european space agency
agence spatiale européenne

Pages 1 to 17

THERMISTORS

(THERMALLY SENSITIVE RESISTORS)

RANGE 2000 TO 15000 OHMS AT +25°C WITH

A TEMPERATURE RANGE OF −40 TO +160 °C

ESA/SCC Detail Specification No. 4006/001

space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 2	November 1995		
Revision 'A'	June 1996		
Revision 'B'	December 2001		

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 1 and incorporates all modifications defined in Revisions 'A', 'B' and 'C' to Issue 1 and the changes agreed in the following DCR's:-		
		Cover Page	: Title amended	221322
		DCN		None
		Para. 1.1	: First sentence amended	221322
		Table 1(a)	: Column 2, Heading amended and Part Types deleted	221322
			: Column 4, "(%)" amended to "($\pm$%)"	23753
			: Variants 03, 05 08, resistance at +160°C amended to "302.9"	221280
		Table 1(b)	: No. 3, Characteristic amended to "Power Dissipation"	221280
			, Symbol amended to "P_D"	221280
			, Maximum Rating amended to "2.0"	221280
			, Unit amended to "mW"	221280
			, Note 3 added in Remarks	221280
			: No. 6, Note number amended to "4"	221280
			: New Note 3 added and old Note renumbered to "4"	221280
		Figure 1	: Figure 1 reference added	23753
		Figures 2(a), (b)	: Imperial dimensions deleted	23753
			: Note changed	221280
		Para. 2	: Reference to "MIL-STD-1276" deleted and others renumbered	21025
		Para. 4.1	: Second paragraph added	21019
		Para. 4.2.1	: New paragraph added for "Deviations for Special In-process Controls" and subsequent paragraphs renumbered to 4.2.2 to 4.2.5	23753
		Para. 4.2.3	: Title amended	23753
		Para. 4.2.4	: Title amended	23753
		Para. 4.3.1	: Paragraph standardised	23753
		Para. 4.3.2	: Weight for all variants changed to "1.7 grammes"	221280
		Para. 4.3.3	: "Section 9" amended to "Para. 9.13"	23753
			: Applied Force amended to "4.45(+1.1 −0) N"	221280
		Para. 4.4.2	: Paragraph standardised	21025
		Para. 4.5.1	: Paragraph standardised	23753
		Para. 4.5.3	: Paragraph standardised and Variant reference standardised to "01"	23753
		Para. 4.5.4	: Paragraph standardised	23753
		Para. 4.5.5	: Paragraph deleted	23753
		Para. 4.6.3	: Text deleted and replaced with "Not applicable."	23753
		Para. 4.7.3	: Text deleted and replaced with "Not applicable."	23753
		Table 2	: Columns standardised	23753
		Table 3	: Columns standardised	23753
			: No. 3 corrected to No. "1"	23753
		Figure 4	: Figure 4 reference added	23753
		Table 4	: No. 1, temperature in Characteristics amended to "+25 $\pm$ 0.03°C"	221280
		Table 5	: No. 2, Symbol "P_{tot}" corrected to "P_D"	23753
		Figure 5	: Figure 5 reference added	23753
		Para. 4.8	: Title amended	23753
		Para. 4.8.1	: Title and first sentence amended	23753

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		Para. 4.8.2	: Title, first and second sentences amended	23753
		Para. 4.8.3	: Title and first sentence amended	23753
		Para. 4.8.4	: Second sentence amended to reference "Table 5"	23753
		Table 6	: Format amended and corrected	23753
'A'	June '96	P1. Cover page		None
		P2A. DCN		None
		P6. Table 1(a)	: For Variant 05, +160°C column corrected	23808
'B'	Dec. 01	P1. Cover page		None
		P2A. DCN		None
		P6. Table 1(a)	: Change of resistance value (-20°C) for Variants 02 and 07	23951

TABLE OF CONTENTS

Page

TABLES

FIGURES

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 Thermistors, Thermally Sensitive Resistors, Range 2000 to 15000 Ohms at +25°C with a Temperature Range of −40 to +160 °C. It shall be read in conjunction with ESA/SCC Generic Specification No. 4006, the requirements of which are supplemented herein.

1.2 TYPE VARIANTS

Variants of the basic type thermistors 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 thermistors 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 thermistors specified herein are shown in Figure 2.

