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Pages 1 to 19

RESISTORS, FIXED, FILM

NON-HERMETICALLY SEALED

BASED ON TYPE RLR 20

ESA/SCC Detail Specification No. 4001/007



space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 4	May 1996		
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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 3 and incorporates all modifications defined in Revision 'A' to Issue 3 and the changes agreed in the following DCR's:-		
		Cover Page		None
		DCN		None
		Para. 3	: Text extended	23788
		Table 1(a)	: Resistance Range extended	221351
		Table 1(b)	: Min./Max. columns deleted	221351
			: No. 1, in Remarks, "Note 1" added and Remarks deleted	221351
			: Items 2 and 3 renumbered as "6" and "5" respectively and subsequent items renumbered	221351
			: Old No. 5, in Remarks, "Note 2" added and Remarks deleted	221351
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		Para. 4.4.2	: Title amended	23788
		Para. 4.5.1	: Rewritten	23788
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			: "(See Note)" added to Type Variant entry	23788
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		Table 4	: Test numbered as "1" and Symbol corrected	23788
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1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Resistors, Fixed, Film, Non-hermetically Sealed, based on Type RLR 20. It shall be read in conjunction with ESA/SCC Generic Specification No. 4001, the requirements of which are supplemented herein.

1.2 RANGE OF COMPONENTS

The range of resistors covered by this specification is 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 resistors specified herein, are as scheduled in Table 1(b).

1.4 PARAMETER DERATING INFORMATION

The parameter derating information applicable to the resistors specified herein is given in Figure 1.

1.5 PHYSICAL DIMENSIONS

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

1.6 FUNCTIONAL DIAGRAM

The functional diagram for the resistors specified herein, is shown in Figure 3.

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. 4001, Resistors, Fixed, Film.

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. In addition, the following symbols are used:-

- V_T = Test Voltage.
- TC = Temperature Coefficient.

TABLE 1(a) - RANGE OF COMPONENTS

No.	Resistance Range (Note 1)		Tolerance (±%)	Value Series	Temperature Coefficient (± 10 ⁻⁶ /°C)
	MIN. (Ω)	MAX. (MΩ)			
01	4.22	4.70	1.0	E96	100
02	4.22	4.70	2.0	E24	100

NOTES

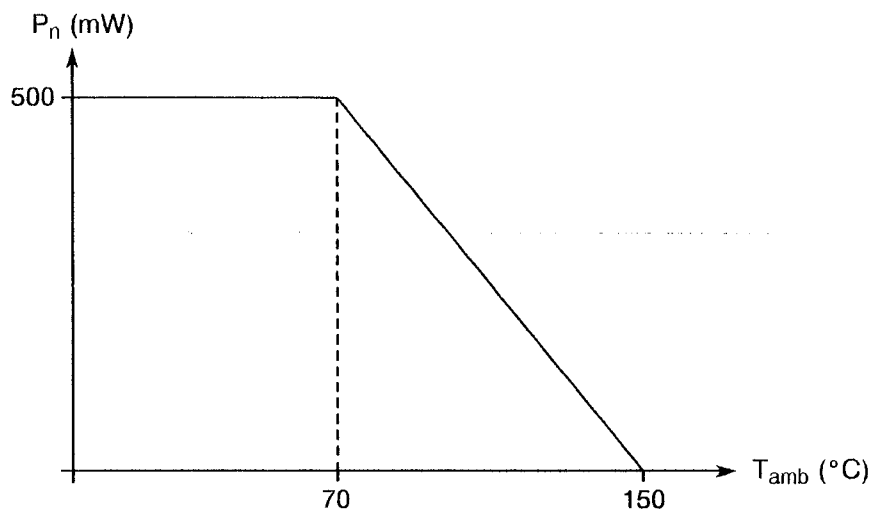
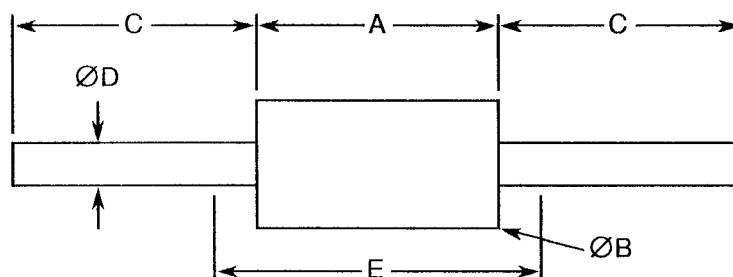
1. Critical resistance = 245 000Ω.

