



**DIODES, MICROWAVE, SILICON,
PIN, BROADBAND,
BASED ON TYPES ML4660, ML4661, ML4663,
ML4665, ML4667, ML4669 AND
ML4671 THRU ML4674
ESCC Detail Specification No. 5513/005**

**ISSUE 1
October 2002**



	ESCC Detail Specification		PAGE ii ISSUE 1
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ESA/SCC Detail Specification No. 5513/005



space components
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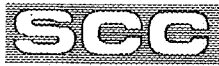




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APPENDICES (Applicable to specific Manufacturers only)

None

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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, PIN, Broadband, based on Types ML4660, ML4661, ML4663, ML4665, ML4667, ML4669 and ML4671 thru ML4674. 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 3400V.

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**

(1) VARIANT	(2) BASED ON TYPE	(3) FIGURE	(4) INSERTION LOSS IL (dB) (Maximum)	(5) LEAD MATERIAL AND FINISH
01	ML4660 - 116	2(a)	1.5	D2
02	ML4660 - 144	2(b)	1.5	D2
03	ML4660 - 144B	2(b)	1.5	D2
04	ML4661 - 116	2(a)	0.7	D2
05	ML4661 - 144	2(b)	0.7	D2
06	ML4661 - 144B	2(b)	0.7	D2
07	ML4663 - 116	2(a)	0.7	D2
08	ML4663 - 144	2(b)	0.7	D2
09	ML4663 - 144B	2(b)	0.7	D2
10	ML4665 - 116	2(a)	0.7	D2
11	ML4665 - 144	2(b)	0.7	D2
12	ML4665 - 144B	2(b)	0.7	D2
13	ML4667 - 116	2(a)	0.7	D2
14	ML4667 - 144	2(b)	0.7	D2
15	ML4667 - 144B	2(b)	0.7	D2
16	ML4669 - 116	2(a)	1.0	D2
17	ML4669 - 144	2(b)	1.0	D2
18	ML4669 - 144B	2(b)	1.0	D2
19	ML4671 - 116	2(a)	1.0	D2
20	ML4671 - 144	2(b)	1.0	D2
21	ML4671 - 144B	2(b)	1.0	D2
22	ML4672 - 116	2(a)	1.2	D2
23	ML4672 - 144	2(b)	1.2	D2
24	ML4672 - 144B	2(b)	1.2	D2
25	ML4673 - 116	2(a)	1.2	D2
26	ML4673 - 144	2(b)	1.2	D2
27	ML4673 - 144B	2(b)	1.2	D2
28	ML4674 - 116	2(a)	1.2	D2
29	ML4674 - 144	2(b)	1.2	D2
30	ML4674 - 144B	2(b)	1.2	D2

