CRYSTAL UNITS IN METAL HOLDER,

BASED ON TYPE T2111,

FREQUENCY RANGE 0.8 - 50MHZ

ESCC Detail Specification No. 3501/020

(Follow-up Specification to ESA/SCC Detail Specification No. 3501/003)

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space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 2	September 2002		

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	CHANGE Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 1 and incorporates all modifications defined in the following DCRs:-		
		Cover page		None
		DCN		None
		Para. 3	: Turning Point Temperature definition added	221686
		Table 1(a)	: New No. 3 added and all subsequent Items and Note references incremented by 1 except for Item No. 19 Note reference	221686
			: Alinea (b) deleted from Note 2	221686
			: New Note 3 added and all subsequent Notes incremented by 1	221686
			: Note 4 values rewritten	221686
			: Note 5 rewritten	221686
			: Notes for "Applicable Items" and "Intended Application" reversed in sequence	221686
		Table 1(b)	: Note 1 expanded	221686
		Para. 4.6.1	: New sentence added	221686
		Para. 4.6.2	: In the second sentence, Item numbers amended	221686
		Para. 4.7.2	: Second sentence deleted and new text added	221686
		Table 2	: In Limits, Item references incremented by 1 after Item 1	221686
		Table 3	: In Limits, Item references incremented by 1	221686
		Table 5	: Title and Condition amended and Note added	221686
		Para. 4.8.3	: Paragraph rewritten	221686

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TABLES

FIGURES

APPENDICES (Applicable to specific Manufacturers only)

None.

1. GENERAL

1.1 SCOPE

This specification details the values, physical and electrical characteristics, test and inspection data for Crystal Units in Metal Holder, based on Type T2111, Frequency Range 0.8 - 50MHz.

It shall be read in conjunction with ESA/SCC Generic Specification No. 3501, the requirements for which are supplemented herein.

This is a follow-up specification to ESA/SCC Detail Specification No. 3501/003 which should be consulted by:-

(a) Users seeking information concerning the availability of variants previously ordered to these specifications.

(b) Manufacturers before introducing a new specific crystal identification as outlined in Para. 1.2.

1.2 RANGE OF COMPONENTS

The specific characteristics shall be negotiated between the Manufacturer and the Orderer on the basis of Table 1(a).

The contents of the individual tables shall relate to the design parameters of individual crystal units, optimised for the intended application.

The agreed table shall be held under configuration control by the Manufacturer who will allocate a specific crystal identification number sequentially when a request for a crystal is received.

1.3 MAXIMUM RATINGS

The maximum ratings, which shall not be exceeded at any time during use or storage, applicable to the crystal units specified herein, are as scheduled in Table 1(b).

1.4 PHYSICAL DIMENSIONS

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

1.5 FUNCTIONAL DIAGRAM

The functional diagram showing lead identification of the crystal units 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. 3501 for Quartz Crystal Units.

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:-

Resonance Frequency = f_r
Load Resonance Frequency = f_L
Reference Temperature = T_0
Turning Point Temperature = T_{TP}
Resonance Resistance = R_r
Load Resonance Resistance = R_L
Rated Drive Level = P_0

Static Capacitance = C_0
Load Capacitance = C_L
Motional Capacitance = C_1
Motional Inductance = L_1
Response Resistance = R_P
Response Impedance = $|Z_P|$
Insulation Resistance = Ri

TABLE 1(a) - FORMAT FOR INDIVIDUAL TABLES 1(a)

