. 1. Four of the basic designs for holding magnets. From these designs other holding magnets, geometrically similar but with any desired pull force, can be derived. Magnetic material is in black, steel in gray; all dimensions are in inches. Design numbers correspond to those on effectiveness curves and in Performance Table II.

Effectiveness curves, Fig. 2, are plotted in terms of pull effectiveness E vs reach factor $G/\sqrt{P}$ (Table I). A magnet with high pull effectiveness has high pull for low magnetic material weight W.

Pull effectiveness E ($=PG/W$) remains constant between any two geometrically similar magnetic systems because P is proportional to the ratio factor K^2 (face area), G is proportional to factor K (length of magnet) and PG is proportional to volume or weight. This is significant because P and G are known or specified for a new design, and a calculation of W can be made from PG/W.

Reach factor $G/\sqrt{P}$ measures G for a specified pull. P is proportional to area; therefore, $\sqrt{P}$, like G, is proportional to linear dimensions. Result is a constant reach-factor value for all geometrically similar magnets. Thus, the same curves — effectiveness vs reach factor — can be used for any magnets similar to the four design examples, regardless of size.

Zero-gap effectiveness E_o has a different value than for a magnet with an air gap, because in this case G is zero.

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TABLE I — Nomenclature

- **G** Air gap, measured from closest point of magnet assembly to armature, in.
- **P** Pull, lb.
- **W** Weight of magnetic material in basic design, lb.

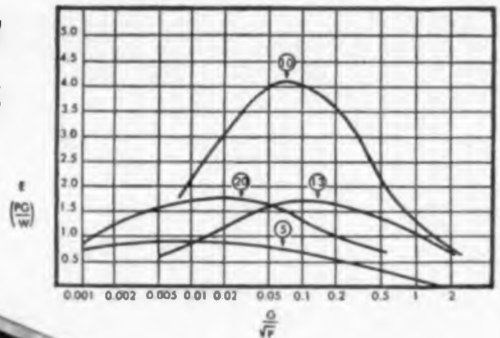

FIG. 2. EFFECTIVENESS CURVES

Indox I (non-oriented) — Design 5
Indox V (oriented) — Design 10
Alnico V (cast) — Designs 13 and 20

HOW TO USE THE METHOD

EXAMPLE: A holding magnet, air-gap type, is required to produce a 10-lb pull at 0.05-in. gap. Reach factor $G/\sqrt{P}$ is $0.05/\sqrt{10}=0.0158$. In the effectiveness curves shown, Design 10 has the highest effectiveness at this reach factor. From the curve, E = 2.7. If this shape is adaptable to the application, the weight of magnet material required is $PG/2.7 = 10 \times 0.05/2.7 = 0.185$ lb. Design 10 in Performance Table uses 0.27 lb of material, so each linear dimension of Design 10 is multiplied by $K = \sqrt[3]{0.185/0.27} = 0.88$ to establish new magnet dimensions.

TABLE II — Performance of Four Basic Holding Magnet Designs

		Indox I	Indox V	Alnico V	
Design Number		5	10	13	20
Weight, lb — Magnetic Material	Actual Wt.	0.27	0.27	0.27	0.27
	Practical Min.	0.01	0.15	0.01	0.002
Weight, lb — Magnet Assy. Wt.		0.55	0.53	—	0.72
Pull for Air Gaps Shown, lb.	0.00	77	20	19	60
	0.002	46	—	—	—
	0.005	39	—	—	41
	0.010	25	—	12.0	32
	0.02	12.0	17.6	9.7	22
	0.04	6.0	14.5	7.2	12.0
	0.08	2.0	11.0	5.2	6.0
	0.15	—	7.5	3.1	2.4
	0.3	—	3.2	1.3	0.8
	0.6	—	0.8	0.4	—

A complete reprint of "Short Cut for Holding-Magnet Design" appears in the October-December, 1957, Applied Magnetics. The article covers the 24 basic designs of holding magnets in all magnetic materials, and discusses material selection considerations in detail. Write for your free copy . . . Dept. N-3.


IT&T
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Today, in 21 locations from coast to coast, thousands of scientists, engineers, technicians, and craftsmen of "*IT&T electronics in the U. S.*" are working to build a greater, more efficient, and stronger America. The scope of their creativity, skills, productivity, and service ranges from tiny diodes to radio navigation and missile control systems . . . from simple fuses to over-the-horizon microwave . . . from miniature rectifiers to manpower to operate the DEW Line! Collectively, their capacity represents one of America's most prolific sources of *Quality Supply* . . . as well as a vital and continuing source of *New Ideas* for tomorrow's electronic and telecommunication systems, equipments, and components. Similar resources and facilities are available around the world . . . through IT&T laboratories, factories, communications, and operating units in 20 countries.

tubes, high-fidelity loudspeakers, microphones, and electronic components. Its subsidiary, Airmatic Systems Corporation, Rochelle Park, N. J., supplies completely engineered automatic, semi-automatic, and manual pneumatic tube systems, and automatic paper and document conveyor systems.

(7) KELLOGG SWITCHBOARD AND SUPPLY COMPANY
Chicago, Ill., Clifton, N. J., and Corinth, Miss.
Engineers, develops, and manufactures switching equipment, subscriber carrier and microwave, and ground communications systems for guided missiles. A leading independent telephone industry supplier for sixty years.

(8) ROYAL ELECTRIC CORPORATION
Pawtucket, R. I., Woonsocket, R. I. and Los Angeles, Cal.
Center of IT&T's wire and cable research, development, and production in the United States. Manufactures a full line of coaxial cables, insulated wire, power supply cords, fuses, and wiring devices.

(9) FARNSWORTH ELECTRONICS COMPANY
Fort Wayne, Ind.
One of the nation's pioneers and oldest leaders in research and development of electronic technology, producing equipment and systems that meet the specialized and advanced capabilities vital to national defense and industry.

OTHER IT&T OPERATIONS IN THE U. S.

International Standard Electric Corporation, New York. Directs the research, development, and manufacturing activities of the IT&T System *outside* the United States.

American Cable and Radio Corporation, New York. The largest American-owned international telegraph system.

IT&T Telephone and Radio Operating Group, New York. Engaged in communications installations, primarily in foreign countries.

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IT&T

Circle 114 on Inquiry Card, page 101

new

flame retardant plastic laminate

INSUROK® XT-901

by Richardson

Here's another new Richardson product which offers many advantages for electronic and electrical applications.

New INSUROK XT-901, as shown in the photos above, is flame retardant. This self-extinguishing feature is not affected by age or service conditions. This material also resists the formation of a carbonized path in the presence of an arc, which feature is desirable in many high voltage applications. Electrical characteristics of this paper base laminate, which is identified by its distinctive red color, exceed the published NEMA values for XXXP phenolic laminates. Electrical and arc resistance properties are retained after exposure to high humidity or immersion in water. It is readily fabricated and punches in the temperature range of 225-275°F.

USES FOR XT-901 INCLUDE:

- High voltage applications such as the TV flyback transformer.
- Applications involving sliding contacts because XT-901 has superior wear and abrasion resistance coupled with excellent arc resistance.
- Riveted assemblies such as relays because low cold flow assures retention of spacing.

Additional features are low water absorption and good dimensional stability under humid conditions.

Write today to Dept. 33 for more information on new XT-901.

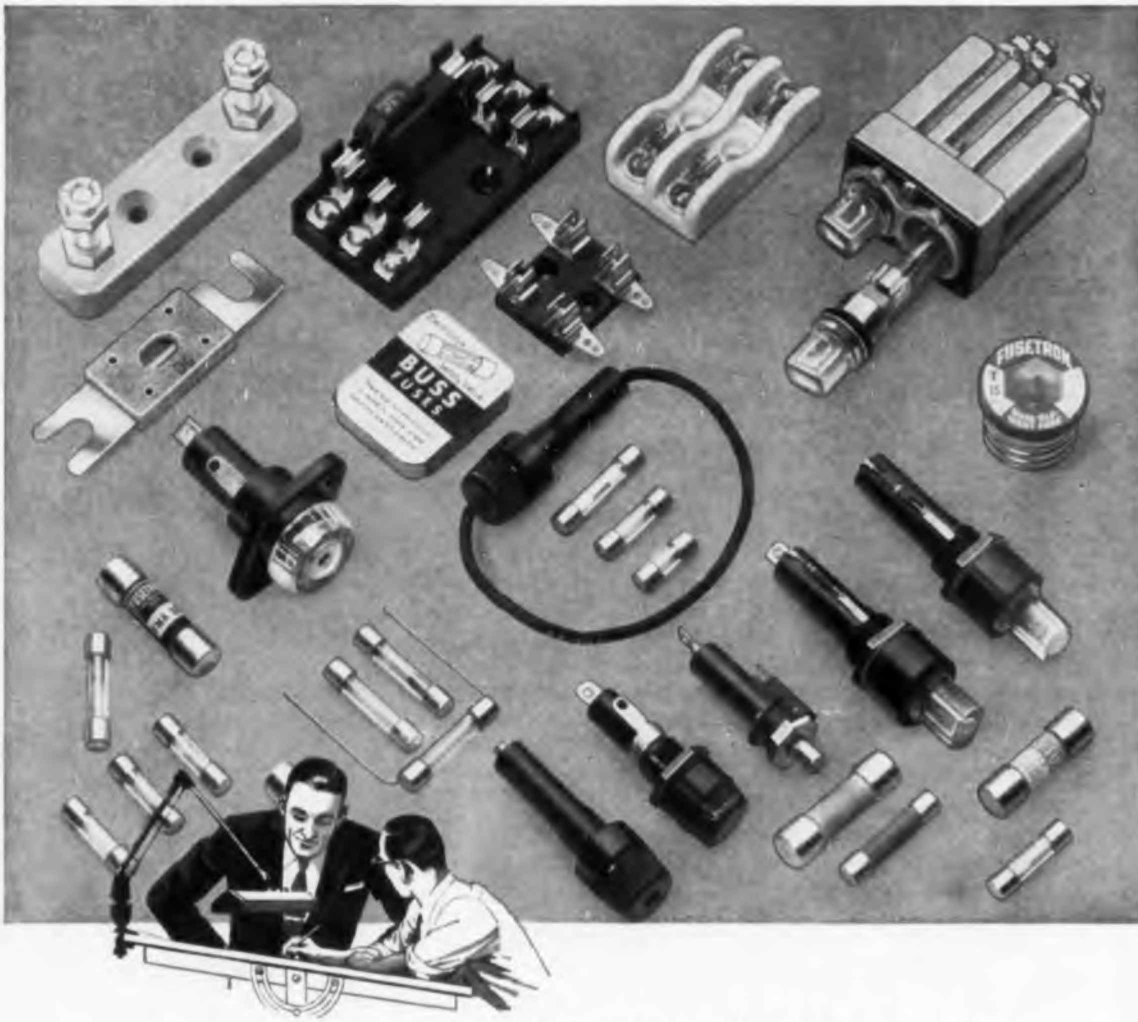
See XT-901 in Booth 1628—I.R.E. Convention
New York Coliseum—March 24-27, 1958

100 YEARS OF EXPERIENCE AND IMAGINATION 1858 1958

the RICHARDSON COMPANY

RICHARDSON PLASTICS LAMINATED and MOLDED

2790 LAKE STREET • MELROSE PARK, ILLINOIS • OFFICES IN PRINCIPAL CITIES



Circle 116 on Inquiry Card, page 101

DeJUR precision potentiometers

...THE ONE BEST ANSWER TO YOUR DESIGN PROBLEMS

SERIES C-050

SUB-MINIATURE ½" • SEALED CONSTRUCTION

ACTUAL SIZE

- One piece nickel plated bronze case and bearing.
- Electrical rotation–320°; Mechanical rotation–325°, or continuous 360°
- Voltage breakdown–1000 volts AC.
- Threaded bushing mounting.

SERIES C-078

MINIATURE ⅞" • GANGED MULTIPLES • INDEPENDENT PHASING

ACTUAL SIZE

- Unit height ⅝"; weight ⅛ oz.
- Independent linearity: ± 1% is standard.
- Linear or non-linear windings on flat card; res. tol. – ± 5% std., ± 1% on order.

SERIES C-158

INTERMEDIATE 1⅝" • GANGED MULTIPLES • INDEPENDENT PHASING

½ ACTUAL SIZE

- Independent linearity: ± 0.5% of total resistance is standard.
- Linear or non-linear windings std., ± 1% on order. on flat card; res. tol – ± 5%
- Rotation: electrical – 320°. Mechanical–325°.

SERIES C-200 (sleeve bearing) BC-200 (ball bearing)

IN-FIELD GANGING • UNLIMITED MULTIPLES • ADJUSTABLE TAPS

2" DIAM.

- Resistance ± 5% standard; to ± 1% on special order.
- Linearity: ± 0.5% independent linearity is standard; ± 0.3% on special order for C-200; ± 0.2% on special order for BC-200.
- Mounting: Servo type or single hole mounting with optional non-turn device.

SERIES C-300

SINE-COSINE

3" DIAM.

- Independent brush contacts produce accurate sine and cosine outputs.
- Function accuracies of ± 1% are standard.
- Multiple ganged units are available.

SERIES KS-200 (sleeve bearing) K-200 (ball bearing)

LONG FUNCTION ANGLES • CLAMP PHASING • HIGH RESOLUTION

2" DIAM.

- Resistance: linear, on triple Formvar copper mandrel.
- Independent linearity: ± 0.5% is standard; ± .1% on order.
- K-200 pots are completely enclosed and may be used as single or multiple ganged units.

SERIES HP-200, HP-300, HP-500

HIGH RESOLUTION • LONG FUNCTION ANGLES • GANGING MULTIPLES

2", 3", 5" DIAM.

- Linearity: ± .5% standard to ± .1% on order.
- Resistance: ± 5% standard to ± 1% on order.
- Rotation: 360° mechanical; 356° ± ½° electrical standard.

WRITE FOR COMPLETE TECHNICAL LITERATURE

Our engineering department can supply prototypes to meet unusual design specifications for tests and approval. Send us your specs for analysis. Electronic Sales Division, DeJUR-Amsco Corporation, 45-01 Northern Blvd., Long Island City 1, New York.

You're always sure with **DeJUR**

PRECISION POTENTIOMETERS

See our complete line at IRE Show, Booth 3911-3913

Guyed tower was designed and built by Blaw-Knox to meet the needs of a southern microwave system.

the towers that simplify microwave expansion

Microwave is set for a big future. More and more progressive companies choose microwave to improve service and lower operating costs. And they're looking for the towers that can keep pace with their expanding microwave plans. Here's how Blaw-Knox microwave towers provide the answer.

designed to established specifications

Blaw-Knox towers provide the positive dependability that only exacting engineering can deliver. All standard towers *meet or surpass* standards and recommendations of the Radio-Electronic-Television Manufacturers Association for safety, wind loading and quality of construction. By maintaining rigid requirements for torque and deflection, these durable towers pay off with trouble free service in the toughest weather and roughest terrain.

360 degree orientation

Even mounting a single dish antenna can cause a problem. But Blaw-Knox towers can be equipped with ring mounts to simplify precise orientation, and to permit future changes in signal path with minimum effort. Then as the system grows, two or three more dishes can be installed and orientated with less work and less cost.

Whether your installation calls for ring or fixed mounts, self-supporting or guyed towers, Blaw-Knox has the experience and the know-how to build the tower system to fulfill your present needs . . . and effectively meet your future needs.

Ring mounts simplify orientation, make future antenna installation easier and less costly.

For details on Blaw-Knox tower design, engineering and fabrication service, send for Bulletin 2538.

BLAW-KNOX COMPANY
Equipment Division
Pittsburgh 38, Pennsylvania

MICROWAVE TOWERS
Guyed and self-supporting towers for Microwave, AM, FM, TV, Radar, Communications . . . Transmission Towers . . . Parabolic Antennas . . . Special Structures. All custom built to meet your requirements.

Circle 118 on Inquiry Card, page 101

NOTICE TO SUBSCRIBERS

A change of address requires four weeks notice. Please notify the Circulation Department, ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Philadelphia 39, Pa., as early as possible. Include, if you can, the imprinted strip on the magazine wrapper showing exactly how it is now addressed. This will enable us to put the change into effect with a minimum of delay. Also, please notify your local postmaster.

THE PUBLISHER ASKS

a favor from you who are users of our Annual June Directory issue. If you're one of the many who prefer the ELECTRONIC INDUSTRIES' directory issue to similar product-finding guides of other publishers, will you write and tell us why you prefer ours? Your letter will be shown to advertising men all over the United States. Your testimonial is as important to us as a sports or show business celebrity's would be to a consumer product. Can you spare a minute to write us a few lines?

ELECTRONIC INDUSTRIES

Chestnut & 56th Sts.
Philadelphia 39, Pa.

Circle 119 on Inquiry Card, page 101

Readin', 'Ritin', and Reliability

Synthane plastic laminated bushings and breaker arms for automotive ignition.

Dependable operation of a school bus, a truck, or your own car involves the functioning of many parts. One breakdown can wipe out the memory of ten thousand trouble-free miles.

Some of these parts are made of laminated plastics. They're usually unseen, unsung, small in size yet efficiently performing their job.

Their cost is relatively insignificant when compared with the cost of equipment in which they work, but it should be sufficient to insure dependability.

Actually, what you pay for Synthane laminated plastics is little or no more than you'd pay for any other plastic laminate. But the Synthane price includes top quality materials, product control, excellent facilities and workmanship, an assurance of continuous supply, and a long reputation for fair dealing.

If you are interested in a reliable source of laminated plastics—sheets, rods, tubes, or completely fabricated parts, write for an interesting catalog or call our representative nearest you.

SYNTHANE

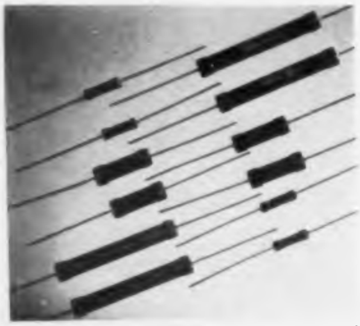
SYNTHANE CORPORATION, 11 RIVER RD., OAKS, PA.

Circle 120 on Inquiry Card, page 101

New Products . . . for the Electronic Industries

FILM RESISTORS

N-style and S-style film type resistors are now available with improved temperature coefficients in all 3 sizes, 1.2, 1 and 2w. The N-20, N-25 and N-30 and S-20, S-25 and S-30 now



have a temperature coefficient of ±0.015% per degree C. The S-style resistors are capable of operating at temperatures up to 200°C and the N-style up to 140°C. Maximum resistance of the N-20 and S-20 in 1.2 w. size is 500K. The N-25 and S-25 in the 1 w. size have a max. resistance of 1.5 meg. Maximum resistance of the N-30 and S-30 in the 2 w. size is 4.2 meg. Corning Glass Works, Corning, N. Y.

Circle 251 on Inquiry Card, page 101

ACCELEROMETER

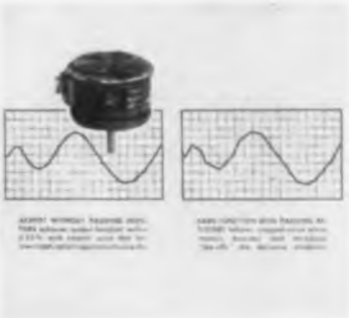
Development of a self-calibrating accelerometer, designed primarily for control and guidance in aircraft and missiles has been announced. Additional applications include fire con-

trol, servo guidance and pitch and yaw correction characteristics. Known as the Glennite Differential Transformer Accelerometer, Model ADT-905, the unit is equipped with a self-contained calibration system which can be used to check the operation of the accelerometer while in use, or to calibrate the accelerometer statically or dynamically. Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J.

Circle 253 on Inquiry Card, page 101

NONLINEAR POTS

A new line of nonlinear, precision, wire-wound Acepots have terminal conformity to 0.25% without padding resistors. They achieve desired output function by use of winding equip-



ment of microscopic accuracy plus newly developed manufacturing techniques. A tabulation of check points showing voltage ratio is supplied for each unit. They can be custom designed for particular applications. In AIA sizes they are immediately available in sine, cosine, square law and logarithmic functions that meet applicable sections of MIL Specs. Ace Electronics Associates, Inc., 99 Dover St., Somerville, Mass.

Circle 255 on Inquiry Card, page 101

MULTIVERTERS

The D (digital to voltage) series of completely transistorized Multiverters is available. This group of high speed (in excess of 500,000 conversions /sec.) devices generate a voltage that is the product of a digital number and a fixed or varying reference voltage. If the reference is an ac voltage, the generated voltage is ac. If the reference is a fixed voltage, the units operate as conventional digital to voltage con-

verters. The devices are completely solid state and contain no moving parts. Packard-Bell Computer Corp., 11766 W. Pico Blvd., Los Angeles 64, Calif.

Circle 252 on Inquiry Card, page 101

VARIABLE TRANSFORMER

A 1.5 ampere unit, Model VT1R5, is now available. It will deliver 1.5 a. at any brush setting, even at full overvoltage. The brush arm carries no current. A pigtail shunts the current from the brush directly to a large copper graphite slip ring. A ceramic hub aligns and mounts the brush arm and provides 3000 vac insulation between parts at line potential and the shaft assembly. It features an internal stop which elimi-

nates possibility of damage to brush and brush arm. Heavy rhodium plating on the brush track prevents oxidation. Ohmite Manufacturing Co., 3667 Howard St., Skokie, Ill.

Circle 254 on Inquiry Card, page 101

PLUG-IN COMPONENTS

A plug-in component package, named "Comp-Plug PR5" is especially designed for use with the new AMP shielded patch cord programming system. These components can be used to patch an entire program into a computer, telemetering equipment or testing equipment. Component is encapsulated in a package with one end terminated in an AMP male pin. The other end can be furnished as a solder terminal, a female receptacle,

or a cable. Diodes, capacitors and RC networks can be supplied to specifications. Eastern Precision Resistor Corp., 675 Barbey St., Brooklyn 7, N. Y.

Circle 256 on Inquiry Card, page 101

New Products

FIXED NETWORKS

Fixed loss and branching networks, numbered 7302 and 7304, replace 4 previous types, known as numbers 1008, 1201, 3046, and 2702. The new items are designed for recording stu-

dios, laboratories, and TV and broadcasting stations. Frequency range is from 20 to 20,000 cps, and are available in line impedances of 30, 50, 150, 250, 500 and 600 ohms. Range of loss is from zero to 50 db. They provide loss for correcting and leveling gain in program circuits and are available as branching networks for circuit mixing. Standard loss pads are provided in "T" and balanced "H" network configurations. Cinema Engineering, 1100 Chestnut St., Burbank, Calif.

Circle 257 on Inquiry Card, page 101

DIODE MACHINERY

New machine feeds, cuts, forms in S or C shape, and welds the cat whisker wire on beaded or unbeaded lead wires for small crystal diodes. It is designed for automatic loading and unloading. Estimated production of 3000 an hour with automatic load and up to 1000 an hour with manual

load. A synchronous electronic timer insures uniform welding. All operating positions are easily accessible for maintenance. Kahle Engineering Co., 1400 7th St., North Bergen, N. J.

Circle 258 on Inquiry Card, page 101

New Products

TRANSDUCERS

The COMPU-TRAN Displacement Transducer, based on improved linear variable differential transformer techniques, features long linear range, higher output (sensitivity)

and linearity ranging from 0.1% to 0.5%. The line covers a complete spread of sizes from miniature models for missile applications to larger units for industrial applications. Coils and lead wires are potted in shock resistant high temperature epoxy. Available in 2 basic types: stainless steel shielding for normal environments and magnetic shielding for protection from external magnetic disturbances. International Resistance Co., 401 N. Broad St., Phila. 8, Pa.

Circle 259 on Inquiry Card, page 101

COAXIAL TR TUBE

Substantial savings in space and weight are made possible by a new construction for low frequency high power TR (transmit-receive) tubes. Type TR860, first to employ the new design, is a 9 in. diameter tube which utilizes a large metal-to-ceramic seal. It is cylindrical in shape with smaller

window and seal areas than previous low frequency wave-guide TRs. This results in a more rugged yet lighter and smaller tube. Sylvania Electric Products Co., Woburn, Mass.

Circle 260 on Inquiry Card, page 101

New Products

ACCELEROMETER

A completely transistorized precision linear servo accelerometer, the Model 4310, has been introduced. The unit is available in ranges from ± 0.05 g to ± 50 g. It is portable and

can be operated from a simple battery power supply providing ± 15 v. at 6 ma. Repeatability is 0.01% of full-scale and linearity is within 0.05% of full-scale. Unit weighs 3.2 oz. When weight and space requirements are more critical, the acceleration pick-up portion can be separated from the servo-amplifier part of the instrument. Donner Scientific Co., 888 Galindo St., Concord, Calif.

Circle 261 on Inquiry Card, page 101

FOIL INSERTS

The 0.004 in. flexible Netic and Co-Netic magnetic shielding foils are now available as an insert in all IERC heat dissipating tube shields. Foils were developed by Magnetic Shield Div., Perfection Mica Co. They do not require periodic annealing and retain full magnetic shielding prop-

erties regardless of shocks endured during transportation or rolling around tube or inserting in aluminum shield. International Electronic Research Corp., Burbank, Calif.

Circle 262 on Inquiry Card, page 101

MISSILE QUALITY AC DRIVE MOTORS

Oster®

Complete Line / *Gear Trains Available with Many Types*

Meet MIL-E-5272A / Dimensions from 15/16" to 2–3/8".

