




**CRYSTAL UNITS IN GLASS CASE,  
BASED ON TYPE DA (HC-27/U),  
FREQUENCY RANGE 2.5 - 300MHZ**

**ESCC Detail Specification No. 3501/021**

**(Follow-up Specification to ESA/SCC Detail Specification No. 3501/006)**

**ISSUE 1  
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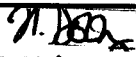
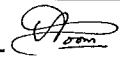
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**space components  
coordination group**

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**DOCUMENTATION CHANGE NOTICE**

Rev. Letter	Rev. Date	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 Note No. 3 added and all subsequent Items and Note references incremented by 1 except for Item 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**

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**FIGURES**

1	Parameter Derating Information	N/A
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4	Circuits for Electrical Measurements	N/A
5	Electrical Circuit for Burn-in and Life Test	N/A

**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 Glass Case, based on Type DA(HC-27/U), Frequency Range 2.5 - 300MHz.

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. 3501/006 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	= $f_r$	Static Capacitance	= $C_0$
Load Resonance Frequency	= $f_L$	Load Capacitance	= $C_L$
Reference Temperature	= $T_0$	Motional Capacitance	= $C_1$
Turning Point Temperature	= $T_{TP}$	Motional Inductance	= $L_1$
Resonance Resistance	= $R_r$	Response Resistance	= $R_P$
Load Resonance Resistance	= $R_L$	Response Impedance	= $ Z_{Pl} $
Rated Drive Level	= $P_0$	Insulation Resistance	= $R_i$



**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 $R_L$			$\Omega$	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 $ Z_p /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  $T_o$ 
  - (a) For a crystal unit functioning in a non-controlled temperature environment, the reference temperature is normally  $+25 \pm 2$  °C.
3. Turning Point Temperature TTP
  - (a) For a crystal unit functioning 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  $T_o$  or 1% of the nominal load capacitance, whichever is smaller.

5. Rated Drive Level  $P_o$ 

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  $\pm 20\%$ .
6. Frequency Adjustment Tolerance
  - (a) When a crystal unit must function at its series resonance frequency, the resonance frequency measured at  $T_o$  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  $T_o$  shall be within the tolerance specified. The standard value of the adjustment tolerance shall also 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  $T_o$  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  $R_L = R_r \left( 1 + \frac{C_o}{C_L} \right)^2$ .
8. Frequency and Resistance Variation with Temperature

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

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ISSUE 2**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 symbol 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	2.5 to 300	MHz	Note 1
2	Drive Level Range	P	0.005 to 0.2	mW	
3	Operating Temperature Range	T <sub>op</sub>	-	°C	Note 2
4	Storage Temperature Range	T <sub>stg</sub>	-55 to +100	°C	Note 3
5	Soldering Temperature	T <sub>sol</sub>	+260	°C	Note 4

**NOTES**

1.

Fundamental and Overtone Order	Approx. Frequency Range (MHz)
Fundamental	2.5 - 20
3	4.0 - 60
5	40 - 100
7	70 - 140
9	90 - 180
11	110 - 220
13	130 - 300

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.

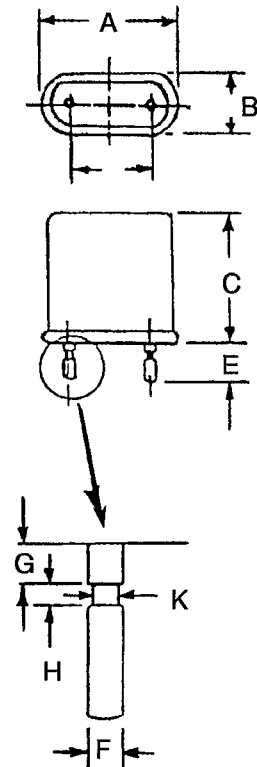
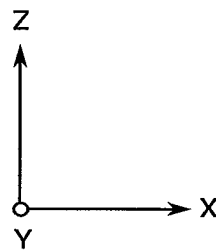


**FIGURE 1 - PARAMETER DERATING INFORMATION**

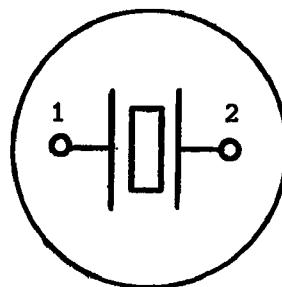
Not applicable.

