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Pages 1 to 32

**DIODES, MICROWAVE, SILICON,  
MULTIPLIER VARACTOR,  
BASED ON TYPES ML4402, ML4404  
THRU ML4409 AND ML40721  
ESA/SCC Detail Specification No. 5512/001**



**space components  
coordination group**



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		SCCG Chairman	ESA Director General or his Deputy
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## TABLE OF CONTENTS

	<u>Page</u>
<b>1. <u>GENERAL</u></b>	<b>5</b>
1.1 Scope	5
1.2 Type Variants	5
1.3 Maximum Ratings	5
1.4 Parameter Derating Information	5
1.5 Physical Dimensions	5
1.6 Functional Diagram	5
1.7 Handling Precautions	5
<b>2. <u>APPLICABLE DOCUMENTS</u></b>	<b>5</b>
<b>3. <u>TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS</u></b>	<b>5</b>
<b>4. <u>REQUIREMENTS</u></b>	<b>21</b>
4.1 General	21
4.2 Deviations from Generic Specification	21
4.2.1 Deviations from Special In-process Controls	21
4.2.2 Deviations from Final Production Tests	21
4.2.3 Deviations from Burn-in and Electrical Measurements	21
4.2.4 Deviations from Qualification Tests	21
4.2.5 Deviations from Lot Acceptance Tests	21
4.3 Mechanical and Environmental Requirements	21
4.3.1 Dimension Check	21
4.3.2 Weight	22
4.3.3 Terminal Strength	22
4.4 Materials and Finishes	23
4.4.1 Case	23
4.4.2 Lead Materials and Finish	23
4.5 Marking	23
4.5.1 General	23
4.5.2 Cathode Identification	23
4.5.3 The SCC Component Number	24
4.5.4 Traceability Information	24
4.6 Electrical Measurements	24
4.6.1 Electrical Measurements at Room Temperature	24
4.6.2 Electrical Measurements at High and Low Temperatures	24
4.6.3 Circuits for Electrical Measurements	24
4.7 Burn-in Tests	24
4.7.1 Parameter Drift Values	24
4.7.2 Conditions for High Temperature Reverse Bias Burn-in	24
4.7.3 Conditions for Power Burn-in	24
4.7.4 Electrical Circuits for High Temperature Reverse Bias and Power Burn-in	24
4.8 Environmental and Endurance Tests	29
4.8.1 Electrical Measurements on Completion of Environmental Tests	29
4.8.2 Electrical Measurements at Intermediate Points and on Completion of Endurance Tests	29
4.8.3 Conditions for Operating Life Tests	29
4.8.4 Electrical Circuits for Operating Life Tests	29
4.9 Total Dose Irradiation Testing	29
4.9.1 Application	29
4.9.2 Bias Conditions	29
4.9.3 Electrical Measurements	29
4.10 Special Testing	29

		<p style="text-align: center;">ESA/SCC Detail Specification No. 5512/001</p>	<p style="text-align: center;">Rev. 'C'</p>	<p>PAGE 4 ISSUE 1</p>
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**TABLES**

		<u>Page</u>
1(a)	Type Variants	6
1(b)	Maximum Ratings	9
2	Electrical Measurements at Room Temperature - D.C. Parameters	25
	Electrical Measurements at Room Temperature - A.C. Parameters	26
3	Electrical Measurements at High and Low Temperatures	26
4	Parameter Drift Values	26
5(a)	Conditions for High Temperature Reverse Bias Burn-in	28
5(b)	Conditions for Power Burn-in and Operating Life Tests	28
6	Electrical Measurements at Intermediate Points and on Completion of Endurance Testing	30
7	Electrical Measurements During and on Completion of Irradiation Testing	31

**FIGURES**

1	Parameter Derating Information	10
2	Physical Dimensions	11
3	Functional Diagram	20
4	Circuits for Electrical Measurements	27
5(a)	Electrical Circuit for High Temperature Reverse Bias Burn-in	28
5(b)	Electrical Circuit for Power Burn-in and Operating Life Tests	28
6	Bias Conditions for Irradiation Testing	30

**APPENDICES (Applicable to specific Manufacturers only)**

'A'	Agreed deviations for M/A-Corn Ltd. (G.B.)	32
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**1. GENERAL****1.1 SCOPE**

This specification details the ratings, physical and electrical characteristics, test and inspection data for a Diode, Microwave, Silicon, Multiplier Varactor, based on Types ML4402, ML4404 thru ML4409 and ML40721. It shall be read in conjunction with ESA/SCC Generic Specification No. 5010, the requirements of which are supplemented herein.

**1.2 TYPE VARIANTS**

Variants of the basic diodes specified herein, which are also covered by this specification are given in Table 1(a).

**1.3 MAXIMUM RATINGS**

The maximum ratings, which shall not be exceeded at any time during use or storage, applicable to the diodes specified herein, are as scheduled in Table 1(b).

**1.4 PARAMETER DERATING INFORMATION**

The derating information applicable to the diodes specified herein is shown in Figure 1.

**1.5 PHYSICAL DIMENSIONS**

The physical dimensions of the diodes specified herein are shown in Figure 2.

**1.6 FUNCTIONAL DIAGRAM**

The functional diagram, showing lead identification, of the diodes specified herein, is shown in Figure 3.

**1.7 HANDLING PRECAUTIONS**

These devices are susceptible to damage by electrostatic discharge. Therefore, suitable precautions shall be employed for protection during all phases of manufacture, testing, packaging, shipment and any handling.

These components are Categorised as Class 2 with a Minimum Critical Path Failure Voltage of 3000V.

**2. APPLICABLE DOCUMENTS**

The following documents form part of this specification and shall be read in conjunction with it:

- (a) ESA/SCC Generic Specification No. 5010 for Discrete Microwave Semiconductor Components.

**3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS**

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESA/SCC Basic Specification No. 21300 shall apply.

**TABLE 1(a) - TYPE VARIANTS**

VARIANT (1)	BASED ON TYPE (2)	FIGURE (3)	TOTAL CAPACITANCE (4) $C_T$ (pF)		JUNCTION CAPACITANCE (5) $C_J$ (pF)		BODY-LID AND LEAD MATERIAL AND FINISH (6)
			MIN	MAX	MIN	MAX	
01	ML4402 - 30	2(a)	0.40	0.65	0.2	0.45	A7-D2
02	ML4402 - 31	2(b)	0.40	0.65	0.2	0.45	A7-D2
03	ML4402 - 32	2(c)	0.51	0.76	0.2	0.45	A7-D2
04	ML4402 - 34	2(d)	0.60	0.85	0.2	0.45	A7-D2
05	ML4402 - 43	2(e)	1.00	1.25	0.2	0.45	A7-D2
06	ML4402 - 56	2(f)	0.73	0.98	0.2	0.45	A7-D2
07	ML4402 - 91	2(g)	0.51	0.76	0.2	0.45	A7-D2
08	ML4402 - 92	2(h)	0.51	0.76	0.2	0.45	A7-D2
09	ML4402 - 96	2(i)	0.38	0.63	0.2	0.45	A7-D2
10	ML4402 - 97	2(j)	0.38	0.63	0.2	0.45	A7-D2
11	ML4402 - 111	2(k)	0.51	0.76	0.2	0.45	A7-D2
12	ML4402 - 120	2(l)	0.36	0.61	0.2	0.45	D2
13	ML4402 - 148	2(m)	0.31	0.56	0.2	0.45	A7
14	ML4402 - 144B	2(n)	0.74	0.99	0.2	0.45	D2
15	ML4402 - 186	2(o)	0.35	0.60	0.2	0.45	D2
16	ML4404 - 30	2(a)	0.40	0.65	0.2	0.45	A7-D2
17	ML4404 - 31	2(b)	0.40	0.65	0.2	0.45	A7-D2
18	ML4404 - 32	2(c)	0.51	0.76	0.2	0.45	A7-D2
19	ML4404 - 34	2(d)	0.60	0.85	0.2	0.45	A7-D2
20	ML4404 - 43	2(e)	1.00	1.25	0.2	0.45	A7-D2
21	ML4404 - 56	2(f)	0.73	0.98	0.2	0.45	A7-D2
22	ML4404 - 91	2(g)	0.51	0.76	0.2	0.45	A7-D2
23	ML4404 - 92	2(h)	0.51	0.76	0.2	0.45	A7-D2
24	ML4404 - 96	2(i)	0.38	0.63	0.2	0.45	A7-D2
25	ML4404 - 97	2(j)	0.38	0.63	0.2	0.45	A7-D2
26	ML4404 - 111	2(k)	0.51	0.76	0.2	0.45	A7-D2
27	ML4404 - 120	2(l)	0.36	0.61	0.2	0.45	D2
28	ML4404 - 148	2(m)	0.31	0.56	0.2	0.45	A7
29	ML4404 - 144B	2(n)	0.74	0.99	0.2	0.45	D2
30	ML4404 - 186	2(o)	0.35	0.60	0.2	0.45	D2
31	ML4405 - 30	2(a)	0.60	1.00	0.4	0.8	A7-D2
32	ML4405 - 31	2(b)	0.60	1.00	0.4	0.8	A7-D2
33	ML4405 - 32	2(c)	0.71	1.11	0.4	0.8	A7-D2
34	ML4405 - 34	2(d)	0.80	1.20	0.4	0.8	A7-D2
35	ML4405 - 43	2(e)	1.20	1.60	0.4	0.8	A7-D2
36	ML4405 - 56	2(f)	0.93	1.33	0.4	0.8	A7-D2

