Collins UHF airborne transceiver — see cover story page 5.

electronics and communications

IRE
ELECTRONIC CONFERENCE
GUIDE ISSUE

an age publication
SEPTEMBER 1961

LITTON ALL-INERTIAL AUTOMATIC NAVIGATOR
INSTALLED IN AN OPERATIONAL FIGHTER

NEW PROOF OF LITTON'S CONTINUING CONTRIBUTIONS TO THE DEVELOPMENT OF INERTIAL NAVIGATION IS FURNISHED BY THE LN-3-2B AUTOMATIC NAVIGATOR THAT IS NOW BEING INSTALLED IN CANADA'S CF-104 FIGHTER.

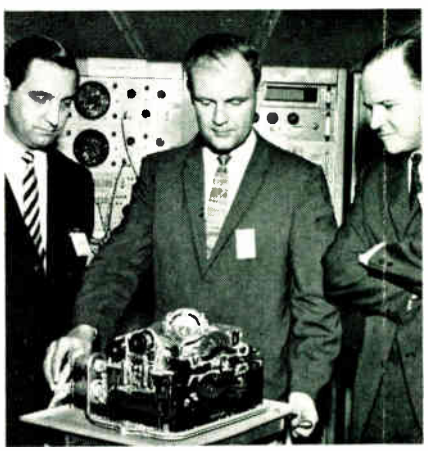
Three-hundred-and-sixty-degree freedom of aircraft maneuver on every axis is made possible by four-gimbal isolation of the Litton stable platform that keeps the system's accelerometers aligned in inertial space. Voltage signals from the accelerometers are transmitted to a computer where they are integrated to compute vehicle position components.

In addition, an adapter unit provides 27 outputs of pitch, roll and heading angles and ground speed to other equipment in the aircraft such as bombing computer and autopilot.

In flight, tight servo loops hold all sensitive elements of the stable platform at null regardless of acceleration. Any relative motion between the gyro case, which is fixed to the platform, and the floated gyro rotor, which is fixed in space, is sensed and corrected to keep the platform including accelerometers oriented to vertical and north. Any acceleration along an axis produces an accelerometer torquer current which is proportional to the applied acceleration. This torquer current holds the accelerometer at null, and the same signal is transmitted to the navigation computer.

Litton Systems (Canada) Ltd. is playing an increasingly vital role in Canada's CF-104 program. At its Rexdale facility the company is undertaking:

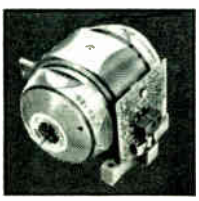
- The manufacture of electronic sub-systems for the LN-3.
- The final test and calibration of the complete LN-3 system.
- The design and manufacture of ground support and other special purpose electronic test equipment.
- The training of R.C.A.F. and industry personnel.
- After-sales service including provision of spares and field representation.
- Maintenance, repair and overhaul.

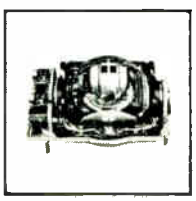


EXAMINING LN-3 STABLE PLATFORM UNDER TEST AT LITTON'S WOODLAND HILLS, CALIF. FACILITY ARE L-R: VIC SYMONDS, LITTON-CANADA; P. LUTH, LITTON-CALIF.; O. BELYEA, DDP.

These programs are being carried forward by engineers and technicians specializing in inertial navigation and related techniques.

If you have experience in fire control, analog, servo or gyro systems this may be your opportunity to gain further knowledge in this continuously expanding field in Canada with one of the world's leaders in inertial navigation systems. Opportunities also exist for field service representatives. To apply, write to Personnel Manager, Litton Systems (Canada) Limited, 123 Rexdale Blvd., Rexdale, Ontario.





LITTON SYSTEMS
(CANADA) LIMITED
Rexdale, Ontario

DIVISION OF LITTON INDUSTRIES
BEVERLY HILLS, CALIFORNIA

For complete details check No. 43 on handy card, page 91

MARCONI TUBES OFFER EXTRAS THAT COUNT

Extras above and beyond the call of business — personal, helpful service . . . a sincere interest in your problems . . . speedy delivery when you're in a jam. These are the extra benefits you get when you specify Marconi Radiotrons. As well, you get the famous Marconi quality — rigid manufacturing standards . . . finest components . . . expert craftsmanship . . . careful testing. When next you order, remember the extras that count. Insist on Marconi Tubes.

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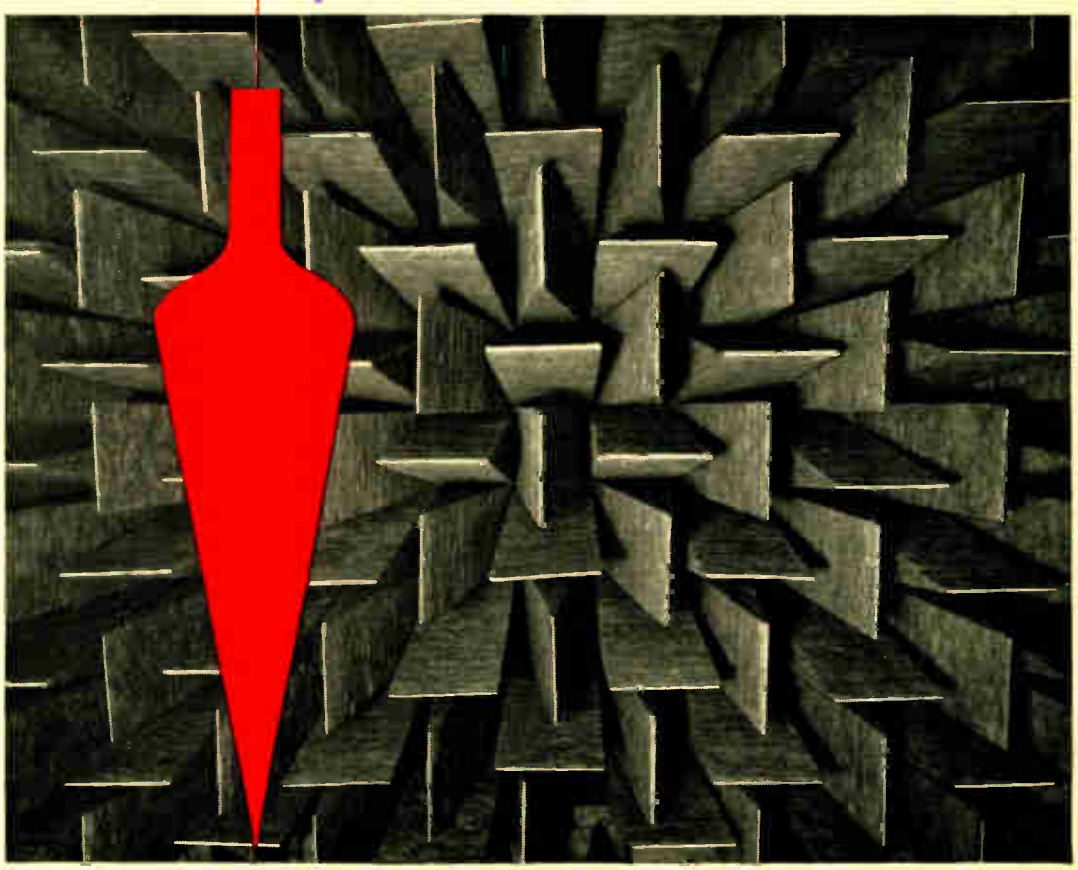
For complete details check No. 15 on handy card, page 91

TO PLUMB NEW DEPTHS IN SOUND,

Northern Electric Research and Development Laboratories built a floating anechoic chamber. Although the appearance of this room is weird, its purpose is perfection; for here, there are no echoes, reflections or vibrations to distort the accuracy measurements of sound waves. ■ Wedges of Fiberglas, five feet long, project towards the middle of the room from all six surfaces, so that the equipment under test is completely surrounded by a mass of sound absorbent material. ■ This anechoic chamber is being used to test microphones, speakers, telephone transmitters and receivers, intercom systems and other communications equipment. ■ The chamber is an important new asset, but it represents just a fraction of the total facilities and personnel dedicated to the quest for progress in communications at the Research and Development Laboratories of Northern Electric Company Limited.

■ RESEARCH AND DEVELOPMENT LABORATORIES



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electronics and communications

Canada's pioneer journal in the field of electronics and communications engineering

contents SEPTEMBER, 1961

Vol. 9 No. 9

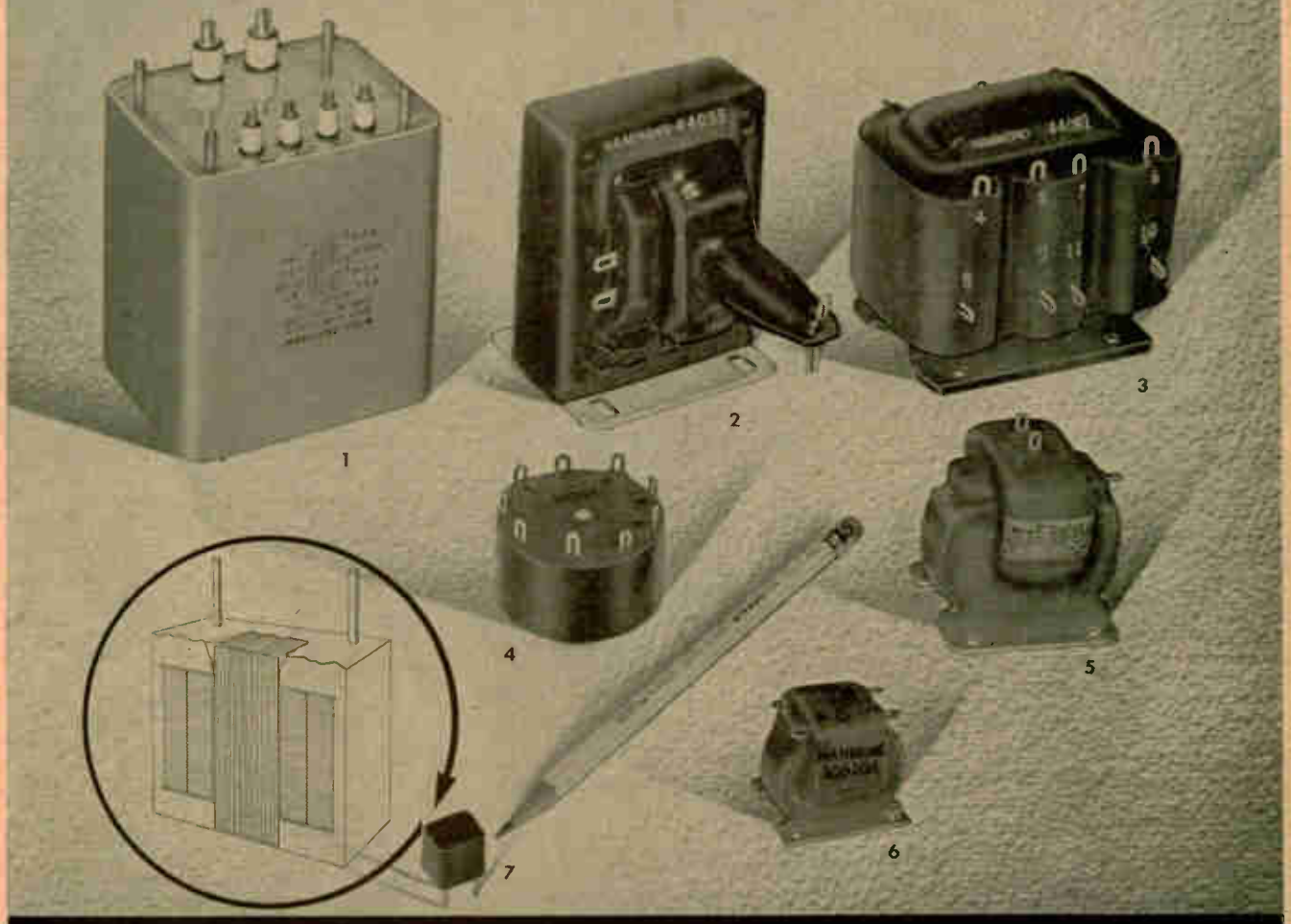
departments

COVER STORY

This pattern of precision gears forms part of the mechanical tuning drive of the AN/ARC-552 UHF airborne transceiver. It is manufactured by Collins Radio Co. of Canada Ltd. for use by the RCAF, NATO and other air forces. The drive permits the automatic tuning of any one of 3,500 communication channels.

HAMMOND Epoxy — Protected Transformers

1. Epoxy Filled, Metal Cased, Hermetically Sealed Power Transformer. Primary 115 v, 50-60 cycles. Secondary #1 6.5 v., 0.45 amp. Secondary #2 6.5 v., 9.5 amp.
2. Epoxy Encapsulated, High Voltage Filament Transformer. Primary 117 v., 50-63 c.p.s. Secondary 36 v., 0.5 amp. (18,000 volts R.M.S. Test).
3. Encapsulated 3 Phase 400 c.p.s. 675 va., 6 Phase Rectifier Transformer.
4. Cast Epoxy Toroid Transformer for transistorized power supply.
5. Epoxy Encapsulated, Low Capacity High Voltage Pulse Transformer. Primary 10 ohms, 20 . . . Sec., 10 kv. peak working. Secondary 75 ohms.
6. Epoxy Encapsulated Isolating Transformer. Primary 115 v., 380 to 420 cycles. Secondary 115 v., 0.15 amp.
7. Cast Epoxy Sub-miniature Transformer. Primary 20,000 ohms. Secondary 5,000 ohms.



High Performance Lightweight Transformers

FOR MILITARY AND OTHER EXACTING REQUIREMENTS!

Hammond Cast, Potted and Epoxy Encapsulated Transformers utilize a Hammond developed, modified epoxy resin with "vacuum cycle" application. In impregnating the transformer original insulation is improved and efficiency increased.

Hammond Epoxy-Protected Transformers have exceptional resistance to moisture, contaminants, temperature variation and physical shock. They should be considered wherever lightweight and high performance are essential, and as a possible alternative to hermetically sealed construction.

HAMMOND

EPOXY INSULATED TRANSFORMERS

Canada's leading jobbers stock Hammond Transformers.

HAMMOND MANUFACTURING COMPANY LIMITED • GUELPH, ONTARIO, CANADA

For complete details check No. 31 on handy card, page 91

2 NEW PRODUCT ADVANCES FROM Transitron

ACTUAL SIZE

TMD-914 and TMD-916
DIFFUSED SILICON MICRODIODES
MICRO-EQUIVALENTS of the
1N914 and 1N916

Duplicating the specifications of the popular 1N914 and 1N916, these microminiature very fast switching silicon diodes offer low capacitance and are designed for use in extremely high speed transistorized computer circuitry. Their durable construction in an all-glass package features TRUE hermetic sealing and a unit capable of providing long-term reliability under extreme environmental conditions.

Recovery time: 0.004 micro-second.

SPECIFICATIONS AT 25°C

	TMD-914	TMD-916
Maximum Forward Voltage at 10mA	1 Volt	1 Volt
Maximum Inverse Current at 20V	.025 μA	.025μA
Minimum Inverse Voltage at 100μA	100 Volts	100 Volts
Maximum Capacitance at 0 Volts	4 μμF	2 μμF

For further information, write for Bulletin PB-71C.

ACTUAL SIZE

6.3 VOLT CERTIFIED
SILICON VOLTAGE REFERENCES

Now, for the first time in the industry, silicon voltage references that have exhibited voltage stabilities as low as ±.002% for 1000 hours are being CERTIFIED and offered by Transitron. These significant features are associated with each unit:

- Actual readings recorded periodically over 1000 hours included with each certification document.
- Serialization of units for convenient reference to their production and life test histories at Transitron.

Manufacturers of missiles and precision instruments who require a stable voltage reference of small size and weight may look to Transitron for these references which are certified at point of purchase.

Type	Certified* Voltage Stability (%)	Voltage Range at $I_Z = 7.5$mA at 25°C (Volts) Min.	Max.	Temperature Stability Maximum Voltage Change (+25°C to +100°C) at $I_Z = 7.5$mA (Volts)	Maximum Dynamic Resistance at $I_Z = 7.5$mA at 25°C (Ohms)
1N3501	±0.01	6.2	6.5	±0.006	12
1N3502	±0.01	6.2	6.5	±0.003	12
1N3503	±0.005	6.2	6.5	±0.006	12
1N3504	±0.002	6.2	6.5	±0.006	12

*Voltage References certified for voltage stability observed during 1000 hours operation.

For further information, write for Bulletin TE-1352F-1.

SEE US AT CANADIAN IRE — BOOTH 134

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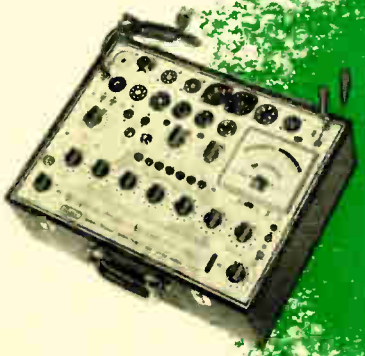
LOW ONLY IN PRICE

MODEL SMG-57
Sweep Marker Generator Continuous coverage from 3 to 260 MC. Complete with 4.5 MC crystal. Calibrated to 1% accuracy. Vernier dials.
Wired $139.95



MODEL 12-22
Dynamic Mutual Conductance Tube Tester. Versatile Portable; Tests both European and American Tubes for Shorts, Leakage and Quality. Self-Cleaning Lever Switches.
Kit $149.50
Wired $199.50

MODEL OSK-1
5" Oscilloscope Kit. 5" C.R.T., Push-Pull Horizontal and Vertical Amplifiers.
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MODEL MK-3
Multi-Range Multimeter. 20,000 Ohms/Volt, Molded Case, Unbreakable Meter Front.
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MODEL VMK-2
Vacuum Tube Voltmeter. 6" Full View Meter, Input Impedance 10.5 Megacycles. Proven Printed Circuit.
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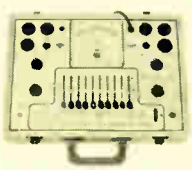
Wired $59.70



MODEL 9-99
Tube Tester
Kit $69.95
Wired $99.95

MODEL CRT-38
Picture Tube Tester & Rejuvenator
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MODEL TM-7
Pocket Multimeter
Wired $29.95

MODEL 1001
Multi-Range VOM
Kit $39.50
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For complete details check No. 62 on handy card, page 91

Class V—up to 100 operations per second.

where extra high speed and long life are both important

Helpful selection data
Class V Series

LIFE EXPECTANCY
More than 1 billion operations, without change, maintenance or adjustment

OPERATING SPEED
Up to 100 operations per second

OPERATE TIME
Approx. 3 milliseconds

CONTACT LOAD RATING
Will switch 250 volt-ampere loads with max. of 5 amps, 500 volts

TEMPERATURE RANGE
Minimum —30°C (freezing point of mercury).
Maximum 107°C internal
(melting point of potting material).

VIBRATION
10 G, 10-500 c.p.s. (no mechanical damage).

The new Class V Relay by Automatic Electric, is designed to meet the exacting requirements of data processing equipment, automatic control devices, and high-speed keying circuits. A mercury-wetted-contact relay, it can make 100 transfers a second, with an operate time of 3 milliseconds and no trace of contact bounce. Effective life is more than 1 billion operations.

Because of its unique construction, the new Class V requires no maintenance whatsoever. Contact and armature assemblies are hermetically sealed in a glass capsule with a high pressure hydrogen atmosphere, and mercury wetting renews the contacts continuously, eliminating both wear and welding problems. The relay is wax-potted and enclosed in a rugged steel cover. With its standard octal plug it can be installed in seconds.

If you would like further details, call or write Automatic Electric Sales (Canada) Limited, 185 Bartley Drive, Toronto, Ontario. Branches across Canada.

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GENERAL SYSTEM

AN ORGANIZATION SERVING CANADIAN INDUSTRIES WITH COMMUNICATION AND CONTROL SYSTEMS
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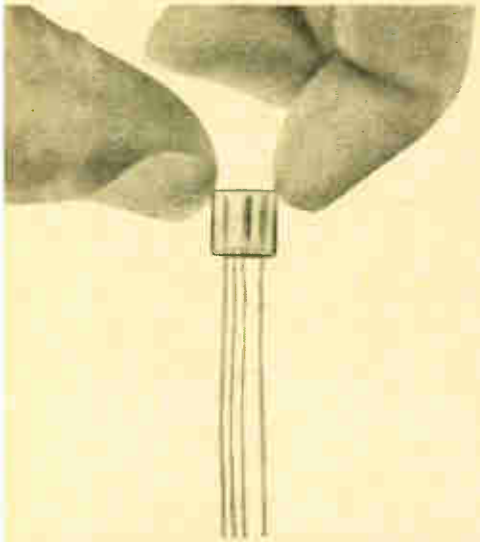
For complete details check No. 9 on handy card, page 91

PHILIPS

ALLOY DIFFUSED TRANSISTORS—

preferred quality range for 100 kcs. to 250 Mcs. at mass production prices!



In the two years since their introduction into Canada by Philips alloy diffused transistors have earned broad and enthusiastic acceptance by Canadian equipment manufacturers. Through strict control of important device parameters, the alloy diffusion process produces the advantages of high input impedance, high output impedance, very low feedback capacitance and low noise, resulting in high overall gain without neutralizing, and narrow spread in transistor performance.

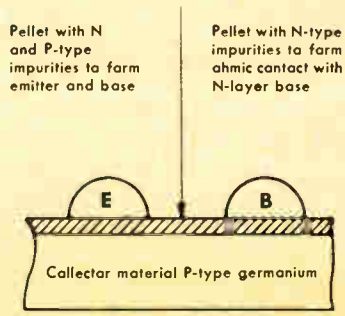
THE PHILIPS ALLOY DIFFUSED TECHNIQUE:

The Alloy Diffused Transistor is built up on a wafer of P-type germanium. To decrease the resistance between the emitter and base pellets and therefore the base resistance, a pre-diffusion process is used which gives a controlled depth of N-type material on the surface of the wafer. Two metal pellets, B for the base, and E for the emitter are placed together on one side of the wafer. Pellet B contains only N-type impurities, while pellet E contains both N and P types.

When this assembly is heated to an appropriate temperature in a gaseous atmosphere, germanium dissolves into the metal pellets until saturation is reached. The impurities in pellets B and E diffuse into the germanium wafer beyond the depth of the pre-diffused layer.

The P-type impurities in pellet E diffuse very slowly and penetrate only a negligible distance into the wafer. The N-type impurities in both pellets B and E have a high rate of diffusion and penetrate further into the wafer to form an N-type layer.

Basic components of Alloy Diffused transistor before heating
N-type prediffused layer



NOW PHILIPS OFFERS A PREFERRED RANGE OF ALLOY DIFFUSED TRANSISTORS FOR ALL APPLICATIONS FROM 100 kcs. TO 250 Mcs.!

These were the forerunners:

Type	Vce.	Ic	Dissipation	I_{cBo}	Noise Factor	Power Gain	Application
AF114	20V	10mA	80mW	1.2μA	8db at 100Mc	14db at 100Mc	R.F.Amplifier for use at 100Mc.
AF115	20V	10mA	80mW	1.2μA	3db at 10Mc	*conversion gain 23db* at 20Mc	R.F.Amplifier up to 27Mc and converter up to 100Mc.
AF116	20V	10mA	80mW	1.2μA	3db at 10.7 Mc	25db at 10.7 Mc	R.F.Amplifier up to 16Mc and 10.7Mc I.F.Amplifier
AF117	20V	10mA	80mW	1.2μA	1.5db at 1Mc	42db at .45Mc	R.F. and I.F. Amplifier and converter in Broadcast receivers.

These new transistors are now available:

AF102	25V	10mA	80mW	2μA	6db at 200Mc	13db at 200Mc	R.F.Amplifier for use up to 260Mc.
AF118	50V	30mA	(with cooling fin) 250mW	5μA	f_1=175Mc	Coe 13μμF.	Medium power Video Amplifier.
AFZ11	12V	10mA	80mW	4μA	6db Maximum at 100Mc	10db at 100Mc	Low noise R.F.Amplifier for 100Mc.

These alloy diffused types for special professional applications are now becoming available:

ASZ21 Ultra high speed switching transistor. Average total switching time 0.13 u Sec.

ASZ23 Specially manufactured avalance transistor for very high speed pulse work. Typical output pulse of 1 m u sec.

ATZ10 P-N-P-N Switch. Suitable for ring counters up to 30kc or as a speech contact in telephone exchanges.

AUY10 High frequency, high power alloy diffused transistor. V_{CB} 75, Ic 750 mA and minimum cut-off frequency 60Mc. For use as R.F. power amplifier or as a high speed core driver.

For more detailed information and application data, write

PHILIPS

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6104

For complete details check No. 52 on handy card, page 91

Canadian
Radio
Technical
Planning
Board

newsletter

by P. C. Poulter

Committee Activities

The Broadcast Committee met in July to consider drafts of three specifications, RSS-150, RSS-151 and RSS-156. In dealing with RSS-150, "Auxiliary equipment for use with AM Broadcast Transmitters in the 535-1605 Kc/s band", the Committee indicated that the Planning Board's interest in this specification is probably limited to frequency monitors, modulation monitors, phase monitors and remote metering devices. The most significant aspect of the work of this Committee was the expeditious handling of the standards which resulted in the early authorization of stereophonic broadcasting in Canada. (See announcement in "Briefing the Industry")

Meeting in Montreal in July the Maritime Committee considered and completed a lengthy agenda including a number of recommended changes to RSS-160 and RSS-117. Consideration of RSS-104 is held over for a meeting scheduled in early September.

The Special Committee on General Services Band Radio met in Toronto on August 9, to complete its final recommendations on RSS-136. Meeting the following day, the Executive Committee considered the final recommendations and suggested two minor changes. If the Committee agrees to the changes, the recommendations could be in the hands of the Official Board for voting before the end of August. This would enable the recommendations to be in the hands of the Department of Transport before the end of September.

New Drafts Issued

RSS-139 sets forth the minimum standards required for type — approval of Land and Mobile Stations FM or PM Radiotelephone Transmitters and Receivers operating in the 30-50 megacycles band with 20 kilocycles channel separation. The draft specification has been referred to the Land Fixed and Mobile Committee for consideration.

The Department of Transport has requested comments from the Planning Board regarding Radio Standards Procedure 104. This is the procedure for Having Type-Approval Tests of radio equipment performed at the Radio Regulations Engineering Laboratory, in Ottawa. The format has been revised to conform with other departmental Procedures and Specifications. Sponsor organizations and Committee Chairmen have been invited to submit comments or suggestions to the Planning Board for transmittal to the Department by early September.

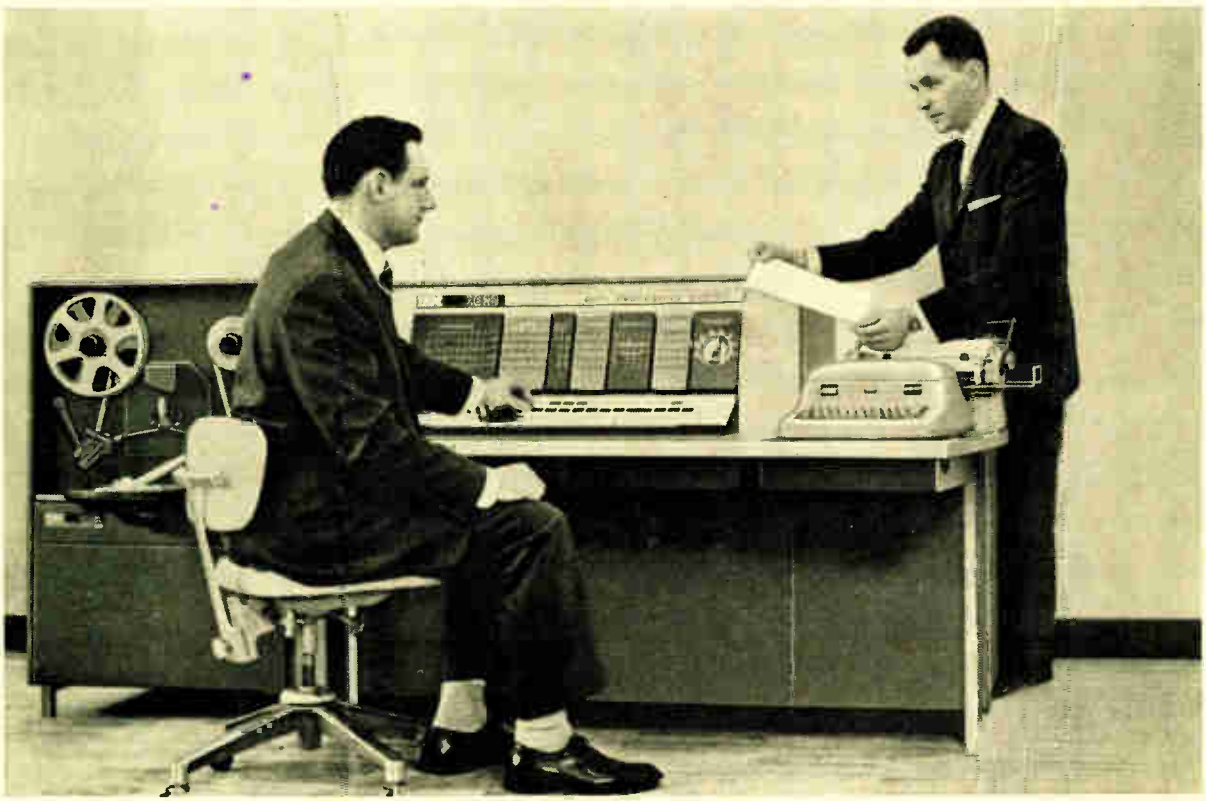
Representatives Named by NCATA

E. R. Jarmain, London TV Cable Service Limited, has been named by the National Community Antenna Television Association as main representative to the Canadian Radio Technical Planning Board with H. R. Young, Peterborough Television Transmission Company Limited as alternate. Mr. Jarmain's address is 13 King Street, London, Ontario. Mr. Young's address is 636 Bolivar Street, Peterborough, Ontario.

Douglas Randall Ltd. offers prizes at IRE

Visitors to Douglas Randall's Booths (Nos. 442, 444 & 446) can win a Polaroid-Land camera by submitting ideas for digital logic using standard modules. Best two schemes will win prize awards for their authors.

See the IBM* 1620 Desk Size Engineering Computer in operation at the IRE Conference



An outstanding low-cost engineering and scientific computer with small system convenience—large system features

This solid state computer was designed for scientific research, engineering and management science computations. Complex computations can be performed on a continuous or production basis.

The IBM 1620 is powerful and fast (solves a set of ten simultaneous equations in 20 seconds). It is easy to use and does not require air conditioning, so installation and operating costs are kept at a minimum.

A wide variety of programs is available, including both FORTRAN, designed especially for engineering and research calculations, and GOTRAN, the more simplified computer language. Demonstrations at the IRE Conference will include applications for many phases of industry and science.

Delegates are invited to visit the IBM Booths to see the 1620 in operation and to discuss the application of the IBM 1620 to their own engineering problems.

IBM*

balanced data processing

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*Trade Mark

For complete details check No. 38 on handy card, page 91

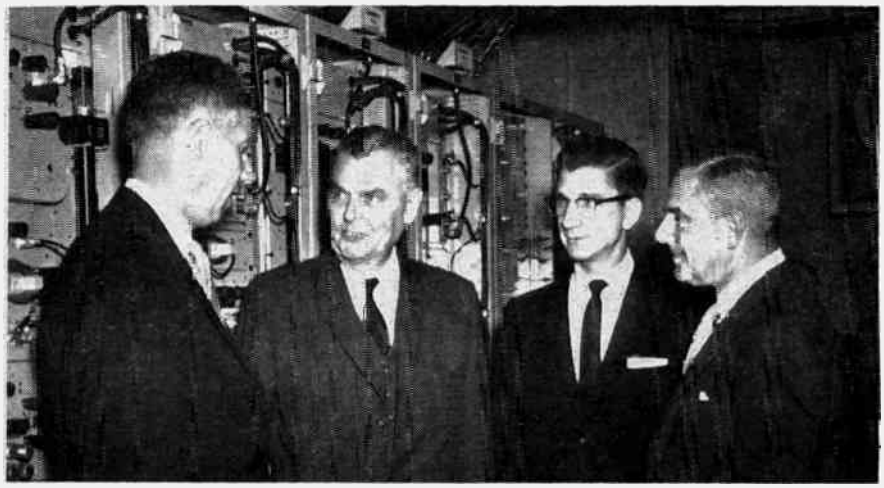
NEW COLLINS SSB MOBILE RADIO

Collins 32MS-1A Single Sideband Transceiver delivers mobile communication dependability you can count on. This versatile unit is at home on land in jeep, truck, car and as a fixed station at your headquarters . . . or in marine or aircraft installations. ■ By adopting the 32MS-1A as basic equipment for your network, you eliminate the need to stock more than one set of spare parts. Maintenance and training problems are reduced, too. ■ The 32MS-1A system provides your operator with a choice of either SSB or compatible AM operation on any of the four preset frequencies in the 1.6-15.0 mc range. And . . . all functions, including channel selection, are controlled by pushbuttons for ease of operation even by your unskilled personnel. ■ A power output of 100 watts PEP (50 watts AM) can be obtained from plug-in power supplies of either 12 v dc, 28 v dc or 115-230 v ac, 50-400 cps single phase power sources. ■ Get complete details about the 32MS-1A from your authorized Collins dealer, or write Collins Radio Company of Canada, Ltd., 11 Bermondsey Road, Toronto 16, Ontario.

COLLINS

the industry's business

Prime Minister opens Alaska Hwy. communications system



Attending the recent opening of the new microwave communications system along the Alaska Highway were from the left: J. D. Houlding, President, RCA Victor Company Ltd., Prime Minister Diefenbaker, Erik Nielsen, M.P. Yukon Territory, and J. R. White, General Manager, Canadian National Telecommunications.

The world's most advanced microwave communications system was officially placed into operation in Western Canada July 22, by the Right Honorable John Diefenbaker, Prime Minister of Canada.

Built by RCA Victor Company, Ltd. under prime contract to Canadian National Railways, the $25 million system provides greatly improved telephone and telegraph facilities along the Alaska Highway stretching 1,300 miles from Grand Prairie in northwestern Alberta to Mount Dave on the Yukon-Alaska border.

This communications triumph initially will be able to provide up to 600 telephone voice channels — their performance substantially exceeding the recognized standards for such communications systems according to John D. Houlding, president of RCA Victor Company, Ltd.

With relatively minor changes additional microwave channels can be added to the system, as each one is capable of carrying 600 voice channels or, alternatively, television programs, Mr. Houlding noted.

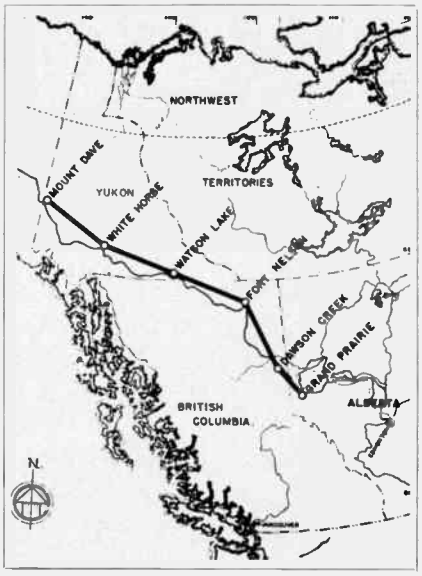
Mr. Houlding paid tribute to the Canadian engineers of Canadian National and RCA Victor for having completed the project within the unprecedented period of 21 months under conditions that would have required three to four years normally.

The RCA Victor MM-600 equipment used in this microwave system is the result of many years of research and development in the field of radio relay equipment and systems in Montreal.

The new system basically consists of 42 microwave stations, located at approximately 30 mile intervals adjacent to, or within distances of up to 15 miles from the Alaska Highway.

These stations consist of building, towers, power plants, access roads, aerial-tramways, and all electronic equipment, and are designed for completely automatic, unattended operation.

A special feature of this new facility is an unattended supervisory maintenance communications system. Every station in each of the five major sections of the system is interconnected by a party line voice channel.



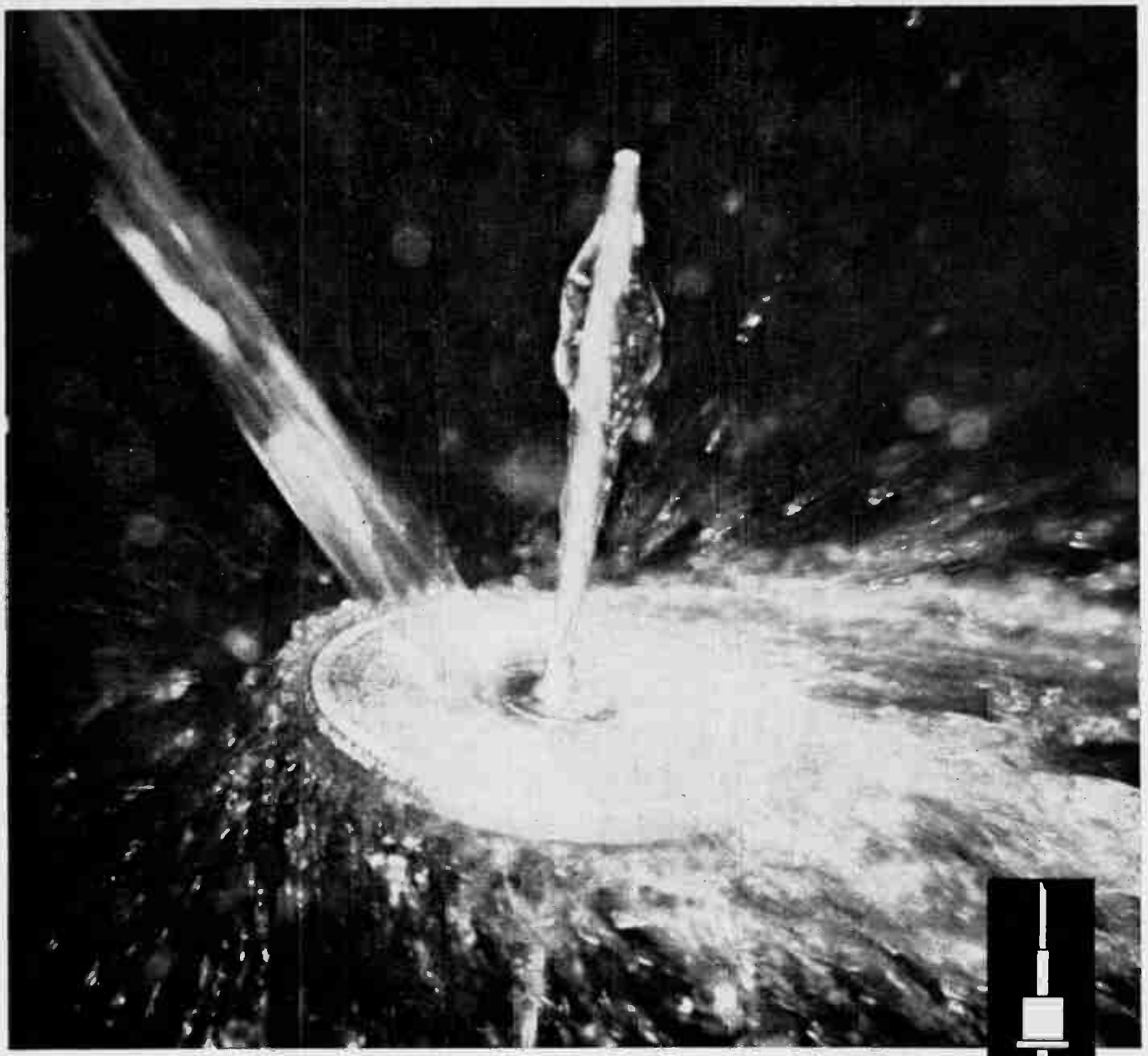
Map showing route of new telegraph and telephone facilities along the 1,300-mile Alaska Highway.

Pat on the back for Litton (Canada)

D. A. Golden, deputy minister of Defense Production and Air Vice Marshall A. C. Annis, Air Officer Commanding, AMCHQ, visited the Rexdale plant of Litton Systems (Canada) Limited. They complimented the management and staff for their accomplishment in "ahead of schedule" deliveries of two Canadian LN-3 Inertial Navigation Systems for the RCAF's CF-104 supersonic fighter.

Here seen greeting the visiting dignitaries is J. M. Bridgman, vice-president and general manager of Litton Systems (Canada) Limited. From left to right, Mr. Bridgman, Air Vice Marshal Annis, Dr. W. Jacobi, vice-president of Litton Systems Inc., and Mr. Golden.

Continued on page 24



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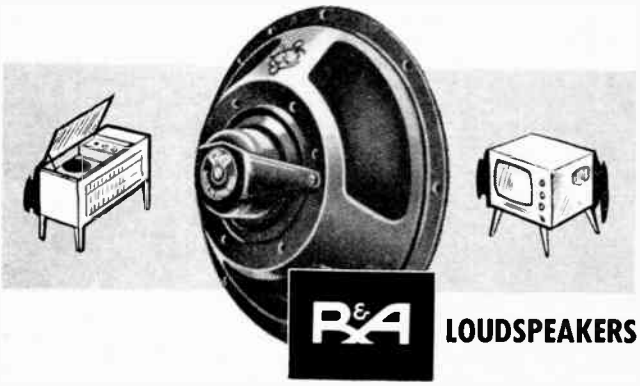

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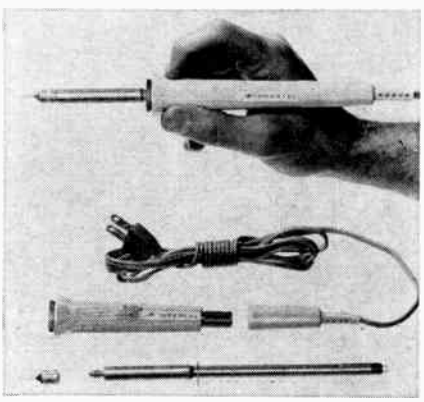

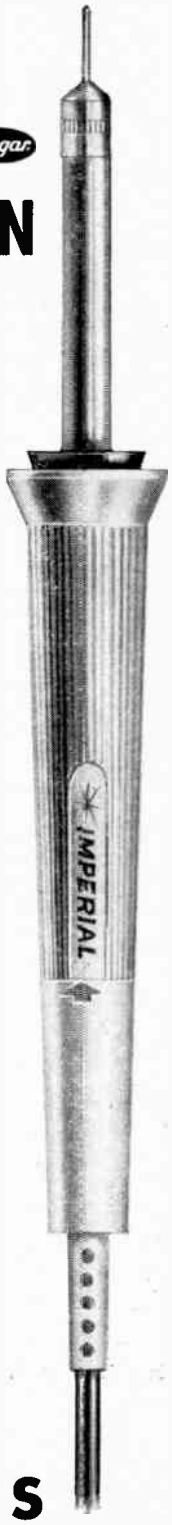

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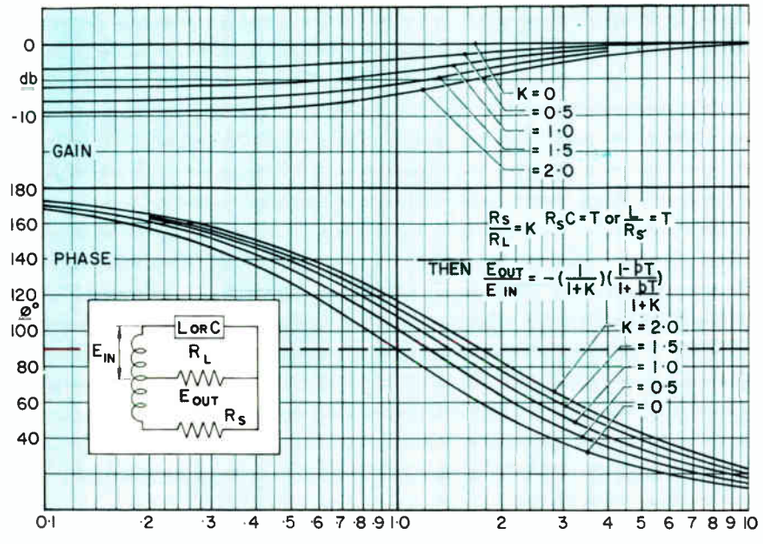
Fast design of linear phase-shifters

by A. E. Maine

The Bridge Phase-Shifter shown in the inset of Figure 1 is frequently used in low power control circuits where it is inherently capable of producing a phase shift of a sinewave signal over a range of nearly 180°. The design of bridge phase shifters is a very simple matter if the load resistance can be regarded as being infinite as is often possible in the design vacuum tube circuits. In the case of transistor applications, this assumption can rarely be made and the presence of a finite load complicates the design process. For this reason the two charts given on this page have been drawn; their use enables most designs to be quickly worked out as suggested by the following example.

