RESISTOR NETWORKS, THICK FILM,

IN S.I.L. PACKAGES

ESCC Detail Specification No. 4005/003

ISSUE 1

October 2002

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

LEGAL DISCLAIMER AND COPYRIGHT

european space agency
agence spatiale européenne

Pages 1 to 20

RESISTOR NETWORKS, THICK FILM,

IN S.I.L. PACKAGES

ESA/SCC Detail Specification No. 4005/003

space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 2	January 1999		

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:-		
		Table 1(b)	: No. 1, second variant "05" corrected to "06"	221500
		Figure 2(a)	: In the Table, Dimension "S" amended	221500
		Figure 2(b)	: In the Table, Dimension "S" amended	221500
		Figure 2(c)	: In the Table, Dimension "S" amended	221500
		Figure 2(d)	: In the Table, Dimension "S" amended	221500

TABLE OF CONTENTS

1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Resistor Networks, Thick Film, in S.I.L. Packages. It shall be read in conjunction with ESA/SCC Generic Specification No. 4005, the requirements of which are supplemented herein.

1.2 TYPE VARIANTS AND RANGE OF COMPONENTS

The type variants and range of resistor networks 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 resistor networks specified herein, are as scheduled in Table 1(b).

1.4 PARAMETER DERATING INFORMATION

The parameter derating information applicable to the resistor networks specified herein is shown in Figure 1.

1.5 PHYSICAL DIMENSIONS

The physical dimensions of the resistor networks specified herein are shown in Figure 2.

1.6 FUNCTIONAL DIAGRAM

The functional diagram for the resistor networks 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. 4005, Resistor Networks, Thick 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 abbreviations are used:-

V_T = Test Voltage.
V_I = Insulation Voltage.

TABLE 1(a) - TYPE VARIANTS AND RANGE OF COMPONENTS

VARIANT	FUNCTIONAL DIAGRAM FIGURE	WEIGHT (g)	CASE FIGURE	RESISTANCE RANGE			TOLERANCE	TEMPERATURE CHARACTERISTIC OF RESISTANCE (10^{-6}/°C)
				MIN (Ω)	MAX (Ω)	VALUE SERIES		
01	3(a)	0.4	2(a)	46.4	1.0M	E48	R≤100Ω ±2.0Ω R>100Ω ±2.0%	±150
02	3(b)	0.4						
03	3(c)	0.5	2(b)					
04	3(d)	0.5						
05	3(e)	0.7	2(c)					
06	3(f)	0.7						
07	3(g)	0.6	2(d)					

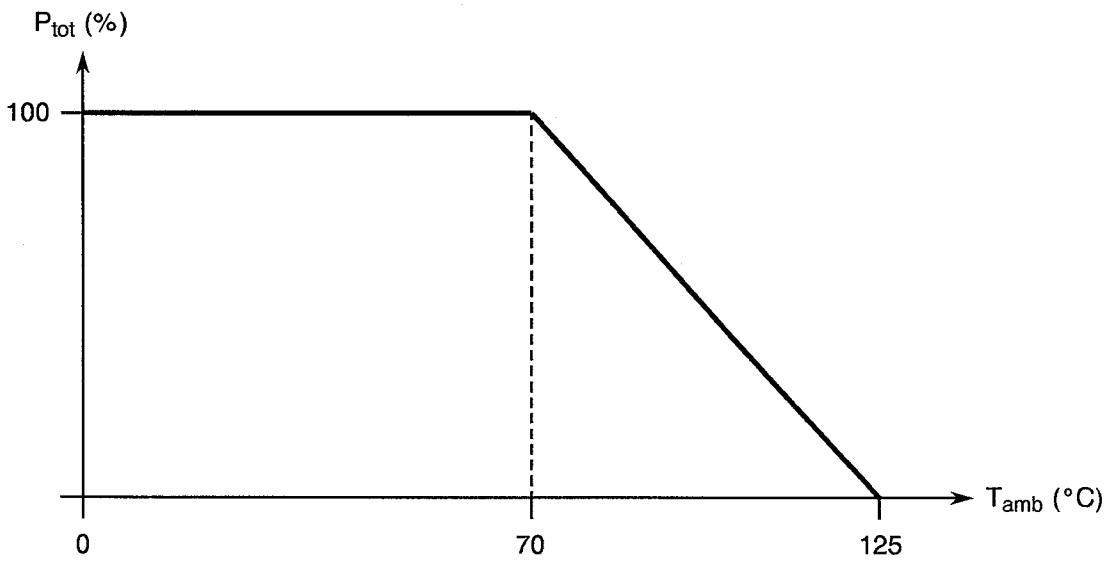
TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Rated Dissipation of Resistor Elements Variants 01, 03, 05 Variants 02, 04, 06, 07	P_n	 0.18 0.10	W	-
2	Rated Dissipation of Package Variants 01, 02 Variants 03, 04 Variants 05, 06 Variant 07	P_{tot}	 0.5 0.7 0.9 0.8	W	Note 1
3	Limiting Element Voltage	U_L	100	V	-
4	Rated Voltage	U_R	$\sqrt{Pn.Rn}$	V	Note 2
5	Insulation Voltage	V_I	100	V	Note 3
6	Voltage Proof	VP	200	V	-
7	Operating Temperature Range	T_{op}	−55 to +125	°C	T_{amb}
8	Storage Temperature Range	T_{stg}	−55 to +150	°C	-
9	Soldering Temperature	T_{sol}	+260	°C	Note 4

