A McGraw-Hill Weekly 75 cents August 16, 1963

electronics®

FRONTIERS IN PHOTOGRAPHY

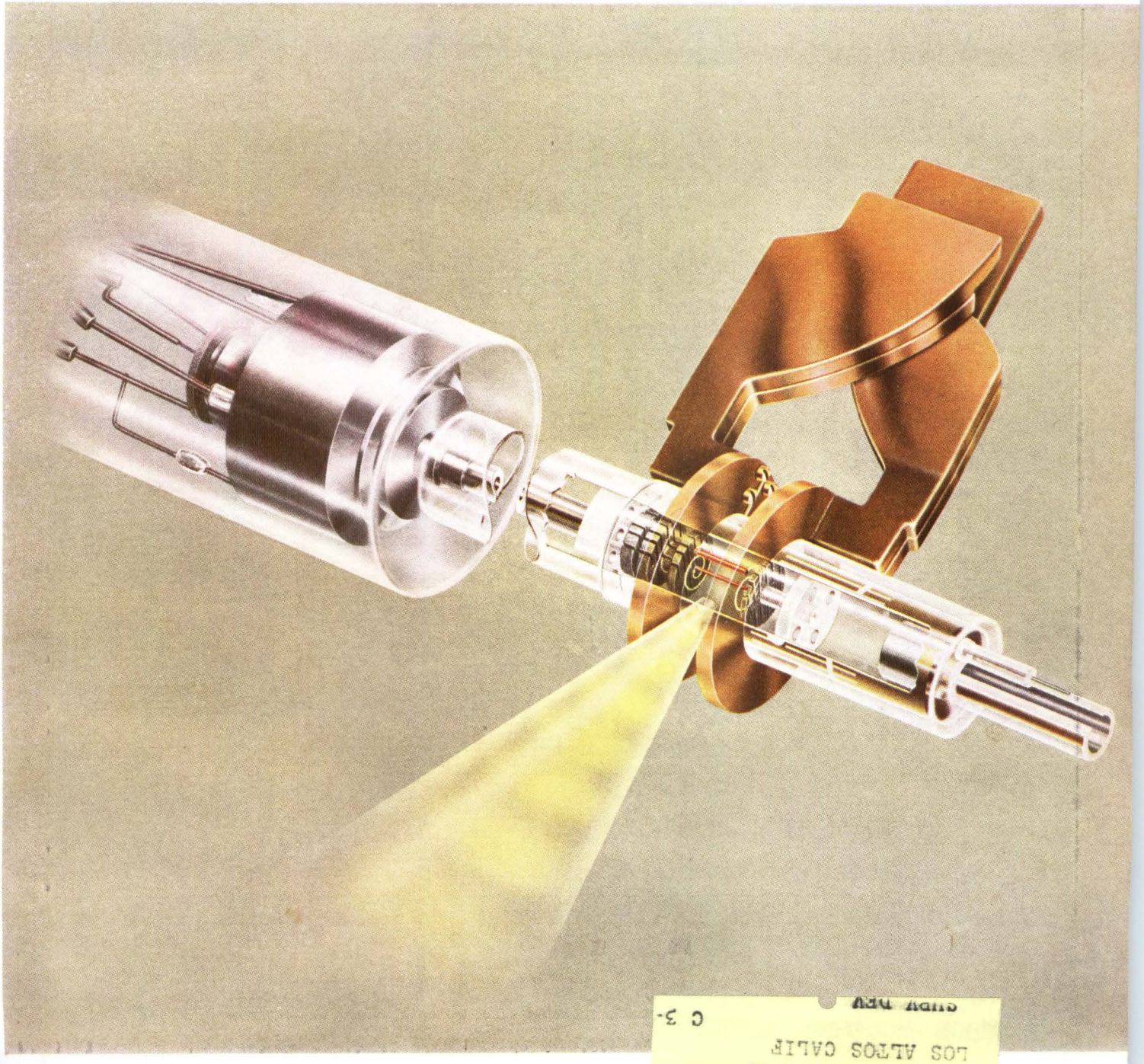
Exciting new roles for lasers, p 16

INFRARED ALARMS

Immune to spoofing by intruders, p 26

TALKING COMPUTERS

Answering questions over telephone, p 30

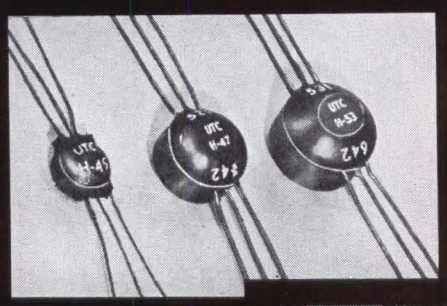


TORNADOTRON, *a generator for one-millimeter waves, p 21*

PULSE TRANSFORMERS
FROM STOCK

MINIATURE STABLE WOUND CORE—HERMETIC MIL-T-21038B, TYPES TP7SX4410AZ & TP7SX1110

UTC miniature, wound core, pulse transformers are precision (individually adjusted under test conditions), high reliability units, hermetically sealed by vacuum molding and suited for service from —70° C. to +130° C. Wound core structure provides excellent temperature stability (unlike ferrite). Designs are high inductance type to provide minimum of droop and assure true pulse width, as indicated on chart below. If used for coupling circuit where minimum rise time is important, use next lowest type number. Rise time will be that listed for this lower type number . . . droop will be that listed multiplied by ratio of actual pulse width to value listed for this type number. Blocking oscillator data listed is obtained in standard test circuits shown. Coupling data was obtained with H. P. 212A generator (correlated where necessary) and source/load impedance shown. 1:1:1 ratio.



DEFINITIONS

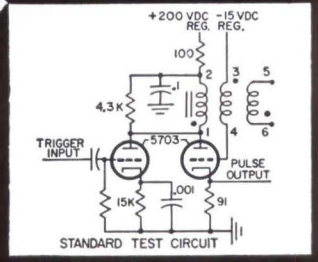
Amplitude: Intersection of leading pulse edge with smooth curve approximating top of pulse.
Pulse width: Microseconds between 50% amplitude points on leading and trailing pulse edges.
Rise Time: Microseconds required to increase from 10% to 90% amplitude.
Overshoot: Percentage by which first excursion of pulse exceeds 100% amplitude.
Droop: Percentage reduction from 100% amplitude a specified time after 100% amplitude point.
Backswing: Negative swing after trailing edge as percentage of 100% amplitude.

Type No.	APPROX. DCR, OHMS 1-2	3-4	5-6	BLOCKING OSCILLATOR PULSE Width μ Sec.	Rise Time	% Over Shoot	% Droop	% Back Swing	COUPLING CIRCUIT CHARACTERISTICS P Width μ Sec.	Volts Out	Rise Time	% Over Shoot	% Droop	% Back Swing	Imp. in, out, ohms
H-45	3	3.5	4	.05	.022	0	20	10	.05	17	.01	20	0	35	250
H-46	5.5	6.5	7	.10	.024	0	25	10	.10	19	.01	30	10	50	250
H-47	3.7	4.0	4	.20	.026	0	25	8	.20	18	.01	30	15	65	500
H-48	5.5	5.8	6	.50	.03	0	20	5	.50	20	.01	30	20	65	500
H-49	8	8.5	9	1	.04	0	20	10	1	24	.02	15	15	65	500
H-50	20	21	22	2	.05	0	20	10	2	27	.05	10	15	35	500
H-51	28	31	33	3	.10	1	20	8	3	26	.07	10	10	35	500
H-52	36	41	44	5	.13	1	25	8	5	23	.15	10	10	45	1000
H-53	37	44	49	7	.28	0	25	8	7	24	.20	10	10	50	1000
H-54	50	58	67	10	.30	0	20	8	10	24	.25	10	10	50	1000
H-55	78	96	112	16	.75	0	20	10	16	23	.40	5	15	20	1000
H-56	93	116	138	20	1.25	0	25	10	20	23	.6	5	10	10	1000
H-57	104	135	165	25	2.0	0	30	10	25	24	1.5	5	10	10	1000
H-60	.124	.14	.05	.05	.016	0	0	30	.05	9.3	.012	0	0	20	50
H-61	.41	.48	.19	.1	.016	0	0	30	.1	8.2	.021	0	0	15	50
H-62	.78	.94	.33	.2	.022	0	0	18	.2	7.4	.034	0	5	12	100
H-63	1.86	2.26	.70	.5	.027	2	10	20	.5	7.5	.045	0	20	25	100
H-64	3.73	4.4	1.33	1	.033	0	12	25	1	7	.078	0	15	23	100
H-65	6.2	7.3	2.22	2	.066	0	15	25	2	6.6	.14	0	10	20	100
H-66	10.2	12	3.6	3	.087	0	18	30	3	6.8	.17	0	10	20	100
H-67	14.5	17.5	5.14	5	.097	0	23	28	5	7.9	.2	0	18	28	200
H-68	42.3	52.1	14.8	10	.14	0	15	28	10	6.5	.4	0	15	30	200

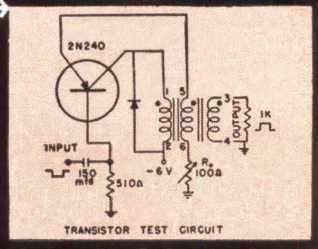
Note: 0 = Negligible

ALSO 5:3:1 RATIO UNITS AVAILABLE FROM STOCK

Vacuum Tube Type Ratio 1:1:1



Transistor Type Ratio 4:4:1



H-45, 46, 60 thru 68 are 3/8 cube, 1 gram **H-47 thru 52, 9/16 cube 4 grams** **H-53 thru 57, 5/8 cube 6 grams**

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August 16, 1963

electronics

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Contents Continued

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CONTENTS continued

DEPARTMENTS

Tools for Freedom

PRESIDENT *John F. Kennedy and Charles Francis Adams, president of Raytheon Company, watch as Philippine Ambassador Amelito Mutuc reads a plaque acknowledging 62 tons of machine tools and other equipment being sent to the Ramon Magsaysay Memorial School*

OPPORTUNITIES to help others while simultaneously helping yourself are rare, but the Tools for Freedom Foundation, a nonprofit organization, has found a way to do just that.

Got any outdated ammeters or voltmeters? How about oscilloscopes or signal generators that have seen better days? Hand tools? Radio and tv subassemblies? Radar sets? Analog computers?

If you have, how about donating some of them to technical schools in underdeveloped countries? The schools will use them to train students in electronics. The program applies only to established schools that have qualified instructors able to put the equipment to immediate use and keep it in good repair.

It is hoped that students trained in the program will go on to establish electronics in their native lands that, in time, may be customers for components and equipment made in other countries. Human nature being what it is, they will tend to lean toward products with which they are familiar. And they will be familiar with the products of companies that contribute because each piece of equipment distributed through the program bears the name of the donor. Generosity today may mean larger foreign markets tomorrow.

So far Tools for Freedom has delivered more than $1,900,000 worth of machinery and equipment to 97 technical and vocational schools in 17 countries, mainly the Philippines, Pakistan, Nigeria, Kenya, Costa Rica, Colombia and Chile. These initial shipments have generated requests from an additional 340 schools in 56 countries. Altogether, they have asked for 465 specific items of equipment. A list of these items, plus other information, may be obtained from Tools for Freedom Foundation, 345 East 47th Street, New York 17, New York.

THE MEDICAL LASER. A devotee of the mixed-up metaphor has described laser technology as "a virgin field pregnant with possibilities."

At various times in the past three years, or so it seemed, all the lasers in captivity were bursting balloons or punching holes in razor blades or blasting away at steel plates. In between times, the communications application was being alternately glorified and discounted. All the while, work was quietly going on at many centers of medical and biophysics research to determine the effects wrought by this new energy source on living systems, from cellular to human systems. The possible implications are legion, ranging from genetics to weaponry.

Seldom have the researchers and experimenters swapped notes in public, partly because of the preliminary nature of the work thus far, partly because of the medical profession's understandably cautious attitude toward drawing conclusions from such first steps.

But last week in Boston, significant notes on biological effects of lasers were swapped—and our man in Boston was there. In his report, on p 15 you will detect a conscious effort to avoid the sensational while pin-pointing the significant in an area of technology in which human emotions and aspirations are necessarily involved.

COMMENT

RFI

Congratulations on a truly excellent rfi survey in the June 21 issue (p 37). Your comprehensive discussion will, I am sure, be of real service to the industry.

MORRIS ENGELSON
Pentrix Corporation
Brooklyn, New York

Micropower Circuits

I would like to thank you greatly for the fine treatment which our last article on Micropower Circuits received in your journal (p 47, July 19). We had many fine comments on it and we are extremely happy about the handling of it.

WOLFGANG W. GAERTNER
CBS Laboratories
Stamford, Connecticut

RFI Control

Your June 14 *Crosstalk* (p 3) on radio-frequency interference, What Price RFI Control?, intrigues my interest, and recalls my 1912 rfi control system designed for security of a radio torpedo-control system, which I have long believed to be the answer for such problems.

Much like the superheterodyne system, but more like multiplex carrier cable and microwave relay, it used an r-f carrier modulated by i-f and again by a fixed a-f, with tuning to all three of these frequencies at the receiver. Detectors of course were used to demodulate at each frequency step in the receiver. Therefore other signals devoid of the i-f and a-f modulations could not excite the final control relay.

Static signals could, of course, shock the r-f carrier circuits into wavetrain oscillations, but having no i-f modulation, these were rejected by the i-f tuned amplifier. Even with the correct i-f modulation, the signal required a correct a-f modulation of the i-f subcarrier to pass the a-f-tuned circuits in order to actuate the final a-f tuned circuit or tuned-reed relay of the receiver.

Admittedly such a radio broadcast system would radiate an r-f band comparable with that of present-day f-m systems, but sideband suppression circuits could be used to alleviate this criticism.

A decided advantage, however, is that it would eliminate the i-f oscillators now used in all superheterodyne receivers, since the i-f subcarrier is introduced in the transmitter. Also, as in present-day multiplex carrier systems, a single transmitter could broadcast a number of simultaneous programs if the r-f carrier frequency were raised sufficiently high.

The details of circuits and apparatus for such a system are already in operation, but the millions of broadcast receivers now in use would require alterations or go into obsolescence; likewise the present broadcast stations, a situation not easily overcome. The price for such rfi control might well be too high for the adoption of such a system.

B. F. MIESSNER
Miessner Inventions, Inc.
Miami Shores, Florida

Thermoelectric Cooling

The thermoelectric coefficient performance figures used in the May 17 article on Consumer Electronics (p 46) are probably lower, we feel, than can presently be obtained in typical devices. Properly designed, the thermoelectric system very definitely is competitive with the compressor in a two to three cubic foot size and offers other advantages as well.

One would assume that your figure of 0.2 is based on low-quality thermoelectric material or on a very high temperature difference, which would have the same effect. As an example, at a temperature difference of 40 deg C on the modules, a coefficient performance of 0.4 can be obtained, and this rises to 1.3 at 20 deg C temperature difference.

Coefficient of performance, as a function of the material used and of the temperature difference, is reflected in the quality of the design, and wide differences will be noted from one design to the next.

JAMES KEANE
Needco Frigistors Ltd.
Montreal, Quebec, Canada

PHILCO, LEADER IN
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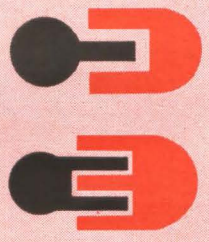
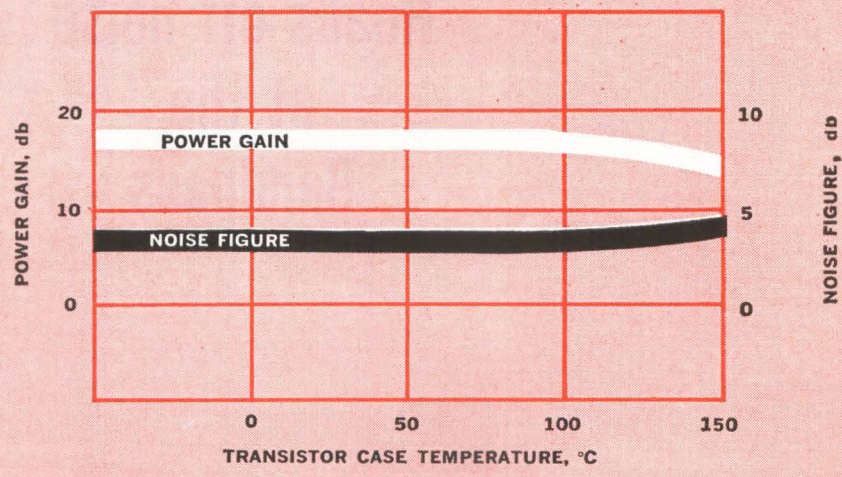
ANNOUNCES

Silicon Planar Amplifiers



Philco Interdigitated base-emitter configurations provide higher linear gain in Philco Epitaxial Silicon Planar NPN Amplifier Transistors.

Typical Power Gain and Noise Figure vs. Temperature for Type 2N918 at 200 mc (V_{CE} = 10 volts, I_C = 1ma).



PHILCO TYPE*	PG, db	N.F., db	P_{out}, mw	V_{CEO}, volts
2N917	9db min. @ 200mc	6db max. @ 60mc	10mw min. @ 500mc	15v. min.
2N918	15db min. @ 200mc	6db max. @ 60mc	30mw min. @ 500mc	15v. min.
2N2954	15db min. @ 100mc	5db max. @ 100mc		20v. min.

*All elements isolated from case. To-18 outline with 4 leads.

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126A rides herd over a roomy 5 to 1620 kc range, keeping a tight rein on accuracy all the way (typical limit of error, ±0.8 db). It can be a tunable or flat voltmeter depending how you set the selector knob. And it lets you play the range by ear with a switch that broadens the bandwidth to 2500 cps.

$1,195 corrals everything a 126A has to offer. Except for a 50-megohm probe, which costs $195, and input transformers for 600, 135, and 75Ω lines priced at $75 each. Our new literature surveys Sierra's select herd of prime voltmeters and wave analyzers. Write for it, or have your Sierra sales representative saddle up for a faster-than-by-mail response to your needs.

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ComSat Awards Its First Contract

WASHINGTON — The Communications Satellite Corp. has placed its first contract with industry. It is for $150,000, split between three companies, for three-month studies on multiple-access techniques for communication satellites (p 18, Aug. 9).

• AT&T will carry on its previous studies and work, for an approach to permit multiple-access without requiring any equipment other than that needed for single paired-access operation. This proposed system would require that the ground stations regulate the power output of their transmitters

• RCA's approach will be to investigate a ferrite limiter (in the satellite), aimed at providing multiple-access operation without requiring ground-station power control

• Hughes will study application of methods of multiple access to stationary satellites, including the testing of a 10-kw traveling-wave tube designed to provide high efficiency when amplifying 600 channels simultaneously in the satellite. The work complements NASA's Syncom program.

The AT&T and RCA approaches, ComSat said, are applicable either to the intermediate altitude or synchronous stationary satellite systems but are primarily useful for intermediate altitudes.

Telstar II Functioning After a Long Silence

ANDOVER, MAINE—Telstar II responded normally Monday for the first time since it stopped June 16. It was triggered by the usual 1 kw command transmitter but through a receiving horn giving 600 kw effective. No results were obtained on previous high-powered commands. The reason for the recent silence is so far unknown; unlike Telstar I, there has been no telemetered evidence of radiation or other damage.

Smoke Detector Uses Uranium as the Sensor

COCOA BEACH, FLA. — Exemption from uranium-use licensing is expected to be granted by the AEC this September to Electra-Tronics, Inc., for a new type of fire and smoke detector. The sensor has an insulated plate with about 0.005 microcuries of natural uranium on it, enclosed in a perforated casing. The uranium emits a steady stream of alpha particles which represent a positive-particle electric current to ground, establishing a potential pattern between the plate and case.

When smoke particles from a burning or smoldering area enter the space between the uranium plate and ground plate, they change the potential distribution and affect the positive-particle current. A flip-flop is incorporated in the system to detect both positive ions and negative electrons. Sensitivity can be controlled to prevent false alarms from sources like cigarettes and burning toast. Inventors are Cdr. O. K. Bell (Navy, ret.) and T. F. Parkinson, University of Florida.

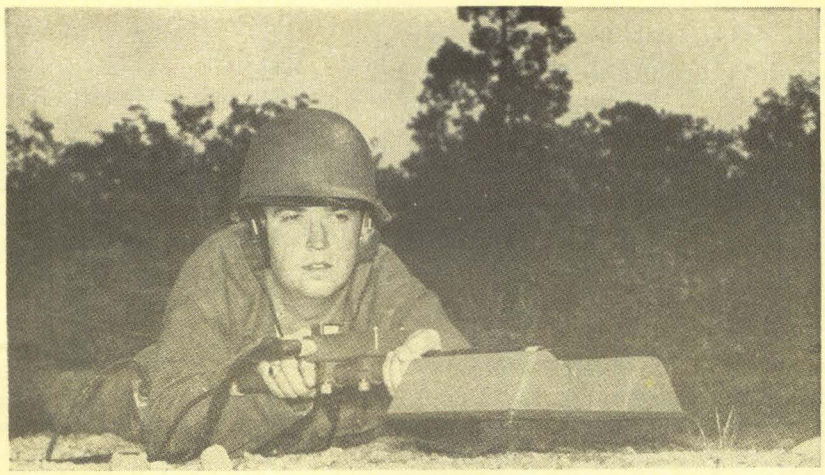
2 U. S. Firms Compete For Rights to Telcan

LONDON—Interest is still booming in the Telcan tv tape recording system (p 8, July 5), but competition for the license to manufacture the device has narrowed down to two American companies. Nottingham Electronic Valve Co., developers of the system, classifies both as major U. S. international firms. Initially, six U. S. firms were vying for the rights.

Numerous articles in the general press have described Telcan, which tape records tv audio and video for playback on the tv receiver at will. Cost is estimated at $177. Technical details have been scanty, but last week ELECTRONICS was informed the system differs from the normal video recording practice by using a fixed instead of a rotating head that is cheap to manufacture and permits recording at 2 Mc with a tape speed of 120 inches per second.

Recording tapes are standard European triple-play audio tapes

Microwave Mine Detector



FIRST PHOTOGRAPH *of microwave mine detector (p 8, Aug. 9) released by Army last week. Device detects metal, plastic and wooden mines*

such as the Agfa PE.65. Telcan is working with two European manufacturers to produce tape that will raise the overall signal-to-noise ratio from 28 db to 35 db.

Telcan may reach the market in the United Kingdom in early 1964. Marketing in the U.S. is not likely before the fall of 1964 because the system must first be converted to 525 lines. The bandwidth of the U. S. system will be 2.25 Mc.

British Atlas Computers Sought by the Russians

LONDON—Russian trade missions have been negotiating for two years to purchase the world's fastest computer—the British Atlas machine developed by Ferranti Ltd. and the University of Manchester. The order would be for four machines and would amount to $24 million. It has not been accepted because the Atlas is on the strategic materials list.

This information was released by Basil Ferranti, managing director of Ferranti Ltd., as the company agreed to sell its computer department to International Computers and Tabulators Ltd. for an estimated $23 million in cash and securities. Talks are proceeding with the British government to remove the computer from the strategic list. It is not known how the Russians would use the machines.

Atlas is capable of one million completed instructions a second with multiple time-shared program facilities.

Study Will Predict Future Of Digital Computers

FORT MONMOUTH— National Cash Register, Sylvania and Minneapolis-Honeywell are making a 12-month study for Army to forecast the state of the art in digital computers in 1975-85. Called Mildata, the project is concerned with getting the maximum use from a bank of computers handling a wide variety of military data.

It is related to the current CCIS-70 project-managed program (p 32, April 12), a hardware project for a command-control information system with a target date of 1970. Once the CCIS-70 eqiupment has been tested and evaluated for field use, work can begin on translating the Mil data study into hardware.

Path for Radio Signals Discovered in Ionosphere

SAN FRANCISCO—A new path for long-distance radio signals has been discovered by Dr. Robert B. Fenwick, research associate at Stamford Radio-Science Lab. He found that signals travel regularly around the world along the underside of the ionosphere.

To use the method the right tilt in the ionosphere must be located for each station. The tilts are mapped by the National Bureau of Standards. Present use of the ionosphere bounce has ignored these tilts, available over a given path for about five or six hours. With this method, communications reliability over long distances can be improved, Fenwick said.

Doppler Sonar Guides Deep-Diving Submarine

DOPPLER SYSTEM that bounces four high-frequency acoustic beams off the ocean floor will be used for navigating the Alvin, a two-man Woods Hole submarine capable of descending to 6,000 feet. Developed by Janus Products Inc., the sonar, along with an analog computer, provides true speed over the bottom, true distance travelled and drift angle. Beam frequency is controlled by a crystal oscillator.

2-30 Mc Directional Array Weighs Under 150 Pounds

ELECTRICAL characteristics nearly identical to those of a large log-periodic dipole array are reported by Antenna Research Associates, Inc., of Beltsville, Md., for its passive network array. A receiving antenna system measuring 8 by 12 feet, mounted atop a 20-foot tower, covers the full 2 to 30-Mc frequency range. A transportable version weighing less than 150 pounds, complete with rotator, can be erected in the field by a crew of three men in 20 minutes, the company says.

In Brief . . .

SUPPLYING support gear to government aerospace projects is a $7-billion-a-year business, according to a speaker at the First Internation Conference on Aerospace Support last week in Washington.

BURROUGHS has licensed Eitel-McCullough to manufacture, use and sell Burroughs' indicator tubes.

TWO SOUND circuits have been fitted to Russian experimental tv sets to permit reception of two languages with one picture, it was reported in Vienna. The system is expected to be popular in bilingual border areas.

FACSIMILE recorder designed to provide a 70 percent larger picture area for Tiros 8 and Nimbus weather satellite photos in Automatic Picture Transmission ground acquisition systems has been delivered to the Weather Bureau by Alden Electronic.

RAYTHEON is working on a high-repetition-rate, pulsed ruby laser system for applications in optical radar, welding and sheet metal work. The immediate goal is 10 pulses per second for a half-hour or an hour; 6 to 7 have been achieved so far.