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ES/SCC Detail Specification

No. 5512/001

PAGE 7

ISSUE 1

**TABLE 1(a) - TYPE VARIANTS (CONT'D)**

VARIANT (1)	BASED ON TYPE (2)	FIGURE (3)	TOTAL CAPACITANCE (4) $C_T$ (pF)		JUNCTION CAPACITANCE (5) $C_J$ (pF)		BODY-LID AND LEAD MATERIAL AND FINISH (6)
			MIN	MAX	MIN	MAX	
37	ML4405 - 91	2(g)	0.71	1.11	0.4	0.8	A7-D2
38	ML4405 - 92	2(h)	0.71	1.11	0.4	0.8	A7-D2
39	ML4405 - 96	2(i)	0.58	0.98	0.4	0.8	A7-D2
40	ML4405 - 97	2(j)	0.58	0.98	0.4	0.8	A7-D2
41	ML4405 - 111	2(k)	0.71	1.11	0.4	0.8	A7-D2
42	ML4405 - 120	2(l)	0.56	0.96	0.4	0.8	D2
43	ML4405 - 148	2(m)	0.69	1.09	0.4	0.8	A7
44	ML4405 - 144B	2(n)	0.94	1.34	0.4	0.8	D2
45	ML4405 - 186	2(o)	0.55	0.95	0.4	0.8	D2
46	ML4406 - 30	2(a)	0.90	1.40	0.7	1.2	A7-D2
47	ML4406 - 31	2(b)	0.90	1.40	0.7	1.2	A7-D2
48	ML4406 - 32	2(c)	1.01	1.51	0.7	1.2	A7-D2
49	ML4406 - 34	2(d)	1.10	1.60	0.7	1.2	A7-D2
50	ML4406 - 43	2(e)	1.50	2.00	0.7	1.2	A7-D2
51	ML4406 - 56	2(f)	1.23	1.73	0.7	1.2	A7-D2
52	ML4406 - 91	2(g)	1.01	1.51	0.7	1.2	A7-D2
53	ML4406 - 92	2(h)	1.01	1.51	0.7	1.2	A7-D2
54	ML4406 - 96	2(i)	0.88	1.38	0.7	1.2	A7-D2
55	ML4406 - 97	2(j)	0.88	1.38	0.7	1.2	A7-D2
56	ML4406 - 111	2(k)	1.01	1.51	0.7	1.2	A7-D2
57	ML4406 - 120	2(l)	0.86	1.36	0.7	1.2	D2
58	ML4406 - 148	2(m)	0.99	1.49	0.7	1.2	A7
59	ML4406 - 144B	2(n)	1.24	1.74	0.7	1.2	D2
60	ML4406 - 186	2(o)	0.85	1.35	0.7	1.2	D2
61	ML4407 - 30	2(a)	1.20	2.70	1.0	2.5	A7-D2
62	ML4407 - 31	2(b)	1.20	2.70	1.0	2.5	A7-D2
63	ML4407 - 32	2(c)	1.31	2.81	1.0	2.5	A7-D2
64	ML4407 - 34	2(d)	1.40	2.90	1.0	2.5	A7-D2
65	ML4407 - 43	2(e)	1.80	3.30	1.0	2.5	A7-D2
66	ML4407 - 56	2(f)	1.53	3.03	1.0	2.5	A7-D2
67	ML4407 - 91	2(g)	1.31	2.81	1.0	2.5	A7-D2
68	ML4407 - 92	2(h)	1.31	2.81	1.0	2.5	A7-D2
69	ML4407 - 96	2(i)	1.18	2.68	1.0	2.5	A7-D2
70	ML4407 - 97	2(j)	1.18	2.68	1.0	2.5	A7-D2
71	ML4407 - 111	2(k)	1.31	2.81	1.0	2.5	A7-D2

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ESA/SCC Detail Specification  
No. 5512/001

Rev. 'A'

PAGE 8

ISSUE 1

**TABLE 1(a) - TYPE VARIANTS (CONT'D)**

VARIANT (1)	BASED ON TYPE (2)	FIGURE (3)	TOTAL CAPACITANCE (4) $C_T$ (pF)		JUNCTION CAPACITANCE (5) $C_J$ (pF)		BODY-LID AND LEAD MATERIAL AND FINISH (6)
			MIN	MAX	MIN	MAX	
72	ML4407 - 120	2(l)	1.16	2.66	1.0	2.5	D2
73	ML4407 - 148	2(m)	1.29	2.79	1.0	2.5	A7
74	ML4407 - 144B	2(n)	1.54	3.04	1.0	2.5	D2
75	ML4407 - 186	2(o)	1.15	2.65	1.0	2.5	D2
76	ML4408 - 30	2(a)	2.20	4.20	2.0	4.0	A7-D2
77	ML4408 - 31	2(b)	2.20	4.20	2.0	4.0	A7-D2
78	ML4408 - 32	2(c)	2.31	4.31	2.0	4.0	A7-D2
79	ML4408 - 34	2(d)	2.40	4.40	2.0	4.0	A7-D2
80	ML4408 - 43	2(e)	2.80	4.80	2.0	4.0	A7-D2
81	ML4408 - 56	2(f)	2.53	4.53	2.0	4.0	A7-D2
82	ML4408 - 91	2(g)	2.31	4.31	2.0	4.0	A7-D2
83	ML4408 - 92	2(h)	2.31	4.31	2.0	4.0	A7-D2
84	ML4408 - 111	2(k)	2.31	4.31	2.0	4.0	A7-D2
85	ML4408 - 148	2(m)	2.29	4.29	2.0	4.0	A7
86	ML4408 - 144B	2(n)	2.54	4.54	2.0	4.0	D2
87	ML4409 - 34	2(d)	3.90	8.40	3.5	8.0	A7-D2
88	ML4409 - 43	2(e)	4.30	8.80	3.5	8.0	A7-D2
89	ML4409 - 56	2(f)	4.03	8.53	3.5	8.0	A7-D2
90	ML4409 - 101	2(p)	4.00	8.50	3.5	8.0	A7-D2
91	ML4409 - 144B	2(n)	4.04	8.54	3.5	8.0	D2
92	ML40721 - 186	2(o)	1.15	2.65	1.0	2.5	D2



**TABLE 1(b) - MAXIMUM RATINGS**

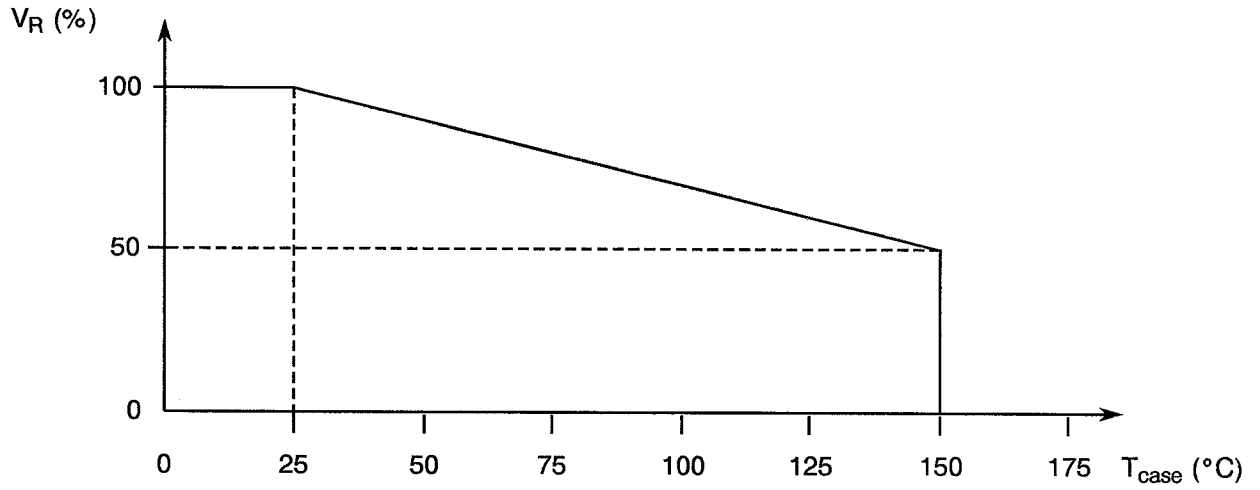
No.	CHARACTERISTIC	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	D.C. Reverse Voltage Variants 01 to 30 Variants 31 to 45 Variants 46 to 60 Variants 61 to 75 and 92 Variants 76 to 86 Variants 87 to 91	$V_R$	-15 -20 -30 -45 -60 -75	V	Note 1
2	D.C. Forward Current (Continuous) Variants 01 to 30 Variants 31 to 86 and 92 Variants 87 to 91	$I_F$	200 300 500	mA	Note 1
3	R.F. Power Dissipation Variants 01 to 14 and 16 to 29 Variants 15 and 30 Variants 31 to 44 Variants 45, 60, 75 and 92 Variants 46 to 59 Variants 61 to 74 Variants 76 to 86 Variants 87 to 91	$P_{tot}$	2.0 0.5 2.8 0.6 3.6 4.2 5.0 0.7	W	Note 1
4	Operating Temperature Range	$T_{op}$	-65 to +150	°C	$T_{case}$
5	Storage Temperature Range	$T_{stg}$	-65 to +150	°C	
6	Soldering Temperature	$T_{sol}$	+230	°C	Note 2

**NOTES**

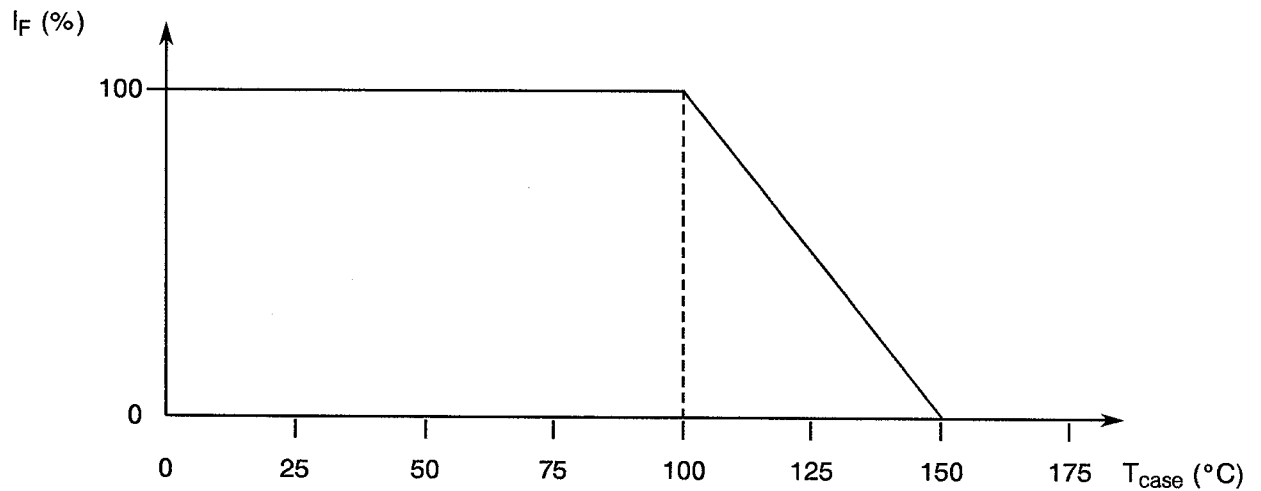
- At  $T_{case} = +25^\circ\text{C}$ . For derating at  $T_{case} > +25^\circ\text{C}$ , see Figure 1.
- Duration 5 seconds maximum (at a distance of not less than 1.5mm from the body for Variants 14, 15, 29, 30, 44, 45, 59, 60, 74, 75, 86 and 91) and the same termination shall not be resoldered until 3 minutes have elapsed.



