



Page 1 of 16

**CRYSTAL UNIT IN METAL HOLDER,  
FREQUENCY RANGE: 2.5 to 71MHz**

**BASED ON TYPE: T1507**

**ESCC Detail Specification No. 3501/019**

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**TABLE OF CONTENTS**

1	GENERAL	5
1.1	SCOPE	5
1.2	APPLICABLE DOCUMENTS	5
1.3	TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS	5
1.4	THE ESCC COMPONENT NUMBER AND COMPONENT TYPE VARIANTS	5
1.4.1	The ESCC Component Number	5
1.4.2	Component Type Variants and Range of Components	5
1.4.3	Manufacturer Specific Crystal Identification	6
1.5	MAXIMUM RATINGS	8
1.6	PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION	9
1.7	FUNCTIONAL DIAGRAM	10
1.8	MATERIALS AND FINISHES	10
2	REQUIREMENTS	10
2.1	GENERAL	10
2.1.1	Deviations from the Generic Specification	10
2.2	MARKING	11
2.2.1	Characteristic: Resonance Frequency	11
2.3	ELECTRICAL MEASUREMENTS AT REFERENCE, HIGH AND LOW TEMPERATURES	11
2.3.1	Reference Temperature Electrical Measurements	11
2.3.2	High and Low Temperatures Electrical Measurements	12
2.4	PARAMETER DRIFT VALUE MEASUREMENTS	12
2.5	INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS	13
	APPENDIX A	16

**1 GENERAL**

**1.1 SCOPE**

This specification details the ratings, physical and electrical characteristics and test and inspection data for the component type variants and/or the range of components specified below. It supplements the requirements of, and shall be read in conjunction with, the ESCC Generic Specification listed under Applicable Documents.

**1.2 APPLICABLE DOCUMENTS**

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

- (a) ESCC Generic Specification No. [3501](#).

**1.3 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.

**1.4 THE ESCC COMPONENT NUMBER AND COMPONENT TYPE VARIANTS**

**1.4.1 The ESCC Component Number**

The ESCC Component Number shall be constituted as follows:

Example: 350101901X1234

- Detail Specification Reference: 3501019
- Component Type Variant Number: 01 (as required)
- Manufacturer Specific Crystal Identification: X1234 (as applicable) where:
  - X: First letter of the applicable Manufacturer's name
  - 1234: A unique 4 digit number, sequentially allocated by the applicable Manufacturer to a specific crystal design.

**1.4.2 Component Type Variants and Range of Components**

The component type variants and range of components applicable to this specification are as follows:

Variant Number	Package Description (Note 1)	Lead Material and Finish (Note 2)	Available Nominal Frequency (MHz) (Note 2)	Other Characteristics	Weight Max (g)
01	5 Lead Metal Can	D2	2.5 to 71	See Para. 1.4.3(b)	2
02	5 Lead Metal Can	D3 or D4	2.5 to 71	See Para. 1.4.3(b)	2

**NOTES:**

1. For the purposes of determining the Mechanical Shock test conditions during Chart F4 in the Generic Specification, this package is considered similar to style TO-8. See Para. 1.6.
2. In accordance with the requirements of ESCC Basic Specification No. [23500](#).

3. The available nominal frequency depends on the Overtone Order as follows:

Overtone Order	Available Nominal Frequency (Approximate) (MHz)
1 (fundamental)	2.5 to 22
3	10 to 33
5	15 to 71

1.4.3 Manufacturer Specific Crystal Identification

A Crystal Characteristics Table shall be produced by the Manufacturer after negotiation with the Orderer and shall be held under configuration control by the Manufacturer who will allocate a unique Manufacturer Specific Crystal Identification sequentially when a request for a crystal unit is received.

