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THERMISTORS

(THERMALLY SENSITIVE RESISTORS), NTC,

RANGE 1 000 TO 5 000 OHMS AT +25°C WITH

A TEMPERATURE RANGE OF −55 TO +150 °C

ESA/SCC Detail Specification No. 4006/013

space components
coordination group

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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
'A'	Jun. '99	P1. Cover page	: Page count amended to "17"	221512
			: Maximum temperature amended in Title	221512
		P2. DCN		None
		P4. T of C	: Appendix 'A' entry added	221512
		P5. Para. 1.1	: Maximum temperature amended in first sentence	221512
		P6. Table 1(a)	: For Variants 04 and 05, +125°C Column heading changed to " +115" and values amended	221512
			: +150°C Column deleted in toto	221512
			: In Note 2, the first tolerance range amended and the last tolerance range deleted	221512
		P7. Table 1(b)	: No. 3, Maximum Rating deleted and "Note 3" added	221512
			: No. 4, in Remarks, Note number amended to "4"	221512
			: New Note 3 added and existing Note 3 renumbered as "4"	221512
		P9. Para. 4.2.4	: Deviation (a) added	221512
		P12. Table 2	: No. 3, Conditions and Limit deleted and "Not applicable" added	221512
			: No. 4, Max. Limit amended to "25"	221512
		P13. Table 4	: No. 1, Change Limits amended	221512
		Table 5	: No. 1, Conditions deleted and "Note 1" added	221512
			: No. 2, Conditions deleted and "2.0" added	221512
			: Existing Note deleted and new Note added	221512
		P15. Table 6	: No. 2, entry made "Not applicable"	221512
			: No. 3, Max. Limit amended to "25"	221512
		New P17.	: Appendix 'A' added as Page 17	221512
'B'	Feb. '02	P1. Cover Page		None
		P2. DCN		None
		P6. Table 1(a)	: New Table 1(a) inserted	221663
		P7. Table 1(b)	: No. 1, Power Dissipation, Maximum Rating for Variant 01 amended	221663
		P9. Para. 4.2.4	: Deviations (b) and (c) added	221663
		P10. Para. 4.5.1	: (a) amended	221663
		Para. 4.5.2	: Paragraph deleted and subsequent paragraphs renumbered	221663
		P12. Table 2	: No. 3 deleted and Table renumbered	221663
		Table 3	: No. 5, deleted	
			: Note 2, deleted	221663
		P13. Table 4	: "Test Conditions" and "Change Limits" amended	221663
		Table 5	: No. 1, "Note 2" added to "Conditions"	221663
			: New Note 2 added	221663

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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 Thermistors, Thermally Sensitive Resistors, NTC, Range 1 000 to 5 000 Ohms at +25°C with a Temperature Range of −55 to +115 °C. It shall be read in conjunction with ESA/SCC Generic Specification No. 4006, the requirements of which are supplemented herein.

1.2 COMPONENT 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.

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-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. In addition, the following symbols are used:-

NTC = Negative Temperature Coefficient.

R_Z = Zero Power Resistance.

TABLE 1(a) - TYPE VARIANTS

(1) VARIANT	(2) BASED ON TYPE	(3) R_Z (Note 1)	(4) RESISTANCE/TEMPERATURE CHARACTERISTICS (NOTES 2 AND 3)								
			−55°C	−40°C	−25°C	0°C	+25°C	+50°C	+75°C	+100°C	+115°C
01	1K3A351	NOM. (Ω)	95 620	33 512	13 017	3 265	1 000	360	148.0	67.9	-
		TOL. (±%)	3.69	2.32	2.10	1.02	0.88	0.76	1.16	1.46	-
02	2K3A352	NOM. (Ω)	191 239	67 023	26 034	6 530	2 000	720	296.0	135.8	-
		TOL. (±%)	3.69	2.32	2.10	1.02	0.88	0.76	1.16	1.46	-
03	3K3A353	NOM. (Ω)	287 937	100 701	39 073	9 795	3 000	1 080	444	203.6	-
		TOL. (±%)	3.70	2.33	2.10	1.02	0.88	0.76	1.16	1.46	-
04	4K3A354	NOM. (Ω)	383 916	134 268	52 098	13 060	4 000	1 440	592	271	177.8
		TOL. (±%)	3.70	2.33	2.10	1.02	0.88	0.76	1.16	1.46	1.36
05	5K3A355	NOM. (Ω)	479 895	167 835	65 122	16 325	5 000	1 800	740	339	222
		TOL. (±%)	3.70	2.33	2.10	1.02	0.88	0.76	1.16	1.46	1.36