SIZE	VOLTAGE	FREQ. C.P.S.	NO. PHASES (SUPPLY)	NO LOAD SPEED (RPM)	CAPACITOR (MFD)	RUNNING CURRENT AMPERES	RUNNING WATTS INPUT	OUTPUT	WEIGHT	GEAR RATIO	TYPE NUMBER
10	115	400	1	10,000	.05	.035	4.0	0.112 oz. in. at 6000 rpm	2.0 Oz.	....	10-A 8104-02
10	115	400	1	11,000	None (Shaded Pole)	.085	7.5	.096 oz. in. at 7000 rpm	3.5 Oz.	....	10-A 8101-01
11	115	400	1	12,000 Synch	0.1	.070	8.0	.08 oz. in. at 12,000 rpm	4.0 Oz.	....	11-A 8110-01
11	115	300-1800	1	10,000 (400 CPS)	0.5 (In Parallel)	.060 (400 CPS)	8.0 (400 CPS)	0.10 oz. in. at 9000 rpm (400 CPS)	5.0 Oz.	....	11-A 8223-01
11	115	400	1	60 Synch	0.1	.070	8.0	12 oz. in. at 60 rpm	7.75 Oz.	200:1	11-R 9003-02
11	26	400	1	30 Synch	2.0	0.35	8.0	14.5 oz. in. at 30 rpm	5.5 Oz.	195:1	11-R 9052-01
15	115	400	1	6,000 Synch	0.3	0.138	15.6	0.14 oz. in. at 6,000 rpm	8 Oz.	....	15-A 8120-01
18	115	400	1	12,000 Synch	0.35	0.148	14.7	0.41 oz. in. at 12,000 rpm	8 Oz.	....	18-A 8125-01
18	115	400	1	7600	0.6	0.45	4.5	2.45 oz. in. at 6800 rpm	24 Oz.	....	18-A 8126-01
18	115	60	1	8.5	1.0	0.175	17.5	30 oz. in. at 8 rpm	20 Oz.	405:1	18-R 9302-01
18	115	60	1	6.0	1.0	0.177	17.8	40 oz. in. at 5.75 rpm	20 Oz.	565:1	18-R 9302-02
21	115	400	1	22,000	1.0	0.75	80.0	1 oz. in. at 20,000 rpm	18.5 Oz.	....	21-A 8142-01
24	115	400	1	11,800	1.5	0.85	130.0	6.17 oz. in. at 10,800 rpm	29 Oz.	....	24-A 8161-01
24	115	60	1	20,000	None Required	1.2	175	8.9 oz. in. at 7,500 rpm	28 Oz.	....	24-U 8826-02
24	115	400	1	78	4.0	1.65	175	1530 oz. in. at 72 rpm	3 Lbs.	1528:1	24-R 9452-02
34	115	60	1	14,000	None Required	1.5	125	15 oz. in. at 4500 rpm	3-3/4 Lbs.	....	34-U 8901-02
34	115	60	1	1,780	3.75	0.45	50	12 oz. in. at 1700 rpm	4-3/4 Lbs.	....	34-A 8044-01

- All motors are continuous duty except Type 24-U-8826-02.
- −55°C to +85°C operating temperature range.
- All motors can be modified to meet your precise specification.
- For faster service, detail requirements when requesting further information.

Other products include servos, synchros, motor-gear-trains, resolvers, DC motors, servo mechanism assemblies, servo torque units, motor tachs, reference and tachometer generators, actuators and motor driven blower and fan assemblies.

John Oster

MANUFACTURING COMPANY
Your Rotating Equipment Specialist
Avionic Division
Racine, Wisconsin

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Burton Browne Advertising

Engineers For Advanced Projects: / Interesting, varied work on designing transistor circuits and servo mechanisms. Contact Mr. Robert Burns, Personnel Manager, in confidence.

Circle 100 on Inquiry Card, page 101

New Products

MICROFILM PROCESSOR

On-the-spot reproduction of microfilmed engineering drawings for reference purposes can now be made at low cost on a microfilm reader-enlarger-processor known at REP II.

It provides for opaque visual reference to the filmed drawings. If one or more prints of the drawing are desired, conveyor belt system is put into action to bring a sheet of sensitized photographic copy paper into position under glass beneath the enlarging projector. At full capacity it can turn out 60 prints per hour. The entire process is completed in the unit. Remington Rand, 315 4th Ave., New York 10, N. Y.

Circle 263 on Inquiry Card, page 101

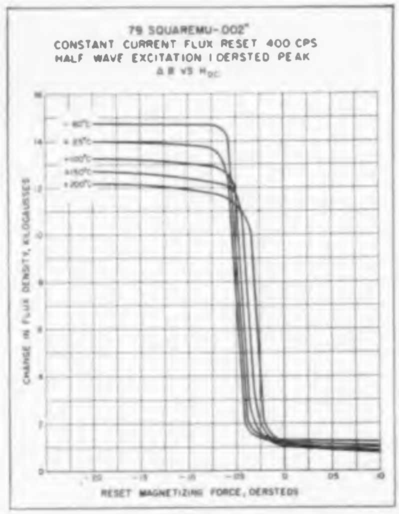
STROBOSCOPE

A new white light stroboscope with built in synchronizing generator known as Model 7N12 is available. This deluxe unit has a pulsing rate which is variable from 8 to 100 pulses per sec., providing 3-lumen sec. of light with a flash duration of 10 μsec. In addition, the unit has a set of contacts for external synchronization. Light intensity can be approximately

doubled if less than 30 cps. are required. The stroboscope is ac powered and measures 6 in. wide, 5 in. high and 5¾ in. deep. Western Gear Corp., P. O. Box 182, Lynwood, Calif.

Circle 264 on Inquiry Card, page 101

DESIGNews



Magnetic Metals Company processes tape wound Centricores to provide thermal stability

■ New Processing Techniques developed by Magnetic Metals Company now provide Centricores with *superior* thermal stability characteristics. Results of tests made on Centricores of 79 Squaremu, .002" material are presented here; curves shown indicate an almost constant gain between —60° C. and +200° C. Such stability will prove a vital assist to the designer of magnetic amplifiers, who must contend with ever-increasing variations in temperature environment.

The design engineer will find of great importance also the standard of uniformity which has been achieved in Centricore production. Exceedingly small variations exist within production lots, eliminating production quality problems.

Magnetic Metals Company Centricores are available in all standard and many special sizes. Price lists and engineering data may be had on request.

The Roberts Constant Current Flux Reset Method provides dependable core measurements.

Specify Centricores for magnetic amplifier applications in

INDUSTRIAL MACHINERY
COMMUNICATIONS EQUIPMENT
ELECTRONIC DEVICES
ELECTRICAL EQUIPMENT

MAGNETIC METALS COMPANY

ELECTROMAGNETIC CORE PARTS AND SHIELDS • HAYES AVENUE AT 21st ST. • CAMDEN 1, N. J.

Circle 103 on Inquiry Card, page 101

New Products

AUTOMATIC TESTER

A multiple function automatic tester which makes possible 30 individual wiring checks per minute is now available. The device is capable of selecting a maximum of any 5

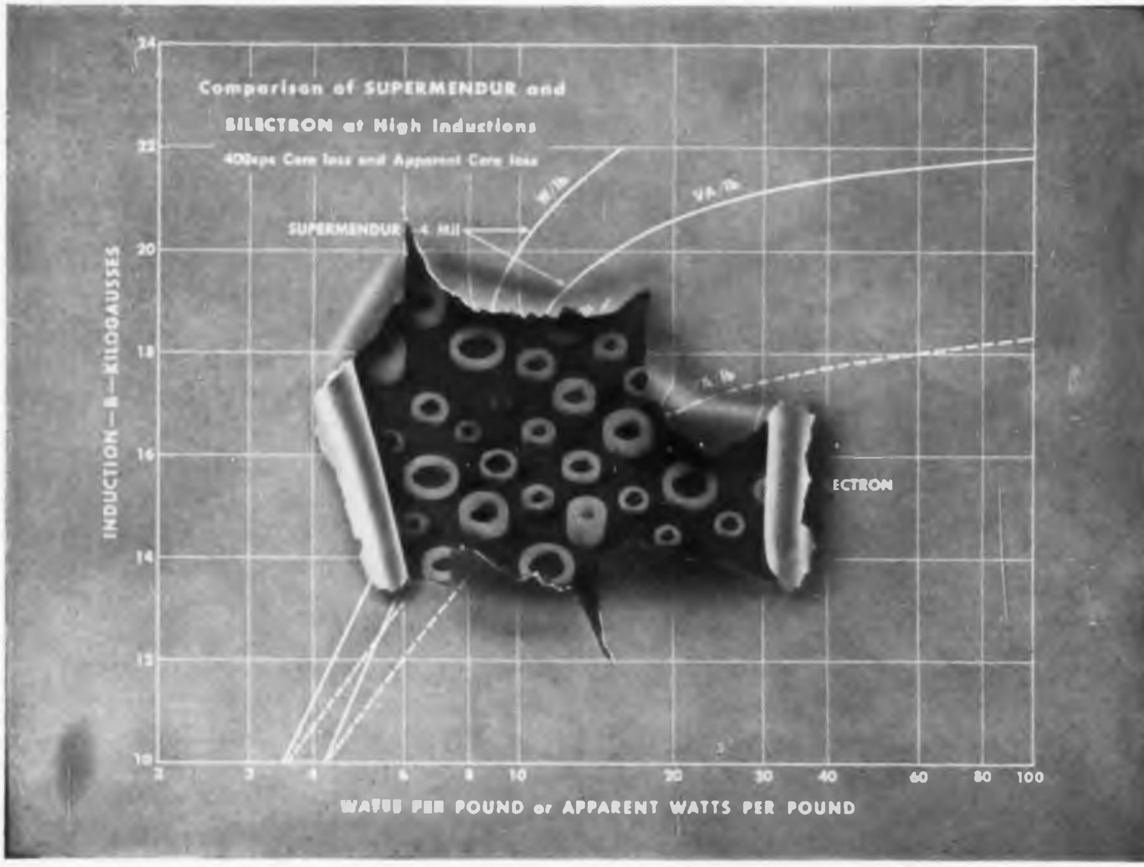
points simultaneously for a given test. Each of the 5 points may be routed to any of 22 separate points: i.e., voltage sources, signal sources, voltage output points, bridges, etc. Tests include continuity, megger and resistance. The multiple purpose automatic tester has an average speed of one test every 2 sec. and a capacity of 900 input points. Allen B. Du Mont Labs., Inc., 760 Bloomfield Ave., Clifton, N. J.

Circle 265 on Inquiry Card, page 101

LOAD BANK

A new line of Standardized Load Banks for obtaining artificial electrical loads has been announced. Now load bank design is offered in a wide range of loading resistors and switch selection in combination with standard size enclosures and mountings. For use by testing labs, jet engine and motor manufacturers, communications equipment makers, etc. Available in capacities up to 70 kw per unit, 600 v. max. Multiple units may be combined for higher capacities. Ward Leonard Electric Co., Mount Vernon, N. Y.

Circle 266 on Inquiry Card, page 101



SUPERMENDUR TAPE WOUND CORES
. . . A Real Breakthrough in Miniaturization

The successful development of tape wound cores of Supermendur represents a giant step in the field of circuit miniaturization and simplification. The unique characteristics of this new rectangular-loop core material in the range of induction from 16 to 22 kilogausses permit significant weight and size reduction of toroidal transformers and magnetic amplifiers.

Supermendur, an oriented cobalt-iron-vanadium alloy, combines the high saturation flux density of the cobalt-iron alloys with the desired hysteresis loop rectangularity of the oriented 50% nickel-irons.

Coercive forces substantially lower than those of previously available cobalt-iron alloys are obtained. The lower core losses and excitation properties of Supermendur show a decided improvement in high density characteristics compared with oriented silicon steel, as illustrated by the curves partially shown above. ***Complete curves are available in a new Supermendur Bulletin TC-113, available on request.***

Specific advantages of Supermendur cores in toroidal transformers are: high operating induction, low core loss, low exciting current and high permeability at high induction. In magnetic amplifiers or saturable reactors, they include: rectangular hysteresis loop, high saturation induction and moderate excitation at high induction. Advantages in all uses are: thin tape, small size and low weight.

Supermendur is an ideal material for high temperature core components, because of its high Curie temperature.

● Supermendur is manufactured by Arnold under license arrangement with the Western Electric Company. We'll be glad to send you additional information or furnish you engineering assistance on any of your tape core applications if you'll just drop us a line.

WSW 7028

Visit us at the
IRE SHOW
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BOOTH 2201-2205

THE ARNOLD ENGINEERING COMPANY

Main Office & Plant: Marengo, Illinois
Repath Pacific Division Plant: 641 East 61st Street, Los Angeles, Calif.
District Sales Offices:
Boston: 49 Waltham St., Lexington Los Angeles: 3450 Wilshire Blvd.
New York: 350 Fifth Ave. Washington, D.C.: 1001-15th St., N.W.

Circle 129 on Inquiry Card, page 101

New Products

TEST SET

A portable test set that functions as a signal generator, dc voltmeter and r-f field strength indicator is available. With adapter plugs, it will test all Bendix and competitive two-

way radio equipment and meters 16 transmitter-receiver-exciter functions as well as several functions within the test set. RF signal generator covers IF, HF, VHF, and UHF ranges. Four internal crystal positions are provided. It has a 20,000-ohms/v. dc voltmeter. Field strength indicator has a 10,000 μv. sensitivity. Set weights 9½ lbs. Case measures 13½ x 6 x 8½ in. Bendix Radio, Baltimore 4, Md.

Circle 267 on Inquiry Card, page 101

TORQUE GAUGE

Low torque, both clockwise and counter-clockwise, of 0.025 to 0.6 oz.-in. can be read directly on the large watch-face dial of the new Torque-Watch gauge. Quick and convenient means for measuring torque on miniaturized apparatus is provided in this new gauge. The linear scale on the dial can be furnished calibrated in ounces - inches or gram - centimeters.

Standard accuracy is ±5% of full scale. Accuracy of ±1% at any point in the range, or ±2% of the full range can be furnished. Waters Mfg., Inc., Wayland, Mass.

Circle 268 on Inquiry Card, page 101

Circle 107 on Inquiry Card, page 101

CLEVITE 'BRUSH'

High Resolution Magnetic Heads

WITH GAPS AS NARROW AS **20** MICROINCHES

Clevite "Brush" high resolution magnetic heads permit major improvements in tape recording systems:

Greater packing density and/or higher frequency recording at your present tape or drum velocity. *Less volume of tape required.*

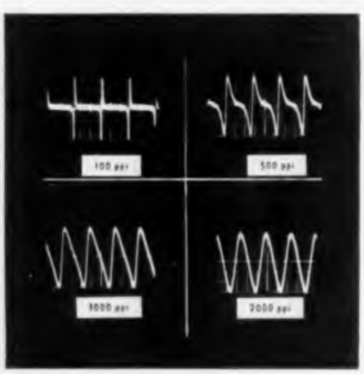
Up to 10 to 1 reduction in tape or drum velocity at your present frequencies or pulse repetition rate. *More recording time on the same length of tape.*

Reduced playback pulse width, allowing extended pulse width modulation (pwm) recording; for example, 5 microsecond pulse width at 120 inches per second tape velocity.

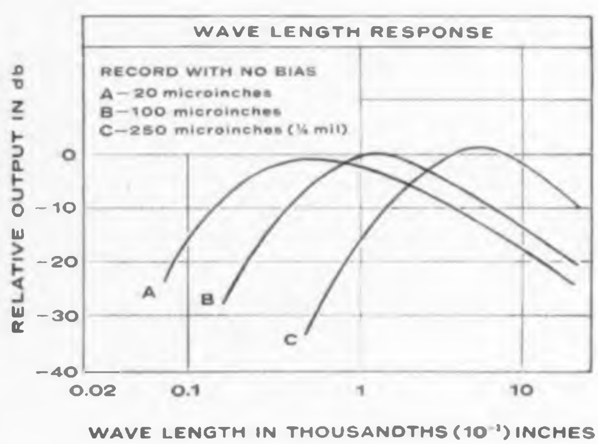
Special high resolution heads were developed by Clevite to meet specific customer applications. They are now commercially available in 2 to 32 channel form in a variety of mechanical configurations. These heads, slightly modified, may fit your present design requirements. One of our specialists will be pleased to discuss your application by detailed correspondence or personal visit. Write: Product Manager. Magnetic Heads, Clevite Electronic Components, 3311 Perkins Avenue, Cleveland 14, Ohio.

Typical Clevite narrow gap multi-channel head records more data on an equal length of tape.

VISIT BOOTH NO. 2622, IRE SHOW, N.Y.C., MARCH 24-27.



Oscilloscope photos of pulse recordings on Clevite high resolution head. Pulse duration, 1 microsecond; tape speed, 60 inches/sec.



Clevite 'Brush' High Resolution Heads for radar recording • high density tape recording • high density drum recording • video recording • VHF instrumentation for missile telemetering

CLEVITE ELECTRONIC COMPONENTS

DIVISION OF CLEVITE CORPORATION

MAGNETIC HEADS
TRANSDUCERS
PIEZOELECTRIC CRYSTALS, CERAMICS AND ELEMENTS

International

ELECTRONIC SOURCES

ELECTRONIC INDUSTRIES' exclusive monthly digest of the world's top electronic engineering articles

ANTENNAS, PROPAGATION

*A New Approach to Propagation Gives Us the Magnetic Field Antenna, W. J. Polydoroff. "El. Ind." March 1958. 3 pp. Completely new shapes and forms of antenna can be designed from the magnetic point of view. Most conventional theory is based on the electric field—neglecting the magnetic component. The magnetic field theory is especially important for new missile and aircraft antennas, collectors, deflectors, and perhaps radar-invisible skins. (U.S.A.)

Long-Wave and Intermediate-Wave Cylindrical Slot Antennas, G. Z. Aizenberg, A. M. Model', L. P. Posdniakov. "Radiotek." Oct. 1957. 12 pp. The paper describes radio broadcast antennas which are mounted on low supports. It demonstrates that by using cylindrical slotted dipoles in the capacity of intermediate-wave antennas (these antennas are common in the field of centimeter and decimeter waves, but are substantially modified for use in the intermediate-wave range), it is possible to lower the height of the antennas by 70% while retaining a high efficiency and the required pass band. A theoretical analysis is given which proves the possibility of obtaining a high efficiency for such antennas. Experimental data is given for operational tests. (U.S.S.R.)

Methods to Determine the Position of Artificial Satellites, "Toute R.," No. 220. Nov. 1957. 2 pp. This is a translation of a Russian article which describes dual antenna input stages gated by a multivibrator system. Similar to the operation of Minitrack, the trajectory of the satellite can be determined from the received signal. The satellite passes through azimuth when the signals from the two antennas reach equal amplitudes. (France.)

Coupling Between Antennas, K. Baur. "Freq.." Vol. 11, No. 10. Oct. 1957. 4 pp. The coupling of antennas with electro-magnetic fields is analyzed and formulae are provided. The paper treats antennas exposed to fields with elliptical polarization. The text is brief and to the point. (Germany.)

A New Way to the Solution of the Problem of Wide-Band Antennas, H. Meinke. "Nach. Z." December 1957. 8 pp. A novel explanation for the process of wave formation at a radiator is used for showing why the input impedance and the radiation pattern of most antennas are a function of frequency. This also points a way for precautions which will lead to the design of antennas with very little frequency sensitivity. By means of a non-linear coordinate system the field equations are represented in a form, which will result in a suitable approximate solution for wide-band antennas of comparatively simple shapes. (Germany.)

An Investigation of Periodic Rod Structures for Yagi Aerials, J. O. Spector. "Proc. BIEE." January, 1958. 7 pp. The periodic structure of conducting rods, normally used for Yagi-type aerials, is investigated from the point of view of a guide for surface waves. In a series of resonator experiments it is found that a non-radiating plane surface wave of the HE_{11}-mode may be guided along the structure, and that radiation occurs only from a discontinuity. (England.)

CIRCUITS

A Carrier-Energized Bistable Circuit Using Variable-Capacitance Diodes, E. O. Keizer. "RCA." December 1957. 11 pp. A variable-capacitance junction diode, when used in a simple circuit driven from a high-frequency a-c source, can cause that circuit to have a bistable characteristic suitable for dynamic memory, or to have a sensitive output-input characteristic suitable for control or detection purposes. This paper outlines the principles of operation of the basic bistable circuit and describes several variations, including a tran-

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REGULARLY REVIEWED

AUSTRALIA

AWA Tech. Rev. AWA Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers

CANADA

Can. Elec. Eng. Canadian Electronics Engineering
El. & Comm. Electronics and Communications

ENGLAND

ATE J. ATE Journal
BBC Mono. BBC Engineering Monographs
Brit. C.&E. British Communications & Electronics
E. & R. Eng. Electronic & Radio Engineer
El. Energy. Electrical Energy
GEC J. General Electric Co. Journal
J. BIRE. Journal of the British Institution of Radio Engineers
Proc. BIEE. Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

Ann. de Radio. Annales de Radioelectricite
Bul. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Onde. L'Onde Electrique
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El. Uber. Archiv der Elektrischen Ubertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electroakustik
NTF. Nachrichtentechnische Fachberichte
Nach. Z. Nachrichtentechnische Zeitschrift
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Arch. Auto. i Tel. Archiwum Automatyki i Telemechaniki
Prace ITR. Prace Instytutu Tele-i Radiotechnicznego
Roz. Elek. Rozprawy Elektrotechniczne

USA

Auto. Con. Automatic Control
Av. Age. Aviation Age
Av. Week. Aviation Week
Bell J. Bell Laboratories Journal
Comp. Computers and Automation
Con. Eng. Control Engineering
El. Electronics
El. Des. Electronic Design
El. Eq. Electronic Equipment
El. Ind. ELECTRONIC INDUSTRIES
El. Mfg. Electronic Manufacturing
IRE Trans. Transactions of IRE Prof. Groups
I. & A. Instruments & Automation
Insul. Insulation
M/R. Missiles and Rockets
NBS J. Journal of Research of the NBS
NRL. Report of NRL Progress
Proc. IRE. Proceedings of the Institute of Radio Engineers
Rev. Sci. Review of Scientific Instruments

USSR

Avto. i Tel. Avtomatika i Telemekhanika
Radio. Radio
Radiotek. Radiotekhnika
Rad. i Elek. Radiotekhnika i Elektronika
Iz. Acad. Bulletin of Academy of Sciences USSR

OTHER

Radio Rev. La Radio Revue (Belgium)
Kovo. Kovo Export (Czech)
J. ITE. Journal of the Institution of Telecommunication Engineers (India)
J. IECE. Journal of the Institute of Electrical Communication Engineers (Japan)
Phil. Tech. Philips Technical Review (Netherlands)
Eric. Rev. Ericsson Review (Sweden)
J. UIT. Journal of the International Telecommunication Union (Switzerland)

sistor version in which the two junctions of a transistor are used in place of two variable-capacitance diodes. (U.S.A.)

New Trends in FM, R. Deschepper. "Toute R." No. 220. November 1957. 8 pp. The article outlines various circuit details of recently designed FM receivers. (France.)

On the Design of Input Circuits of Electronic Amplifiers of Autocompensators. D. E. Polonnikov. "Avto. i. Tel." October 1957. 4 pp. The importance of interference noise due to the filament circuit for the amplifiers of autocompensators is demonstrated and the formula to calculate it is presented. The author discovers the source of noises that appear with the parting of input circuits, and the method for their elimination is offered. The optimum coefficient of the input transformation providing the maximum sensitivity is determined. (U.S.S.R.)

A Feedback Electrometer Amplifier, D. Allenden. "El. Eng." January 1958. 3 pp. The drift problem in direct-coupled electrometers is discussed briefly, and a design for a direct-coupled feedback electrometer amplifier which uses its inherent feedback loop gain to stabilize the electrometer valve filament supply is presented and described in detail. It is concluded that direct-coupled amplifiers with zero stabilities of the order of a few millivolts per hour can be realized using economical circuits and simple power supplies. (England.)

A 4000 Mc/s Wide-Band Amplifier Using a Disc-Seal Triode, J. P. M. Gieles. "Phil. Tech." November 1957. 12 pp. Description of an amplifier for frequencies from 3800 to 4200 Mc/s, in which tubes EC 56 or EC 57 can be used. With a gain of 8 db, the amplifier can deliver a power of 0.5 W and 1.5 W respectively, the bandwidth being 55 Mc/s. The low-level gain is 12 and 13 db respectively. The input and output can be connected to waveguides. For coupling several of these amplifiers in cascade, the coupling is preferable effected by means of ferrite isolators. The variation of group delay in the frequency band covered is much smaller than with the IF amplifiers normally used in beam transmitters. (Netherlands.)

A Versatile Pulse Pattern Generator, Peter H. Cutler and L. R. Peters. "El. Eng." January 1958. 4 pp. Two independent pulse pattern generators are used to produce any sequence of pulses of either polarity: either sequence contains up to ten pulses, and the pulse duration may be varied from 45 usec to 1 sec. The two separate patterns may be combined to give a third pattern whose maximum length is ninety pulses. (England.)

Non-linear Converters with Single Input, L. W. Medvedev, A. A. Feldbaum, L. N. Fitzner. "Avto. i. Tel." October 1957. 6 pp. The methods of designing an electronic non-linear converter with one input are considered. The results of working out schemes of basic types of non-linear converters—diode, diode-triode, combined, and compensation converters—are given. The fields of application are pointed out. (U.S.S.R.)

Strain Gage Oscillator for Flight Testing, William H. Foster. "El." January 31, 1958. 3 pp. Completely transistorized strain gage oscillator for resistive-type gages produces frequency-modulated signal output that is directly proportional to applied force such as stress or pressure. (U.S.A.)

A Three-Phase Three-Valve Multivibrator, W. F. Lovering. "El. Eng." February 1958. 2 pp. The two valve multivibrator is a well-known source of rectangular voltage waves. In this article a three-valve, three-phase version of this circuit is described. (England.)

Magnetic Amplifiers With Half-Cycle Response, Part 1, B. W. Gover. "El. Energy." January 1958. 8 pp. All "half-cycle" response magnetic amplifiers are shown to fall into one of eight classes according to the types of output obtained. This type of classification is adequate for single- and two-core stages, but for four-core duo-directional output stages, a classification is adequate to circuit arrangement is necessary, such a classification is given, and by means of this it is shown that there are only four basic ways in which the output circuit of a duo-directional four-core full-wave circuit without split power windings can be connected. (England.)

New Approaches to the Amplification of Microwaves, James P. Wittke. "RCA." December 1957. 17 pp. Two types of "molecular" microwave amplifiers—the maser and the parametric amplifier—are described. The maser amplifies by converting internal energy of molecules to radiation energy. Parametric amplification is based on the "negative resistance" introduced into a circuit by a non-linear reactance when driven by a strong high-frequency signal. The basic principles governing the operation of these amplifiers are discussed. Both types of amplifier have relatively narrow bandwidths, but have excellent noise properties. This low-noise aspect of their behavior will probably determine their application in the near future. (U.S.A.)

FM Demodulator Time-Constant Requirements for Interference Rejection, Elie J. Baghdady. "Proc. IRE." February 1958. 9 pp. An investigation has been made of the demands imposed on fm receiver circuits in order that they may operate satisfactorily in the presence of a high level interfering signal. It is found that these demands require that ideally the time constants of the limiter and discriminator circuits must be short enough to cope with the sharp amplitude and frequency changes that are characteristic of a disturbed signal. (U.S.A.)

The Calculation of a Magnetic Circuit and Coil of Alternating Current for Given Parameters, B. K. Bool. "Avto. i. Tel." October 1957. 4 pp. A method is given for the calculation of the electrical, magnetic, and design parameters of a circuit and coil of alternating current. Calculation taking account of coil resistance, losses in steel, and also using the non-linear magnetic characteristics. It is shown that the method of calculation could also be applied to circuits of direct current. The calculation of several variations with different given parameters is described. A numerical example is given. (U.S.S.R.)

Junction Transistor Sawtooth Waveform Generators, K. P. Padmanabhan Nambiar. "El. Eng." February 1958. 5 pp. The bootstrap and Miller integrators are two well-known thermionic valve circuits for generating linear sweeps or sawtooth waveforms. In this article these circuits and their equivalents using junction transistors are discussed. It is shown that sufficient currentswing can be obtained for applications such as electromagnetic scanning of miniature television camera tubes using currently available low power transistors. (England.)