TABLE 1(b) - MAXIMUM RATINGS

No.	Characteristics	Symbol	Limits	Unit	Remarks
1	Rated Dissipation	P _n	0.5	W	Note 1
2	Limiting Element Voltage	U _L	350	V	-
3	Rated Voltage	U _R	$\sim\sqrt{0.5 R_n}$	V	Note 2
4	Insulation Voltage	U _i	500	V _{rms}	-
5	Operating Temperature Range	T _{op}	- 55 to + 150	°C	T _{amb}
6	Storage Temperature Range	T _{stg}	- 65 to + 150	°C	-
7	Soldering Temperature	T _{sol}	+ 260	°C	Note 3

NOTES

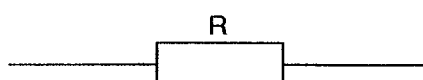
1. At T_{amb} ≤ + 70°C. For derating at T_{amb} > + 70°C, see Figure 1.
2. Shall never exceed Limiting Element Voltage.
3. Duration 10 seconds maximum at a distance of not less than 1.6mm from the device body


FIGURE 1 - PARAMETER DERATING INFORMATION

Rated Dissipation versus Temperature
FIGURE 2 - PHYSICAL DIMENSIONS


SYMBOL	MILLIMETRES		NOTES
	MIN.	MAX.	
A	7.30	10.57	
ØB	2.60	4.09	
C	25.00	-	
ØD	0.54	0.86	
E	-	11.40	1

NOTES

1. Max. length is "clean lead to clean lead".

FIGURE 3 - FUNCTIONAL DIAGRAM


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4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the resistors specified herein shall be as stated in this specification and ESA/SCC Generic Specification No. 4001. 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

None.

4.2.2 Deviations from Final Production Tests (Chart II)

(a) Para. 9.1, Overload: The test conditions shall be:-

Voltage: $\sqrt{0.75 R_n}$ or 350V, whichever is less.
 Test Temperature: +15 to +30 °C.
 Duration: 24 hours minimum.

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

(a) Para. 9.5.3, "Electrical Measurements at High and Low Temperatures": Not applicable.

4.2.4 Deviations from Qualification Tests (Chart IV)

(a) Para. 9.1, Overload: Test conditions as Para. 4.2.2(a).


4.2.5 Deviations from Lot Acceptance Tests (Chart V)

None.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the resistors specified herein shall be verified in accordance with the requirements set out in Para. 9.4 of ESA/SCC Generic Specification No. 4001 and shall conform to those shown in Figure 2 of this specification.

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4.3.2 Weight

The maximum weight of the resistors specified herein shall be 0.75 grammes.

4.3.3 Robustness of Terminations

The requirements and test conditions for robustness of terminations are specified in Section 9 of ESA/SCC Generic Specification No. 4001. The test conditions shall be as follows:-

Test U_{a1} : Tensile.

Applied Force: 22 N.

Duration: 10 ± 1.0 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 components specified herein to meet the performance requirements of this specification shall be used. Acceptance or approval of any constituent material does not guarantee acceptance of the finished product.

4.4.1 Case

As a minimum, the resistance element shall be protected by a suitable resin coating.

4.4.2 Lead Material and Finish

The lead material shall be Type 'A' with Type '3 or 4' finish in accordance with the requirements of ESA/SCC Basic Specification No. 23500.

