RESISTORS, FIXED, SURFACE MOUNT, FILM,

NON-HERMETICALLY SEALED

BASED ON TYPE MS1

ESCC Detail Specification No. 4001/022

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space components
coordination group

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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 1 and incorporates all modifications defined in Revision 'A' to Issue 1 and the changes agreed by the following DCRs:-		
		Cover page		None
		DCN		None
		Para. 4.2.3	: (a) Text changed	21192
			: New (b) to (d) added	21192
			: Old (b) renumbered (e)	21192
		Para. 4.7	: Para. deleted	21192
		Para. 4.7.1	: Para. deleted	21192
		Para. 4.7.2	: Para. deleted	21192
		Para. 4.7.3	: Para. deleted	21192
		Table 4	: Not applicable, replaces existing Table	21192
		Table 5	: Title amended	21192
		Figure 5	: Title amended	21192
		Para. 4.8	: Paras. 4.8 to 4.8.6 renumbered 4.7 to 4.7.6	21192

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APPENDICES (Applicable to specific Manufacturers only)
None.

1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Resistors, Fixed, Surface Mount, Film, Non-hermetically Sealed, based on Type MS1. 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 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 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 ($\pm 10^{-6}$/°C)
	MIN. (Ω)	MAX. (MΩ)			
01	43.2	1.0	0.1	E96	50
02	10.0	1.0	0.5	E96	50
03	2.2	5.11	1.0	E96	50
04	43.2	1.0	0.1	E96	25
05	10.0	1.0	0.5	E96	25
06	10.0	1.0	1.0	E96	25
07	43.2	0.221	0.1	E96	15
08	10.0	0.511	0.5	E96	15

NOTES

1. Critical resistance = 160 000Ω

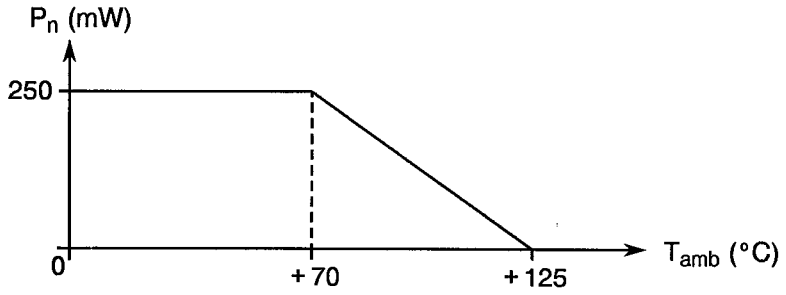
TABLE 1(b) - MAXIMUM RATINGS

No.	Characteristics	Symbol	Limits	Unit	Remarks
1	Rated Dissipation	P_n	0.25	W	Note 1
2	Limiting Element Voltage	U_L	200	V	-
3	Rated Voltage	U_R	$\sqrt{(0.25\ R_n)}$	V	Note 2
4	Insulation Voltage	U_I	>500	Vrms	-
5	Operating Temperature Range	T_{op}	−55 to +125	°C	T_{amb}
6	Storage Temperature Range	T_{stg}	−65 to +155	°C	-
7	Soldering Temperature	T_{sol}	+260	°C	Note 3

NOTES

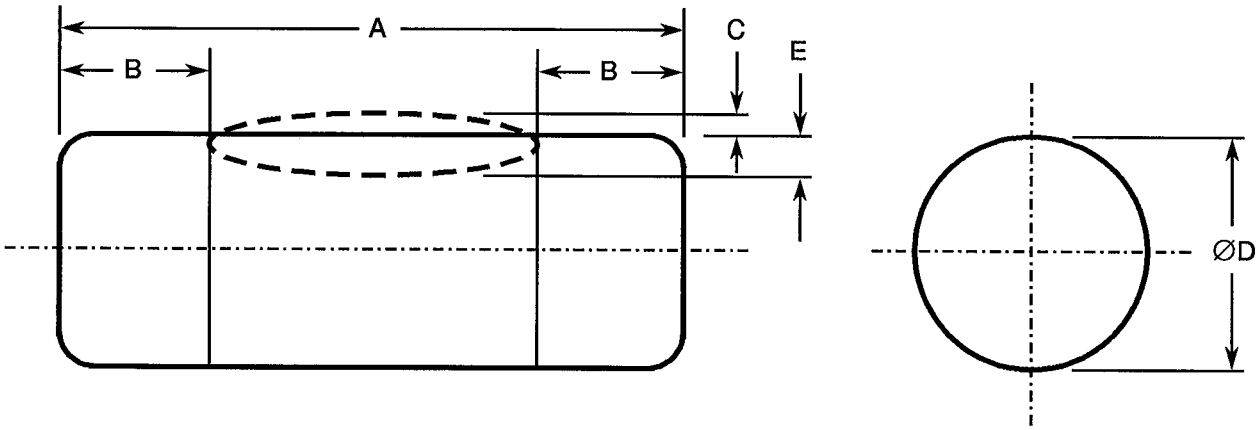
1. At $T_{amb} \leq +70$ °C. For derating at $T_{amb} > +70$ °C, see Figure 1.
2. Shall never exceed Limiting Element Voltage.
3. Duration 10 seconds maximum.