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

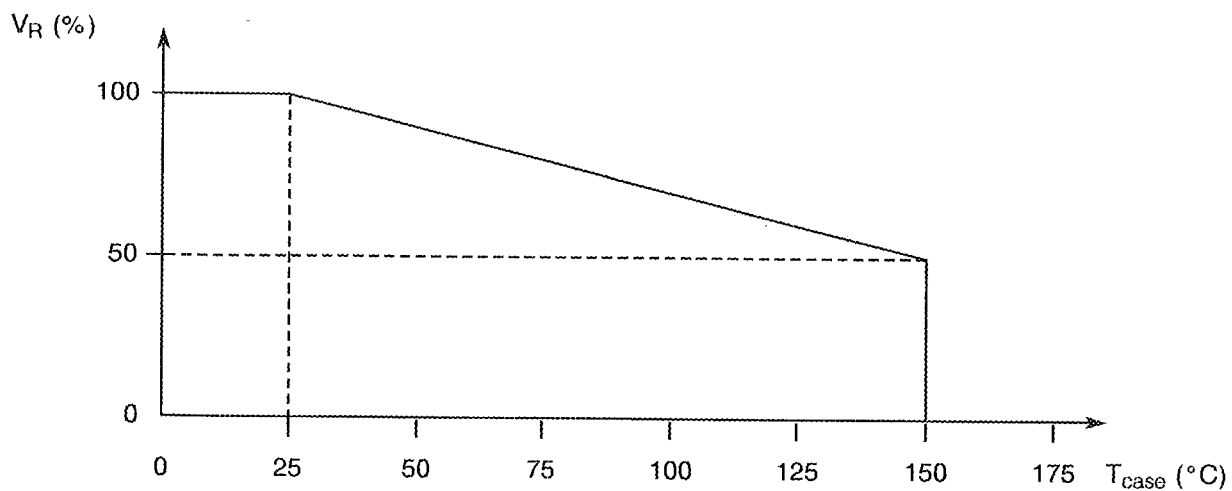
No.	CHARACTERISTIC	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	D.C. Reverse Voltage Variants 01 to 03 Variants 04 to 06 Variants 07 to 09 Variants 10 to 12 Variants 13 to 15 Variants 16 to 18 Variants 19 to 21 Variants 22 to 24 Variants 25 to 27 Variants 28 to 30	V_R	- 15 - 40 - 70 - 100 - 150 - 200 - 300 - 400 - 500 - 600	V	Note 1
2	D.C. Forward Current (Continuous) Variants 01 to 09 Variants 10 to 21 Variants 22 to 30	I_F	150 200 250	mA	Note 1
3	R.F. Power Dissipation Variants 01 and 03 Variant 02 Variants 04, 06, 07 and 09 Variants 05 and 08 Variants 10, 12, 13 and 15 Variants 11 and 14 Variants 16 and 18 Variant 17 Variants 19 and 21 Variant 20 Variants 22, 24, 25, 27, 28 and 30 Variants 23, 26 and 29	P_{tot}	0.80 0.92 1.56 1.09 3.13 1.67 3.57 1.79 4.17 1.92 5.00 2.08	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

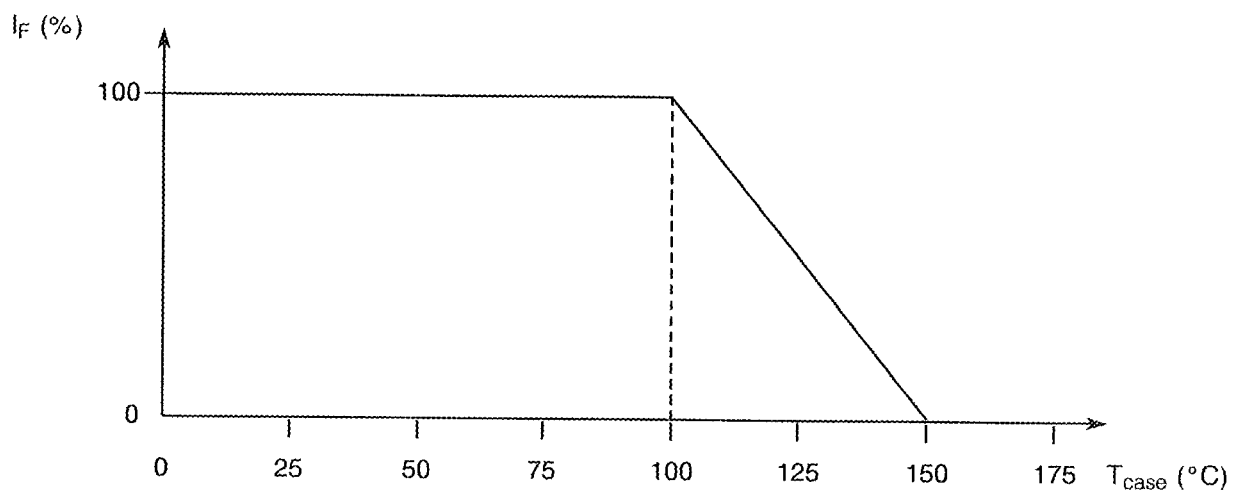
1. At $T_{case} = +25^{\circ}C$. For derating at $T_{case} > +25^{\circ}C$, see Figure 1.
2. Duration 5 seconds maximum at a distance of not less than 1.5mm from the body and the same termination shall not be resoldered until 3 minutes have elapsed.