4.4.3 Films

Films shall be uniformly deposited. They shall be free from blisters, thin spots, areas inadequately bonded to the core, discoloured spots or other blemishes likely to cause flaking or non-uniform ribbons when spiralled (helixed). Where used, spiralling shall occupy at least 70% of the actual length of the resistance element.

4.5 MARKING

4.5.1 General

The marking of all 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 each component in its primary package.

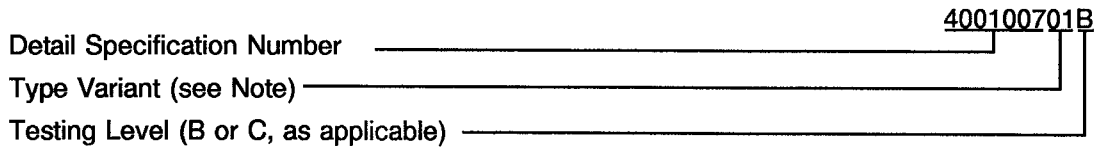
The information to be marked and the order of precedence, shall be as follows:-

- (a) The SCC Component Number.
- (b) Electrical Characteristics and Ratings.
- (c) Traceability Information.



4.5.2 The SCC Component Number

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



N.B.

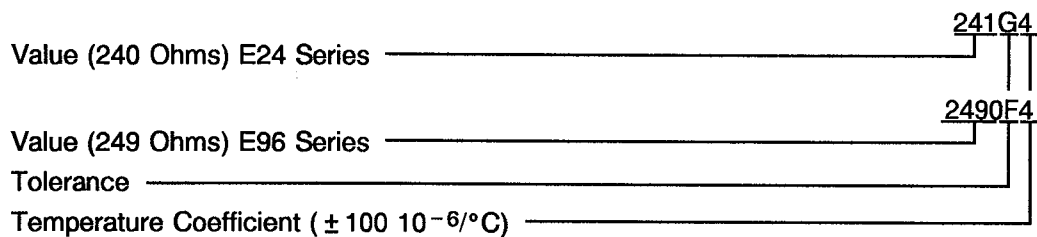
Marking of the Type Variant Number is mandatory. No further reference to type variants is made in this specification.

4.5.3 Electrical Characteristics and Ratings

The electrical characteristics and ratings to be marked in the following order of precedence are:-

- (a) Resistance Value.
- (b) Tolerance.
- (c) Temperature Coefficient.

The information shall be constituted and marked as follows:



4.5.3.1 Resistance Values

Resistance values shall be expressed by means of the following codes. The unit quantity for marking shall be Ohms (Ω).

Numerical Value	Code (E96)	Code (E24)
X.XX	XRXX	XRX
XX.X	XXRX	XX0
XXX	XXX0	XX1
XXX10 ¹	XXX1	XX2
XXX10 ²	XXX2	XX3
XXX10 ³	XXX3	XX4
XXX10 ⁴	XXX4	XX5

For values of 10 Ω (E24 series) or 100 Ω (E96 series) and above, the first 2, respectively 3, digits (X) represent significant figures and the last digit specifies the number of zeros to follow.

When values of less than 10 Ω (E24 series) or 100 Ω (E96 series) are required, the letter 'R' is used to indicate the decimal point. When the letter is used, all successive digits represent significant figures.

Where more practicable, resistance values may be expressed using the colour code specified in the Table of Para. 5.9.4 of ESA/SCC Basic Specification No. 21700.

4.5.3.2 Tolerance

The tolerance on resistance values shall be indicated by the code letters specified hereafter.

Tolerance ($\pm\%$)	Code Letter
1.0	F
2.0	G

In the case where the colour code is used for resistance values, the appropriate colour for tolerance shall be used, as shown in the colour code Table referenced in Para. 4.5.3.1 of this specification.

4.5.3.3 Temperature Coefficient

The Temperature Coefficient shall be indicated by the numerical code specified hereafter.

Digit	Temperature Coefficient ($\pm 10^{-6}/^{\circ}\text{C}$)
4	100

4.5.4 Traceability Information

Each component shall be marked in respect of traceability information in accordance with the requirements of 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 $T_{\text{amb}} = +22 \pm 3^{\circ}\text{C}$.

