CAPACITORS, FIXED, CHIPS, MULTIPLE LAYER, CERAMIC DIELECTRIC, HIGH FREQUENCY, TYPE I, BASED ON TYPES CDR 13, CDR 14 AND CDR 21

ESCC Detail Specification No. 3009/017

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ESA/SCC Detail Specification No. 3009/017

space components
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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 2 and incorporates all modifications defined in the following DCR's:-		
		Cover Page		None
		DCN		None
		Table 1(a)	: Variant 05 added	221184
			: Note 1 amended	221184
		Table 1(b)	: No. 2, TC deleted and subsequent tests renumbered	221069
			: Notes amended	221184
		Figure 2(a)	: Variant 05 added to column heading	221184
		Para. 3	: Text added	23680
		Para. 4.3.2	: Variant 05 added	221184
		Para. 4.4.1	: Paragraph deleted	221184
		Para. 4.4.2	: Renumbered as "4.4.1"	221184
			: Variant 05 details added	221184
		Para. 4.4.3	: Renumbered as "4.4.2"	221184
			: Title and text amended	221184
		Para. 4.5.2	: Type Variant amended	221184
		Table 2	: No. 4, Symbol corrected	23680
		Table 3	: Nos. 1, 2, 3, renumbered to "3", "5(i)", "5(ii)" respectively and Notes transfered from Characteristics column to Remarks column	221069
			: In new 5(i) and 5(ii), Para. reference changed to "9.11"	221124
		Table 5	: No. 2, Test Voltage increased to "2.0U_R"	221069
		Table 6	: Rewritten	221069/ 221124/ 23680
'A'	Apr. '96	P1. Cover Page	: Page count amended	23795
		P2. DCN		None
		P19. Table 6	: Contents amended	23795
		P20. Table 6	: Page added	23795

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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 Capacitors, Fixed, Chips, Multiple Layer, Ceramic Dielectric, based on Types CDR 13, CDR 14 and CDR 21. It shall be read in conjunction with ESA/SCC Generic Specification No. 3009, the requirements of which are supplemented herein.

1.2 RANGE OF COMPONENTS

The range of capacitors covered by this specification is 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 capacitors specified herein are scheduled in Table 1(b).

1.4 PARAMETER DERATING INFORMATION (FIGURE 1)

Not applicable.

1.5 PHYSICAL DIMENSIONS

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

1.6 FUNCTIONAL DIAGRAM

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

2. APPLICABLE DOCUMENTS

The following documents for part of this specification and shall be read in conjunction with it:-

(a) ESA/SCC Generic Specification No. 3009 for Capacitors, Fixed, Chips, Ceramic Dielectric, Types I and II.

(b) I.E.C. Publication No. 68.2.21, Basic Environmental Test Procedure for Robustness of Terminations and Integral Mounting Devices.

TABLE 1(a) - RANGE OF COMPONENTS

Capacitance (pF)	Capacitance Tolerance (±)	Temperature Coefficient ppm/°C	Rated Voltage (U_R) (V)
0.1	0.1 pF	0 ± 30 90 ± 20	500
0.2	0.1 pF		
0.3	0.1, 0.25 pF		
0.4	0.1, 0.25, 0.5 pF		
0.5			
0.6			
0.7			
0.8			
0.9			
1.1			
1.2			
1.3			
1.4			
1.5			
1.6			
1.7			
1.8			
1.9			
2.0			
2.1			
2.2			
2.4			
2.7			
3.0			
3.3			
3.6			
3.9			
4.3			
4.7			
5.1			
5.6			
6.2			
6.8	0.1, 0.25pF, 5-10-20%		
7.5			
8.2			
9.1			
10	1-2-5-10-20%		
11			
12			
13			
15			
16			
18			
20			
22			
24			
27			
30			
33			
36			
39			

NOTES: See Page 7.

TABLE 1(a) - RANGE OF COMPONENTS (CONTINUED)

Capacitance (pF)	Capacitance Tolerance (±)	Temperature Coefficient ppm/°C	Rated Voltage (U_R) (V)
43	1-2-5-10-20%		
47			
51	1-2-5-10-20%	0 ± 30 90 ± 20	500
56			
62			
68			
75			
82			
91			
100			
110			300
120			
130			
150			
160			
180			
200			
220			200
240			
270			
300			
330			
360			
390			
430			
470			
510			100
560			
620			
680			50
750			
820			
910			
1000		0 ± 30	
1100			
1200			
1300			
1500			
1600			
1800			
2000			
2200			
2400			
2700			
3000			
3300			
3600			
3900			
4300			
4700			
5000			
5100			

NOTES 1. As specified in Para. 4.4.1 and Figure 2, these ranges are available in 5 Variants.

TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	LIMITS		UNIT	REMARKS
			MIN.	MAX.		
1	Rated Voltage	U_R	See Table 1(a)		V	
2	Operating Temperature Range	T_{amb}	−55	+125	°C	Without derating
3	Storage Temperature Range	T_{stg}	−55	+125	°C	
4	Maximum Soldering Temperature Variants 01, 02 and 05 Variants 03 and 04	T_{sol}	-	 +235 +260	°C	 Note 1 Note 2

NOTES

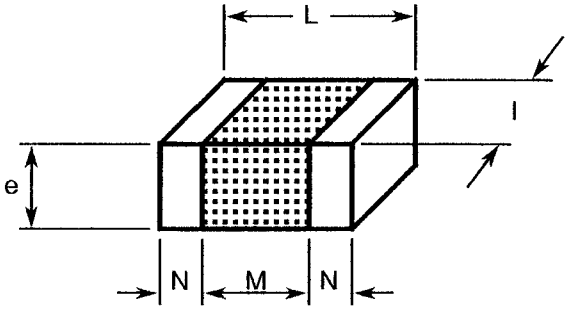
1. Pre-heating at +150°C for 45 seconds, $t_{sol} \leq 5.0$ seconds.
2. $t_{sol} \leq 5.0$ seconds, Distance from chip body ≥ 3.0mm.

FIGURE 1 - PARAMETER DERATING INFORMATION

Not applicable.

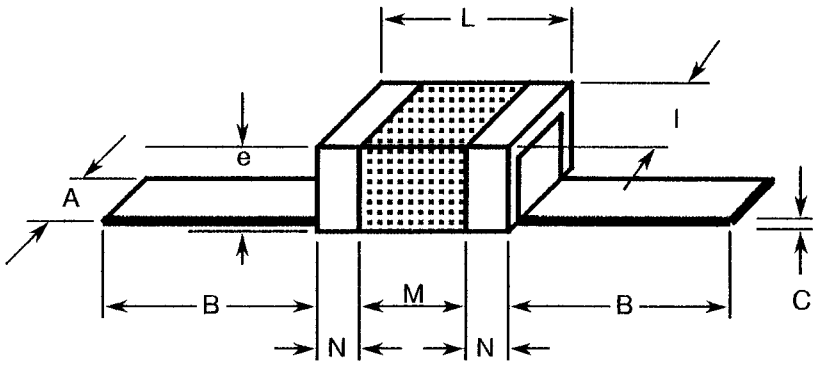
FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(a) - VARIANTS 01, 02 AND 05



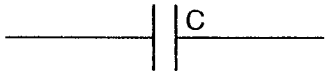
Dimensions (mm)				
	Variants 01 and 05		Variant 02	
	Min.	Max.	Min.	Max.
L	2.29	3.30	2.16	3.43
I	2.29	3.30	2.29	3.30
e	1.47	2.59	1.47	2.59
M	0.38	-	0.38	-
N	0.13	0.63	0.13	0.63

FIGURE 2(b) - VARIANTS 03 AND 04



Dimensions (mm)				
	Variant 03		Variant 04	
	Min.	Max.	Min.	Max.
A	2.20	2.60	1.00	1.60
B	6.25	6.35	6.25	6.35
C	0.075	0.125	0.07	0.23
e	1.47	2.59	1.47	2.59
L	2.16	3.43	2.16	3.43
I	2.29	3.30	2.29	3.30
M	0.38	-	0.38	-
N	0.13	0.63	0.13	0.63

FIGURE 3 - FUNCTIONAL DIAGRAM



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.

4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the capacitors specified herein are stated in this specification and ESA/SCC Generic Specification No. 3009 for Capacitors, Fixed, Chips, Ceramic Dielectric, Types I and II. 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 are 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 Tests (Chart III)

None.

4.2.4 Deviations from Qualification Tests (Chart IV)

For Variants 03 and 04 only, the following deviations shall apply:-

Subgroup I

"Mounting" shall not be performed.

Para. 9.5: the following test shall replace "Adhesion":-

Robustness of Terminations:

The capacitors shall be subjected to Test 'Ua 1' of IEC Publication No. 68.2.21.

Final Examination:

After each of the tests, the capacitors shall be visually examined. There shall be no evidence of damage.