GENERAL TELEPHONE has received a contract from the Army Satellite Communications Agency (SatCom) to study an Initial Satellite Communications Control Center (ISACCC).

RYAN AERONAUTICAL has initiated a developmental study for a warning system against "unconventional weapons," apparently nerve gas and other biochemical agents. Other companies involved are Arthur D. Little, North American Aviation, Hoffman Electronics and Meteorological Research Inc.

WESTINGHOUSE has received a contract from NASA to study an aircraft and ship navigation system using a combination of satellites and ground stations.

Did you know Sprague makes...?

MAGNETIC LOGIC DEVICES

Core-diode and core transistor magnetic shift registers and magnetic counters for switching and storage applications in computer and logic circuitry.

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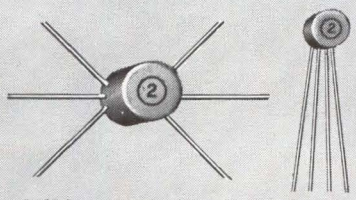
MOLDED PULSE TRANSFORMERS



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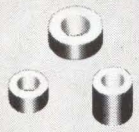

Series "300" Cores with logical flux values in popular physical sizes are stocked in production quantities for fast delivery. They're value engineered for quality with economy!

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ELECTRONIC MODULES TO CUSTOMER REQUIREMENTS

Custom packaging is no novelty at Sprague's Special Products Division, where "specials" are continually being developed and produced with countless variations in electrical characteristics and mechanical configurations.

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For application engineering assistance (without obligation, of course) on any of the above products, write or call the Special Products Division, Sprague Electric Company, 35 Union Street, North Adams, Massachusetts.

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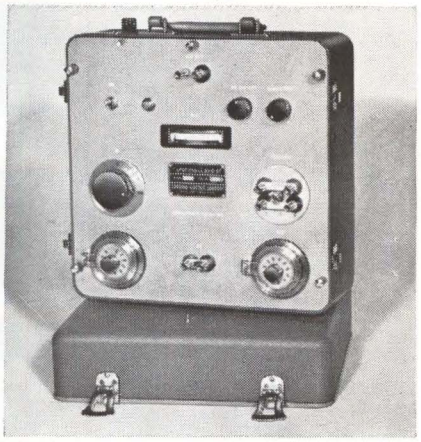
New Bridge Design For Safe, Accurate, Easy Measurement of 'Lytic Capacitors



The Sprague Model 1W2A Capacitance Bridge introduces new, improved technical refinements as well as restyling for added attractiveness and ease of operation. Built *by* capacitor engineers *for* capacitor users, it incorporates the best features of bridges used for many years in Sprague laboratories and production facilities.

Precision Measurements over Entire Range from 0 to 120,000 μF

The internal generator of the 1W2A Bridge is a line-driven frequency converter, and detection is obtained from an internal tuned transistor amplifier-null detector, whose sensitivity increases as the balance point is approached. It has provision for 2-terminal, 3-terminal, and 4-terminal capacitance measurements, which are essential for accurate measurement . . . $\pm 1\%$ of reading $+ 10\mu\mu F$ . . . of medium, low, and high capacitance values, respectively.

No Damage to Capacitors

The model 1W2A Capacitance Bridge will not cause degradation or failure in electrolytic or low-voltage ceramic capacitors during test, as is the case in many conventional bridges and test circuits. The 120 cycle A-C voltage, applied to capacitors under test from a built-in source, never exceeds *0.5 volt!* It is usually unnecessary to apply d-c polarizing voltage to electrolytic capacitors because of this safe, low voltage.

Complete Specifications Available

For complete technical data on this precision instrument, write for Engineering Bulletin 90,010A to Technical Literature Service, Sprague Electric Company, 35 Marshall Street, North Adams, Massachusetts.

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A MIGHTY BIG STEP

A MIGHTY IMPORTANT STEP FOR YOU! YOU CAN NOW BUY PRINTED CIRCUITS WITH YOUR CONDUCTOR AND HOLE PATTERN . . . WITHOUT ARTWORK . . . WITHOUT QUOTATIONS . . . WITHOUT TOOL CHARGES, AND IN MOST CASES, AT HALF THE USUAL COST AND IN HALF THE USUAL DELIVERY TIME! *Our new Standard Circuit Division reduces printed circuit manufacturing overhead to the barest minimum by automation and standardization. Mass production techniques drastically reduce costs, delivery time, and improve quality— yet still give you flexibility in board design. Sound exciting? For complete information write today for our 16 page brochure detailing this major printed circuit breakthrough.*

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200,000 OHMS PER VOLT

NEW AND THE FIRST

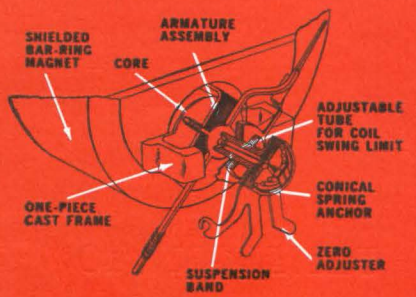
TRIPLETT

Model 630-NS
VOLT-OHM-MICROAMMETER

$99.50
SUGGESTED U.S.A. USER NET

TRIPLETT SUSPENSION MOVEMENT

no pivots . . . no jewels . . .
no hair springs . . . thus NO FRICTION.



FACTS MAKE FEATURES

1 **200,000 OHMS PER VOLT D.C. for greater accuracy on high resistance circuits. 20,000 OHMS PER VOLT A.C.**

2 **5μa SUSPENSION METER MOVEMENT. No pivots, bearings, hairsprings, or rolling friction. Extremely RUGGED. Greater sensitivity and repeatability.**

3 **62 Ranges, usable with frequencies through 100 Kc. Temperature compensated. 1½% D.C. ACCURACY, 3% A.C.**

Low voltage ranges and high input impedance make the 630-NS especially useful in transistor circuit measurement and testing. Input impedance, at 55 volts D.C. and above, is *higher than most vacuum tube voltmeters.*

The unit is designed to withstand overloads and offers greater reading accuracy. Reads from 0.1μa on 5μa range. Special resistors are rigidly mounted and directly connected to the switch to form a simplified unit. Carrying cases with stands are priced from $9.90.

TRIPLETT ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO

62 RANGES

D.C. VOLTS	0-0.6-3-12-60-300-1200 at 100,000 Ohms/Volt. 0-0.3-1.5-6-30-150-600 at 200,000 Ohms/Volt. 0-0.150 at 60μa
A.C. VOLTS	0-3-12-60-300-1200 at 10,000 Ohms/Volt. 0-1.5-6-30-150-600 at 20,000 Ohms/Volt.
DB	-20 to 77 in 10 ranges.
D.C. MICRO-AMPERES	0-5 at 300 MV. 0-60-600 at 150 MV. 0-120 at 300 MV.
D.C. MILLI-AMPERES	0-6-60-600 at 150 MV. 0-1.2-12-120-1200 at 300 MV.
D.C. AMPERES	0-6 at 150 MV. 0-12 at 300 MV.
OHMS	0-1K-10K-100K (4.4-44-440 at center scale)
MEGOHMS	0-1-10-100 (4400-44,000-440,000 Ohms center scale)

OUTPUT: Condenser in series with A.C. Volt ranges.

630 630-A 630-PL 630-APL 630-NA 630-NS 630-T 631 310 310C 666-HH 800 666-R

THE WORLD'S MOST COMPLETE LINE OF V-O-M'S. AVAILABLE FROM YOUR TRIPLETT DISTRIBUTOR'S STOCK

WASHINGTON THIS WEEK

ALL-CHANNEL TV BOOSTERS SEEK R&D AID AND TAX CUT

FEDERAL RESEARCH may be the next step in the government's promotion of uhf-tv broadcasting. Projects to improve uhf transmitting and receiving equipment are being considered by the Committee for the Full Development of All-Channel Broadcasting.

FCC Commissioner Robert E. Lee, who heads the group, is also trying to pursuade FCC to support legislation to drop the excise tax on all-channel sets for two or three years. This would cut the differential in cost between straight-vhf sets and all-channel sets. Lee says the all-channel set law could be evaded by assembling and marketing vhf-only sets within the same state. He feels this may prove troublesome in some markets. But the Treasury Department isn't likely to approve—it strongly opposes tampering with excise tax schedules.

Research to improve lead-in cable is one idea under consideration by the all-channel committee. Round antenna lead-in cable has been found preferable for uhf; yet flat cable, in use for vhf sets, is desirable because of its shape. The problem is to find a good flat cable for uhf. Lee's committee will urge government support for such technical proposals as this, if they will increase the acceptability of uhf.

PENTAGON TO PUSH VALUE ENGINEERING

PENTAGON will push value engineering techniques even further. Only 47 of 100 prime contractors have value engineering programs now. As defense procurement officials try to shift from cost-plus-fixed-fee contracts to fixed-cost and incentive procurement, they will try to have agreements to apply value engineering included. Today, use of value engineering is far below potential, officials feel, and can be used to gain more than the $450-million cost saving proposed by Defense Secretary McNamara. Contractors get 10 percent of the savings in cost-plus-fixed-fee contracts, and up to 25 percent in fixed-price and incentive contracts. The Pentagon wants prime contractors to extend this savings to subcontractors.

FCC-COMSAT ARGUMENT: WHO'S BOSS?

COMMUNICATIONS Satellite Corp. doesn't intend to be shoved by the FCC. In a sharp rebuttal to FCC criticism that temporary directors are moving too slowly toward a stock issue and permanent directors, the corporation says there will be no stock issue until sufficient economic and technical studies are conducted to make the offering meaningful to prospective buyers. Leo D. Welch, corporation chairman, charged FCC with "an invasion of the managerial functions of the corporation" by stipulating that not more than $500,000 of a recent $600,000 loan request by the corporation be used for research and design contracts.

NAVY CHECKING NUCLEAR SUBS

THRESHER DISASTER has led the Navy to begin a program of electronic tests on welds and joints in its nuclear submarine fleet. This means that for the 30 or so nuclear subs in existence, some 8,000 connections on each sub must be tested. Labor costs alone will be millions of dollars. In an over-all tightening up on construction of the subs, electronic sensing systems to detect material weakness, as well as other safety measures, are being considered.

Cool indifference—up to 310°C.

That's the big difference with AMPLIMICA* Capacitors!

This stacked foil capacitor goes right on giving dependable performance in control systems, high voltage power supplies, pulse forming networks, and atomic reactors under temperature ratings up to 310°C. And the big reason for this is our new dielectric—a processed mica which takes all the advantages of raw mica and makes them more readily controllable for today's miniaturization and operational requirements.

In addition to being effectively resistant to high temperatures, our new AMPLIMICA Capacitors are also resistant to radiation . . . even high dosage rates cause no appreciable capacitance loss.

If your requirements call for a capacitor that assures reliable, stable performance under temperatures ranging up to 310°C., we offer AMPLIMICA Capacitors in a complete range of sizes and configurations . . . ready to do the job. Send for complete information today.

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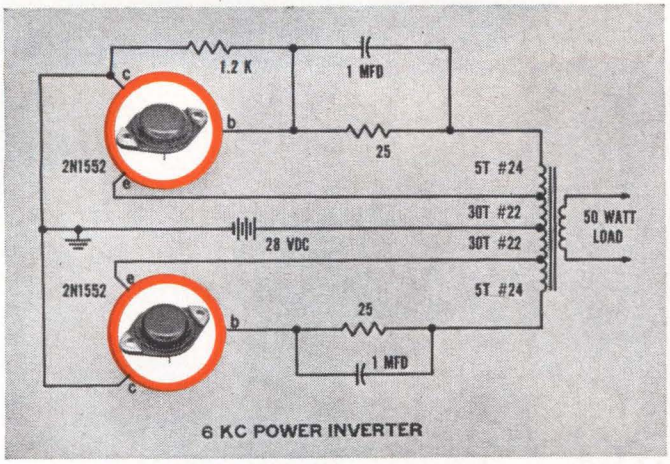
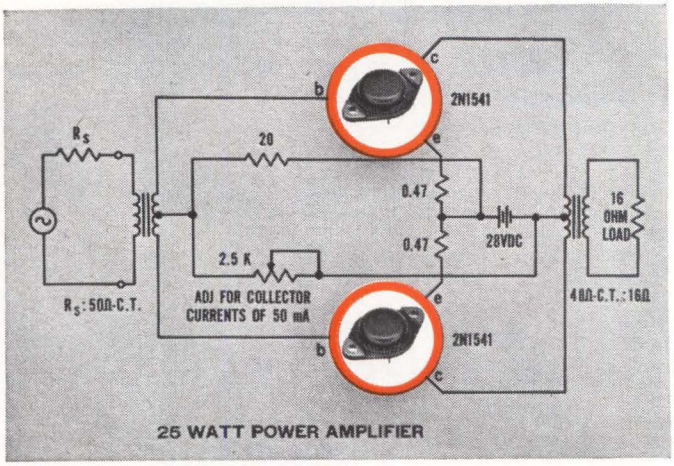
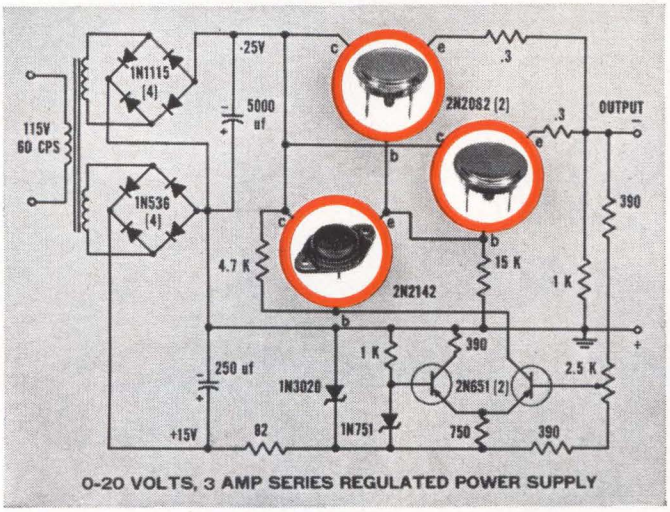


6 KC POWER INVERTER



25 WATT POWER AMPLIFIER



0-20 VOLTS, 3 AMP SERIES REGULATED POWER SUPPLY

FOR UP TO 60 AMP REQUIREMENTS

. . . OR APPLICATIONS TO 160 VOLTS

. . . there is a *Standard* Motorola power transistor type for over 90% of all circuit applications!

No need to waste valuable time searching for costly "specials" to meet your specific power transistor design requirements. Motorola now has a standard device to fit nearly every special application . . . with a selection of over 150 different power transistor types from which to choose.

You can design equipment with the assurance that the Motorola power transistor you specify is from the industry's most rugged line of transistors. Many of these devices are available in the "Meg-A-Life" series . . . the quality assurance program that offers industrial power transistors with the *certified* reliability of military units.

Motorola now offers all roundbase (TO-36) and diamond (TO-3) power transistor types in the "low silhouette" package for equipment designs where headroom is at a premium. All Motorola's TO-36 devices feature 170 watt power dissipation with 0.5°C per watt thermal resistance ratings. Motorola TO-3 types, in addition to proven performance, offer you the most complete electrical specifications ever given for power transistors.

Units are available for immediate delivery from your local Motorola Semiconductor distributor.

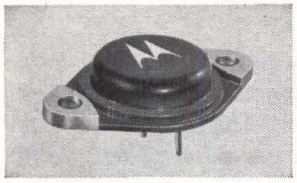
TO-36 package

TYPES AVAILABLE

2N173-74(A)	2N1099-1100	2N2152-58
2N277-8	2N1358	MP500-506
2N441-3	2N1412	2N2075-82

plus, military types

JAN2N174	USN2N1412
USA2N1358	JAN2N1358M



TO-3 package

TYPES AVAILABLE

2N297A	2N1529-60
2N627-30	2N2137-46
2N1011	2N2526-28
	2N1359-65

plus, military types

USA2N297A	USA2N1120
USA2N1011	USN2N1165

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THE MEDICAL LASER

New Tool for Cancer Research

Early experiments in lasers' biological effects show promise

By THOMAS MAGUIRE, New England Editor

BOSTON — Scarcely three years after its discovery, the laser is opening up a new area of cancer research.

This development came into sharp focus last week at the 2nd Boston Laser Conference as preliminary data was exchanged, in some cases for the first time publicly, on experiments ranging from laser irradiation of tissue cultures during cell growth to treatment of transplanted human tumors in animals and use of coherent light sources to treat skin growths on humans. The conference was held at Northeastern University.

CANCER EXPERIMENTS—These facts emerged from the session:

• Preliminary data on tissue irradiation indicate unique effects of laser beams on cell growth in tissue culture. And in some early cases, a differential effect on malignant cells as opposed to healthy cells has been noted. Work of this kind is going on at the Pasadena Foundation for Medical Research in cooperation with Hughes Aircraft

• Microbeam irradiation of single cells by focused laser beams —typically of 3-micron spot size— has resulted in destruction of several chromosomes in a single cell. This work, in progress at New York University and reported by Norman Saks, indicates the possibility of getting information on genetics that may be of importance in cancer studies.

• Laser beams have had destructive effects on certain types of human malignant tumors transplanted into hamsters (ELECTRONICS, p 7, July 19). Dr. Paul E. McGuff of the Tufts-New England Medical Center will present data on these experiments to the American College of Surgeons' meeting in San Francisco in October.

• Laser beam has been used as a cauterizing tool on humans, for treatment of skin growths and blemishes. Experiments to date, said Dr. Leon Goldman, of the University of Cincinnati, indicate that the laser is superior to conventional cauteries in several respects. It has resulted in faster, cleaner cures, without secondary infections. At the university's Medical Laser Laboratory, a new center nearing completion, experiments will include effects of high-energy and low-energy beams (above and below 25 joules per square cm) on blood cells, on bones, and on exposed skin flaps.

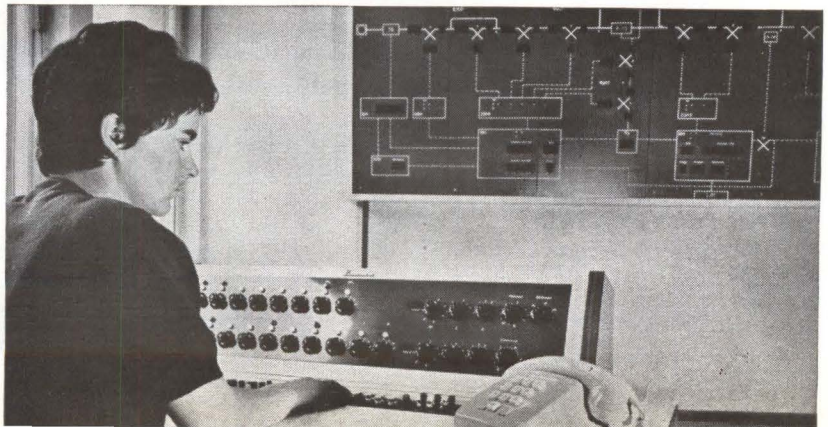
EYE TREATMENT—Among other centers of medical laser research represented were: the Medical College of Virginia, where ocular radiation effects on rabbits are being investigated; the NYU department of ophthalmology in cooperation with TRG Inc.; Roswell Park Memorial Institute in Buffalo, and Northeastern University.

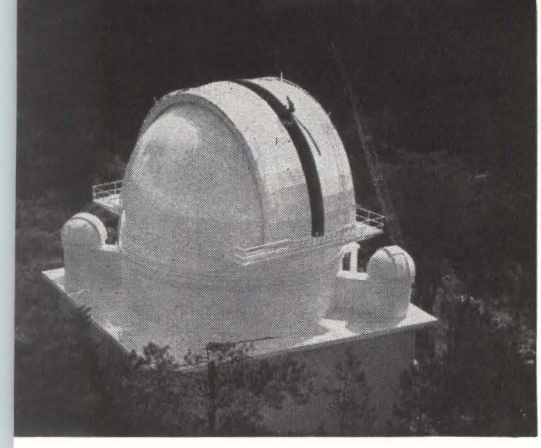
Although reports on retinal irradiation were restricted to work with rabbits, it was indicated that several research centers including the Retina Foundation in Boston are approaching clinical trial of the laser as a photocoagulator for repair of detached human retinas. The session was organized by Gerald Grosof, of TRG, and NYU.

One of the few reported cases of laser coagulation of human retinas was performed at Columbia Presbyterian Hospital, New York (ELECTRONICS, p 7, Jan. 5, 1962). In an optimistic though cautious report to the American Academy of Ophthalmology and Otolaryngology earlier this year, Dr. Charles J. Campbell and co-workers said the experiments "demonstrate the feasibility and suggest the desirability of producing coagulations of the retina with a maser." Work of a similar nature is in various stages at other laboratories and medical centers (ELECTRONICS, p 7, April 12, and p 30, April 19, 1963; p 27, Jan. 26, 1962).

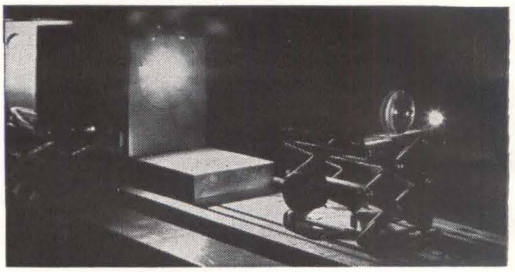
Pushbutton Telephone Office

REED RELAYS, *electronically controlled, comprise a telephone switching center just placed in public operation at Stuttgart, Germany. The system, developed by Standard Elektrik Lorenz Aktiengesellschaft, German ITT affiliate, employs a pushbutton calling set (on desk). Test console and indicators are necessary because errors can no longer be traced visually*





CLOUDCROFT OBSERVATORY *will be used by Air Force to study satellite tracking with lasers*



GIANT-PULSE *laser developed by Korad creates high-intensity arc in air*

From Flash Guns to Lasers

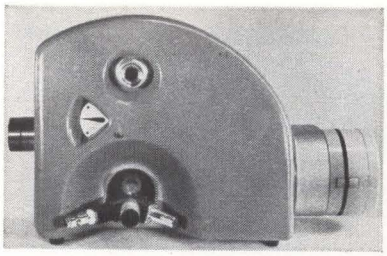
By HAROLD C. HOOD
Pacific Coast Editor (Los Angeles)

Megapulse lasers now give photographers all the light they can use

LOS ANGELES—With the laser, the limiting factor for high-speed photography is no longer the amount of light on the subject, but the vulnerability of the subject to damage from the laser beam.

This comment by Korad Corporation's Harvey Schultz at last week's Society of Photographic Instrumentation Engineers symposium points up the impact of lasers on photography.

Korad's system uses a Kerr cell and polarizer as an optical shutter that can open in 5×10^{-9} second to permit emission of a 50-Mw pulse from the ruby laser rod. This pulse is beamed through another ruby rod that amplifies it to 500 Mw, setting up a corresponding field gradient of roughly 5 Mv/inch. When focused by the lens shown, the beam causes a field of 100 Mv/inch and forms an arc in the air. Quartz crystal or optical glass shatters in this focus point.



HIGH-SPEED *framing camera, shown for first time at SPIE meeting by Electro-Optical Instruments, is one-third size of previous models*

SHOOTING THE MOON—Schultz' co-author, Arnold Gillmer, said that high-time-resolution pictures of the moon may be made possible in the future by lasers producing many gigawatts of power in nanoseconds of pulse-width. Differential distances on the order of one foot might be resolved if multiple reflections don't interfere.

Other company sources hint that 10 to 50-gigawatt lasers are in preliminary design and could be readied for tests in months, with proper incentives. Principle wavelength being exploited is 6,943 Å, although work is proceeding at 10,600 Å, 23,600 Å, and harmonically created wavelengths in the blue, green, and ultraviolet regions. Also in development are microsecond lasers. Another promising area is photographic studies of plasma and combustion phenomena, using nanosecond lasers and Schlieren techniques.

First effort to track a satellite—an Agena-B—with an integrated laser-optical system reportedly will be made later this year from the Air Force's Cloudcroft Observatory in New Mexico. The system is expected to push the present limit of 40 miles for optical tracking of satellite-size objects to 600 miles. Resolution will be about one foot at 100-mile distances.

A 15-inch guide telescope for tracking and the TRG ruby ranging laser will be strapped to the side of the 48-inch optical telescope. Westinghouse has developed the associated optical radar receiver. There is unofficial pessimism about the compatibility of the systems being mated.

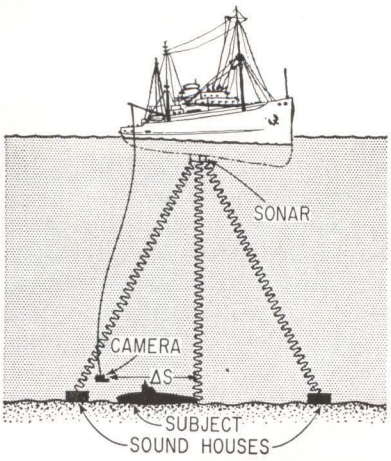
The site, atop a 9,000-foot mountain, was selected to minimize atmosphere interference and will probably be the location of much future USAF experimental laser activity.

SONAR—Harold Edgerton, who invented much of the gear used in the Thresher search, posed the idea that "soundhouses"—ocean-floor, vlf sonar counterparts of lighthouses—could play a useful role in pinpoint ocean navigation for underwater photography. Ships would use calibrated listening equipment to determine bearing and distance from the soundhouse.

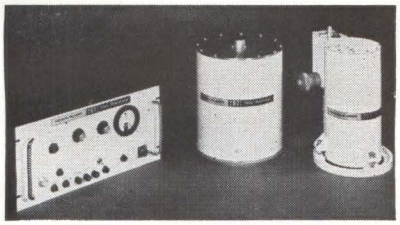
A new Perkin-Elmer polarimeter will monitor torque and calibrate highly sensitive instrumentation aboard Navy's Flip (Floating Instrument Platform). The 355-foot spar buoy will determine phase

Pulses Promise

VERTICAL EDGES *of signal train, as seen on scope, oscillate according to input voltage and frequency*



SOUNDHOUSES *on ocean floor are proposed as way to accurately position underwater cameras*



COMPONENTS *of Perkin-Elmer polarimeter for buoy twist measurements*

distortion and directional characteristics of sound waves in the ocean by comparing the output of transducers on the buoys' lower end with data obtained by optically and electronically tracking distant targets at sea level.

