



THE RADIO AND ELECTRONIC ENGINEER

The Journal of the Institution of Electronic and Radio Engineers

Volume 35, 1968
January-June

Published by the INSTITUTION OF ELECTRONIC AND RADIO ENGINEERS
8-9 Bedford Square, London, W.C.1

Telephone : 01-636 1901.

Telegrams : Instrad London, W.C.1

BOUND VOLUMES OF THE JOURNAL

Limited numbers of the following bound volumes are available:—

| | | |
|------------------|---------------------|--|
| Volume 6 (1946) | £2 12s. 6d. | Volume 21 (January-June 1961) £3 10s. 0d. |
| Volume 7 (1947) | £2 12s. 6d. | Volume 22 (July-December 1961) £3 10s. 0d. |
| Volume 8 (1948) | £2 12s. 6d. | Volume 23 (January-June 1962) £3 10s. 0d. |
| Volume 9 (1949) | £3 5s. 0d. | Volume 24 (July-December 1962) £3 10s. 0d. |
| Volume 10 (1950) | £3 15s. 0d. | Volume 25 (January-June 1963) £3 10s. 0d. |
| Volume 11 (1951) | £3 15s. 0d. | Volume 26 (July-December 1963) £3 10s. 0d. |
| Volume 12 (1952) | £3 15s. 0d. | Volume 27 (January-June 1964) £3 15s. 0d. |
| Volume 13 (1953) | £3 15s. 0d. | Volume 28 (July-December 1964) £3 15s. 0d. |
| Volume 14 (1954) | £3 15s. 0d. | Volume 29 (January-June 1965) £3 15s. 0d. |
| Volume 15 (1955) | £3 15s. 0d. | Volume 30 (July-December 1965) £4 0s. 0d. |
| Volume 16 (1956) | £4 0s. 0d. | Volume 31 (January-June 1966) £4 0s. 0d. |
| Volume 17 (1957) | £4 10s. 0d. | Volume 32 (July-December 1966) £4 0s. 0d. |
| Volume 18 (1958) | £4 10s. 0d. | Volume 33 (January-June 1967) £4 0s. 0d. |
| Volume 19 (1959) | £4 10s. 0d. | Volume 34 (July-December 1967) £4 0s. 0d. |
| Volume 20 (1960) | £4 10s. 0d. | Volume 35 (January-June 1968) £4 0s. 0d. |

Members' own copies of the *Journal* can be bound into volumes at a cost of 25s. per volume (postage and packing extra: 5s. 6d. Great Britain; 6s. 6d. Overseas).

The appropriate *Journals* should be sent to: Publications Department, 9 Bedford Square, London, W.C.I.

DECLARATION ON FAIR COPYING

Under the terms of the Royal Society's Declaration on Fair Copying, to which the Institution subscribes, material may be copied from any issue of the *Journal* which is *out of print* and of which no reprints are available.

CORRECTIONS

Volume 34, No. 6, December 1967

page 384, col. 1, line 22, read Ref. 2 instead of Ref. 1.

Volume 35, No. 2, February 1968

page 79, Table 1 (contd.), the seventh item should read:

CARBON GRADE I RESISTORS 522 267 11 600·882 etc.

The accidental failure rate per 1000 hours for the fourteenth item, CARDS, should read: 0·000 53%

Volume 35, No. 2, February 1968

page 113, col. 2, line 3, expression for g_{\max} should read:

$$g_{\max} = \frac{1}{s} \cdot \left| \frac{p_{21}}{p_{12}} \right|$$

page 114, col. 1, the value of y_{21} should read:

70 m mho and not 70 μ mho

Volume 35, No. 6, June 1968

page 347, col. 2, Section 4.2 ends at five lines after eqn. (13). Section 5. 'Application to Fabry-Perot Resonator with ADP as Dielectric', should start with the sentence 'As in the case of a resonance . . .'

The Institution is not, as a body, responsible for expressions of opinion appearing in its publications, unless otherwise stated.

