



**CRYSTAL UNITS FOR SURFACE MOUNTING,  
BASED ON TYPE 101,  
FREQUENCY RANGE 10 - 30MHZ  
ESCC Detail Specification No. 3501/013**

Issue 2	January 2014
---------	--------------



### **LEGAL DISCLAIMER AND COPYRIGHT**

European Space Agency, Copyright © 2014. All rights reserved.

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

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

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

**DOCUMENTATION CHANGE NOTICE**

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

DCR No.	CHANGE DESCRIPTION
807	Specification upissued to incorporate editorial changes per DCR.

**TABLE OF CONTENTS**

1	GENERAL	6
1.1	SCOPE	6
1.2	RANGE OF COMPONENTS	6
1.3	MAXIMUM RATINGS	6
1.4	PHYSICAL DIMENSIONS	6
1.5	FUNCTIONAL DIAGRAM	6
2	APPLICABLE DOCUMENTS	6
3	TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS	6
4	REQUIREMENTS	12
4.1	GENERAL	12
4.2	DEVIATIONS FROM GENERIC SPECIFICATION	12
4.2.1	Deviations from Special In-process Controls	12
4.2.2	Deviations from Final Production Tests (Chart II)	12
4.2.3	Deviations from Burn-in Tests (Chart III)	12
4.2.4	Deviations from Qualification Tests (Chart IV)	12
4.2.5	Deviations from Lot Acceptance Tests (Chart V)	12
4.3	MECHANICAL REQUIREMENTS	12
4.3.1	Dimension Check	12
4.3.2	Weight	13
4.3.3	Robustness of Terminations	13
4.4	MATERIALS AND FINISHES	13
4.4.1	Case	13
4.4.1.1	Cap	13
4.4.1.2	Base	13
4.4.2	Terminal Finish	13
4.5	MARKING	13
4.5.1	General	13
4.5.2	Characteristics	13
4.5.2.1	Frequency	13
4.5.2.2	Specific Crystal Identification Number	14
4.5.3	Traceability Information	14
4.5.4	The ESCC Component Number	14
4.5.5	Manufacturer's Name, Symbol or Code	14
4.6	ELECTRICAL MEASUREMENTS	14
4.6.1	Electrical Measurements at Reference Temperature	14



4.6.2	Electrical Measurements at High and Low Temperatures	14
4.6.3	Circuits for Electrical Measurements (Figure 4)	14
4.7	BURN-IN TESTS	15
4.7.1	Parameter Drift Values	15
4.7.2	Conditions for Burn-in	15
4.7.3	Electrical Circuits for Burn-in (Figure 5)	15
4.8	ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESCC GENERIC SPECIFICATION No. 3501)	17
4.8.1	Measurements and Inspections on Completion of Environmental Tests	17
4.8.2	Measurements and Inspections at Intermediate Points and on Completion of Endurance Tests	17
4.8.3	Conditions for Operating Life Test (Part of Endurance Testing)	17

**1 GENERAL**

**1.1 SCOPE**

This specification details the values, physical and electrical characteristics, test and inspection data for Crystal Units for Surface Mounting, based on Type 101, Frequency Range 10 - 30MHz.

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

**1.2 RANGE OF COMPONENTS**

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

The contents of the individual table shall relate to the design parameters of the individual crystal unit, 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 the crystal unit 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) ESCC 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 ESCC 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	=	$T_o$	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_p $
Rated Drive Level	=	$P_o$	Insulation Resistance	=	$R_i$

**TABLE 1(a) - FORMAT FOR INDIVIDUAL TABLES 1(a)**  
**SPECIFIC CRYSTAL IDENTIFICATION NUMBER – X1234**

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	$\Delta f/f$			$10^{-6}$	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 $T_{op}$	$\Delta f/f$			$10^{-9}$	From frequency measured at $T_o$ °C Note 8
10	Resistance Variation with Temperature over $T_{op}$	$\Delta R/R$			%	From resistance measured at $T_o$ °C Note 8
11	Operating Temperature Range	$T_{op}$			°C	
12	Frequency Variation with Drive Level	$\Delta f/f$			$10^{-6}$	From: $P_{S1} =$ mW to $P_{S2} =$ mW Note 9
13	Resistance Variation with Drive Level	$\Delta R/R$			%	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	$C_0$			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	$\Delta f/f$			$10^{-6}$	Note 14
20	Intended Application	-			-	Note 15