Synthesis of Mixed Relay Circuits of the Series-Parallel Type, V. N. Roginskii. "Avto. i. Tel." December 1957. 12 pp. The paper deals with analytical methods for effecting equivalent transformations of relay networks, and with methods for obtaining mixed relay networks by introducing elements with a finite conductivity. It is demonstrated that these methods can diminish the number of contacts in the network when multi-relay networks are synthesized. (U.S.S.R.)

Direct-Coupled Amplifiers, D. J. R. Martin. "E. & R. Eng." December 1957. 4 pp. The article describes a method of artificially matching valves to obtain improved mutual compensation for the effects of normal heater-supply voltage changes. Adjustment is easier than selecting naturally-matched pairs of valves, and considerably better balance is obtained. (England.)

An Atomic Reference Oscillator, M. P. G. Capelli. "Brit. C. & E." February 1958. 3 pp. One of the spectrum lines of the caesium atom is used as the final frequency reference of a highly stable and accurate frequency source. (England.)

High-Frequency Crystal Filter Design Techniques and Applications, David I. Kosowsky. "Proc. IRE." February 1958. 11 pp. This paper gives what is probably the first description of the use of crystals in filters at frequencies well above one megacycle. (U.S.A.)

COMMUNICATIONS

***Forward Scatter . . . Above 2000 Megacycles!,** John L. Gardner. "El. Ind. Ops. Sect." March 1958. 4 pp. In this relatively uncrowded region, more information can be transmitted within a smaller frequency band. Radiated power is more effective from a given parabolic antenna in a given location. (U.S.A.)

***Analyzing Interference in the FM Communications System,** N. H. Shepherd. "El. Ind. Ops. Sect." March 1958. 3 pp. FM interference is caused by performance limitations of the receivers and the transmitters. The author discusses the kinds and causes of interference, describes measuring techniques, and presents a powerful method of analyzing the results. (U.S.A.)

***Systems Engineering a PDM*/FM Telemetry System,** Francis J. Enge. *Pulse Duration Modulation. "El. Ind." March 1958. 2 pp. A basic application of information theory leads to basic principles of PDM/FM system design. (U.S.A.)

The Attenuation of Radio Waves Reflected from the E-Region of the Ionosphere, R. W. Meadows. "Proc. BIEE." January 1958. 5 pp. Measurements of the absorption of waves travelling between Slough and Inverness (740 km), and reflected once from the E-region during the process, are compared with similar measurements made simultaneously for vertical incidence at Slough. The absorption over the oblique path, calculated by Martyn's absorption theorem from the value obtained at vertical incidence, was found to be much too low. Approximately correct values are obtained from the formula for non-deviative absorption, provided that the lowest-frequency (2 Mc/s) vertical-incidence results are used: otherwise the oblique-incidence value is too high. (England.)

Evaluating the Transmission Capabilities of a Communications Channel Whose Parameters Are Random Time Functions, I. A. Ofseevich, M. S. Pinsker. "Radiotek." Oct. 1957. 7 pp. The paper derives formulas for computing the transmission capability of a channel whose parameters are random time functions. The formulas make it possible to compute the transmission capability for several different types of actual channels. Although the causes for the variation in the channel properties may differ, their effect upon the transmitted signal can in most cases be analyzed by assuming that the signal is modulated by some random time function. Such an approach also reflects the physical difference between ordinary channel noise and distortion which is caused by the parameter effect in the channel. (U.S.S.R.)

A Communication Transmitter with a Power Output from 50 to 100 W, C. H. Guilbert. "Toute R." No. 220. November 1957. 6 pp. Details are given for the construction of a crystal control transmitter which can be tuned over a frequency range from 3.5 to 28 MC. (France.)

The Effect of Fading on the Accuracy of Measurement of Ionospheric Absorption, R. W. Meadows. "Proc. BIEE." January, 1958. 6 pp. The rapid and slow components of a fading signal are separated by a semi-empirical process in which each component is, in turn, assumed to consist of a steady or specularly reflected component with a random component added. The process is applied to some measurements of the amplitude of first-order reflections from the E-region at vertical and oblique incidence on equivalent frequencies. The standard deviation of the amplitude variation due to rapid fading was found to be greater at vertical than at oblique incidence, but insufficient evidence is yet available to determine whether the variation due to slow fading was also greater. (England.)

Frequency-Modulation Distortion in Linear Networks. R. F. Brown. "AWA Tech. Rev." October 1957. Vol. 10, No. 2. 28 pp. The problem of distortion of frequency-modulated waves by 4-terminal linear passive networks has become of increasing importance with the development of multi-channel f-m communication systems. The paper surveys the somewhat confusing historical background of this subject and after discussion of some essential basic concepts presents a detailed analysis of the problem of small-order distortion. An attempt has been made, using the work of Medhurst (1954), to present the results in a form suitable for computer programming. (Australia.)

An Improved Receiver for the 40 MC Band. H. Schreiber. "Toute R." No. 220. November 1957. 2 pp. Details are given for the construction of a 40 MC receiver for the reception of the signals transmitted by Sputnik. The receiver consists of two RF stages, a mixer, two IF stages, and a detector. (France.)

The Effect of the Earth's Magnetic Field on Absorption for a Single-Hop Ionospheric Path. R. W. Meadows and A. J. G. Moorat. "Proc. BIEE." January 1958. 8 pp. Magneto-ionic calculations show that deviative absorption is not necessarily negligible at vertical incidence for waves reflected from the E-region at frequencies considerably below the penetration value. Consequently, the value of absorption calculated by the conventional 'non-deviative' formula for a short-wave oblique path from vertical-incidence absorption measurements tends to be too high. Deviative absorption on paths sufficiently oblique is, however, negligible. (England.)

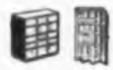
Control Devices for Unattended Transmitters with Passive Stand-By Equipment. P. T. Zehnel. "Freq." Vol. 11. No. 12. December 1957. 5 pp. Treated are the problems associated with active and passive stand-by equipment. Active stand-by equipment are devices operating in parallel. Should one fail, the power output will reduce. Passive stand-bys are such which only go into action when the operating unit fails. Comparisons are made and various passive stand-by short-wave equipment developed by Telefunken is described. (Germany.)

COMPONENTS

***An Evaluation . . . Strain Gages in Supersonic Aircraft.** Robert J. Stewart. "El. Ind." March 1958. 2 pp. Weldable strain gages, requiring no elevated temperature curing and providing a 13% error in sensitivity through 1200°F, appear most promising for supersonic aircraft study. (U.S.A.)

The Minimum Volume of a Pulse Transformer. Ia. S. Itskhoki. "Radiotek." Oct. 1957. 18 pp. A new method is proposed for designing power pulse transformers with a minimum volume of metal (iron and copper). The paper demonstrates that it is possible to construct transformers in which the volume of metal comprises approximately 0.5 grams per watt of average transformer power. (U.S.S.R.)

The Transactor. A. W. Keen. "E. & R. Eng." December 1957. 3 pp. The two-terminal constant-current and constant-voltage generators used in equivalent circuits of active networks are replaced by transmission-type active elements called transactors in order to display more accurately the transmission ('signal flow') properties of such networks. (England.)



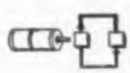
COMPUTERS

An Analysis of Block Diagrams for Series Electronic Digital Computers. G. A. Mikhailov. "Avto. i Tel." December 1957. 11 pp. The paper analyzes the utilization of the operating time and of the structural elements of series electronic digital computers. An analysis is made of the effect of the construction of the basic units in the computer and the type of problems solved by the computer upon the speed of computation and other characteristics of the computer. Single-address, two-address and three-address systems of command coding are compared. (U.S.S.R.)

Programming Digital Computers. Part I. J. F. Davison. "Brit. C. & E." February 1958. 4 pp. In the first two articles, the author deals with programming for electronic digital computers. The computer itself, from the programmer's point of view, will be dealt with in the second part. A typical application will also be worked through in detail. (England.)

A New Storage Element Suitable for Large-Sized Memory Arrays—The Twistor. Andrew H. Bobeck. "Bell J." November 1957. 22 pp. Three methods have been developed for storing information in a coincident-current manner on magnetic wire. The resulting memory cells have been collectively named the "twistor." Two of these methods utilize the strain sensitivity of magnetic materials and are related to the century-old Wertheim or Wiedemann effects; the third utilized the favorable geometry of a wire. (U.S.A.)

A New Bistable Element Suitable for Use in Digital Computer, Part I. C. D. Florida. "El. Eng." February 1958. 7 pp. The article describes the development of a trigger circuit which uses both pnp and npn types of transistor. The circuit has fast (0.2 usec) switch-on and switch-off times but is characterized primarily by its current handling capacity and hence by its ability to drive several other similar circuits. The transient response of this circuit to a voltage ramp input at either the turn-on or the turn-off terminals is dealt with in two mathematical appendices. (England.)



CONTROLS

A Method for Obtaining Complicated Laws of Regulation with the Use of Only an Error Signal or Regulating Coordinate and Its First Derivative. S. W. Emelyanov. "Avto. i Tel." October 1957. 6 pp. The method of obtaining different laws of control using only an error signal and its first derivative. It is shown that the effectiveness of such correction in linear control systems will be the same at the various scale measurements of the magnitude of the disturbance influence. The article gives one of the possible schemes for the realization of a nonlinear corrector, carrying out the various laws of control. (U.S.S.R.)

Introduction to Statistical Design of Servomechanisms. S. DeMczynski. "El. Energy." January 1958. 8 pp. An outline of the statistical methods for the design of servomechanisms is presented. These methods constitute the most logical approach to the design problems and are the only techniques available if a large amount of contaminating noise is present in the signal's frequency band. The minimum mean square error criterion and the physical realizability of networks are discussed. Only time invariant linear networks and stationary time signals satisfying the ergodic theorem are treated. (England.)

Concerning the Influence of Some Non-Linear Characteristics of Elements of P. I. Controller on the Dynamic Characteristics of an Automatic Control System. E. K. Krug, O. M. Minina. "Avto. i Tel." October 1957. 6 pp. An automatic control system, used as an example, contains the simplest object of control and a P. I. controller. It is shown how transient form is influenced by limited motion of the control device and the non-linear characteristics in control elements which realize the proportion and integral terms of the law of control. (U.S.S.R.)

Automatic Control of Ground Instrumentation During the Launching and Flight of Experimental Guided Missiles. R. J. Farvey. "El. Eng." February 1958. 7 pp. The article describes the program switch associated with the launching and flight of experimental guided missiles. This unit switches control and recording equipment on and off automatically to a pre-arranged program set up for the particular missile. The switching is effected by two uniselectors which control output relays according to time settings on a selector board. There are 30 output channels and each one can be preset to switch remote equipments on and off at any time during a 14 minute automatic cycle. (England.)

The Synthesis of Multi-Loop Control Systems Which Contain Lag Elements. M. V. Meerov. "Avto. i Tel." December 1957. 11 pp. The paper examines multi-loop control systems with lag elements and establishes the basic properties of such systems. Methods are given for synthesizing systems which are stable for arbitrarily large gain coefficients in individual loops. The conditions governing autonomy are obtained. (U.S.S.R.)

A Function Generator. N. Hambley. "El. Eng." February 1958. 4 pp. When it is desired to control an operation according to a complex variable function, it is convenient to obtain control directly from a graphical function. The apparatus described here uses a photocell and cathode-ray tube to convert graphical data into a suitable electrical form. The conversion accuracy is better than one per cent. (England.)

GENERAL

***A New Broadcast Dimension . . . FM in the Car.** William Maron and Ann Maron. "El. Ind. Ops. Sect." March 1958. 2 pp. How about FM in the car? Well, here is a report by a radio engineer; he gives actual readings with an FM auto radio in urban, suburban, and country driving. His conclusions will interest every FM broadcaster. (U.S.A.)

Index to IRE Standards on Definitions of Terms, 1942-1957. "Proc. IRE." February 1958. 28 pp. The entire technical language of the radio engineer, from "A and R Display" to "Zoning," culled from some three dozen IRE Standards on the subject, is brought together in this one alphabetical list. (U.S.A.)

Certain New Fields of Radio-Electronics. I. S. Dzhigit, M. E. Zhabotinskii. "Radiotek." October 1957. 9 pp. Survey article on developments in radio-astronomy and radiospectroscopy since World War II. (U.S.S.R.)

Observation of Scatter-Back Echos Received from Short-Wave Broadcast Transmitters. H. U. Widdel. "Arc. El. Uber." Vol. 11. No. 11. November 1957. 10 pp. Pulsed short-wave broadcasting transmitters were used to determine the influence of the antenna radiation pattern on the observed amount of back-scatter echo. The maximum observable back-scatter depends on the vertical radiation pattern of the antenna system. Insufficient horizontal directivity, and poor front-to-back ratio cause a complex echo pattern and make the interpretation more difficult; especially when the perimeter of the skip zone fails to be concentric with respect to the transmitter site. By means of a simple mathematical conversion method, the propagation paths and the origin of the echo can be determined. Also detected were scatter processes within the ionosphere. (Germany.)

Acoustic Environment, R. Kaminski. "Environmental Quarterly." First Qtr., 1958. 2 pp. Intense noise can cause electronic and structural failure. Here is a report of investigations carried out in the Research Div. Labs of Bell Aircraft by D. W. Fricke, Mr. S. Kuzara, and the author. (U.S.A.)

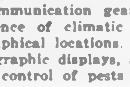
Coordination of Electrical and Mechanical Design in Guided Weapon Electronics, G. R. Beswick. "Brit. C. & E." February 1958. 4 pp. The importance of overall planning of all aspects of electronic design is emphasized, with particular reference to the problem of reliability. The engineering of electronic systems into environmental-proof forms is not a matter which can be deferred to a late stage in the development program; the final packaging problem must be considered in the earliest phases of design. (England.)

Pest and Corrosion Control for Communication Equipment, W. M. H. Schulze. "Freq." Vol 11. No. 10. October 1957. 12 pp. Since World War II, great attention has been paid to the damages caused to electronic equipment by microorganisms, insects, vermin, and others. Organic matter, such as wood, paper, and leather, is extremely vulnerable to attack, especially in the tropics. The article provides a detailed study of the various factors causing damage to communication gear. Highlighted are the influence of climatic conditions, as well as geographical locations. The article is supported by graphic displays, and means are given for the control of pests and corrosion. (Germany.)

Simulation of Non-linear Field Problems, I. C. Hutcheon. "Brit. C. & E." February 1958. 4 pp. Problems having as solution the distribution of a variable in two dimensions can be solved on conventional analogue computers by dividing the area into strips and solving along each in time. This requires a considerable number of amplifiers which must be increased many times if the problem is three-dimensional. Some of these problems can be solved automatically, and at much lower cost, by using a resistance network in conjunction with a single a.c. amplifier, a function generator, a scanning switch and a number of simple analogue memory units to control currents withdrawn from the network. (England.)

The German Radio, TV, and Phono Exhibition in Frankfurt/Main 1957, "Freq." Vol. 11. No. 10. October 1957. 18 pp. This article describes some of the outstanding products which were exhibited at the exhibition. A number of unconventional circuits and products are described. (Germany.)

Putting a Satellite into Outer Space, Lewis H. Young. "Con Eng." January 1958. 4 pp. Complete control of space vehicles is still an unsolved problem. Launching a satellite takes a combination of on-board control instrumentation and command signals from the ground. Here's a look at satellite control problems for the present and the future. (U.S.A.)



INDUSTRIAL ELECTRONICS

Electronics and Process Control Systems, J. M. Keating. "J. BIRE." December 1957. 9 pp. A brief history of the development of process control and instrumentation up to existing conventional pneumatic and electronics systems is given and the use of miniaturization, graphic panels and console desks discussed. Two possible future systems of process control are described, one whereby the plant is programmed by punched card input, and the second whereby the plant performance is continuously analyzed and monitored by computer. Problems concerning maintenance, safety, choice of components, and other items of importance to process control are discussed. (England.)

Instrumentation for the Control of Process Streams in Some Atomic Energy Projects, H. Bisby. "J. BIRE." December 1957. 8 pp. Radiometric instrumentation has already proved valuable as an aid in the control of process schemes within the U. K. Atomic Energy Authority. Design features of plant instruments covering radioactivity assay by direct emission and absorption techniques are discussed with illustrations of recent instruments. In addition the part played by automatic sample-handling machines in plant assay laboratories is illustrated. (England.)

A Stethoscope for Industrial and Medical Use, M. Bonhomme. "Toute R." No. 220. November 1957. 4 pp. Described is the construction of a transistorized pocket amplifier which can be used to amplify signals from various pick-ups. Printed wiring technique is used. (France.)

MATERIALS

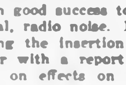
Ferrite Cores Filter Out Radio Noise with Low Loss, James C. Senn. "Av. Age." January 1958. 3 pp. Ferrite core filters recently have been used with good success to overcome that hardy perennial, radio noise. Here is an easy way of figuring the insertion losses of such filters, together with a report on typical applications and on effects on circuit-performance. (U.S.A.)

Characteristics of Magnetic Materials for the Cores of Magnetic Amplifiers with the Step-up Supply Frequency, G. V. Subbotina. "Avto. i Tel." October 1957. 8 pp. The characteristics of several Soviet soft-magnetic alloys for the account of magnetic amplifiers is given. The characteristics are taken on tape of 10-20μ thickness on a frequency of from 500 to 20,000 cps. (U.S.S.R.)

New Particle Magnet of High Field Density, R. Hubner. "El. Rund." January 1958. 1 p. Single-domain particle of a cobalt-iron-alloy (40:60) with an average diameter of 200 A. length: width of 5.4 : 1 and an internal coercitivity of 1950 Oe have been produced by G. E. C. Laboratories, Lynn, Mass. (Germany.)

Some Thermal Aspects of Epoxy Resins, E. Klopfenstein. "Insul." February 1958. 4 pp. (U.S.A.)

The Use of Dielectric Materials to Enhance the Reflectivity of a Surface at Microwave Frequencies, G. B. Walker and J. T. Hyman. "Proc. BIEE." January 1958. 4 pp. The padding of a metal surface by one or more layers of a dielectric material is examined, and it is shown that an improvement in reflectivity can be obtained provided that the loss factor of the dielectric is small enough. (England.)



MEASURING & TESTING

***For Indicating VSWR . . . A Phase-Sensitive Detector**, Kenneth G. Beauchamp. "El. Ind." March 1958. 4 pp. Carrier amplitude is measured by extracting with a probe the impressed a-f modulation on an r-f wave traveling down a guide. A phase sensitive probe, pulsed at modulation frequency, permits use down to fractions of a microvolt. (U.S.A.)

***Measuring Dielectric Constants at UHF**, Dr. Joseph J. Kyame. "El. Ind. Ops. Sect." March 1958. 2 pp. This novel measuring method consists of determining the impedance of a small capacitance cell, made part of a load terminating a transmission line. It is used for the 250-900 MC range. (U.S.A.)

A Precision Thermo-Electric Wattmeter for Power and Audio Frequencies, J. J. Hill. "Proc. BIEE." January 1958. 8 pp. The output e.m.f. given by a conventional thermal convertor is not proportional to the square of the heater current, and wattmeters using two such convertors cannot therefore be used for the precise measurement of power. The causes of non-compliance with a square law are examined, and a means of compensation is given to provide a convertor system in which the output e.m.f. is within 0.1% of the calculated square-law value. (England.)

Series of Articles on Reliability. "El. Eq." January 1958. 13 articles, 44 pp. Included are articles on definition, Dept. of Defense policy, TV Receiving Tubes, Organizing a Quality-Engineering Group, Packaged Circuits, and Transistorized Equipment. (U.S.A.)

Continuous Recording of Waveforms on Photographic Film, V. B. Hulme. "El. Eng." January 1958. 5 pp. Limits to the information capacity of photographic film as a medium for recording electrical waveforms are examined. The limitations of the system using conventional cathode-ray tubes are discussed. The advantages of variable-area recording are pointed out, with particular reference to a new type of tube, in which the beam cross-section has a ribbon shape, producing a fluorescent line instead of a spot. (England.)

Distortion of Curves by Galvanometers, Loop Oscillographs and Direct Reading Recorders, E. William. "El. Rund." January 1958. 6 pp. In supplementation of the author's previous papers on curve distortion by RC and resonance elements it is shown how distortions caused by galvanometers, loop oscillographs and direct reading recorders can be exactly calculated provided velocity proportional friction is present. For any given curve it is only necessary to transform it into a power series and to adapt the equations as specified. (Germany.)

A Vibration Table and Associated Control Equipment for Vibration Research, F. M. Leyden. "AWA Tech. Rev." October 1957. 21 pp. The present paper gives an account of some investigations of techniques in vibration testing, and describes a system suitable for routine testing of small items up to one half pound in mass at constant accelerations up to 10 g, over the frequency range 20 to 10,000 c/s. Design considerations are given for the small vibration table employed and for an automatic-gain-control system used for maintaining adjustable but constant acceleration over the working frequency range. (Australia.)

Methods for Generating the Intermediate Frequency for a Calibration Receiver from the Received Frequency of the Transmitter to be Tested, R. Kersten. "Freq." Vol. 11, No. 12. December 1957. 10 pp. This is the first part of a paper which analyzes the factors which must be considered for the design of calibrated test receivers. An extensive amount of mathematics supports the analysis. (Germany.)

Computation of Crystal Admittance, W. J. Lucas and P. B. Barber. "E. & R. Eng." December 1957. 5 pp. The paper summarized the results of a digital-computer programme designed to calculate the admittance, relative to 1/68 mho, of a coaxial crystal with the same dimensions as the CV2226 for various values of the video resistance R, spreading resistance r and barrier capacitance C over a frequency range 2,000-18,000 Mc/s. The equivalent circuit used in the calculation is discussed. (England.)

Impedance Bridges, J. F. Golding. "Brit. C. & E." February 1958. 6 pp. After a short discussion of impedance, various types of impedance bridge and their applications are described. A table gives brief specifications of representative bridges available in Britain. (England.)

Some Methods for Generating Homogeneous Weak Magnetic Fields. "Roz. Elek." Vol. 3. No. 3, 1957. 42 pp. Some typical methods for generating homogeneous magnetic fields are discussed in this paper as well as the experiments performed in the Electrotechnical Institute of the Polish Academy of Sciences on the construction of Helmholtz coils. (Poland.)

A Time-Multiplex Oscilloscope for Electroencephalography, T. J. McDermott. "El. Eng." February 1958. 6 pp. A small instrument has been designed, using pulse time multiplex techniques, to amplify and display simultaneously on one c.r.t. six electroencephalographic potentials. (England.)

Special Timing Techniques Employed on Guided Missile Ranges, R. J. Garvey. "El. Eng." January 1958. 8 pp. A central equipment consisting essentially of a crystal oscillator and a number of frequency dividing circuits provides timing and reference signals to the various measuring stations dispersed over a guided missile test range. The signals serve as time markers for the various recordings made and are also concerned with the control and firing of the missile. (England.)

Bearing Memory Improves Direction Finder, Roy E. Anderson. "El." January 31, 1958. 5 pp. Four independent receiver-bearing indicator units operate from single antenna array in Doppler system. Memory fills in time space between code pulses and presents continuous bearing at all code speeds. (U.S.A.)

B-H Tester Measures Memory Core Parameters, T. H. Bonn et al. "El." January 17, 1958. 5 pp. Flux, drive current, remanent flux to maximum flux ratio, squareness ratio and ratio of coercive force to maximum magnetizing force are read directly from window potentiometers as B-H loop is presented on crt. (U.S.A.)

Cathode-Ray Recorder Compares Transients, C. W. Hargens. "El." January 17, 1958. 4 pp. Selected portions of time base lines of different channels can be related and examined. Sweep speed is recorded. Closely-grouped cathode-ray tubes for each of 12 channels are photographed on 4 by 5 in. film. Projector, located in reading desk, enlarges film negative images to twice crt display size and presents four crt images simultaneously. (U.S.A.)

Ultrasonic Gage Speeds Field Work, Henry N. Nerwin. "El." January 31, 1958. 3 pp. Sweep-frequency sensing system and direct-reading indicator assembly measure thickness ultrasonically by determining frequency of standing wave generated within material. (U.S.A.)

RADAR, NAVIGATION

On Transient Errors in VAR Direction Finding by UHF Direction Finding Equipment, A. R. Wendlinger. "El. Rund." January 1958. 3 pp. The phenomenon occasionally observed in the direction finding of certain visual and aural radio ranges (VAR) for air traffic control and maritime Consol stations by uhf direction finding equipment consisting in jumps of the direction finder in the rhythm of keying is explained. (Germany.)

Measurement of the Radar Cross Section of a Man, F. V. Schultz, et. al. "Proc. IRE." February 1958. 6 pp. This is the first disclosure of quantitative measurements of how good a radar target a man is. CW Doppler measurements were performed at five frequencies ranging from 410 mc to 9375 mc, using both vertical and horizontal polarization from various angles. (U.S.A.)

The Power Level Control in Transmitters for the Instrument Landing System (ILS), K. May. "Nach. Z." December 1957. 6 pp. The transmitters for the instrument landing system, the approach course and glide path transmitters are fitted with power level controls which permit the adjustment of the energy for the centre antennas (carrier and sidebands) of the approach course transmitter and for the sideband antennas of the glide path transmitter. (Germany.)

1958 Missile Guidance Roundup, Heyward E. Canney, Jr. "M/R." February 1958. 7 pp. A report on missile guidance systems and industry participation. (U.S.A.)

Microwave Interferometer for Missile Guidance "Scans" Electronically, Arnold Levine and William Waer. "Av. Age." January 1958. 8 pp. New type of radar homer is especially suited to high speed air-to-air and surface-to-surface types. (U.S.A.)

Directly Double-Integrating Accelerometer Looks Good for Inertial Guidance, Kenneth E. Pope. "Av. Age." January 1958. 3 pp. The performance of its accelerometer decides how well as inertial guidance system works. This article reviews the various types of accelerometers that have been proposed for inertial guidance. (U.S.A.)

A New Receiver of the Australian DME Beacon, B. R. Johnson. "Proc. AIRE." November 1957. 8 pp. A new beacon receiver which was designed to overcome problems of coverage and echo interference in the Australian DME system is described. The arrangement of the R. F. stages which provide a beacon triggering sensitivity of 3μV is briefly described and the operation and design criteria for the instantaneous automatic gain control used for echo suppression are discussed. The introduction of instantaneous automatic gain control imposes requirements on the video circuits of the receiver which are analyzed. Result of field trials of a prototype equipment are given. (Australia.)

