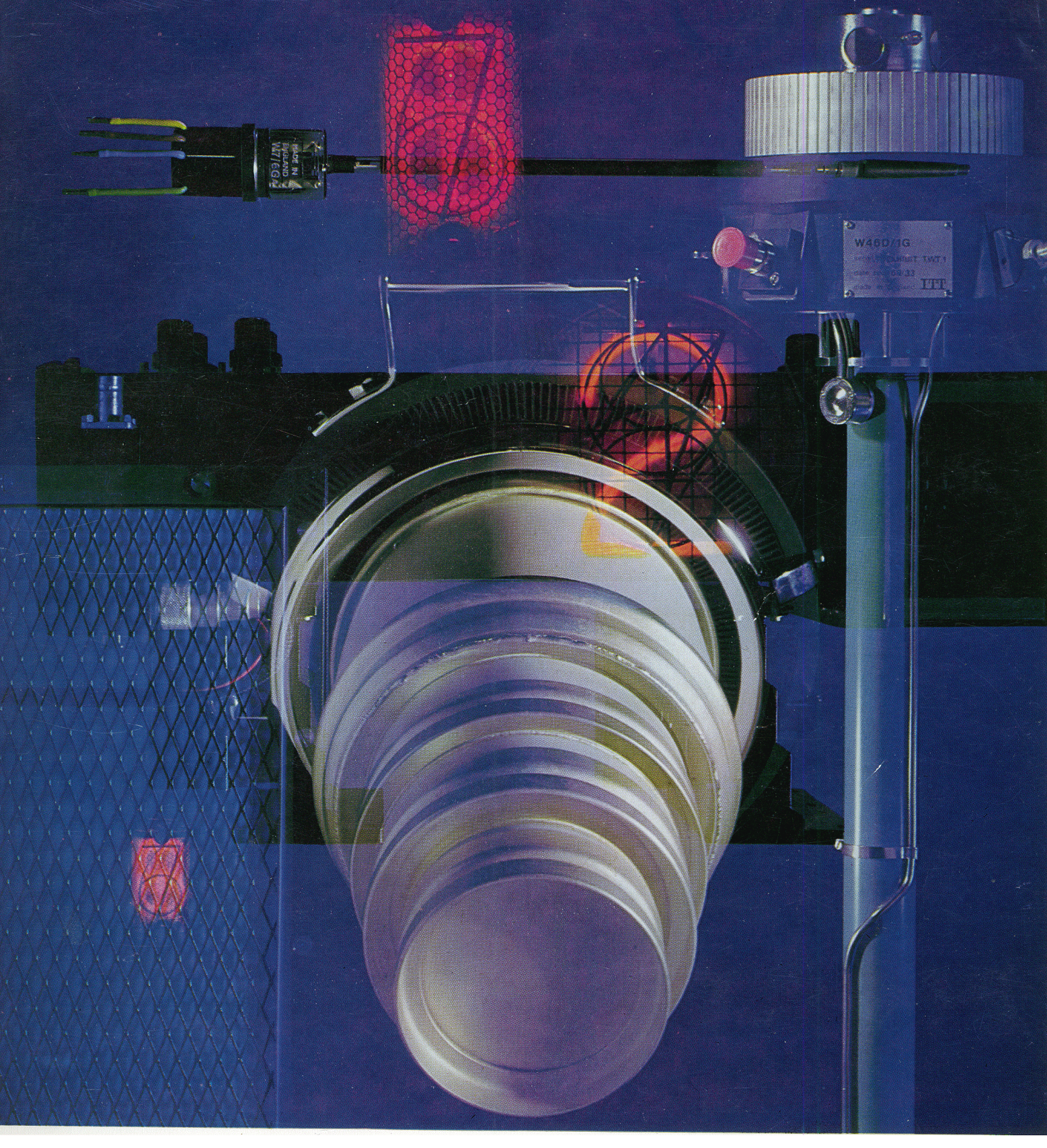

Electronic Tube and Microwave Device Summary

1970/71

6000/302E

COMPONENTS ITT

Printed in Great Britain at THE KYNOCH PRESS, Birmingham

Electron Tubes and Microwave Devices

Introduction

This publication contains abridged data on ITT Electron Tubes and Microwave Devices. Other publications in the series are:

6000/300 Product list, all components.
6000/302 Active components, thermionic (electron tubes etc.).
6000/303 Active components, semiconductor.
6000/304 Electro-mechanical components.
6000/305 Rectifier Stacks, Modules, Assemblies and Equipment practice.

The above publications are available in English, French and German languages.

More detailed data for each of the components quoted are available on request (though not necessarily in more than one language version).

Application for detailed data, or prices, on specific components can be made to any of the addresses shown on the back cover.

For the convenience of customers outside Europe, each range of devices bears an indication of the country of manufacture, by the following code:

A Austria
B Belgium
CH Switzerland
D Germany
F France
GB United Kingdom
I Italy
NL Holland
P Portugal
USA The United States of America

Requests for further information from countries without an ITT Branch or Agent should be made to the ITT Branch in the country where the device is manufactured.

Erratum

For: 6000/302 Active components, thermionic (electron tubes etc.).
Please read: 6000/301 Passive components.

Microwave Tubes

Travelling-wave amplifier tubes
Communications types
Travelling-wave tubes
Radar receiver types
Travelling-wave tubes
Commercial and military types
Power travelling-wave amplifier tubes for T.V. or pulse service
AM-PM compensators
Power amplifier klystrons for T.V.
Pulsed amplifier klystrons
Reflex klystrons
Pulsed magnetrons
C.W. magnetron
Waveguide components
S.H.F. triodes
Backward-wave oscillators
Coaxial-line oscillators (Heil tubes)
H-wave oscillators
Noise sources
Thermocouples
Microwave power neon indicator tubes

Solid State Microwave Devices

Step-recovery diodes
Varactor diodes for frequency multiplication
Tuning varactor diodes
P.I.N. devices
Gunn-effect diodes
Microwave sources
Microwave diodes, miscellaneous types

Power Tubes

Triodes, forced-cooled
Triodes, radiation-cooled
Tetrodes and pentodes, forced-cooled
Tetrodes and pentodes, radiation-cooled
Pulse triodes, vacuum
Pulse tetrodes, vacuum
Hydrogen thyratrons (ceramic)
Hydrogen thyratrons (glass)
Triggered spark gaps
Pulse modulator (Trigatron)
Crowbar spark gaps
Crowbar thyratrons
Hydrogen diodes
Vacuum diodes, forced-cooled
Vacuum diodes, radiation-cooled
Rectifiers, gas-filled
Rectifiers, mercury vapour
Thyratrons, gas-filled
Thyratrons, mercury vapour
Accessories for Power Tubes

Low Power Tubes

Regulator tubes
General purpose tubes

Cold Cathode Indicator Tubes

Nuclear Particle Detector Tubes

Counter tubes for Alpha and Beta detection
Counter tubes for Gamma detection
Counter tubes for thermal (slow) neutron detection (BF_3) (100°C)
Counter tubes for thermal (slow) neutron detection (He_3) (200°C)
Counter tubes for thermal (slow) neutron detection (BF_3) (200°C)
Counter tubes for fast neutron detection
Beta and gamma detector probes

Electro-optic Tubes

Vacuum photo-diode tubes
Photo-multiplier tubes
Image dissector tubes
Electron multipliers
Image converter tubes
Image intensifier tubes
Correlation devices
Accessories for electro-optic tubes
Direct view storage tubes

Picture Tubes

Black and white tubes
Colour tubes
Special tubes for industrial applications
Accessories

Miscellaneous Tubes and Devices

Xenon lamps
Thermal delay switches
Resistance lamps
Trigger tubes
Voltage stabilisers
Corona stabilisers
Vacuum gauges

Index and Equivalents List

0.05NE1T to 3C/351H

Tubes and microwave devices are listed in numeral-alphabetical sequence.

ITT equivalents are shown together with the number of the page on which tabulated data appears. Some near equivalents are included.

Certain replacement types, which are not tabulated, are designated by a letter or letters as shown below.

M = replacement types recommended for maintenance of existing equipments only.

P = new types for which preliminary information only exists.

S = products manufactured to special order.

† = near equivalents. For tubes there may be slight differences in mechanical or electrical features: for varactor diodes, the difference is more usually in efficiency/performance in specific multiplier circuits.

Type Index	ITT Equivalent	Page
0.05NE1T	0.05NE1T	62
0.05NE1TS	0.05NE1TS	62
0.06NE3/1	0.06NE3/1	62
0.1NE3/1	0.1NE3/1	62
0.2NE3/1	0.2NE3/1	62
0.8NE2T	0.8NE2T	60
0.8NE2TS	0.8NE2TS	60
0A2	0A2 (G150/4K)	84
0A3	VR75/30 (G75/2D)	84
0A3/VR75	VR75/30 (G75/2D)	84
0B2	0B2 (G108/1K)	84
0C3	VR105/30 (G105/1D)	84
0C3/VR105	VR105/30 (G105/1D)	84
0D3	VR150/30 (G150/3D)	84
0D3/VR150	VR150/30 (G150/3D)	84
0M5	5A/157D	M
1	1 (G160/1C)	M
1.25NE3	1.25NE3	62
1.5NE12	1.5NE12	62
1.5NE12T	1.5NE12T	63
1A	1A (G279/1C)	M
1G35	4C35A	48
1G45P	3C45	48
1N263	1N263	34
1N263F	1N263F	34
1N4386	VBC119J†	31
1N4387	VBC99J†	31
1N4388	VBC87B†	31
1N4885	VBC99J†	31
1N5142	VQA418B	32
1N5142A	VQA418C†	32
1N5144	VQA419B	32
1N5144A	VQA419C	32
1N5146	VQA420B	32
1N5146A	VQA420C†	32
1N5148	VQA421B	32
1N5148A	VQA421C	32
1N5149	VJC87D†	31
1N5150	VJE77M	30
1N5152	VSE66M	30
1N5152A	VSE66P	30
1N5153	VJE66M	30
1N5153A	VJE66P	30
1N5154	VVE44M†	S
1N5155	VSE44M†	30
1N5157	VSE43M†	30
1NE2T	1NE2T	62
1NE2TS	1NE2TS	62
1NE3	1NE3	62
2	2 (G155/1C)	M
2A/230D	29C1 (2A/230D)†	50
2B26	6146	46
2C39A	2C39A (3H/151J)	27
2D21	2D21 (4G/280K)	50
2G/402A	3B28 (2G/402A)	50
2G/472B	4B32 (2G/472B)	50
2H/28	3B28 (2G/402A)	50
2H/66	866A (2V/400A)	50
2J/262E	2J/262E	50
2S/280K	19G6 (2S/280K)	50
2S/306B	19H1 (2S/306B)	M
2S/370D	19E2 (2S/370D)	50
2S/460A	ESU112 (2S/460A)	50
2S/460C	ESU77 (2S/460C)	50
2S/490C	V1901 (2S/490C)	S
2S/550C	19H5 (2S/550C)	50
2S/590E	19H12 (2S/590E)	50
2T/240D	19G3 (2T/240D)	50
2T/350D	19H4 (2T/350D)	50
2T/360B	19G12 (2T/360B)	50
2V/301B	ESU101 (2V/301B)	50
2V/302B	ESU115 (2V/302B)	M
2V/395C	ESU76 (2V/395C)	M
2V/400A	866A (2V/400A)	50
2V/400B	ESU866ES (2V/400B)	S
2V/470C	4049C (2V/470C)	M
2V/471A	872A (2V/471A)	50
2V/471C	872A (2V/471A)	50
2V/500C	4049D (2V/500C)	50
2V/530E	2V/531E	50
2V/531E	2V/531E	50
2V/560E	2V/561E	50
2V/561E	2V/561E	50
2W/530E	2W/540E	M
2W/540E	4222B (2W/540E)	M
2W/542E	4222B (2W/540E)	M
2W/543E	2W/540E	M
2XM-600M	866A (2V/400A)	50
3A/107A	3A/107A	M
3A/107AP	3A/107A	M
3A/107B	3A/107B	M
3A/108A	3A/108A	M
3A/108B	3A/108B	M
3A/109A	3A/109A	M
3A/109B	3A/109B	M
3A/110A	3A/110A	M
3A/110AP	3A/110A	M
3A/110B	3A/110B	M
3A/118A	3A/141A	M
3A/119A	3A/141A	M
3A/120A	3A/141A	M
3A/121A	3A/107A	M
3A/121B	3A/107B	M
3A/122A	3A/108A	M
3A/122B	3A/108B	M
3A/123A	3A/142A	M
3A/123AW	3A/142A	M
3A/124A	3A/142A	M
3A/125A	3A/142A	M
3A/126A	3A/109A	M
3A/126B	3A/109B	M
3A/127A	3A/110A	M
3A/127B	3A/110B	M
3A/129A	3A/144A	M
3A/130A	3A/144A	M
3A/131A	3A/144A	M
3A/141A	3A/141A	M
3A/142A	3A/142A	M
3A/144A	3A/144A	M
3A/146J	3A/146J	M
3A/167M	3A/167M	44 & 52
3A/172B	3A/172B	M
3A/205D	HL23 (3A/205D)	52
3B17C	3B17C	61
3B28	3B28 (2G/402A)	50
3B/102B	4033L (3B/252B)†	M/S
3B/150A	3B/151A	M
3B/151A	3B/151A	M
3B/170A	4300A (3B/400A)†	M
3B/200B	4033L (3B/252B)†	M/S
3B/240M	3B/240M	M
3B/241M	3B/241M	M
3B/251A & B	4033L (3B/252B)	M/S
3B/251BW	4033L (3B/252B)†	M/S
3B/251BZ	4033L (3B/252B)†	M/S
3B/251X	4033L (3B/252B)†	M/S
3B/252A	4033L (3B/252B)†	M/S
3B/252B	4033L (3B/252B)	M/S
3B/503B	4304CB (3B/504B)	M
3B/504B	4304CB (3B/504B)	M
3B/651A	4242A (3B/850A)	44
3B/652A	4242A (3B/850A)	44
3B/850A	4242A (3B/850A)	44
3C45	3C45	48
3C45W	3C45W	48
3C/150A	3C/150A	M
3C/201A	4212EC (3C/270B)	44
3C/250A	4212EC (3C/270B)†	44
3C/270A	4212E (3C/270A)	44
3C/270B	4212EC (3C/270B)	44
3C/272A	3C/272A	44
3C/350E	4270A (3C/350E)	M
3C/351H	4357A (3C/351H)	M

Type Index	ITT Equivalent	Page
3C/402E	ES833 (3C/402E)	44
3C/495A	V1501 (3C/495A)	M
3C/750G	EHZ350 (3C/750G)	M
3C/800E	3C/800E	44
3CPN10A5	7815	27
3CW5000A1	3CW5000A1	42
3CW5000A3	3CW5000A3	42
3CW5000F1	3CW5000F1	42
3CX100A5	7289	27
3CX2500A3	3CX2500A3	43
3CX2500F3	3CX2500F3	43
3CX3000A1	3CX3000A1	43
3CX3000A7	3CX3000A7	43
3CX3000F1	3CX3000F1	43
3CX3000F7	3CX3000F7	43
3D21	3D21	50
3D21A	3D21A (5B/152D)	47 & 54
3D22	3D22 (4G/401A)	50
3D/100A	3D/100A	44
3D/102E	ES1001 (3D/102E)	44
3G3C	3G3C	61
3G5	3G5	61
3G6	3G6	61
3G8B	3G8B	61
3G8.500	3G8.500	61
3G10	3G10	61
3G12	3G12	61
3G12C	3G12C	61
3G70	3G70	61
3G100	3G100	61
3G500	3G500	61
3G1000	3G1000	61
3G3000	3G3000	61
3G10000	3G10000	61
3H/151J	2C39A (3H/151J)	27
3H/151JY	2C39A (3H/151JY)	27
3HC/152J	7289 (3HC/152J)	27
3J/121E	3J/121E	44
3J/122E	3J/122E	M
3J/160E	3J/160E	44
3J/161J	3J/162J	44
3J/162J	3J/162J	44
3J/166E	16J12 (3J/166E)	43
3J/167E	ESA1500 (3J/167E)	43
3J/170E	3J/170E	43
3J/187E	3J/187E	43
3J/188E	3J/188E	42
3J/188G	3J/188G	42
3J/191E	3J/195E	M
3J/192E	3J/192E	42
3J/195E	3J/195E	M
3J/196E	ESA891 (3J/196E)	43
3J/197E	ESA892 (3J/197E)	43
3J/198E	ESA5000 (3J/198E)	43
3J/199E	3J/199E	42
3J/202E	3J/202E	M
3J/203E	3J/203E	42
3J/210E	3J/210E	41
3J/221E	3J/221E	M
3J/221S	3J/221S	41
3J/222E	3J/222E	M
3J/223E	3J/223E	41
3J/232E	3J/232E	41
3J/252EW	3J/252EW	40
3J/260E	3J/260E	40
3J/261E	3J/261E	40
3J/280E	3J/280E	40
3J/294E	3J/294E	39
3JC/187E	3JC/187E	43
3JC/203E	3JC/203E	42
3JC/223E	3JC/223E	41
3JC/262E	3JC/262E	S
3NE12	3NE12	62
3NE12T	3NE12T	63
3Q/120G	4013C (3Q/120G)	M
3Q/121E	3Q/121E (3J/121E less radiator)	44
3Q/122E	3Q/122E	M
3Q/167E	ESW1500 (3Q/167E)	43
3Q/184E	4220C (3Q/184E)	M
3Q/188E	3Q/188E	42
3Q/191E	3Q/195E	M
3Q/192E	3Q/192E	42
3Q/195E	3Q/195E	M
3Q/196E	ESW891 (3Q/196E)	41
3Q/197E	ESW892 (3Q/197E)	41
3Q/198E	ESW5000 (3Q/198E)	42
3Q/199E	3Q/199E	42
3Q/200A	3Q/200A	M
3Q/211E	SS1971 (3Q/211E)	M
3Q/213E	3Q/213E	M
3Q/221E	3Q/221E	M
3Q/250A	3Q/221E†	M
3Q/260E	3Q/260E	40
3Q/261E	3Q/261E	M
3Q/290E	4030D (3Q/293E)	M
3Q/291E	4030D (3Q/293E)	M
3Q/292E	4030D (3Q/293E)	M
3Q/293E	4030D (3Q/293E)	M
3Q/294E	3QC/294J	39
3Q/310E	3Q/310E	M
3Q/330E	3Q/331E†	M
3Q/331E	3Q/331E	39
3QC/294J	3QC/294J	39
3R/167E	16P13 (3R/167E)	43
3R/167S	16P12, 7974 (3R/167S)	43
3R/167W	16P14 (3R/167W)	43
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3R/187E	3R/187E	43
3R/188E	3R/188E	42
3R/199E	3R/199E	42
3R/202E	3R/202S	42
3R/202S	3R/202S	42
3R/203E	3R/203E	S
3R/222E	3R/222E	41
3R/223E	3R/223E	40
3R/252E	3R/252E	40
3R/262E	3R/262E	40
3R/280E	3R/280E	40
3RC/223E	3RC/223E	40
3RM/215G	3RM/215G	41
3V/470A	4049GD (3V/500A)	50
3V/490A	3V/490A	50
3V/490E	4049GD (3V/500A)†	50
3V/500A	4049GD (3V/500A)	50
3V/530E	3V/531E	50
3V/531E	3V/531E	50
3V/560E	3V/561E	50
3V/561E	3V/561E	50
3Z/197E	ESV892	M/S
3Z/222EW	3Z/222EW	41
3Z/252E	3Z/252E	40
3Z/253S	3Z/253S	40
4A/137B	4045A (4A/137B)	M
4B13	813 (5C/100A)	46
4B32	4B32 (2G/472B)	50
4B/550E	4B/550E	47
4B/551B	4B/551B	47
4B/551BD	4B/551BD	S
4B/601E	4B/603E	47
4B/602E	4B/602E	M/S
4B/603E	4B/603E	47
4B/700A	4282B (4B/700A)	M
4C35A	4C35A	48
4C/800E	4278A (4C/800E)	M
4CV8000A	4CV8000A	45
4CW10000A	4CW10000A	45
4CW25000A	4CW25000A	45
4CX250B	4CX250B	45
4CX3000A	4CX3000A	45
4CX5000A	4CX5000A	45
4CX5000R	4CX5000R	45
4CX10000D	4CX10000D	45
4CX15000	4CX15000	45
4D1	3A/172B	M
4DT6	6F33 (5A/201K)†	54
4F15R	4CX250B	45
4F20R	4X150D	S
4G14C	4G14C	61
4G/280K	2D21 (4G/280K)	50
4G/281D	20A2 (4G/281D)	M/S
4G/401A	3D22 (4G/401A)	50
4G/402A	4G/402A	M/S
4H72	872A (2V/471A)†	50
4H73	4049D (2V/500C)†	50
4H88A	4049D (2V/500C)†	50
4H/135M	4X150A (4H/135M)	45
4H/160M	4CX250B (4HC/160M)	45
4H/180E	4H/182E	45
4H/181E	4H/181E	45
4H/182E	4H/182E	45
4HC/160M	4CX250B (4HC/160M)	45

Index and Equivalents List

4J/155E to 14NE31T

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4JC/201S	4JC/201S	45
4JC/301J	4JC/301J	45
4JC/302J	4JC/302J	45
4KC/160M	4KC/160M	45
4KM100LA	4KM100LA	23
4KM100LF	4KM100LF	23
4KM100LH	4KM100LH	23
4KM150LA	4KM150LA	23
4KM150LF	4KM150LF	23
4KM150LH	4KM150LH	23
4NE31	4NE31	62
4NE31T	4NE31T	63
4Q/230A	4Q/230A	45
4Q/231A	4Q/231A	M
4QC/300J	4QC/300J	45
4X150A	4X150A (4H/135M)	45
4X150G	4X150A (4H/135M)	45
4X250B	4CX250B (4HC/160M)	45
4ZC/300J	4ZC/300J	S
5A/102A	5A/102A	M
5A/102D	5A/102D	54
5A/102P	5A/102P	S
5A/102S	4311B (5A/102S)	M
5A/136A	4328A (5A/136A)	M
5A/136D	4328D (5A/136D)	M
5A/152G	5A/152G	54
5A/152M	5A/152M	54
5A/156M	5A/156M	M
5A/157D	5A/157D	M
5A/157DZ	5A/157DZ	M
5A/163K	5A/163K	54
5A/180M	5A/180M	M/S
5A/200D	6F32 (5A/200D)	M
5A/201K	6F33 (5A/201K)	54
5A/204D	11E2 (5A/204D)	47
5A/206K	5A/206K	54
5A/207D	SP41 (5A/207D)	M
5A/210K	6F17 (5A/210K)	47 & 54
5B/102D	11E14 (5B/102D)	47 & 54
5B/103B	11E3 (5B/103B)	47
5B/104D	5B/104D	54
5B/110M	5B/110M	54
5B/152D	3D21A (5B/152D)	47 & 54
5B/251M	5B/254M	46
5B/252M	5B/255M	46
5B/253M	5B/256M	46
5B/254A	5B/254A	M
5B/254G	5B/254G	46
5B/254M	5B/254M	46
5B/255M	5B/255M	46
5B/256M	5B/256M	46
5B/257M	5B/257M	46
5B/258M	5B/258M	46
5B/351D	12E1 (5B/351D)	54
5B/353D	12E1B (5B/353D)	S
5B/354D	12E14 (5B/354D)	54
5B/355D	12E1C (5B/355D)	54
5B/600A	4052A (5B/600A)	M
5B/700A	828 (5B/700A)	M
5B/900A	13E1 (5B/900A)	54
5B/901A	13E12 (5B/901A)	54
5C22	5C22	48
5C/100A	813 (5C/100A)	46
5C/450A	5C/450A	46
5D21	4B/602E	S
5D/100A	5D/100A	46
5J/180E	5J/180E	45
5NE12	5NE12	62
5NE12T	5NE12T	63
5NE40	5NE40	62
5NE40T	5NE40T	63
5R4GY	5R4GY	M
5T33	ES833 (3C/402E)	44
5Z3	4274A (22S/200A)†	M
6A/203K	6H1 (6A/203K)	M
6F17	6F17 (5A/210K)	47 & 54
6F32	6F32 (5A/200D)	M
6F33	6F33 (5A/201K)	54
6H1	6H1 (6A/203K)	M
6N030T	S30/2K	83
6N090T	385/1K	81
6SN7GT	6SN7GT	M
6T1	6T1	26
6T3	6T3	24
6T4	6T4	24
6T5	6T5	24
6T9	6T9	25
6T10	6T10	25
6T11	6T11	25
6T12	6T12	25
6T13A	6T13A	25
6T13B	6T13B	25
6T15	6T15	25
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6T18	6T18	24
6T19	6T19	24
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6T21	6T21	26
6T23A	6T23A	25
6T23B	6T23B	25
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6T50	3C/800E	44
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6T53	6T53	24
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6T62A	6T62A	25
6T62B	6T62B	25
6T63	6T63	25
6T65	6T65	25
6T67	6T67	24
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6T79	6T79	26
6T84	6T84	26
6T89	6T89	25
6T90	6T90	26
6T95	6T95	25
6T96	6T96	26
6T97	6T97	26
6T100	6T100	25
6V6GT	6V6GT	M
6T101	6T101	26
7C25	7C25	44
8C25A	8C25A	40
8D4	5A/157D	M
8F66RA	7007 (4JC/201E)	45
8NE31	8NE31	62
8NE31T	8NE31T	63
8T92R	ESA892 (3J/197E)	42
10C5	10C5	60
10C8	10C8	60
10NE40	10NE40	62
10NE40T	10NE40T	63
11D12	11D12 (33B/260D)	44 & 54
11E2	11E2 (5A/204D)	47
11E3	11E3 (5B/103B)	47
11E13	11E13 (55B/100K)	46
11E14	11E14 (5B/102D)	47 & 54
12B1P	12B1P	60
12B1PC	12B1PC	60
12B2P	12B2P	60
12B3P	12B3P	60
12B5P	12B5P	60
12B6P	12B6P	60
12E1	12E1 (5B/351D)	54
12E1B	12E1B (5B/353D)	S
12E1C	12E1C (5B/355D)	54
12E12	4B/603E	47
12E14	12E14 (5B/354D)	54
13AP7	13AP7	60
13AP9	13AP9	60
13B16	13B16	60
13E1	13E1 (5B/900A)	54
13E12	13E12 (5B/901A)	54
14D13	4212EC (3C/270B)	44
14NE31	14NE31	62
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4030A, B & C	4030D (3Q/293E)	M
4030D	4030D (3Q/293E)	M
4033A	4033L (3B/252B)	M/S
4033L	4033L (3B/252B)	M/S
4040B	3A/108B	M
4045A	4045A (4A/137B)	M
4049A	4049C	M
4049C	4049C (2V/470C)	M
4049D	4049D (2V/500C)	50
4049GA	4049GD (3V/500A)	50
4049GD	4049GD (3V/500A)	50
4052A	4052A (5B/600A)	M
4064A	872A	50
4078A	2V/531E	50
4078GA	3V/531E	50
4079A	2V/561E	50
4079GA	3V/561E	50
4101D	3A/141A	M
4101E	3A/141A	M
4101G	3A/141A	M
4102D	3A/142A	M
4102DR	3A/142A	M
4102E	3A/142A	M
4102G	3A/142A	M
4104D	3A/144A	M
4104E	3A/144A	M
4104G	3A/144A	M
4120A	4120A (B4B/1A)	M
4120AA	4120AA (B4B/1C)	M
4121AB	4121AB (B8B/1C)	M
4205E	3B/151A	M
4211D	4242A (3B/850A)	44
4211E	4242A (3B/850A)	44
4212D	4212E (3C/270A)	44
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4212EC	4212EC (3C/270B)	44
4212H	4212H (3C/272A)	44
4220C	4220C (3Q/184E)	M
4222A	4222B (2W/540E)	M
4222B	4222B (2W/540E)	M
4242A	4242A (3B/850A)	44
4270A	4270A (3C/350E)	M
4274A	4274A (22S/200A)	M
4278A	4278A (4C/800E)	M
4279A	4279Z	M
4279Z	4279Z	M
4282B	4282B (4B/700A)	M
4304BB	4304CB (3B/504B)	M
4304CB	4304CB (3B/504B)	M
4311B	4311B (5A/102S)	M
4313C	4313C (G150/1A)	M
4328A	4328A (5A/136A)	M
4328D	4328D (5A/136D)	M
4357A	4357A (3C/351H)	M
5031	872A (2V/471A)	50
5121	2D21 (4G/280K)	50
5221	3B28 (2G/402A)	50
5606A	F5606A	41
5666	F5666	40
5680	F5680	43 & 47
5762	3J/188G†	42
5771	F5771	40
5860	5860	55
5874A	F5874A	40
5918	F5918	39
5919	F5919	40
5923	5923 (3Q/188E)	42
5924	5924 (3J/188E)	42
5948A	5948A	48
5949A	5949A	48
5956	5956	48
5957	5957	48
5958	5958	48
5959	5959	48
6073	0A2	85
6076	6076 (4J/155E)	45
6080	6080 (11D12.33B/260D)	44 & 54
6130	6130	48
6146	6146 (5B/230D)	46
6166	7007 (4JC/201E)	45
6360	6360 (55B/100K)	46
6366	F6366	43
6367	F6367	43
6379	F6379	39
6398	6398	39
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6400A	F6400A	42
6522	5C22	48
6587	6587	48
6691	F6691	40
6692	F6692	39
6696	F6696	39
6697A	F6697A	40
6777	6777	48
6800A	F6800A	40
6801	F6801	41
6803	F6803	39
6804	F6804	40
6844A	GN-4	57
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6925	F6925	43
6926	F6926	42
6926J	F6926J	42
6929	F6929	72
6960	6960 (3Q/199E)	42
6961	6961 (3J/199E)	42
7007	7007 (4JC/201E)	45
7012	F7012	47
7030	7030	50
7034	4X150A	45
7092	7092 (3C/800E)	44
7100	7100	50
7131	7131	50
7174	7174	77
7178	7178	49
7203	4CX250B	45
7207A	F7207A	40
7289	7289	27
7322	7322	48
7390	7390	48
7423	7423	77
7482	F7482	39
7559	7559	49
7560	F7560	39 & 47
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7590	7590	49
7603	7603	49
7605	7605	49
7620	7620	48
7621/KU70C	7621/KU70C	48
7665/KU72	7665/KU72	48
7666	7666	48
7667	7667	48
7779	7779	50
7782/KU71	7782/KU71	48
7815	7815	27
7820A	F7820A	42
7839	F7839	47
7866/KU274	7866/KU274	48
7869	F7869	50
7890	7890	48
7971	S11E12 (L.5B/280D)	54
7972	13E1 (5B/900A)	54
7973	S2P20 (L.5A/220K)	54
7974	16P12 (3R/153S)	43
7975	7975	50
8034	4304CB	50
8037	GN-4	57
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8146A	F8146A	39	A59-12W	A59-12W	80	B4B/1C	4120AA (B4B/1C)	M
8147	F8147	40	A59-20W	A59-20W	80	B8B/1C	4121AB (B8B/1C)	M
8161	8161	43	A59-22W	A59-22W	80	B142	833A (3C/402E)	44
8162A	8162A	43	A59-91	A59-91	80	B1153	3C/800E	44
8169	8169	45	A61-120W/2	A61-120W/2	80	BAY66	VEC87M	31
8170	8170	45	A63-11X	A63-11X	80	BAY96	VBC89J	31
8170W	8170W	45	A63-200X	A63-200X	80	BRI29	ESA5000 (3J/198E)	42
8171	8171	45	A65-11W	A65-11W	80	BRI52B	3J/121E	44
8207J	8207J	50	A65-13W	A65-13W	80	BR175	ESA892 (3J/197E)†	42
8238A	8238A	43	A1834	11D12 (33B/260D)	44 & 54	BR1129	3J/162J	44
8239A	8239A	43	A4475	11D12 (33B/260D)	44 & 54	BR1138	3J/122E	M
8240A	8240A	42	A4535	11D12 (33B/260D)	44 & 54	BR1160	3J/188G	42
8241A	8241A	42	A4535A	11D12 (33B/260D)	44 & 54	BR1162	6961 (3J/199E)	42
8242A	8242A	42	ACS4	6076 (4J/155E)	45	BR1165	5924 (3J/188E)	42
8251	8251	43	ACT9	3J/121E	44	BT83	5C22	48
8264/KU52	8264/KU52	49	ACT9B	3Q/121E (3J/121E	44	BT85	4C35A	48
8274/KU92	8274/KU92	49		without rad.)		BW129	ESW5000 (3Q/198E)	42
8275/KU93	8275/KU93	49	AF350	4212EC (3C/270B)	44	BW1162	6960 (3Q/199E)	42
8276/KU94	8276/KU94	49	AG866A	866A (2V/400A)	50	BW1162J3	3R/199E	42
8281	8281	45	AG872A	872A (2V/471A)	50	BW1165	5923 (3Q/188E)	42
8301/KU275	8301/KU275	48	AG5210	0B2	85	BXY27	VSE66M†	30
8326A/KU74B	8326A/KU74B	48	AG5211	0A2	85	BXY28	VSE44M†	30
8329	8329	49	AG8008	ESU8008	S	BXY29	VSE43M†	30
8333	F8333	40	AH217	872A (2V/471A)	50	BXY32	VSE43L†	30
8354	8354	48	AH221	4049D (2V/500C)	50	C143	813 (5C/100A)	46
8370/E38	8370/E38	48	AR300	4212EC (3C/270B)	44	C200	3C/150A	M
8376/KU93A	8376/KU93A	49	AS110-3	AS110-3	81	C1148	4B/551B	47
8386	F8386	39	AS110-8	AS110-8	81	C1149/1	4B/602E	S
8387	F8387	40	AS110-64	AS110-64	81	C1150/1	4B/603E	47
8388	F8388	39	AS110-64W	AS110-64W	81	C1158	13E1	54
8424	8424	48	AS110-71	AS110-71	81	C1166	4B/551B†	47
8479/KU275A	8479/KU275A	48	ASG5121	2D21 (4G/280K)	50	CD24	GN-4	57
8488/KU29	8488/KU29	48	AT714-36	AT714-36	81	CP3/A	CP3/A	22
8494	F8494	40	AT917-0	AT917-0	81	CP3/B	CP3/B	22
8550	F8550	39	AT1111-1	AT1111-1	81	CR4T4	CR4T4	34
8553/KU72Z	8553/KU72Z	48	AT1116-3d	AT1116-3d	81	CR192A	4JC/201S	45
8554/KU274B	8554/KU274B	48	AT1118-6	AT1118-6	81	CR1100	6076 (4J/155E)	45
8613	8613	48	AT1118-7	AT1118-7	81	CV5	4049D (2V/500C)†	50
8636	F8636	40	AT1118-71	AT1118-71	81	CV19	V1901	S
8636J	8636J	40	AT1118-72	AT1118-72	81	CV25	4242A (3B/850A)	44
8765/KU71Z	8765/KU71Z	48	AT1118-84	AT1118-84	81	CV26	813 (5C/100A)	46
38166	866A (2V/400A)	50	AT1118-85	AT1118-85	81	CV27	4357A (3C/351H)	M
38172	872A (2V/471A)	50	AT1118-86	AT1118-86	81	CV28	3J/121E	44
68812	68812	81	AT1118-87	AT1118-87	81	CV30	4270A (3C/350A)	M
74624	74624	81	AW17-69	AW17-69	80	CV32	866A (2V/400A)	50
A17-69BE	A17-69BE	80	AW59-91	AW59-91	78	CV53	3A/146J	M
A17-69GJ	A17-69GJ	80	AX224	3B28 (2G/402A)	50	CV73	11E3 (5B/103B)	47
A17-69GM	A17-69GM	80	AX230	4B32 (2G/472B)	50	CV74	ESU77	50
A17-69LF	A17-69LF	80	AX9904	5923 (3Q/188E)	42	CV75	4313C (G150/1A)	M
A25-10W	A25-10W	80	AX9904R	5924 (3J/188E)	42	CV85	24B9	49
A28-13W	A28-13W	80	AX9907R	6076 (4J/155E)	45	CV118	SP61	M/S
A31-15W	A31-15W	80	AX9911	4C35A	48	CV121	19H1 (2S/306B)	M
A31-19W	A31-19W	80	AX9912	5C22	48	CV125	24C3	M
A41-10W	A41-10W	80	B1B/1E	4006A (B1B/1E)	M	CV132	6H1 (6A/203K)	M
A44-13W/3	A44-13W/3	80	B1B/2E	4006B (B1B/2E)	85	CV190	DLS10	84
A47-27W/2	A47-27W/2	80	B1C/1C	4003A (B1C/1C)	M	CV216	VR150/30 (G150/3D)	85
A51-10W	A51-10W	80	B1C/1E	B1C/1E	84	CV228	V246A/1K	M
A55-14X	A55-14X	80	B2B/1C	4004A (B2B/1C)	M	CV234	V230A/1K	M
A55-15X	A55-15X	80	B2B/2C	4004B (B2B/2C)	M	CV243	4045A (4A/137B)	M
A56-120X	A56-120X	80	B4B/1A	4120A (B4B/1A)	M	CV245	4328D (5A/136D)	M

