DIODES, MICROWAVE,

GALLIUM ARSENIDE, GUNN,

BASED ON TYPES ML4901 TO ML4906 AND

ML4910 TO ML4911

ESCC Detail Specification No. 5511/002

ISSUE 1

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Pages 1 to 22

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APPENDICES (Applicable to specific Manufacturers only)

1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for a Diode, Microwave, Gallium Arsenide, Gunn, based on Types ML4901 to ML4906 and ML4910 to ML4911. 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 (FIGURE 1)

Not applicable.

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 unclassified.

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.

(b) MIL-STD-750, Test Methods and Procedures for Semiconductor Devices.

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) OPERATING FREQUENCY f_o (GHz)		(5) OUTPUT POWER P_{out} (mW) (Minimum)	(6) BODY-LID AND LEAD MATERIAL AND FINISH
			MIN	MAX		
01	ML4901 - 30	2(a)	5.0	8.0	100	A7-D2
02	ML4901 - 111	2(b)	5.0	8.0	100	A7-D2
03	ML4901 - 118	2(c)	5.0	8.0	100	A7
04	ML4901 - 148	2(d)	5.0	8.0	100	A7
05	ML4901 - 275	2(e)	5.0	8.0	100	A7
06	ML4902 - 30	2(a)	5.0	8.0	250	A7-D2
07	ML4902 - 111	2(b)	5.0	8.0	250	A7-D2
08	ML4902 - 118	2(c)	5.0	8.0	250	A7
09	ML4902 - 148	2(d)	5.0	8.0	250	A7
10	ML4902 - 275	2(e)	5.0	8.0	250	A7
11	ML4903 - 30	2(a)	8.0	12.4	100	A7-D2
12	ML4903 - 111	2(b)	8.0	12.4	100	A7-D2
13	ML4903 - 118	2(c)	8.0	12.4	100	A7
14	ML4903 - 148	2(d)	8.0	12.4	100	A7
15	ML4903 - 275	2(e)	8.0	12.4	100	A7
16	ML4904 - 30	2(a)	8.0	12.4	250	A7-D2
17	ML4904 - 111	2(b)	8.0	12.4	250	A7-D2
18	ML4904 - 118	2(c)	8.0	12.4	250	A7
19	ML4904 - 148	2(d)	8.0	12.4	250	A7
20	ML4904 - 275	2(e)	8.0	12.4	250	A7
21	ML4905 - 30	2(a)	12.4	18.0	100	A7-D2
22	ML4905 - 111	2(b)	12.4	18.0	100	A7-D2
23	ML4905 - 118	2(c)	12.4	18.0	100	A7
24	ML4905 - 148	2(d)	12.4	18.0	100	A7
25	ML4905 - 275	2(e)	12.4	18.0	100	A7
26	ML4906 - 30	2(a)	12.4	18.0	250	A7-D2
27	ML4906 - 111	2(b)	12.4	18.0	250	A7-D2
28	ML4906 - 118	2(c)	12.4	18.0	250	A7
29	ML4906 - 148	2(d)	12.4	18.0	250	A7
30	ML4906 - 275	2(e)	12.4	18.0	250	A7
31	ML4910 - 30	2(a)	5.0	8.0	500	A7-D2
32	ML4910 - 111	2(b)	5.0	8.0	500	A7-D2
33	ML4910 - 118	2(c)	5.0	8.0	500	A7
34	ML4910 - 148	2(d)	5.0	8.0	500	A7
35	ML4910 - 275	2(e)	5.0	8.0	500	A7

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

(1) VARIANT	(2) BASED ON TYPE	(3) FIGURE	(4) OPERATING FREQUENCY f_o (GHz)		(5) OUTPUT POWER P_{out} (mW) (Minimum)	(6) LEAD MATERIAL AND FINISH
			MIN	MAX		
36	ML4911 - 30	2(a)	8.0	12.4	500	A7-D2
37	ML4911 - 111	2(b)	8.0	12.4	500	A7-D2
38	ML4911 - 118	2(c)	8.0	12.4	500	A7
39	ML4911 - 148	2(d)	8.0	12.4	500	A7
40	ML4911 - 275	2(e)	8.0	12.4	500	A7

TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTIC	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Operating Frequency Range	f_o	5 to 18	GHz	
2	Operating Voltage Variants 01 to 10 Variants 11 to 20 Variants 21 to 30 Variants 31 to 35 Variants 36 to 40	V_G	 14.0 12.0 10.0 14.0 12.0	V	
3	Operating Temperature Range	T_{op}	−40 to +70	°C	T_{amb}
4	Storage Temperature Range	T_{stg}	−55 to +125	°C	
5	Soldering Temperature	T_{sol}	+230	°C	Note 1

NOTES

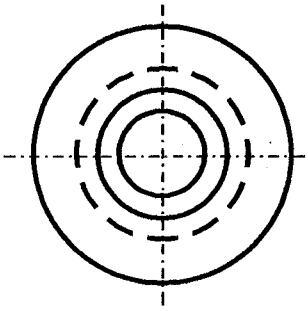
1. Duration 5 seconds maximum and the same termination shall not be resoldered until 3 minutes have elapsed.

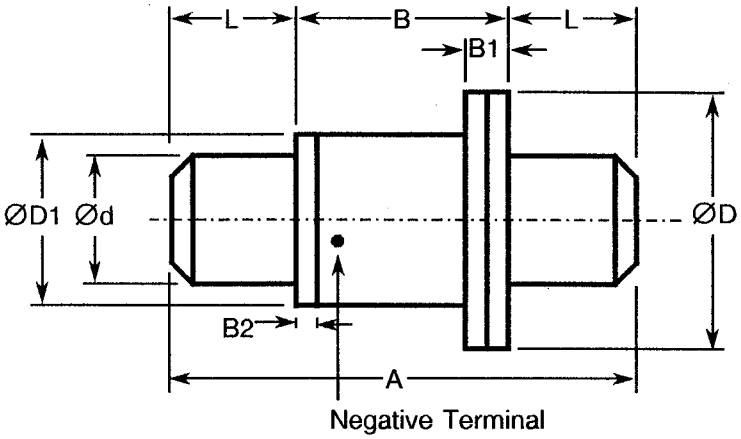
FIGURE 1 - PARAMETER DERATING INFORMATION

Not applicable.

FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(a) - VARIANTS 01, 06, 11, 16, 21, 26, 31, 36





SYMBOL	MILLIMETRES	
	MIN	MAX
A	5.20	5.72
B	2.16	2.46
B1	0.41	0.61
B2	0.15	0.25
Ød	1.52	1.63
ØD	3.00	3.23
ØD1	1.95	2.11
L	1.52	1.63