**FIGURE 2 - PHYSICAL DIMENSIONS**

Symbol	Millimetres	
	Min.	Max.
A	18.4	19.2
B	8.0	8.9
C	19.0	19.7
D	12.1	12.5
E	5.6	6.3
F	1.2	1.3
G	0.6	0.8
H	0.9	1.1
K	0.7	0.8



**FIGURE 3 - FUNCTIONAL DIAGRAM**



(Bottom View)



#### 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 3.0 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

The case shall be hermetically sealed and shall have a sintered-glass base and a glass cap.



4.4.2 Lead Material and Finish

The lead material shall be Type 'D' with Type '3 or 4' 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) 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:

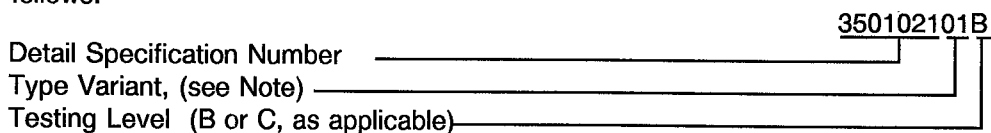
- Letter : First letter of the crystal manufacturer's name.
- 4 digit number : Sequentially allocated by each Manufacturer.

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:-



**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  $T_{TP} \pm 1^{\circ}\text{C}$ .

##### 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. 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  $T_{\text{amb}} = T_0 \pm 2^{\circ}\text{C}$ . 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 <sub>O</sub> - with C <sub>L</sub>	f <sub>r</sub> (T <sub>0</sub> , P <sub>0</sub> ) f <sub>L</sub> (T <sub>0</sub> , P <sub>0</sub> )	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 <sub>O</sub> - with C <sub>L</sub>	R <sub>r</sub> (T <sub>0</sub> , P <sub>0</sub> ) R <sub>L</sub> (T <sub>0</sub> , P <sub>0</sub> )	Para. 9.2.1.1	Table 1(a), Item 8	Ω
3	Frequency variation with Drive Level	$\frac{\Delta f}{f}$ (T <sub>0</sub> , ΔP)	Para. 9.2.1.1	Table 1(a), Item 12	10 <sup>-6</sup>
4	Resistance variation with Drive Level	$\frac{\Delta R}{R}$ (T <sub>0</sub> , ΔP)	Para. 9.2.1.1	Table 1(a), Item 13	%
5	Motional Inductance	L <sub>1</sub>	Para. 9.2.1.3	Table 1(a), Item 14	mH
6	Static Capacitance	C <sub>0</sub>	Para. 9.2.1.4	Table 1(a), Item 16	pF
7	Unwanted response	R <sub>p</sub> /R or  Z <sub>p</sub>  /R	Para. 9.2.1.5	Table 1(a), Item 18	-
8	Insulation Resistance	R <sub>i</sub>	Para. 9.2.1.6	100 Min.	kΩ

**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 <sub>op</sub>	$\frac{\Delta f}{f}$ (ΔT, P <sub>0</sub> )	Para. 9.2.1.2	Table 1(a) Item 9	10 <sup>-9</sup>
10	Resistance variation with Temperature over T <sub>op</sub>	$\frac{\Delta R}{R}$ (ΔT, P <sub>0</sub> )	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 ( $\Delta$ )	Unit
1	Resonance frequency drift	$\frac{\Delta f}{f}$	As per Table 2	As per Table 2	$\pm 2.0$	$10^{-6}$
2	Resonance resistance drift	$\frac{\Delta R}{R}$	As per Table 2	As per Table 2	$\pm 10$ or (1) $\pm 1.0$	% $\Omega$