**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  $T_o$ 

For a crystal unit functioning in a non-controlled temperature environment, the reference temperature is normally  $+25 \pm 2^\circ\text{C}$ .
3. Turning Point Temperature  $T_{TP}$ 
  - (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 with this load 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 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  $R_L = R_r (1 + C_o/C_L)^2$



8. Frequency and Resistance Variation with Temperature

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

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 ESCC 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	10 to 30	MHz	Note 1
2	Drive Level Range	P	0.01 to 0.2	mW	Note 1
3	Operating Temperature Range	T <sub>op</sub>	-	°C	Note 2
4	Storage Temperature Range	T <sub>stg</sub>	-65 to +125	°C	Note 3
5	Soldering Temperature	T <sub>sol</sub>	+260	°C	Note 4

**NOTES**

1.

Fundamental and Overtone Order	Approx. Frequency Range (MHz)	Drive Level Range (mW)
Fundamental	10 to 30	0.05 to 0.2

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

2. See Tables 1(a).

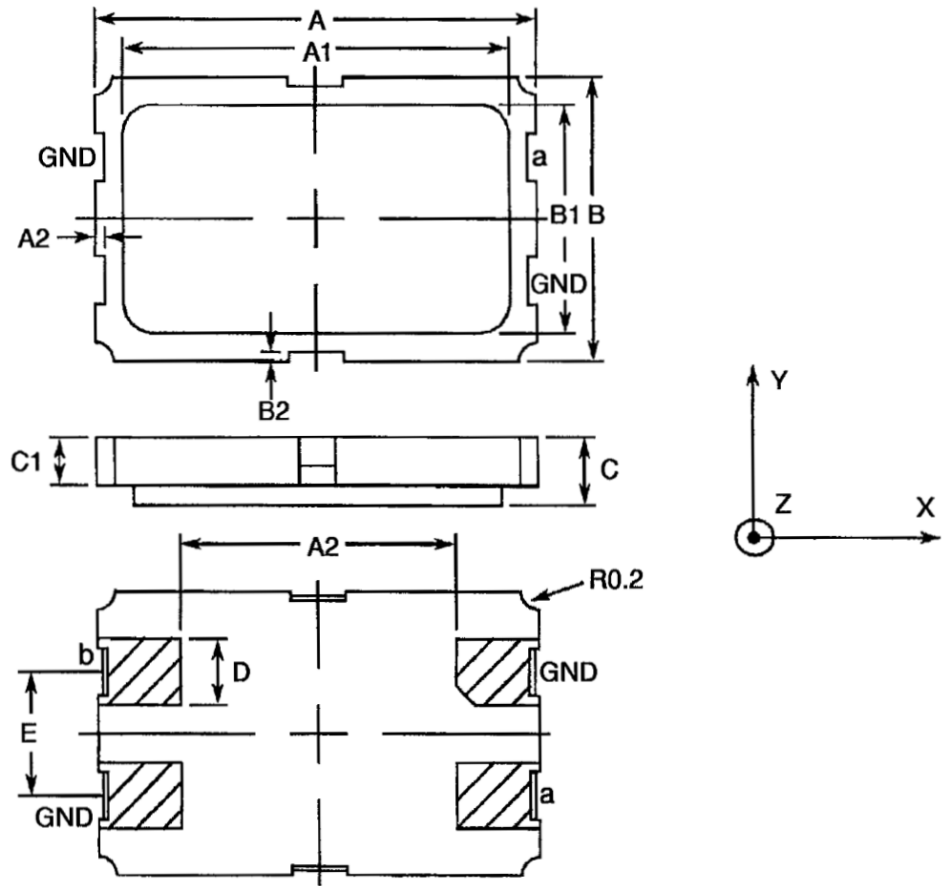
3. The duration at maximum storage temperature shall not exceed 16 hours.

4. Duration 10 seconds maximum at a distance of not less than 3mm from the device body and the same lead shall not be resoldered until 3 minutes have elapsed.

**FIGURE 1 - PARAMETER DERATING INFORMATION**

Not applicable.