4.6.2 Electrical Measurements at High and Low Temperatures (Table 3)

Not applicable.

4.6.3 Circuits for Electrical Measurements (Figure 4)

Not applicable.


4.7 BURN-IN TESTS

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, measurements shall be performed at $T_{\text{amb}} = +22 \pm 3^{\circ}\text{C}$. The parameter drift values (Δ) applicable to the parameters scheduled, shall not be exceeded. In addition to these drift value requirements, the appropriate limit value specified in Table 2 for a given parameter shall not be exceeded.

4.7.2 Conditions for Burn-in

The requirements for burn-in are specified in Section 7 of ESA/SCC Generic Specification No. 4001. The conditions for burn-in shall be as specified in Table 5 of this specification.

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The resistors shall be tested with a d.c. voltage or a full-wave rectified a.c. voltage, provided the ripple does not exceed 5.0%.

A voltage of 350V or $\sqrt{0.5 R_{\eta}}$, whichever is smaller, shall be applied in cycles of 90 minutes "on" and 30 minutes "off" throughout the test.

The resistors shall be connected by their terminations to suitable clips on a rack of insulating material. They shall be so arranged that the temperature of any one resistor does not appreciably influence the temperature of any other resistor. There shall be no undue draught over the resistors. After 168 (+24 - 0) hours, the resistors shall be removed from the chamber and allowed to cool under normal atmospheric conditions for a minimum of 4 hours. They shall then be visually examined. There shall be no evidence of damage and the marking shall still be legible.

4.7.3 Electrical Circuit for Burn-in

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

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

No.	Characteristics	Symbol	ESA/SCC 4001 Test Method	Test Conditions	Tolerance (± %)	Limits		Unit
						Min.	Max.	
1	Resistance	R _A	Para. 9.5.1	Para. 9.5.1	1.0	0.990 R _n	1.010 R _n	Ω
					2.0	0.980 R _n	1.020 R _n	

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

Not applicable.

FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS

Not applicable.

TABLE 4 - PARAMETER DRIFT VALUES

No.	Characteristics	Symbol	Spec. and/or Test Method	Test Conditions	Change Limits (Δ)	Unit
1	Resistance Change	$\frac{\Delta R_A}{R_A}$	As per Table 2	As per Table 2	± 0.5 or (1) ± 0.1	% Ω

NOTES

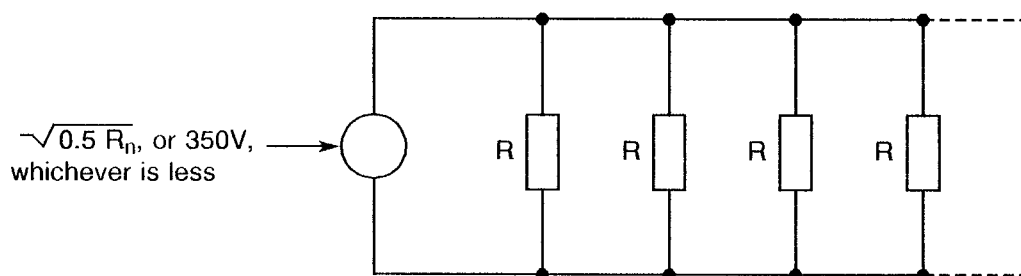
1. Whichever is greater.





TABLE 5 - CONDITIONS FOR BURN-IN AND OPERATING LIFE TESTS

No.	Characteristics	Symbol	Condition	Unit
1	Ambient Temperature	T_{amb}	$+ 70 \pm 3$	$^{\circ}\text{C}$
2	Test Voltage	V_T	$\sim\sqrt{0.5 R_n}$, or 350V, whichever is less	V

FIGURE 5 - ELECTRICAL CIRCUIT FOR 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. 4001)

4.8.1 Measurements and Inspections on Completion of Environmental Tests

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

4.8.2 Measurements and Inspections at Intermediate Points during Endurance Tests

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

4.8.3 Measurements and Inspections on Completion of Endurance Tests

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

4.8.4 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. 4001. The conditions for operating life testing shall be as specified in Table 5 and Para. 4.7.2 of this specification.