**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)	$^{\circ}\text{C}$

**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  $T_{amb} = T_o \pm 2^{\circ}\text{C}$ .

##### 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  $T_{amb} = T_o \pm 2^{\circ}\text{C}$ .

##### 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	<b>Initial Measurements</b>	Table 2 Item 1	f	Table 2 Item 1		10 <sup>-6</sup>
			Resonance Resistance	Table 2 Item 2	R	Table 2 Item 2		
			<b>Final Measurements</b>	Table 2 Item 1	$\frac{\Delta f}{f}$	-1.0	+1.0	
			Resonance Frequency Drift	Table 2 Item 2	$\frac{\Delta R}{R}$	-10 or (2)	+10	
			Resonance Resistance Drift		$\Delta R$	-1.0	+1.0	$\Omega$
03	Vibration	Para. 9.4	<b>Initial Measurements</b>	Table 2 Item 1	f	Table 2 Item 1		10 <sup>-6</sup>
			Resonance Resistance	Table 2 Item 2	R	Table 2 Item 2		
			<b>Final Measurements</b>	Table 2 Item 1	$\frac{\Delta f}{f}$	-1.0	+1.0	
			Resonance Frequency Drift	Table 2 Item 2	$\frac{\Delta R}{R}$	-10 or (2)	+10	
			Resonance Resistance Drift		$\Delta R$	-1.0	+1.0	$\Omega$
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	<b>Final Measurements</b> Visual Examination	No corrosion or obliteration of marking	-	-	-	-
06	External Visual Inspection	Para. 9.9	<b>Final Measurements</b> 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	<b>Initial Measurements</b>					
			Resonance Frequency	Table 2 Item 1	f	Table 2 Item 1		
			Resonance Resistance	Table 2 Item 2	R	Table 2 Item 2		
			<b>Final Measurements</b>					
09	Cold	Para. 9.14.3	Resonance Frequency	Table 2 Item 1	$\frac{\Delta f}{f}$	-2.0	+2.0	10 <sup>-6</sup>
			Resonance Resistance	Table 2 Item 2	$\frac{\Delta R}{R}$	-10	+10	%
			Drift		$\Delta R$	or (2) -1.0	+1.0	Ω
			<b>Final Measurements</b>					
10	Damp Heat (Accelerated) Remaining Cycles	Para. 9.14.4	Resonance Frequency	Table 2 Item 1	f	Para. 9.14.1.3 Final Measurements		
			Resonance Resistance	Table 2 Item 2	R			
			Drift		$\frac{\Delta f}{f}$	-2.0	+2.0	10 <sup>-6</sup>
			Resonance Resistance	Table 2 Item 2	$\frac{\Delta R}{R}$	-10	+10	%
11	Rapid Change of Temperature	Para. 9.15	Drift		$\Delta R$	-1.0	+1.0	Ω
			<b>Final Measurements</b>					
			Insulation Resistance	Table 2 Item 8	Ri	500	-	MΩ
12	Robustness of Terminations	Para. 9.16	<b>Initial Measurements</b>					
			Resonance Frequency	Table 2 Item 1	f	Para. 9.14.4.2 Final Measurements		
			Resonance Resistance	Table 2 Item 2	R			
			Drift		$\frac{\Delta f}{f}$	-2.0	+2.0	10 <sup>-6</sup>
13	Robustness of Terminations	Para. 9.16	Resonance Resistance	Table 2 Item 2	$\frac{\Delta R}{R}$	-10	+10	%
			Drift		$\Delta R$	or (2) -1.0	+1.0	Ω
			<b>Final Measurements</b>					
			Recovery of 2 hours					
14	Robustness of Terminations	Para. 9.16	Resonance Frequency	Table 2 Item 1	f			
			Resonance Resistance	Table 2 Item 2	R			
			Drift		$\frac{\Delta f}{f}$			
15	Robustness of Terminations	Para. 9.16	Resonance Resistance	Table 2 Item 2	$\frac{\Delta R}{R}$			
			Drift		$\Delta R$			
			<b>Final Measurements</b>					
16	Robustness of Terminations	Para. 9.16	Insulation Resistance	Table 2 Item 8	Ri			
17	Robustness of Terminations	Para. 9.16	Tensile Strength	Gen. 3501 Para. 9.16.1				
			Visual Examination Bending	No visible damage 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	<b>Initial Measurements</b>					
			Resonance Frequency	Table 2 Item 1	f	Table 2 Item 1		
			Resonance Resistance	Table 2 Item 2	R	Table 2 Item 2		
			<b>Intermediate Measurements</b>	At 500 hours				
			Resonance Frequency	Table 2 Item 1	$\frac{\Delta f}{f}$	-2.0	+2.0	10 <sup>-6</sup>
			Drift					
			Resonance Resistance	Table 2 Item 2	$\frac{\Delta R}{R}$	-10	+10	%
			Drift		R	or (2)		
					$\Delta R$	-1.0	+1.0	$\Omega$
			<b>Intermediate Measurements (Chart IV) and Final Measurements (Chart V)</b>	At 1000 hours				
			Resonance Frequency	Table 2 Item 1	$\frac{\Delta f}{f}$	-2.5	+2.5	10 <sup>-6</sup>
			Drift					
			Resonance Resistance	Table 2 Item 2	$\frac{\Delta R}{R}$	-10	+10	%
Drift		R	or (2)					
		$\Delta R$	-1.0	+1.0	$\Omega$			
<b>Final Measurements (Chart IV)</b>	At 2000 hours							
Resonance Frequency	Table 2 Item 1	$\frac{\Delta f}{f}$	-3.0	+3.0	10 <sup>-6</sup>			
Drift								
Resonance Resistance	Table 2 Item 2	$\frac{\Delta R}{R}$	-10	+10	%			
Drift		R	or (2)					
		$\Delta R$	-1.0	+1.0	$\Omega$			

**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.