"S.A.R.A.H.": A UHF (253 Mc/s Pulse Coded Air/Sea Rescue System, D. Kerr. "J. BIRE." December 1957. 12 pp. The simplification in construction and operation of the personal radio beacon which a pulsed system gives justifies the need for a special receiver in the search aircraft or vessel. A double pulse is used to (1) give maximum system sensitivity, (2) permit discrimination between beacons, (3) facilitate synchronization. Speech may be transmitted from the beacon by pulse frequency modulation. Reception from the search vessel is by a super-regenerative circuit. The search equipment can detect beacon pulses at a range of 90 statute miles at 10,000 ft. (145 km at 3,050 m). When mounted in a boat, double Yagi aerials are used giving a detection range of six miles (9.7 km). (England.)

Monitor Displays Radar Noise Figures, Leo Young. "El." January 31, 1958. 3 pp. Direct and continuous measurement of radar receiver noise figure is provided by comparing, in a difference amplifier, d-c signals proportional to gated monitor pulse and noise generated during receiver dead time. (U.S.A.)

Modern Sonar Systems Guide Atom Subs, James A. Rummell. "El." January 3, 1958. 7 pp. New transducers and new electronic scanning and searchlighting techniques give increased detection ranges for both active and passive sonar, along with additional data on bearing, course, range-changing rate and type of vessel. (U.S.A.)

Target Simulator Tests Beam-Rider Missiles, G. E. Hendrix. "El." January 31, 1958. 4 pp. System that eliminates expensive test drones in evaluating missile performance uses cam-actuated linear potentiometers and noise generators to provide azimuth and elevation drive signals for missiles radar that approximate actual tracking conditions. (U.S.A.)

SEMICONDUCTORS

***P-I-N Type Structures as Medium Power Silicon Rectifiers,** Dr. R. J. Andres and Dr. E. L. Steele. "El. Ind." March 1958. 4 pp. A new design consisting of 3 layers—, P^+ Intrinsic, N^+—for silicon power rectifiers promises simple and economical assembly, rugged structure, and satisfactory heat dissipation for the low and medium power ranges. (U.S.A.)

***Transistors and Diodes in Strong Magnetic Fields,** Henry A. Kampf. "El. Ind." March 1958. 3 pp. What happens when a semiconductor is operated in a very strong magnetic field? Some show parameter change, some show orientation sensitivity, and some show no detectable change—but all show superior performance over vacuum tubes. (U.S.A.)

Recent Advancements in the Field of Semi Conductors, W. Taeger. "Freq." Vol. 11, No. 11, November 1957. 10 pp. The article describes various applications of non-linear solid-state devices and recent advancements made in producing germanium and silicon diodes and transistors. First the operation of diodes and transistors is discussed. This is followed by a description of circuits for audio amplifiers and reflex receivers. Finally, counters and multi-vibrators, as used for electronic computers and switching circuits, are outlined. The article closes with descriptions of special transistors, such as transistor tetrodes, fieldistors, photo-transistors, etc. Highlighted are the characteristics of transistors and diodes made by Telefunken. (Germany.)

A Method for Simplifying the Design of a Transistor Amplifier Stage, A. A. Sokolov. "Avto. i Tel." December 1957. 3 pp. Equivalent circuits and equations are derived for a transistor amplifier stage in terms of r_{11}—resistances. Several generalized examples are given. (U.S.S.R.)

High Frequency Parameters of Transistors and Valves, J. Zawels. "El. Eng." January 1958. 3 pp. High frequency equivalent circuits for thermionic valves in the common-cathode, common-grid and common-anode (cathode-follower) configurations are developed, analogous to the common-emitter, common-base and common-collector configurations of junction transistors. From these, the exact open-circuit (z), short-circuit (y) and hybrid (h) parameters for each of the above circuits are tabulated. The approximations permitted by the relative magnitudes of various elements are also indicated. (England.)

Experimental and Theoretical Analysis of a Frequency-Stabilized Transistor Oscillator, Operating at 8 MC, R. Schaffhauser and M. Strutt. "Arc. El. Uber." Vol. 11, No. 11. November 1957. 6 pp. The first part derives the conditions for a feed-back oscillator. The amplifier, its load, and the feed-back network are treated as four-terminal networks which are reduced to a single four-pole for which the conditions of oscillation are obtained. In the second part, a definite circuit is considered, and in the third part the input parameters of the transistor are discussed as dependent upon temperature and emitter current. (Germany.)

A 1kc/s Junction Transistor T-Parameter Measurement Set, R. A. Hall. "El. Eng." February 1958. 4 pp. A set has been constructed for measurement of the parameters of the simple T-equivalent circuit of a junction transistor at a frequency of 1kc/s. A description of the set is given, together with the experimental procedure. (England.)

Simplified Treatment of Electric Charge Relations at a Semiconductor Surface, E. O. Johnson. "RCA." December 1957. 31 pp. Simple, graphical representation is used to describe the electric charge and potential relations at a semiconductor surface. The balance between trapped and mobile charge at the surface is considered for both equilibrium and non-equilibrium situations. The graphical treatment illuminates some of the contemporary surface measuring techniques and shows what happens at metal-semiconductor and gas-semiconductor contacts. (U.S.A.)

The Hall Effect and Its Application to Power Measurement at 10 Gc/s, H. E. M. Barlow and S. Kataoka. "Proc. BIEE." January 1958. 8 pp. The paper describes experiments on the measurement of microwave power at 10 Gc/s employing the Hall effect produced in single crystals of n- and p-type germanium when erected on the axis of a hollow metal rectangular waveguide carrying the power. So far as is known, this is the first recorded observation of the Hall effect at this frequency, and it has been shown possible to apply the effect, with the help of a suitable phase-adjustment device, to the design of a wattmeter. For this purpose the Hall output from a crystal was calibrated against the power measured independently, and the relationship was found to be practically linear. (England.)

Electron Mobility in the Germanium-Silicon Alloys, B. Goldstein. "RCA." December 1957. 8 pp. This paper describes a method for measuring the conductivity mobility of a semiconductor, and an application of this method to the measurement of the majority carrier mobility in the germanium-silicon alloy system. (U.S.A.)

Some Measurements on Commercial Transistors and Their Relation to Theory, F. J. Hyde. "Proc. BIEE." January 1958. 8 pp. The effective lifetimes of minority carriers in the bases of five types of transistor have been measured under both steady-state and transient conditions as functions of emitter current. For alloy transistors, good agreement is obtained by the two methods in an overlay range of emitter current, within which both methods are valid. The lower emitter efficiency of the surface-carrier transistor prevents a direct comparison from being made in its case. (England.)

Comparison of the Semiconductor Surface and Junction Photovoltages, E. O. Johnson. "RCA." December 1957. 24 pp. It is shown analytically that the surface and junction photovoltages are almost identical phenomena. The functional dependence of the two photovoltages on the light-injected carrier densities is exactly the same, except in the region of saturation. On the other hand, the surface and the junction are basically different with respect to the effect of electric charge changes in traps. These charge changes can have a profound effect on the surface photovoltage but no direct effect at all on the total junction photovoltage. (U.S.A.)

Silicon Unijunction Transistor, Part 1, S. R. Brown and T. P. Sylvan. "El. Des." January 8, 1958. 8 pp. The silicon unijunction transistor is a three-terminal semi-conductor device different from the conventional two-junction transistor. Six standard types are now available having regular JETEC numbers. Part 1 of this two-part article deals with the structure and basic characteristics of the unijunction transistor. (U.S.A.)

Silicon Unijunction Transistor, Part II, S. R. Brown and T. P. Sylvan. "El. Des." January 22, 1958. 5 pp. Part 2 deals with practical characteristics and circuitry. (U.S.A.)

Transistor Physics, Bruce M. Williams. "Semicon." Jan./Feb. 1958. 8 pp. The author discusses some of the basic principles of semiconductor physics. Initially, information on the element germanium is introduced, such as the atomic properties, conductivity, and electron and hole mobility. A discussion then follows on diode action and the "Diode" equation is introduced. Finally, the author introduces the concept of transistor action developing the necessary associated equations. (U.S.A.)

The Elemental Semiconductors-Silicon and Germanium, Part 3, J. Shields. "El. Energy." December 1957. 3 pp. (England.)

Influence of Hydration-DeHydration of the Germanium Oxide Layer on the Characteristics of P-N-P Transistors, J. Torker Wallmark and R. R. Johnson. "RCA." December 1957. 13 pp. It has been found that when germanium p-n-p transistors are subjected to a change in temperature, the current-transfer ration a:e, shows a corresponding change, approaching an asymptotic value in approximately 48 hours. Simultaneously the saturation current of the emitter and collector junctions show a similar change. In this paper, this effect is interpreted in terms of a hydrated oxide layer on the germanium surface. (U.S.A.)

Diode Protection of Power Transistors from Temperature Variations and Voltage Surges, Dr. H. C. Lin. "Semicon." Jan./Feb. 1958. 4 pp. Transformer coupled transistor amplifiers are often susceptible to temperature variations and voltage surges. The effect of temperature is to cause a variation in d-c conductance. The condition for voltage breakdown is aggravated by the presence of reverse bias at the base. These undesirable effects can be eliminated or minimized by the use of diodes, which have many advantages over other schemes. (U.S.A.)

TELEVISION

IRE Standards on Television: Measurement of Luminance Signal Levels, 1957. Committee Personnel (57 IRE 23. S1). "Proc. IRE." February 1958. 5 pp. This Standard specifies the method by which operating personnel of a television transmitter may measure the relative levels of monochrome signals or of the luminance portion of color signals by means of an oscilloscope. (U.S.A.)

Television Standards of the International Radio-broadcasting Organization, S. V. Novakovskii. "Radiotek." October 1957. 7 pp. Detailed analysis of the television standards jointly adopted in March 1957 by the USSR, China, Czechoslovakia, Bulgaria, Albania, Mongolia, Poland, Romania, Hungary, North Korea and North Vietnam. (U.S.S.R.)

Waveform Testing Methods for Television Links, A. R. A. Rendall. "E. & R. Eng." December 1957. 8 pp. The subjective effects of phase and frequency distortion in television links are not readily discernible from steady-state measurements of transmission characteristics. Since the fundamental requirement is the preservation of waveform, a system of testing links by means of three standard waveforms has been evolved. Acceptance limits for received waveforms have been fixed by relating the waveform distortions to subjective picture quality, and a rating factor established. (England.)

A System for Simultaneous 12-Channel Television Reception. V. D. Kuznetsov. "Radiotek." Oct. 1957. 9 pp. The paper describes a new system for simultaneous television and UHF broadcasting in the frequency bands: 48.5-100 and 175-230 megacycles. The design formulas and engineering design data for the system are given. The following aspects of the problem are discussed: 1) a directional antenna; 2) a weakly-directional antenna; 3) branching systems; 4) amplifiers. (U.S.S.R.)

An Evaluation of the Quality of Horizontal Synchronizing Circuits in TV Receivers, H. Lutz. "Arc. El. Uber," Vol. 11, No. 11. November 1957. 10 pp. The paper evaluates the important parameters for judging the horizontal synchronization of TV sets. The noise characteristics and the response to sin or pulse disturbances are calculated. An arrangement is devised for measuring these characteristics. In addition, an arrangement is described which permits a quantitive analysis of pull-in and holding synchronization. (Germany.)

A Luminous Frame Around the Television Screen, J. J. Balder. "Phil. Tech." November 1957. 3 pp. Observers viewing a picture screen were asked to adjust the brightness and width of a uniformly illuminated frame around the picture so as to give most agreeable viewing conditions. This experiment was made with 20-25 observers each under conditions of a number of luminance values of screen and surroundings. The preferred frame width was found to be independent of screen and ambient luminance. (Netherlands.)

THEORY

Plate-Circuit Self-Modulation in Short-Wave Transmitters, Z. I. Model'. "Radiotek." Oct. 1957. 11 pp. The paper examines the possibility of improving the modulation characteristic in screen-grid tubes and in tubes employing grounded-grid amplification. In choosing the methods of compensating nonlinear distortion, preference is given to the method of large negative feedback. Methods of increasing the efficiency are given, and the special features of the computation are noted. It is concluded that plate self-modulation is practical in short-wave transmitters which are designed according to the principle of grid modulation and in transmitters of new design. (U.S.S.R.)

Theoretical Considerations Concerning the Frequency Compression of Periodically Recurring Processes, R. A. Kaenel. "Nach Z." December 1957. 2 pp. The frequency band compression of periodically recurring processes is investigated theoretically on the basis of the known sampling theorem. The requirements resulting from this, as far as the sampling frequency and the spectrum of the sampling pulse train are concerned, are quoted with a view to a practical realization of such a compression equipment (sampling circuit). (Germany.)

Theory of Parametric Amplification Using Nonlinear Reactances, S. Bloom and K. K. N. Chang. "RCA." December 1957. 16 pp. The parametric amplifier is analyzed phenomenologically in terms of an equivalent-circuit model. The model consists of a signal circuit resonant at W_1, and idling circuit at W_2, and a pumping circuit at $W_3 = W_1 + W_2$, these three circuits being coupled across a nonlinear inductance. The analysis is general enough to delineate the conditions on the signal level and circuit parameters which lead to distortionless amplification. (U.S.A.)

Transient and Steady-State Processes in Pulse Systems Containing Variable Parameters Which Vary Discontinuously, F. M. Kilin. "Avto. i. Tel." December 1957. 20 pp. The paper analyzes one of the methods for determining transient and steady-state responses in pulse systems with variable parameters that vary step-wise. The method of step functions combined with continuous functions is used to describe the phenomena which arise in such systems. The following examples are dealt with: 1) the passage of height-modulated pulses through a pulse-envelope detector and a tuned amplifier; 2) transient and steady-state responses in a pulse-envelope detector and a tuned amplifier; 3) equivalent circuits for a pulse-envelope detector and a tuned amplifier. (U.S.S.R.)

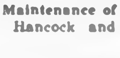
Synthesis of Pulse Circuits and Systems Incorporating Pulse Feedback, V. P. Perov. "Avto. i. Tel." December 1957. 17 pp. The paper determines the optimum characteristics of pulse systems. The optimalization criterion is assumed to be the minimum error dispersion for a specified dynamic accuracy and a specified transient response time of the system. The perturbation is assumed to consist of noise and signal, where the signal represents the sum of a stationary random component and a regular component. (U.S.S.R.)

Numeric Approach to Determine a Two-Pole Function which Approximates a Given Complex Function in an Interval of Real Frequencies, R. Unbehauen. "Arc. El. Uber." Vol. 11. No. 11. November 1957. 9 pp. A method is devised that in a purely numerical manner supplies a two-pole function which approximates a given complex function in an interval of real frequencies. After transformation of the variables the approximation is solved with the aid of polynominals. Subsequently, general rational functions are determined which approximate the polynominals found in the transformed frequency range. (Germany.)

On the Evaluation of the Region Within Which it is Possible to Find the True Periodic Solution Which is Approximately Defined by the Method of Harmonic Balance, I. V. Glatenok. "Avto. i. Tel." December 1957. 4 pp. This paper demonstrates that there exists [when certain limitations are imposed] a stable periodic solution if the method of harmonic balance determines a periodic solution when it is applied to this equation. It is also demonstrated that the true solution is found in a certain vicinity of the periodic solution which is obtained by the method of harmonic balance. The dimensions of such an area are evaluated. (U.S.S.R.)

Frequency Offset of Short-Wave Frequency-Modulated Broadcast Transmitters, P. Klamm. "Freq." Vol. 11. No. 11. November 1957. 9 pp. A few years ago it was discovered that the frequency spacing of two geographically adjacent short-wave FM transmitters, carrying the same program, can be reduced to 30 KC without causing any interference. This phenomenon, which is not fully understood, is presently used by the transmitters located at Cologne and Bonn. The article provides a mathematical analysis, supported by experiments to the question: What conditions must be met to permit multiple use of a frequency channel so as not to cause interference? (Germany.)

Theory of Networks of Linearly Variable Resistances, Harold Levenstein. "Proc. IRE." February 1958. 8 pp. A network theory is derived for circuits constructed of linear rheostats driven from a common input shaft. A correspondence between these networks and RL networks is used to demonstrate that driving point impedances and transfer functions are real rational fractions in a real variable, the input shaft rotation. (U.S.A.)



TRANSMISSION

A Standing-Wave-Ratio Measuring Instrument for Use in the Maintenance of Aircraft Installations, A. G. Hancock and T. S. Kepner. "AWA Tech. Rev." October 1957. 10 pp. A portable instrument for measuring the standing-wave ratio on transmission lines in v-h-f aircraft installations is described. The complete battery-operated instrument includes small bridges for 50 ohm and 70 ohm installations, oscillators for the bands of frequencies used, and an indicating meter, all of which are carried in a small instrument case. (Australia.)

A Note on the Fourier Series Representation of the Dispersion Curves for Circular Iris-Loaded Waveguides, P. N. Robson. "Proc. BIEE." January 1958. 4 pp. The dispersion curve for the lowest pass band in a uniform corrugated circular waveguide, such as is used in traveling-wave linear accelerators, may be expressed as a Fourier series of period 2π/(corrugation pitch). (England.)

Ghost Modes in Imperfect Waveguides, E. T. Jaynes. "Proc. IRE." February 1958. 3 pp. This paper calls attention to the fact that imperfections in a waveguide, such as that caused by placing a dielectric in it, can cause so-called ghost modes in the immediate vicinity of the imperfection which can give rise to unexpected and troublesome resonance effects, especially in high-power applications. (U.S.A.)

The Propagation Characteristics of Electro-Magnetic Waves Inside Axially-Stacked Metal Rings, G. Piefke. "Arc. El. Uber." Vol. 11. No. 11. November 1957. 6 pp. This is the second part of the article that appeared in the October 1957 issue. The paper investigates the propagation of electro-magnetic waves in a waveguide consisting of axially-stacked metal rings which are insulated from each other. (Germany.)

Transverse Film Bolometers for the Measurements of Power in Rectangular Waveguides, J. A. Lane. "Proc. BIEE." January 1958. 4 pp. The paper describes a simple standard technique, using thin metallic films sputtered on mica, for the direct measurement of powers in the range 1-100 mW. The experiments were carried out at a frequency of 10G/s (wavelength 3cm), but the methods used are of general application in rectangular waveguides. (England.)

Waveguide Design for Die-Casting, P. Humphreys. "E. & R. Eng." December 1957. 7 pp. This article explains how components which have been designed in normal rectangular waveguide may be easily modified on a theoretical basis to make them suitable for die-casting manufacturing methods. The theory is applicable to cases where the waveguide can be manufactured by splitting it along the length of the central E-plane and the unit is therefore cast in two halves. (England.)

TUBES

Low-Voltage Oscilloscope Tubes, F. de Boer and W. F. Nienhuis. "Phil Tech." November 1957. 6 pp. An account is given of the development of two oscilloscope tubes (type DG 7-32 and DG 7-31) requiring an anode voltage of only 400 V. One tube has been designed for symmetrical, the other for asymmetrical application of the sweep voltage. (Netherlands.)

Dispenser Cathodes, I, Introduction, A. Venema. "Phil. Tech." December 1957. 8 pp. This introductory article gives a recapitulation of the principles and properties of the L cathode developed some years ago in the Philips Laboratories at Eindhoven. The L cathode has been successfully used in many electronic tubes, especially where high continuous emission with long life is required. (Netherlands.)

Dispenser Cathodes, II, The Pressed Cathode, R. C. Hughes. "Phil. Tech." December 1957. 7 pp. A cathode is described which is fabricated by the press-molding of a tungsten-molybdenum alloy powder and a powder of barium-calcium aluminate, followed by a short heat treatment. The pressed cathode has the same emission characteristics as the L cathode: the electron emission of the metal surface is greatly enhanced by the presence of a monatomic layer of oxygen and barium. The molybdenum content ensures a suitable rate of barium dispensation. (Netherlands.)

Dispenser Cathodes, III, The Impregnated Cathode, R. Levi. "Phil. Tech." December 1957. 5 pp. The impregnated cathode is manufactured by impregnating a porous tungsten body with molten barium aluminate or barium-calcium aluminate. As in the L cathode, the emitting surface is tungsten covered with a monatomic layer of oxygen and barium. The emission properties are therefore similar to those of the L cathode and the pressed cathode. The impregnated cathode has short out-gassing and activation times. It can withstand several exposures to air, being reactivable several times. (Netherlands.)

Ferrite Waveguide Rectifiers which Utilize the Principle of Ferromagnetic Resonance, A. L. Mikhaelian, A. K. Stoliarov. "Radiotek." Oct. 1957. 14 pp. The paper examines theoretical and design problems associated with resonant rectifiers (valves) which are used in radio-relay communication lines, instrumentation, etc. The following problems are discussed: 1) resonant phenomena in a rectangular waveguide with transverse magnetization of a ferrite plate; 2) resonant phenomena in the case of an additional dielectric plate; 3) methods of increasing the band width of resonant rectifier (valve) systems. (U.S.S.R.)

A High-Power Periodically Focused Traveling-Wave Tube, O. T. Purl, et al. "Proc. IRE." February 1958. 8 pp. The design considerations, construction, and performance of an S-band, pulsed, kilowatt-level traveling-wave tube, focused by means of periodic permanent magnets are described. The tube exhibits saturated power gain in excess of 30 db, with a bandwidth of approximately 2-4 kmc and weighs 17 pounds or less, complete with package. (U.S.A.)

AC Operation of Constant Current Magnetrons, W. Schmidt. "El. Rund." January 1958. 3 pp. The connections between current and voltage maximum values and time average values as well as between the power of the input and the angle of plate current flow are discussed. The maximum values are essentially higher for the same operation compared with the respective values reached by DC operation. (Germany.)

The Reactance Valve at Audio Frequencies, B. J. Alcock. "El. Eng." February 1958. 3 pp. The reactance valve circuit is analyzed to derive circuits producing an inductive impedance at audio frequencies with particular reference to obtaining a large Q factor. (England.)

Developmental Position and Method of Operation of Microwave Tubes, III, R. Muller and W. Stetter. "El. Rund." January 1958. 4 pp. Whereas the previous articles gave constructional details of retarded-wave tubes and various types of klystrons, the present article is a survey of traveling-wave tubes. The dependence of the amplification and of the noise factor upon the helix voltage as well as that of the heating power are shown by diagrams. (Germany.)

The Physics of the Cathode, L. S. Nergaard. "RCA." December 1957. 26 pp. Recent work on thermionic emitters suggests some generalizations bearing on all electron emitters. Four propositions are advanced for consideration and discussion. (U.S.A.)

U. S. GOVERNMENT

Research reports designated (LC) after the PB number are available from the Library of Congress. They are photostat (ph) or microfilm (mi), as indicated by the notation preceding the price. Prepayment is required. Use complete title and PB number of each report ordered. Make check or money order payable to "Chief, Photoduplication Service, Library of Congress," and address to Library of Congress, Photoduplication Service, Publications Board Service, Washington 25, D. C.

Orders for reports designated (OTS) should be addressed to Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Make check or money order payable to "OTS, Department of Commerce." OTS reports may also be ordered through Department of Commerce field offices.

An Experimental Two-Helix Backward Wave Mixer, G. C. Gray, Univ. of Calif. Mar. 1957. 24 pages. 75 cents. (PB 131022, OTS) This report provides useful information on the two most important aspects of the operation of a backward-wave mixer tube: conversion loss characteristics and noise figure. The work was a continuation of an experimental study of a mixer tube in which the mixing takes place in a hollow electron beam. In the tube, the two signals to be mixed are introduced onto the beam by means of two helix structures which interact with the beam in the backward mode. Reduced conversion loss was attempted by using a time-impedance output gap and sufficient starting oscillation separation between circuits. A conversion loss of about zero db was obtained by using two helices with lengths in the ratio of 2:1 and an output gap impedance of about 30,000 ohms. Reduction of the noise figure was approached by design of a low noise gun. Its application revealed that there were several sources of noise, the most important of which was the component of noise leaving the cathode at the intermediate frequency. Resulting overall noise figures were in the range 30-40 db. Design of a proper low noise mixer, it was concluded, must depend on an analysis of both mixing process and noise figure.

Secondary Electron Current from a Pulsed Electron Accelerator, A. E. Evans, Jr., and others, Wright Air Development Center. Sept. 1956. 20 pages. 50 cents. (PB 121757, OTS) During a study of neutron time-in-flight, it was proposed to use a 2 MEV electrostatic accelerator as part of the system. Neutrons were to be produced by a (γ,n) reaction in beryllium, with gamma rays produced by bombardment of a gold target with 2 MEV electron pulses. Initial tests showed the gamma-ray counting rate of the system to be too high between accelerator pulses. This study was undertaken to identify the source of the radiation and eliminate it. The accelerator, with a .06 microsecond pulsed electron source, was found to produce radiation afterpulses occurring as late as 150 microseconds after cessation of the source pulse. The mechanism for formation of the afterpulses and the instrumentation for their study are discussed.

Hydrogen Contamination in Titanium and Titanium Alloys: Part 2—Comparison of Various Methods of Hydrogen Analysis, J. W. Seeger and J. A. Winstead, Wright Air Development Center. Oct. 1956. 94 pages. $2.50. (PB 121761, OTS) This volume contains information valuable for control of hydrogen content in mill products. Analytical methods used (to mid-1956) for hydrogen determination in titanium and its alloys are described, along with their operating procedures and costs. The various techniques are grouped in two main categories. The first is extraction of hydrogen under vacuum from a solid or fused specimen, methods which require elaborate apparatus but perform a higher rate of analyses than single-specimen systems. The second technique is through combustion of a specimen with gas sweep and oxidation of hydrogen to water. These methods are less expensive and may be fabricated in the laboratory. Laboratories using these methods generally are in disagreement, according to the report, and vary considerably in analytical reproducibility. These differences are discussed, and the report suggests that perhaps the methods are less at fault than the differences among laboratories themselves using the same method. A model experiment for a single sheet disputed between laboratories is suggested.

Hydrogen Contamination in Titanium and Titanium Alloys: Part 3—Strain Aging Hydrogen Embrittlement in Alpha-Beta Titanium Alloys, H. M. Burte, Wright Air Development Center. Oct. 1956. 51 pages. $1.50. (PB 121786, OTS) Strain aging embrittlement resulting from hydrogen contamination has been shown to lead to sudden brittle fracture during use of alpha-beta titanium alloys. This work was concerned with the effects of hydrogen on the room temperature mechanical properties of those alloys, and led to a proposed mechanism for strain aging embrittlement. This type of embrittlement was shown to have its greatest effect on mechanical properties measured at slow strain rates. It caused low ductility in room temperature tensile tests and premature brittle fracture in rupture tests. Both alloy composition and microstructure affected susceptibility to strain aging embrittlement. Increasing test temperature seemed to decrease the tendency toward embrittlement, but increased the rate at which embrittlement could occur. The proposed mechanism involves microsegregation of hydrogen to the grain boundaries in plastically deformed material.