SPECIFIC CRYSTAL IDENTIFICATION NUMBER - ________

No.	Characteristic	Symbol	Limits		Unit	Remarks
			Min.	Max		
1	Resonance Frequency	f_r or f_L			MHz	Note 1
2	Reference Temperature	T_o			°C	Note 2
3	Turning Point Temperature	T_{TP}			°C	Note 3
4	Overtone Order	-				
5	Load Capacitance	C_L			pF	Note 4
6	Rated Drive Level	P_o			mW	Note 5
7	Frequency Adjustment Tolerance	$\frac{\Delta f}{f}$			10^{-6}	At T_o °C Note 6
8	Resonance Resistance	R_r or R_L			Ω	At T_o °C Note 7
9	Frequency Variation with Temperature over T_{op}	$\frac{\Delta f}{f}$			10^{-9}	From frequency measured at T_o °C Note 8
10	Resistance Variation with Temperature over T_{op}	$\frac{\Delta R}{R}$			%	From resistance measured at T_o °C Note 8
11	Operating Temperature Range	T_{op}			°C	
12	Frequency Variation with Drive Level	$\frac{\Delta f}{f}$			10^{-6}	From P_{S1} = mW to P_{S2} = mW Note 9
13	Resistance Variation with Drive Level	$\frac{\Delta R}{R}$			%	From P_{S1} = mW to P_{S2} = mW Note 9
14	Motional Inductance	L_1			mH	Notes 10 and 11
15	Motional Capacitance	C_1			fF	Note 10
16	Static Capacitance	C_o			pF	Note 10
17	Q Factor	Q			-	Notes 10 and 12
18	Ratio of Unwanted: Response Resistance to Resonance Resistance or Response Impedance to Resonance Resistance	R_p/R or $\lvert Z_p \rvert/R$				In the frequency range: f - kHz to f + kHz Note 13
19	Ageing	$\frac{\Delta f}{f}$			10^{-6}	Note 14
20	Intended Application					Note 15

NOTES: See Pages 7 and 8.

NOTES TO TABLE 1(a)

1. Resonance Frequency f_r or f_L

   (a) If C_L is not specified, Symbol and measurement shall be f_r.

   (b) If C_L is specified, Symbol and measurement shall be f_L.

2. Reference Temperature T_0

   (a) For a crystal unit functioning in a non-controlled temperature environment, the reference temperature is normally +25 ±2 °C.

3. Turning Point Temperature T_{TP}

   (a) For a crystal unit functioing in a temperature controlled environment (OCXO), the turning point temperature shall be within the limits specified for the reference temperature range.

   (b) To be specified for OCXO crystal units in addition to the reference temperature.

4. Load Capacitance C_L

   (a) When a crystal unit must function at its series resonance frequency, C_L shall be infinite.

   (b) When a crystal unit must function with a load capacitance, the C_L value shall be specified.

   (c) When a crystal unit must function with an adjustable load capacitance, the minimum and maximum limits shall be specified.

   N.B.
   The tolerance on the load capacitance shall be that value which results in a frequency change not exceeding 10% of the frequency tolerance at T_0 or 1% of the nominal load capacitance, whichever is smaller.

5. Rated Drive Level P_0

   The rated drive level shall be selected from the standard drive levels specified below:

   - 0.25mW, 0.2mW, 0.1mW, 0.05mW, 0.02mW and 0.01mW at ±20%.

6. Frequency Adjustment Tolerance

   (a) When a crystal unit must function at its series resonance frequency, the resonancy frequency measured with this load at T_0 shall be within the tolerance specified. The standard value of the adjustment tolerance shall be $\pm 10 \times 10^{-6}$.

   (b) When a crystal unit has to function with a fixed load capacitance, the resonance frequency measured with this load at T_0 shall be within the tolerance specified. The standard value of the adjustment tolerance shall be $\pm 10 \times 10^{-6}$.

   (c) When a crystal unit is required to operate with an adjustable load capacitance with the limits indicated in Item 5 of the Table, the resonance frequency shall be adjustable to its correct T_0 value so the frequency adjustment tolerance does not need to be specified.

7. Resonance Resistance

   (a) Generally, the maximum value only is specified.

   (b) R_L may be calculated by $R_L = R_r\left(1 + \frac{C_0}{C_L}\right)^2$.

8. Frequency and Resistance Variation with Temperature

   These values shall be specified such that they are consistent with the operating temperature range.

NOTES TO TABLE 1(a) (Continued)

9. Frequency and Resistance Variation with Drive Level

   These limits and the Drive Level range (P_{S1} to P_{S2}) shall be specified for very special crystals only (i.e. crystals used in very high stability oscillators).

10. Electrical Values

    The electrical values shall be specified only when required for the correct functioning of the equipment in which the crystal is used.

11. Motional Inductance L_1

    Because the inductance value may be restricted by other chosen parameters, the Manufacturer shall propose the value of L_1 in accordance with the Customer's requirements.

12. 'Q' Factor

    If 'R' and 'L' have been already specified, it will not be necessary to specify the minimum value of the 'Q' factor.