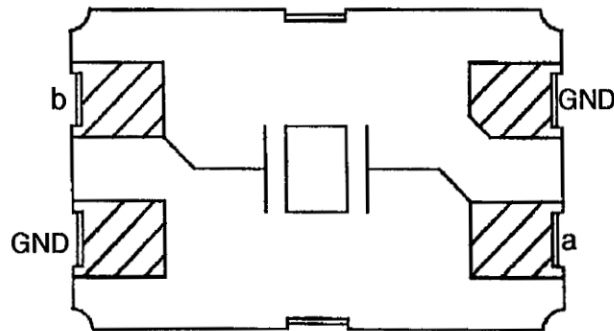
**FIGURE 2 - PHYSICAL DIMENSIONS**



Symbol	Millimetres		Remarks
	Min.	Max.	
A	-	7.15	
A1	-	5	
A2	4.47	4.73	
B	-	5.15	
B1	-	3	
B2	-	0.15	
C	-	0.98	
C1	-	0.7	
D	-	1	Note 1
E	2.41	2.67	

**NOTES**

1. All terminals.

**FIGURE 3 - FUNCTIONAL DIAGRAM**

#### 4 **REQUIREMENTS**

##### 4.1 **GENERAL**

The complete requirements for procurement of the crystal units specified herein shall be as stated in this specification and ESCC 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 ESCC requirements and do not affect the components' reliability, are listed in the appendices attached to this specification.

##### 4.2 **DEVIATIONS FROM GENERIC SPECIFICATION**

###### 4.2.1 **Deviations from Special In-process Controls**

None.

###### 4.2.2 **Deviations from Final Production Tests (Chart II)**

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 0.2 grammes.

#### 4.3.3 Robustness of Terminations

The requirements for robustness of termination testing are specified in Section 9 of ESCC 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*

Kovar with gold flash over nickel.

##### 4.4.1.2 *Base*

Ceramic block.

#### 4.4.2 Terminal Finish

The terminal material shall be Type '14' in accordance with the requirements of ESCC Basic Specification No. 23500.

### 4.5 MARKING

#### 4.5.1 General

The marking of all components delivered to this specification shall be in accordance with the requirements of ESCC Basic Specification No. 21700 and the following paragraphs. When the component is too small to accommodate all of the marking specified, as much as space permits shall be marked and the marking information, in full, shall accompany 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 ESCC 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:

Example: X1234

- 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 ESCC Basic Specification No. 21700.

#### 4.5.4 The ESCC Component Number

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

Example: 350102001B

- Detail Specification Number: 3501013
- 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 ESCC 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  $T_{amb} = T_o \pm 2^{\circ}C$ . 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 ESCC 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	ESCC 3501 Test Method	Limits	Unit
1	Resonance frequency at reference temperature and rated drive level - with $C_0$ - 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 $\pm$ Item 7	MHz
2	Resonance resistance at reference temperature and rated drive level - with $C_0$ - 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	$\Omega$
3	Frequency variation with Drive Level	$\Delta f/f(T_o, \Delta P)$	Para. 9.2.1.1	Table 1(a), Item 12	$10^{-6}$
4	Resistance variation with Drive Level	$\Delta R/R(T_o, \Delta P)$	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	$C_0$	Para. 9.2.1.4	Table 1(a), Item 16	pF
7	Unwanted response	$R_p/R$ or $ Z_p /R$	Para. 9.2.1.5	Table 1(a), Item 18	-
8	Insulation Resistance	$R_i$	Para. 9.2.1.6	500 Min.	$M\Omega$

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

No.	Characteristics	Symbol	ESCC 3501 Test Method	Limits	Unit
9	Frequency variation with Temperature over $T_{op}$	$\Delta f/f (\Delta T, P_o)$	Para. 9.2.1.2	Table 1(a) Item 9	$10^{-6}$
10	Resistance variation with Temperature over $T_{op}$	$\Delta R/R (\Delta T, P_o)$	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 ( $\Delta$ )	Unit
1	Resonance frequency drift	$\Delta f/f$	As per Table 2	As per Table 2	$\pm 2$	$10^{-6}$
2	Resonance resistance drift	$\Delta R/R$	As per Table 2	As per Table 2	$\pm 10$ or (1) $\pm 1$	%  $\Omega$

**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)	$^{\circ}C$

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

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

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 ESCC Generic Specification No. 3501. The test shall be performed as a high temperature storage test and the test temperatures are specified in ESCC 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.	ESCC 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>					
			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>					
Resonance Frequency Drift	Table 2 Item 1	$\Delta f/f$	-1	+1	$10^{-6}$			
Resonance Resistance Drift	Table 2 Item 2	$\Delta R/R$	-10	+10	%			
				$\Delta R$	-1	+1	$\Omega$	
03	Vibration	Para. 9.4	<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>					
Resonance Frequency Drift	Table 2 Item 1	$\Delta f/f$	-1	+1	$10^{-6}$			
Resonance Resistance Drift	Table 2 Item 2	$\Delta R/R$	-10	+10	%			
				$\Delta R$	-1	+1	$\Omega$	