1.6 FUNCTIONAL DIAGRAM

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

1.7 HIGH TEMPERATURE TEST CONDITIONS

For tin-lead plated or solder-dipped lead finish, all tests to be performed at a temperature that exceeds +125°C shall be carried out in a 100% inert atmosphere.

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. 4006, Thermistors (Resistors, Thermally Sensitive).

(b) MIL-STD-105, Sampling Procedures and Tables for Inspections by Attributes.

(c) MIL-STD-202, Test Methods for Electronic and Electrical Component Parts.

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 (NOT USED)	(3) FIGURE	(4) RESISTANCE TOLERANCE (±%)	(5) RESISTANCE/TEMPERATURE CHARACTERISTICS (Ω)										
				−40°C	−20°C	0°C	+25°C	+40°C	+60°C	+80°C	+100°C	+120°C	+150°C	+160°C
01	-	2(a)	1.0	-	29710	11400	4002	2292	1166	637.3	369.4	226.5	-	-
02	-	2(a)	1.0	44135	14855	5700	2001	1146	583.1	318.7	184.7	113.1	-	-
03	-	2(a)	1.0	-	-	44420	15000	8397.3	4159.5	2211.8	1250.3	745.38	373.71	302.9
04	-	2(a)	1.0	88270	29710	11400	4002	2292	1166	-	-	-	-	-
05	-	2(a)	1.0	-	-	-	-	-	-	-	6395	3608	1682	861.5
06	-	2(b)	1.0	-	29710	11400	4002	2292	1166	637.3	369.4	226.5	-	-
07	-	2(b)	1.0	44135	14855	5700	2001	1146	583.1	318.7	184.7	113.1	-	-
08	-	2(b)	1.0	-	-	44420	15000	8397.3	4159.5	2211.8	1250.3	745.38	373.71	302.9
09	-	2(b)	1.0	88270	29710	11400	4002	2292	1166	-	-	-	-	-
10	-	2(b)	1.0	-	-	-	-	-	-	-	6395	3608	1682	861.5

TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Resistance Range	R	Note 1	Ω	
2	Resistance Tolerance	ΔR	Note 2	%	
3	Power Dissipation	P_D	2.0	mW	Note 3
4	Operating Temperature Range	T_{op}	Note 1	°C	
5	Storage Temperature Range	T_{stg}	−55 to +200	°C	
6	Soldering Temperature	T_{sol}	+245	°C	Note 4

NOTES

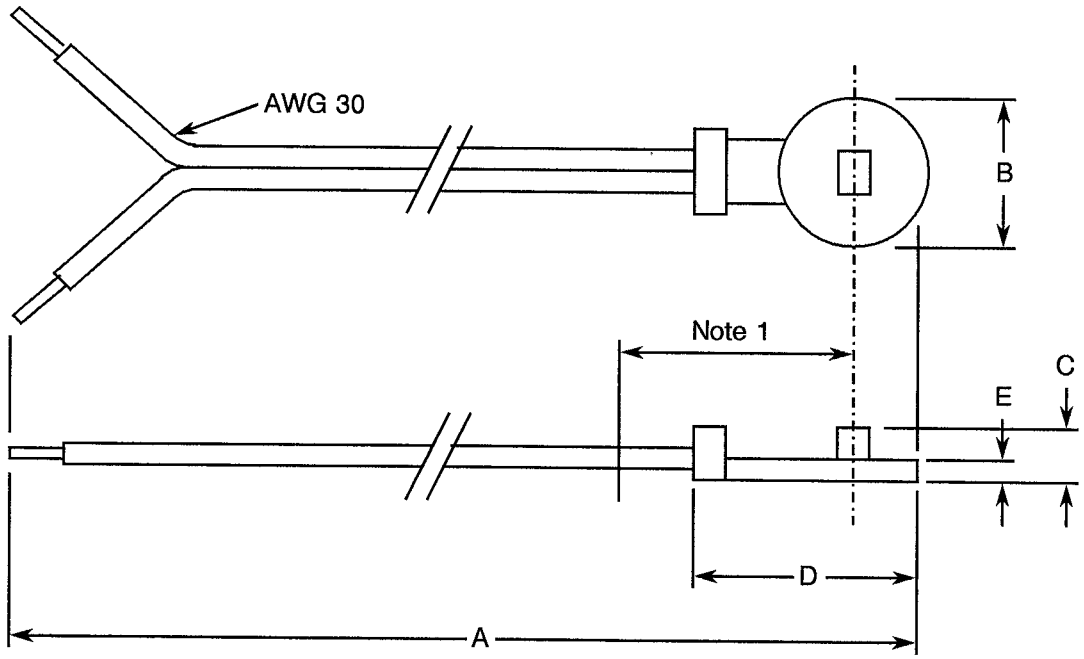
1. See Column 5 of Table 1(a).
2. See Column 4 of Table 1(a).
3. Never to be exceeded in the temperature measurement mode. The thermistors specified herein shall not be used in the self-heat mode.
4. Duration 10 seconds maximum at a distance of not less than 10mm from the device body and the same lead 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 TO 05