Subgroup VI

Para. 9.6, "Solderability", shall be amended as follows:-

9.6.1 Procedure

The capacitors shall be subjected to Test 'Ta' of I.E.C. Publication No. 68.2.20 using either Method 1 (Solder Bath) or Method 3 (Solder Globule).

9.6.2 Final Examination

When the test procedures have been carried out, the capacitors shall be visually examined. There shall be not evidence of damage.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

For Variants 03 and 04 only, the following deviations shall apply:-

Level 1

"Mounting" shall not be performed for the "Adhesion" Subgroup.

Para. 9.5: The following test shall replace "Adhesion":-

Robustness of Terminations:

The capacitors shall be subjected to Test 'Ua 1' of I.E.C. Publication No. 68.2.21.

Final Examination:

After each of the tests, the capacitors shall be visually examined. There shall be no evidence of damage.

Level 3

"Mounting" shall not be performed for the "Solderability" Subgroup.

Para. 9.6, "Solderability" shall be amended as follows:-

9.6.1 Procedure

The capacitors shall be subjected to Test 'Ta' of IEC Publication No. 68.2.20 using either Method 1 (Solder Bath) or Method 3 (Solder Globule).

9.6.2 Final Examination

When the test procedures have been carried out, the capacitors shall be visually examined. There shall be no evidence of damage.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the capacitors specified herein shall be verified in accordance with the requirements set out in Para. 9.3 of ESA/SCC Generic Specification No. 3009 and they shall conform to those shown in Figure 2 of this specification.

4.3.2 Weight

The maximum weight of the capacitors specified herein shall be 0.1 grammes for Variants 01, 02 and 05, 0.14 grammes for Variant 03 and 0.12 grammes for Variant 04.

4.3.3 Adhesion

The requirements for adhesion are specified in Para. 9.5 of ESA/SCC Generic Specification No. 3009.

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 capacitors 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 Terminations

Variant 01:

The capacitors shall be terminated with metallised pads suitable for reflow soldering.

Variant 02:

The capacitors shall be terminated with solder coating, 188°C, 62 Sn, 36 Pb, 2 Ag %.

Variants 03 and 04:

The capacitors shall be terminated with silver ribbon leads. Recommended solder: 62 Sn, 36 Pb, 2 Ag %.

Variant 05:

The capacitors shall be terminated with gold with nickel underplating,
Ni thickness: min. 1.27µm, max. 6.35µm.
Au thickness: min. 1.27µm, max. 2.54µm.

4.4.2 Dielectric

Monolithic, ceramic or porcelain.

4.5 MARKING

4.5.1 General

The marking of all component delivered to this specification shall be in accordance with the requirments of ESA/SCC Basic Specification No. 21700 and the following paragraphs.

These components being too small to accommodate the marking as specified hereafter, the marking information in full shall accompany each component in its primary package. Such marking shall comprise:

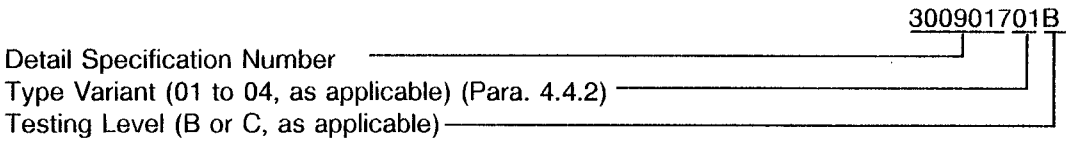
(a) The SCC Component Number.

(b) Electrical Characteristics and Ratings.

(c) Traceability Information.

4.5.2 The SCC Component Number

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



4.5.3 Electrical Characteristics and Ratings

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

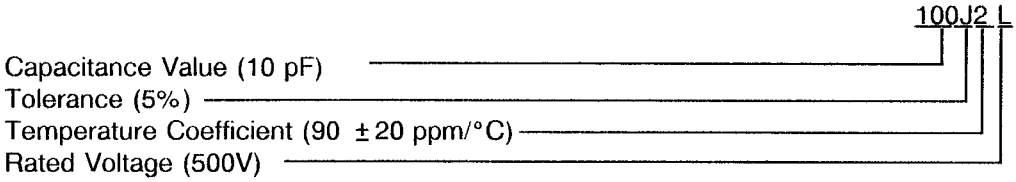
(a) Capacitance Value.

(b) Tolerance.

(c) Temperature Coefficient.

(d) Rated Voltage.