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CV265	19E2 (2S/370D)	50
CV276	11E2 (5A/204D)	47
CV277	19G3 (2T/240D)	50
CV299	V230A/1K	M
CV315	4304CB (3B/504B)	M
CV329	6F33 (5A/201K)	54
CV342	SH342	84
CV345	12E1 (5B/351D)	54
CV349	24B9†	49
CV358	5A/157D	M
CV359	NE17 (GWP-2)	28
CV360	NE18 (GWP-3)	28
CV371	19G6 (2S/280K)	50
CV372	3C45	48
CV391	5B/255M	46
CV393	V230A/1K	M
CV395	G180/2M	85
CV398	4B/603E	47
CV413	G150/2D	85
CV416	6F17 (5A/210K)	46 & 54
CV427	4B/602E	S
CV428	5B/254M	46
CV430	29C1 (2A/230D)	50
CV433	B1C/1E	84
CV438	Replace by CV5880 + adaptor	85
CV445	5J/180E	45
CV446	3Q/260E	40
CV447	3V/531E	50
CV485	V246A/2K	27
CV490	19H5 (2S/550C)	50
CV499	5B/256M	46
CV511	6V6GT	M
CV536	4120AA (B4B/1C)	M
CV570	3Q/195E	M
CV631	828 (5B/700A)	M
CV635	ES833 (3C/402E)	44
CV642	872A (2V/471A)	50
CV685	VR150/30	85
CV686	VR105/30 (G105/1D)	85
CV717	5R4GY	M
CV797	2D21 (4G/280K)	50
CV904	ESA892 (3J/197E)	42
CV979	DLS10 (S60/1B)	84
CV1061	4074A (33A/138A)	M
CV1062	4304CB (3B/504B)	M
CV1072	ESU101 (2V/301B)	50
CV1081	4052A (5B/600A)	M
CV1109	3A/172B	M
CV1111	19G12 (2T/360B)	50
CV1116	6F32 (5A/200D)	M
CV1130	HL23 (3A/205D)	54
CV1220	4033L (3B/252B)	M/S
CV1252	4212E (3C/270A)	44
CV1288	4304CB (3B/504B)	M
CV1310	3A/108A	M
CV1316	3A/109B	M
CV1335	SP41 (5A/207D)	M
CV1355	4049C	M
CV1420	2V/531E	50
CV1422	3D/100A	44
CV1447	4030D (3Q/293E)	M
CV1448	4043C (3B/351A)	M
CV1449	872A (2V/471A)	50
CV1450	4228A (3Q/150E)	M
CV1451	4274A (22S/200A)	M
CV1452	4300A (3B/400A)	M
CV1504	V1901 (2S/490C)	S
CV1506	5C/450A	46
CV1540	33B/152M	M
CV1574	SP41 (5A/207D)	M
CV1586	HL23 (3A/205D)	54
CV1604	SS1971 (3Q/211E)	M
CV1605	4013C (3Q/120G)	M
CV1619	4212E (3C/270A)	44
CV1626	ESU101 (2V/301B)	50
CV1627	5D/100A	46
CV1630	5C/450A	46
CV1635	5A/163K	54
CV1638	3A/141A	M
CV1639	3A/141A	M
CV1640	3A/142A	M
CV1641	3A/142A	M
CV1648	3B/151A	M
CV1653	3A/108A	M
CV1655	3A/107B	M
CV1657	3A/108B	M
CV1659	3A/110B	M
CV1663	3A/109B	M
CV1664	3A/110A	M
CV1670	3A/172B	M
CV1671	3A/109A	M
CV1672	PEN36C	M
CV1678	3B/101B	M
CV1688	4033L (3B/252B)	M/S
CV1694	3A/144A	M
CV1699	SP41 (5A/207D)	M
CV1700	SP41 (5A/207D)	M
CV1724	5A/102D	54
CV1734	3Q/213E	M
CV1759	2C26A (3B/105D)	M
CV1787	4C35A	48
CV1832	0A2 (G150/4K)	85
CV1833	0B2 (G108/1K)	85
CV1835	3B28 (2G/402A)	50
CV1848	20A2 (4G/281D)	M
CV1883	4H/182E	45
CV1884	33A/158M	M
CV1994	3Q/121E	M
CV2027	G150/4N	S
CV2028	5A/170N	S
CV2029	G180/2G	85
CV2160	ESU77 (2S/460C)	50
CV2174	G240/2D	85
CV2180	19H4 (2T/350D)	50
CV2187	Z239/1G	23
CV2188	W7/2D	M
CV2189	V240C/2K	M
CV2190	V233A/1K	27
CV2194	G400/1K	85
CV2208	G50/2G	85
CV2209	6F33 (5A/201K)	54
CV2214	3B/240M	M
CV2220	5B/257M	46
CV2221	V235A/1K	27
CV2224	G1/371K	85
CV2243	5A/206K	54
CV2245	3J/160E	44
CV2283	V243A/1K	S
CV2329	4004B (B2B/2C)	M
CV2347	5B/258M	46
CV2377	13E1 (5B/900A)	54
CV2394	ES1101 (3B/402A)	M
CV2465	5B/254G	46
CV2487	4CX250B	45
CV2499	W9/1E	M/S
CV2516	2C39A (3H/151J)	27
CV2518	4B32 (2G/472B)	50
CV2519	4X150A (4H/135M)	45
CV2520	5C22	48
CV2577	4212E (3C/270A)	44
CV2609	4300A	M/S
CV2615	4313C	M
CV2619	4328A (5A/136A)	M
CV2659	3D21A (5B/152D)	47 & 54
CV2686	ESW5000 (3Q/198E)	42
CV2687	ESA5000 (3J/198E)	42
CV2688	ESA891 (3J/196E)	43
CV2734	4003A (B1C/1C)	M
CV2738	ESU101	50
CV2798	11E13 (55B/100K)	46
CV2851	3D22 (4G/401A)	50
CV2905	3J/170E	43
CV2908	3J/260E	40
CV2943	ESU76 (2V/395C)	M
CV2947	4049C	M
CV2984	11D12 (33B/260D)	54
CV3518	5948A	48
CV3521	5949A	48
CV3523	6146	46
CV3524	G1/236G	M
CV3581	V1501 (3C/495A)	M
CV3629	3C45	48
CV3784	5A/102A	M
CV3798	VR75/30 (G75/2D)	85
CV3873	3Q/310E	M
CV3875	KU54	48
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MA4048F	VJC87D†	S
MA4055AA2	VSC52E†	31
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RK20	4052A (5B/600A)	M
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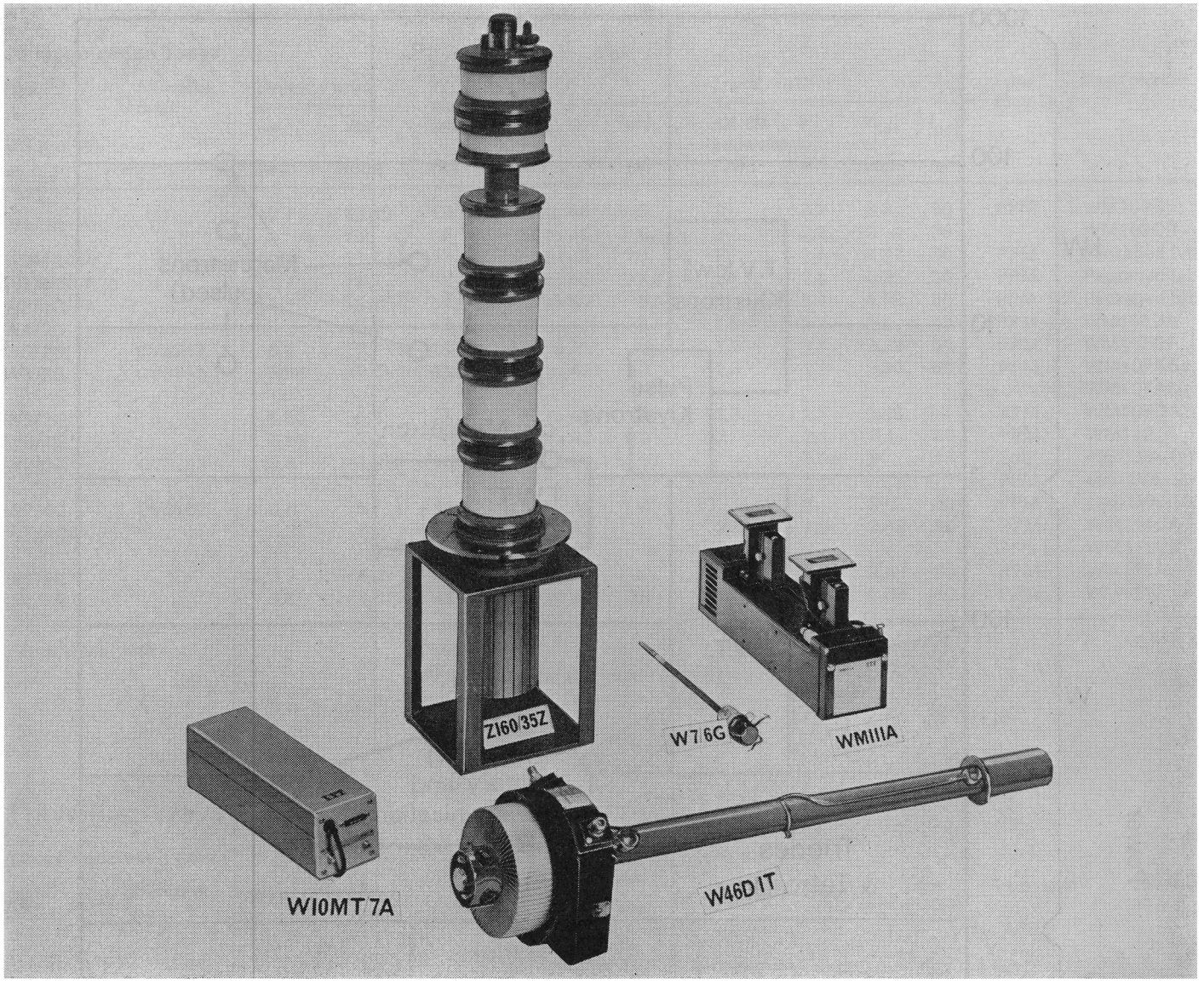
Glossary of Symbols

C_o	diode total capacitance at zero bias
C_{-4}	diode total capacitance at −4V bias
C_j	diode junction capacitance
$C_{j(o)}$	diode junction capacitance at zero bias
$C_{j(-4)}$	diode junction capacitance at −4V bias
$C_{j(-6)}$	diode junction capacitance at −6V bias
f	frequency
f_{in}	input frequency
f_{out}	output frequency
Δf (−3dB)	electronic tuning range between half power tuning points
g_m	tube mutual conductance/slope/transconductance
I_a	anode current
$I_{a\,d.c.}$	anode direct current
I_{amean}	mean value of anode current
I_{apeak}	peak value of anode current
$I_{a\,r.m.s.}$	root mean square value of anode current
I_{beam}	beam current
I_{col}	collector current
I_f	filament current
I_F or $I_{forward}$	forward current
I_g	control grid or grid 1 current
I_h	heater current
I_k	cathode current
i_k	cathode peak current
I_R	reverse current
I_{res}	resonator current (microwave tubes) reservoir current (hydrogen thyratrons and diodes)
P_a	anode power dissipation
P_{drive}	drive power
P_g	control grid or grid power dissipation
P_{g2}	grid 2 power dissipation
PIV	peak inverse voltage
P_{max}	maximum dissipation
Q	varactor capacitance quality factor
Q_{-4}	varactor capacitance quality factor at −4V bias
r_a	anode impedance
r_s	diode series resistance
r_{s-6}	diode series resistance at −6V bias
R_{th}	thermal resistance
R_j	diode junction resistance
t_p	pulse duration time
t_r	recovery time
t_{sw}	Switching time
t_t	transition time
$T_{working}$	working temperature
V_a	anode voltage
V_{beam}	beam voltage
V_{BR}	breakdown voltage
V_{col}	collector voltage
$V_{forward}$	forward voltage
V_g	grid voltage
V_{g1}	control grid or grid 1 voltage
V_{g2}	grid 2 voltage
V_{g4}	grid 4 voltage
V_h	heater voltage
V_{hel}	helix voltage
V_{a-k}	anode-to-cathode voltage
V_k	cathode voltage
V_{k-k}	cathode-to-cathode voltage
V_{MW}	maximum working voltage
V_{out}	output voltage
V_{pt}	punch-through voltage
V_{ref}	reflector voltage (reflex klystrons)
V_{res}	resonator voltage (microwave tubes) reservoir voltage (hydrogen thyratrons and diodes)
VSWR	voltage standing wave ratio
μ(mu)	tube amplification factor
screen μ	inner (screen) amplification factor
η (eta)	efficiency
γ (gamma)	diode slope factor
∅ (phi)	diode contact potential
$\tau_{(tau)}$	minimum carrier life time
p.r.r.	pulse repetition rate
p.p.s.	pulses per second
<	less than
>	greater than
≈	approximately equal to



Introduction

ITT Microwave Tubes comprise travelling wave amplifier tubes, klystrons, SHF triodes, backward-wave oscillators, magnetrons and noise sources. There is also a miscellany of waveguide components for 26 to 40GHz use, and disc-sealed thermocouples and gas discharge tubes for microwave power measurement and standing wave indication at lower microwave frequencies.

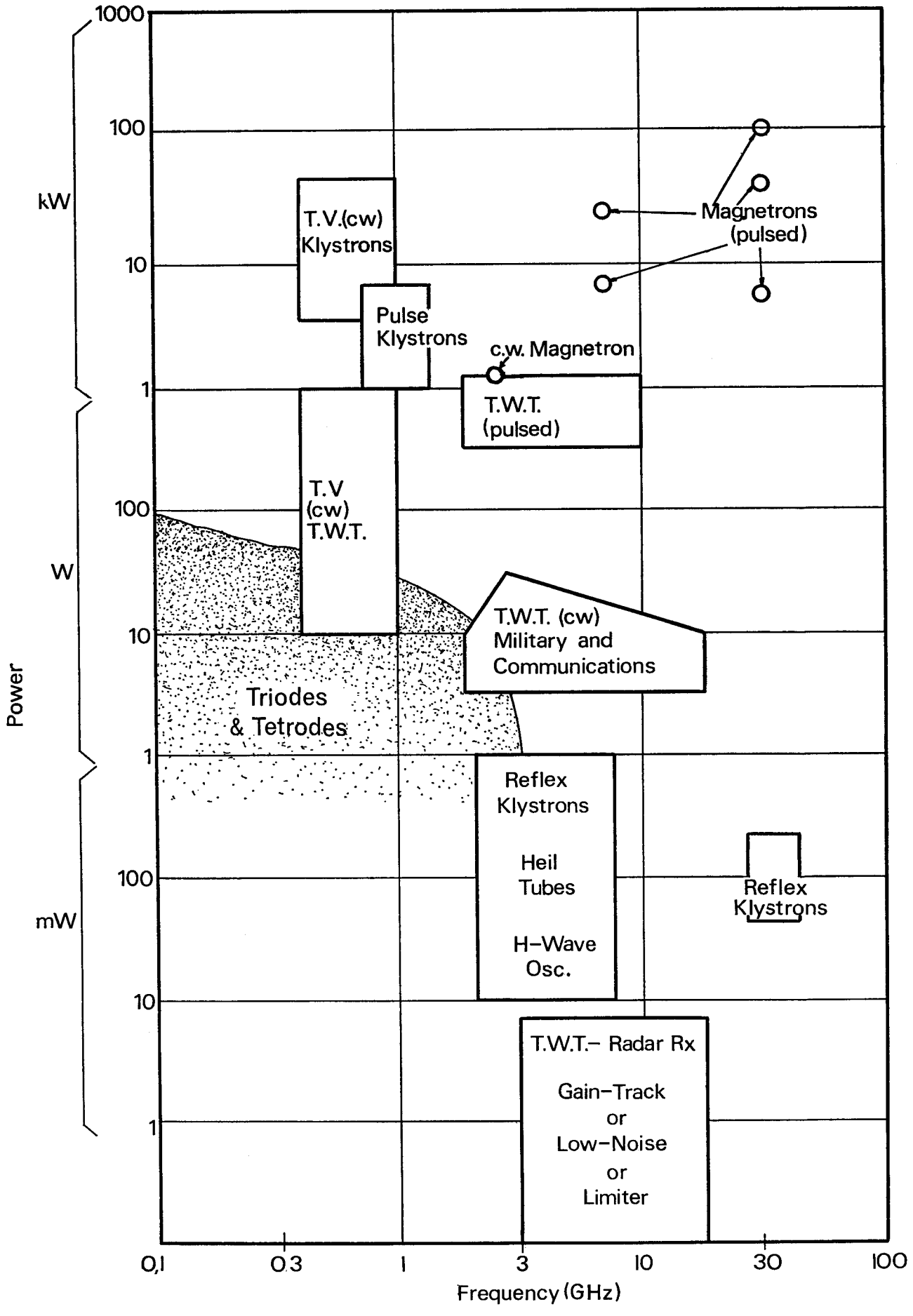
Travelling-wave tubes are available for UHF television transmitters/transposers; for microwave link amplifiers in 4, 6 and 11GHz bands and for military applications. These include high power pulsed beam tubes and CW radar receiver tubes comprising ultra low-noise tubes, low noise gain tracking tubes and tubes which use the saturation characteristic to limit.

Klystrons range from high power TV CW amplifier tubes and high power pulsed tubes to low power reflex klystrons including 35GHz types and a range of coaxial line oscillators (Heil tubes); also H-wave oscillators working on the same principle but with waveguide resonator configuration.

Magnetrons are available for pulsed operation in X-band and Q-band (35GHz) and for 2 450MHz CW industrial heating/drying/cooking applications.

Microwave Tubes

Power/frequency limits



Travelling-Wave Amplifier Tubes

Communication Types

Type	Alternative codes	Frequency range min. (GHz)	Frequency range max. (GHz)	P_{out} max. saturated (W)	Gain (dB)	Gain at P_{out} (W)	Typical operation AM–PM conversion (°/dB)	Typical operation V_{col} (kV)	Typical operation V_{hel} (kV)	Typical operation I_{col} (mA)	Focus (Note 1)	Mount codes
W3/2G		10,7	13,25	12	40 to 45	5	2	2,2	3,3	30	PPM	WM109C:
		9	15	5	35 to 45	3	2	2,2	3	30		WM109CR
W3MC/3A		10,7	11,7	17	40 to 45	10	2	2,4	4,32	36	PPM	Packaged tube
W3MC/5A		11,7	12,7	16	38 to 45	7,5	2	2,4	4,25	36	PPM	Packaged tube
W3MC/6A		12,7	13,25	11,5	38 to 45	7,5	2	2,4	4,18	36	PPM	Packaged tube
W4/2G		7	8,5	15	36 to 47	5	1,5	2	3,3	40	PPM	WM108DA
W5/2GF	CV6247	6,6	7,9	19	34 to 45	7	1,8	2,1	3,29	50	PPM	WM107DF
W5/2G	CV6163	5,85	7,2	25	36 to 43	10	2,4	2,1	3,38	50	PPM	WM107AB: WM107AD
W5/2GD		5,85	6,4	25	40 to 45	7	1,8	2,1	3,45	50	PPM	WM107DA
W5/4G*		5,85	7,2	25	36 to 42	10	2	2,1	3,4	50	PPM	WM112
W7/3G	CV5293	3,6	4,2	10	24 to 28	8		3,05	3	43	Sol.	495-LVA-009
											PPM	495-LVA-104
W7/4G	CV6162	3,6	5	15	35 to 42	6		2	3	40	PPM	495-LVA-101
W7/6GC		3,7	5	41	38 to 43	10	2,5	1,9	2,68	65	PPM	WM111CA: WM111CB
W7/6GA		3,7	4,2	41	39 to 44	20	2,5	1,9	2,68	80	PPM	WM111A
W7/6GZ		3,6	4,2	41	40 to 45	20	2,5	1,9	2,68	80	PPM	WM111Z

* *Provisional data*

Note 1. Focus

PPM = Periodic permanent magnet
Sol. = Solenoid electro-magnet

Origin GB

Travelling-Wave Tubes

Radar Receiver Types

Type	Alternative codes	Frequency range (GHz)	to (GHz)	P_{out} (dBm)	Noise factor small signal (dB)	Gain low-level (dB)	V_{col} (V)	V_{hel} (V)	I_{col} (μA)	Focus (Note 1)	Focus mount	Description (Note 2)
W10MT/7A		2	4	+8 to +16	<13	30 to 36	(H.T. +450/0/−325V d.c.)			SFPM	Integral	A
W10ML/6A		2	4,1	+7 to +13	17	25 to 35	450	280	650	SFPM	Integral	B
W9/2E	CV6090	2,5	4,1	+4,8 to +10,8	<10	38 to 50	600	400	400	Sol.	495-LVA-005C	C
W9/3E	CV6127	2,5	4,1	−12 to −4	<18	11 to 20	300	200	125	Sol.	495-LVA-007E	D
W10MQ/5A	CV6239	2,7	3,3	−10 min.	<5	22 to 30	(H.T.=500V at 2mA d.c.)			SFPM	Integral	E
W10PQ/5A		2,7	3,3	−10 min.	<5	22 to 30	(H.T.=240V a.c.)			SFPM	Integral	E
W10/3E		2,7	3,7	4,7	7,5	20 to 26	700	450	400	Sol.	495-LVA-003 495-LVA-006	C
W6MT/2A		4	7,5	+7 to +17	<13	30 to 36	(H.T. +450/0/−650V d.c.)			SFPM	Integral	A
W6ML/1C	CV6205	4,1	7	+7 to +13	—	28 to 38	750	600	430	PPM	Integral	B
W3MQ/1D		7	11,5							SRPM	Integral	F
W3MQ/1F		7	11,5	+3 to +15	<11	35 min.	1 200	950	450	SRPM	Integral	F
W3MQ/1N		7	10,4							SRPM	Integral	F
W3MT/4A*		7,5	12	+8 to +16	<15	30 to 36	(H.T. +1 300V)			SFPM	Integral	A

* *Provisional data*

Note 1. Focus

SFPM = Straight field permanent magnet
Sol. = Solenoid electro-magnet
PPM = Periodic permanent magnet
SRPM = Single reversal permanent magnet

Note 2. Description

A = Packaged low-noise gain-track tube; integral power distribution network
B = Packaged limiter tube
C = Low-noise amplifier tube; separate focus mount
D = Limiter tube; separate focus mount
E = Packaged ultra-low-noise amplifier; integral power distribution network
F = Packaged low-noise amplifier

Origin GB

Travelling-Wave Tubes

Commercial-Military Types

Type	Frequency range min (GHz)	Frequency range max. (GHz)	P_{out} nom. (W)	Gain nom. (dB)	V_g (V)	V_{hel} (kV)	V_{col} (kV)	I_k (mA)	Duty cycle	Focus (Note 1)	Origin
F2577	2	4	1 000 pk.	35	−100/+200*	8	8	1,8	0,02	PPM	USA
W10/4G	2,6	3,6	12	39		3,1	2	40	CW	PPM	GB
F2098	4	8	200 pk.	45	−70/+160*	6	6	0,5	0,005	PPM	USA
D2032	5,4	5,9	4 000 pk.	27		11,5 pk.	11,5 pk.	3	0,01	Sol.	USA
F2084	5,4	11	10	55	−15	3,6	2	0,07	CW	PPM	USA
F2090	7	11	10	40	−15	3,6	2	0,07	CW	PPM	USA
F2552	7,05	11	20	55	−15	3,6	2	0,07	CW	PPM	USA
F2085	7,05	11	1 000 pk.	34	−90/+270*	11	11	1,8	0,01	PPM	USA
F2094	8	12	10	40	−15	3,6	2	0,07	CW	PPM	USA
F2087	8,2	12,4	15	50	−15	3,6	2	0,07	CW	PPM	USA
F2088	8,5	9,6	25	60	−15	3,6	2	0,07	CW	PPM	USA
F2097	8	10	1 250 pk.	40	−90/+270*	11,5	11,5	1,8	0,01	PPM	USA

** Sharp cut-off grid for grid pulsing, values shown for cut-off and pulse on*

Note 1. Focus
Sol. = Solenoid electro-magnet
PPM = Periodic permanent magnet

Power Travelling-Wave Amplifier Tubes

For T.V. or Pulse Service

Code	Frequency range (MHz) to (MHz)	P_{out} Combined sound and vision (peak synch.) (W)	Vision (peak synch.) (W)	Pulse peak (W)	Pulse duty (%)	Typical operating conditions Gain min. (dB)	V_{col} (kV)	V_{hel} (kV)	I_k (A)	V_h (V)	I_h (A)	Focus mount Type	Focus mount Code
W46D/1S	470 860	1 000 (sound only)	1 000	1 250	50	32	3,3	3,8	1,4	11,5	4,7	Solenoid	WM461S
W46D/1T	470 860	270		1 000	50	32	3,2	3,7	1,1	11,5	4,7	Solenoid	WM461S
W46D/2T	400 1 200			500	50	18	3/3,5	3,3/3,8	1,3	11,5	4,7	Solenoid	WM461S
W45B/5E	470 960	50	200	500	10	32	2,8	3,0	0,75	6,3	2,8	PM	WM455A

Origin GB

AM-PM Compensators

Type	Frequency range (MHz) to (MHz)	Insertion loss (dB)	Power supply d.c.	Description	Origin
CP3/A	460 650	<2	+24 V/−12 V	For AM-PM conversion compensation in high-power travelling-wave tubes such as types W45B/5E and W46D/1G-1T.	GB
CP3/B	600 860				

Power Amplifier Klystrons for T.V.

Type	Cooling (Note 1)	Alternative codes	Frequency range min. (MHz)	Frequency range max. (MHz)	P_{out} (pk. sync.) min. (kW)	Power gain min. (dB)	V_{beam} max. (kV)	I_{beam} max. (A)	No. of cavities Internal	No. of cavities External	Mounts ITT	Mounts Alternatives
Z158/200Z*	VWA	VA950A	470	566							ZM158A	VA1950A
Z168/200Z*	VWA	VA951A	566	698	40	48	24	8	5	—	ZM168A	VA1951A
Z178/200Z*	VWA	VA952A	694	890							ZM178A	VA1952A
Z155/150Z	VWA		470	610					—	4	ZM155Z	K4102
Z166/150Z	VWA		590	720	40	40	23	7	—	4	ZM166Z	K4103
Z188/150Z	VWA		720	890					4	—	ZM188Z	
Z154/150Q	WA	4KM150LA	470	610						4	ZM155Q	K4054, H163
Z165/150Q	WA	4KM150LF	590	720	40	40	23	7	—	4	ZM166Q	K4055, H156
Z180/150Q	WA	4KM150LH	720	890					4	—	ZM188Q	H173
Z157/120Z*	VWA	VA946A	470	566							ZM158A	VA1950A
Z167/120Z*	VWA	VA947A	566	698	25	46	21	6,1	5	—	ZM168A	VA1951A
Z177/120Z*	VWA	VA948A	694	890							ZM178A	VA1952A
Z154/100Z	VA		470	610	25	40	23	6	—	4	ZM155Z	K4102
Z165/100Z	VA		590	720	25	40	23	6	—	4	ZM166Z	K4103
Z180/100Z	VA		720	890	25	40	23	6	4	—	ZM188Z	
Z154/100Q	WA	4KM100LA	470	610					—	4	ZM155Q	K4054, H163
Z165/100Q	WA	4KM100LF	590	720	25	40	23	6	—	4	ZM166Q	K4055, H156
Z180/100Q	WA	4KM100LH	720	890			(20)		4	—	ZM188Q	H173
Z151/50Z	VA		470	610							ZM150	K4105;
Z161/50Z	VA		590	720	12	38	14	3,5	—	4	ZM160	K4106
Z171/50Z	VA		700	860							ZM170	K4107
Z150/35Z	VA		470	610							ZM150	K4089
Z160/35Z	VA		590	720	8	38	12,5	3	—	4	ZM160	K4090
Z170/35Z	VA		700	860							ZM170	K4091

* *Data given is provisional* *Note 1 Cooling: V=vapour W=forced-water A=forced-air* *Origin GB*

Pulsed Amplifier Klystrons

Type	Alternative code	Frequency range min. (MHz)	Frequency range max. (MHz)	P_{out} peak (kW)	Gain (dB)	V_{beam} (kV)	I_{beam} (peak pulse) (A)	Duty cycle (%)	V_h (V)	Origin
SAL-89		960	1 215	12	26	12,5	4	2,5	4,2	F
Z211/1G	CV5314	950	1 213	7	34	15	2	3	12,6	GB

Reflex Klystrons

Type	Frequency range min. (GHz)	Frequency range max. (GHz)	Δf (−3dB) (MHz)	P_{out} mean (mW)	V_k* (kV)	I_k (mA)	V_{ref}* (kV)	V_h (V)	Origin
KL2T4A	26,5	31,5							
KL2T4B	31,5	37	±25	50	−2	20	−2,3	6,3	F
KL2T4C	37	40							
KL2T5A	26,5	31,5							
KL2T5B	31,5	37	±25	200	−2,5	30	−2,8	6,3	F
KL2T5C	37	40							
KL3T2	34	36	±50	>20	−0,5	60 max.	−0,6	6,3	F
KL3T3	34	36	±40	>30	−0,5	60 max.	−0,6	6,3	F
Z220/1G	1,75	2,1	±8	250	−0,35	50	−0,5	6,3	GB
Z237/1KW	3,505	3,535	±5†	130	−0,3	50	−0,4	6,3	GB
Z239/1G	3,6	4,2	±18	1 200	−1	60	−1,2	6,3	GB
Z239/1GW	3,6	4,2	±5†	1 200	−1	60	−1,2	6,3	GB

* *Voltages shown relative to earthed resonator* † *2nd harmonic – 70dB*

Pulsed Magnetrons

Type	Frequency range		P_{out}		V_k pulsed	I_k pulse	V_h	Origin
	min. (GHz)	max. (GHz)	peak (kW)	mean (W)	(kV)	(A)	(V)	
MG57T2	9,345	9,405	24	24	−8	8,25	6,3	F
MG60T1	9,3	9,9	8	16	−6	5,5	6,3	F
MG31T4	34,5	35,2	100	100	−20	28	6,3	F
MG9T3	34,4	35,4	40	16	−14	16	6,3	F
MG44T2	34,4	35,4	6,5	6,5	−9	6	6,3	F

C.W. Magnetron

Type	f	P_{out}		V_a peak	I_a	V_h	I_h stand-by	Focus	Origin
		at VSWR 1,1	flat load coupled 70%						
	(MHz)	(kW)	(kW)	(kV)	(mA)	(V)	(A)		
MG82T1	2 450	1,47	1	3,55	625	4,6	20	PM	F

Waveguide Components – Q Band

Type	Waveguide		Coupling rings	Frequency range	VSWR	Additional data
	length (mm)	type				
Rectangular Guides						
6T3	50	RG96U/WR28	RLO86	26,5 to 40	<1,02	Attenuation 0,65dB/m
6T4	100					
6T52	500					
6T53	1 000					
6T17 (17 pieces)	20 to 100					
Circular Guide						
6T75	50		RL086	26,5 to 40	<1,1	Mode H11
6T76	100		RL086	26,5 to 40	<1,1	Mode H11
6T77	82	Transient RG96U	RL086	26,5 to 40	<1,1	
90° Twist						
6T5	50	RG96U/WR28	RL086	26 to 40	<1,1	
6T67	13	RG96U/WR28	RL086	34 to 36	<1,15	
Elbows						
6T18		RG96U/WR28	RL086	26,5 to 40	<1,1	Angle 90° Plane H
6T19						Angle 90° Plane E
6T36						Angle 60° Plane E
6T37						Angle 60° Plane H
6T38						Angle 30° Plane E
6T39						Angle 30° Plane H

Origin F

Waveband Components – Q Band (continued)

Type	Waveguide		Coupling rings	Frequency range	VSWR	Additional data
	length (mm)	type				
Short Transitions (BI Standard)						
6T62A	12,5	RG96U/WR28	RL086 UG-599/U	26,5 to 40	<1,02	
6T62B	12,5	RG96U/WR28	RL086 UG-599/U			
6T63	12,5	RG96U/WR28	RL086 UG-381/U			
6T100	25	RG96U/WR28	RL086 UG-600/U			
Pressure Window						
6T65	20	RG96U/WR28	RL086	34 to 36	<1,15	Insertion loss <0,2dB
Matched Loads						
6T11		RG96U/WR28	RL086	26,5 to 40	<1,02	Power dissipation, max. 1W
6T24		RG96U/WR28	RL086	26,5 to 40	<1,05	Power dissipation, max. 12W
Variable Attenuators						
6T13A	70	RG96U/WR28	RL086	26,5 to 40	<1,1	Power dissipation 500mW: attenuation >30dB max.
6T13B	70	RG96U/WR28	RL086	26,5 to 40	<1,1	Insertion loss 0,2dB
Phase Shifters						
6T23A	70	RG96U/WR28	RL086	26,5 to 40	<1,1	Power dissipation 15W max: Phase shift, calculated ±1% >180°
6T23B	70	RG96U/WR28	RL086	26,5 to 40	<1,1	Power dissipation 15W max: Phase shift, uncalculated >180°
Short-Circuit Post (Variable)						
6T12	100	RG96U/WR28	RL086	26,5 to 40		
Impedance Match						
6T15	43	RG96U/WR28	RL086	26,5 to 40	<1,1	Power dissipation, max. 20W
Switch						
6T54	92	RG96U/WR28	RL086	26,5 to 40	<1,1	Isolation >40dB: Phase shift <0,1dB
Horns						
6T29	50	RG96U/WR28	RL086	34 to 36	<1,1	Gain >20dB
6T89	311,4	RG96U/WR28	RL086	34 to 36	<1,1	Gain 25 ±0,5dB
6T95	32	RG96U/WR28	RL086	34,1 to 35,7	<1,1	Gain 3dB
T Junctions						
6T9	40	RG96U/WR28	RL086	32 to 40	<1,25	Plane H: Attenuation, equi-division ±0,2dB
6T10	38,55	RG96U/WR28	RL086	26,5 to 40	<1,1	Plane E: Attenuation, equi-division ±0,2dB

Origin F

continued overleaf

Waveguide Components – Q Band (continued)

Type	Waveguide		Coupling rings	Frequency range	VSWR	Additional data
	length (mm)	type				
Directional Couplers						
6T16	90	RG96U/WR28	RL086	33 to 56	<1,2	Coupling 10dB : Direct attenuation 20dB : Insertion loss 0,2dB
6T21	80	RG96U/WR28	RL086	32 to 36	<1,1	Coupling 40dB : Direct attenuation 20dB : Insertion loss 0,2dB
6T74	80	RG96U/WR28	RL086	32 to 36	<1,1	Coupling 25dB : Direct attenuation 20dB : Insertion loss 0,2dB
Rat Race						
6T20	69	RG96U/WR28	RL086	33 to 36	<1,25	Plane E : Decoupling >20dB : Attenuation, equi-division ±0,25dB
Short Slot Hybrid						
6T61	63 (centres)	RG96U/WR28	RL086	34,25 to 35,5	<1,2	Plane H : Decoupling >20dB : Attenuation, equi-division ±0,25dB
Total Coupling						
6T79	118	RG96U/WR28	RL086	34,1 to 35,7	<1,25	Plane H : Decoupling >20dB : Insertion loss <0,5dB
Unidirectional Line						
6T84	140	RG96U/WR28	RL086	34,4 to 35,4	<1,15	Through-power 700mW : Insertion loss : forward <1dB reverse >20dB
Circulator						
6T90	37 (each limb)	RG96U/WR28	RL086	34,4 to 35,4	<1,25	
Wavemeters						
6T30	80	RG96U/WR28	RL086	33 to 36,5	1,05	Precision 3MHz. Transmission at resonance 20dB
6T31	80	RG96U/WR28	RL086	33,5 to 36,5	<2	Precision 1,5MHz. Transmission at resonance 5 ±1dB
6T97		RG96U/WR28	RL086	26,5 to 40	<1,05	Precision 5MHz
Wattmeter						
6T26	(170)	RG96U/WR28	RL086	26,5 to 40	<1,1	20W maximum
6T96	(95)	RG96U/WR28	RL086	30 to 40	<1,15	1 to 500mW ±10%
Balanced Mixer						
6T101	65	RG96U/WR28	RL086	34 to 36	<2	Isolation from signal 15dB. Crystal 1N53
Diode Mount						
6T1		RG96U/WR28	RL086	26,5 to 40 30 to 40		C=9pF : crystal detector type CR4T4, coax. output. PIN diode switch 49T1 (see page 33)
Low Noise Mixer						
73T1	43			9,375	1,3	Conversion loss 5,75dB. Crystal 1N263. Noise factor 7,5dB at 20°C. BNC output

Origin F

S.H.F. Triodes

Type	Cooling (Note 1)	Alternative code	Maximum ratings					Typical operating conditions										
			P_a (W)	P_g (W)	V_a (kV)	I_k (mA)	f (MHz)	Service (Note 2)	V_a (kV)	V_g (V)	I_a (mA)	I_g (mA)	P_{drive} (W)	P_{out} (W)	Pulse length (μs)	Duty factor	μ	g_m (mA/V)
7289	FA		100	2	1	125	2 500	C	0,9	−22	90	10	—	17	—	—	100	25
			100	2	1	125	500	C	0,9	−40	90	30	6	40	—	—	—	—
			27	2	3,5pk	3 000pk	3 000	C-AP	3,5pk	—	3 000pk	1 800pk	—	1 600pk	3	0,0025	—	—
2C39A	FA	CV2516	100	2	1	125	2 500	C	0,9	−22	90	27	—	20	—	—	100	24
			100	2	1	125	500	C	0,9	−40	90	30	6	45	—	—	—	—
7815	C		10 mean	2 mean	3,5pk	3 000pk	3 000	C-AP	3,5pk	—	3 000pk	3 mean	—	2 000pk	5	0,003	100	25
			10 mean	2 mean	2pk	3 000pk	3 000	C-GP	1,7	−45	1 900pk	1 100pk	400	1 500pk	3,5	0,001	—	—

Note 1. Cooling
FA = Forced-air
C = Conduction

Note 2. Service
C = Class C r.f. amplifier or oscillator, unmodulated.
C-AP = Class C r.f. amplifier or oscillator, anode pulsed.
C-GP = Class C r.f. amplifier, grid or cathode pulsed.

Origin GB, F

Note 3. Heater ratings
The basic ratings are: 6V/1A (7289 and 7815) and 6,3V/1A (2C39A).
These values are reduced at higher operating frequencies as detailed in data sheets.