Adhesive for Composite Material Used in Printed Circuitry, Houghton Laboratories, Inc. Mar. 1956. 83 pages. $2.25. (PB 121960, OTS) The aim of the study was development of improved adhesive systems for composite materials using electrolytic or rolled copper foil. Laminates were produced from paper, nylon, glass, and Orlon by use of phenolics, melamine, epoxide, silicone, Teflon, and diallyl phthalate resins. The foil clad laminates were of the XXXP type most frequently used in printed circuitry. Many techniques of surface treatments were explored and a number of new adhesives with outstanding bond strengths were evaluated. The best copper-clad laminates were prepared from copper foil surface-treated with Ebanol Special "C" and bonded with HYSOL 2217 adhesive. Bond strength and solder dip resistance were exceptionally good in nylon-phenolic, melamine-glass, epoxide-glass, and diallyl phthalate-Orlon laminates bonded with the system. The report contains a recommendation that the extensive data from the project be used in upgrading various military specifications concerning foil clad laminates. U. S. Army Signal Corps Specification MIL-P-13949 is cited in particular.

Symposium on Advanced Programming Methods for Digital Computers. ONR. Oct. 1956. 83 pages. $2.25. (PB 121670, OTS) This meeting was held in June 1956 to discuss progress since 1954 in advanced programming and its effect on the operation of computing installations. The symposium was co-sponsored by ONR and the Navy Mathematical Computing Advisory Panel and attended by more than 250 representatives of Government agencies and contractors. Speakers were from Federal and industrial research organizations. They were selected to present as complete a picture as possible of present and future developments in the programming field. Among the subjects covered in the 13 technical papers are automatic coding principles, common language automatic programming systems, large computer programs, redundant programming, and automatic programming for commercial problems.

Dynamic System Studies: Part 5—Analog Computation. F. W. Bratten, Naval Ordnance Lab. Sept. 1956. 78 pages. $2. (PB 121678, OTS) This report describes recently-developed (to 1956) analog computer components and systems and their characteristics. General purpose computers are considered and future developments in the systems and their components are anticipated. Sections also cover commercially available analog computing equipment, operating characteristics of the Reeves analog equipment, measurement techniques, and analysis of an operational amplifier.

Dynamic System Studies: Part 6—Operation and Maintenance Procedures for Analog Computers, W. R. Allen, Univ. of Chicago. 126 pages. $3.25. (PB 121792, OTS) This volume contains a detailed discussion of analog computers, from basic philosophy of the devices to their final useful application. The report is primarily concerned with the electronic differential analyzer. Information is provided for setting up problems, checking problem setups, or solutions, analyzing computer solutions, examining the operating staff, and deciding on maintenance procedure. Appendices discuss special computer techniques, a mathematical model useful in setting up spare parts inventories, and fast time computers.

The Effect of Various Heat Treatment Cycles Upon the Mechanical Properties of Titanium Alloys with Various Interstitial Levels. B. F. Hadley, et. al. Mallory-Sharon Titanium Corp. Mar. 1957. 220 pages. $5.50. (PB 131009, OTS) The effects of various heat treatments on mechanical properties of the alloys Ti-5Al Complex, Ti-3Mn Complex, Ti-6Al-4V, and Ti-4Al-4Mn were examined. The heat treatments were a solution treatment and age cycle, a step quench cycle, and a solution treatment, isothermal transformation cycle. The effects of interstitial levels, or interstitial element contents, and section size were also studied.

Wear Studies with Titanium. R. J. Benzing and A. N. Damask, Wright Air Development Center. Jan. 1957. 20 pages. 50 cents. (PB 121885, OTS) This study was undertaken to provide data for comparison with other studies dealing with friction coefficients and wear of specimens in non-standard lubricant testers. Using typical oils, wear of titanium was measured on the Falex Wear Tester and the Shell Four-Ball Wear Tester. A mineral oil, diester, silicate ester silicone, and halogenated hydrocarbon were the oils studied. The alloys were C-130-AM, Ti-150A, and 3Al-5Cr.

The Effect of Microstructural Variables and Interstitial Elements on the Fatigue Behavior of Titanium and Commercial Titanium Alloys, C. B. Dittmar, et. al. Mallory-Sharon Titanium Corp. Jan. 1957. 96 pages. $2.50. (PB 121972, OTS) The effect of microstructure on the fatigue behavior of the commercial alloys Ti-5Al-2.5Sn, Ti-6Al-4V, and Ti-3Mn Complex was investigated. Interstitial contents representative of the basis for commercial titanium specification were also studied for effect on the same commercial alloys.

Summary of Joint FIL-TDC Simulation Activities in Air Traffic Control, S. M. Berkowitz, et. al. Franklin Institute Lab. Mar. 1957. 32 pages. $1. (PB 121919, OTS) Certain operational requirements must be met for a common system of air navigation and traffic control. This report summarizes the joint air traffic control simulation activities performed at The Franklin Institute Laboratories (FIL) and the Technical Development Center (TDC) of the Civil Aeronautics Administration during a two-year contract period ending in June 1955. The program was sponsored by the Air Navigation Development Board. The simulation activities are concerned with solving problems in the field of air traffic control. Most of the actual simulation effort was conducted on a dynamic air traffic control simulator. Much of the information yielded by the project concerns new operational procedures, techniques, equipment, and facilities. Detailed recommendations for future research are listed.

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Circle 84 on Inquiry Card, page 101

New Products

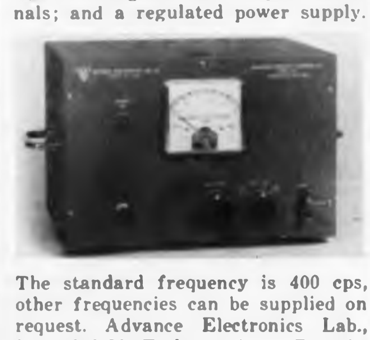
DIGITAL TAPE SYSTEM

A new digital computer input/output system offers transfer rates as high as 90,000 six-bit characters/sec. Known as the "Ampex Digital Tape System," it consists of 4 interdependent items: tape handler, read/write heads, electronics, and a special magnetic tape. FR-300 tape handler operates at 150 in./sec. and can record 2 six-bit characters side by side on 1 in. tape (½ in. also available). Packing densities up to 300 bits/in. The tape handler's reliably repeatable start and stop times is less than 1.5 msecs. Ampex Corp., 934 Charter St., Redwood City, Calif.

Circle 269 on Inquiry Card, page 101

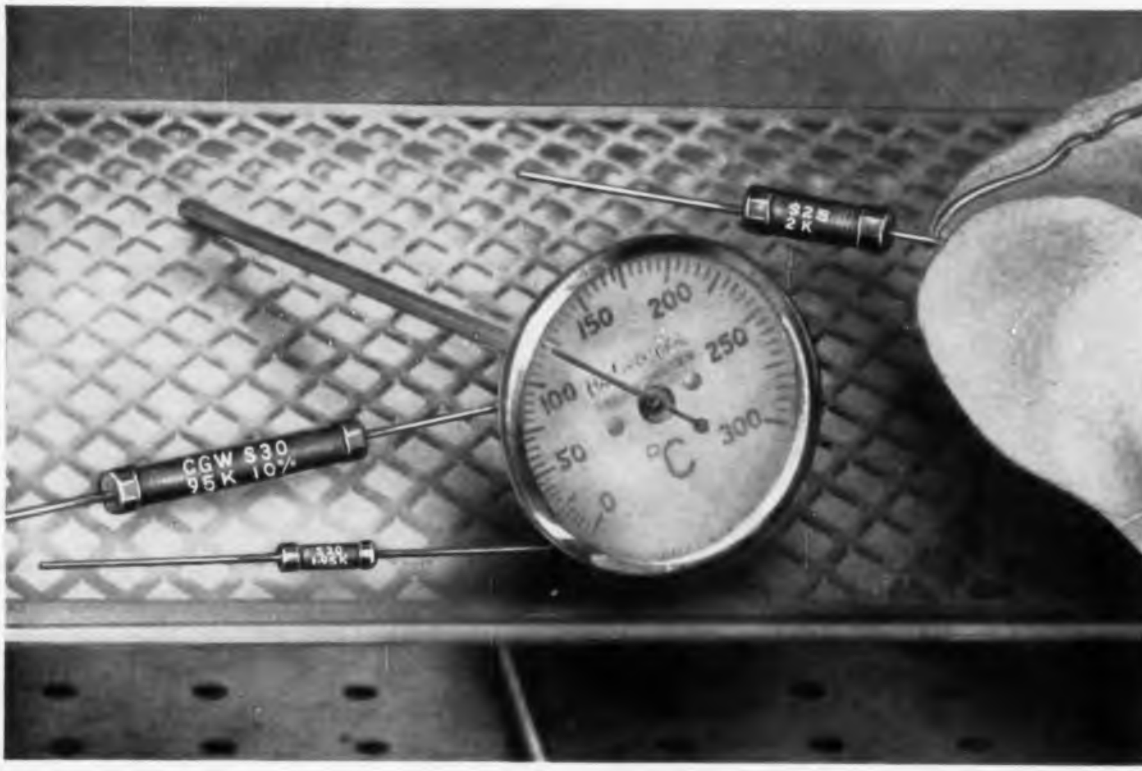
SIGNAL GENERATOR

Type 209 standard frequency signal generator consists of a tuning fork oscillator, with negative feedback for amplitude stabilization; a Twin-T filter with a cascode amplifier for elimination of harmonic distortion; an output cathode follower; a resistive attenuator with 2500 ohms impedance; an output meter circuit to indicate the signal voltage at the output terminals; and a regulated power supply.



The standard frequency is 400 cps, other frequencies can be supplied on request. Advance Electronics Lab., Inc., 249-59 Terhune Ave., Passaic, N. J.

Circle 270 on Inquiry Card, page 101



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

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

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

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

Three sizes are now available in production quantities:

S-20—½-watt at 120° C. (or 1-watt at 40° C.). Range from 50 ohms to 500,000 ohms.

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S-30—2-watts at 120° C. (or 4-watts at 40° C.). Resistance range from 100 ohms to 4.2 megohms.

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

Tolerances of 1%, 2%, 5% and 10% are available to meet your exact applications.

And how does a volume price of 25¢ each for the S-20 ± 1% tolerance sound to you?

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Type H—High-frequency 2% or 5% tolerance. Standard ranges from 50 to 1,000,000 ohms and ratings from 7 to 140 watts.

Type HP—High-power resistors. 17, 30, 70, and 150 watts. Tolerances of 2% or 5%. 50 to 500,000 ohms.

Type WC-5—Water-cooled. Range—35 to 300 ohms. Versatile and adaptable.

Type N—Accurate grade. Made to meet all requirements of MIL-R-10509B.

Other products for Electronics by Corning Components Department: Fixed Glass Capacitors*, Transmitting Capacitors, Canned High-Capacitance Capacitors, Subminiature Tab-Lead Capacitors, Special Combination Capacitors, Direct-Traverse and Midget-Rotary Capacitors*, Metallized Glass Inductances, Attenuator Plates.

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Circle 87 on Inquiry Card, page 101

IRE Fellows Predict

(*Continued from page 134*)

proved knowledge in the world of classical and quantum physics. Some idea of what this means is gained by considering the possibility of measuring the circumference of the earth with a precision of one part in 10^{11}. This would amount to an error of about one hundredth of an inch in 25,000 miles."

Warren A. Marrison, The Ramo-Wollridge Corporation—"The measurement of time and its reciprocal, frequency, continues to present an interesting challenge to the mind and a valuable tool in research and engineering. The most intriguing evolution taking place is the concept of two kinds of measurable time: astronomical time being irrevocably associated with the apparent motions of massive heavenly bodies, and philosophical time which is measured by quantum-mechanical effects unperturbed by the passage of time. The variations in astronomical time, which is the time we live by in everyday affairs, can now be measured by the transitions in certain substances, notably caesium 135 and other alkali atoms. The inherent stability of the caesium "clock" may soon enable us, by placing such clocks in satellite orbits, to observe the relation between velocity and measured time and so add to our knowledge of relativity."

F. H. Wells

P. E. Haggerty

Frank H. Wells, Atomic Energy Research Establishment, England—"Nuclear Physics research and reactor design are becoming more and more dependent on the most advanced electronic techniques. Many experiments demand the utmost in short time resolution down to fractions of a millimicrosecond and, as soon as an improved nuclear particle detector can be made, work in this field will use even shorter time intervals. This will require the extension of circuit bandwidths from the 200 MC region up to at least 1000 MC."

P. E. Haggerty, Texas Instruments Incorporated—"Management of industrial organizations exploiting recent scientific developments involves standard management practices, but with a change in emphasis. This change in emphasis, however, is sufficiently profound in some cases to represent quite a different kind of management. Appreciation of this fact, together with establishment of policies and practices to conform to it, not only can rebound to the success of the organization, but frequently to the advancement of a whole industry. A persistent problem in management of organizations of this kind is the selection of markets. More often than not there is little or no guide to the market potential for products developed from technological advances. It is of vital importance, however, that markets be available or created since, typically, the exploitation of products derived from such advances requires disproportionately large expenditures for research and engineering. Still another consideration is matching of market potential and organizational potential. In this respect, timing the product's introduction is all important. Market research must have determined that the customer need is of sufficient scope to assure volume—and therefore profitable—production. And the organization must be prepared to provide customers with sufficient technical help to handle the product in a manner advantageous to both customer and supplier. Two cases in point, I believe, were the development and production in commercial quantities of the first silicon transistor and the bringing into mass production of a low-price high-frequency germanium transistor. The former broadened the potential areas of transistor application to military control systems, instrumentation in high speed aircraft and missiles, and many other military and industrial fields where the ability to operate at relatively high temperature and extreme reliability are vital.

Industrial Firms Equip University Lab

Two industrial firms have come to the aid of the Univ. of Colorado in obtaining urgently needed scientific equipment.

The university will receive thousands of dollars of electronic and measuring equipment for use in physics lab instruction at a cost of only $1,300.

Acquisition of the equipment is being made possible through the General Electric Company's educational assistance program and a $5,000 grant from the Carl A. Norgren Foundation, Englewood, Colo.

Several months ago G.E. agreed to provide the university with 195 pieces of badly needed instructional equipment if the university could put up $6,300, a fraction of the total cost.

Because of budget limitations, the university could allot only $1,300 for the equipment, and was about to turn down the offer when Carl A. Norgren, president of the foundation and pneumatic products firm bearing his name, volunteered to make up the difference.

IRE Technical Program

(Continued from page 95)

Sample and Hold Circuits for Time Correlation of Analog Voltage Information—W. T. Eddins
A Transistorized Six-Channel Airborne Digitizer—S. H. McMillan and W. A. Sutton
Channel Selection for Multi-Carrier Telemetry—L. S. Taylor and G. F. Bigelow
Telemetering Receiving Station Time Pulse Detector—J. Star

Techniques and Criteria Considerations in Electronic Engineering

Monday, March 24
2:30-5:00 P.M.
Sert Room—Waldorf Astoria
Chairman: J. M. Bridges
Office of Asst. Secretary of Defense (Research and Engineering)
Use of Kros-Term System for Quick Retrieval of the Technical Detail from Large Pools of Information—A. P. Vigliotta and K. D. Swartzel
Techniques for the Presentation of Three-Dimensional Information—E. J. Kennedy and E. F. LaForge
Transistorized Airborne Military Television Techniques—J. J. Kelly
Design Criteria for Missile Automatic Test Equipment—W. O. Campbell
Active Space-Frequency Correlation Systems—W. E. Kock and J. L. Stone

Panel: Educational Needs in Systems Engineering

Monday, March 24
2:30-5:00 P.M.
Grand Ballroom—Waldorf-Astoria
Chairman: R. P. Johnson
Vice Pres., Research and Development
The Ramo Wooldridge Corp.
Participants:
H. Chestnut, Control System Engineering, General Electric Co.
H. H. Goode, Dept. of E. E., Univ. of Michigan
S. Herwald, Director of Research, Westinghouse Electric Corp., Air Arm Div.
R. J. Kochenburger, Dept. of E. E., Univ. of Connecticut
W. K. Linvill, Weapons Systems Evaluation Group, Dept. of Defense, Washington, D. C.
J. Moore, Manager, Autonetics Div., North American Aviation, Inc.

Engineering Writing and Speech

Monday, March 24
2:30-5:00 P.M.
Morse Hall—Coliseum
Chairman: A. A. McKenzie
McGraw-Hill Technical Book Dept.
Roadblocks in Technical Writing—T. Griggs
Writing for a Technical Journal—E. T. Ebersol, Jr.
Non-Technical Help for Engineer Writers—R. B. MacPherson
We Are What We Say—A. Henesian
Preparation of Auto-Abstracts—H. P. Luhn

Radio Frequency Interference

Monday, March 24
2:30-5:00 P.M.
Marconi Hall—Coliseum
Chairman: Eric J. Isbister
Sperry Gyroscope Co.
Bandwidth Conservation in Pulse Modulated Radars—R. A. Rosien and R. Shavlach
Measurement of Spurious Radiation from Missileborne Electronic Equipments—A. L. Albin and C. B. Pearlston
Small, Lightweight, RF Interference Suppressors Using Transistors—W. Pecota
Transmission Interference in Low Level Instrumentation Systems—J. C. Crosby
Spurious Frequency Measurement in Waveguide—M. Morelli

Advances in Production Engineering

Monday, March 24
2:30-5:00 P.M.
Faraday Hall—Coliseum
Chairman: Jack Davis
Consumer Products Engineering
Motorola, Inc.
Automatic Transistor Classifier—F. J. Morcerf and L. F. Roehm
Circuit Packaging and Integration of Transistor Assemblies—H. H. Hagens

Automatic Soldering Machine for Printed Circuit Assembly Boards—W. L. Oates
Wire Processing for Low Volume Electronic Production—R. D. Peters
"Case" History—T. C. Combs
Tension in Coil and Tape Winding—E. J. Saxl

Automatic Control—General

Tuesday, March 25
10:00 A.M.-12:30 P.M.
Starlight Roof—Waldorf-Astoria
Chairman: John M. Salzer
The Magnavox Co.
A Servo Pressure Control System for the Iron Lung—G. A. Biernson and J. E. Ward
Gain-Phase Relations of Non-Linear Circuits—E. Levinson
On the Design of Adaptive Systems—H. L. Groginsky
The Organization of Digital Computers for Process Control—G. Post and E. L. Braun
A Self-Adjusting System for Optimum Dynamic Performance—G. W. Anderson, J. A. Aseltine, A. R. Mancini, C. W. Sarture

Controlled Thermonuclear Power

Tuesday, March 25
10:00 A.M.-12:30 P.M.
Astor Gallery—Waldorf-Astoria
Chairman: Edward W. Herold
C. Stellarator Associates
Controlled Thermonuclear Fusion and Its Meaning for the Radio Engineer—E. W. Herold
Hydromagnetic Instabilities—A Pictorial Approach—I. Bernstein
Microwave Measurements in Controlled Fusion Research—M. Heald
Measurements of Neutron Production in a Dynamic Pinch—R. Pyle
Production of Intense Magnetic Fields and Their Relation to Fusion Reactors—M. Levine
Plasmas for Propulsion—W. Bostick

Broadcast Transmission Systems

Tuesday, March 25
10:00 A.M.-12:30 P.M.
Jade Room—Waldorf-Astoria
Chairman: G. E. Hagerty
Westinghouse Broadcasting Co.
Video Modulation Limiter—L. S. Sadler
Color TV Recording on Magnetic Tape—J. L. Grever
An Automatic TV Level Control Using Vertical Interval Test Signals—J. R. Popkin-Clurman and Frank Davidoff
Report on Remote Control of a Directive Antenna System—H. F. Rhea
A Novel System for Feeding a Single Tower AM, FM and TV Signals—A. C. Goodnow

Stereophonic Disc Recordings

Tuesday, March 25
10:00 A.M.-12:30 P.M.
Sert Room—Waldorf-Astoria
Chairman: H. E. Roys
RCA Victor Record Division
RIAA Engineering Committee Activities with Respect to Stereophonic Disc Records—W. S. Bachman
The Westrex Stereodisk System—C. C. Davis and J. G. Frayne
Tracing Distortion in Stereophonic Disc Recording—M. S. Corrington and T. Murakami
Compatibility Problems in Stereophonic Disc Reproduction—B. B. Bauer and R. Snepvangers
Phonograph Pickups for Stereophonic Record Reproduction—W. S. Bachman and B. B. Bauer
The Requirements of a Record Changer, Component Parts and Associated Equipment for Stereophonic Record Reproduction—W. Faulkner

Planning Against Time

Tuesday, March 25
10:00 A.M.-12:00 Noon
Grand Ballroom—Waldorf-Astoria
Chairman: Charles R. Burrows
Ford Instrument Company
Weapons Systems Development—Maj. Gen. Bernard A. Schriever
Commercial Product Development—R. Thalner
Scientific Manpower—H. A. Meyerhoff

Aeronautical and Navigational Electronics

Tuesday, March 25
10:00 A.M.-12:30 P.M.
Morse Hall—N. Y. Coliseum
(Continued on page 184)

(Continued from page 183)

Chairman: Eugene G. Fubini
Airborne Instruments Lab., Inc.

A Vortac Traffic Control System—P. E. Ricketts

Airborne Vortac DME for Federal Airways System—S. M. Dodington and B. B. Mahler

IDEA Integrated Defense Early Warning Air Traffic Control—B. H. Baldridge

The AN/APN 96 Doppler Radar Set—M. W. McKay

Increasing the Traffic Capacity of Transponder Systems—H. Davis and M. Setrin

Medical Electronics

Tuesday, March 25
10:00 A.M.-12:30 P.M.
Marconi Hall—Coliseum
Chairman: Walter E. Tolles
Airborne Instruments Lab., Inc.

A New Nipkow Disk Scanner for Accurate Cytological Measurements—H. S. Sawyer and R. C. Bostrom

Electrocardiograph Telemetering (Radio)—J. C. Webb, L. E. Campbell and J. G. Hartsock

Electronics in Biochemical Spectroscopy—M. Ruzoff and T. Gallagher

Patient Data Systems for Hospitals—G. Guy Knickerbocker and G. N. Webb

A New Intracardiac Pressure Measuring System for Infants and Adults—A. Warnick and E. H. Drake

The Electronic Evaluation of Fetal Distress—E. H. Hon

General Communications Systems

Tuesday, March 25
10:00 A.M.-12:30 P.M.
Faraday Hall—Coliseum
Chairman: R. L. Marks
Rome Air Development Center

Digital Communication Systems—R. L. Plouffe

Constant Amplitude Speech—P. J. Ferrell

Exploitation of Physical Phenomena for Communications—J. L. Ryerson

Reduction of Intermodulation in Microwave Systems by Using Ferrite Load Isolators—N. P. Weinhouse

The Effects of Pulse Shape and Frequency Separation on FSK Transmission Through Fading—G. L. Turin

A 45 Channel PPM System—S. M. Schreiner and B. McAdams

New Trends in Directional Communications—R. C. Benoit Jr. and F. Coughlin Jr.

Changing Demands on the Breadth of Electrical Engineering Education—A Panel Discussion

Tuesday, March 25
2:30-5:00 P.M.
Starlight Roof—Waldorf-Astoria
Chairman: J. D. Ryder
Dean of Engineering
Michigan State Univ.

Participants:

S. W. Herwald, Mgr., Air Arm Division, Westinghouse Electric Corp.

H. Pollak, Technical Staff, Bell Telephone Labs Inc.

D. B. Sinclair, Vice Pres. for Engrg., General Radio Co.

G. K. Teal, Asst. Vice President, Research, Texas Instruments Inc.

Atomic Clocks and Masers

Tuesday, March 25
2:30-5:00 P.M.
Astor Gallery—Waldorf-Astoria
Chairman: A. Gardner Fox
Bell Telephone Laboratories, Inc.

A Gas Cell "Atomic Clock" Using Optical Pumping and Optical Detection—M. Arditi and T. R. Carver

The Atomichron®—An Atomic Frequency Standard Physical Foundations—A. O. McCoubrey

The Atomichron®—An Atomic Frequency Standard System, Operation and Performance—W. A. Mainberger

Analysis of the Emissive Phase of a Pulsed Maser—H. H. Theissing, F. A. Dieter and P. J. Caplan

A Two-Cavity Unilateral Maser Amplifier—N. Sher

Broadcast Transmission Systems and Communications Systems

Tuesday, March 25

(Continued on page 198)

MICROWAVE AND SPECIAL TUBE NEWS from SYLVANIA

Trigger Thyratrons Survive Rigorous Environmental Tests

Rugged Sylvania cold cathode thyratrons meet and withstand the tough requirements of today's military equipment

Under actual operating conditions, in military applications, Sylvania cold cathode thyratrons regularly meet and withstand new extremes in heat, shock and vibration. In light signal beacons and other equipment, too, the Sylvania trigger tubes readily survive rugged treatment in the field with flying colors.

These small, lightweight tubes deliver high instantaneous peak current. Since no heater is required, circuits are simpler, heat dissipation is negligible, and a transformer is not needed.

Type 6873—Sylvania's premium cold cathode thyratron, type 6873, is especially suited for military applications. It is designed to withstand a 10 G vibration from 10 to 500 CPS and a guillotine impact shock of 50 to 100 G in 5 milliseconds without voltage breakdown. It exhibits a smooth output curve with negligible time jitter.

The type 6873 has an operating temperature range of −55° to +85° C., and can withstand temperatures in excess of 100° C. for more than an hour. The use of the keep-alive grid insures stable triggering characteristics throughout life, with a maximum anode delay of 8 microseconds under typical operating conditions.

Industry Takes to Trigger Thyratrons

Sylvania types replace relays in many control applications

Sylvania type 6483 used in photoflash equipment

Growing use of electronics in industry has expanded the application of Sylvania cold cathode thyratrons. They are used extensively in photoflash applications and to an increasing extent as overload protectors. Cold cathode thyratrons are replacing relays in control equipment because the tubes offer these advantages:

• *longer life* • *high reliability* • *lower cost*
• *compactness* • *no moving parts*
• *silent operation*
• *continuous operation without maintenance*

Type 6483—Housed in a T3 bulb, Sylvania cold cathode thyratron type 6483 is ideal for devices where small size, weight and cost are controlling factors. Its low plate voltage characteristics make it highly popular for application in standard battery-operated devices such as photoflash equipment. Its flexible leads permit easy assembly on printed circuit boards, and easy potting.

Type OA5—Sylvania's type OA5 is especially suitable for industrial control applications. It has a standard 7-pin socket to facilitate installation and replacement, and uses a size T5½ bulb.

ELECTRICAL RATINGS

Type 6873

Anode Voltage	500 to 1000 Volts dc
Trigger Voltage	
tp = 2 usec.	215 Volts Min.
tp = 200 usec.	180 Volts Min.
Hold-Off Voltage	1500 Volts Min.
Peak Cathode Current	
Minimum	10 Amperes
Maximum	500 Amperes

Type 6483

Anode Voltage	350 to 500 Volts dc
Trigger Voltage	200 Volts Min.
Hold-Off Voltage	550 Volts Min.
Peak Cathode Current	10 Amperes Min.