NOTES

1. At T_{amb} = +70°C. For derating at T_{amb} > +70°C, see Figure 1.
2. The Rated Voltage shall never exceed the Limiting Element Voltage.
3. The Insulation Voltage shall be measured between adjacent but electrically isolated resistors.
4. Duration 10 seconds maximum at a distance of not less than 1.5mm from the case.

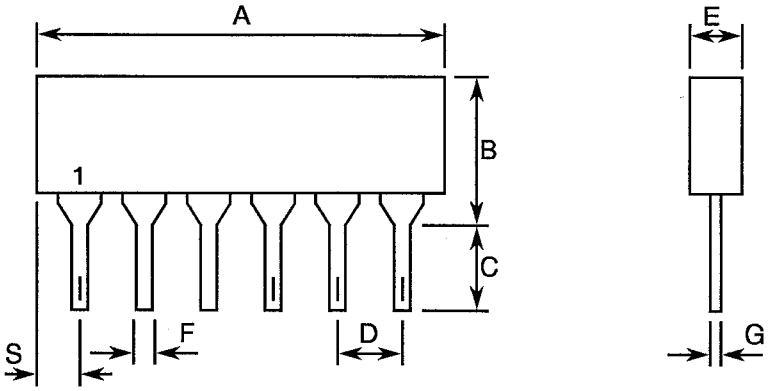
FIGURE 1 - PARAMETER DERATING INFORMATION



Power Derating versus Temperature

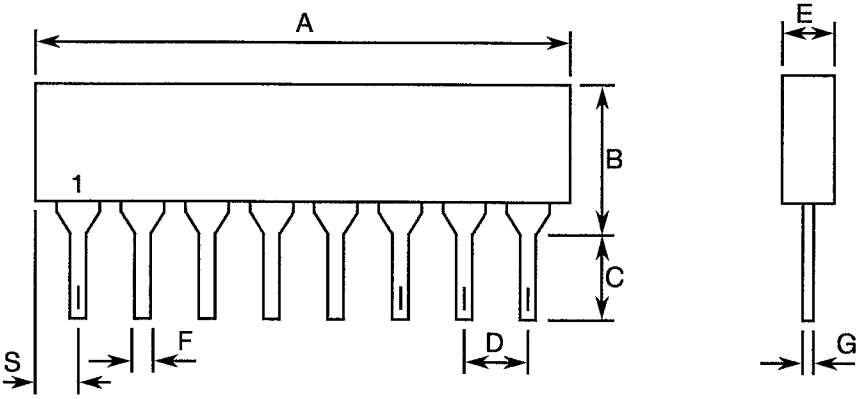
FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(a) - VARIANTS 01, 02