NOTES

1. For test purposes, when zero power is dissipated and the ambient temperature is held as specified, the value is referred to as R_Z (Zero Power Resistance).

2. Temperature Tolerance ranges are as follows:-

   ±0.5°C from −55°C to −41°C and +100°C to +115°C.
   ±0.35°C from −40°C to −1°C and +75°C to +99°C.
   ±0.2°C from 0°C to +74°C.

3. The reference resistance is specified at +25°C.

TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Power Dissipation Variant 01 Variants 02, 03, 04 , 05	P_D	 0.01 2.0	mW	Note 1
2	Operating Temperature Range	T_{op}	Note 2	°C	
3	Storage Temperature Range	T_{stg}	Note 3	°C	
4	Soldering Temperature	T_{sol}	+245	°C	Note 4

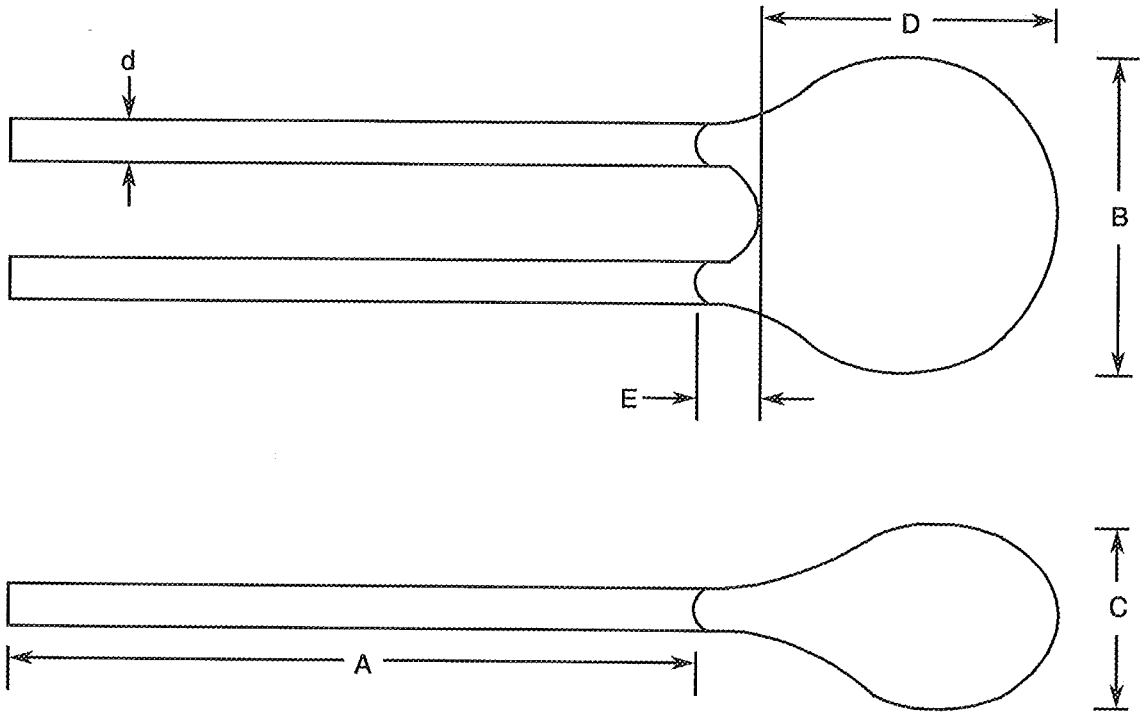
NOTES

1. Never to be exceeded in the temperature measurement mode. The thermistors specified herein shall not be used in the self heat mode.
2. See Column 4 of Table 1(a).
3. −65°C to the Maximum Operating Temperature specified in Column 4 of Table 1(a).
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