PRINCIPAL CONTENTS OF VOLUME 35, 1968

JANUARY

| | | | | | | | |
|--|----|----|----|----|----|----|----|
| The Presidential Address of Major-General Sir LEONARD ATKINSON, K.B.E. | .. | .. | .. | .. | .. | .. | 3 |
| The Electronics Industry: Looking Ahead with Hindsight. E. EASTWOOD, C.B.E. | .. | .. | .. | .. | .. | .. | 11 |
| The <i>Ariel III</i> Satellite Project. F. P. CAMPBELL and A. C. LADD | .. | .. | .. | .. | .. | .. | 17 |
| A Wideband Array of Non-uniformly Spaced Directional Elements. J. C. LIM | .. | .. | .. | .. | .. | .. | 33 |
| Atomic Second Adopted as International Unit of Time | .. | .. | .. | .. | .. | .. | 40 |
| Thermal Design and Thermal Testing of the UK-3 Spacecraft. E. C. SEMPLE | .. | .. | .. | .. | .. | .. | 41 |
| Conversion Between Binary Code and Some Binary-decimal Codes. K. J. DEAN | .. | .. | .. | .. | .. | .. | 49 |
| The University of Birmingham Electron Density and Temperature Experiments on the <i>Ariel III</i> Satellite. J. H. WAGER | .. | .. | .. | .. | .. | .. | 55 |

FEBRUARY

MARCH

| | |
|---|-----|
| The Technology of Thick Films. Professor J. C. ANDERSON | 117 |
| Conference on Thick Film Technology: Programme and Synopses of Papers | 118 |
| Satellite-borne Equipment for a Global Survey of Terrestrial Radio Noise. B. N. HARDEN and V. A. W. HARRISON | 125 |
| The <i>Ariel III</i> Power System. F. C. TREBLE, R. C. COOK and P. G. GARRATT | 135 |
| Some Design Aspects of the <i>Ariel III</i> V.H.F. Communications System. R. S. HILDERSLEY | 143 |
| An Investigation of the Effect of the Divisor Polynomial on the Responses of R-C Active Networks Designed by the Yanagisawa Procedure. A. G. J. HOLT and F. W. STEPHENSON | 157 |
| Noise Spectra of Beam-type Microwave Oscillators. B. V. RAO and Professor W. A. GAMBLING | 165 |
| A C.W. Comparator for Precision R.F. Attenuators. R. W. A. SIDDELE and I. A. HARRIS | 175 |
| Attitude Determination of the <i>Ariel III</i> Satellite. R. B. BENT | 182 |
| Discussion on the <i>Ariel III</i> Satellite | 182 |

PRINCIPAL CONTENTS

APRIL

| | |
|--|-----|
| Anticipating the Future | 185 |
| Convention in Cambridge University on Electronics in the 1970s—Provisional Programme | 186 |
| Standards for Electrical Circuit Properties at Radio Frequencies: A Survey of Some U.K. Developments. I. A. HARRIS | 189 |
| Digital Analysis of Current Noise at Very Low Frequencies. I. R. M. MANSOUR, R. J. HAWKINS and G. G. BLOODWORTH | 201 |
| Measurements of Current Noise in M.O.S. Transistors from 5×10^{-5} to 1 Hz. I. R. M. MANSOUR, R. J. HAWKINS and G. G. BLOODWORTH | 212 |
| Measurements on Microcircuits in the range 100–1000 MHz. H. A. KEMHADJIAN, A. NEGANDHI and B. J. LEWIS | 217 |
| Noise Source Calibration in the Decimetre Band. G. J. HALFORD and E. G. ROBUS | 227 |
| The Service of Broadcasting: Some Technical Requirements for the Reception of Sound Broadcasting including Transmission from Earth Satellites. R. A. ROWDEN | 237 |
| A Simple Method for the Measurement of Varactor Q -factor. R. B. SMITH | 245 |

MAY

JUNE

| | | | | | | | |
|---------------------------|----|----|----|----|----|----|-----|
| Subject Index | .. | .. | .. | .. | .. | .. | 377 |
| Index of Persons | .. | .. | .. | .. | .. | .. | 382 |
| Index of Abstracts | .. | .. | .. | .. | .. | .. | 384 |

THE INSTITUTION OF ELECTRONIC AND RADIO ENGINEERS

FOUNDED 1925

INCORPORATED BY ROYAL CHARTER 1961

Patron

HER MOST GRACIOUS MAJESTY QUEEN ELIZABETH II

THE COUNCIL OF THE INSTITUTION 1968

President

MAJOR-GENERAL SIR LEONARD ATKINSON, K.B.E., B.SC.