SYMBOL	MILLIMETRES	
	MIN.	MAX.
A	-	15.20
B	-	5.08
C	3.00	4.00
D	2.46	2.62
E	-	2.50
F	-	0.50
G	-	0.30
S	1.00	1.50

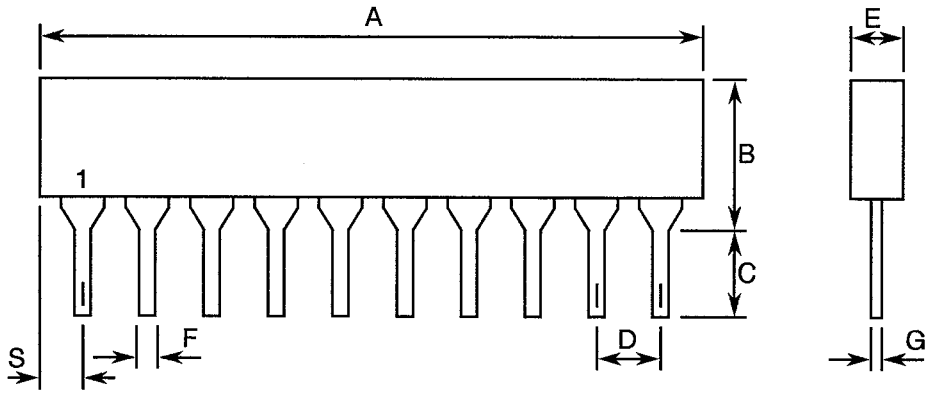
FIGURE 2(b) - VARIANTS 03, 04



SYMBOL	MILLIMETRES	
	MIN.	MAX.
A	-	20.30
B	-	5.08
C	3.00	4.00
D	2.46	2.62
E	-	2.50
F	-	0.50
G	-	0.30
S	1.00	1.50

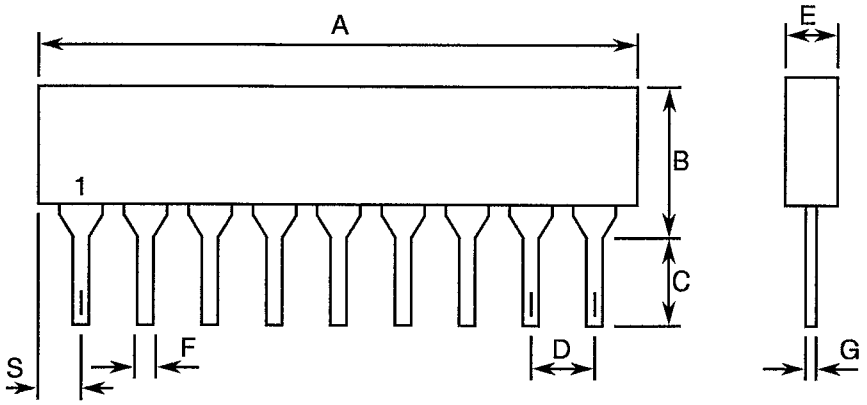
FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

