



Pages 1 to 14

**THERMISTORS (THERMALLY SENSITIVE RESISTORS), NTC,  
RANGE 1000 TO 100000 OHMS AT +25°C WITH A  
TEMPERATURE RANGE OF -55 TO +115°C**

**ESCC Detail Specification No. 4006/013**

Issue 5	May 2009
---------	----------



Document Custodian: European Space Agency - see <https://escies.org>

**LEGAL DISCLAIMER AND COPYRIGHT**

European Space Agency, Copyright © 2009. All rights reserved.

The European Space Agency disclaims any liability or responsibility, to any person or entity, with respect to any loss or damage caused, or alleged to be caused, directly or indirectly by the use and application of this ESCC publication.

This publication, without the prior permission of the European Space Agency and provided that it is not used for a commercial purpose, may be:

- copied in whole, in any medium, without alteration or modification.
- copied in part, in any medium, provided that the ESCC document identification, comprising the ESCC symbol, document number and document issue, is removed.

**DOCUMENTATION CHANGE NOTICE**

(Refer to <https://escies.org> for ESCC DCR content)

DCR No.	CHANGE DESCRIPTION
482	Specification up issued to incorporate editorial and technical changes per DCR.

**TABLE OF CONTENTS**

<b><u>1.</u></b>	<b><u>GENERAL</u></b>	<b><u>5</u></b>
1.1	Scope	5
1.2	Component Type Variants	5
1.3	Maximum Ratings	5
1.4	Parameter Derating Information (Figure 1)	5
1.5	Physical Dimensions	5
1.6	Functional Diagram	5
<b><u>2.</u></b>	<b><u>APPLICABLE DOCUMENTS</u></b>	<b><u>5</u></b>
<b><u>3.</u></b>	<b><u>TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS</u></b>	<b><u>5</u></b>
<b><u>4.</u></b>	<b><u>REQUIREMENTS</u></b>	<b><u>7</u></b>
4.1	General	7
4.2	Deviations from Generic Specification	8
4.2.1	Deviations from Special In-Process Controls	8
4.2.2	Deviations from Final Production Tests (Chart II)	8
4.2.3	Deviations from Burn-in and Electrical Measurements (Chart III)	8
4.2.4	Deviations from Qualification Tests (Chart IV)	8
4.2.5	Deviations from Lot Acceptance Tests (Chart V)	8
4.3	Mechanical Requirements	8
4.3.1	Dimension Check	8
4.3.2	Weight	8
4.3.3	Terminal Strength	8
4.4	Materials and Finishes	9
4.4.1	Case	9
4.4.2	Lead Material and Finish	9
4.5	Marking	9
4.5.1	General	9
4.5.2	ESCC Component Number	9
4.5.3	Traceability Information	9
4.6	Electrical Measurements	10
4.6.1	Electrical Measurements at Room Temperature	10
4.6.2	Electrical Measurements at High and Low Temperatures	10
4.6.3	Circuits for Electrical Measurements (Figure 4)	10
4.7	Burn-in Tests	10
4.7.1	Parameter Drift Values	10
4.7.2	Conditions for Burn-in	10
4.7.3	Electrical Circuit for Burn-in (Figure 5)	10
4.8	Environmental and Endurance Tests (Charts IV and V of ESCC Generic Specification No. 4006)	11
4.8.1	Measurements and Inspections on Completion of Environmental Tests	11
4.8.2	Measurements and Inspections at Intermediate Points During Endurance Tests	12
4.8.3	Measurements and Inspections on Completion of Endurance Tests	12
4.8.4	Conditions for Operating Life Tests (Part of Endurance Testing)	12
4.8.5	Electrical Circuit for Operating Life Tests (Figure 5)	12

**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 1000 to 100000 Ohms at +25°C with a Temperature Range of -55 to +115°C. It shall be read in conjunction with ESCC 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) ESCC Generic Specification No. 4006, Thermistors (Resistors, Thermally Sensitive).
- (b) IEC 60410, Sampling Procedures and Tables for Inspection 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 ESCC Basic Specification No. 21300 shall apply. In addition, the following symbols are used:-

NTC = Negative Temperature Coefficient.

R<sub>Z</sub> = Zero Power Resistance.