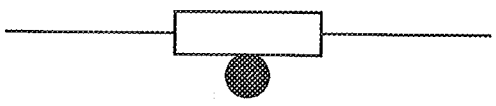


SYMBOL	Variant 01		Variant 02		Variant 03		Variant 04		Variant 05	
	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
A	50.8	-	50.8	-	50.8	-	50.8	-	50.8	-
B	-	4.87	-	3.43	-	2.81	-	2.54	-	2.54
C	-	4.87	-	3.43	-	2.81	-	2.54	-	2.54
D	-	6.35	-	4.40	-	3.68	-	3.50	-	3.50
d	0.23	0.28	0.23	0.28	0.23	0.28	0.23	0.28	0.23	0.28
E	-	2.00	-	2.00	-	1.60	-	1.60	-	1.60

NOTES

1. The leads shall not be bent, or the means of fastening them cause bending in any direction within a distance of 15mm from the centre of the thermistor.
2. All dimensions are in millimetres.

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)

(a) Para. 9.3.1.2, Dissipation Constant : Not applicable.

(b) Para. 9.15, Short Load Time : Not applicable.

(c) Para. 9.17, High Temperature Storage : Not applicable.

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 0.5 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 thermistor shall be covered with an epoxy encapsulant.

4.4.2 Lead Material and Finish

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

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:-

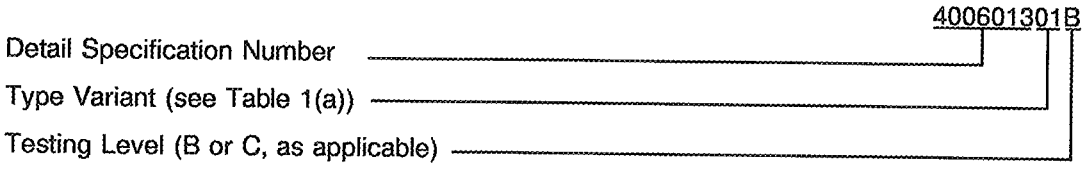
(a) The ESA Symbol, for qualified components only.

(b) The SCC Component Number.

(c) Traceability Information.

4.5.2 The SCC Component Number

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



4.5.3 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 $T_{amb} = +25 \pm 0.05$ °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 $T_{amb} = +25 \pm 0.05$ °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

No.	CHARACTERISTICS	SYMBOL	ESA/SCC 4006 TEST METHOD AND CONDITION	LIMITS		UNIT
				MIN.	MAX.	
1	Zero Power Resistance	R_Z	Para. 9.3.1.1 T_{amb} = +25°C	Note 1		Ω
2	Insulation Resistance	Ri	Para. 9.3.1.4 Note 2	100	-	MΩ
3	Thermal Time Constant	KH	Para. 9.3.1.3 In Still Air Note 3	-	25	secs.

NOTES

1. See Column 4 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.
3. Test to be performed on 10 samples during Chart II only.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

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

NOTES

1. See Column 4 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 Change	$\frac{\Delta R_Z}{R_Z}$	As per Table 2	As per Table 2 Variants 01 to 05	±0.2	%

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

No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	Note 1 Note 2	°C
2	Power Dissipation	P_D	2.0	mW

NOTES

1. Maximum Operating Temperature specified in Column 4 of Table 1(a).
2. The Temperature Tolerance = (+0 −3) °C.

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 $T_{amb} = +25 \pm 0.05$ °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 $T_{amb} = +25 \pm 0.05$ °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 $T_{amb} = +25 \pm 0.05$ °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 (Figure 5)

Not applicable.