FIGURE 2(c) - VARIANTS 05, 06



SYMBOL	MILLIMETRES	
	MIN.	MAX.
A	-	25.40
B	-	5.08
C	3.00	4.00
D	2.46	2.62
E	-	2.50
F	-	0.50
G	-	0.30
S	1.00	1.50

FIGURE 2(d) - VARIANT 07



SYMBOL	MILLIMETRES	
	MIN.	MAX.
A	-	22.80
B	-	5.08
C	3.00	4.00
D	2.46	2.62
E	-	2.50
F	-	0.50
G	-	0.30
S	1.00	1.50

FIGURE 3 - FUNCTIONAL DIAGRAM

FIGURE 3(a) - VARIANT 01 : 6 PINS

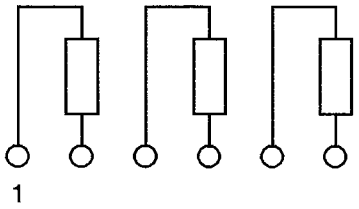


FIGURE 3(b) - VARIANT 02 : 6 PINS

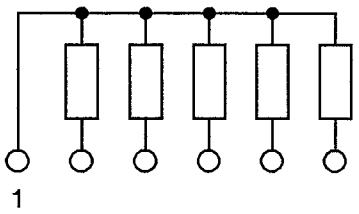


FIGURE 3(c) - VARIANT 03 : 8 PINS

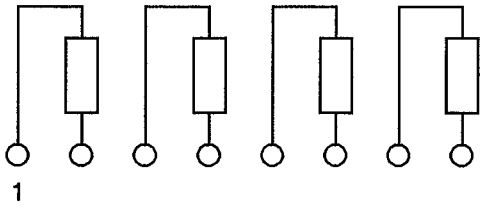


FIGURE 3(d) - VARIANT 04 : 8 PINS

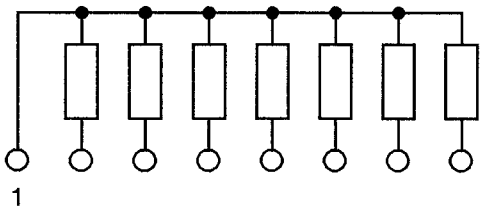


FIGURE 3 - FUNCTIONAL DIAGRAM (CONTINUED)

FIGURE 3(e) - VARIANT 05 : 10 PINS

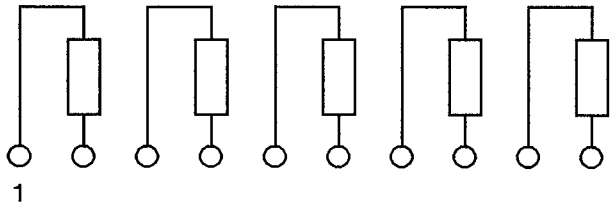


FIGURE 3(f) - VARIANT 06 : 10 PINS

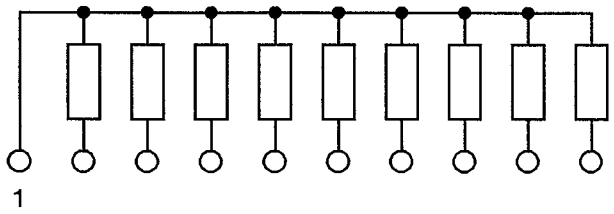
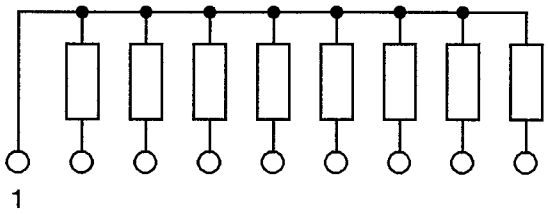


FIGURE 3(g) - VARIANT 07 : 9 PINS



4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the resistor networks specified herein are stated in this specification and ESA/SCC Generic Specification No. 4005 for Resistor Networks, Thick Film. 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. 9.3, Overload: The resistor networks shall be operated at 2.5 times the nominal power, without exceeding twice the maximum voltage specified in Table 1(b) of the Detail Specification, for a period of 5 ± 1 seconds.

(b) Para. 9.4, Seal Test: Not applicable.

4.2.3 Deviations from Burn-in Tests (Chart III)

(a) Para. 9.4, Seal Test: Not applicable.

(b) Para. 9.8, Radiographic Inspection: Not applicable.

4.2.4 Deviations from Qualification Tests (Chart IV)

(a) Para. 9.4, Seal Test: Not applicable.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

(a) Para. 9.4, Seal Test: Not applicable.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the resistor networks specified herein shall be checked. They shall conform to those shown in Figure 2.

4.3.2 Weight

The maximum weight of the resistor networks specified herein shall be as specified in Table 1(a).

4.3.3 Drying Procedure

When required, the resistor networks shall be dried using Procedure I described in Para. 9.7.1 of ESA/SCC Generic Specification No. 4005.

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 resistor networks 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 resistor networks shall be protected with an epoxy coating.

4.4.2 Lead Material and Finish

The lead material shall be Type 'B' 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) Lead Identification.

(b) The SCC Component Number.

(c) Electrical Characteristics and Ratings.