Each Crystal Characteristics Table shall include the following information:

- (a) The ESCC Component Number for the crystal, including the Manufacturer Specific Crystal Identification (see Para. 1.4)
- (b) The crystal unit characteristics and limits information as follows:

Characteristics	Symbols	Limits (Note 16)		Units	Remarks
		Min	Max		
Resonance Frequency	$f_r$ or $f_L$			MHz	Note 1
Reference Temperature	$T_o$			°C	Notes 2, 3
Turning Point Temperature	$T_{TP}$			°C	Note 3
Overtone Order	-			-	
Load Capacitance	$C_L$			pF	Note 4
Rated Drive Level	$P_o$			mW	Note 5
Frequency Adjustment Tolerance	$\Delta f/f$			$10^{-6}$	At $T_o$ Note 6
Resonance Resistance	$R_r$ or $R_L$			$\Omega$	At $T_o$ Note 7
Frequency Variation with Temperature over $T_{op}$	$\Delta f/f$			$10^{-9}$	Referenced to $f$ at $T_o$ Note 8
Resistance Variation with Temperature over $T_{op}$	$\Delta R/R$			%	Referenced to $R$ at $T_o$ Note 8
Operating Temperature Range	$T_{op}$			°C	
Frequency Variation with Drive Level $P_{S1}$ to $P_{S2}$	$\Delta f/f$			$10^{-6}$	Note 9
Resistance Variation with Drive Level $P_{S1}$ to $P_{S2}$	$\Delta R/R$			%	Note 9
Motional Inductance	$L_1$			mH	Notes 10, 11
Motional Capacitance	$C_1$			fF	Note 10
Static Capacitance	$C_0$			pF	Note 10
Q Factor	$Q$			-	Notes 10, 12

Characteristics	Symbols	Limits (Note 16)		Units	Remarks
		Min	Max		
Ratio of Unwanted: Response Resistance to Resonance Resistance or Response Impedance to Resonance Resistance	R <sub>p</sub> /R  or  Z <sub>p</sub>  /R			-	From f- to f+ Note 13
Ageing	Δf/f			10 <sup>-6</sup>	Note 14
Type Variant (package)	-			-	See Paras. 1.4.2, 1.6
Intended Application	-			-	Note 15

**NOTES:**

1. Resonance Frequency  
If C<sub>L</sub> is not specified, symbol and measurement shall be f<sub>r</sub>.  
If C<sub>L</sub> is specified, symbol and measurement shall be f<sub>L</sub>.
2. Reference Temperature  
When a crystal unit must function in a non-controlled temperature environment, T<sub>o</sub> is normally +25 ±2°C.
3. Turning Point Temperature  
When a crystal unit must function in a controlled temperature environment (i.e. OCXO), T<sub>TP</sub>, shall be within the limits specified for the T<sub>o</sub> range.  
T<sub>TP</sub> shall be specified for OCXO crystal units in addition to T<sub>o</sub>.
4. Load Capacitance  
When a crystal unit must function at its series resonance frequency, C<sub>L</sub> shall be infinite.  
When a crystal unit must function with a load capacitance, the C<sub>L</sub> value shall be specified.  
When a crystal unit must function with an adjustable load capacitance, the minimum and maximum limits for C<sub>L</sub> shall be specified.  
Note: The tolerance on the value of C<sub>L</sub> shall be that value which results in a frequency change not exceeding 10% of the frequency tolerance at T<sub>o</sub> or 1% of nominal C<sub>L</sub>, whichever is smaller.
5. Rated Drive Level  
The rated drive level shall be selected from the standard drive levels as follows (in μW, ±20%):
  - 250, 200, 100, 50, 20, 10
6. Frequency Adjustment Tolerance  
When a crystal unit must function at its series resonance frequency, the Resonance Frequency, f<sub>r</sub>, measured at T<sub>o</sub> shall be within the tolerance specified. The standard value of the Frequency Adjustment Tolerance shall be ±10 x10<sup>-6</sup>.  
When a crystal unit has to function with a fixed load capacitance, C<sub>L</sub>, the Resonance Frequency, f<sub>L</sub>, measured with this load at T<sub>o</sub> shall be within the tolerance specified. The standard value of the Frequency Adjustment Tolerance shall be ±10 x10<sup>-6</sup>.  
When a crystal unit is required to operate with an adjustable load capacitance, C<sub>L</sub>, with the limits indicated in the Table, the Resonance Frequency, f<sub>L</sub>, shall be adjustable to its correct T<sub>o</sub> value so the Frequency Adjustment Tolerance does not need to be specified.
7. Resonance Resistance  
Generally, the maximum value only is specified. R<sub>L</sub> may be calculated as follows:
  - $R_L = R_r \times \left\{ \frac{C_L + C_0}{C_L} \right\}^2$