Backward-Wave Oscillators

Type	Frequency range min. (GHz)	max. (GHz)	P_{out} (mW)	V_{g1} (V)	V_{g2} (V)	V_{hel} (kV)	V_{col} (Note 1) (V)	I_k (mA)	Focus (Note 2)	Origin
F2507	1,8	2,8	100	0 to −20	120	250 to 700	125	11	PM	USA
F2508	1	2	100	0 to −20	120	250 to 1 150	125	15	PM	USA
F2513	1,3	4	25	0 to −20	100	100 to 2 400	100	12	PM	USA
F2556	2,6	5,2	10	0 to −20	150	160 to 900	0	10	PM	USA
F2509A	2	4	100	0 to −20	125	300 to 1 800	125	10	PM	USA
F2517	3,7	5,5	50	0 to −20	130	300 to 960	100	15	PM	USA
F2555	4	8	10	0 to −20	150	250 to 2 000	0	15	PM	USA
F2510A	4	8,2	25	0 to −20	150	250 to 2 200	100	12	PM	USA
F2547	7	11	10	0 to −20	150	325 to 1 250	0	15	PM	USA
F2520A	7	12,4	20	0 to −20	150	390 to 2 400	100	8	PM	USA
F2511A	8	12,4	25	0 to −20	150	550 to 2 400	100	10	PM	USA
F2554	8	12	10	0 to −20	150	325 to 2 000	0	10	PM	USA
F2518	6,6	8,7	50	0 to −20	225	460 to 1 025	100	12	PM	USA

Note 1. Positive with respect to helix *Note 2. Focus: PM=permanent magnet*

Coaxial Line Oscillators (Heil Tubes)

Type	Alternative code	Frequency range min. (GHz)	max. (GHz)	Δf (−3dB) (MHz)	P_{out} min. (mW)	V_{res} (V)	I_k typ. (mA)	Cavity Code	R.F. output	Origin
V190C/1M		0,5	0,95	±1	250	280 to 350	45	495-LVA-202	Coax.	GB
		0,8	1,2	±2	2 000	180 to 400	70	495-LVA-203	Coax.	
V233A/1K	CV2190	2,7	4,2	±1	300	190 to 380	65	495-LVA-201	Coax.	GB
V235A/1K	CV2221	2,7	4	±1	500	190 to 350	65	495-LVA-226	Coax.	GB
V237C/2K		3,56	3,79	11	250	225 to 285	45	439-LTA/1C	WG	GB
V238A/1K	CV5292	3,55	4,25	±1	550	365 to 410	50	495-LVA-251	Coax.	GB
V238A/2KS		3,55	4,25	±1						
V239C/1K	CV5048	3,78	4,04	±4	350	235 to 285	45	439-LTA/1B	WG	GB
V239C/2K	CV6165	3,79	4,02	11	250	230 to 280				
V241C/2K	CV6166	4,02	4,24	11	250	230 to 310				
V243A/2FS	CV5463	4,263	4,297	—	750	235 to 275	65	495-LVA-251	Coax.	GB
V246A/2K	CV485	4,58	4,86	±3	250	200 to 250				
V247C/1K		4,6	4,8	±8,5	200	230 to 265	50	439-LTA/32A*	WG	GB
V249C/1K		4,8	5	±8	200	240 to 290				

** For coaxial output, cavity 495-LVA-251 is suitable*

H-Wave Oscillators

Type	Alternative code	Frequency range min. (GHz)	Frequency range max. (GHz)	Δf (−3dB) min. (MHz)	P_{out} min. (mW)	V_{res} typ. (V)	I_k max. (mA)	Accessories: Tuning cavity	Accessories: WG output	Origin
V261C/1M		5,85	6,35	±8,5	800	530	65	495-LVA-356	495-LVA-355	GB
V265A/1M		5,85	7,5	—	150	325	60	495-LVA-353	495-LVA-354	GB
V271C/3M	CV5911	6,85	7,35	±8,5	800	530	60	495-LVA-351	495-LVA-352	GB
V275C/3M		7,25	7,77	±8,5	800	530	60	495-LVA-351	495-LVA-352	GB
		7,28	8,3	±5	300	590	60	495-LVA-351A	495-LVA-352	

Noise Sources

Type	Frequency range (GHz) to	Frequency range (GHz)	Noise output (dB)	Firing voltage (kV)	Operating voltage (V)	Operating current (mA)	Transmission line	Flanges	Origin
F2865A	13,5	15,5	18,5	0,9	60	60	RG-91/U	UG-419/U	USA
F2877A	18	26,5	18,3	1,2	130	50	RG-53/U	UG-595/U UG-596A/U	USA
F2887A	26,5	40	18,3	1,2	150	40	RG-96/U	UG-600A/U UG-599/U	USA
F2897A	50	75	18	1,2	175	35	RG-98/U	UG-385/U	USA
F2898A	60	90	18	1,2	175	35	RG-99/U	UG-387/U	USA
F2899AS	75	110	18	1,5	200	30	WR-10	TRG-714	USA
F2899A	90	140	18	1,2	175	35	WR-8	TRG-723	USA

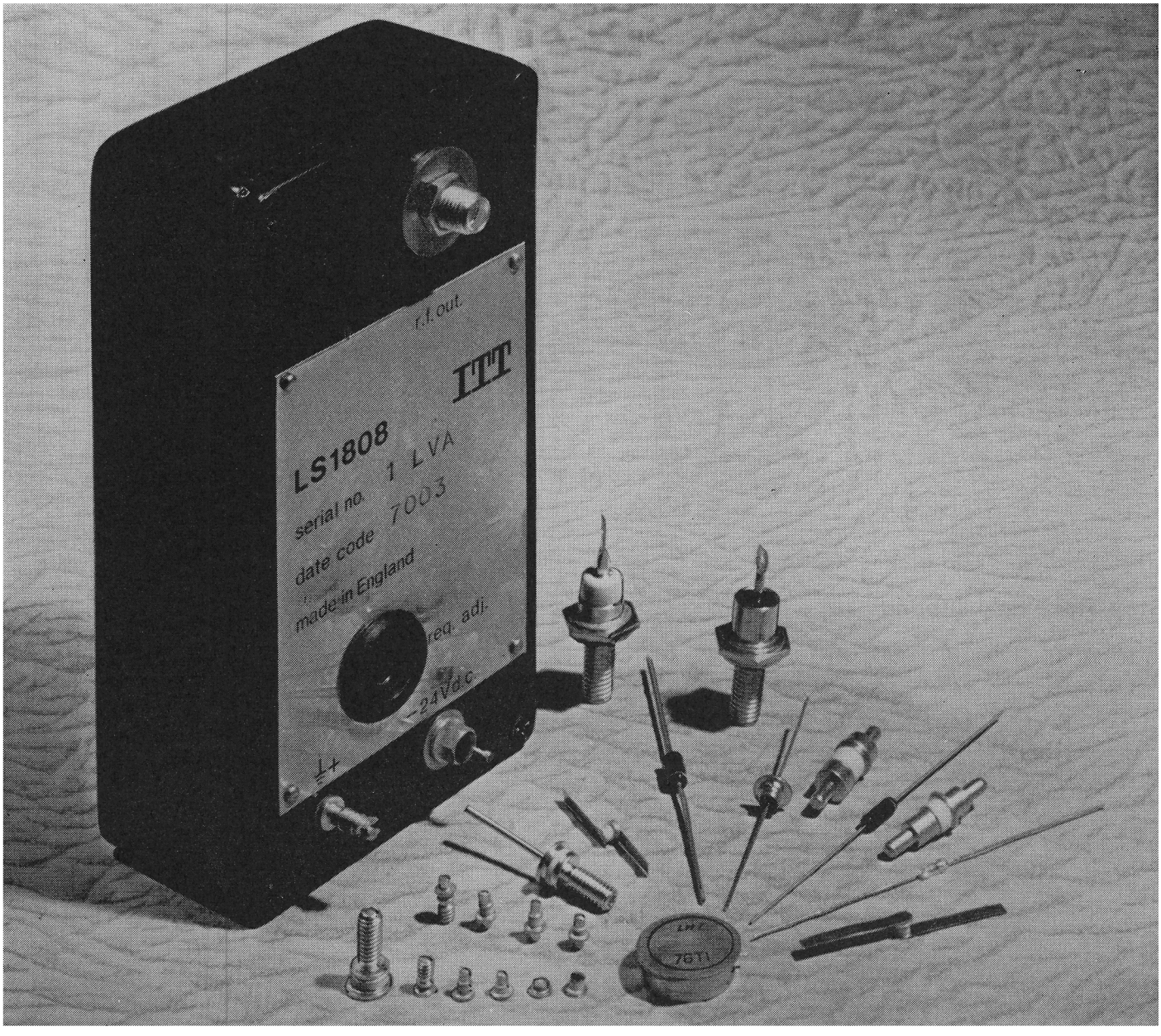
Note: For all types listed $V_h = 6,3V$: $I_h = 1,25A$

Thermocouples (For use in waveguides)

Type	Frequency range (MHz) to	Frequency range (MHz)	Output at cap	Resistance of couple nom. (Ω)	Safe I_h max. (mA)	I_h to produce in couple an open circuit e.m.f. of 15mV (mA)	Origin
T2H/60JA	300	6 000	Positive to disc	6	60	38	GB
T2H/60JB	300	6 000	Negative to disc				

Microwave Power Neon Indicator Tubes

Type	Alternative codes	Frequency band	Peak power (kW)	Glow height (cm)	Overall length (mm)	Max. diameter (mm)	Origin
NE17	CV359	S	100 to 200	>3	120	10	GB
NE18	CV360	S	100 to 200	>4,5	120	10	GB
NE19	CV263	S to X	0 to 1	>4,5	120	14	GB



ITT solid state microwave devices comprise the following items:

1. Step-recovery diodes for frequency multiplier and up-converter applications.

2. Dual mode varactor diodes for frequency multiplication and up-converter applications.

3. Tuning varactor diodes with a constant linear log C/log V characteristic. For very high Q and limited bias voltage range diodes from categories 1 and 2 above may also be useful for tuning or phase-shifting in conjunction with a circulator.

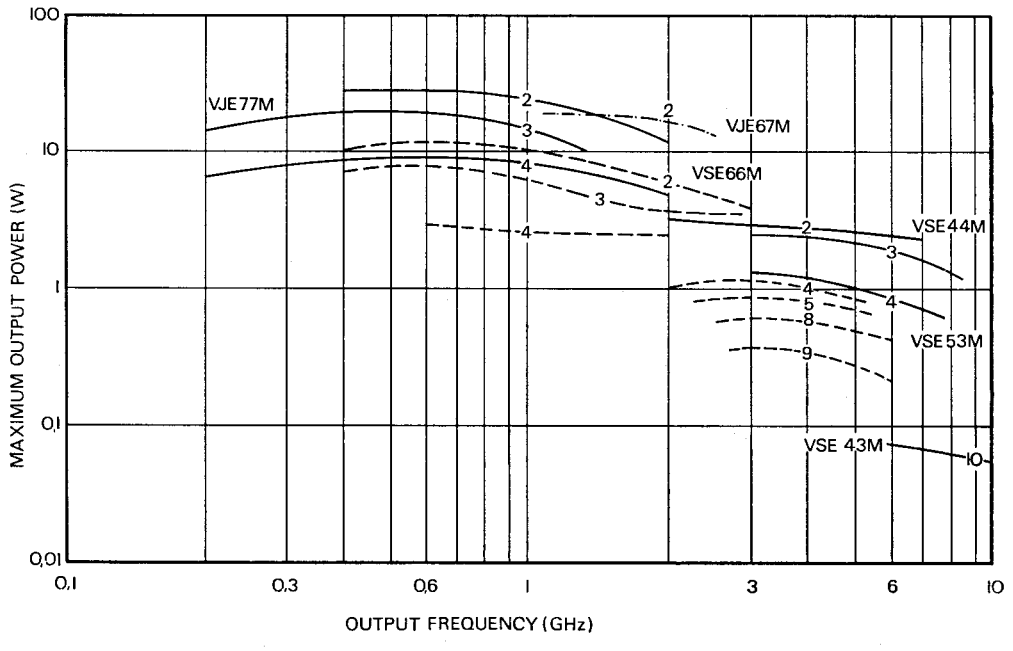
4. PIN diodes which behave as variable resistors rather than variable capacitors. Uses include amplitude modulation, switching of delay networks for phase shift applications, variable attenuators, limiters etc.

Diodes are available in chip form for integrated circuits, wire ended encapsulations, or complete subassemblies suitable for coaxial or strip-line mounting.

5. Gunn effect devices. Preliminary data only available immediately. Enquiries are invited for C, X and J-band devices.

6. Modules comprising frequency multipliers and transistor oscillators. Enquiries are invited for units for L. S, C and X-bands.

Step Recovery Diode Performance



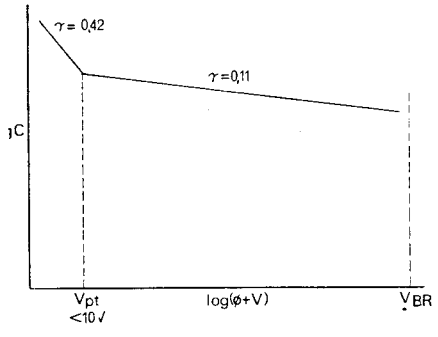
Step-Recovery Diodes

Diode code	V_{BR} min.	Characteristics					Multiplier performance				Case outline
		$C_{j(-6)}$ min.	max.	t_t max.	τ min.	R_{th} max.	P_{in}	η min.	f_{in}	f_{out}	
	V	pF	pF	ps	ns	°C/W	W	%	GHz	GHz	
Cartridge Types											
VJE											
66M	70	5	7,5	2 000	100	12	10	55	1	2	J
66P	70	5,4	6,6	2 000	100	12	12	60	1	2	J
67M	70	10	14	5 000	200	10	20	55	1	2	J
77M	90	10	14	5 000	250	9	37	65	0,5	1	J
Pill Types											
VSE											
43L	25	0,5*	1,5*	300	20	50	0,25	6	0,9	9	S
43M	25	0,3*	0,9*	250	20	50	0,25	10	0,9	9	S
44M	35	1,5	2,5	250	25	33	5	55	2	4	S
53M	48	0,5	1,0	500	25	30	1,0	30	0,5	4	S
66M	70	5,0	7,5	2 000	100	15	10	55	1	2	S
66P	70	5,4	6,6	2 000	100	15	12	60	1	2	S

* $C_{j(o)}$ *value*

Origin GB

Step Recovery Diodes
Typical Capacitance/Voltage Characteristic



Dual-mode Varactor Diodes
Typical Capacitance/Voltage Characteristic

C = *diode capacitance*

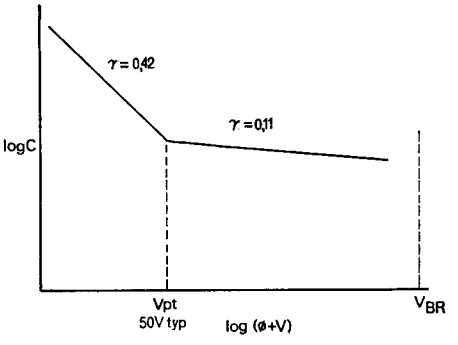
V = *bias voltage*

ø = *contact potential*

γ = *slope factor*

V_{pt} = *punch-through voltage*

V_{BR} = *breakdown voltage*



Dual Mode Varactor Diodes for Frequency Multiplication

Diode code	V_{BR} min.	Characteristics				Multiplier performance				Case outline
		$C_{j(-6)}$ min.	max.	$r_{s(-6)}$ max.	R_{th} max.	P_{in}	η min.	f_{in}	f_{out}	
	V	pF	pF	Ω	°C/W	W	%	GHz	GHz	
Stud Types										
VBC75A	90	2	4	1,6	12	6	60	0,5	1,0	B
VBC78A	90	19	29	0,6	7	12	55	0,15	0,45	B
VBC86D	120	15*	30*	1,2	10	15	60	0,5	1,0	B
VBC86J	120	5	7	1,2	10	15	60	0,5	1,0	B
VBC87B	120	10	14	0,8	9	10	60	0,15	0,45	B
VEC87M	100	10,5	13,5	0,5†	9	10	60	0,15	0,45	E
VAC88K	120	19	26,5	0,9	8	10	60	0,15	0,45	A
VBC89J	120	28	39	0,9	7,5	20	65	0,15	0,45	B
VBC98C	150	19	29	1,0	7	20	60	0,15	0,45	B
VBC99J	150	28	39	0,9	6	30	65	0,15	0,45	B
VBC107D	180	10	20	1,5	8	20	60	0,15	0,45	B
VBC118D	200	16	20	1,2	7	30	60	0,15	0,45	B
VBC118J	200	19	29	1,2	6	30	60	0,15	0,45	B
VBC119J	200	38	58	0,9	5	50	60	0,15	0,45	B
Cartridge Types										
VHC	VJC									
42J	42J	30	0,25	0,5	2,2	70				H, J
42L		24	0,3	0,6	2,2	70	0,04	3,2	0,8	6,4	H, J
	43F	30	0,5	1,0	1,1	35					J
43K		30	0,5	1,0	0,9†	35	0,1	25	0,8	4,0	H
53E		48	0,5	1,0	1,2						H
	63C	60	0,5	1,0	1,3	30					J
64K		60	0,8	1,6	1,3	22	0,4	18	0,8	4,0	H
64L		60	0,8	1,6	1,3	22	0,65	6,3	0,8	6,4	H
64M		60	1,0	2,0	1,3	22	1,0	7	0,8	6,4	H
	65D	60	2,0	4,0	0,8	16					
	66E	60	5	7	0,6	12	6	60	1,0	2,0	J
	75D	90	2	4	0,9	16	5	64	0,5	1,0	J
	76J	90	5	7	0,7	12	10	64	0,5	1,0	J
	77J	90	10	14	0,6	9	20	64	0,5	1,0	J
	87D	120	10	14	0,8	9	20	60	0,5	1,0	J
	97J	150	10	14	1,2	9	30	60	0,5	1,0	J
Wire-ended Types										
VMC										
66M		60	5	7	—	220	0,5	10	0,04	0,4	M
75M		90	2	4	—	230	1,0	60	0,15	0,45	M
76M		90	5	7	—	220	1,0	65	0,15	0,45	M
77M CV9860		90	10	14	—	220	0,9	55	0,06	0,24	M
Pill Types										
VSC										
42F		30	0,25	0,5	2,2	100				S
43E		30	0,5	1,0	1,1	50				S
52E		48	0,25	0,5	2,2	93				S
54J		48	1,0	2,0	1,1	33	3	50	2	4	S
62F		60	0,25	0,5	2,4	86					S
63C		60	0,5	1,0	1,3	43	4,5	56	2	4	S
63J		60	0,5	1,0	1,3	43					S
64J		60	1,0	2,0	1,3	31	3	55	2	4	S
65D		60	2,0	4,0	0,8	22	5	55	2	4	S
66E		60	5	7	0,6	17	6	40	1	2	S
75D		90	2	4	0,9	22	5	64	0,5	1	S
87D		120	10	14	0,8	12	20	60	0,5	1	S

* $C_{j(o)}$ *value*
† *typical value*

Origin GB

Tuning Varactor Diodes

Type (Note 1) (Note 4)	V_{MW} (V)	C_{-4} nom. (pF)	Q_{-4} min. at 50MHz	Tuning ratio $C_{-4}/C_{-V(MW)}$ min.	I_R leakage, max. at V_{MW} 25°C (μA)	I_R leakage, max. at V_{MW} 100°C (μA)	$T_{working}$ max. (°C)	Case outline	Origin
60 Volts Series									
VQA415	60	4,7	350	2,8				Q	GB
VQA416	60	6,8	350	2,9				Q	GB
VQA417	60	10	300	3,0				Q	GB
VQA418	60	15	300	3,0				Q	GB
VQA419	60	22	250	3,0	0,05	5,0	175	Q	GB
VQA420	60	33	200	3,1				Q	GB
VQA421	60	47	200	3,1				Q	GB
VLA422	60	68	150	3,1				L	GB
VLA423	60	100	100	3,2				L	GB
100 Volts Series									
VQA515	100	4,7	250	3,4				Q	GB
VQA516	100	6,8	200	3,6				Q	GB
VQA517	100	10	200	3,7				Q	GB
VQA518	100	15	200	3,7				Q	GB
VQA519	100	22	150	3,8	0,05	5,0	175	Q	GB
VQA520	100	33	150	3,8				Q	GB
VLA521	100	47	120	3,9				L	GB
VLA522	100	68	100	3,9				L	GB
150 Volts Series									
VQA715		4,7		4,1				Q	GB
VQA716	150	6,8	120	4,3				Q	GB
VQA717	150	10	120	4,4				Q	GB
VQA718	150	15	120	4,5				Q	GB
VQA719	150	22	120	4,6	0,05	5,0	175	Q	GB
VLA720	150	33	100	4,6				L	GB
VLA721	150	47	100	4,7				L	GB
VLA722	150	68	80	4,7				L	GB

Type	V_{MW} (V)	$C_{j(-4)}$ nominal (pF)	$C_{j(-4)}$ tolerance (%)	Q_{-4} min. (Note 2)	Tuning ratio	I_R leakage, max. at V_{MW} 25°C (μA)	I_R leakage, max. at V_{MW} 100°C (μA)	$T_{working}$ max. (°C)	Case outline	Origin
60 Volts, Low-Capacity, High Q Series										
VSA408	60	0,33	±30	350						
VSA409	60	0,47	±30	400						
VSA410	60	0,68	±30	450						
VSA411	60	1,0	±20	500	Note 3	0,02	2,5	200	S	GB
VSA412	60	1,5	±20	500						
VSA413	60	2,2	±20	500						
VSA414	60	3,3	±20	500						

Note 1. For specific diodes, each of these type codes will have a suffix letter A, B or C which indicates the C_{-4} tolerance, namely $A = \pm 20\%$. $B = \pm 10\%$. $C = \pm 5\%$

Note 2. Q_{-4} at 50MHz derived from measurement at 600MHz. Note that Q_{-4} apparently decreased for low capacitance values, due to inclusion of case capacitance (typically 0,25pF).

Note 3. Slope factor (γ) is 0,46 minimum: hence $C_{j(-4)}/C_{j(-60)}=3,2$ min. and $C_{j(-2)}/C_{j(-60)}=4,2$ min.

Note 4. Any diodes listed above are available in alternative encapsulations as follows:

Nominal C_{-4} up to 15pF. Pill – codes VSA, VYA, etc.
Nominal C_{-4} up to 47pF. Cartridge – codes VHA, VJA, etc.

Tuning Varactor Diodes (continued)

Typical (Normalised) Capacitance/ Voltage Characteristic 150V Tuning Varactor Diode

C_{j-4} = *Diode junction capacitance at −4V bias*

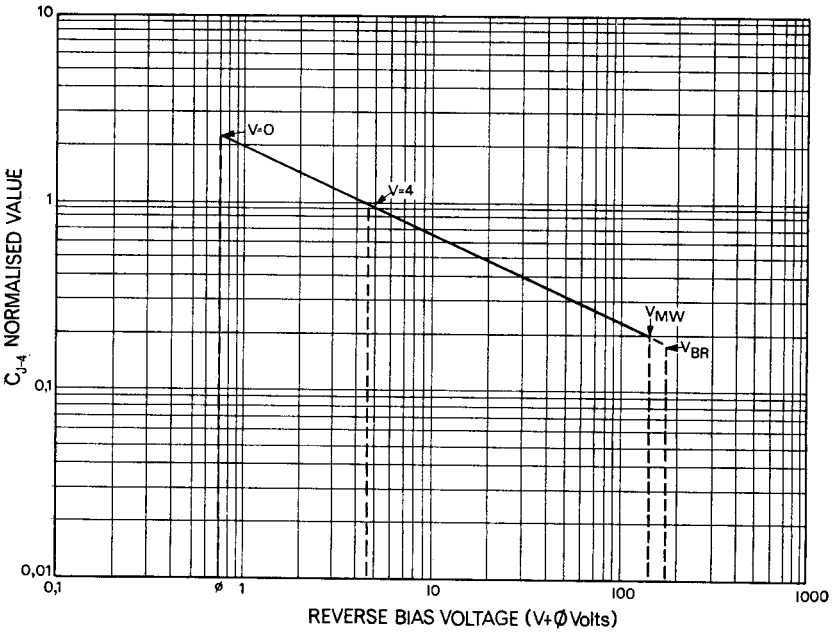
V = *Bias voltage*

γ = *Slope factor*

V_{MW} = *Maximum working voltage*

V_{BR} = *Breakdown voltage*

$\varnothing$ = *Contact potential*



P.I.N. Devices

Type	Frequency range min. (GHz)	Frequency range max. (GHz)	V_{BR} (V)	$P_{max.}$ c.w. (W)	$P_{max.}$ peak (W)	t_{sw} (ns)	t_r (ns)	Attenuation (dB)	C_o min. (pF)	C_o max. (pF)	r_s at I_F (Ω)	r_s at I_F (mA)	VSWR (no bias)	Outline (Note 1)	Intended mounting (Note 2)
P.I.N. Modulator Sub-Assemblies															
75T1	0,5	12,4	−100	8	75	20	100	0,5–2,0/20–45	2,2	2,8	0,5/1,5	+100	≤2	a	L, M
75T2	0,4	12,4	−100	12	75	20	100	0,5–3,0/18–45	2,2	2,8	0,5/1,5	+100	≤2	a	L, M
76T1	0,5	12,4	−100	8	75	100	10	0,5–1,5/25–45	2,2	2,8	0,5/1,5	−100	≤2	a	L, M
76T2	0,5	12,4	−100	8	75	10	10	0,5–1,5/25–45	2,2	2,8	0,5/1,5	−100	≤2	a	L, M
76T3	0,5	12,4		8	75	10	10	0,5–1,5/25–45	2,2	2,8	0,5/1,5	−100	≤2	a	L, M
67T1*	0,1	3,0	>100	2		70	400	<2/>18			<1	+50	<2		L
59T1*	3 ±5%		>100	5		70	400	<2/>20			<1	+50	<2		N
61T1*	1	2	>100	2		70	400	<3/>17			<1	+50	<2		L
P.I.N. Diodes									nom. C_{j-30}	max. C_{j-30}					
49T1	30	40	−80	0,4	150	50	150	<3/>40		0,6	1	50			N (6T1 page 26)
52T1	0,1	6,5	>100	5		70	400	<2/>18						b	L, M, N
65T1	4	11	−100	2	100	50	400	<2/>18		0,75	1	50		c	L, M, N
84T1			−100 min.	2	40	20	30		0,25		0,7	50		d	L, M, O
84T2			−150 min.	2	40	20	30		0,4		1	50		d	L, M, O
84T3			−150 min.	2	40	20	30		0,5		1	50		d	L, M, O
84T11			−150 min.	2	40	20	30		0,25†		0,75	100		d	L, M, O
84T12			−200 min.	2	40	20	30		0,25†		0,75	100		d	L, M, O
94T1			−170 min.	4	70	20	30		0,15		0,6	50		e	M, O
94T2			−170 min.	4	70	20	30		0,25		0,6	50		e	M, O
94T3			−170 min.	4	70	20	30		0,30		1,0	50		e	M, O
94T4			−170 min.	4	70	20	30		0,40		1,0	50		e	M, O
94T5			−170 min.	4	70	20	30		0,50		1,5	50		e	M, O

* *Replacement diode is type 52T1.* † C_j *at −50V.*

Origin F

Note 1. Outline or Encapsulation
a = Flanged cylindrical
b = Cartridge encapsulation
c = Wire-ended DO-7 encapsulation
d = Wire-ended encapsulation, body diameter 1,91 mm max; length 1,91 mm max; wire ends length 25,4 mm min.
e = Chip, 300×300×100µ

Note 2. Intended mounting
L = Coaxial
M = Stripline
N = Waveguide
O = Integrated circuit

Gunn-Effect Diodes*

Diode Code	Frequency Range min. (GHz)	Frequency Range max. (GHz)	P_{out} (CW) typ. (mW)	P_{out} (CW) min. (mW)	Input (V)	Input (mA)	Cavity	R.F. connector	Case Outline	Origin
LS1501B	8	10,5	10	5	10	180	Coaxial	TNC	S	GB
LS1502	9	10	10	5	10	180	LS1602	WG16	S	GB

Microwave Sources*

(Transistor Oscillator plus Varactor Multiplier Composite Modules)

Unit Code	Frequency Range min. (GHz)	Frequency Range max. (GHz)	△f (MHz)	Tuning	P_{out} (CW) typ. (mW)	P_{out} (CW) min. (mW)	Input (typ.) (V)	Input (mA)	Temp. range (°C)	Dimensions (mm × mm × mm)	R.F. connector 50Ω coax.	Origin
LS1805	2,4			Fixed		60	20	120	−30/+60	115×32×53	BNC	GB
LS1807	5,8			Fixed	6	3	6	17	−25/+50	60×70×22	OSM	GB
LS1808	3,0	3,6	†	Mechanical	40	20	−24	210	−40/+55	111×61×40	OSM	GB
LS1809	5,0	6,1	†	Mechanical	40	20	−24	250	−40/+55	111×61×40	OSM	GB
TS5001	4,3		±75	Electronic		300	−28	300	−40/+100	165×48×45	TNC	GB
TS5002	3,0		±100	Electronic	170	150	−18	150	−40/+60	96×31×121	TNC	GB

* *Tentative data*

† *Electronically tuned versions can be made available*

Microwave Diodes – Miscellaneous Types

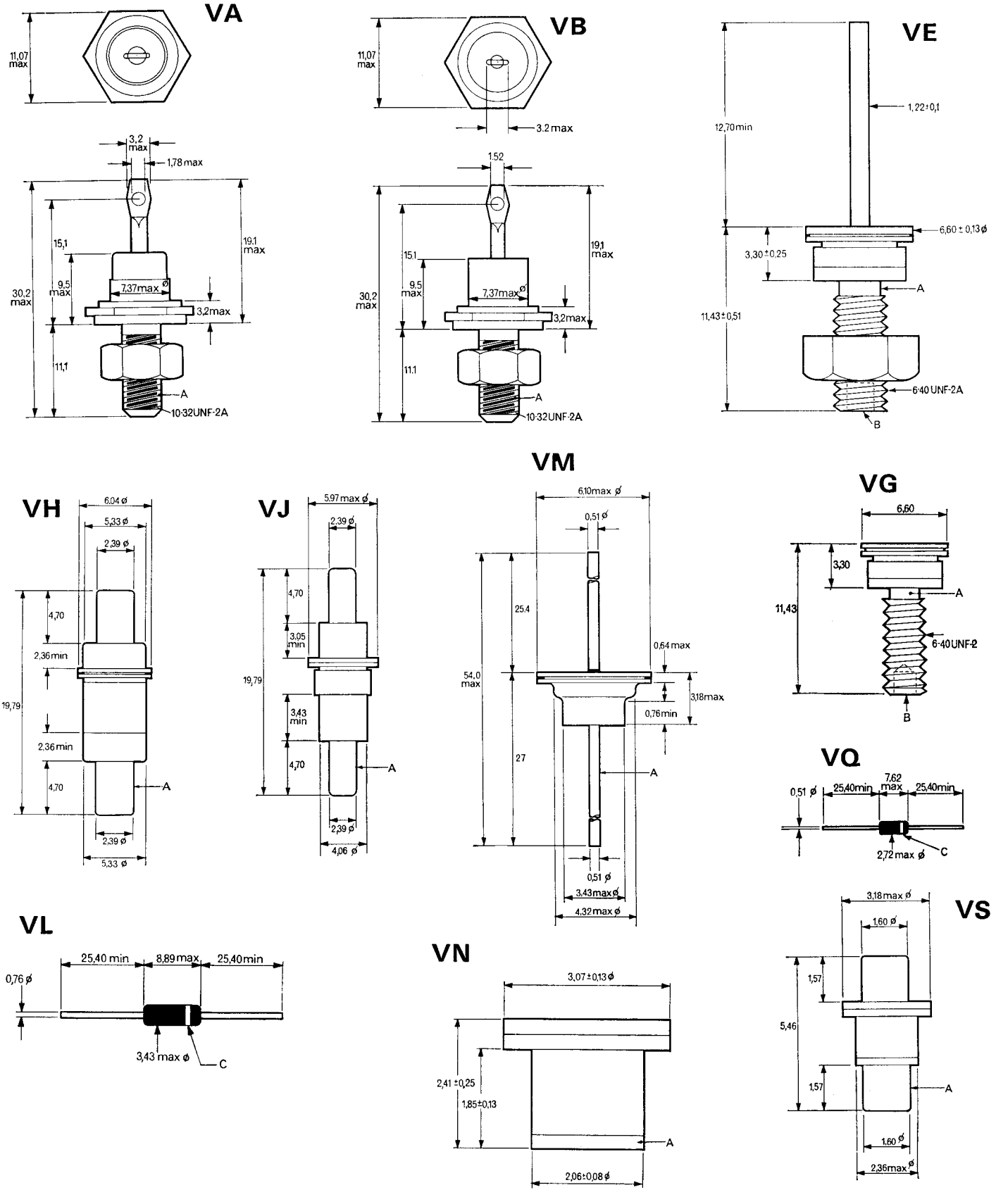
Type	Description	Frequency range min. (GHz)	Frequency range max. (GHz)	V_{BR} (V)	P_{max} c.w. (W)	peak (W)	t_{sw} (ns)	t_r (ns)	Attenuation broadband (dB)	Attenuation max. (dB)	Encapsulation	Intended mounting
39T1	Germanium modulator/ limiter diodes	4	7	−15	0,05	1	10	100	<2/>20	35	Cartridge	W.G. or coaxial
39T2		5	8	−15	0,05	1	10	100	<2/>20	35	Cartridge	W.G.
39T3		7	11	−15	0,05	1	10	100	<2/>20	35	Cartridge	W.G.
38T2 1N263 (1N263F)	Low-noise reversible germanium mixer diodes*	1 (test f=9,375)	12	1,5 V bias	<1,3ergs (burnout)		L.F. impedance 140–210Ω VSWR <1,3					73T1, JAN 266
CR4T4	Silicon detector diode†	26,5	40		0,01		Detection efficiency 500μA/mW Output capacitance 1–2pF					6T1, used with 6T12

* *Conversion loss <5,75dB, noise figure <7,5dB* † *Conversion loss 8dB, noise figure 14dB*

Origin F

Microwave Semiconductor Outlines

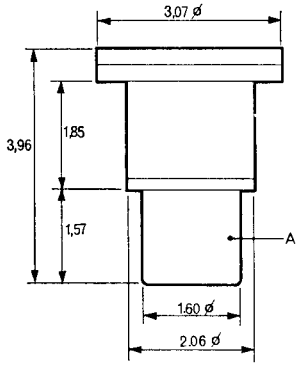
All dimensions are nominal unless otherwise stated



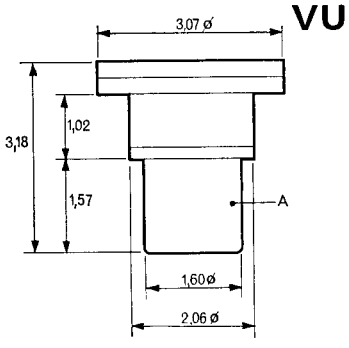
A Heat sink
B 18,796 ⌀ internal Bristol type spline 1,778 mm deep
C Polarity Band (cathode)
* Dimension through slot

Microwave Semiconductor Outlines (continued)

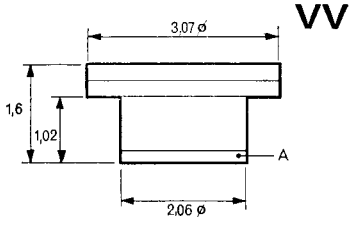
VT



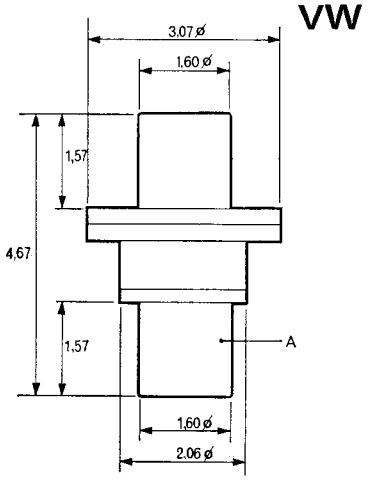
VU



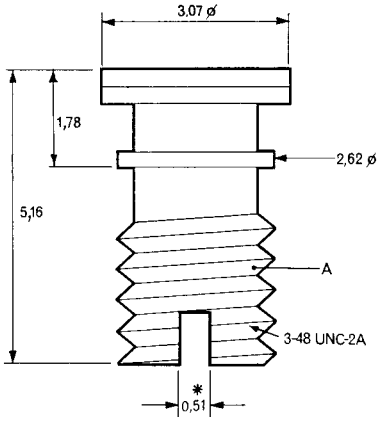
VV



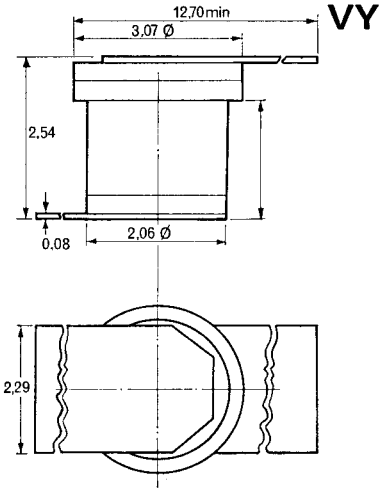
VW



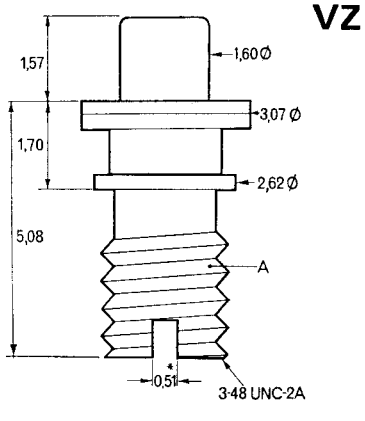
VX



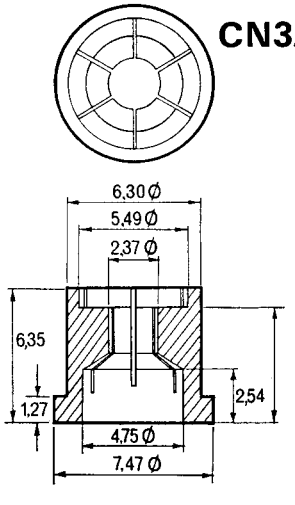
VY



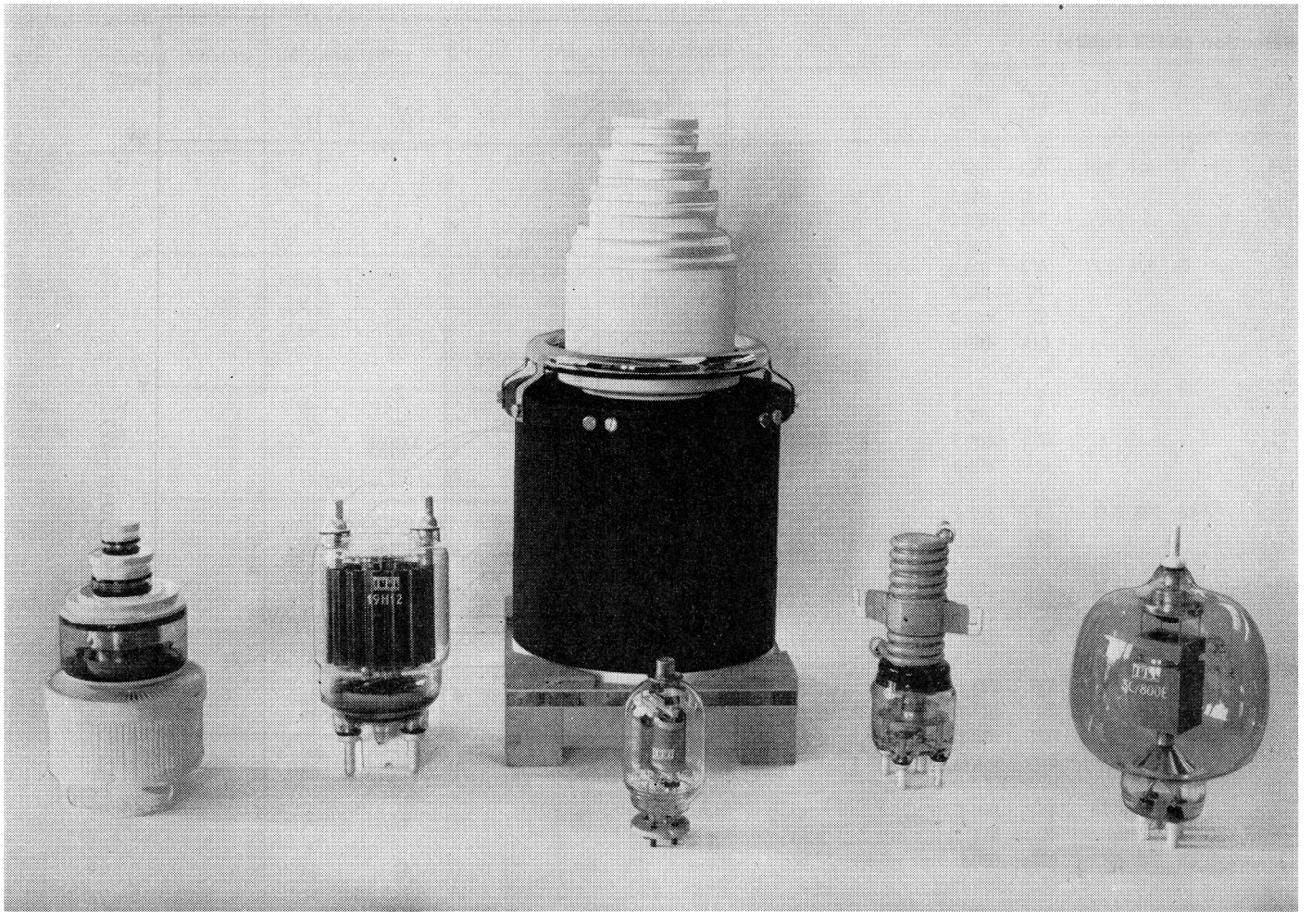
VZ



CN3A



A Heat sink
B 18,796 ⌀ internal Bristol type spline 1,778 mm deep
C Polarity Band (cathode)
• Dimension through slot



Introduction

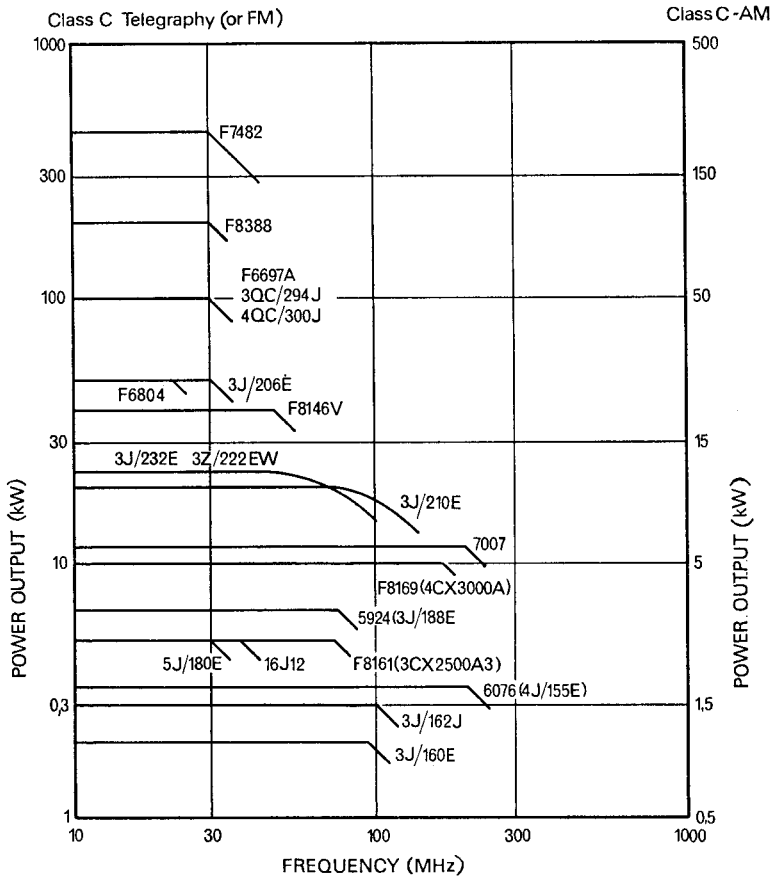
ITT power tubes comprise a full range of triodes, tetrodes and pentodes with radiation cooling up to 1kW anode dissipation and a choice of forced air, water or vapour cooled anodes at higher ratings. The tubes are listed with the form of anode cooling popular for a given type. Alternative forms of cocling could be offered in many cases. Tubes are listed in descending order of ancde dissipation and ratings and typical operating conditions quoted for popular forms of application for each type. These applications are by no means exclusive and enquiries are invited for recommended additional operating conditions.