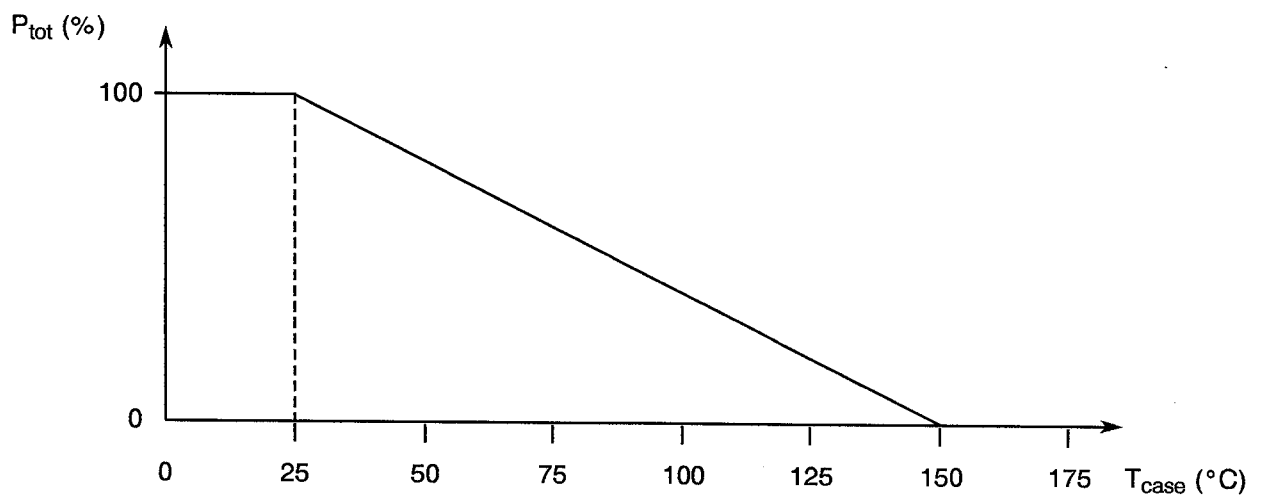
**FIGURE 1 - PARAMETER DERATING INFORMATION**



Reverse Voltage versus Temperature



Forward Current versus Temperature



Power Dissipation versus Temperature



**FIGURE 2 - PHYSICAL DIMENSIONS**

FIGURE 2(a) - VARIANTS 01, 16, 31, 46, 61, 76

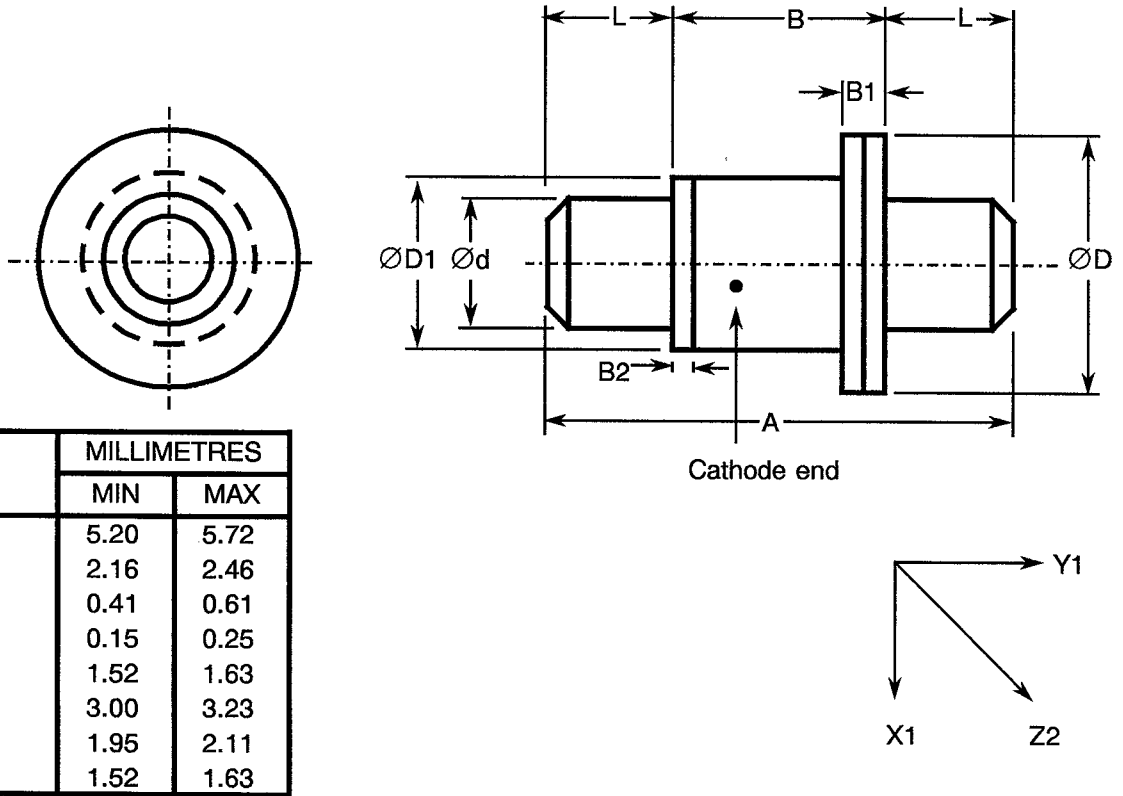
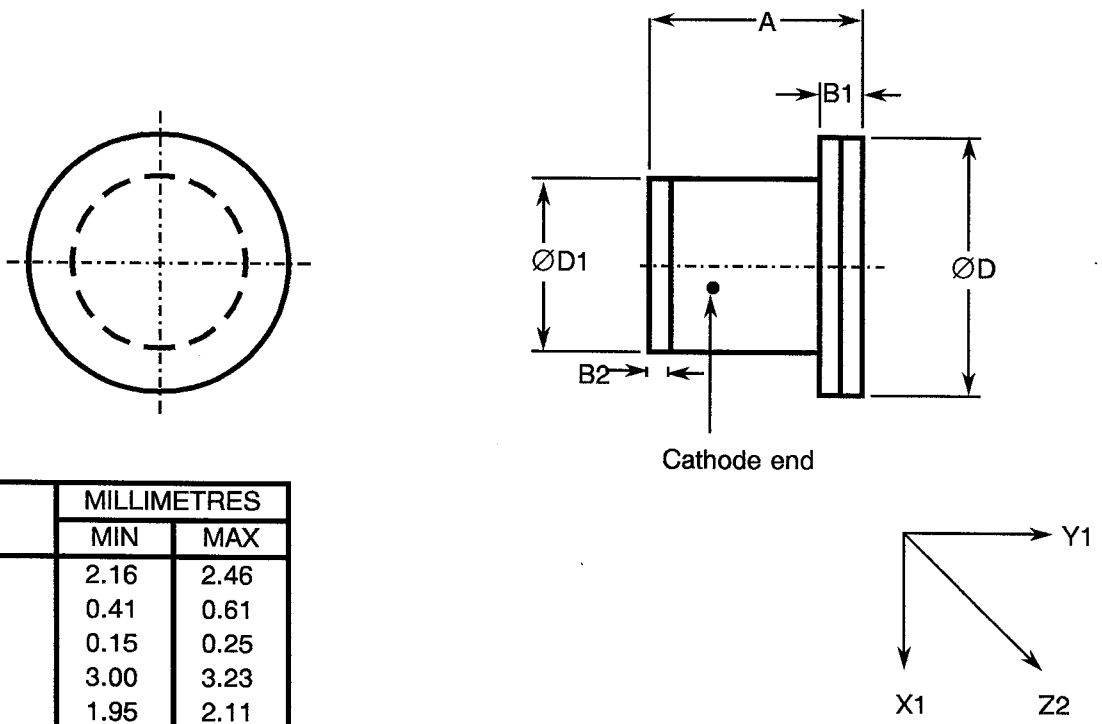


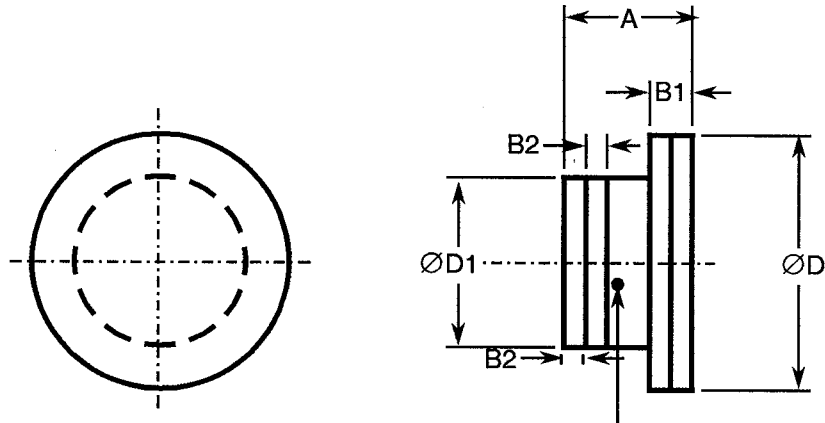
FIGURE 2(b) - VARIANTS 02, 17, 32, 47, 62, 77





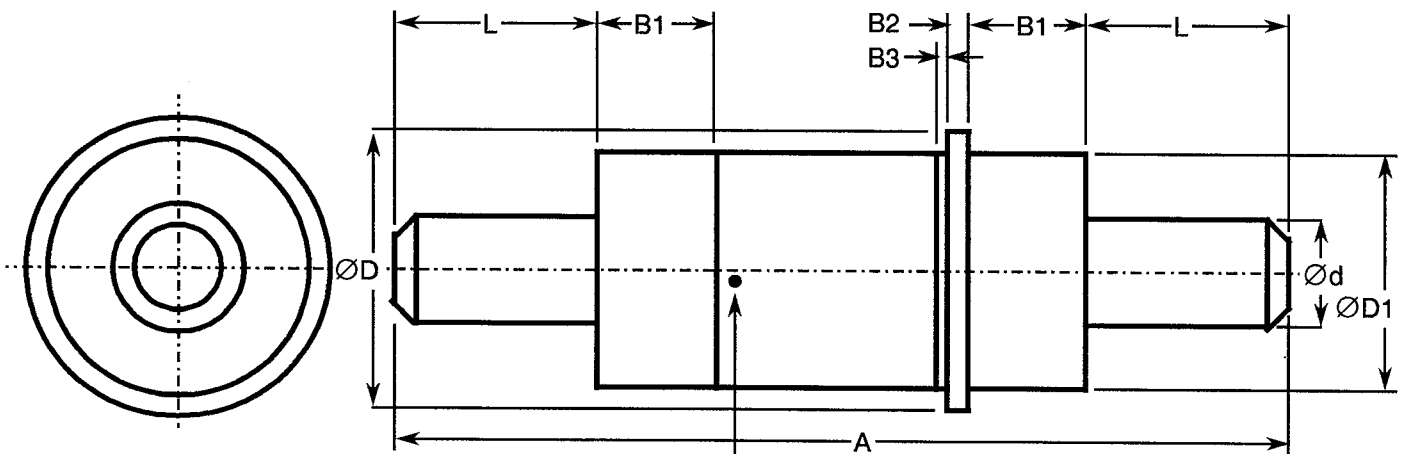
**FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)**