Unless compensated for, twisting of the sausage-shaped hull distorts readings. The polarimeter detects twist of 3 seconds of arc.

Simpler Audio

BOSTON—A two-state modulation system, to be described next week at WESCON, gives promise of simplifying design of hi-fi amplifiers, tape recorders d-c current transformers and other devices. The technique is a combination of pulse-duration modulation and frequency modulation.

Prof. Amar G. Bose of the Research Laboratory of Electronics at MIT, will report on a modulator that converts an input signal of varying amplitude and frequency to a rectangular output signal of fixed amplitude. The output signal is generated by a fixed voltage which switches between two

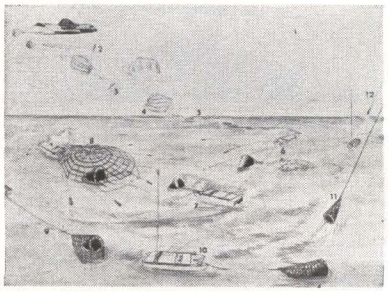
values. On an oscilloscope, the output wave appears as a train of rectangles whose vertical edges oscillate rapidly. The distance through which the edges move corresponds to the voltage of the input signal, and the rate at which they oscillate corresponds to frequency. The modulating signal can be recovered by low-pass filtering.

The modulation system uses all transistors, operating in the switching mode only, permitting high-efficiency, low-power operation, simplicity and light weight. The technique is said to virtually eliminate cooling problems in amplifier applications. Bose has used the technique in a d-c to 20-kc power amplifier and d-c to 300-cps tape recorder.

Among other uses to which the modulator can be adopted are: a d-c power system for aircraft and spacecraft in transformer and voltage regulator functions would be combined, nonlinear control systems; and temperature control in which high-speed switching would smooth out variations and provide improved temperature stability.

Sea Drone Snares Capsules

Retrieval plane uses radio-controlled boat to make sea rescue



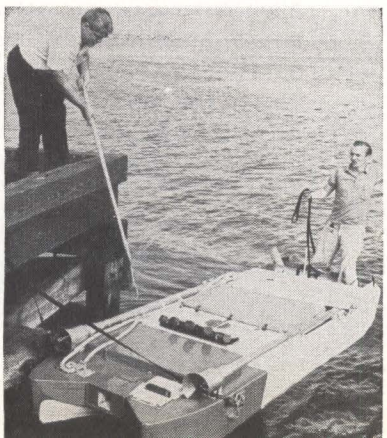
RETRIEVAL *sequence. Numbered steps are explained in text*

CHICAGO—Air Force is testing a new system — a radio-controlled, skydiving boat—to retrieve from the ocean objects such as reentered Samos space capsules. Developed by Cook Technological Center, Morton Grove, Ill., the craft sets up the object for retrieval by snatch hooks dangling from the mother craft.

The procedure, as numbered in the illustration, is:

- Circling mother plane releases the chute-lowered boat (1, 2, 3) and maneuvers the outboard electric motor that propels it to the target. Target could be equipped with a radio beacon for automatic homing (4, 5)
- Electronic console aboard the mother plane fires a snare line from a drogue gun aboard the boat, activates a winch to haul the target in and collects parachute lines into a box for cutoff (6, 7)
- Radio signals then trigger a five-barreled mortar that projects a capture net over the target. Another signal orders the boat to draw back, closing the net by tightening a drawstring (8, 9)
- Springs and gas pressure mechanisms aboard the boat are remotely activated to erect a pickup mast topped by a hook. Recovery-net line is attached to hook (10)
- Lowering trapeze pickup gear, the plane flies low over the boat to engage the hook and pull up the net line and target (11, 12).

A spare mast, equipped with a load transfer mechanism—in case the first mast is damaged by the first pass—can be used for second try, or to reclaim the boat.



BOAT *is docked after unmanned test run on Lake Michigan. Pickup masts are on either side of net-firing mortar*

MEETINGS AHEAD

WESTERN ELECTRONICS SHOW AND CONFERENCE, WEMA, IEEE; Cow Palace San Francisco, Calif., **August 20-23.**

DATA PROCESSING NATIONAL CONFERENCE & EXHIBITION, Association for Computing Machinery; Denver Hilton Hotel, Denver, Colo., **Aug. 27-30.**

AUTOMATIC CONTROL INTERNATIONAL CONGRESS, International Federation of Automatic Control; Basle, Switzerland, **Aug. 27-Sept. 4.**

EFFECTS OF SATELLITE OBSERVATION MEETING, Hoover Institution on War etc. and Sylvania Products Inc.; Stanford University, **Sept. 4-6.**

MILITARY ELECTRONICS NATIONAL CONFERENCE, IEEE-PTGMIL; Shoreham Hotel, Washington, D. C., **Sept. 9-11.**

ELECTRICAL INSULATION CONFERENCE, IEEE, NEMA; Conrad-Hilton Hotel, Chicago, **Sept. 10-14.**

JOINT ENGINEERING MANAGEMENT CONFERENCE, IEEE, ASME; Biltmore Hotel, Los Angeles, **Sept. 12-13.**

INTERNATIONAL ASSOCIATION FOR ANALOG COMPUTING, AICA; Brighton College of Technology, Lewes Rd., Brighton, England, **Sept. 14-18.**

INDUSTRIAL ELECTRONICS ANNUAL CONFERENCE, IEEE, ISA; Michigan State University, East Lansing, Mich., **Sept. 18-19.**

NATIONAL POWER CONFERENCE, IEEE, ASME; Netherland-Hilton Hotel, Cincinnati, Ohio, **Sept. 22-25.**

INTERNATIONAL TELEMETERING CONFERENCE, IEE, IEEE, ISA, ARS, IAS; London, England, **Sept. 24-27.**

PHYSICS OF FAILURE IN ELECTRONICS SYMPOSIUM, Armour Research Foundation and Rome Air Development Center, Illinois Institute of Technology, Chicago, **Sept. 25-26.**

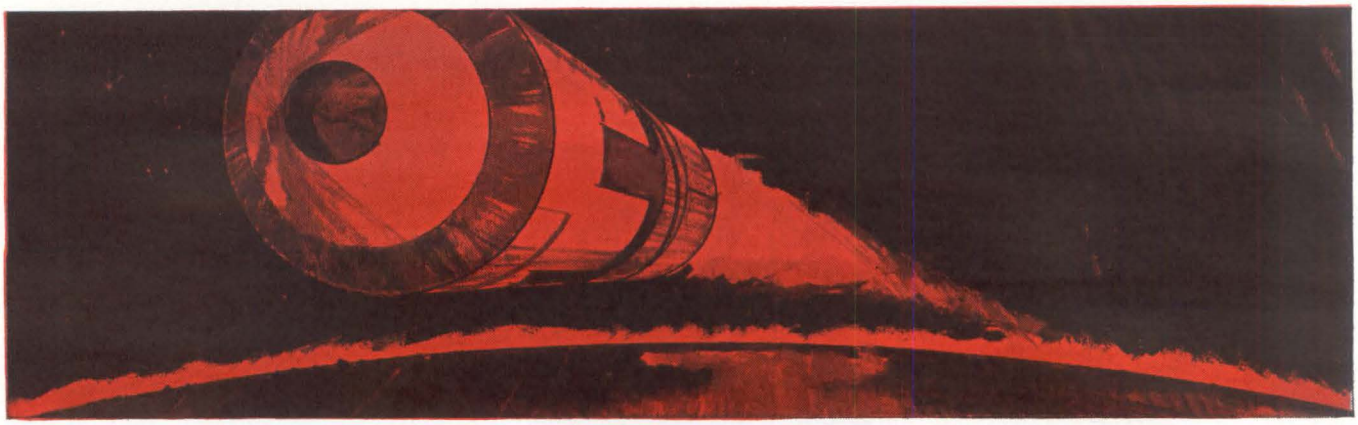
ELECTROCHEMICAL SOCIETY FALL MEETING, ECS; New Yorker Hotel, New York, **Sept. 29-Oct. 3.**

CANADIAN ELECTRONICS CONFERENCE, IEE REGION 7; Automotive Bldg., Toronto, Ont., Canada, **Sept. 30-Oct. 2.**

SPACE ELECTRONICS NATIONAL SYMPOSIUM, IEEE-PTG-SET; Fontainbleu Hotel, Miami Beach, Fla., **Oct. 1-3.**

ADVANCE REPORT

INTERNATIONAL SOLID-STATE CIRCUITS CONFERENCE, IEEE, *University of Pennsylvania; Philadelphia, Feb. 19-21, 1964; Nov. 1 is deadline for submitting both 35-word abstract, 300 to 500-word summary to Howard Parks, program committee secretary, Martin Co., R & AT Dept., Mail 683, Baltimore 3, Md. Some invited topics: circuit design techniques and developments, integrated circuits, solid-state data storage, optoelectronics, cryogenics, maser and laser techniques, sensors.*



Through confidence in their reliability Avco used Allen-Bradley hot molded resistors

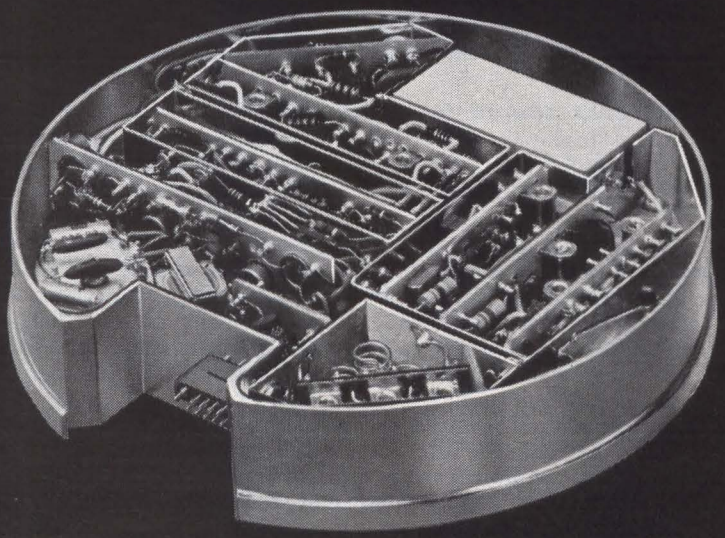
FOR THEIR RECEIVER IN THE FIRST MULTIPLE COMMAND CONTROL SYSTEM IN A NASA SATELLITE

■ To insure continued reliable performance, despite the vibration and shock incidental to a missile launching, Avco Corporation uses Allen-Bradley hot molded resistors in their command receiver designed for space satellites. Operating with the receiver is a special Avco decoder, which activates on-off controls of electronic equipment in the satellite. Both use only Allen-Bradley Type CB ¼ watt hot molded resistors.

Allen-Bradley's exclusive hot molding process results in such amazingly uniform characteristics from resistor to resistor—and from year to year—that long term resistor performance can be accurately predicted. Furthermore, there exists no instance on record where an Allen-Bradley hot molded resistor has failed catastrophically in service.

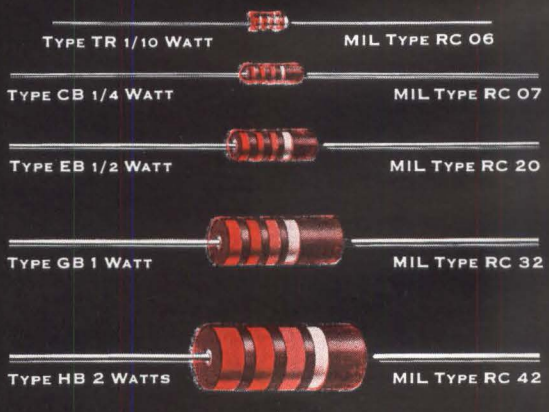
Just as has been the experience of hundreds and hundreds of users of Allen-Bradley resistors, you, too, can assure yourself of the ultimate in resistor performance by specifying standard A-B hot molded resistors—their quality has not yet been equaled.

For more complete information on the entire line of Allen-Bradley quality electronic components, please write for Publication 6024: Allen-Bradley Co., 110 W. Greenfield Ave., Milwaukee 4, Wis. In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



Satellite Receiver AD 183114 developed by the Electronics Division, Avco Corporation, uses A-B Type CB, ¼ watt hot molded resistors. This miniaturized receiver measures 6.3 inches in diameter, 1.13 inches high, and weighs only 1.5 pounds.

ALLEN-BRADLEY HOT MOLDED FIXED RESISTORS are available in all standard EIA and MIL-R-11 resistance values and tolerances.

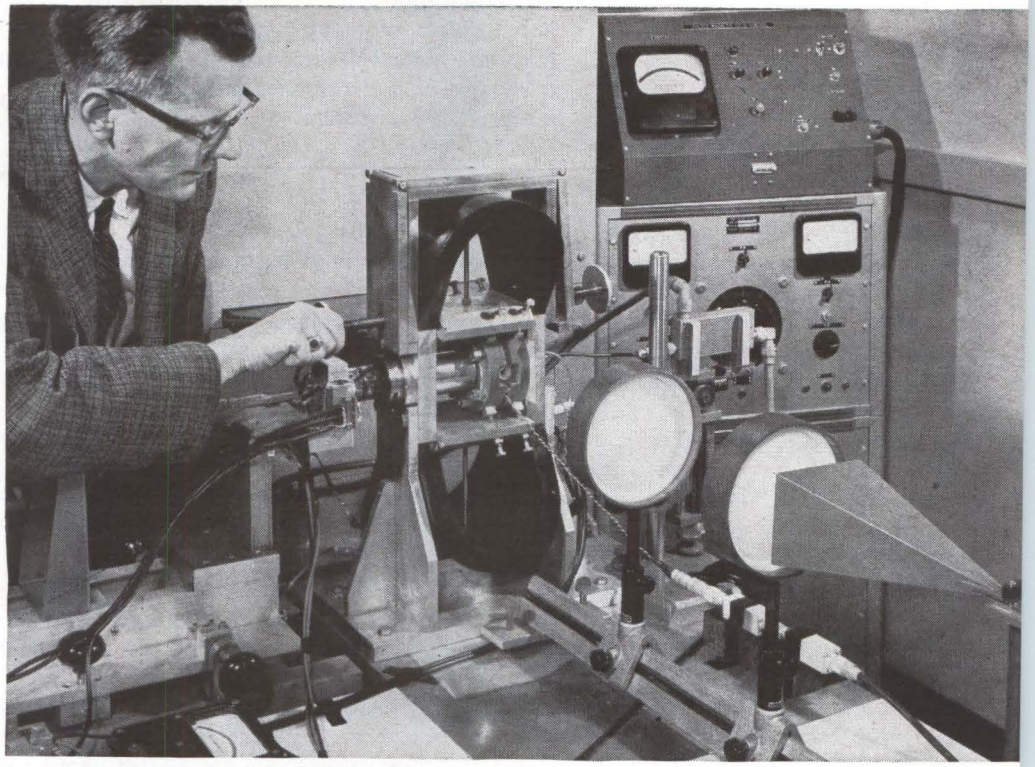


A-B QUALITY

ALLEN-BRADLEY

QUALITY ELECTRONIC COMPONENTS

electronics
A McGraw-Hill Weekly August 16, 1963



AUTHOR *Dressel adjusts the focusing magnetic field on the Tornadotron before measuring radiation output. Two dielectric lenses collimate energy into the receiving antenna*

LATEST THING IN MICROWAVE

First engineering details, latest experimental data and future plans for the famous Tornadotron

Generator for One-Millimeter Waves

By H. DRESSEL
G. E. WEIBEL
General Telephone & Electronics Laboratories, Inc., Bayside, New York

MANY problems inherent in generating appreciable microwave power at millimeter and submillimeter wavelengths have already been discussed.[1, 2] The extension of conventional microwave tube design to these higher frequencies, although advancing,[3, 4] is faced with a severe power limitation as the output wavelength decreases. One approach promising to overcome most of these problems is to apply recent advances in attaining high magnetic fields to millimeter-wave devices. The Tornadotron does just this. High magnetic fields are used to convert energy from microwave to millimeter or shorter wavelengths.[5] The Tornadotron can supply high pulsed-power output at these short wavelengths. Experiments conducted on a device of this type operating at frequencies as high as 290 gigacycles (290×10^9 cps), indicate some of the potential and problems of this approach.

As in other beam-type microwave tubes, the Tornadotron uses a Brillouin focused beam to provide electrons for interaction. In most conventional microwave tubes, these electrons are acted upon by r-f fields during their transit through the tube. However, in the Tornadotron, these electrons periodically build up a cloud of electrons that is confined for an extended period,

NEW PUSH ON THE UNKNOWN

Man's assault continues on what Charles H. Townes called "the no man's land" between the microwave region and visible light. Lasers of many types are moving deep into the near infrared. Meanwhile microwave tubes are moving up from the other side of the spectrum. Here are details on a leading contender, the Tornadotron

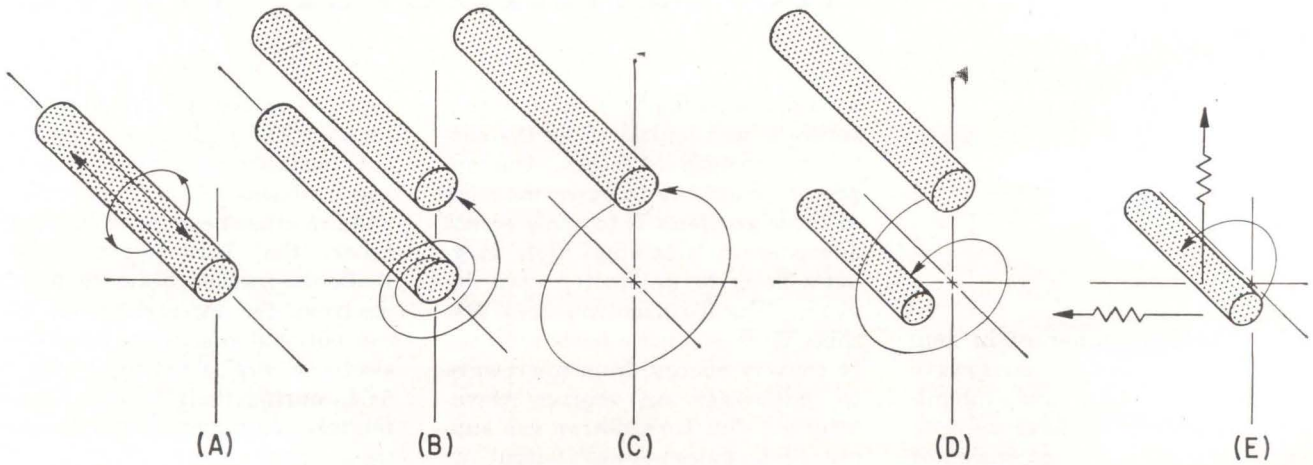
and then sequentially acted upon by applied electric and magnetic fields. This cloud of electrons then acts as a medium for energy conversion in a cyclic process.

PRINCIPLES—The cycle of Tornadotron operation is shown in Fig. 1. Only the motions of the electron cloud are shown. First, electrons are injected and trapped inside a chamber. The axial potential distribution in the chamber limits their longitudinal excursions, and an axial magnetic field limits their transverse excursions.[6] The charge cloud is then pumped up to a circular orbit by applying an additional radial electric field at cyclotron frequency as determined by the axial magnetic field strength used for confinement.[7] (An electron moving at right angles to a uniform magnetic field will move in a circular path; the frequency of rotation, called the cyclotron frequency, depends only upon the magnetic field strength.) After orbital motion of the cloud has been established, a high, pulsed magnetic field is applied. Now the orbit of the cloud becomes smaller as does the cloud cross-section. The cloud now orbits at a new frequency, one to two orders of magnitude higher than before. Considerable energy in the rotating cloud is now available for radiation at wavelengths that depend upon the strength of the applied magnetic field. Energy will be radiated because the cloud motion is equivalent to an array of dipole radiators. Also, coupling circuits may be used to selectively extract energy from the rotating beam.

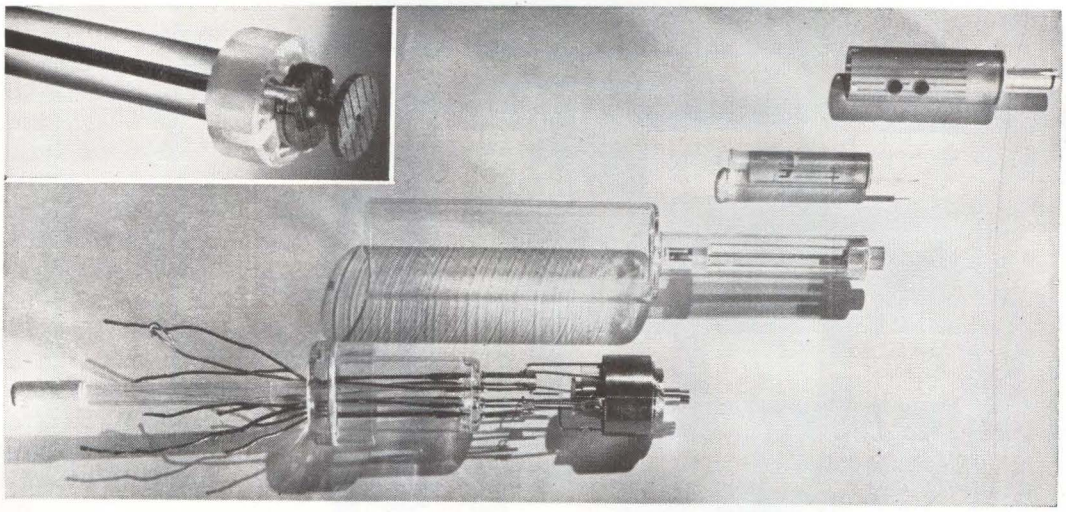
Appreciable power output may be achieved in such a device because an appreciable amount of energy is transferred from the pulsed magnetic field to the electrons as betatron acceleration. As a consequence, the energy transferred increases as output frequency increases. Moreover, performing sequential operations upon many electrons as a small, well-defined unit results in coherent radiation in which the power output is proportional to the square of the number of participating electrons.

TUBE—Realization of an actual Tornadotron tube depends on construction techniques that will permit operation in a rapidly changing high magnetic field. The initial tube design is for operation with pulsed fields up to 100 kilogauss. The tube components are shown in Fig. 2. From bottom to top they are the gun-header assembly, the tube envelope including the beam-injection electrodes, the confinement chamber and the outer r-f shield for the chamber.

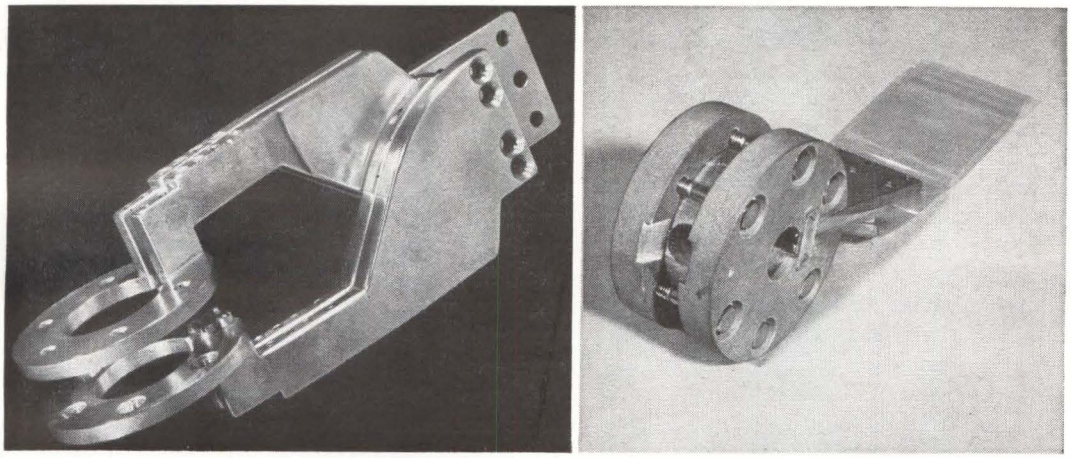
The electron gun provides a converging flow of electrons, and, being located an appreciable distance from the pulsed magnetic field, is constructed using conventional techniques. The remaining parts must be made to withstand the effects of the high rate of change in the magnetic field. Electrodes and r-f surfaces are deposited as patterns of thin gold and silver coatings on glass forms. Patterns are photoetched in the coatings, and form the proper potential surfaces while preventing the flow of large eddy currents during the rise and col-



STEPS *in Tornadotron operation: trapping a cloud of electrons (A); pumping at cyclotron frequency (B and C); high magnetic field pulsing (D); radiation (E)—Fig. 1*



TORNADOTRON *tube components; inset shows graphite electrodes—Fig. 2*



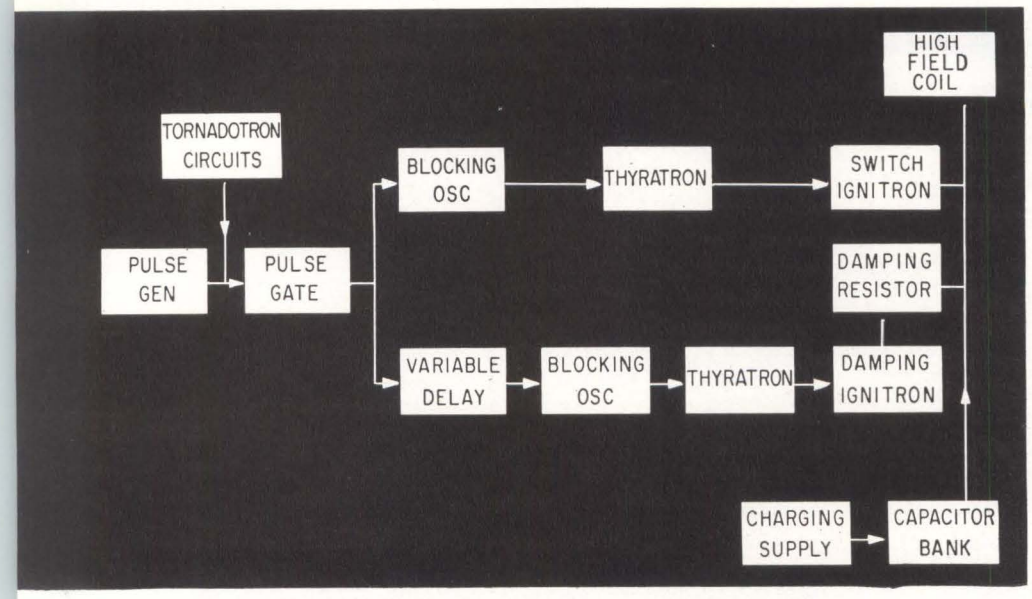
COIL PAIR *for generating 100-kilogauss magnetic field: assembly (left), incasement (right) provides increased mechanical strength and electrical insulation of coils—Fig. 3*

lapse of the pulsed magnetic field. The same technique has been used for parts located in areas subjected to significant fringing fields of the pulsed coils. Apertured electrodes subjected to electron bombardment are made of graphite, similarly patterned (Fig. 2 inset).