A preliminary guide to tube selection by performance comprises power/frequency achievement charts overleaf. Location of tube by type number is assisted by reference to the general index at the front of this volume.

For pulse operation, hard tube and gas tube modulators are shown on the same diagram. Peak power graph lines are shown and conversion of peak voltage/peak current combinations ideal for the tube to those required for the load may often be achieved by use of a pulse transformer.

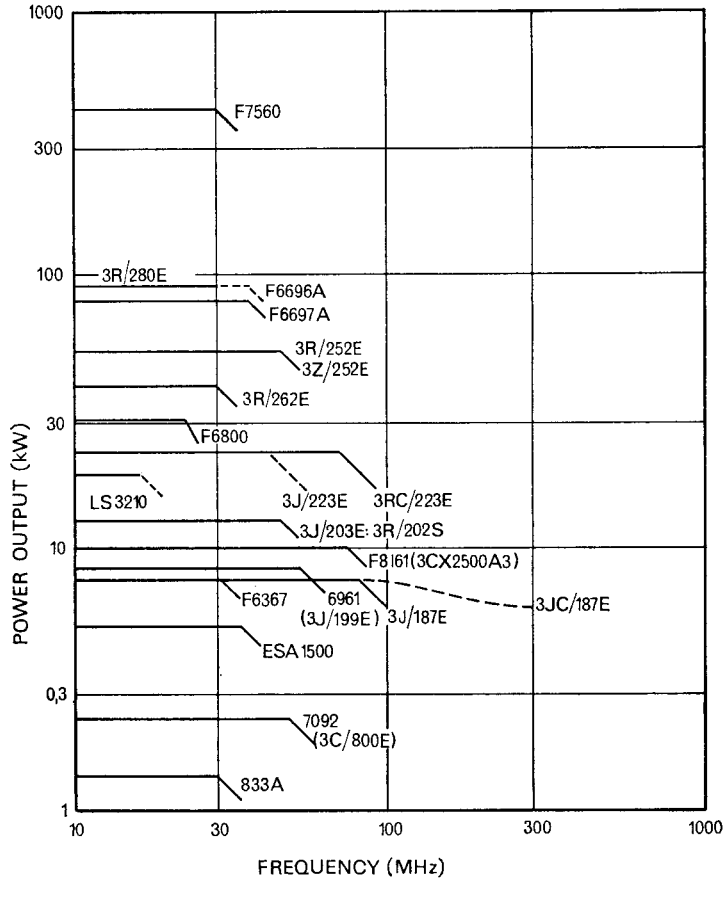
Transmitter Performance

(Selection of ITT Tubes)



Selection of Tubes for R.F. heating

Industrial Heating Oscillators
Triodes - Class C



Triodes

Forced-cooled

Code	Cooling (Note 1)	Alternate code	Maximum ratings					Typical operating conditions							Characteristics				Origin
			P_a (kW)	P_g (W)	V_a (kV)	I_a d.c. (A)	f (MHz)	Service (Note 2)	V_a (kV)	V_g (V)	I_a (A)	I_g (A)	P_{drive} (W)	P_{out} (kW)	V_f (V)	I_f (A)	μ	g_m (mA/V)	
F6398	W		225		22	20		B-AF	18	−830	2 × 19		4 500	480	15,5	420	21		USA
			150		18	16,5	24	C-AM	17	−2 500	16	2,2	7 900	200					
			225		23	25	24	C	16	−2 400	21,7	3,5	13 000	250					
F7482	V		200		20	30		B-AF	15	−320	2 × 28		5 000	550	14,5	450	45		USA
			200		20	20	30	B	17,5	−350	12,4		1 350	75					
			130		15	20	30	C-AM	14	−1 000	20,5	3,5	5 700	220					
			200		20	35	30	C	20	−1 000	29	3,4	6 000	440					
F7560	W		175		20	30		B-AF	15	−320	2 × 28		5 000	550	14,5	450	45		USA
F7560N	W		175		20	20	30	B	17,5	−350	12,4		1 350	75					
			115		15	20	30	C-AM	14	−1 000	20,5	3,5	5 700	220					
			175		20	35	30	C	20	−1 000	29	3,4	6 000	440					
3Q/331E	W		105		14	11	22	C-AM	13	−1 300	10	1,0	2 300	90	27,5	600	55		GB
			160		17,5	22	22	C	16	−1 480	13,5	2,72	6 800	140					
F8388	V		100		17	19	30	C	15,5	−1 800	17	1,5	3 800	175	14,5	330	22		USA
F8386	W		100		17	16		B-AF	12	−480	2 × 11		550	165	14,5	330	22		USA
F5918	W		80		19,5	9		B-AF	14	−300	2 × 8		1 500	150	11	285	41		USA
			80		17,5	12	22	B	15	−375	4,9		770	25					
			53		14	12	22	C-AM	14	−800	10	1,4	2 000	104					
			80		17,5	15	22	C	14	−1 200	12,5	1,45	3 300	130					
F6803	W		70		19	9		B-AF	14	−300	2 × 8		1 500	150	11	190‡	41		USA
			70		17	7	22	B	15	−375	4,9		770	25					
			47		14	12	22	C-AM	14	−800	10	1,4	2 000	104					
			70		17,5	15	22	C	14,5	−2 250	8,25	1,5	5 000	95					
F6379	W		70		17,5	15	AF	AB_1	14,7	−3 000	2 × 10			144	11	285	5		USA
F6696	W		60		16	11		B-AF	12	−600	2 × 10		600	152	13	205	20		USA
			60		11	9	40	B	12	−550	6,8		1 500	28					
			40		10	8,5	40	C-AM	9,5	−1 600	8,4	0,9	2 000	60					
			60		16	11	40	C	15	−1 600	7	0,3	600	80					
F1089	A		45		17,5	15	22	C	14	−800	10	1,4	2 000	104	11	285	40		USA
F8550	A		45		19,5	9		B-AF	14	−300	2 × 8		1 500	150	11	190	41		USA
			30		14	12	22	C-AM	14	−800	10	1,4	2 000	104					
			45		17,5	15	22	C	14,5	−2 250	8,25	1,4	5 000	90					
3QC/294J	W		27	1 800	11	7	30	C-AM	11	−1 200	6,7	3,0	5 400	57	12,5	225	20	40	GB
			40	1 800	13,5	14	30	C	13	−1 100	10,3	2,4	4 550	104					
			38	1 620	12,8	13,3	30	C-IH	12	−1 070	11,7	2,3	4 300	100					
3J/294E	A		27	1 800	11	7	2	C-AM	11	−1 200	6,7	3,0	5 400	57	12,5	197	20	60	GB
			27	1 800	8	7	22	C-AM											
			40	1 800	13,5	14	2	C	13	−1 100	10,3	2,4	4 550	104					
			40	1 800	10	14	22	C											
			38	1 620	12,8	13,3	2	C-IH	12	−1 070	11,7	2,3	4 300	100					
			38	1 620	9,5	13,3	22	C-IH											
F6692	W		40		12,5	6	30	C	12,5	−1 300	5,9	0,725	1 400	58	5	260	21		USA
F8146A	W		40		11	8		B-AF	8,5	−520	2 × 6,4		110	70	11	155	17		USA
F8146V	V		40		11	6	50	B	8,5	−460	5,7		575	16					
			26		8,5	6	50	C-AM	8	−1 400	5,6	0,6	1 250	36					
			40		11	8	50	C	7,5	−800	7,5	0,45	545	38					

Notes 1 and 2 are on page 44

continued overleaf

Triodes – Forced-cooled (continued)

Code	Cooling (Note 1)	Alternate code	Maximum ratings					Typical operating conditions							Characteristics				Origin
			P_a (kW)	P_g (W)	V_a (kV)	I_a d.c. (A)	f (MHz)	Service (Note 2)	V_a (kV)	V_g (V)	I_a (A)	I_g (A)	P_{drive} (W)	P_{out} (kW)	V_f (V)	I_f (A)	μ	g_m (mA/V)	
F6697A	A		35		16	11		B-AF	10	−450	2 × 8,7		550	110	13	205	20		USA
			35		16	9	40	B	12	−550	4,3		450	18					
			23		10	8,5	40	C-AM	9,5	−1 600	8,4	0,9	2 000	60					
			35		16	11	40	C	10	−1 200	10	0,81	1 500	72					
F8494	V		35		8	5	A.F.	AB_1	7	−1 400	2 × 1,6			13,75	7	110	6		USA
F8387	A		30		13	16	30	C-AM	12	−1 400	15	2,2	4 600	136	14,5	330	22		USA
3R/280E	WJ		30	1 000	13	10	10	C-IH	12	−760	10	1,31	1 590	77,5	8	300	24	50	GB
F8333	V		30		10	8	15	C	7,5	−1 200	5,2	0,53	900	28	7,5	200	18		USA
F5919	A		25		19	9		B-AF	10	−220	2 × 2,9		820	37	11	285	40		USA
			20		14	12	22	C-AM	10	−750	6,6	0,9	1 200	50					
			25		17,5	15	22	C	10	−1 000	6,4	1,1	1 700	50					
F6804	A		25		19	9		B-AF	10	−220	2 × 2,9		820	37	11	190‡	40		USA
			20		14	12	22	C-AM	14	−900	5,7	0,9	1 300	50					
			25		17,5	15	22	C	10	−1 000	6,4	1,1	1 700	50					
F5874A	W		25		8	5	A.F.	AB_1	5	−900	2 × 1,3			7,4	7	110	6		USA
3R/252E 3Z/252E	WJ V		24	500	13	6	50	C-IH	12	−680	5	0,8	790	48	8	125	24	60	GB
3Z/253S	V		24	50	13	6		AB_1	12	−330	2 × 3,2			30	7,75	125	36		GB
			24	50	13	6	50	B-SSB	10	−300	4	0,03	3 000*	20					
3R/262E	WJ		24	1 000	7	10	30	C-IH	6,5	−925	9,9	1,37	1 885	48	8	300	12	60	GB
F5771	W	356	22,5		12,5	5		B-AF	12,5	−600	2 × 3,2		430	55	7,5	170	20		USA
			22,5		12,5	4	25	B	12,5	−625	2,4		1 000	12					
			15		10	4	25	C-AM	10	−840	3,8	0,78	1 000	29					
			22,5		12,5	6	25	C	12,5	−630	4,8	0,75	1 000	44					
F6800A	W		20		15	3,5	22,5	C	12,5	−1 200	3,5	0,45	900	33	7,5	107	19,5		USA
3J/260E	A	CV2908	20	800	13	3,75	30	B-TEL	10	−290	3	0,1	50	12	9,5	78	35		GB
3Q/260E	W	CV446	13	800	10	3,75	30	C-AM	9	−800	3	0,51	660	20					
			20	800	13	7,5	30	C	12	−800	5,85	1,2	1 920	50					
F8636	W	8636J	20		12	4	2	C	8	−1 600	3,5	0,7		21	7,5	132	17		USA
F8147	A		13		8,5	6	50	C-AM	8	−1 400	5,6	0,6	1 250	36	11	155	17		USA
			20		10	8	50	C	7,5	−800	7,5	0,45	545	38					
3J/261E	A		13	800	6,4	3,75	70	C-AM	6	−715	2,8	0,6	3 900*	15	9,5	78	34		GB
			20	800	8	7,5	70	C	7,5	−640	5,9	1,1	8 500*	35					
3J/280E	A		18	1 000	13	10	10	C-IH†	12	−760	10	1,31	1 590	77,5	8	300	24	50	GB
F6691	A		17		12,5	6	30	C	12,5	−1 300	4,25	0,5	900	42	5	260	21		USA
F7207A	A		17		8	5	A.F.	AB_1	7,6	−1 400	2 × 2,5			21	7	110	6		USA
F5666	W		12,5		10	2		B-AF	7,5	−300	2 × 1,6		150	15	11	120	21		USA
			12,5		10	1	22,5	B	9	−350	0,8		110	2,5					
			7,5		8	1	22,5	C-AM	7,5	−1 200	0,88	0,08	140	5					
			12,5		10	2	22,5	C-IH	7,5	−600	1,8	0,2	270	8,9					
3J/252EW	A		8	500	10,5	3	50	C-AM	9,5	−485	2,75	0,072	44	19,5	8	125	28	60	GB
			12	500	13	6	50	C	12	−580	3,25	0,13	95	28,5					
8C25A	A		12		8	5	A.F.	AB_1	5	−900	2 × 1,3			7,4	7	110	6		USA
3R/223E 3RC/223E	WJ WJ		12	500	7	6	50 100	C-IH	6	−660	5,6	0,75	695	26	8	200	12	60	GB

Notes 1 and 2 are on page 44

Triodes – Forced-cooled (continued)

Code	Cooling (Note 1)	Alternate code	Maximum ratings					Typical operating conditions							Characteristics				Origin
			P_a (kW)	P_g (W)	V_a (kV)	I_a d.c. (A)	f (MHz)	Service (Note 2)	V_a (kV)	V_g (V)	I_a (A)	I_g (A)	P_{drive} (W)	P_{out} (kW)	V_f (V)	I_f (A)	μ	g_m (mA/V)	
3R/222E 3Z/222EW	WJ V		12	500	7	6	30	C-IH	6	−660	5,6	0,75	696	26	8	125	12	60	GB
3J/221S	A		10		17,5	1	15	B-TEL	15	−580	1			5,4	22	70	26		GB
					12	1	22	B-TEL											
			6,7		14	1	15	C-AM	13	−1 100	0,885	0,175	290	9,6					
					9,5	1	22	C-AM											
			10		17,5	2	15	C	17	−1 180	1,8	0,34	710	22,5					
					12	2	22	C											
F6801	A		10		15	3,5	22,5	C	12,5	−1 200	3	0,43	850	28	7,5	107	95		USA
3RM/215G	WJ		10		6,5	5,5	10	C-IH	6	−520	5,2	0,1	100	23	12,5	12	42	40	GB
ESW892	W	3Q/197E	7,5		15	2		B-AF	12,5	−170	0,4		420	22	11	60‡	48	7,5	GB
		892	10		15	1	1,6	B-TEL	14	−190	0,95		30	4					
					12,75	1	7,5												
					11,4	1	20												
			6,6		10	1	1,6	C-AM	10	−1 600	0,72	0,12	260	6					
					8,5	1	7,5												
					7,6	1	20												
					15	2	1,6	C	12	−1 600	1,64	0,18	500	14					
					12,75	2	7,5												
					11,4	2	20												
F5606A	W		7,5		15	2	1,6	B-AF	10	−90	2 × 1,65		240	20	22	60	36		USA
			10		15	1	1,6	B	10	−100	0,77	0,06	133	2,5					
			6,6		10	1	1,6	C-AM	8	−1 300	0,82	0,24	430	5					
			10		15	2	1,6	C	10	−1 300	1,4	0,24	495	10					
3J/232E	A		10	280	13	3	50	C-IH	12	−680	2,5	0,4	396	24	5	104	24	32	GB
3JC/223E 3J/223E	A A		10	500	7	6	100 30	C-IH	6	−660	5,6	0,75	697	26	8	200	12	60	GB
3J/210E	A		9	500	8	4,5	100	C	7,5	−700	3	0,75	4 500*	19,5	5	125	23,5	17	GB
F8131	W		8		6,5	3	80	B-AF	5	−250	2 × 2		110	14	9,5	50	20		USA
F8132	A		5		5,2	2,5	80	C-AM	5	−700	1,7	0,185	167	6,3					
			8		6,5	3	80	C	5	−450	2,6	0,285	220	7,3					
F8104	W		8		6	2,2	30	C	5,5	−600	2	0,18	230	6,8	15	36	25		USA
ESW891	W	891	5		15	2		B-AF	12,5	−1 450	2 × 1,4		350	22	11	60‡	8		GB
			6		15	1	1,6	B	14	−1 600	0,56			2,275					
			6		12,3	1	7,5												
			6		10,8	1	20												
			4		8	1	1,6	C-AM	8	−2 400	0,78	0,08	260	5					
			4		6	1	7,5												
			4		5,2	1	20												
			6		12	2	1,6	C	10	−2 000	1,45	0,1	310	10					
			6		9	2	7,5												
					6	2	20												

Notes 1 and 2 are on page 44

Triodes – Forced-cooled (continued)

Code	Cooling (Note 1)	Alternate code	Maximum ratings					Typical operating conditions							Characteristics				Origin
			P_a (kW)	P_g (W)	V (kV)	I_a d.c. (A)	f (MHz)	Service (Note 2)	V_a (kV)	V_g (V)	I_a (A)	I_g (A)	P_{drive} (W)	P_{out} (kW)	V_f (V)	I_f (A)	μ	g_m (mA/V)	
6961	A	TBL7/8000 3J/199E	6	250	7,2	2,8	85	B-AF	7	−250	2 × 2	2 × 0,53	620	20	12,6	33	32	15	GB
		CV5239	4	250	5,5	1,8	85	C-AM	5	−400	1,6	0,5	432	6,4					
3R/199E	WJ	TBH7/8000	6	250	7	2,0	55	C-IH	6,5	−450	1,7	0,5	350	8,6					
6960	W	3Q/199E	6	250	6,5	2	85	C-IH	5	−382	1,7	0,45	350	6,1					
		TBW7/8000	6	250	7,2	2,2	85	C	6,5	−450	2	0,6	460	10					
3J/203E	A		6	280	7	3		B-AF	5	−350	2 × 1,9	2 × 0,084	75	12	5	160	12	32	GB
3R/202S	WJ		6	280	7	3	50	C-IH	6,5	−770	3	0,35		14,1		104			
3JC/203E	A		6	280	7	3	160	C-IH											
F6926	W		6		6,5	2	30	C	4	−800	1,6	0,23	300	4,4	13	36	17		USA
F6926J	WJ																		
F6399	W		6		6,2	1,5	30	C	5	−600	1,2	0,13	160	4	11	29	25		USA
F6400/6400A	WJ		6		6	2	30	C	5,5	−600	1,7	0,19	270	5,9	13	36	25		USA
5923	W	3Q/188E	6	120	6	1,5		B-AF	6	−165	2 × 1,5	2 × 0,28	230	13,3	12,6	33	32	17	GB
		TBW6/6000	6	120	6	1,1	75	B	6	−180	0,99	0,3	170	1,9					
		TY6-5000W	4	120	5	1,3	75	C-AM	5	−400	1,2	0,3	205	4,7					
			6	120	6	1,5	75	C	6	−400	1,5	0,31	275	6,9					
3R/188E	WJ	TY6-5000H	5	120	5	1,9	75	C-A5+	5	−200 (S)	2 × 1,9 (S)	2 × 0,25 (S)	250 (S)	9 (S)					
		TBH6/6000	4	120	4	1,6	220	C-A5+	4	−150 (S)	2 × 1,6 (S)	2 × 0,2 (S)	450 (S)	6 (S)					
			6	120	5	1,9	75	C-A5−	5	−200 (W)	2 × 1,9 (W)	2 × 0,25 (W)	250 (W)	9 (W)					
			5	120	5	1,9	75	B-A5+	5	−200 (S)	2 × 1,9 (S)	2 × 0,25 (S)	250 (S)	9 (S)					
			4	120	4	1,6	220	B-A5+	4	−150 (S)	2 × 1,6 (S)	2 × 0,1 (S)	450 (S)	6 (S)					
5924	A	CV3926 3J/188E	5	120	6	1,5		B-AF	6	−165	2 × 1,5	2 × 0,28	230	13,3	12,6	33	32	17	GB
		TBL6/6000	5	120	6	1,1	75	B	6	−180	0,99	0,3	170	1,9					
YD1120	A	3J/188G	3,4	120	5	1,3	75	C-AM	5	−400	1,2	0,3	205	4,7					GB
		CV8730	5	120	6	1,5	75	C	6	−400	1,5	0,31	275	6,9					
			5	120	5	1,9	75	C-A5−	5	−200 (W)	2 × 1,9 (W)	2 × 0,25 (W)	250 (W)	9 (W)					
ESW5000	W	889A	5		8,5	2		B-AF	7,5	−300	2 × 1,6			15	11	125	20	10	GB
		CV2686	5		8,5	1	50	B	7,5	−300	0,9			2					
ESA5000	A	889R	3		6	1	50	C-AM	6	−900	1	0,1	142	4					
		CV2687	5		8,5	2	50	C	7,5	−800	2	0,24	440	10					
3CW5000A3	W	8242A	5		6	2,5		B-AF	5	−190	2 × 1,6		115	11	7,5	51	22,5		USA
			3,35		5	2	75	C-AM	5	−550	1,45	0,1	76	5,58					
			5		6	2,5	75	C	6	−500	2,08	0,18	136	10					
3CW5000A1	W	8240A	5		6	2,5	75	AB_1	6	−1 300	2 × 1,35			10	7,5	51	5		USA
3CW5000F1	W	8241A					30												
3Q/192E	W		4,5	350	7	1,3	22	B-TEL	6,5	−340	2 × 0,5	0,04		2,3	5	66	19		GB
			3	350	5,5	1,3	22	C-AM	5	−690	0,96	0,18	180	3,7					
3J/192E	A		4,5	350	7	2,6	22	C	6,5	−680	2,2	0,46	610	10					
			4,25	315	6,65	2,45	22	C-IH	6	−680	2,13	0,47	610	9,25					
F7820A	A		4,3		8	5	AF	AB_1	5	−900	2 × 1,3			7,4	7	110	6		USA
ESA892	A	CV904	4		12,5	2		B-AF	8	−60	2 × 1,15		400	10,5	11	60‡	48	7,5	GB
		892R	4		12,5	1	1,6	B-TEL	8	−40	0,71			1,7					
			4		10,6	1	7,5	B-TEL											
			4		9,5	1	20	B-TEL											
			2,5		10	1	1,6	C-AM	8	−1 300	0,75	0,18	350	5					
			2,5		7,5	1	7,5	C-AM											
			2,5		6,5	1	20	C-AM											
			4		12,5	2	1,6	C	10	−1 300	1,4	0,18	350	10					
			4		9,4	2	7,5	C											
			4		6,25	2	20	C											

Notes 1 and 2 are on page 44

Triodes – Forced-cooled (continued)

Code	Cooling (Note 1)	Alternate code	Maximum ratings					Typical operating conditions							Characteristics				Origin
			P_a (kW)	P_g (W)	V_a (kV)	I_a d.c. (A)	f (MHz)	Service (Note 2)	V_a (kV)	V_g (V)	I_a (A)	I_g (A)	P_{drive} (W)	P_{out} (kW)	V_f (V)	I_f (A)	μ	g_m (mA/V)	
ESA891	A	CV2688	4		10	2		B-AF	8	−800	2×1		100	10	11	60‡	8,5	4,3	GB
		891R	3,5		10	1	1,6	B-TEL	8	−820	0,8			1,3					
			3,5		8,3	1	7,5	B-TEL											
			3,5		7,5	1	20	B-TEL											
			2,5		8,5	1	1,6	C-AM	6	−2 000	0,75	0,1	250	43					
			2,5		6,4	1	7,5	C-AM											
			2,5		4,25	1	20	C-AM											
			3,5		10	2	1,6	C	10	−200	1,4	0,11	310	10					
			3,5		7,5	2	7,5	C											
			3,5		5	2	20	C											
3JC/187E	A		4	200	6	2		B-AF	5	−350	2×1,9	2×0,08	85	12	5	78	12	22	GB
			4	200	6,5	2	220	C-IH	6,5	−720	1,8	0,15	145	8,9					
			4	200	5,5	2	300	C-IH	5	−560	1,6	0,1	76	5,4					
3J/187E	A		4	200	6	2		B-AF	5	−350	2×1,9	2×0,08	85	12	5	78	12	22	GB
3R/187E	WJ		4	200	6,5	2	100	C-IH	6,5	−720	1,8	0,15	145	8,9					
			4	200	5,5	2	120	C-IH	5	−560	1,6	0,1	76	5,4					
F8104R	A		3,5		6	2,2	30	C	5,5	−600	1,4	0,15	180	5,5	15	36	25		USA
3J/170E	A		3,5	150	6	0,6	50	B-TEL	5	−290	0,6			1,1	10	21	17,5	5,5	GB
3R/170E	WJ		2,35	150	4,75	0,6	50	C-AM	4,5	−665	0,6	0,12	120	2,2					
			3,5	150	6	1,2	50	C	6	−630	1,19	0,16	176	4,5					
			3,5	150	5,7	1,1	50	C-IH	5,5	−600	1	0,25	275	4,1					
ESW1500	W	3Q/167E																	
16P12	WJ	3R/167S	3	200	8	1,5	40	C-IH	6	−350	1,5	0,135	108	6,3	8	26	24	7,5	GB
16P13	WJ	3R/167E																	
16P14	WJ	3R/167W																	
16J12	A	3J/166E	3	200	7,5	1,5		B-AF	5	−90	2×1	2×0,145	130	6	8	25	55	6,5	GB
			3	200	7,5	0,75	40	B-TEL	7	−130	0,5	0,009	2,5	1,25					
			2	200	6	0,75	40	C-AM	6	−520	0,5	0,12	104	2,46					
			3	200	7,5	1,75	40	C	7	−430	1	0,22	180	5,4					
F6925	A		3		6,5	2	30	C	4	−800	1,6	0,23	300	4,4	13	36	17		USA
F6367	A		3		6,2	2		B-AF	5	−150	2×1,125		175	7,2	13	36	25		USA
			3		6,2	1,5	30	B	6	−160	0,56		47	1					
			2		5	1,5	30	C-AM	5	−800	0,74	0,1	130	2,7					
			3		6,2	2	30	C	6	−800	1,4	0,16	225	6					
F6366	A		3		6,2	1,3	30	C	4,5	−500	1	0,12	120	3	11	29	25		USA
3CX3000A1	A	8238A	3	50	6	2,5	75	AB_1	6	−1 300	2×1,35			10	7,5	51	5		USA
3CX3000F1	A	8239A					30												
ESA1500	A	3J/167E	3	200	6	1,5		B-AF	5	−200	2×1	2×0,076	75	6	8	26	24	7,5	GB
			3	200	6	1,5	40	C-IH	6	−350	1,5	0,135	108	6,3					
3CX3000A7	A		3	225	5	2,5		B-AF	4		2×2	2×0,43	120	11	7,5	51	200		USA
3CX3000F7	A	8162A	3	225	5	2,5	75	B	4		0,82	0,21	15	1,1					
							30	B											
			3	225	5	2,5	75	B-SSB	5		1,56	0,33	215	5,5					
							30	B-SSB											
3CX2500A3	A	8161	2,5	150	6	2,5		B-AF	6	−240	2×1,5		113	13	7,5	51	22,5		USA
3CX2500F3	A	8251	1,7	150	5	2	75	C-AM	5	−550	1,25	0,15	115	5,3					
							30												
			2,5	150	6	2,5	75	C	6	−500	2,1	0,18	136	10					
							30												
F5680	A		2,5		6	2		B-AF	5	−150	2×1,125		175	7,2	13	36	25		USA
			2,5		6	1,5	30	B	6	−160	0,56		47	1					USA
			1,6		5	1,5	30	C-AM	5	−800	0,74	0,1	130	2,7					
			2,5		6	2	30	C	6	−800	1,4	0,16	225	6					

Notes 1 and 2 are on page 44

Triodes – Forced-cooled (continued)

Code	Cooling (Note 1)	Alternate code	Maximum ratings					Typical operating conditions							Characteristics				Origin
			P_a (kW)	P_g (W)	V_a (kV)	I_a d.c. (A)	f (MHz)	Service (Note 2)	V_a (kV)	V_g (V)	I_a (A)	I_g (A)	P_{drive} (W)	P_{out} (kW)	V_f (V)	I_f (A)	μ	g_m (mA/V)	
7C25	A		1,6		4	1	50	C-AM	3,5	−500	0,82	0,11	100	2	11	28	25		USA
			2,5		5	1,3	50	C	4,5	−500	1,2	0,1	110	3,1					
3J/160E	A	CV2245	2	75	3	2,2		AB_2	2,8	−130	2 × 1,25	2 × 0,328	214	4,5	10	29	19	14,6	GB
			2	75	3	1,1	120	B-TEL	2,8	−130	0,84	0,05	25,3	0,75					
			1,34	75	2,4	1,1	120	C-AM	2,25	−440	0,61	0,24	178	1,0					
			2	75	3	2,2	120	C	2,8	−310	0,855	0,272	166	1,8					
3J/162J	A		1,35	120	2,4	0,75	175	C-AM	2,4	−370	0,665	0,16	460*	1,45	5	40	20	15	GB
			2	120	3	1,5	175	C	3	−375	1,25	0,325	1 100*	3,15					
3J/121E	A	CV28	0,73		8	0,225	3	C-AM	8	−475	0,225	0,015	13	1,4	16	22	42		GB
			1,1		10	0,45	3	C	10	−525	0,37	0,02	20	2,8					

Note 1. Cooling

A = *Forced-air*
W = *Water, separate jacket*
WJ = *Water, integral jacket*
V = *Vapour*

Other abbreviations

(S) = *Synch. level*
(W) = *White level*
* = *Cathode drive power, grounded grid operation*
† = *Intermittent rating*
‡ = *Per phase*

Note 2. Service

AB_1 = *Class AB_1 push-pull amplifier*
AB_2 = *Class AB_2 push-pull amplifier*
B = *Class B r.f. power amplifier*
B-AF = *Class B a.f. power amplifier*
B-TEL = *Class B r.f. linear amplifier – grid driven, carrier conditions*
B-SSB = *Class B r.f. linear amplifier – cathode driven*
B-A5+ = *Class B r.f. linear amplifier – TV service, positive synch, negative modulation*
C = *Class C r.f. amplifier or oscillator, unmodulated*
C-AM = *Class C r.f. amplifier or oscillator, anode subject to 100% modulation*
C-IH = *Class C r.f. oscillator, industrial heating service*
C-A5+ = *Class C r.f. amplifier, grid modulated TV service, positive synch, negative modulation*
C-A5− = *Class C r.f. amplifier, grid modulated TV service, negative synch, positive modulation*

For accessories see page 46

Triodes

Radiation-cooled

Type	Alternative codes	P_a (W)	P_g (W)	V_a (kV)	I_a d.c. (mA)	f (MHz)	Service (Note 1)	V_a (kV)	V_g (V)	I_a (mA)	I_g (mA)	P_{drive} (W)	P_{out} (W)	V_f (V)	I_f (A)	μ	g_m (mA/V)	Origin
ES1001		1 000	150	6		40	C-IH	5	−265	1 000	190	105	3 900	10	18	40	8	GB
3D/100A	CV1422	1 000		3	1 000	20	C	3	−390	950	135		2 000	10	21	22	7	GB
7092	TY6-800, 3C/800E, TB5/2500	800	120	7	750	50	C-IH	5	−560	780	225		2 700	6,3	32,5	22	5	GB
833A	3C/402E	400	20	4	500		B-AF	4	−100	2 × 400		29	2 400	10	10	35	4	GB
		270	20	3	450	30	C-AM	3	−300	415	85	37	850					
		400	20	4	500	30	C-IH	4	−200	450	75	26	1 220					
4212EC	3C/270B	275		3	400		B-AF	3	−180	2 × 320	2 × 40	30	1 400	14	6,25	16	8,5	GB
4212H	3C/272A	275		3	300	1,5	B-TEL	3	−190	145			160					
4212E	CV1252	185		2,4	300	1,5	C-AM	2,4	−305	300	50	7	610					
	CV1619	275		3	400	1,5	C	3	−260	395	55	7	930					
6080	11D12, 33B/260D	2 × 13		0,55	2 × 125		Regulator							6,3	2,5	2	7	GB
3A/167M	CV5112	6,5		0,35	6,5		A	0,15		40				6,3	0,45	47	47	GB
4242A	CV25	85		1,25	150		B-AF	1	−85	2 × 180	2 × 17	6	220	10	3,3	12	4	GB

Note 1. Service

A = *Class A amplification*
B-AF = *Class B a.f. power amplifier*
B-TEL = *Class B r.f. linear amplifier – grid driven, carrier conditions*
C = *Class C r.f. amplifier or oscillator, unmodulated*
C-IH = *Class C r.f. oscillator, industrial heating service*
C-AM = *Class C r.f. amplifier or oscillator, anode subject to 100% modulation*

Tetrodes and Pentodes — Forced-cooled

Type	Cooling (Note 1)	Alternative codes	Maximum ratings					Typical operating conditions						Characteristics				Origin
			P_a (kW)	P_{g2} (W)	V_a (kV)	I_a d.c. (A)	f (MHz)	Service (Note 2)	V_a (kV)	I_a (A)	V_{g2} (V)	P_{out} (kW)	P_{drive} (W)	V_f (V)	I_f (A)	g_m (mA/V)	Screen μ	
4JC/301J	A	—	30	1 200	14	10	30	AB_1	10	5,1	1 500	32,5	—	8	300	65	6	GB
4JC/302J	A	CV10251	20	800	11	10	30	C-AM	10	6,7	1 500	50	100	8	300	65	6	GB
4QC/300J	W	—	27	800	11	10	30	C-AM	10	6,7	1 500	50	100	8	300	65	6	GB
			40	1 200	14	10	30	C	13	10,1	2 000	100	83					
4CW25000A	W	—	25	450	10	6	110	AB_1	10	4,25	1 500	28,5		6,3	160			USA
			25	450	10	5	110	C	7,5	4,65	750	26,5	220					
4CX15000	A	8281	15	450	10	6		AB_1-AF	10	2 × 4,25	1 500	57		6,3	160		4,5	USA
			15	450	10	6	110	AB_1	10	4,25	1 500	28,5						
			10	450	8	4	110	C-AM	8	3,65	750	23,5	150					
			15	450	10	5	110	C	10	4,55	750	36,5	220					
7007	A	—	12	400	7,5	4	220	B-A5+	6	3,8 (S)	700*	12 (S)	1 200 (S)*					
									5,85	3,2 (S)	1 000	12 (S)	100 (S)	5	180	17	10	GB/USA
4JC/201S	A		8		5	2	220	C-AM	4,8	1,8	800	6	100					
4Q/230A	W	—	10	550	9	1	22	C-AM	9	0,9	1 400	4	250	22	70	4	10	GB
			5	800	11	2	22	C	11	1,3	1 400	8,5	275					
		8171	12	250	7,5	4		AB_1-AF	7,5	2 × 3,6	1 500	34		7,5	75		4,5	USA
4CX10000D	A	CV6184	12	250	7,5	4	30	AB_1	7,5	3,6	1 500	17						
		CV8699	6,65	250	5,5	2,5	30	C-AM	5	2,4	500	8,5	120					
			10	250	6,5	3	110	C	6,5	2,3	500	10	250					
4CW10000A	W	—	12	250	7,5	4		AB_1-AF	7,5	2 × 3,33	1 500	32		7,5	75		45	USA
			12	250	7,5	4	30	AB_1	7,5	3,33	1 500	16						
			6,65	250	5	2,5	30	C-AM	5	2,4	500	8,5	120					
			10	250	7,5	3	30	C	7,5	2,8	500	16	120					
4CV8000A	V	—	8	175	7	2		AB_1-AF	6	2 × 2	850	14,5		9	41,5		5,5	USA
			8	175	7	2	150	AB_1	6	2	850	7,25						
			5,5	175	5	1,4	150	C-AM	5	1,35	400	5,5	42					
			8	175	7	2	150	C	7	1,9	500	11	47					
			6	250	7,5	4		AB_1-AF	7	2 × 1,8	1 250	17,5		7,5	75			USA
4CX5000A	A	8170	6	250	7,5	4	30	AB_1	7,5	1,9	1 250	10		7,5	75			USA
4CX5000R	A	8170W	3,5	250	5,5	2,5	30	C-AM	5	1,4	500	5,8	25					
			5	250	6,5	3	110	C	6,5	2,3	500	10	25					
6076	A	4J/155E	3	100	5	1 (I_k)	200	AB_1	5	0,64	1 000	1,4	3	6,3	32,5	19	8,5	GB
		CV5219	3	100	4	1,5	220	B-A5+	4	2 × 1,4 (S)	800	5,0 (S)	300–400 (S)					
			3	100	4	1,5	220	C-A5+	4	2 × 1,4 (S)	800	5,9 (S)	200–300 (S)					
			3	100	4	1,1	220	C-A5−	4	2 × 0,8 (W)	800	4,0 (W)	200–300 (W)					
			3	100	5	1,1	220	C	5	1,1	800	3,9	30					
4CX3000A	A	8169	3	175	7	2	150	AB_1	5	1,65	850	5,6		9	41,5		5,5	USA
			3	175	5	1,4	150	C-AM	5	1,35	400	5,5	42					
			2	175	7	2	150	C	7	1,9	500	11	47					
5J/180E	A	CV445	2,35	100	4,8	1,25	30	C-AM	4,5	1	1 500	2,9		9	30	5,7	4	GB
			3,5	150	6	2,5	30	C	6	1,4	1 500	5,75						
4H/181E	A	—	1	30	2,5	0,6	110	C	2,25	0,57	500	0,82		5	22,5	9	3,5	GB
4H/182E	A	CV1883	1	30	3,5	0,6	50	C	2,25	0,57	500	0,82		5	22,5	9	3,5	GB
			0,67	20	2	0,3	50	C-AM	2	0,3	250	0,42						
4CX250B	A	CV6137	0,25	12	2	0,25	500	AB_1	2	0,25	350	0,325		6	2,6	12	5	GB
		CV6174	0,165	12	1,6	0,2	500	C-AM	1,5	0,2	250	0,25	2,1					
4KC/160M	C	—	0,25	12	2	0,25	500	C	2	0,25	300	0,26	35					
4X150A	A	CV2519	0,25	12	2	0,25	150	AB_1	2	0,25	350	0,325		6	2,6	12	5	GB
			0,165	12	1,6	0,2	150	C-AM	1,6	0,2	275	0,230	3					
			0,25	12	2	0,25	150	C	2	0,25	250	0,37	2,5					

Note 1. Cooling
A = Forced-air
W = Water
V = Vapour
C = Conduction

Note 2. Service
AB_1 = Class AB_1, r.f. linear amplifier
AB_1-AF = Class AB_1, audio frequency – push-pull
B-A5+ = Class B, r.f. linear amplifier, TV service positive synch; negative modulation
C = Class C, telegraphy or f.m.
C-AM = Class C, anode and screen modulated
C-A5+ = Class C, grid modulated TV service; positive synchronisation, negative modulation
C-A5− = Class C grid modulated TV service; negative synch. positive modulation
(S) Synch. level
(W) = White level
** = Cathode driven; grounded grid operation, V_{g2} relative to ground*

For accessories see page 46

Tetrodes and Pentodes

Radiation-cooled

Type	Alternative codes	Maximum ratings					Typical operating conditions						Characteristics			
		P_a (W)	P_{g2} (W)	V_a (V)	I_a d.c. (mA)	f (MHz)	Service (Note 1)	V_a (V)	I_a (mA)	V_{g2} (V)	P_{out} (W)	P_{drive} (W)	V_f (V)	I_f (A)	g_m (mA/V)	Screen μ
5D/100A	CV1627	1 000	850	3 000	1 000	10	C	3 000	650	950	1 300		10	10	4,5	
		1 000	850	3 000	1 000	10	C-SM	3 000	450	800	430					
5C/450A		450	100	3 000	600	10	C	3 000	500	850	1 080		10	13	5,5	5
		450	100	3 000	600	10	C-SM	3 000	250	600	300					
813	CV26	100	22	2 000	180	30	C	2 000	180	400	275	2	10	5	3,7	8,5
		67	15	1 600	150	30	C-AM	1 600	150	300	180	2,8				
		100	15	2 000	100	30	B	2 000	75	400	50					
5B/254G	—												6,3	0,9		
5B/254M	CV428												6,3	0,9		
5B/255M	CV391	25	4,5	600	100	60	C	600	100	250	40	0,3	6,3	0,9	6	9
5B/256M	CV499	16,5	3	475	83	60	C-AM	475	83	250	28	0,4	19	0,3		
5B/257M	CV2220	25	4,5	600	80		B-AF	600	2 × 100	300	80		12	0,47		
5B/258M	CV2347												19	0,3		
6146	CV3523	25	3	750	150	60	C	600	112	150	52	0,2	6,3	1,25	7	4,5
	CV8218	16,7	2	600	125	60	C-AM	475	94	135	34	0,3				
		25	3	750	135		B-AF	400	2 × 114	190	55	0				
6360	11E13	5 × 2	1 × 2	300	2 × 50 (I_k)	225	C	300	38 × 2	175	14	0,5	6,3	0,83	3,3	7,5
	CV2798	3,3 × 2	0,65 × 2	250	2 × 35 (I_k)	225	C-AM	200	34 × 2	175	9	1	12,6	0,42	3,3	7,5

Note 1. Service

C = Class C, telegraphy or f.m.