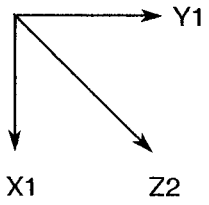
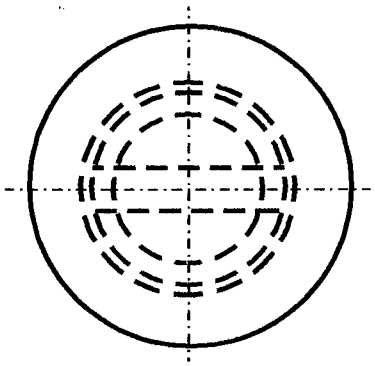
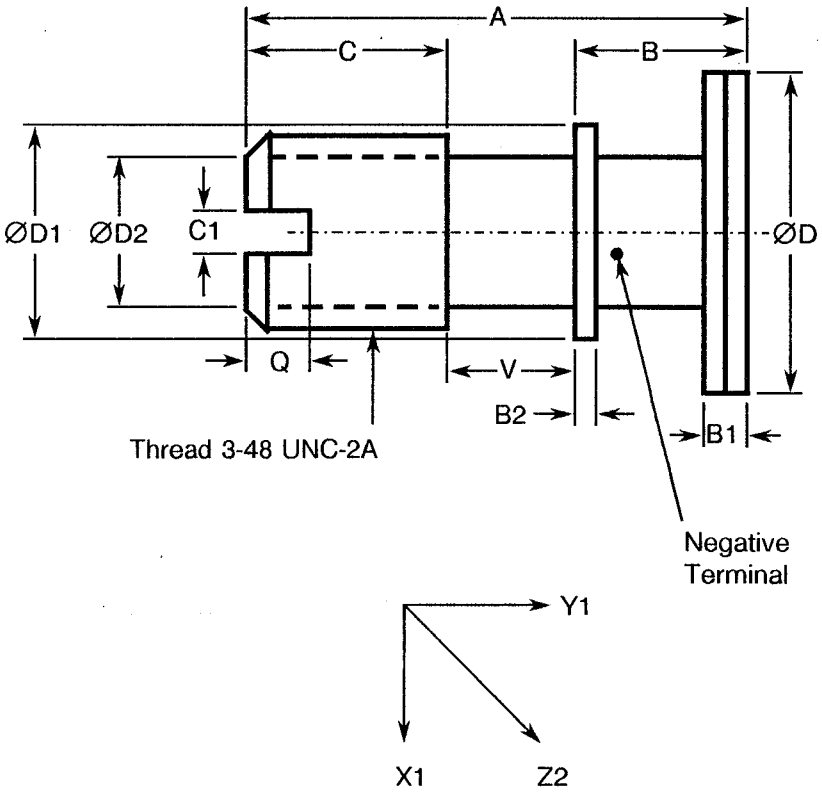


FIGURE 2(b) - VARIANTS 02, 07, 12, 17, 22, 27, 32, 37

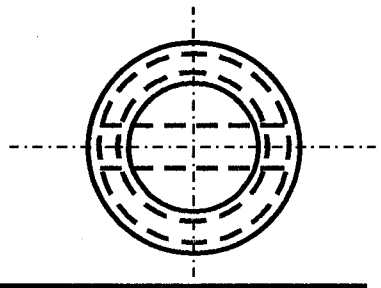


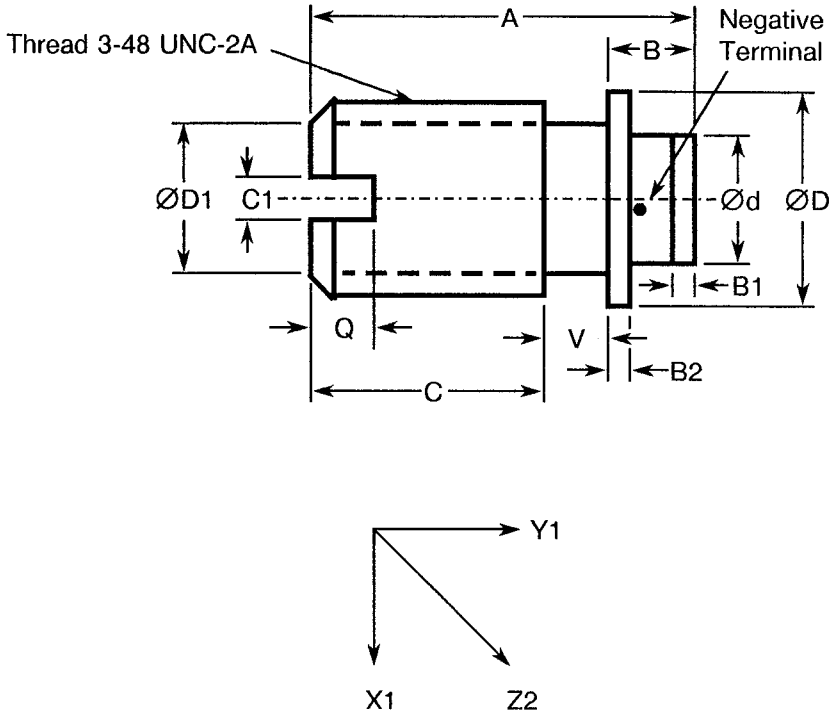


SYMBOL	MILLIMETRES	
	MIN	MAX
A	4.71	5.30
B	1.47	1.80
B1	0.41	0.61
B2	0.20	0.30
C	1.50	2.80
C1	0.38	0.64
ØD	3.00	3.23
ØD1	2.49	2.59
ØD2	0.90	2.20
Q	0.76	1.02
V	0.11	2.33

FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

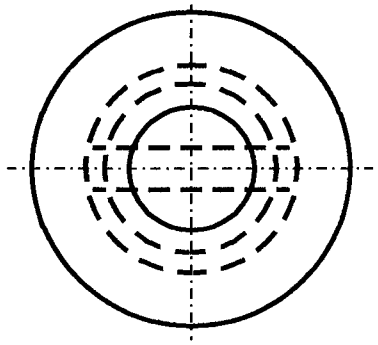
FIGURE 2(c) - VARIANTS 03, 08, 13, 18, 23, 28, 33, 38

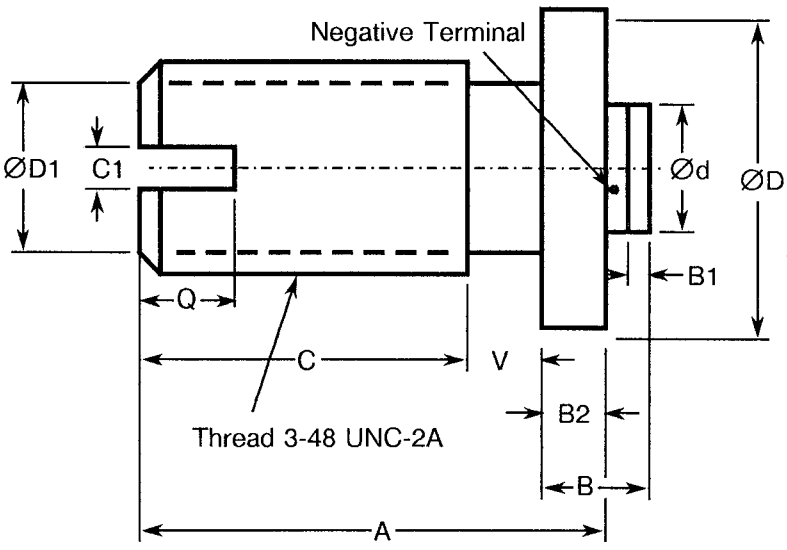


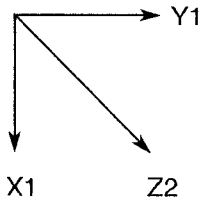


SYMBOL	MILLIMETRES	
	MIN	MAX
A	4.19	4.70
B	0.77	1.04
B1	0.20	0.30
B2	0.22	0.28
C	2.21	3.29
C1	0.38	0.64
Ød	1.22	1.32
ØD	2.49	2.59
ØD1	1.60	2.00
Q	0.64	1.14
V	0.64	0.94