Type OA5

Anode Voltage	500 to 1000 Volts dc
Trigger Voltage	180 Volts Min.
Hold-Off Voltage	1500 Volts Min.
Peak Cathode Current	10 Amperes Min.

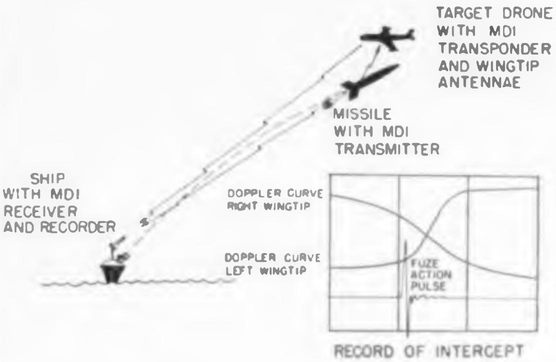
SEE US AT THE I.R.E. SHOW BOOTHS 2402–2507

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N.Y.
In Canada: Sylvania Electric (Canada) Ltd.
Shell Tower Bldg., Montreal

LIGHTING • TELEVISION • RADIO • ELECTRONICS • PHOTOGRAPHY • ATOMIC ENERGY • CHEMISTRY-METALLURGY

Circle 123 on Inquiry Card, page 101



U.S. NAVAL ORDNANCE LABORATORY'S MISS DISTANCE INDICATOR

Missile sends signals to both the ship and target aircraft. Latter retransmits signals and the distance of miss is determined by the difference in frequency between the missile's and target's signals.

IRE PROFESSIONAL GROUPS

In descending order of membership size as of 11/30/57

Electronic Computers	PGEC
Circuit Theory	PGCT
Audio	PGA
Engineering Management	PGEM
Electron Devices	PGED
Microwave Theory and Techniques	PGMTT
Instrumentation	PGI
Military Electronics	PGMIL
Aeronautical and Navigational Electronics	PGANE
Antennas and Propagation	PGAP
Information Theory	PGIT
Automatic Control	PGAC
Telemetry and Remote Control	PGTRC
Communication Systems	PGCS
Broadcast and Television Receivers	PGBTR
Industrial Electronics	PGIE
Nuclear Science	PGNS
Medical Electronics	PGME
Component Parts	PGCP
Reliability and Quality Control	PGRQC
Broadcast Transmission Systems	PGBTS
Vehicular Communications	PGVC
Production Techniques	PGPT
Ultrasonics Engineering	PGUE
Engineering Writing and Speech	PGEWS
Education	PGE
Radio Frequency Interference	PGRFI
Human Factors in Electronics	PGHFE

(Continued from page 184)

2:30-5:00 P.M.
Jade Room—Waldorf-Astoria
Chairman: Andrew L. Hammerschmidt
National Broadcasting Co.

Remote Control of 50 KW Transmitter—R. N. Harmon
Report on Multiplex Experimental Work at WCAU FM—E. J. Meehan
Field Test of Compatible Single Sideband at WABC—R. M. Morris
Improved CSSB Equipment for the Standard Broadcast Service—L. R. Kahn
An Incrementally Tuned, Drift Cancelled Communications Receiver—Saul Fast and R. Caulk
Polyphase Telephone Carrier System—J. R. Mensch
Tele Mac—H. Hoffman, Jr.

Beam and Display Tubes

Tuesday, March 25
2:30-5:00 P.M.
Morse Hall—Coliseum
Chairman: Bernard Salzberg
Airborne Instruments Lab., Inc.

High Transconductance Wideband Television Gun—E. Atti
The Annular Geometry Electron Gun: A New Electron Device—J. W. Schwartz
Recent Developments in Shaped Beam Display and Recording Techniques—R. M. Peterson and R. C. Ritchart
"ELF," A New Electroluminescent Display—E. A. Sack
A Tube that Tells Time—W. T. Eriksen and E. J. Handly

Audio, Amplifier and Receiver Developments

Tuesday, March 25
2:30-5:00 P.M.
Sert Room—Waldorf-Astoria
Chairman: M. S. Carrington
RCA Victor Television Division

Distortion in Audio Phase Inverter and Driver Systems—W. B. Bernard
Latest Advances in Extra Fine Groove Recording—P. Goldmark
Design of a Transistorized Record Playback Amplifier for Dictation Machine Application—R. Fleming
Single Tuned Transformers for Transistor Amplifiers—S. H. Colodny
Design Considerations for Transistorized Automobile Receivers—R. A. Santilli
Voltage Sensitivity of Local Oscillators—Wen Yuan Pan

Biological Transducers—Panel Discussion

Tuesday, March 25
2:30-5:00 P.M.
Marconi Hall—Coliseum
Chairman: Otto H. Schmitt
Dept. of Physics
University of Minnesota

Reliability Through Components

Tuesday, March 25
2:30-5:00 P.M.
Faraday Hall—Coliseum
Chairman: L. Podolsky
Sprague Electric Co.

Reliability of Missile Guidance Systems—A. R. Gray
Component Part Failure Rate Analysis for Prediction of Equipment Reliability—R. L. Vander Hamm
A Progress Report on the ARMA Inertial Guidance System Reliability Program—E. F. Dertinger
An Impulse Test for Evaluating the Vibrational Characteristics of Receiving Tubes Over a Wide Frequency Range—S. A. Jolly and W. U. Shipley
Reliability of Power Amplifier Klystrons in Tropo Scatter Communication Systems—R. F. Lazzarini and H. A. Bailey

Electronics in Space—A Panel Discussion

Tuesday, March 25
8:00-10:30 P.M.
Starlight Roof—Waldorf-Astoria
Chairman: L. DuBridge, President
California Institute of Technology

Propulsion and Interplanetary Travel—W. von Braun, E. Stuhlinger and A. Ehricke
Navigation and Control—C. S. Draper
Man in the Space Environment—D. G. Simons
Communications and Telemetering—J. B. Wiesner
Terminal Environment—F. L. Whipple

A Prelude to Space Travel—Preparation has begun and major new phases of evolution are under way as a consequence. The round table panel of eight outstanding scientists will discuss informally the major problems to be encountered, including the use of electronics for propulsion, navigation, communications, telemetering and instrumentation. What new areas must be anticipated for existence en route and in the terminal environment.

Electronics Systems in Industry—A Panel Symposium

Tuesday, March 25
8:00-10:30 P.M.
Faraday Hall—Coliseum
Chairman: J. D. Ryder, Dean
College of Engineering
Michigan State Univ.

Participants:
J. M. Bridges, Director Electronics, Office of the Assistant Secretary of Defense (Research and Engineering)
C. C. Hurd, Vice-Pres. and Director of Automation Research, IBM Corp.
T. R. Jones, President and Chairman of the Board, Daystrom, Inc.
J. D. Ryder, Dean, College of Engineering, Michigan State University, East Lansing, Mich.

The great impact which electronics had on American industry will be highlighted at this Panel Symposium.

J. D. Ryder will act as Chairman and open the symposium with a paper on "New Trends in Engineering Education." The emphasis in Dean Ryder's talk will be on strengthening the requirements in fundamental sciences, without which neither the demands of industry nor those of our defense establishments can be satisfied.

C. C. Hurd will discuss new ideas which found their entry in industry in connection with fully automatic processes.

T. R. Jones will speak about organization of complete electronic systems utilizing the resources of several integrated organizations.

(Continued on page 190)

Today's courier sits at a Kleinschmidt keyboard

The lightweight portable Kleinschmidt teletypewriter is a one-man communication center, transmitting and receiving printed communications at any location, under any conditions.

The mobility of our modern Army demands the receipt of vital information instantly and accurately. There can be no delays, no uncertainty. Kleinschmidt teletypewriters and related equipment, developed in cooperation with the U.S. Army Signal Corps, speed teleprinted communications between outpost and command control, provide both sender and recipient with an identical original simultaneously. Looking ahead . . . planning ahead . . . setting the pace for almost 60 years has made the Kleinschmidt name synonymous with development and progress in the teleprinted communications field. Now the engineering skill and research facilities of Kleinschmidt Laboratories, Inc., are joined with those of Smith-Corona Inc, forecasting boundless new achievements in electronic communications for business and industry.

Pioneer in teleprinted communications equipment

KLEINSCHMIDT LABORATORIES, INC.

A subsidiary of Smith-Corona Inc · Deerfield, Illinois

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IRE Technical Program

(Continued from page 188)

J. M Bridges will highlight the military aspects associated with electronic systems engineering and their relationship to the electronic engineering professional society.

Aeronautical and Navigational Electronics

Wednesday, March 26
10:00 A.M.-12:30 P.M.
Starlight Roof—Waldorf-Astoria
Chairman: John F. Morrison
Bell Telephone Labs., Inc.

Airborne Dual Antenna System for Aerial Navigation—W. M. Spanos and J. M. Ashbrook
Engineering Evaluation of an Automatic Ground Controlled Approach System (AN/MSN-3)—R. M. Brooks and W. F. Hoy
A Quantitative Analysis of Automatic Target Detection-Position Estimation Schemes Observing Scintillating Targets in Noise—C. M. Walter
Applying the Amplitron and Stabilotron to MTI Radar Systems—T. A. Weil
Transistorized Airborne Frequency Standard—G. R. Hykes

Statistical Applications

Wednesday, March 26
10:00 A.M.-12:30 P.M.
Astor Gallery—Waldorf-Astoria
Chairman: R. M. Fano
Dept. of Electrical Engineering, M.I.T.

Frequency-Domain Statistical Model of Linear Variable Networks for Finite Operating Time—G. W. Johnson
The Root Square Locus Plot—A Geometrical Method for Synthesizing Optimum Servo Systems—S. S. L. Chang
TV Bandwidth Reduction by Digital Coding—W. F. Schreiber and C. F. Knapp
Subjective Experiments in Visual Communication—R. E. Graham
Demonstration of Some Visual Effects of Using Frame Storage in Television Transmission—M. W. Baldwin, Jr.

Electronic Component Parts

Wednesday, March 26
10:00 A.M.-12:30 P.M.
Jade Room—Waldorf-Astoria
Chairman: Richard J. Framme, Chief, Prod. Control Office
WCLD, Directorate of Labs.
Wright Air Development Center

Development of Electronic Components for the Nuclear Radiation Environment—J. W. Clark
Design of Shielded Air-Cored Inductors—R. O. Schildknecht
Ceramic Coating Applications in the Electrical Field—P. Huppert
The Components Engineer and The Sales Engineer, Partners in Reliability—P. C. Knox
Miniature Ruggedized Precision Meters—J. F. Faughnan and R. E. Loiselle

Circuit Theory I and Ultrasonics I: Symposium on "Modern Aspects of Delay Lines"

Wednesday, March 26
10:00 A.M.-12:30 P.M.
Sert Room—Waldorf-Astoria
Chairman: H. A. Wheeler
Wheeler Laboratories, Inc.

Low-Dispersion Wired Delay Lines—M. J. DiToro
Electrical Design of the Transducer Networks of a Magnetostrictive Delay Line—L. Rosenberg and A. Rothbart
The Approximation Problem in Lumped Delay Line—A. Papoulis
Coiled Wire Torsional Wave Delay Line—R. N. Thurston and L. M. Tornillo
Variable Delay Line Using Ultrasonic Surface Waves—J. D. Ross, S. J. Kapuscienski and K. B. Daniels

The Canadian Automation Systems of Postal Operations

Wednesday, March 26
10:00 A.M.-12:30 Noon
Grand Ballroom—Waldorf-Astoria
Chairman: Squadron Leader G. S. Coburn
(Tentative)
Royal Canadian Air Force

The Canadian Automation System of Postal Operations—M. Levy
Organization of the Electronic Computer for the Canadian Electronic Mail Sorting System—A Barszczewski
Coding and Error Checking in the Canadian System—M. Levy and V. Czorny
The Canadian Automation System of Postal Operations—H. Jensen and K. H. Ullyatt

Radar in Military Electronics

Wednesday, March 26
10:00 A.M.-12:30 P.M.
Morse Hall—Coliseum
Chairman: R. Sargent
Office of Asst. Secretary of Defense
(Research and Engineering)

Automatic and Continuous Radar Performance Monitor—W. C. Woods
Analysis and Theoretical Investigation of New Military Electronic Missile and Aircraft Borne Equipment—D. Ehrenpreis
Packaged High Power Radar Transceivers—H. N. C. Ellis-Robinson
Limitations of the Output Pulse Shape of High Power Pulse Transformers—R. G. deBuda and J. Vilcans
A Radar Electronic Countermeasures Simulator—L. Sternlicht

Microwave Measurements

Wednesday, March 26
10:00 A.M.-12:30 P.M.
Marconi Hall—Coliseum
Chairman: Wilbur L. Pritchard
Raytheon Manufacturing Company

Power Limiting Using Ferrites—R. F. Soohoo
An Ultra-Precise Microwave Interferometer—G. R. Blair
Direct Reading Microwave Phase Meter—H. A. Dropkin
A Microwave Spin Resonance Spectrometer—R. R. Unterberger
A New Microwave Rotary Joint—W. E. Fromm, E. G. Fubini, and H. S. Keen

1958 IRE NATIONAL CONVENTION – TECHNICAL PROGRAM

	WALDORF-ASTORIA HOTEL					NEW YORK COLISEUM		
	Starlight Roof	Astor Gallery	Jade Room	Sert Room	Grand Ballroom	Morse Hall	Marconi Hall	Faraday Hall
Monday, March 24 2:30 – 5:00 p.m.	Session 1 Tutorial Session on Detection Theory and Its Applications	Session 2 Vehicular Communications	Session 3 Telemetry and Remote Control	Session 4 Techniques and Criteria Considerations in Electronic Engineering	Session 5 *Panel:* Educational Needs in Systems Engineering	Session 6 Engineering Writing and Speech	Session 7 Radio Frequency Interference	Session 8 Advances in Production Engineering
Tuesday, March 25 10:00 a.m. – 12:30 p.m.	Session 9 Automatic Control – General	Session 10 Controlled Thermonuclear Power	Session 11 Broadcast Transmission Systems	Session 12 Stereophonic Disc Recordings	Session 13 * Planning Against Time	Session 14 Aeronautical and Navigational Electronics	Session 15 Medical Electronics	Session 16 General Communications Systems
Tuesday, March 25 2:30 – 5:00 p.m.	Session 17 *Panel:* Changing Demands on the Breadth of Electrical Engineering Education	Session 18 Atomic Clocks and Masers	Session 19 Broadcast Transmission Systems and Communications Systems	Session 20 Audio, Amplifier and Receiver Developments		Session 21 Beam and Display Tubes	Session 22 *Panel:* Biological Transducers	Session 23 Reliability through Components
Tuesday, March 25 8:00 – 10:30 p.m.	Session 24 *Panel:* Electronics in Space							Session 25 *Panel:* Electronics Systems in Industry
Wednesday, March 26 10:00 a.m. – 12:30 p.m.	Session 26 Aeronautical and Navigational Electronics	Session 27 Statistical Applications	Session 28 Electronic Component Parts	Session 29 Circuit Theory I and Ultrasonics I: Symposium on "Modern Aspects of Delay Lines"	Session 30 * The Canadian Automation System of Postal Operations	Session 31 Radar in Military Electronics	Session 32 Microwave Measurements	Session 33 Semiconductor Devices
Wednesday, March 26 2:30 – 5:00 p.m.	Session 34 Reliability through Systems	Session 35 Information Theory: Coding and Detection	Session 36 Electronic Component Parts	Session 37 Computers and Control		Session 38 Instrumentation Systems	Session 39 Microwave Components	Session 40 Propagation and Antennas I – General
Thursday, March 27 10:00 a.m. – 12:30 p.m.	Session 41 Magnetics and Computers	Session 42 Circuit Theory II – Unusual Aspects of Filter Design	Session 43 Ultrasonics II – Delay Line Measurements	Session 44 Industrial Electronics	Session 45 * Aspects of RF Interference in Military Electronic and Communications Systems	Session 46 Data Reduction and Recording	Session 47 Antennas II – General	Session 48 Microwave Tubes
Thursday, March 27 2:30 – 5:00 p.m.	Session 49 General Systems	Session 50 Circuit Theory III – Application of Topological and Group Concepts	Session 51 Ultrasonics III – Measurement of Radiated Acoustic Power	Session 52 Long Distance Communications		Session 53 High Accuracy Instruments, Measurement and Calibration	Session 54 Antennas III – Microwave Antennas	Session 55 Radio and Television

* Sessions terminate at 12:00 Noon

Semiconductor Devices

Wednesday, March 26
10:00 A.M.-12:30 P.M.
Faraday Hall—Coliseum
Chairman: Robert M. Ryder
Bell Telephone Labs., Inc.

A New Passive Semiconductor Component—R. M. Warner, Jr.
Use of the RCA 2N384 Drift Transistor as a Linear Amplifier—D. M. Griswold and V. J. Cadra
High Current Switching Times for a PNP Drift Transistor. Numerical Analysis on the I.B.M. 704 Digital Computer—A. Mitchell and L. Lapidus
A New High Frequency Diffused Base Transistor—J. Sardella and R. Wanson
A New Five Watt Class A Power Amplifier—G. Freedman, J. Williams, P. Flaherty, D. Root, D. Spittlehouse, W. Waring, P. Kaufmann, P. Wharlskey

Reliability Through Systems

Wednesday, March 26
2:30-5:00 P.M.
Starlight Roof—Waldorf-Astoria
Chairman: Norman H. Taylor
Computer Div., Lincoln Lab., MIT

On an Analytical Design Technique—J. B. Heyne
Reliability or Life Performance—A. R. Matthews
Reliability Improvement Through Redundancy at Various System Levels—B. J. Flehinger
Fundamental Techniques in Doppler Radar Navigation System Reliability Measurements—P. D. Stahl
Reliability Prediction and Test Results on USAF Ground Electronic Equipment—E. Krzysiak and J. Noreshy

Information Theory: Coding and Detection

Wednesday, March 26
2:30-5:00 P.M.
Astor Gallery—Waldorf-Astoria
Chairman: L. G. Fischer
Federal Telecommunication Labs.

On Communication Processes Involving Learning and Random Duration—R. Bellman and R. Kalaba
The Application of "Comparison of Experiments" to Detective Problems—N. Abramson
Signals with Uniform Ambiguity Functions—R. M. Lerner
Evaluation of Some Error Correction Methods Applicable to Digital Data Transmission—A. B. Brown and S. T. Meyers
Algebraic Decoding for the Binary Erasure Channel—M. A. Epstein

Electronic Component Parts

Wednesday, March 26
2:30-5:00 P.M.
Jade Room—Waldorf-Astoria
Chairman: John A. Csepely
Westinghouse Electric Corp.
Electronics Div.

Effect of High Intensity Radiation on Electronic Parts and Materials—C. P. Lascaro and A. L. Long
Some Guideposts to the Use of Metallized Capacitors—W. C. Lamphier
New Amplifiers for Automatic Control of Active D C Loads—E. Levi
Magnetostriction Transducers for Mechanical Filters—R. L. Sharma and H. O. Lewis
Application of Piezoelectric Ceramic Resonators to Modern Band Pass Amplifiers—A. Lungo and K. W. Henderson

Computers and Control

Wednesday, March 26
2:30-5:00 P.M.
Sert Room—Waldorf-Astoria
Chairman: Frank M. Verzuh
Asst. Dir., Computation Center, MIT

A Preventive Maintenance Program for Large General Purpose Electronic Analog Computers—R. P. Sykes
The TRICE—A High Speed Incremental Computer—S. Ruhman and J. M. Mitchell
Digital Moon Radar Antenna Programmer with Analog Interpolator Servo—O. A. Guzmann
A Balanced Precision Reference Regulator for Computer Application—D. A. Noden
A Solid State Analog-to-Digital Conversion Device—M. Palevsky
J Axis Translation of Transfer Functions—J. L. Ryerson

Instrumentation Systems

Wednesday, March 26
2:30-5:00 P.M.
Morse Hall—Coliseum
Chairman: Ferdinand Hamburger, Jr.
Electrical Engineering Dept., Johns Hopkins University

An Earth Satellite Instrumentation for Cloud Measurement—R. Hanel and R. A. Stampfl
A Precise Optical and Radar Tracking Range—E. V. Kullman
A High Speed Radar Signal Measurement and Recording System—A. Nirenberg, R. Burfiend, M. Baller and A. Wight
A High Performance Multi-Channel Instrumentation System—W. G. Wolber
Instrumentation Dynamically Analyzed for Optimum Reliability, Weight and Geometric Space Envelope Subjected to Severe Vibrations and Shock—D. Ehrenpreis

Microwave Components

Wednesday, March 26
2:30-5:00 P.M.
Marconi Hall—Coliseum
Chairman: Seymour B. Cohn, Group Head
Stanford Research Institute

Yttrium Garnet UHF Isolator and Reciprocal Phase Shifter—F. R. Morgenthaler and D. L. Fye
High Power Broadband Microwave Gas Discharge Switch Tube—S. J. Tetenbaum and R. M. Hill
High Power Microwave Filters—J. H. Vogelman
A Band Separation Filter for the 225-400MCS Band—A. I. Grayzel
Direct-Coupled Band Pass Filters with 3/4 Resonators—G. L. Matthaei

Propagation and Antennas I—General

Wednesday, March 26
2:30-5:00 P.M.
Faraday Hall—Coliseum
Chairman: H. G. Booker
Electrical Engineering Dept.
Cornell University

Extreme Useful Range of VHF Transmission by Scattering From the Lower Ionosphere—R. C. Kirby
Meteor Trail Propagation—J. T. deBettencourt, A. Ward and B. Goldberg
The Duty Cycle Associated with Forward Scattered Echoes from Meteor Trails—H. J. Wirth and T. J. Keary
A New Low Frequency Antenna—E. W. Seeley and J. D. Burns
Logarithmically Periodic Antenna Designs—R. H. DuHamel and F. R. Ore
Phase Center of Helical Beam Antennas—S. Sander and D. K. Cheng

Magnetics and Computers

Thursday, March 27
10:00 A.M.-12:30 P.M.
Starlight Roof—Waldorf-Astoria
Chairman: R. E. Meagher, Res. Prof. Physics, Chief Engr., Digital Comp. Lab.
University of Illinois

A High Speed n-pole, n-position Magnetic Core Matrix Switch—A. L. Lane and A. Turczyn
Apertured Plate Memory: Operation and Analysis—W. J. Haneman, J. Lehmann and C. S. Warren
Molecular Storage and Read-Out with Microwaves—C. H. Becker, R. L. Pierce and J. R. Martin
Calculation of Flux Patterns in Ferrite Multipath Core Structures—S. A. Abbas and D. L. Critchlow
Logic by Ordered Flux Changes in Multipath Ferrite Cores—N. F. Lockhart
Flux Responsive Magnetic Heads for Low Speed Read Out of Data—L. W. Ferber

Circuit Theory II—Unusual Aspects of Filter Design

Thursday, March 27
10:00 A.M.-12:30 P.M.
Astor Gallery—Waldorf-Astoria
Chairman: Benjamin J. Dasher, Professor and Director
School of Electrical Engineering
Georgia Institute of Technology

Multichannel-Filter Synthesis in Terms of Dipole Potential Analog—H. A. Wheeler
Minimum Insertion Loss Filters—E. G. Fubini and E. A. Guillemin
A New Approach to the Design of High Frequency Crystal Filters—R. A. Sykes
Synthesis of Active RC Single-tuned Bandpass Filters—J. J. Bongiorno
A New Class of Filters—A. Papoulis

Ultrasonics II—Delay Line Measurements

Thursday, March 27
10:00 A.M.-12:30 P.M.
Jade Room—Waldorf-Astoria
Chairman: C. M. Harris
Electronics Research Labs., Columbia University

Measurements of Delay in Ultrasonic Systems—D. L. Arenberg
Precise Measurement of Time Delay—J. E. May, Jr.
The Measurement of Delay Line Transducer Resistance—J. G. McCue and J. A. Leavitt
Ultrasonic Delay Line Terminating Circuits and Passband Measurements—M. Axelbank
Measurement of Temperature and Frequency Dependence of Insertion Loss in Delay Lines—A. H. Meitzler
The Measurement of the Total Spurious Responses of an Ultrasonic Delay Line—M. S. Zimmerman

Industrial Electronics

Thursday, March 27
10:00 A.M.-12:30 P.M.
Sert Room—Waldorf-Astoria
Chairman: E. W. Leaver
Electronic Associates, Ltd.
Willowdale, Ontario, Canada

Distributor Test Stand—J. A. Lovell
A Digital Setting System for an X-Ray Thickness Gage—V. A. Blumhagen
Application of Magnetic Core Logic to Industrial Controls—H. Tellefson and S. Alessio
A Coordinated System of Automatic Control—R. R. Batcher

Aspects of RF Interference in Military Electronic and Communications Systems

Thursday, March 27
10:00 A.M.-12:00 Noon
Grand Ball Room—Waldorf-Astoria
Chairman: C. L. Engleman
Engleman & Co., Inc.

Treatment and Methods for the Reduction of Pulse and Random Interference—P. M. Creutz
Reduction of Bandwidth Requirements for Radio Relay Systems—D. L. Jacoby, R. H. Levine, A. Mack and A. Meyerhoff
Analysis of the Spectral Shape of Modulation Splatter—R. Price
Near Zone Power Transmission Formulas—Ming-Kuei Hu

Data Reduction and Recording

Thursday, March 27
10:00 A.M.-12:30 P.M.
Morse Hall—Coliseum
Chairman: R. J. Bibbero
Bulova R & D Labs., Inc.

Instrumentation for Recording and Analysis of Audio and Sub-Audio Noise—D. D. Howard
An Xerographic Cathode Ray-Tube Recorder—H. H. Hunter, O. A. Ullrich and L. E. Walkup
Theory of Magnetography—S. J. Begun
Applications of Magnetography to Graphic Recording—J. B. Gehman
A Shaft Position Digitizer System of High Precision—L. G. deBey and R. C. Webb
A High Precision Digital Shaft Position Indicator—D. H. Raudenbush

Antennas II—General

Thursday, March 27
10:00 A.M.-12:30 P.M.
Marconi Hall—Coliseum
Chairman: A. H. Waynick
Electrical Engineering Dept.
Pennsylvania State College

Early Warning Radar Antennas—J. M. Flaherty and Eugene Kadak
Phase and Amplitude Measurements in the Near Field of Microwave Lenses—C. W. Morrow, P. E. Taylor and H. T. Ward
Annular Slot Direction Finding Antenna—H. H. Hougardy and N. Yaru
A Novel Antenna for Mobile Radio Relay Operation in the UHF Range—F. J. Triolo
Lightweight, High Gain Antenna—R. G. Malech
Voltage Breakdown Characteristics of Microwave Antennas—J. B. Chown, T. Morita and W. E. Scharfman

(Continued on page 192)

(Continued from page 191)

Microwave Tubes

Thursday, March 27
10:00 A.M.-12:30 P.M.
Faraday Hall—Coliseum
Chairman: Leon S. Nergaard
RCA Labs.