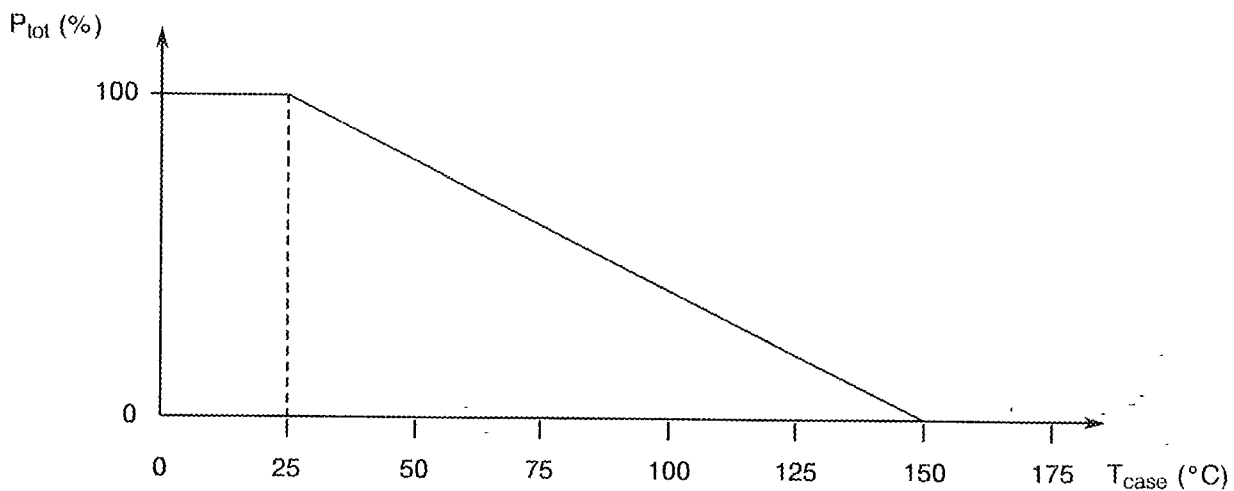
FIGURE 1 - PARAMETER DERATING INFORMATION