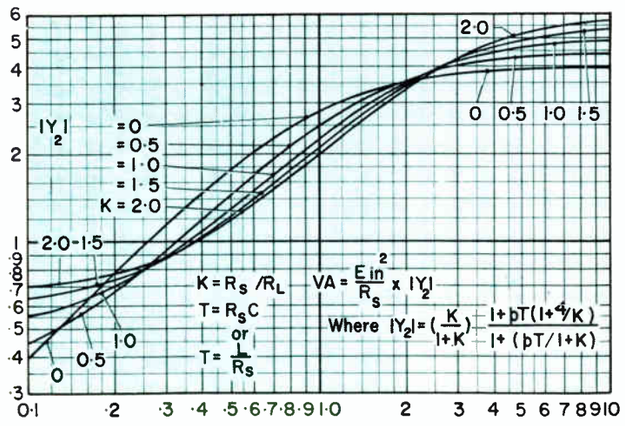


wT → FOR RC BRIDGE , 1/wT → FOR RL BRIDGE

FIG. 1. PHASE SHIFTER TRANSFER FUNCTION

TYPICAL PROBLEM

A three-phase Static Inverter requires a 90° signal to be developed from a 400 c/s single-phase supply at a level of 4 volts into 500Ω using an RC bridge. Establish circuit values and the total VA required from the source.



wT → FOR RC BRIDGE, 1/wT → FOR RL BRIDGE

FIG. 2 PHASE SHIFTER IMPEDANCE FUNCTION

Solution

(1) The ratio of output VA and total circuit VA varies with the phase angle (Φ) and the value K. Suitable values lie in the range 0.5 to 1.0. A starting value of 0.5 is taken.

(2) From Figure 1, the value of ωT, for K = 0.5 and $\Phi = 90°$ is given as 1.22, and the attenuation (from the upper part of the diagram) is 1.6 dB.

(3) Evaluating for T, $T = 1.22/2\pi f = 0.485$ mS.

(4) $T = CR_L$, therefore C = 1.94 uF, say, 2 uF nominal.

(5) 1.6 dB corresponds to a ratio of 1.2, therefore E_{in} becomes $4 \times 1.2 = 4.8$ VRMS.

(6) Total input VA = $E_{in}^2/R_L \times |Y|$. From Figure 2 and T = 1.22 and K = 0.5, $|Y| = 2.85$. Therefore $VA_{in} = 262$ mVA.

Design summary

R_L	= 500Ω	E_{in}	= 4 VRMS
R_S	= 250Ω	E_{in}	= 9.6 VRMS-CT.
C	= 2 uF	VA_{in}	= 262 mVA
Φ	= 90°	VA_{out}	= 32 mVA

The main use of the design charts is that they enable many designs to be roughed out in order that some aspect, for example, a preferred component value, may be incorporated and an optimum result obtained. The procedure for LR phase shifters is much the same as for CR types but care should be taken to use the chart abscissae for the reciprocal of ωT. Also to be noted is that significant errors can occur if the Q of the inductor is low, say, below 10. In these circumstances a more detailed network analysis should be made.

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Index

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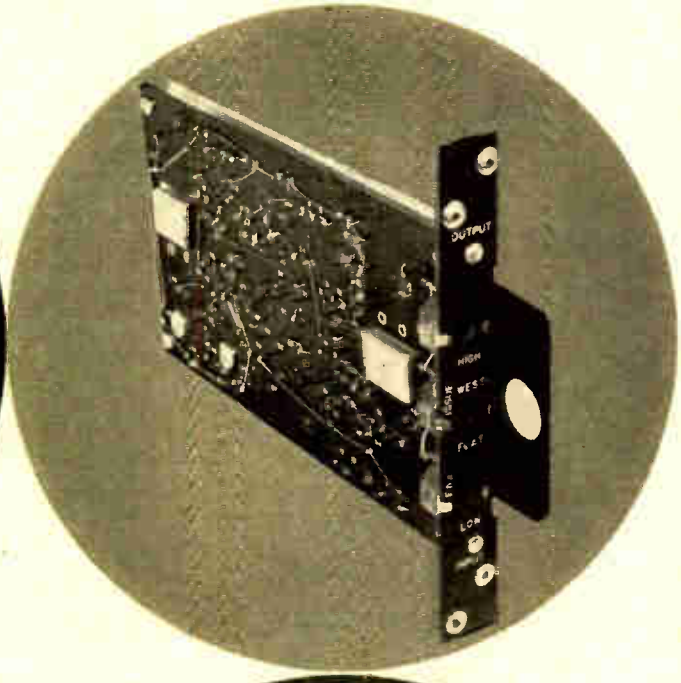

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For complete details check No. 42 on handy card, page 91

Electronic Industries Association of Canada news

by R. T. O'Brien

Broadcast Transmitter Standard Approved

A new Canadian Standard has been approved by Electronics Division Chairman W. S. Kendall and Director of Engineering R. A. Hackbusch. Originating in the Electronics Division's Broadcast Equipment Engineering Committee the document is intended for application to all broadcast transmitters approved for installation in Canada.

Entitled, "CRS-19, EIA of Canada Standard for AM Broadcast Transmitters (540-1600 KC)" the Standard sets forth the recommended minimum performance requirements in the power source; the power output capability; modulation capability; carrier shift; audio frequency response; AF harmonic distortion; carrier frequency stability; normal load characteristics; input impedance; and methods of measurement.

New EIA Membership

Five new memberships in two Divisions are announced. Sperry-Gyroscope Company of Canada Ltd., Montreal; Standard Telephones & Cables Manufacturing Co. (Canada) Ltd., also of Montreal; and Pye Canada Limited of Toronto have joined the Electronics Division. Components Division memberships are approved for Daystrom Limited of Cooksville, Ontario, and the Federal Wire and Cable Division, H. K. Porter Company (Canada) Ltd. of Guelph, Ontario.

Main representative to the Association for Sperry is R. H. Littlefield, Director of Contracts; Standard Telephones is represented by T. C. Lewis, Component Sales Manager; J. W. Paddon, acting General Manager, represents Pye Canada Limited; Federal Wire and Daystrom are represented by J. B. Clarke, General Sales Manager, and H. W. Cowan, Vice-President and General Manager, respectively.

Committee Appointment for P. J. Heenan

Dave Knapp, Chairman of the Components Division, has announced the appointment of P. J. Heenan, Centralab Canada Limited, Ajax, as Chairman of Components Division Tariff Committee.

Mr. Heenan, a Director of EIA and very active in Components Division affairs, was Vice-Chairman of the Committee and succeeds former chairman J. R. Longstaffe, Renfrew Electric Company Ltd., Toronto, who has relinquished his duties as chairman of this important committee after many years of valuable service to the industry on tariff matters. Mr. Longstaffe will continue his tariff activities in EIA, however, as Chairman of the Resistors Group.

the industry's business

Continued from page 14

Interprovincial to distribute "Vibroground"

Exclusive Canadian distribution of the new Vibroground resistivity measuring instruments employed in the cathodic protection and corrosion field has been awarded to Interprovincial Corrosion Control Co., Ltd. of 1150 Plains Road East, Burlington, Ontario, by the manufacturers, Associated Research, Inc. of Chicago, U.S.A.

Aerovox Canada first to give two-year warranty

A two-year warranty is now in effect on Aerovox capacitors and resistors sold through all industry markets. This is the first major change in product warranty made by a manufacturer of these components in recent years. A one-year warranty has been traditional in the electrical and electronic components industry.

Continued on page 94

Resistors?

STACKPOLE matches every requirement

If you have a burning yearning for improved resistor dependability coupled with on-time deliveries, here's a hot tip:

In Performance Stackpole Coldite 70+ fixed composition resistors go well beyond MIL-R-11 requirements—with added dividends in load life, moisture resistance and humidity characteristics. For extra reliability, their carbon resistance elements and outer insulating shells are cold-molded of similar materials. These are formed by a new process into a solid, homogeneous structure that remains free from catastrophic failure or erratic changes in resistance in severe environments.

In Production Stackpole Coldite 70+ Resistors remain one of the easiest components to solder either by dip or iron. They're the only resistors having leads that are solder dipped—not once, but twice—in addition to the usual tin coating. That's why leads stay smooth and tarnish free even after months in storage.

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industry personnel

Norris

Davis

Two new appointments at Welwyn Canada

Welwyn Canada Limited have announced the appointment of **K. R. Davis,** as a director of the company. Mr. Davis assumes responsibility for direction of sales activities for North America. He was formerly assistant director of sales for the Canadian market.

R. Wilton, vice-president and general manager, also announced the addition of **C. A. Norris** to the company's administrative staff. Mr. Norris is well-known to the Canadian electronics industry. He held the positions of chief engineer with I.R.C. Canada and later general manager of Copper Wire Products. This was followed by extensive experience with Remington-Rand in Canada, where he was engaged in activities associated with their Computer Division.

DOT retirements

William Elliott Connelly, MBE, 67, superintendent of common carrier and landlines in the Transport Department's telecommunications branch retired on August 11.

A DOT employee with one of the longest records of service, Mr. Connelly has contributed to the forming of the Canadian Overseas Telecommunication Corporation and was active in the work of the International Telecommunications Union. Of major significance is his contribution to the planning for the round-the-world telephone cable system now being established by commonwealth countries.

Harold Edgar Walsh, MBE, 65, chief of the design and construction division in the Department of Transport's telecommunications branch retired on August 28.

In 1946 he was honored with an MBE in recognition for his direction of the establishment of aviation navigation radio aids during the war to serve the requirements of home defense and Commonwealth training. He was also awarded the Coronation Medal in 1953.

New chief engineer for Essex Electronics

The appointment of **J. E. Kalfus** as chief engineer of Essex Electronics of Canada Ltd. was announced by Bernard M. Goldsmith, president of the parent company Nytronics, Inc., Berkeley Heights, New Jersey.

Mr. Kalfus has had extensive experience as an electronics development engineer with such organizations as Canadian G.E., Pye Canada Ltd., and Philips Canadian, and in addition he has been associated with the University of Toronto, as a lecturer.

Walker

Kalfus

U.K. lecture tour for Dr. Walker of UBC

Dr. George Walker, research professor in the department of electrical engineering at the University of British Columbia, has been invited as a visiting professor to four British universities under a scheme sponsored by the British Council.

Dr. Walker will give lectures at the Universities of Oxford, Cambridge, London and Sheffield on research work in the field of microwave electronics which is being carried out at UBC by a group under the direction of Dr. Walker.

Radionics name Zieba as field sales engineer

Radionics Limited, Montreal 9, Que. announce the recent appointment of **Edward S. Zieba** as field sales engineer for the Toronto and Western Ontario area.

Mr. Zieba has established a new Toronto office. Mailing address is P.O. Box 9, Downsview, Ontario.

Senior Department of Transport appointment

Cecil Mornington Brant, P. Eng., chief of technical and policy co-ordination in the Department of Transport's Telecommunications Branch, has been appointed deputy director, Air Services, Transport Minister Leon Balcer announced early this month. The appointment comes into effect September 5.

Mr. Brant succeeds Dr. Thomas G. How, as the third and last appointee in a six-year program under which senior officers in the department have received special training on a rotating basis.

Railway & Power Engineering increase sales force

The following appointments and transfers in the Aviation Division of Railway & Power Engineering Corporation Limited, are announced by R. J. Conrath, division manger.

Harry A. Talbot has been transferred to Ottawa where he becomes the Ottawa District representative. He has been with the company for eight years has served as a technical sales representative in Toronto.

Raymond R. Finney recently joined the company and was appointed technical sales representative in the Montreal area.

Kenneth E. Norwood takes a position as technical sales representative in Toronto. He has been with the company for four years and was previously responsible for aviation activities in Vancouver. This position will be assumed by **Gordon Marshall** who has been district manager in that area for several years.

Talbot

Norwood

Paddon

Finney

Pye appoints Paddon

Pye Canada Limited has named **John W. Paddon** as general manager of the company. Mr. Paddon has been associated closely with Canadian electronics, both in government and industry, for the past 20 years. He is a senior member of the Institute of Radio Engineers.

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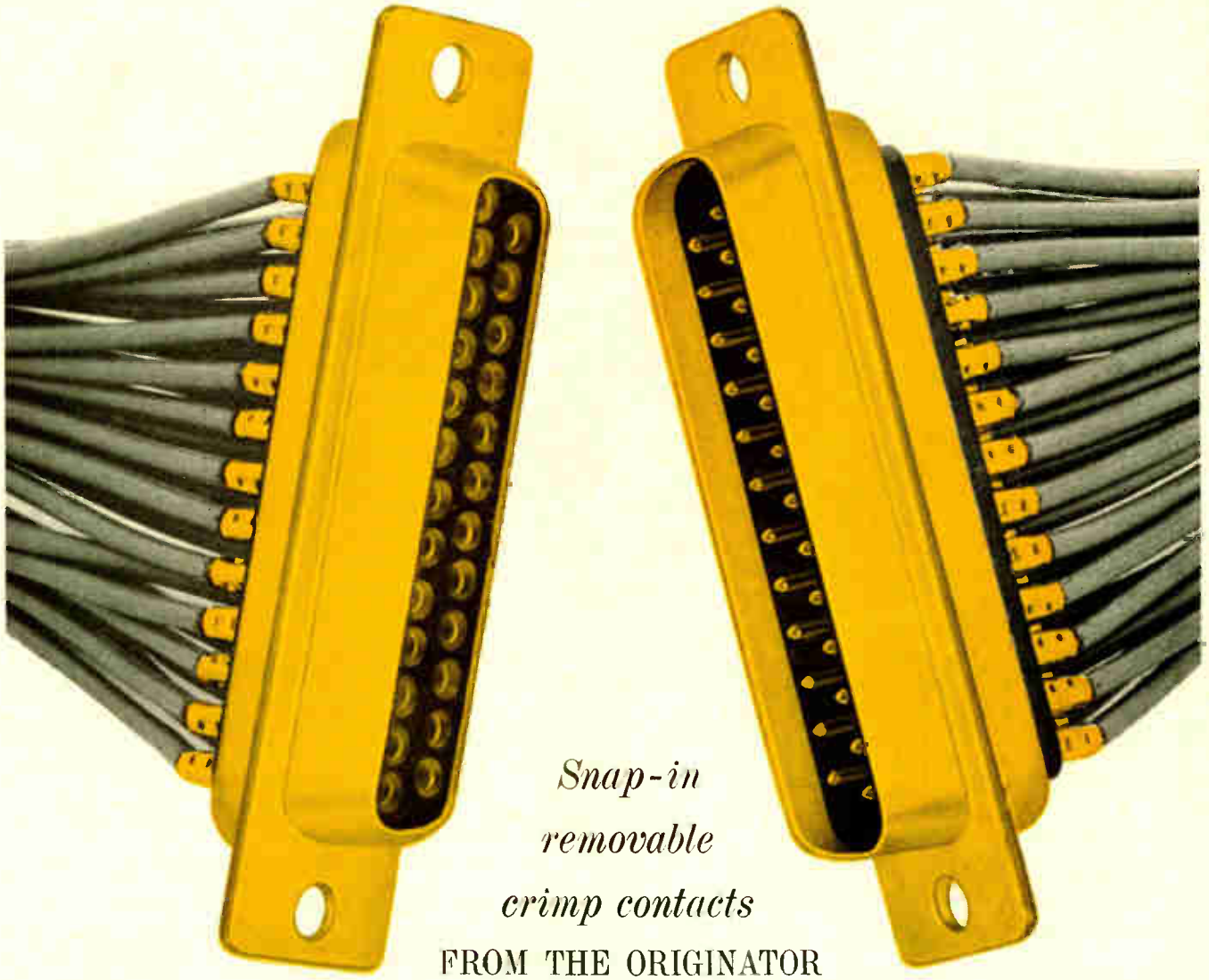

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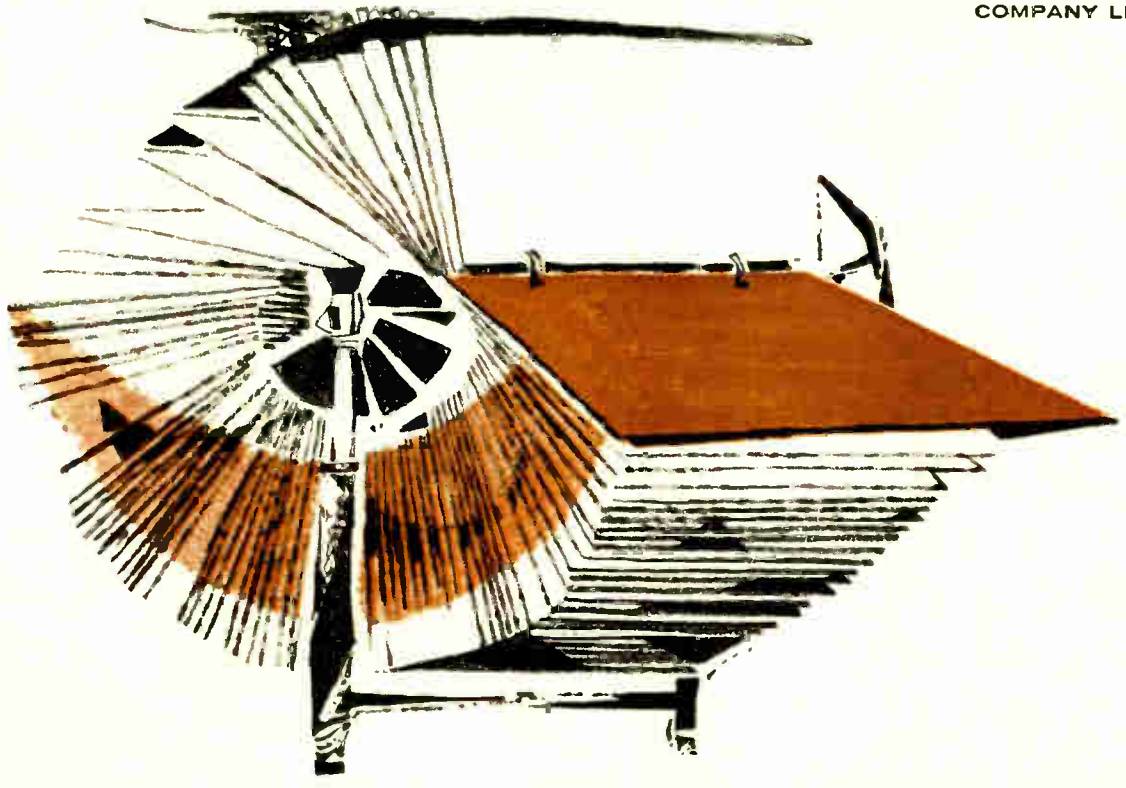

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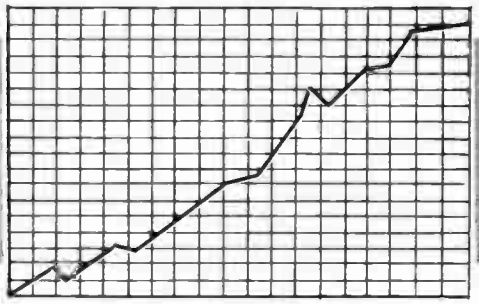

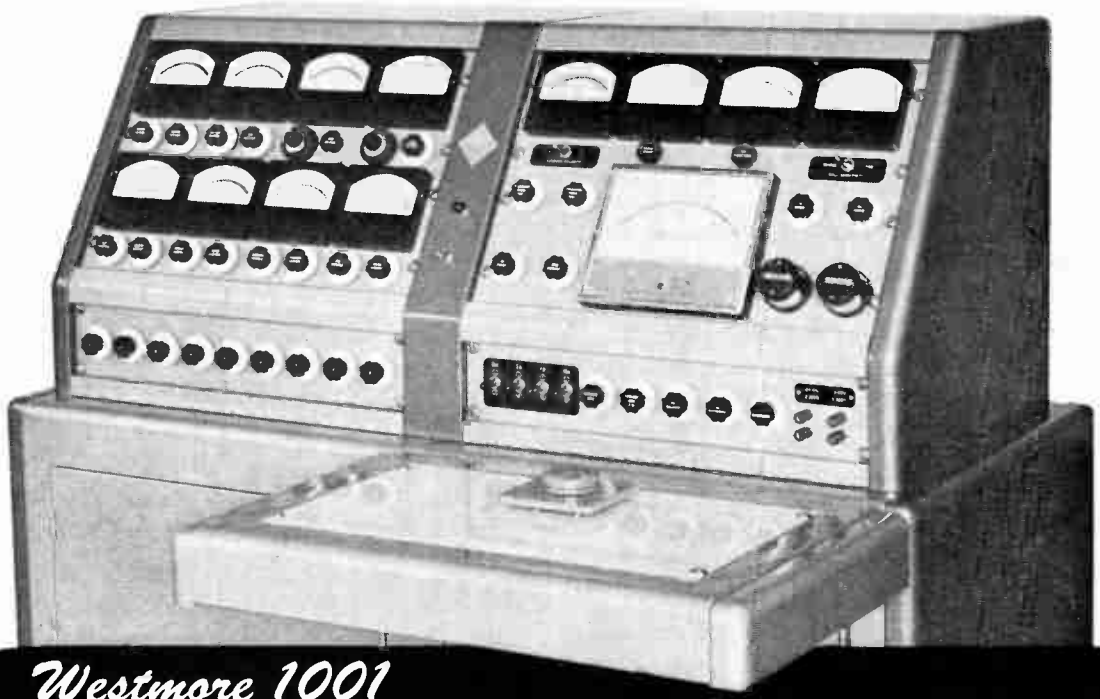

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With today's emphasis on controlled instrumentation, it has become increasingly important to know the in-circuit performance of electron tubes — their characteristics at any point of excursion in the specified range as well as at performance limits • The new Westmore 1001 makes it possible to do this easily and with unprecendented accuracy, before a given tube is installed and periodically during its operational life. The 1001 measures true mutual conductance, using the proven circuitry first introduced by Westmore, as well as plate resistance and amplification factors. Bridge circuits, sensitive null detector, 1% regulated power supplies, variable voltages for tube elements and other advanced features provide the maximum in precision, accuracy, convenience and versatility • The 1001 also measures electrode insulation to 100 megohms, leakage currents to 0.1 microamps. Mobile console measures only 50"w x 60"h x 24"d. WRITE FOR TECHNICAL BULLETIN 101.

Westmore INC.

INSTRUMENTATION DIVISION

137 South Avenue, Fanwood, N. J.

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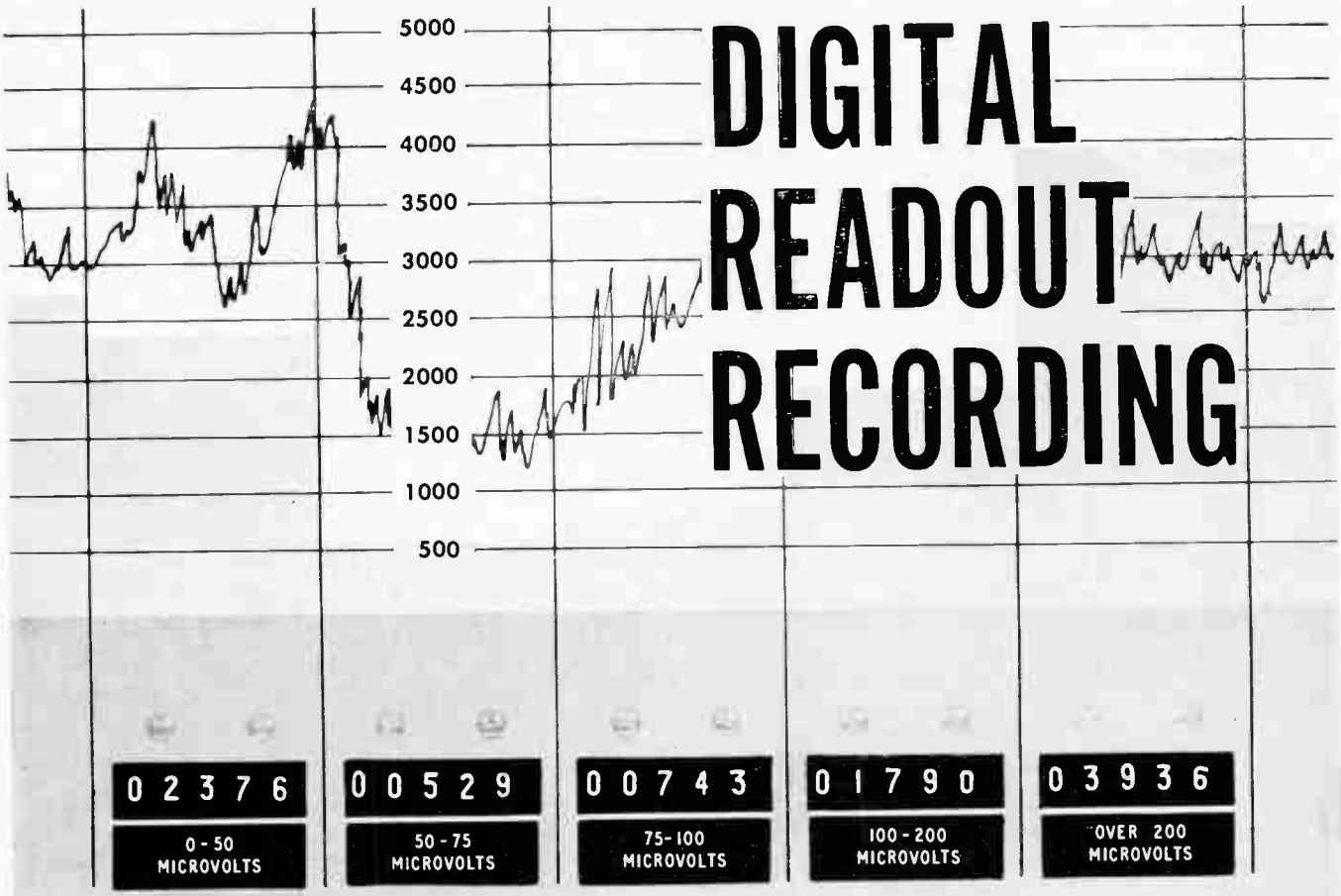

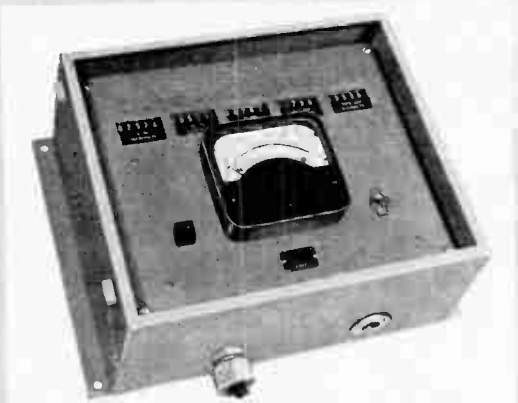

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Designed to record any function (e.g. Voltage, temperature, field strength) which, with the use of a suitable transducer, can be displayed on a panel meter, it operates by sampling the function value at preset intervals (from 1 sec. to 20 min.). *Counter readings record the number of times this value has been found to be in each "value group" or subdivision of the function's range.* With a sampling rate compatible with the rate of change of the function, these readings, multiplied by sampling interval, yield the total time that the value of the function fell within each value group.

As a result, where a statistical record of function behaviour rather than a complex minute-by-minute tracing of its variations is required, the Digital Recorder is the simple, economical answer.

The Digital Recorder is available in standard five- or ten-counter versions (others to special order) for standard rack mounting, in moisture- and dust-proof CEMA 12 housings, or in wood cases for bench or portable use. Wide ranges of sensitivity, scales and value group arrangement are feasible.

Your inquiries are invited.

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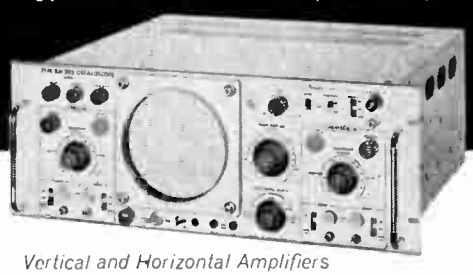

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- reliability-tested specifications

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Type	Maximum Power Dissipation at 100°C Case (Watts)	Maximum Collector Voltage V_{CB} (Volts)	Minimum DC Common Emitter Current Gain at 2 Amps β	Typical Collector Saturation Resistance (Ohms at 2 Amps)
2N1616	30	60	15	0.7
2N1617	30	80	15	0.7
2N1618	30	100	15	0.7
2N1210	30	60	15	0.7
2N1211	30	80	15	0.7
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2N2018	150	20	20	125	3.5
2N2019	200	20	20	140	3.5
2N2020	150	20	40	125	3.5
2N2021	200	20	40	140	3.5
2N1647	80	20	15	60	1.9
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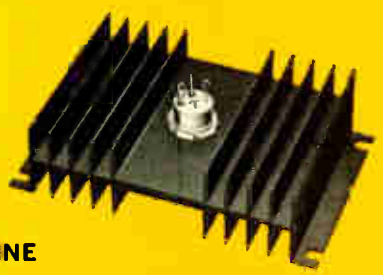

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For further information, write for Application Notes AN-1355C and Bulletin TE-1355-1.

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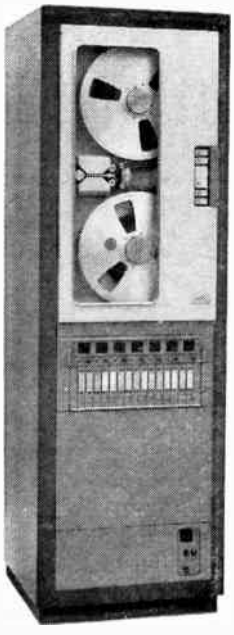

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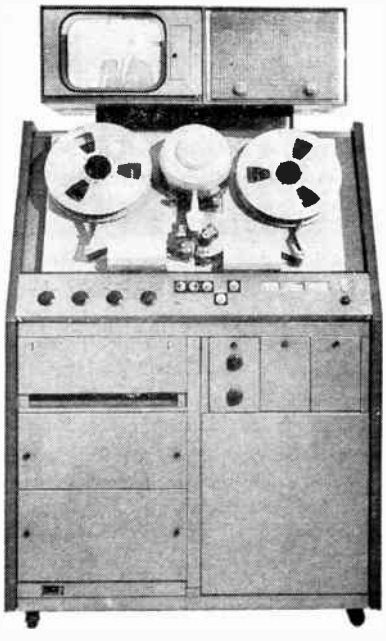

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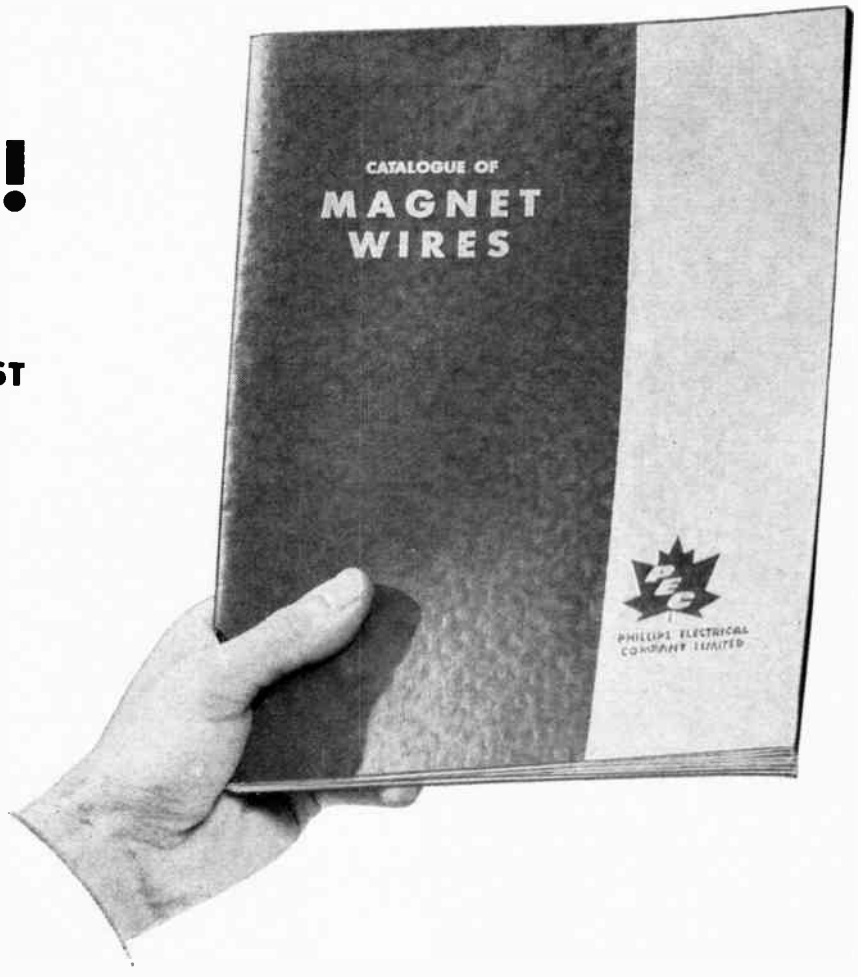

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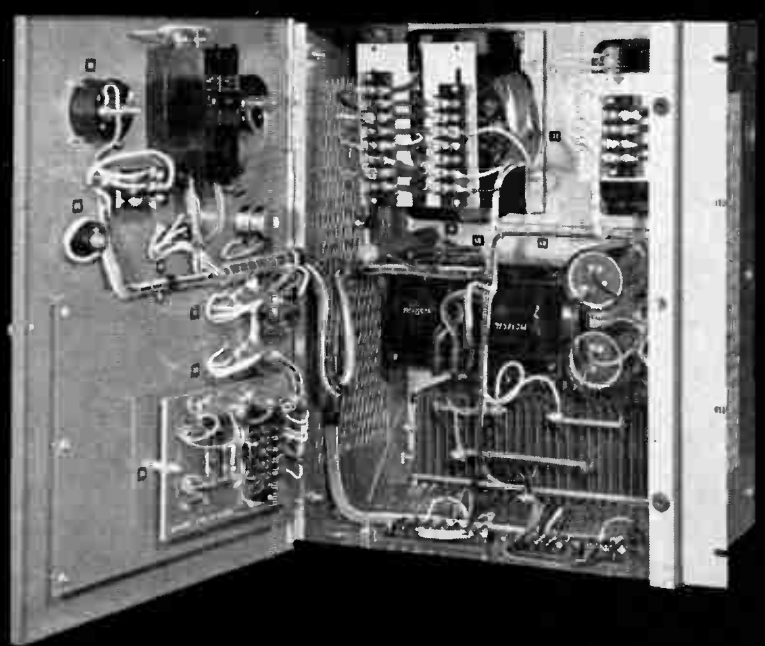

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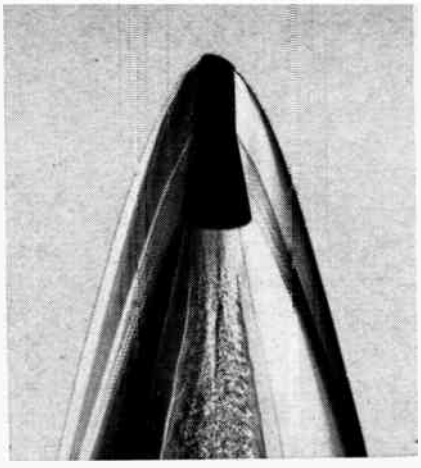
Letarte

Both authors are with The Canadian Armament Research & Development Establishment, Quebec. Mr. Letarte is Head of the Instrumentation Section and Mr. Moir is with the Aero-physics Wing.



Shadowgraph of ballistic model showing bow waves and turbulent wake at a velocity of 5,000 feet per second.

High "g" telemetry – a new tool for research

External instrumentation has served the field of ballistics research for a number of years. Advanced researches into model stability and plasma phenomena have shown the need for telemetry carried within the test vehicle. Article describes most recent developments of new electronics to fulfill this requirement.

by M. Letarte and L. E. Moir

The application of the ballistic range technique to the solution of aerodynamic problems involves firing scale models from guns into a controlled atmosphere where the desired measurements are made. These measurements may be external or internal to the model. External measurements such as photography and yaw card, or signature card, methods for determining the model trajectory [1][2] have been successfully carried out for many years. On the contrary, it is only recently, with the development of the High "g" Telemetry, that internal measurements such as temperature at the stagnation point, stability data of models in flight, pressure distribution around the model, radiation intensity from inside the model, behavior of the model during the impact, and many others are now possible. On full scale models, internal measurements are easily made because the launching accelerations are rather low, and the space limitations are not too severe. It is the purpose of this article to report on the progress made on the internal measurement problem at the Canadian Armament Research and Development Establishment (CARDE).

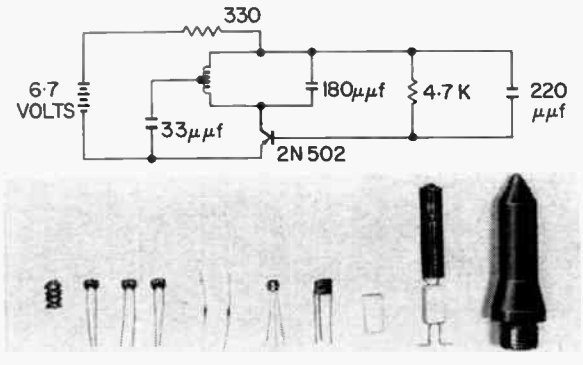


Fig. 1. Circuit diagram of transmitter and photograph of component parts.

Early work

Early work on this project was started in 1958. The aim of this program was to develop a system where the final product would be light, compact and capable of withstanding the very high accelerations encountered in the gun. The simplest system is that in which a radio frequency oscillator is frequency modulated directly by a transducer. This system has a great advantage in that its frequency response is high but, on the other hand, only one channel of information can be telemetered. To increase the number of channels an FM-FM system has to be developed where the transducer frequency modulates a subcarrier oscillator which, in turn, frequency modulates the transmitter. As a first step in this program, simple oscillator circuits were developed and in tests subjected to accelerations up to 225,000 g's. The purpose of this early work was to establish the feasibility of the system and to prove out various components.

One of the circuits used for these tests appears in Figure 1 which illustrates all the components and the unit at various stages of production. This RF oscillator is a standard Hartley type, in which the number of components has been minimized. The tank coil serves as the RF radiator as well as the inductive element of the tuned circuit, The radiated power is very low (a few microwatts) but is sufficient for the near field antenna system which is used in CARDE ranges. For applications requiring higher power as, for example, vertical firings, the transmitted power can be increased by coupling the tank coil to the metallic portion of the vehicle which then serves as the antenna.

A special projectile was developed to serve as a vehicle in which practical telemetering systems could be assessed. The projectile weighed 2.1 pounds and

when subjected to a 225,000 g acceleration, could be launched at velocities higher than 6,000 ft./sec. using a conventional 3.125" smooth bore gun. With the same projectile, but employing the light gas gun, velocities up to 12,000 ft./sec. could be realized.

In the construction of these units [3][4] the need for compactness made it necessary to eliminate mounting boards and to use three-dimensional construction. The circuits of all packages are tested on a breadboard and then assembled so they will fit a ⅝" diameter mould. Figure 2 shows a typical telemetering unit at three different stages of production. Before each potting,

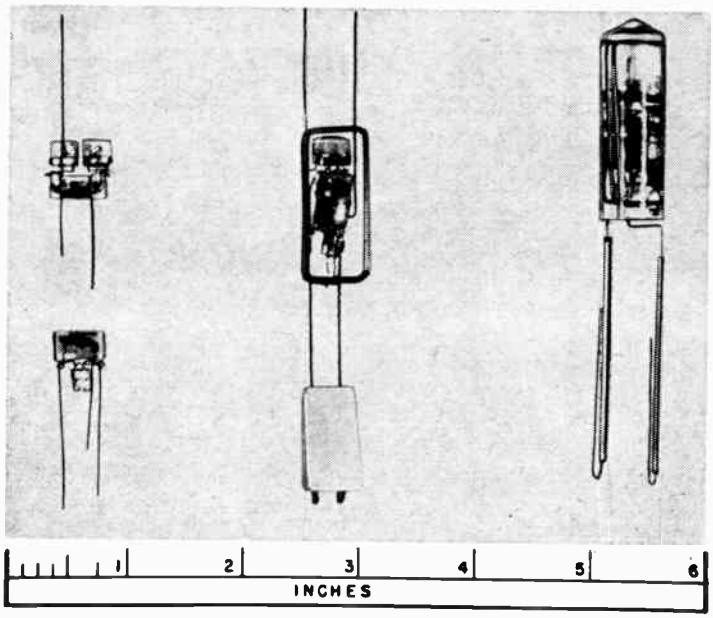


Fig. 2. Illustrating the steps in the production of a telemetering unit.

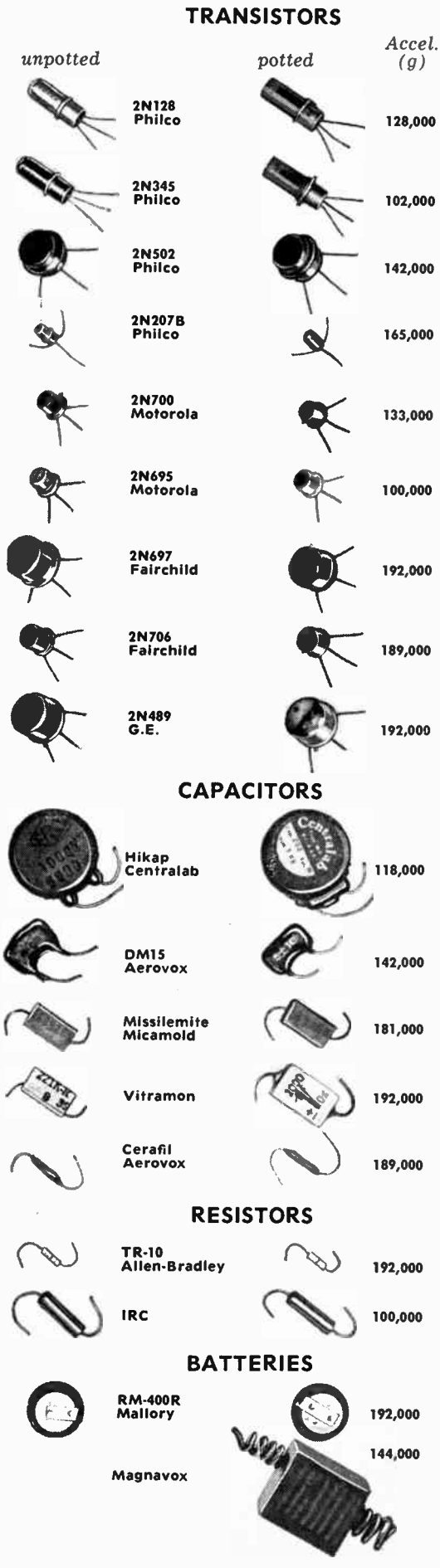
the unit is cleaned so the araldite will bond to all the surfaces for maximum strength. For the second potting, the unit is wrapped with fiberglass cloth and then placed in a plexiglass mold. The mold is placed in a pool of araldite and then evacuated by applying a vacuum to the top of the mold. This process impregnates the fiberglass with araldite and forms a very strong package when the epoxy has hardened. The package is then machined so it can be screwed into the aluminum carrier. Figure 3 shows some of the components which have been tested successfully. It can be seen that quite a few transistors survive the gun loads. To achieve this result, most of these transistors have to be potted internally where experience has indicated that transistors with low I_{c_o} have the best chance of surviving the potting process: the mesa type transistors are particularly suited for this type of work.