    The maximum value of the 'Q' factor is never specified.

13. Ratio of Unwanted Response Resistance to Resonance Resistance

    The standard minimum value is 2, but it is possible to obtain higher values.

    The frequency range within which the minimum value of the ratio is required shall also be specified.

14. Ageing

    Specify limits under appropriate column and ageing period under "Remarks".

15. Intended Application

    For definitions of the selected symbols to be added, see ESA/SCC Generic Specification No. 3501, Para. 3.

16. Not Applicable Items

    For all items where limits are not specified, "Not applicable" shall be entered in the Limits column.

TABLE 1(b) - MAXIMUM RATINGS

No.	Characteristic	Symbol	Values	Unit	Remarks
1	Nominal Frequency Range	f	0.8 to 50	MHz	Note 1
2	Drive Level Range	P	0.1 to 2.0	mW	
3	Operating Temperature Range	T_{op}	-	°C	Note 2
4	Storage Temperature Range	T_{stg}	-65 to +125	°C	Note 3
5	Soldering Temperature	T_{sol}	+260	°C	Note 4

NOTES

1.

Fundamental and Overtone Order	Approx. Frequency Range (MHz)
Fundamental	0.8 to 10
3	10 to 30
5	15 to 50

In use, the rated drive level shall not be exceeded.

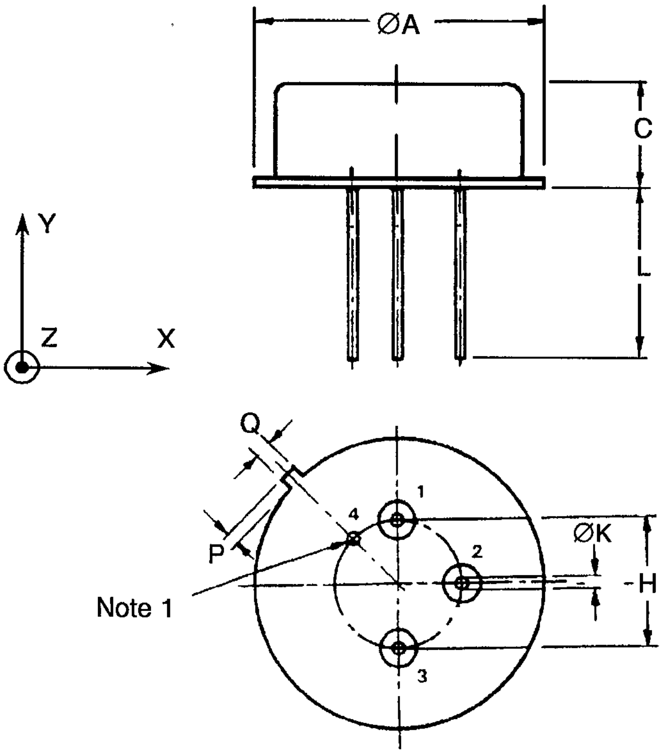
2. See Tables 1(a).
3. The duration at maximum storage temperature shall not exceed 16 hours.
4. Duration 10 seconds maximum at a distance of not less than 3.0mm from the device body and the same lead shall not be resoldered until 3 minutes have elapsed.

FIGURE 1 - PARAMETER DERATING INFORMATION

Not applicable.

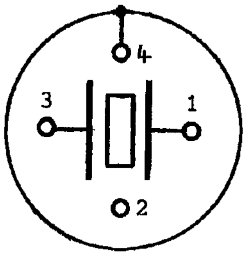
FIGURE 2 - PHYSICAL DIMENSIONS

Symbol	Millimetres		Remarks
	Min.	Max.	
ØA	-	22.00	
C	-	11.60	
H	9.29	9.77	Pitch 9.52mm
ØK	0.40	0.48	
L	25.00	26.00	
P	-	0.90	Note 2
Q	-	0.95	Note 2



NOTES
1. Lead No. 4 is grounded to case.
2. The tag's position or presence is optional.

FIGURE 3 - FUNCTIONAL DIAGRAM



(Bottom View)

NOTES
1. Crystal connections 1 and 3.
2. Terminal 4 connected to Case.
3. Terminal 2 not connected.