TABLE 6 - MEASUREMENTS AND INSPECTIONS 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	Dissipation Constant	Para. 9.3.1.2 and Para. 4.2.4 of this spec.	**Initial Measurements** Zero Power Resistance **Final Measurements** Dissipation Constant	Not applicable Not applicable	R_Z K_{DISS}			
03	Thermal Time Constant	Para. 9.3.1.3 In Still Air	**Initial Measurements** Zero Power Resistance **Final Measurements** Thermal Time Constant	Para. 9.3.1.3(c) Para. 9.3.1.3(f)	R_Z KH	Record Values -	 25	Ω sec.
04	External Visual Inspection	Para. 9.5	ESA/SCC 20500	-	-	-	-	-
05	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 No Open or Short Circuiting Table 2 Item 1 No evidence of damage	R_Z - $\Delta R_Z/R_Z$ -	Table 2 Item 1 - -2.0 -	 - +2.0 -	 - % -
06	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 No Open or Short Circuiting Table 2 Item 1 No evidence of damage	R_Z - $\Delta R_Z/R_Z$ -	Table 2 Item 1 - -2.0 -	 - +2.0 -	 - % -
07	Immersion	Para. 9.9	Visual Examination	No evidence of damage	-	-	-	-
08	Dielectric Withstanding Voltage	Para. 9.10	**During Test** Visual Examination **After Test** Visual Examination	No evidence of breakdown or flashover No evidence of damage, arcing or breakdown	- -	- -	- -	- -
09	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 No evidence of damage	R_Z -	Table 2 Item 1 -	 -	 -
10	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 -	 % MΩ

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 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.	
11	Terminal Strength	Para. 9.13	**Initial Measurements**					
			Zero Power Resistance	Table 2 Item 1	R_Z	Table 2 Item 1		
			Final Measurements					
			Zero Power Resistance Change	Table 2 Item 1	$\Delta R_Z/R_Z$	−2.0	+2.0	%
			Visual Examination	No evidence of damage	-	-	-	-
12	Operating Life	Para. 9.14	**Initial Measurements**					
			Zero Power Resistance	Table 2 Item 1	R_Z	Table 2 Item 1		
			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	Short Time Load	Para. 9.15	Zero Power Resistance	Table 2 Item 1	R_Z	Table 2 Item 1		
			Visual Examination	No evidence of arcing, burning or charring	-	-	-	-
14	Low Temperature Storage	Para. 9.16	**Initial Measurements**					
			Zero Power Resistance	Table 2 Item 1	R_Z	Table 2 Item 1		
			Final Measurements					
			Zero Power Resistance Change	Table 2 Item 1	$\Delta R_Z/R_Z$	−2.0	+2.0	%
			Visual Examination	No evidence of damage	-	-	-	-
15	High Temperature Storage	Para. 9.17	**Initial Measurements**					
			Zero Power Resistance	Table 2 Item 1	R_Z	Table 2 Item 1		
			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
16	Solderability	Para. 9.18	-	-	-	-	-	-
17	Permanance of Marking	Para. 9.20	ESA/SCC 24800	-	-	-	-	-

NOTES

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

APPENDIX 'A'

AGREED DEVIATIONS FOR BETATHERM (IRL)

ITEMS AFFECTED	DESCRIPTION OF DEVIATION
Para. 4.2.4	(a) Para. 9.2, Thermal Shock: May be performed as follows: "Test Condition 'C' except that the maximum temperature shall be the maximum operating temperature specified in Column 4 of Table 1(a) of this specification." (b) Para. 9.17, High Temperature Storage: May be omitted.
Para. 4.2.5	(a) Para. 9.2, Thermal Shock: May be performed as follows: "Test Condition 'C' except that the maximum temperature shall be the maximum operating temperature specified in Column 4 of Table 1(a) of this specification."