C-AM = Class C, anode and screen modulated

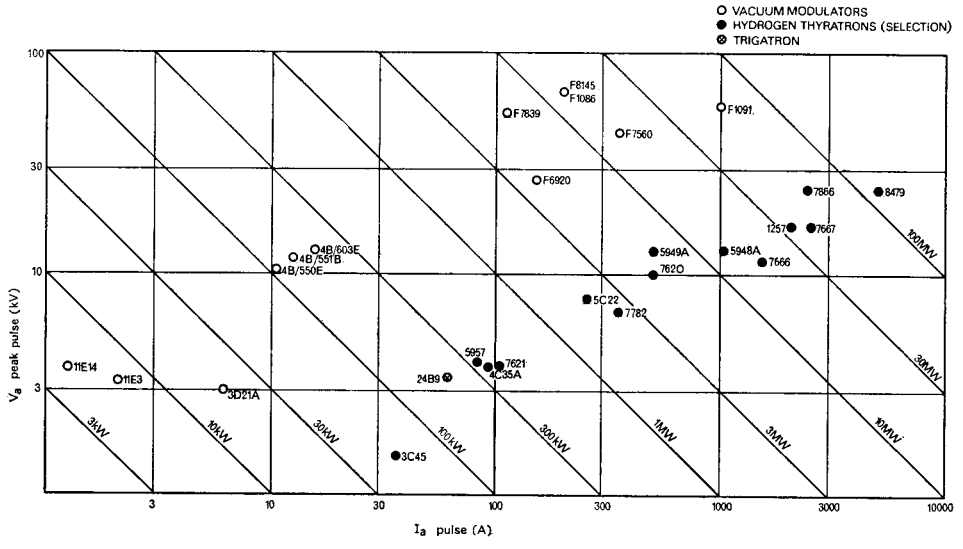
C-SM = Class C, suppressed grid modulated

B = Class B, carrier conditions for amplitude modulated r.f. applied to grid

B-AF = Class B, 2 valves push-pull audio frequency

Origin GB

Pulse Tubes Peak Power Output Chart



Pulse Triodes Vacuum

Type	Cooling (Note 1)	Alternative code	Maximum ratings						Typical operating conditions						Characteristics		
			P_a average (kW)	V_a (kV)	I_a peak (A)	I_k peak (A)	t_p (μs)	Duty factor	Service (Note 2)	V_a (kV)	I_a peak (A)	V_g (V)	V_{out} peak (kV)	P_{out} peak (kW)	V_f (V)	I_f (A)	μ
F7C23	A		1,2	17,5	20		90	0,005	P-C	15				60	11	29	
F5680	A		2,5	17,5		35		0,03	P-C	15,5		−750		90	13	36	25
F7012	A		2,5	17,5		40		0,03	P-C	15,5		−750		90	15	36	25
F6920	A		10	40	100		15	0,002	PM	18	90	−1 250	16,5	1 485	11	285	41
			10	40	150		15	0,002	PM	30	150	−1 000	27,5	4 125	11,9		41
F7839	A		10	65	160		2 000	0,06	PM	60	110	−1 700	55	6 000	12,6	285	41
F1086	W		90	75		275	1 000	0,01	PM	65	160	−3 200	59	9 400	12,6	285	25
F7560	W		175	50		550	1 000	0,01	PM	50	350	−1 800	45	15 700	14,5	450	45
F1091	W		390	75		2 000	1 000	0,01	PM	72	1 000	−4 200	58	58 000	31	970	25

Note 1. Cooling *A = Forced-air*
W = Water

Note 2. Service *P-C = Anode pulsed, Class C operation*
PM = Pulse modulation
BM = Break modulator

Origin USA

Pulse Tetrodes Vacuum

Type	Alternative code	Maximum ratings						Typical operating conditions							Characteristics			Tube base
		P_a average (W)	V_a (kV)	V_{g2} (kV)	I_a peak (A)	t_p (μs)	Duty factor	Service (Note 2)	V_a (kV)	V_{g2} (kV)	I_a (A)	V_{g1} (V)	V_{out} (kV)	P_{out} peak (kW)	V_h (V)	I_h (A)	g_m (mA/V)	
	CV416																	
6F17	CV11025 CV4040	3,5	0,6	0,6	0,25	2	0,05	PM	0,5	0,5	0,1	−30	0,4	0,04	6,3	0,3	8,3	B7G
11E2	CV276	5	10	0,55	1			BM	0,5	0,5	1	−80	10		6,3	0,9		IO-8
11E3	CV73	10	3,5	0,7	2	10	0,002	PM	3,5	0,5	2	−60	3,3	6,6	4,2	2,5	7,5	B7
			12,5	0,7	1			BM	0,5	0,5	1	−60	10					
11E14	EL360	10	5	0,55	4	1	0,001	PM	4	0,4	1,2	−150	3,8	4,5	6,3	1,2	16	IO-7
3D21A	CV2659	15	3,5	0,85	7	12	0,05	PM	3,5	0,8	6	−150	3	18	6,3 or 12,6	1,7 0,85	5,5	IO-8
4B/550E		40	12	1,25	12		0,001	PM	12	0,7	10	−500	10,5	105	26	1,2		B4A
4B/551B		40	14	1,25	12		0,001	PM	14	1	12	−400	12	144	6,3	5		B5F
4B/603E	CV398	60	15	1,25	15		0,001	PM	15	1,25	15	−800	13	194	26	2		B4A

Origin GB

Hydrogen Thyratrons

Ceramic

Type	P_{out} peak, max.	Heating* factor max.	$V_{forward}$ peak max.	$I_{a(peak)}$ max.	$I_{a(mean)}$ max.	$I_{a(r.m.s.)}$	Heaters				Grid drive	
							Cathode		Reservoir		Min. amplitude	Max. impedance
							V_h	I_h	V_{res}	I_{res}		
	(MW)		(kV)	(A)	(A)	(A)	(V)	(A)	(V)	(A)	(V)	(Ω)
7621/KU70C	0,4	$2,7\times10^9$	8	100	0,1	2	6,3	3	†		150	1 500
7782/KU71	2	4×10^9	14	350	0,2	5	6,3	5,5	6,3	1,5	175	1 500
8765/KU71Z	2	4×10^9	12	350	0,2	5	6,3	6	†		175	1 500
8553/KU72Z	4	7×10^9	16	500	0,5	6,5	6,3	7	†		200	500
8613	4	10×10^9	16	500	0,5	8	6,3	11,5	†		175	500
F103‡	4	10×10^9	16	500	0,5							
7665/KU72	5	7×10^9	20	500	0,5	6,5	6,3	5,8	6,3	1,5	200	500
7620	5	10×10^9	20	500	0,5	8	6,3	10,6	6,3	1,5	200	500
7322	12	20×10^9	25	1 000	2	36	6,3	22	6,3	6	500	400
8354	12	25×10^9	25	1 000	2,2	40	6,3	18	6,3	8	500	200
7666	18	20×10^9	25	1 500	2	40	6,3	22	2,5/6	6	500	400
7390	33	30×10^9	33	2 000	4	72	6,3	35	3,5/5,5	12	1 300	70
7667	40	40×10^9	33	2 400	4	90	6,3	35	3,5/5,5	20	1 300	70
7890	48	55×10^9	40	2 400	2,6	75	6,3	35	2,5/5,5	16	1 300	70
7866/KU274	60	55×10^9	50	2 400	4	90	6,3	35	3,5/5,5	20	1 300	70
F104‡	60	55×10^9	50	2 400	4							
8326A/KU74B	66	60×10^9	33	4 000	7	120	6,3	45	3,5/5,5	20	1 300	100
8554/KU274B	100	60×10^9	50	4 000	7	120	6,3	45	3,5/6	20	750	100
8479/KU275A	125	400×10^9	50	5 000	8	200	6,3	55	3,5/6	25	1 500	100
8301/KU275	125	400×10^9	50	5 000	8	200	6,3	55	3,5/6	25	1 500	100

** Product of peak forward voltage, peak current and pulse repetition rate* — *Origin USA*
† Reservoir connected internally across cathode heater
‡ Incorporates auxiliary electrode for minimum delay time variation

Glass

Type	Alternative code	P_{out} peak max.	Heating* factor max.	$V_{forward}$ peak max.	$I_{a(peak)}$ max.	$I_{a(mean)}$ max.	$I_{a(r.m.s.)}$	Heaters				Grid drive	
								Cathode		Reservoir		Min. amplitude	Max. impedance
								V_h	I_h	V_{res}	I_{res}		
		(MW)		(kV)	(A)	(mA)	(A)	(V)	(A)	(V)	(A)	(V)	(Ω)
KU-15		0,05	$0,3\times10^9$	3	35	45	1,25	6,3	2,5	None		175	1 500
KU-99		0,05	$0,3\times10^9$	3	35	45	1,25	6,3	2,7	†		175	1 500
3C45	CV372 / CV3629	0,05	$0,3\times10^9$	3	35	45	1,25	6,3	2,5	None		175	1 500
3C45W		0,05	$0,3\times10^9$	3	35	45	1,25	6,3	2,7	†		175	1 500
6130		0,05	$0,3\times10^9$	3	35	45	1,25	6,3	2,5	None		175	1 500
5958		0,12	$0,75\times10^9$	8	35	45	1,25	6,3	2,5	None		175	1 500
5959		0,12	$0,75\times10^9$	8	35	45	1,25	6,3	2,5	None		175	1 500
6777		0,12	$0,75\times10^9$	8	35	45	1,25	6,3	2,7	†		175	1 500
7583		0,12	$1,1\times10^9$	8	35	45	1,25	6,3	2,5	None		175	1 500
8370/E38		0,22	$1,25\times10^9$	5	90	100	3	6,3	6,7	†		175	1 500
5956		0,33	2×10^9	8	83	100	2,9	6,3	6,7	†		175	1 500
KU-17		0,33	2×10^9	8	83	100	2,9	6,3	6,7	†		175	1 500
5957		0,33	2×10^9	8	83	100	2,9	6,3	6,7	†		175	1 500
4C35A	CV1787 / CV5247	0,35	2×10^9	8	90	100	3	6,3	6,7	†		175	1 500
8424		1,5	$3,8\times10^9$	12	300	200	7,8	6,3	11,6	†		200	1 500
KU-27		2	$3,9\times10^9$	16	325	225	6,3	6,3	10,6	6,3	1	200	500
KU-28		2	$3,9\times10^9$	16	325	225	6,3	6,3	11,6	†		200	500
5C22	CV2520	2	$3,2\times10^9$	16	325	200	6,3	6,3	11,6	†		200	500
6587		2	$3,9\times10^9$	16	325	225	6,3	6,3	11,6	†		200	500
8488/KU29		2	$3,9\times10^9$	16	325	225	6,3	6,3	11	†		200	500
5949A		6	$6,3\times10^9$	25	500	500	15	6,3	22	3/5,5	6	550	200
KU-54	CV3875	12	9×10^9	25	1 000	1 000	30	6,3	33	2,5/5,5	8	700	200
5948A		12	9×10^9	25	1 000	1 000	30	6,3	33	2,5/5,5	8	700	200
1257		33	20×10^9	33	2 000	2 600	60	6,3	40	3,4/6	12	1 300	70
KU-48		40	20×10^9	40	2 400	2 600	60	6,3	40	3,5/6	12	1 300	70

** Product of peak forward voltage, peak current and pulse repetition rate* — *Origin USA*
† Reservoir connected internally across cathode heater

Pulse Modulator (Trigatron)

Type	Alternative code	Limit ratings				Typical operating conditions					P_{out} peak
		I_k (anode earthed) min. d.c. (kV)	max. pk. (kV)	I_k peak (A)	Heat factor*	p.r.r. (p.p.s.)	V_k peak (kV)	Pulse length (μs)	Line and load impedance (Ω)	Trigger voltage peak (kV)	(kW)
24B9	CV6173	3,7	8,8	60	$0,6\times10^9$	1 200	−7,2	1	80	8,5	150
	CV6008					2 500	−7,4	0,25	120	unloaded	100

* *Heat factor* $= V_{pk} \times I_{pk} \times p.r.r.$

Origin GB

Crowbar Spark Gaps

Type	Operating voltage (d.c.) (kV)	Discharge energy (J)	Peak current (kA)	Trigger voltage (kV)	Origin
F810	3,5 to 11	200	15	10	USA
F811	2 to 6	200	15	10	USA
F812	6 to 1,7	200	15	6	USA
F815	6 to 16	200	15	10	USA
F820	10 to 24	2 500	100	15	USA
F821	6 to 16	2 500	100	15	USA
F822A	12 to 36,5	2 500	100	20	USA
F823	2 to 5	2 500	100	15	USA
F830	25 to 70	4 000	100	25	USA
F831	20 to 50	4 000	100	25	USA

Crowbar Thyratrons

Type	V_a forward peak	I_a peak (1ms)	I_a peak (100ms)	Heaters				Origin
				Cathode		Reservoir		
	(kV)	(A)	(A)	V_f (V)	I_f (A)	V_{res} (V)	I_{res} (A)	
Glass Types								
8329	16	500	12	6,3	12	*		USA
7559	25	1 500	50	6,3	30	2,5/5,5	5	USA
7590	25	1 000	25	6,3	22	2,5/5,5	5	USA
7603	10	200	5	6,3	7	*		USA
7605	25	3 000	90	6,3	30	2,5/5,5	5	USA
Ceramic Types								
KU471	20	250	5	6,3	6	2,5/6,3	4	USA
KU472	20	500	10	6,3	8	2,5/6,3	4	USA

* *Reservoir internally connected*

Hydrogen Diodes

Type	Pulse diode			Rectifier			Heaters			
							Cathode		Reservoir	
	V_a peak inverse (kV)	I_a peak max. (A)	I_a r.m.s. (A)	V_a inverse peak (kV)	I_a peak max. (A)	I_a d.c. (mA)	V_f (V)	I_f (A)	V_{res} (V)	I_{res} (A)
Glass Types										
KU51	15	*	*	10	0,8	0,2	5	6,2	5	0,8
7178	16	500	15	*	*	*	5	22	5	5
8264/KU52	18	*	6,3	15	2	0,6	5	11,5	5	4
Ceramic Types										
91	15	150	3,5	10	1	0,3	5	6,5	4/5	4
8274/KU92	20	300	6,3	15	2	0,6	5	9,5	4/5	4
8275/KU93	30	500	15	20	8	2	5	27	4/5	5,5
8376/KU93A	33	750	20	25	10	2,5	5	15	4/5	5
8276/KU94	40	2 000	60	25	15	4 500	5	28	4/5	20

* *Consult manufacturer*

Origin USA

Vacuum Diodes — Forced-cooled

Type	Cooling (Note 1)	Rectifier			Shunt			Charging			V_f	I_f
		PIV max. (kV)	I_a peak (A)	I_a average or r.m.s. (A)	PIV max. (kV)	I_a peak (A)	I_a average or r.m.s. (A)	PIV max. (kV)	I_a peak (A)	I_a average or r.m.s. (A)	(V)	(A)
F8110	A	60	36	12 av.	60	150		60		16 rms	7,5	210
F7869	A	56	21	4 av.	65	100*		65	100*		15	36
2J/262E	A	50	7,5	1,5 av.							5	40
7975	A	46	21	5	55	100		55	100		15	36
7131	A	40	15	3 av.	40	150*		40		6 rms	13	36
7100	A	30	20	6 av.	30	100		30		7,5 rms	15	36
8207J	W	30	12	6 av.	30	100		30		7,5	15	36
7030	A	25	20	6	30	75*	0,7* av.	30	75*	0,7 av.	13	36
7779	A	25	20	6	30	75*	0,7	30	75	0,7*	13	35
8034	A	25	20	3 av.	25	70*		25		4,5 rms	7,5	51

** Obtained at elevated filament voltages (+5%) Note 1 Cooling A=Forced-air B=Water* *Origin USA/GB(2J/262E)*

Vacuum Diodes — Radiation-cooled

Type	Alternative code	Rectifier/Charging diode				Overswing/Shunt diode			V_f	I_f	Base
		PIV (kV)	I_a peak (A)	I_a average (mA)	P_a (W)	PIV (kV)	I_a peak (A)	P_a (W)	(V)	(A)	
29C1	CV430	0,1 (a)		3					4	0,8	I0-8
19E2	CV265					4	12	5	4	2	I0-8
19G6	CV371	6	0,18	30					4	0,5	B7G
S19G6 (b)	CV4057	5	0,18	30					4	0,5	B7G
S19G6F (b)	CV4042	5	0,18	30					4	0,5	B7G/F
19G3	CV277	6,5	0,375	50					4	1,4	I0-8
19G12	CV1111	12,5	0,35	50					4	1,1	B4
19H4	CV2180	20	0,18	30					2,5	1,7	I0-8
19H5	CV490	18	1	180 (c)	25	18 27 (d)	10 10 (d)	25 32 (d)	4	4	Goliath E.S.
19H12	CV5718					25	30	50	4	12	Special VH833
ESU77	CV2160	40	1,1	350	130	40	2,5	130	4	12	Goliath E.S.
ESU112	CV8265	40	1,1	350	130	40	2,5	130	4	12	B4F

Notes. (a) Forward voltage: this tube has tungsten filament and is intended for use as saturable diode.
(b) Special quality type with shock resistant construction.
(c) Choke input: rating reduced to 125mA for capacitor input filter.
(d) Value for use of tube as clamping diode.
Origin GB

Rectifiers

Type	Alternative code	PIV max. (kV)	I_a peak (A)	I_a average (A)	D.C. output Half-wave (kV)	D.C. output bi-phase (A)	V_f (V)	I_f (A)
Gas-Filled Types								
3B28*	CV1835	10	1	0,25	3,2	0,5	2,5	5
4B32*	CV2518	10	5	1,25	3,2	2,5	5	7,5
Mercury Vapour Types								
ESU101		10	1,25	0,25	3,2	0,5	4	2,7
866A*	CV32	10	1	0,25	3,2	0,5	2,5	5
872A*	CV1449	10	5	1,25	3,2	2,5	5	7,25
4049D	CV5	20	5	1,25	6,3	2,5	4	11
2V/531E	CV1420	20	10†	2,5†	6,3	5	5	20
2V/561E		20	20†	7,5†	6,3	12,5	5	40

** Plug-in semiconductor replacement devices also available † Current ratings double these values if V_a and V_f phases are in quadrature* *Origin GB*

Thyratrons — Gas-filled

Type	Alternative code	PIV max. (kV)	I_a peak max. (A)	I_a average max. (A)	V_h (V)	I_h (A)	Base
2D21 (a)	CV797	1,3	0,5	0,1	6,3	0,6	B7G
3D22 (a)	CV2851	1,5	8	0,8	6,3	2,6	B7D

Note. (a)=Tetrode *Origin GB*

Thyratrons — Mercury vapour

Type	Alternative code	PIV max. (kV)	I_a peak max. (A)	I_a average max. (A)	Grid control ratio (approx.)	V_f (V)	I_f (A)	Base
3V/490A		2,5	40	6,4	100	5	10,5	B4D
4049GD		20	5	1,25	700	4	11	B4F
3V/531E	CV447	20	10*	2,5*	1 000	5	20	Special 3-pin
3V/561E		20	20*	7,5*	1 000	5	40	Special 3-pin

** Current ratings double these values if V_a and V_f phases are in quadrature* *Origin GB*

Code	Associated Tubes
Air Jackets	
RT-53134-12 Type 1	F-7C23, F5680, F7012
RT-53134-12 Type 2	F6366, F6367
RT-53134-12 Type 3	F6801
RT-53134-12 Type 4	F6691
RT-53892	F5919
RT-54887-1* Type 3	F7869
RT-55001-1*	F8132
RT-55098-1	F6920, F7839
RT-55140 (a) / RT-55240 (b)	F8147
RT-55301 (a) / RT-55302 (b)	F6697A
RT-55397 Type A (a)	F8387
RT-55397 Type B (a)	F8550, F1089
RT-55398 (b)	F8387, F8550
RT-55240	F8110
RT-56353	8169/4CX3000A
RT-56038	8170/4CX5000A and R
RT-56232	8170/4CX10000D
RT-56354	8281/4CX15000A

* *Epoxy resin* (a) *Air distributor* (b) *Tube support*

Glass Support Tubes	
GC1	16J12, ESA1500
GC8	3J/170E, 3J/192E, 3J/203E, 3JC/203E, 5J/180E
GC11	3J/223E, 3JC/223E, 3J/232E

Air Socket Systems	
RT-55104 (c)	8147
RT-56036 (d)	4CW10000A, 8170/4CX5000A and R, 8171 (4CX10000D), 8281, 4CX15000A
RT-56350 (d)	4CV8000A
RT-56351 (e)	8169/4CX3000A
RT-56352 (e)	8169/4CX3000A

(c) *Socket assembly* (d) *Air socket system* (e) *Air socket system with screen bypass capacitor*

Water Jackets	
RT-54139	F1086
RT-52903	F5606A
RT-53221	F5666, F6800
RT-54320	F5771
RT-54841	F5874
RT-54319	F5918A, F6379, F6692, F6803, F8148, F8386
RT-55113	F6398
RT-53933	F6399A, F6400A, F6926, F8104
RT-55359	F6696A
RT-55070	F8146
JK115A / JK115B	4QC/300J

Boilers (external condenser)	
305-LVA-210	3Z/252E, 3Z/253S
305-LVA-114 (f)	3Z/222EW

(f) *Steam-down type*

Condenser (30kW type)	
305-LVA-106	3Z/252E, 3Z/253S

Level Sensing Tank	
SV1A	Vapour-cooled tubes

Accessories for Power Tubes

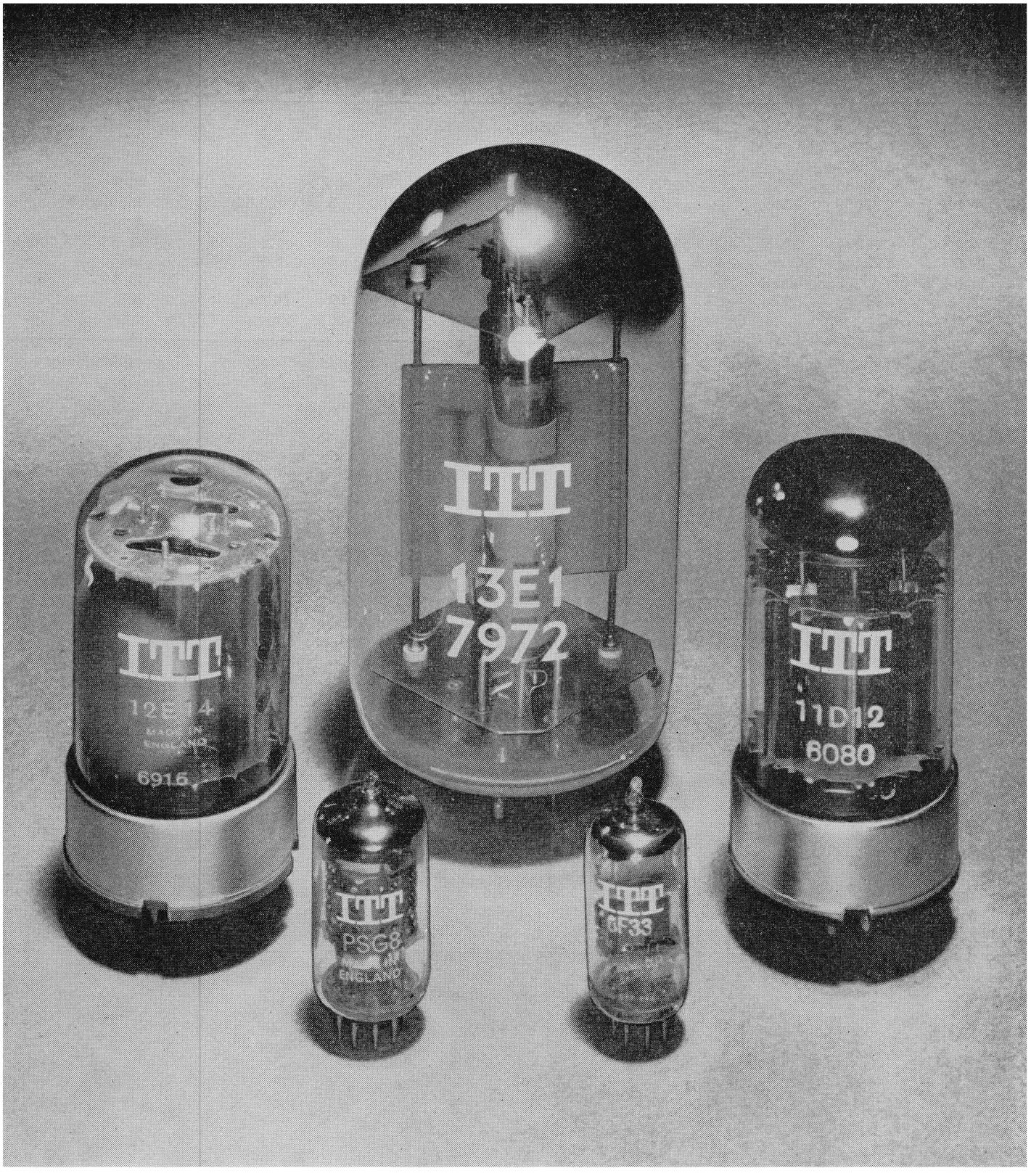
Accessories for Power Tubes (continued)

Code	Description	Associated Tubes
Connector Assemblies		
RT-52578	Connector (1 required for each grid and filament connection)	F1091, F5606A, F5666, F5771, F5918A, F5919, F6398, F6692, F6800, F6801, F6803, F6804, F6920, F7839, F8110, F8333, F1089
RT-52578	Connector (6 required)	F1089
RT-53974	Connector (6 required)	F1086
RT-53978	Terminal connector (4 required)	F5874A, F7207A, F7820
RT-54400	Grid connector ring (1 required)	F6398
RT-54410-1 RT-54410-2 RT-54410-3	Filament connector (2 required) Filament centre – tap connector (1 required) Grid connector (1 required)	F-7C23, F5680, F6366, F6367, F6399, F6400, F6925, F6926, F6926J, F7012, F8104
RT-54764 RT-54765 RT-55052	Filament connector, large (1 required) Filament connector, small (1 required) Grid ring connector assembly (1 required)	F8146, F8147
RT-55246 RT-55247 RT-55248	Grid connector (1 required) Filament connector, large (1 required) Filament connector, small (1 required)	F6696, F6697
RT-55356 (g)	Connector assembly (1 required)	F8131, F8132
RT-55464 RT-55469 RT-55476	Grid connector (1 required) Filament connector No. 2 (1 required) Filament connector No. 1 (1 required)	F8386, F8387, F8388
RT-55655	Connector assembly (1 required)	F8131, F8132
RT-55760 RT-55761 RT-55762	Grid connector (1 required) Filament connector No. 1 (1 required) Filament connector No. 2 (1 required)	7560, 7560V, 7560N
RT-56577 RT-56548 RT-56587	Filament connector No. 1 (1 required) Filament connector No. 2 (1 required) Grid connector (1 required)	F1091
RT-52843	Spanner wrench (2 required for Terminal Connectors RT-52578, RT-53974 and RT-53978)	
CN-1A CN-1B CN-1C	Filament connector, small (1 required) Filament connector, large (1 required) Grid connector (1 required)	3J/187E, 3R/187E, 3JC/187E, 3R/202S, 3J/203E, 3JC/203E, 3R/222E, 3Z/222EW, 3J/223E, 3JC/223E, 3JC/223E, 3R/223E, 3RC/223E, 3J/232E, 3J/252EW, 3R/252E, 3Z/252E, 3Z/253S
CN-2A CN-2B	Filament connector, small (1 required) Filament connector, large (1 required)	3R/262E, 3J/280E, 3R/280E, 3QC/294J, 4QC/300J, 4JC/301J, 4JC/302J
CN-2C	Grid connector (1 required)	3R/262E, 3J/280E, 3R/280E, 4QC/300J, 4JC/301J, 4JC/302J
CN-2D	Grid connector with corona ring (1 required)	3QC/294J, 4QC/300J, 4JC/301J, 4JC/302J

(g) For h.f. applications olnly

Miscellaneous

MG125A	Focus magnet	3RM/215G
HS10A	Heat sink block	4KC/160M
RT-53492	Mounting ring	F1086
RT-54002	Corona ring assembly	F1086
RN5A	Corona ring, anode	3QC/294J



Introduction

Many tubes listed in the general index are not included in the data tables because their use is primarily the maintenance of a limited number of equipments. However, data sheets are available for most of these tubes as well as for types with tabulated data in this volume.

It is worth noting, that pulse tubes listed on page 47 are also suitable for series and shunt regulator applications in addition to those tabulated on page 54.

Regulator Tubes

Type	Alternative code	I_k max. (mA)	r_a (Ω)	g_m (mA/V)	V_{g2} max. (V)	V max. (V)	P_a max. (W)	V_{g1} max. (V)	P_{g2} max. (W)	V_f (V)	I_f (A)	Base	Origin
6080 (b)	11D12 CV8216 CV2984	2×125	280	7		250	2×13			6,3	2,5	I0-8	GB
11E14 (c)	CV5830	200		16,5	400	800/2 000	10/6		4/2	6,3	1,2	I0-7	GB
3D21A (c)	CV2659	200		5,5	850	3 500	15	−500	3	6,3/12,6	1,7/0,85	Med. shell octal	GB
S11E12 (c), (d)	CV4060	300	400	14	300	800	28	−100	5	6,3	1,6	I0-8	GB
12E1* (c)	CV345	300	380	14	300	800	35	−100	5	6,3	1,6	I0-8	GB
12E14† (c)		300	380	14	300	800	35	−100	5	6,3	1,6	I0-8	GB
13E1 (c)	CV6045	800	130	35	300	800	90	−100	10	26/13	1,3/2,6	B7A	GB
13E12 (c)		800	110	25	300	800	90	−100	10	26/13	1,3/2,6	B7A	GB

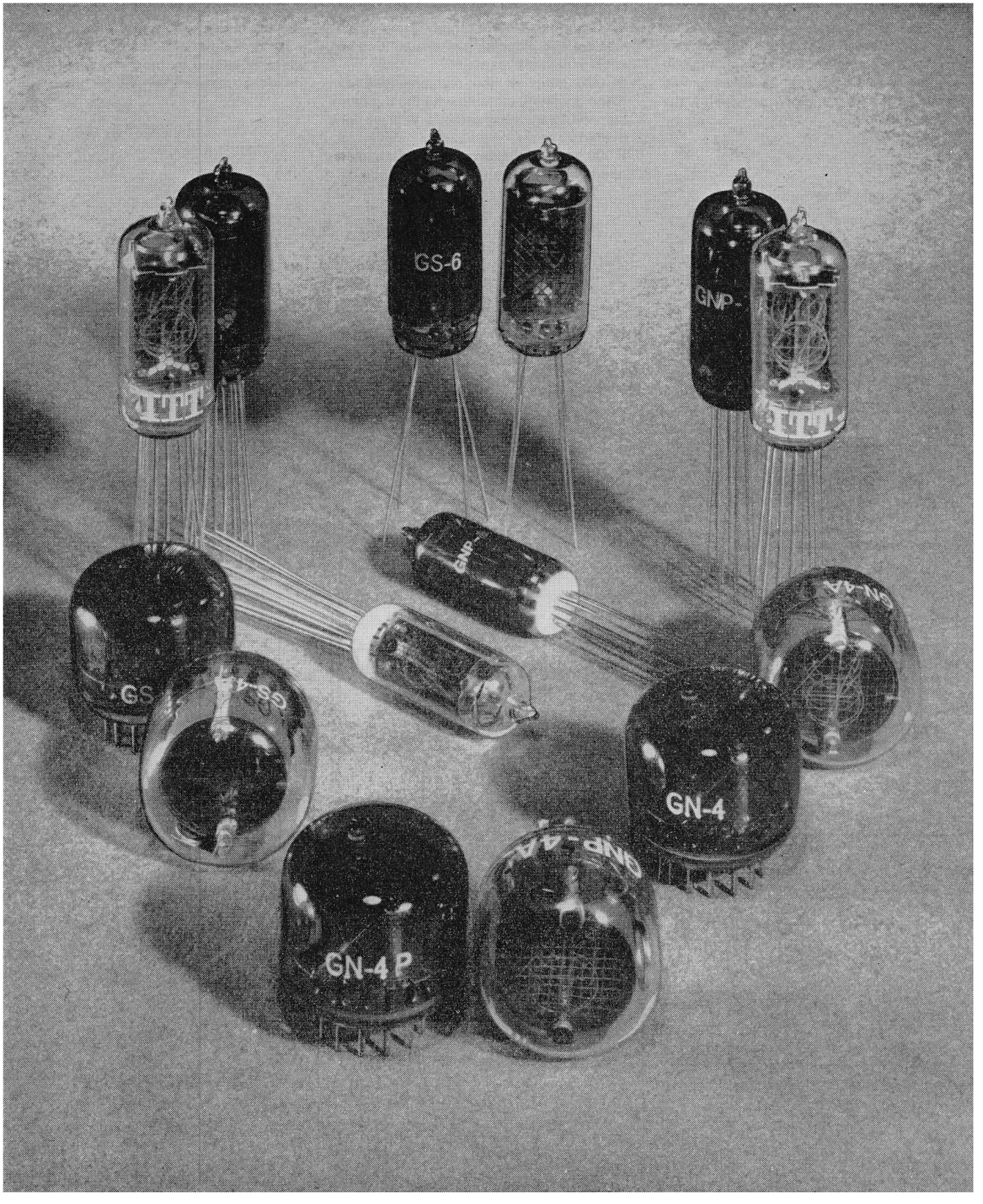
** Double-ended improved version is available under code 12E1C*
† Single-ended version of 12E1; preferred for new equipment design

Notes. (a) = Triode (c) = Beam tetrode
(b) = Double triode (d) = Special quality type

General Purpose Tubes

Type	Alternative code	Description	μ	Screen grid μ	g_m (mA/V)	V_a max. (V)	V_{g2} max. (V)	P_a max. (W)	P_{g2} max. (W)	V_f (V)	I_f (A)	Origin
L.3A/167M* 3A/167M	CV5112	High slope triode			47	350		6,5		6,3	0,45	GB
L.5A/170K*	CV3998	High slope beam tetrode		50	16,5	210	175	3,3	0,9	6,3	0,3	GB
S2P20*	CV4097	R.F. beam tetrode			4,3	150	150	5	2	5/2,5	0,23/0,46	GB
S6F33* 6F33	CV4064 CV2209	Dual control pentode		42	4	300	300	3	1,5	6,3	0,35	GB
CV4083*		Dual control pentode		42	4	300	300	3	1,5	6,3	0,3	GB
6F17 S6F17* S6F17F*	CV416 CV4040 CV4041	Pulse and r.f. tetrodes			8,3	600	600	3,5	0,7	6,3	0,3	GB
5A/206K	CV2243	R.F. tetrode		33	8,4	300	300	4,5	1,2	6,3	0,35	GB
HL23	CV1586	2V triode	32		1,5					2	0,05	GB
5A/102D	CV1724	Pentode		3,5	2,5	180	150			7,5	0,85	GB
5B/104D	CV9994	Beam tetrode		4,5	3	200	110	10	0,8	24	0,2	GB
5A/152M & G		Pentode		30	7,5	250	150	5		6,3	0,46	GB
5B/110M		Pentode		10	6,5	250	150	11		6,3	0,8	GB
5A/163K	CV1635	High slope pentode		50	32	350	175	6		6,3	0,45	GB

** Special quality tubes*


GS-6
GN-4
GN-4 P

Cold Cathode Indicator Tubes

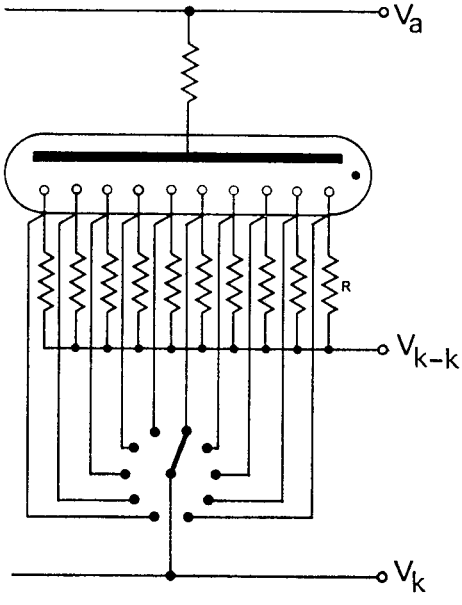
Description

Each tube has an anode and a number of cathodes, the latter being of the shape of the character to be displayed. On the application of a voltage between the anode and a selected cathode, the cathode glows to display the character required.

Applications

- Electronic data handling systems
- Measuring apparatus
- Machine control systems
- Signalling circuits
- Calling systems and similar equipment
- Lift indicators
- Telecommunications channel indicators
- Aircraft and train movement displays

Methods of Operation



V_a	=	⌒⌒	⎍
V_k	⏚ O/C or $V_{k\text{-}k}$	⏚ O/C or $V_{k\text{-}k}$	⎍
$V_{k\text{-}k}$			⏚

The switch in typical circuit above may be replaced by transistors, integrated circuit, thyristor, cold-cathode trigger tubes, amplifier valves or beam switch tube.