Past Presidents

J. LANGHAM THOMPSON

COLONEL G. W. RABY, C.B.E.

PROFESSOR E. WILLIAMS, PH.D., B.ENG.

Vice-Presidents

A. A. DYSON, O.B.E.

Sir ARNOLD LINDLEY, C.G.I.A.

Professor W. A. GAMBLING, PH.D., B.SC.

J. A. SARGROVE

D. W. HEIGHTMAN

A. ST. JOHNSTON, B.SC., A.C.G.I.

Ordinary Members of Council

Fellows:

J. BILBROUGH

F. N. G. LEEVERS, B.SC.(ENG.)

S. R. WILKINS

B. F. GRAY, B.SC.(ENG.)

C. POWELL

G. WOOLDRIDGE, PH.D., M.SC.

E. ROBINSON, PH.D., B.SC.

Members:

J. R. HALSALL, DIP.EL.

Dr. C. A. F. JOSLIN, M.B., B.S.

J. S. SHAYLER, B.SC.(TECH.)

Companion:

Captain G. B. C. BRITTON, C.B.E., M.A., R.N.(RTD.)

Honorary Treasurer

G. A. TAYLOR (*Fellow*)

Secretary

GRAHAM D. CLIFFORD, C.M.G. (*Fellow*)

Chairmen of Local Sections in Great Britain *and ex-officio Members of Council:*

G. G. BLOODWORTH, M.A. (*Member*) Southern

E. H. JONES, B.SC.(ENG.) (*Fellow*) South Wales

E. A. H. BOWSHER (*Fellow*) East Anglian

E. G. LAMB, B.SC.(ENG.) (*Fellow*) Merseyside

F. S. BROWN, B.SC.(ENG.) (*Member*) South Western

I. C. I. LAMB, M.B.E. (*Member*) Yorkshire

M. T. CHALLENGER (*Member*) South Midland

Sqdn.-Ldr. D. R. McCALL, B.SC. (*Member*) East Midland

J. HAMBLETON (*Fellow*) North Eastern

R. D. PITTILO, B.SC. (*Member*) Scottish

B. A. HORLOCK (*Member*) North Western

C. C. RICHARDSON, B.SC. (ENG.) (*Fellow*) Thames Valley

V. G. WELSBY, PH.D. (*Fellow*) West Midland

DIVISIONS AND LOCAL SECTIONS OF THE INSTITUTION

GREAT BRITAIN

East Anglian

Chairman: E. A. H. BOWSHER, C.ENG., F.I.E.R.E.
Honorary Secretary: J. G. COTTRELL, C.ENG., F.I.E.R.E.
43 Colbert Avenue, Thorpe Bay, Essex.

East Midland

Chairman: Sqdn.-Ldr. D. R. McCALL, B.Sc., C.ENG., M.I.E.R.E.
Honorary Secretary: T. L. PERRY, C.ENG., M.I.E.R.E.
9 Goscote Hall Road, Birstall, Leicester.

Merseyside

Chairman: E. G. LAMB, B.Sc.(ENG.), C.ENG., F.I.E.R.E.
Honorary Secretary: J. A. HARDCASTLE
82 Acacia Avenue, Blacklow Hall Farm Estate, Huyton,
Liverpool.

North Eastern

Chairman: J. HAMBLETON, C.ENG., F.I.E.R.E.
Honorary Secretary: P. RIVKIN
43 Ladywell Way, West Farm Estate, Ponteland,
Newcastle-upon-Tyne.

North Western

Chairman: B. A. HORLOCK, C.ENG., M.I.E.R.E.
Honorary Secretary: E. C. DAVIS, C.ENG., M.I.E.R.E.
1 Garners Close, Bowdon, Altrincham, Cheshire.

Scottish

Chairman: R. D. PITTILO, B.Sc., C.ENG., M.I.E.R.E.
Honorary Secretary: D. DICK, D.I.C., C.ENG., M.I.E.R.E.,
Napier College of Science and Technology,
Colinton Road, Edinburgh.

Yorkshire

Chairman: I. C. I. LAMB, M.B.E., C.ENG., M.I.E.R.E.
Honorary Secretary: P. A. BENNETT, C.ENG., M.I.E.R.E.
414 Redmires Road, Lodge Moor, Sheffield 10.