The success of this early work proved the feasibility of the high "g" telemetry system and a basis was laid for subsequent designs.

Temperature measurement methods

Typical test conditions at a velocity of 5,000 ft/sec, involve a temperature rise at the model's stagnation point of the order of 1000°F. This temperature is measured by a glass backed heat transfer gauge located appropriately on the model. Higher temperatures are obtained in a range of 10 mm of Hg and a velocity of 12,000 ft/sec.

Fig. 3. Components successfully tested showing peak acceleration forces applied.



The temperature gauge developed for this measurement consists of a thin layer of Hanovia platinum paint deposited with an airbrush on a highly polished pyrex pellet. The gauge is baked at a temperature of 1250°F in a well ventilated oven. After slow cooling at room temperature, the thickness of the platinum film is less than 1 micron. The nominal resistance of the gauge can be accommodated in the range 200 ohms to 1500 ohms with a temperature coefficient of 0.00125 per degree F.

Figure 4 shows the circuit diagram of the first units fired. The gauge is connected in parallel with the emitter resistance of the multivibrator circuit which forms the sub-carrier oscillator. Any change in the resistance is translated by a change in the frequency of the multivibrator. The value of the resistance in parallel with the gauge depends on the temperature change expected and the resolution required. The higher the value of this resistance the greater the resolution or the lower the temperature change that can be measured. An X-ray photograph of the complete telemetering package is shown in Figure 5.

The instrumentation layout for the recording of the telemetry signal is given in Figure 6. A two-wire transmission line made of copper tubing ¾" in diameter runs parallel to the line of fire for the complete length of the range. This transmission line is terminated at both ends into its characteristic impedance (300Ω). The line is then matched to a receiver. The output of the receiver is fed to a monitoring scope for visual observation during firing, and to an Ampex CP/100 for the recording of the sub-carrier frequency over the complete length of the range. The tape is then slowed down by a factor of as much as 1024 so the sub-carrier frequency can be recorded directly on a slow frequency response pen recorder. This permits a very accurate analysis of the record for the complete flight.

Temperature flight tests

Many projectiles were fired using the system described but the early results were not as expected. On many occasions the recorded signal indicated that the gauges at the beginning of the trajectory were short circuit and then gradually were reaching the open circuit condition. It was very difficult to explain these failures since it was hardly conceivable there was enough ionization at 4,600 ft/sec to account for the short circuit condition. The open circuit condition could be explained by ablation of the platinum film as

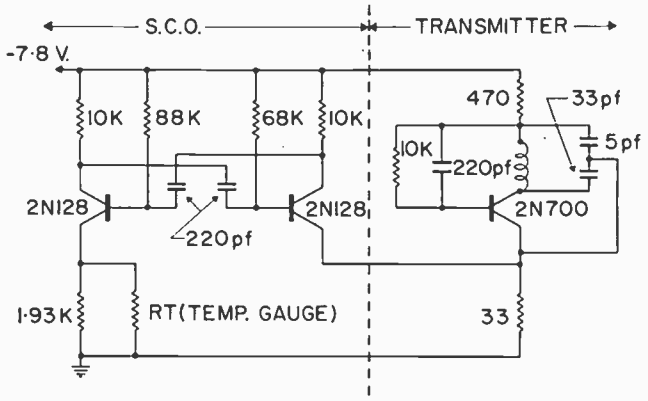


Fig. 4. Circuit diagram of 'high-g' temperature measuring telemetering system.

some of the projectiles were launched at muzzle velocities as high as 6,300 ft/sec.

One trial firmly, established that the telemetry unit was operating satisfactorily. Three projectiles were fired with the temperature gauge completely embedded inside the projectile so the gauge would not have contact with the plasma sheet. In the three cases the frequency recorded was the same as the preflight calibration frequency. Certain modifications were made to the system including the circuit changes shown in Figure 7 and these contributed to much improved results. The gauge was baked at a higher temperature and the temperature cycling time was increased which made the bond of the platinum gauge to the pyrex pellet much stronger. Then the surface of the gauge was covered with a coat of silicon monoxide to protect it from any ionization present in the shock wave. The gauge was mounted inside a brass hemispherical nose. The metallic part of the nose was grounded to the negative side of the power supply to remove any electrostatic charge which could come in contact with the nose. The gauge was insulated from the metallic nose by a thin ring of mica.

Five rounds were fired with the modified system, and the results obtained are presented in Figure 8. All the curves have been normalized so they may be compared together. The fifth curve is not shown on this figure because of a malfunction in the telemetering system which occurred during flight.

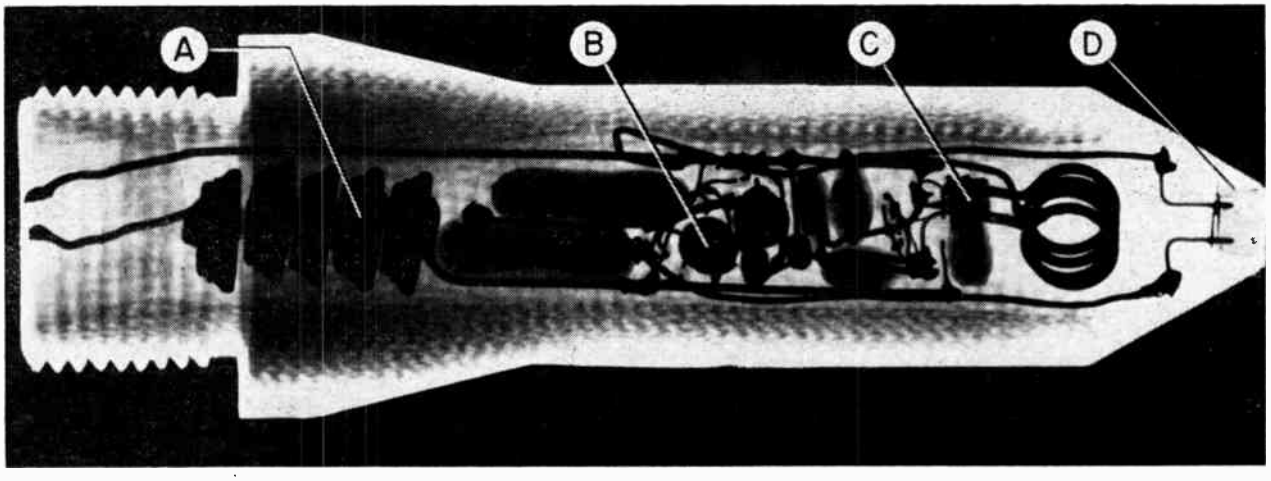


Fig. 5. X-ray photograph of complete telemetering package.

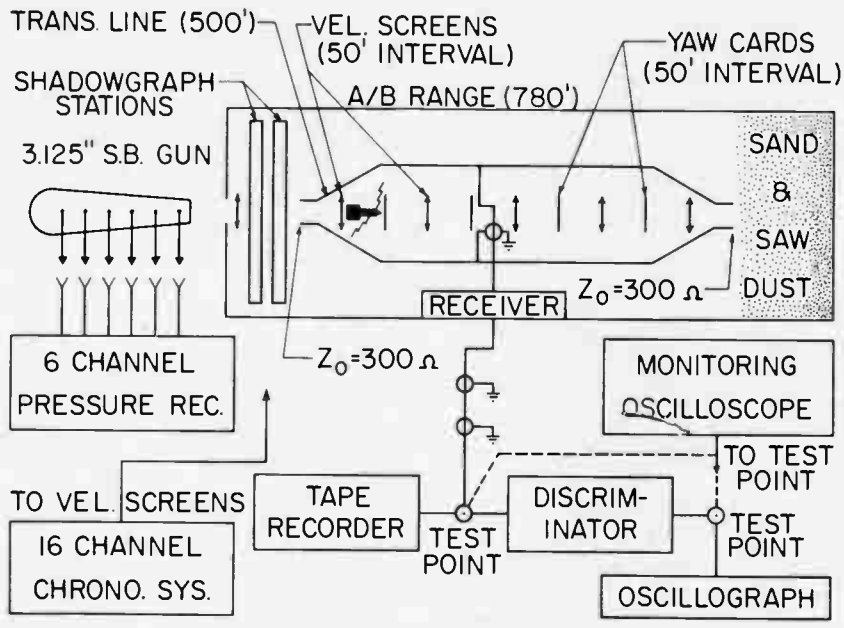


Fig. 6. Block diagram showing layout of high "g" telemetering instrumentation.

One experimental curve has been compared with one obtained using the ALWAC computer and was based on the heat transfer rate equation for stagnation point heat transfer to a blunt body of revolution in hypersonic flow (given in reference 5). The shapes of both curves and the time of their maximum temperature were found to be in agreement, but not their amplitudes. Part of this disagreement may be explained because the gauge was recessed and the theoretical curve had been calculated for a hemispherical pyrex nose while the experimental gauge was only a flat pyrex pellet ¼" in diameter and mounted on a hemispherical brass nose. Probably the main diagreement was due to a spurious frequency shift of the sub-carrier oscillator. If an accurate temperature measurement is required, it is imperative that compensation be made for this frequency shift. One way of doing this is to calibrate the sub-carrier oscillator frequency during flight. The input of the sub-carrier oscillator may be switched electronically between a calibrating resistor and the temperature gauge. With this system data-reduction of the record becomes more tedious but the accuracy of the results is greatly improved.

Stability data measurements

For stability investigations of models, discreet measurements of model attitude have been used successfully for substitution into the equations of motion. The advantage of a continuous record of accelerations is obvious: five accelerometers mounted in a projectile provide all the information necessary to deduce the stability derivatives of the model.

In order to test the techniques which has been fully described [6], airborne units containing as many as three accelerometers, either mounted in the nose or at the center of gravity of the projectile, have been developed and fired successfully. The accelerometers mounted in these units are miniature units, model 512 produced by the Columbia Research Laboratory. The small size of these units, as well as their ruggedness and high sensitivity, makes them suitable for this type of work.

One of the circuits developed for stability telemetering is shown in Figure 9. The output of the accelerometer is fed to a multi-stage high-input impedance amplifier and an 'attenuation' capacitor is added to the circuit to keep the signal within the working range of the amplifier. The signal is then fed to the base circuit of the transmitter for frequency modulation.

Figure 10 shows a four-fin dart model together with its telemetering package before assembly, which has been fired successfully. This model was subjected to 50,000 g's and launched at a velocity of 2,000 ft/sec. The results obtained with telemetry were compared with those gathered from two series of yaw cards (thin paper screens through which the model passes) along with the trajectory: the agreement between the two methods was found to be exceedingly close.

Other models subjected to 100,000 g's and fired at a muzzle velocity of 5,000 ft/sec have also exhibited excellent agreement with yaw-card data, thus firmly establishing the validity of the method.

Of some interest is the fact that an attempt was made to recover a 2-channel telemetery projectile in order to salvage the accelerometers. To this effect, two boxes, 10 ft. long, one filled with dry sawdust and the other with foam rubber, were mounted in the trajectory near the butt. Unfortunately, the projectile hit a 2 x 4 wood frame before going through the boxes, hit another 2 x 4 before penetrating 17 ft. inside the butt (a mixture of sand and sawdust). The projectile was recovered and was still working, an X-ray photograph showing the internal electronics to be perfectly intact. In addition to this two-channel unit, another model was launched with three accelerometers mounted inside. The

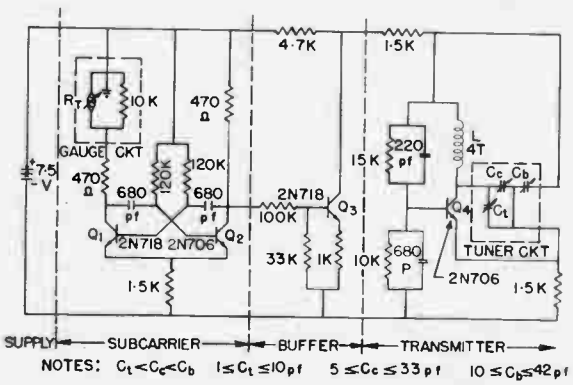


Fig. 7. Circuit diagram of modified temperature telemetering system.

recorded signal was very strong, but inter-modulation of the sub-carrier frequencies rendered data reduction very difficult. This particular projectile was fired through yaw cards in order to compare the results obtained by telemetry with those obtained by yaw card techniques. Passage through the cards, at approximately 1 mS intervals, was accompanied by interference with the transmitted signal. The mechanism whereby this interference is produced, is not understood at the present time and enquiries, into heavy ionization effects and mechanical shock are being made.

For the present, filtering techniques have been attempted for separating the individual signals, but the noise resulting from the yaw cards interrupt the RF signal and make it impossible to use standard discriminating techniques for separating the individual signals.

Conclusion

This article has outlined electronic methods developed for measurement of temperature at the stagnation point, and stability data of ballistic models in flight. Some of the results obtained have been reported herein.

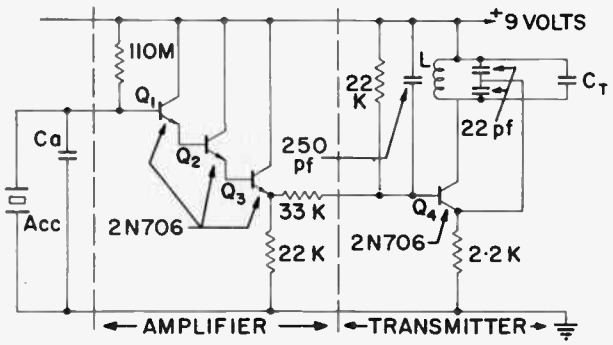


Fig. 9. Circuit diagram of single channel yaw measurement telemetering system.

Other measurements such as infra-red radiation and plasma property studies are currently under investigation. For the infra-red measurement, a lead sulphide detector mounted behind a quartz window has been successfully tested in the laboratory with a breadboard circuit. This circuit also included an in-flight calibration of the signal received. On the other hand with a double Langmuir probe it will be possible to measure the degree of ionization present in the plasma sheet of a hypervelocity projectile. The circuitry developed for these two measurements is similar to that developed for temperature measurement and preliminary firings have already been made.

Before concluding, one point should be mentioned: on many occasions during this program units have shown they could withstand much higher accelerations than the ones quoted. On one occasion a model in flight hit a 2" aluminum pipe and broke into two pieces sustaining a calculated deceleration of over 500,000 g's. One piece contained the complete RF oscillator and was still operating when a new battery supply was added in the laboratory. Survival of electronic packages after severe impacts appear to have tremendous applications, an important example being the hard-landing of equipment on the moon. Successful application of this technique, evidently, would be of great help to many outer space research scientists.

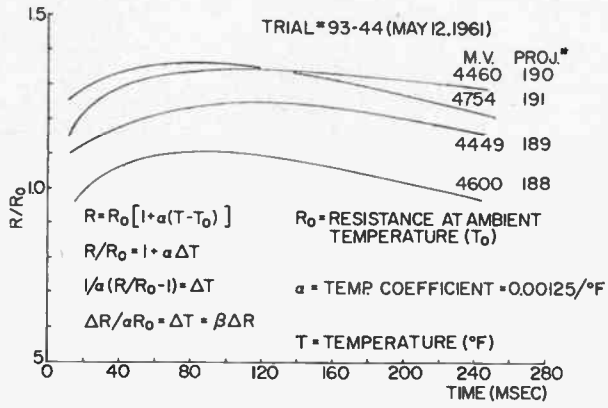


Fig. 8. Normalised temperature telemetering results.

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6. *Mantle, P. J. and Phillips, L. W.; The Extraction of Stability Data by Means of Telemetry from Configurations Tested in Ballistic Range (U), CARDE TM AB-70, March 1961.*

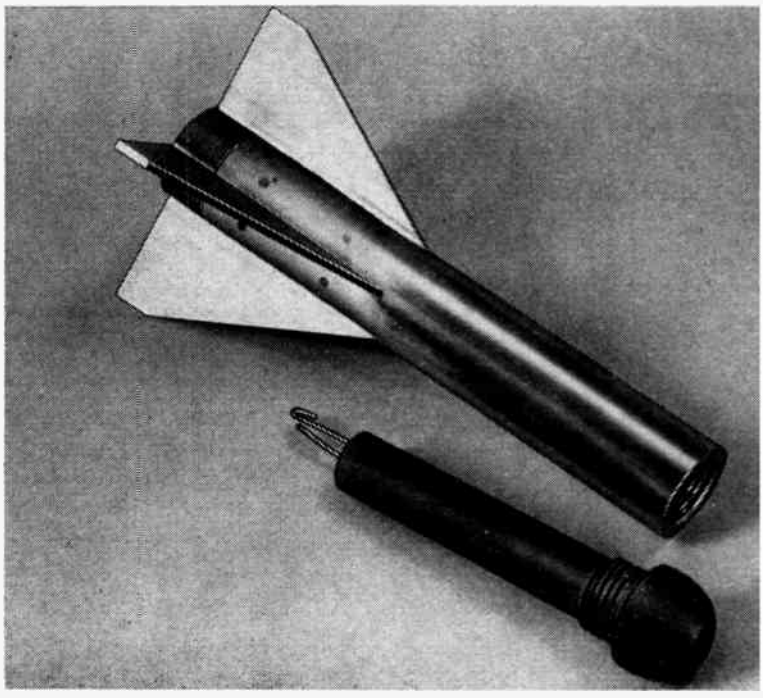


Fig. 10. Photograph of a four fin dart and telemetering package used for stability measurements.

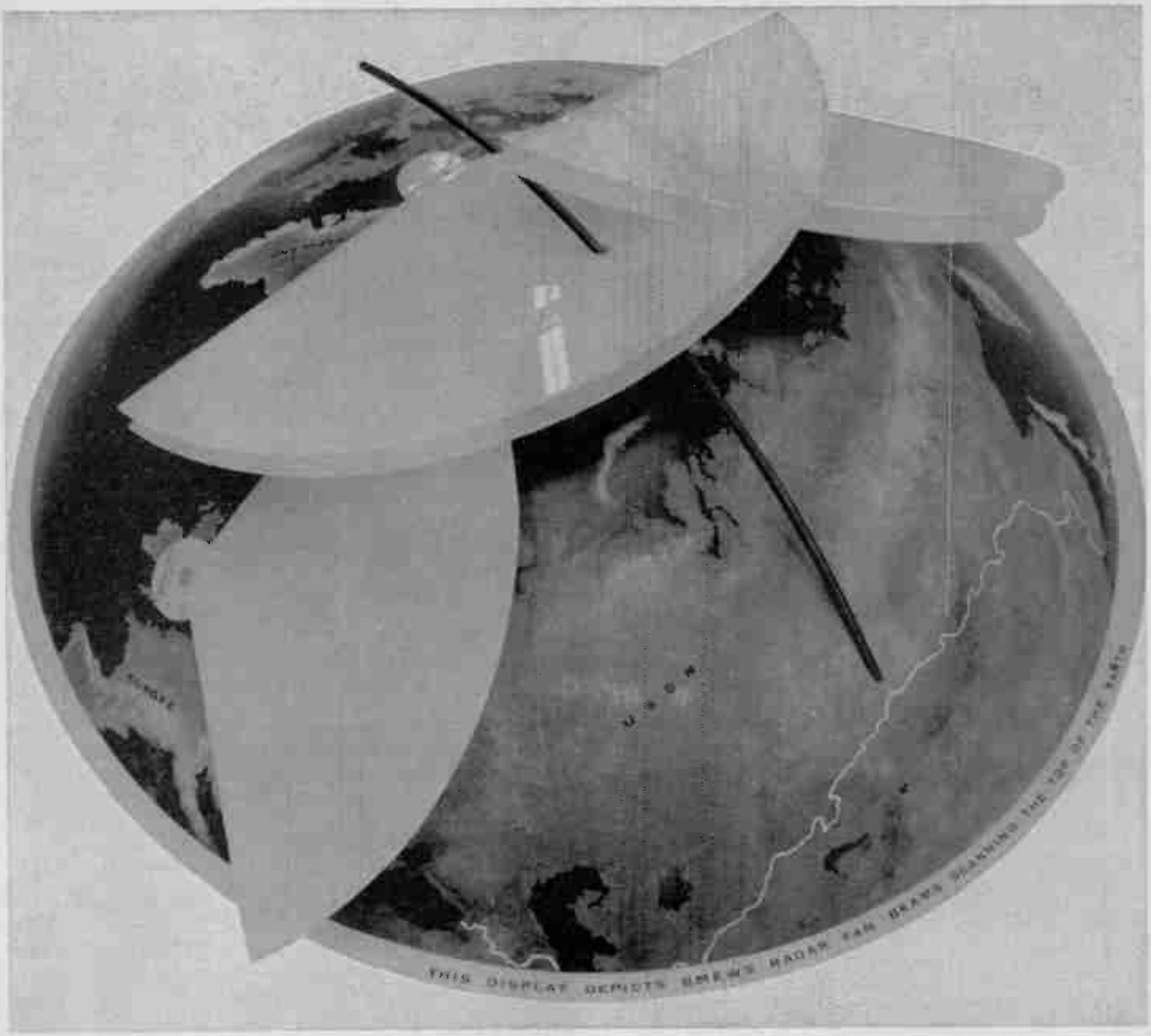


Fig. 1. Model shows how radars installed at the U.S. Air Force stations at Thule, Clear, will detect ballistic missiles as they rise over polar regions.

LOGISTICS

The BMEWS heavy surveillance radar

Article gives thumbnail sketch of giant surveillance radars and outlines the immensity of the logistics problems arising from their installation.

If a ballistic missile attack is launched against North America from across the north polar regions it will be detected far out in space by huge radar fans scanning the top of the world as shown by the model illustrated in Figure 1. Each radar thrusts out curtains of signals, effective out to three thousand miles and provides up to fifteen minutes warning of a possible attack.

Designated the AN/FPS-50, these "king-size" surveillance radar systems were developed, produced and installed by the General Electric Company's Heavy Military Electronics Department in Syracuse, N.Y., under a subcontract from the Radio Corporation of America.

Briefly, this is how the BMEWS surveillance radars detects missiles.

As the radar's antenna system probes the sky over the northern polar regions, it radiates narrow fans of RF energy at two different degrees of elevation above the earth's surface. These fans are scanned simultaneously across the face of the huge antenna reflector

by means of high-speed scanning switches and a massive array of feedhorns, forming two horizontal detection fans one above the other.

If a missile passes through the lower fan, radar pulses are returned and detected by super-sensitive receivers. From these radar echoes, the position and velocity of the missile is determined. Seconds later, as the missile passes through the upper fan, radar echoes again are picked up and position and velocity co-ordinates are measured. The ballistic missile's trajectory then can be calculated from these co-ordinates since the missile is in "free flight" (unpowered phase of its trajectory) as it passes through the radar fans. Calculation of the missile's trajector permits prediction of the impact area, impact time and area of launch. Data processing equipment installed at the radar stations rapidly computes this data and flashes a warning to the North American Air Defense Command Headquarters in Colorado Springs, and also to retaliatory strategic striking forces.

Heart of the mammoth surveillance radar subsystem is a combination transmitter-receiver unit. This unique equipment sends out an extremely short burst of radio frequency energy at a power level measured in multi-megawatts. After each pulse, the transmitter shuts down and extremely sensitive receivers listen for any tiny echo reflected from a target, which might be a nosecone smaller than a barrel and 3,000 miles out

Fig. 2. Bank of high voltage transformers and rectifiers for supplying 120,000 volt DC power to transmitter. Photograph shows units undergoing test at G.E.'s high power radar laboratory, Syracuse.

in space. The power level of the return echo, is typically of the order of 10^{-15} watt.

The high power energy transmitted is generated by banks of nine-foot high Klystron tubes mounted in shielded power amplifier cabinets and located in the two transmitter buildings. Rows of high voltage regulators, transformers, rectifiers and giant capacitors, shown in Fig. 2, make up the power supply section of the transmitter.

More than 2 miles of aluminum waveguide, which resembles conventional air ducts, have been installed to direct the radio frequency energy generated by the transmitters through a 1,500-foot long enclosed, tunnel to the scanner buildings, located directly in front of each of the three antenna reflectors. An additional 12 miles of waveguide have been installed in the scanner buildings to "pipe" the energy from the high speed, mechanically rotated scanning switches (Fig. 3)

Fig. 4. Pick-up truck is dwarfed by 70-ft. long steel latticework backstays which support the three 900-ton antenna reflectors.

Fig. 3. Being tested (in background) is the high-speed scanning switch housed in large tank. Switch handles multi-megawatt pulses and milli-micro-microwatt return signals.

to the hundreds of radar feedhorns. Arranged in upper and lower banks, these feedhorns reflect the RF energy off the 17-storey high reflectors at precisely the right angles for the required spatial coverage. Twelve active de-icing heater units (4 per scanner building), capable of providing a total of 2,500,000 BTU/Hr., keep the feedhorn windows free of ice during the sub-zero Alaskan winter.

Each of the three torus-shaped steel reflectors illustrated in Fig. 4, measures 165 feet high and 400 feet wide and weighs 900 tons. The massive steel structures are designed to withstand severe cold, earthquake conditions, and winds up to 110 mph, as well as a ½" coating of ice. Twenty trusses and twenty 70-foot long steel latticework backstays support each of the antennas. Some 10,000 cubic yards of concrete were used to anchor the reflector to their 120 foundation footings and related concrete structures.

In all, an estimated 12,500 packaging units representing 8,000 tons of equipment were shipped to Clear, Alaska for installation in the surveillance radar subsystem. Approximately 852,000 lbs. of equipment were airlifted to the site to meet the accelerated operational schedule.

The complexity of the logistics and transportation problem can be visualized by the antenna steel alone which comprised approximately 2,500 pieces weighing a total of more than 4,850,000 lbs., and requiring 205

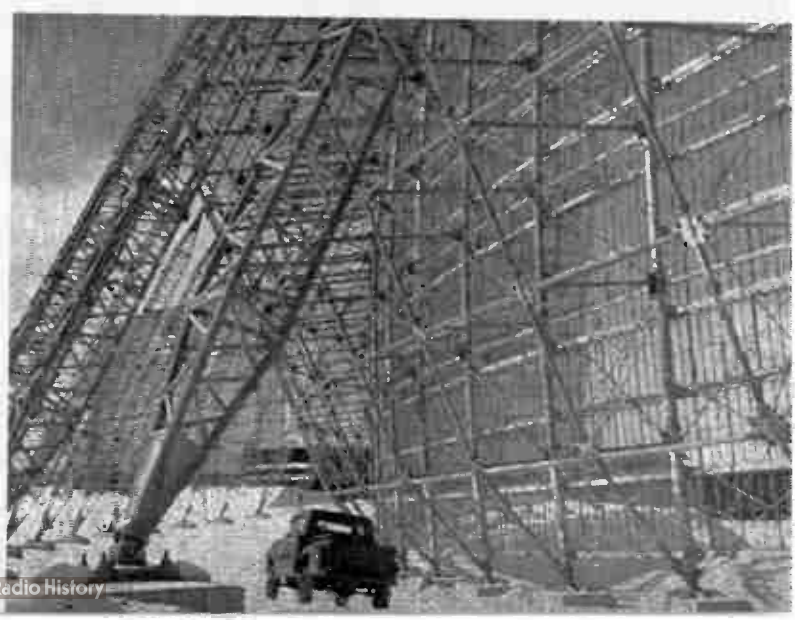


Fig. 5. The complexity of the electronic equipment which makes up the BMEWS surveillance radar sub-system is evidenced by this RF Switching cabinet shown being assembled at the General Electric Company's plant.

railroad cars for shipment. Complexity of 220 cabinets of electronic equipment and monitor and control consoles, which comprise the radar sub-systems installed at each site, is indicated by the following component totals.

320,000	resistors	5,450	relays
72,890	capacitors	610,000	individual components
65,716	diodes	2,275	printed wire boards
36,428	transistors	504	miles of cabinet wiring
31,920	connectors		
10,542	tubes		

In addition 700,000 wiring connections, both solder and crimp type; 13,300 pieces of electrical cable in varying lengths and totalling approximately 2,000,000 feet, were used to inter-connect these cabinets of electronic equipment. Over 1,200 test cables were supplied to check out the equipment yielding an estimated total cable weight of 190 tons.

Fourteen miles of aluminum waveguide weighing some 1,400 tons were installed to direct high power RF energy from banks of transmitters through the long passageways to the six high speed scanner switches, and to the hundreds of feedhorns.

General Electric reports that over two hundred highly skilled engineers and technicians are accommodated on site to install and set-up the complete radar sub-system.

PROJECT MANAGEMENT

Value engineering

"Value engineering", a new concept in engineering management that is expected to help meet the challenge of the competitive '60s, has been inaugurated on a company-wide scale by Hughes Aircraft Company, Culver City, Cal.

Value engineering, according to Anthony R. Tocco, who will head the program at Hughes, can be described as "a scientific approach to the attainment of required function at the lowest cost." More specifically, as applied by a military contractor, it is an objective appraisal of a project from the standpoint of specifications, design and manufacture. Thus value engineering has a dual interest in a product: 1) that the product meet its requirements, and 2) that it do so at the lowest possible cost.

The new technique recently has been attracting increasing interest in the aircraft and electronics industry. On the West Coast, Hughes, which produces airborne armament control systems, Falcon air-to-air guided missiles and other military electronic equipment, is the first company to adopt a formal value engineering program on the corporate level.

In practice, a company value engineer normally exercises his function during three states of a project 1) specification review, 2) design review, and 3) hardware analysis.

Specifications are studied because they are often the primary cause of the high cost in an end item. *A critical review of the "specs" by a value team comprised of the value engineer, the project engineer and a marketing representative can uncover areas of "over specification". In such instances the value team establishes what it believes to be the minimum requirements, and initiates waiver requests to the customer.* Such critical examination by contractors is now officially encouraged by many military agencies.

Periodic design reviews are held to assure a balanced "trade off" of essential characteristics as the design progresses. Here the value engineer may serve as chairman of a design review panel consisting of representatives from the project office, manufacturing, materiel, reliability, quality control, design and others as required.

A second look at the product after start of production affords the value engineer an opportunity to determine what changes are necessary to improve its value. This analysis is generally conducted on the unit level with a functional study being made to determine the lowest cost that can achieve the desired performance.

Individual accomplishments often seem small, but the cumulative effect on a large project can result in savings of hundreds of thousands of dollars. Even on small equipment savings can be significant. In the Hughes Communications division, for example, it was recently found that a vacuum tube shield costing 65 cents was being used on an item already in production. Someone found a shield costing only 8 cents that would do the job as well. A call to the value engineer, quick-action and co-operation by purchasing and manufacturing resulted in cancellation of the balance of orders on the old shield and a substitution of the cheaper one. Net savings: $3,557.

A basic difference between value engineering and "efficiency programs" sometimes promoted by companies, it is pointed out, is the fact that value engineering cannot be legislated. To be effective it must be understood and supported by all levels of management and by the engineering, purchasing and marketing staffs in an organization. Its success depends on voluntary effort and on individuals using good judgment, creative thinking, evaluation and good human relations on the job.

. . . from the IRE executives . . .

Dr. L. V. Berkner — International IRE President

The IRE Candian Electronics Conference has become one of the outstanding events in the world of electronics. It is significant that this should be so, for as the expanding field of electronics knows no borders, the IRE as an international organization knows no boundaries.

It is certain that out of the work of this Conference will come important contributions to the progress of electronics science and art. The Board of Directors of IRE joins me in expressing our compliments for your achievements and our best wishes for continued success.

B. R. Tupper — Director Canadian Region

Canada's development as a nation has depended always on communications. In the beginning it was the canoe, and in rapid succession the lake boat, the railway and the highway. Next we see the civil engineer stepping aside briefly for the electrical engineer to introduce the telegraph and telephone. Quickly the radio engineer came along with network radio, carrier telephone and microwave techniques. Today we are launching a Canadian satellite to probe the ionosphere; tomorrow communications will be in space.

But through all the development of our vast nation communications on a person-to-person basis continues to be one of the most vital factors in our everyday life. Documentation of all researches, verbal interplay and visionary thinking are all part of man-to-man contacts.

May the 1961 IRE Canadian Conference be the site of many man-to-man contacts; may it encourage further documentation and verbal interplay; and may it also foster visionary thinking.

F. J. Heath — General Chairman IRE Executive Committee

Since the institute was organized in 1912, it has striven for increasing standards in science, literature and education. Meetings, Symposia and Conferences are proving to be a most valuable means to meet these aims. It is my earnest hope, and the hope of all those who are working with me that our IRE Canadian Electronics Conference will continue to serve the advancement of the art in its application to human needs.

Your participation will enable our Conference to be an outstanding success.

IRE CANADIAN CONFERENCE PROGRAM

Dates	October 2 - 3 - 4, 1961.
Location	Automotive Building, Exhibition Park, Toronto.
Exhibit Hours	Monday, October 2nd — 10:00 a.m. to 6:00 p.m. Tuesday, October 3rd — 10:00 a.m. to 6:00 p.m. Wednesday, October 4th — 10:00 a.m. to 8:30 p.m.
Technical Sessions	Monday, October 2nd — 2.30 p.m. to 5:00 p.m. Tuesday, October 3rd — 10:00 a.m. to 12:30 p.m. 2:30 p.m. to 5:00 p.m. Wednesday, October 4th — 10:00 a.m. to 12:30 p.m. 2:30 p.m. to 5:00 p.m.
Registration	At the Convention Building during exhibit hours. Fee is $1.00.
Convention Banquet	Tuesday, October 3rd — 7:30 p.m. at the Queen Elizabeth Bldg.
All Industry Cocktail Party	Monday, October 2nd — 5:00 p.m. to 7:00 p.m. at the Automotive Building. (Tickets — $3.00).
Ladies Headquarters	Royal York Hotel.

Program of technical papers

Monday, October 2

Afternoon Session, 2:30 - 5:00 p.m.

1 COMPUTERS IN CONTROL

TOTEM ROOM

1136 The Future in Real-Time Control by Computers

J. Kates, Traffic Research Corp. Ltd., Toronto, Ontario.

Because of their high operating speeds, electronic computers can greatly compress the time scale familiar to human beings. Observations and computations requiring many man-hours of effort prior to taking certain action may be performed by a computer in a fraction of a second.

Similarly, a computer can greatly expand the normal time scale by providing a permanent record of rapidly occuring events for later study.

This has made possible great developments in real-time control where a single electronic computer may be used to operate a complex physical system in a completely automatic manner.

1137 Controlling Traffic by Electronic Computers

J. Kates, Traffic Research Corp. Ltd., Toronto, Ontario.

An outline is presented of how real-time control by computers is being put to use and what is in store in the near future. For illustration, there is described a fully-automatic traffic signal system using real-time computer control. This system has been under study in an experimental area of Toronto for over a year.

1138 TCA Reservec Systems

L. R. Richardson, Trans-Canada Air Lines, Montreal, Quebec.

At the present time Trans-Canada Air Lines is completing the installation and commencing to check out a large scale data processing system which is to be placed in operational service by the end of this year.

The system consists of a large number of input-output devices called transactors, which are located in varying numbers at most operating centers across the country. A real time communication network connects all operational points with a data processing center which is located in Toronto.

This paper describes the operating system and some of the factors which enter into its design. Attention also is given to the future system wherein a greatly expanded operation is obtained.

1139 Reservec Equipments

H. G. Helwig, Ferranti-Packard Electric Ltd., Toronto, Ontario.

The operational requirements of the Trans-Canada Air Lines data processing system have demanded the design of a number of unique equipments. This paper describes these equipments and outlines the design problems and eventual solution.

2 COMPONENTS

SHEAF ROOM

1067 Reliability Measurement and Prediction for Solid Tantalum Capacitors

G. H. Didinger, Jr., Kemet Co., Division of Union Carbide Corp., Cleveland, Ohio.

Both long term and accelerated life tests have demonstrated the unusual reliability of solid tantalum capacitors. The details of these test programs are given and the correlation of accelerated with non-accelerated results is established. In addition, the physical and mathematical foundations of the accelerated test methods are presented. This includes a distribution of ordered failure times whose linear map is sensitive to all three classical lifetime intervals.

INSTITUTE OF RADIO ENGINEERS
1961
Canadian Electronics Conference

Exhibition Park, Toronto — October 2, 3 & 4

R I E

electronics and communications

CONFERENCE GUIDE

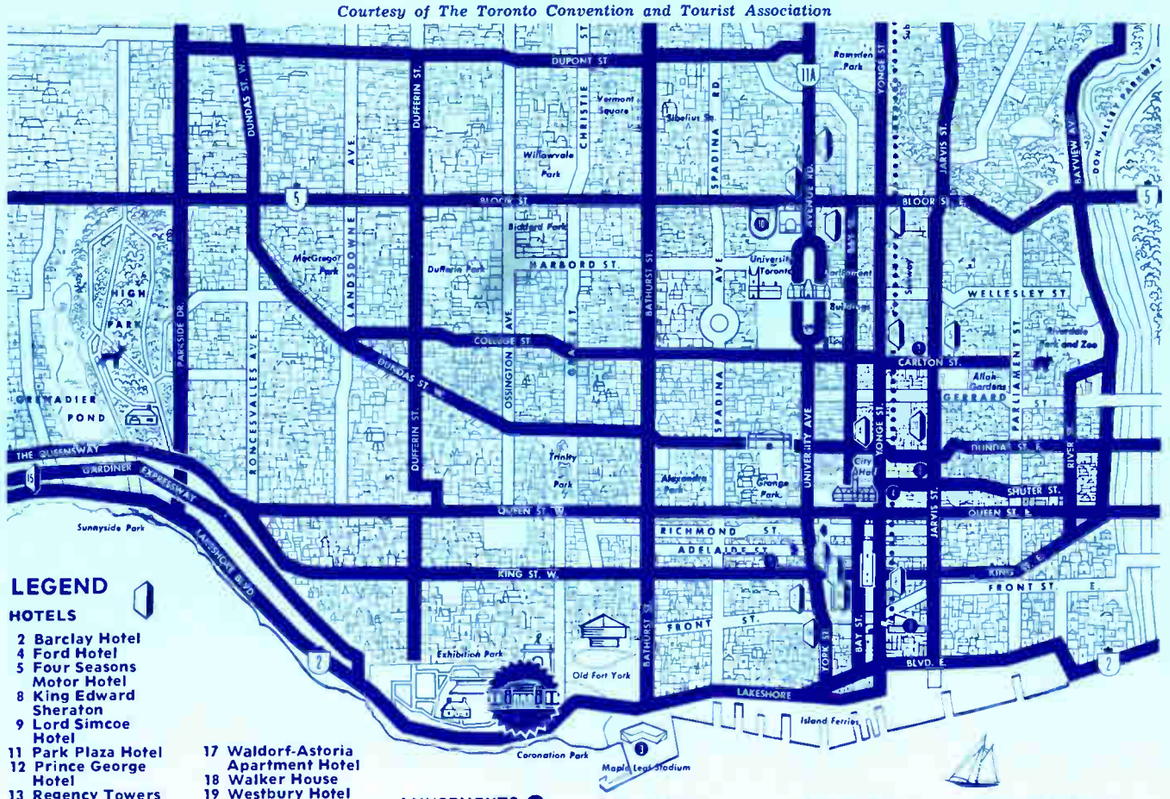
an age publication

CONFERENCE TIMETABLE

WHEN	WHERE				
	TOTEM ROOM	SHEAF ROOM	MAPLE ROOM	BEAVER ROOM	ANCHOR ROOM
Monday October 2 2.30 P.M. 5 P.M.	1 Computers in Control	2 Components	3 Radio & TV Broadcasting	4 Plasma Physics	5 Medical Electronics
Tuesday October 3 10 A.M. 12.30 P.M.	6 Computer Design and Applications	7 Semi-conductors I	8 Communica-tions Systems I	9 Microwave Techniques	10 Circuit Design I
Tuesday October 3 2.30 P.M. 5 P.M.	11 Business Data Processing	12 Semi-conductors II	13 Communica-tions Systems II	14 Millimeter & Sub-Millimeter Waves	15 Circuit Design II
Wednesday October 4 10 A.M. 12.30 P.M.	16 Pulse Transmission & Radar	17 Reliability	18 Antennas & Propogation	19 Parametric & Negative Resistance Amplifiers	20 Radiation Instrumenta-tion
Wednesday October 4 2.30 P.M. 5 P.M.	21 Import & Export Problems (Panel Discussion)	22 Education (Panel Discussion)	—	—	—

DOWNTOWN TORONTO

Courtesy of The Toronto Convention and Tourist Association



LEGEND

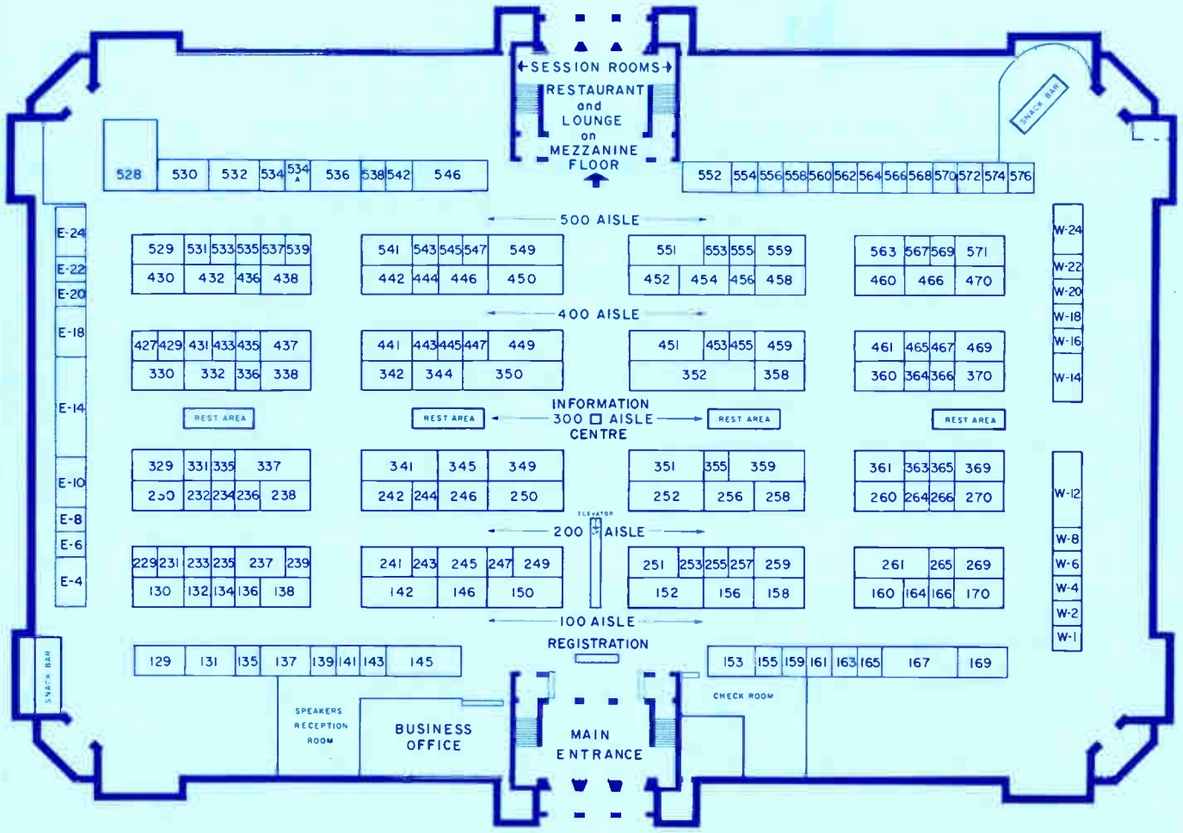
HOTELS

2 Barclay Hotel
4 Ford Hotel
5 Four Seasons Motor Hotel
8 King Edward Sheraton
9 Lord Simcoe Hotel
11 Park Plaza Hotel
12 Prince George Hotel
13 Regency Towers Hotel
14 Royal York Hotel
15 Seaway Hotel
17 Waldorf-Astoria Apartment Hotel
18 Walker House
19 Westbury Hotel
20 Westminster Hotel
21 Windsor Arms

AMUSEMENTS

2 Maple Leaf Gardens
3 Maple Leaf Stadium
4 Massey Hall
5 Mutual Street Arena
7 O'Keefe Centre
9 Royal Alexandra Theatre
10 Varsity Stadium

Official floor plan–Automotive Building



Locate booths from floor plan above

Alphabetical list of exhibitors showing booth numbers

	Booth No.
Abbey Electronics Ltd.	142 & 241
The Ahearn and Soper Company Ltd.	W-12
Airtron Canada Ltd.	349
Alfax Paper & Engineering Company Inc.	470
Alpha Aracon Radio Co. Ltd.	136
Amalgamated Electric Corp.	454
American Electrical Heater Company	558
American Electronics Laboratories Inc.	562
American Superior Electric Co. Ltd.	369
Ampex of Canada Ltd.	152
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Aviation Electric Ltd.	251
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Barnard Stamp & Stencil Ltd.	235
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Vitro Corporation	155
Ward Leonard of Canada Ltd.	547
W. R. Watkins Co. Ltd.	455
Westmore Inc.	566
White Radio Ltd.	232, 234 & 236
Whittaker Electronics Ltd.	256
Wholesale Radio & Electronics Ltd.	449
Willer Engineering & Sales Co.	260
The Wind Turbine Co. of Canada Ltd.	W-14
Yokogawa Electric Works Ltd.	235

Mean life is charted as a function of definition of failure, confidence level, temperature, applied voltage, and capacitor rating. With these data, the reliability engineer is enabled to achieve his objectives.