Noise Characteristics of a Backward Wave Oscillator—J. B. Cicchetti and J. Munushian
The Pulsed M-Type Backward Wave Oscillator and Its Modes of Operation—G. Klein and A. L. Winters
The ESTIATRON—An Electrostatically Focused Medium Power Traveling Wave Amplifier—D. J. Blattner and F. E. Vaccaro
The Generation of Shaped Pulses Using Microwave Klystrons—D. H. Preist
Wide Band UHF 10 KW Klystron Amplifier—H. Goldman, L. F. Gray and L. Pollack

General Systems

Thursday, March 27
2:30-5:00 P.M.
Starlight Roof—Waldorf-Astoria
Chairman: Kenneth E. Iverson
Assistant Professor, Harvard University Computation Lab.

Combat Computers—W. F. Luebbert
The USAF Automatic Language Translator Mark I—G. A. Shiner
Non-Binary Switching Theory—O. Lowenschuss
Automatic Type Size Normalization in High Speed Character Sensing Equipment—A. I. Tersoff
Minimum Time Programming on a Drum Computer—B. Shiffman

Circuit Theory III—Application of Topological and Group Concepts

Thursday, March 27
2:30-5:00 P.M.
Astor Gallery—Waldorf-Astoria
Chairman: M. E. Van Valkenburg, Associate Prof. Electrical Engineering
University of Illinois

Signal Flow Graph and Network Topology—O. Wing
New Transpositions in Power Transformer Windings—R. G. deBuda
Two-Terminal Pair Symmetry Relations—R. C. Kiessling
Analysis of Nonreciprocal Networks by Digital Computer—Wataru Mayeda and M. E. Van Valkenburg
On Non-Series-Parallel Realization of Driving Point Function—Wan H. Kim

Ultrasonics III—Measurement of Radiated Acoustic Power

Thursday, March 27
2:30-5:00 P.M.
Jade Room—Waldorf-Astoria
Chairman: O. E. Mattiat
Aerophysics Development Corp.

Power Handling Capability of Ferroelectric Ceramics—G. W. Renner, R. A. Plante and T. F. Hueter
Measurement of Acoustic Power Radiated from Underwater Sound Transducers—R. J. Bobber
An Instrument for Determining Intensity of Ultrasound—J. F. Herrick, B. H. Anderson and M. Neher
Measurements of Acoustic Power in Industrial Ultrasonic Equipment—W. Welkowitz
Panel Discussion—Problems in Power Measurement: Panel Members: G. E. Henry, General Electric Eng. Lab., General Electric Co., Schenectady, N. Y.; S. E. Jacke, Detrex Corp.; Frank Massa, Massa Labs., Inc.; Murray Strasberg, David Taylor Model Basin, Washington, D. C.

Long Distance Communications

Thursday, March 27
2:30-5:00 P.M.
Sert Room—Waldorf-Astoria
Chairman: A. G. Clavier
Federal Telecommunication Labs.

Single Channel Radioteletype Communication—H. B. Voelcker, Jr.
A World-Wide High Frequency SSB Radio Network—E. Bray
Comparison of Multi-Channel Radioteletype Systems Over a 5,000-Mile Ionospheric Path—A. T. Brennan, B. Goldberg and A. Eckstein
Basic Analysis on Controlled Carrier Operation of Tropospheric Scatter Communication Systems—L. P. Yeh
Transportable Tropospheric Scatter Communications Systems—A. J. Svien and J. C. Domingue
Evaluation of IF and Baseband Diversity Combining Receivers—R. T. Adams and B. M. Mindes
Transmission of Digital Data over Multi-Hop Tropospheric—C. N. Lawrence and R. L. Marks

High Accuracy Instruments, Measurement and Calibration

Thursday, March 27
2:30-5:00 P.M.
Morse Hall—Coliseum
Chairman: Frank G. Marble
Boonton Radio Corp.

A Feedback Amplifier with Negative Output Resistance for Magnetic Measurements—W. P. Harris and I. L. Cooter
Millimicrosecond Wide Aperture Electro-optical Shutter—J. A. Hull
A Quartz Servo Oscillator—N. Lea
A New Method to Simplify Bridge Type Measurements on Quartz Crystal Units—E. Hafner
RF Voltage Calibration Consoles—M. C. Selby, L. F. Behrent and F. X. Ries

Antennas III—Microwave Antennas

Thursday, March 27
2:30-5:00 P.M.
Marconi Hall—Coliseum
Chairman: L. C. Van Atta
Microwave Lab.
Hughes Aircraft Company

A Compact Dual-Purpose S-Band Beacon and VHF Telemetry Antenna—W. O. Puro, W. G. Scott and W. A. Meyer
A Volumetric Electrically Scanned Two-Dimensional Microwave Antenna Array—J. L. Spradley
Closely Spaced Polyrod Arrays—L. W. Mickey, G. G. Chadwick
Wave Guide Loaded Surface Wave Antenna—R. F. Hyneman and R. W. Hougardy
Dielectric Image Line Surface Wave Antenna—H. W. Cooper, M. Hoffman and S. [illegible]
A Dual Beam [illegible] Doppler Navigation Systems—H. Saltzman and G. Stavis

Radio & Television

Thursday, March 27
2:30-5:00 P.M.
Faraday Hall—Coliseum
Chairman: D. D. Israel
Emerson Radio & Phonograph Corp.

Design Problems in [illegible] Single Rectifier TV Receivers—D. [illegible]
Problems in Two Dimensional Television Systems—R. M. Bowie
A New High Power Horizontal Output Tube Deflection System for Color Television—J. P. Wolff and R. G. Routh
Improvements in Deflection Amplifier Design—C. Droppa
AGC Design Considerations for TV Receivers—R. H. Overdeer

"Three Output Immittance Theorems"

The following changes and additions should be made in the article, "Three Output Immittance Theorems" which appeared in the Jan. 1958 issue of EI:

P. 62, column 1, line 18, following the word "network": assuming that the non-passivated network is of the general type shown in Fig. 2.

Eq. (1): $Z + Z/Z$ should be $Z_1 + Z/Z$.

P. 63, column 1, line 9 from bottom should read: since for the direct determination of output immittance the Thevenin-Norton theorem applies only to networks with constant sources.

The equation system below Fig. 4: I should have been I'.

Fig. 1: h_1 should have been h_r.

Figs. 1 and 3: all capacitor symbols should have been drawn in accordance with the official standards (Government-ASA-IRE), with one of the lines curved.

4 FLOORS

4 MINUTES FROM TIMES SQUARE!

It takes the **whole** Coliseum to show you 800 new ideas in radio-electronics — here you find more than 80% of your industry's productive capacity represented. Attend the Convention. See the Show. If you are in radio-electronics, your year begins here!

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Circle 105 on Inquiry Card, page 101

Letters

to the Editor

(*Continued from page 21*)

"Heat Transfer In Power Transistors"

Editor, ELECTRONIC INDUSTRIES:

I have received more mail in response to my article, "Heat Transfer in Power Transistors," which appeared in your December 1957 issue than any other that I have ever written. This is one of the most gratifying.

Ioury G. Maloff
RCA Victor TV Division
Camden 8, N. J.

Dear Mr. Maloff:

Congratulations on your fine article "Heat Transfer in Power Transistors" recently published in ELECTRONIC INDUSTRIES.

We were pleased to note the applications of thermal design recommendations that we have been "preaching" for some years, especially for usage in military electronic equipment. I gather that you are perhaps not aware that the theory and transistor cooling portions of C.A.L. Report HF-710-D-16 (NAVSHIPS 900,190) which you mention have been supplemented by the more up-to-date data presented in C.A.L. Report HF-845-D-8 (NAVSHIPS 900,192) "Design Manual of Natural Methods of Cooling Electronic Equipment". Copies are available from the Navy Department, Bureau of Ships, Attn. Code 817C3 or the Superintendent of Documents, G.P.O.

It is imperative that electronic engineers place increased emphasis on the thermal aspects of their designs. More articles such as yours are needed.

James P. Welsh
Head, Electronics Section
Safety Design Research Dept.
Cornell Aeronautical Laboratory, Inc.
of Cornell University

Editor, ELECTRONIC INDUSTRIES:

We were exceedingly happy to note the steps your publication is taking to make American electronics engineers aware of new developments in Europe in their field. As you can well imagine, we are wholeheartedly in favor of all such activities.

I am taking the liberty of sending a copy of your editorial to our office in Europe. I shall ask our staff—especially Mr. E. R. Kun, our electrical engineer—to do whatever he can to provide you with information

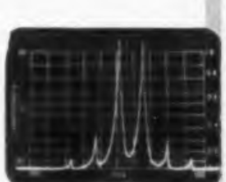
(*Continued on page 210*)

Operator adjusts Panalyzor gain control to spectrum analysis readings in two tone linearity test of Technical Materiel Corporation SSB transmitter, Model No. GPT-750D. Model SB-12a, Panalyzor permits precise readings of in-band intermodulation products down to 60 db. Courtesy: Technical Materiel Corporation.

NOW

60 db range ...fewer control settings in analyzing

SSB (Single Side Band) TRANSMITTER LINEARITY



Intermodulation distortion components are seen either side of carrier (center) and upper IKC side band in two tone test of SSB transmitter

PANORAMIC'S new SB-12a PANALYZOR

- **Measures in-band (odd order) intermodulation products precisely down to —60 db**
- **New 20 db attenuator multiplies main tones permitting smaller sideband levels to be read accurately**
- **Continuously variable sweep, resolution, and scan rate PLUS . . .**
- **New fixed sweep widths of 150, 500, 2000 and 10,000 cps with . . .**
- **Resolution and gain automatically optimally tracked**
- **10 cps side band resolution capabilities**
- **Improved I.F. skirt selectivity aids in hum analysis**
- **5" High Persistence CRT with camera mount**
- **New Vertical and Horizontal Outputs for auxiliary graphic recorder (Model RC-3) or large screen CRT**

Here's the instrument you've been waiting for. Specifically designed for SSB (single side band) investigations, the SB-12a's highly convenient preset narrow band scans, range-extending attenuator, speed the standard two-tone test, hum sideband determinations and other spectrum measurements. Like other Panoramic Panalyzors, the SB-12a measures RF signals up to 1000 mc by heterodyning in the input stage converter and using an external VFO.

An input center frequency of 500 kc . . . maximum deviation of ± 50 kc . . . a high order of sweep stability (AFC on scans up to 2 kc) . . . 10 cps resolution capability . . . and extended dynamic range, make the new SB-12a uniquely suitable for rapid visual analysis of **• dynamic transmission band occupancy • non-linearities such as intermodulation products and sideband splatter • residual carrier and suppressed sideband levels • hum and other low frequency modulations • out of band radiations such as RF harmonics, parasitics, etc.**

Write, wire, phone TODAY for technical bulletin on the new SB-12a.

PANORAMIC RADIO PRODUCTS, INC.

Send for our new CATALOG DIGEST and ask to be put on our regular mailing list for The PANORAMIC ANALYZER featuring application data.

PANORAMIC RADIO PRODUCTS, Inc.

540 South Fulton Avenue, Mount Vernon, N. Y. • Phone: OWens 9-4600

Cables: Panoramic, Mount Vernon, New York State

Circle 133 on Inquiry Card, page 101

News of Reps

REPS WANTED

A well known manufacturer of **microwave test equipment** is seeking representation for Illinois, Indiana, and Minnesota, also Ontario and Quebec Provinces in Canada, and the Kansas City and St. Louis areas. (R3-1, Editor, Electronic Industries)

The Los Angeles Chapter of **"The Representatives"** have just elected Charles R. Fetty, President; T. Louis Snitzler, Vice-President; Richard A. Strassner, Secretary-Treasurer of their organization.

Alan E. DeCew Agency, Sodus, N. Y., are now reps in Upper New York State for Electronic Component of Baso Inc.

Donert Associates, 353 W. 57th St., New York City, has been appointed sales reps for the Radio Receptor Co.'s semiconductor components.

The John G. Twist Co., 5232 W. Diversey Ave., Chicago, Ill., are now reps for Elgin National Watch Co.'s relay sales in Chicago, Northern Ill., Southern Wisconsin and Michigan territories, and **E. W. McGrand Co.**, Box 8876, Kansas City, Mo., are their reps in Southern Illinois, Missouri, Kansas, Iowa and Nebraska areas.

John Francis O'Halloran and Associates is a new rep firm which is located at 11636 Ventura Blvd., North Hollywood, Calif. They will service the areas of California, Arizona and Nevada.

G. Curtis Engel and Associates, Inc., are now reps for the John Fluke Mfg. Co. Their home office is located at 210 S. Broad St., Ridgewood, N. J.

Ridgway Engineering, Inc., are now sales reps for Ling Electronics, Inc., in the territory of Indiana, Illinois, Wisconsin, Western Kentucky and Eastern Iowa.

Jerry Greenberg Associates are now located at new and larger quarters at 1193 E. Broadway, Hewlett, L. I., N. Y.

Collins Havercamp Assoc., Kansas City, Mo., are now reps in Iowa, Nebraska, Kansas and Missouri for the Alliance Mfg. Co., Inc.

George W. Letter and Assoc., Los Angeles, Calif., are now exclusive engineering sales reps for Ryan Industries Div. of the Lundy Mfg. Corp. in the states of California and Washington.

News of Reps

Gawler-Knoop Co., Roseland, N. J., are now sales reps in Metropolitan New York and Atlantic Seaboard area for Deltime, Inc.

Jack Goss Co., 99 Highland Ave., Somerville, Mass., is now New England sales rep for Federal Selenium Rectifiers.

Roger A. Allen, 1000 Peachtree St., N. E., Atlanta, and **J. J. Gallcher**, 617 Cleveland St., Clearwater, are now sales reps in Georgia and Florida respectively for the Ward Leonard Electric Co.

Pacific Scientific Co., 25 Stillman St., San Francisco, Calif., have been appointed West Coast reps for the Electro Tec Corp.

The Kittelson Co. are now reps in California, Nevada, Utah, Wyoming, Colorado, Arizona and New Mexico for Epsco, Inc.

R. G. Bowen & Co. have been named reps in the Rocky Mountain area for Bud Radio, Inc. Their main office is located at 721 S. Broadway, Denver, Colo.

W. A. Brown & Assoc., Indian River City, Fla., are now reps for Mechatrol Div. of Servomechanisms, Inc., in Florida, Alabama, Mississippi, Georgia, North and South Carolina and Tennessee.

Ed Trompeter, 7713 Oakdale Ave., Canoga Park, Calif., is representing the Nems-Clarke Co. in the states of California, Arizona, New Mexico, Colorado, Utah and Nevada.

Electrorep, a division of **Lloyd N. Allen, Inc.**, will represent the Nutron Mfg. Co., Inc., in Michigan, Ohio and Indiana areas, while **Arthur K. Elliott Co.** will represent them in Missouri, Kansas, Iowa and Nebraska area.

H. R. Brede, Inc. and J. R. Dannemiller Assoc., Inc. are newly appointed reps for the Magnetic Controls Co. They will handle the company's line of magnetic amplifiers and industrial controls.

McCarthy Assoc. will handle the California, Arizona and Nevada areas for the Hamner Electronics Co., Inc., of Princeton, N. J.

Polytechnic Research & Development Co., Inc. has appointed **CDB Enterprises**, 43 Barrister Rd., Levittown, N. Y. and **Engineering Assoc.** 3120 St. Paul St., Baltimore, Md., as sales reps.

GRADUATE EE'S: GENERAL ELECTRIC DISCLOSES HIGH PRIORITY PROGRAM FOR ATLAS

GUIDANCE SYSTEM. MANY POSITIONS OPEN IN ELECTRONIC MISSILE TECHNIQUES=

ACCURACIES ON ORDER OF 1 PART IN 10 MILLION

required for portions of G.E.'s ICBM ATLAS Guidance System

Delivering an ICBM over a > 5000 mile trajectory into the target area demands a guidance system of unprecedented accuracy—and this is the calibre of the electronic system General Electric engineers are creating for ATLAS.

But achieving designated accuracies and reliabilities in the laboratory is not enough. *These high standards must be maintained in actual operational environments, with virtually no interruption or degradation.*

CAREERS IN STEP WITH THE FUTURE

Engineers who join the Missile Guidance Product Section of G.E. are doing more than hastening development of one of the nation's most urgent programs—guidance for ATLAS. As Manager of the Section Richard L. Shetler states: *"With this job behind us, there will remain no significant obstacle to the practical guidance and navigation of other space vehicles."*

PROGRAM ACCELERATION OPENS UP WIDE RANGE OF POSITIONS IN:

- Systems analysis, evaluation & integration
- Systems and component reliability
- Transistorized circuits, pulse circuitry, IF-Video circuits
- RF and Microwave components & plumbing
- Communications control devices
- Doppler radar design & development
- Digital data processing techniques, data transmission involving D & D of ground-based & airborne antennae, transmitters, receivers; application of transducers, transponders, etc.
- Test operations, including planning, range instrumentation & test execution; development & application of automatic test equipment

If you feel that your special skills and interests fit you to work in any of the above areas, why not write us in detail? Qualified candidates will be invited to visit our facilities to meet with technical managers and gain first hand knowledge of the living advantages of our locations at Syracuse and Utica, N. Y.

Write in complete confidence to Mr. E. A. Smith, Room 3-D

MISSILE GUIDANCE PRODUCT SECTION

GENERAL ELECTRIC

Court Street, Syracuse, N.Y.

PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

Design Engineers • Development Engineers • Administrative Engineers • Engineering Writers
Physicists • Mathematicians • Electronic Instructors • Field Engineers • Production Engineers

Collins Dept. Moves, 250 Job Openings in KC

The Dallas Transformer Dept. of Collins Radio Co. moves to Lee's Summit, Mo., this month, becoming part of Collins' subsidiary, Communication Accessories Co. The move will create job opportunities for 250 people in the Kansas City area.

Communications Accessories Co. has recently moved into a new 50,000 sq. ft. building that will accommodate the new operations. Through the transfer, CAC's line of toroidal transformers and electrical filters is now being filled out with transformers of the more standard laminated type construction.

Electronic Supplies Scarce in Florida

The Florida Chamber of Commerce reports that a need exists in that state for Electronic and Electrical Supply Houses capable of anticipating the needs of Florida aircraft firms and remaining abreast of the constant changes in the electrical-electronic field: not a mere catalog house. Greatest demand would probably be in the following lines:

a. Test equipment.

b. Components (resistors, capacitors, etc.).

c. Instrumentation tape recorders.

Engineering Technicians

The U. S. Civil Service Commission announces that there is still need in the Federal service for Engineering Aids, Physical Science Aids, Engineering Technicians, and Physical Science Technicians. The salaries range from $3,175 to $5,440 a year.

Further information and application forms may be obtained at many post offices throughout the United States, or from the U. S. Civil Service Commission, Washington 25, D. C.

INFRARED TESTING

This subterranean 150-ft. tunnel beneath Federal Telecommunications' Labs' new R&D complex in San Fernando, Calif. is the latest advance in IR measurement facilities. Equipment can be run without interruption.

Sperry to Market Transistors, Diodes

First commercial marketing of transistors and semiconductor diodes has been announced by Sperry Rand Corp.

Arthur M. Varnum, marketing specialist from Sperry Gryoscope Co. will direct the new sales program. He will be assisted by 15 semiconductor representatives of the nine Sperry sales offices covering key regions of the U. S.

Using semi-automatic equipment recently installed in its hospital-clean production laboratory, Sperry is now producing 17 types of silicon diodes for special requirements of other electronic system manufacturers, in addition to Sperry. The facility will continue to concentrate its volume output exclusively on new types of transistors and semiconductor diodes for critical and advanced applications.

The new Sperry diodes are so small that several dozen are required to fill a thimble.

Army Missile Agency Looking for Engineers

Applications are being sought from qualified scientists and engineers for employment at the Redstone Arsenal and Army Ballistic Missile Agency at Huntsville Ala.

Redstone is the control center of all activities in the Army's guided missile and rocket weapons fields. Employment in these positions provides an opportunity to serve with top scientists, engineers and military technicians in vital and challenging work essential to the national defense.

There is an immediate and urgent need for chemists, engineers, electronic scientists, mathematicians, metallurgists and physicists for filling positions with salaries ranging from $4,480 to $12,690 a year. Information about the requirements may be obtained from the U. S. Civil Service Comm., Wash. 25, D. C.

Raytheon To Double Missile Payroll

The Raytheon Mfg. Co.'s missile plant in Bristol, Tenn., plans to double its work force within the next 18 months to two years.

The present work force of about 1300 persons will reach 2500 persons, and perhaps higher, according to Vaughn Andrews, director of personnel and industrial relations. Hiring during the next few months will be confined to skilled craftsmen and engineers.

Raytheon has primary responsibility for development and production of two major missile programs — the Navy's Sparrow III, air-to-air missile, and Army Ordnance's Hawk, ground-to-air missile.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 99.

Engineering Manpower

. . . a prediction of future supply and demand

Continuous shortage? No future shortage? What can we expect? Here is an authoritative discussion of the situation through 1960 and beyond, prepared by Deutsch & Shea, Inc., specialists in technical manpower.*

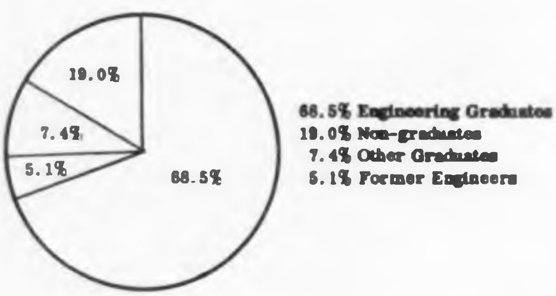


Fig. 1: Predicted background, new entrants to engineering, 1957-60.

SOME experts predict a continuous shortage of engineers for the next generation or more. Others claim there is no shortage of engineers at present, there will be none in the immediate future and, indeed, there has been no shortage at any time in the recent past. Such claims and counter-claims are examined in a current report, "The Supply and Demand of Engineers 1950-1960," prepared by Deutsch & Shea, Inc., specialists in the field of technical manpower.

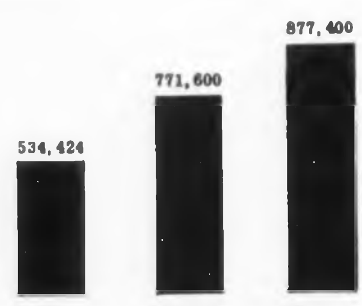
The demand for engineers is largely dependent upon the amounts spent by industry and government for research and development and for new plants and equipment. As expenditures in these areas go up, the demand for engineers increases; as expenditures in these areas decline, the demand for engineers declines. Any forecast of the future demands for engineers must be based upon a forecast of the future level of expenditures in these two areas.

The current state of confusion about the immediate future of the economy makes any forecast of future developments perilous. Nevertheless, there are certain indicators which suggest the probable trend of engineer demand for the next few years.

Current analyses which suggest that the demand for engineers will be at a low level from 1958 to 1960 are based upon an extrapolation into that period of conditions peculiar to the summer and fall of 1957. The sharp cuts in defense expenditures in the summer and fall of 1957 had the immediate effect of reducing the demand for engineers sharply. But this reduction in demand was essentially a short run response to a short run situation. The assumption that demand will remain at a low level for any length of time is open to serious question on the following grounds:

1. The decline in defense expenditures came at a time when industry was absorbing the annual supply of June engineering graduates. Consequently, industry reacted more sharply in reducing its recruiting efforts than would have been the case if the defense cuts had come at a different time in the year. Thus the decline in the demand for engineers gave the appearance of

Fig. 2: Supply of engineers, 1950, 1957, and 1960.



* From "The Supply and Demand of Engineers 1950-1960," Deutsch & Shea, Inc.

being much more significant than it actually was.

2. The belief that the demand for engineers will remain at a low level for the next three years is based upon the assumption that defense expenditures will remain at the low 1957 level for that period. But the reduction in defense expenditures was made only for the late 1957-early 1958 period and was very much tied in to 1957 fiscal conditions. There is at least as much likelihood that defense expenditures will rise in the next three years as that they will remain constant. Thus the belief that the engineer demand conditions of late 1957 will operate for the next three years is based on a highly dubious assumption.

3. The 1957 defense cuts still left the defense budget at a fairly high level. Even if defense expenditures remain at the 1957 level for the next three years, the demand for engineers will be high if the private sector of the economy continues to expand.

The average demand for all engineers from April 1950 to April 1957 was in excess of 46,000 per year. The record level of expenditures in 1956 produced a record demand from April 1956 to April 1957 substantially above the average for the period as a whole. Assuming that the level of expenditures during the next three years does not fall below the 1956 levels, it seems likely that the demand for engineers through April 1960 will be substantially in excess of 46,000 per year.

College Graduates

How will this demand for engineers be met in the next three years? Will the supply of college graduates be sufficient to meet the demand, or will employers find it necessary to hire partly trained men to fill new engineering jobs?

Table I

Freshman Enrollments, 1953-1955, and Engineering Graduates, 1957-1959[1]

Freshman and Graduating Years	Freshman Students Engineering	First Degree Graduates Engineering	Engineering Graduates as % of Engineering Freshmen
1953 - 1957	60,000	34,500*	57*
1954 - 1958	65,505	37,300*	57*
1955 - 1959	72,825	41,500*	57*

*Estimates

For the three years from 1957 through 1959 the number of engineering graduates is estimated at 113,300. Approximately 93% of these engineering graduates will enter the profession. Thus the number of engineering graduates entering the profession from 1957 through 1959 will be 105,400. An additional 11,310 college graduates with degrees in other fields than engineering will enter the field each year; and

Fig. 3: Engineering freshmen as percentage of all college freshmen.

this group will be supplemented by 4300 college graduates returning to the engineering profession from other fields. The total accessions of college graduates to the profession from April 1957 to April 1960 will be approximately 121,000.

During the same period, the profession will lose approximately 26,000 college graduates through death, retirement, or transfer to other occupations.

The net increase of college graduates in engineering from April 1957 to April 1960 is estimated at 95,000, a three-year increase of 20%. The total supply of college graduates in engineering in April 1960 is estimated at 575,800.

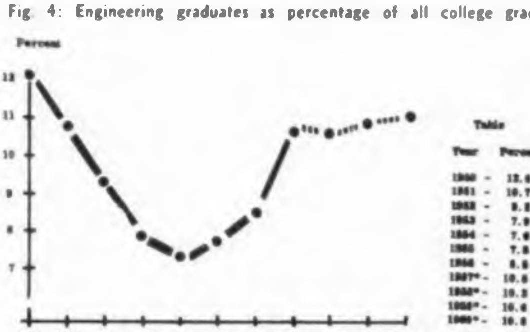
It seems clear that the accessions of college graduates between 1957 and 1960 will not satisfy the total demand for engineers from 1957 to 1960.