FIGURE 1 - PARAMETER DERATING INFORMATION



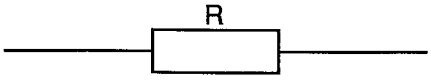
Rated Dissipation versus Temperature

FIGURE 2 - PHYSICAL DIMENSIONS



Symbol	Millimetres		Notes
	Min.	Max.	
A	3.4	3.6	
B	0.5	0.9	
C	-	0.05	
ØD	1.3	1.5	
E	-	0.1	

FIGURE 3 - FUNCTIONAL DIAGRAM



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 as follows:-

Voltage : $\sqrt{2.5\ R_n}$ or 630V, whichever is less.
Duration : (0.1 ± 0.01)s
$\Delta R/R$: $\leq \pm (0.25\% R_n + 0.05\Omega)$

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

(a) No serialisation of parts.

(b) Para. 9.5.2, Parameter Drift Value Measurements: not applicable.

(c) Para. 7.1.1, Conditions for Burn-in Test, and Para. 9.18, Burn-in: not applicable.

(d) Para. 9.3, Seal Test: not applicable.

(e) Para. 9.17, External Visual Inspection: In addition to the applicable ESA/SCC Basic Specification, the following specific requirements must be considered:

- There shall be no gap at the lacquer-cap junction. However, after temperature testing hairline cracks shall be allowed between the lacquer and the cap.
- The termination (cap) must be free of any lacquer for the dimension "B min" given in Figure 2.
- Pretinning shall exhibit a clean smooth surface, without pin holes or rough spots concentrated in one place, and without irregular solder balling.

4.2.4 Deviations from Qualification Tests (Chart IV)

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

(b) Para. 9.10.2.3, Bend Strength of the End Face Plating: Not applicable.

(c) Para. 9.12, Rapid Change of Temperature: Not applicable.

(d) Para. 9.13, Vibration: Not applicable.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

(a) Para. 9.10.2.3, Bend Strength of the End Face Plating: Not applicable.

(b) Para. 9.13, Vibration: Not applicable.

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.

4.3.2 Weight

The maximum weight of the resistors specified herein shall be 0.1 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.

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 laquer coating.

4.4.2 Terminations

The end-cap material shall be steel with 1.0µm nickel plating and with a tin-lead plated finish (minimum 6% lead).

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). When used, spiralling shall occupy at least 70% of the active 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 infomation to be marked and the order of precedence, shall be as follows:-

(a) The SCC Component Number.

(b) The 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:

400102201B

Detail Specification Number

Type Variant (see Note)

Testing Level (B or C, as applicable)

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:

2490F3

Value (249 Ohms)

Tolerance (±1.0%)

Temperature Coefficient (±50 10^{-6}/°C)

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).

Resistance Value	Code
XX.X	XXRX
XXX	XXX0
XXX10^1	XXX1
XXX10^2	XXX2
XXX10^3	XXX3
XXX10^4	XXX4

For values of 100Ω and above, the first 3 digits (X) represent significant figures and the last digit specifies the number of zeros to follow.

When values of less than 100Ω are required, the letter 'R' is used to indicate the decimal point. When the letter is used, all successive digits represent significant figures.

4.5.3.2 Tolerance

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

Tolerance (±%)	Code Letter
0.1	B
0.5	D
1.0	F

4.5.3.3 Temperature Coefficient

The temperature coefficient shall be indicated by the numerical codes specified hereafter.

Digit	Temperature Coefficient ($\pm 10^{-6}$/°C)
1	15
2	25
3	50

4.5.3.4 Marking of the Resistors

A colour code shall be applied in accordance with ESA/SCC Basic Specification No. 21700.