The confinement chamber provides the electric potentials for trapping as well as for pumping at cyclotron frequency. Windows in the conducting surfaces of the chamber permit the outward flow of radiation. The shield reduces the pumping power lost by radiation. Pumping power, at S-band, is inductively coupled to the chamber by a reentrant thimble in the glass envelope at the collector end of the tube. Tubes with these features have withstood continued cycling to fields of over 100 kilogauss with no deleterious effects.

MAGNETIC FIELD—A steady focusing field of 1,000 gauss is required to confine the electron cloud. This field is produced by two U-shaped permanent magnets. The pulsed magnetic field concentrated at the confining chamber of the tube has a half-sinewave variation with time. The peak value of magnetic field is reached in about 5 microseconds. The field is created by two single-turn coils[8] arranged series-aiding in the form of a Helmholtz coil pair. This arrangement generates a uniform field with an unimpeded exit for radiation from the tube window. The coils require about 200,000 amperes to produce a peak field of 100 kilogauss. Field uniformity over a cylinder of about 0.3 inch diameter by 0.5 inch long is within about 2 percent.

The energy for the coil pair shown in Fig. 3 is supplied from a bank of eight storage capacitors, each with a nominal rating of 15 microfarads. These capacitors are connected in parallel and charged to about 7.5 kilovolts for a field of 100 kilogauss. The capacitors are then discharged through two ignitrons operating in parallel sending current through the coils. A minimum number of mechanical joints was used in forming the high-current circuits in certain areas because of the impact forces created by high pressures during pulsing of the field. An additional pair of ignitrons in the circuit permits damping of the oscillation energy after



TIMING CIRCUITS *for the pulsed, high magnetic field—Fig. 4*

the current in the coil has reached its maximum value. This extends the life of the ignitrons and capacitors in the circuit, and also reduces the duration of mechanical stress on the coil.

Timing generators coordinate the sequence of events occurring in the tube. Repetition of all phases of operation, with the exception of high-field pulsing, occur at 60 cps. The triggering circuit for the high magnetic field is armed manually; thereafter, actual firing occurs at the proper time in the first subsequent cycle of operation. A block diagram of the field synchronizing circuit is shown in Fig. 4.

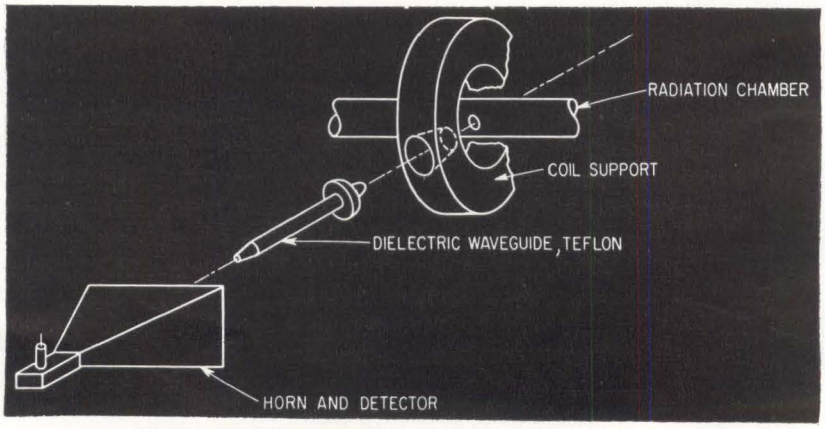
DETECTION—The rest of the experimental setup consists of equipment to collect and measure the r-f output. Initially, dielectric lenses collimated the r-f energy and then focused it onto a suitable detector. The lenses were subsequently replaced by a length of dielectric waveguide, made of Teflon, which is simpler to adjust and more efficient in operation. This system (Fig. 5) has been found by GT&E to be satisfactory over the wide range of frequencies measured.

Components in the detection circuit, particularly the detector mounts and crystals, have to meet stringent requirements in response capability to short r-f bursts and wideband operation. The entire detection system also requires shielding to reduce the pickup of spurious signals originating in the high-energy switching circuits.

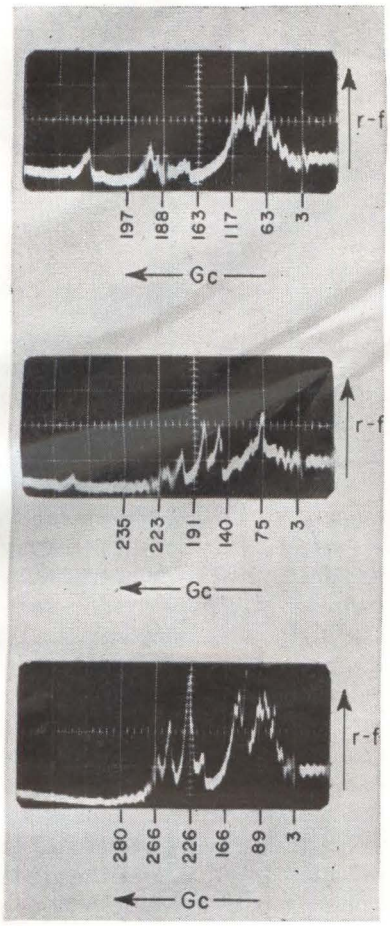
Operation of the experimental Tornadotron tube has been carried out to peak magnetic-field strengths beyond 100 kilogauss. Microwave output has been found in ranges covering much of the spectrum from 16 to 290 Gc. The experimental evidence accumulated thus far shows that the motion of the electron cloud as a unit is maintained during the magnetic field pulse, confirming the basic physical concept behind this device.

Only part of the available energy in the orbiting cloud has been extracted in experiments so far, as shown by continued radiation during the collapse of the magnetic field. Output appears at many frequencies during the period of magnetic field rise; the nature of the output spectrum is a function of operating conditions; examples are seen in Fig. 6 for differing peak magnetic fields. This characteristic is due to the modal properties of the circuit surrounding the orbiting cloud. Excitation of resonant modes in the structure of conducting surfaces surrounding the cloud leads to the frequency-selective enhancement of the output. The generation of harmonic output, as might be expected, was also noted at several frequencies with evidence of output at a frequency corresponding to twice the frequency of cloud motion. Tests were run at many peak fields (and frequencies) to observe the effects of changes in operating parameters. These tests were possible since the device is tunable by changing the value of the peak magnetic field.

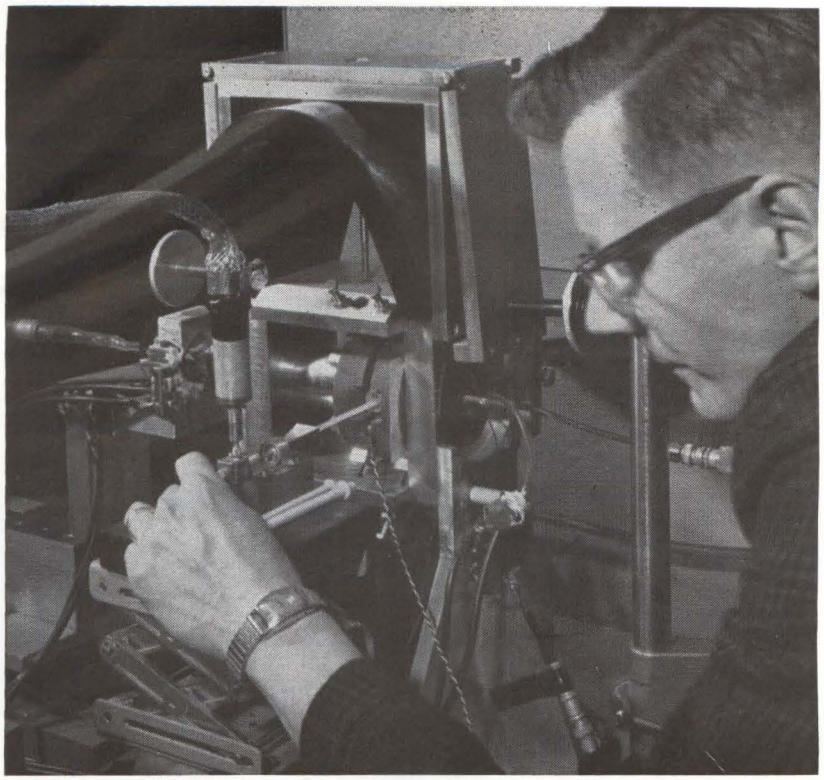
Power output levels obtained with



TORNADOTRON *detection system—Fig. 5*



OUTPUT SPECTRA *examples— Fig. 6*



TUNING *a millimeter-wave detector mount to measure radiation. Output from the Tornadotron is through a dielectric waveguide*

the experimental tube range from 100 milliwatts around 30 Gc, to fractions of a milliwatt at frequencies approaching 300 Gc. These results are not considered indicative of the ultimate capability of the device for several reasons. In the present tube, designed primarily for demonstrating device feasibility, the trapping of electrons, the cyclotron pumping and the extraction of r-f energy are all performed under conditions far from optimum. A single chamber is used for the entire cycle of operation, and the design of this important part of the tube had therefore to incorporate many compromises.

FUTURE—A more advanced design of the electron trapping region is expected to result in more perfectly confined clouds of higher density and a more uniform cyclotron pumping field, allowing the pumping to larger orbit radii. This is expected to result in greatly increased energy storage in the swirling pencil beam. Perhaps even more significant improvements can be expected from a more sophisticated design of the magnetic pulsing chamber. By using structures capable of supporting resonant modes with suitable field patterns and Q values, selective extraction of energy can be achieved at a desired frequency, while other interactions can be suppressed, depending on the symmetry of the pattern and the location of the electron orbit. Under such conditions the output would be nearly monochromatic, and the energy stored in the pencil beam could be released with high efficiency while other modes are largely suppressed.

Finally, it should be mentioned that the amount of energy required to produce the pulsed high magnetic field could be reduced significantly by employing field concentrators, and the use of pulse-shaping networks would permit operation of the tube under more suitable pulsing conditions than those prevailing in the experiments.

The research reported here was partially supported by the Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, under contract No. AF33(616)-7507.

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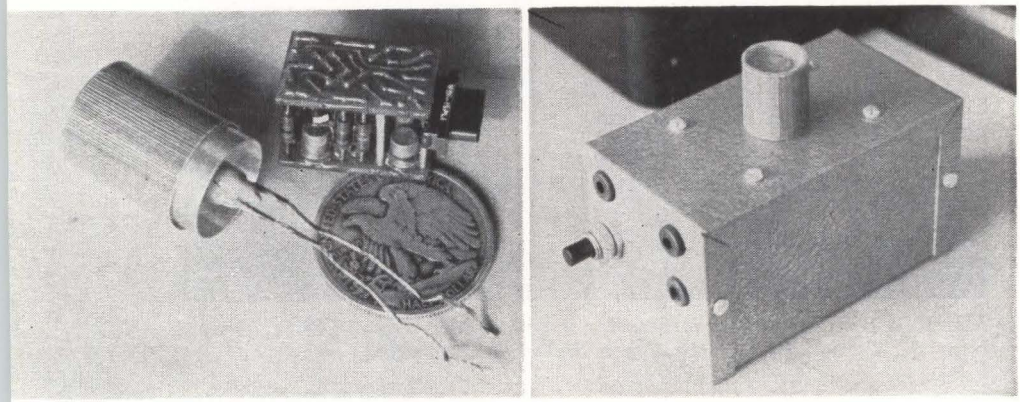
IMMUNE TO COUNTERMEASURES Infrared System

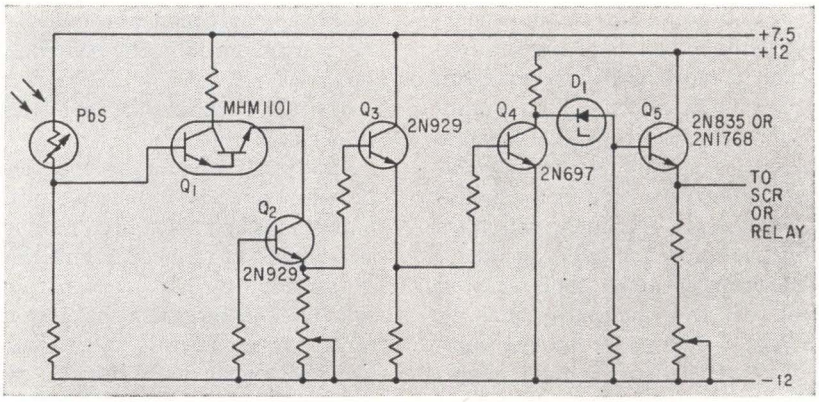
Simple, economical detector uses motion of the intruder to chop the signal.

A range of 100 feet is easily obtained, even for outside surveillance in rain

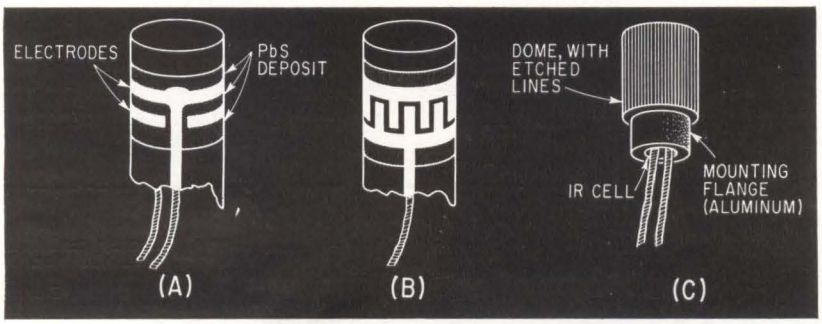
FOR DETECTING intruders in homes, businesses, and classified areas, passive infrared has important advantages. Most all other systems—ultrasonic, doppler, capactitance or inductance change—need a transmitter, which, though small and of minute power, is easily detectable and therefore a target for countermeasures. Also, harmonics can create spurious triggers and interfere with other equipment.



CIRCUIT *and detector cell with dome (left) and complete detector with batteries. Housing is larger than needed*



MOST OF THE *circuit gain comes from the darlington transistor. High negative feedback provides stability—Fig. 1*



SIMPLE *PbS cell (A) gives satisfactory performance but sensitivity can be increased by electrode design (B). Cover for detector cell (C) has etched lines to chop the signal—Fig. 2*

In a passive infrared detection system, the intruder himself is the transmitter, as all objects above absolute zero radiate electromagnetic energy. The temperature of human blood, 98.6 F, represents a wavelength of approximately 9.3 microns, which is readily detected by a photoconductive cell. The detector shown in the photographs has no moving parts, a volume of about two cubic inches, and a drain of less than ten milliamperes; a small battery or power supply adds another two cubic inches while the alarm or display is a separate device.

The optics were designed for an indium antimonide cell, but an inexpensive lead sulphide unit also works well. Omnidirectional surviellance is obtained with the cylindrical dome; etched lines on the dome chop the signal as the intruder moves across detector field.

OPTICS—As a limited range is desirable, receiver sensitivity can be low. Cell optics consist simply of an ir dome with grid lines and three dielectric films on the inside of the dome for ir filtering. Range is approximately 50 feet but may be increased to compensate for fog or rain in outside installations.

The ir spectrum of interest in detecting people and animals extends from 2.3 microns (μ) (filter cutoff) to 11 μ. Although PbS cell response is nil for 5-μ and longer wavelengths, enough energy is provided by spectral distribution to give a usable signal in the cell response range. Also, the target is not a black body and the radiating surfaces of skin and clothes vary in efficiency. Response of the room-temperature cell at its peak (2.45 μ) is down about 1,000 times with

August 16, 1963

Detects Intruders

By W. E. OSBORNE, Staff Scientist, Gilfillan Corp., Los Angeles, Calif.

respect to a black body at 9.3 μ ($w_\lambda/w_{\lambda max}$, w in watts) but response at 3-μ is still $\frac{1}{3}$ of maximum and the available signal is ten times stronger at this point. Net loss at 3-μ is therefore 54 db, which is satisfactory with a modern PbS cell. About 0.1 percent of the energy from a 9½-μ target is available as signal.

AMBIENT EFFECTS—Intruder temperature differs from ambient and clothing will be cooler than skin; if face and hands are covered, a response to about 80 F or 9½ microns will be required. On cold days, this could become 30 F or 10½ μ. An intruder moving at one foot per second 10 feet away would generate 6.25 cps with a 4 inch circumference dome etched with 100 lines per inch. The number of lines per inch can vary from about 25 to 400.

No preamp bootstrapping is necessary to raise receiver input impedance, Fig. 1, and negative feedback gives high stability. Average dark resistance of a PbS cell will vary from about 100,000 ohms to 2 megohms or more, so a reasonably good input match is mandatory to avoid further losses. Because of the low signal frequencies, all stages are directly coupled. Tuned stages are not possible so high quality components with low leakage currents were used. Sensitivity, while only fair by the standards of larger equipment, is adequate. The output signal current, at all anticipated frequencies, is designed to trigger a 2-ma relay or fire a silicon switch.

FALSE ALARMS—Many improvements could be made to meet special requirements. Assuming the gridline or automatic scan feature is retained, positioning data could be obtained from multiple cells, each individually collimated, with either a time-sharing switch or separate receivers. In a larger receiver, range-gating and noise-gating could be added, together with frequency multipliers that would simplify design and reduce cost. To prevent false alarms in outdoor operation from falling snow or blowing leaves, a spectral cut-off above about 10 μ could be obtained with a fourth interference filter. This would, however, be marginal on relatively warm items such as leaves or dust.

The PbS cell used, Fig. 2, was designed with lowest possible resistance consistent with high sensitivity. Uncooled dark resistance of the cell was 97,000 ohms and amplifier input impedance at 100 cps was approximately 115,000 ohms. Gold electrode leads were used in the cell, which contained two circular electrodes sublimed in an evacuated envelope of arsenic trisulfide (As_2S_3). This material was also used for the ir dome. It has a spectral transmission of almost 60 percent (for 2 mm thickness) at the maximum required wavelength of 11 microns and can be machined easily.

INSB CELLS—Detector cells of the PEM (photoelectromagnetic) type of indium antimonide may also be used uncooled, and improve performance by about 100 percent, since response peaks at over 6μ. Relative sensitivity is lower than PbS by approximately 2.2 orders of magnitude, but the signal energy from a human target to an InSb cell is more than a hundred times greater. The low impedance of the PEM InSb cell (30 to 200 ohms) is also attractive but its price of up to $100 (against $10 to $25 for commercial PbS types) is unsuited to small home or business alarm installations, although satisfactory for military, bank and similar security applications.

To reduce false alarms from blowing objects in outside areas, horizontal etched lines on a second ir dome can feed another cell and a second MHM 1101 transistor. The amplified signal is rectified to place a holding bias on the main receiver. Objects blowing or falling in within about 45 degrees of vertical activate this hold, and prevent about 70 percent of false alarms.

RAIN—Heavy rain (from 0.1 to 2 inches per hr) over a detection path of 20 meters cuts down the signal to 0.152 percent of the original. At 9.3 microns, the energy radiated by a human being neglecting clothing is approximately 5×10^{-2} watt per cm². Assuming one square meter for total skin area, ir radiation is 500 watts total. Estimating an attenuation factor of 20 for further scattering, 100 for clothing (with consequent shift in wavelength), and 1,000 for spectral distribution losses, noise level at the receiver is 2.5×10^{-8} watt per cm² for a target at 20 meters. With a signal to noise ratio of 2 to 1, required receiver sensitivity is 5×10^{-8} watt per cm², which is low by normal standards.

No optical gain is presently used in the receiver (although it could be introduced) and thus represents a large loss. While the sensitivity with optics is approximately 1×10^{-11} watt per cm² (D^* of 2×10^{10}), the level without is nearer 7×10^{-8} watt per cm². This still gives adequate sensitivity for operation in rain of up to 100 feet or more. Cooling the detector cell with CO_2 would give an additional gain factor of 200, which includes the additional signal available from extended wave-length response.

LET INFRARED DO IT

We are all walking infrared transmitters, operating at about 500 watts and transmitting on a wavelength of about 9.3 microns. This could be bad news to burglars, spies and curiosity seekers, if the victims of their activities have an infrared intruder alarm system. Even a simple system can be effective

SCHMITT TRIGGER DRIVES

APPLICATIONS

This d-c trigger circuit can be used to drive loads such as high-capacitance coaxial cables. The low output impedance of the circuit reduces the distortion of the output pulse that can be caused by low-impedance loads

NORMALLY, it is difficult to drive low-impedance loads from a Schmitt trigger, due to the relatively high output impedance associated with common-emitter-connected transistors. In a coaxial-cable driving application, it was necessary to shape the incoming signal and drive a high capacitance cable with a good rise time and a minimum of components. A new form of trigger circuit had to be developed to conform with the requirements. Although the new circuit is derived from the Schmitt trigger, it has important differences. These are: lower output impedance, fewer basic components and continuous conduction of the output transistor.

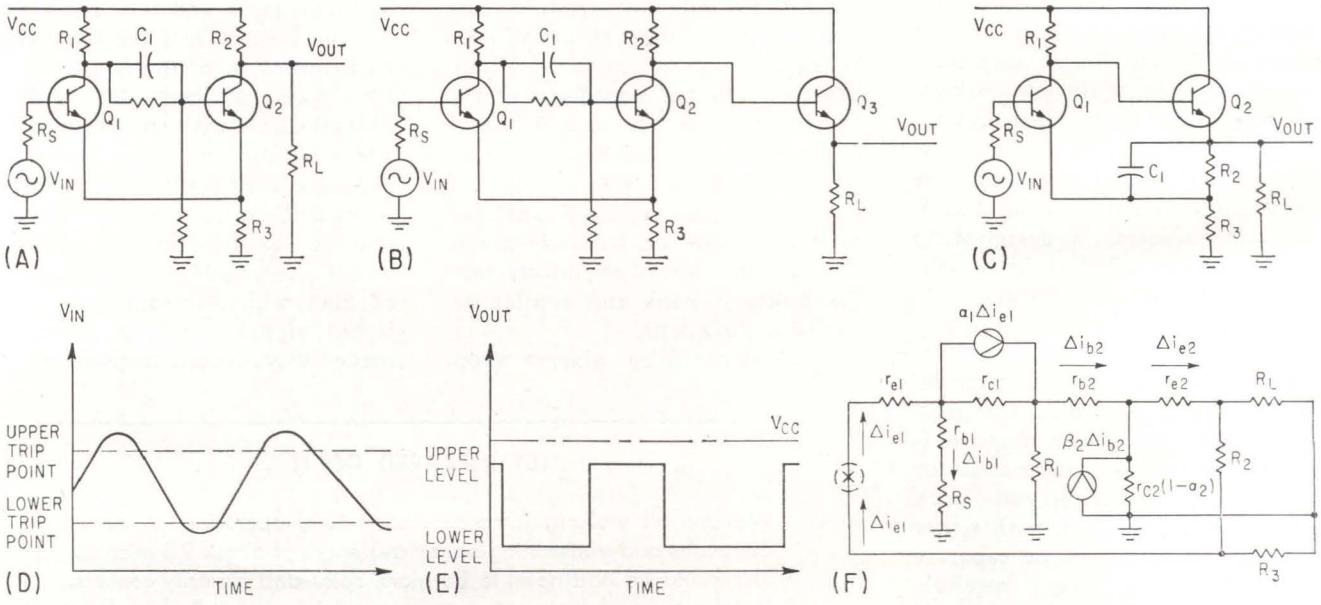
Figures 1A and 1C compare the conventional Schmitt circuit with the new trigger circuit. Both circuits perform the same function, except for the difference in output impedances. The more conventional way of reducing the output impedance of a Schmitt trigger would be the addition of an emitter follower as shown in Fig. 1B. This has the disadvantage of a third transistor and increased drain on the power supply.

CIRCUIT APPROACH—The new approach (Fig. 1C) eliminates the extra emitter follower, incorporating it into the original Schmitt circuit. The output is taken from the emitter of Q_2. Since there is no impedance in the collector of Q_2, the transistor performs as a conventional emitter follower. The circuit is bistable and regenerative switching between states takes place. Since Q_2 is in the active range of operation in both stable states, the output impedance always remains low (about 30 ohms) and does not vary appreciably throughout the different parts of the triggering cycle of the circuit.

The input and output waveforms of the new trigger are shown in Fig. 1D and 1E respectively. When the voltage at the input exceeds the upper trip point (utp), regenerative switching takes place and the output voltage drops sharply to its lower level. When the input voltage swings below the lower trip point (ltp), regeneration takes place again and the output voltage rises to its upper level (note that the circuit is an inverter).

When the input voltage is below the utp, the emitter of Q_1 is at the utp, which is determined by R_2, R_s and V_{cc}. Since the base of Q_1 is negative with respect to the emitter of Q_1, Q_1 is cut off. As the input voltage rises above the utp, the base of Q_1 becomes forward biased, bringing Q_1 into the active region. The collector potential of Q_1 starts to drop, dragging the base of Q_2 with it. The emitter of Q_2 follows its base and drops Q_1 emitter potential lower. This has the effect of further turning on Q_1. Regenerative action follows, until Q_1 is saturated.