The demand for engineers during the period from 1950 to 1957 was in excess of 46,000 a year. With the expansion of industrial employment in general and employment on research and development programs in particular, the annual demand for engineers from 1957 to 1960 will be even greater than the annual demand during the preceding period. The one bright spot in the picture is the fact that the number of engineering graduates will increase substantially year by year from 1957 to 1960. This is in contrast to the steady decline from 1950 to 1955.

The average annual additions of college graduates to the engineering profession from April 1957 to April 1960 will be 40,300, a substantial increase over the 33,600 of the preceding period. Thus the period 1957 to 1960 will be one in which the demand for

(*Continued on page* 202)

Fig. 4: Engineering graduates as percentage of all college grads.



(*Continued from page* 201)

engineers will increase steadily and the supply of college graduates to the engineering profession will increase steadily.

But there will remain a substantial gap between the total demand for new engineers and the total supply of new college graduates to the engineering profession. The yearly increase of college graduates in engineering from 1957 to 1960 (40,300) will even fall short of the average annual demand for engineers from 1950 to 1957 (more than 46,000).

Non-Graduates

The gap between the demand for engineers and the supply of college graduates to the engineering profession will continue to be filled by the employment of partly trained men to fill engineering jobs. In high skill areas, shortages of trained men will either not be filled at all or more likely will be filled by the employment of graduate engineers with only partial knowledge of the particular industrial field. In less skilled areas, the excess of demand over supply will doubtless be met by the employment of men without college degrees.

To be sure, the non-graduate segment of the additions to the profession will probably be lower than the 25% figure of the preceding period. The high percentage during the early 1950s was the result of an increasing demand for engineers and a declining supply of new engineering graduates. These conditions will not operate in the same way from 1957 to 1960. The increasing supply of new graduates will reduce the pressure which caused employers to hire large numbers of non-graduates during the 1940's and early 1950's. And the experience gained by employers in the effective utilization of engineering personnel will further reduce the demand for non-graduates.

Nevertheless, the total demand for engineers will still exceed the total supply of college graduates to the engineering profession. Non-graduates will still be hired in substantial numbers to fill engineering jobs between 1957 and 1960. Probably 29,200 non-graduates will enter the engineering profession between 1957 and 1960. This will constitute 19% of all new entrants into the profession.

Engineers After 1960

The practice of employing non-graduates to fill engineering jobs will continue so long as the supply of new college graduates to the engineering profession falls short of the demand for additions to the engineering profession. The future demand for additions to the engineering profession will depend upon general trends in the industries which are the predominant employers of technical personnel.

The supply of new college graduates to the engineering profession depends upon the total size of college classes and the ratio of engineering graduates to all graduates. In 1950, a record total of 52,732 students received bachelors degrees in engineering but thereafter the supply of engineering graduates declined precipitously. From 52,732 in 1950, the number of engineering graduates declined to 41,893 in 1951, 30,286 in 1952, 24,164 in 1953, 22,236 in 1954, 22,589 in 1955, and 26,306 in 1956.

Although some decline was to be expected as a result of the decline in the total number of college graduates in the early nineteen-fifties, the precipitous fall from 1950 to 1955 was unexpected. The number of engineering graduates declined by 57% between 1950 and 1955 while the total number of college graduates fell only 34%. In other words, there was a sharp decline in the ratio of engineering graduates to other college graduates. Engineering students constituted only 7.8% of all bachelors degree graduates in 1955 as compared to 12.0% in 1950. Not until 1957 did the ratio of engineering graduates to all graduates return to a level of 10% (see Figures 14 and 15).

Thus, the acute shortage of college graduates in engineering during the early 1950s was the result not only of the relatively small number of college graduates in all fields, but also of the relatively low ratio of engineering graduates to other college graduates.

The total number of college students will increase markedly during the 1960's as: (1) the large

(Continued on page 205)

 Circle 505 on "Opportunities" Inquiry Card, page 103

Industry News

E. J. Poole has been named Executive Vice President of Cinch Mfg. Co. and retains his title of General Manager.

E. J. Poole

I. J. Steinberg

Irwin J. Steinberg has been promoted to the position of General Manager of the Vibro-Ceramics Div. of Gulton Industries, Inc. Mr. Steinberg was formerly Director of Public Relations and Advertising before assuming duties as head of this ultrasonic and medical instruments division.

W. J. Frair has joined the Application Engineering Dept. of The Bristol Co.

James E. Young is now serving in the new post of Manager of the Dayton Ohio Sales Office of Bendix Aviation Corp.

Roegner J. Cushing, Stromberg-Carlson Telecommunication Sales Representative, has joined the West Coast Branch where he will serve independent telephone companies in California, Nevada, and Arizona.

William J. Lehner has assumed the duties of Manager, Automation Engineering, for the Radio and Television Div. of Sylvania Electric Prod., Inc.

Richard Hesse has been appointed Sales Engineer in Charge of Sola Electric Co., Chicago office.

Raymond Grassi has been appointed Personnel Manager at ESC Corp.

Wallace J. Fletcher has been appointed as Assistant to the President for Personnel at Ace Electronics Associates, Inc.

Maj. Gen. Haywood S. Hansel, USAF (Ret.) is now Manager of the General Electric Company's Defense and Development Operation.

H. S. Hansel

J. S. Chafee

John S. Chafee has been elected President of the Ansonia Wire & Cable Co.

(Continued on page 206)

(*Continued from page 203*)
baby crop of the 1940's reaches college age; and (2) a larger proportion of the college age population actually goes to college. But this expansion of the total number of college students will result in an increase of engineering graduates only if the ratio of engineering graduates to other college graduates is at a high level.

The ratio of engineering graduates to other college graduates depends upon students' conception of conditions in the engineering profession. The severe shortage of college graduates in engineering during the period from 1950 to 1957 was due to the fact that the size of graduating classes in engineering reflected the market conditions of the late forties rather than the market conditions of the early fifties. During the late forties, when it seemed that conditions in the engineering profession were likely to become less attractive in the future, the ratio of engineering students to other students declined. During the early fifties, when it became clear that conditions in the profession were becoming more and more attractive, this ratio increased.

But the ratio of engineering students to other students did not change as quickly as the conditions in the market for engineers. The number of new college graduates in engineering did not rise substantially until 1957, four years after the marked change in prevailing attitudes and seven years after the change in market conditions.

There is no easy way to increase or decrease the number of engineering graduates in a short time. But there are ways of reducing the time lag between changes in market conditions and changes in prevailing conceptions of these conditions. There is a relatively fixed time lag of four years between changes in market conditions and changes in the number of engineering graduates. But there is no reason why the time lag has to operate for seven years, as was the case in the early 1950's.

Business executives can reduce the time lag by acting quickly to alter the conditions of engineering employment in accordance with changes in the engineer supply-demand ratio. School administrators can reduce the time lag by acting quickly to communicate information about changes in the conditions of engineering employment to their students. Effective action by both groups can influence not only the ratio of engineering students to other students but also the rate of transfer of students from engineering to other fields and from other fields to engineering.

An intelligent approach by responsible officials to the problem of adjusting the supply of engineering graduates to the demand for engineers can thus do something to improve conditions. If the conditions of engineering employment are maintained at an attractive level, and if the attractions of the engineering profession are explained to beginning college students, then the gap between the demand for engineers and the supply of engineering graduates can be bridged early in the nineteen-sixties.

The continuing problem posed by the character of the market for engineers is not that of meeting a shortage or that of preventing a surplus but that of adjusting supply to demand under all conditions so as to limit the magnitude of future shortages and future surpluses. Short-run gaps between demand and supply cannot be wholly prevented in a market which requires highly trained personnel. But the time lag between major changes in market conditions and changes in the supply of graduate engineers can be reduced substantially if intelligent policies are pursued.

1. Data derived from annual reports of the U. S. Office of Education.

Data Reduction System For Missile Testing

Epsco Inc. of Boston, Mass., has delivered to the General Electric Missile and Ordnance Systems Dept., Phila., a data reduction system that automatically prepares telemetry data for analysis in a large scale digital computer.

Inputs are tape recordings of data telemetered to the ground during missile flights. The system includes separate facilities for FM-PAM data and for FM/PDM and FM/FM.

Industry News

(*Continued from page* 204)

Michael F. Burke has joined the staff of Federal Telecommunication Laboratories as a Contractor Administrator. Mr. Burke was previously associated with the Office of General Counsel, Department of the Navy, and the Department of Justice.

Thomas W. LeNay, Chief Development Engineer of Perkin Engineering Corp. has been appointed Vice-President.

John H. Hunt has been named Director of Manufacturing and **C. J. Jordan**, Production Planning Manager, for Stavid Engineering, Inc.

Thomas S. Mederos has been appointed Sales Assistant to the President and **Robert E. Navin**, Manager of the Instrumentation Div., at Applied Science Corp. of Princeton (ASCOP).

Fred S. Miller has been promoted to Manager, Solid Propellant Production, at Aerojet-General's Solid Rocket Plant.

Paul M. Beard is now serving in the newly-created position of Director of Sales for the Rotron Mfg. Co. Mr. Beard was formerly Sales Manager for Aerovox Corp.

Percy L. Spencer has been elected Sr. Vice-President of Raytheon Mfg. Co. Mr. Spencer will continue as head of the Microwave and Power Tube Div.

P. L. Spencer

G. M. Arisman, Jr.

George M. Arisman, Jr. has been appointed President and General Manager of the Mallory Battery Co., a Div. of P. R. Mallory & Co., Inc. Mr. Arisman was formerly controller of the Mallory organization.

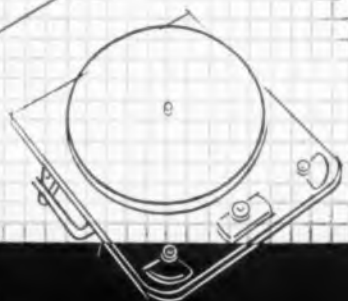
Philip N. Lehr has been elected Vice-President in Charge of Research and Development at Dictograph Products, Inc.

Richard G. Jones will now serve as District Manager, Western area, for Motorola's Microwave and Industrial Control Products.

(*Continued on page* 208)

A new standard in

HYSTERESIS MOTOR DESIGN



imc

- Uniform Speed To Meet Exacting Requirements.
- Low Noise Level approaching Inaudibility.
- High Starting Torque for instantaneous efficient operation.

SPECIFICATIONS*

	WC2913H Turntable	WC2913H-1 ** Tape Recorder
Volts	115	115
CPS	60	60
Watts Input	21	24
Amperes	.25	.22
Number of Poles	4	4
RPM	1800	1800
H.P.	1/150	1/125
T.P.I. (oz. in.)	3.0	4.5
T.P.O. (oz. in.)	3.5	5.0
T.ST. (oz. in.)	2.3	4.0
Capacitor (mfd) 220 Volts A. C.	1	2.5
Weight	1 lb.	1 lb.

*All specifications are relative to frame size. The hysteresis series is available in seven frame sizes from [illegible]" diameter to 4½".

**Can be supplied with magnetic shielding (Mu-Metal)

A new era of electronic enterprise continues to place greater and greater emphasis upon engineering design and creative production. New tape recorder and turntable applications have required hysteresis motors unusually precise in their performance, rugged construction to withstand continued use, built within smaller and smaller frames . . . all this to meet the competitive price requirements of the end product.

A large order— but Induction Motors has done just that in its line of hysteresis motors—compact in size, precision manufacture with assured reliability. Typical of these design achievements are the types which today find themselves in such fine recorders as those made by Ampex.

Induction Motor's reputation of quality has been proven over the years in their manufacture of a complete line of precision sub-fractional horsepower motors.

For complete information on IMC hysteresis and torque motors for tape recorders and turntables, write for catalogue HT.

Induction Motors Corp.

570 Main St., Westbury, L. I., N. Y. • Phone EDgewood 4-7070

Industry News

(*Continued from page 206*)

Dr. Wendell B. Sell is now Divisional Vice President of American Machine and Foundry Co. His headquarters will be in Pomona, Calif. Other AMF appointments include **Joseph E. Mulheim** as Director of Aircraft Products Engineering and Manufacturing and **Hayes Crapo** as Chief Engineer of Aircraft Products, The Leland Electric Co.

Malcolm A. Pelton has been promoted to position of Applications Engineer at Filtors, Inc.

Arthur J. Critchlow is now Manager of Applied Research at International Business Machines Corp., San Jose Research Laboratory.

Lowell S. Pelfrey will now serve as Director of Research and Development at International Rectifier Corp.

L. S. Pelfrey   Dr. C. L. Kober

Dr. Carl L. Kober has joined AVCO's Crosley Div. as Vice President and Technical Director. Dr. Kober was formerly Technical Director of the entire mechanical division at General Mills.

John McCardle has been named to the newly-created post of Director of Minneapolis - Honeywell's European operation.

John W. Bjorkman has been appointed Military Marketing Manager of Allen B. Du Mont Laboratories, Inc.

Dr. Ernst Weber is now President of the Polytechnic Institute of Brooklyn.

Fabian Fornall is now Factory Superintendent of Shure Brothers, Inc.

Curtis Kelly has joined National Co., Inc., as Sales Manager—Consumer Products. Mr. Kelly was formerly a Field Applications Engineer for Raytheon Mfg. Co.

Myron Baldwin becomes Sales Manager of the Instrument Div., Beckman & Whitley, Inc. in a new assignment of responsibilities.

Letters

to the Editor

(Continued from page 194)

which may be of interest to your editors.

May we wish you the best of success with your new approach to the situation. I have not yet seen anything like it in any of the other technical journals and I am sure your service will be appreciated by your subscribers.

Irving D. Canton
Assistant Manager
Armour Research Foundation
of Illinois Inst. of Technology
Chicago 11 Ill.

Ed Note: ARF has recently established a European Technical Observation Group Program consisting of study groups working in mechanical, electrical and chemical engineering and in chemistry and metallurgy.

"Electroflors"

Editor, ELECTRONIC INDUSTRIES:

I thought your readers might be interested in recent happenings with regard to "Electroflors." As a result of my article which you published in the February, 1957 Issue of "Electronic Industries and Tele-Tech," a tremendous amount of interest was stimulated in the possibilities of Electroflors and Electroflor devices for indicators, radar type displays, 3-D displays and data storage elements. Frankly, the amount of interest amazed me.

We have received many varied inquiries and have been able to foresee solutions to many problems which have been presented. Among these are on-off indicators for transistorized computers, bar-chart displays for aircraft flight test instrumentation, multi-color radar-type flat plate instrument panel displays, transparent radar-type displays for use in aircraft windshields, electrically controllable color filters for balancing colors in color film printing or for dimming down aircraft or vehicle windshields, 3-D "fishbowl-type" displays for air traffic control, and finally memory elements for computers in the form of minute matrix arrays.

In these various applications, Electroflors appear to offer a dual advantage. First, the information may be displayed in *subtractive* colors and can therefore be observed in bright light, even direct sunlight. Second, the control function may be readily adapted to transistorized circuitry.

Along with the above mentioned interests, it has come to our attention that other concerns have been doing work along lines similar to ours. The

(Continued on page 212)

Silicone Sponge Rubber

for sealing, gasketing, pressure pads, vibration dampening —100 F to 480 F

Low density COHRlastic R-10470 silicone sponge rubber is completely flexible after 72 hrs. at 480°F, shows no brittleness after 5 hrs. at −100°F. High tensile, tear and elongation. Closed cell construction is non-absorbing. Called out on aircraft and electronic drawings and specifications. Available from stock in sheets 1/16" thru 1/2", in rod .180" thru .585". Special extruded shapes made to order.

FREE SAMPLES and folder—write, phone or use inquiry service

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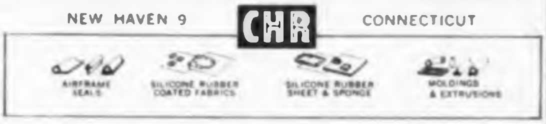
NEW HAVEN 9 CHR CONNECTICUT



Circle 149 on Inquiry Card, page 101

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Keying Relays
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Sensitive Relays
Latching Relays
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Relay Sales

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"J" RELAY

Following combinations in stock—3C, 4C, and 6C. Complete range of DC coils. 100, 500, 1300, 4000, 6500 and 10,000 ohms.

We also have complete stocks of all other major manufacturers' relays. Order one, or any quantity.

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P.O. Box 186-EV, West Chicago, Ill.
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Circle 150 on Inquiry Card, page 101

FOR PUBLIC ADDRESS, RADIO, and kindred fields, specify JONES 400 SERIES PLUGS AND SOCKETS *of proven quality!*

P 406-CCT

S 406-AB

Double Contact Area

Phosphor bronze knife-switch socket contacts engage both sides of flat plug contacts.

Socket contacts phosphor bronze, cadmium plated. Plug contacts hard brass, cadmium plated. Insulation molded bakelite. Plugs and sockets polarized. Steel caps with baked crackle enamel. 2, 4, 6, 8, 10, 12 contacts. Cap or panel mounting.

Information on complete line, in Jones Catalog No. 21: Electrical Connecting Devices, Plugs, Sockets, Terminal Strips. Write

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HOWARD B. JONES DIVISION
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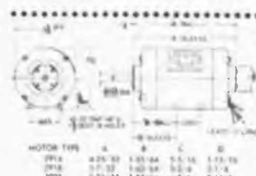
Circle 151 on Inquiry Card, page 101

THIS HOWARD INDUCTION MOTOR

Rated 1/100 to 1/15 H. P.



FITS A WIDE RANGE OF APPLICATIONS

Available in several models, Howard 2900 capacitor type motors are used for applications requiring quiet operation, minimum vibration, minimum maintenance, long life and overall uniform performance.

DESCRIPTIONS & APPLICATIONS

(1) Non-Synchronous Capacitor Motors (Types RBC and RWC)—For laboratory equipment, vending machines and general service.
(2) Standard Synchronous Capacitor Motors (Types SBC and SWC)—For tape pulling, sound cameras, telegraph-terminal equipment and other applications requiring a constant speed motor.
(3) Hysteresis Synchronous Capacitor Motors (Types HBC and HWC)—Ideal for recording and facsimile equipment. When equipped with sleeve bearings, these motors are the ultimate in quiet operation and low rumble level. Can be supplied as 2 or 3 speed synchronous motors.
(4) Torque Motors—high resistance rotors (Types RBH and RWH)—For take-up reels and use where high starting loads are encountered. The speed varies with load changes.

Howard 2900 Motors are available as: 1, 2, or 3 phase capacitor; split-phase (synchronous and non-synchronous).

Available with gear heads with a wide range or gear ratios. Write today for complete data.

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Divisions: Electric Motor Corp. • Cyclohm Motor Corp. • Racine Electric Products

Circle 152 on Inquiry Card, page 101

Letters

to the Editor

(Continued from page 210)

surprising part about this is that such work was not pushed along much earlier than now. It apparently required the power of the press and the stimulation of your publication to bring some of these workers to light.

At least two concerns have let it be known that they have worked with effects related to our Electroflors. In all fairness we will mention no names, since our analysis of their efforts reveals that their results have largely duplicated work which was done not less than thirty years ago. We mention this and the following explanatory material so that it will be clearly understood by all concerned that we are not so naive as to believe we can claim a new development on a re-hash of work done twenty-five or thirty years ago.

In the oldest issue in our library of the "Rubber" Handbook of Chemistry and Physics, which happens to be the 1928 edition, there is described an electric polarity indicator paper. This uses a paper impregnated with a salt solution and an indicator such as phenolphthalein. Contacting the wet paper by battery leads indicates polarity by a red stain at the negative electrode.

In 1935, Patent No. 2,012,270 was issued. In this patent solutions are employed similar to the "polarity indicator," and also certain electrochemical changes are employed which cause darkening of the electrodes by an electro-plating action. Interested persons may refer to the above literature for further details.

We do not believe that now is the proper time to discuss details of just how electroflors are made. However, we do think it appropriate to point out that the materials mentioned above are *not* Electroflors, although there is some degree of relationship. We think it important to bring out this point, lest some misunderstanding arise. For example, one concern undertook to duplicate Electroflors in their laboratory. They got about as far as the "polarity indicator" and were disappointed to find that such materials would not provide sharp color change indications in response to short pulses. The fact that their expensive laboratory people were unable to make "Electroflors" meant to them that Electroflors were of no value. Such hasty conclusions could well be distressing from the standpoint of unwarranted unfavorable publicity and possible embarrassment to all concerned.

We are sure that Electroflors will find their proper place in the field of electronic instrumentation and we are

(Continued on page 214)

(Continued from page 212)

hopeful that many concerns will undertake a sincere study of the possibilities of these unique materials. May I express my appreciation of your efforts in bringing Electroflors to the attention of your readers.

James R. Alburger
President
Shannon Luminous Materials Co.
7356 Santa Monica Blvd.
Hollywood 46, Calif.

Change Firm Name

F-R Machine Works, 26-12 Borough Pl., Woodside, N. Y., manufacturers of a full line of microwave test equipment and microwave components, begins a campaign this month to establish its identity as "FXR" to better reflect their product line.

James W. Dougherty has been appointed Chief Engineer of Philco Corporation's Automotive Div. In his new position he will be responsible for design and production coordination of electronic products for the automotive industry.

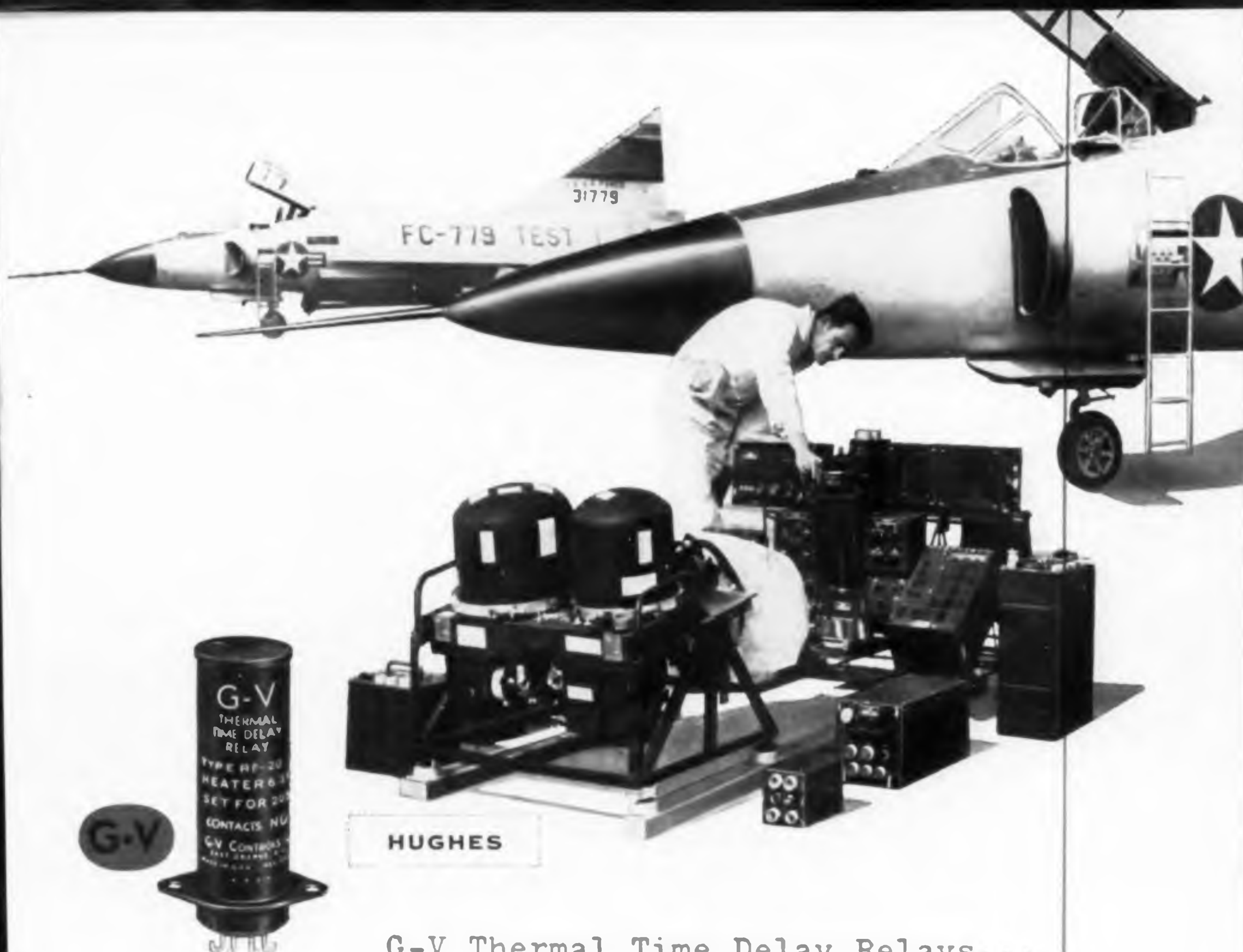
Joshua Ginsparg has been named Chief Industrial Engineer of Shure Bros., Inc. He has been associated with the company for 11 years.

ELECTRONIC INDUSTRIES Advertisers—March 1958

* In Operations Edition Only.

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this Index.

For product information, use inquiry card on page 101



G-V Thermal Time Delay Relays...
used in Hughes Airborne Armament Control System

The F-102A all weather interceptor and many other planes in the U. S. and Canadian Air Defense Commands are fully equipped with this system developed and manufactured by the Hughes Aircraft Company. G-V thermal time delay relays are relied upon in all of these systems.

In both military and industrial equipment, G-V thermal relays are providing long, dependable, proven service in time delay applications, voltage and current sensing functions and circuit protection.

Write for extensive application data and catalog material.

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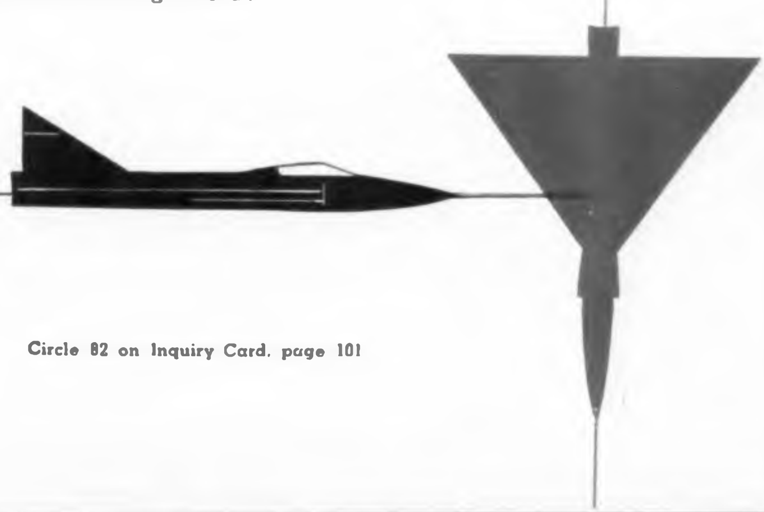

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50 Hollywood Plaza, East Orange, New Jersey

Circle 82 on Inquiry Card, page 101