8. Frequency and Resistance Variation with Temperature  
Values shall be specified such that they are consistent with the defined operating temperature range,  $T_{op}$ . Variation shall be referenced to the value at  $T_o$ . These characteristics, when required, shall be measured in accordance with Para. 2.3.2 High and Low Temperatures Electrical Measurements of the Detail Specification.
9. Frequency and Resistance Variation with Drive Level  
Values shall only be specified for very high stability crystal units. Variation shall be referenced over the range  $P_{S1}$  to  $P_{S2}$ .
10. These characteristics shall only be specified when required for the correct functioning of the equipment in which the crystal unit is to be used.
11. Motional Inductance  
The Manufacturer shall propose the value of  $L_1$  to meet the Customer's requirements as  $L_1$  may be restricted by other parameters.
12. Q Factor  
If  $R_r$  or  $R_L$  and  $L_1$  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 be specified (i.e. f- to f+).
14. Ageing  
Change in Resonance Frequency limits, the applicable ageing period and the extrapolation method shall be specified.
15. Intended Application  
See ESCC Generic Specification No. 3501, Para. 3 (i.e. XO, TCXO, VCXO, OCXO)
16. For any characteristics where limits are not specified, "Not applicable" shall be entered in the limits column.

1.5 MAXIMUM RATINGS

The maximum ratings shall not be exceeded at any time during use or storage.

Maximum ratings shall only be exceeded during testing to the extent specified in this specification and when stipulated in Test Methods and Procedures of the ESCC Generic Specification.

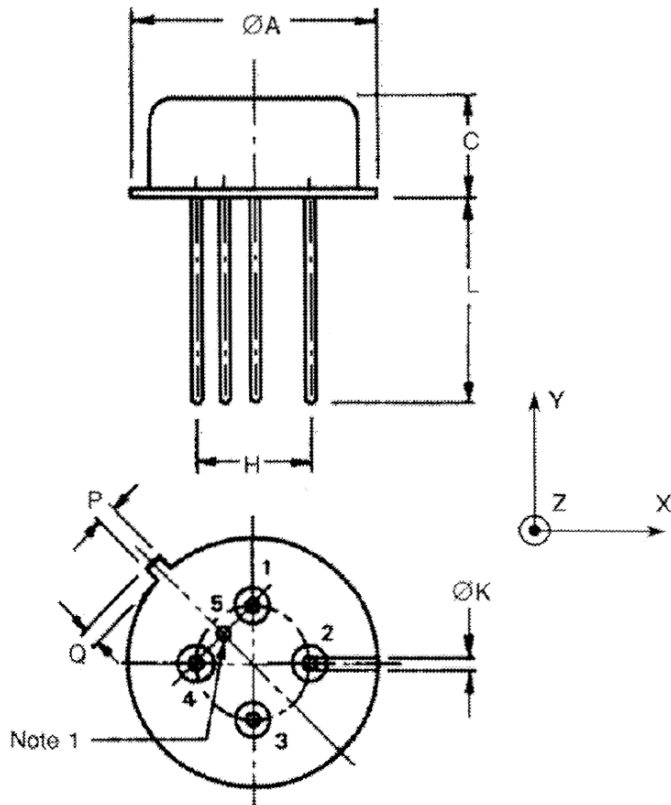
Characteristics	Symbols	Maximum Ratings	Units	Remarks
Rated Drive Level	P	$P_o +20\%$	$\mu W$	Note 1
Operating Temperature Range	$T_{op}$	Note 1	$^{\circ}C$	$T_{amb}$
Storage Temperature Range	$T_{stg}$	-65 to +125	$^{\circ}C$	Note 2
Soldering Temperature	$T_{sol}$	+260	$^{\circ}C$	Note 3