Reverse Voltage versus Temperature



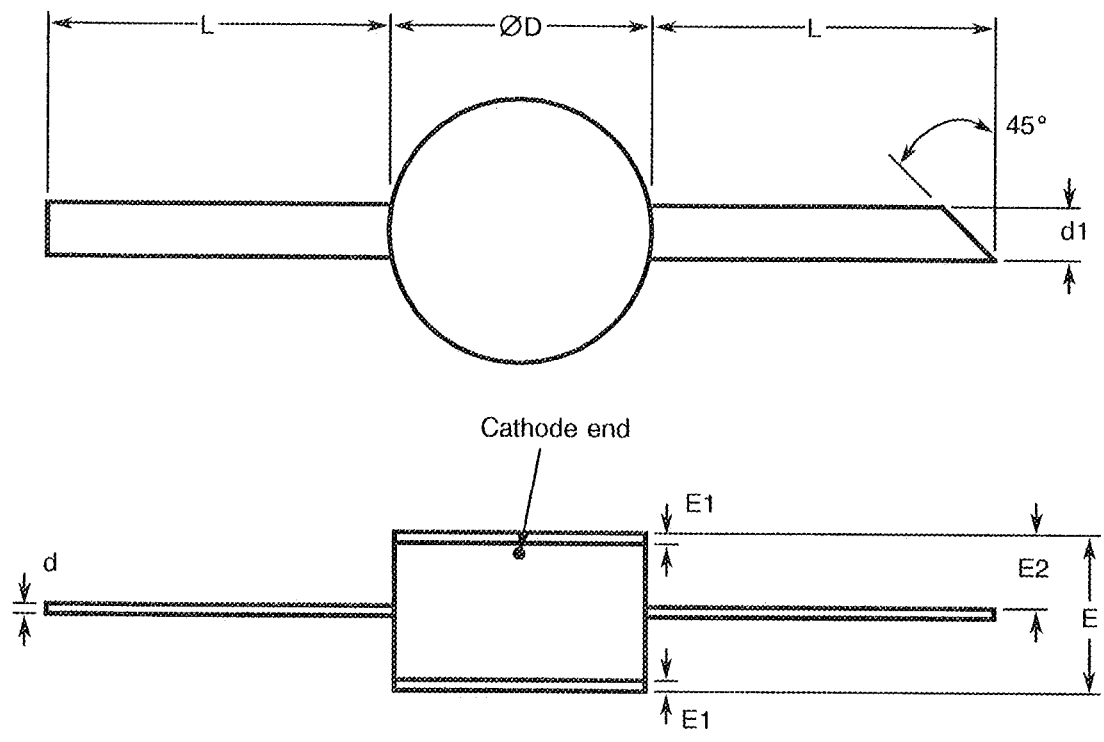
Forward Current versus Temperature



Power Dissipation versus Temperature

FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(a) - VARIANTS 01, 04, 07, 10, 13, 16, 19, 22, 25, 28



SYMBOL	MILLIMETRES	
	MIN	MAX
d	0.08	0.13
d1	0.46	0.56
ØD	2.29	2.79
E	2.00	2.50
E1	0.20	0.35
E2	0.90	1.20
L	2.00	2.50

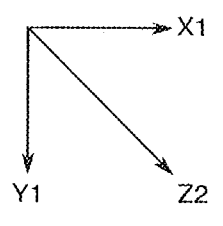
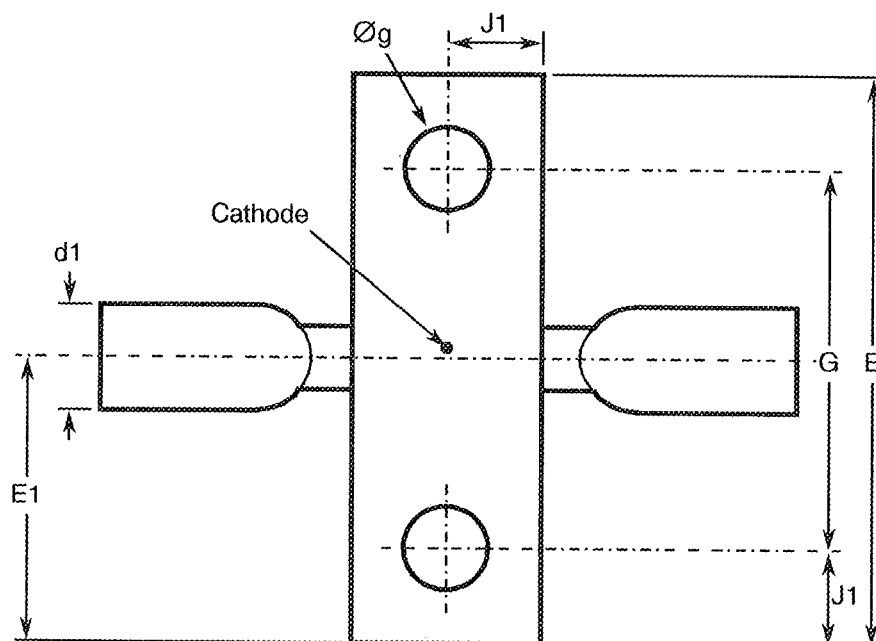
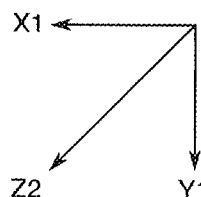
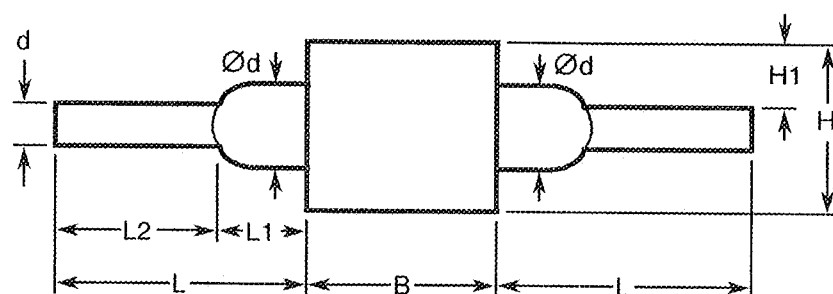
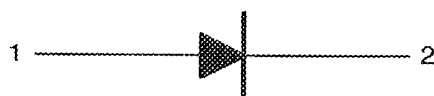


FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)
FIGURE 2(b) - VARIANTS 02, 03, 05, 06, 08, 09, 11, 12, 14, 15, 17, 18, 20, 21, 23, 24, 26, 27, 29, 30


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 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.
3. The heatsink end shall be the same as the cathode end.



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.
- (c) Para. 5.3, Wafer Lot Acceptance: Shall be performed as an S.E.M. Inspection only.

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

- (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 02, 03, 05, 06, 08, 09, 11, 12, 14, 15, 17, 18, 20, 21, 23, 24, 26, 27, 29 and 30 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))


- (a) Para. 9.2, 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 02, 03, 05, 06, 08, 09, 11, 12, 14, 15, 17, 18, 20, 21, 23, 24, 26, 27, 29 and 30 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.

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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 0.14 grammes for Variants 01, 04, 07, 10, 13, 16, 19, 22, 25 and 28 and 0.99 grammes for Variants 02, 03, 05, 06, 08, 09, 11, 12, 14, 15, 17, 18, 20, 21, 23, 24, 26, 27, 29 and 30.

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 01, 04, 07, 10, 13, 16, 19, 22, 25 and 28:

(b) Force: 3.1N.

(c) Duration: 5 seconds.

Variants 02, 03, 05, 06, 08, 09, 11, 12, 14, 15, 17, 18, 20, 21, 23, 24, 26, 27, 29 and 30:

(b) Force: 5.1N.

(c) Duration: 5 seconds.

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 or kovar body. The lid shall be welded or preform soldered

4.4.2 Lead Materials and Finish

The 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.

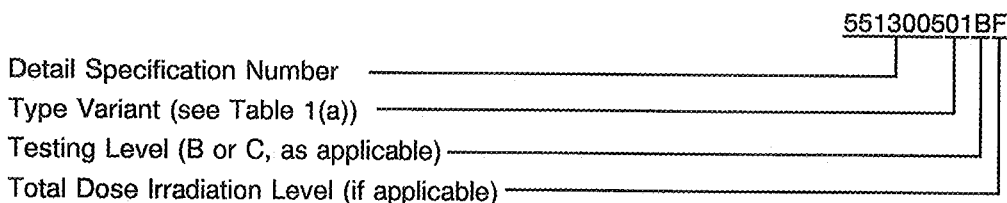
(c) Traceability Information.

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:



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

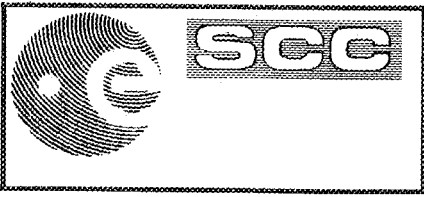
Burn-in shall be Category 2 of Chart III(a).

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 (Δ) 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.