4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the crystal units specified herein shall be as stated in this specification and ESA/SCC Generic Specification No. 3501 for Quartz Crystal Units. Deviations from the Generic Specification applicable to this specification only, are detailed 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 Tests (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 crystal units specified herein shall be checked. They shall conform to those shown in Figure 2.

4.3.2 Weight

The maximum weight of the crystal units specified herein shall be 7.0 grammes.

4.3.3 Robustness of Terminations

The requirements for robustness of termination testing are specified in Section 9 of ESA/SCC Generic Specification No. 3501.

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 crystal units 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

4.4.1.1 Cap

Copper, nickel plated and gold plated.

4.4.1.2 Base

Kovar, nickel plated and gold plated.

4.4.2 Lead Material and Finish

The lead material shall be Type 'D' with Type '2' 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 precendence, shall be as follows:-

(a) Characteristics.

(b) Traceability Information.

(c) The SCC Component Number.

4.5.2 Characteristics

The characteristics to be marked are the frequency and the specific crystal identification number.

4.5.2.1 Frequency

The resonance frequency of the crystal units shall be clearly specified in MHz. Where necessary, it shall be specified to 6 decimal places.

4.5.2.2 Specific Crystal Identification Number

This identification shall be allocated by the Manufacturer (see Para. 1.2) and shall consist of the following:

- Letter : First letter of the crystal manufacturer's name.
- 4 digit number : Sequentially allocated by each Manufacturer.

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.

4.5.4 The SCC Component Number

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

350102001B
Detail Specification Number ——— 3501020
Type Variant, (see Note) ——— 01
Testing Level (B or C, as applicable) ——— B

N.B.
Marking of the Type Variant is mandatory. No further reference to type variants is made in this specification.

4.5.5 Manufacturer's Name, Symbol or Code

The Manufacturer's marking shall be in accordance with the requirements of ESA/SCC Basic Specification No. 21700.

4.6 ELECTRICAL MEASUREMENTS

4.6.1 Electrical Measurements at Reference Temperature

The parameters to be measured in respect of electrical characteristics are scheduled in Table 2.

The measurements shall be performed at the temperatures specified in the individual Tables 1(a), Item 2.

Measurements at reference temperature for OCXO crystal units shall be performed at $T_{TP} \pm 1°C$.

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. These measurements shall only be performed if values are specified in Tables 1(a) Items 9 and/or 10.

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 $T_{amb} = T_0 \pm 2$ °C. The parameter drift values (Delta) applicable to the scheduled parameters 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. 3501.

The test shall be performed as a high temperature storage test and the temperature to be applied shall be as specified in Table 5 of this specification.

For a crystal unit functioning in a temperature controlled environment (OCXO), the test should preferably be performed as an operating life test in an oscillator, at the Turning Point Temperature, with a daily measurement of the resonance frequency of the oscillator.

4.7.3 Electrical Circuits for Burn-in (Figure 5)

Not applicable.

TABLE 2 - ELECTRICAL MEASUREMENTS AT REFERENCE TEMPERATURE

No.	Characteristics	Symbol	ESA/SCC 3501 Test Method	Limits	Unit
1	Resonance frequency at reference temperature and rated drive level - with C_O - with C_L	f_r (T_o, P_o) f_L (T_o, P_o)	Para. 9.2.1.1	Table 1(a), Item 1 ± Item 7	MHz
2	Resonance resistance at reference temperature and rated drive level - with C_O - with C_L	R_r (T_o, P_o) R_L (T_o, P_o)	Para. 9.2.1.1	Table 1(a), Item 8	Ω
3	Frequency variation with Drive Level	$\frac{\Delta f}{f}$ (T_o, ΔP)	Para. 9.2.1.1	Table 1(a), Item 12	10^{-6}
4	Resistance variation with Drive Level	$\frac{\Delta R}{R}$ (T_o, ΔP)	Para. 9.2.1.1	Table 1(a), Item 13	%
5	Motional Inductance	L_1	Para. 9.2.1.3	Table 1(a), Item 14	mH
6	Static Capacitance	C_o	Para. 9.2.1.4	Table 1(a), Item 16	pF
7	Unwanted response	R_P/R or $\lvert Z_P \rvert /R$	Para. 9.2.1.5	Table 1(a), Item 18	-
8	Insulation Resistance	Ri	Para. 9.2.1.6	500 Min.	MΩ