1098 Improved Aluminum Electrolytic Capacitors

F. J. Burger and D. M. Cheseldine, The Telegraph Condenser Co. (Canada) Ltd., Toronto, Ontario.

Results are presented of work done at The Telegraph Condenser Co. (Canada) Ltd., Toronto and sponsored by the Canadian Defense Research Board, having as its objective the development of an aluminum electrolytic capacitor with an extended temperature range.

It is demonstrated that etched foil aluminum electrolytics can be made with a performance comparable to that of tantalum foil capacitors, both operating within the temperature range −55 C to +125 C.

Such aluminum electrolytics should compare favorably with plain foil tantalum capacitors in cost, volume and weight per cv, maximum working voltage and absence of strategic materials in their construction.

1013 Computer Program for Electro-Mechanical Relay Design and Analysis

P. Nador, Northern Electric Co. Ltd., Montreal, Quebec.

A computer program has been developed for the LPG-30 computer which enables the relay designer to calculate the electrical characteristics of a relay when its structural parameters are given. Its logic is based on a step-by-step analysis of the relation between the variables involved. The program uses the actual hysteresis curve of the iron to perform the calculation and takes care of any change in spring load during operation. It also makes calculations economical by producing a curve of coil current, armature velocity, armature displacement, flux, torque, and some other variables as a function of time, in about one to two hours.

While the method has been developed for wire spring type relays, it can be extended to other types. Work is still in progress to increase the accuracy of the calculation by using a better approximation of the actual magnetic circuit.

1122 The IF Circuit Module — A New Type of Component for Communications Receivers

G. G. Armitage and B. Tennent, Ferritronics Ltd., Willowdale, Ontario.

Through the use of coils wound on subminiature ferrite bobbins, threaded ferrite cup cores and of PADT transistors, the IF strips of communications receivers have been packed into compact, hermetically sealed, pre-tuned components. This ensures built-in optimum performance, reliability and standardization of an important section of such receivers for all frequency ranges and simplifies maintenance.

3 RADIO & TV BROADCASTING

MAPLE ROOM

1051 The Mount Royal Multiple Transmitting Antenna System

N. Tomcio, Canadian General Electric Co. Ltd., Toronto, Ontario.

Due to the topology of Montreal, the best location for transmitting antennas is on top of Mount Royal. To preserve the aesthetic aspects of this park, authorities would permit only one antenna system to be erected. The Canadian Broadcasting Corp., prime owner of the existing antenna support structure atop Mount Royal, prepared specifications for a multiple antenna system which includes 5 TV antennas (some for multiplex operation), 2 FM antennas (4 channels), 4 VHF and 2 UHF comunication antennas, and antennas for 3 microwave systems. The paper discusses the principle design aspects and performance characteristics of the transmitting systems with particular reference to the antennas.

1057 Transistorized Switching of Television Video Signals

M. F. Macpherson, RCA Victor Co. Ltd., Montreal, Quebec.

Of the three main switching systems for routing video signals within a television plant, the use of semiconductors offers the greatest number of advantages. Switching can be accomplished more rapidly than with electromechanical relays, and the actual signal paths can be kept to a minimum. Also, the switching action can be automatically related to the system timing so that the transition between pictures can be made to occur in the Vertical interval between television fields. This paper describes a basic switching system which can be expanded to increase the number of inputs and outputs to suit the particular installation. The switching system used at CFTO-TV, Toronto, is used to illustrate one typical end result of system planning where transistorized components are employed.

1039 A Design Method for Tuning and Phasing Circuits

R. G. de Buda, Canadian General Electric Co. Ltd., Toronto, Ontario.

This paper deals with tuning and phasing networks for AM broadcast antenna arrays, and with a method which has been developed to design these networks.

An overall antenna network consists of a number of circuit elements in separate locations. Because of this, they are sometimes considered as entities. The new method of analysis, however, considers them all as part of the one network and calculates component impedances by using, as parameters, the components currents (which can be selected by the designer). This method allows accurate control over the component currents and ratings. Also, the greater freedom of design permits the use of assymmetrical tee and pi circuits in preference to tank circuits.

1151 To be announced

4 Tutorial Session on PLASMA PHYSICS

BEAVER ROOM

1030 The Earth's Plasma Environment

C. O. Hines, Defense Research Telecommunications Establishment, Defense Research Board, Ottawa, Ontario.

The earth's atmosphere is appreciably ionized from a height of 100 km upwards, while the sun's ionized corona extends as far outwards as the earth and beyond. These two plasma domains — of which at least one is dominated by a strong magnetic field — provide gigantic natural laboratories for the study of hydromagnetic processes, and their interaction on occasion gives rise to some of the most interesting of terrestrial phenomena. The present paper reviews the current picture of our plasma environment, and outlines some of the processes that are thought to occur within it.

1142 Magnetohydrodynamics

J. D. De Leeuw, The Institute of Aerophysics, University of Toronto.

Some fundamental aspects of magnetohydrodynamics will be considered. The inter-action between the flow of a conducting gas and an electromagnetic field has a dual character. In the first place the motion of the gas through the field induces currents which modify the field. Secondly the induced currents modify the flow and also the gas as a consequence of the forces that result from the presence of the induced currents in the magnetohydrodynamic field. The non

dimensional parameters controlling the importance of these distinct interacting mechanisms will be discussed.

A few examples of magnetically influenced gas flows will be given such as the generation of power, the magnetohydrodynamic pump and the possible uses of magnetohydrodynamic principles for the generation of thrust in space vehicles. In addition some laboratory experiments making use of shock-tubes will be mentioned.

1143 To be announced

1144 Semiconductor Plasmas

M. Glicksman, RCA Laboratories, Princeton, New Jersey.

Many of the effects peculiar to plasmas, such as avalanche ionization, self-pinching, hydromagnetic waves and various types of instabilities may also be observed in semiconductors. In this case the plasmas will consist of free electrons (or holes) and ions bound to the lattice, or of free electrons and holes. Their behaviour shows both similarities to and differences from that seen in normal gaseous plasmas. Methods of producing semiconductor plasmas and studying their properties are described. Observations of the plasma effects listed above are interpreted and related to our general knowledge of plasma phenomena.

1145 Thermonuclear Plasma

M. P. Bachynski, RCA Victor Co. Ltd., Montreal, Quebec.

The process of obtaining a net energy yield from the "fusing" together of certain light nuclei is a problem of considerable importance in the field of high temperature plasma physics. This paper reviews the attempts which have been made at ignition, control and diagnosis of the thermonuclear fusion reaction. Consideration is given to confinement schemes, stability requirements, energy loss mechanisms, heating and diagnostics of the plasma.

5 MEDICAL ELECTRONICS

ANCHOR ROOM

1099 Physical Evaluation of a Polarographic PO_2 Sensor and Its Application as a Hypoxia Warning Device

Institute of Aviation Medicine, Toronto, Ontario.

Details to be announced.

1111 Impedance Measurements and Electrical Stimulation of the Canine Heart during Hypothermia.

J. A. Hopps and O. Z. Roy, Radio and Electrical Engineering Division, National Research Council, Ottawa, Ontario.

Cardiac impedances and stimulation responses of normothermic and hypothermic canine hearts were studied at the Banting Institute, Toronto. As sub-threshold and at defibrillating current levels, impedance varied inversely with current. The depolarized muscle impedance at normal temperature varied from 45 to 60 ohms, for a 2-ampere current. The capacitive reactance of the cell membrane increased the impedance at low frequencies. When current was normalized to a constant value no impedance change was noted in hypothermia.

Interrupted DC bias potentials and conventional square-wave or exponential-decay pulses controlled the heart at lowered temperature, but were unable to sustain blood pressure. Several procedures are reported.

1152 The Use of Gamma Ray Pulse Height Analyzers in Medical Research

K. G. McNeill, University of Toronto.

The characteristic gamma radiation associated with many radio-isotopes, in conjunction with sensitive detectors and circuits capable of differentiation between electrical pulses of different sizes, enables one to undertake clinical investigations hitherto difficult or impossible. Descriptions of the appartus necessary and the types of experiment possible are given.

1153 Automatic Time Analysis of Eye Movement Films

E. Llewellyn Thomas and M. R. Howat, Defense Research Medical Laboratories, Toronto, Ontario.

This paper describes appartus for automatically producing a time analysis of the records produced by an optical eye marker head camera. This record consists of an 8 mm motion picture film which shows the scene in front of the subject with a bright spot superimposed upon it indicating his eye fixations and movements.

The film is projected onto a matrix of self-generating selenium cells. As the eye spot moves around the scene, it energizes the cell on which it falls. Thus, through a two-stage transistor amplifier and relay, it controls the recording device. A film produced by the camera will be shown, together with its analysis.

1155 Electromyography of the Diaphragm: Direct Recording Technique in the Rabbit

J. V. Basmajian and W. H. Boyd, Department of Anatomy, Queen's University, Kingston, Ontario.

A long series of rabbits had multiple (up to 16) electrodes implanted in their diaphragms at open operation. Following complete post-operative recovery of the rabbits, the wires leading from these electrodes can be connected to an electromyograph and recordings made along with spirometry under "normal" conditions. A color film demonstrates the techniques of implanting the specially designed electrodes and the experimental procedure for simultaneous spirometric and electromyographic recordings.

Tuesday, October 3

Morning Sessions, 10 a.m. - 12:30 p.m.

6 COMPUTER DESIGN & APPLICATIONS

TOTEM ROOM

1128 Computer Applications

E. A. Racicot, Remington Rand Ltd., Toronto, Ont.

The general pattern in data processing has been an after-the-fact accounting in traditional areas. However, certain users have transcended conventional application to gain in economy and control. Inventory control problems have underlined the inadequacy of recording only the past.

These and similar breakthroughs have caused an evolution in the concept of data processing to one of a "nervous system" of the organization. As a consequency, there is a demand today for computers which will control increasing company telecommunications, co-ordinate, within hours rather than weeks, the action of an extended organization, and keep crucial control information current.

This paper presents UNIVAC's experience in this area and the type of equipment now available.

1062 The Development and Application of a Conditional Probability Computer

H. C. Ratz, G. H. M. Thomas and R. J. A. Buhr, University of Saskatchewan, Saskatoon, Saskatchewan.

This special purpose computer measures time-weighted frequencies of occurrence of all the possible patterns arising from its five binary inputs. These frequencies are used to estimate certain conditional probabilities which can be used to infer complete input

patterns when only partial patterns are presented to the computer.

This computer can be used as an adaptive code-correcting device. For suitable codes, when the input pattern contains an error, the computer will automatically select the nearest of several code words, and will adapt itself to slow change in vocabulary. Another application is optimizing a simple process. This is being done presently for a process simulated by an analog electrical network. Preliminary results are favorable.

1053 Direct Experimentation with Adaptive Digital Random Networks

G. S. Glinski and J. Therrien, University of Ottawa, Ontario.

This paper describes an experimental set-up used to study the properties of random digital nets, with regard to their ability to "learn", and their reliability. Transistorized neurons are interconnected at random to form a net which, at the start of experiments, has no well-defined logical properties. The net adjusts its response to correspond to a norm set by the experimenter.

Each learning experiment consists of a learning period and a test period. In the learning period, pulse patterns are applied and the right response forced. In the test period, one checks if the net has learned properly. Investigation of the reliability of the net consists of noting the changes in the properties of the net as some of the cells fail.

The paper describes an experimental net using 16 neurons.

1064 Cascaded Switching Networks Two-Input Flexible Cells

K. K. Maitra, Stromberg Carlson, Rochester, New York.

A logically flexible element is one which can be adjusted at will to perform different logical functions at different times. Switching networks constructed of such flexible elements seem to contribute to improved system performance. Especially promising future applications of flexible logic elements lie in the areas of self-organizing networks and adaptive systems.

This paper considers a particular type of adjustable switching network which is structurally a cascade of 2-input, 1-output, completely flexible logical cells. The results presented in this paper include the characterization of the class of n-place switching functions realizable by a generalized n-input cascade, test for realizability of an arbitrary n-place function and synthesis of realizable n-place functions by n-input cascaded networks.

7 SEMI-CONDUCTORS — 1

SHEAF ROOM

1125 A Survey of Four-Layer Semiconductor Switches

D. H. Lewis, Ferranti-Packard Electric Ltd., Toronto, Ontario.

The basic principles of operation of four-layer devices are described, using, as far as possible, an equivalent circuit composed of familiar semiconductor devices. This is used to facilitate examination of the pertinent device parameters.

Then a classification of four layer switches is made. Possible conflicts in the device optimization process are examined to emphasize compromise in characteristics which must be accepted.

It is hoped that some information will be available on device failure mechanisms. The paper concludes with a brief discussion of some applications.

1052 Semiconductor Networks

W. A. Adcock, Texas Instruments Inc., Dallas, Texas.

The formation of complete electrical networks utilizing semi-conductor materials is described. The emphasis has been on digital circuits and the feasibility of forming a limited variety of linear circuits has also been demonstrated.

The semi-conductor network program includes design and manufacture of these devices and application to equipments. The latter effort includes the solving of problems of interconnections, power dissipation, and maintenance at the equipment level.

Semi-conductor networks were initially based upon the design and existing circuits. This capability has been extended by research investigations of semi-conductor phenomena. The most significant applivation may be the unique combination of semi-conductor capabilities with system requirements.

1072 Analysis of Charge Storage in Transistors

J. M. Stewart, RCA Victor Co. Ltd., Montreal, Quebec.

The transient response characteristics of junction transistors are considered, using the concepts of charge control instead of the more usual small-signal parameters. The significance of stored charge in determining the rise, fall and delay times is discussed for nonsaturated operation of transistors, along with the effects of the collector and emitter transition capacitance. The discussion emphasizes the operation of the transistor in the saturation mode. An analysis is presented to show that recovery time from saturation (storage time) of any transistor is characterized by a single time constant T_s which determines the excess stored charge which must be extracted from the transistor. Factors governing the value of T_s such as bulk and surface lifetime, are discussed. T_s is shown to be independent, to a first approximation, of collector current and degree of saturation for all transistor structures except the mesa, but including the epitaxial mesa. Finally, a model is proposed to explain the strong dependence of T_s on collector current in the mesa structure and a description is given of a simple means of measuring the value of T_s for any transistor using a constant current technique.

1126 High Precision Fast Switching Tunnel Diodes

H. Schindler, A. G. Stanley and V. Vulcan, General Instrument Corp., Hicksville, Long Island, N.Y.

There is a widespread requirement in the electronics industry for a fast-switching tunnel diode with the peak current held constant to within very close tolerances. Such a device finds application as a threshold switch for industrial control systems and as a trigger pulse generator for precise timing applications. In response to several requests, a germanium tunnel diode with switching times down to 0.5 nsec and peak current constant within ± 2 per cent has been developed at General Instrument. This paper describes the method of producing the diodes, the controls available over the diode's characteristics, and some possible applications.

8 COMMUNICATIONS SYSTEMS — 1

MAPLE ROOM

1003 Engineering and Systems Advances in 6 Ge Medium-Route Microwave Systems

F. S. Fraser, Lenkurt Electric Co. of Canada Ltd., Vancouver, B.C.

Detailed information is presented to show how design improvements were carried out in IF amplifier, baseband noise and response characteristics, baseband regulators, and power supplies. These improvements will now allow the inherent flexibility of back-to-back repeaters, while still meeting long haul requirements for medium-route microwave systems.

1090 Signal Loss Due To Ice, Snow And Leaves In Horizontally Mounted Microwave Antennas

F. R. Willis, Andrew Corp., Chicago, Illinois.

The accumulation of foreign material in horizontally-mounted parabolic antennas will produce a serious loss in signal in microwave relay systems. This paper presents the results of a series of tests performed to determine the extent of this loss for ice, snow and leaves. Tthe analysis of these results and a mathematical study give an indication of the cause of the loss.

1075 A Baseband Combiner for TD-2 Microwave Systems

E. J. Henley, Western Electric Co., New York, N.Y.

This paper discusses the development of a baseband combiner for use on light-route military and commercial TD-2 microwave systems. Improved signal-to-noise performance, as well as error-free transmission of teletype or comparable data signals were the prime objectives. The design minimizes service interruptions due to equipment trouble as well as operating errors.

1019 A New Microwave Tower for Heavy Route Applications

J. E. H. Donovan, Alberta Government Telephones, Edmonton.

When the Alberta Government Telephones were requested to extend their existing microwave network from Edmonton, north to Grande Prairie and to have it completed, for the opening of the Alaska microwave link this year, it became obvious that there would not be sufficient time to locate sites, fabricate and erect self-supporting towers such as used with the TD-2 microwave system. It was, therefore, decided to use guyed towers.

The original requirements were for a minimum tower load of four cornucopia antennas, circular waveguide, filters and associated hardware. Several VHF antennas, and in one or two cases, two 10-ft. paraboloids and other assorted antennas added to the tower load. No more than 1 deg. twist, or ½ deg. deflection could be permitted under 100 mph wind with tower structure and attachments coated with ½ in. ice. Slides and photographs will be used with this paper to describe the main construction features of the towers and erection problems. Figures on cost of installation and maintenance will also be given.

9 MICROWAVE TECHNIQUES

BEAVER ROOM

1036 Millimeter Wave Generation Using Ferrites

G. W. Williams and A. W. Smith, Defense Research Telecommunications Establishment, Defense Research Board, Ottawa, Ontario.

Ferromagnetic resonance in ferrite is a nonlinear system which may be used for generating harmonics. A ferrite sample is placed in a waveguide and located in a DC magnetic field which determines its resonant frequency. The microwave magnetic field perpendicular to the DC field drives the sample at resonance, and a second harmonic field is generated parallel to the DC field. Experiments are described at 10 Gc and 35 Gc which produced a maximum output of 20 watts. The effect of sample shape and magnetic properties on the output are of the technique is determined by described. The upper frequency limit available magnetic field, or in some cases, by the internal anisotropy field of the sample.

1130 Generation of Microwave Harmonics in an Electrodeless Discharge

C. B. Swan, University of Toronto, Toronto, Ontario.

This paper briefly reviews the theoretical basis for the production of harmonic power in a microwave discharge. Previous work is discussed and reasons are suggested for the very poor conversion efficiencies reported. The author has used a 2.9 Gc CW source in the power range 10-50 watts. By containing the discharge in a small quartz vessel, and with special attention given to the configuration of the electric fields, conversion efficiencies of 20 per cent, 5 per cent and 2 per cent have been obtained for the 2nd, 3rd and 4th harmonics respectively.

It is concluded from these experiments that high electric field gradients in the discharge are essential for efficient harmonic generation. The microwave techniques used to obtain these results are described in detail. Problems involved in scaling the device to millimeter wavelengths are considered.

1034 A Microwave Interferometer Using High-Resolution Focussed Beams for Plasma Studies

R. A. Hayami, Defense Research Telecommunications Establishment, Defense Research Board, Department of National Defense, Ottawa, Ontario.

A microwave interferometer using high resolution focussed beams has been developed to study the plasmas created by hypersonic projectiles in ballistic ranges. Large aperture lenses are used to produce a microwave fence normal to the line of flight of the projectile by stacking a number of pencil beams focussed along a vertical axis through the lime of flight. Comparison of the integrated phase shifts in the different beams transmitted through the plasma gives a measure of the diameter of he plasma column, and hence the average electron density. While the system described operates at 35 Gc, with spatial resolution in the focal plane of 0.5" (1.5 times the wavelength), it is adaptable to millimeter wavelengths with correspondingly better resolution.

1024 A Hi-Q Open Resonant Cell for Microwave Spectroscopy

J. Cummins, Canadian Armament Research and Development Establishment, Defense Research Board, Quebec, Quebec.

Dielectric rod waveguides operating in the HE_{11} mode have unique properties which make them particularly suitable for the construction of hi-Q resonators with the additional advantage, for a certain type of spectroscopic work, of being open structures.

Such a cell is studied here systematically as a lossy transmission line. A model is proposed for the mathematical analysis of the resonator by flow graph techniques. A simple measurement procedure is described whereby very high Q can be measured accurately within ±2 per cent without recourse to highly stabilized sources.

10 CIRCUIT DESIGN

ANCHOR ROOM

1093 An Improved RC-Coupled Monostable Flipflop

J. Rywak, Northern Electric Co. Ltd., Ottawa, Ontario.

A two-transistor monostable circuit is proposed whose features of interest are its relative insensitivity to temperature effects, noise or transients in power supplies, and its fast recovery after self-reset.

Design equations are derived for use in calculating the "operate" or ON time, and amplitude of tolerable transients in positive and negative power supplies. Typical applications and methods of control are also suggested.

1114 Temperature and Noise Effects in Simple Transistor Choppers

J. H. Simpson, Radio and Electrical Engineering Division, National Research Council, Ottawa, Ontario.

The performance of low-level transistor choppers is analyzed with the help of the large-signal equations of Ebers and Moll. The validity of the theoretical results concerning both magnitude and variation with temperature of the chopper errors is verified

by measurements on a dozen modern general-purpose transistors.

Methods of compensating for the errors of one-transistor and two-transistor (balanced) chopping circuits and their variation with temperature are described. The design of a low noise amplifier stage which receives the chopper output is also discussed and an arrangement capable of detecting differences of the order of 0.1 uv between two DC signals is described.

1113 A Direct-Coupled Complementary-Symmetry Audio Amplifier

R. S. Richards, Radio and Electrical Engineering Division, National Research Council, Ottawa, Ontario.

This paper describes the design of a transformerless audio frequency amplifier which operates from a single voltage DC supply and which is able to provide very nearly the maximum power theoretically available from the supply, provided that transistor breakdown voltage and maximum current ratings are not exceeded. At full output power the total harmonic distortion and the intermodulation distortion are less than 0.1 per cent and 1 per cent respectively.

The principal design problem is to satisfy the conflicting requirements of providing full drive to the output stage and of obtaining adequate bias stability; in the solution presented, a separate DC amplifier senses and corrects for changes in bias: this is shown to be a logical and simple development from a well-known two-stage feedback amplifier.

1092 Harmonic Distortion in Transistors at Audio Frequency

E. F. Johnson, Northern Electric Co. Ltd., Ottawa, Ontario.

Input and output transfer characteristics for alloy and double diffused transistors are derived and analyzed for harmonic distortion. The distortion arises from the non-linear form of the transfer characteristics and is found to be expressible as a function of the transistor current gain, base emitter and collector resistances, load and generator resistances and signal amplitude. Grounded base and grounded emitter configurations are studied and graphs suitable for quick evaluation of distortion up to three harmonics are provided. Some numerical examples are quoted.

Tuesday, October 3

Afternoon Sessions, 2:30 - 5:00 p.m.

11 BUSINESS DATA PROCESSING

TOTEM ROOM

1133 The Dissemination of Information for the Toronto Stock Exchange

H. McLachlan, Canadian National Telecommunications, Toronto, Ontario.

This paper provides a brief history of the Toronto Stock Exchange, and describes the three main systems used for dissemination of information to stock brokers. They are: (a) the high-speed stock ticker communications network over which all sales transactions and the latest bid and asked quotations are transmitted to more than 400 tickers located in 75 Canadian and four United States cities; (b) the dial ticker system whereby brokers in Toronto dial a 3-digit stock number to receive a printout of the latest bid and asked prices on 600 of the more active stocks; (c) the automatic quotation display board system, which is an electromechanical display which is automatically up-dated each time a change in bid and asked prices occurs on the trading floor.

NOTICE

A Conference Proceedings will not be published.

1134 High-Speed Document Sorting from Magnetic Ink Characters

G. W. L. Davis, Ferranti-Packard Electric Ltd., Toronto, Ontario.

This paper describes the history of the use of bank cheques for payment of accounts and examines the extremely rapid growth of the use of this medium in the last twenty years. The growth pattern has made it necessary to mechanize wherever possible the handling of these documents. The methods by which the actual transfer of funds is made are examined and the way in which a machine readable code was developed are considered in some detail. Following the development of this code the methods of sorting are examined and a comparison was made between the various techniques involving digital and dictionary types of operation. The current state of the art in this field is discussed and the feasibility of incorporating both the sorting and accounting functions in one pass is examined.

Various refinements to suit individual needs are considered and the extreme flexibility which the presence of a code-mark on a cheque offers is described.

1140 Some Problems of Data Processing Applications

R. Fallis, Computing Devices of Canada Ltd., Ottawa.

This paper deals with the barriers and short-comings of some electronic data processing systems' applications that must be overcome if an installation is to be a success. Some of the characteristics of both punched card and electronic data processing systems are discussed.

Management requirements and responsibilities are presented. Certain requirements of data processing and how they affect the type of computer required for a successful operation, are also presented.

1141 The Management Operating System for Manufacturing Industries

R. Carroll, International Business Machine Co. Ltd., Toronto, Ontario.

The use of computers for Management Control in the manufacturing industries has developed rapidly in the last two years. One of the most advanced systems is the "management operating system' developed by IBM to assist customers to design systems for Electronic Data Processing Equipment.

This sophisticated production control system illustrates the integration and control of six functions: (1) forecasting, (2) materials planning, (3) inventory management, (4) scheduling, (5) dispatching, (6) operations evaluation.

12 SEMICONDUCTORS — II

SHEAF ROOM

1080 The Utilization of Planar Techniques to Improve Yield and Reliability in Diffused Diode Structures.

G. P. Zenner, Northern Electric Co. Ltd., Montreal, Quebec.

In 1960 the first successful manufacture of planar devices was announced. In the planar design of diodes, the device is fabricated in its final configuration during the diffusion operation. The improved characteristics of planar diodes over the conventional diodes is attributed to the location of the junction under a thermally grown passive oxide layer which remains on the finished device.

The fabrication of planar diodes involves various techniques and processing like oxide masking, photo-etching and metalic evaporation.

Electrical measurements taken on finished devices indicated that leakage current is 100 times smaller than in

conventional diodes. The breakdown point (i.e. the breakdown voltage) is sharper and more defined. For a large number of diodes made from the same material the voltage-current characteristic is almost identical between wafers.

The planar structure can be used for practically any diode device on the market.

1006 Failure Mechanisms in Mesa and Planar Silicon Transistors

G. H. Li and A. G. Stanley, General Instrument Corp., Hicksville, Long Island, N.Y.

Mechanical failure of silicon wafer material in mesa and planar devices can result in increased leakage current, erratic electrical characteristics and open or shorting contacts. Controlled experiments on silicon transistors with wafers of different thicknesses show that the failure rate obeys a Poisson distribution. A special chart has been developed at General Instrument for graphic evaluation of transistor reliability data, and studies show that the failure rate or probability of defect formation is directly proportional to the maximum surface stress.

A high percentage of defects or cracks is introduced during contacting, or gold wire bonding operations. This mainly arises from using too high a bonding pressure. To reduce this, and still obtain satisfactory bonds, an improved aluminum evaporated strip has been developed. The paper includes microphotos of the old and improved strips for comparison.

1081 Epitaxial Varactor Diodes for Microwave Power Applications

D. Walsh, Northern Electric Co. Ltd., Montreal, Quebec.

This paper is concerned with the design and fabrication of high voltage breakdown varactor diodes using epitaxial grown silicon. The structure is the diffused mesa type, the junction being located in a thin high resistivity epitaxial layer, which is formed on a very low resistivity substrate by vapor deposition. Arsenic is chosen as the n-type impurity in the substrate so that impurity diffusion into the epitaxial layer from the latter is kept to a minimum. Unlike conventional varactor diodes both low series resistance and high voltage breakdown can be achieved simultaneously. Cut-off frequencies as high as 200 Gc have been obtained with breakdown voltages greater than 30 volts. Applications discussed are harmonic generation and mixers.

1073 An Analysis of the Transient Response of P-N-P-N Devices

J. M. Stewart and J. C. Boag, RCA Victor Co. Ltd., Montreal, Quebec.

In recent years several papers have appeared in the literature describing the design and electrical performance of various types of four-layer p-n-p-n or p-n-p-n two and three terminal semiconductor devices. To a large extent emphasis has been placed on the use of these devices in power applications and, although a few have been designed to carry as much as 50 to 100 amperes of current in the "on" condition. In these power applications, the prime criteria are not switching speed and low storage time. It is the purpose of this paper to describe an investigation of the static and transient characteristics of one of the triode p-n-p-n structures — the Germanium Thyristor, paying particular attention to the question of switching speed. The properties of the electron-injecting collector contact and the electron current gain are described as functions of collector current and temperature, while analytical expressions for the rise, fall and saturation times are derived and compared with measurement. Although this analysis is done specificaly for the thyristor, it is applicable in general to any p-n-p-n structure. Finally the design of a simple blocking oscillator is presented in order to demonstrate the advantages of using p-n-p-n devices in such circuits. The design of a simple triggered nanosecond pulse generator is also described which produces pulses of 50 volts maximum amplitude across 50 ohms with pulse-width controllable from 10 nsec to 1 usec with rise and fall times of 3 nsec and a maximum repetition rate of 5 Mc.

13 COMMUNICATIONS SYSTEMS — II

MAPLE ROOM

1060 Descriptions and Some Design Consideration on a Microwave Radio Relay Equipment

E. Podraczky and M. C. Kiryelejza, RCA Victor Co. Ltd., Montreal.

In modern communications systems, increasing emphasis is being placed on economy. This results in a desire for low initial cost and low operating expense. At the same time, performance is being upgraded, and CCIR standards are specified for the majority of installations. The design engineer is faced with the problem of obtaining the best balance between performance and cost.

This paper consists of two parts. The first describes the type RCA MH-300-2 radio equipment and its performance; the design philosophy is outlined in the second part.

The radio equipment described is an FM, 300 voice multiplex channel system operating in the 1700-2300 Mc band. It is capable of carrying monochrome TV signals. With 300 channel loading, the CCIR standard of performance is obtained, and up to 480 channels can be carried with slightly reduced performance.

1118 A Modern Medium-Route Microwave System

T. W. Purdy, Canadian Motorola Electronics Co., Toronto, Ontario.

A description is given of some of the techniques employed in the design of a new communications system. A basis 240-channel system has capacity doubled using a new 1-for-2 switch permitting one protection channel for two operating channels. The "piggy-back" method of coupling this system to one in a different frequency band leads to efficient use of hardware and reduces tower loading requirements. Modern transistorized alarm and control circuits monitor the system operation. The ultimate noise performance of a microwave system can be determined using noise loading techniques. Field results obtained on this system are presented in graphical form.

1004 Multiplex Equipment for Use on Light-Route Radio

H. R. Heron and R. L. Weeks, Lenkurt Electric Co., Vancouver, B.C.

This paper discusses factors to be considered in the design of multiplex for light-route radio, with particular emphasis on reliability, accessibility, carrier frequency synchronization and stackability. Built-in signalling compatible with the present day needs in toll switching plant, yet sufficiently low in cost for these low cross section systems, is also described. Slides and sample units illustrate the mechanical concepts.

1069 The Use of Broad-Band Radio for a Studio Transmitter Link

J. E. Konrad, Brown-Boveri (Canada) Ltd., Montreal, Quebec.

This paper describes the application of Brown-Boveri RT6 broad-band radio for use as a studio transmitter link. The major requirements of this equipment are outlined and the relevant specifications given. Special features of the RT6 system are described as they relate to the operational characteristics of the equipment. Brief reference is made to the use of this equipment for multi-channel operation with the type Mk3 multiplex system.

14 Tutorial Session on MILLIMETER & SUBMILLIMETER WAVES

BEAVER ROOM

1146 Generation of Millimeter and Submillimeter Waves

P. D. Coleman, University of Illinois, Urbana, Ill.

Theoretical and experimental results on the frequency conversion properties of a microwave plasma in the low millimeter range are presented. A simple analytical treatment of the problem yields results which are in excellent agreement with experiment in multipliers up to and beyond the 7th harmonic and in frequency adders.

Recent results on the megavolt electronics approach to submillimeter wave problem are given. Transition radiation, Fabry-Perot resonators, and Cerenkov couplers using scalar and tensor media are discussed. Transition or annihilation radiation beam couplers have now been explored up to the 42nd beam harmonic frequency. Beam excitation of a Fabry-Perot resonator at 35 Gc is described.

1147 Propagation of Millimeter and Submillimeter Waves

F. G. R. Warren, RCA Victor Co. Ltd., Montreal, Quebec.

The factors affecting propagation in the millimeter and submillimeter wave region of the spectrum differ from those which are predominant at longer wavelengths. Quantitative differences arise because in this frequency range even the smaller details of structure of both natural and man-made objects may have dimensions of many wavelengths. There are also qualitative differences resulting from absorption bands due to molecular resonances in atmospheric gases at these frequencies.

The significance of these factors in the propagation of millimeter and submillimeter waves is outlined. Guided propagation and plasma effects are discussed briefly.

1148 Masers

J. A. Giordmaine, Columbia University, New York, N.Y.

Details to be announced.

1149 Application of Solid State Materials at Millimeter Wave Lengths

G. S. Heller, Lincoln Laboratories, Massachusetts Institute of Technology, Lexington, Mass.

Details to be announced.

15 CIRCUIT DESIGN — II

ANCHOR ROOM

1012 Circuit Design Automation

J. P. Hesler, General Electric Company, Syracuse, N.Y.

This paper describes methods of utilizing computers as tools for the improvement of circuit reliability. It is mainly concerned with the development of programs to solve the equations of synthesis for drift-tolerant circuits. The first step is derivation of equations using "worst-case" design criteria. The second step is programming a digital computer to solve the equations, and the third step is verification of the programs through laboratory measurements. Programs have been written for the following circuit topologies: (1) symmetrical base-return, flip-flops; (2) non-symmetrical, base-return, flip-flops; (3) iterative NAND-NOR circuit; (4) special purpose NAND-NOR circuit. The paper discusses the direct and indirect advantages of the program, and describes three areas in which the work is being extended.

1043 Optimum Design of Sampled-Data Control Systems

D. W. C. Shen, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, and General Dynamics/Electronics, Rochester, New York.

This paper describes the application of least square filtering and z-transform technique to synthesize the physically realizable transfer function of a feedback control system when random signals corrupted by noise are sampled before filtering. The optimum transfer function cannot be factorized by the conventional method because the expression contains both the continuous and the sampled functions. The difficulty can be circumvented by sampling the expression again, computing the response for positive time only, and then evaluating the limit as the sampling period tends toward infinity. A simple example shows that under least square optimization the holding circuit should be a polygon-approximate predictor.

1063 Computer Study of Partially Neutralized Transistor Amplifiers

G. H. Cohen and D. Platnick, University of Rochester, New York.

The "black box" approach to transistor IF amplifier design is most expedient. However, for a satisfactory understanding of the behavior of transistor amplifiers the equavelent circui (inaccurate as it may be) is still use ful. The hybrid pi equivalent circui has been shown to be accurate a frequencies below alpha cutoff.

In the design of narrow band ampli fiers the normal pi equivalent circui is quite valid and leads to simpl expressions for potential stability transducer gain and bandwidth. Sim plifying assumptions have been mad and results compared with a machin solution using the complete hybrid p parameters.

The paper also discusses the effec that imperfect neutralization in th amplifier configuration has on per formance. When the effects of engi neering approximations are known one can devise a logical design pro cedure based on the equivalent circuit The paper extends analysis to includ more than one iterative stage wher the effect of imperfect neutralizatio becomes more pronounced.

1021 Two-Variable Feedback Contro Systems

E. V. Bohn, University of Britis Columbia, Vancouver, B.C.

Two-variable feedback systems are special class of the more genera multivariable system. They are o particular interest due to their rela tively frequent occurrence in practice Systems of this type have been ana lyzed by Krasovsky using a comple number method and by Newman usin matrix methods. Both of these method are restricted to assymmetrical inter connections.

This paper discusses the use of sys tem eigenvalues as a means of deter mining system stability for a genera multivariable system. If this metho is applied to the two-variable assym metrical connection, considerably mor insight into system stability is ob tained. A more direct comparison wit single-variable compensation method becomes possible.

Wednesday, October 4

Morning Sessions, 10 a.m. - 12:30 p.m

16 PULSE TRANSMISSION & RADAR

TOTEM ROOM

1087 Transmission of Radar Picture Over Telephone Lines by Slowed Down Video

T. W. R. East, Raytheon Canada Ltd. Waterloo.

Video signals from an air traffic con trol radar are converted into a signa of less than 1.5 kc bandwidth in a dual gun storage tube. By suitable modula

tion on an audio carrier, this signal is transmitted through a telephone circuit of wirephoto quality. At the receiving end, the signal is detected and written into a second dual-gun storage tube. TV readout is used to display the result on TV monitors. The transmitting and receiving equipment are described, the specification on the telephone circuit given, and overall performance described.

1102 Use of the Switched Message Network for Data Transmission

K. B. Harris, Bell Telephone Co. of Canada, Montreal.

New techniques are being developed to permit the use of a switched message telephone network for the transmission of data from one business machine to another. They will encompass a broad range of speed capabilities and meet a variety of performance requirements. They will necessitate close co-ordination with the business machine manufacturers to ensure compatibility. A close look will be required to consider: 1) Amplitude frequency response; 2) Net loss; 3) Noise; 4) Envelope delay-frequency characteristics; 5) Compandors and echo suppressors and their turnaround time. The present offerings, classed at Data-phone 100, 200, 400, and 600, are illustrated and their capabilities and limitations discussed.

1007 Comar — A Contour Mapping Radar System

H. E. Lustig, General Instrument Ltd., Westbury, Long Island.

COMAR is an airborne radar system for the generation of a terrain elevation contour record. All points on a terrain, whatever their elevation, are located by true vertical projection onto a horizontal reference plane. The paper describes the basic theory of COMAR, a proposed implementation, and the results of an error analysis carried out to establish realistic expectations for vertical and horizontal location capabilities.

1074 Synthesis of an Optimal Set of Radar Track-While-Scan Smoothing Equations

T. R. Benedict and G. W. Bordner, Cornell Aeronautical Laboratory, Buffalo, N.Y.

Performance-measure are described which realistically reflect both noise-reduction and manoeuver-following capability of radar track-while-scan system. Illustrations are given which compare various smoothing equations on the basis of this per performance-measure. Finally, a set of position and velocity tracking equations is synthesized by a calculus-of-variations technique. The synthesized set is optimum for both position and velocity tracking within the given performance sense, in the class of all fixed parameter, linear tracking equations. The resulting optimally synthesized set characterizes the commonly termed "α-β" tracker.

17 RELIABILITY

SHEAF ROOM

1027 Application of Parts in Military Electronic Equipments

A. P. Harris, Canadian Military Electronics Standards Agency, Dept. of National Defense, RCAF, Ottawa, Ont.

The "application" of parts is defined as matching the performance of parts to the conditions of stress they encounter inside the equipment under field conditions. The stress conditions are fundamentally electrical and environmental. The natural and induced environments are discussed and the deterioration of parts under these conditions reviewed. The steps to correct application are mentioned. When the equipment specification states a quantitative reliability requirement the problem is complicated by the necessity for determining the failure rate of each part and assessing its contribution to the failure rate of the equipment.

1086 The Exponential Failure Distribution as Related to Reliability

J. T. Hanes, Canadian Arsenals Ltd., Toronto, Ontario.

This paper explains why the failure rates of component parts must be known in order to predict the Mean Time Between Failures of an equipment design. The exponential distribution is desirable for the designer and there is evidence that it is found in practice. The exponential case is described and mean life derived. Parts life tests are dealt with and confidence limits of life estimates simply explained. Limitations of the exponential hypothesis are discussed. The replacement type life test is considered and related to the equipment life test. The paper is given from the engineer's standpoint without attempting any advanced statistical mathematics.

1023 A Critical Review on the Reliability of Components

A. Simoni, Precision Electronic Components (1956) Ltd., Toronto, Ontario.

The tendency of individuals and committees in charge of determining reliability of components is to use mass test procedures. And it has been suggested that manufacturers should be obliged to test their components in large quantities to provide statistical information. However, the economics of large-scale testing are such that it is not practical to test components for more than one stress condition, namely load life. This provides no information on other stresses which can lead to failure.

This paper presents some examples of failures in components due to stresses other than load life. It also suggests solutions to the problem of determining quality and reliability of components.

1132 Some Aspects of Accelerated Life Testing

G. Lengyel, Ontario Research Foundation, Toronto, and **H. Lysons,** Secretary, Electr. Component Research and Development Committee, Defense Research Board, Ottawa, Ontario.

The possibility of carrying out an accelerated life test depends on the existence and knowledge of a mathematical relationship between aging factor and life, such as the Arrhenius law. But there are limits af applicability. In functional life testing simulating service conditions, more than one aging factor is applied simultaneously. This causes difficulties in evaluation of test results, and comparison of data from different laboratories becomes almost impossible even when tests are carried out under rigorously specified conditions. Application of one aging factor at a time yields more fundamental knowledge.

Failure mechanisms deserve considerable attention, as they may give valuable information to improve the quality and reliability of the product. The failure mechanism must also be known to set up reasonable failure criteria for the life test. This paper gives an example for an ambiguous failure criterion from experience with transformers at Ontario Research Foundation. The paper also discusses economy of life tests. The main cost factors are the time required for a test and the number of samples to be tested. Increased acceleration of testing, and its limits are described.

18 ANTENNAS & PROPAGATION

MAPLE ROOM

1031 Experimental Frequency-Stable Transmissions at 80 kc from a Transmitter at Ottawa

J. S. Belrose, Radio Physics Laboratory, Defense Research Telecommunications Establishment, Defense Research Board, Ottawa, Ontario.

The accuracy of frequency comparison of distant radio wave transmissions is limited by doppler shifts caused by ionospheric variations. At HF, the doppler shift introduces errors of the order of 1 part in 10^7 to 10^8, but in the VLF and LF range, the reflecting layers of the ionosphere are quite stable throughout large portions of the day, and frequency comparison is often possible within a few parts in 10^{10} or 10^{11}. The Radio Physics Laboratory is operating an experimental frequency-stable 80-kc transmitter at Ottawa, and phase variations of the received signal at Churchill are being recorded. From the recordings, the mean relative drift between the terminal oscillators can be obtained, and the departures of the phase from that predicted by the mean drift curve are due almost entirely to propagation variations. These results are discussed, and some effects of ionospheric disturbances are indicated. The main emphasis of the paper is, however, concerned with methods of phase comparison, a subject of wide-spread, current interest because of application to world-wide time-frequency synchronization.