Marking of the temperature coefficient shall be either with a colour dot or with a body colour as specified hereafter.

TC ($\pm 10^{-6}$/°C)	Colour Dot	Body Colour
15	Orange	Violet
25	Yellow	Pink
50	None	Beige

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 $T_{amb} = +22 \pm 3$ °C.

4.6.2 Electrical Measurements at High and Low Temperatures

The parameters to be measured on a sample basis at high and low temperatures are scheduled in Table 3.

The distribution of the sample shall be as follows:

- 1/3 with the lowest resistance value.
- 1/3 with the highest resistance value.
- 1/3 with the median resistance value or the critical resistance value if procured, of the procured range.

4.6.3 Circuits for Electrical Measurements (Figure 4)

Not applicable.

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

No.	Characteristics	Symbol	ESA/SCC 4001 Test Method	Test Conditions	Tolerence (±%)	Limits		Unit
						Min.	Max.	
1	Resistance	R_A	Para. 9.5.1	Para. 9.5.1	0.1 0.5 1.0	0.999 Rn 0.995 Rn 0.990 Rn	1.001 Rn 1.005 Rn 1.010 Rn	Ω

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	Characteristics	Symbol	ESA/SCC 4001 Test Method	Test Conditions (Note 1)	Limits		Unit
					Min.	Max.	
2	Resistance Change between −55(+3−0) °C and +22±3 °C	$\frac{\Delta R}{R}$	Para. 9.5.1	Para. 9.5.1 ±15 10^{-6}/°C ±25 10^{-6}/°C ±50 10^{-6}/°C	 −0.12 −0.2 −0.4	 +0.12 +0.2 +0.4	%
3	Resistance Change between +125(+0−3) °C and +22±3 °C	$\frac{\Delta R}{R}$	Para. 9.5.1	Para. 9.5.1 ±15 10^{-6}/°C ±25 10^{-6}/°C ±50 10^{-6}/°C	 −0.16 −0.26 −0.55	 +0.16 +0.26 +0.55	%

NOTES

1. The measurements shall be performed on a sample basis in accordance with General Inspection Level II, Table IIA, AQL = 0.65% of IEC Publication No. 410 on the total production lot. In addition, see Para. 4.6.2 for distribution of the sample.

FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS

Not applicable.

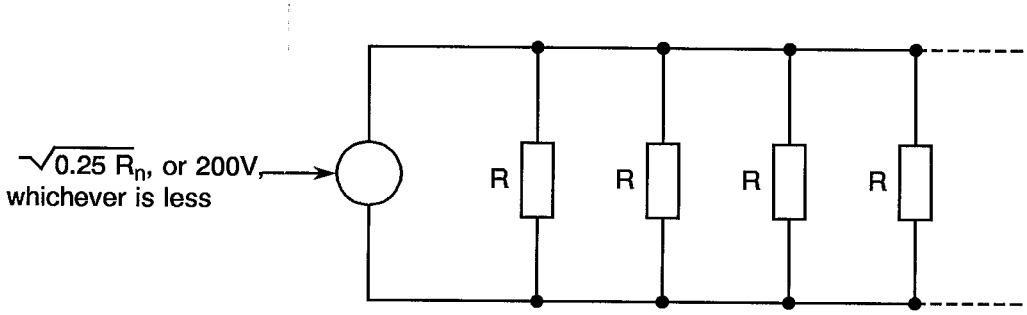
TABLE 4 - PARAMETER DRIFT VALUES

Not applicable.

TABLE 5 - CONDITIONS FOR OPERATING LIFE TEST

No.	Characteristics	Symbol	Condition	Unit
1	Ambient Temperature	T_{amb}	+70(+0−3)	°C
2	Test Voltage	V_T	$\sqrt{0.25\ R_n}$, or 200V, whichever is less	V

FIGURE 5 - ELECTRICAL CIRCUIT FOR OPERATING LIFE TEST



4.7 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESA/SCC GENERIC SPECIFICATION No. 4001)

The resistors shall be mounted as prescribed in ESA/SCC Generic Specification No. 4001, Para. 9.20. The substrate material shall be epoxy glass laminated board.

4.7.1 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.

4.7.2 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 scheduled in Table 6 of this specification. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm 3$ °C.

4.7.3 Measurements and Inspections on Completion of Endurance Tests

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

4.7.4 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 of this specification.