FIGURE 2(d) - VARIANTS 04, 09, 14, 19, 24, 29, 34, 39



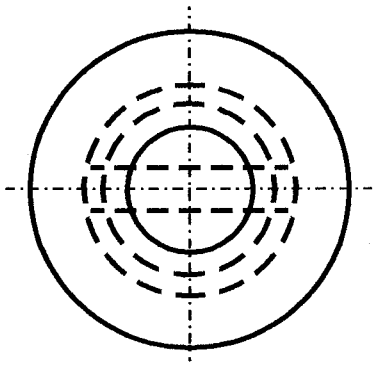


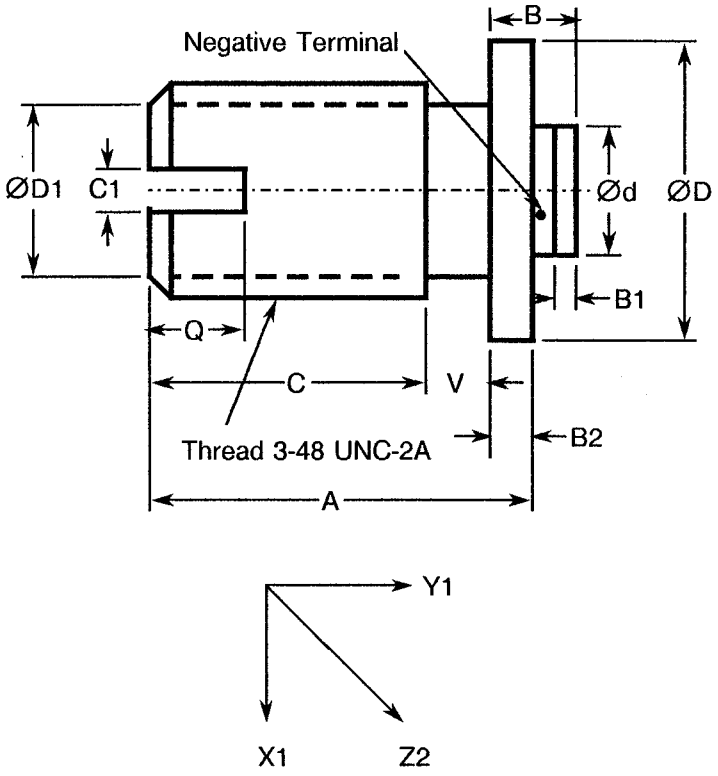


SYMBOL	MILLIMETRES	
	MIN	MAX
A	4.24	4.75
B	1.02	1.32
B1	0.20	0.30
B2	0.46	0.56
C	2.74	3.65
C1	0.38	0.64
Ød	1.22	1.32
ØD	2.87	3.00
ØD1	1.60	2.00
Q	0.89	1.14
V	0.64	0.89

FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

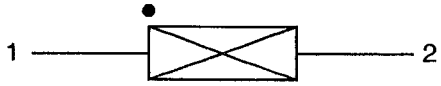
FIGURE 2(e) - VARIANTS 05, 10, 15, 20, 25, 30, 35, 40





SYMBOL	MILLIMETRES	
	MIN	MAX
A	4.04	4.55
B	0.84	1.12
B1	0.20	0.30
B2	0.46	0.56
C	2.54	3.45
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	0.94

FIGURE 3 - FUNCTIONAL DIAGRAM



1. Negative Terminal
2. Positive Terminal

NOTES

1. The negative terminal shall be marked with a black dot or band. The marking will not be on the terminal but adjacent to it.

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. 5.2.2, Total Dose Irradiation Testing: Shall be performed during qualification and extension of qualification.

(b) Para. 5.2.2, 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)

(a) Para. 9.2.2, Die Shear: Shall not be performed and no additional thermal tests shall be performed to replace this test.

(b) Para. 9.14, Vibration, Variable Frequency: Shall not be performed.

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

None.

4.2.4 Deviations from Qualification Tests (Chart IV)

(a) Para. 9.2.4, Die Shear: Shall not be performed. Output power 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:

- Variants 01, 06, 11, 16, 21, 26, 31 and 36: 0.12 grammes.
- Variants 02, 03, 07, 08, 12, 13, 17, 18, 22, 23, 27, 28, 32, 33, 37 and 38: 0.14 grammes.
- Variants 04, 05, 09, 10, 14, 15, 19, 20, 24, 25, 29, 30, 34, 35, 39 and 40: 0.15 grammes.

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: 'D2' (Stud Torque)**

Variants 02, 07, 12, 17, 22, 27, 32 and 37:

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

Variants 03, 04, 05, 08, 09, 10, 13, 14, 15, 18, 19, 20, 23, 24, 25, 28, 29, 30, 33, 34, 35, 38, 39 and 40:

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

(b) **Condition: Compression**

Variants 01, 02, 06, 07, 11, 12, 16, 17, 21, 22, 26, 27, 31, 32, 36 and 37:

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

Variants 03, 04, 05, 08, 09, 10, 13, 14, 15, 18, 19, 20, 23, 24, 25, 28, 29, 30, 33, 34, 35, 38, 39 and 40:

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

4.3.4 Bond Strength

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

(a) Condition : 'A'.