1032 Frequency Sounding as an Aid to Air-Ground HF Communications

J. P. Murray and G. W. Jull, Defense Research Telecommunications Establishment, Defense Research Board, Ottawa, Ontario.

Recent trials have demonstrated the effectiveness of ionospheric sounding as an aid to HF air-ground communications, particularly on long northern flights at auroral zone latitudes during ionospheric disturbances. Sporadic E modes of propagation were found to be useful for HF communications for a large percentage of the time during severe disturbances, when normal modes of propagation had failed. Reception quality on any one assignment often changed considerably in short periods of time, and complete blackouts across the HF band were experienced. To minimize the effect of blackouts, it was necessary to pass traffic with minimum delay when suitable propagation conditions were found by sounding.

1117 Radiation Patterns and Impedance of a VHF/UHF Dipole Antenna Inside a Supporting Tower

J. Y. Wong, Radio and Electrical Engineering Division, National Research Council, Ottawa, Ontario.

The problem of a vertical dipole antenna located inside a metal lattice-type tower is investigated. In order to compute the radiation pattern, the actual configuration is approximated by an idealized two-dimensional model. The analysis assumes that the longitudinal tower members are small and act as uniform scatterers. Results of pattern and impedance measurements are presented for practical towers of triangular and rectangular cross section to demonstrate the feasibility of this type of antenna structure for providing omnidirectional coverage.

1084 High Speed Analog Simulation of Antenna Arrays

J. Gilbert, Canadian Armament Research and Development Establishment, Defense Research Board, Quebec, Quebec.

This paper describes a high-speed analog simulator for synthesizing two-dimensional antenna arrays. The method of simulation utilized enables the computation of the overall amplitude radiation produced by a number of radiators arbitrarily distributed on a plane without placing any restriction on the orientation of their respective radiation patterns. Because of the high frequency response of transistorized computing elements specially designed for the simulator, the radiation characteristics of a given array can be visually displayed either on a cathode ray tube or a slow pen recorder. The positions and currents of the individual radiators are directly determined by dial calibrated potentiometers. In this manner, trial-and-error design procedures are largely simplified, since the effects of changes on the parameters of the array can be continuously monitored. In practice, the method of simulation has the advantage of requiring only a limited number of basic computing elements for the various problem operations.

NOTICE

Order Banquet tickets early . . . attendance limited to 300.

19 PARAMETRIC & NEGATIVE-RESISTANCE AMPLIFIERS

BEAVER ROOM

1112 A Parametric Amplifier for an L-Band Surveillance Radar

A. C. Hudson, Radio and Electrical Engineering Div., National Research Council, Ottawa, Ontario.

A negative-resistance type parametric amplifier operating at 1300 Mc has been designed and built in the laboratories of the National Research Council. The amplifier is of the non-degenerate, variable-capacitance diode type and is pumped at X band. The noise factor of the amplifier and following mixer is 2 db.

The amplifier will be on display, and experience gained in construction and test of this device will be described. Flight trial results and other tests performed on an operating surveillance radar will be presented.

1042 Circuit Impedance Effects in a Non-Degenerate Parametric Amplifier

D. G. Vice, Northern Electric Co. Ltd., Ottawa, Ontario.

From the general energy relations which have been developed for non-linear reactive elements under the influence of a high frequency pump and lower frequency signal, it is shown that the terminating impedances presented to each of the various sideband and harmonic frequencies determine the characteristics of the resulting device.

This paper derives some expressions for the energy relationships under various sideband frequency terminating impedance conditions, and then shows how these effects are demonstrated in a practical circuit. Bandwidth and tuning considerations are included.

1127 Synthesis of Negative Resistance Amplifiers

Norman L. Weinberg, Applied Physics Group, Air Arm Div., Westinghouse Electric Corp., Baltimore, Md.

This paper presents a synthesis technique for determining the element values and the performance of a negative resistance microwave amplifier utilizing a circulator. The general procedure is based on the synthesis of the input impedance of a lossless network terminated by a negative resistance, after the required impedance is derived from the gain function. The low pass equivalent ladder network is obtained for amplifiers having the Butterworth, Tschebyscheff, and elliptic responses. Application of the synthesis procedure yields the terminating shunt capacitance for the general order Butterworth and Tschebyscheff amplifiers. This leads to expressions for normalized bandwidth and graphs are presented which indicate the bandwidth improvement achieved at the expense of pass band ripple. The technique can be applied to many suitable functions enabling the engineer to synthesize and evaluate the device.

1097 Noise Characteristics of Tunnel Diodes and Tunnel Diode Amplifiers

J. Shewchun, University of Waterloo, Waterloo, Ontario.

This paper examines the basic mechanisms by which a tunnel diode contributes thermal and shot noises to electrical circuits, and hence attempts to establish a limiting criterion on the noise figures of one-port and two-port amplifier configurations. Mathematical expressions are developed to express the noise characteristic of a diode, but it is shown that the work involved in obtaining a numerical evaluation exceeds that involved in obtaining an equally acceptable value through a graphical analysis of a measured characteristic. The importance in having an explicit relationship for the noise characteristic lies in the ability to prescribe physical specifications for manufacturing a tunnel diode giving a minimum noise.

20 RADIATION INSTRUMENTATION

ANCHOR ROOM

1154 The Ontario Radiation Protection Laboratory — Equipment and Program

E. O. Braaten, Industrial Hygiene Branch, Department of Health, Toronto, Ontario.

The unique construction and specialized instrumentation of The Ontario Radiation Protection Laboratory is discussed in relation to the requirements for measuring radiation from natural and artificially produced radio-active material found near reactors, uranium mines, refineries etc. A general program relating to these objectives is described.

1071 Low Noise Transistor Preamplifier for Use with Silicon Junction Alpha Particle Detectors

A. J. S. Davidson, RCA Victor Co. Ltd., Montreal, Quebec.

Some factors in the design of a transistor preamplifier for optimum resolution of pulse heights from a silicon junction particle detector are discussed. The charge amplifier feedback configuration is found preferable to compensate for variation in the detector capacitance. The output noise is calculated, taking into account the detector noise and an analysis is presented of the signal to noise expected of a transistor input stage. The effect of pulse shaping networks on signal to noise ratio is considered for the case where the signal is a decaying exponential waveform. Measurements on an amplifier designed on these principles are described giving a noise line width (f.w.h.m.) of 18 kev with a 12 pf input capacitance.

1070 An Alpha Particle Contamination Monitor Using Silicon Junction Detectors

J. C. Boag, RCA Victor Co. Ltd., Montreal, Quebec.

An alpha particle detecting portable monitor has been developed utilizing 8 large area pn silicon junction detectors. The active area of each detector is 2 sq. cm, providing a total area of 16 sq. cm. When used for detection of distributed sources of alpha activity, the sensitive area may be as large as 40 sq. cm depending on the arrangement of the detectors.

The paper describes briefly the principle of operation of silicon pn junction radiation detectors and discusses suitable input configurations for measuring the detected signal. An analysis is presented of the signal-to-noise ratio readily obtainable using high frequency drift transistors.

The design of a simple linear count rate indicator is described, with a discussion of accuracy expected on random counts. The monitor covers the range 0 to 2 x 10^6 counts per minute in four switched decades, and has been designed to be insensitive to variations in transistor parameters, and temperature in the range −30°C to +50°C.

1135 A High-Speed Analog to Digital Converter

W. F. Korczynski, Computing Devices of Canada Ltd., Ottawa, Ontario.

A newly developed solid state 400-channel pulse height analyzer uses an encoder for analog to digital conversion which takes advantage of a two-step process to permit high speed with a relatively low clock frequency. The input signal charges a capacitor to the peak value of the pulse. The capacitor is subsequently discharged in steps equal to 10 channel widths until its potential is reduced to a value corresponding to the 13th channel level. Discharging then proceeds in steps equal to single channel width until the base line potential is reached. A 10-volt pulse, with channel width set at 25 millivolts, is encoded in approximately 50 μsec. Excellent linearity is achieved except in the first few channels.

CONFERENCE OFFICE

1819 Yonge Street, Toronto 7
Telephone HUdson 8-7768

1154 Details to be announced.

Wednesday, October 4

Afternoon Sessions, 2:30 - 5:00 p.m.

21 Panel Discussion on IMPORT & EXPORT PROBLEMS

TOTEM ROOM

Moderator: R. Story, Vice-President and General Manager, Radio Valve Co. Ltd., Toronto, Ontario.

A panel of leading executives in the Canadian electronics industry will deal with the various aspects of the import and export of electronic products. Their joint experience gained in discussions with the industry, government, as well as with representatives of the U.S. industry, ensure a highly interesting session on this controversial topic. Panel members are:

W. H. Jeffery, Vice-President and General Manager, Philco Corporation of Canada, Don Mills, Ontario.

W. S. Kendall, Marketing Director, Computing Devices of Canada, Ottawa, Ontario.

22 Panel Discussion on EDUCATION

SHEAF ROOM

Moderator: Prof. A. D. Moore, Electrical Engineering Department, University of British Columbia, Vancouver, British Columbia. Chairman of the IRE Canadian Region Education Committee.

A panel of experts who are well acquainted with the various types of technical education in electronics and in the placement of the graduates of these courses in both industry and government organizations, will discuss these and other problems involved in choosing a career in electronics. Panel members are:

B. R. Myers, Chairman, Department of Electrical Engineering, University of Waterloo, Ontario.

C. M. Jackson, Principal, Western Ontario Institute of Technology, Windsor, Ontario.

R. C. Poulter, Director of Education, Radio College of Canada, Toronto, Ontario.

W. F. McMullen, Engineering Personnel Manager, Canadian General Electric Co. Ltd., Peterborough, Ontario.

H. R. Smyth, Head of Navigational Aids, Radio and Electrical Engineering Division, National Research, Council, Ottawa, Ontario.

A distinguished contributor to electronics in Canada, Major Richardson was the first Chairman of the Canadian Section of IRE in 1925.

Major C. L. Richardson, P.Eng.

In retrospect

. . . "looking ahead" and "forward thinking" are catch phrases of our times . . . occasionally, a pause to look back is in order . . . this invited article by a distinguished Canadian engineer provides such an interlude . . . Editor

My father, the late Prof. C. G. Richardson, F. G. S., onetime head of the Department of Chemistry, Ontario Veterinary College, once remarked: The great industrial revolution in England took place during the lifetime of his father, and that the greatest scientific progress had taken place during his own lifetime. I might likewise say "The development and progress in the science of wireless communication and its concomitant fields, now covered by the generic term "Electronics" has occurred during my lifetime."

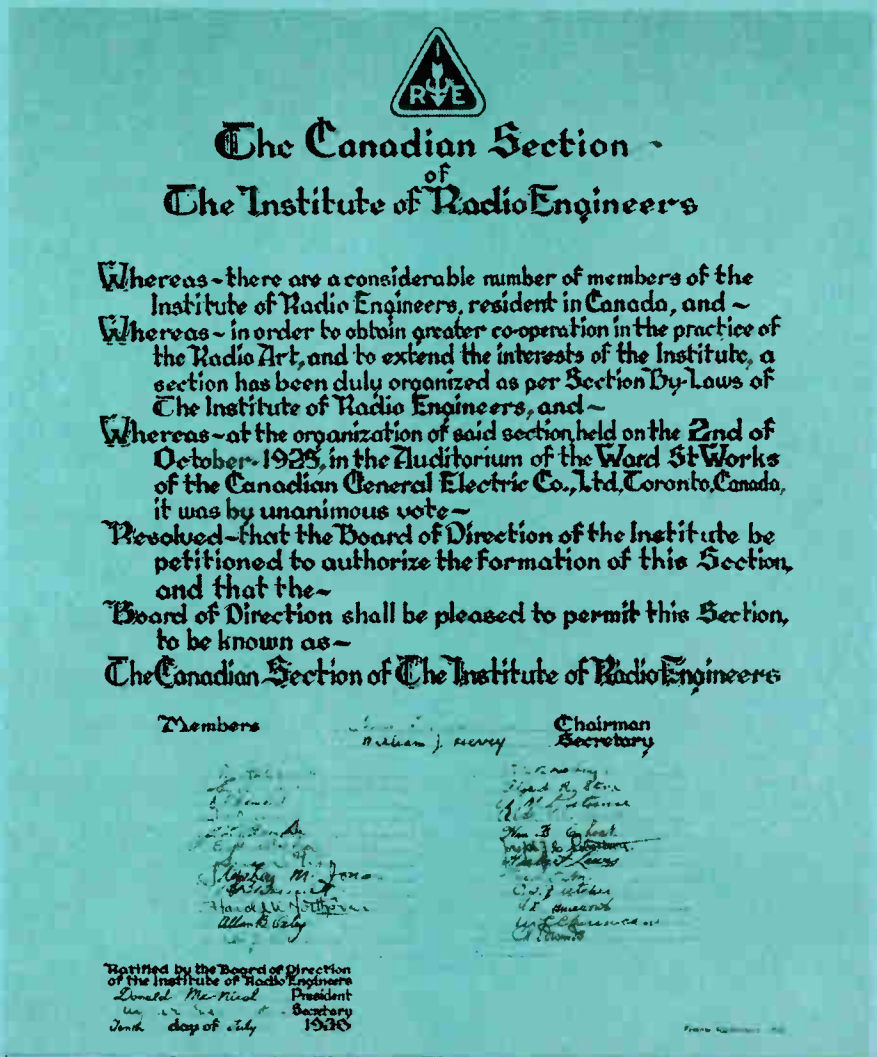
The inquiring minds, who over a period of time, contributed their bits and pieces of knowledge to the mosaic extend as far back to the year 1729 in England, when Stephen Gray gathering together threads of prior knowledge, in pointing out the difference between conductors and insulators of electricity.

Following along the years, we come to the contributions of many inquiring minds, each investigating phenomena; formulating theories; laws, and often producing crude apparatus of demonstration. The list is long and distinguished: Volta's chemical battery in 1793; Humphrey Davy's 200 cell battery at the Royal Institution in 1809 to demonstrate the effects of high voltage; and many others. From 1813 followed the work of Oersted, Ohm, Ampere, Leyden, Wallaston and Arago. By 1830, the genesis of wire telegraphy began.

Farraday and Henry's work led to that of Heinrich Ruhmkoff in 1851, and the development of the Ruhmkoff coil, now known as an induction coil. This was the basic instrument for the production of Hertzian waves in 1887, and is the point of departure from wire to wireless telegraphy.

From thereon followed the investigations into the phenomena of high frequency oscillations by such scientists as Lord Kelvin, Clerk Maxwell, Kirchoff, Pupin, Edison and John Stone.

The story of wire telephony begins with Alexander Graham Bell's telephone in 1876, and its development and expansion together with wire tele-



The Canadian Section
of
The Institute of Radio Engineers

Whereas - there are a considerable number of members of the Institute of Radio Engineers, resident in Canada, and -
Whereas - in order to obtain greater co-operation in the practice of the Radio Art, and to extend the interests of the Institute, a section has been duly organized as per Section By-Laws of The Institute of Radio Engineers, and -
Whereas - at the organization of said section held on the 2nd of October 1925, in the Auditorium of the Ward St Works of the Canadian General Electric Co., Ltd, Toronto, Canada, it was by unanimous vote -
Resolved - that the Board of Direction of the Institute be petitioned to authorize the formation of this Section, and that the -
Board of Direction shall be pleased to permit this Section, to be known as -
The Canadian Section of The Institute of Radio Engineers

Members — Chairman — Secretary

Ratified by the Board of Direction of the Institute of Radio Engineers
Edward Bennett President
Secretary
Tenth day of July 1926

Facsimile of the original Articles of Association of the Canadian IRE Section.

graphy was both on a practical and commercial basis. Telephony without wires was to come later.

From Roemer's observation of the eclipses of the moons of Jupiter, he deduced that light travelled at about a speed of 186,000 miles per second, and Maxwell concluded that light waves must be electromagnetic. Hertz detected them; Marconi harnessed them to signalling and Pupin made them the bearers of sound. Thus Bell's work came into the orbit of communication without wires.

In an article, short as this, one cannot digress or detail credit to the work of the many contributors in this field except to bring to notice the highlights of development and the main personages, such as Sir Oliver Lodge, Dr. J. A. Flemming, Wm. H. Preece, Braun, Slaby, Arco, Zennick, R. A. Fessenden, Nikola Tesla, Poulsen, and Prof. Pickard, etc. were the outstanding scientists at this time.

The breakthrough and fundamental element of modern electronics was Dr. Lee DeForest's three element tube in 1907, it was in part developed from Flemming's valve coupled with the Edison effect. It is strange that Edison somehow missed this important development in history. However, the three element tube led a host of investigators on a new round of discovery and we are presented with the names of Arnold, Hazeltine, Hogan, Logwood, Langmuir, Morecroft and Espenchied

I came into the picture when Marconi sent the letter "S" across the Atlantic, from St. John's, Newfoundland to Poldhu in Cornwall on Dec. 21, 1901. The world was electrified in 1909 by the "Republic" and Jack Binns in the rescue operations, the first time at sea. I followed the developments through publications and experimentation to the years 1914. I made most of the apparatus by hand, from crystal detectors, coherers, to magnetic detectors or "Maggies". Made my own transmitters, wound induction coils, tuners, jiggers and other equipment. Later experimented with Flemming valves and DeForest's Audios. I still have a pair of N.E. R205-D tubes.

The next breakthrough came when the A.R.R.L. group set up short wave transmissions from the U.S. to Andrascoggin, Scotland in December 1921. The results were to direct attention to the use of short wave instead of long wave transmission which was more costly. Short waves lead to the study of skip-distance communication, also it eventually led to microwave techniques.

From now on there appeared a new series of study and investigations with the names of people like Dr. G. A. Campbell, F. B. Jewett, E. H. Colpitts, Van der Bijl, Alexanderson, Dubilier, Collins, Meissner, Cady, A. W. Hull, E. W. Kellog, Carl Dreher, A. W. Rice, R. V. L. Hartley, Dr. Goldsmith, and Melville Eastham and R. A. Baker.

Canada had her inquiring minds too, I am reminded of some of them like Alexander Roach, R. A. Weagant, Arthur H. Morse, Col. Arthur Steel, Prof. Rosebrugh, D. P. R. Coats, J. O. G. Cann, Ted Rogers, Keith Russell, Dr. Ormond Solandt, Prof. B. deF. Bailey, and George Eaton.

It will be appreciated, that I have made an inadequate survey of the past. Today, the horizon has expanded enormously which will continue for some time to come. Electronics embraces many fields and now we come to Robert Watson-Watts' Radar, Direction finders, Sonar, Television, complex landing and guidance systems, microwave communications, telemetering systems for space flight to say nothing of computers and self-organizing electronic brains. In one sense we may say the wheel has turned full cycle in which crystal detectors have now become transistors!

To me, it is fascinating to look back over the last decades of progress in the science of electronics. The meeting ground for scientists and engineers from all over the world has been the Institute of Radio Engineers which began its corporate life May 13, 1912. The Canadian Section of this great organization was formed in 1926 and I had the honor of being its first chairman. The 1961 Canadian Electronics Conference viewed against these early beginnings, is surely a source of great satisfaction to all those many dedicated persons, who over the years have helped the Institute to achieve its present world-wide status as a senior scientific body.

. . . on the following pages . . . our special Feature Product section . . .

a preview of products selected by the exhibitors to be on show at the I.R.E. Exhibition . . . make enquiries directly at booths or circle product numbers on the Reader Service Card, page 91. For other products on display, consult the Product Locator Department beginning on page 77.

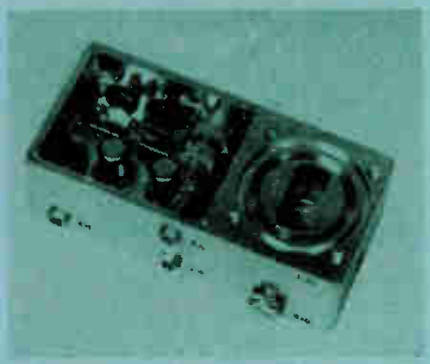
feature products

For further information on Feature Products use Readers' Service Cards on pages 91 and 92

Mixer-preamplifier

Shown at Booth 533 — Item 2

The smallest available microwave front end assemblies are offered in LEL's new mixer-preamp series, model XBO-8. Combin-



ing an Orthomode mixer and a Nuvistor IF preamp, the device features small size, low power drain, lower cost and excellent noise figures, less than 8 db in the X-band model. Units with conventional tubes are available in the range of 3.95 to 10.5 KMC. Power gain is 22 db, IF is 30 or 60 Mcs.

E. G. Lomas, 227 Laurier Ave. West, Ottawa, Ont.

Solid tantalum capacitors

Shown at Booth 530 — Item 5

Kemets Company's new 75-volt solid tantalum capacitors, the highest rated units of their kind, have been designed for military and commercial appleations that require high reliability features combined with miniaturization, and meet or exceed some of the most rigid requirements of MIL-C-26655A. The operating range for the 75 volt capacitors is from 55°C to +125°C. They are furnished in 14 standard EIA capacitance values, ranging from .1 to 15 microfarads in tolerances of ±20, 10, and 5 per cents.

Melcolm, 1969 Avenue Road, Toronto 12, Ontario.

Tuned amplifier and null detector

Shown at Booth 252 — Item 8

An unusually versatile and compact instrument Type 1232-A, measures only 8" x 6" x 7¾". In addition to its main use as a

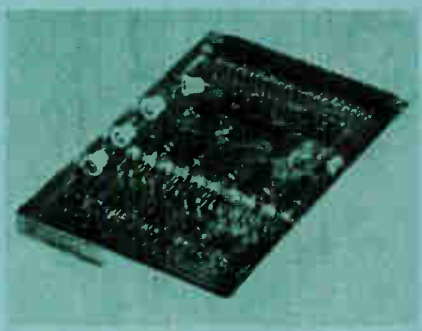
bridge detector with its high sensitivity of 1 μv it has applications as a preamplifier, a tuned audio amplifier and an audio spectrum analyzer. Completely transistorized and battery operated, the unit is housed in a G-R rack bench cabinet.

General Radio Company, 9 Floral Parkway, Toronto 15, Ont.

Quadruple flip-flop packages

Shown at Booth 161 — Item 3

Type 4216 is a four flip-flop shift register package with shift and parallel read-in gates. Level inputs are by 1500 ohm capa-



citor diode gates. Two pulse inverters are included to drive each set of the above gates. It may be used for parallel-to-serial conversion. Type 4213 flip-flop package may be used for connections as a shift or buffer resister, and Type 4214 was designed to meet set-reset applications.

Digital Equipment Corp., 146 Main St., Maynard, Mass.

Aluminum solder

Shown at Booth 461 — Item 6

Belling & Lee Ltd. manufacture a rosin cored solder specifically for the soldering of aluminum and the majority of aluminum alloys. It's most successful on light gauge components and wires in the radio industry, but is highly suitable for fluorescent lamp caps made of aluminum. It may be used with an ordinary soldering iron under normal hand soldering conditions. Should be of interest to Radio and Lamp industries, for chassis soldering and also used in lightweight TV cameras.

Astral Electric Co., Ltd., 44 Danforth Road, Scarborough, Ontario.

Analog and digital recorders

Shown at Booth 152 — Item 9

The FR-100C analog and digital recorders feature all solid state electronics, capable of either Direct, FM, PDM or PCM, (serial

and parallel) recording and reproduction, up to 300 KC.

A video loop unit records up to 30 seconds of 4 MC information using a stationary head and 1300 ips tape speed.

Ampex of Canada Ltd., 1458 Kipling Ave. North, Rexdale, Ont.

Slo-Syn translator

Shown at Booth 369 — Item 4

A pulse-to-step converter called Slo-Syn translator type ST-150 is available for use in programmed positioning, remote position-

ing and indicating applications. This device is designed to convert low level signal pulses or square waves into the correct switching sequence needed to drive a Slo-Syn Synchronous Motor at 200 discrete steps per revolution.

The American Superior Electric Co., Ltd., 174 Evans Ave., Toronto 18, Ont.

Precision breadboard development kits

Shown at Booth 244 — Item 7

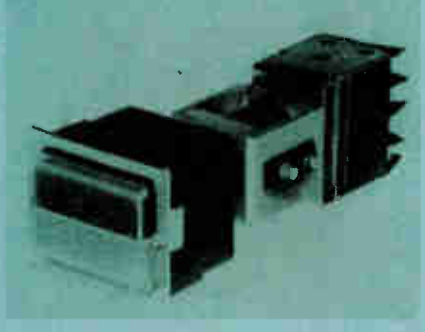
These kits include Precision 1, 2, and 3 gears, ultra precision shafting, adjustable hub clamps, engraved disc and drum dials, miter and bevel gears, miniature-multi-jaw coupling, anti-backlash gear assemblies, shaft hangars, speed reducers, differentials, non-metallic spur gears, fine pitch "certified" racks, universal joints, precision tool components, universal multi-ratio gear box, miniature chain and sprockets, spiroid gears, and adjustable bellows couplings.

PIC Design Corp., 477 Atlantic Ave., East Rockaway, Long Island, N.Y.

Illuminated push button switch

Shown at Booth 363 — Item 10

Burgess micro switch Model 3AA14, is a solonoid hold push botton switch panel mounted by either barrier or flange mount-operating position if coil is energised. Avail-



ing. Switch may be depressed and held in able with momentary action and alternate action. Circuiting is 2 pole or 4 pole, 5 amps resistive to 250 AC. Four lamps illuminate the display panel which acts as a button for operating switches.

Burgess Micro Switch, 5 Brooklyn Ave., Toronto 8, Ont.

feature products

For further information on Feature Products use Readers' Service Cards on pages 91 and 92

Shaft position coder

Shown at Booth 364 — Item 11

The Kelk shaft position coder Model 541 is an analogue-to-digital converter which accepts a shaft rotation input and delivers

electrical outputs which express the instantaneous angular position of the input shaft in decimal circuit form. It is designed so only one output per decade is possible at any time and ambiguity of output representation is impossible. Magnetic circuits are used for switching to reduce friction and wear.

George Kelk Ltd., 5 Lesmill Road, Don Mills, Ont.

IF filter test set

Shown at Booths 342, 344 & 350 — Item 14

The Jerrold IF-filter test set Model 1701 is a laboratory or production test instrument which is particularly useful in the quantitative and comparative measurement of filters in the 2 to 70 MC range that exhibit dynamic ranges of approximately 80 db. In addition it accurately measures and compares gain, loss and VSWR of other electronic components within the specified range. Test sets with a range to 100 mc are available on special order. An accessory, the Jerrold Model KSB-50 rf bridge will extend VSWR measuring capabilities.

Jerrold Electronics (Canada) Ltd., 50 Wingold Ave., Toronto, Ont.

Precision RMS decade voltmeter

Shown at Booth 138 — Item 17

Believed to be one of the most accurate AC voltmeters in the world, the Muirhead D-930-A precision RMS voltmeter

has a wide voltage range of 1 mV to 300 V and a useful frequency range of 5 c/s to 100Kc/s. Over the greater portion of this range the measurement accuracy is 0.05 per cent and the reading accuracy over the whole range is 0.025 per cent.

Muirhead Instruments Ltd., 677 Erie St., Stratford, Ont.

Automated soldering machine

Shown at Booth 545 — Item 12

Semi- or completely automated soldering is now possible on many components produced in and for the industrial market with

Kester's universal soldering machine, SD-4 Model 1. This unique soldering machine is designed so the adapters can be varied to accommodate a variety of units to be soldered using Kester "Solderforms" to complete the automation.

Kester Solder Co. of Canada Ltd., P.O. Box 474, Brantford, Ont.

Precise AC measuring instruments

Shown at Booth 235 — Item 15

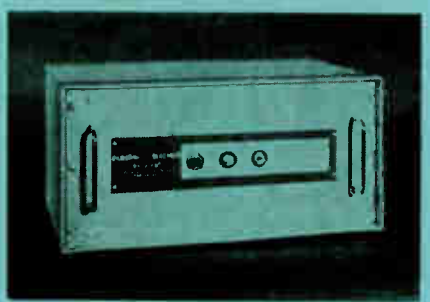
YEW model SPF series instruments are designed for use in fields where precise AC measurement is required. These instruments conform with the requirements for 0.5 per cent portable of the American Standard for Electrical Indicating Instruments. They employ a newly designed pure iron cup shield to minimize the external magnetic field influence. Scales are hand-calibrated and fitted with mirrors to eliminate parallax errors. The instruments are designed to use in a horizontal position.

Yokogawa Electric Works, Ltd., 40 Worth St., New York 13, N.Y.

Voltage regulator

Shown at Booth 352 — Item 18

Inductrol induction voltage regulators and Sta-Vo-Trol static voltage regulators are now available. Inductrol regulators feature drift-free control, 100 per cent overload



capacity, 97 to over 99 per cent efficiency, and rugged and compact design. The Sta-Vo-Trol regulators feature zenerdiode sensing, rapid response, remote sensing, and compact size.

Voltage Regulator Products Div., General Electric Co., 100 Woodlawn Ave., Pittsfield, Mass.

Double vapour diffused junction rectifiers

Shown at Booth 331 — Item 13

Samples shown are from a wide range of double vapor diffused junction rectifiers

manufactured by Syntron (Canada) Limited. Peak inverse voltages cover the range from 50 to 1,500 volts. Units are supplied in various packaging configurations and all feature long operating life, low reverse currents and high rectifier efficiency.

Syntron (Canada) Ltd., 930 Queenston Rd., P.O. Box 10, Stoney Creek, Ont.

Direct view storage tube

Shown at Booth 145 — Item 16

The EEV E-702 direct view storage tube is incorporated in a Remscope oscilliscope being used for the display and measurement of intricate electronic information in research and measurement laboratories. A series of separate signals can be recorded with this device and maintained for prolonged periods. A feature of this tube is the storage of half-tone information and this permits the storage of pictorial information. The tube is incorporated in a Teleremscope to permit the electronic scanning of steel strips.

Canadian Marconi Co., 1830 Bayview Ave., Toronto 17, Ont.

Miniature circular plugs

Shown at Booth 452 — Item 19

New KPT/KSP line of miniature circular Cannon Plugs are designed to meet requirements of MIL-C-26482. KPT general

duty plugs are available in seven shell styles and six service types. KSP plugs are similar, except they feature a non-conductive finish and a large flange located for rear panel mounting. Crimp type as well as solder pot contacts are available.

Cannon Electric Canada Ltd., 160 Bartley Drive, Toronto 16, Ont.

feature products

For further information on Feature Products use Readers' Service Cards on pages 91 and 92

Transmission measuring set

Shown at Booth 170 — Item 20

The TMS-0100 swept-band transmission measuring set has been designed to meet the needs of the communications industry

for both initial testing and routine maintenance. The instrument makes it possible to examine the transmission characteristics within a prescribed frequency band and display these characteristics on a repetitive basis on the face of a cathode ray tube with long persistance.

Tele-Radio Systems Ltd., 3633 Dundas St. W., Toronto 9, Ont.

Self-supporting communications tower

Shown at Booth 336 — Item 23

The addition of three heavy duty 20 foot sections to the basic, self-supporting Rohn design has resulted in a new 170 foot communications tower. This gives the extra height and support needed to increase the rating, so it can be used for bigger and heavier jobs

This has lengthened the towers to new heights which will prove exceptionally valuable in communications construction. Prior to this time the Rohn self-supporting line of towers had a maximum height of 130 feet.

Rohn Manufacturing Co., Box 2000, Peoria, Ill.

Communications test equipment

Shown at Booth 349 — Item 26

Developed by RCA for precise measurement of performance on high capacity multi-channel telephone microwave relay systems designed to comply with CCIR/

CCITT recommendations. RF sweep generator Type CG-75 features center frequency in range 1.6 - 2.6 kmc; sweep range 0 - 1 kmc; rate 60 cps (int.) or 0.1 - 2 kc (ext.); amplitude flatness ±0.1 db/50 mc or +1db/1 kmc; and output 0 - 200 mw.

RCA Victor Co., Ltd., 1001 Lenoir Street, Montreal, P.Q.

Fully-transistorized computer

Shown at Booth 242 — Item 21

Designed for complex scientific and engineering computations, the powerful stored-program computer. Its solid-state compo-

nents and advanced computer circuits provide reliable, high-speed operation. It consists of two modular units, a central processing unit and a paper tape reader and punch. Special design features include 20,000 digits of magnetic core storage.

International Business Machines Co. Ltd., Don Mills Road, Don Mills, Ont.

Precision AC panel meters

Shown at Booth 351 — Item 24

Honeywell has announced extension of its product line to include a broad range of iron vane AC volt meters, ammeters, and milliammeters. They are matched style-wise to the line of DC meters and are available in the following ranges: volt meters, one to 800 volts; ammeters, one to 800 amperes; and milliammeters, 10 to 800 milliamperes. The moving iron vane mechanisms feature magnetic damping, impregnated field coils, and selected fixed and moving iron material to provide long, trouble-free operation.

Honeywell Controls Ltd., Precision Components Division, Vanderhoof Ave., Toronto 17, Ont.

Hermetically-sealed rotary switch

Shown at Booth E-6 — Item 27

Designed for landing gear applications, this rotary switch manufactured in Canada, has been incorporated in the Canadair CF-104. It's designed with contacts rated at 28 volts DC, 25 amps resistive. Temperature

range is −65° to +250°F. It has passed 10,000 cycles at 60 g's vibration and 1,000 cycles at 100 g's vibration. Two models are available: self-centering model 35° switch actuation and non-centering type with 185° travel.

Licon Switch Division, Canada Illinois Tools Ltd., 67 Scarsdale Rd., Don Mills, Ont.

Transistorized infra-red detector

Shown at Booth 241 — Item 22

A portable instrument designed to detect faults in high voltage transmission lines, may also be used in a variety of industrial

and research roles to determine temperature differences or (in modified form) to make accurate temperature measurements. One version has been used as an intrusion alarm. The instrument normally may be mounted on a tripod while it is being used.

Canadian Patents and Development Ltd., National Research Council, Ottawa, Ont.

Epoxy copolymer dipping compound

Shown at Booth 253 — Item 25

Hysol 5034 is a single component, 100 per cent solids epoxy compound designed for dip coating. A substantial coating thickness can be applied in one application, with excellent bond strength to steel, aluminum and many other materials. It has an extended tank life.

Typical applications include insulating electrical components, e.g. bus bar, capacitors, coils, etc., and providing metal to metal bonds. This material can also be "B" staged, from a dipping compound to a film adhesive.

Hysol (Canada) Ltd:, P.O. Box 53, Station R, Toronto, Ont.

Versatile sweeping oscillator

Shown at Booth 534 — Item 28

Ligna-Sweep Model SKV is a 50 cps to 220 mc sweeping oscillator and frequency marker. It provides repetition rate of log and linear sweeps from 0.2 cps to 30 cps, manual frequency control, and high-level

AGC'd RF output. Another oscillator Sona-Sweep Model M is a 20 cps to 200 kc audio sweeping oscillator and frequency marker, which provides sharp pulse type crystal markers, stable sweep widths as narrow as 20 cps.

Kay Electric Company, Maple Avenue, Pine Brook, N.J.

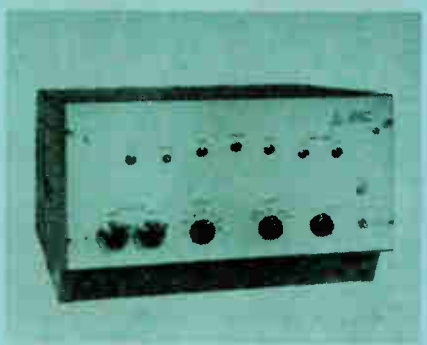
feature products

For further information on Feature Products use Readers' Service Cards on pages 91 and 92

Pulse height analyzer

Shown at Booth 469 — Item 29

This 5 Mc analyzer has 256 channels with a dead time of (13+0.2N) microseconds where N is the channel number. Channel



capacity is 65,535 counts and rise and fall times of ADC are 0.6 microseconds or faster, differential linearity is better than ±2.0 per cent from channel 3 to 255, while integral linearity is 0.5 per cent or better for the same channel range.

The Glendon Instrument Co. Ltd., 46 Crockford Blvd., Scarborough, Ont.

Rotary switch

Shown at Booth 541 — Item 32

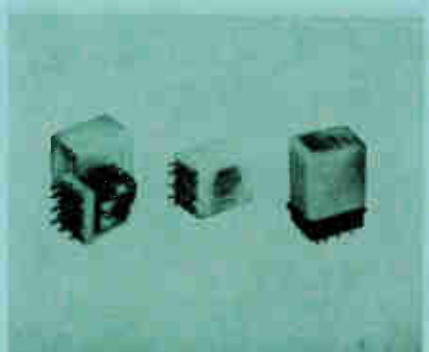
This rotary switch, series 600, has a diameter of 1¼" and was designed to meet MIL-S-3786 A. It's available with ceramic, phenolic or Mycalex sections. The switch can be supplied with adjustable or fixed stops with 30° or 60° indexing. It has up to 12 terminals on each side of the stator of which eight can be insulated. Contact resistance is 3 milliohms, current rating is 2 amps at 15 VDC and 250 ma at 110 VAC, and life test is 25,000 cycles minimum.

Centralab Canada Ltd., P.O. Box 400, Ajax, Ont.

Long-life miniature relay

Shown at Booth 555 — Item 35

A small, rugged, high performance KHP series realy, model 4PDT, adds a new dimension in reliability to electromagnetic switching. This was designed to meet require-



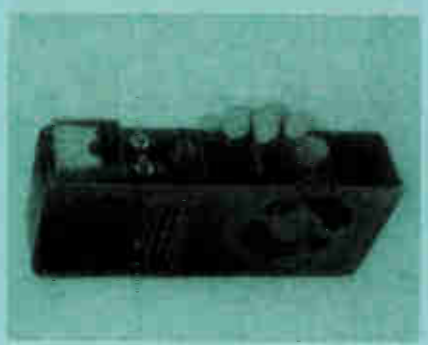
ments of data processing, process control, etc. It is insulated with molded glass reinforced alkyd and has a life in excess of 100 million mechanical operations. Contact arrangements are: 4 Form C (4PDT) and 2 Form Z (2PDT-DB).

Potter & Brumfield, 135 Oxford St., Guelph, Ont.

Miniaturized DC potentiometer

Shown at Booth 534A — Item 30

The Model PC "PocketPot" is a .05 per cent accurate, miniaturized DC potentiometer for use as an infinite impedance



calibrator and measuring instrument. Pocket Pot's uniqueness is that in spite of its small size, it is a completely self-contained, high accuracy potentiometer with internal galvanometer, standard reference source and direct "in line" dial readout.

Sensitive Research Instrument Corp., 310 Main St., New Rochelle, N.Y.

Filtercons

Shown at Booth 433 — Item 33

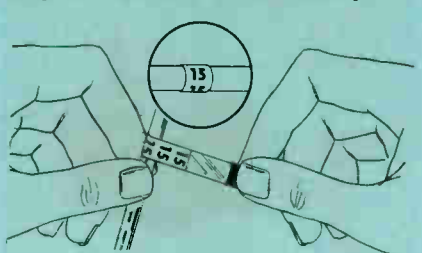
This is the name applied to newly developed three terminal, high frequency, low pass filters. Several advantages of the designs are: the resistive component is magnetically induced and is effective only at high frequencies: negligible DC voltage drop is obtained since the only DC resistance present is that of the feed-thru wire itself which is less than 0.01 ohms; and units may be either soldered or bolted to the chassis.

Erie Resistor of Canada Ltd., 7 Fraser Ave., Trenton, Ont.

Self-adhering wire markers

Shown at Booth 159 — Item 36

These self-laminating, self-adhering and precoded E-Z-Code wire markers contain a transparent lamination extension which wraps around and over the coded part to



provide protection. Recommended for use in machine tool wire identification, switches, signals, etc., they are available in several sizes and lengths. They are also resistant to all conventional oils, greases, chemicals, etc.

Northern Industrial Products, Ltd., 18 Coldwater Rd., Don Mills, Ont.

Portable magnetometer

Shown at Booth 360 — Item 31

Type 327 is a sensitive precision instrument designed to measure the earth's magnetic field. The instrument was developed

to record observations of inclination, declination, total intensity, orthogonal component intensity and time variation. Absolute intensity range is 0 to 100,000 gammas; the frequency response of the device is 0-1 cycle per second.

Canadian Applied Research, P.O. Box 4004, Terminal A, Toronto, Ont.

Constant temperature oil bath

Shown at Booth 431 — Item 34

Model 804 constant temperature bath is designed to meet the stringent requirements of ASTM kinematic viscosity test D 445-60. However, it is useful in any application requiring precise temperature control. Its range is from 80° to 300°F. A temperature sensitive AC bridge circuit with a resistance thermometer in one arm is used to sense the bath temperature. The elimination of all moving parts and vacuum tubes gives it excellent long-term reliability.

Polytronics Co., 582 Bathurst St., Toronto 4, Ont.

High-speed relay

Shown at Booth 563 — Item 37

A new Class V mercury-wetted-contact, high-speed relay is available. Designed for use with computers, data-processing and control equipment, the relay has an operate

time of approximately 3 milliseconds. A hermetically sealed glass capsule encloses the contact assembly and a small pool of mercury in a pressurized hydrogen atmosphere. It has a life of more than one billion operations without wear.

Automatic Electric Sales (Canada) Ltd., 185 Bartley Drive, Toronto 16, Ont.

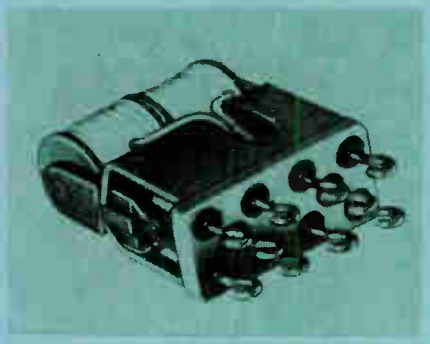
feature products

For further information on Feature Products use Readers' Service Cards on pages 91 and 92

Magnetic latching relay

Shown at Booth 238 — Item 38

Type LF magnetic latching crystal can relay is similar in internal design and external appearance to the well accepted



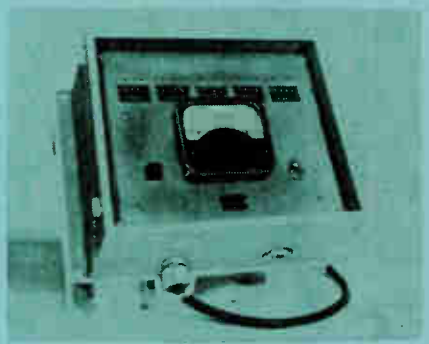
Type F. The relay withstands exposure to even more severe environmental extremes, provides the "memory" of a latching device, and may be operated with relatively low power input. Two permanent magnets provide latching forces which hold the contacts in either of two stable positions.

C. P. Clare Canada Ltd., 840 Caledonia Road, Toronto 9, Ont.

Tuning fork resonant relays

Shown at Booth 164 — Item 39

Stevens-Arnold tuning fork resonant relays are miniature, plug-in components installed at the receiving end of low cost



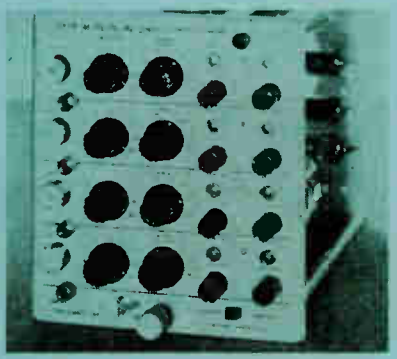
selective calling or remote control systems. These vibrating reed relays operate only when energized at their rated frequency. This unique selective characteristic allows individual control of up to thousands of functions at the receiving end of a cable pair or radio channel.

John Herring and Co. Ltd., 3468 Dundas St. W., Toronto 9, Ont.

Oscilloscope plug-in unit

Shown at Booth 160 — Item 40

For viewing up to four signals, either separately or in any combination, the Type M Plug-in Unit offers individual input ampli-



fiers — each with its own attenuator, variable gain, and vertical position controls. Triggered or free-running electronic switching, positive or negative polarity, little or no cable switching ideally suit this 20 mv cm maximum sensitivity preamplifier for multiple-trace work.

Tektronix Inc., 3 Finch Avenue East, Willowdale, Ont.