4.8.5 Electrical Circuit for Operating Life Tests

The electrical circuit for use in performing the operating life tests is shown in Figure 5 of this specification.

4.8.6 Conditions for High Temperature Storage Test (Part of Endurance Testing)

The requirements for the high temperature storage test are specified in ESA/SCC Generic Specification No. 4001. The conditions for high temperature storage shall be $T_{amb} = +150(+0-5)$ °C.



TABLE 6 - MEASUREMENTS AND INSPECTIONS ON COMPLETION OF ENVIRONMENTAL TESTS AND AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING

NO.	ESA/SCC GENERIC SPEC. NO. 4001		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		MIN.	MAX.	
01	Overload	Para. 9.1 and Paras 4.2.2 and 4.2.4 of this spec.	Initial Measurements Chart IV Resistance Final Measurements Visual Examination Chart II Resistance Chart IV Resistance Change	Table 2 Item 1 After a recovery period of 1-2 hrs No evidence of damage and marking legible Table 2 Item 1 Table 2 Item 1	R_A - R_A $\Delta R_A/R_A$	Record Values - Table 2 Item 1 $\pm (0.5 + \frac{0.05\Omega \times 100}{R_n})$	- - %	
02	Seal Test (Hermetically Sealed only)	Para. 9.3	Not applicable					
03	Insulation Resistance (Insulated only)	Para. 9.6	Final Measurements Insulation Resistance	Para. 9.6.1 of ESA/SCC 4001 (2)	R_i	1000	-	M Ω
04	Temperature Coefficient	Para. 9.7 Procedure I	Temperature Coefficient	Para. 9.5.1 of ESA/SCC 4001	TC	- 100	+ 100	10 ⁻⁶ /°C
05	Voltage Proof	Para. 9.8	During Test Visual Examination	1.4 x U _i (3) for 60 ± 5 sec No breakdown or flashover	-	-	-	-
06	Solderability	Para. 9.9 Procedure I	Initial Measurements Resistance Final Measurements Resistance Change	After Drying Table 2 Item 1 24 ± 4 hrs after soldering Table 2 Item 1	R_A $\Delta R_A/R_A$	Record Values $\pm (0.5 + \frac{0.05\Omega \times 100}{R_n})$	- %	
07	Robustness of Terminations	Para. 9.10.1	Initial Measurements Resistance Final Measurements Resistance Change Visual Examination	Table 2 Item 1 Table 2 Item 1 No evidence of damage	R_A $\Delta R_A/R_A$ -	Record Values $\pm (0.5 + \frac{0.05\Omega \times 100}{R_n})$ -	- - %	
08	Resistance to Soldering Heat	Para. 9.11 Procedure I	Initial Measurements Resistance Final Measurements Visual Examination Resistance Change	After Drying Table 2 Item 1 No evidence of damage and marking legible After 24 ± 4 hours Table 2 Item 1	R_A - $\Delta R_A/R_A$	Record Values - $\pm (0.5 + \frac{0.05\Omega \times 100}{R_n})$	- - %	
09	Rapid Change of Temperature	Para. 9.12	Initial Measurements Resistance Final Measurements Visual Examination Resistance Change	Table 2 Item 1 After a recovery period of 1-2 hrs No evidence of damage Table 2 Item 1	R_A - $\Delta R_A/R_A$	Record Values - $\pm (0.5 + \frac{0.05\Omega \times 100}{R_n})$	- - %	

NOTES

- The tests in this Table refer to either Chart IV or V and shall be used as applicable.
- Test Voltage: $V_T = 100V$.
- For value of U_i, see Table 1(b) Item 4.