**FIGURE 2(c) - VARIANTS 03, 18, 33, 48, 63, 78**



SYMBOL	MILLIMETRES	
	MIN	MAX
A	1.37	1.68
B1	0.41	0.61
B2	0.15	0.20
ØD	3.00	3.23
ØD1	1.95	2.11

**FIGURE 2(d) - VARIANTS 04, 19, 34, 49, 64, 79, 87**

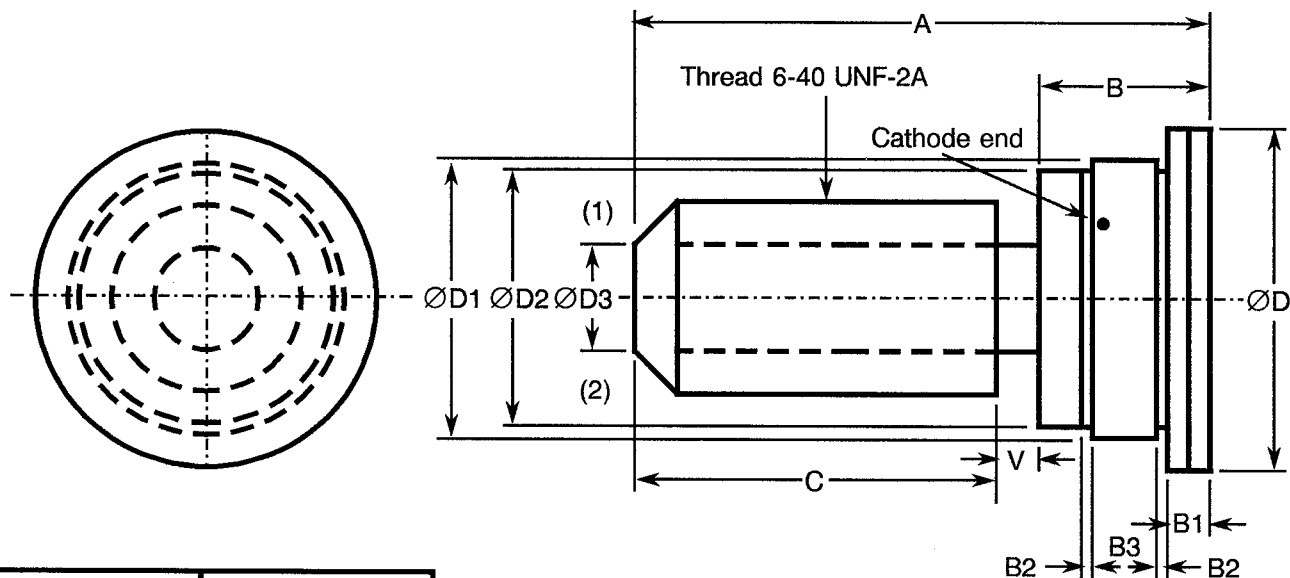


SYMBOL	MILLIMETRES	
	MIN	MAX
A	19.45	20.12
B1	2.54	-
B2	0.53	0.83
B3	0.19	0.41
Ød	2.33	2.44
ØD	-	6.10
ØD1	5.20	5.46
L	4.57	4.83

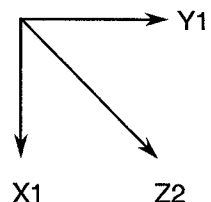


**FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)**

**FIGURE 2(e) - VARIANTS 05, 20, 35, 50, 65, 80, 88**



SYMBOL	MILLIMETRES	
	MIN	MAX
A	11.18	11.68
B	3.02	3.66
B1	0.64	0.89
B2	0.18	0.23
B3	1.17	1.27
C	6.50	7.90
$\varnothing D$	6.48	6.73
$\varnothing D1$	5.20	5.50
$\varnothing D2$	4.80	5.20
$\varnothing D3$	2.00	2.70
V	0.76	1.02



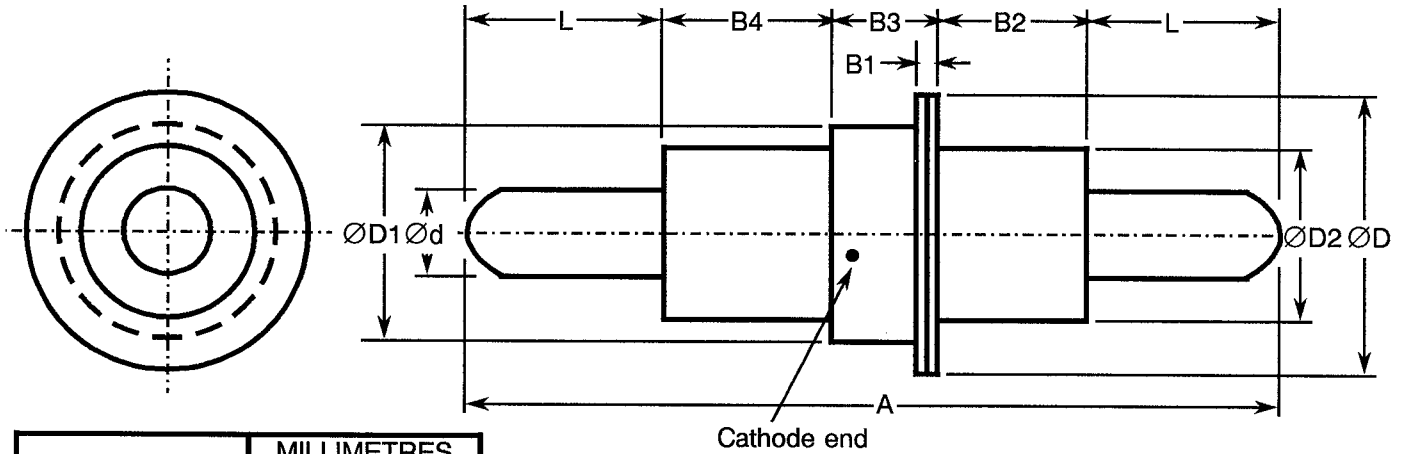
**NOTES**

1. Spline socket to fit S-072 Bristol spline key 1.78mm deep.
2. 0.51mm x  $45^\circ$ .

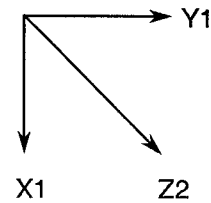


**FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)**

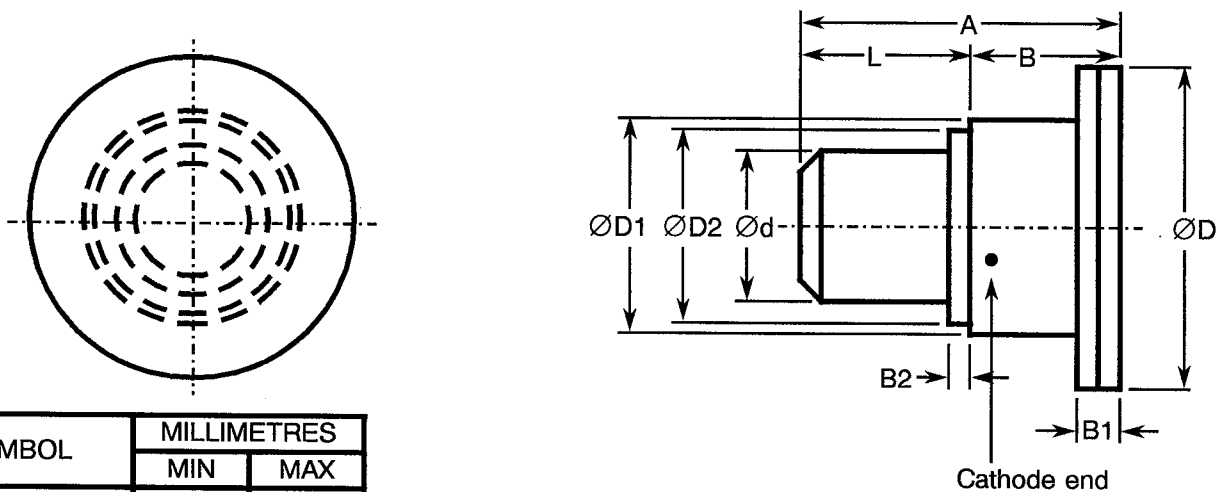
**FIGURE 2(f) - VARIANTS 06, 21, 36, 51, 66, 81, 89**



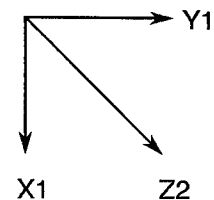
SYMBOL	MILLIMETRES	
	MIN	MAX
A	19.46	20.12
B1	-	0.76
B2	3.00	3.60
B3	2.41	2.67
B4	3.68	3.94
Ød	2.33	2.39
ØD	-	6.10
ØD1	4.72	4.83
ØD2	3.81	4.19
L	4.57	4.83



**FIGURE 2(g) - VARIANTS 07, 22, 37, 52, 67, 82**



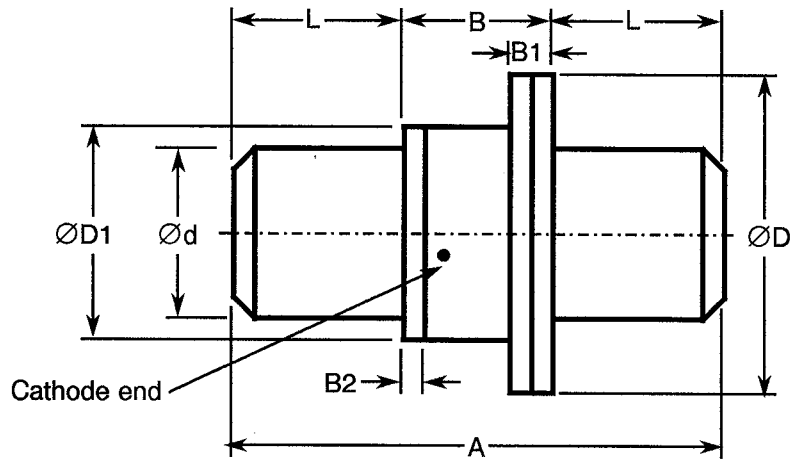
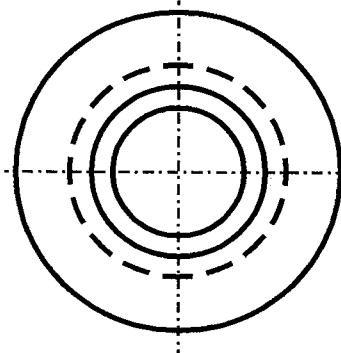
SYMBOL	MILLIMETRES	
	MIN	MAX
A	2.92	3.28
B	1.40	1.65
B1	0.41	0.61
B2	0.15	0.20
Ød	1.52	1.63
ØD	3.00	3.23
ØD1	1.95	2.11
ØD2	1.85	2.03
L	1.52	1.63