When the input voltage drops below the ltp, which



CIRCUITS *shown are the basic Schmitt trigger (A), Schmitt trigger with emitter follower (B) and new d-c trigger (C). Input (D) and output (E) of d-c trigger, whose equivalent circuit during regeneration is shown in (F); arrows show current direction during turnoff—Fig. 1*

is set by R_1, R_3 and V_{cc}, Q_1 is brought into the active region again. The base of Q_1 starts to drop below its emitter voltage, tending to turn Q_1 off. The collector potential of Q_1 starts to rise toward V_{cc}, dragging the Q_2 base up. The Q_2 emitter follows its base, raising Q_1 emitter potential, thus increasing the reverse bias on Q_1. Regeneration occurs, until Q_1 is cut off.

ANALYSIS—The equivalent circuit of the d-c trigger circuit is shown in Fig. 1F during regeneration. To determine that regeneration does occur, and the relationship of the parameters for switching action, the feedback loop is broken at point X. For regeneration, the gain around the feedback loop has to be at least one. Therefore, if Δi_{e1} on one side of the break is equated to Δi_{e1} on the other side, the relationship of the parameters for regeneration can be determined.

After making a few simplifying assumptions and then using conventional circuit analysis techniques, the equations around the loop reduce to

$$\Delta i_{e1} = \frac{\Delta i_{e1} R_1 R_3 R_L}{R_2 [R_3 + R_s/(\beta + 1)] [R_2 + R_L]} \qquad (1)$$

Equation 1 defines the circuit completely for regeneration.

To start the design, the following has to be specified: load resistance R_L, supply V_{cc}, the utp, the source resistance R_s and the output voltage swing. The sum of R_2 and R_3 should be smaller than R_L, to reduce the dependence of R_1 on R_L. Resistor R_1 should be as small as consistent with the switching requirements as expressed in Eq. 1 to keep the upper level of the output voltage as close to V_{cc} as possible.

During switching, Q_1 is in the common-base configuration, since the feedback is applied to the emitter. Capacitor C_1 has to supply the overdrive current needed to speed up switching time. If C_1 has too large a capacitance, it will cause oscillation, because of R_s. Too small a value may not be effective. The best way to select C_1 is to calculate its approximate value from Eq. 2 and then determine the optimum value empirically. Thus

$$C_1 = \frac{(V_{cc} - V_{ce1})(N - 1)\,\Delta t}{(R_1 + R_3)(V_{cc} - utp)} \qquad (2)$$

where N is the necessary overdrive to switch the transistor in time Δt. Capacitor C_1 should be chosen as small as possible, since maximum repetition rate of the trigger depends mainly on the time constant of C_1R_2.

If source resistance R_s is small, the common-base input impedance of Q_1 is low. Since this input impedance shunts R_3 to ground, R_3 has negligible effect on the output impedance. The output impedance can be approximated as the parallel combination of R_2 and $R_1/(\beta_2 + 1)$. Since Q_2 is always in the active region, this beta remains essentially constant and so does the output impedance. The output impedance thus obtained is low, since β_2 is usually high.

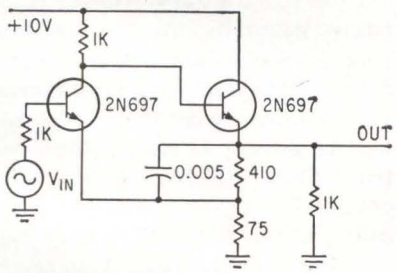
Component values are shown in Fig. 2, while the significant characteristics are listed in the table. The output impedance is low (26.6 ohms), while the rise and fall times of the output are 2.75 μsec with a 1,000-ohm resistive load. When the output is loaded with a 1-μf capacitor, rise time is 100 μsec, indicating the circuit's ability to drive long coax cables.

Joseph Gaon's suggestions are gratefully acknowledged.

LOW IMPEDANCE LOADS

This direct-current trigger circuit is similar to that old standby, the Schmitt trigger circuit. But it is designed for low-output-impedance applications

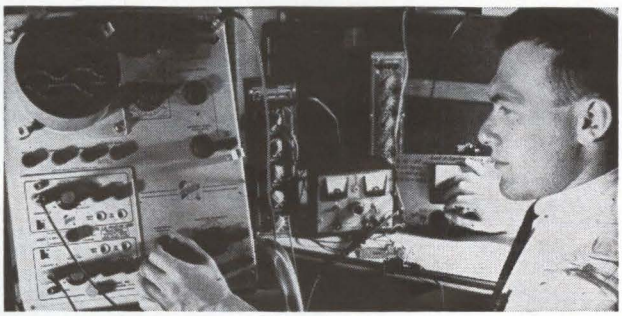
By GEORGE KLEIN, Standard Instrument Corp., New York, N. Y.



D-C TRIGGER *has low-impedance output—Fig. 2*

CIRCUIT CHARACTERISTICS

Voltage Swing	8.5 v
Upper Trip Point	2 v
Lower Trip Point	1.6 v
Hysteresis	0.4 v
Switching Time	2.75 μsec
Max Rep Freq	75 Kc
Output Impedance	26.6 ohms



CRO TRACES *show input (top) and output (bottom) of d-c trigger circuit. Output risetime is 90 μsec; output is loaded with a 1-μf capacitor*

REMOVING THE BOTTLENECKS

Computers and humans communicate in such radically different ways that problems arise when they have to communicate with each other. A question about Joe Doe's pay increase must be translated to punched card before the computer can understand it, and then the process has to be reversed before Joe Doe sees whether he can afford a down-payment on a new car. If he could talk directly to the computer the translating processes could be automated, eliminating card-punching.

Divot is a prototype of such a translating machine

Now a Talking Computer Answers

Voice system can be tied in with digital computer to give verbal results of are picked-off according to a digital code. Fifty simultaneous messages up to 13

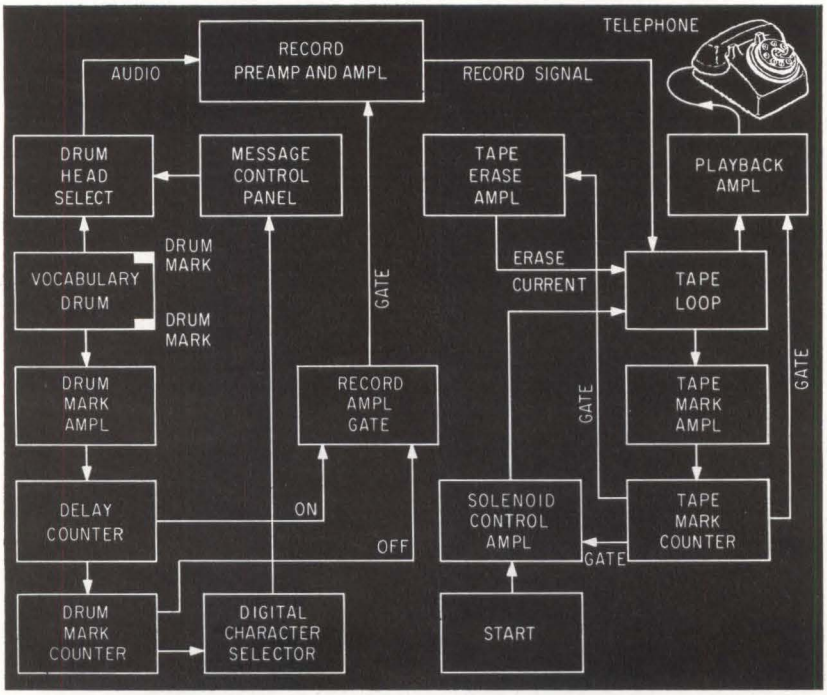
By L. H. LEE and R. B. MULVANY, IBM Advanced Systems Development Division, San Jose, California

MANY BUSINESSES would welcome peripheral computer equipment with voice output in response to simple problems, instead of printing the answer on punched-tape. The production manager could have his query about stock level answered directly at his desk telephone, instead of waiting for the printed answer to arrive by messenger. Credit and stock-quotation services, too, could offer clients more efficient response to queries if the computer answered questions directly. One such system, called DIVOT for digital-to-voice translator is being developed by IBM at San Jose, California. Promising divot applications are characterized by relatively short messages, vocabularies limited to a few hundred words, and large numbers of records that change frequently.

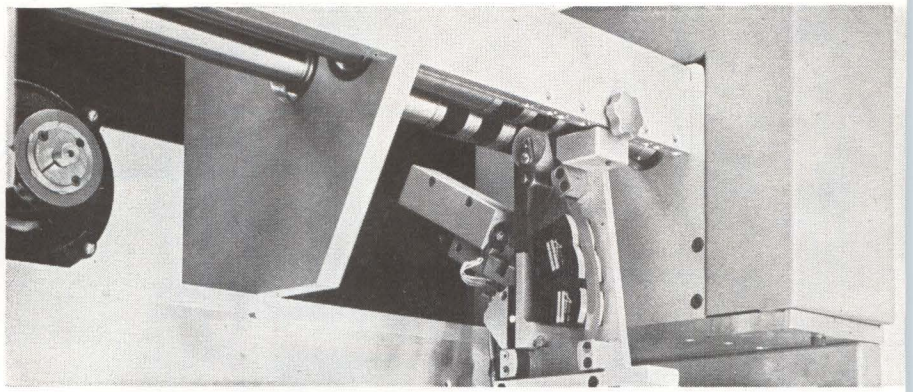
To query the system, an inquirer dials the address that contains the program to compose the answer to his specific request. The program is read into divot where it controls the selection of audio signals from a prerecorded vocabulary and transfers them at high speed to a playback buffer. The composed message is transmitted back to the inquirer almost immediately. The process from dialing to reply occurs in a matter of seconds.

Present digital-to-voice translators generally use a slowly revolving vocabulary drum. Digital data selects and plays back a track (vocal word) with each revolution of the drum. A sequence of control digits (hence tracks) thus creates a spoken message. Typically, units of this type have been real-time composition systems, responding to a single inquiry at a time. However, by modular extension using several drums, they can be made to handle multiple inquiries simultaneously. Such systems generally require a separate translation channel—consisting of a character-register, selection-network, amplifier, and possibly a vocabulary drum—for each independent output.

In many applications, dozens, and sometimes hundreds of independent inquiries must be an-



DIGITAL CODE *in control panel selects audio words from drum, records them on tape, then has the sentence played back over telephone*



MODULAR *construction of buffer tape unit permits quick removal for maintenance. Tape is shown in position around drive capstan waiting for solenoid to press it against a drive shaft*

Inventory Inquiries

calculations. Spoken words stored on magnetic drum words long can be assembled and fed to separate telephones

swered simultaneously. In these applications, real-time systems are inevitably cumbersome and expensive. Because divot composes messages at high speed, a single translation channel can serve many independent output lines with considerably less hardware.

In the laboratory model of divot, a single composition channel—consisting of a character register, decoder and vocabulary drum—provides 50 simultaneous outputs through a message buffer for every channel. The buffers are two-speed tape units onto which the individual words are assembled at high speed then played back at low speed.

In the block-diagram (left), the message control panel is a register containing the digital code for selecting specific sentences from the vocabulary drum. The control code can be set up manually in message control panel; in a computer application the control code would be generated by the computer in response to an inquiry.

Audio words specified by the control digits in the message control panel are read from the vocabulary drum and transferred at about 150 words per second to a tape loop traveling at high speed. When message assembly is complete, the tape loop is slowed to one-fiftieth of its recording speed, ready for playback to the inquirer at normal speech rates.

DIVOT OPERATION—When a message has been set up in divot's message control panel and the start button is pressed, one of the buffer's tape loops is accelerated to its higher speed. When a timing mark on the loop is sensed, the tape-mark counter registers a ONE, the erase amplifier is gated on, and the playback amplifier is gated off. Six drum marks (three drum revolutions) are now counted by a delay counter, allowing the tape loop to reach its stable speed of 200 ips. A drum-mark counter next registers a ONE; and the tape-loop record amplifier is gated on.

Sensing the ONE in the drum-mark counter, the character register releases the first character of the message-specifying-code to the drum's head-selection network and the first audio word is read. The audio signal from the drum is amplified and then recorded at high speed on the tape loop.

After half a drum revolution, a second drum-mark pulse advances the drum-mark counter to TWO. The character register releases the second character set up in the control panel to the drum head-selection network, and the second word of the message is read out, amplified, and recorded on the tape loop . . . and so on until the entire message is assembled. When the drum-mark counter reaches 14, a 13-word message has been assembled, and the record amplifier is gated off.

The timing mark on the tape loop is sensed a second time when the tape-loop has completed a revolution at high speed and the message has been recorded. The tape-mark counter now advances to TWO, the erase amplifier is gated off, and the playback amplifier is gated on. The tape loop is switched from high to low speed and the message is played back to the inquirer.

When the timing mark on the tape loop is sensed a third time, at the end of playback, the tape-mark counter is advanced to THREE, the playback amplifier is gated off, and the tape loop comes to a stop ready for another message.

VOCABULARY DRUM—The laboratory model's prerecorded vocabulary is stored on an 8-inch-diameter, nickel-cobalt-surfaced drum equipped with magnetic heads normally used for digital recording.

The vocabulary to be stored on the drum is first recorded on magnetic tape for ease in editing, then rerecorded on the vocabulary drum at 90 rpm. The bandwidth of interest is 300 to 3,000 cps—the typical telephone bandwidth. Drum storage is semipermanent; further recording is needed only when the vocabulary must be altered.

Word lengths are $\frac{1}{3}$ sec or $\frac{2}{3}$ sec. Each short word is recorded twice on a single track, long words are recorded once each on two tracks. The beginning of one long-word signal is recorded 180 degrees round the drum from the beginning of the other. Thus, any combination of long and short words can be assembled without awkward gaps between words. Words of

AUTHORS *Lee (left) and Mulvany discuss the tape buffer module. Unit incorporates three magnetic heads, photoelectric tape-mark detector and solenoid for positioning drive-wheel against fast-or-slow powershafts*

three and more lengths can be accommodated by extension of this technique.

During message composition, the drum operates at 4,500 rpm (50 times real-time recording speed), raising the recording bandwidth from 300-to-3,000 cps to 15 Kc-to-150 Kc. Subjective tests of recording on the drum revealed no noticeable wow, flutter or distortion, and the audible signal was highly noise free.

Signals read from the drum are amplified by three stages of differential amplification, preemphasized and mixed in the correct amount with the a-c bias signal in the tape-loop record amplifier. As a result, head-selection pulse peaks —about six times greater at the drum than audio peaks—are reduced to negligible levels on the tape loop.

TWO-SPEED BUFFER — Tape loops were selected as the most-efficient means of providing a multichannel, two-speed audio buffer (photo previous page), on which the message could be assembled at high speed from the drum. Tape transports are modular and can be removed individually from the buffer for ease of tape replacement or maintenance.

To make full use of its single high-speed translation channel, divot has independently operable two-speed tape-loop transports equal in number to the ratio of the input and output speeds of the buffer. Thus, a complete system with a message assembly speed of 50 times playback speed requires 50 independently operable tape transports. The buffer of the laboratory model can accommodate up to 16 transports, all driven by two common capstan shafts at the 50:1 speed ratio.

To minimize tape and head wear, the tape heads were designed to create an air bearing during high-speed message assembly. At 200 in. per sec, the tape operates with about 60 microinches of air-film separation from the tape heads.

Tape-loop speed is determined by a solenoid-controlled moving pinch pulley, which brings the tape to bear on either of two continuously rotating (high and low-speed) capstan shafts. When not in use the pulley is held in its centered, or tape-stop position.

A length of aluminized video splicing tape, serving as the tape timing mark, reflects light to a photocell; the resulting signal is amplified and shaped for logic control functions.

Uniform tape tension is maintained by a vacuum column. The tape transport of the laboratory model can accommodate tape loops from 20 to 80 inches long.

The a-c-bias-and-erase technique employed has the important advantage of higher inherent signal-to-noise ratio; however, disadvantages of the a-c technique which are acceptable at lower frequencies grow with higher frequency operation. These disadvantages include the expense of fabricating the heads from thinner laminations to reduce head losses; higher current, voltage and power requirements; increased circuit complexity; and resonance resulting from head and stray capacitance.

These disadvantages are not insurmountable, but their existence opened the question of using d-c for erase and record-bias. When direct current was employed, voice quality remained good but signal-to-noise ratio for sine-wave signals dropped to 36 db from the 50 db obtained with a-c bias.

At the tape loop's 200 in per sec recording speed, a 5-sec message consisting for example of fifteen $\frac{1}{3}$-sec words, can be composed and recorded in 100 milliseconds. When message assembly is complete, the tape loop is slowed to 4 in. per sec for playback. During the 5 seconds required for playback, 49 other messages are composed on 49 other tape loops. Thus, with one composing channel, consisting of one character register, one decoder and one vocabulary drum, a continuous flow of 50 independent messages can be transmitted simultaneously.

PERFORMANCE—Frequency response of the laboratory model extends well beyond the 300 to 3,000-cps pass band of telephone lines. The measured s/n ratio was 30 db and intermodulation distortion varied between 15 and 20 percent. Wow introduced by the two-speed tape transport was 0.05 to 0.15 percent, and flutter 0.2 to 0.3 percent. The level of performance is the result of a limited effort and could be improved.

To evaluate the intelligibility of divot's output, 80 nine-word messages were transmitted over telephone lines to 30 test subjects. Subjects' comprehension of tape recordings of messages composed by divot and the same messages recorded directly on tape from live dictation showed no statistically significant differences. In both cases, fewer than one percent of the messages was reported incorrectly by the test subjects, and error rates per word averaged about 0.1 percent.

British Develop New VLF Navaid

Using existing stations, system provides 6,000-mile navigation range

By DEREK BARLOW
McGraw-Hill World News

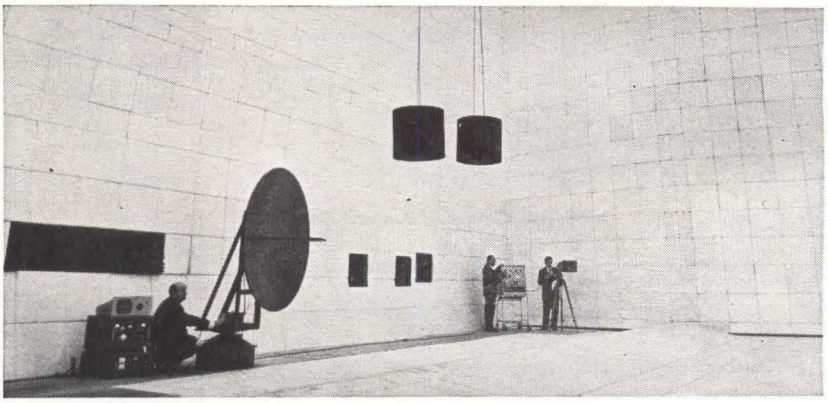
LONDON — Radio propagation studies conducted over the past two years by the Royal Aircraft Establishment at Farnborough prove the feasibility of a VLF navigation system that provides high-accuracy position indication up to 6,000 miles. Besides its long-range capability, the system has other advantages as a commercial navaid in that it uses existing VLF transmitters in the 16-to-20-Kc band, and does not require special ground equipment. By receiving a number of stations in multichannel receivers, the system uses redundancy to compute confidence limits attributable to its position estimate.

The long-range capability arises from the excellent propagation characteristics of VLF continuous-wave transmissions. Pulse systems such as Loran C are not practical for long-range VLF operation since the pulses must be short enough for reliable separation of ground and skywaves.

The RAE system measures the phase of the signal from each ground station and continuously compares it with that of an airborne high-stability oscillator (one part in 10^9). Tests on a Comet aircraft used VLF stations GBR (Rugby) and NAA (Cutler) on trial runs over the Atlantic and down to the Mediterranean. In regions where accurate flying was possible, relative errors between VLF data and the navigator's flight line were less than three miles.

AIRBORNE EQUIPMENT — The basic airborne system comprises only three units: stable oscillator, multichannel receiver with digital output, and computer. At the aircraft's starting point, the initial

Radio Test Chamber for Agena



ONE OF THE LARGEST *shielded chambers in the U.S., this new facility was built by Lockheed Missiles & Space Co. in Sunnyvale, California for checking out the radio transmitters of an entire Agena satellite with all its associated gear. It was required because the satellite will use simultaneously five or six telemetry carriers, two radar frequencies, one or two command frequencies, plus six or more frequencies required by the payload. The 30 × 60 × 30-ft microwave anechoic chamber will permit checking out all the satellite's frequencies without echo or interference*

phase reading from each ground transmitter is taken as zero reference. Increments in the aircraft's flight are determined from the continuous phase change occurring between the received inputs and the oscillator, measured by using each receiver channel in a self-balancing servo system. The incoming signal's phase is compared with the oscillator output; any phase error is digitized and adjusts countdown circuits between the oscillator and receiver to null the error, at the same time giving an output indication of the phase difference within 1/20 wavelength.

A stored-program computer converts the phase readings to distance-to-transmitter values, from which a fix is plotted. A fix is possible with the two concentric circle intersections of the phase measurements from two stations. Using more than two stations introduces redundant data, used to assess the accuracy of the fix.

An iterative program forms an initial estimated position, and then converges the normalized error between the estimated and actual phase readings to a minimum by adjusting the initial position estimate. Byproduct of this operation is a compatibility figure that checks for consistent system operation, displayed to alert the pilot of possible phase slips. The compatibility figure could also be used to trim the oscillator to minimize constant errors due to oscillator shift.

VLF VARIATION—A major problem has been countering errors introduced by diurnal variations in propagation. VLF propagation resembles a waveguide mode, bounded by the ground and the ionosphere. Diurnal wandering of the ionosphere alters propagation velocity, introducing errors of up to seven miles between night and day readings. These errors can be compensated for with RAE's Mercury computer.

Still to be resolved are Arctic path variations, involving long periods of day and night, and large differences in local time between ends of relatively short great-circle routes.

System display has yet to be developed. One idea is to feed the

flight plan into the computer before takeoff; any deviation from the flight plan could then be displayed to the pilot as a correction signal.

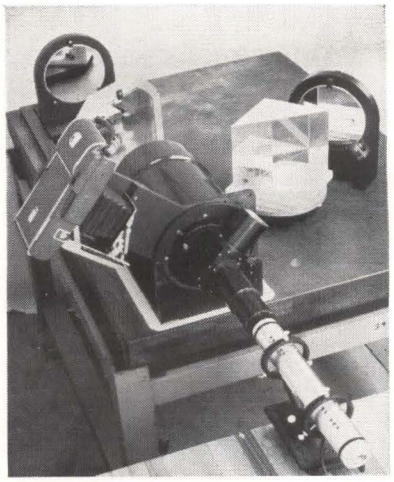
The RAE development team feels the system can provide a basis for a unified navigation system giving the pilot position in longitude and latitude, an estimate of the position indication reliability and an estimate of the individual data reliability from each unit in the system.

Gas Laser Applied to Inspecting Large Optics

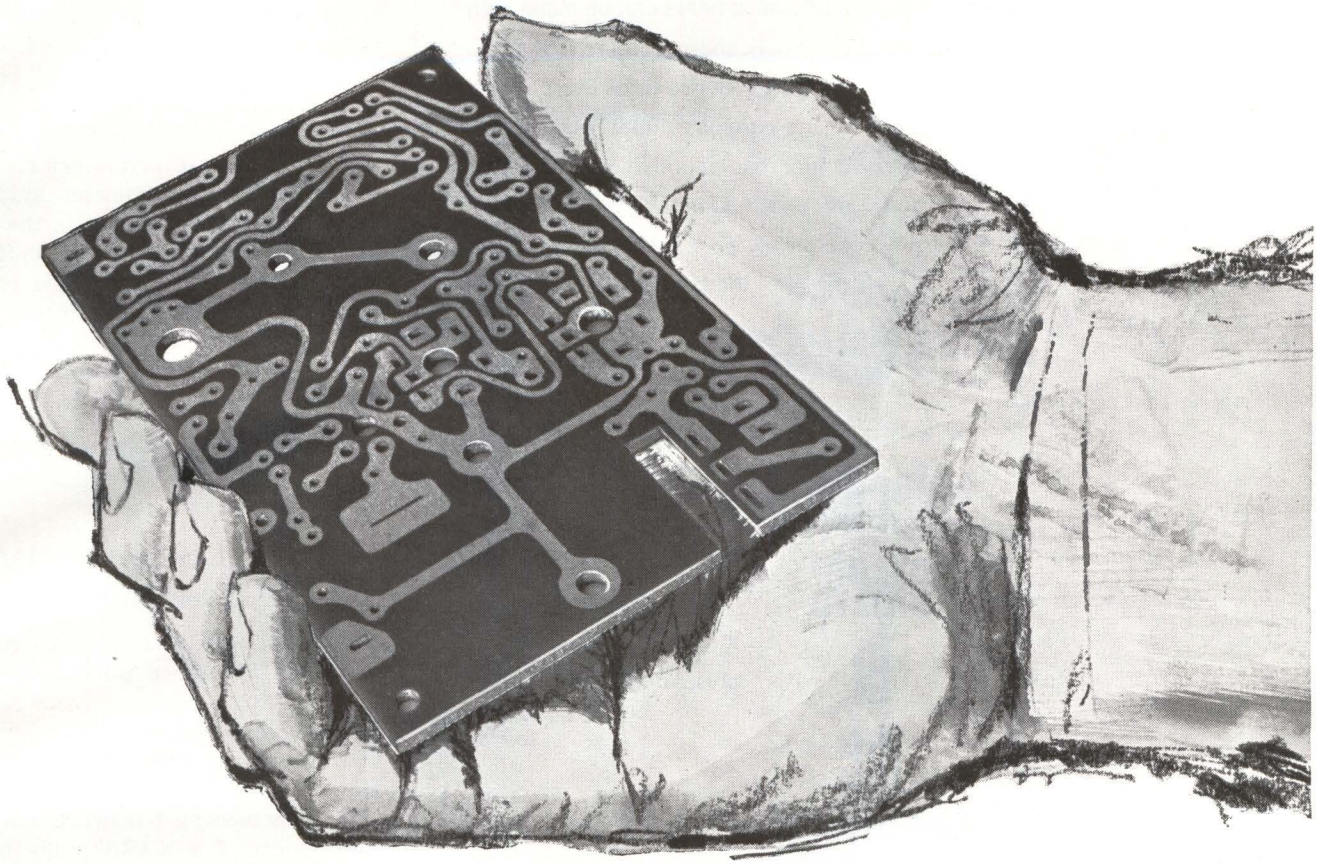
THE LASER'S highly coherent light output is being applied by the Perkin-Elmer Corporation in Norwalk, Conn., to production inspection of large optical items, and evaluation of thick lenses and prisms.