**Table 1(a) - Type Variants**

Variant	Based on Type	R <sub>Z</sub> (Note 1)	Resistance/Temperature Characteristics (Note 2)								
			-55°C	-40°C	-25°C	0°C	+25°C	+50°C	+75°C	+100°C	+115°C
01	1K3A351	NOM (Ω)	95620	33512	13017	3265	1000.0	360.0	148.00	67.90	-

Variant	Based on Type	R <sub>Z</sub> (Note 1)	Resistance/Temperature Characteristics (Note 2)								
			-55°C	-40°C	-25°C	0°C	+25°C	+50°C	+75°C	+100°C	+115°C
		Tol. (± %)	3.69	2.32	2.1	1.02	0.88	0.76	1.16	1.46	-
02	23A352	NOM (Ω)	191239	67023	26034	6530	2000.0	720.0	296.00	135.80	-
		Tol. (± %)	3.69	2.32	2.1	1.02	0.88	0.76	1.16	1.46	-
03	3K3A353	NOM (Ω)	287937	100701	39073	9795	3000	1080.0	444.0	203.60	-
		Tol. (± %)	3.7	2.33	2.1	1.02	0.88	0.76	1.16	1.46	-
04	4K3A354	NOM (Ω)	383916	134268	52098	13060	4000	1440.0	592.0	271.00	177.80
		Tol. (± %)	3.7	2.33	2.1	1.02	0.88	0.76	1.16	1.46	1.36
05	5K3A355	NOM (Ω)	479895	167835	65122	16325	5000	1800.0	740.0	339.00	222.00
		Tol. (± %)	3.7	2.33	2.1	1.02	0.88	0.76	1.16	1.46	1.36
06	10K3A739	NOM (Ω)	959790	335670	130244	32650	10000	3600.0	1480.0	678.0	444.0
		Tol. (± %)	3.7	2.33	2.1	1.02	0.88	0.76	0.76	1.46	1.36
07	100K6A441	NOM (Ω)	-	-	1508530	351017	100000	33598	12932	5574.3	3525.0
		Tol. (± %)	-	-	2.5	1.08	0.93	0.82	0.72	1.27	1.64

**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<sub>Z</sub> (Zero Power Resistance).
2. 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, 06, 07	P <sub>D</sub>	0.01 2	mW	Note 1
2	Operating Temperature Range	T <sub>op</sub>	Note 2	°C	
3	Storage Temperature Range	T <sub>stg</sub>	Note 3	°C	
4	Soldering Temperature	T <sub>sol</sub>	+245	°C	Note 4

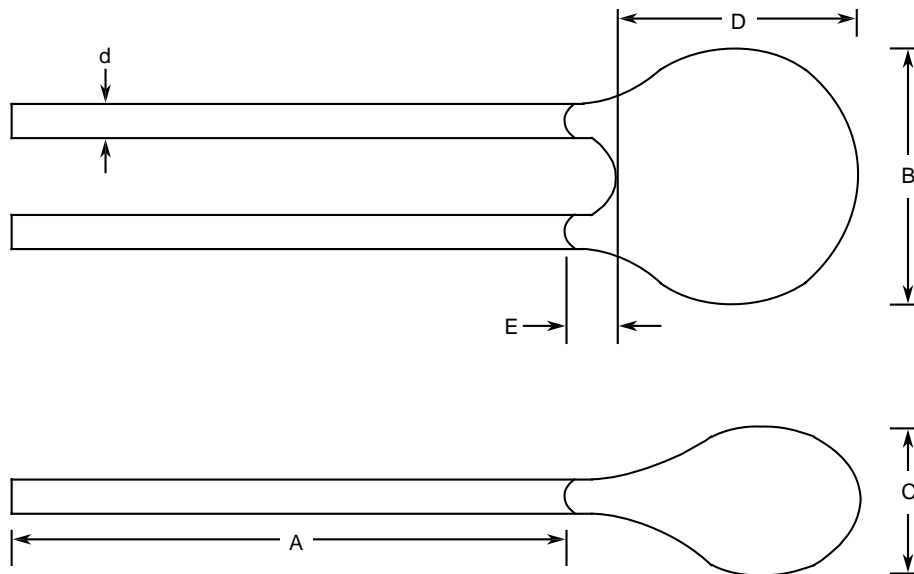
**NOTES:**

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. -55°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 DIMENSION**



Symbol	Variant 01		Variant 02		Variant 03		Variant 04		Variant 05		Variant 06		Variant 07	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
A	50.8	-	50.8	-	50.8	-	50.8	-	50.8	-	50.8	-	50.8	-
B	-	4.87	-	3.43	-	2.81	-	2.54	-	2.54	-	2.54	-	2
C	-	4.87	-	3.43	-	2.81	-	2.54	-	2.54	-	2.54	-	2
D	-	6.35	-	4.4	-	3.68	-	3.5	-	3.5	-	3.5	-	3.5
d	0.23	0.28	0.23	0.28	0.23	0.28	0.23	0.28	0.23	0.28	0.23	0.28	0.23	0.28
E	-	2	-	2	-	1.6	-	1.6	-	1.6	-	1.6	-	1.6

**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 ESCC 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 ESCC 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) Thermal Shock: 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.