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	Characteristics	Symbol	ESA/SCC 3501 Test Method	Limits	Unit
9	Frequency variation with Temperature over T_{op}	$\frac{\Delta f}{f}$ (ΔT, P_o)	Para. 9.2.1.2	Table 1(a) Item 9	10^{-6}
10	Resistance variation with Temperature over T_{op}	$\frac{\Delta R}{R}$ (ΔT, P_o)	Para. 9.2.1.2	Table 1(a) Item 10	%

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	Resonance frequency drift	$\frac{\Delta f}{f}$	As per Table 2	As per Table 2	± 2.0	10^{-6}
2	Resonance resistance drift	$\frac{\Delta R}{R}$	As per Table 2	As per Table 2	± 10 or (1) ± 1.0	% Ω

NOTES

1. Whichever is the highest value.

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

No.	Characteristics	Symbol	Condition (Note 1)	Unit
1	Ambient Temperature	T_{amb}	+105 (+0-5)	°C

NOTES

1. See Para. 4.7.2.

FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN AND LIFE TEST

Not applicable.

4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESA/SCC GENERIC SPECIFICATION NO. 3501)

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 $T_{amb} = T_0 \pm 2$ °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 $T_{amb} = T_0 \pm 2$ °C.

4.8.3 Conditions for Operating Life Test (Part of Endurance Testing)

The requirements for the operating life test are specified in Section 9 of ESA/SCC Generic Specification No. 3501. The test shall be performed as a high temperature storage test and the test temperatures are specified in ESA/SCC Generic Specification No. 3501 for Qualification Testing and in Table 5 of this specification for LAT Testing.

For a crystal unit functioning in a temperature controlled environment (OCXO), the test should preferably be performed as an operating life test in an oscillator, at the Turning Point Temperature, with a daily measurement of the resonance frequency of the oscillator.

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. 3501		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		Min.	Max.	
01	Electrical Measurements at Reference Temperature	Para. 9.2.4	Electrical Measurements	Table 2		Table 1(a)		
02	Shock	Para. 9.3	**Initial Measurements**					
			Resonance Frequency	Table 2 Item 1	f	Table 2 Item 1		
			Resonance Resistance	Table 2 Item 2	R	Table 2 Item 2		
			Final Measurements					
			Resonance Frequency Drift	Table 2 Item 1	$\frac{\Delta f}{f}$	−1.0	+1.0	10^{-6}
			Resonance Resistance Drift	Table 2 Item 2	$\frac{\Delta R}{R}$	−10 or (2)	+10	%
					ΔR	−1.0	+1.0	Ω
03	Vibration	Para. 9.4	**Initial Measurements**					
			Resonance Frequency	Table 2 Item 1	f	Table 2 Item 1		
			Resonance Resistance	Table 2 Item 2	R	Table 2 Item 2		
			Final Measurements					
			Resonance Frequency Drift	Table 2 Item 1	$\frac{\Delta f}{f}$	−1.0	+1.0	10^{-6}
			Resonance Resistance Drift	Table 2 Item 2	$\frac{\Delta R}{R}$	−10 or (2)	+10	%
					ΔR	−1.0	+1.0	Ω
04	Seal Test	Para. 9.5	Fine Leak Gross Leak	Para. 9.5.1 Para. 9.5.2		Para. 9.5.1 Para. 9.5.2		
05	Permanence of Marking	Para. 9.8	**Final Measurements** Visual Examination	No corrosion or obliteration of marking	-	-	-	-
06	External Visual Inspection	Para. 9.9	**Final Measurements** Visual Inspection	ESA/SCC No. 20500	-	-	-	-
07	Solderability	Para. 9.13	-	-	-	-	-	-

NOTES

1. The tests in this table refer to either Chart IV or V, and shall be used as applicable.
2. Whichever is the highest value.