**NOTES:**

1. Actual maximum rating values shall be as specified in the specific Crystal Characteristics Table; see Para. 1.4.3.
2. The duration that a component is held at the maximum storage temperature shall not exceed 16 hours.
3. Duration 10 seconds maximum at a distance  $\geq 3mm$  from the device body and the same lead shall not be resoldered until 3 minutes have elapsed.



1.6 PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION  
5 LEAD METAL CAN

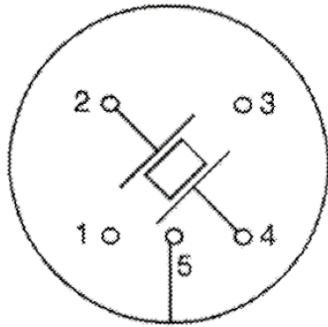


Symbols	Dimensions (mm)		Remarks
	Min	Max	
$\varnothing A$	-	15.75	
C	-	6.9	
H	6.9	7.4	
$\varnothing K$	0.4	0.48	
L	12.7	-	
P	-	0.9	Note 2
Q	-	0.95	Note 2

**NOTES:**

1. Lead 5 is grounded to case.
2. Terminal identification: the crystal is connected between leads 2 and 4.
3. The tab's position or presence is optional.

## 1.7 FUNCTIONAL DIAGRAM



### **NOTES:**

1. As viewed from the bottom.
2. The crystal is connected between leads 2 and 4 (see Para. 1.6).
3. Lead 5 is connected to the case (see Para. 1.6).
4. Lead 1 and 3 are not connected (see Para. 1.6).

## 1.8 MATERIALS AND FINISHES

- (a) Case  
The case shall be hermetically sealed and have a metal body with hard glass seals. The cap shall be copper, nickel plated, or nickel and gold plated. The base shall be kovar, nickel plated, or nickel and gold plated.
- (b) Lead Material and Finish  
See Para. 1.4.2.

## 2 REQUIREMENTS

### 2.1 GENERAL

The complete requirements for procurement of the components specified herein are as stated in this specification and the ESCC Generic Specification. Permitted deviations from the Generic Specification, applicable to this specification only, are listed below.

Permitted deviations from the Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESCC requirement and do not affect the component's reliability, are listed in the appendices attached to this specification.

#### 2.1.1 Deviations from the Generic Specification

None.

2.2 MARKING

The marking shall be in accordance with the requirements of ESCC Basic Specification No. 21700 and as follows.

The information to be marked on the component or its primary package, and the order of precedence shall be:

- (a) The ESCC qualified components symbol (for ESCC qualified components only).
- (b) The ESCC Component Number (see Para. 1.4.1).
- (c) Traceability information.
- (d) Characteristic: Resonance Frequency.

2.2.1 Characteristic: Resonance Frequency

Resonance Frequency shall be marked in MHz. Where necessary, it shall be specified to 6 decimal places.

2.3 ELECTRICAL MEASUREMENTS AT REFERENCE, HIGH AND LOW TEMPERATURES

Unless otherwise specified, measurements shall be performed at the specified  $T_{amb} = T_o \pm 2^\circ\text{C}$ , and, when specified in the specific Crystal Characteristics Table (see Para. 1.4.3), at high and low temperatures over  $T_{op}$ .