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

None.

### 4.2.4 Deviations from Qualification Tests (Chart IV)

- (a) Thermal Shock: 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. 9.3.1.2, Dissipation Constant: Not applicable.
- (c) Para. 9.15, Short Time Overload: Not applicable.
- (d) Para. 9.17, High Temperature Storage: Not applicable.
- (e) Para. 9.20, Permanence of Marking: Not applicable.

### 4.2.5 Deviations from Lot Acceptance Tests (Chart V)

- (a) Thermal Shock: 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. 9.20, Permanence of Marking: Not applicable.

## 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 ESCC 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 ESCC 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 ESCC 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 ESCC 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 ESA Symbol, for qualified components only.
- (b) The ESCC Component Number.
- (c) Traceability Information

##### 4.5.2 ESCC Component Number

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

Example: 400601301B

- Detail Specification Number: 4006013
- Type Variant (See Table 1(a)): 01
- Testing Level (B or C, as applicable): B

##### 4.5.3 Traceability Information

Each component shall be marked in respect of traceability information in accordance with the requirements of ESCC 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, measurements shall be performed at  $T_{amb}=+25\pm 0.01^{\circ}\text{C}$ .

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. The temperature tolerance shall be  $\pm 0.01^{\circ}\text{C}$ .

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 as specified in Table 4 of this specification. Unless otherwise stated, measurements shall be performed at  $T_{amb}=+25\pm 0.01^{\circ}\text{C}$ . The parameter drift values ( $\Delta$ ) 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 ESCC Generic Specification No. 4006. The conditions for burn-in shall be as specified in Table 5 of this specification.

4.7.3 Electrical Circuit for Burn-in (Figure 5)

Not applicable.

**Table 2- ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - DC PARAMETERS**

No.	Characteristics	Symbol	ESCC 4006 Test Method and Conditions	Limits		Unit
				Min	Max	
1	Zero Power Resistance	$R_z$	Para. 9.3.1.1	Note 1		$\Omega$
2	Insulation Resistance	$R_i$	Para. 9.3.1.4 $T_{amb}=+25\pm 1^{\circ}\text{C}$ Note 2	100	-	$M\Omega$
3	Thermal Time Constant	KH	Para. 9.3.1.3 $T_{amb}=+25\pm 1^{\circ}\text{C}$ In Still Air Note 3	-	25	sec.

**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, Single Sampling Plan for Normal Inspection, AQL = 1.0 of IEC 60410.
3. Test to be performed on 10 samples during Chart II only.

**Table 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES**

No.	Characteristics	Symbol	ESCC 4006 Test Method and Conditions	Limits		Unit
				Min	Max	
1	Zero Power Resistance	$R_Z$	Para. 9.3.1.1 At each specified temperature, over operating range	Note 1		$\Omega$

**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	Methods and Test Conditions	Change Limits ( $\Delta$ )	Unit
1	Zero Power Resistance Change	$\Delta R_Z/R_Z$	As per Table 2	$\pm 0.2$	%

**Table 5 - CONDITIONS FOR BURN-IN AND OPERATING LIFE TESTS**

No.	Characteristics	Symbol	Condition	Unit
1	Ambient Temperature	$T_{amb}$	Note 1 Note 2	$^{\circ}C$
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)  $^{\circ}C$ .

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

Not applicable.

4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESCC 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  $T_{amb} = +25 \pm 0.01^{\circ}C$ .

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  $T_{amb}=+25\pm 0.01C$ .

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  $T_{amb}=+25\pm 0.01^{\circ}C$ .

4.8.4 Conditions for Operating Life Tests (Part of Endurance Testing)

The requirements for operating life testing are specified in Section 9 of ESCC 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 Circuit for Operating Life Tests (Figure 5)

Not applicable.