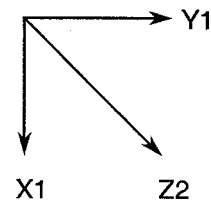


**FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)**

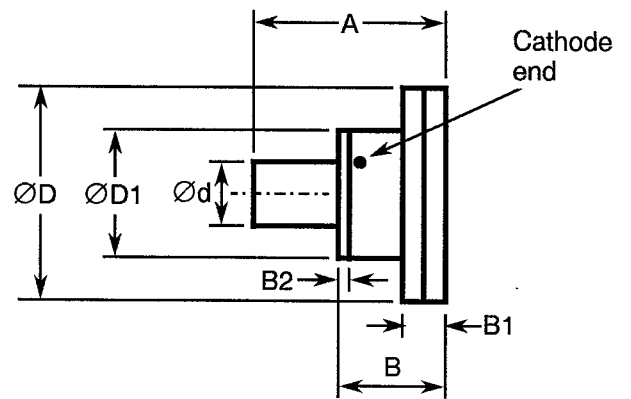
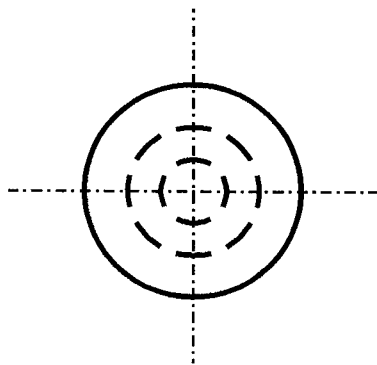
**FIGURE 2(h) - VARIANTS 08, 23, 38, 53, 68, 83**



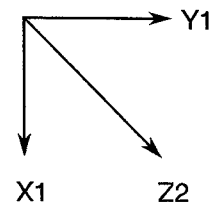
SYMBOL	MILLIMETRES	
	MIN	MAX
A	4.42	4.93
B	1.40	1.65
B1	0.41	0.61
B2	0.15	0.20
Ød	1.52	1.63
ØD	3.00	3.23
ØD1	1.95	2.11
L	1.52	1.63



**FIGURE 2(i) - VARIANTS 09, 24, 39, 54, 69**



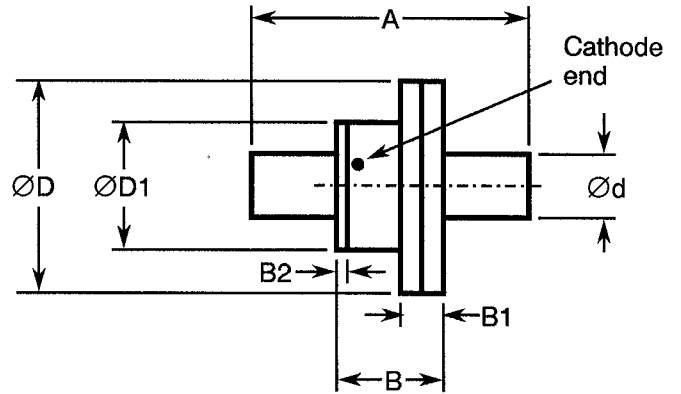
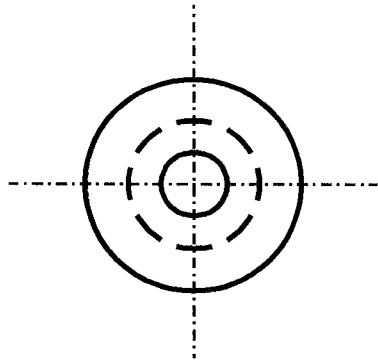
SYMBOL	MILLIMETRES	
	MIN	MAX
A	1.78	2.03
B	1.02	1.27
B1	-	0.38
B2	0.10	0.25
Ød	0.61	0.66
ØD	1.98	2.18
ØD1	1.19	1.35





**FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)**

FIGURE 2(j) - VARIANTS 10, 25, 40, 55, 70



SYMBOL	MILLIMETRES	
	MIN	MAX
A	2.54	2.79
B	1.02	1.27
B1	-	0.38
B2	0.10	0.25
Ød	0.61	0.66
ØD	1.98	2.18
ØD1	1.19	1.35

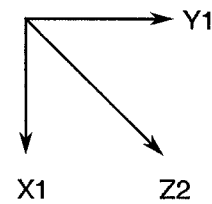
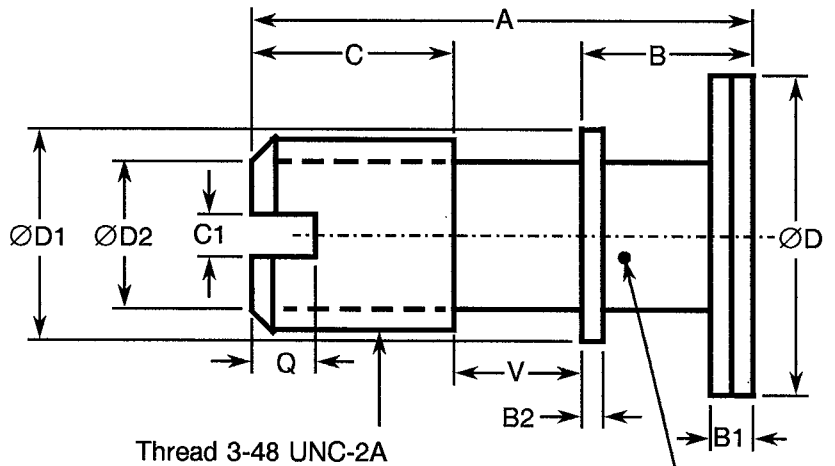
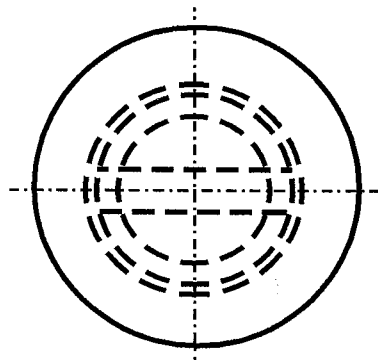
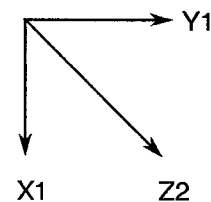


FIGURE 2(k) - VARIANTS 11, 26, 41, 56, 71, 84



SYMBOL	MILLIMETRES	
	MIN	MAX
A	4.71	5.30
B	1.47	1.80
B1	0.41	0.61
B2	0.20	0.30
C	1.50	2.80
C1	0.38	0.64
ØD	3.00	3.23
ØD1	2.49	2.59
ØD2	0.90	2.20
Q	0.76	1.02
V	0.11	2.33

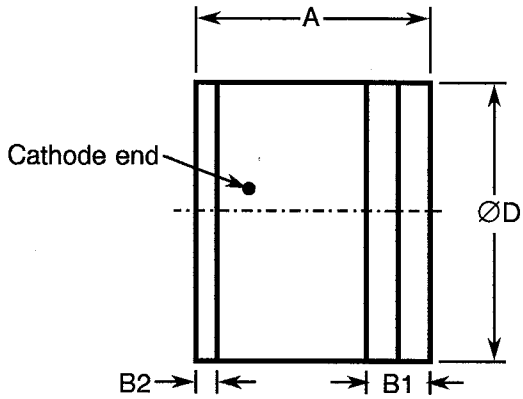
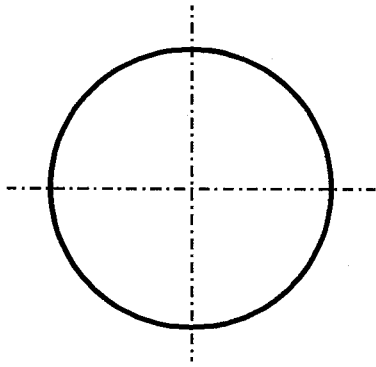






**FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)**

FIGURE 2(l) - VARIANTS 12, 27, 42, 57, 72



SYMBOL	MILLIMETRES	
	MIN	MAX
A	1.02	1.27
B1	0.23	0.33
B2	0.10	0.15
ØD	1.29	1.40

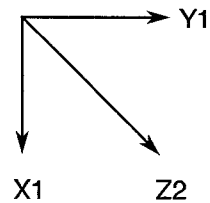
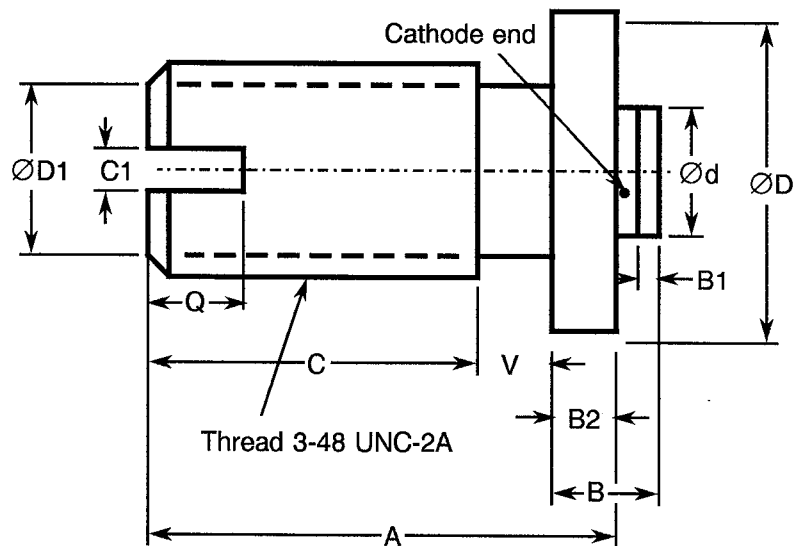
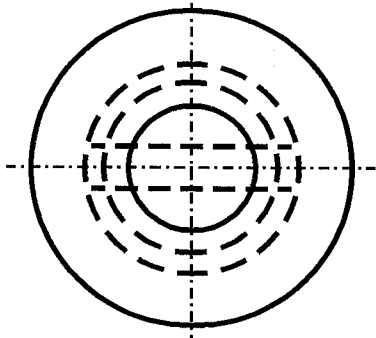
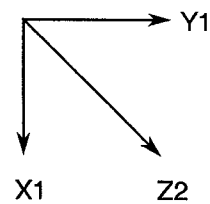