4.7.5 Electrical Circuits for Operating Life Tests

Circuits for use in performing the operating life tests are shown in Figure 5 of this specification.

4.7.6 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 $T_{amb} = +125(+0-5)$ °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 hours 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 $\pm(0.25+\frac{0.05\Omega \times 100}{Rn})$	 - 	 - %
02	Seal Test (Hermetically Sealed only)	Para. 9.3	Not applicable					
03	Insualtion Resistance (Insulated only)	Para. 9.6	**Final Measurements** Insulation Resistance	 Para. 9.6.2 of ESA/SCC 4001 (2)	 Ri	 1000	 -	 MΩ
04	Temperature Coefficient	Para. 9.7 Procedure I	Temperature Coefficient	Para. 9.5.1 of ESA/SCC 4001	TC	−15 −25 −50	+15 +25 +50	10^{-6}/°C
05	Voltage Proof	Para. 9.8	**During Test** Visual Examination	$1.4xU_i$ (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 $\pm(0.15+\frac{0.05\Omega \times 100}{Rn})$	 	 %
07	Robustness of Terminations	Para. 9.10.2 Adhesion Paras. 4.2.4 and 4.2.5 of this spec. Bend Strength of End Plate Facing	- **Initial Measurements** Resistance **Final Measurements** Resistance Change Visual Examination Not applicable	After mounting Table 2 Item 1 Table 2 Item 1 No damage, lifting, cracking or dry joints	- R_A $\Delta R_A/R_A$ -	- Record Values $\pm(0.25+\frac{0.05\Omega \times 100}{Rn})$ -	- - 	- % -
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 - $\pm(0.15+\frac{0.05\Omega \times 100}{Rn})$	 - 	 - %
09	Rapid Change of Temperature	Para. 9.12 and Para. 4.2.4 of this spec.	Not applicable					
10	Vibration	Para. 9.13 and Paras. 4.2.4 and 4.2.5 of this spec.	Not applicable					

NOTES

1. The tests in this Table refer to either Chart IV or V and shall be use as applicable.
2. Test Voltage: $V_T = 100V$.
3. 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.	
11	Climatic Sequence	Para. 9.14 Procedure I	**Initial Measurements** Resistance	After Drying Table 2 Item 1	R_A	Record Values		
			Final Measurements	Following completion of D.C. load test and after a recovery period of 1-2 hrs				
			Visual Examination	No evidence of damage and marking legible	-	-	-	-
			Insulation Resistance	Para. 9.6 of ESA/SCC 4001 (2)	Ri	1000	-	MΩ
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	$\pm(0.5+\frac{0.05\Omega \times 100}{Rn})$		%
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	After a recovery period of 1-2 hrs No evidence of damage	-	-	-	-
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	$\pm(0.35+\frac{0.05\Omega \times 100}{Rn})$		%
			Final Measurements (2000 hrs) Visual Examination	After a recovery period of 1-2 hrs No evidence of damage	-	-	-	-
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	$\pm(0.5+\frac{0.05\Omega \times 100}{Rn})$		%
			Insulation Resistance	Para. 9.6 of ESA/SCC 4001 (2)	Ri	1000	-	MΩ
		Para. 9.15 Chart V	**Initial Measurements** Resistance	Table 2 Item 1	R_A	Record Values		
			Final Measurements (1000 hrs) Visual Examination	After a recovery period of 1-2 hrs No evidence of damage	-	-	-	-
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	$\pm(0.35+\frac{0.05\Omega \times 100}{Rn})$		%
			Insulation Resistance	Para. 9.6 of ESA/SCC 4001 (2)	Ri	1000	-	MΩ
13	High Temperature Storage	Para. 9.16	**Initial Measurements** Resistance	Table 2 Item 1	R_A	Record Values		
			Intermediate Measurements (1000 hrs) Visual Examination	After a recovery period of 1-2 hrs No evidence of damage	-	-	-	-
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	$\pm(0.35+\frac{0.05\Omega \times 100}{Rn})$		%
			Final Measurements (2000 hrs) Visual Examination	After recovery period of 1-2 hrs No evidence of damage	-	-	-	-
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	$\pm(0.5+\frac{0.05\Omega \times 100}{Rn})$		%
			Insulation Resistance	Para. 9.6 of ESA/SCC 4001 (2)	Ri	1000	-	MΩ
14	Permanence of Marking	Para. 9.19	**Final Measurements** Visual Examination	No corrosion or abliteration of marking				

NOTES: See Page 15.