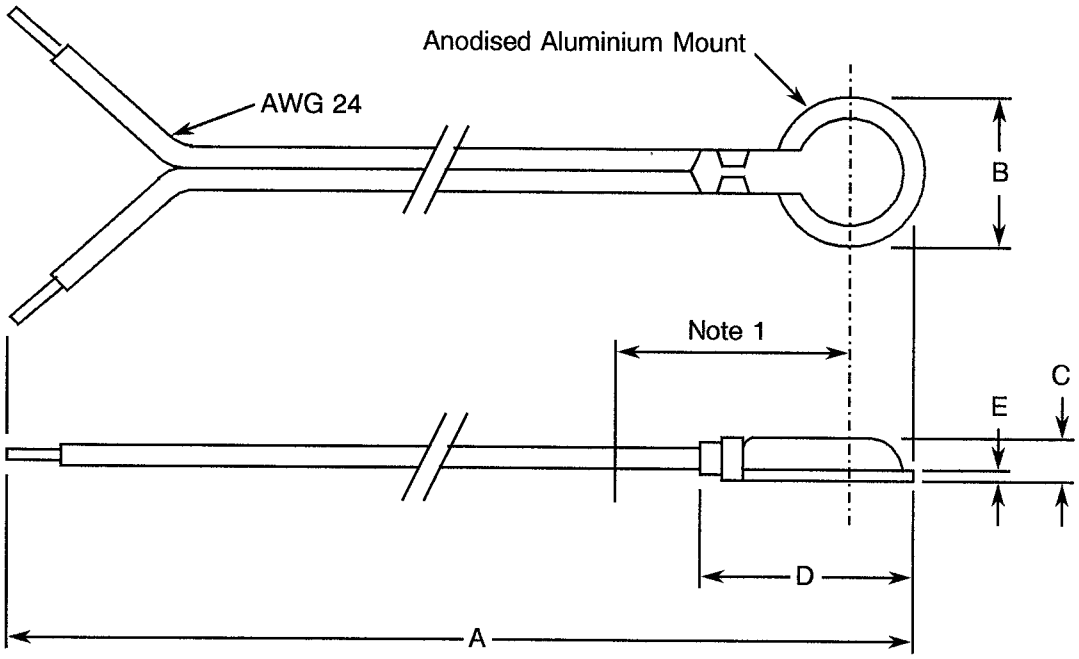
SYMBOL	MILLIMETRES	
	MIN.	MAX.
A	280.00	330.00
B	6.00	6.70
C	-	2.40
D	-	9.50
E	0.08	0.18

NOTES

1. The means of fastening the leads must not drop below the mounting plane of the disk by more than 0.127mm.

FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

FIGURE 2(b) - VARIANTS 06 TO 10

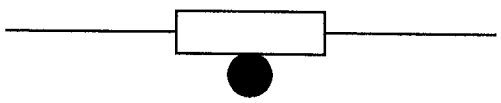


SYMBOL	MILLIMETRES	
	MIN.	MAX.
A	280.00	330.00
B	6.10	6.60
C	-	2.40
D	-	9.50
E	0.33	0.48

NOTES

1. The means of fastening the leads must not drop below the mounting plane of the disk by more than 0.127mm.

FIGURE 3 - FUNCTIONAL DIAGRAM



4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the thermistors specified herein are stated in this specification and ESA/SCC Generic Specification No. 4006 for Thermistors (Resistors, Thermally Sensitive). 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)

None.

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

None.