(b) Separation Force : 0.04N minimum.

4.3.5 Die Shear

Not applicable.

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 brazed, welded or preform soldered.

4.4.2 Lead Materials and Finish

(a) For Variants 01, 02, 06, 07, 11, 12, 16, 17, 21, 22, 26, 27, 31, 32, 36 and 37, 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 03, 04, 05, 08, 09, 10, 13, 14, 15, 18, 19, 20, 23, 24, 25, 28, 29, 30, 33, 34, 35, 38, 39 and 40, the lead material shall be Type 'A' with Type '7' 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) Negative Terminal Identification.

(b) The SCC Component Number.

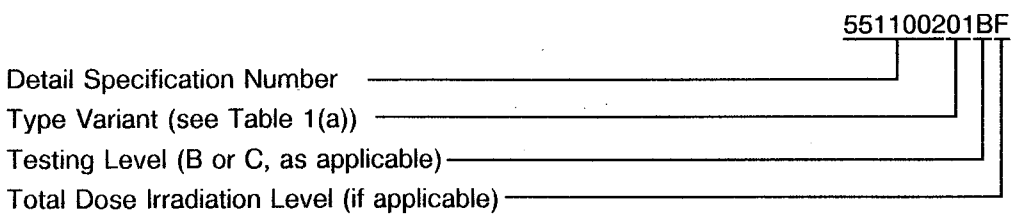
(c) Traceability Information.

4.5.2 Negative Terminal Identification

Negative terminal 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 $T_{amb} = +70(+0-3)$ °C.

4.6.3 Circuits for Electrical Measurements

Circuits for use in performing electrical measurements listed in Tables 2 and 3 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 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(a) of this specification.

4.7.3 Electrical Circuit for Power Burn-in

The circuit for use in performing the power burn-in test is shown in Figure 5 of this specification.

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

No.	CHARACTERISTICS	SYMBOL	TEST FIG.	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	Threshold Current	I_{TH}	4	Note 1			mA
				Variants 01 to 05	-	750	
				Variants 06 to 10	-	1050	
				Variants 11 to 15	-	975	
				Variants 16 to 20	-	1580	
				Variants 21 to 25	-	1130	
				Variants 26 to 30	-	1580	
				Variants 31 to 40	-	2250	
2	Operating Current	I_{OP}	4	V_G = 14.0V			mA
				Variants 01 to 05	-	500	
				Variants 06 to 10	-	700	
				Variants 31 to 35	-	1500	
				V_G = 12.0V			
				Variants 11 to 15	-	650	
				Variants 16 to 20	-	1050	
				Variants 36 to 40	-	1500	
				V_G = 10.0V			
				Variants 21 to 25	-	750	
				Variants 26 to 30	-	1050	

NOTES

1. See Note 1 to Figure 4.

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

No.	CHARACTERISTICS	SYMBOL	TEST FIG.	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
3	Operating Frequency	f_o	4	V_G = Note 1	Note 2		GHz
4	Output Power	P_{out}	4	f_o = Note 2	Note 3		mW

NOTES

1. See Table 1(b), Item 2.
2. See Column 4 of Table 1(a).
3. See Column 5 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.	
4	Output Power	P_{out}	As per Table 2	As per Table 2	Note 1		mW

NOTES

1. ±50% of the value recorded during Table 2 measurements.