No.	ESCC Generic Spec. No. 3501		Measurements And Inspections		Symbol	Limits		Unit
	Environmental And Endurance Tests (1)	Test Method And Conditions	Identification	Conditions		Min.	Max.	
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	ESCC No. 20500	-	-	-	
07	Solderability	Para. 9.13	-	-	-	-	-	
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>					
			Resonance Frequency Drift	Table 2 Item 1	$\Delta f/f$	-2	+2	$10^{-6}$
			Resonance Resistance Drift	Table 2 Item 2	$\Delta R/R$	-10 or (2)	+10	%
					$\Delta R$	-1	+1	$\Omega$
09	Cold	Para. 9.14.3	<b>Initial Measurements</b>					
			Resonance Frequency	Table 2 Item 1	f	Para. 9.14.1.3		
			Resonance Resistance	Table 2 Item 2	R	Para. 9.14.1.3		
			<b>Final Measurements</b>					
			Resonance Frequency Drift	Table 2 Item 1	$\Delta f/f$	-2	+2	$10^{-6}$
			Resonance Resistance Drift	Table 2 Item 2	$\Delta R/R$	-10 or (2)	+10	%
					$\Delta R$	-1	+1	$\Omega$
10	Damp Heat (Accelerated) Remaining Cycles	Para. 9.14.4	<b>Initial Measurements</b>					
			Resonance Frequency	Table 2 Item 1	f	Para. 9.14.3.2		
			Resonance Resistance	Table 2 Item 2	R	Para. 9.14.3.2		
			<b>Final Measurements</b>					
			Resonance Frequency Drift	Table 2 Item 1	$\Delta f/f$	-2	+2	$10^{-6}$
			Resonance Resistance Drift	Table 2 Item 2	$\Delta R/R$	-10 or (2)	+10	%
					$\Delta R$	-1	+1	$\Omega$
			Insulation Resistance	Table 2 Item 8	Ri	500	-	M $\Omega$
11	Rapid Change of Temperature	Para. 9.15	<b>Initial Measurements</b>					
			Resonance Frequency	Table 2 Item 1	f	Para. 9.14.4.2		
			Resonance Resistance	Table 2 Item 2	R	Para. 9.14.4.2		
			<b>Final Measurements</b>					
			Resonance Frequency Drift	Table 2 Item 1	$\Delta f/f$	-2	+2	$10^{-6}$
			Resonance Resistance Drift	Table 2 Item 2	$\Delta R/R$	-10 or (2)	+10	%
					$\Delta R$	-1	+1	$\Omega$

No.	ESCC Generic Spec. No. 3501		Measurements And Inspections		Symbol	Limits		Unit	
	Environmental And Endurance Tests (1)	Test Method And Conditions	Identification	Conditions		Min.	Max.		
12	Robustness of Terminations	Para. 9.16	Adhesion	Gen. 3501 Para. 9.16.2.2 No visible damage	-	-	-	10 <sup>-6</sup> % Ω	
			Visual Examination		-	-	-		
			Resonance Frequency Drift	Table 2 Item 1	Δf/f	-2	+2		
			Resonance Resistance Drift	Table 2 Item 2	ΔR/R	-10	+10		
					or (2)				
					ΔR	-1	+1		
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 500hrs					
			Resonance Frequency Drift	Table 2 Item 1	Δf/f	-2	+2	10 <sup>-6</sup>	
			Resonance Resistance Drift	Table 2 Item 2	ΔR/R	-10	+10	%	
						or (2)			
						ΔR	-1	+1	Ω
			<b>Intermediate Measurements (Chart IV) and Final Measurements (Chart V)</b>	At 1000hrs					
			Resonance Frequency Drift	Table 2 Item 1	Δf/f	-2.5	+2.5	10 <sup>-6</sup>	
			Resonance Resistance Drift	Table 2 Item 2	ΔR/R	-10	+10	%	
						or (2)			
						ΔR	-1	+1	Ω
<b>Final Measurements (Chart IV)</b>	At 2000hrs								
Resonance Frequency Drift	Table 2 Item 1	Δf/f	-3	+3	10 <sup>-6</sup>				
Resonance Resistance Drift	Table 2 Item 2	ΔR/R	-10	+10	%				
			or (2)						
			ΔR	-1	+1	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.