**Table 6 - MEASUREMENTS AND INSPECTIONS AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING**

No.	ESCC 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 (2)	-	-	-	-	-	-
02	Thermal Time Constant	Para. 9.3.1.3 In Still Air	<b>Initial Measurements</b> Zero Power Resistance	Para. 9.3.1.3(c)	R <sub>Z</sub>	Record Values		Ω
			<b>Final Measurements</b> Thermal Time Constant	Para. 9.3.1.3(f)	KH	-	25	sec
03	External Visual Inspection	Para. 9.5	ESCC 20500	-	-	-	-	-
04	Shock (Specified Pulse)	Para. 9.7	<b>Initial Measurements</b> Zero Power Resistance	Table 2 Item 1	R <sub>Z</sub>	Table 2 Item 1		
			<b>During Shock</b> Intermittent Contact	No Open or Short Circuiting	-	-	-	-
			<b>After Shock</b> Zero Power Resistance Change	Table 2 Item 1	ΔR <sub>Z</sub> /R <sub>Z</sub>	-2	+2	%
			Visual Examination	No evidence of damage	-	-	-	-
05	Vibration	Para. 9.8	<b>Initial Measurements</b> Zero Power Resistance	Table 2 Item 1	R <sub>Z</sub>	Table 2 Item 1		
			<b>During Vibration</b> Intermittent Contact	No Open or Short Circuiting	-	-	-	-
			<b>After Vibration</b> Zero Power Resistance Change	Table 2 Item 1	ΔR <sub>Z</sub> /R <sub>Z</sub>	-2	+2	%
			Visual Examination	No evidence of damage	-	-	-	-

No.	ESCC Generic Spec. No. 4006		Measurements and Inspections		Symbol	Limits		Unit	
	Environmental and Endurance Tests (1)	Test Method and Conditions	Identification	Conditions		Min	Max		
06	Immersion	Para. 9.9	Visual Examination	No evidence of damage	-	-	-	-	
07	Dielectric Withstanding Voltage	Para. 9.10	<b>During Test</b> Visual Examination	No evidence of breakdown or flashover	-	-	-	-	
			<b>After Test</b> Visual Examination	No evidence of damage, arcing or breakdown	-	-	-	-	
08	Resistance to Soldering Heat	Para. 9.11	<b>After Test</b>	After a recovery period of 24±4 hrs					
			Zero Power Resistance Visual Examination	Table 2 Item 1 No evidence of damage	R <sub>Z</sub> -	Table 2 Item 1 -	-	-	-
09	Moisture Resistance	Para. 9.12	<b>Initial Measurements</b>	Not less than 1.5 hrs after removal from drying oven					
			Zero Power Resistance	Table 2 Item 1	R <sub>Z</sub>	Table 2 Item 1			
			<b>Final Measurements</b>	Within 24 hrs of removal from 1.5 to 3.5 hr conditioning					
			Zero Power Resistance Change	Table 2 Item 1	ΔR <sub>Z</sub> /R <sub>Z</sub>	-2	+2	%	
			Insulation Resistance	Table 2 Item 2	R <sub>i</sub>	100	-	MΩ	
10	Terminal Strength	Para. 9.13	<b>Initial Measurements</b>						
			Zero Power Resistance	Table 2 Item 1	R <sub>Z</sub>	Table 2 Item 1			
			<b>Final Measurements</b> Zero Power Resistance Change	Table 2 Item 1	ΔR <sub>Z</sub> /R <sub>Z</sub>	-2	+2	%	
			Visual Examination	No evidence of damage	-	-	-	-	
11	Operating Life	Para. 9.14	<b>Initial Measurements</b>						
			Zero Power Resistance	Table 2 Item 1	R <sub>Z</sub>	Table 2 Item 1			
			<b>Intermediate Measurements</b>						
			Zero Power Resistance Change	Table 2 Item 1	ΔR <sub>Z</sub> /R <sub>Z</sub>	-1	+1	%	
			Insulation Resistance	Table 2 Item 2	R <sub>i</sub>	100	-	MΩ	
			<b>Final Measurements</b> Zero Power Resistance Change	Table 2 Item 1	ΔR <sub>Z</sub> /R <sub>Z</sub>	-1	+1	%	
			Insulation Resistance	Table 2 Item 2	R <sub>i</sub>	100	-	MΩ	
12	Low Temperature Storage	Para. 9.16	<b>Initial Measurements</b>						

No.	ESCC Generic Spec. No. 4006		Measurements and Inspections		Symbol	Limits		Unit
	Environmental and Endurance Tests (1)	Test Method and Conditions	Identification	Conditions		Min	Max	
			Zero Power Resistance <b>Final Measurements</b>	Table 2 Item 1	$R_Z$	Table 2 Item 1		
			Zero Power Resistance Change	Table 2 Item 1	$\Delta R_Z/R_Z$	-2	+2	%
			Visual Examination	No evidence of damage	-	-	-	-
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.
2. Thermal Shock Test Method and Conditions shall use the deviation of this specification as applicable.