South Midland

Chairman: M. T. CHALLENGER, C.ENG., M.I.E.R.E.
Honorary Secretary: S. W. C. HAWKINS, C.ENG., M.I.E.R.E.
'Elmfield', Picken End, Hanley Swan, Nr. Worcester.

South Wales

Chairman: E. H. JONES, B.Sc.(ENG.), C.ENG., F.I.E.R.E.
Honorary Secretary: I. D. DODD, B.Sc., C.ENG., M.I.E.R.E.
Glamorgan College of Technology, Treforest, Glamorgan.

South Western

Chairman: F. S. BROWN, B.Sc.(ENG.), C.ENG., M.I.E.R.E.
Honorary Secretary: W. E. WHEELDON, B.Sc., C.ENG., M.I.E.R.E.
Department of Electrical Engineering, Bath University of
Technology, Ashley Down, Bristol 7.

Southern

Chairman: G. G. BLOODWORTH, M.A., C.ENG., M.I.E.R.E.
Honorary Secretary: C. R. FOX
56 Fellows Road, Farnborough, Hampshire.

West Midland

Chairman: V. G. WELSBY, PH.D., C.ENG., F.I.E.R.E.
Honorary Secretary: V. L. C. MITCHELL, C.ENG., M.I.E.R.E.
29 St. Thomas Place, Penkhull, Stoke-on-Trent, Staffordshire.

Thames Valley

Chairman: C. C. RICHARDSON, B.Sc.(ENG.), C.ENG., F.I.E.R.E.
Honorary Secretary: F. R. DENNING, C.ENG., M.I.E.R.E.
'Hill Trees', Wood Lane, Sonning Common, Nr. Reading,
Berkshire.

OVERSEAS

Canadian Division

Chairman: Professor A. D. BOOTH, D.Sc., Ph.D., C.ENG., F.I.E.R.E.
Administrative Secretary: Mrs. M. PETERSON
Room 300, Burnside Building, 151 Slater Street,
Ottawa 4, Ontario.

Auckland Section

Chairman: D. P. JOSEPH, C.ENG., F.I.E.R.E.
Honorary Secretary: C. W. SALMON, C.ENG., M.I.E.R.E.
P.O. Box 3381, C.P.O., Auckland.

Wellington Section

Chairman: B. A. BERNON, C.ENG., M.I.E.R.E.
Honorary Secretary: J. F. C. JOHNSON, C.ENG., M.I.E.R.E.
P.O. Box 5100, Wellington, N.Z.

South African Section

Chairman: A. W. R. WOODS, C.ENG., M.I.E.R.E.
Secretary: R. S. MYERS
310/313 Alris Buildings, 3rd Floor, 3 Rissik Street South,
Johannesburg.

Indian Division

Chairman: Professor J. N. BHAR, D.Sc., C.ENG., F.I.E.R.E.
Administrative Secretary: Miss BELLA TATA
7 Nandidurg Road, Bangalore 6.

Karachi Section

Chairman: S. A. AZIZ, B.Sc., M.Sc., C.ENG., F.I.E.R.E.
Honorary Secretary: I. A. ANSARI, M.Sc., C.ENG., M.I.E.R.E.
Technical Training School, Radio Pakistan,
Block 74, Pakistan Secretariat, Karachi, Pakistan.

Lahore Section

Honorary Secretary: MUHAMMAD KAREEM, C.ENG., M.I.E.R.E.
Bungalow 266b, Victoria Road, Lahore, Pakistan.

Israeli Section

Chairman: Z. GLADSTEIN, C.ENG., M.I.E.R.E.
Honorary Secretary: R. DANOR, C.ENG., F.I.E.R.E.
P.O. Box 21045, Tel-Aviv.

French Section

Chairman: M. MARTINOFF, C.ENG., M.I.E.R.E.
Secretary: P. J. C. PREVOST, C.ENG., M.I.E.R.E.,
29 Rue Victor-Massé, Paris 9e.



[Photograph by C. Edwards & Son Ltd.]

MAJOR-GENERAL SIR LEONARD HENRY ATKINSON, K.B.E., B.SC., C.ENG., M.I.MECH.E., F.I.E.E., F.I.E.R.E.
Twentieth President of the Institution