TABLE 6 - MEASUREMENTS AND INSPECTIONS ON COMPLETION OF ENVIRONMENTAL TESTS AND AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING (CONT'D)



NO.	ESA/SCC GENERIC SPEC. NO. 4001		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		MIN.	MAX.	
10	Vibration	Para. 9.13	Initial Measurements Resistance Final Measurements Visual Examination Resistance Change	Table 2 Item 1 No evidence of damage Table 2 Item 1	R_A - $\Delta R_A/R_A$	Record Values - - $\pm (0.5 + \frac{0.05\Omega \times 100}{R_n})$	- - %	
11	Climatic Sequence	Para. 9.14 Procedure I	Initial Measurements Resistance Final Measurements Visual Examination Insulation Resistance Resistance Change	After Drying Table 2 Item 1 Following completion of D.C. load test and after a recovery period of 1-2 hrs No evidence of damage and marking legible Para. 9.6.1 of ESA/SCC 4001 (2) Table 2 Item 1	R_A - R_i $\Delta R_A/R_A$	Record Values - - 100 - $\pm (1.0 + \frac{0.05\Omega \times 100}{R_n})$	- - MΩ %	
12	Operating Life	Para. 9.15 Chart IV	Initial Measurements Resistance	Table 2 Item 1	R_A	Record Values	-	
			Intermediate Measurements (1000 hrs) Visual Examination Resistance Change	After a recovery period of 1-2 hrs No evidence of damage Table 2 Item 1	- $\Delta R_A/R_A$	- - $\pm (1.5 + \frac{0.05\Omega \times 100}{R_n})$	- %	
		Final Measurements (2000 hrs) Visual Examination Resistance Change Insulation Resistance	After a recovery period of 1-2 hrs No evidence of damage Table 2 Item 1 Para. 9.6.1 of ESA/SCC 4001 (2)	- $\Delta R_A/R_A$ R_i	- - $\pm (2.0 + \frac{0.05\Omega \times 100}{R_n})$ 1000 -	- - MΩ		
		Para. 9.15 Chart V	Initial Measurements Resistance Final Measurements (1000 hrs) Visual Examination Resistance Change Insulation Resistance	Table 2 Item 1 After a recovery period of 1-2 hrs No evidence of damage Table 2 Item 1 Para. 9.6.1 of ESA/SCC 4001 (2)	R_A - $\Delta R_A/R_A$ R_i	Record Values - - $\pm (1.5 + \frac{0.05\Omega \times 100}{R_n})$ 1000 -	- - %	

NOTES: See Page 16.

TABLE 6 - MEASUREMENTS AND INSPECTIONS ON COMPLETION OF ENVIRONMENTAL TESTS AND AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING (CONT'D)

NO.	ESA/SCC GENERIC SPEC. NO. 4001		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		MIN.	MAX.	
13	High Temperature Storage	Para. 9.16	Initial Measurements Resistance Intermediate Measurements (1000 hrs) Visual Examination Resistance Change Final Measurements (2000 hrs) Visual Examination Resistance Change Insulation Resistance	Table 2 Item 1 After a recovery period of 1-2 hrs No evidence of damage Table 2 Item 1 After a recovery period of 1-2 hrs No evidence of damage Table 2 Item 1 Para. 9.6.1 of ESA/SCC 4001 (2)	R _A - ΔR _A /R _A - ΔR _A /R _A Ri	Record Values - ± (1.5 + $\frac{0.05\Omega \times 100}{R_n}$) - ± (2.0 + $\frac{0.05\Omega \times 100}{R_n}$) 1000	- - - - MΩ	
14	Permanence of Marking	Para. 9.19	-	-	-	-	-	-

NOTES: See Page 16.

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APPENDIX 'A'

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AGREED DEVIATIONS FOR SFERNICE (F)

ITEMS AFFECTED	DESCRIPTION OF DEVIATIONS
Para. 4.2.2	Para. 4.4, Marking: The Type Variant defined in Para. 4.5.2 of this specification need not be marked on the component.