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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	μA
2	Reverse Current 2	I_{R2}	4016	$V_R = \text{Note 2}$	-	100	nA
3	Forward Voltage	V_F	4011	$I_F = 100\text{mA}$	-	1.0	V
4	Thermal Resistance	$R_{TH(J-C)}$	3101	$I_F = 1.0\text{A}$ Note 3 Variants 01, 03 Variant 02 Variants 04, 06, 07, 09 Variants 05, 08 Variants 10, 12, 13, 15 Variants 11, 14 Variants 16, 18 Variant 17 Variants 19, 21 Variant 20 Variants 22, 24, 25, 27, 28, 30 Variants 23, 26, 29	-	100 135 80 115 40 75 35 70 30 65 25 60	$^{\circ}\text{C/W}$

NOTES

1. Table 1(b), Item 1.
2. Half the value of Table 1(b), Item 1.
3. Pulsed measurement, pulse width = 4.0 μs , p.r.f. = 1.0kHz.

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	Minority Carrier Lifetime	τ_L	-	4(a)	$I_F = 10\text{mA}$ Variants 01 to 03 Variants 04 to 06 Variants 07 to 09 Variants 10 to 12 Variants 13 to 15 $I_F = 4.5\text{mA}$ Variants 16 to 18 Variants 19 to 21 Variants 22 to 27 Variants 28 to 30	-	25 40 120 250 400 0.7 1.0 3.5 4.0	ns μs

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - A.C. PARAMETERS (CONT'D)

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST FIG.	TEST CONDITIONS	LIMITS		UNIT
						MIN.	MAX.	
6	Insertion Loss	IL	-	4(b)	$V_R = -10V$	-	1.5	dB
					Variants 01 to 03			
					Variants 04 to 15			
					$V_R = -20V$			
7	Isolation	ISO	-	4(b)	$I_F = 100mA$	20	-	dB

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	μA

TABLE 4 - PARAMETER DRIFT VALUES

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

NOTES

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



FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS

FIGURE 4(a) - MINORITY CARRIER LIFETIME

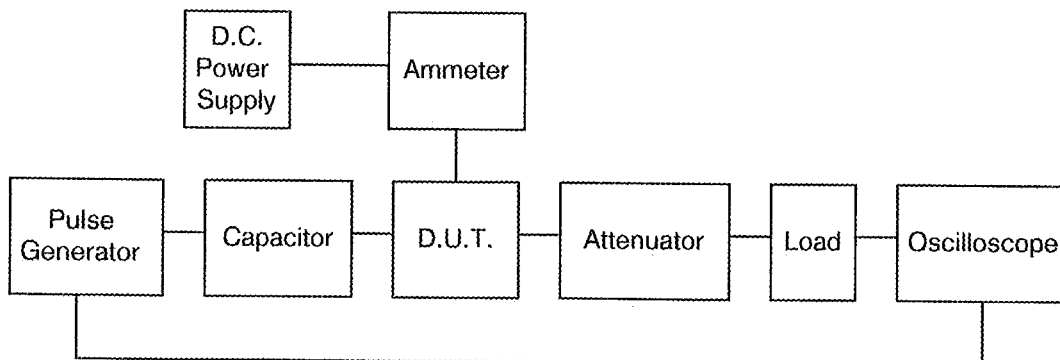
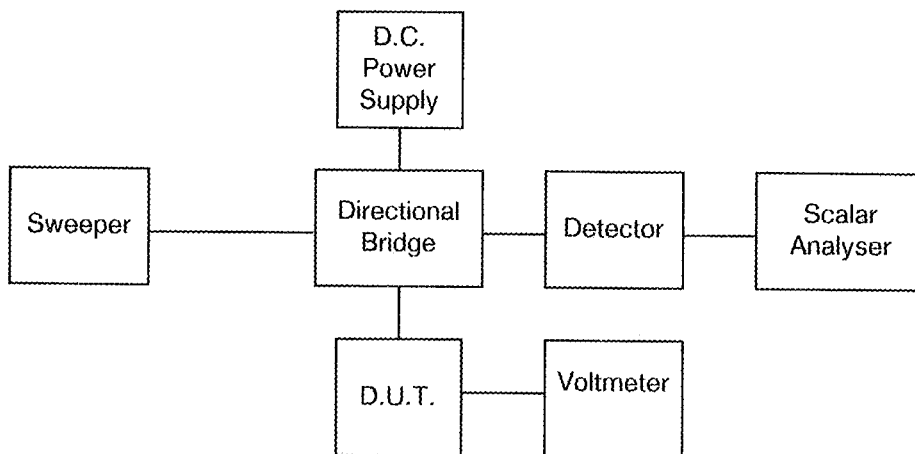