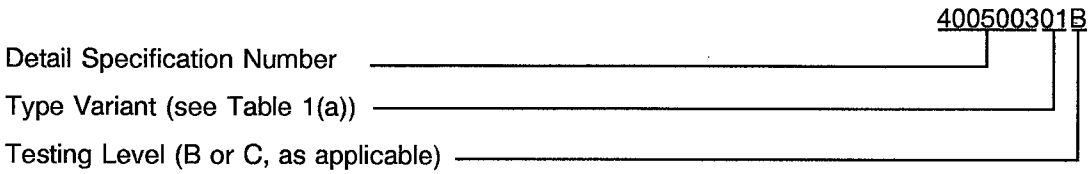
(d) Traceability Information.

4.5.2 Lead Identification

Identification of Pin No. 1 shall be as shown in the appropriate outline drawing (see Figures 2 and 3).

4.5.3 The SCC Component Number

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



4.5.4 Electrical Characteristics and Ratings

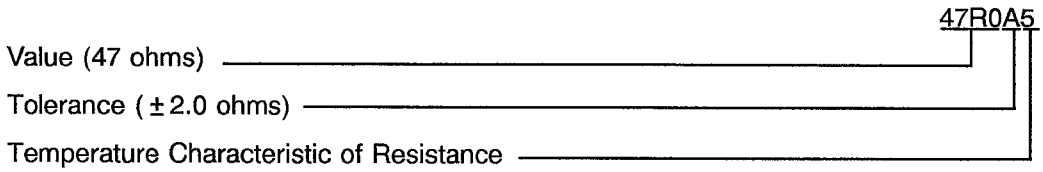
The electrical characteristics and ratings to be marked in the following order of precedence are:-

(a) Resistance Value.

(b) Tolerance.

(c) Temperature Characteristic of Resistance.

The information shall be constituted and marked as follows:-



4.5.4.1 Resistance Values

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

RESISTANCE VALUE	CODE
XX.X	XXRX
XXX	XXX0
XXX 10^1	XXX1
XXX 10^2	XXX2
XXX 10^3	XXX3

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

When values of less than 100 are required, the letter 'R' is used to indicate the decimal point.

When the letter is used, all succeeding digits represent significant figures.

4.5.4.2 Tolerance

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

TOLERANCE	CODE LETTER
±2.0%	G
±2.0Ω	A

4.5.4.3 Temperature Characteristic of Resistance

The temperature characteristic of resistance shall be indicated by the code number specified hereafter.

DIGIT	TEMPERATURE CHARACTERISTIC OF RESISTANCE (10^{-6}/°C)
5	150

4.5.5 Traceability Information

Each component shall be marked in respect of traceability information in accordance with the requirements of ESA/SCC Basic Specification No. 21700.

(a) Manufacturing Date Code.

(b) Serial Number.

(c) Manufacturer's Name.

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 at high and low temperatures are scheduled in Table 3. The measurements shall be performed between $T_{amb} = +125(+5-0)$ and $-55(+0-5)$ °C respectively. The distribution of the sample shall be as follows:

- 1/3 with lowest resistance values.
- 1/3 with median resistance values.
- 1/3 with highest resistance values.

Three resistors shall be tested in each network. These shall be the two positioned at the extreme ends and the one positioned nearest to the physical centre, of the network.

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 $T_{amb} = +22 \pm 3$ °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. 4005. The conditions for burn-in shall be as specified in Table 5 of this specification.

4.7.3 Electrical Circuits for Burn-in

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

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

No.	CHARACTERISTICS	SYMBOL	ESA/SCC 4005 TEST METHOD AND CONDITION	LIMITS		UNIT
				MIN.	MAX.	
1	d.c. Resistance (Each Element)	R	Para. 9.5.1.1	Table 1(a)		Ω
2	Voltage Proof	VP	Para. 9.5.1.2	200	-	V
3	Insulation Resistance	Ri	Para. 9.5.1.3	10	-	GΩ