The information shall be constituted and marked as follows:-



4.5.3.1 Capacitance Values

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

Capacitance Value	Code
X.X	XCX
XX	XX0
XX10[1]	XX1
XX10[2]	XX2

4.5.3.2 Tolerances

The tolerances on capacitance values shall be indicated by the code letters specified hereafter.

Tolerance (pF)	Code Letter
± 0.1	B
± 0.25	C
± 0.5	D

Tolerance (%)	Code Letter
± 1.0	F
± 2.0	G
± 5.0	J
±10	K
±20	L

4.5.3.3 Temperature Coefficient

The temperature coefficient shall be indicated by the code numbers specified hereafter.

ppm/°C	Code Number
0 ± 30	1
90 ± 20	2

4.5.3.4 Rated Voltage

The rated voltage shall be indicated by the code letters specified hereafter.

Rated Voltage (U_R) (V)	Code Letter
50	C
100	E
200	G
300	J
500	L

4.5.4 Traceability Information

Traceability information shall be marked in accordance with the requirements of ESA/SCC Basic Specification No. 21700.

(a) Manufacturing Date Code.

(b) 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, measurements shall be performed at T_{amb} = +22 ± 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

A circuit for use in performing the electrical measurements listed in Table 2 of this specification is shown in ESA/SCC Generic Specification No. 3009.

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 ± 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. 3009. The conditions for burn-in shall be as specified in Table 5 of this specification.

On completion of burn-in, a recovery period of 24 ± 2 hours is necessary before performance of the end-measurements.

4.7.3 Electrical Circuits for Burn-in (Figure 5)

Not applicable.

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

No.	CHARACTERISTICS	SYMBOL	ESA/SCC 3009 TEST CONDITIONS	LIMITS		UNIT
				MIN.	MAX.	
1	Capacitance	C	Para. 9.4.1.1	Tolerance shown in Table 1(a)		pF
2	Tangent of Loss Angle	$T_{g\delta}$	Para. 9.4.1.2	-	15 (1)	10^{-4}
3	Insulation Resistance	R_i	Para. 9.4.1.3	1 000 (2)	-	GΩ
4	Voltage Proof	VP	Para. 9.4.1.4	$2.5U_R$	-	V

NOTES

1. For TC 90 ± 20 10^{-6}/°C.
   For TC 0 ± 30 10^{-6}/°C: 5.10^{-4}.
2. For 0.1pF to 470pF.
   For 510 to 5100pF: 100GΩ.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	TEST CONDITIONS ESA/SCC 3009	LIMITS		UNIT	REMARKS
				MIN.	MAX.		
3	Insulation Resistance at +125 ± 3 °C	R_i	Para. 9.4.1.3	100	-	GΩ	Notes 1 and 2
5(i)	Temperature Coefficient	TC	Para. 9.11 Between −55 and +20 ± 2 °C Between +20 ± 2 and +125 °C	(5) −30 +70 −30 +70	(5) +30 +110 +30 +110	10^{-6}/°C	5 parts for each capacitance value Notes 2, 4 and 6
5(ii)	Temperature Coefficient	TC	Para. 9.11 Between +20 ± 2 and +125 °C	(5) −30 +70	(5) +30 +110	10^{-6}/°C	5 parts for each dielectric lot Notes 3, 4 and 6

NOTES

1. Single sample; Inspection Level S3; AQL = 2.5%.
2. Applicable to Level 'B' only.
3. Applicable to Level 'C' only.
4. The temperature coefficient measurement is normally not applicable to capacitance values equal to, or less than 20pF due to equipment limitations.

   If TC measurement is required below 20pF, it may be necessary to accept wider limits than those specified in the above table.
5. First value for TC 0 ± 30 10^{-6}/°C.

   Second value for TC 90 ± 20 10^{-6}/°C.
6. If 1 failure out of 5 parts, then test 100%.

   1% rejects maximum allowed in case of 100% testing.

FIGURE 4 - TEST CIRCUITS

Not applicable.

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
1	Capacitance Change	$\frac{\Delta C}{C}$	ESA/SCC Gen. Spec. 3009	Paras. 9.4.2 and 9.4.1.1	± 0.5 ± 1.0	pF % Notes 1 and 2

NOTES
1. For all percentage tolerances, whichever is greater.
2. For pF tolerances, Δ = 0.1pF.