Using a Twyman-Green type interferometer and a gas-phase laser as a source of brilliant continuous light, fringe patterns indicative of optical homogeneity have been observed in paths as long as 14 inches in large prisms. Previously, mercury arc lamps were used, which did not permit inspection of glass elements thicker than about an inch.

The Perkin-Elmer laser operates at 6,328Å. The narrow red beam is



CONTINUOUS WAVE *gas laser in ring mount, foreground, emits beam passing through interferometer and then reflected through prism under test, right. Optical fringes are observed in eyepiece on interferometer*



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controlled with a neutral-density filter and an intensity control. Optical qualities of the tested component are indicated by the amount of parallelism of light fringes observed in the interferometer.

The laser-interferometer system can check local variations in the index of refraction or in optical homogeneity of a single glass component or of an entire optical assembly, without using a known or perfect compensating disc in a comparsion light beam as was done formerly.

Astronaut Sensor System Aim of Research Program

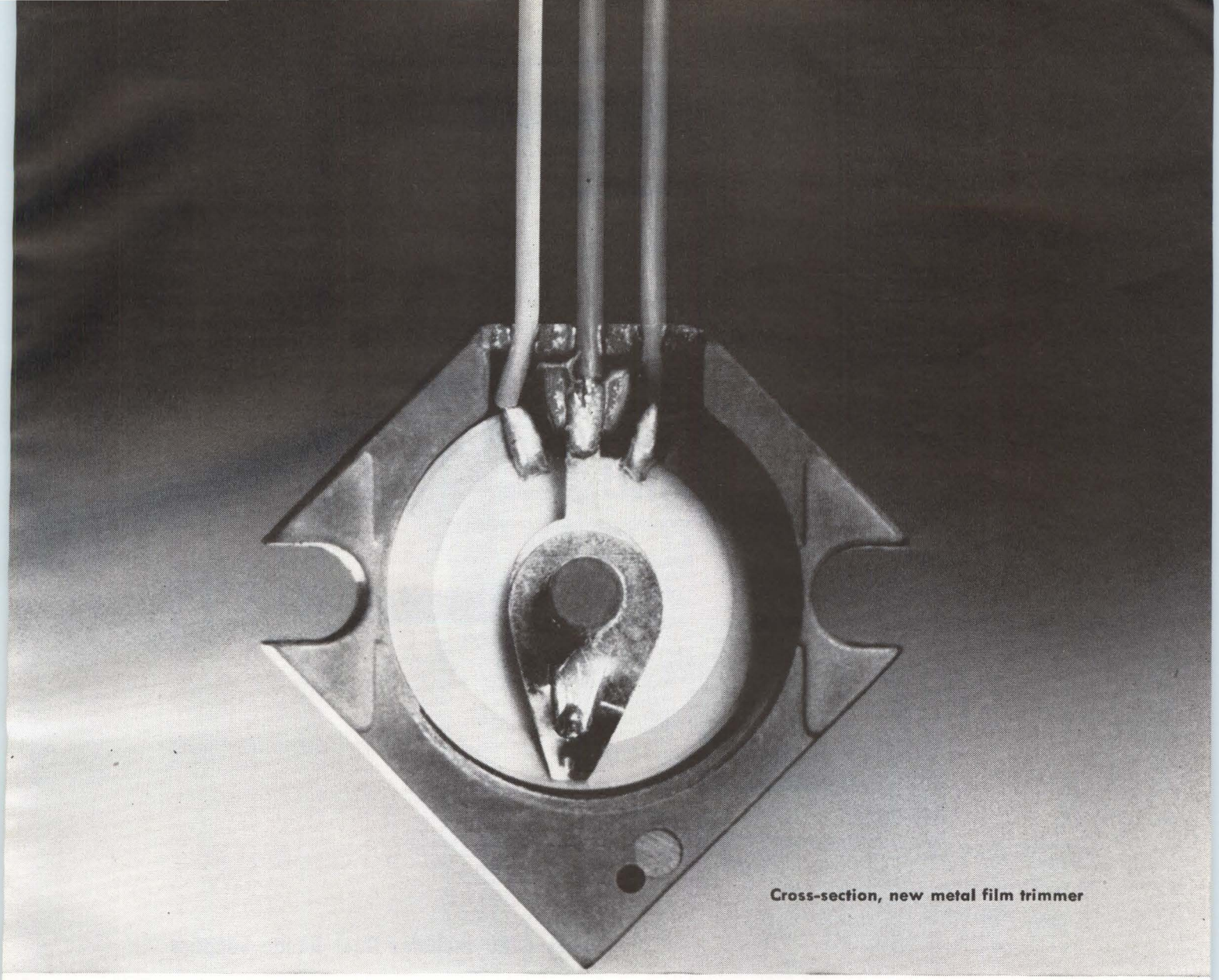
OPTIMUM IN-FLIGHT physiological state for aerospace pilots and astronauts can be maintained by feedback of data picked off by sensors attached to the bodies of personnel. How to combine human reactions and compensating hardware will be the subject of a NASA study program awarded to Lear Siegler, Inc., of Santa Monic, Calif. Total cost of the study, to be monitored by NASA's center at Edwards, is expected to exceed one million dollars.

Named psychophysical information acquisition processing and control system (PIAPACS) it will sense and record physical functions of both pilot and vehicle. It is expected that computer controls, working on this information, will modify environment to attain an optimum condition for pilot effectiveness.

An important point in the program is the development and construction of a unique sensor system that will be mounted in the pilot's headgear and suit. It will replace the present uncomfortable system of attaching sensors to the pilot by tapes and internal instruments.

Besides the ultimate control function, the data provided by the sensors can be recorded and processed for computer reduction. It can be immediately displayed to show the pilot's psychological and physical condition from moment to moment.

Flight experiments will be directed by Dr. Eugene B. Konecci, director of Biotechnology and Human Research at NASA.



Cross-section, new metal film trimmer

New infinite resolution trimmer has wire TC

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If you want to trim down to absolute null, this new ½″ square Micropot metal film trimmer gives you infinite resolution with ultra-low temperature coefficient comparable to the best wirewound trimmers. Consider:

INFINITE RESOLUTION to make all your circuit parameters exact.

LOW TC Temperature coefficient is only 50 ppm/°C nom. (Compare this to other infinite resolution trimmers with TC's of 500 and 800 ppm.)

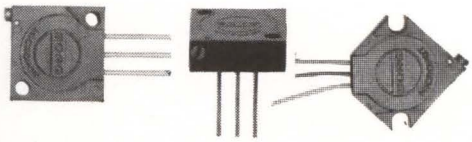
HIGH TEMPERATURE —65°C to 175°C.

HIGH RELIABILITY metal film is deposited on ceramic substrate, eliminating potential catastrophic failure inherent in wirewound trimmers.

SILVER BRAZED TERMINATIONS—no fine wire connections.

This Model 2950 metal film trimmer is designed to meet the requirements of MIL-R-27208A. It is humidity-proof, dustproof, and will withstand 2,000 cps at 20 g's. Ruggedized construction includes positive wiper positioning, damage-proof clutch mechanism, and bondable Teflon leads for the most reliable possible sealing.

Now, eyes right for those engineers who want infinite resolution with unusually low TC. After scanning these specs, phone your nearby Borg distributor. Or, a note to R. K. Johnson, Sales Manager, will bring you complete data by return mail.



ACTUAL SIZES

Resistance values	500 to 20K ohms
Resistance tolerance	±10%
Power rating	1 watt at 70°C, 0 watt at 175°C
Resolution of adjustment	Infinite
Mechanical adjustment	25 turns nominal
Temp coefficient of Pot	50 ppm/°C nominal
Operating temperature range	−65 to +175°C
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Cordwood Package Gets New Tubular Ceramic Capacitors

Monolithic construction offers improved volumetric efficiency

By JOE AUER, Manager of Applications Engineering
Vitramon, Incorporated
Bridgeport, Connecticut

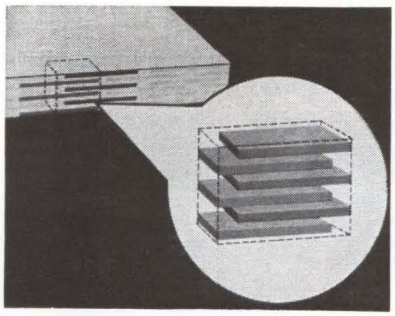
CERAMIC capacitors with volumetric efficiencies of 4.5 μF per cubic inch and capacitance of 0.01 μF are now being used for cordwood packages. Voltage rating is 100-v d-c. Capacitance change is $\pm$ 15 percent for operating range between -55 C and 125 C. Leads can be soldered or welded.

Design and techniques used in production of these units opened up the way for ceramic capacitors having a capacitance considerably larger than 0.01 μF. Preliminary designs show volumetric efficiencies slightly over 10 μF per cubic inch. Both axial and radial configurations are used. These units will be shown at WESCON, August 20 to 23.

Vitramon's solid-state miniature capacitors, called V-Lam, were developed as a result of a market survey of capacitors needed for cordwood packaging. The survey found a void which could be filled by ceramics. This area has a market potential estimated at over a million dollars a year. The survey showed that the most sought after improvements were in areas of volumertic efficiency and reliability.

Test data, compiled by Vitramon on the 0.01 μF units showed only one catastrophic failure in 256,000 unit hours of test time at 125 C, and twice the rated voltage. This corresponds to a maximum failure rate, at rated voltage, of less than 0.5 percent per thousand hours, with 90 percent confidence.

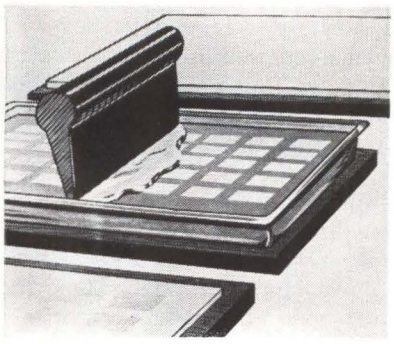
PROPER MATE — Specifications for the ceramic capacitors were met by mating a monolithic construction with one of the more stable high K ceramics. Alternate layers of ceramic and platinum electrodes are built up in a solid laminate, see photo. These layers are molecularly fused and then molded into a cylindrical form.



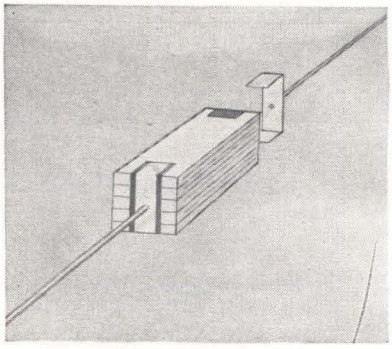
AFTER *firing, the capacitor body is precision cut in sections on diamond saw*

The choice of the dielectric narrowed down to a formulation, developed by Vitramon, that has a dielectric constant of 1,700. The dielectric strength is over 400 volts per mil. The problem was to choose an electrode compatible with the ceramic and its firing temperature of 2,500 F. Platinum, while expensive, was found to be the best material for this purpose.

Experience with ceramic film thickness of much less than 2 mils indicated difficulty in producing a consistent single film. It was necessary to screen two films for each layer of dielectric to meet re-



PLATINUM *electrode pattern of ceramic capacitor is formed in alternative layers*



LEAD *assembly is a gold-plated Dumet wire, welded to nickel clip. Unit is then molded into a cylindrical configuration*

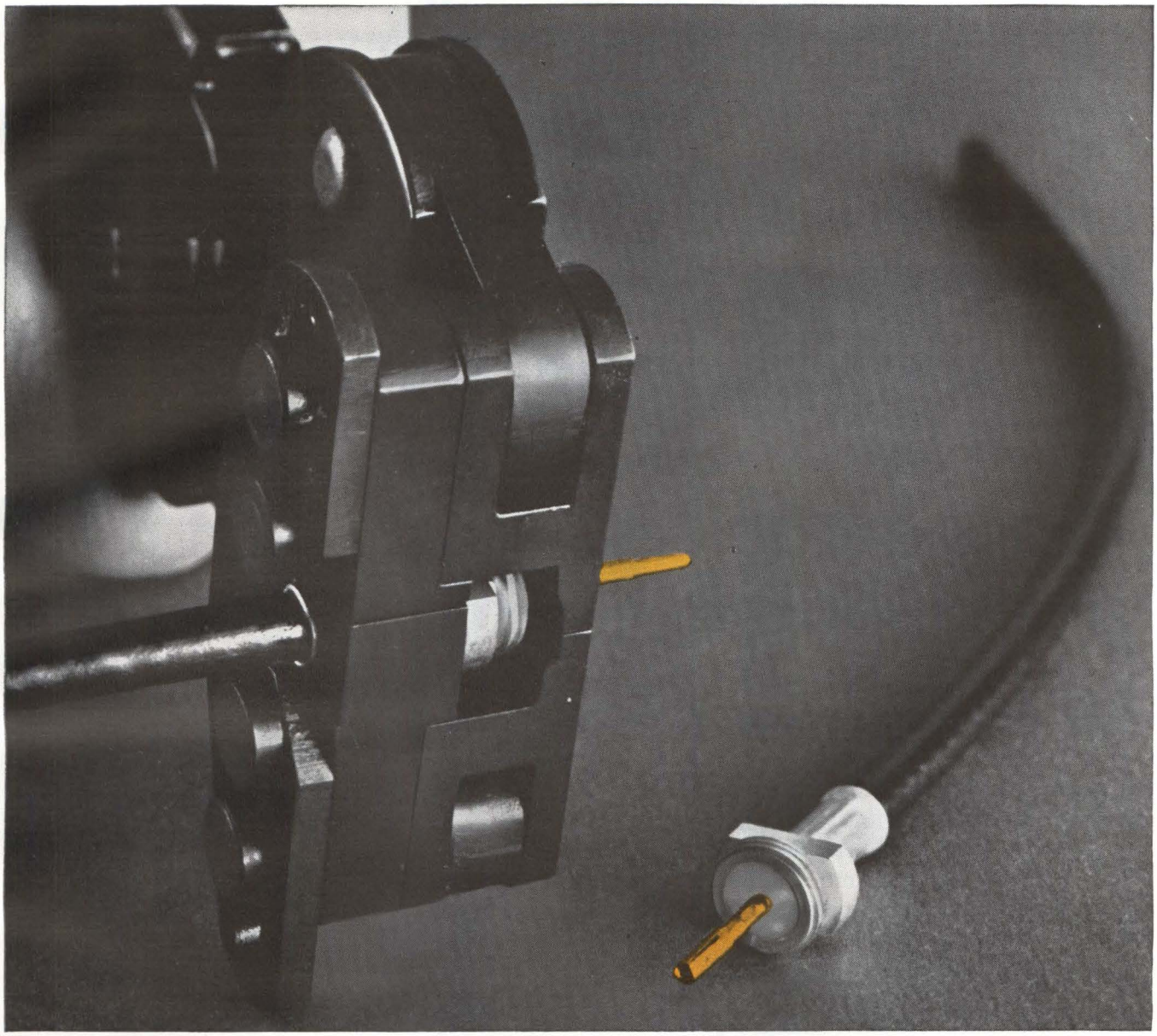
liability levels. This led to a minimum dielectric thickness of approximately 4 mils, resulting in a very conservative 100-v d-c rating at 125 C operating temperature. New units, now planned for production, will have minimum dielectric thickness of approximately 3 mils.

TERMINATIONS — Observations in weakness of termination in similar components dictated that the strength of the termination must be incorporated in the design, and must not rely on the case or encapsulation. Requirements were met by the terminal design shown in the photo. Gold-plated Dumet wire was selected for the lead material because of its suitability for either soldering or welding.

Transfer molding epoxy resin was used for encasing the solid laminate. Although the initial capital investment for manufacturing the case was substantial, handling costs are kept to a minimum. This saving is reflected in lower cost of final unit.

The capacitor body measures 0.280-in by 0.1-in max. The compactness of design, together with dimensional uniformity requirements, made it desirable to choose transfer molding as the method for making the case. This assures uniform protection, and requires minimum jigging. Minimum set up time is needed for feeding the epoxy resin in at a constant rate.

The chemical industry now has developed a number of new materials suitable for transfer molding. It is now possible to select a material with properties that will



One bold stroke kills rejects

One stroke of our matching crimping tool terminates inner conductor, outer braid and insulation support of this COAXICON★ BNC Connector . . . simultaneously! Once and done and no rejects at all! Never a reject. Never a faulty connection. Our precisely engineered tool isolates every possibility in less than ten seconds. Here's why. All three points of termination must be perfectly aligned to each crimping position or the tool will not function. The patented ratchet control will not release until the crimping dies have fully bottomed. And the precisely controlled pressures built into the tool create identical terminations time after time.

Compare this one stroke method to solder techniques. Compare it to multiple stroke crimping methods. Point by point, the advantages of the three-in-one, one stroke crimp are obvious. It's faster. It's reliable. Reject loss is nil.

Want other features? Other advantages? Our COAXICON BNC Connector is fully intermatable with comparable UG/U series connectors and available in a wide range of RG/U cable sizes. Connections are electrically stable . . . deliver maximum discontinuity at 4,000 megacycles. Voltage standing wave ratio is 1.12:1. Adapters are available in all standard types—Right Angle, Tee and Bulkhead—to meet all your design requirements.

And there are more!

Complete information, specifications, test data . . . all these are available for our BNC Series and other COAXICON Connectors for RF applications. Write today.

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assure immunity to the most severe environments.

The epoxy used to encase the laminate does not flow onto the leads. This is of primary importance for cordwood construction. Here it is sometimes necessary to weld the leads as close to the capacitor body as possible.

The new capacitors conform to MIL-C-11015C.

Navy Buys Silicon-Block Standards

PHOENIX—Eight diode gates have been accepted as standards for integrated circuits by Navy's Bureau of Ships. These computer blocks will reach industry within the next few weeks.

The new specs mark a milestone in the evolution of semiconductor standards, according to Motorola's C. L. Hogan.

The diode-transistor logic (DTL) blocks—gates, dual inverters and memory diode clusters—are covered by MIL-M-23700 (Navy). Circuits meet 6 nanosecond propagation delay per stage. Blocks were developed by Univac Division of Sperry Rand for Navy computer program. Motorola produced the units.

All eight logic circuits meet performance equivalents of semiconductor spec MIL-S-19500, Motorola says. This spec became the Department of Defense Tri-service document for transistors and semiconductor diodes. The original standard was proposed in 1956 as a general specification for transistors.

Military Calls All Capacitor Firms

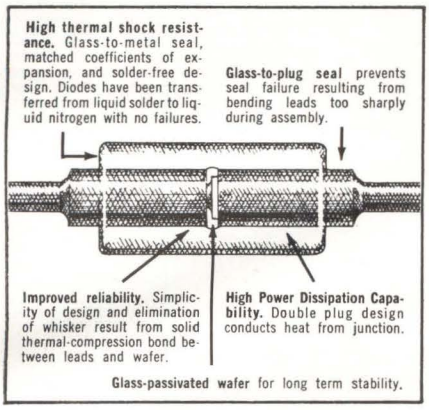
MANUFACTURERS making fixed dipped mica or fixed paper or plastic dielectrics are urged to contact the Defense Electronics Supply Center for an opportunity to have their products tested. Components should meet MIL-C-39001 for the former, MIL-C-14157C for the latter. Both specifications are dated June, 1963.

Future awards will be made only for tested and approved products.

Inquiries should be addressed to Defense Electronics Supply Center, attention DESC-EQ, 1507 Wilmington Pike, Dayton, Ohio.

NEWARK NEWSLETTER

FEATURING LATE RELEASES FROM TEXAS INSTRUMENTS

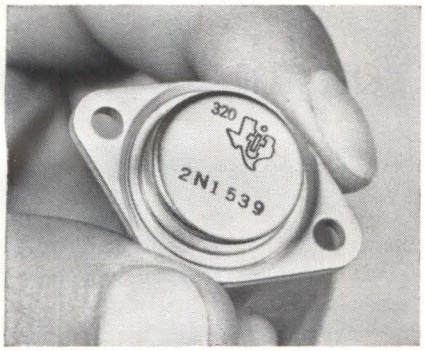


New UNI/G* diodes feature rugged construction

Computer designers can now select from a series of TI silicon diodes which offer a new high in reliability, power-handling capacity, and stability.

An entirely new concept in diode construction makes it possible for *UNI/G* diodes to meet extreme reliability requirements in military computer applications. Recently five different types of *UNI/G* diodes were tested according to the requirements of MIL-S-19500/116,/114,/118,/265A (EL). There were *no failures of any parameter of any unit.*

UNI/G diodes are presently available in the following types: 1N251; 1N659; 1N660; 1N662; 1N663; 1N914; 1N914A; 1N914B; 1N915; 1N916; 1N916A; 1N916B; 1N917; JAN 1N251; UNS 1N914; USN 1N3064; U/G 625, 626, 627 (electrically identical to 1N625, 1N626, 1N627); U/G 3064 (electrically identical to the 1N3064); and TI71-75.

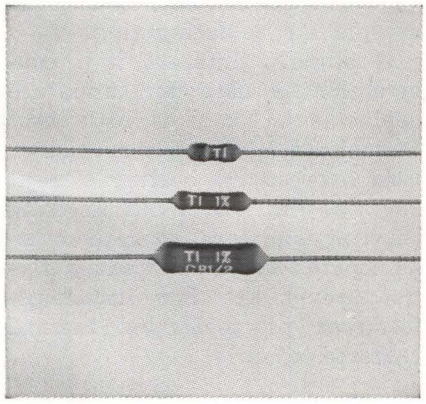


New power transistors dissipate 150 watts

TI's new 2N1539 series of germanium-alloy power transistors offers guaranteed power-dissipation capability of 150-watts – highest available in the TO-3 diamond package.

This high power capability assures lower junction temperatures and thus greater reliability. It also permits operation at higher ambient temperatures without temperature compensation.

A tight 2-to-1 h_{FE} ratio (50 to 100 at three amps) makes these devices particularly useful for power-amplifier applications requiring critical stability. Major equipment applications include power supplies, power regulators, servo and power amplifiers, and peripheral computer gear.



epoxy.plus* carbon-film resistors meet military requirements at low cost

These new TI precision resistors are ideal for military and commercial applications calling for the most inexpensive RN55D, RN60D and RN65D package sizes.

Epoxy-plus resistors are coated with a new double-tough synthetic sealant by an exclusive TI process that assures extremely high moisture resistance over the entire operating temperature range.

These new TI units surpass the doubled requirements of characteristic D, MIL-R-10509 D – handling full load rating at 125°C and double-wattage rating at 70°C. *Epoxy-plus* resistors are now immediately available in a wide range of resistance values.

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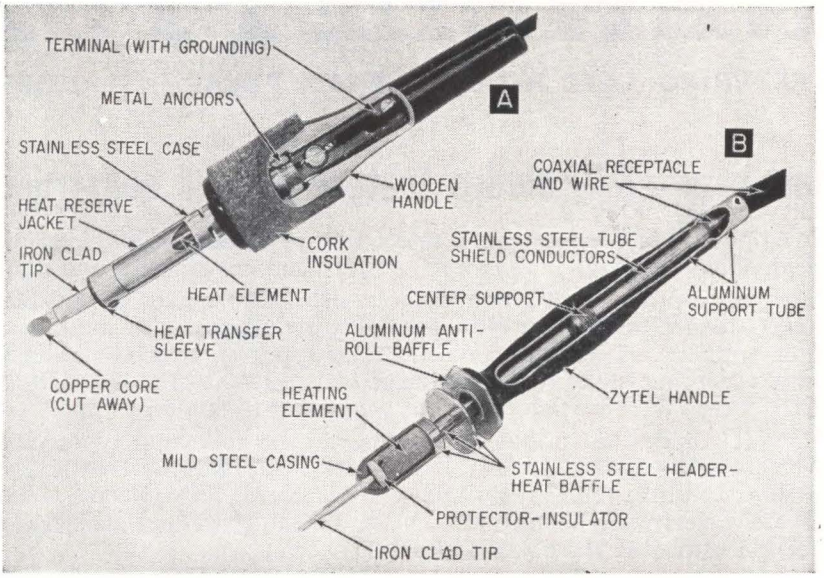

CONSTRUCTION FEATURES *indicate complexity of iron-tip construction for proper heat supply to reach work—Fig. 1*

TABLE I — IRON CLASSIFICATION

General Classification	Watts
Miniature	to 25
Small electrical	25–35
Medium electrical	35–45
Large electrical	45–60
Light duty	60–100
Heavy duty	100–Up

Selecting the Right Soldering-Iron and Tip

By H. H. MANKO, Alpha Metals, Inc., Jersey City, N. J., R. R. ROSS, IBM Corp., Poughkeepsie, N. Y.

Adequate heat content, shape and conductivity are paramount factors

IMPORTANT DETAILS are required to accurately evaluate commercially available soldering iron and soldering tip combinations. Thermal characteristics of soldering irons and tips must be carefully matched to all production jobs, but many makes and models vary critically in iron construction, iron size, and tip materials.

IRON CONSTRUCTION — Good construction permits optimum heat energy to be conducted to working surfaces. Protection for assembly as well as operator is provided by proper grounding, as shown in the iron in Fig. 1A.

A brass heat reserve jacket between sleeve and heating element increases the metallic mass within the iron. A bronze heat transfer sleeve within the heating element accepts the soldering tip.

A slightly different iron construction is used for miniature applications. There is little heat content due to a protector-insulator used between the heating element and tip, Fig. 1B. When selecting small or miniature irons, the overall length, weight and shape factors are of secondary importance to irons of preferable thermal characteristics.