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	ESA/SCC 4005 TEST METHOD AND CONDITION	LIMITS		UNIT
				MIN.	MAX.	
1	Resistance Change between $-55(+3-0)$ °C and $+22 \pm 3$ °C	$\frac{\Delta R}{R}$	Para. 9.5.1.1	-	± 1.15	%
2	Resistance Change between $+22 \pm 3$ °C and $+125(+0-3)$ °C	$\frac{\Delta R}{R}$	Para. 9.5.1.1	-	± 1.6	%

NOTES

1. Measurements performed on a sample basis, LTPD7 or less.

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	d.c. Resistance (Each Element)	$\frac{\Delta R}{R}$	As per Table 2	As per Table 2	± 0.5 (1)	%

NOTES

1. For $R \leq 100\Omega$, ΔR max. = 1.0Ω.

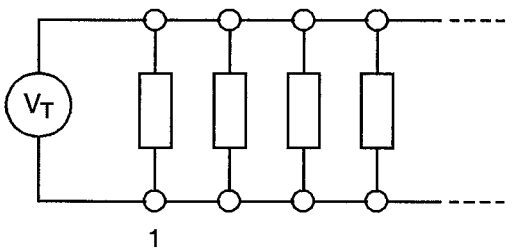
TABLE 5 - CONDITIONS FOR BURN-IN AND OPERATING LIFE TESTS

No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+ 70 ± 3	°C
2	Test Voltage	V_T	$\sqrt{Pn.Rn}$ or (1) 100	V

NOTES

1. Whichever is smaller.

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



4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESA/SCC GENERIC SPECIFICATION NO. 4005)

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 and on Completion of Endurance Tests

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

4.8.3 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. 4005. The conditions for operating life testing shall be as specified in Table 5 for the burn-in test.

4.8.4 Electrical Circuits for Operating Life Tests

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

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

The requirements for the high temperature storage test are specified in Section 9 of ESA/SCC Generic Specification No. 4005. The temperature to be applied shall be the maximum storage temperature specified in Table 1(b) of this specification.

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

No.	ESA/SCC GENERIC SPECIFICATION NO. 4005		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		MIN.	MAX.	
01	Rapid Change of Temperature	Para. 9.2	**Initial Measurements**					
			Resistance	Table 2 Item 1	R	Table 2 Item 1		
			Final Measurements	After recovery period of 1 to 2 hrs				
			Resistance Change ($R \leq 100\Omega$)	Table 2 Item 1	ΔR	−1.0	+1.0	Ω
			Resistance Change ($R > 100\Omega$)	Table 2 Item 1	$\frac{\Delta R}{R}$	−0.5	+0.5	%
02	Temperature Characteristic of Resistance	Para. 9.7	Resistance Change	Table 3 Item 1	TCR	−150	+150	10^{-6}/°C
				Table 3 Item 2	TCR	−150	+150	
03	Shock	Para. 9.9	**Initial Measurements**					
			Resistance	Table 2 Item 1	R	Table 2 Item 1		
			Final Measurements					
			Resistance Change ($R \leq 100\Omega$)	Table 2 Item 1	ΔR	−1.0	+1.0	Ω
			Resistance Change ($R > 100\Omega$)	Table 2 Item 1	$\frac{\Delta R}{R}$	−0.5	+0.5	%
			Visual Examination	-	-	-	-	-
04	Vibration	Para. 9.10	**Initial Measurements**					
			Resistance	Table 2 Item 1	R	Table 2 Item 1		
			Final Measurements					
			Resistance Change ($R \leq 100\Omega$)	Table 2 Item 1	ΔR	−1.0	+1.0	Ω
			Resistance Change ($R > 100\Omega$)	Table 2 Item 1	$\frac{\Delta R}{R}$	−0.5	+0.5	%
05	Resistance to Soldering Heat	Para. 9.11	**Initial Measurements**					
			Resistance	Table 2 Item 1	R	Table 2 Item 1		
			Final Measurements	After 10 ± 1 sec.				
			Resistance Change ($R \leq 100\Omega$)	Table 2 Item 1	ΔR	−1.0	+1.0	Ω
			Resistance Change ($R > 100\Omega$)	Table 2 Item 1	$\frac{\Delta R}{R}$	−0.5	+0.5	%
			Visual Examination	-	-	-	-	-
06	Climatic Sequence	Para. 9.12	**Initial Measurements**	After Drying				
			Resistance	Table 2 Item 1	R	Table 2 Item 1		
			Final Measurements					
			Visual Examination	-	-	-	-	-
			Resistance Change ($R \leq 100\Omega$)	Table 2 Item 1	ΔR	−1.0	+1.0	Ω
			Resistance Change ($R > 100\Omega$)	Table 2 Item 1	$\frac{\Delta R}{R}$	−0.5	+0.5	%
			Insulation Resistance	Table 2 Item 3	Ri	100	-	MΩ
07	Robustness of Terminations	Para. 9.13	**Initial Measurements**					
			Resistance	Table 2 Item 1	R	Table 2 Item 1		
			Final Measurements					
			Visual Examination	-	-	-	-	-
			Resistance Change ($R \leq 100\Omega$)	Table 2 Item 1	ΔR	−1.0	+1.0	Ω
			Resistance Change ($R > 100\Omega$)	Table 2 Item 1	$\frac{\Delta R}{R}$	−0.5	+0.5	%