4.2.4 Deviations from Qualification Tests (Chart IV)

None.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

None.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the thermistors specified herein shall be verified in accordance with the requirements set out in Para. 9.4 of ESA/SCC Generic Specification No. 4006 and they shall conform to those shown in Figure 2 of this specification.

4.3.2 Weight

The maximum weight of the thermistors specified herein shall be 1.7 grammes.

4.3.3 Terminal Strength

The requirements for terminal strength testing are specified in Para. 9.13 of ESA/SCC Generic Specification No. 4006. The test conditions shall be as follows:-

Applied Force: 4.45(+ 1.1 – 0)N.
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 thermistors 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

The case shall be anodised aluminium.

4.4.2 Lead Material and Finish

The lead material shall be multicore Type 'A' with Type '4' finish in accordance with the requirements of ESA/SCC Basic Specification No. 23500, and the insulation shall be as follows:-

Variants 01 to 05: Teflon.
Variants 06 to 10: Kapton.

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 the component in its primary package.

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

(a) Lead Identification.

(b) The SCC Component Number.

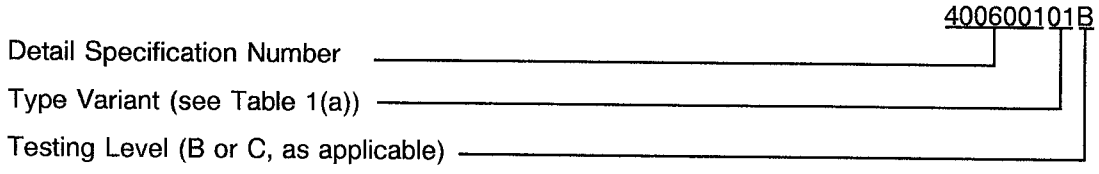
(c) Traceability Information.

4.5.2 Lead Identification

Lead identification shall be as shown in Figure 2.

4.5.3 The SCC Component Number

The SCC Component Number shall be constituted and marked as follows:



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 $T_{amb} = +25 \pm 3$ °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.

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 $T_{amb} = +25 \pm 3$ °C. The parameter drift values (Δ) applicable to the parameters scheduled, 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 Burn-in

The requirements for burn-in are specified in Section 7 of ESA/SCC Generic Specification No. 4006. The conditions for burn-in shall be as specified in Table 5 of this specification.

4.7.3 Electrical Circuits for Burn-in (Figure 5)

Not applicable.

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - d.c. PARAMETERS

No.	CHARACTERISTICS	SYMBOL	ESA/SCC 4006 TEST CONDITION	LIMITS		UNIT
				MIN.	MAX.	
1	Zero Power Resistance at +25 ± 3 °C	R_Z	Para. 9.3.1.1	Note 1		Ω
2	Insulation Resistance	Ri	Para. 9.3.1.4 Note 2	100	-	MΩ

NOTES

1. See Columns 4 and 5 of Table 1(a) for resistance values.
2. If more than 20 devices have to be measured, the test shall be performed on a sample basis in accordance with Level II, Table IIA, AQL = 1.0 of MIL-STD-105.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	ESA/SCC 4006 TEST CONDITION	LIMITS		UNIT
				MIN.	MAX.	
1	Zero Power Resistance at each specified temperature, over operating range	R_Z	Para. 9.3.1.1	Note 1		Ω

NOTES

1. See Columns 4 and 5 of Table 1(a) for resistance values.

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	Zero Power Resistance at +25 ± 0.03 °C	R_Z	As per Table 2	As per Table 2	± 0.2	%

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

No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+150 ± 3	°C
2	Power Dissipation	P_D	No Load	-

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

Not applicable.

4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESA/SCC GENERIC SPECIFICATION No. 4006)

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 2. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +25 \pm 3$ °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 scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +25 \pm 3$ °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 tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +25 \pm 3$ °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. 4006. The conditions for operating life testing shall be as specified in Table 5 for the burn-in test.

4.8.5 Electrical Circuits for Operating Life Tests

Not applicable.