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

No.	CHARACTERISTIC	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+125	°C
2	Test Voltage	V_T	$2.0U_R$	V

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. 3009)

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 specified, measurements shall be performed at T_{amb} = +22 ± 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 specified, measurements shall be performed at T_{amb} = +22 ± 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 specified, measurements shall be performed at T_{amb} = +22 ± 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. 3009. 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 ON COMPLETION OF ENVIRONMENTAL TESTS AND AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING

NO.	ESA/SCC GENERIC SPECIFICATION NO. 3009		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		MIN.	MAX.	
01	Mounting	Para. 9.15	**Final Examination**					
			Terminals	Good Tinning	-	-	-	-
			Final Measurements					
			Capacitance	Table 2 Item 1	C	Record Values		pF
			Tangent of Loss Angle	Table 2 Item 2	$T_{g\delta}$	Table 2 Item 2		10^{-4}
			Insulation Resistance	Table 2 Item 3	R_i	Table 2 Item 3		GΩ
02	Adhesion	Para. 9.5	**Final Examination**					
			Visual Examination	Damage or loosening	-	-	-	-
			Capacitance	Table 2 Item 1	C	Table 2 Item 1		pF
03	Solderability	Para. 9.6	**Final Examination**					
			Visual Examination	Para. 9.6	-	-	-	-
04	Rapid Change of Temperature	Para. 9.7	**Initial Measurements**					
			Capacitance	Table 2 Item 1	C	Item 01 Value		pF
			Final Measurements	Recovery period 24 ± 2 hours				
			Visual Examination	No damage	-	-	-	-
			Capacitance Change	Table 2 Item 1	$\frac{\Delta C}{C}$	−0.1	+0.1	pF or % (2)
			Tangent of Loss Angle	Table 2 Item 2	$T_{g\delta}$	-	(3)	10^{-4}
05	Climatic Test Sequence	Para. 9.8	**Initial Measurements**					
			Capacitance	Table 2 Item 1	C	Item 01 Value		pF
			Final Measurements	Recovery Period 1 -24 hrs				
			Visual Inspection	Para. 9.8.7	-	-	-	-
			Capacitance Change	Table 2 Item 1	$\frac{\Delta C}{C}$	−0.1	+0.1	pF or % (2)
			Tangent of Loss Angle	Table 2 Item 2	$T_{g\delta}$	-	(3)	10^{-4}
			Insulation Resistance	Table 2 Item 3	R_i	100	-	GΩ
06	Damp Heat Steady State	Para. 9.9	**Initial Measurements**					
			Capacitance	Table 2 Item 1	C	Item 01 Value		pF
			Final Measurements	Recovery Period 6 - 24 hrs				
			Visual Examination	No damage	-	-	-	-
			Capacitance Change	Table 2 Item 1	$\frac{\Delta C}{C}$	−0.1	+0.1	pF or % (2)
			Tangent of Loss Angle	Table 2 Item 2	$T_{g\delta}$	-	(3)	10^{-4}
			Insulation Resistance	Table 2 Item 3	R_i	100	-	GΩ

NOTES

1. The tests in this table refer to either Chart IV or V and shall be used as applicable.
2. Whichever is the greater.
3. Twice the values specified in Table 2 of this specification.

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. 3009		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		MIN.	MAX.	
07	Operating Life	Para. 9.10	**Initial Measurements**					
			Capacitance	Table 2 Item 1	C	Item 01 Value		pF
			Intermediate Measurements to be performed at 1000 hrs (Chart IV)	Recovery period 1 hour min				
			Capacitance Change	Table 2 Item 1	$\frac{\Delta C}{C}$	−0.1	+0.1	pF or
						−0.1	+0.1	% (2)
			Insulation Resistance	Table 2 Item 3	R_i	100	-	GΩ
			Final Measurements	Recovery period 24 ± 2 hours				
			Capacitance Change	Table 2 Item 1	$\frac{\Delta C}{C}$	−0.1	+0.1	pF or
						−0.1	+0.1	% (2)
			Tangent of Loss Angle	Table 2 Item 2	$T_{g\delta}$	-	(3)	10^{-4}
			Insulation Resistance	Table 2 Item 3	R_i	100	-	GΩ
			Voltage Proof	Table 2 Item 4	VP	Table 2 Item 4		V
			Visual Examination	No damage	-	-	-	-
08	Temperature Coefficient	Para. 9.11	Capacitance Changes	Table 3 Item 5(i) or 5(ii)	TC	Table 3 Item 5(i) or 5(ii)		10^{-6}/°C

NOTES

1. The tests in this table refer to either Chart IV or V and shall be used as applicable.
2. Whichever is the greater.
3. Twice the values specified in Table 2 of this specification.