High vacuum coating unit

Shown at Booth 538 — Item 41

The Edwards high vacuum coating unit model 12E3 consists of a fully valved high vacuum pumping system developing a chamber pumping speed of 80 litres per second. Vacuum instrumentation is a combination of Pirani-Penning Gauge measuring chamber and foreline pressures. High tension power is supplied for ionic bombardment, and low tension power for source heating. A Variac is switched into either of these circuits to give fine control. Accessories are also available to assemble a versatile system.

Edwards High Vacuum (Canada) Ltd., P.O. Box 515, Cumberland Ave., Burlington, Ont.

High-voltage VHF transistor

Shown at Booth 143 — Item 42

A high-voltage NPN silicon epitaxial mesa transistor, type 2N707A, has a collector-base voltage rating of 70 volts and a power dissipation of 1 watt. It is intended for VHF oscillator and Class-C amplifier applications. Capable of oscillating at frequencies in excess of 600 megacycles, it also features a low typical collector saturation voltage of .18 volts, and collector capacitance of 4 picofarads. Applications for this transistor is in communications equipment, telemetry, etc.

Canadian Motorola Electronics Co., 105 Bartley Drive, Toronto 16, Ont.

Paper dielectric condensers

Shown at Booth 131 — Item 43

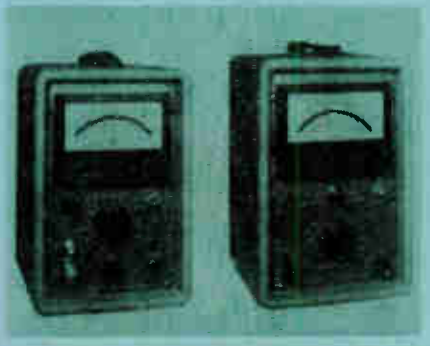
Supamolds are newly developed paper tubular condensers, the elements being molded into a new plastic material. They are of clean appearance with a closely controlled physical size and have been introduced to cater for the higher temperatures encountered in modern TV sets. The plastic casing offers good protection against the ingress of moisture and enables the IR of the condenser to remain at a high level for long periods under adverse conditions.

The Telegraph Condenser Co. (Canada) Ltd., 50 Bertal Road, Toronto 15, Ont.

Ultra-sensitive multimeters

Shown at Booth 564 — Item 44

The MV-07B is an ultra-sensitive current and voltage multimeter, with ranges from 10 uV through 1000 V and 10 uuA through 1 mA. Accuracy is 1 per cent for volt ranges



and 2 per cent for amp ranges. It has individual calibration controls.

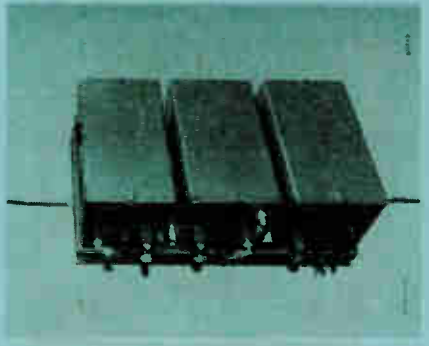
The MV-279B ranges from 1 ohm full scale to 2.5 megohms full scale, with an accuracy of 1 per cent with 0.25 per cent accuracy full scale.

Millivac Instruments, Inc., Box 997, Schenectady, N.Y.

Studio transmitter program link

Shown at Booth 535 — Item 45

Brown Boveri RT6 studio transmitter program link may be used as a music link between radio stations and their transmitting towers especially in FM installations. It is characterized by small dimen-



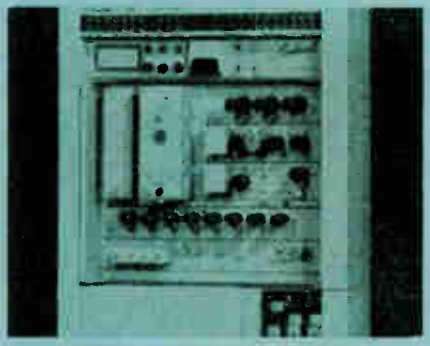
sions, careful and robust construction, and reliable operation. The frequency range of standard series (RT 646) is 450-470 Mc/s; total number of switchable rf channels is four; maximum frequency deviation is 60 kc/s.

Brown Boveri (Canada) Ltd., 1015 Beaver Hall Hill, Montreal, P.Q.

Light route radio

Shown at Booth 559 — Item 46

Type 71 light-route radio is a family of low cost FM radio and associated equipment designed specifically to provide toll grade service for up to 24 multiplex voice channels in the 150, 300 and 450 mc frequency bands and up to 48 channels in the 900 mc



band over distances of up to 10 hops. Greater channel capacity may be provided over shorter distances, but exact number of channels depends on equipment arrangement.

Lenkurt Electric Co. of Canada Ltd., 7018 Lougheed Hwy., North Burnaby P.O., Vancouver, B.C.

feature products

For further information on Feature Products use Readers' Service Cards on pages 91 and 92

Flash photography system

Shown at Booth 329 — Item 47

The Avro ultra-high-speed flash photography sytem provides a rugged, flexible, self-contained, two camera photography station primarily designed for shadowgraph applications in hypervelocity ballistic ranges; however it is adaptable to other uses of photographing high speed phenomena. Two air-filled spark gaps provide a light pulse of 1.5×10^9 lumens for a duration of 0.2 microseconds.

Avro Aircraft, Malton, Ont.

Voltage reference

Shown at Booth 134 — Item 48

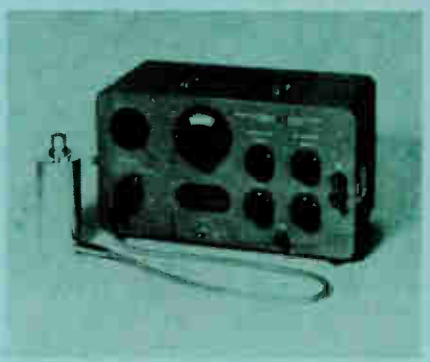
A series of 6.3 volt voltage references with each device certified as to its stability after 1,000 hours of operating is now available. The certified voltage stability of the devices range from +0.01 per cent to ±0.002 per cent. These units can serve as replacements for standard cells in many applications particularly in missiles.

Transitron Electronic Sales Corp., 1229 The Queensway, Suite 9, Toronto 18, Ont.

HF transfer voltmeter

Shown at Booths 247 & 249 — Item 49

Ballatine's Model 393 is a transfer device by means of which an unknown AC voltage may be measured with high accuracy in terms of a DC voltage. Designed so the transfer impedance of the probe is uniform from 25 cps to 30 Mc, its primary use will be in standards laboratories for calibration of rf signal sources, rf voltmeters, and the frequency response of amplifiers or other devices.



Bayly Engineering Ltd., First Street, Ajax, Ont.

Soldering tip cleaning sponge

Shown at Booth W-8 — Item 50

This pure cellulose sponge saves time and extends soldering iron tip life. It eliminates tip wear caused by abrasives, and contamination caused by use of wiping rags. Fine porosity holds more water and contains no damaging acids. Aluminum tray contains adequate water supply — keeps sponge wet. This device cleans while tip is hot, without removing protective solder. The sponge is large enough for all size soldering tips used in industry.

Hexacon Electric Co., 161 West Clay Ave., Roselle Park, N.J.

Microminiature soldering iron

Shown at Booth 558 — Item 51

Specifically developed for the soldering of microminiature components, this featherweight electric soldering iron has a heating element rated at only 22½ watts input. It assures perfect soldered joints even where relatively large "heat sinks" are involved. Tip temperature is over 700°F. Its features include antiroll baffle — iron remains where it's placed, and simple interchangeable copper tips.

American Electric Heater Co., 6110 Cass Ave., Detroit 2, Mich.

Low noise transistor

Shown at Booths 432, 436 & 438 — Item 52

Fairchild announces Type 2N2049 transistor which has the lowest guaranteed noise figure of any transitor — germanium or silicon. It has a passivated surface which reduces low-frequency flicker noise; middle frequency shot noise is masked by the higher signal-to-noise ratio due to the high gain. It also has very low leakage current which allows low current operation for lower noise without biasing difficulties.

Lake Engineering Company Ltd., 123 Manville Road, Scarborough, Ont.

Digital recorder

Shown at Booths 130 & 229 — Item 53

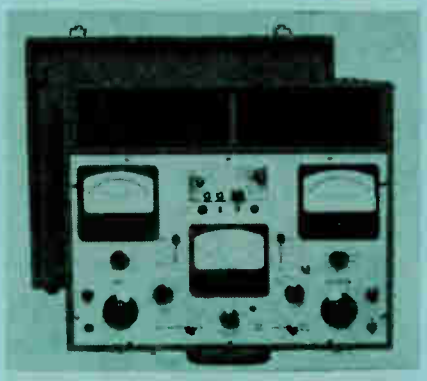
The key feature of this digital recorder is its ability to record the frequency of occurence of 10 or more different events, and present this in digital form. This allows the device to operate unattended for long periods. The elimination of pens, ink, etc., removes a major area of unreliability under unfavorable environmental conditions common to conventional recorders.

Bach-Simpson Ltd., 1255 Brydges St., London, Ont.

Transistor analyzer

Shown at Booth 360 — Item 54

For the ultimate in transistor analysis, Model 3490 offers among other features: three independent power supplies; collector current to 10 amperes; input currents to 1 ampere; separate input and collector meters (4½") monitor emitter or base; continuously variable emitter or base voltage or current.



Len Finkler Ltd., 1794 Avenue Road, Toronto 12, Ont.

Radio termination unit

Shown at Booth 531 — Item 55

This unit provides the following facilities: subscriber service to a CB or automatic telephone exchange; tie line circuit between two CB or automatic telephone exchanges; and multi-subscriber service into CB switchboards over long distances, incorporates singing-suppressors and in-band signalling. The unit is supplied in a cabinet using standard 19" racks.

Etelco Canada Ltd., 199 Ashtonbee Road, Scarborough, Ont.

Exhibitors & Attending Personnel

IRE Canadian Conference & Exhibition

Toronto, Canada – October 2, 3, 4, 1961

Abbey Electronics Ltd., 555 Wilson Ave., Downsview P.O., Toronto, Ontario; S. Applebaum, L. McNabb, M. Moore, P. Manion, Wm. MacRae; **Booth 142.**

The Ahearn and Soper Company Ltd., 840 Caledonia Road, Toronto, Ont. **Booth W-12.**

Airtron Canada Ltd., 349 Carlaw Avenue, Toronto, Ontario; J. Muller, D. E. Lloyd, L. Albert; **Booth 349.**

Alfax Paper & Engineering Company Inc., Washington Street, Westboro, Mass.; **Booth 470.**

Alpha Aracon Radio Co. Ltd., 555 Wilson Avenue, Downsview, Ont.; L. McNabb, S. Applebaum, P. Manion, M. Moore, K. Gladstone, B. MacRae; **Booth 136.**

Amalgamated Electric Corp., 384 Pape Ave., Toronto, Ontario; **Booth 454.**

American Electrical Heater Company, 6110 Cass Avenue, Detroit 2, Michigan; Richard C. Oxley, Robert A. Kuhn, Frank W. Kuhn, Len Finkler; **Booth 558.**

Amercan Electronics Laboratories Inc., 121 North 7th Street, Philadelphia 6, Pa.; **Booth 562.**

American Superior Electric Co. Ltd., 174 Evans Avenue, Toronto 13, Ontario; J. S. Louden, P. R. James, R. Gilbreath, R. E. Spencer, E. Crapser, E. Ziomek; **Booth 369.**

Ampex of Canada Ltd., Rexdale, Ontario; J. E. Detlor, Ed Koller, Charles Wirth, Tom Pressley, Charles Norton; **Booth 152.**

Amphenol Canada Ltd., 349 Carlaw Avenue, Toronto, Ontario; J. B. Partridge, A. C. Johnston, G. Burgess, James Van Laine, T. Jones, D. Lloyd, L. Albert; **Booth 358.**

Andrew Antenna Corp. Ltd., 606 Beech Street, Whitby, Ontario; **Booth 156.**

Astral Electric Co. Ltd., 44 Danforth Road, Toronto, Ontario; D. W. Rippin, J. R. Hampton, D. Reid, G. G. Smith; **Booth 461.**

Atlas Instrument Corporation Ltd., 50 Wingold Avenue, Toronto 19, Ontario; L. C. Bradford, F. W. Sargeant, B. Feldman, A. L. Rosenthal, M. Kusmierak, Miss L. Starnino; **Booths 342, 344 & 350.**

Atlas Polar Co. Ltd., 60 Northline Road, Toronto, Ontario; **Booth E-24.**

Atlas Radio Corp. Ltd., 50 Wingold Avenue, Toronto, Ontario; **Booths 342, 344 & 350.**

Automatic Electric Sales (Canada) Ltd., 185 Bartley Drive, Toronto 16, Ontario; A. C. Stewart, L. A. Haizelden, J. D. Breedon, B. H. Martin, W. R. Boast, R. W. Lindsey; **Booth 563.**

Autotronics, Inc., P.O. Box 208, Florissant, Mo.; **Booth 365.**

Aviation Electric Ltd., 200 Laurentian Blvd., Montreal, P.Q.; D. R. Taylor, D. Garbutt, J. H. Crisp, A. Ramsay, J. Teolis, F. Williams, L.L. Jones, A. J. Lewis, L. Balmforth, J. Scholefield, B. Ratcliffe, C. Groebler, **Booth 251.**

Avro Aircraft, Malton, Ontario; J. E. Lockyer, L. H. Wise; **Booth 329.**

Bach-Simpson Ltd., P.O. Box 484, London, Ontario; J. R. Bach, R. Wilton, H. Leah, G. F. Bates, G. Smith; **Booths 130 & 299.**

Barnard Stamp & Stencil Ltd., Hamilton, Ontario; **Booth 235.**

Barnes Engineering Co. Inc., Stamford, Conn.; **Booth 159.**

Bausch & Lomb Optical Co. Ltd., 16 Grosvenor Street, Toronto, Ontario; T. S. Jones, V. Ryland, R. K. Rogers; **Booth 141.**

Bayly Engineering Ltd., Hunt Street, Ajax, Ontario; B. deF. Bayly, H. F. Philp, C. B. Joyce, R. J. Brimbecom, D. L. McPherson, C. E. Doeringer, R. H. Grignon; **Booths 247 & 249.**

Beatty Bros. Ltd., Hill Street, Fergus, Ontario; **Booth 465.**

Beckman Instruments Inc., Helipot Division, 3 Six Points Road, Toronto 18, Ontario; D. C. McNeely, K. Heller, G. Williams, B. James, L. Harris; **Booth 243.**

Beechey Enterprises, 3212 Weston Road, Weston, Ontario; **Booth 158.**

Behlman Engineering Company, 2911 Winona Avenue, Burbank, California; **Booth 155.**

Belden Manufacturing Company, 415 S. Kilpatrick Avenue, Chicago 44, Illinois; James F. Olson, R. Sharp; **Booth 236.**

F. W. Bell Inc., Columbus 12, Ohio; **Booth 560.**

Bishop Sons & Co. Ltd., 108 Carnforth Road, Toronto, Ontario; **Booth 335.**

Boston Insulated Wire & Cable Co. Ltd., 118 Shaw Street, Hamilton, Ontario; Alden C. Davis, Rudolph F. Berner, Stanley Wolkowski, Edward McCosker; **Booth 543.**

Brian Engineering Ltd., 5275 Van Horne Avenue, Montreal, Quebec; **Booth 137.**

Brown Boveri (Canada) Ltd., 1015 Beaver Hall Hill, Montreal, P.Q.; H. G. Laett, J. E. Konrad, W. J. Gluck, W. Creighton, M. Colpitts, P. Hopkin, B. Manning; **Booth 535.**

Burgess Micro Switch Company, 5 Brooklyn Avenue, Toronto, Ontario; E. J. Mulvey, C. G. Bell; **Booth 363.**

Burndy Canada Limited, 1530 Birchmount Road, Scarborough, Ontario; **Booth 460.**

Canadian Applied Research Ltd., P.O. Box 4004, Terminal A, Toronto, Ontario; D. J. Dalznell, W. V. O'Leary, G. J. Evans; **Booth 360.**

Canadian Astronautical Society, c/o de Havilland Aircraft of Canada, Guided Missile Division, Downsview, Ont.; **Booth 500M.**

Canadian Electronics Engineering, 481 University Avenue, Toronto 2, Ontario; H. Price, I. R. Dutton, C. A. King, R. E. Swan, K. Wichcombe; **Booth 366.**

Canadian General Electric Co. Ltd., 214 King Street West, Toronto, Ontario; **Booth 352.**

Canadian Marconi Company, 1830 Bayview Avenue, Toronto 17, Ontario; Mel Oldershaw, Jim Biscott, Harry Tracey, Ernie Morrison, Len McCormick, George Morton, Art Ferry, Sam Masson, Mike Mandl; **Booth 145.**

Canadian Motorola Electronics Company, 105 Bartley Drive, Toronto 16, Ontario; H. M. Pipher, D. Hollingshead, **Booth 143.**

Canadian Patents & Development Ltd., National Research Council, Ottawa, Ontario; J. R. Johnson, S. A. Gardiner; **Booth 241.**

Canadian Westinghouse Co. Ltd., Electronics Division, Longwood Road, Hamilton, Ontario; F. R. Aitken, J. C. Wilder, J. J. Vitali, E. S. Cockle, H. J. Merritt, E. M. Hepburn, K. Jenner; **Booth 450.**

Canadian Wilbur B. Driver Co. Ltd., 50 Ronson Drive, Rexdale, Ontario; G. A. Fielding, F. J. McCulley, P. R. Flaherty; **Booth 567.**

Cannon Electric Canada Ltd., 160 Bartley Drive, Toronto 16, Ontario; George Heathwood, Jim Callan, Mike Scott, Gordon Whyte; **Booth 452.**

Capitol Radio Eng. Institute, Washington, D. C.; **Booth 163.**

Dale Electronics Limited, 18 Curity Avenue, Toronto 16, Ontario; H. Smith, K. Beeby, K. Game; **Booth 332.**

Centralab Canada Ltd., P.O. Box 400, Aja Ontario; R. P. Mitchell, D. H. McHug D. W. Noland, W. W. Roseborough; Boo 541.

C. P. Clare Canada Ltd., 840 Caledonia Roa Toronto 19, Ontario; V. H. Ames, R. Schaeff, A. H. Royce, D. W. McEwe **Booth 238.**

Collins Radio Co. of Canada Ltd., Bermondsey Road, Toronto, Ontari **Booth 551.**

Conway Electronics Enterprises, 1514 Egli ton Ave. West, Toronto 10, Ontari **Booths 560 & 576.**

Allan Crawford Associates Ltd., 2 Finc Avenue, Willowdale, Ontario; Allan Crawford, Olivia Radgett, Bernard Roberts, James H. Smiley, John W. Zeve bergen; **Booths 167 & 169.**

Croven Limited, 500 Beech Street, Whitb Ontario; J. P. Jones, F. A. Worsley, W. Kent, H. Eberhardt, L. D. Hart; **Booth 27**

CTS of Canada Ltd., 80 Thomas Stree Streetsville, Ontario; R. P. Scott, C. Meredith, A. S. Mackie, J. W. Hanle **Booth 370.**

Cushing & Nevell Ltd., 181 Eglinton Av East, Toronto 12, Ontario; J. R. Simpso N. Conklin, N. R. White, D. Patterson, Sommerville, F. Keay; **Booth 445.**

Daystrom Limited, 1480 Dundas Highwa East, Cooksville, Ontario; D. R. Best, Clarke, G. Rosamond, C. H. Rutledg **Booth 528.**

Delevan Electronics Corp., East Auror New York; **Booth 165.**

Department of Transport, Ottawa, Ontari **Main Entrance.**

A. Deskin Sales Corp., 1091 Shorecre Avenue, Chomedey, Montreal 40, P.Q A. Deskin, R. Zanetta, R. Deenan, Walters, J. Van Baaren, R. Dalton, Family, R. Lapetina; **Booths 265 & 269.**

Digital Equipment Corporation, 146 Mai Street, Maynard, Mass.; Stanley C. Olse Harlan E. Anderson; **Booth 161.**

Edwards High Vacuum (Canada) Ltd., P.O Box 515, Cumberland Avenue, Burlingto Ontario; P. W. King, G. E. Neapole, J. Morgan, F. R. Morgan, B. M. Stockdal **Booth 538.**

Eitel-McCullough, Inc., San Carlos, Cal fornia; **Booth 556.**

Elder Electronics, 541 Brant Street, Burlin ton, Ontario; **Booth 544.**

Electro Impulse Labs. Inc., Red Bank, N.J **Booth W-16.**

Electro Instruments, 3540 Aero Court, Sa Diego 11, California; **Booth 155.**

Electro Sonic Supply Co. Ltd., 543 Yong Street, Toronto, Ontario; **Booth 536.**

Electrodesign Ltd., 9124 St. Lawrence Blvd Montreal, P. Q.; **Booth 135.**

Electromechanical Products, Markham Roa Agincourt, Ontario; A. G. Shack, J. DeGroot; **Booth 155.**

Electronic Marketing Co. of Canada Ltd 6555 Cote des Neiges Road, Montreal, P.Q F. Segal, R. Ryan, Wm. Gasoi, M. Mane L. Vaughn, R. Kendall, D. Buell, E. Lacey **Booth W-22.**

Electronic News, New York 3, N.Y.; Boo **W-16.**

Electronic Research & Development C Ltd., 210-Ninth Avenue S.E., Calgary Alberta; **Booth 542.**

Electronics and Communications, Ag Publications Ltd., 450 Alliance Avenue Toronto 9, Ontario; H. E. (Bud) Dally Arthur E. (Mick) Maine, Derek Reynolds Ron Wood; **Booth 435.**

Exhibitors / Attending Personnel

EMI-Cossor Electronics Ltd., P.O. Box 525, Dartmouth Nova Scotia; W. Lindow, K. McDonald, W. Garrick, L. Young; **Booth 266.**

Erie Resistor of Canada Ltd., 7 Fraser Avenue, Trenton, Ontario; J. J. Walsh, F. W. Deacon, E. J. Young; **Booth 433.**

Esna Canada Ltd., 12 Gower Street, Toronto 16, Ontario; F. G. Complin, P. F. Tyler, P. Brink Weaver, A. Taylor; **Booth E-20.**

Etelco Canada Limited, 199 Ashtonbee Road, Scarborough, Ontario; Bryn Jones, M. Vail; **Booth 531.**

Ferranti-Packard Electric Ltd., Industry Street, Mount Dennis; G. W. L. Davis, W. M. Lower, F. E. Paine, B. P. Hollander, H. H. Fouls; **Booth 259.**

Ferritronics Ltd., 157 Willowdale Ave., Willowdale, Ont.; **Booth 443.**

Len Finkler Ltd., 1794 Avenue Road, Toronto 12, Ontario; Len Finkler, Bob Rafton, George Welter, Bernie Glucksman, Don McCormack; **Booth 360.**

Garrett Manufacturing Co., 4 Racine Rd., Rexdale, Ontario; **Booth 153.**

General Instrument — F. W. Sickles of Canada Ltd., 151 Weber Street South, Waterloo, Ontario; R. E. Seifert, J. McKerrow, C. W. Ambrose, C. A. Pipe, S. R. Mester, H. Nanson, F. J. Martin, J. Thompson; **Booth 459.**

General Radio Co., 99 Floral Parkway, Toronto 15, Ontario; Art Kingsnorth, Dick Provan, Bill Gailitis, S. W. DeBlois, F. J. Pfaffmann; **Booth 252.**

The Glendon Instrument Company Ltd., 46 Crockford Blvd., Scarborough, Ontario; S. A. Rybb, Ron Brighty, Al Byers, John Peterson; **Booths 467, 469 & W-18.**

Hackbusch Electronics Ltd., 23 Primrose Avenue, Toronto 4, Ontario; R. A. Hackbusch, J. D. Hackbusch, H. B. Knap, C. W. Cranfield, L. A. Davidge; **Booth 129.**

Hammond Manufacturing Co. Ltd., Guelph, Ontario; C. Robinson, H. Iller, R. Brown, E. Britton, G. Godfrey, K. Hammond, L. Hammond, R. Hammond; **Booth 441.**

Hellerman Canada Ltd., 44 Danforth Road, Scarborough, Ontario; David Reid, D. W. Rippin, H. Roy Gray; **Booth 461.**

John Herring & Company, Ltd., 3468 Dundas Street West, Toronto 9, Ontario; M. L. Jacob, John Herring, Fred Utter, Tom Ure; **Booth 164.**

Hewlett-Packard Company, 1501 Page Mill Road, Palo Alto, Calif.; **Booth 350.**

Hexacon Electric Company, 161 W. Clay Avenue, Roselle Park, N.J.; Richard O. Johnson, James L. Grindrod; **Booth W-8.**

Hickok Electrical Instrument Co., Cleveland, Ohio; **Booth 239.**

Honeywell Controls Ltd., Precision Components Division, Vanderhoof Avenue, Toronto 17, Ontario; W. H. Seeley, J. C. Cowdrey, W. J. Rimmer, J. M. R. Findlay, J. C. Christie, P. J. Hudon, J. C. Wilkins; **Booth 351.**

M. J. Howard & Co. Ltd., 1168 Edgeland Place, Ottawa, Ontario; M. J. Howard, Gene Egan, R. Latin, J. R. Copley; **Booth E-4.**

Hysol (Canada) Ltd., P.O. Box 53, Station B, Toronto, Ontario; Russell H. Smith, David Caven, William Jenner, William Childs; **Booth 253.**

The Institute of Radio Engineers, 72 West 45th Street, New York 36, N. Y.; Herbert A. White, William C. Copp; **Booth 166.**

Instronics Ltd., P.O. Box 100, 11 Spruce Street, Stittsville, Ontario; **Booth 553.**

International Business Machines Co. Ltd., Don Mills Road, Don Mills, Ontario; **Booth 242.**

Jerrold Electronics (Canada) Ltd., 50 Wingold Avenue, Toronto 19, Ontario; **Booths 342, 344 & 350.**

Kay Electric Company, Maple Avenue, Pine Brook, N.J.; Karl Sturz, James Connor; **Booth 534.**

Keithley Instruments Inc., Cleveland, Ohio; **Booth 255.**

George Kelk Ltd., 5 Lesmill Road, Don Mills, Ontario; G. F. Kelk, H. E. Parkes; **Booth 364.**

Kemet Company, Div. of Union Carbides Corp., 11901 Madison Avenue, Cleveland 1, Ohio; **Booths 530 & 532.**

Kester Solder Co. of Canada Ltd., P.O. Box 1012, 51 Bruce Street, Brantford, Ontario; **Booth 545.**

Kistler Instrument Company, 15 Webster Street, North Tonawanda, New York: **Booth 155.**

Lake Engineering Co. Ltd., 123 Manville Road, Scarborough, Ontario; Art Ainlay, Frank Taylor, Ted Thompson, George Gibson, Ray Turner, Andy Gardner, Ellis Greene, Nick Knowlton, Don McLean; **Booths 432, 436 & 438.**

Leesona Corporation, P.O. Box 6088, Providence 4, Rhode Island; W. T. Crocker, W. L. Rainford, C. J. Zalkowski, A. W. Wachta, W. J. Quinn, I. J. Marsh; **Booth 522.**

Leland Electric Co. Ltd., 50 Crimea Street, Guelph, Ontario; **Booth 466.**

Lenkurt Electric Co. of Canada Ltd., 7018 Lougheed Hwy., North Burnaby P.O., Vancouver, B.C.; H. R. Herron, J. B. Tindall, S. T. Luck, R. C. Fawcett, J. L. Mathers; **Booth 559.**

Licon Division, Canada Illinois Tools Ltd., 67 Scarsdale Road, Don Mills, Ontario; D. J. McTaggart, E. J. Kernohan, J. Roeser, B. Hinchcliffe, W. Mitchell; **Booth E-6.**

Litton Industries, Beverly Hills, California; **Booth 430.**

Litton Systems (Canada) Ltd., 123 Rexdale Blvd., Rexdale, Ontario; A. E. Kennedy; **Booth 458.**

E. G. Lomas, 227 Laurier Avenue West, Ottawa, Ontario; E. G. Lomas, L. E. Lomas, V. Allnutt, R. W. Sprague, E. Stromsted; **Booth 533.**

Magna Electronics Inc., 970 Broadview Avenue, Toronto, Ontario; **Booth 546.**

McCurdy Radio Industries Ltd., 22 Front Street West, Toronto, Ontario; G. E. McCurdy, Norm Farr, Graham Fawcett, Ken MacKenzie, Wally Evan-Jones; **Booth 245.**

B. H. McGregor, P.O. Box 156, Station H., Toronto 13, Ontario; **Booth 437.**

Measurements Corp., Toronto, Ontario; **Booth 456.**

Melcom, 1969 Avenue Road, Toronto 12, Ontario; **Booth 530.**

Mel Sales Ltd., 1969 Avenue Road, Toronto 12, Ontario; **Booths 530 & 532.**

Millivac Instruments, Inc., Box 997, Schenectady, New York; Imik Metzger, Donald Morey; **Booth 564.**

Modular Electronics Ltd., Toronto 12, Ontario; **Booth 539.**

Muirhead Instruments Ltd., 677 Erie Street, Stratford, Ontario; R. W. Watler, Ian H. H. Smith, L. F. Purcer, R. A. Oliver; **Booth 138.**

Multitone Electronics Limited, 130 Merton Street, Toronto, Ontario; T. W. Stoddart, G. W. Crossan, M. C. Patterson, H. J. Scheibner; **Booth 447.**

National Fibre Co. of Canada, Ltd., 107 Atlantic Avenue, Toronto 3, Ontario; H. Frankel, S. Sinclair, D. Manley, R. Bogart, A. Christie; **Booth 338.**

National Research Council, Radio and Electrical Engineering Division, Ottawa, Ontario; G. A. Miller, A. W. G. Johnson; **Booth 330.**

Nilfisk Limited, Willowdale, Ontario; **Booth W-1.**

Northern Electric Co. Ltd., 1600 Dorchester Blvd., West, Montreal, P.Q.; A. H. Gregory, C. E. Rickards, G. Woolnough, U. P. Ronald, J. S. Brown; **Booths E-14 & E-18.**

Northern Industrial Products, 18 Coldwater Road, Don Mills, Ontario; Jerry Thompson, Doug Cunningham, Ken Kiteley; **Booth 159.**

Pfeiffer Electronic Laboratories, Box 316, Trenton, Ontario; **Booth 427.**

Philip Electronics Industries Ltd., Tubes, Semiconductors & Components Depts., 116 Vanderhoof Avenue, Toronto 17, Ont.; D. S. Simkins, P. Bas, V. Cummings, A. Booth, A. Yake, D. C. Morffit, J. Beardall, J. Pounder, R. Clark, K. Johnson, R. Hinze, N. Hill; **Booths 146 & 150.**

Philip Electronics Industries Ltd., Electronic Equipment Group, 116 Vanderhoof Ave., Toronto 17, Ontario; A. Hutcheon, J. Valliant, H. L. Pollock, E. Batler, D. R. Stephenson; **Booth 549.**

PIC Design Corp., 477 Atlantic Avenue, East Rockaway, Long Island, New York; Charles Keenan, Philip French, Al Mosher; **Booth 244.**

Polytronics Co., 582 Bathurst Street, Toronto 4, Ontario; J. Zubko, E. Zubko, A. Wilczewski, B. Binelli; **Booth 431.**

Potter, & Brumfield, Division of AMF Canada Ltd., Oxford Street, Guelph, Ontario; Alan Laws, Garth Millard, Frank Eakin; **Booth 555.**

Precision Electronic Components Ltd., 50 Wingold Ave., Toronto 19, Ontario; **Booth 350.**

Premier Metal Housings Ltd., 5810 Smart Avenue, Montreal, P.Q.; **Booth 264.**

Prentice-Hall of Canada, Ltd., 34 Davidson Road, Aurora, Ontario; Wallace Matheson, Eric Campbell, John Davis; **Booth 345.**

Probescope Co. Inc., Port Washington, L.I., N.Y.; **Booth 570.**

Quan-Tech Labs Inc., Boonton, N.Y.; **Booth 574.**

Radio Components Ltd., 50 Wingold Avenue, Toronto 19, Ontario; **Booth 350.**

Radio Trade supply Ltd., Toronto, Ontario; **Booth W-2.**

Radionics Ltd., 8230 Mayrand Street, Montreal, P. Q.; Stanley H. Ungar, George G. Beyrouty, Edward S. Zieba, Ray Delcamp; **Booths 451 & 533B.**

Douglas Randall (Canada) Ltd., 126 Manville Road, Scarborough, Ontario; H. D. Randall, G. E. Geduld, A. I. Reid, P. Perryon, K. Feeney, R. Neill, E. M. Muldoon, J. Gallagher, R. Hurley, I. Goldberg; **Booths 442, 444 & 446.**

Raytheon Canada Limited, P.O. Box 8, Waterloo, Ontario; **Booth 261.**

RCA Victor Company, Ltd., 1001 Lenoir Street, Montreal, P.Q.; **Booth 349.**

Renfrew Electric Co. Ltd., IRE Resistors Division, 349 Carlaw Avenue, Toronto, Ont.; J. W. Barnes, D. E. Lloyd, J. Dunsmoor, P. Perrault, M. Hargraves, C. Pelz; **Booth 358.**

Renfrew Electric Co. Ltd., Struthers-Dunn Relays Division, 349 Carlaw Avenue, Toronto, Ontario; R. A. Bomer, J. Rowbottom, A. Shelson; **Booth 358.**

Rogan Bros. Inc., 8031 N. Monticello, Skokie, Illinois; J. J. Rogan; **Booth W-6.**

Rohn Manufacturing Co., P.O. Box 2000, Peoria, Illinois; R. A. Kleine; **Booth 336.**

R-O-R Associates Ltd., 1470 Don Mills Road, Ontario; J. S. Root, P. Philliban, R. Hansen, J. Wootten, W. Mainguy, R. Wood, J. Stemler; **Booths 258 & 359.**

RUF Corporation, 21 Elm Avenue, Hudson, New Hampshire; **Booth 155.**

H. P. Ruggles Co. Ltd., 88 Caroline Street North, P.O. Box 62, Hamilton, Ontario; **Booth E-22.**

Rutherford Agencies P.O. Box 1013, St. Laurent, Que.; **Booth 232.**

Ryerson Institute of Technology, 50 Gould Street, Toronto, Ontario; **Booth 529.**

Sealectro Corporation, 139 Hoyt Street, Mamaroneck, New York; Milan E. Robich, George E. Mohr; **Booth 234.**

Sensitive Research Instrument Corp., 310 Main Street, New Rochelle, N.Y.; Earl Elliott, James Turner, Fred Ball, Al McQuarrie; **Booth 53A.**

Shakespeare Co. (Canada) Ltd., Rexdale, Ontario; **Booth W-20.**

Exhibitors / Attending Personnel

E. J. Sharpe Instruments of Canada Ltd., 6080 Yonge Street, Willowdale, Ontario; **Booth 571.**

D. T. Shaw Company, 2340 Lucerne Road, Montreal 16, P.Q.; **Booth 343.**

Sigma Instruments Incorporated, South Braintree, Mass.; **Booth 341.**

A. C. Simmonds & Sons Ltd., L. Claude Simmonds, David S. Simmonds, G. Douglas Pettifer, W. A. Strangways, W. B. Campion, R. C. Ferguson, D. Ralph Snyder; **Booths 246 & 250.**

Sinclair Radio Laboratories Ltd., P.O. Box 179, 21 Toronto Road, Downsview, Ontario; P. Yachimec, W. V. Tilson, F. G. Buckles, R. G. Sears, P. Castrucci, E. Adams, T. Nagano, W. M. Pearce, J. Morrison, G. Demkiw, G. Sinclair; **Booth 139.**

Sola-Basic Products Ltd., 377 Evans Avenue, Toronto, Ontario; J. R. McGovern, R. J. Bruce, F. C. Snider, J. W Roe, R. French; **Booth E-8.**

Spaulding Fibre of Canada Ltd., 70 Coronet Road, Toronto 18, Ontario; **Booth 569.**

Stark Electronic Sales Co., Ajax, Ontario; M. J. Stark, Les Samuel, Larry Simons, Gord Micklewright, Ben Manis, Mrs. F. Moffatt, Mrs. K. Cunningham; **Booth 237.**

Strippit Tool & Machine Co., 40 Hanson Road, Brampton, Ontario; C. Somerton, J. Elmer, H. Cartwright, E. Taylor, J. Rutland, J. Rawlinson; **Booth 337.**

Syntron (Canada) Ltd., 930 Queenston Road, P.O. Box 10, Stoney Creek, Ontario; W. B. Armstrong, A. L. Dean, A. L. Fromanger, J. S. Plewes, J. W. Potma; **Booth 331.**

Tasso Agencies, Emile, Montreal 25, Quebec.

Tektronix, Inc., 3 Finch Avenue East, Willowdale, Ontario; Dale Brous, Bill Kladke, Marvin Crouch, Gordon Dickson, Ray Lisiecki, Kerm Fleck, Dick Zahn, Lew Loebe; **Booth 160.**

The Telegraph Condenser Co., 50 Bertal Road, Toronto, Ontario; **Booth 131.**

Tele-Radio Systems Ltd., 3633 Dundas Street West, Toronto 9, Ontario; I. H. Nixon, P. A. Vatcher, M. E. Laidlaw, I. B. Lennox; **Booth 170.**

Tenny Engineering Inc., 1090 Springfield Road, Union, New Jersey; **Booth 532.**

Tensor Electronic Development Corp., Brooklyn 33, N.Y.; **Booth 568.**

Terminal Radio International Ltd., New York 11, N.Y.; **Booth 537.**

Texas Instruments Incorporated, Dallas, Texas; **Booth W-24.**

John R. Tilton Ltd., 51 McCormack St., Toronto 9, Ont.; **Booth 132.**

TMC (Canada) Limited, R.R. No. 5, Ottawa, Ontario; D. V. Carroll, H. C. Ashdown, A. G. Sheffield, C. A. White; **Booth 361.**

F. V. Topping Electronics Ltd., 94 Laird Drive, Toronto, Ontario; **Booth 257.**

Transitron Electronic Corporation of Canada Ltd., 168-182 Albion Street, Wakefield, Mass.; Lawrence W. King, Frank Wilkins, Jay McArthur; **Booth 134.**

Universal Instruments Corp., 139 E. Frederick Street, Binghamton, N.Y.; P. J. Wilson, F. H. Lawson, J. D. Ahearn, Gary Johnson, T. Gerlock; **Booth E-10.**

Vacuum-Electronics Corp., Terminal Drive, Plainview, Long Island, N.Y.; Stanley H. Ungar, Marvin Eisenberg, Howard White; **Booth 453A.**

Vitro Corporation, 919 Jesup-Blair Drive, Silver Spring, Md.; **Booth 155.**

Voltage Regulator Products Section, General Electric Co., 100 Woodlawn Avenue, Pittsfield, Mass.; S. K. Billingsley; **Booth 352.**

Ward Leonard of Canada Ltd., 1070 Birchmount Road, Box 70, O'Connor Postal Station, Toronto 16, Ontario; W. R. Wiltshire, G. S. Brown, J. L. Proulx, P. Shaw, J. H. Kluge; **Booth 547.**

W. R. Watkins Co. Ltd., 41 Kipling Avenue, Toronto 18, Ontario; **Booth 455.**

Westmore Inc., Fanwood, N.J.; **Booth 566.**

White Radio Ltd., P.O. Box 463, 41 West Avenue North, Hamilton, Ontario; **Booths 232, 234 & 236.**

Whittaker Electronics Ltd., 1171 Whitmore Avenue, Ottawa 3, Ontario; Ernie Whittaker, Al Ingram, Ken Tinker, Bob Welsh, Rudy Ferrari; **Booth 256.**

Wholesale Radio & Electronics Ltd., 66 Orfus Road, Toronto, Ontario; **Booth 449.**

Willer Engineering & Sales Co., 676 Richmond Street West, Toronto 3, Ontario; Murray D. Willer; **Booth 260.**

The Wind Turbine Co. of Canada Ltd., 145 Lucan Street, Waterloo, Ontario; **Booth W-14.**

Yokogawa Electric Works, Ltd., 40 Worth Street, New York 13, N.Y.; Toshi Sasaki, Yugio Horie, Yasuo Karakisawa, Milton J. Stark, Les L. Samuel, Tony Kasperski; **Booth 235.**

IRE news features

A special Conference presentation

The Executive Committee of the 1961 IRE Canadian Electronics Conference: (sitting, left to right) F. A. Ford, Recording Secretary; F. J. Heath, General Chairman; A. P. H. Barclay, Past Canadian Region Director and representing Bertram R. Tupper, 1961 Region Director; and E. L. Palin, EIA Liaison; (standing, left to right) A. R. Low, Technical Program; T. M. Lynd, Finance; G. G. Armitage, Social Activities; Ross Willmot, Public Relations and Publicity; Grant Smedmor, Conference Manager; R. J. A. Turner, Toronto Section IRE (1959-60); E. Vanderpol, Conference Management. Absent: G. C. Eastwood, Exhibits; L. M. Price, Registration and Reception; T. W. Purdy, IRE Region 8 Liaison; L. C. Simmonds, Vice-Chairman; H. R. Smyth, Awards; and Stuart D. Browlee, EIA Representative.

Toronto Section IRE — fall program

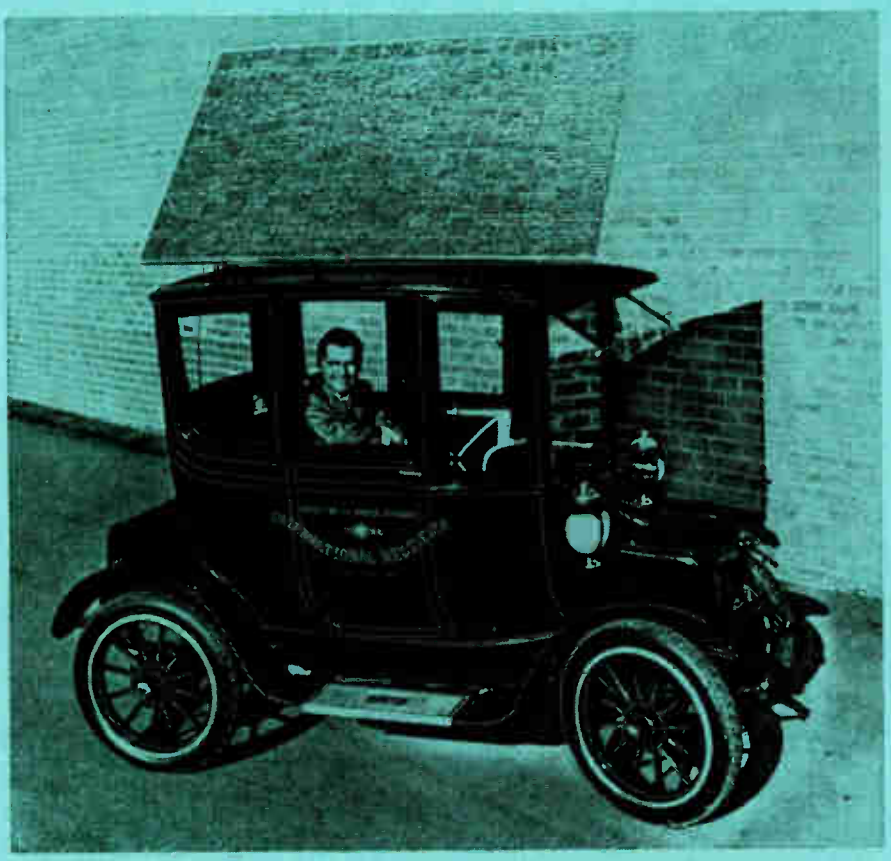
The Institute of Radio Engineers, Toronto Section, has formulated its program for the 1961-62 session.

The first meeting will be held on September 11, 1961, at 7:30 p.m. at the Scarborough Field Station of the Meteorological Branch, Department of Transport.

A short address outlining the past history and present status of the Field Station will be given by an official of the station. A guided tour of the facilities including instrument test, radiation and air pollution instrumentation, radiosonde training program, etc., will follow.