FIGURE 2(m) - VARIANTS 13, 28, 43, 58, 73, 85



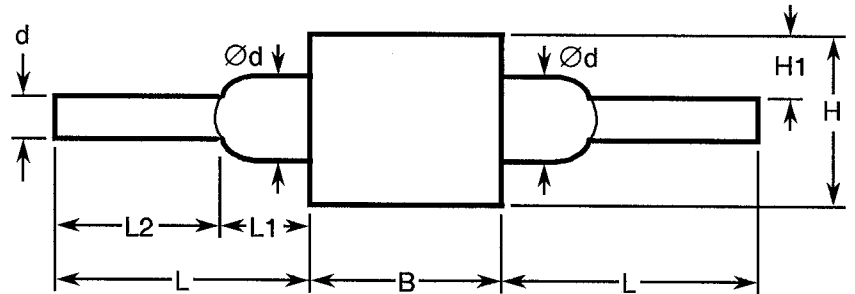
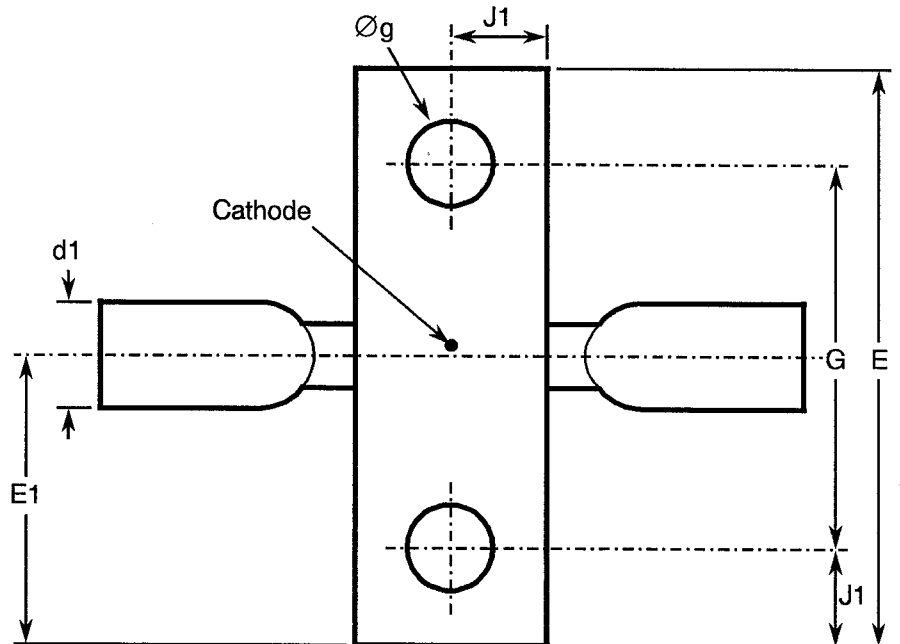
SYMBOL	MILLIMETRES	
	MIN	MAX
A	4.24	4.75
B	1.02	1.32
B1	0.20	0.30
B2	0.46	0.56
C	2.74	3.65
C1	0.38	0.64
Ød	1.22	1.32
ØD	2.87	3.00
ØD1	1.60	2.00
Q	0.89	1.14
V	0.64	0.89



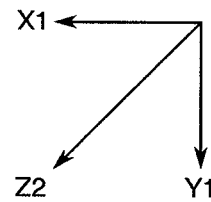


**FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)**

**FIGURE 2(n) - VARIANTS 14, 29, 44, 59, 74, 86, 91**



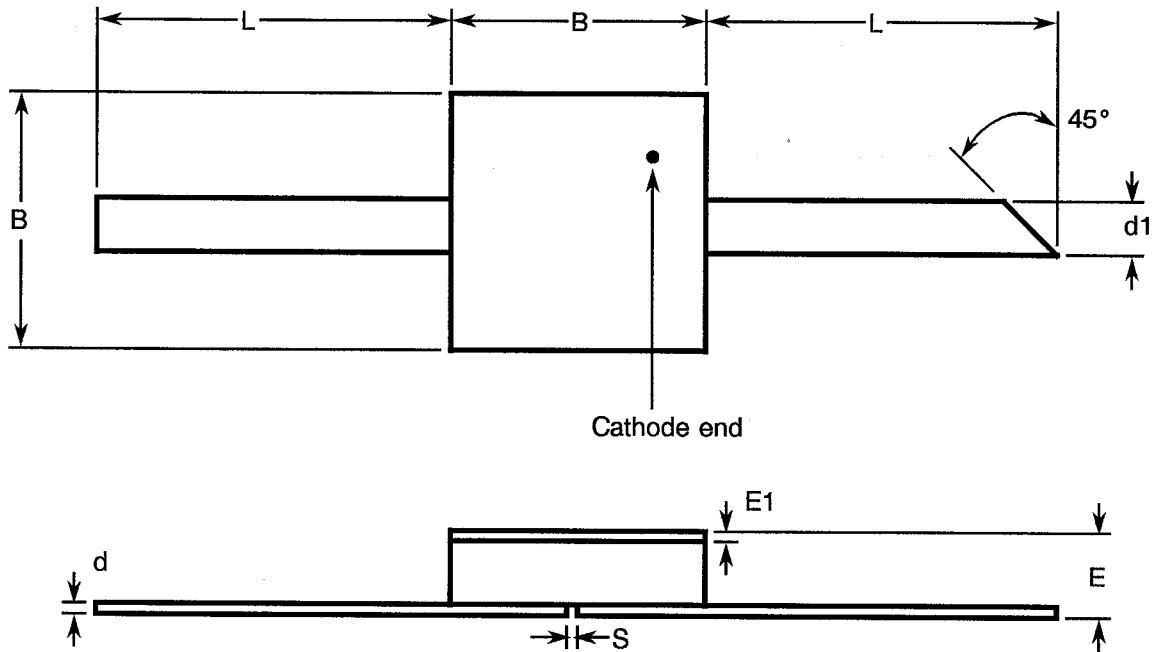
SYMBOL	MILLIMETRES	
	MIN	MAX
B	3.94	4.19
d	0.07	0.25
d1	0.50	1.30
Ød	0.25	0.40
E	10.16	10.67
E1	4.95	5.46
Øg	2.34	2.54
G	6.10	6.60
H	3.05	3.30
H1	1.12	1.92
J1	1.91	2.16
L	2.00	-
L1	0.10	1.00
L2	1.00	-



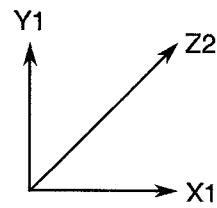


**FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)**

FIGURE 2(o) - VARIANTS 15, 30, 45, 60, 75, 92



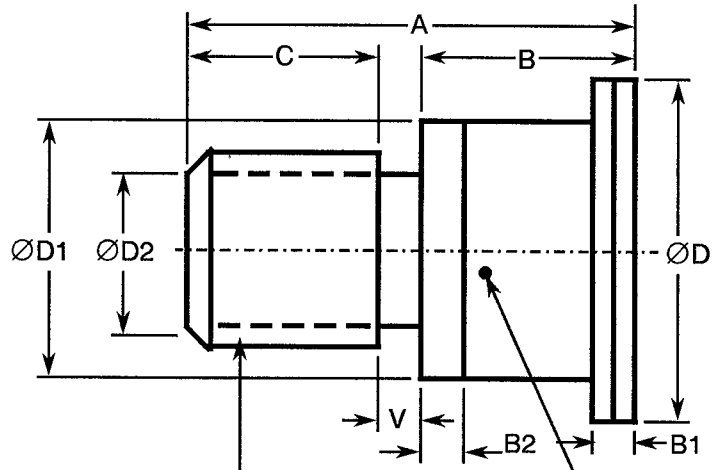
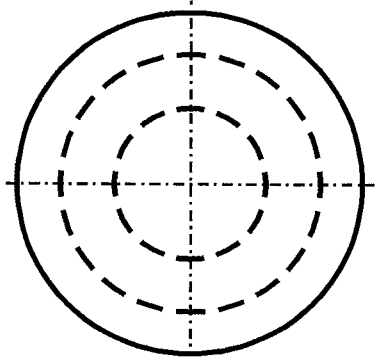
SYMBOL	MILLIMETRES	
	MIN	MAX
B	2.39	2.62
d	0.07	0.15
d1	0.48	0.56
E	0.79	1.12
E1	0.10	0.18
L	3.30	5.84
S	0.10	-





**FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)**

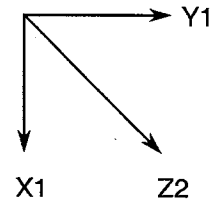
**FIGURE 2(p) - VARIANT 90**



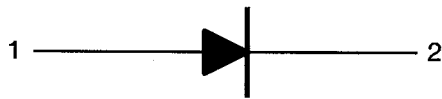
Thread 3-48 UNC-2A

Cathode end

SYMBOL	MILLIMETRES	
	MIN	MAX
A	5.34	5.74
B	2.52	2.72
B1	0.61	0.81
B2	0.65	0.85
C	1.68	2.58
∅D	4.03	4.09
∅D1	3.05	3.25
∅D2	1.60	2.00
V	0.64	0.94




**FIGURE 3 - FUNCTIONAL DIAGRAM**



- 1. Anode
- 2. Cathode

**NOTES**

- 1. The cathode end shall be marked with a black dot or band. The marking will not be on the cathode connection but adjacent to it.
- 2. The cathode shall be marked with a black dot.

	<p style="text-align: center;">ESA/SCC Detail Specification No. 5512/001</p>	<p style="text-align: center;">Rev. 'C'</p>	<p>PAGE 21 ISSUE 1</p>
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#### 4. REQUIREMENTS

##### 4.1 GENERAL

The complete requirements for procurement of the diodes specified herein shall be as stated in this specification and ESA/SCC Generic Specification No. 5010 for Discrete Microwave Semiconductor Components. Deviations from the Generic Specification applicable to this specification only, are listed in Para. 4.2.

Deviations from the applicable Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESA/SCC requirements and do not affect the components' reliability, are listed in the appendices attached to this specification.

##### 4.2 DEVIATIONS FROM GENERIC SPECIFICATION

###### 4.2.1 Deviations from Special In-process Controls

- (a) Para. 5.2.3, Total Dose Irradiation Testing: Shall be performed during qualification and extension of qualification.
- (b) Para. 5.2.3, Total Dose Irradiation Testing: Shall be performed during procurement on a lot acceptance basis at the total dose irradiation level specified in the purchase order.

###### 4.2.2 Deviations from Final Production Tests (Chart II)

- (a) Para. 6.3, Pre-burn-in: Shall be performed in accordance with Para. 9.21(a).
- (b) Para. 9.2.2, Die Shear: Shall not be performed for Variants 14, 29, 44, 59, 74, 86 and 91 and no additional thermal tests shall be performed to replace this test.