TABLE II — HEAT CHARACTERISTICS OF TIP METALS

Metal or Alloy	HEAT CONDUCTIVITY Cal/sq cm/cm/ Deg. C/sec*	Percent of Copper	Measured at Deg. C	Specific Heat Per Volume
Aluminum	0.461	50.0	0	0.56
Brass	0.204	23.0	0	....
Copper	0.920	100.0	0	0.81
German silver	0.070	7.6	0	....
Gold	0.744	81.0	0	0.60
Iron (1%C)	0.1085	11.8	18	0.82
Nickel	0.140	15.2	18	0.92
Silver	1.096	120.0	0	0.59
Tantalum	0.130	14.0	17	0.60
Tungsten	0.383	41.5	0	0.62

* Volume heat capacity rather than weight heat capacity is used to compare tips having constant volume but made of different metals

TIP MATERIALS—In the past, most soldering tips were made of inexpensive copper with good thermal conductivity and high heat content per unit volume. However, tin-lead soldering alloys attack and dissolve copper. Also, the amount of impurities imparted to a solder joint by a bare copper tip is objectionable. Adding tellurium to copper improves wear and oxidation resistance.

Iron and nickel tips, in spite of their low conductivity, are wet-

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Allen electronic components, made primarily for electronic organs, are finding a growing list of prominent users in other industries—commercial, scientific and government.

Allen is widely acknowledged the most respected name in electronic organs and to maintain this high standard, Allen manufactures its own configurations in quantity, under rigid quality control.

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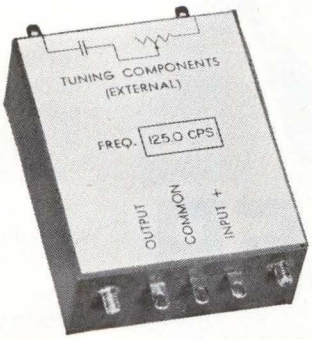
Write for our catalog, indicating which of the components may be of interest to you.

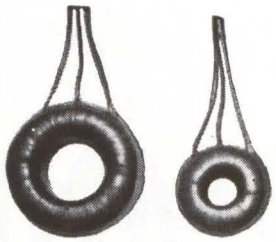
Allen Frequency Source Type C

A moderately priced compact audio oscillator designed for applications that do not have most stringent requirements for stability in respect to temperature and frequency drift.



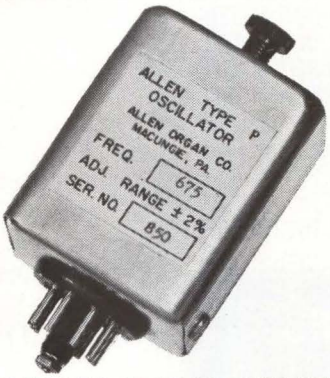
Allen Toroids

Over 150 sizes available from stock include Permalloy, Ferrite and Powdered Iron types. Inductance and Q measured at 1 volt 1,000 c.p.s. Inductance tolerance ±2%.



Allen Frequency Source Type P

A plug-in sine wave oscillator with standard octal tube base type connector. A knurled thumb-type adjustment located at top of unit provides for variable fine adjustment of frequency ±2% of specified frequency.

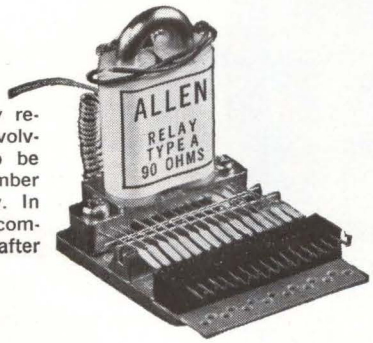


Allen Light Controlled Relays

A 4-terminal electro-optical device designed for use as a relay or remote control element, especially valuable where it is not necessary that control resistance be zero. Voltage variations in the input circuit result in a resistance variation in the output circuit.

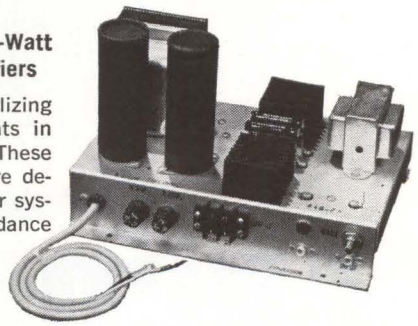
Allen Multi-Contact Relays

Economical and extremely reliable in applications involving a single potential to be switched to a large number of circuits simultaneously. In tests these units showed completely normal operation after 50 million cycles.



Allen 20-Watt and 50-Watt Transistorized Amplifiers

Audio-range units utilizing the latest developments in solid-state technology. These high-gain amplifiers are designed to drive speaker systems from a high-impedance source.



Allen Organ Company, Macungie, Pa. Phone 215-965-9801

Allen COMPONENTS DIVISION

SOLDER AND SOLDERING

In practice, the skilled may select the right combinations of soldering iron and tip, but modern demands for reliability and quality control require a scientific approach to selection. There is still little data available to the engineer for scientific evaluation, says H. H. Manko, whose book "Solder and Soldering" is soon to be published by McGraw-Hill

table and easily tinned. These materials offer the greatest resistance to erosion with a specific heat matching that of copper. Iron-clad copper tips are used in a large percentage of modern electric soldering iron tips.

Silver and gold tips have excellent conductivity and low-heat content properties, but dissolve readily in molten tin alloy solders.

Brass and other copper-alloy tips have lower conductivity characteristics and erode like copper, but at a slightly slower rate.

Nickel-silver tips do not erode as fast as copper but have very low conductivity.

Tungsten and tantalum are not easily wetted and are used as non-wetted, heat transfer tips for special applications.

TIP CONSIDERATIONS—Guides for efficient tip selection are:

- Maximum contact of tinned areas between tip and work
- Appropriate shape for access to work; straight or hatchet tips are available
- Tip taper, short as possible for good heat transfer; avoid small cross sections that impede heat flow
- Short length of tip to minimize wobble and heat path
- Large-diameter shank for maximum heat transfer between heating elements and tips
- Proper tip diameter for optimum heat transfer. Turned-down tips operate at higher temperatures but have lower caloric content. Larger diameter tips operate at lower temperatures, but have greater heat reserves.

CLASSIC JOBS OF MEASUREMENT

PERFORMED BY ELECTRO INSTRUMENTS

A Foreword by
Dr. Walter East
President, Electro Instruments, Inc.

"You name it, we'll find a way to measure it," our brash engineers keep assuring me. I like their spirit, even if it has been costly to me in the way of expensive dinner bets!

It was with a measuring breakthrough that Electro Instruments was born. Our original Stepping Switch Digital Voltmeter was the first to substitute electronically driven switches for mechanical needle movement devices. It quickly proved itself an ideal instrument for speedier, more accurate, more reliable measurement—with useful applications in many industrial operations.

Since that time we have pioneered 19 other electronic "firsts."

These have lead to ways of refining many older measuring systems. But, more important, they have extended the areas in which our instruments, and our systems, can serve industry.

The end result for which industry employs measurement is economy . . . be it in personnel . . . time . . . materials . . . investment. Looking through our "case histories," I ran across a number of outstanding examples of economies effected by use of Electro Instruments.

I thought we might usefully present these to industrial engineers, executives, superintendents, as ideas they might consider for their own operations.

Many readers, I appreciate, will have industrial measuring problems quite different from those cited in the examples. On this point, I think our engineers are worth re-quoting: "You name it, we'll find a way to measure it!"

Electro Instruments' *solid state* Digital Multimeters bring greater speed, higher reliability to many jobs of measurement, and at a lower investment.

Telescoping a job that once required 500 man hours into a 33½-hour operation is no mean feat! Yet a system employing an Electro Instrument Digital Multimeter accomplished just that — for one of America's major spacecraft* companies.

What was involved was the testing of printed circuit cards. Each of 1000 cards produced daily by the company had to be given 32 separate tests for quality. It took an experienced electronics technician and inspector 15 to 45 minutes per card to perform the job.

In the interest of speeding up this tedious job, experiments with an automatic electronic testing machine were begun. The eventual solution proved to be a punched tape system — designed, incidentally, by one of the company's engineers — with an Electro Instruments Digital Multimeter employed as a key parameter.

Each of the 1000 cards are now given the 32 quality tests in *less than 2 minutes*—with results being displayed at the push of a button! (*Name on request)

In many biochemical operations, recorded profiles are necessary for accurate identification of compounds, and for purposes of quantitative assay. Used in connection with newly developed instruments capable of exciting molecules to a state of phosphorescence, Electro Instruments X-Y Recorders have proved a means of producing visual display of spectra without need for photographic equipment or processes.

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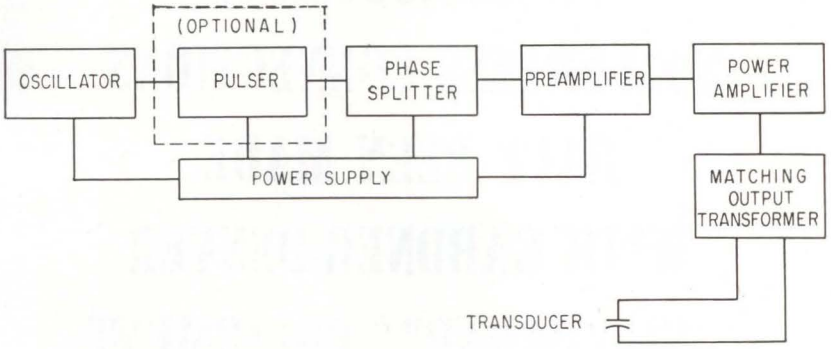
Broadband instrument will operate between 5 kc and 2 Mc

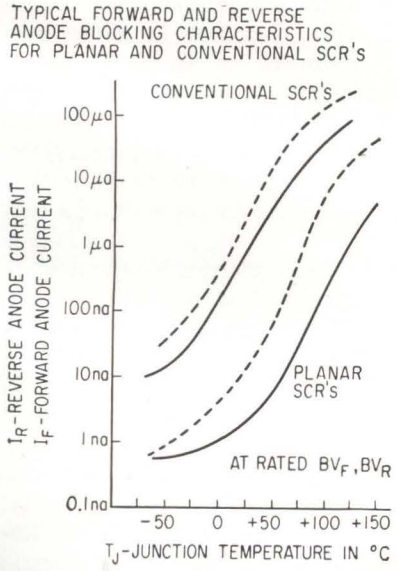


MARKETED by Macrosonics Corp., Cartaret, N. J., generator for sonic and ultrasonic processing has continuously variable power output between 5,000 cps and 2 Mc. Called Multisons, the unit provides acoustic energy density at a well-defined frequency to give research engineers a generator powerful enough to operate above critical-intensity threshold. According to the manufacturer, Multisons is the first 500 watt generator for sonic and ultrasonic processing over this wide a frequency range. Moreover, the unit permits very wide scanning of the spectrum while maintaining a constant, reasonable acoustic output over its entire range.

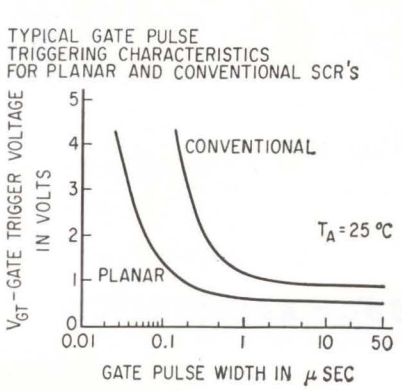
Generator is intended for applications in hydrophone and microphone testing, medical ultrasonics, biological studies, metals processing, chemical processing, coagulation and emulsification, soldering, welding and cleaning studies. It is designed for continuous duty at maximum output, 125 ohms impedance and requires 111 to 120 volts a-c for primary power. At 500 watts output, the generator consumes about 20 amps from the line, and has engineering and design features including: maximum operator safety, accidental start-up impossibility, programmed automatic start-up sequences, instantaneous reset and fixed tuning.

CIRCLE 301, READER SERVICE CARD

All-Planar SCR's Have Increased Gain



MANUFACTURED by Texas Instruments, Inc., Dallas, Texas, new all-planar silicon-control rectifiers are more flexible than conventional devices produced with diffusion techniques. New scr's have I_F of 20 μa max at 150 C, I_R of 100 μa max at 150 C and will operate between −65 and 150 degrees. Units have forward current ratings of 350 ma, surge currents of 6 amps up to 150 C, t_{on} of 0.3 μsec and t_{off} of 10 μsec. Moreover, planar SCR's have a turn-off gain (β_{off}) of 5 at 200 ma and 100 volts.



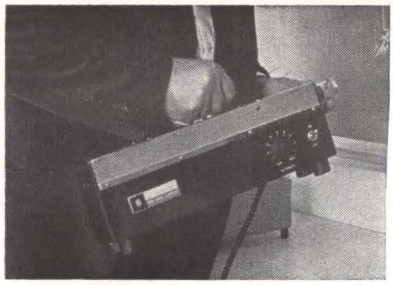
According to the manufacturer, these rectifiers are excellent for high-reliability military and space programs and will find application where higher sensitivity and resistance to radiation are important. Some typical uses include squib firing, sensitive-relay replacements,

high-speed ring counters, shift registers, Nixie-tube drivers and electroluminescent panel drivers.

CIRCLE 302, READER SERVICE CARD

Tape Recorder Is Portable Unit

LOW-COST portable instrumentation tape recorder, model PI-6100, is a 4-channel, 40-lb instrument for f-m and direct recording of scientific and industrial data. A novel feature of the recorder is a series of three operating speeds in the ratio of 100:10:1. A closed-loop transport is controlled by programmed logic circuitry which precludes tape damage due to incorrect push-button operation. Precision Instrument Co., 3170 Porter Drive, Palo Alto, Calif. (303)



Portable Gas Laser Produces 2.5 mm Beam

NEWLY announced by Spectra-Physics, Inc., 1255 Terra Bella Ave., Mountain View, Calif., model 130 portable gas laser uses a hemispherical resonator to generate a 0.1 milliwatt c-w beam of visible coherent light in uniphase wavefront at 6,328 Angstroms. According to the company's engineers, the unique feature of this unit is that it uses d-c excitation without a hot-cathode laser tube to achieve longer life than conventional devices where tubes last but a few hours.

Model 130 can produce 0.25 milliwatt c-w from each end of a confocal resonator and is versatile in that optics are supplied to permit use at this increased power level. Plasma-tube windows and resonator reflectors are optical quality, Schlieren free, fused silica. Reflectors are multi-layer dielectric

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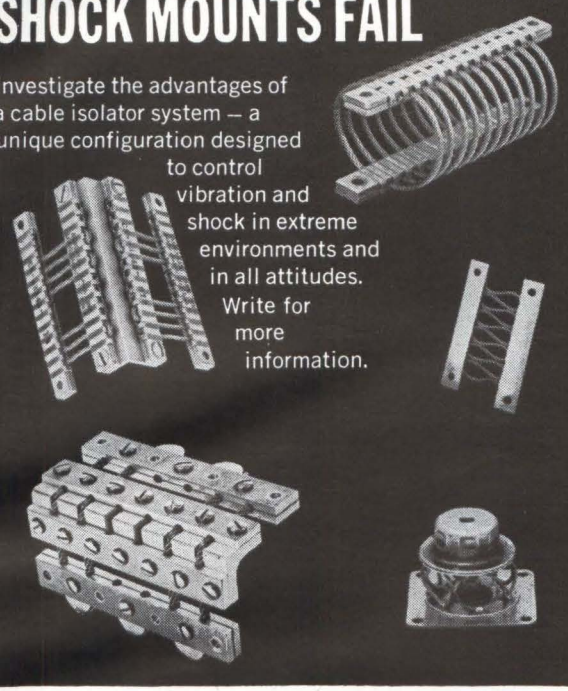
investigate the advantages of a cable isolator system – a unique configuration designed to control vibration and shock in extreme environments and in all attitudes. Write for more information.



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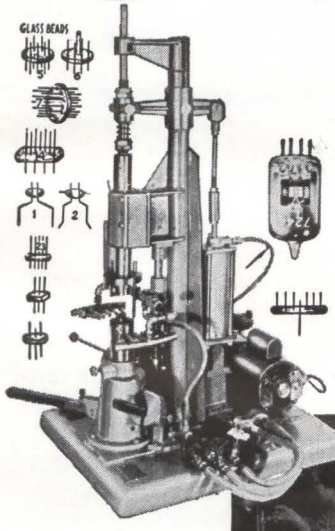

At left: No. 105-BSTI single position Button Stem and Wafer making machine—Fully automatic. Designed for small production runs on special tube parts or for laboratory use. Produces button stems up to 1¼" diameter. Machine can be supplied with up to 24 positions.

Illustrated below: An Eisler precision Vertical Spot Welder designed exclusively for welding of electronic components. Available in sizes from ½ to 7½ KVA.

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Charles Eisler Jr., President
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FOUR NEW WAYS TO HOUSE MICROFUSES*

Front panel mount (hexagon nut rear of panel). Aluminum body, knurled cap; can be anodized in color. Fungus, shock resistant. Sealing "O" rings in cap, on body.

Rear panel mount (round nut front of panel). Aluminum body, knurled cap; can be anodized in color. Fungus and shock resistant. Sealing "O" rings in cap, on body.

Front panel mount (hexagon nut rear of panel). Molded from dielectric material. Knurled cap. Rugged "Eye" type brass terminals; barrier provides full insulation.

Indicating Microfuse holder —when the fuse blows indicating bulb glows. Serrated, transparent knob. Molded from dielectric material. Voltage ranges, 2½ to 125 volts.

Microfuses achieve low fuse resistance values with high reliability in ultra-fast blowing characteristics. Microfuses can be hermetically sealed, suitable for potting applications. Glass enclosed visible filament. Microfuses available in 1/500 through 5 amps at 125V. Short circuit interrupting capacity 125 V—10,000 amps. DC.

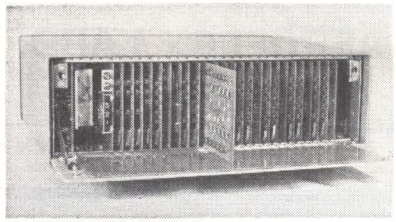
LITTELFUSE
DES PLAINES, ILLINOIS

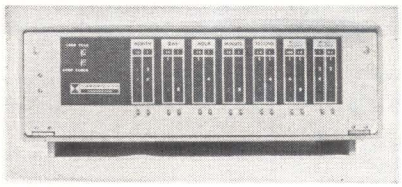
*Products shown actual size

CIRCLE 55 ON READER SERVICE CARD

coated for better than 99-percent reflectivity at the desired wavelength. Moreover, optics are antireflection coated on their back surfaces. A readily interchangeable third reflector supplied as an option, permits both hemispherical and confocal operation. Beam divergence can be collimated to the diffraction limit of the effective aperture of an illuminated-lens system. For example, a collimating lens placed at the exit aperture can collimate the beam to less than 80 seconds of arc. The output beam of the confocal resonator will collimate to less than 10 minutes of arc. The unit contains a current-stabilized d-c power supply yielding about 5 watts maximum plasma-tube excitation with 115 volts primary power. It weighs 11 pounds including power supply and sells for $1,525.

CIRCLE 304, READER SERVICE CARD

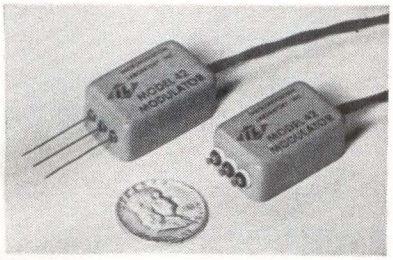




Digital Clocks Are Accurate to 100 μsec

MANUFACTURED by Chrono-Log Corporation, 2583 West Chester Pike, Broomall, Pa., series 10,000 solid-state digital clocks are accurate to 1 part in 10^6 when used with an internal oscillator. If line frequency is used as a time base, units will display line-frequency accuracy. Available with several options for added flexibility, clocks can be supplied with parallel, buffered-parallel or serial readout and have front-panel display in binary-coded decimal or BCD plus parity. With serial readout, a 13 digit time/date message requires about 280 μsec at a 50 kc data rate. While a typical thirteen-digit clock has time format in months, days, hours, minutes, seconds and milliseconds,

other formats such as millidays and deciminutes are also available. Series 10,000 clocks have ambiguity of less than 5 μsec and an external hold to prevent time change during readout. As shown in the photograph, these units feature modular construction with glass epoxy plug-in cards with hinged front and rear doors for access. Clocks are supplied in standard 19″ rack mountings and vary between $1,093 and $2,002 in price **(305)**



Modulator Is All Solid-State Device

CHOPPER model 42 features: long life (more than 25,000 hr with negligible change in noise and phase angle); very low self-generated current (less than 10^{-12} amp); and very low noise current (10^{-14} amp rms). Operating voltage is 80-130 v rms with an average current of 2 ma with a frequency range of 30-400 cps. Chopping efficiency is 99 percent at 60 cps with a phase angle lag of 5 deg. Instrumentation Laboratory, Inc., 9 Galen St., Watertown 72, Mass. **(306)**

Ratiometer Shows Transducer Output

MODEL 103 transducer ratiometer operates from built-in rechargeable battery or a-c line, indicates voltage-ratio output of potentiometric transducers within ±15 ohms from 0 to 10,000 ohms, shows current through pot element while protecting transducer from inadvertent burn-out or over-current damage. Pacific Metrology Laboratories, Inc., P.O. Box 3552, San Diego 3, Calif. **(307)**

Literature of the Week

CONNECTORS Physical Sciences Corp., 314 East Live Oak Ave., Arcadia, Calif., has issued a new and revised 4-page bulletin covering its type PS series plugs and receptacles, coded PS-4.
CIRCLE 308, READER SERVICE CARD

TOROIDAL TRANSFORMERS Spectran Electronics Corp., 146 Main St., Maynard, Mass., has available catalog No. 31505 describing wide-band, toroidal transformers. **(309)**

RELAY BROCHURE Babcock Relays, a division of Babcock Electronics Corp., 3501 Harbor Blvd., Costa Mesa, Calif. A 4-page technical brochure on half-size crystal can relays has been released. **(310)**

MAGNETOSTRICTIVE DELAY LINES ESC Electronics Corp., 534 Bergen Blvd., Palisades Park, N. J. A 4-page bulletin contains a description of magnetostriction and a glossary of magnetostrictive delay line terms. **(311)**

SEMICONDUCTOR DETECTORS Nuclear Diodes, Inc., 1640 Old Deerfield Road, Highland Park, Ill., offers an 8-page brochure on all types of solid state detectors with useful nomogram giving alpha, proton, and electron ranges in silicon. **(312)**

PLUG-IN TESTER Telemetrics, Inc., 12927 So. Budlong Ave., Gardena, Calif. Model 110 plug-in tester is described in data sheet 37. **(313)**

RELAYS Midway Mfg. Co., 10136 Pacific Ave., Franklin Park, Ill. A 4-page brochure lists and describes a line of general purpose latch, heavy duty, and gang-mount relays for OEM's and designers. **(314)**

DIGITAL AXIS POSITIONER Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif. Bulletin illustrates and describes the DAP-400 digital axis positioner. **(315)**

PRECISION DEVICES Assembly Engineers, Inc., 3650 Holdrege Ave., Los Angeles 16, Calif., has prepared a 16-page capability brochure illustrating its ability to design, engineer and produce precision devices for the aerospace and electronics industries. **(316)**

ELECTRICAL-NOISE ANALYSIS SYSTEM Quan-Tech Laboratories Inc., Boonton, N. J. Technical data sheet describes model 2158 noise analysis system, which is designed for the detailed study of electrical noise generated in electronic components and systems. **(317)**

F-M/F-M TELEMETERING SYSTEM Solid State Electronics Co., 15321 Rayen St., Sepulveda, Calif. Bulletin describes model 5000 silicon transistorized ultraminiature f-m/f-m telemetering system. **(318)**

TI Reassigns Executives

PRESIDENT P. E. Haggerty has announced the following new responsibilities within Texas Instruments Incorporated:

Fred Bucy has been elected a vice president to be in charge of the Apparatus division, headquartered in Dallas. Previously he was a manager of the division's Industrial Products Group, headquartered in Houston.

Vice president H. J. Wissemann, formerly in charge of the Apparatus division, will manager the Corporate Research & Engineering activity, also headquartered in Dallas. He replaces vice president R. W. Olson, who has been named to head a newly-created Special Projects office which will assume coordination of several major corporate programs and report to executive vice president Mark Shepherd, Jr.

Ross Macdonald has been appointed director of the Central Research Laboratories in Dallas, reporting to vice president Wissemann. Robert Stratton succeeds Macdonald as director of the Physics Research Laboratory.

In Houston, Edward Hill formerly in charge of the Recorder department, has been appointed manager of the Industrial Products Group.

General Electric Promotes Wagner

LEONARD B. WAGNER has been named manager of engineering in the General Electric Company's Semiconductor Products Department, Syracuse, N.Y. He will direct and be responsible for all of GE's signal level semiconductor engineering and advanced research studies. Included under his direction are semiconductor materials engineering, transistor and diode engineering and integrated microelectronic circuit engineering.

Immediately prior to his latest promotion, Wagner was manager of silicon low-frequency transistor engineering and engineering-support activities.

Kavanau Accepts Key Industry Post

LAWRENCE KAVANAU, formerly special assistant for space to the Director, Defense Research and Engineering, Department of Defense, has been appointed executive vice president of North American Aviation's Space and Information Systems division, Downey, Calif. His primary responsibility will be for technical aspects of the division's activities under the direction of Harrison Storms, president of the division.

In his Department of Defense assignment, Kavanau served as principal advisor to Harold Brown on DOD space matters including coordination with the National Aeronautics and Space Administration. He had held the post since early in 1961.

ESMA To Sponsor WESCON Seminar

THE Electronic Sales-Marketing Association will sponsor a WESCON seminar on "New Developments in International Electronics Marketing" on Thursday morning, August 22nd, at the Jack Tar Motor Hotel in San Francisco, according to C. G. Rockwood, ESMA program chairman and sales manager, Varian

Associates Tube Division, Palo Alto, Calif.