The second meeting of the session concerned with microwave techniques, will be held on September 25, 1961.

IRE displays first solar car



The IRC solar-powered car is the first one in history and will be displayed at the IRE Canadian Electronics Conference. It is planned to use this car to carry important guests of Canada's largest scientific conference and exposition. The raised panel on the roof carries the cells which utilize the sun's power to operate the car.

Highlighting the rapidly growing importance of solid-state devices the first solar-powered car in history is to be displayed at the IRE Canadian Electronics Conference. It is planned use the car to carry important guests of Canada's largest scientific conference and exposition.

The electric automobile, owned and operated by the International Rectifier Corporation, of El Segundo, California (Represented in Canada by Douglas Randall (Canada) Ltd., Booth 442), graphically demonstrates the commercial possibilities of silicon solar cells. Some 10,640 of these cells are mounted on top the 1912-vintage Baker Electric to form the largest solar panel ever assembled. They directly convert sunlight into electrical energy which, through the use of intermediate storage batteries, propels the car.

The cell array occupies an area of 25 square feet and is mounted on a light-weight fiber and plastic honeycomb of a type employed in space vehicles. Total weight of the complete structure is only 45 lb. The theoretical maximum output based upon 12 per cent efficient cells and optimum sunlight conditions is 200 watts. The interim, present standard, uses 5 per cent cells and provides a 100 W output at 115 V open circuit. Cost of the demonstration solar panel is reported to be $15,000, but IRC forecasts a reduction to $2,000 - $3,000, on a quantity production basis.

International interest in the Canadian IRE Conference

Attendance at this year's Canadian Electronics Conference is expected to be at least 9,000 and with strong representation from many countries, especially the United States and the United Kingdom.

In regard to British interest, E & C has just learned that The Department of Trade and Commerce of the office of the Canadian High Commissioner in London, England, have requested copies of the Conference Program to meet the many enquiries that have been made about the conference in that country. Also it is learned that several Russian scientists will be travelling to Toronto especially for the conference.

These, and many other expressions of interest around the world clearly show that the IRE conference, for long, Canada's major scientific event, is now truly achieving international status and recognition.

Industry future to be explored

"Foreign competition, merchandizing possibilities abroad, and the outlook for the domestic market will be topics of considerable discussion at the Conference," said Grant Smedmor, conference manager.

"As Canada's largest scientific event, the conference will provide an unparalleled opportunity for the Canadian Electronics Industry to demonstrate to Government agencies and the business community its accomplishments and potential."

IRE Social Activities

The main social activities of the IRE Canadian Electronics Conference will be the cocktail party and banquet. George Armitage, Social Committee Chairman, has organized the former as essentially a get-together function and it will be held Monday, October 2. Admission is by ticket.

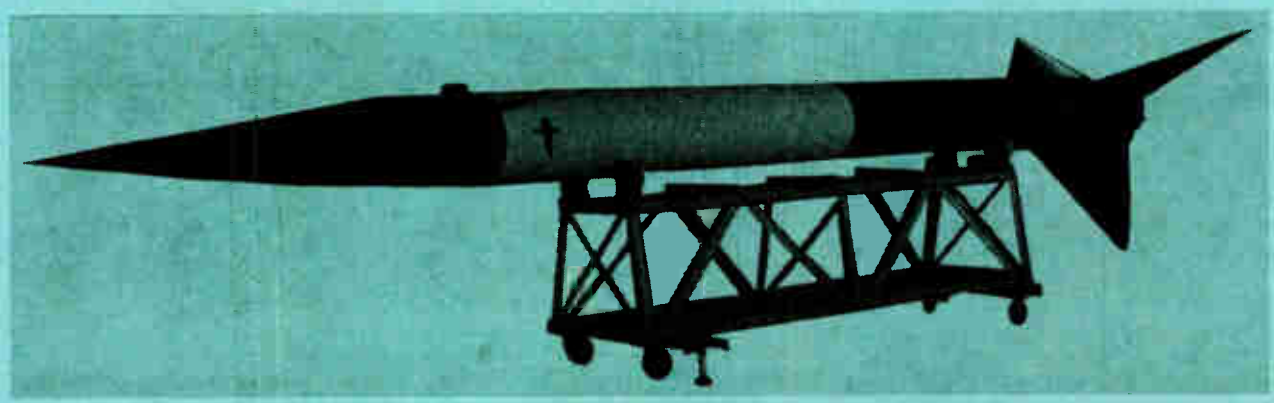
The main banquet will be held October 3, at 7:30 p.m. in the Queen Elizabeth Bldg. at the CNE grounds. Attendance has been limited to 300 guests. Dr. Lloyd V. Berkner, the International IRE president, will preside at this function.

A tour of the O'Keefe Centre will highlight this year's ladies activities during the conference. Mrs. George Armitage, chairman of the IRE Conference Ladies Social Committee has proposed a less formal set-up rather than an extensive program. Mrs. Armitage has located her headquarters in the Royal York Hotel. Accommodation for delegates is available at a number of excellent Toronto hotels and motels. Reservation should be made in advance.

REGISTRATION AND RECEPTION COMMITTEE

L. M. Price, Chairman. Other members to be designated.

Canadian Astronautical Society brings Mercury and Black Brant to IRE show



Canadian research rocket Black Brant II, designed by Bristol Aero-Industries, Winnipeg, in association with CARDE who conducted basic R&D on the Black Brant I, also expected to be on display at the show.

The Mercury space capsule and the Bristol Black Brant research rocket will form the center-piece of The Canadian Astronautical Society's exhibit at the IRE Canadian Electronics Conference. The CAS booth (500M) will be located on the mezzanine floor and, as in previous years, will feature many items of astronautical interest.

The Mercury capsule, supplied to the society by NASA, will be an almost exact replica of the vehicles used in the recent United States sub-orbital shots and the exhibit will be arranged so close scrutiny of the capsule's internal arrangement can be made easily. The Black Brant presented, together with electronic telemetery packages, represents an all-Canadian effort in the research rocket field and were made available to the society by Bristol Aero-Industries, Winnipeg, Manitoba.

It is expected that other Canadian items will be on show at the booth, including extensible antennas made by De Havilland for a variety of U.S. space vehicles. It has been reported that a full scale model of the Canadian Top-Side Satellite, also using the special antennas, may be available in time for display at booth. Other interesting exhibits on the CAS booth are understood to be forthcoming from the Canadian Armament Research and Development Establishment, Val Cartier, Quebec.

The illustration shows an earlier version of the Mercury space capsule to be displayed at the Canadian Astronautical Society's booth (500M). Mercury score to date: two manned sub-orbital shots and one orbital un-manned.

Canadian Conference chosen by several manufacturers for the unveiling of completely new equipment

Several manufacturers have announced that equipment and components never shown before will be displayed at the Canadian I.R.E. Electronics Conference. A brief sampling of some of these is given here. General Radio Co. (Canadian Branch office) of 99 Floral Parkway, Toronto 15, have announced the presentation of eight newly designed electronic instruments at their booth (No. 252). Highlighting these is the type 1130-A Digital Time and Frequency Meter. Newly developed circuitry enables this versatile instrument to count random events, measure frequency ratios compute phase-shifts and measure pulse characteristics in addition to its role as a frequency and time meter. Other instruments include a Vibration Calibrator, a new Frequency Standard and a Tuned Amplifier Null Detector. The Eitel-McCullough Company, (Booth 556) manufacturers of Eimac vacuum tubes will be showing a range of new vacuum tubes including the 3-400Z power triode primarily intended for zero bias Class-B amplifiers in audio or radio frequency applications. In the grounded-gird, cathode driven service, power gains as high as 20 times can be achieved. Another interesting tube to be shown by Eitel is the 4CX250R, a radial-beam tetrode for use in Class AB_1 amplifiers in situations where severe shock and vibration would preclude the use of other types. Plate dissipation in radio-frequency service with forced air cooling is 250 watts

They made the Conference possible – IRE committee members

Executive Committee

F. J. Heath, General Chairman
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L. M. Price, Registration and Reception
T. W. Purdy, Liaison — Canadian Region — IRE
L. C. Simmonds, Vice-Chairman
H. R. Smyth, Awards
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R. J. A. Turner, Toronto Section IRE 1959-60
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Dr. G. Sinclair 1958
E. L. Palin 1959

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David Boyd, President Canadian Aeronautical Institute
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James Key, Past President, Electronic Industries Association of Canada
J. W. Kerr, President, Canadian Electrical Manufacturers' Association
Dr. P. A. Lapp, President, Canadian Astronautical Society
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T. R. McLagan, Past President, Canadian Manufacturers' Association
Ian F. McRae, President Canadian Nuclear Association
D. B. Mundy, Director, Electronics Branch, Department of Defense Production
F. H. R. Pounsett, President, Canadian Radio Technical Planning Board
Dr. F. S. Rivers, Chief Director, Ontario Department of Education
Dwight S. Simmons, Past President, Association of Professional Engineers of Ontario
Prof. G. F. Tracy, Head, Department of Electrical Engineering, University of Toronto
J. S. Vanderploeg, President, Canadian Industrial Preparedness Association

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Other members to be designated

Ladies Social Activities Committee

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Mrs. A. P. H. Barclay
Mrs. C. A. Norris
Mrs. E. L. Palin
Mrs. F. H. R. Pounsett

Exhibit Award Committee

H. R. Smyth, Chairman
Dr. G. A. Miller
S. F. Love
O. L. Britney

Registration and Reception Committee

L. M. Price, Chairman
Other members to be designated

Conference Staff

Grant Smedmor, Conference Manager
David Holland, Exhibits
Edward Vanderpol, Technical Program

Downtown Toronto hotel rates

HOTELS	APPROXIMATE RATES Single	Twin	Bedsitting	Suites
Downtown				
Royal York	9.50-11.50	13.50-15.50	13.00-20.00	35.00 up
King Edward Sheraton	7.50-10.50	11.50-14.50	10.50-16.00	20.00 up
Lord Simcoe	7.50-11.50	13.50-15.50	14.25-19.00	22.50 up
Midtown				
Park Plaza	10.00-12.00	12.00-16.00	16.00-17.00	13.50 up
Westbury	10.50-12.50	14.50-17.50	16.50	27.50 up
Regency Towers	8.50-16.50	12.00-20.00		20.00 up
Frontenac Arms	5.50- 8.50	8.50-12.50	8.50-11.50	12.50 up
Westminster	5.50- 6.50	8.50- 9.00		14.00
Motels (Lakeshore)				
Seaway	8.50- 9.50	12.00-13.00		
Universal	7.00	10.00		
Chancellor	6.00	8.00-10.00		

Exhibit Award Competition

To stimulate electronic research and development in Canada, the IRE is again holding its Exhibit Award Competition in connection with the conference. One award will be given for the outstanding Canadian product and one for the outstanding Canadian component exhibited.

A special committee has been set up to handle the awards under the chairmanship of H. Ross Smyth, of the National Research Council. The awards will take the form of engraved sterling plaques and will be presented at the conference banquet, October 3.

Product Locator

IRE Canadian Conference & Exhibition

Toronto, Canada, October 2, 3, 4, 1961

product locator

COMMUNICATIONS TEST EQUIPMENT
The Ahearn and Soper Co. Ltd. W-12
RCA Victor Co., Ltd. 349

COMPANDORS
Etelco Canada Ltd. 531

COMPARATORS
Douglas Randall (Canada) Ltd. 442, 444 & 446

COMPARATORS, impedance
Whittaker Electronics Ltd. 256

COMPARATORS, wide band
Jerrold Electronics (Canada) Ltd. 342, 344 & 350

COMPONENT HANDLING SYSTEMS
Universal Instrument Corp. E-10

COMPONENT LEAD FORMING EQUIPMENT
Willer Engineering & Sales Co. 260

COMPONENTS
A. C. Simmonds & Sons Ltd. ..... 246 & 250

COMPONENTS, coaxial
Andrew Antenna Corp. Ltd. 156

COMPONENTS, communication
Willer Engineering & Sales Co. 260

COMPONENTS, electronic
Aviation Electric Ltd. 251

COMPONENTS, handsets and cords
Etelco Canada Ltd. 531

COMPONENTS, industrial control
A. C. Simmonds & Sons Ltd. ..... 246 & 250

COMPONENTS, micro
Transitron Electronic Corp. of Canada Ltd. 134

COMPONENTS, miniature
Astral Electric Co. Ltd. 461

COMPONENTS, microwave
Radionics Ltd. ..... 451 & 533B

COMPONENTS, servo
Electronics Marketing Co. of Canada Ltd. W-22

COMPONENTS, telephone communication & signalling
Hackbusch Electronics Ltd. 129

COMPONENTS, waveguide
E. G. Lomas 553

COMPONENT TESTERS
Electronics Marketing Co. of Canada Ltd. W-22
R-O-R Associates Ltd. 258 & 359

COMPUTERS
International Business Machines Co. Ltd. 242

CONNECTORS
Douglas Randall (Canada) Ltd. 442, 444 & 446
Sealectro Corp. 234
Whittaker Electronics Ltd. 256

CONNECTORS, circular
Amphenol Canada Ltd. 358

CONNECTORS, electrical multi-contact
Cannon Electric Canada Ltd. 452

CONNECTORS, miniature
Amphenol Canada Ltd. 358

CONNECTORS, RF
Abbey Electronics Ltd. ..... 142 & 241
Amphenol Canada Ltd. 358

CONNECTORS, wire
Esna Canada Ltd. E-20

CONSOLES, audio
McCurdy Radio Industries Ltd. 245

CONSOLES, supervisory service channel
RCA Victor Co., Ltd. 349

CONTROL APPARATUS, electrical
Automatic Electric Sales (Canada) Ltd. 563

CONTROL KNOBS
Rogan Bros. Inc. W-6

CONTROLS
John Herring & Co. Ltd. 164

CONTROL SYSTEMS SERVICE
Automatic Electric Sales (Canada) Ltd. 563

CONTROLLERS, indicators
Bach-Simpson Ltd. ..... 130 & 299

CONTROLLERS, temperature
Polytronics Company 431

CONTROLS, lighting
CTS of Canada, Ltd. 370

COOLING DEVICE, transistorized
Lake Engineering Co. Ltd. ..... 432, 436 & 438

COOLING PACKAGES
Whittaker Electronics Ltd. 256

CORDS, telephone
Belden Manufacturing Co. 236

COUNTERS
A. Deskin Sales Corp. 265 & 269

COUNTERS, digital
The Glendon Instrument Co. Ltd. ..... 467, 469 & W-18
M. J. Howard & Co. Ltd. E4

COUNTERS, electronic
Atlas Instrument Corp. Ltd. ..... 342, 344 & 350

COUNTERS, preset
Philips Electronics Industries Ltd., Tubes, Semiconductors & Components Depts. 146 & 150

COUNTER-TIMERS, solid state
Radionics Ltd. ..... 451 & 533B

COUNTING EQUIPMENT
R-O-R Associates Ltd. 258 & 359

CRAFTSCOPES
Aviation Electric Ltd. 251

CRIMPING TOOLS
Esna Canada Ltd. E-20

CRYSTALS
Philips Electronics Industries Ltd., Electronic Equipment Group 549

CUTTERS, precision
Len Finkler Ltd. 360

DATA PROCESSING EQUIPMENT
Ferranti-Packard Electric Ltd. 259

DATAPHONE EQUIPMENT
Northern Electric Co. Ltd. ..... E-14 & E-18

DATA REDUCTION EQUIPMENT
Electromechanical Products 155
R-O-R Associates Ltd. 258 & 359

DATA TRANSMISSION EQUIPMENT
Northern Electric Co. Ltd. ..... E-14 & E-18

DELAY & LINEARITY TEST SET
RCA Victor Co., Ltd. 349

DELAY LINES
Beckman Instruments Inc., Helipot Div. 243
General Instrument—F. W. Sickles of Canada Ltd. 459

DEFLECTION YOKES
General Instrument—F. W. Sickles of Canada Ltd. 459

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Lake Engineering Co. Ltd. ..... 432, 436 & 438
John R. Tilton Ltd. 132

DELRIN
National Fibre Co. of Canada Ltd. 338

DETECTORS
Whittaker Electronics Ltd. 256

DETECTORS, frequency
Willer Engineering & Sales Co. 260

DETECTORS, infra-red
Canadian Patents & Development Ltd. 241

DIALS
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Whittaker Electronics Ltd. 256

DICTATING EQUIPMENT, pocket
Astral Electric Co. Ltd. 461

DIFFERENTIALS
John Herring & Co. Ltd. 164
Whittaker Electronics Ltd. 256

DIGITAL CLOCKS
The Glendon Instrument Co. Ltd. ..... 467, 469 & W-18

DIGITAL COUNTERS
The Glendon Instrument Co. Ltd. ..... 467, 469 & W-18

DIGITAL INDICATING AND CONTROL SYSTEMS
R-O-R Associates Ltd. 258 & 359

DIGITAL MODULES,
Electronics Marketing Co. of Canada Ltd. W-22

DIGITAL MULTIMETERS
The Glendon Instrument Co. Ltd. ..... 467, 469 & W-18

DIGITAL READOUT DEVICE
Litton Systems (Canada) Ltd. 458

DIGITAL RECORDER
Bach-Simpson Ltd. ..... 130 & 299

DIGITAL TAPE HANDLER
Ampex of Canada Ltd. 152

DIGITAL VOLTMETERS
The Glendon Instrument Co. Ltd. ..... 467, 469 & W-18
R-O-R Associates Ltd. 258 & 359

DIODES
Douglas Randall (Canada) Ltd. 442, 444 & 446
R-O-R Associates Ltd. 258 & 359
Transitron Electronic Corp. of Canada Ltd. 134

DIODES, backward
Transitron Electronic Corp. of Canada Ltd. 134

DIODES, germanium
General Instrument—F. W. Sickles of Canada Ltd. 459
Transitron Electronic Corp. of Canada Ltd. 134

DIODES, germanium tunnel
General Instrument—F. W. Sickles of Canada Ltd. 459

DIODES, silicon
General Instrument—F. W. Sickles of Canada Ltd. 459
Syntron (Canada) Ltd. 331

DIODES, tunnel
Transitron Electronic Corp. of Canada Ltd. 134

DIODES, variable capacitance
E. G. Lomas 553

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Canadian Motorola Electronics Co. 143
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R-O-R Associates Ltd. 258 & 359

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Sensitive Research Instrument Corp. 53A

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The Glendon Instrument Co. Ltd. ..... 467, 469 & W-18

ENCAPSULATIONS
Transitron Electronic Corp. of Canada Ltd. 134

EQUIPMENT, carrier
Philips Electronics Industries Ltd., Electronic Equipment Group 549

EQUIPMENT, data processing
Ferranti-Packard Electric Ltd. 259

EQUIPMENT, dataphone
Northern Electric Co. Ltd. ..... E-14 & E-18

EQUIPMENT, electro medical
Multitone Electronics Ltd. 447

EQUIPMENT, electronic
National Research Council 330

EQUIPMENT, marking
Barnard Stamp & Stencil Ltd. 235

EQUIPMENT, printing
Barnard Stamp & Stencil Ltd. 235

EQUIPMENT, teaching, audio-visual
Litton Systems (Canada) Ltd. 458

EQUIPMENT, telegraph
Etelco Canada Ltd. 531

EQUIPMENT, telephone
Etelco Canada Ltd. 531

EQUIPMENT, ultrasonic cleaning
Electronic Marketing Co. of Canada Ltd. W-22

EVAPORATING EQUIPMENT, vacuum
Vacuum-Electronics Corp. 453A

EXCITER, digitally tuned
F. V. Topping Electronics Ltd. 257

FABRICATED PARTS, phenolite
National Fibre Co. of Canada Ltd. 338

FABRICATORS
Strippit Tool & Machine Co. 337

FACSIMILE UNIT
The Ahearn and Soper Co. Ltd. W-12
Muirhead Instruments Ltd. 138

FANS
Whittaker Electronics Ltd. 256

FERRITES
Philips Electronics Industries Ltd., Tubes, Semiconductors & Components Depts. 146 & 150

FERRITES, four part circulator
Airtron Canada Ltd. 349

FIBRE, vulcanized
National Fibre Co. of Canada Ltd. 338

FIBRE OPTICS
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FILM CHAIN, high resolution
Northern Electric Co. Ltd. ..... E-14 & E-18

FILTERS
Bayly Engineering Ltd. ..... 247 & 249
A. Deskin Sales Corp. 265 & 269
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Lake Engineering Co. Ltd. ..... 432, 436 & 438
Sinclair Radio Laboratories Ltd. 139
The Telegraph Condenser Co. (Canada) Ltd. 131

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Willer Engineering & Sales Co. 260

FREQUENCY STANDARD
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GALVANOMETERS
The Glendon Instrument Co. Ltd. ..... 467, 469 & W-18

GAUGES
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GAUGES, precision
Bausch & Lomb Optical Co. Ltd. 141

GAUGES, resistance strain
R-O-R Associates Ltd. 258 & 359

GAUGING SYSTEMS, micro
Strippit Tool & Machine Co. 337

GEARHEADS
Whittaker Electronics Ltd. 256

GEARS, precision
Whittaker Electronics Ltd. 256

GENERATORS
Douglas Randall (Canada) Ltd. 442, 444 & 446

GENERATORS, AC power
Whittaker Electronics Ltd. 256

GENERATORS, post
Allan Crawford Associates Ltd. ..... 167 & 169

GENERATORS, pulse
The Ahearn and Soper Co. Ltd. W-12

GENERATORS, random signal
The Glendon Instrument Co. Ltd. ..... 467, 469 & W-18

GENERATORS, servo motor
Beckman Instruments Inc., Helipot Div. 243

GENERATORS, signal
Atlas Instrument Corp. Ltd. ..... 342, 344 & 350
Bayly Engineering Ltd. ..... 247 & 249
R-O-R Associates Ltd. 258 & 359

GENERATORS, sine and square wave
The Glendon Instrument Co. Ltd. ..... 467, 469 & W-18

GENERATORS, sweep
Jerrold Electronics (Canada) Ltd. 342, 344 & 350
RCA Victor Co., Ltd. 349
Whittaker Electronics Ltd. 256

GENERATORS, synthesized sideband
TMC (Canada) Ltd. 361

GENERATORS, thermoelectric
General Instrument—F. W. Sickles of Canada Ltd. 459

GENERATORS, very low frequency waveform
The Glendon Instrument Co. Ltd. ..... 467, 469 & W-18

GLANDS, water sealing
Hellerman Canada Ltd. 461

GLASS SEALS, hermetic
Astral Electric Co. Ltd. 461

GRAPHIC RECORDING INSTRUMENTS
R-O-R Associates Ltd. 258 & 359

GROMMETS
A. Deskin Sales Corp. 265 & 269
Hellerman Canada Ltd. 461

GROUND SUPPORT EQUIPMENT
Litton Systems (Canada) Ltd. 458

product locator

product locator

product locator

Be sure to

ATTEND

the forthcoming

IRE

CANADIAN ELECTRONICS CONFERENCE

October 2nd, 3rd and 4th, 1961 at the Automotive Bldg. Exhibition Park Toronto, Canada

This is the one time during the year when the entire electronics industry in Canada meets. There will be exhibits of over 150 leading companies and 80 technical papers will be given, plus an opportunity for members of the industry to rub shoulders and compare notes.

Be sure to visit us at our exhibit #435 and tour the convention hall with the help of "E & C's" Conference Guide issue.

an age publication

electronics and communications

Defense industry barometer — *DDP contract awards*

Given below is a list of unclassified contracts for $10,000 or more awarded to Canadian electronics companies by the Department of Defense Production during the month of July. Figures represent total dollar value of one or more contracts in each case.

Firm	item	dollar value
Airtron Canada Ltd. Renfrew, Ont.	electronic equipment	$13,300
Ampex of Canada Ltd. Ottawa, Ont.	instrumentation, recorder/reproducer	$24,226
Atlas Instrument Corporation Toronto, Ont.	oscilloscopes	$11,098
Automatic Electric (Canada) Ltd. Ottawa, Ont.	telephone equipment	$79,604
Canadian Marconi Company Montreal, P.Q.	electronic tubes	$51,750
	co-axial feeder equipment	$155,907
Canadian Motorola Electronics Co. Toronto, Ont.	error detection and correction equipment	$683,024
Canada Wire and Cable Co. Ltd. Ottawa, Ont.	cables	$169,690
Collins Radio Co. of Canada Ltd. Toronto, Ont.	spares for flight equipment	$37,562
Computing Devices of Canada Ltd. Ottawa, Ont.	spectrometer	$25,878
Domac Technical Sales Ltd. Ottawa, Ont.	signal generators	$13,500
E.M.I. - Cossor Electronics Ltd. Dartmouth, N.S.	sonobuoys	$438,814

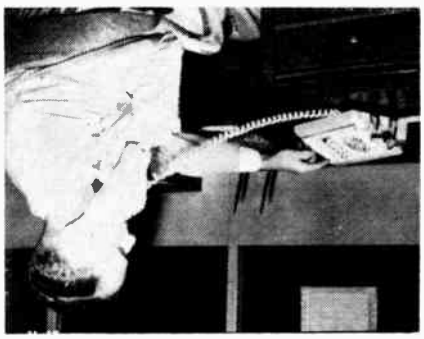
Letter to the editor

Dear Sir:

On page 33 of the July issue you committed a grave gaucherie when you interfered with the digital dexterity of the operator by transposing right to left and thus converting a true blue right hand into a mere pinkie.

Yours truly,
Peter P. Vaughan,
Canadian Westinghouse,
Hamilton, Ont.

Reader Vaughan is thanked for drawing attention to the unfortunate right-to-left transposition of the photograph in the July issue. To set the record straight the corrected picture is reprinted herewith. — Editor.



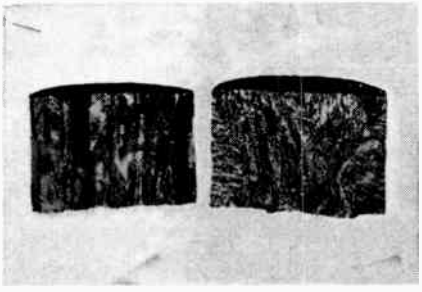
Cabinet approves $12 million 'survival' plan

The Cabinet has approved an Army plan to take control of any Canadian city hit by a nuclear blast. Defense contracts worth about $12 million will go to the construction and communications industries.

Firm	item	dollar value
Electronic Materials International Ltd. Ottawa, Ont.	electronic components	$12,240
EDO (Canada) Ltd. Cornwall, Ont.	repair of electronic equipment	$74,995
H. S. Gellman & Co. Ltd. Toronto, Ont.	weapons system evaluation	$131,453
Honeywell Controls Ltd. Toronto, Ont.	cable assemblies	$15,938
Instronics Ltd. Stittsville, Ont.	radio set harness	$38,716
Mallory Battery Co. of Canada Ltd. Toronto, Ont.	communications receivers	$69,367
National Telecommunication Supply Ltd. Ottawa, Ont.	batteries	$15,186
Northern Electric Co. Ltd. Ottawa, Ont.	telecommunication cable plant	$39,075
Plessey Co. of Canada Ltd. Montreal, P.Q.	teletype spares	$85,376
RCA Victor Co. Ltd. Montreal, P.Q.	radio-set harness	$132,057
Raytheon Canada Ltd. Ottawa, Ont.	overhaul of electronic equipment	$49,500
	electronic tubes	$219,728
Sperry Gyroscope Ottawa Ltd. Ottawa, Ont.	synch. repeater gyro compass	$21,661
Stewart-Warner Corporation of Canada Ltd. Belleville, Ont.	test-sets and accessories	$435,755
Sylvania Electric (Canada) Ltd. Montreal, P.Q.	electronic tubes	$29,619
T.M.C. (Canada) Ltd. Ottawa, Ont.	electronic equipment	$81,410
	transmitters	$163,838
Telecables and Wires Ltd. Fort Garry, Man.	cables	$24,719
Topping Electronics Ltd. Toronto, Ont.	electronic equipment	$130,087
Union Carbide Canada Ltd. Toronto, Ont.	batteries	$201,520
Varian Associates of Canada Ltd. Georgetown, Ont.	klystrons	$22,900

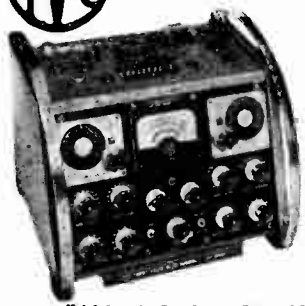
Manufacturing breakthrough leads to super energy permanent magnets

U.S. Magnet and Alloy Corporation announce a radically improved Alnico type magnet material that produces an energy product of 7,500,000 gauss-oersteds, a full million BH greater than that of the best Alnico alloys hitherto available. Secret of the new material is a propriety process which permits 100 per cent grain orientation through the entire cross-section of the material. Photograph below, shows grain structure of new "Alnicus" material (left) compared with that of conventional magnet. Besides offering



a significant reduction in size of practical magnets, material can be formed into all the usual magnet shapes. Field of application is very wide and already highly successful motor and alternator designs have been produced. The company is presently making Alnicus magnets for nuclear resonance instruments and foresee a future for the material in beam-shaping of ion propulsion engines. Two grades of material are supplied: USM75 has a nominal energy product of 7.5 million gauss-oersteds, a residual B_r of 13,900 gauss and a coercive force of 750 oersteds. Material type USM65 has BH of 6.5 million, B_r of 13,500g and H_c of 650. The density of both materials is 0.265 lb./cubic inch and the mechanical properties are hard-brittle. The company's address is 266 Glenwood Ave., Bloomfield, N.J.

DYNAMIC MUTUAL CONDUCTANCE



TUBE TESTER

(VALVE CHARACTERISTIC METER)

Completely analyzes practically all receiving tubes and many small transmitting types.

Will provide you with: complete tube characteristic measurements . . . plate, screen and grid currents . . . amplification factor, plate resistance . . . mutual conductance . . . interelectrode insulation measurement in megohms . . . breakdown of cathode or heater to other electrodes in megohms . . . cathode-heater insulation in megohms . . . heater continuity . . . quick "Good/Bad" reading . . . overload cut-out.

Designed to meet progressive trends in tube development.

R.H. Nichols CO. LTD. 584

4544 DUFFERIN STREET, TORONTO

TORONTO MAIL: P.O. Box 500 DOWNSVIEW, Ontario

OTTAWA P.O. Box 113

VANCOUVER 624 Voncouver Block 736 Granville Street

For complete details check No. 46 on handy card, page 91

---

compact, portable easy to operate

TRANSISTOR ANALYZER

A battery-operated instrument for checking small signal and medium power transistors under normal operating conditions. Provides for use of external supplies. Both internal and external supplies can be monitored on the internal meter.

COLLECTOR VOLTAGE: 1.5, 3, 4.5, 6, 10.5 volts or external.

BASE CURRENT: 0-40 ma. in two ranges using internal supply.

COLLECTOR CURRENT: Can be measured to 1 amp in five ranges.

BETA: (hfe) Measured at 1000 c/s in two ranges 0-25 and 0-250.

NOISE: Noise equivalent of transistor under test is directly indicated on the attenuator scale. Ranges are calibrated 1-20 and 20-40 db.

The internal meter ranges, amplifier, and oscillator are available for voltage and current measurement, signal tracing, etc.

R.H. Nichols CO. LTD. 601

4544 DUFFERIN STREET, TORONTO

TORONTO MAIL: P.O. Box 500 DOWNSVIEW, Ontario

VANCOUVER: 624 Voncouver Block, 736 Granville Street

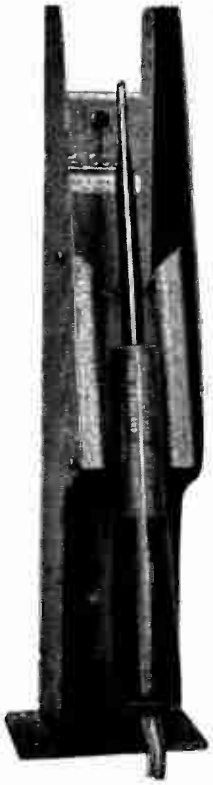
For complete details check No. 47 on handy card, page 91

1/8" Bit L. No. 70
Shield L. No. 68

ADCOLA

PRODUCTS LIMITED
Regd Trade Mark

L. No. 64
3/16" Bit



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SOLDERING INSTRUMENTS

Designed in Three Sizes 1/8" 3/16" & 1/4" Bits.

Manufactured for All Supply Voltages 6/7 to 230/50 v.

Instruments maintain soldering temperatures and thorough jointing is achieved in all the fields of soldering, from pin point to general work in all sound equipment.

Insulation standards are approved in all leading countries.

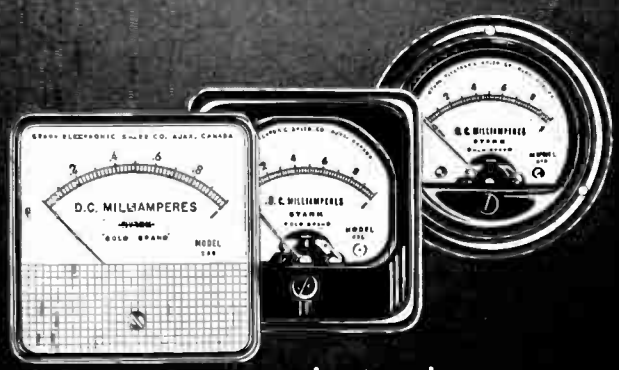
All Designs Cover the Demands for Continual Bench Production Assembly.

Canadian, British and Foreign Pats. Reg. designs, etc.

ADCOLA PRODUCTS LTD.

BOX 103, WESTON, ONT.

For complete details check No. 1 on handy card, page 91



High Quality Low *Low* Cost

Now everyone can afford quality meters by Stark. Never before have meters of such quality, accuracy and reliability been offered at such low prices.

Available in sizes from 1" to 6" round, square, edgewise, clear plastic and switch board. Special stylings can be designed to customer's requirements.

Write today for catalogue.

STARK ELECTRONIC SALES COMPANY

AJAX, ONTARIO

For complete details check No. 63 on handy card, page 91

The international scene

Radio telephone speeds farming operations

Picture shows farm foreman in England using the new Pye transportable radio-telephone to report progress of work and arrange for the transfer of labor from one job to another. Weighing approximately 20 pounds and having a range of up to 20

miles — depending on location and frequency used — this new set can easily be carried by hand and yet gives all the advantages of a vehicle mounted set. It is already in use in many countries of the world.

The normal set works on one channel over frequencies between 25 and 174 megacycles on the HF band. The 12 volt 20 ampere-hour power pack simply clips on the bottom of the set, and is easily interchangeable for re-charging.

New computer organization formed in Europe

Announcement is made of the establishment of the European Computer Manufacturers Association (ECMA) with headquarters and secretariat in Geneva.

Members of the Association are companies which in Europe develop, manufacture and market data processing machines designed to process information for business, engineering, scientific and other similar purposes.

The object of the Association is to further the adoption of data processing standards for the benefit of users, and industry. It will work in close co-operation with various national and international standards organizations.

Continued on page 100

Briefing the industry

Stereophonic radio broadcasts authorized in Canada

The Department of Transport and the Board of Broadcast Governors are ready to authorize radio stations to broadcast in stereo starting September 1. As the Federal Communications Commission in the U.S. has adopted the same standards for authorizing such broadcasts, Canadians and Americans in border areas will be able to receive each other's stereo programs. Under the system adopted by both countries and recommended in Canada by the Canadian Radio Technical Planning Board, the sounds picked up by two microphones are combined and broadcast as one signal over a certain FM channel. This enables listeners on non-stereo FM sets to receive the broadcast monaurally, However, the "difference" between the sounds picked up by the two microphones is broadcast as a second signal superimposed over the first one on the same channel. The second signal is not recognizable as music or speech when heard separately, but it makes for stereo reception when combined with the first signal. It will take a special receiver or adapter to receive the second signal.

Canadian Reliability Training Course announced

A Reliability Training Course, sponsored by the IRE and ASQC will be held Oct. 30-Nov. 4. The course, several of which have been conducted in the U.S.A., gives the theory, management and application of modern reliability techniques. The planned syllabus will be supplemented by well-known guest speakers from various fields of Reliability. Venue for meeting will be Hotel Sheraton, Mt. Royal, Montreal. Further details may be obained from L. C. Thomas, Canadian Aviation Electronics Ltd., Montreal, Quebec.

Canadians to participate in satellite project

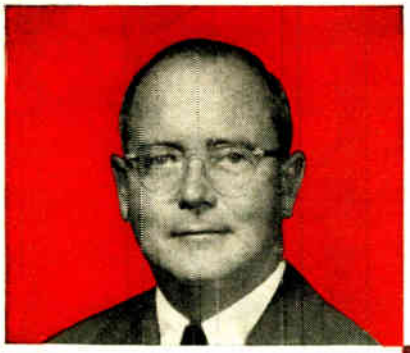
Two Canadians due in London late in August will start work with British scientists on a joint U.S.-U.K. project that will see two communications satellites in orbit next autumn.

They are O. L. Britney, chief engineer in the research, development and programing unit of the Department of Transport telecommunications branch, and his assistant, E. J. Klein. Both are from Ottawa.

Named Project Relay and sponsored by the U.S. National Aeronautics and Space Administration (NASA), the communications experiment calls for one-way television transmission, a number of two-way voice channels and certain radiation measurements to test the survival of components in space.

Plans for a completely operational system call for the orbiting of some 30 satellites . . . when one falls below the horizon another replaces it. Additionally, complex ground tracking and communication stations are slated for construction in several countries.

MEET THE WORLD'S FINEST DISTRIBUTOR TEAM



Francis R. Hine
Airwork Corporation, Miami, Fla.

Lester Avnet
Avnet Electronics Corporation,
Westbury, L.I., N.Y.

John W. Busacker
Contact Electronics, Inc.,
Dallas, Texas

Harold H. Powell
Harold H. Powell Co., Philadelphia, Pa.

Robert Avnet
Avnet Corporation, Los Angeles, Calif.

. . . serving industry with quality

BENDIX ELECTRICAL CONNECTORS

Each member of this world's finest team heads an organization having experience, ability and facilities unmatched elsewhere in the field of connector distribution. The entire team works toward the same goal—fast, efficient supply of the Bendix® Electrical Connectors best suited to *your* exact needs.

They supply to industry a nearly incredible number of connectors—running into literally tens of thousands of models—through a system pioneered by Scintilla Division in 1953. This is the *component assembly* technique, which anticipates connector needs and even permits overnight deliveries when required.

Their strategically located stocks are both broad and deep—with factory assembly and quality control standards that are extensions of those we maintain in our own manufacturing operations. Remember when you need high-quality connectors—your Bendix distributor can be an indispensable member of *your* team!

Scintilla Division
SIDNEY, N. Y.

THE Bendix CORPORATION

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

For complete details check No. 13 on handy card, page 91

TECHNICAL LITERATURE BRIEFS

Microwave crossguide couplers: 8-page, color-illustrated, catalog XT-61 provides data on new series of microwave crossguide couplers. **Tech Associates, 23 St. Thomas Street, Toronto, Ont.**
Item 56

Relay catalog: descriptions, dimensions, technical specifications and prices are given for more than 450 variations of the 40 standard basic relays in this 8-page brochure. **Potter & Brumfield, Division of AMF Canada Ltd., 135 Oxford Street, Guelph, Ont.**
Item 57

Selenium photovoltaic cells: bulletin No. 03-201-A discusses the features, selection and applications of an improved selenium photovoltaic cell. **Daystrom Limited, 1480 Dundas Highway East, Cooksville, Ontario.**
Item 58

Wire-wound potentiometers: 12-page catalog from Clarostat for the OEM market details 14 different series of potentiometers, plus military versions. **Tri-Tel Associates Ltd., 81 Sheppard Avenue West, Willowdale, Ont.**
Item 59

Millimeter wave tubes: 52-page catalog provides data and outline drawings of monitor diodes, noise tubes, high power floating drift tube klystrons, reflex klystrons, etc. **Lake Engineering Co. Ltd., 123 Manville Road, Scarborough, Ont.**
Item 60

Potentiometer and turns-counting dial: descriptive data for each Borg Micropot potentiometer and Microdial turns-counting dial is included in the brochure. **Atlas Radio Corporation Ltd., 50 Wingold Ave., Toronto 19, Ont.**
Item 61

Panel meter specifications: data sheet covering panel meter (style 42) features photos and outline drawings, as well as specifications and modifications available. **Helipot Division of Beckman Instruments, Inc., No. 3 Six Points Road, Toronto, Ont.**
Item 62

Miniaturized solid state power pack: calalog 124 covers Hypac miniaturized high voltage solid state power packs. It provides full descriptive and specification data. **Electronic Research Associates, Inc., 67 Factory Place, Cedar Grove, N.J.**
Item 63

Rigid PVC electrical conduit: 8-page, three-color brochure describes rigid PVC plastic pipe, recently approved for use as electrical conduit. Complete specifications and suggested applications are included. **Lasco Industries, 1561 Chapin Road, Montebello, Calif.**
Item 64

Four-terminal test clips: ESI catalog sheet C-31 describes Kelvin Klips and Klamps, precision accessories designed for making rapid, high accuracy four-terminal measurements even with relatively high lead and contact resistances. **Electro Scientific Industries, 7524 S. W. Macadam Avenue, Portland 19, Oregon.**
Item 65

Industrial internal timers: bulletin 6151 describes details given on the "Electro-Time" models, that are transistorized and eliminate motors, clutches and solenoids. **Electro-Seal Corp., 938 North Avenue, Des Plaines, Ill.**
Item 66

Tunnel diode power source: 3-page technical bulletin covers Model TD6M, and provides full descriptive data, specification information and circuit description of this new power source. **Electronic Research Associates, Inc., 67 Factory Place, Cedar Grove, N.J.**
Item 67

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If you have recently CHANGED your address please note former address here:

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Company ..... Nature of Business .....

(State, when applicable, whether electronic equipment or components are manufactured, sold, or used in manufacturing, etc.)

ARE YOU AN ENGINEER? Yes ☐ No ☐

Signature ..... Position

9-61

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☐ 73	☐ 74										

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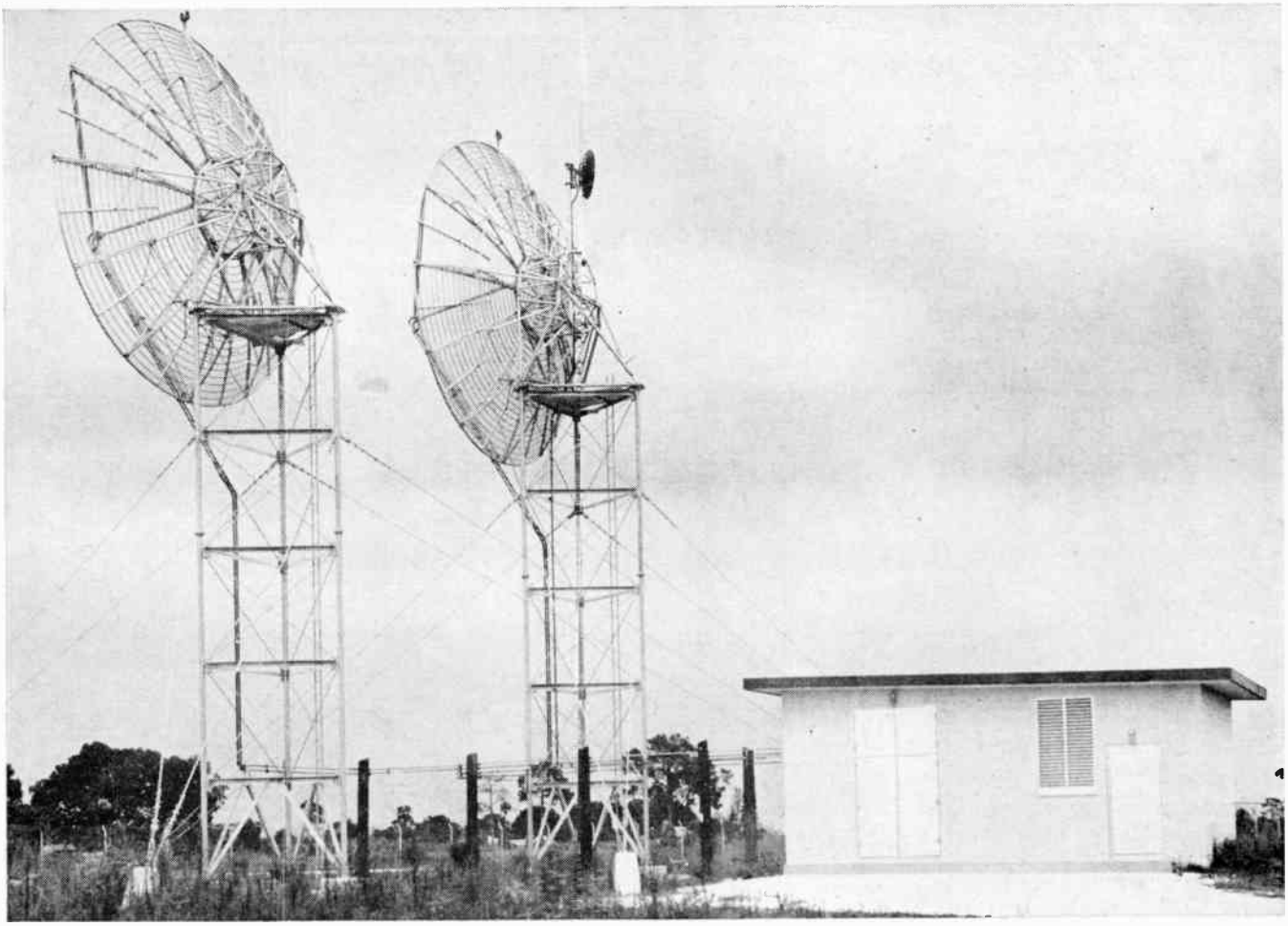


NOW IN SERVICE

ON THE 4400-5000 M.C. BAND . . .