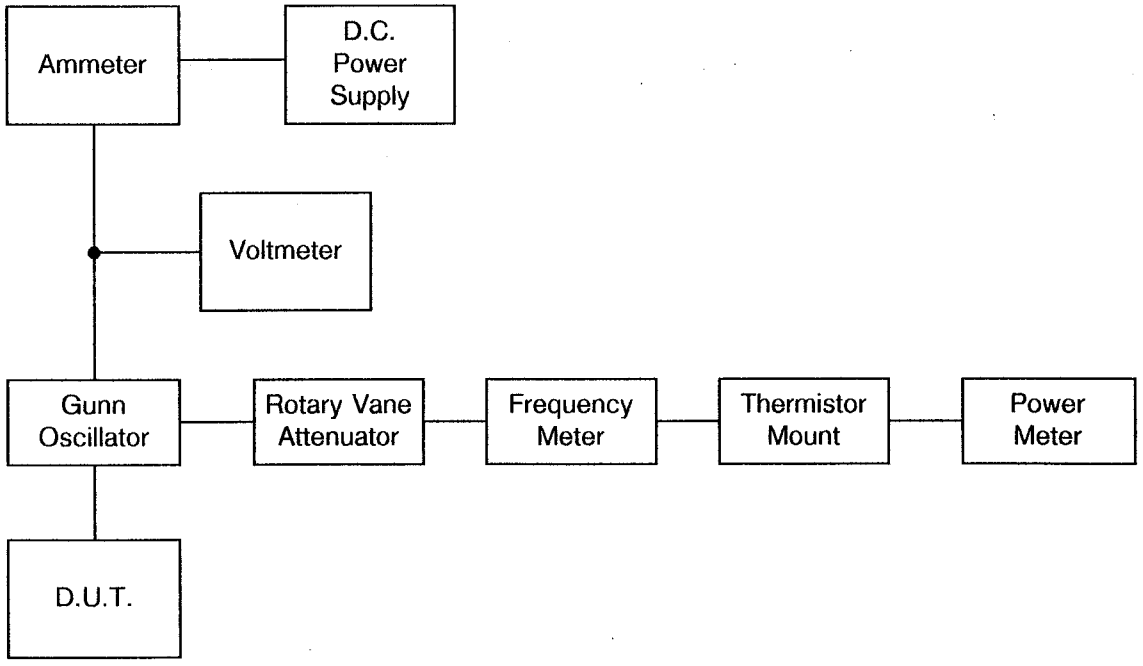
TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC.AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
4	Output Power	P_{out}	As per Table 2	As per Table 2	±25 (1)	%

NOTES

1. Δ1 = Δ2.

FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS



NOTES

1. For the measurement of Threshold Current, the D.C. Power Supply voltage is to be increased until maximum current is reached.

TABLE 5(a) - CONDITIONS FOR POWER BURN-IN

No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Ambient Temperature	T_{amb}	+70(+0−3)	°C
2	Operating Voltage	V_G	Note 1	V

NOTES

1. See Table 1(b), Item 2.

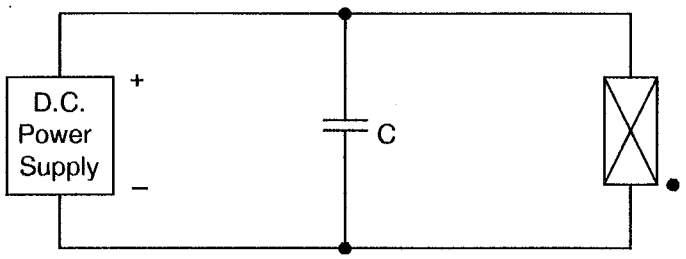
TABLE 5(b) - CONDITIONS FOR OPERATING LIFE TESTS

No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Ambient Temperature 1	T_{amb1}	+60(+0−3)	°C
2	Operating Voltage 1	V_{G1}	Note 1	V
3	Ambient Temperature 2	T_{amb2}	+70(+0−3)	°C
4	Operating Voltage 2	V_{G2}	Note 1	V

NOTES

1. See Table 1(b), Item 2.

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



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 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.