FIGURE 4(b) - INSERTION LOSS AND ISOLATION



**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

1. 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 09: 75 Variants 10 to 21: 100 Variants 22 to 30: 125	mA



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

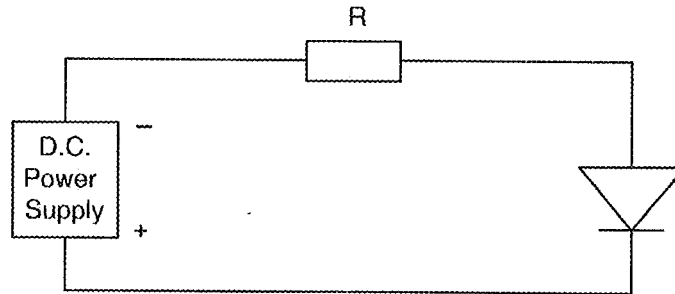
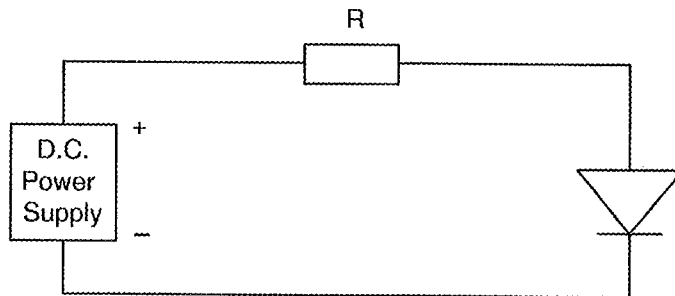




FIGURE 5(b) - ELECTRICAL CIRCUIT FOR POWER BURN-IN AND OPERATING LIFE TESTS



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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.

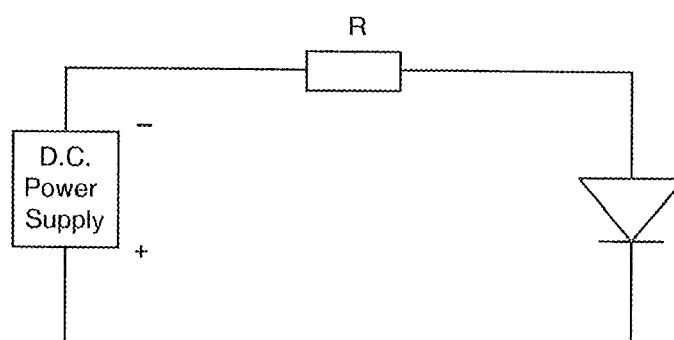
TABLE 6 - ELECTRICAL MEASUREMENTS AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING

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		μA
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
6	Insertion Loss	IL	As per Table 2	As per Table 2	As per Table 2		dB
7	Isolation	ISO	As per Table 2	As per Table 2	As per Table 2		dB

NOTES

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

FIGURE 6 - BIAS CONDITIONS FOR IRRADIATION TESTING



NOTES

1. A reverse bias of 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 (Δ)	UNIT
6	Minority Carrier Lifetime	τ_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.