Life Behaviour

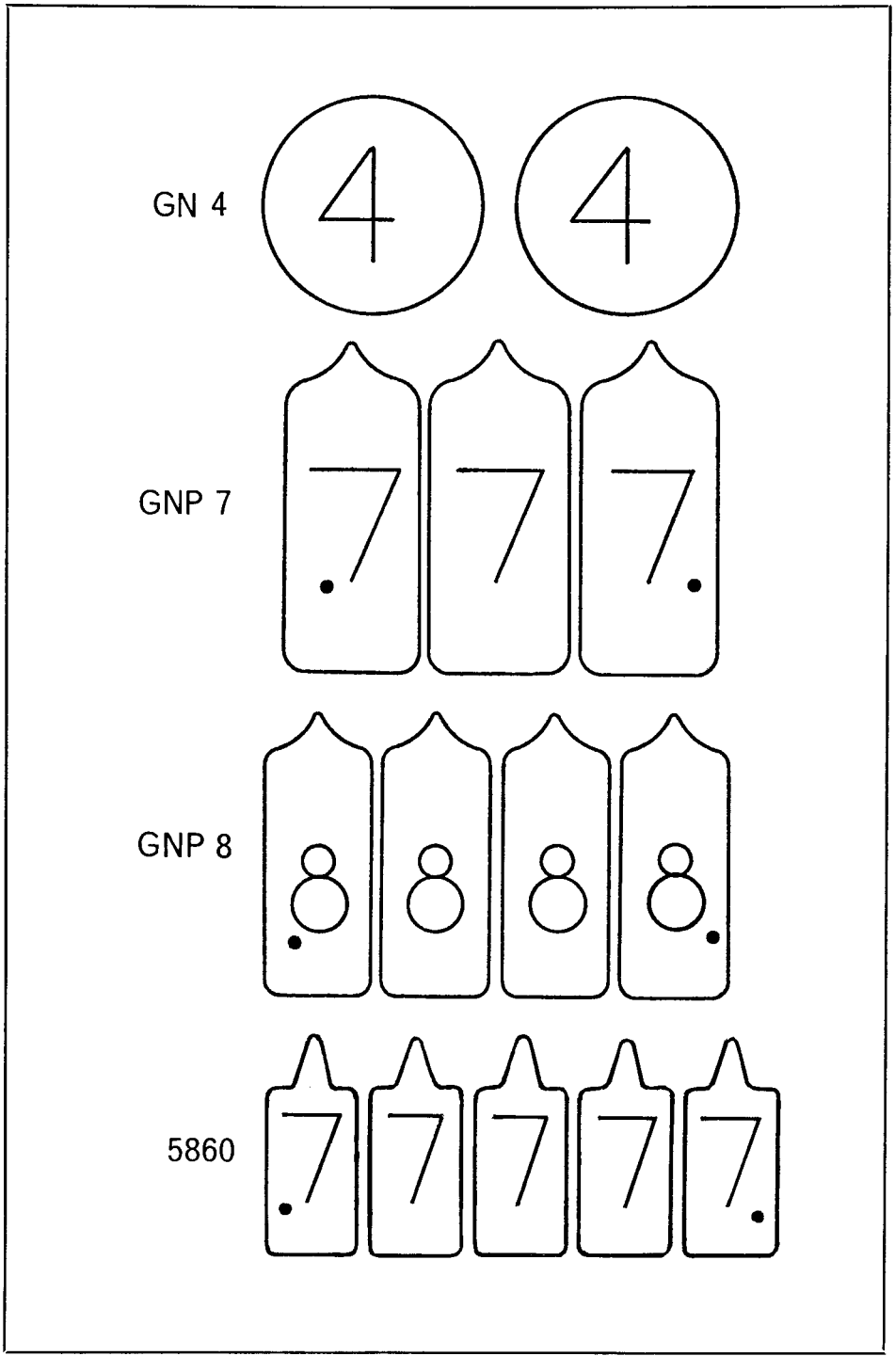
All tubes in the current range have a special gas filling and processing to ensure long life. Typical expected lives are:

30 000 hours at the recommended d.c. mean operating currents with the discharge stepped to the next cathode at least once every 100 hours.

5 000 hours at the recommended d.c. mean operating current on any one cathode.

Bulb Temperature

Recommended operating range −20°C to +70°C. Below 0°C there are likely to be wider variations in tube characteristics and life of tube may be shortened.



Abridged Data

Code	Characters		V_a min.	I_k average		i_k peak (Note 1)		Pre-bias (V_{k-k})		Outline diagram
	Description	Height		min.	max.	min.	max.	min.	max.	
		(mm)	(V)	(mA)	(mA)	(mA)	(mA)	(V)	(V)	
Side View Types										
5860	Digits 0 to 9 and two decimal points	13,5	170		5,0† 0,5‡		20† 2‡	30	110	E
GN-6* GN-6A GN-9	Digits 0 to 9	14	170	1,25	2,5		12	60	110	A
GNP-7* GNP-7A	Digits 0 to 9 and two decimal points	15,5	170	1,5† 0,1‡	3,0† 0,5‡		12 2	60	110	A
GNP-7H* GNP-7AH	Digits 0 to 9 and two decimal points	15,5	180		3,0† 0,5‡	12† 2‡	25† 6‡	25	100	A
GNP-8* GNP-8A	Digits 0 to 9 and two decimal points	14	200	1,25† 0,2‡	2,5† 0,4‡		12 3	70	110	B
GNP-8H* GNP-8AH	Digits 0 to 9 and two decimal points	14	180		2,5† 0,4‡	12† 2‡	25† 6‡	25	100	B
GS-6* GS-6A	Symbols + − ~	8,9	170	1,25	2,5		12	60	110	A
End View Types										
GN-4* GN-4A	Digits 0 to 9	15,5	170	1,5	3,0		10	60	110	C
GN-4P* GNP-4A	Digits 0 to 9 and one decimal point	15,5	170	1,5† 1,0‡	3,0† 0,5‡		10† 4‡	60 60	110 110	C C
GS-4* GS-4A	Symbols V A + − % ~	15,5	170	1,5	3,0		10	60	110	C
GN-5* GN-5A	Digits 0 to 9	25,4	200	2,5	5,0		10	75	110	D

Note 1. If tubes are required to work outside current limits shown, please consult manufacturer. For pulse operation, pulse width limits for all types are 100µs minimum and 20ms maximum.

* *Bulb is red-lacquered*

† *Cathode current for digits*

‡ *Cathode current for decimal point*

Type	Base connections													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
5860	k_1	k_2	k_3	k_4	k_5	k_6	a	k_7	k_8	a	k_9	k_0	$k_{d.p.}$	$k_{d.p}$
GN-6 GN-6A	a	k_0	k_1	k_2	k_3	k_4	k_5	k_6*	k_7	k_8	k_9			
GNP-7 GNP-7A GNP-7H GNP-7AH	k_1	k_2	k_3	k_4	k_5	$k_{d.p.}$	$k_{d.p.}$*	k_6	k_7	k_8	k_9	k_0	a	
GNP-8 GNP-8A	a	k_1	k_2	k_3	k_4	$k_{d.p.}$	k_5*	k_6	k_7	k_8	k_9	$k_{d.p.}$	k_0	
GNP-8H GNP-8AH	a	k_1	k_2	k_3	k_4	$k_{d.p.}$	k_5*	k_6	k_7	k_8	k_9	$k_{d.p.}$	k_0	
GN-9	k_1	k_2	k_3	I.C.	k_4	k_5	k_6	k_7	k_8	I.C.	k_9	k_0	a	
GS-6 GS-6A	a	I.C.	k_-*	I.C.	$k_\sim$	I.C.	k_+							
GN-4 GN-4A	I.C.	a	k_0	k_9	k_8	k_7	k_6	I.C.*	k_5	k_4	k_3	k_2	k_1	
GN-4P GNP-4A	I.C.	a	k_0	k_9	k_8	k_7	k_6	$k_{d.p.}$*	k_5	k_4	k_3	k_2	k_1	
GS-4 GS-4A	I.C.	a	k_Ω	$k_\%$	I.C.	k_v	k_+	I.C.*	$k_\sim$	k_A	I.C.	k_-	I.C.	
GN-5 GN-5A	k_1*	k_2	k_3	k_4	k_5	k_6	k_7	k_8	k_9	k_0	N.C.	a*		

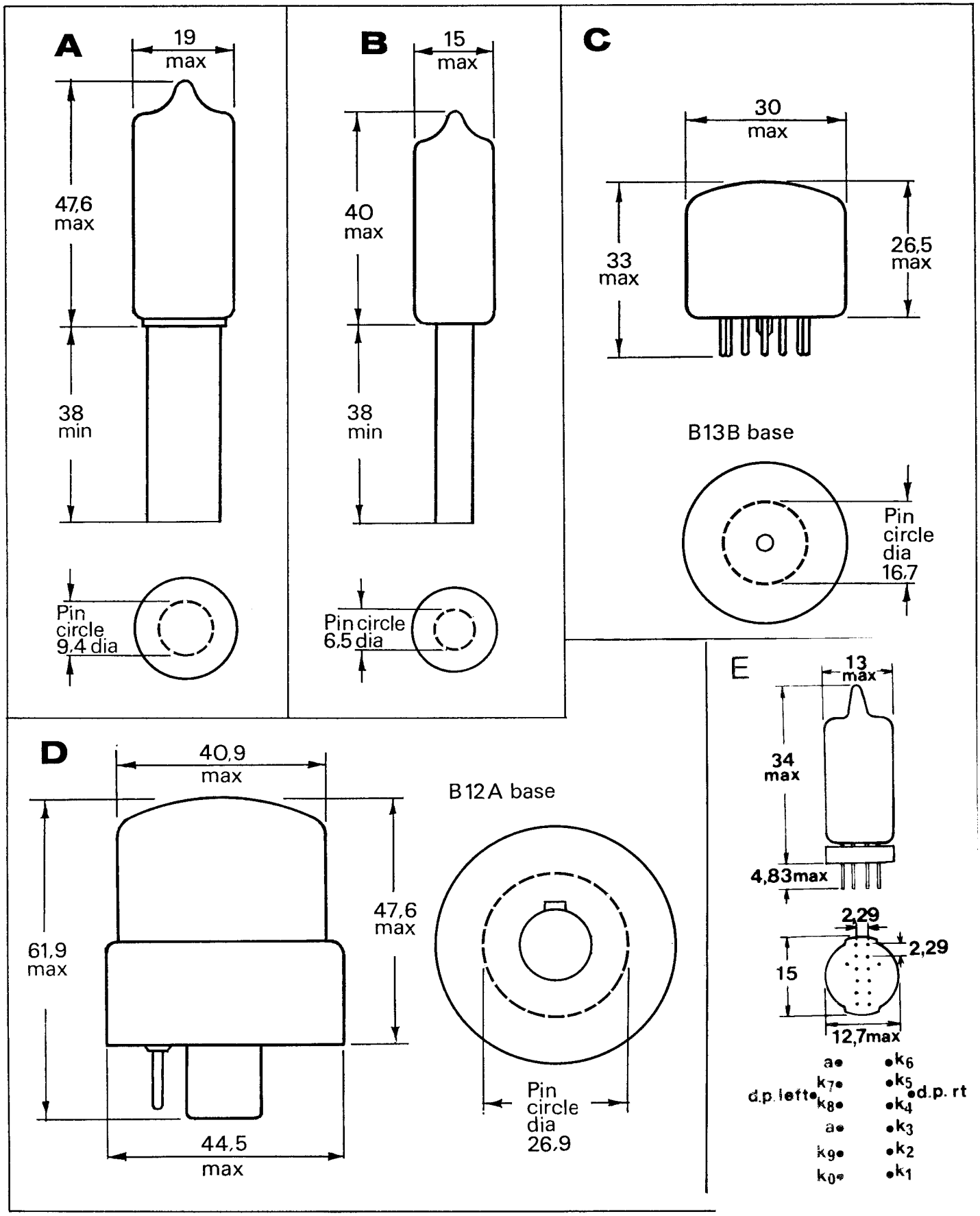
* *Indicates viewing point for side view tubes and top of characters for end view types*

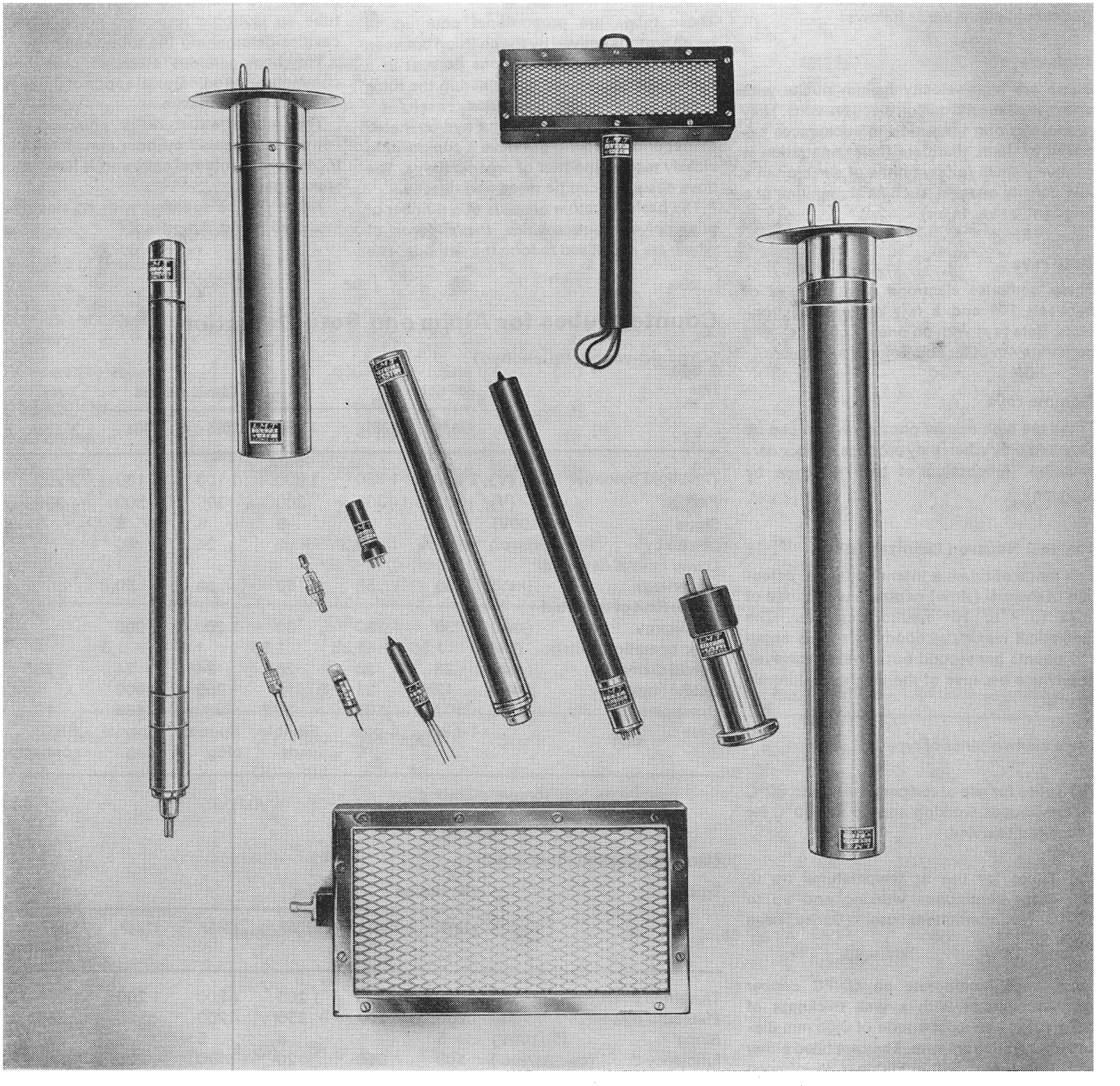
I.C. = Internally connected; no voltages to be applied

N.C. = Base pin not connected to tube

Origin GB

Outlines


A
19
max
47,6
max
38
min
Pin
circle
9,4 dia
B
15
max
40
max
38
min
Pin circle
6,5 dia
C
30
max
33
max
26,5
max
B13B base
Pin
circle
dia
16,7
D
40,9
max
61,9
max
47,6
max
44,5
max
B12A base
Pin
circle
dia
26,9
E
13
max
34
max
4,83max
2,29
2,29
15
12,7max
a
k7
k8
a
k9
k0
k6
k5
k4
k3
k2
k1
d.p. left
d.p. rt



Nuclear Particle Detection Tubes

These tubes, which are of the Geiger-Muller type, are designed for particle detection and measurement of alpha, beta and gamma radiation and of cosmic radiations.

They consist of two basic types of construction which are:

(a) Cylindrical type, in which the tube wall is either thick for gamma or cosmic radiations or thin for beta radiations. The tube lengths of particular types range from a few centimetres to one metre, and the tube diameter from a few millimetres to a few centimetres.

(b) Window type, made in various shapes and in which the window consists of very thin mica, aluminium or mylar to allow the passage of alpha rays or low-energy beta rays.

The main element of all types is similar. The positive electrode or anode consists of a wire with a diameter of from 50 to 100μm. The cathode is either the tube envelope, when this is metallic, or a wire when the envelope is non-metallic. The tubes contain a mixture of a rare gas and a quenching gas, the latter being organic or halagon vapour.

The main characteristics of alpha, beta and gamma radiations are as follows:

Alpha rays

These are high-velocity helium nuclei with energies of several million electron-volts. They produce strong ionisation in substances exposed to them, therefore their penetration is relatively small (a few tenths of a micron in a low density material, such as aluminium, or a few centimetres in air).

Beta rays

These comprise electrons with energies of between 10^5 and a few millions electron-volts. Beta rays with an energy of 1 MeV will penetrate 4m of air and 2mm of aluminium.

Gamma rays

These are high energy photons which can be detected only when they produce a secondary emission (production of beta radiation by collision).

Thermal Neutron Counter Tubes

This range of tubes is intended for the detection of thermal (slow) neutrons with fluxes of from 10^{-3} to 10^5 neutrons/cm²/sec. The theoretical maximum counting rate is about 10^5 counts per second but is never achieved in practice because of the mechanical inertia effects.

There are two series of types:

(a) Tubes for use at temperatures up to 80°C for continuous working and up to 100°C for intermittent service.

(b) Tubes for use at temperatures up to 200°C for continuous working and up to 250°C for intermittent use. (Codes have suffix T.)

All tubes incorporate an OHFC copper cylinder cathode with a wall thickness of 0,5 mm, and an axial anode of 0,05 mm diameter molybdenum wire. They are filled either with BF_3 (boron trifluoride) gas re-inforced with B^{10} to increase sensitivity, or helium 3.

BF_3 counters, except for NE3/1 types, have bases UG496U for connection to the corresponding male pins. The centre lead is the anode connection; the outer is cathode.

The higher working temperature types (suffix letter T) can be supplied with either a UG496U connector with special insulator, or with a rigid wire anode output.

The NE3/1 types are supplied either with a rigid anode wire inside a small tube screwed to the cathode cylinder extremity or with a BNC type coaxial plug (code suffix F).

All types, except the NE3/1 variety, can be supplied fitted inside a brass shield which is electrically insulated from the actual counter: the connection to the external circuit by a triaxial connector type EF69 (tube code final suffix CA, e.g. 14NE31T CA).

Fast Neutron Counter Tubes

These tubes are proportional counters of recoil protons derived by the collision between fast neutrons and the protons present in a hydrogenated material contained in the tube.

The counters are particularly useful for biological dosimetry since the hydrogenated matter and the filling gas have a composition closely resembling that of organic tissue. The dose absorbed can be measured directly.

The basic structure consists of a number of pure polyethylene cavities, the surfaces of which are metallised to form the cathode. The cavities are assembled in series to give the tube an isotropic response, the number of cavities determining the tube sensitivity.

The homogeneous stack of cells has a common longitudinal axial anode of 0,025 mm diameter tungsten wire.

The whole structure is enclosed in a hermetically-sealed cylinder connected electrically to the internal cells and is filled with a special gas.

Tubes can be supplied with an electrically insulated shield, if required.

Counter Tubes for Alpha and Beta Detection

(Organic-vapour-quenched)

Type		Bell types			Cosmic counters		X-ray counter
		13AP7	13B16	13AP9	10C5	10C8	20XP2A
Threshold potential	(V)	1 350	1 350	1 300	1 100	1 100	2 200
Plateau	(V)	300	300	300	300	300	200
Slope	(%/100V)	5	5	5	5	5	5
Efficiency	(counts/sec.)	4,4	3,3	2	25	50	
Lower limit of detected γ energy	(keV)	50	50	50	50	50	
Lower limit of detected β energy	(keV)	30	80	30	1 000	1 000	
Max. operating voltage	(kV)	1,55	1,55	1,55	1,3	1,3	
Useful diameter	(mm)	28	28	28	24	24	28*
Useful length	(mm)	42	31	16	250	500	
Overall length	(mm)	107	107	26,5	435	685	19
Base		4-pins	4-pins	Flexible leads	Special plug	Special plug	BNC connector

(Organic-vapour-quenched)

Type		Flat counters					
		12B1P	12B2P	12B3P	12B5P	12B6P	12B1PC (circulation)
Threshold potential	(V)	1 200	1 200	1 200	1 200	1 200	1 800
Plateau	(V)	250	250	250	250	125	250
Slope	(%/100V)	5	5	5	5	5	50
Efficiency	(counts/sec.)	100	250	20	70	25(γ) 50(β)	
Lower limit of detected γ energy	(keV)	5	5	5	5	50	3
Lower limit of detected β energy	(keV)	150	150	150	15	50	30
Max. operating voltage	(V)	1 350	1 350	1 350	1 350	1 350	1 350
Useful surface	(cm²)	245	700	50	175	100	245
Useful dimensions	(mm × mm)	216 × 117	340 × 200	125 × 40	440 × 40	136 × 74	216 × 117
Window thickness (density)	(mg/cm²)	19	19	19	19	29	1
Base		BNC connector – all types					

* *Useful surface in cm²*

Origin F

Counter Tubes for Gamma Detection

(Halogen-vapour-quenched)

Type		3G3C	3G5	3G6	3G8B	3G12 3G12C	3B17C	3G10
Threshold potential	(V)	420	430	430	445	390	390	360
Plateau	(V)	200	100	100	100	160	160	80
Slope	(%/100V)	7	8	12	20	7	7	30
Efficiency	(counts/sec.)	130 000	14 000	5 500	1 200	70 000	100 000	10
Lower limit of detected γ energy	(keV)	50	50	50	50	50	10	40
Lower limit of detected β energy	(MeV)	0,8	0,8	0,8	2	0,8	0,25	2
Max. operating voltage	(V)	600	550	550	550	550	550	450
Useful diameter	(mm)	16	7,5	6	4	16	20	1
Overall diameter	(mm)	23	13	13	13	23	23	7
Useful length	(mm)	185	45	20	8	100	100	0,4
Overall length	(mm)	271	82	60	46	186	186	34
Base (Note 1)		Noval	Flexible leads	Flexible leads	End caps	Flexible leads or Noval	Noval	Flexible leads

Type		3G70	3G100	3G500	3G1000	3G3000	3G8.500	3G10000	4G14C
Threshold potential	(V)	360	360	360	360	360	360	360	520
Plateau	(V)	80	80	80	80	80	80	80	150
Slope	(%/100V)	30	25	20	20	7	7* 15†	7	7
Efficiency	(counts/sec.)	70	100	500	1 000	3 000	8 000* 500†	10 000	250
Lower limit or detected γ energy	(keV)	40	40	40	40	40	50	40	50
Lower limit of detected β energy	(MeV)	2	2	2	2	2		2	2
Max. operating voltage	(V)	450	450	450	450	450	450	450	450
Useful diameter	(mm)	1,5	1,5	4,1	4,1	4,1	7,5* 4†	7,5	26,4
Overall diameter	(mm)	7	7	9,5	9,5	9,5	12	12	34,5
Useful length	(mm)	1,85	1,85	2	5,5	24	30* 1,5†	36	230
Overall length	(mm)	34	34	34	38	55	70	65	325
Base (Note 1)		Flexible leads	Flexible leads	Flexible leads	Flexible leads	Flexible leads	Flexible leads	Flexible leads	Flexible leads

* *Data for 8 000 structure*

† *Data for 500 structure*

Origin F

Note 1. Excepting type 3G8B, all types can be supplied either with base or flexible leads.

Counter Tubes for Thermal (Slow) Neutron Detection

Boron trifluoride filled

(For use at temperatures up to 100°C)

Type		0,06NE3/1	0,1NE3/1	0,2NE3/1	1,5NE12	3NE12	5NE12	4NE31	8NE31	14NE31	23NE31	5NE40	10NE40
Sensitivity for 1 neutron/cm²/sec (counts/sec.)		0,06	0,10	0,17	1,4	2,8	4,7	3,7	7,2	12	23	5,3	10,4
Electrical Characteristics (Note 1)													
Threshold potential	(V)	1 000	1 400	1 900	1 350	1 800	2 400	1 300	1 800	2 350	2 350	1 350	1 800
Minimum plateau	(V)	150	150	150	150	150	150	150	150	150	150	150	150
Maximum slope	(%/100V)	6	5	4	3	3	4	3	3	4		3	3
Capacitance (with coaxial plug)	(pF)	2	2	2	6	6	6	8	8	8		10	10
Physical Characteristics													
Overall length	(cm)	7,5	7,5	7,5	27,5	27,5	27,5	46,5	46,5	46,5	46,5	60,5	60,5
External diameter	(cm)	1	1	1	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
Useful length	(cm)	3	3	3	12	12	12	31	31	31	31	45	45
Useful surface	(cm²)	9,4	9,4	9,4	94	94	94	243	243	243	243	253	253
BF_3 pressure	(cm. Hg)	20	40	70	20	40	70	20	40	70		20	40
Maximum ambient temperature (Note 2)	(°C)	100	100	100	100	100	100	100	100	100	100	100	100

Type		18NE40	42NE40/5	73NE40/5	15NE14/5	1,25NE3	1NE3	0,05NE1TS*	1NE2TS†
Sensitivity for 1 neutron/cm²/sec (counts/sec.)		17,5	36,5	59	12,6	1,16	1	0,05	1
Electrical Characteristics (Note 1)									
Threshold potential	(V)	2 350	2 000	2 600	2 000	2 500	1 900	1 900	1 900
Minimum plateau	(V)	150	150	150	150	150	150	1 600	1 900
Maximum slope	(%/100V)	4	4	4	4	4	4	6	8
Capacitance (with coaxial plug)	(pF)	10	10	10	—	—	—		
Physical Characteristics									
Overall length	(cm)	60,5	62	62	25	15,1	15,1	0,42	6
External diameter	(cm)	2,5	5	5	5	2,5	2,5	0,10	2,5
Useful length	(cm)	45	40	40	13,8	3	3	0,08	2,1
Useful surface	(cm²)	253	628	628	217	23,5	23,5		
BF_3 pressure	(cm. Hg)	70	40	70	40	70	60	70	70
Maximum ambient temperature (Note 2)	(°C)	100	100	100	100	100	100	100	100

Note 1. Data for an amplifier gain of 7 000 (14 000 for NE3/1 types); a differentiation of 3×10^{-5} seconds; an integration of 3×10^{-7} seconds; and a discriminator threshold of 15V.
** The 0,5NE1TS can be supplied with a screen and H.T. BNC connector UG931-U.*

Note 2. For exposures limited to 50 hours.

† The 1NE2TS can be supplied with a different filling which gives an operating voltage of 1 800V (tube code is 0,8NE2TS).
Both the 1NE2TS and 0,8NE2TS can be supplied with a screen and connector UG496-U (tube codes 1NE2T and 0,8NE2T).

Origin F

Counter Tubes for Thermal (Slow) Neutron Detection (continued)

Helium 3 filled

(For use at temperatures up to 200°C)

Type		15NH15	24NH15	33NH15	30NH30	47NH30	65NH30	24NH15K	47NH30K
Nuclear Characteristic									
Sensitivity for 1 neutron/cm^2/sec.									
at pressure of 2 bar	(counts/sec.)	15	15	15	30	30	30	15	30
at pressure of 4 bar	(counts/sec.)	24	24	24	47	47	47	24	47
at pressure of 10 bar	(counts/sec.)	33	33	33	65	65	65	33	65
Electrical Characteristics									
Operating voltage (for gas amplification factor M=50)	(V)	850	970	1 330	850	970	1 330	1 100	1 100
Input threshold potential	(mV)	0,2	0,3	0,6	0,2	0,3	0,6	0,4	0,4
Minimum plateau	(V)	110	110	150	110	110	150	120	120
Slope	(%/100V)	5	5	5	5	5	5	5	5
Pulse height (thermal peak with 250pF input capacitance)	(mV)	9	9	9	9	9	9	9	9
Physical Characteristics									
Overall length	(mm)	248	248	248	398	398	398	248	398
External diameter	(mm)	25	25	25	25	25	25	25	25
Useful length	(mm)	150	150	150	30	300	300	150	300
Useful diameter	(mm)	23	23	23	23	23	23	23	23
Helium 3 pressure	(bar)	2	4	10	2	4	10	4	4
Total pressure	(bar)	2	4	10	2	4	10	6*	6*
Max. ambient temperature	(°C)	200	200	200	200	200	200	200	200
Connector (Teflon insulated), type		HN	HN	HN	HN	HN	HN	HN	HN

** Includes 2 bars of Krypton. Tubes are for spectrometry of fast neutrons*

Origin F

Counter Tubes for Thermal (Slow) Neutron Detection

Boron trifluoride filled

(For use at temperatures up to 200°C)

Type		1,5NE12T	3NE12T	5NE12T	4NE31T	8NE31T	14NE31T	5NE40T	10NE40T	18NE40T
Sensitivity for 1 neutron/cm^2/sec.	(counts/sec.)	1,4	2,8	4,7	3,7	7,2	12	5,3	10,4	17,5
Electrical Characteristics (Note 1)										
Threshold potential	(V)	1 350	1 800	2 400	1 300	1 800	2 350	1 350	1 800	2 350
Minimum plateau	(V)	150	150	150	150	150	150	175	175	150
Maximum slope	(%/100V)	3	3	4	3	3	4	3	3	4
Capacitance (with coaxial plug)	(pF)	9	9	9	12	12	12	13	13	13
Physical Characteristics										
Overall length	(cm)	25	25	25	44	44	44	58	58	58
External diameter	(cm)	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
Useful length	(cm)	12	12	12	31	31	31	45	45	45
Useful surface	(cm^2)	94	94	94	243	243	243	353	353	353
BF_3 pressure	(cm. Hg)	20	40	70	20	40	70	20	40	70
Maximum ambient temperature (Note 2)	(°C)	200	200	200	200	200	200	200	200	200

Note 1. Data for an amplifier gain of 7 000; a differentiation of 3×10^{-5} seconds; an integration of 3×10^{-7} seconds; and a discriminator threshold of 15V.

Note 2. For exposures limited to 50 hours.

Origin F

Counter Tubes for Fast Neutron Detection

Type		DNR2A (2 cavities)	DNR5A (5 cavities)	DNR10A (10 cavities)
Insulation resistance	(Ω)	10^{14}	10^{14}	10^{14}
Operating voltage	(V)	1 400 to 1 600	1 400 to 1 600	1 400 to 1 600
Multiplication coefficient		2 000	2 000	2 000
Sensitivity	(C/rad.)	$0{,}6\times10^{-4}$	$1{,}4\times10^{-4}$	$2{,}8\times10^{-4}$
Load resistance	(kΩ)	10	10	10
Maximum operating temperature	(°C)	75	75	75
Base		All types can be supplied with a 2-pin plug or coaxial connector type 34BKT (centre lead anode).		

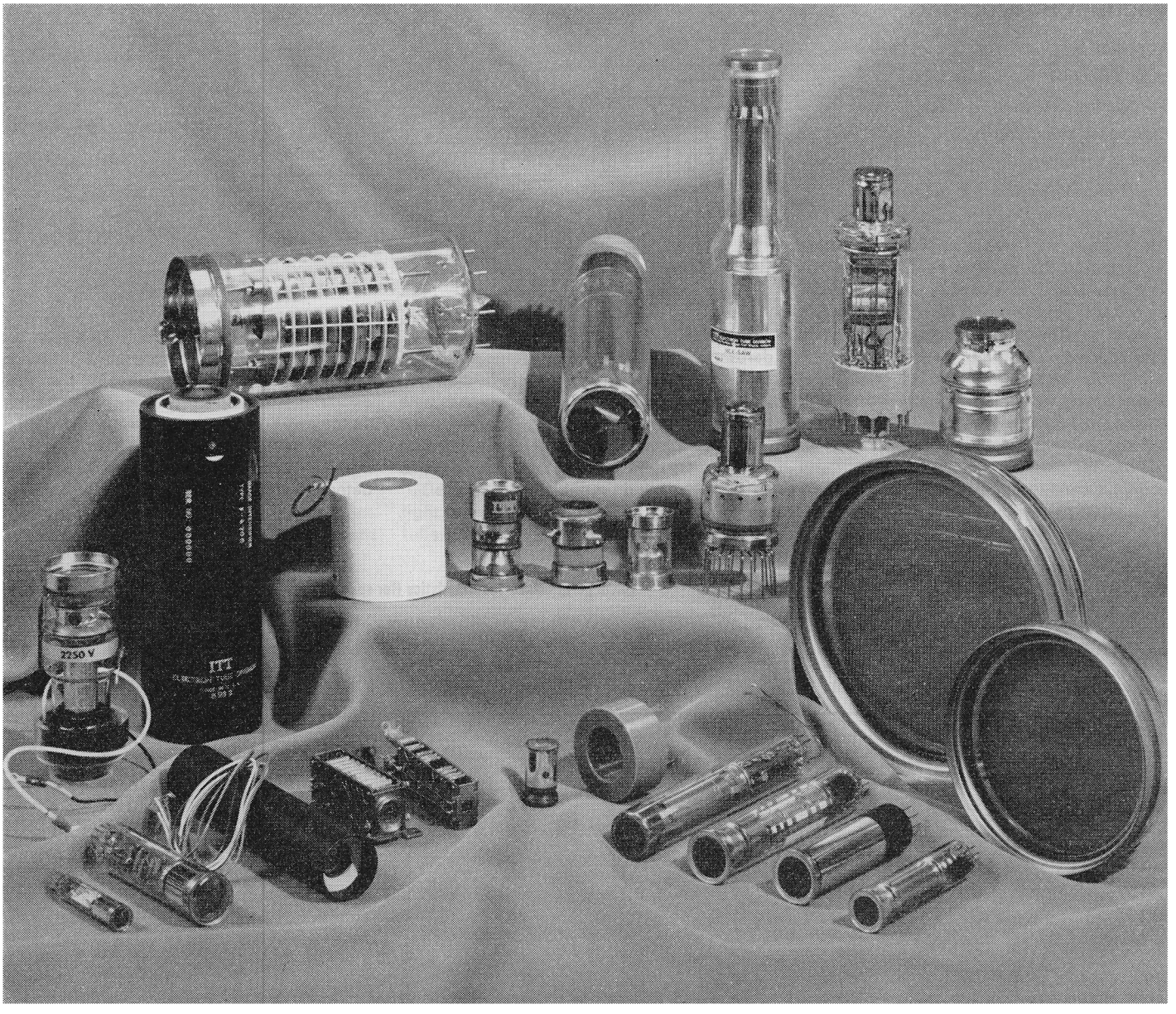
Origin F

Beta, Gamma and Thermal Neutron Detector Probes

Type		Beta Probe* SB6P-6	Gamma Probe SG10.000-6	Neutron Probe SNE12/12
Nuclear Characteristics				
Gamma sensitivity				
at 1 mR/h. C_0 60	(counts/sec.)		10	
at 0,1 mR/h. C_0 60	(counts/sec.)	25		
Lower limit of detected gamma energy	(keV)	3	50	
Average beta efficiency (2π)	(%)	50		
Carbon 14	(%)	>10		
Prometheum 147	(%)	>20		
Lower limit of detected beta energy	(keV)	50		
Background				
without shield, approx.	(counts/sec.)	4		
under 5cm lead, max.	(counts/sec.)		15	
Gamma intensity				
for 50% saturation, min.	(R/h)		1	
for 100% saturation, min.	(R/h)		20	
Electrical Characteristics				
Power supply voltage, nominal	(V)	6	6	12
Load resistance, average	(Ω)	16	22	35
Output pulse		5,5V × 2μs	5,5V × 2μs	
Max. power consumption (under saturating dose)	(mW)	100	120	300
Coaxial length, max.	(m)	100	100	
Physical Characteristics				
Operating temperature range	(°C)	−10 to +50	−40 to +70	
Overall length (less connector)	(mm)	187	190	
Overall width	(mm)	102		
Overall height	(mm)	94		
Overall diameter	(mm)		50	
Useful surface	(cm^2)	101		
Useful length	(mm)		36	
Coaxial cable length	(m)	100	100	100
Connector		BNC UG931/U	BNC R90810	

* *Data given for this probe is provisional*

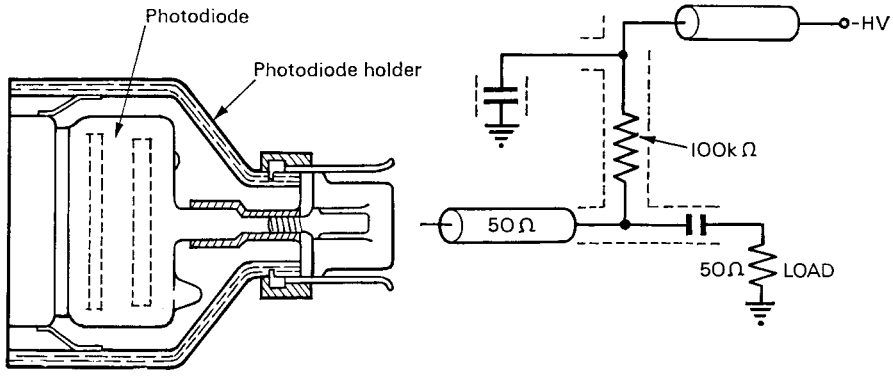
Origin F


2250 V
ITT

Vacuum Photodiode Tubes

Applications

Laser detection
Scintillation detection
High speed switching
Solar radiation monitoring
Interference detection



These tubes are used in applications where the radiation flux level is relatively high. A complete range of tubes is available with diameters ranging from 19 mm to 178 mm and spectral sensitivities from ultraviolet to near infrared.

Primarily because of the plane parallel geometry or biplanar configuration of the anode and cathode, high linear output currents can be generated.

Other features of the 'biplanar' photodiodes include sub-nanosecond response times, low dark currents, stability, high voltage operation, and wide dynamic range.

High level light and radiation response with high linearity are achieved over a wide dynamic range in a relatively simple vacuum photodiode tube design, consisting of a photocathode and the anode.

The photocathode is excited by light reaching it through the faceplate and the mesh anode. Electrons released are attracted to the anode and constitute the signal current.

Scintillator materials are available for placing in faceplate cavities of several designs for detecting radioactive energy.

Type	Spectral response (see Fig. 1)	Tube diameter nom. (mm)	Useful cathode diameter (mm)	Typical performance characteristics (for specified voltage at 25 °C)					Tube holder
				Operating voltage d.c. or pk. a.c. (kV)	Typical luminous sensitivity (μA/1m)	Max. anode dark current (μA)	Max. linear signal output current (A)	$t_{anode\ rise}$ (s)	
FW114	S4	57	44,5	2,5	30	0,005	5	5×10^{-10}	F4502
FW114A	S20 (a)	57	44,5	2,5	80	0,005	5	5×10^{-10}	F4502
FW127	S4	127	107,9	2,5	30	0,01	30	5×10^{-10}	
FW128	S4	32	21,3	1	30	0,005	0,5	7×10^{-10}	F4503
FW140	UV (b)	19	11,4	0,15	(c)	0,00001	—	—	
FW156	UV (b)	19	11,4	0,15	(c)	0,00001	—	—	
FW157	UV (b)	19	11,4	0,15	(c)	0,00001	—	—	
FW162	S4	19	11,4	1	25	0,0001	0,1	—	
F4000 (S1)	S1	57	44,5	2,5	12	0,05	5	5×10^{-10}	F4502
F4000 (S5)	S5	57	44,5	2,5	30	0,005	5	5×10^{-10}	F4502
F4000 (S20UVG)	S20 (e)	57	44,5	2,5	80	0,005	5	5×10^{-10}	F4502
F4007 (S4)	S4	178	152,4	2,5	30	0,005	60	5×10^{-10}	
F4014 (S1)	S1	19	10,2	1	10	0,05	0,1	1×10^{-10}	
F4014 (S4)	S4	19	10,2	1	20	0,0001	0,1	1×10^{-10}	
F4018 (S1)	S1	32	21,3	1	10	0,05	0,5	5×10^{-10}	F4503
F4018 (S5)	S5	32	21,3	1	30	0,005	0,5	5×10^{-10}	F4503
F4018 (S20)	S20 (a)	32	21,3	1	80	0,005	0,5	5×10^{-10}	F4503
F4018 (S20UVG)	S20 (e)	32	21,3	1	80	0,005	0,5	5×10^{-10}	F4503
F4018 (C_sT_eUVG)	UV (b)	32	21,3	1	(c)	0,005	0,5	5×10^{-10}	F4503
F4040 (S20)	S20	46	27,9	0,1	80	0,002	—	—	

Notes

(a) The S-20 designation is for a multi-alkali photosurface on a translucent glass substrate. The FW114A photocathode is formed on an opaque metal substrate, therefore there may be a departure from the typical S-20 spectral response curve.