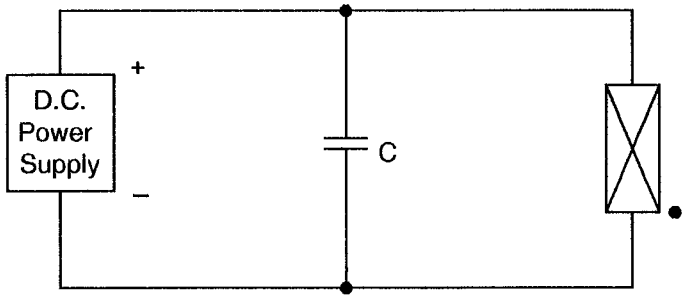
4.10 SPECIAL TESTING

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	Threshold Current	I_{TH}	As per Table 2	As per Table 2	As per Table 2		mA
2	Operating Current	I_{OP}	As per Table 2	As per Table 2	As per Table 2		mA
3	Operating Frequency	f_o	As per Table 2	As per Table 2	As per Table 2		GHz
4	Output Power	P_{out}	As per Table 2	As per Table 2	As per Table 2		mW

FIGURE 6 - BIAS CONDITIONS FOR IRRADIATION TESTING



NOTES

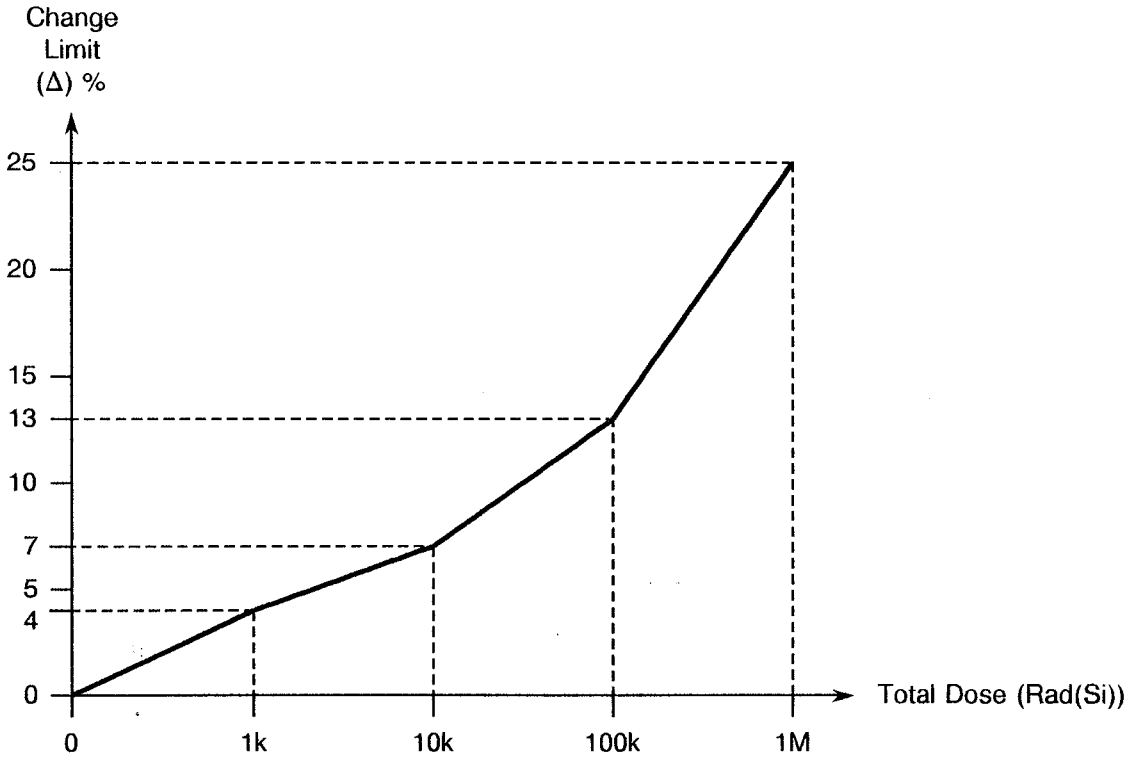
1. A bias as specified in Table 1(b), Item 2, shall be applied.

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
4	Output Power	P_{out}	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.



APPENDIX 'A'

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 +125(+0−3) °C.