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. 4006		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		MIN.	MAX.	
01	Thermal Shock	Para. 9.2	-	-	-	-	-	-
02	Shock (Specified Pulse)	Para. 9.7	**Initial Measurements** Zero Power Resistance **During Shock** Intermittent Contact **After Shock** Zero Power Resistance Change Visual Examination	 Table 2 Item 1 Open or Short Circuiting Table 2 Item 1 Evidence of damage	 R_Z - $\Delta R_Z/R_Z$ -	 Table 2 Item 1 - −2.0 -	 - +2.0 -	 Ω - % -
03	Vibration	Para. 9.8	**Initial Measurements** Zero Power Resistance **During Vibration** Intermittent Contact **After Vibration** Zero Power Resistance Change Visual Examination	 Table 2 Item 1 Open or Short Circuiting Table 2 Item 1 Evidence of damage	 R_Z - $\Delta R_Z/R_Z$ -	 Table 2 Item 1 - −2.0 -	 - +2.0 -	 Ω - % -
04	Immersion	Para. 9.9	Visual Examination	Evidence of damage	-	-	-	-
05	Dielectric Withstanding Voltage	Para. 9.10	**During Test** Visual Examination **After Test** Visual Examination	 Evidence of breakdown or flashover Evidence of damage, arcing or breakdown	 - -	 - -	 - -	 - -
06	Resistance to Soldering Heat	Para. 9.11	**After Test** Zero Power Resistance Visual Examination	After a recovery period of 24 ± 4 hrs Table 2 Item 1 Evidence of damage	 R_Z -	 Table 2 Item 1 -	 -	 Ω -
07	Moisture Resistance	Para. 9.12	**Initial Measurements** Zero Power Resistance **Final Measurements** Zero Power Resistance Change Insulation Resistance	Not less than 1.5 hrs after removal from drying oven Table 2 Item 1 Within 24 hrs of removal from 1.5 to 3.5 hr conditioning Table 2 Item 1 Table 2 Item 2	 R_Z $\Delta R_Z/R_Z$ Ri	 Table 2 Item 1 −2.0 100	 +2.0 -	 Ω % MΩ
08	Terminal Strength	Para. 9.13	**Initial Measurements** Zero Power Resistance **Final Measurements** Zero Power Resistance Change Visual Examination	 Table 2 Item 1 Table 2 Item 1 Evidence of damage	 R_Z $\Delta R_Z/R_Z$ -	 Table 2 Item 1 −2.0 -	 +2.0 -	 Ω % -

NOTES

1. The tests in this Table refer to either Chart IV or V and shall be used as applicable.

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. 4006		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		MIN.	MAX.	
09	Operating Life	Para. 9.14	**Initial Measurements**					
			Zero Power Resistance	Table 2 Item 1	R_Z	Table 2 Item 1		Ω
			Intermediate Measurements					
			Zero Power Resistance Change	Table 2 Item 1	$\Delta R_Z/R_Z$	−1.0	+1.0	%
			Insulation Resistance	Table 2 Item 2	Ri	100	-	MΩ
			Final Measurements					
			Zero Power Resistance Change	Table 2 Item 1	$\Delta R_Z/R_Z$	−1.0	+1.0	%
			Insulation Resistance	Table 2 Item 2	Ri	100	-	MΩ
10	Short Time Load	Para. 9.15	Zero Power Resistance	Table 2 Item 1	R_Z	Table 2 Item 1		Ω
			Visual Examination	Evidence of arcing, burning or charring	-	-	-	-
11	Low Temperature Storage	Para. 9.16	**Initial Measurements**					
			Zero Power Resistance	Table 2 Item 1	R_Z	Table 2 Item 1		Ω
			Final Measurements					
			Zero Power Resistance Change	Table 2 Item 1	$\Delta R_Z/R_Z$	−2.0	+2.0	%
			Visual Examination	Evidence of damage	-	-	-	-
12	High Temperature Storage	Para. 9.17	**Initial Measurements**					
			Zero Power Resistance	Table 2 Item 1	R_Z	Table 2 Item 1		Ω
			Intermediate Measurements					
			Zero Power Resistance Change	Table 2 Item 1	$\Delta R_Z/R_Z$	−1.0	+1.0	%
			Insulation Resistance	Table 2 Item 2	Ri	100	-	MΩ
			Final Measurements					
			Zero Power Resistance Change	Table 2 Item 1	$\Delta R_Z/R_Z$	−1.0	+1.0	%
			Insulation Resistance	Table 2 Item 2	Ri	100	-	MΩ
13	Solderability	Para. 9.18	-	-	-	-	-	-

NOTES

1. The tests in this Table refer to either Chart IV or V and shall be used as applicable.