Reservations may be made by contacting either Alex White, ESMA executive director, P.O. Box 1, Bellerose, L.I., N.Y., or C. G. Rockwood at Varian, 611 Hansen Way, Palo Alto. Registration fee is $10 for ESMA members and $15 for non-members.

The Electronic Sales-Marketing Association is an international association made up of 200 sales and marketing managers representing every facet of the electronics industry.

PEOPLE IN BRIEF

James I. Leabman leaves Computer Control Co. to join Navigation Computer Corp. as v-p, marketing. **George Abeg,** formerly of Texas Crystals' Chicago plant, named to head up its newly acquired Los Angeles facility. Promotions at HRB-Singer, Inc.: **Charles E. Duke** to exec v-p; **J. S. Holtwick** to v-p, administration and management services; **Wayne A. Burnett** to technical director. **Donald J. Bailey** moves up to production mgr. of Permali, Inc. **Irving Wolf,** recently with GE, appointed mgr. of Ampex Corp.'s materials research group. **Bob van Hees,** previously with Kelvin Electric Co., named mgr., Resistor div. engineering, for Genistron, Inc. **John M. Miller Jr.** advances to director of engineering, automotive products, for Bendix Radio. **Donald S. Beyer,** ex-National Cash Register Co., appointed senior project leader at the Thin Film div. of the G. T. Schjeldahl Co. **Karl Philippi,** formerly with GE, now exec v-p at Tempel Steel Co. **Lincoln Brown,** with Melpar, Inc., since 1949, elected v-p for contract management. **John W. Dymecki,** from Philco to Ferroxcube Corp. of America as computer products mgr. Reon Resistor Corp. upgrades **John C. Jacobs** to v-p, marketing and sales. **Rex H. Beers,** formerly with Republic Electronics, now mgr. of military systems planning for Manson Laboratories Inc. **Harold Goldstein** advances to director of engineering at Paradynamics, Inc.

EMPLOYMENT OPPORTUNITIES

electronics

WEEKLY QUALIFICATION FORM FOR POSITIONS AVAILABLE

ATTENTION: ENGINEERS, SCIENTISTS, PHYSICISTS

This Qualification Form is designed to help you advance in the electronics industry. It is unique and compact. Designed with the assistance of professional personnel management, it isolates specific experience in electronics and deals only in essential background information.

The advertisers listed here are seeking professional experience. Fill in the Qualification Form below.

STRICTLY CONFIDENTIAL

Your Qualification form will be handled as "Strictly Confidential" by ELECTRONICS. Our processing system is such that your form will be forwarded within 24 hours to the proper executives in the companies you select. You will be contacted at your home by the interested companies.

WHAT TO DO

1. **Review the positions in the advertisements.**
2. **Select those for which you qualify.**
3. **Notice the key numbers.**
4. **Circle the corresponding key number below the Qualification Form.**
5. **Fill out the form completely. *Please print clearly.***
6. **Mail to: Classified Advertising Div., ELECTRONICS, Box 12, New York, N. Y. 10036. (No charge, of course).**

COMPANY	SEE PAGE	KEY #
AFSC-AFLC Joint Professional Placement Office New York, N. Y.	63	1
AEROSPACE PLACEMENT CORP. Philadelphia, Penna.	138*	2
ATOMIC PERSONNEL INC. Philadelphia, Penna.	138*	3
BELL AEROSYSTEMS CO. Div. of Bell Aerospace Corporation A Textron Company Buffalo, New York	62	4
GENERAL ELECTRIC-APOLLO SUPPORT DEPT. Daytona Beach, Fla.	140*	5
INTERNATIONAL BUSINESS MACHINES New York, N. Y.	141*	6
LINK DIVISION General Precision Inc. Binghamton, New York	64	7
LOCKHEED CALIFORNIA CMOPANY Div. of Lockheed Aircraft Corp. Burbank, Calif.	122*	8
NORTH AMERICAN AVIATION INC. Space & Information Systems Div. Downey, Calif.	138*-135*	9
PAN AMERICAN WORLD AIRWAYS INC. Guided Missiles Range Div. Patrick AFB, Fla.	142	10
SPACE TECHNOLOGY LABORATORIES Sub. of Thompson Ramo Wooldridge Inc. Redondo Beach, California	14*	11
XEROX CORPORATION Rochester, N. Y.	143*	12

* These advertisements appeared in the August 9th, issue.

(cut here) **electronics WEEKLY QUALIFICATION FORM FOR POSITIONS AVAILABLE** (cut here)

(Please type or print clearly. Necessary for reproduction.)

Personal Background

NAME .....

HOME ADDRESS .....

CITY .....**ZONE**.....**STATE**.....

HOME TELEPHONE .....

Education

PROFESSIONAL DEGREE(S) .....

MAJOR(S) .....

UNIVERSITY .....

DATE(S) .....

FIELDS OF EXPERIENCE (Please Check)

81663

- ☐ Aerospace
- ☐ Antennas
- ☐ ASW
- ☐ Circuits
- ☐ Communications
- ☐ Components
- ☐ Computers
- ☐ ECM
- ☐ Electron Tubes
- ☐ Engineering Writing
- ☐ Fire Control
- ☐ Human Factors
- ☐ Infrared
- ☐ Instrumentation
- ☐ Medicine
- ☐ Microwave
- ☐ Navigation
- ☐ Operations Research
- ☐ Optics
- ☐ Packaging
- ☐ Radar
- ☐ Radio—TV
- ☐ Simulators
- ☐ Solid State
- ☐ Telemetry
- ☐ Transformers
- ☐ Other .....
- ☐ .....
- ☐ .....
- ☐ .....

CATEGORY OF SPECIALIZATION

Please indicate number of months experience on proper lines.

	Technical Experience (Months)	Supervisory Experience (Months)
RESEARCH (pure, fundamental, basic)	.....	.....
RESEARCH (Applied)	.....	.....
SYSTEMS (New Concepts)	.....	.....
DEVELOPMENT (Model)	.....	.....
DESIGN (Product)	.....	.....
MANUFACTURING (Product)	.....	.....
FIELD (Service)	.....	.....
SALES (Proposals & Products)	.....	.....

CIRCLE KEY NUMBERS OF ABOVE COMPANIES' POSITIONS THAT INTEREST YOU

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc. Look in the forward section of the magazine for additional Employment Opportunities advertising.

Positions Vacant	Civil Service Opportunities	Employment Agencies
Positions Wanted	Selling Opportunities Wanted	Employment Services
Part Time Work	Selling Opportunities Offered	Labor Bureaus

DISPLAYED ———**RATES**——— **UNDISPLAYED**

The advertising rate is $40.17 per inch for all advertising appearing in other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

$2.70 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Box Numbers—counts as 1 line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS to CLASSIFIED ADV. DIV. of ELECTRONICS, P.O. Box 12, N. Y., N. Y. 10036

SYSTEMS ENGINEER

AIR TRAFFIC CONTROL

SALARY $14,000 TO $18,000

To perform studies of advanced air traffic control problems, define system requirements, investigate various approaches to problem solution, perform analytical work to support system feasibility, optimize system performance, suggest means for reduction to practice, act as consultant in the fabrication of feasibility hardware.

Requires advanced degree in EE or Physics with minimum 5 years related experience in one or more of the following: radar systems engineering, closed loop control, aerospace vehicle dynamics, operation analysis.

This opening represents an unusually good opportunity to join a company already in the forefront of the field with an all-weather, multi-purpose automatic aircraft landing system which halves current ceiling and visibility requirements. Best known, perhaps, for the Bell AGENA rocket engine, Bell Aerosystems Company is expanding its Avionics Division, which is currently grossing $30 million.

Please submit complete resume to Mr. Thomas Fritschi, Dept. G-26.

ba

BELL AEROSYSTEMS CO.

DIVISION OF BELL AEROSPACE CORPORATION - A textron COMPANY

P.O. BOX #1, BUFFALO 5, NEW YORK

An Equal Opportunity Employer

"Put Yourself in the Other Fellow's Place"

TO EMPLOYERS TO EMPLOYEES

Letters written offering Employment or applying for same are written with the hope of satisfying a current need. An answer, regardless of whether it is favorable or not, is usually expected.

MR. EMPLOYER, won't you remove the mystery about the status of an employee's application by acknowledging all applicants and not just the promising candidates.

MR. EMPLOYEE you, too, can help by acknowledging applications and job offers. This would encourage more companies to answer position wanted ads in this section. We make this suggestion in a spirit of helpful cooperation between employers and employees.

This section will be the more useful to all as a result of this consideration.

Classified Advertising Division

McGRAW-HILL PUBLISHING CO., Inc.

330 West 42nd St. New York 10036, N. Y.

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES

EQUIPMENT - USED or RESALE

DISPLAYED RATE

The advertising rate is $27.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE

$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS, $2.70 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

WALTER:

D.A.T.A. Tabulations keep you current on all Transistors • Semicon • Diodes • Microwave Tubes *in the world.* Characteristics, type numbers, manufacturers. For free literature write: D.A.T.A., INC., 43-15 S. Day St., Orange, N. J. 07050

CIRCLE 951 ON READER SERVICE CARD

RADIO RESEARCH INSTRUMENT CO.

AUTO-TRACK & TELEMETRY ANTENNA PEDESTALS
3 & 10 CM. SCR. 584 AUTOTRACK RADARS.
AN/TPS-10 SEARCH. AN/TPS-10 HT. FINDERS.
AN/FPN-32GCA. AN/APS-10 NAVIG. & WEATHER.
AN/APS-15B PRECISION. AN/APQ-35B PRECISION.
AN/APS-31A SEARCH. DOZENS MORE.
.5-1-2 MEGAWATT HIGH POWER PULSERS.

RADIO RESEARCH INSTRUMENT CO.
550 Fifth Ave., New York Judson 6-4691

RADAR SYSTEMS & COMPONENTS/ IMMEDIATE DELIVERY

CIRCLE 952 ON READER SERVICE CARD

VARIAN KLYSTRONS—BRAND NEW!

Immediate delivery from stock

V-28	KU	14W	$700
VA-64F	KU	15W	$700
VA-64G	KU	15W	$500
VA-67B	KU	1W	$700
VA-201 H, J	X	40mW	$200
VA-217F	X	60mW	$220
VA-242 E. F. G	X	700mW	$130

U. S. MICROWAVE

P. O. Box G, Collingswood, N. J. 609—WO6—2929

CIRCLE 953 ON READER SERVICE CARD

Wanted to purchase
TRANSISTORS AND DIODES
Small or large quantities (overruns)
Give details and make price offer to
ELTRON EXPORT COMPANY
122 Broad Street, New York 4, N. Y.

CIRCLE 954 ON READER SERVICE CARD

PATENTS

License Available: Thermostats. Small temperature responsive switch devices for supervising and regulating fixed operational temperatures (US-Patent). More information by KAPAZITATENVERMITTLUNG. Dr. Raabe, Obernhainer Str. lo, 6 Frankfurt/M., Germany-West.

LOOKING FOR

USED/SURPLUS ELECTRONIC
EQUIPMENT/COMPONENTS?
For an up-to-date listing of such equipment see Searchlight Section of August 9th Issue.

Engineers • Scientists

DURING WESCON INVESTIGATE A POSITION WITH AIR FORCE SYSTEMS COMMAND OR AIR FORCE LOGISTICS COMMAND THAT OFFERS

Professional Challenge
Recognition
Career Advancement
Financial Assurance

At 22 installations throughout the nation Engineers and Scientists of Air Force Systems Command and Air Force Logistics Command are discovering, defining and solving important aerospace problems. If you possess a degree and your competence demands more than routine assignments . . . if you seek the opportunity to gain professional stature and recognition . . . and if you have a desire to contribute to important, long-term programs, you are invited to seriously consider the openings listed below. All of these positions offer full Civil Service status and benefits.

PROFESSOR OF ELECTRICAL ENGINEERING—Will instruct at USAF Institute of Technology highest level courses in theoretical and experimental electronics.

ELECTRONICS ENGINEERS—With a background in development, fabrication, installation, maintenance and experimental operation of large radar sites.

ELECTRONIC ENGINEERS—To propose new theories of design and operation of advanced inertial navigation systems. Must have a thorough understanding of the "state of the art" and its pattern of development.

ELECTRONIC ENGINEERS—Responsibility will involve the maintainability and reliability of electronic components of missile and support systems.

ELECTRONIC ENGINEERS—With necessary experience to maintain technical surveillance over contractor electrical and electronic engineering activities.

ELECTRONIC ENGINEERS—To conduct system and equipment analysis studies to determine the feasibility and applicability of new and novel techniques to range instrumentation systems.

ELECTRONIC ENGINEERS (ELECTRO-MAGNETICS) – With ability to conduct analysis and design studies of complex search and height finding equipments.

If an interview is inconvenient at this time, you are invited to direct your resume or Civil Service Application (SF 57) in complete confidence to:

TO ARRANGE A CONVENIENT INTERVIEW

DURING WESCON

Phone Mr. Vincent Iannoli

583-8385 IN SOUTH SAN FRANCISCO

AFSC-AFLC

JOINT PROFESSIONAL PLACEMENT OFFICE

Room 401
527 Madison Ave. • New York 22, N. Y.

An equal opportunity employer

INDEX TO ADVERTISERS

■

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr. (2557)

■

• See advertisement in the July 25, 1963 issue of Electronics Buyers' Guide for complete line of products or services.

This Index and our Reader Service Numbers are published as a service. Every precaution is taken to make them accurate, but **electronics** assumes no responsibilities for errors or omissions.

electronics

Audit Bureau of Circulation — Associated Business Publications

Audited Paid Circulation

JAMES T. HAUPTLI (2210)
Advertising Sales Manager

DAVID CUNNIFF (3139)
Promotion Manager

HENRY M. SHAW (3485)
Market Research Manager

■

Electronics Buyers' Guide

R. S. QUINT (2335)
General Manager

■

RICHARD J. TOMLINSON (3191)
Business Manager

THEODORE R. GEIPEL (2044)
Production Manager

NEW YORK TELEPHONE: Dial Direct:
971 plus number in parenthesis, Area Code 212

ADVERTISING REPRESENTATIVES

ATLANTA, GA. 30009
Michael H. Miller, Robert C. Johnson
1375 Peachtree St. N.E., Trinity 5-0523
(area code 404)

BOSTON, MASS. 02116
William S. Hodgkinson
McGraw-Hill Building, Copley Square,
Congress 2-1160 (area code 617)

CHICAGO, ILL. 60611
Harvey W. Wernecke, Robert M. Denmead
645 North Michigan Avenue, Mohawk 4-5800
(area code 312)

CLEVELAND, OHIO 44113
Paul T. Fegley
55 Public Square, Superior 1-7000
(area code 216)

DALLAS, TEXAS 75201
Frank Le Beau
The Vaughn Bldg., 1712 Commerce St.
Riverside 7-9721 (area code 214)

DENVER, COLO. 80202
John W. Patten
Tower Bldg., 1700 Broadway,
Alpine 5-2981 (area code 303)

HOUSTON, TEXAS 77025
Kenneth George
Prudential Bldg., Halcombe Blvd.,
Riverside 8-1280 (area code 713)

LOS ANGELES, CALIF. 90017
Ashley P. Hartman, John G. Zisch,
1125 W. 6th St., Huntley 2-5450
(area code 213)

NEW YORK, N. Y. 10036
Donald H. Miller (212) 971 3615
George F. Werner (212) 971 3617
Donald R. Furth (212) 971 3616
500 Fifth Avenue

PHILADELPHIA, PA. 19103
Warren H. Gardner, William J. Boyle
6 Penn Center Plaza, LOcust 8-4330
(area code 215)

SAN FRANCISCO, CALIF. 94111
Richard C. Alcorn
255 California Street, Douglas 2-4600
(area code 415)

LONDON W1:
Edwin S. Murphy Jr.
34 Dover St.

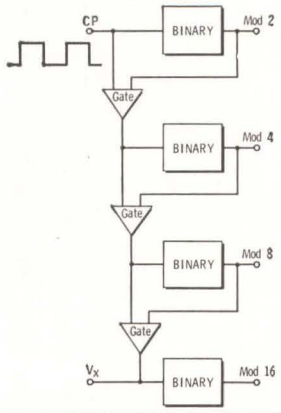
FRANKFURT/Main:
Matthee Herfurth
85 Westendstrasse

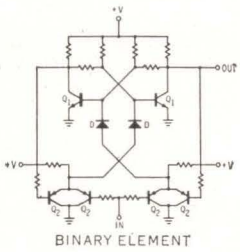
GENEVA:
Michael R. Zeynel
2 Place du Port

TOKYO:
George Olcott,
1, Kotohiracho, Shiba, Minato-ku

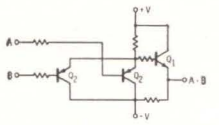
ELIMINATE PARALLEL CARRY NETWORKS IN BINARY CIRCUITS

SERIES CARRY MODULO 16 COUNTER



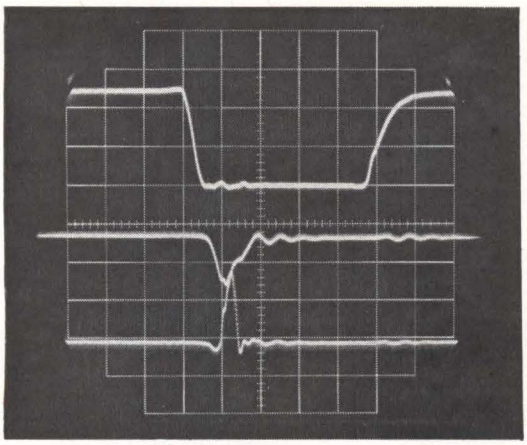


BINARY ELEMENT



HIGH SPEED LOGIC GATE

SILICON PLANAR DEVICES
D = Storage Diode FD300
Q_1 = NPN 2N2369
Q_2 = PNP 2N2894



Upper trace: Count pulse input
Lower trace: Mod 16 transition delays
Scale: Vertical, 0.5 volt/division
Horizontal, 20 nanoseconds/division

The modulo 16 binary counter circuit above features high speed serial-carry propagation to each binary element from a single count pulse input.

Elimination of complex parallel carry circuitry is accomplished using complementary NPN/PNP Planar transistors in the AND gates of each stage. The fast gate carry system delivers count pulse signals along binary input points at virtually the same time. CP to V_X delay is only 7 nanoseconds, or 2.3 nanoseconds per stage.

The scope photo shows the excellent overall speed of both transitions (superimposed): Only 20 nanoseconds from CP input to fourth stage output.

The advanced computer circuit design is made practical using sufficiently fast complementary logic transistors: Fairchild's NPN 2N2369 and PNP 2N2894.

For computer designers, they offer a distinct advantage: the high reliability of circuits using exclusively silicon Planar devices.

3163

PLANAR: A PATENTED FAIRCHILD PROCESS

FASTEST COMPLEMENTARY

NPN PNP

2N2369 2N2894

- V_{CE} (sat) .25V max @ $I_C = 10$ mA, $I_B = 1$ mA
- f_T 500 mc min @ $I_C = 10$ mA, $V_{CE} = 10$V
- h_{FE} 40-120 @ $I_C = 10$ mA, $V_{CE} = 1$V
- t_{on} 12 nsec max @ $I_C = 10$ mA, $I_B = 3$ mA
- t_{off} 18 nsec max @ $I_{B1} = 3$ mA, $I_{B2} = 1.5$ mA

Package: JEDEC TO-18

- V_{CE} (sat) .2V max @ $I_C = 30$ mA, $I_B = 3$ mA
- f_T 400 mc min @ $I_C = 30$ mA, $V_{CE} = 10$V
- h_{FE} 40-150 @ $I_C = 30$ mA, $V_{CE} = .5$V
- t_{on} 60 nsec max @ $I_C = 30$ mA, $I_B = 1.5$ mA
- t_{off} 90 nsec max @ $I_{B1} = I_{B2} = 1.5$ mA, $I_C = 30$ mA

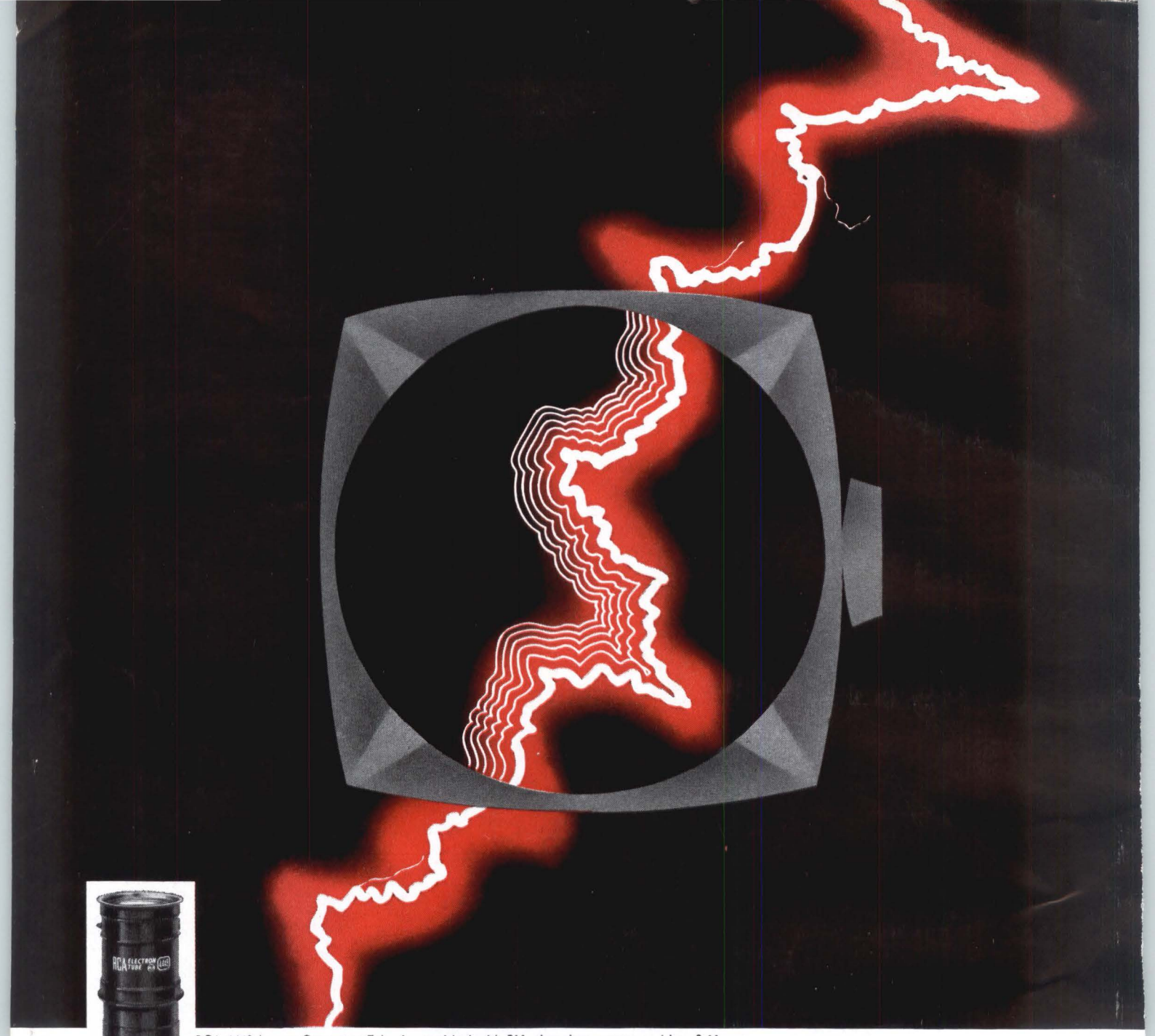
Package: JEDEC TO-18

SILICON PLANAR LOGIC TRANSISTORS AVAILABLE DIRECTLY FROM DISTRIBUTOR STOCKS

FAIRCHILD
SEMICONDUCTOR

FAIRCHILD SEMICONDUCTOR / A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION / 545 WHISMAN ROAD, MOUNTAIN VIEW, CALIF. / 962-5011 / TWX: 415-969-9165

CIRCLE 901 ON READER SERVICE CARD



RCA-4449 Image-Converter Tube is provided with P11 phosphor screen and has S-11 spectral response. Maximum length, 9.93"; Diameter, excluding side tip, 4.04".

RCA IMAGE-CONVERTER TUBE...5-Nanosecond Light Shutter

Shutter speeds as fast as 5 nanoseconds are possible with the 4449—RCA's Image-Converter Tube that can even separate the individual flashes that form a single lightning bolt. Designed specifically as a high-speed light shutter, the RCA-4449 not only permits photography of short-duration phenomena, but also enables three pictures to be made on the same frame within one microsecond.

This new Image-Converter Tube has electrostatic focus, a gating control-grid which functions as a shutter, and an electrostatic deflection system. As a new scientific tool, the RCA-4449 has exciting potential in photographic applications in magnetohydrodynamics, lasers, exploding wires, and gaseous discharge.

Among the outstanding features of the RCA-4449 are: resolution capability of 17 line-pairs per millimeter; minimum radiant power gain of 50; planar photocathode to permit the use of standard lenses, and shutter-grid cut-off voltage of −110 volts.

For technical assistance in the use of the RCA-4449, consult your RCA Industrial Tube Representative. Bulletins are available by writing: Commercial Engineering, Section H-19-Q-2, RCA Electronic Components and Devices, Harrison, N. J.

RCA FIELD OFFICES—OEM SALES: Newark 2, N. J., 32-36 Green St., (201) 485-3900 • Chicago 54, Ill., Suite 1154, Merchandise Mart Plaza, (312) 527-2900 • Los Angeles 22, Calif., 6801 E. Washington Blvd., (213) RA 3-8361 • GOVERNMENT SALES: Harrison, N. J., 415 South Fifth St., (201) 485-3900 • Dayton 2, Ohio, 224 N. Wilkinson St., (513) BA 6-2366 • Washington 6, D. C., 1725 "K" St., N.W., (202) FE 7-8500 • INTERNATIONAL SALES: RCA International Division, Clark, New Jersey, (201) 382-1000

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