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

NO.	ESA/SCC GENERIC SPEC. NO. 3501		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		Min.	Max.	
08	Climatic Sequence Dry Heat	Para. 9.14 Para. 9.14.1	**Initial Measurements**					
			Resonance Frequency	Table 2 Item 1	f	Table 2 Item 1		
			Resonance Resistance	Table 2 Item 2	R	Table 2 Item 2		
			Final Measurements					
			Resonance Frequency Drift	Table 2 Item 1	$\frac{\Delta f}{f}$	−2.0	+2.0	10^{-6}
			Resonance Resistance Drift	Table 2 Item 2	$\frac{\Delta R}{R}$	−10 or (2)	+10	%
					ΔR	−1.0	+1.0	Ω
09	Cold	Para. 9.14.3	**Initial Measurements**					
			Resonance Frequency	Table 2 Item 1	f	Para. 9.14.1.3 Final Measurements		
			Resonance Resistance	Table 2 Item 2	R			
			Final Measurements					
			Resonance Frequency Drift	Table 2 Item 1	$\frac{\Delta f}{f}$	−2.0	+2.0	10^{-6}
			Resonance Resistance Drift	Table 2 Item 2	$\frac{\Delta R}{R}$	−10 or (2)	+10	%
					ΔR	−1.0	+1.0	Ω
10	Damp Heat (Acclerated) Remaining Cycles	Para. 9.14.4	**Initial Measurements**					
			Resonance Frequency	Table 2 Item 1	f	Para. 9.14.3.2 Final Measurements		
			Resonance Resistance	Table 2 Item 2	R			
			Final Measurements					
			Resonance Frequency Drift	Table 2 Item 1	$\frac{\Delta f}{f}$	−2.0	+2.0	10^{-6}
			Resonance Resistance Drift	Table 2 Item 2	$\frac{\Delta R}{R}$	−10 or (2)	+10	%
					ΔR	−1.0	+1.0	Ω
			Insulation Resistance	Table 2 Item 8	Ri	500	-	MΩ
11	Rapid Change of Temperature	Para. 9.15	**Initial Measurements**					
			Resonance Frequency	Table 2 Item 1	f	Para. 9.14.4.2 Final Measurements		
			Resonance Resistance	Table 2 Item 2	R			
			Final Measurements	After minimum Recovery of 2 hours				
			Resonance Frequency Drift	Table 2 Item 1	$\frac{\Delta f}{f}$	−2.0	+2.0	10^{-6}
			Resonance Resistance Drift	Table 2 Item 2	$\frac{\Delta R}{R}$	−10 or (2)	+10	%
					ΔR	−1.0	+1.0	Ω
12	Robustness of Terminations	Para. 9.16	Tensile Strength	Gen. 3501 Para. 9.16.1				
			Visual Examination	No visible damage				
			Bending	Gen. 3501 Para. 9.16.2				
			Visual Examination	No visible damage				

NOTES

1. The tests in this table refer to either Chart IV or V, and shall be used as applicable.
2. Whichever is the highest value.

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

NO.	ESA/SCC GENERIC SPEC. NO. 3501		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		Min.	Max.	
13	Life Test	Para. 9.17	**Initial Measurements**					
			Resonance Frequency	Table 2 Item 1	f	Table 2 Item 1		
			Resonance Resistance	Table 2 Item 2	R	Table 2 Item 2		
			Intermediate Measurements	At 500 hours				
			Resonance Frequency Drift	Table 2 Item 1	$\frac{\Delta f}{f}$	−2.0	+2.0	10^{-6}
			Resonance Resistance Drift	Table 2 Item 2	$\frac{\Delta R}{R}$	−10 or (2)	+10	%
					ΔR	−1.0	+1.0	Ω
			Intermediate Measurements (Chart IV) and Final Measurements (Chart V)	At 1000 hours				
			Resonance Frequency Drift	Table 2 Item 1	$\frac{\Delta f}{f}$	−2.5	+2.5	10^{-6}
			Resonance Resitance Drift	Table 2 Item 2	$\frac{\Delta R}{R}$	−10 or (2)	+10	%
					ΔR	−1.0	+1.0	Ω
			Final Measurements (Chart IV)	At 2000 hours				
			Resonance Frequency Drift	Table 2 Item 1	$\frac{\Delta f}{f}$	−3.0	+3.0	10^{-6}
			Resonance Resistance Drift	Table 2 Item 2	$\frac{\Delta R}{R}$	−10 or (2)	+10	%
					ΔR	−1.0	+1.0	Ω

NOTES

1. The tests in this table refer to either Chart IV or V, and shall be used as applicable.
2. Whichever is the highest value.