###### 4.2.3 Deviations from Burn-in and Electrical Measurements (Chart III)

- (a) Para. 9.21, High Temperature Reverse Bias Burn-in: Shall be performed at 50% of rated  $V_R$ .

###### 4.2.4 Deviations from Qualification Tests (Chart IV)

- (a) Para. 9.2.4, Die Shear: Shall not be performed for Variants 14, 29, 44, 59, 74, 86 and 91 for which thermal resistance measurements shall be performed in accordance with Table 2 of this specification.
- (b) Para. 9.23, Special Testing: Shall not be performed.

###### 4.2.5 Deviations from Lot Acceptance Tests (Chart V)

- (a) Para. 9.23, Special Testing: Shall not be performed.

#### 4.3 MECHANICAL AND ENVIRONMENTAL REQUIREMENTS

##### 4.3.1 Dimension Check

The dimensions of the diodes specified herein shall be checked. They shall conform to those shown in Figure 2.

**4.3.2 Weight**

The maximum weight of the diodes specified herein shall be:

Variant No.	Weight (g)
01, 16, 31, 46, 61, 76	0.12
02, 17, 32, 47, 62, 77	0.06
03, 18, 33, 48, 63, 78	0.08
04, 19, 34, 49, 64, 79, 87	2.14
05, 20, 35, 50, 65, 80, 88	1.10
06, 21, 36, 51, 66, 81, 89	1.80
07, 22, 37, 52, 67, 82	0.11
08, 23, 38, 53, 68, 83	0.13

Variant No.	Weight (g)
09, 24, 39, 54, 69	0.015
10, 25, 40, 55, 70	0.022
11, 26, 41, 56, 71, 84	0.14
12, 27, 42, 57, 72	0.014
13, 28, 43, 58, 73, 85	0.15
14, 29, 44, 59, 74, 86, 91	0.99
15, 30, 45, 60, 75, 92	0.06
90	0.24

**4.3.3 Terminal Strength**

The requirements for terminal strength testing are specified in Section 9 of ESA/SCC Generic Specification No. 5010. The test conditions shall be as follows:-

**(a) Condition: 'A' (Tension)**

Variants 14, 15, 29, 30, 44, 45, 59, 60, 74, 75, 86, 91 and 92:

- Force: 5.1N.
- Duration: 5 seconds.

**(b) Condition: 'D2' (Stud Torque)**

Variants 05, 20, 35, 50, 65, 80 and 88:

- Torque: 70mNm.
- Duration: 5 seconds.

Variants 11, 26, 41, 56, 71, 84 and 90:

- Torque: 56mNm.
- Duration: 5 seconds.

Variants 13, 28, 43, 58, 73 and 85:

- Torque: 42mNm.
- Duration: 5 seconds.

**(c) Condition: Compression**

Variants 01, 02, 03, 04, 05, 06, 07, 08, 11, 16, 17, 18, 19, 20, 21, 22, 23, 26, 31, 32, 33, 34, 35, 36, 37, 38, 41, 46, 47, 48, 49, 50, 51, 52, 53, 56, 61, 62, 63, 64, 65, 66, 67, 68, 71, 76, 77, 78, 79, 80, 81, 82, 83, 84, 87, 88, 89 and 90:

- Force: 50N.
- Duration: 5 seconds.



Variants 09, 10, 12, 13, 24, 25, 27, 28, 39, 40, 42, 43, 54, 55, 57, 58, 69, 70, 72, 73 and 85:

- Force: 10N.
- Duration: 5 seconds.

The compression test shall be performed by applying the specified force to the end-cap by means of a suitable weight applied for the specified time. On completion of the test, a visual examination shall be performed to check for damage to the end-cap or the ceramic body.

#### 4.4 MATERIALS AND FINISHES

The materials and finishes shall be as specified herein. Where a definite material is not specified, a material which will enable the diodes specified herein to meet the performance requirements of this specification shall be used. Acceptance or approval of any constituent material shall not guarantee acceptance of the finished product.

##### 4.4.1 Case

The case shall be hermetically sealed and have a ceramic body. The lid shall be welded or preform soldered.

##### 4.4.2 Lead Materials and Finish

- (a) For Variants 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 76, 77, 78, 79, 80, 81, 82, 83, 84, 87, 88, 89 and 90, the body material shall be Type 'A' with Type '7' finish and the lid material shall be Type 'D' with Type '2' finish, in accordance with the requirements of ESA/SCC Basic Specification No. 23500.
- (b) For Variants 13, 28, 43, 58, 73 and 85, the lead material shall be Type 'A' with Type '7' finish in accordance with the requirements of ESA/SCC Basic Specification No. 23500.
- (c) For Variants 12, 14, 15, 27, 29, 30, 42, 44, 45, 57, 59, 60, 72, 74, 75, 86, 91 and 92, the lead material shall be Type 'D' with Type '2' finish in accordance with the requirements of ESA/SCC Basic Specification No. 23500.

#### 4.5 MARKING

##### 4.5.1 General

The marking of components delivered to this specification shall be in accordance with the requirements of ESA/SCC Basic Specification No. 21700 and the following paragraphs. When the component is too small to accommodate all of the marking specified, as much as space permits shall be marked and the marking information, in full, shall accompany the component in its primary package.

The information to be marked and the order of precedence, shall be as follows:-

- (a) Cathode Identification.
- (b) The SCC Component Number.
- (c) Traceability Information.

##### 4.5.2 Cathode Identification

Cathode identification shall be as shown in Figures 2 and 3 of this specification.

#### 4.5.3 The SCC Component Number

Each component shall bear the SCC Component Number which shall be constituted and marked as follows:

Detail Specification Number		551200101BF
Type Variant (see Table 1(a))		
Testing Level (B or C, as applicable)		
Total Dose Irradiation Level (if applicable)		

The Total Dose Irradiation Level designation shall be added for those devices for which a sample has been successfully tested to the level in question. For these devices, a code letter shall be added in accordance with the requirements of ESA/SCC Basic Specification No. 22900.

#### 4.5.4 Traceability Information

Each component shall be marked in respect of traceability information as defined in ESA/SCC Basic Specification No. 21700.

### 4.6 ELECTRICAL MEASUREMENTS

#### 4.6.1 Electrical Measurements at Room Temperature

The parameters to be measured at room temperature are scheduled in Table 2. Unless otherwise specified, the measurements shall be performed at  $T_{amb} = +22 \pm 3$  °C.

#### 4.6.2 Electrical Measurements at High and Low Temperatures

The parameters to be measured at high and low temperatures are scheduled in Table 3. Unless otherwise specified, the measurements shall be performed at  $+150(+0-3)$  °C.

#### 4.6.3 Circuits for Electrical Measurements

Circuits for use in performing electrical measurements listed in Table 2 of this specification are shown in Figure 4.

### 4.7 BURN-IN TESTS

Burn-in shall be Category 2 of Chart III(a).

#### 4.7.1 Parameter Drift Values

The parameter drift values applicable to burn-in are specified in Table 4 of this specification. Unless otherwise stated, the measurements shall be performed at  $T_{amb} = +22 \pm 3$  °C. The parameter drift values ( $\Delta$ ) applicable to the scheduled parameters shall not be exceeded. In addition to these drift value requirements for a given parameter, the appropriate limit value specified in Table 2 shall not be exceeded.

#### 4.7.2 Conditions for High Temperature Reverse Bias Burn-in

The requirements for the high temperature reverse bias burn-in are specified in Section 7 of ESA/SCC Generic Specification No. 5010. The conditions for high temperature reverse bias burn-in shall be as specified in Table 5(a) of this specification.

#### 4.7.3 Conditions for Power Burn-in

The requirements for power burn-in are specified in Section 7 of ESA/SCC Generic Specification No. 5010. The conditions for power burn-in shall be as specified in Table 5(b) of this specification.

#### 4.7.4 Electrical Circuits for High Temperature Reverse Bias and Power Burn-in

Circuits for use in performing the H.T.R.B and power burn-in tests are shown in Figures 5(a) and 5(b) of this specification.





**TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - D.C. PARAMETERS**

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	Reverse Current 1	$I_{R1}$	4016	$V_R = \text{Note 1}$	-	10	$\mu\text{A}$
2	Reverse Current 2	$I_{R2}$	4016	$V_R = \text{Note 2}$	-	50	nA
3	Forward Voltage	$V_F$	4011	$I_F = 100\text{mA}$ Variants 01 to 45 Variants 46 to 86 and 92 Variants 87 to 91	- - -	1.3 1.2 1.0	V
4	Thermal Resistance	$R_{TH(J-C)}$	3101	$I_F = 1.0\text{A}$ Note 3 Variants 01 to 14 and 16 to 29 Variants 15 and 30 Variants 31 to 44 Variant 45 Variants 46 to 59 Variant 60 Variants 61 to 74 Variants 75 and 92 Variants 76 to 86 Variants 87 to 91	- - - - - - - - - - - -	60 220 45 205 35 195 30 190 25 12	$^{\circ}\text{C/W}$

**NOTES**

1. Table 1(b), Item 1.
2. Half the value of Table 1(b), Item 1.
3. Pulsed measurement, pulse width = 4.0 $\mu\text{s}$ , p.r.f. = 1.0kHz.

		ESA/SCC Detail Specification No. 5512/001	Rev. 'C'	PAGE 26
				ISSUE 1

**TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - A.C. PARAMETERS**

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST FIG.	TEST CONDITIONS	LIMITS		UNIT
						MIN.	MAX.	
5	Total Capacitance	$C_T$	4001	-	$V_R = -6.0V$ $f = 1.0MHz$	Note 1		pF
6	Minority Carrier Lifetime	$\tau_L$	-	4	$I_F = 10mA$ Variants 01 to 15 Variants 16 to 45 Variants 46 to 60 Variants 61 to 75 Variants 76 to 86 Variants 87 to 91 Variant 92	7.0 10 15 35 50 100 80	- - - - - - -	ns
7	Transition Time	$\tau_S$	-	4	$I_F = 10mA$ Variants 01 to 15 Variants 16 to 30 Variants 31 to 45 Variants 46 to 60 Variants 61 to 75 and 92 Variants 76 to 86 Variants 87 to 91	- - - - - - -	75 150 170 200 250 600 1.5	ps      ns

**NOTES**

- See Column 4 of Table 1(a).

**TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES**

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
2	Reverse Current 2	$I_{R2}$	As per Table 2	As per Table 2	-	10	$\mu A$

**TABLE 4 - PARAMETER DRIFT VALUES**

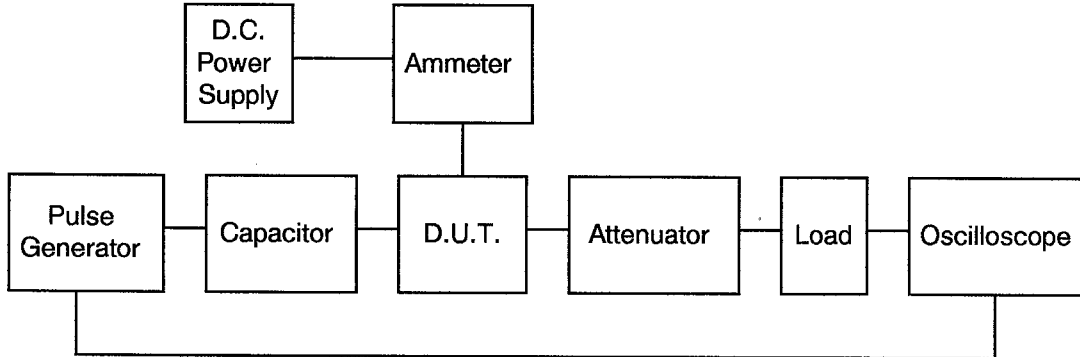
No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS ( $\Delta$ )	UNIT
2	Reverse Current 2	$I_{R2}$	As per Table 2	As per Table 2	$\pm 10$ (1) or (2) $\pm 100$ (1)	nA %
3	Forward Voltage	$V_F$	As per Table 2	As per Table 2	$\pm 100$ (1)	mV

**NOTES**

- $\Delta 1 = \Delta 2$ .
- Whichever is the greater, referred to the initial measurement.



**FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS**



**TABLE 5(a) - CONDITIONS FOR HIGH TEMPERATURE REVERSE BIAS BURN-IN**

No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Ambient Temperature	$T_{amb}$	+ 150(+ 0 - 3)	°C
2	Reverse Voltage	$V_R$	Note 1	V

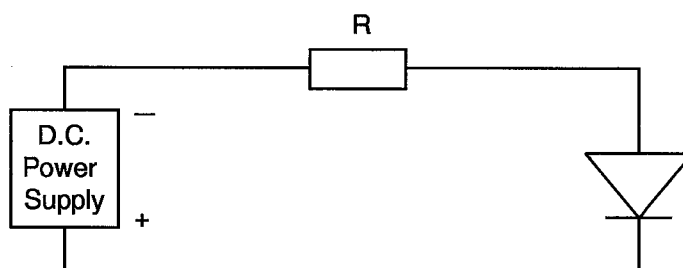
**NOTES**

- Half the value of Table 1(b), Item 1.

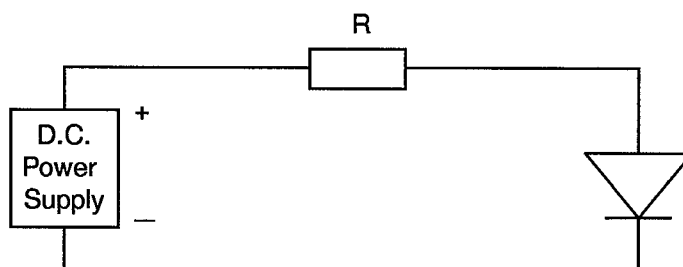
**TABLE 5(b) - CONDITIONS FOR POWER BURN-IN AND OPERATING LIFE TESTS**



No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Ambient Temperature	$T_{amb}$	+ 125(+ 0 - 3)	°C
2	Forward Current	$I_F$	Variants 01 to 30: 100 Variants 31 to 86 and 92: 150 Variants 87 to 91: 250	mA

**FIGURE 5(a) - ELECTRICAL CIRCUIT FOR HIGH TEMPERATURE REVERSE BIAS BURN-IN**



**FIGURE 5(b) - ELECTRICAL CIRCUIT FOR POWER BURN-IN AND OPERATING LIFE TESTS**



 	<p style="text-align: center;">ESA/SCC Detail Specification No. 5512/001</p>	<p style="text-align: center;">Rev. 'C'</p>	<p>PAGE 29 ISSUE 1</p>
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4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESA/SCC GENERIC SPECIFICATION NO. 5010)

4.8.1 Electrical Measurements on Completion of Environmental Tests

The parameters to be measured on completion of environmental tests are scheduled in Table 2. Unless otherwise stated, the measurements shall be performed at  $T_{amb} = +22 \pm 3$  °C.

4.8.2 Electrical Measurements at Intermediate Points and on Completion of Endurance Tests

The parameters to be measured at intermediate points and on completion of endurance tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at  $T_{amb} = +22 \pm 3$  °C.

4.8.3 Conditions for Operating Life Tests (Part of Endurance Testing)

The requirements for operating life testing are specified in Section 9 of ESA/SCC Generic Specification No. 5010. The conditions for operating life testing are specified in Table 5(b) of this specification.

4.8.4 Electrical Circuits for Operating Life Tests

The circuit to be used for performance of the operating life test shall be the same as shown in Figure 5(b) for Power Burn-in.

4.9 TOTAL DOSE IRRADIATION TESTING

4.9.1 Application

If specified in Para. 4.2.1 of this specification, total dose irradiation testing shall be performed in accordance with the requirements of ESA/SCC Basic Specification No. 22900.

4.9.2 Bias Conditions

Continuous bias shall be applied during irradiation testing as shown in Figure 6 of this specification.

4.9.3 Electrical Measurements

The parameters to be measured prior to irradiation exposure are scheduled in Table 2 of this specification. Only devices which meet the requirements of Table 2 shall be included in the test sample.

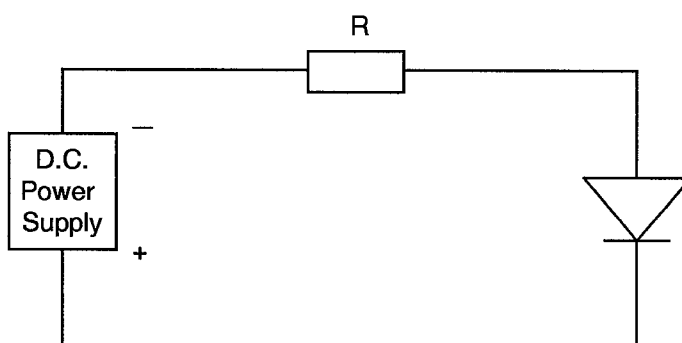
The parameters to be measured during and on completion of irradiation testing are scheduled in Table 7 of this specification.

4.10 SPECIAL TESTING

Not applicable.

**TABLE 6 - ELECTRICAL MEASUREMENTS AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING**

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	Reverse Current 1	$I_{R1}$	As per Table 2	As per Table 2	As per Table 2		$\mu\text{A}$
2	Reverse Current 2	$I_{R2}$	As per Table 2	As per Table 2	As per Table 2		nA
3	Forward Voltage	$V_F$	As per Table 2	As per Table 2	As per Table 2		V
5	Total Capacitance	$C_T$	As per Table 2	As per Table 2	As per Table 2		pF

**FIGURE 6 - BIAS CONDITIONS FOR IRRADIATION TESTING****NOTES**

1. A reverse bias of  $V_R$  = Half the value of Table 1(b), Item 1, shall be applied.

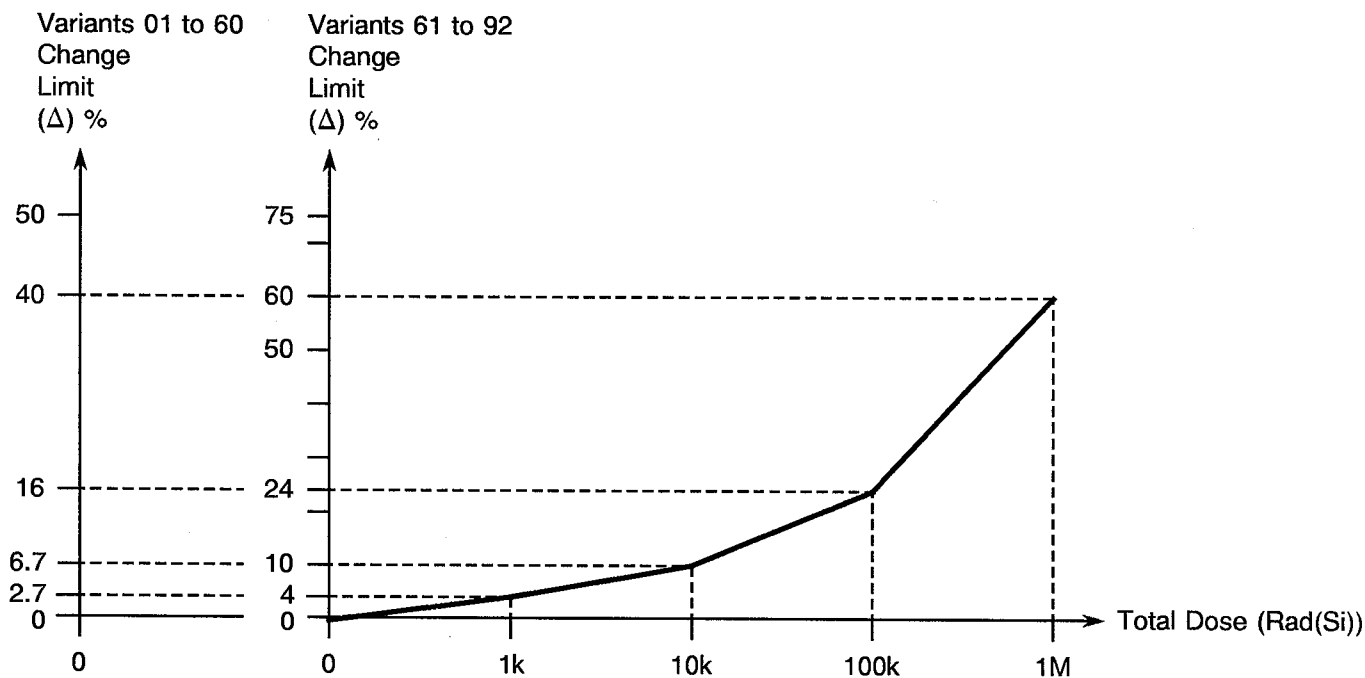


**TABLE 7 - ELECTRICAL MEASUREMENTS DURING AND ON COMPLETION OF IRRADIATION TESTING**

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS ( $\Delta$ )	UNIT
6	Minority Carrier Lifetime	$\tau_L$	As per Table 2	As per Table 2	Note 1	%

**NOTES**

1. The graph given below shall be used to determine the maximum permitted change.





**SCC**

ESA/SCC Detail Specification  
No. 5512/001

PAGE 32

ISSUE 1

**APPENDIX 'A'**

Page 1 of 1

AGREED DEVIATIONS FOR M/A-Com LTD. (G.B.)

ITEMS AFFECTED	DESCRIPTION OF DEVIATIONS
Para. 4.2.2	Para. 9.4, "High Temperature Stabilisation Bake": May be performed at +150(+0 - 3) °C.