WESTINGHOUSE MICROSCATTER BRINGS YOU 4 OPERATING ADVANTAGES AT THIS HIGHER FREQUENCY

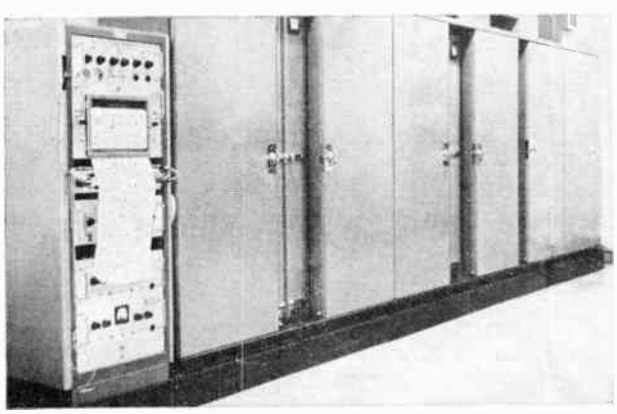
Canadian Westinghouse Company Limited—pioneers in tropospheric scatter at 5000 mc—have supplied equipment for service throughout the world. Operating results substantiate FOUR basic advantages for long range multihop trunk systems.

1. SIZE—Compact radio equipment allows trailer or fixed station installation. Small antennas, 10-28 feet in diameter with high gain. Close antenna spacing, minimum 18 feet centre to centre.

2. PRIMARY POWER—27 kw for 2 kw Quadrupal Diversity terminal, or 14 kw for 2 kw Dual Diversity terminal.

3. FREQUENCY—4400-5000 mc . . . World Wide Licensing and assignments readily obtained.

4. UNATTENDED SITES—Designed for remote operation with proven reliability.



To relate MICROSCATTER to your problem, contact a Westinghouse communications specialist or write to Canadian Westinghouse Company Limited, Electronics Division, Hamilton, Canada.

CANADIAN

Westinghouse

Microscatter

61-A 745

For complete details check No. 17 on handy card, page 91

Industry's business

Continued from page 24

New Arctic weather station installed with nuclear power source

The world's first isotope powered automatic weather station has now gone into operation in the Canadian Arctic. This was announced by the Department of Transport of Canada, the U.S. Department of Commerce — Weather Bureau, and the U.S. Atomic Energy Commission, in a joint statement released recently.

Capable of unattended operation for at least two years the station is designed for use in relatively inaccessible remote locations.

Unique feature of the eight foot long equipment is the nuclear heat source. This consists of a Strontium-90 heat generator and thermocouples within a sealed capsule and shielded by three-quarters of a ton of lead. Batteries and electronic power converters are also provided. Core temperature of the heat source is only 70°F, but this provides sufficient thermo-energy to charge the batteries and power the transmitter. Transported by the Canadian ice-breaker *John A. MacDonald,* the station has been located on Sherwood Head near Resolute.

Temperature, pressure and wind-speed signals have been received 'loud and clear' every three hours since installation.

Finkler appointed Canadian sales rep.

American Electrical Heater Company, 6110 Cass Avenue, Detroit 2, Michigan, recently announced the appointment of Len Finkler Ltd., 1794 Avenue Road, Toronto 12, Ont., as their Canadian sales representatives.

Stark Electronics to build this new plant in Ajax.

Big boom in teaching machines forecast for Ontario

Stark Electronic Sales Co. of Ajax, Ontario, have been instrumental in triggering off a $10 million business boom in Ontario. They were the first company to install their Electronic Language Laboratory in a Canadian secondary school.

The company's "Lingua Trainer" introduced last September into the curriculum of Toronto's Northern Secondary School on an experimental basis, has resulted in another two orders for the Language Laboratory in other schools. Last month the Toronto Board of Education accepted a Stark Electronic tender for the two systems for a total of $40,600.

Continued on page 102

For

Microwave Measurements

consult

MEL SALES LTD.

A Leading Supplier of

Microwave Electronics Test Equipment

Canadian Representatives of:

Boonton Electronics Corp.
Communication Measurements Laboratory Inc.
Digitran, Div. Endevco Corp.
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Instrument Development Laboratories Inc.
Kay Electric Company
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Ling Electronics, Div.
Altec Lansing Corp.
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Narda Microwave Corp.
Optron Corporation
Owen Laboratories Inc.
Polarad Electronics Corp.
Reflectone Electronics Inc.
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Sensitive Research Instrument
Technology Instrument Corp.
Tenney Engineering Inc.

We cordially invite you to visit us at I.R.E. Show Booths Nos. 530 and 532.

MEL SALES LTD.
71 CROCKFORD BLVD., SCARBOROUGH, ONTARIO

For complete details check No. 44

METOX

insulated power resistors

Welwyn

- **HANDLE MORE WATTS PER SIZE.** This is particularly so in the higher resistance values.
- **OFFER HIGHER RESISTANCE RANGES PER SIZE.** For example, up to 47K in the 4W F32 size.
- **ARE VIRTUALLY NON-INDUCTIVE.**
- **INSURE RELIABILITY.** Comprehensive tests have proved that operating these resistors under the most arduous conditions will not cause failure.
- **HAVE SUPERIOR SURGE AND OVERLOAD PERFORMANCE.** The application of ten times the rated load for 5 seconds results in a typical resistance change of less than 0.5%.
- **A PRICE AS COMPELLING AS THE PERFORMANCE . . .** Resulting from control and efficiency in manufacture.

UNIQUELY DIFFERENT AND RADICALLY NEW!

The Welwyn F Series power resistors are composed of a metal oxide element, bonded to a porcelain rod at red heat. This process results in a resistor which is extremely rugged, both electrically and mechanically. The durable coating is intended to provide an insulating cover rather than to protect the element which in itself is highly resistant to mechanical damage and effects of moisture.

WELWYN TYPE DESIGNATION	MAXIMUM LENGTH	POWER RATING	RANGE OF VALUES*
F32	29/32 inches	4 Watts	20 ~ to 47K
F33	1-5/16 inches	6 Watts	30 ~ to 56K
F34	1-23/32 inches	8 Watts	40 ~ to 68K
F35	2-3/32 inches	10 Watts	50 ~ to 75K

*Rated Wattage may be dissipated up to that resistance value set by a potential limitation of 500 V/inch.
Where less than full Wattage is involved, potentials up to 1000 V/inch may be applied.

Welwyn Canada Limited

1255 BRYDGES ST., LONDON, ONTARIO

For complete details check No. 72 on handy card, page 91

Top Performance and budget prices are features of these TWO NEW

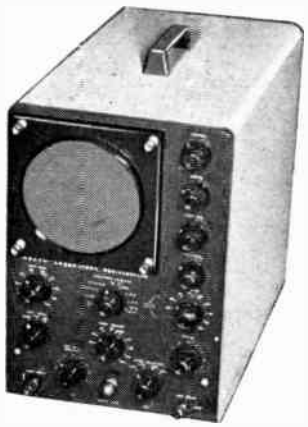
HEATHKIT

TEST INSTRUMENTS!

HEATHKIT VACUUM TUBE VOLTMETER

Specially designed for service bench use, the new Heathkit IM-10 features an oversize 6" 200 ua meter. Multi-colored scales and high contrast panel screening show at a glance the correct range and scale to use for fast, easy reading of all measurements. Recessed, thumbwheel "zero" and "ohms" adjust controls guard against accidental change in settings. Accuracy and wide frequency response are possible through 1% precision resistors and husky capacitors. Separate 1.5 and 5 volt AC scales. The IM-10 measures AC and DC voltages from 0 to 1500 volts in seven ranges; resistance from .1 ohm to 1000 megohms in seven ranges. DB calibrations are provided for relative voltage measurements with circuit components selected to give 10 db steps between ranges. Test leads included.

Kit Model IM-10 ..... **$48.95**



EXTRA-DUTY WIDE BAND 5" OSCILLOSCOPE

Fresh new styling, husky new power supply and added control features make the 10-30 an unbeatable value! Two extra sweep positions are provided in addition to the normal range for switch-selection of 2-preset sweep frequencies. Capacitors are provided to give frequencies of 30 cps and 7875 cps often used in TV servicing. By changing capacitor values any 2 preset frequencies can be made available. Other features include: wide band amplifiers, push-pull output, positive trace position controls, excellent linearity and lock-in characteristics and automatic sync circuit.

Kit Model 10-30 ..... **$89.95**

Write for your free catalogue listing more than 200 easy-to-build HEATHKITS!

DAYSTROM LIMITED

1480 Dundas Hwy. East, COOKSVILLE, ONT.

6128

For complete details check No. 23 on handy card, page 91

PBX SUPPLY

MODEL RTS-1

Features ringing, talking and signalling outputs with improved efficiency and regulation plus increased capacity in much less space.

IMMEDIATE SHIPMENT FROM STOCK

Write for further details to:

PYLON

BUY CANADIAN

PYLON ELECTRONIC DEVELOPMENT company, ltd.

Communications Systems and Equipment

161 CLEMENT ST., VILLE LA SALLE, MONTREAL 32, QUE.

For complete details check No. 56 on handy card, page 91

FOR STEADY AC LINE VOLTAGE

Regulate with

STEDIVOLT

- 0.5% accuracy
- No waveform distortion
- No relay contacts
- Single or three phase
- 2 to 350 KVA
- Custom models available

Made in Canada by a Canadian Company

GEORGE KELK LIMITED

5 Lesmill Rd. Don Mills, Ont.

KELK

For complete details check No. 41 on handy card, page 91

ANNOUNCEMENT

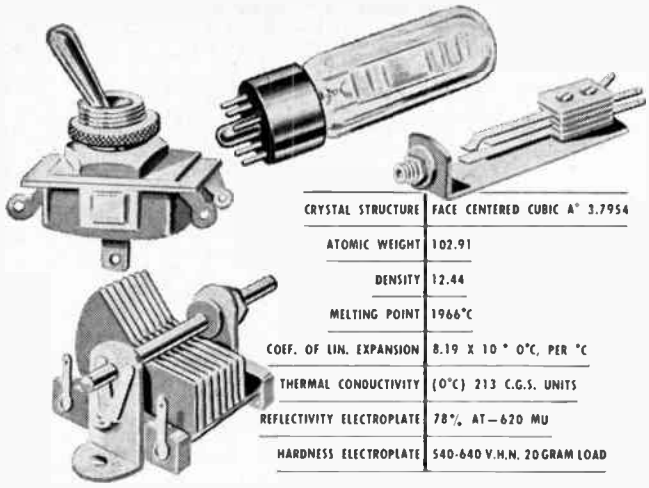
Abbey Electronics to handle two new lines

Abbey Electronics Ltd., of 555 Wilson Avenue, Toronto, have been appointed representatives for Hillburn Relays and Ideal Panel Meters. Products from these lines will be on show at Booths 142 and 241 at the Canadian Electronics Conference, October 2, 3, and 4, 1961.

Toronto firm announces change in name

Final negotiations have been completed for the purchase of Cerl-Dale Limited, 18 Curity Avenue, Toronto 16, Ontario, by Dale Electronics Inc., a subsidiary of Hathaway Instruments. Dale Electronics has been a principal of Cerl-Dale for the past 2 years. A new name is being registered for the Canadian operation, namely Dale Electronics Limited, and Chas. W. Pointon Limited of Rexdale, Ontario, has been appointed as the firm's Eastern Canadian representative.

An expansion program has been slated for the Toronto plant for the latter part of 1961 which will include larger plant facilities and additional products now being manufactured by the parent company in the States. An increase of 50 to 75 per cent employment is expected upon completion of the expansion program.



CRYSTAL STRUCTURE	FACE CENTERED CUBIC A° 3.7954
ATOMIC WEIGHT	102.91
DENSITY	12.44
MELTING POINT	1966°C
COEF. OF LIN. EXPANSION	8.19 X 10 ⁻⁶ 0°C, PER °C
THERMAL CONDUCTIVITY	(0°C) 213 C.G.S. UNITS
REFLECTIVITY ELECTROPLATE	78%, AT—620 MU
HARDNESS ELECTROPLATE	540-640 V.H.N. 20 GRAM LOAD

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Rhodium plating offers outstanding protection against surface corrosion under all atmospheric conditions. Used in electrical and electronic applications, it improves efficiency whenever a low-resistance, long-wearing, oxide-free component is required . . . assures low noise level for moving components . . . provides positive action for components subject to long periods of inactivity . . . eliminates partial rectification and unwanted signals by keeping components oxide-free. Send for complete technical data.

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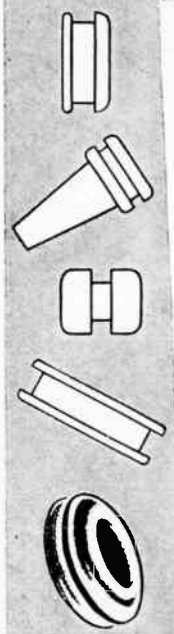
For complete details check No. 28 on handy card, page 91

PVC GROMMETS..



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For complete details check No. 32 on handy card, page 91

TYPE LF relay shown (cover removed) is 2-coil design which controls entire latching operation within relay. (Actual size).

CLARE **LATCHING** SUBMINIATURE crystal can **RELAY**

The new CLARE Type LF, magnetic latching subminiature relay offers designers simplified circuitry in small space by providing latching effect without transistors. Magnetic latching results in power economy.

The Type LF is available with either 2-coil or 1-coil configuration. The 2-coil relay allows complete control of the latching operation within the relay and provides an extremely compact operating unit. The 1-coil relay is somewhat more sensitive; it is adaptable to existing circuits where outside control is provided. The Type LF provides the same wide range of mounting arrangements and terminals as the CLARE Type F relay.

FOR NON-LATCHING OPERATION

CLARE *Type F*
SUBMINIATURE
CRYSTAL CAN RELAY

The CLARE Type F relay is extremely fast and more than moderately sensitive. It is built to withstand temperature extremes, heavy shock and extreme vibration. Contacts, rated at 3 amperes, are excellent for low-level circuit operations. Send for Design Manual 203.

For coil and mounting data on CLARE Type LF relay send for CPC-12. Address: C.P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Canada Ltd., 840 Caledonia Road, Toronto 19, Ontario. Cable address: CLARELAY.

C. P. CLARE & CO.
Relays and related control components

For complete details check No. 19 on handy card, page 91

FORTHCOMING MEETINGS

9th Annual Joint Engineering Management Conference sponsored by ASME, AIEE, ASCE, AIIE, AICHE, AIME, and IRE, is to be held in the Hotel Roosevelt, New York City, September 14-15, 1961. Non-members of sponsoring societies are welcome.

10th Annual Meeting of The Standards Engineers Society will be held at the Sherman Hotel, Chicago, Ill. September 18-20, 1961.

Canadian Electronics Conference and Exposition sponsored by the Canadian Region of The Institute of Radio Engineers, will be held in the Automotive Building at The Canadian National Exhibition Grounds, October 2-4, 1961.

The National Electronics Conference and Exhibition will be held October 9-11, 1961, at the International Ampitheatre, Chicago, Illinois.

8th Annual Symposium of The American Vacuum Society is to be held at Washington, DC, October 16-19 inclusive. Further details from AVS, Box 1282, Boston 9, Mass.

1961 Toronto High Fidelity Exposition of The Dominion High Fidelity Association, will be held in the Seaway Hotel 1926 Lakeshore Blvd. West, Sunnyside, Toronto, October 18-21 inclusive.

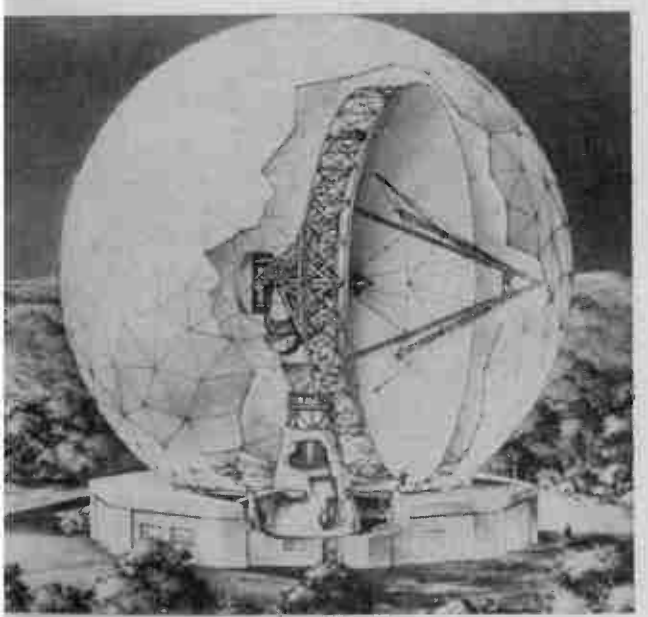
16th Midwest Conference of the American Society for Quality Control, October 19-20, at the Chase-Park Plaza Hotel, St. Louis, Missouri. More than 500 quality control personnel are expected to hear experts develop the theme "The Universality of Statistics'.

Interplanetary Spaceflight Symposium sponsored by CAI (Astronautical Section), CAS, UTIA and the David Dunlap Observatory, University of Toronto will be held in the Lecture Room, UTIA, Dufferin and Steeles, Toronto, on October 26-27. Sessions begin 9.30 a.m. Prominent Canadian and U.S. speakers, social events.

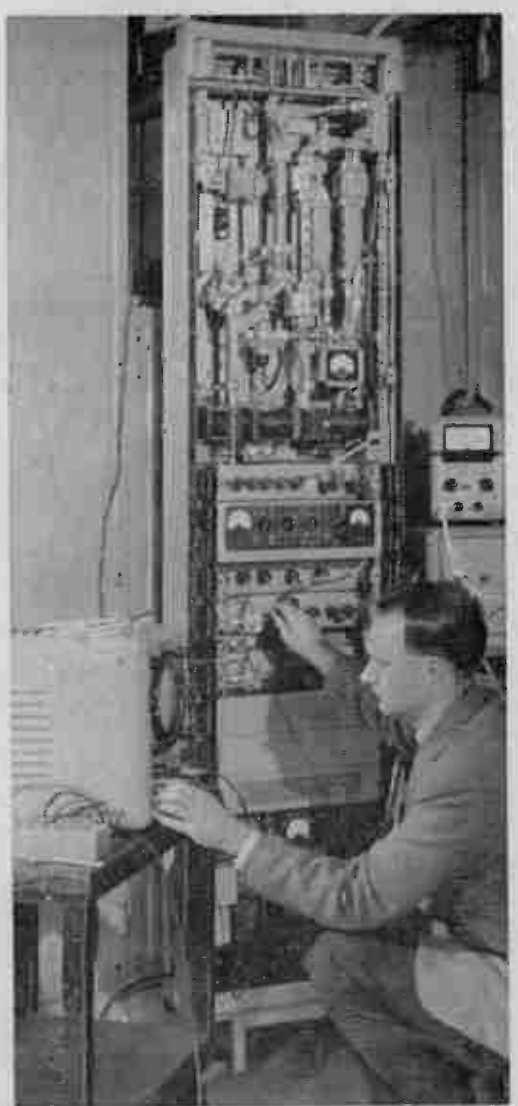
close-up

a pictorial comment of your industry in action

Over 3,000,000 digital bits will be stored on these computer memory drums awaiting installation at Ferranti-Packard Electric Ltd. The rotation of these drums may be phase locked to simulate one large drum, 10" diameter and 60" long.



Artist's conception of USAF's Haystack Hill Radio Research Facility, Tyngsboro, Mass., slated to be the most powerful in the world through use of 100,000 watt plug in transmitters being built by Radiation at Stanford under $1.6 million contracts.



Engineer in General Electric Company Ltd. of England. Coventry, tests prototype super high frequency radio equipment of the type which will be supplied for a broadband radio link between Moncton, New Brunswick and Gore, Nova Scotia. This link will consist of two terminals and two repeater stations, and will form part of the Canadian east coast microwave network.

Pillars of super-power devised by International Rectifier Corporation, will form a giant rectifier "bridge" rated at 35 000 volt DC capacity at 55 amperes and represent the last stage in replacement of power vacuum tubes by solid state physics. Each column contains 360 separate rectifier cells.

The international scene

Continued from page 87

Fixed glass capacitors meet reliability goal

Achievement of the reliability goal for fixed glass capacitors used in production of the inertial guidance and flight control systems for the U.S. Air Force's Minuteman missile was announced jointly by Corning and the Autonetics Division of North American Aviation, Inc.

Corning is the first of the 13 high reliability contractors to Autonetics to produce component parts having a reliability factor of 99.9994 per cent during 1,000 operating hours.

IRC's Japanese affiliate will expand plants

International Rectifier Corporation disclosed July 18 a two-stage expansion program to enlarge administrative and manufacturing facilities of its Japanese affiliate at Soya, Hatano, in the Kanagawa Prefecture, starting in August.

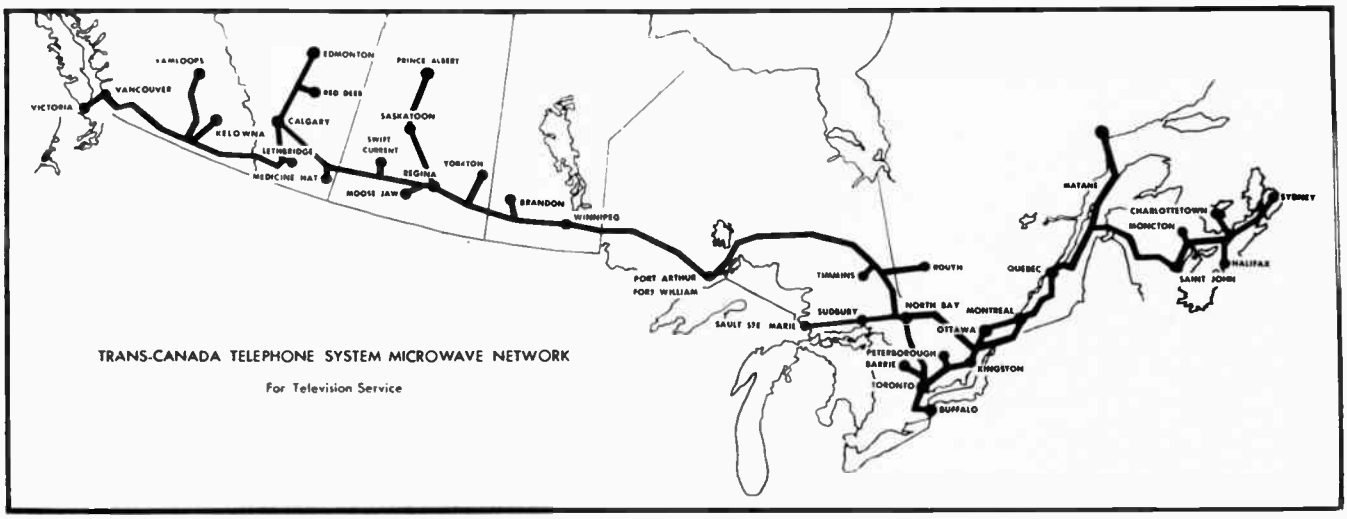
According to word received from IRC (Japan) Ltd., the plans call for an investment of approximately $1,000,000 to increase the annual production rate from $1,000,000 to approximately $3,000,000 during 1963.

New projection color TV in UK

The Marconi Color Television Laboratories have recently completed the development of a new large screen color television projector. It accepts either separate red, green and blue signals, or a composite coded signal and projects a picture measuring 12 by 9 feet onto a screen 25 feet away. Each color channel has a separate 10 Mc/s bandwidth video amplifier which feeds 5 inch cathode ray tube projectors operating at 50 kV EHT. Optics consist of a concave glass reflector with an aspherical glass corrector plate focussing the picture in a flat plane.

The system gives excellent quality suitable for professional and scientific purposes. Equipment is slated for use in teaching hospitals and defense equipment.

Industry's business *Continued from page 94*



$11 million CTV microwave facility program

Spence Caldwell, president of CTV Television Network Ltd., recently announced that CTV and the Bell Telephone Company of Canada, acting on behalf of the Trans-Canada Telephone System have reached agreement concerning the building of a new national microwave facility for the new network. Total amount of the contract is estimated in excess of $11 million.

Equipping the 3,900 mile communication link to carry live television for the network will involve additional installations in more than 130 of the telephone system's relay stations from coast to coast. In some cases equipment buildings at the bases of microwave towers will be enlarged, and in others, additional antennae will be installed. The map shows the route of the completed system.

Target date for modifying the Toronto-Vancouver section of the microwave system for the new network is September 1962 — a year earlier than originally thought — and for the Montreal-Halifax section, June 1963. The contract between CTV and the telephone system calls for a reversible channel, permitting east-west and west-east transmissions alternately, but when the additional equipment is installed, the system will be capable of transmitting television signals simultaneously in both directions, telephone officials say.

Leigh Instruments to open in Carleton Place

Work on renovation of the old Hawthorne Mill property is proceeding steadily in preparation for the opening of Carleton Place's new industry, Leigh Instruments Ltd.

The company will be engaged in the design and development of electronic and electromechanical components which have a wide application in Canadian and United States military and commercial electronic systems.

Edo (Canada) designates new sales rep.

Edo (Canada) Limited, Cornwall, Ontario, has appointed A. Deskin Sales Company, 1091 Shorecrest (14th) Street, St. Martin, Montreal 40, P.Q., as its sales representative in the Maritime Provinces, Ontario and Quebec, for the Burnell line of products which Edo (Canada) manufactures and sells under exclusive franchise in Canada, Great Britain and other Commonwealth areas. Deskin Sales replaces Found Brothers Aviation Limited, Malton, Ontario, who formerly handled the sale of Burnell products.

Continued on page 104

Industry's business

Continued from page 102

Canada - U.S. study FM channel allocation

Steps have been taken to protect Canada's position in the matter of allocating FM channels in the Canadian-U.S. border areas, Transport Minister Leon Balcer announced August 10, in making public an exchange of letters between his department and the U.S. Federal Communications Commission.

The letters confirm a series of discussions between the Board of Broadcast Governors, the Transport Department and the FCC, in which both countries agreed to certain interim criteria in allocating frequency modulated broadcasting station channels along the border.

Further negotiations may follow after the FCC has completed a public inquiry into the entire question of FM channel allocation.

Litton acquires interest in German firm

Litton Industries, of Beverly Hills, California, has acquired an interest in C. Plath KG, of Hamburg, Germany, producer and world-wide distributor of high precision navigation instruments.

J. M. Bridgeman of the Canadian company revealed that Plath will be "an important member of the European industrial team that Litton is forming" to handle production of Litton inertial navigation equipment for NATO countries. He also said plans are underway for an exchange of technology with Plath and for the Germany company to co-operate in various Litton product development programs.

Army tank hauls cables

Fast thinking engineers of B.C.'s Telephone Company have put a World War 2 Sherman Tank to work hauling out four miles of traction cable which served the company's aerial tramway near Hope, B.C. With the gun turret replaced by winch and the heavy tank acting as an anchor, the 11-ton cable was pulled out and new one replaced. Working on the mountain side, having the greatest vertical rise in North America 4525 ft. in 10,300, the difficult feat was accomplished in two weeks. New cable has traction strength of 31 tons and hauls gondola for carrying maintenance engineers to company's microwave station located at top. The Hope station carries television programs and bulk of telephone circuits linking with Eastern Canada.

opportunities

Send all material to the attention of the Classified Editor of ELECTRONICS AND COMMUNICATIONS, 450 Alliance Ave., Toronto 9, Ontario.

ELECTRONIC DESIGN ENGINEER

Our Company Client, a well-known manufacturer of electronic components, requires an Electronic Design Engineer, 28-33, with experience in coils, condensers, or allied products.

Applicants must be electrical graduates, and have potential to advance to management level. Starting salary is open to negotiation.

Candidates are requested to submit concise summaries in strict confidence to Executive Selection Consultants, 330 Bay Street, Toronto, Ontario, or to:

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450 Alliance Avenue, Toronto 9, Ontario

CONSULTING SERVICE

A senior executive with long and proven experience in the Electronics Industry will help your profits and prospects by dealing with such problem areas as: plant layout and flow of materials; day by day cost control; effective quality control for cost reduction; proper manuals for manufacturing processes and methods; product development planning and budgeting; sales and marketing.

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Toronto Area:

$5400 - $7200 annually; sales engineer for sale of instruments used for the detection and measurement of radio-activity, principally for biological and medical research; also for industrial control. Order Number 510-2-x-242A.

$7200 - $8400 annually; data analyst to analyse data in connection with a long-term reliability test program for electronic parts; establish failure rate, drift rate or other characteristics; consultation in establishment of test programs; preparation of reports. Order Number 510-x-565.

$6000 - $7500 annually; to be in charge of consulting engineering division, instrumentation, petro-chemical refinery construction. Order Number 510-2-x-67B.

Eastern Ontario:

$8000 - $9000 annually; advise on design, installation and maintenance of communications equipment. Order Number 512-B1659E.

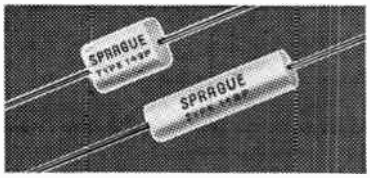
$7000 - $12,000 annually; experienced in VHF and UHF techniques; design of installations, antennas, communication transmitters and receivers. Order Number 512-B1138.

Details and application forms may be secured from Executive and Professional sections of the National Employment Offices.

QUALIFIED DESIGN AND SYSTEMS ENGINEER

With a good background in the telecommunications industry is required for product and systems design of VHF and UHF radio communications equipment. To locate at Calgary plant of large international company. Applications are invited for this senior engineering position from responsible and mature individuals. Excellent salary commensurate with experience and qualifications. Write giving details to:

Mr. Don A. Saunders
P.O. Box 1087, Calgary, Alberta



New Miniature Yellow-Jacket® Film Capacitors

Sprague Yellow-Jacket Wrapper-Protected Filmite "E" Capacitors are ideal for entertainment and commercial applications where size, weight, and cost are important considerations. Type 148P (cylindrical) and Type 149P (semi-oval) Yellow-Jackets are especially suited for transistorized and low-voltage electron tube circuits.

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PORTABLE REGULATED DC POWER SUPPLY

model L3501
6" x 8" x 8"

only **$199.50**

- Constant Voltage 0-35v, 0-1A.
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- Fully transistorized — regulated 5 mv. N.L. to F.L. or 10% line change.
- Remote programming & Current limiting.
- Ripple 250 microvolts rms.
- Several units may be paralleled.
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Electronic Instruments

- SWEEPING OSCILLATORS FREQUENCY MARKERS
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DESIGNED FOR THE PULSED RF APPLICATION

- True Turn-Off — (65 to 80 DB Down)
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- Video Pulses • Trigger Circuits • CW Generator

Frequency Range: 10 to 80 mc; direct-reading dial, accuracy 0.5%.
Pulse Repetition: Variable 400 to 4,000 pps.
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Price: $795.00 f.o.b factory
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SWEEP AUDIO FREQUENCIES and HIGH Q FILTER CIRCUITS

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FEATURES

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- Variable Center Frequency
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- All-Electronic

FREQUENCY RANGE: 20 cps to 200 kc, variable
SWEEP WIDTH: 20 cps to 20 kc, variable
REPETITION RATE: 0.2 to 25 cps, variable
OUTPUT LEVEL: 5.0 volts rms into 600 ohms

PRICE: $895.00 f.o.b. factory — ($985.00 f.a.s. New York)

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editorial

A memo to the U.S. - Canadian R & D for export

In looking for a theme threading through this year's Canadian IRE Electronics Conference, the observer finds many. Progress through electronics . . . . . Recovery and expansion . . . . .Buoyancy . . . . . these and many more are quite apparent. There is one other, however, that is somewhat less easy to state in round terms since conflicting feelings of national pride and modesty are involved. Nevertheless, let us take the plunge and point out that the Conference clearly demonstrates a very high degree of technical competence and production capability in Canada. This year's Conference, the most extensive to date, is represented by over 150 exhibitors and by the presentation of 80 technical papers carefully selected from several hundred excellent contributions submitted for the program. While much of the Industry's effort is directed toward domestic electronic requirements and a growing export business there remains a significant portion, especially in the fields of *research and development* that is not fully committed.

Within the context of mutually similar Canadian-U.S. aspirations and the established defense sharing policies, United States defense agencies and the principals of many Canadian companies in the U.S. are reminded once again of the substantial contributions Canadian scientists and engineers are able to offer in the electronic and associated fields of endeavor. In spite of disturbing influences arising from the change to the Canadian defense posture of two years ago, most Canadian companies have been able to retain and develop their hard-won skills in military electronics and also keep in being their teams of key scientific and engineering personnel.

To foster increased Canadian participation in joint defense procurement activities especially in the R & D areas without asking for, or expecting special favors, calls for an emphasis on existing measures and the institution of some new approaches both in Canada and in the United States. Of special importance in Canada:

- increase in DDP information services concerning Canadian Industry.
- a stepped-up selling program by Industry itself.
- establishment of regular contacts to weld together the government-industry team.
- streamlining of Canadian Commercial Corporation and DDP services to avoid delays and ensure maximum response to bids and to speed-up the administration of contracts.
- cutting out red tape concerning government qualification testing services.

In the United States, the following revisions:

- changes in the "need-to-know" regulations to permit Canadian companies to bid on a technically fair basis with their U.S. counterparts.
- provision for Canadian companies to attend early bid-briefings.
- easement of customs regulations concerning the entry of demonstration hardware.

Changes along the lines suggested should lead to a greater exposure of Canadian capabilities to our United States neighbors . . . . if this results in a greater Canadian contribution, surely in the long haul this will be of benefit to both countries.

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Let us handle your inventory problems and save you time and money on your magnetic core requirements.

Extensive stocks of four types of Arnold cores in the most popular sizes have been set up in our Marengo, Illinois and Fullerton, Calif. plants. Subject of course to temporary exhaustion of stock by prior sales, these cores will be shipped *the same day* on orders received at the warehouse by 12:00 noon. When cores are out of stock at the nearest plant, we may be able to ship within 24 hours from the other.

Arnold core products covered by this warehouse stock program include: 1) Silectron C, E and O cores in 2, 4 and 12-mil tape. 2) Type 6T aluminum-cased cores of Deltamax, Square Permalloy and Supermalloy, in 1, 2 and 4-mil tape. 3) Mo-Permalloy powder cores, both temperature-stabilized and unstabilized types, ranging down to "cheerio" sizes. 4) Iron powder toroids, threaded cores and insert cores.

All four products are available in a wide range of selection, for your convenience and economy in ordering either prototype design lots or regular production quantities. • Stock lists, bulletins, etc. are available—write for information. *The Arnold Engineering Company, Marengo, Ill.*

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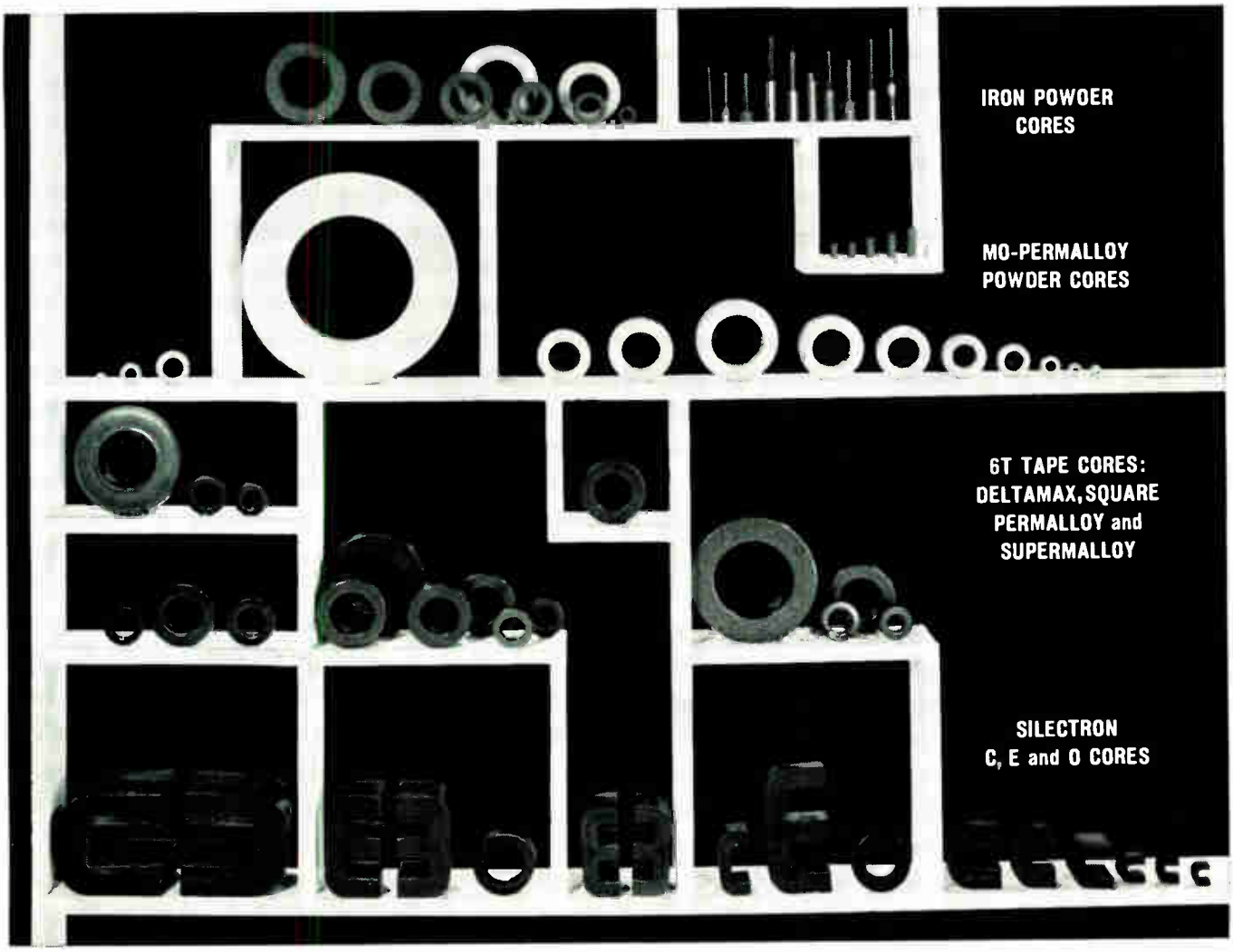

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Yours in this **NEW**

STANDING WAVE INDICATOR

- **Pinpoint resolution for precise attenuation measurements**
- **Scale expansion with no "blind spots," no resetting**
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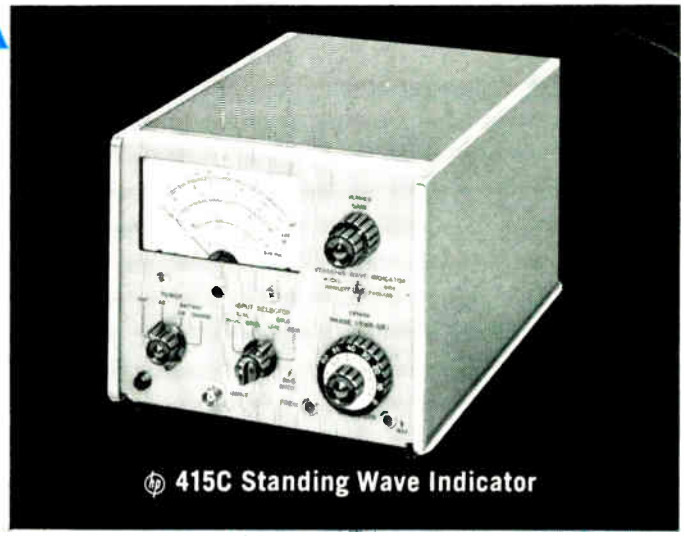
- **All-solid-state design**



415C Standing Wave Indicator

Model 415C Standing Wave Indicator is a new high-gain, low-noise solid state amplifier and voltmeter calibrated for square-law detectors to read directly in SWR or db. The amplifier is tunable, 980 to 1,020 cps, for matching source modulator or for optimizing several instruments in one system. Variable bandwidth (15 to 100 cps) permits both high sensitivity testing and swept-frequency work.

For highest resolution on precise attenuation measurements, you can expand to full scale each 2.5 db portion of any 10 db range with no "blind spots," and the reference is maintained automatically! This expansion gives you 24 calibrated ranges, 0-60 db, in 2.5 db steps. The 415C also reads directly in SWR; it is ideal for measuring reflection coefficient and extremely useful as a null indicator for audio-frequency bridges.

Two peak-limited bias currents, readable on the front-panel meter and adjustable ± 10%, prevent accidental bolometer burnout. Other inputs permit operation with crystals and as a null detector.

The 415C has both an ac output for use as a high-gain tuned amplifier and a dc recorder output. High stability with line changes makes the instrument ideal for long-term monitoring. An internal battery pack (optional) makes the 415C completely portable. It is housed in the new hp modular cabinet, which can mount in half of a rack 7" high, combining conveniently in a single rack width with such companion instruments as hp 431 Power Meter.

SPECIFICATIONS

Frequency:	1,000 cps ±2% by front-panel control. Special-order frequencies available between 400 and 1,500 cps.
Sensitivity:	0.1 μv rms at 200 ohms and 30 cps bandwidth.
Noise Level:	5 db below full scale at 0.1 μv rms sensitivity, minimum bandwidth.
Bandwidth:	Variable, front-panel control, 15 to 100 cps.
Range:	70 db. Input attenuator for 60 db in 2.5 db steps, accuracy ±0.1 db/10 db step. Maximum cumulative error, ±0.2 db.
Expand Accuracy:	±0.05 db from normal to 0.1 db expand; ±0.1 db from normal to other expand ranges
Meter Scales:	SWR 1-4; SWR 3-10; expanded SWR 1⅓ db 0-10; expanded db 0-2.5. Bolo current.
Input:	"Bolo"—200 ohms, bias 8.7 or 4.3 ma; "Crystal"—200 ohms for crystal rectifier; "200 Kilohm"—for crystal rectifier as null detector.
Outputs:	DC (1 ma full scale) for recording. AC (0.25 v rms for full scale deflection) for swept-frequency scope presentation.
Size:	7½" high, 6½" wide, 12½" deep. Weight, 5 lbs.
Accessories Available:	Battery pack.
Price:	$325.00.

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