(b) No "S" designation has been assigned to these types of photocathodes – insensitive to visible and infrared radiation.

(c) Quantum efficiency at 2 735 angstroms is 0,1 electrons per photon.

(d) Output current averaged over 1 second time interval and uniformly distributed over photocathode. The permissible output current will be reduced according to the 3/2 power law for lower operating voltages.

(e) Ultraviolet grade glass entrance window for extended response to the ultraviolet region.

Photo-Multiplier Tubes

Applications

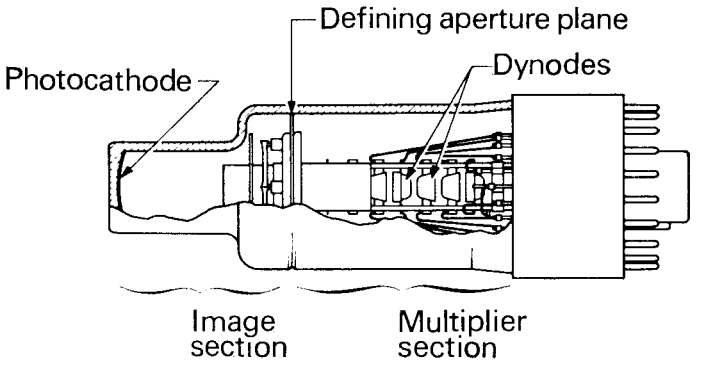
Stellar observations

Star tracking

Laser detection

Vibration analysis

Scintillation counting



A complete range of special purpose photo-multipliers providing broad spectral response from the ultraviolet to the near infrared for the detection of moderate to very low levels of radiated energy.

The range includes star tracker types characterized by low dark currents, low noise, high sensitivity, single electron counting and magnetic deflection capabilities.

Other types are available for applications involving high current operation, high ambient temperature, general scintillation counting, electron energy selection, heterodyne detection, fast gating, and detection of modulated high frequency light beams.

Ruggedized versions of many types are available.

Detection and amplification of low-level light are achieved with ITT photomultiplier tubes within a configuration of three basic elements: a photocathode, a system of dynode multipliers and a collector.

Light impinging on the photocathode stimulates emission which is directed to the first dynode. Secondary emission caused at the first dynode is equivalent to an amplified signal; the process is repeated through each dynode and is collected at the anode which serves as the signal output electrode.

Performance tables for Photo-Multiplier Diodes are given overleaf. Notes for this table are given below.

(a) Available with various Instantaneous Effective Photocathode Diameters (IEPD's). Typical Performance Characteristics shown are for tubes having a 0,1 inch (2,54 mm) diameter IEPD.

(b) Developmental tube type.

(c) Sapphire entrance window for extended response into the ultraviolet region.

(d) Ultraviolet grade glass entrance window for extended response into the ultraviolet region.

(e) No spectral response S-designation has been assigned to this photocathode type.

Special notes

1. Dynode structure; box and grid

2. Dynode structure; linear focused

3. Dynode structure; venetian blind

4. Secondary emitting surface; A_g-M_g-O

5. Secondary emitting surface; C_u-B_e-O

6. Ruggedized

7. Not ruggedized

8. Internal voltage divider

9. No internal voltage divider

Photo-Multiplier Tubes (continued)

Type	Note p. 67	Special features	Spectral response (see Fig. 1) Note p. 67	Photocathode Material	Photocathode Max. useful diameter (mm)	Number dynode stages	Special notes
FW118	(a)	Low-noise, deflectable, photon counting	S1	A_g–O–C_s	19,05	16	1, 4, 7, 9
FW129	(a)		S11	C_s–S_b	19,05	16	1, 4, 7, 9
FW130	(a)		S20	S_b–K–N_a–C_s	19,05	16	1, 4, 7, 9
FW136	(a)	Ruggedized, low-noise deflectable	S11	C_s–S_b	19,05	16	1, 4, 6, 9
FW142	(a)		S1	A_g–O–C_s	19,05	16	1, 4, 6, 9
FW143	(a)		S20	S_b–K–N_a–C_s	19,05	16	1, 4, 6, 9
F4002 (S1)		Quadrant multiplier 4-channel output	S1	A_g–O–C_s	24,64	16	1, 4, 7, 9
F4002 (S11)			S11	C_s–S_b	24,64	16	1, 4, 7, 9
F4002 (S20)			S20	S_b–K–N_a–C_s	24,64	16	1, 4, 7, 9
F4003 (S1)	(a)	Small diameter, low-noise deflectable	S1	A_g–O–C_s	19,05	16	1, 4, 7, 8
F4003 (S11)	(a)		S11	C_s–S_b	19,05	16	1, 4, 7, 8
F4003 (S20)	(a)		S20	S_b–K–N_a–C_s	19,05	16	1, 4, 7, 8
F4004 (S1)	(a)	Short, low-noise deflectable, ruggedized	S1	A_g–O–C_s	19,05	15	1, 4, 6, 9
F4004 (S11)	(a)		S11	C_s–S_b	19,05	15	1, 4, 6, 9
F4004 (S20)	(a)		S20	S_b–K–N_a–C_s	19,05	15	1, 4, 6, 9
F4008 (S1)		High current, fast response	S1	A_g–O–C_s	40,64	6	2, 4, 7, 9
F4008 (S11)			S11	C_s–S_b	40,64	6	2, 4, 7, 9
F4008 (S20)			S20	S_b–K–N_a–C_s	40,64	16	2, 4, 7, 9
F4013 (S20S)	(a)	Deflectable, low-noise	S20 (c)	S_b–K–N_a–C_s	19,05	16	1, 4, 7, 9
F4013 (S20UVG)	(a)	u.v. response	S20 (d)	S_b–K–N_a–C_s	19,05	16	1, 4. 7. 9
F4027 (S1)	(a)	Grid control, low-noise, deflectable	S1	A_g–O–C_s	19,05	16	1, 4, 7, 9
F4027 (S11)	(a)		S11	C_s–S_b	19,05	16	1, 4, 7, 9
F4027 (S20)	(a)		S20	S_b–K–N_a–C_s	19,05	16	1, 4, 7, 9
F4028		High temperature operation	Bialkali (e)	S_b–K–N_a	25,4	16	1, 4, 6, 8
F4030 (S1)		High current, fast response	S1	A_g–O–C_s	40,64	9	2, 4, 7, 9
F4030 (S11)			S11	C_s–S_b	40,64	9	2, 4, 7, 9
F4030 (S20)			S20	S_b–K–N_a–C_s	40,64	9	2, 4, 7, 9
F4034 (S1)	(a)	Low-noise, fast response, deflectable 50Ω coaxial output	S1	A_g–O–C_s	19,05	10	2, 4, 7, 9
F4034 (S11)	(a)		S11	C_s–S_b	19,05	10	2, 4, 7, 9
F4034 (S20)	(a)		S20	S_b–K–N_a–C_s	19,05	10	2, 4, 7, 9
F3035 (S11)		General scintillation capabilities	S11	C_s–S_b	40,13	10	3, 5, 7, 9
F4038 (S11)			S11	C_s–S_b	65,79	10	3, 5, 7, 9
F4039 (S11)			S11	C_s–S_b	11,25	10	3, 5, 7, 9
F4045 (S1)		Small size	S1	A_g–O–C_s	25,4	16	1, 4, 7, 8
F4045 (S11)			S11	C_s–S_b	25,4	16	1, 4, 7, 8
F4045 (S20)			S20	S_b–K–N_a–C_s	25,4	16	1, 4, 7, 8
F4045 (S20S)		Small size, u.v. response	S20 (c)	S_b–K–N_a–C_s	25,4	16	1, 4, 7, 8
F4045 (S20UVG)			S20 (d)	S_b–K–N_a–C_s	25,4	16	1, 4, 7, 8
F4046 ($C_sT_eL_iF$)		Solar blind	UV	C_s–T_e	25,4	16	1, 4, 7, 8
F4046 ($C_sT_eM_gF_2$)			UV	C_s–T_e	25,4	16	1, 4, 7, 8
F4047 (C_sIL_iF)			UV	C_s–I	25,4	16	1, 4, 7, 8
F4060 (S20)	(b)	Interference detection	S20	S_b–K–N_a–C_s	—	14	1, 4, 9
F4063 (S20)		Laser detector	S20	S_b–K–N_a–C_s	25,4	16	1, 4, 7, 8
F4069 (S20)	(b)	Solid state multiplier	S20	S_b–K–N_a–C_s	—	—	—
F4071 (S1)	(a)	Laser ranging, Image dissector and star tracker capability	S1	—	5,08	10	1
F4071 (S11)	(a)		S11	—	5,08	10	1
F4075 (S25)		Photon counting	S25	S_b–K–N_a–C_s	19,2	16	1, 4

Notes for this table are given on page 67

Typical performance characteristics (for specified voltage at 25 °C)

V_{a-k} (kV)	Luminous sensitivity Cathode (μA/lm)	Anode (A/lm)	Current amplification	Anode dark current (μA)	Max. luminous equivalent anode dark current input (lm)	Equivalent luminous noise input (lm)	$t_{transit}$ (s)	$t_{anode\ rise}$ (s)
1,8	20	200	1×10^{7}	1	5×10^{-8}	5×10^{-11}	8×10^{-8}	16×10^{-9}
1,8	65	650	1×10^{7}	0,005	1×10^{-11}	5×10^{-13}	8×10^{-8}	16×10^{-9}
1,8	150	300	2×10^{6}	0,001	5×10^{-12}	1×10^{-13}	8×10^{-8}	16×10^{-9}
1,8	65	650	1×10^{7}	0,005	1×10^{-11}	5×10^{-13}	8×10^{-8}	16×10^{-9}
1,8	20	200	1×10^{7}	1	5×10^{-8}	5×10^{-11}	8×10^{-8}	16×10^{-9}
1,8	150	300	2×10^{6}	0,001	5×10^{-12}	1×10^{-13}	8×10^{-8}	16×10^{-9}
1,8	20	200	1×10^{7}	1	5×10^{-8}	3×10^{-11}	8×10^{-8}	16×10^{-9}
1,8	60	600	1×10^{7}	0,01	2×10^{-12}	—	8×10^{-8}	16×10^{-9}
1,8	150	300	2×10^{6}	0,005	5×10^{-11}	—	8×10^{-8}	16×10^{-9}
1,8	20	100	5×10^{6}	3	5×10^{-8}	3×10^{-11}	8×10^{-8}	16×10^{-9}
1,8	65	330	5×10^{6}	0,005	1×10^{-11}	1×10^{-13}	8×10^{-8}	16×10^{-9}
1,8	150	750	5×10^{6}	0,001	5×10^{-12}	1×10^{-13}	8×10^{-8}	16×10^{-9}
1,8	20	100	5×10^{6}	1	5×10^{-8}	3×10^{-11}	8×10^{-8}	16×10^{-9}
1,8	60	120	5×10^{6}	0,01	1×10^{-11}	5×10^{-13}	8×10^{-8}	16×10^{-9}
1,8	150	300	2×10^{6}	0,005	5×10^{-11}	1×10^{-13}	8×10^{-8}	16×10^{-9}
5	20	—	1×10^{4}	10	—	—	—	$1{,}5\times10^{-9}$
5	45	—	1×10^{4}	1	—	—	—	$1{,}5\times10^{-9}$
5	150	—	1×10^{4}	1	—	—	—	$1{,}5\times10^{-9}$
1,8	150	300	2×10^{6}	0,001	5×10^{-12}	1×10^{-13}	8×10^{-8}	16×10^{-9}
1,8	150	300	2×10^{6}	0,001	5×10^{-12}	1×10^{-13}	8×10^{-8}	16×10^{-9}
1,8	20	50	5×10^{5}	1	5×10^{-8}	3×10^{-11}	16×10^{-9}	16×10^{-9}
1,8	50	200	5×10^{5}	0,05	1×10^{-12}	5×10^{-13}	16×10^{-9}	16×10^{-9}
1,8	100	200	5×10^{5}	0,01	1×10^{-10}	5×10^{-13}	16×10^{-9}	16×10^{-9}
1,8	80	160	2×10^{6}	1	5×10^{-11}	5×10^{-13}	6×10^{-8}	1×10^{-8}
5	20	100	5×10^{6}	10	—	—	—	2×10^{-9}
5	45	—	5×10^{6}	1	—	—	—	2×10^{-9}
5	140	—	5×10^{6}	1	—	—	—	2×10^{-9}
5	20	—	1×10^{6}	—	—	—	16×10^{-9}	8×10^{-10}
5	60	—	1×10^{6}	—	—	—	16×10^{-9}	8×10^{-10}
5	150	—	1×10^{6}	—	—	—	16×10^{-9}	8×10^{-10}
1,5	—	—	—	—	—	—	—	—
1,5	—	—	—	—	—	—	—	—
1,5	—	—	—	—	—		—	—
1,8	20	200	1×10^{7}	5	3×10^{-8}	2×10^{-12}	6×10^{-8}	1×10^{-8}
1,8	40	400	1×10^{7}	1	3×10^{-12}	1×10^{-12}	6×10^{-8}	1×10^{-8}
1,8	100	200	2×10^{6}	0,01	5×10^{-11}	5×10^{-13}	6×10^{-8}	1×10^{-8}
1,8	100	200	2×10^{6}	0,01	5×10^{-11}	5×10^{-13}	6×10^{-8}	1×10^{-8}
1,8	80	100	2×10^{6}	0,01	5×10^{-11}	5×10^{-13}	6×10^{-8}	1×10^{-8}
3	—	—	1×10^{6}	0,0001	2×10^{-21}	—	6×10^{-8}	1×10^{-8}
3	—	—	1×10^{6}	0,0001	2×10^{-21}	—	6×10^{-8}	1×10^{-8}
3	—	—	1×10^{6}	0,0001	2×10^{-21}	—	6×10^{-8}	1×10^{-8}
—	—	—	—	—	—	—	—	—
1,8	120	600	5×10^{6}	0,001	1×10^{-11}	1×10^{-13}	8×10^{-8}	16×10^{-9}
—	—	—	—	—	—	—	—	—
—	20	—	1×10^{5}	2	—	—	—	—
—	50	—	1×10^{5}	0,002	—	—	—	—
1,7	200	200	1×10^{6}	0,0005	3×10^{-11}	1×10^{-13}	8×10^{-8}	16×10^{-9}

Origin USA

Image Dissector Tubes (Camera Tubes)

Applications

Slow-scan T.V. systems
Slide projector readers
Industrial process control
Electronic star trackers
Electronic scanning spectrometers

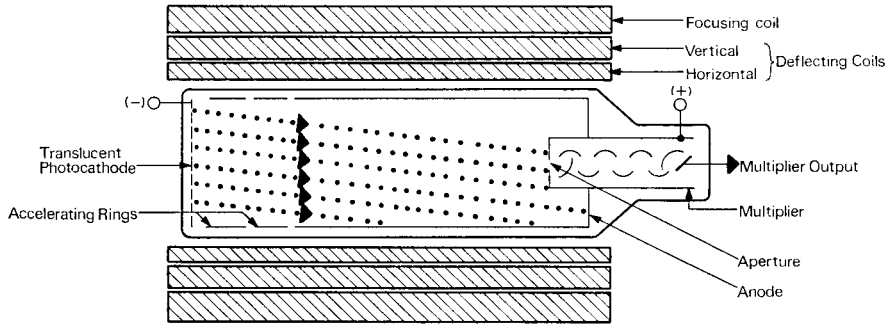


Image dissector tubes surpass all other camera tubes in resolution capability. This range of magnetically focused and deflected camera tubes provides a wide spectral response range from the ultraviolet to the near infrared.

In addition to the inherent high resolution capabilities, the tubes have other features such as non-storage, reliability, variable raster size, fast turn-on, no thermionic cathode, wide dynamic range and simple operation.

The tubes incorporate a high resolution imaging section and a multiplier section for maximum low light level response. The image section includes a photocathode on the inside surface of the faceplate, external focusing and deflecting coil systems, and a very small scanning aperture for highest resolution. The virtually noiseless multiplier section includes a system of secondary emission dynodes, and the anode which collects the signals for video output.

Type	Spectral response (see Fig. 1)	Useful cathode diameter (mm)	Operating voltage (kV)	I_a average (μA)	Typical performance characteristics: Typical photocathode luminous sensitivity (μA/lm)	Current amplification	Resolution (a) (see Fig. 3)	Signal to noise ratio (see Fig. 4)
FW125	S11	76	3,2	10	50	5×10^5		
FW146	S1	76	3,2	10	20	5×10^5		
F4010 (S1)	S1	76	2,23	10	20	5×10^5		
F4010 (S11)	S11	76	2,23	10	50	5×10^5		
F4010 (S20)	S20	76	2,23	10	140	5×10^5		
F4011 (S1)	S1	28	2	10	20	10^6		
F4011 (S11)	S11	28	2	10	50	10^6		
F4011 (S20)	S20	28	2	10	120	10^6		
F4012 (S1)	S1	18	1,6	10	20	10^6		
F4012 (S11)	S11	18	1,6	10	50	10^6		
F4012 (S20)	S20	18	1,6	10	120	10^6		
F4052 (S1) (b)	S1	43	2	10	20	10^6		
F4052 (S11) (b)	S11	43	2	10	50	10^6		
F4052 (S20) (b)	S20	43	2	10	120	10^6		
F4054 (c)	UV	18	1,86	10	—	10^5		

Origin USA

(a) Practical resolution is a complex function involving the defining aperture, focus coil, and deflection coils used. Theoretical resolution at 100% modulation is a function of aperture size only.

$$TV\ lines/cm = \frac{1}{aperture\ width\ in\ cm}$$

(b) Developmental tube type: Values are estimated.

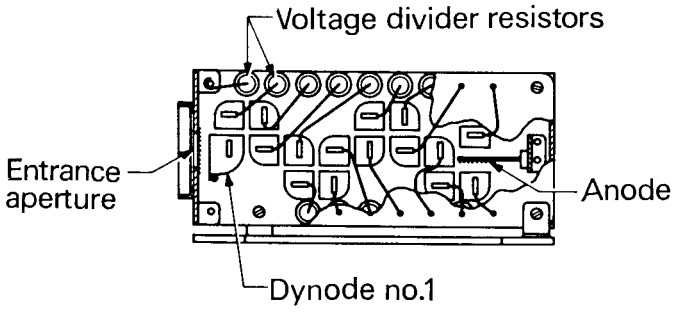
(c) This developmental image dissector of the Vidissector design is available with various types of solar blind photocathodes.

Focus and deflecting coil accessories are listed on page 76

Electron Multipliers

Applications

Space research
Radiation detection
Vacuum monochromators
Single particle counting
Demountable vacuum systems



These 'windowless' or 'tubeless' devices are designed to withstand repeated exposure to the atmosphere without serious loss of gain. They are used in vacuum systems or outer space environments for the detection of electrons, ions, and short wavelength radiations.

Vacuum-sealed voltage divider networks are integral parts of the multiplier units and are used for supplying intermediate dynode potentials.

The devices incorporate three basic elements; an entrance aperture, a set of secondary emission dynodes and a signal output anode. The special 'tubeless' design of the devices requires a vacuum or space environment for operation.

Energy passes through the aperture and excites secondary electrons from the sensitised surface of the first dynode. Continued amplification takes place through the system of dynodes and the useful signal is provided at the output anode. Design variations of dynode 1 can be provided for ultraviolet detection.

Type	Mechanical data (a) (b) (g)			Typical performance characteristics (for specified voltage at 25 °C) (f)					
	Active entrance dimensions (mm)	Dynode (c)		(d) Overall voltage (kV)	(j) (k) I_a average (μA)	Anode dark current max. (A)	(e) Current amplification max.	$t_{anode\ rise}$ max. (s)	(h) Multiplier noise factor max.
		Number of stages	Structure						
FW141	6,4×4,8	16	Box and grid	2	1	10^{-10}	10^5	15×10^{-9}	3
F2020 (1)	6,4×12,7	16	Box and grid	2,5	2	10^{-11}	10^6	15×10^{-9}	3
F4021 (1)	19,1 dia.	14	Toroidal	2,5	5	10^{-10}	10^6	12×10^{-9}	3
F4036	6,4×4,8	16	Box and grid	2,6	1	2×10^{-12}	10^6	15×10^{-9}	3
F4074	7,14×4,8	16	Box and grid	2,6	1	5×10^{-12}	10^6	15×10^{-9}	3

Origin USA

Notes

(a) Maximum operating ambient temperature 75°C. In non-operating condition a maximum bake-out temperature of 350°C for a period of 4 hours is recommended.

(b) All tubes incorporate a voltage divider.

(c) Dynode materials. Substrate C_u-B_e; secondary emitting surface B_e-O.

(d) Dynode No. 1 to anode (+HV) voltage distribution. 1, 1, 1.....1, 1, 1.

(e) 5% maximum change in gain per day with atmospheric exposure. Storage of unit in vacuum is recommended.

(f) Maximum working pressure 10^{-5} mm Hg.

(g) All units shipped in evacuated container to prolong shelf life.

(h) See "Noise Factor Measurements in Multiplier Phototubes", by E. H. Eberhardt. Applied Optics, Vol. 6, p.359, Feb. 1967.

(j) Bleeder current should be at least 10 times average direct anode current.

(k) Values are for continuous operation. Higher peak current possible under pulsed operation.

(l) Ruggedized tubes.

Image Converter Tubes

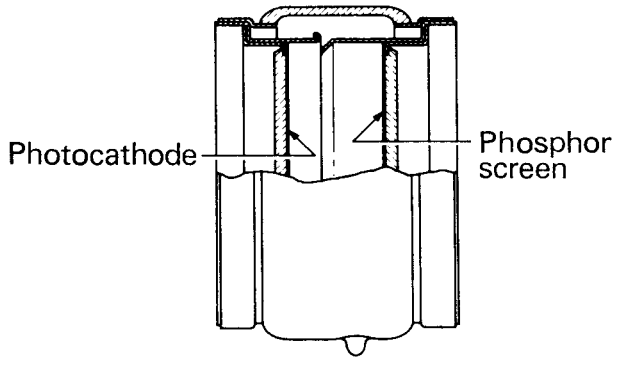
Applications

High-speed photography
Infrared viewing and surveillance
Optical correlation
Pulsed light systems
Ultraviolet detection and viewing

Broad application flexibility is provided by the image converter series of tubes, the features of which include compact electrostatic focusing or fine resolution magnetic focusing, low distortion, fibre optics, and electronic shuttering.

Special image intensifier units can be provided for low light environments.

Essential components of these tubes are a photocathode for image input and a phosphor screen for image output.



Images optically focused on the photocathode excite electron emissions in proportion to light intensity. Focusing, either magnetic or electrostatic, controls electron flow attracted to the highly charged phosphor screen, maintaining essentially a cohesive bundle.

The image is re-created on the fine phosphor screen which luminesces in accord with gradations in beam density and energy.

Type	Spectral response (see Fig. 1)	Phosphor type (see Fig. 2)	Useful cathode diameter max. (mm)	Useful phosphor diameter max. (mm)	(c) Focus	Typical performance characteristics (for specified voltage) (e) Supply voltage (kV)	Luminous sensitivity (μA/lm)	(a) Infra-red conversion index	Cathode resolution (line prs/mm)	(b) Luminous gain (lm/lm)
FW116	S11	P11	38	38	M	10	50	—	50	5
FW167	S1	P11	38	38	M	10	30	10	50	3
FW174	S11	P11	30,5	30,5	E	16	50	—	25	8
F4006 (S11 ; P11)	S11	P11	38	38	M	10	50	—	30 (d)	5
F4068	S20	P20	25,4	22,9	P	4	100	—	20	10
F6914 (Mod.)	S11 or UV	P11 or P20	—	—	E	16	Various types of window-photocathode combinations are available to cover the ultraviolet visible spectral region			
F6929 (Mod.)	S11 or UV	P11 or P20	—	—	E	12				
F6411	S1	P20	24,6	18,5	E	16	25	20	33	3,8
F8598	S1	P20	15,9	15,9	E	13	—	10	65	—

Origin USA

Notes

(a) Defined as the ratio of the luminous flux from the phosphor screen to the luminous equivalent of the infrared incident of the photocathode. The incident infrared flux is that originating from a standard 2 870°K tungsten lamp source and transmitted by a 2 540 Corning filter (melt 1 613, thickness 2,61 mm). Luminous equivalent is defined as the product of the luminous flux incident on the filter and the transmission factor of the filter as determined with a 2 870°K tungsten source and a receiver with a standard S-1 response.

(b) Defined as the ratio of the total luminous flux from the phosphor screen to the total luminous flux incident on the photocathode. The incident source is a standard 2 870°K tungsten lamp.

(c) E, M, and P refer to electrostatic, magnetic, and proximity focusing respectively.

(d) Unclassified fibre optics output.

(e) Image magnification of all tubes is 1,0.

Image Intensifier Tubes

For image pick-up applications under low or high ambient light conditions.

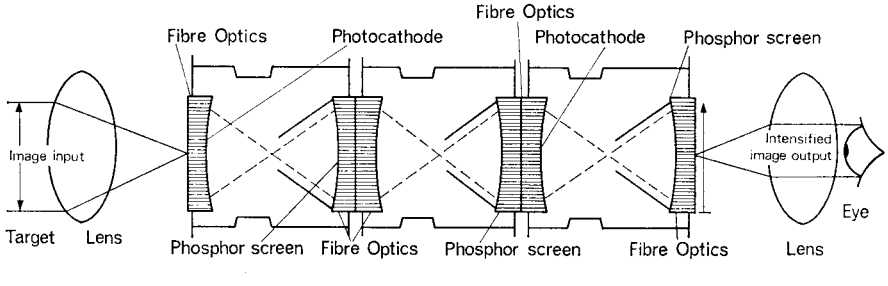


Image Intensifier Tubes (continued)

Type	Photocathode: Spectral response (see Fig. 1)	Photocathode: Sensitivity (2 870°K) (μA/lm)	Photocathode: Useful diameter min. (mm)	Luminous gain	Paraxial magnification min.	Distortion max. (%)	Resolution: paraxial (line.pr/mm)	Resolution: mm from photocathode centre (line.pr/mm)	Input voltage
F4051 (a)	S20 extended red (c) (for all types)	125 to 325	40	50 to 150	0,95	8	57	11/45	8–15kV d.c.
F4700 (a)		125 to 325	25	50 to 150	0,95	8	57	7/45	8–15kV d.c.
F4701 (a)		175	18	30 to 100	0,95	8	57	7/45	8–12kV d.c.
F4708 (a)		125 to 325	40	50 to 150	0,95	8	57	11/45	2,7V d.c.
F4714 (a)		125 to 325	25	50 to 150	0,95	8	57	7/45	2,7V d.c.
F4706 (b)		175	23	35 000	0,82	25	25	7/23	2,8kV*
F4721 (b), (d)									
F4710 (b)		175	17	30 000	0,82	25	30	7/23	2,7V d.c.
F4711 (b)		175	37	35 000	0,82	25	25	11/23	2,8kV*

* *Peak-to-peak figure (1 500 Hz sine wave)*

Origin USA

Notes

(a) Single-stage tube; fibreoptics windowed.

(b) Three-stage tube; fibreoptics coupled.

(c) All tubes can be supplied, to special order, with an S-25 photocathode.

Additional data (all tubes)
Fluorescent screen phosphor P-20 aluminised.
Equivalent background input 2×10^{-11} lm/cm², max.
Modulation transfer – See Fig. 5.

(d) The F-4721 is a 3-stage fibreoptics coupled intensifier which is similar in operation to the F-4706 tube. However, it incorporates an internal oscillator and special circuitry to extend useful operation during the hours of twilight and during other high-light conditions, such as those associated with flares, provided the light is below approximately 10^4 lm/cm². Other characteristics are as for the F-4706 tube.

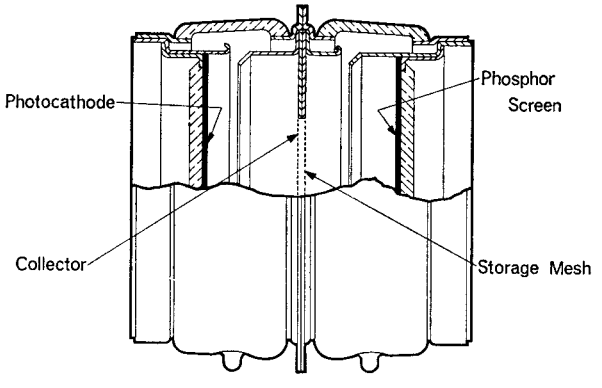
Correlation Devices

Applications
Motion compensation (V/H)
Area correlation
Map reading
Document reading
Tracking

Optical images of high resolution can be integrated, added, subtracted, and stored. Furthermore, by storing one image and then reading it out with a second image, such image manipulations as multiplication, division and correlation can be achieved electronically.

Image correlation tubes are available in two different models: one having a visual output presentation, and the other providing an electrical output signal.

The devices include a photocathode, a storage surface, and a phosphor viewing screen. These units are used as the all-electronic display components for direct review, integrated photographic systems. Incoming images are optically focused on the photocathode, stimulating electrical charges which are retained on the storage surface in proportion to intensity gradations in the original optical image. External magnetic fields are used to focus photo-electrons from the storage element to the phosphor screen. Magnetic deflection fields are applied to move the picture about for image correlation.



Type	Spectral response (see Fig. 1)	Phosphor type (see Fig. 2)	Useful cathode diameter max. (mm)	Useful phosphor diameter max. (mm)	Focus	Deflection	Typical operating conditions: Overall voltage (kV)	(a) Write/ Correlate voltage shift (V)	Focus field (Gauss)	Typical performance characteristics (b) (f): Resolution (line prs/mm)	Photocathode luminous sensitivity (μA/lm)	(c) Phosphor luminous efficiency (lm/μA)	(d) Viewing screen brightness (lm/cm²)
FW231	S11	P11	38	38	M	(e)	10	500	500	10	50	0,08	0,004
FW232	S11	P20	38	38	M	(e)	10	500	500	10	50	0,35	0,017
F4066	S25	P20	25	25	M	M	10	500	500	20	150	0,35	0,002
F4067	S25	—	25	—	M	M	3	500	100–500	20	150	—	—

Origin USA

Notes

(a) Cathode-storage mesh voltage shift between write and correlation or readout phases of operation.

(b) Threshold exposure is expressed in terms of detectable illumination-time product, where illumination is measured in the plane of photocathode, and the time is that of write or image exposure. For all tubes detailed it is 10^{-3} ft/cd/sec. ($10{,}76\times10^{-7}$ lm/cm²/sec.).

(c) Total lumens emitted by the phosphor screen per μA of bombarding current at the screen.

(d) Values given are saturated values with 0,5 μA/cm² cathode current and with the storage surface at equilibrium potential. For threshold images, values may be as low as 5% of saturated values.

(e) These tubes can be magnetically deflected for correlation purposes, but are intended for use primarily as storage tubes.

(f) Number of resolvable units is 10^5 for all tubes.

Characteristic Curves

Fig. 1 Typical absolute spectral response characteristics of Photoemissive devices

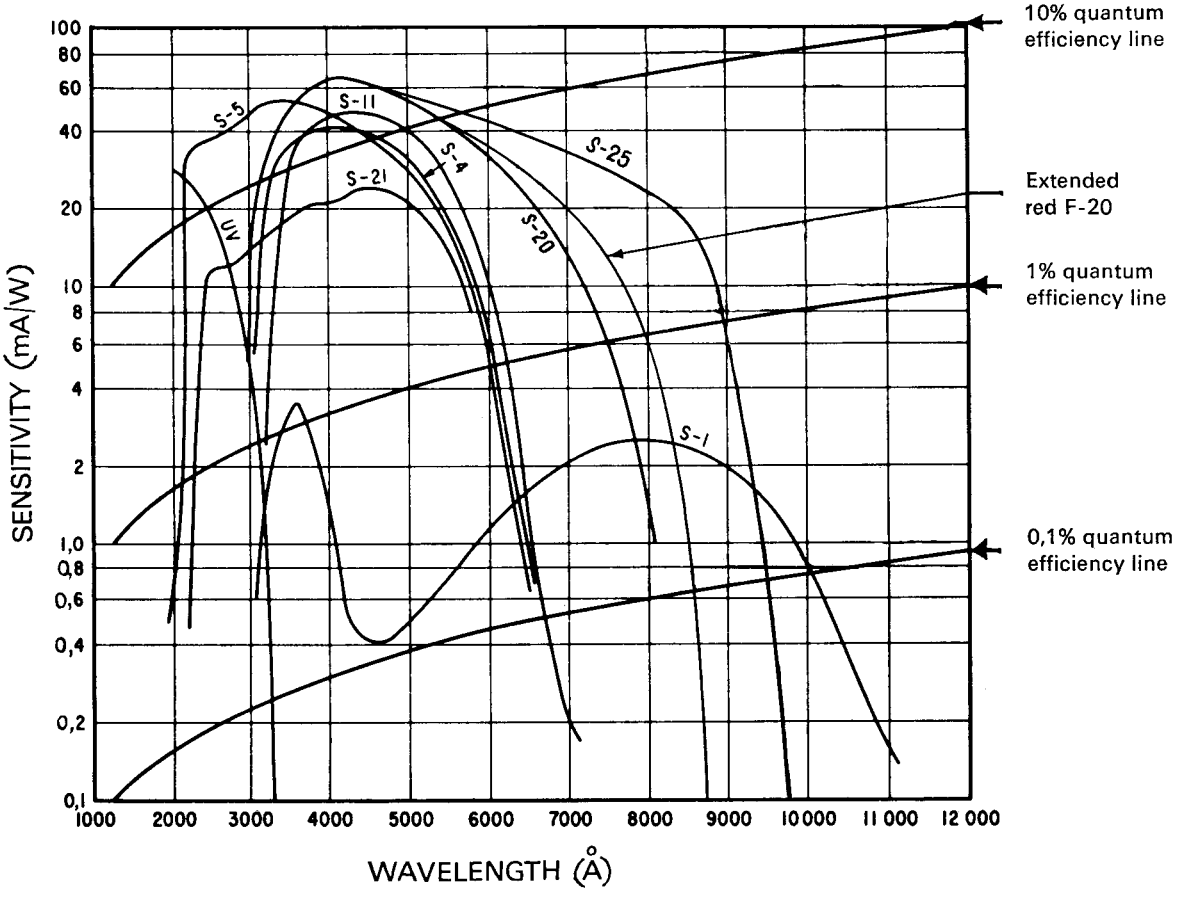


Fig. 2 Typical absolute spectral response characteristics of Aluminized Phosphor Screens

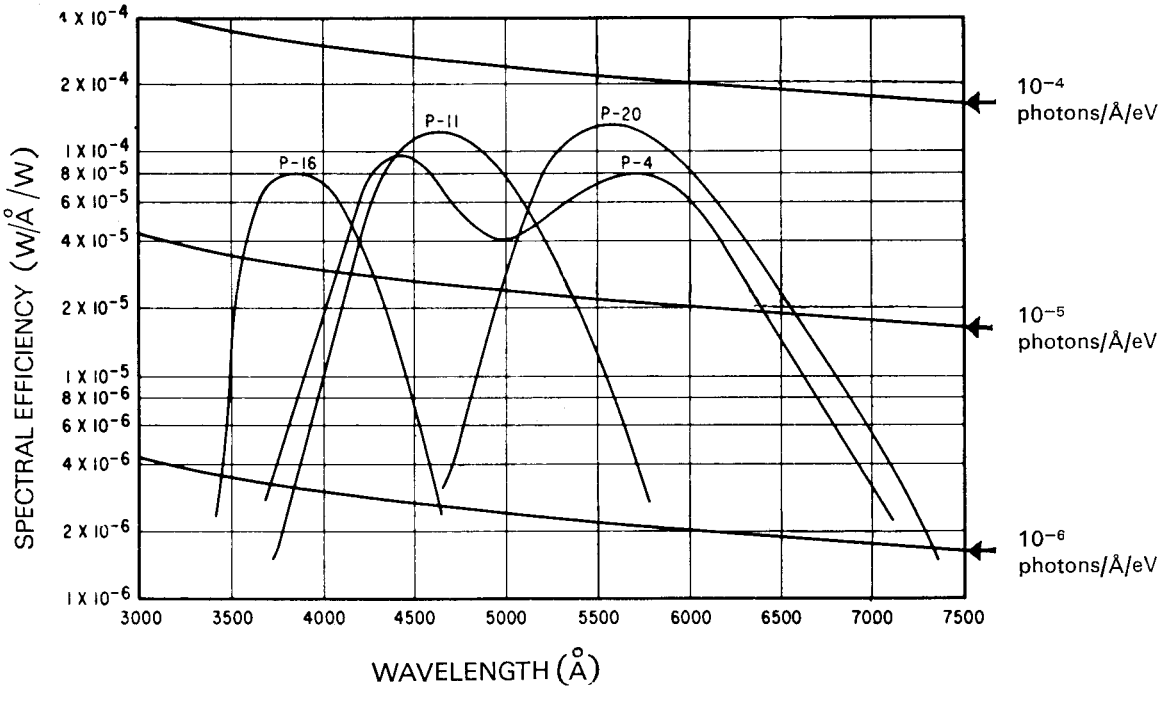
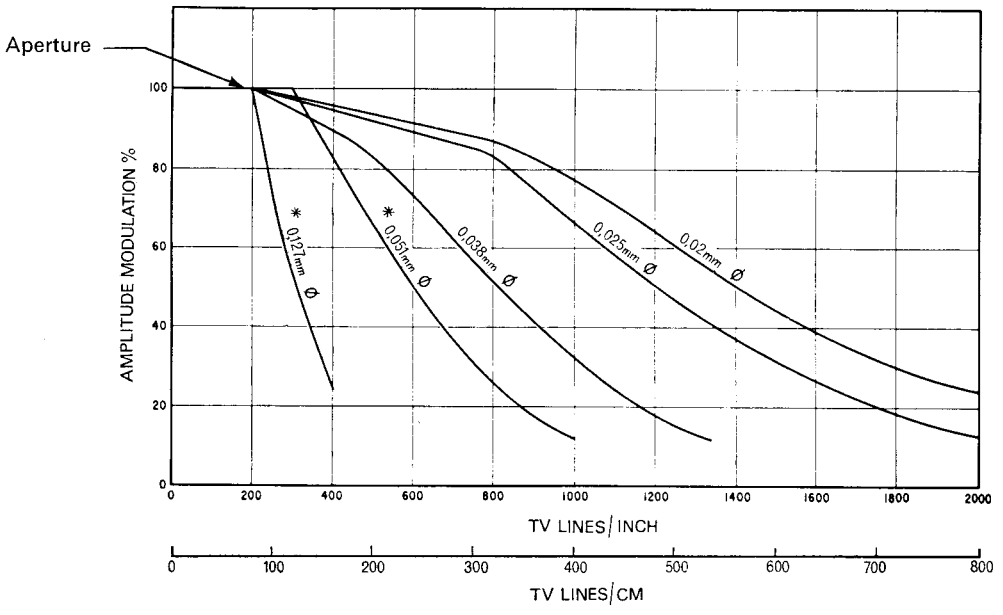


Fig. 3 Typical Vidissector Centre Resolution

Types F4010 F4011 F4012 and F4052



* *For the F4010 refer to these curves only*

Fig. 4 Typical Image Dissector Characteristics

$$S/N = 3{,}6 \times 10^{-10} \sqrt{\frac{J_k\, a\, \Delta t(\sigma^{-1})}{m2\, e\, \sigma}}$$