NOTES: See Page 20.

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 SPECIFICATION NO. 4005		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		MIN.	MAX.	
08	Operating Life	Para. 9.14 1.5 hours ON and 0.5 hours OFF	**Initial Measurements**	For measurements inside the chamber: Within 8 hours				
			Resistance	Table 2 Item 1	R	Table 2 Item 1		
			Insulation Resistance	Table 2 Item 3	Ri	100	-	MΩ
		Change Limits relate to initial (0-hour) measurements	**Intermediate and Final Measurements**	At 500 and 1000 hours. For Room Temp. Measurements: After 45 mins				
			Resistance Change ($R \leq 100\Omega$)	Table 2 Item 1	ΔR	−1.0	+1.0	Ω
			Resistance Change ($R > 100\Omega$)	Table 2 Item 1	$\frac{\Delta R}{R}$	−1.0	+1.0	%
			Insulation Resistance	Table 2 Item 3	Ri	100	-	MΩ
		Change Limits relate to initial (0-hour) measurements	**Final Measurements**	At 2000 hours. For Room Temp. Measurements: After 45 mins				
			Resistance Change ($R \leq 100\Omega$)	Table 2 Item 1	ΔR	−1.0	+1.0	Ω
			Resistance Change ($R > 100\Omega$)	Table 2 Item 1	$\frac{\Delta R}{R}$	−1.5	+1.5	%
			Insulation Resistance	Table 2 Item 3	Ri	100	-	MΩ
09	High Temperature Storage	Para. 9.15	**Initial Measurements**					
			Resistance	Table 2 Item 1	R	Table 2 Item 1		
			Insulation Resistance	Table 2 Item 3	Ri	100	-	MΩ
		Change Limits relate to initial (0-hour) measurements	**Intermediate Measurements**	At 500 and 1000 hours				
			Resistance Change ($R \leq 100\Omega$)	Table 2 Item 1	ΔR	−1.0	+1.0	Ω
			Resistance Change ($R > 100\Omega$)	Table 2 Item 1	$\frac{\Delta R}{R}$	−1.0	+1.0	%
			Insulation Resistance	Table 2 Item 3	Ri	100	-	MΩ
		Change Limits relate to initial (0-hour) measurements	**Final Measurements**	At 2000 hours				
			Resistance Change ($R \leq 100\Omega$)	Table 2 Item 1	ΔR	−1.0	+1.0	Ω
			Resistance Change ($R > 100\Omega$)	Table 2 Item 1	$\frac{\Delta R}{R}$	−1.5	+1.5	%
			Insulation Resistance	Table 2 Item 3	Ri	100	-	MΩ
10	Solderability	Para. 9.16	Visual Examination	-	-	-	-	-
11	Permanence of Marking	Para. 9.18	-	Gen. 4005, Para. 9.18	-	-	-	-
12	External Visual Inspection	Para. 9.20	External Visual Inspection	Gen. 4005, Para. 9.20	-	-	-	-

NOTES

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