J_k = SL ($\mu A/cm^2$)

S = Photocathode sensitivity (μA/lumen)

L = Photocathode illumination (lumen/cm^2)

a = Defining aperture area (mil^2)

(1 mil = $\frac{1}{1\,000}$ inch = 0,0254mm)

Δt = Aperture dwell time (μ sec) $\approx \frac{1}{2\Delta f}$

m = Linear magnification, cathode-to-defining aperture

σ = Multiplier gain per stage

e = Electronic charge = $1{,}6 \times 10^{-19}$ coulombs

Δf = Bandwidth (MHz)

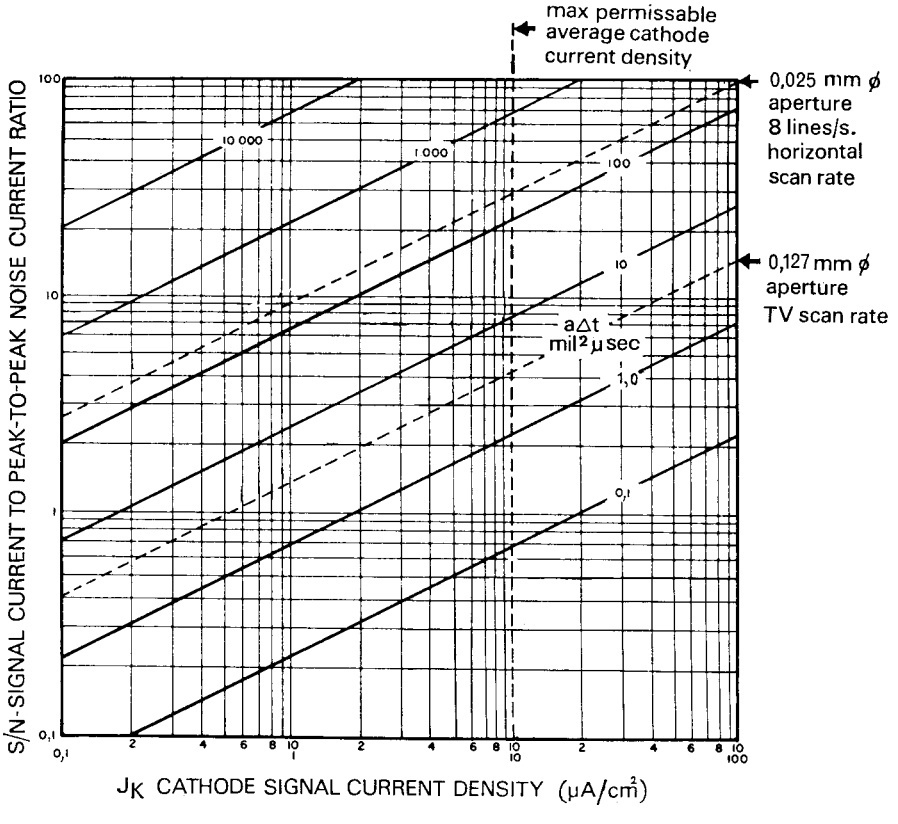
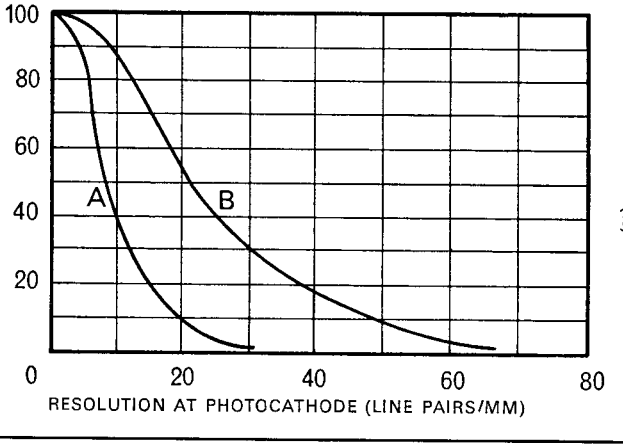


Fig. 5 Typical Intensifier Modulator Transfer Function

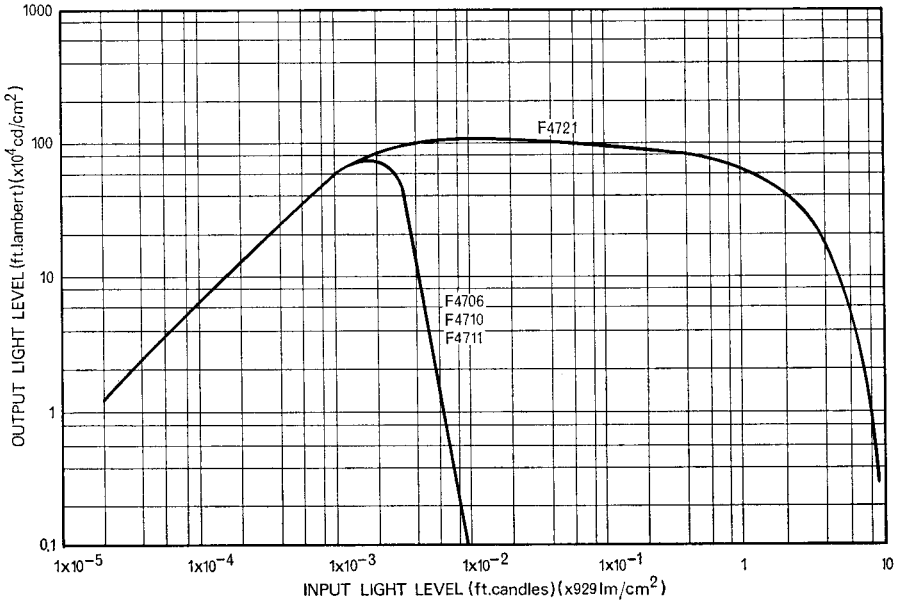
Curve A for types F4706 F4710 F4711 F4721

Curve B for types F4501 F4700 F4706 F4708 F4714 F4701



Characteristic Curves

Fig. 6 Three-stage Intensifier typical output characteristics



Accessories for Electro-Optic Tubes

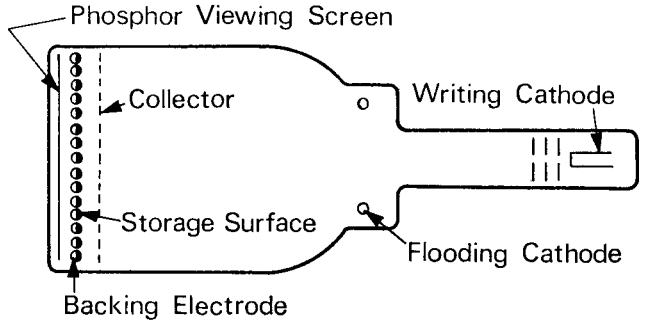
Part number	Description	Associated tubes
FW313	4-ring focus magnet	Image converters FW116, FW167, F4006 Storage image tubes FW231, FW232
FW315	Deflection yoke, Trancor-T core	Deflectable multiplier phototubes
F4501	Deflection yoke, air-core	Deflectable multiplier phototubes
F4501A	Deflection yoke, air-core	Deflectable multiplier phototubes
F4502	Phototube holder	2¼ inch (57 mm) diameter biplanar photodiodes
F4503	Phototube holder	1¼ inch (32 mm) diameter biplanar photodiodes
F4504 (a)	Deflection yoke	Vidissector F4011
F4505 (b)	Deflection yoke	Vidissector F4011
F4506	Focus coil	Vidissector F4011
F4507	Focus coil	Vidissector F4011
F4508 (c)	Deflection yoke	Vidissector F4011
F4509 (d)	Deflection yoke	Vidissector F4012
F4510	Focus coil	Vidissector F4012
F4511	Deflection and focus coil assembly	Image dissectors FW125, FW146, F4010
F4512	Deflection yoke, ferrite core	Deflectable multiplier phototubes
F4513 (e)	Deflection yoke	Vidissector F4011
F4514	Deflection yoke, ferrite core	Deflectable multiplier phototubes
F4518	Deflection yoke, air core	Deflectable multiplier phototubes
F4518A	Deflection yoke, air core	Deflectable multiplier phototubes
F5005	Vidissector camera unit	Vidissector F4011
IL1-2.5	2,5kV power supply	Biplanar photodiodes FW114, FW114A, F4000
IL2-1800	Variable h.v. power supply (1 to 3kV)	Multiplier photodiodes
IL3-1800	Variable h.v. power supply (1 to 3kV)	Multiplier phototubes
IL4-1800	Plug-in h.v. power supply (1,8kV)	Multiplier phototubes FW118, FW129, FW130
IL5-1800	Plug-in h.v. power supply (2,2kV)	Multiplier phototube F4003
IL5-30	20-tap h.v. power supply (1,8 to 30kV)	General phototube use
IL1-12	Miniature h.v. power supply (12kV)	General phototube use
IL2-16	Miniature h.v. power supply (16kV)	General phototube use

Notes	*Horizontal deflection sensitivity*		*Vertical deflection sensitivity*	
	(mA/in.)	*(mA/cm)*	*(mA/in.)*	*(mA/cm)*
(a)	*250*	*98,4*	*30*	*11,8*
(b)	*40*	*15,7*	*40*	*15,7*
(c)	*150*	*59*	*150*	*59*
(d)	*55*	*21,7*	*55*	*21,7*
(e)	*1 400*	*551*	*1 400*	*551*

Direct View Storage Tubes (iatrons)

Applications

Aircraft radar displays
Automatic weapons systems display
Narrow bandwidth picture transmission
Ground air traffic control radar display



These devices produce a visual display of controllable duration.

The tube has two electron guns, a phosphor viewing screen and two fine mesh metal screens. One of the electron guns is termed the writing gun, the other the flooding gun.

The web of one screen is coated on the gun side with a thin dielectric material to form a surface on which the electron beam stores information; the other screen serves as an electron collector.

The writing gun emits a pencil-like electron beam which is intensity modulated by the information to be stored. The information is in the form of an electrical input signal.

The storage surface is scanned by this high resolution beam and actually strikes this surface.

A positive charge image, corresponding in value to the input signal pattern, is imposed on the storage surface until it decays or is erased. The storage screen forms an array of elemental electron guns with each mesh hole acting as a control element of a miniature electron gun. After the desired information has been stored on the storage mesh, the entire surface is flooded by an electron beam from the flooding gun.

The value of positive charge departed at each mesh aperture controls the amount of flood beam current that can pass through the mesh aperture to the phosphor viewing screen The current that passes through the mesh strikes the phosphor viewing screen, where a light output is observed in proportion to the bombarding current density and the energy with which the electrons strike the phosphor: that is, the tube reproduces a grey scale in the stored image. After the stored information has been observed or recorded, it is erased from the storage surface, which is then prepared for storing a new image.

Type	Usable display diameter min. (mm)	Focus/ Deflection (Note 1)	Luminance (Note 2) (cd/m²)	Writing speed (Note 3) (m/s)	Shades of grey min. (Note 4)	Erase time (Note 5) (ms)	Storage time (s)	Resolution (Note 6) (lines/mm)	View screen voltage (kV)	Write-gun cathode voltage (V)
7174	76	EM/EM	4 380	635	6	20	20	2	15	−450
FW241	102	ES/ES	584	2 540	6	10	30	2	9	−1 500
F3006	102	ES/EM	876	2 540	7	8	20	3	8	−2 000
F3007	102	ES/EM	876	2 540	7	8	20	3	8	−2 000
F3013	102	ES/EM	438	1 925	7	10	20	3	10	−2 500
F3048	102	ES/EM	458	762	7	15	30	3	8	−2 500
F3015	102	ES/ES	438	12 700	7	5	30	4	8	−2 000
F3019	102	ES/EM	584	3 810	9	1,5	15	5	10	−2 000
F3019–2	102	ES/EM	2 190	3 810	8	1	10	5	10	−2 500
F3024	102	ES/EM	730	7 620	8	1	15	5	12	−2 500
F3033	102	ES/EM	584	7 620	9	0,6	15	5	10	−2 000
F3034	102	ES/EM	584	7 620	9	0,6	15	5	10	−2 000
F3035	102	ES/ES	730	2 540	7	20	20	3	9	−750
F3039	102	ES/EM	458	2 540	9	2	30	5	10	−1 700
F3045	102	ES/EM	146	2 540	7	5	300	3	10	−1 500
7423	102	ES/ES	1 168	508	6	12	30	2	9	−750
F3016	145	ES/ES	292	76,2	7	50	30	3	9	−750
F3020A	145	ES/EM	584	7 620	9	1,2	60	4	12	−2 500
F3028	145	ES/ES	380	25,4	7	80	30	3	10	−750
FW245	145	EM/EM	219	6,35	8	200	240	3	10	−700
FW257	145	ES/ES	292	12,7	6	75	30	3	9	−750
F3501	145	ES/ES	292	12,7	7	75	30	4	9	−750
F3515	145	EM/EM	204	3 810	7	20	30	4	9	−1 500
F3023	216	ES/EM	234	2 540	7	4	20	4	12	−2 500
F3041	216	ES/EM	175	3 810	8	2	30	4	12	−2 500

Origin USA

Note 1. EM = electromagnetic
ES = electrostatic

Other notes to this table are given overleaf

Direct View Storage Tubes (continued)

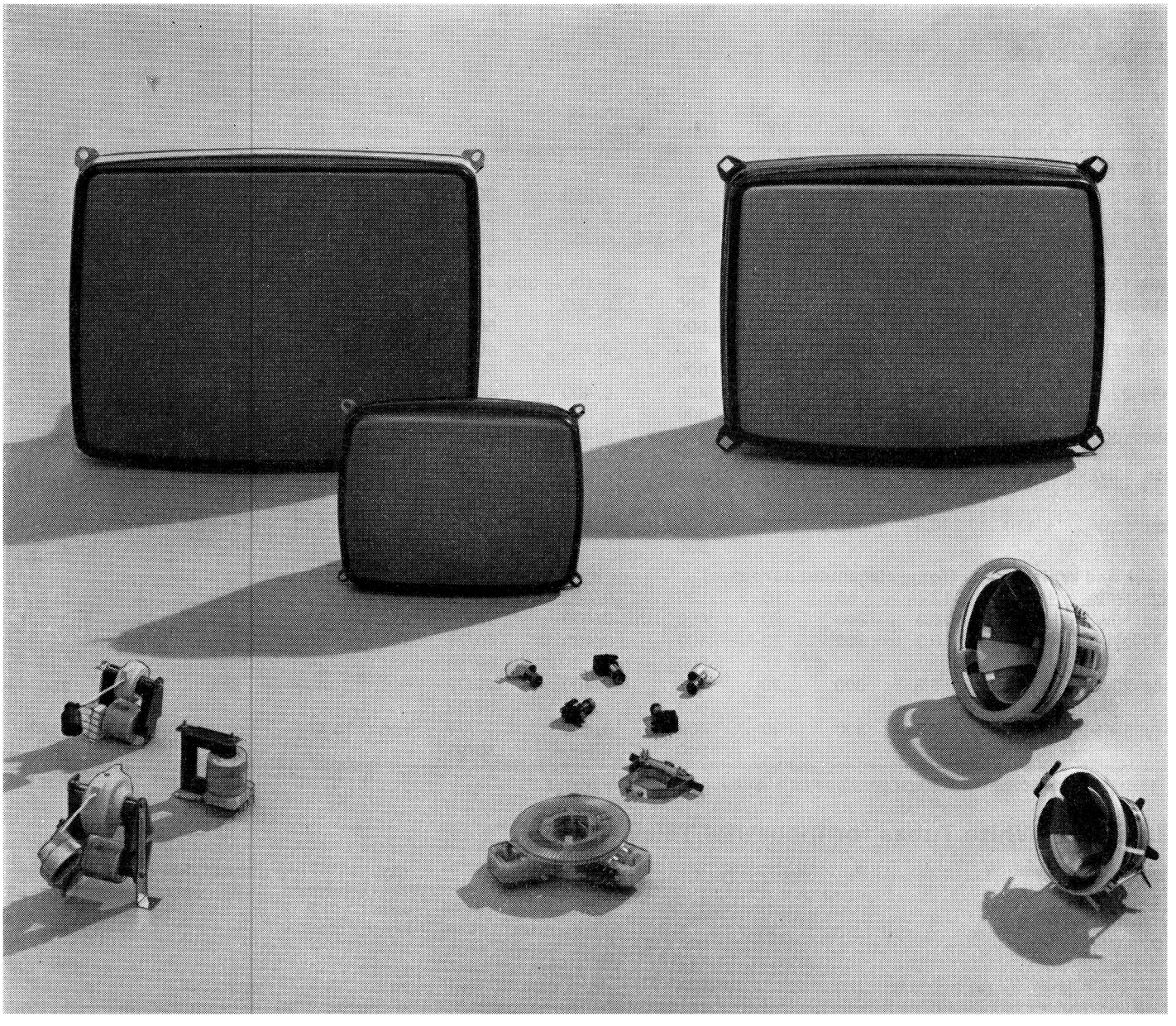
Note 2
Saturation luminance is measured after removing erase pulses from the backing electrode and allowing the tube to write to maximum luminance. Saturation luminances range from 29 to 2 190 cd/m^2 for direct view applications. Typical airborne cockpit displays range from 292 to 584 cd/m^2 at the tube faceplate.

Note 3
Writing speed is measured at 50% saturated luminance with no line overlapping. Writing speeds can be provided for any application up to 25 400 m/s or more. Note that as writing speed increases, viewing time decreases.

Note 4
Shades of grey are the number of clearly evident half-tone or luminance level obtained by applying a suitable staircase video waveform to the writing gun control grid (black and white levels included).

Note 5
Erase time is equal to the maximum period required for a single pulse of optimum amplitude to erase stored information from 100% to 10% of saturated luminance.

Note 6
Resolution is measured by the shrinking raster method, at a raster brightness of 50% saturated luminance.



Introduction

Every picture tube is basically a vacuum tube in which a sharply focussed electron beam of controllable intensity is produced which, on striking a fluorescent screen, gives rise to a luminous dot of variable degree of brightness. By simultaneous horizontal and vertical deflection of the beam, governed by the relevant television standard, and by simultaneous brightness modulation by the video signal a raster is traced out on the fluorescent screen which produces in the human eye the impression of a picture.

With a colour tube, unlike the black-and-white tube which has only one beam, three separate beams of controllable intensity are produced simultaneously. The fluorescent screen does not in this consist of a homogeneous white fluorescing phosphor, but of luminous dots arranged in triplets and of the primary colours – red, green and blue – for additive colour mixing.

Arranging a shadow mask in front of the screen with one hole for each colour triplet results in each of the three beam generating systems being able to excite luminescence of only those colour dots assigned to it.

Picture tubes consist in practice of a glass bulb in the neck of which is sealed the beam generating system consisting of one, or in the case of colour tubes, three electron guns. The flat front face of the bulb is used as the fluorescent screen.

Various types of picture tube are available, the shape, size and electrical characteristics of which depend upon the application. In order to operate the tubes without a protective screen, most tubes are, nowadays, delivered with implosion protection in the form of a tension strap or frame around the bulb.

Picture Tubes

Type	Diagonal deflection angle	V_h	I_h	V_a	V_{g2}	V_{g4}	V_{g1} cut-off	Dimensions				Overall length
								Useful screen diagonal min.	Useful screen width min.	Useful screen height min.	Neck diameter	
	(deg.)	(V)	(mA)	(kV)	(V)	(V)	(−V)	(mm)	(mm)	(mm)	(mm)	(mm)
Black and White												
A28-13W	90	11	68	11	205	0/350	30/60	262,5	228	171	20	245
A31-15W	110	6,3	300	12	300	0/400	35/69	295	257	195	28,6	237,6
A31-19W	90	11	68	11	200–350	0/350	45	295	257	195	20	268
				11	205		30/60					
A44-13W	110	6,3	300	20	500	−100/+300	49/91	413	346	270	28,6	285
A51-10W	110	6,3	300	20	400	0/400	40/77	473	394	308	28,6	321,5
					500		50/93					
A59-12W*	110	6,3	300	20	400	0/400	40/77	566	489	385	28,6	360
					500		50/93					
A59-22W	110	6,3	300	20	400	0/400	40/77	566	489	385	28,6	360
					500		50/93					
A61-120W	110	6,3	300	20	400	0/400	40/77	577	481	375	28,6	362
					500		50/93					
A65-11W	110	6,3	300	20	400	0/400	40/77	416,5	530	416	28,6	381,5
					500		50/93					
A65-13W	110	6,3	300	20	400	0/400	40/77	416,5	530	416	28,6	383
					500		50/93					
Black and White Tubes (for replacement purposes)												
A25-10W	90	12	65	10	90	0/400	29/44	243	227	168	18	255
A41-10W	110	6,3	300	20	400	0/400	60/77	372	322	254	28,6	273
A47-27W/2	110	6,3	300	20	400	0/400	40/77	446	384	305	28,6	302,5
					500		50/93					
A59-20W†	110	6,3	300	20	400	0/400	40/77	566	489	385	28,6	360
					500		50/93					
AW59-91	110	6,3	300	20	400	0/400	40/77	566	489	385	28,6	358
					500		50/93					

* *Metal envelope tube* † *Metal envelope tube without fixing angle pieces*

Black and White Tubes for Industrial Television

Type	Diagonal deflection angle	V_h	I_h	V_a	V_{g2}	V_{g4}	V_{g1} cut-off	Dimensions				Overall length	Fluorescence colour	After-glow time
								Useful screen diagonal min.	Useful screen width min.	Useful screen height min.	Neck diameter			
	(deg.)	(V)	(mA)	(kV)	(V)	(V)	(−V)	(mm)	(mm)	(mm)	(mm)	(mm)		(s)
AW17-69	70	6,3	300	14	300	0/400	35/75	170	128	96	36,5	265	White	10^{-3} to 10^{-1}
A17-69BE													Blue	10^{-5} to 10^{-3}
A17-69GJ													Yellow-green	10^{-3} to 10^{-1}
A17-69LF				14	400	0/400	48/102						Orange	10^{-1} to 1,0
A17-69GM													Purple-blue	10^{-1} to 1,0
M17-18W	75	11	68	11	200/350	−100/+300	45	155	125	95	20	205	White	10^{-3} to 10^{-1}
M17-18GJ													Yellow-green	10^{-3} to 10^{-1}
M17-18BE													Blue	10^{-5} to 10^{-3}
M17-18LF													Orange	10^{-1} to 1,0
M17-18GM	75	11	68	11	250	−100/+300	32/58	155	125	95	20	205	Purple-blue	10^{-1} to 1,0

Colour Television Tubes

Type	Diagonal deflection angle	V_h	I_h	V_a	V_{g3}	V_{g2} cut-off for $V_{g1} = -150V$	I_K to produce white (average %)			Dimensions			
										Useful screen diagonal	Useful screen width	Useful screen height	Overall length
	(deg.)	(V)	(mA)	(kV)	(kV)	(V)	Red	Green	Blue	(mm)	(mm)	(mm)	(mm)
A55-14X	90	6,3	900	25	4,2/5,0	285/685	34	34	32	514	443	346	483
A55-15X										514	443	346	483
A56-120X										533	447	337	472
A63-11X										584	504	396	526
A63-200X										584	504	396	526

Origin D

Deflection Components

(Black and White Tubes)

Line Transformers

Type	V_B (V)	$V_{h.t.}$ ($I_{h.t.}=100\mu A$) (kV)	$V_{booster}$ (V)	Pulse voltages (V)	I_a mean (mA)	Tube complement
AT714-36	220	13,5	860	+100	85	PL81, PY83, EY86
AT917-0	220	14,5	600	+300; −100	110	PL81, PY83, EY86
AT1111-1	240	11	780	+300; −300	70	PL81 (PL500), PY83 (PY88), EY51
AT1116-3d	240	13,5	750	+300; −100	110	PL36, PY88, EY86
AT1118-6	240	17,5	750	+300; −300	100	PL500, PY88, DY86
AT1118-7	230	17,5	840	+300; −300	115	PL500, PY88, DY86
AT1118-71	240	17,5	920	+450; −300	115	PL500, PY88, DY86
AT1118-72	240	17,5	920	+300; −300	115	PL500, PY88, DY86
AT1118-84	240	17,5	920	+300; −300	115	PL500, PY88, DY86
AT1118-85	220*	17,5	860	—	145	PL500, PY88, DY86
	220†	17,2	980	—	140	PL500, PY88, DY86
AT1118-86	240*	17	720	+300; −300	130	PL500, PY88, DY86
	240†	16,7	900	+300; −300	120	
AT1118-87	240	17,5	920	+550; −550	115	PL504, PY88, DY802
TAT911-1	6	10	10,9	+400; +300; −300; −30	2 500 (I_B)	AU103, BY118, BY118
	11	10,5	—	+400; +300; −300; −30	750 (I_B)	
68812	240	13,4	780	+400; −170	100	PL500, PY88, DY86
74624	240	17,5	820	+300; −300	140	PL500, PY88, DY86

* *625 lines* † *819 lines*

Deflection Systems

Type	Horizontal coils (at 25 °C ambient) R (Ω)	L (mH)	P (μW)	Vertical coils (at 25 °C ambient) L (mH)	R (coils) (Ω)	R (total) (Ω)	P (W)	Ambient temperature max. (°C)	Picture tube types
AS110-3	5,2	3,9	1 700	22	6,8	8	0,56	75	110°/28,6 mm ⌀
AS110-64	3,9	2,9	1 700	90	38	47	0,56	75	110°/28,6 mm ⌀
AS110-64W*	3,9	2,9	1 700	90	38	47	0,56	75	110°/28,6 mm ⌀
AS110-71	4,1	2,9	2 100	90	39	46	0,65	85	110°/28,6 mm ⌀
AS110-8	4,1	2,9	2 100	80	36	67	0,65	85	110°/28,6 mm ⌀
TAS90-1	1,2	0,51	420	52	51	60	0,26	80	90°/18,1 mm ⌀
TAS90-2	0,74	0,325	465	44	30	—	0,25	85	90°/20 mm ⌀

* *Electrical values as for AS110-64 with wobble coils ($L=0{,}55$ μH; $f=13{,}56$ MHz/27,12 MHz)* *Origin D*

Deflection Components

(Colour Tubes)

Deflection Systems

Type	Horizontal coils (at 25 °C ambient)			Vertical coils (at 25 °C ambient)				Ambient temperature max.	Picture tube types
	R (Ω)	L (mH)	I (A)	L (mH)	R (coils) (Ω)	R (total) (Ω)	I (A)	(°C)	
FAS90-2	2,8	2,8	1,45	23	13,5	17,5	0,44	85	90°/shadow mask
FAS90-3	2,8	2,8	1,45	92	54	74	0,22	85	90°/shadow mask

Convergence Systems

Type	Coils for vertical frequency currents (at 25 °C ambient)				Coils for vertical frequency currents (at 25 °C ambient)	
	in series L (H)	R (Ω)	in parallel L (H)	R (Ω)	L (mH)	R (Ω)
FRK90-2 } FRK90-20	1,44	166	—	—	0,42	4
FRK90-3 } FRK90-30	1,44	166	0,36	41,5	4,7	40
FRK90-4	1,44	166	0,36	41,5	1,2	11,5

Blue Lateral System – Type FLK90-2

At 25°C ambient

Parallel connection L (μH)	Parallel connection R (Ω)	Series connection L (mH)	Series connection R (Ω)
700	9,5	2,8	38

Linearity Controller – Type FLR90-1

δ (%)	I erasing coil (A)	Ambient temperature max. (°C)
12	1,5	80

High Voltage Transformer – Type FAT925-1

Measured at $I_{h.t.} = 600\,\mu A$

Supply voltage	250 V
H.T., stabilised	25,2 kV
H.T., stabilised (at $I_{h.t.} = 0\,\mu A$)	25 kV
H.T., stabilised (at $I_{h.t.} = 1\,500\,\mu A$)	24,8 kV
Booster voltage	740 V
Cathode current, mean (PL509)	235 mA
Grid 2 current, mean (PL509)	25 mA
Cathode current, peak (PL509)	600 mA
Anode voltage, peak (PL509)	5,9 kV
Cathode voltage, peak (PL500)	4,4 kV
Return time	10,8 μs
Pulse voltage	+470 V

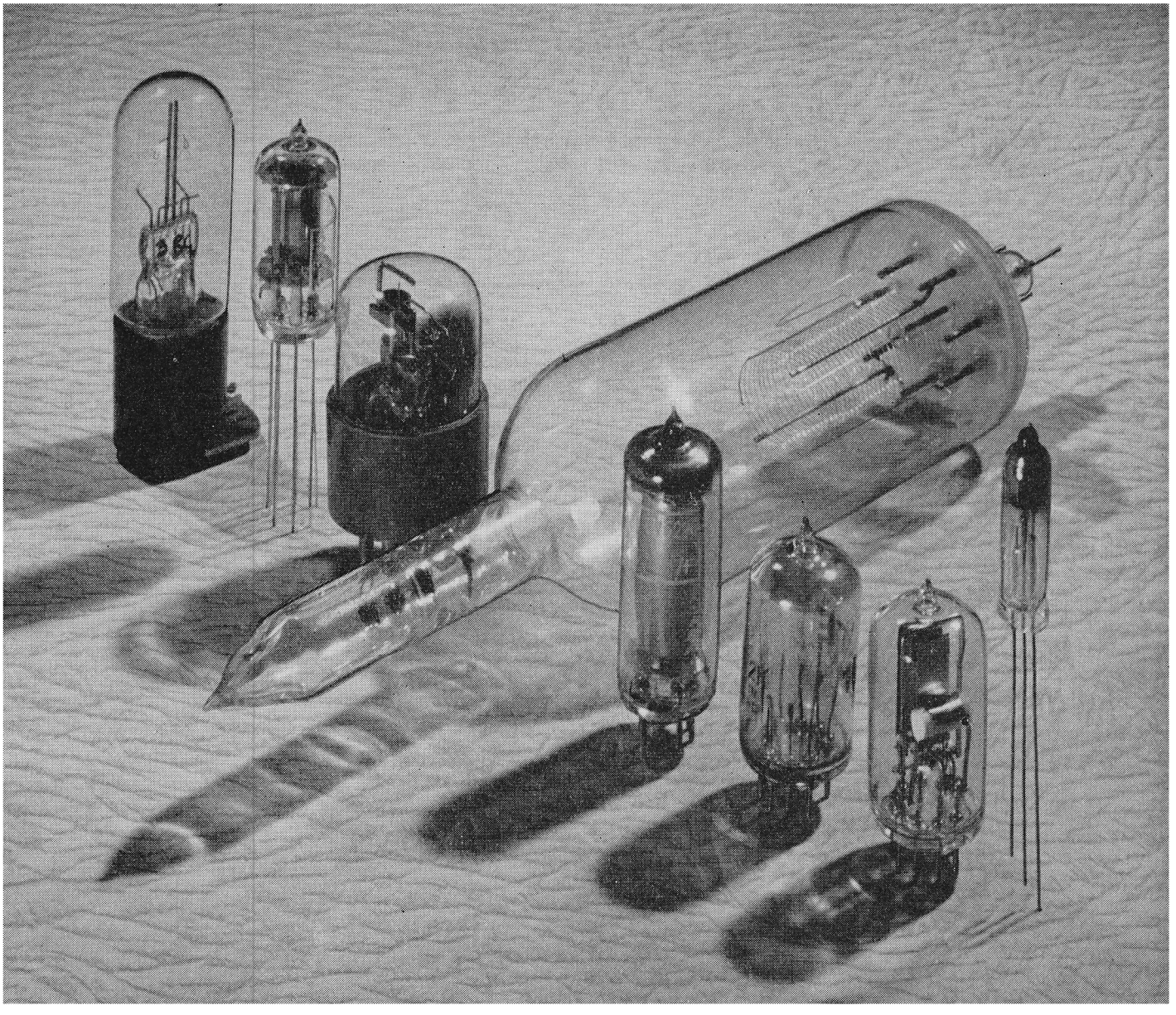
Deflection Transformer – Type FAT900-1

Measured at $V_{h.t.} = 25kV$ and 108% picture width

Supply voltage	250 V
Booster voltage*	825 V
Cathode current, mean (PL504)†	225 mA
Grid 2 current, mean (PL504)	15 mA
Cathode current, peak (PL504)	485 mA
Anode current, peak (PL504)	6,1 kV
Cathode current, peak (PY88)	5 kV
Return time	12 μs
Pulse voltages	+350 V
	+50 V
	−50 V
	−350 V

* *Measured against mass* *Origin D*

† *With load*



Miscellaneous devices comprise:

Voltage stabilisers, both glow and corona discharge types (useful in conjunction with radiation monitor tubes).

Cold cathode trigger tubes.

Vacuum measuring devices including Pirani and Bayard Alpert gauges.

Xenon high intensity lamps for use in searchlights etc. and circuit lamps to compensate for voltage changes at constant current.

Xenon Lamps

Type	Rated power (kW)	Operating current (A)	Operating voltage (V)	Ignition voltage (kV)	Luminous flux (lm)	Arc length (mm)	Cooling	Overall length (mm)	Bulb diameter (mm)
F950	20	465	41,2/44,8	45	8×10^5	13 (cold)	Electrodes : water at 22,7 l/min. Bulb : air at 14,2 m^3/min.	610	127
F951	2,2	100	20,5/24	20 to 30	8×10^4	4 (hot)	Axial air flow : 4,3 m^3/min.	335	57
F952	20	468	41,2/44,8	45	8×10^5	12		480	127

Origin USA

Thermal Delay Switches

Type	Alternative code	Delay time at 20 °C ambient min. (s)	max. (s)	Heater supply, nominal (V)	(A)	Contact ratings Voltage before make (V)	(V)	Current after make (A)	Base	Class of switch (Note 1)
S107/1K		8	15	6,3	0,5	100	220	1	B7G	A
S207/3K		13	24	6,3	0,5	240 500	240 500	1 0,2	B7G	B
S105/1K		20	30	27	0,115	100	220	1	B7G	A
S30/2K	6N030T	23	37	6,3	0,5	250	250	1	B9A	A
S104/1K		23	37	6,3	0,5	100	220	1	B7G	A
S104/2K		23	37	6,3	0,5	250	250	1	B7G	A
S204/2K		27	37	6,3	0,5	250	250	1	B7G	A
DLS10		30	90	4	1,5	250 1 000	250 1 000	6 0,2	B4	D
DLS15		30	90	4	0,75	250	250	5	B4	D
DLS16		30	90	6,3	0,48	1 000	1 000	0,1	I0-8	D
DLS24 (Note 2)		30	90	6,3	0,5	240 500	240 500	1 0,2	B7G	E
S108/1K		36	46	24	0,13	100	220	1	B7G	A
S103/1K		36	54	27	0,115	100	220	1	B7G	A
S106/1K		40	66	19	0,165	100	220	1	B7G	A
S102/1G		44	66	6,3	0,5	100	220	1	B7G/F	A
S102/1K	VLS631 SH342	44	66	6,3	0,5	100	220	1	B7G	A
S102/2K		44	66	6,3	0,5	250	250	1	B7G	A
S75/1K		65	85	30	0,1	100	220	1	B7G	A
S85/1K	6N090T	72	98	6,3	0,5	100	220	1	B9A	A
S109/1K		72	98	6,3	0,5	100	220	1	B7G	A

Origin GB

Note 1. Class of switch

A=Bimetal (active) strip heated by conduction of heat from heater through a ceramic cylinder. Switch incorporates device to compensate for ambient temperature variations. Contacts normally open.

B=Bimetal (active) strip heated by thermal radiation from incandescent heater. Switch incorporates device to compensate for ambient temperature variations. Contacts normally open.

C=Radiated heat from incandescent heater is conducted through ceramic tube to active strip. Contacts normally open.

D=Bimetal (active) strip heated by thermal radiation from incandescent heater. Contacts normally open.

E=Radiated heat from incandescent heater is conducted through ceramic tube to active strip. Switch is temperature compensated. Contacts normally closed.

Note 2

Reverse action switch. Contacts normally closed. Contact ratings refer to 'break' conditions.

Resistance Lamps

Type	Alternative code	Function	I (mA)	Operating conditions V (V)	R (Ω)	Limit ratings V (V)	P (W)	Base
B1C/1E	CV433	Ballast	880 to 1070	3 to 9,5				End caps
4006B	PO-1	Ballast	800 to 1050†	11 to 40†				Special
L100/1G		Tungsten filament circuit element	5/15	0,05/0,4		6		Flying leads
L102/2K	P0-16	Double filament protective device	20 60	2 14	100 235	85* 170†		B9A

** Filaments in parallel* *† Filaments in series*

Origin GB

Trigger Tubes

Type	Alternative codes	Main gap voltage		Control gap striking voltage nom.	I_k max.	Base
		Striking min. (V)	Maintaining nom. (V)	(V)	(mA)	
G1/237G		200	70	75	1,5	Flying leads
G1/238G		200	70	78	1,5	Flying leads
G1/371K*	CV2224	360	175	190	10	B7G
G150/2D	CV413	150	68	70	30	Small octal
G240/2D	CV2174	230	90	75	30	wafer with metal shell

* *With primed trigger*

Origin GB

Voltage Stabilisers

Type	Alternative codes	Striking voltage max. (V)	Stabilising voltage nom. (V)	I_k max. (mA)	Regulation V (V)	Regulation I (mA)	Base
G50/2G	CV2208	90	54	3	−0,3/+1	0,3 to 1/1 to 3	Flying leads
G55/1K	CV5298	90	55	30	3	2 to 30	B7G
VR75/30	CV3798	105	75	40	3/4,5	5 to 30/5 to 40	Small shell octal
G75/3G	CV4030	115	75	60	2,5/5,25	5 to 30/5 to 60	Flying lead loctal
VR105/30	CV686	127	108	40	1/1,3	5 to 30/5 to 40	Small shell octal
OB2	CV1833	127	108	30	1,5	5 to 30	B7G
VR150/30	CV216	180	150	40	1,5	5 to 30	Small shell octal
OA2	CV1832	180	150	30	2	5 to 30	B7G
G180/2G & M	CV395	180	150	45	1	5 to 45	B8G
G400/1K	CV2194	400	306	4	−1	2 to 4	B7G
G400/2G	CV6135	400	306	4	−1	2 to 4	B7GF

Origin GB

Corona Stabilisers

These devices are used mainly to stabilise power supplies of Geiger-Muller counter, proportional counter, and scintillation counter equipments.

Operating conditions		Type	RC435	RC500	RC1000	RC1500	RC1800
		Alternative code		G500/1G	G1000/1G	G1500/1G	G1800/1G
Stabilising voltage	(V)		435 ±15	500^{+20}_{-10}	1 000 ±25	1 500 ±30	1 800 ±40
at a current of	(μA)		25	25	50	50	50
Normal operating d.c. range	(μA)		10 to 60	10 to 60	10 to 60	10 to 60	10 to 60
Regulation for current variation of 50μA, maximum	(V)		6	8	25	30	40
Starting voltage, maximum	(V)		480	550	1 100	1 650	1 980
Continuous direct current, maximum	(μA)		60	60	100	100	100
Rate of regulated voltage variation against temperature (−40°C to +70°C)	(V/°C)		0,2	0,3	0,6	0,9	1,1

Origin F

Vacuum Gauges

Type	Class of gauge	Sensitivity $\frac{I_{col}}{I_g}$ per Torr	Pressure (Torr)	V_f (V)	I_f (A)	Bulb glass
M103/3G	Ionisation	10	10^{-3} to 10^{-7}	6	2,4	C9
M152/2E	Bayard & Alpert	12	10^{-3} to 10^{-11}	6	4,5	Kodial and C9
M156/1E	Bayard & Alpert	20 to 30	10^{-3} to 2×10^{-11}	3 to 4,5	2,5 to 3,5	None
M130/1D	Pirani		10^{-1} to 10^{-3}	7	12,5	Soda lime

Origin GB

ITT

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ITT Components Group Europe
Standard Telephones and Cables Limited
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HARLOW, Essex
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