For components with OCXO as the intended application (see Para. 1.4.3), unless otherwise specified, measurements shall be performed at the specified Turning Point Temperature  $T_{TP} \pm 1^\circ\text{C}$ .

2.3.1 Reference Temperature Electrical Measurements

Characteristics	Symbols	Test Method and Conditions	Limits		Units
			Min	Max	
Resonance Frequency with $C_0$ : with $C_L$ :	$f_r$ $f_L$	ESCC No. 3501 $T = T_o, P = P_o$	See Para. 1.4.3(b)		
Resonance Resistance with $C_0$ : with $C_L$ :	$R_r$ $R_L$	ESCC No. 3501 $T = T_o, P = P_o$	See Para. 1.4.3(b)		
Resonance Frequency Variation with Drive Level	$\Delta f/f$	ESCC No. 3501 $T = T_o$ $P = P_{S1} \text{ to } P_{S2}$	See Para. 1.4.3(b)		
Resonance Resistance Variation with Drive Level	$\Delta R/R$	ESCC No. 3501 $T = T_o$ $P = P_{S1} \text{ to } P_{S2}$	See Para. 1.4.3(b)		
Motional Inductance	$L_1$	ESCC No. 3501	See Para. 1.4.3(b)		
Static Capacitance	$C_0$	ESCC No. 3501	See Para. 1.4.3(b)		
Unwanted Responses	$R_p/R$ or $ Z_p /R$	ESCC No. 3501	See Para. 1.4.3(b)		
Insulation Resistance	$R_i$	ESCC No. 3501	500	-	$M\Omega$

2.3.2 High and Low Temperatures Electrical Measurements

Characteristics	Symbols	Test Method and Conditions	Limits		Units
			Min	Max	
Resonance Frequency Variation with Temperature over $T_{op}$	$\Delta f/f$	ESCC No. 3501 $P = P_o$	See Para. 1.4.3(b)		
Resonance Resistance Variation with Temperature over $T_{op}$	$\Delta R/R$	ESCC No. 3501 $P = P_o$	See Para. 1.4.3(b)		

2.4 PARAMETER DRIFT VALUE MEASUREMENTS

Unless otherwise specified, the measurements shall be performed at  $T_{amb} = T_o \pm 2^\circ C$ .

The test methods and test conditions shall be as per the corresponding test defined in Para. 2.3.1 Reference Temperature Electrical Measurements.

The drift values ( $\Delta$ ) shall not be exceeded for each characteristic specified. The corresponding absolute limit values for each characteristic shall not be exceeded.

Characteristics	Symbols	Drift Value $\Delta$	Limits		Units
			Absolute		
			Min	Max	
Resonance Frequency Drift	$\Delta f/f$	$\pm 2 \times 10^{-6}$	Para. 2.3.1		
Resonance Resistance Drift	$\Delta R/R$	$\pm 10\%$ or (1) $\pm 1\Omega$	Para. 2.3.1		

**NOTES:**

1. Whichever is greater.

2.5 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

Unless otherwise specified, the measurements shall be performed at  $T_{amb} = T_o \pm 2^{\circ}C$ .

The test methods and test conditions shall be as per the corresponding test defined in Para. 2.3.1 Reference Temperature Electrical Measurements.

The drift values ( $\Delta$ ) shall not be exceeded for each characteristic where specified. The corresponding absolute limit values for each characteristic shall not be exceeded.

Test Reference per ESCC No. 3501	Characteristics	Symbols	Limits		Units
			Min	Max	
Mechanical Shock					
Initial Measurements	Resonance Frequency Resonance Resistance	$f_r$ or $f_L$ $R_r$ or $R_L$	Para. 2.3.1 Para. 2.3.1		
Final Measurements	Resonance Frequency Resonance Frequency Drift Resonance Resistance Resonance Resistance Drift	$f_r$ or $f_L$ $\Delta f/f$ $R_r$ or $R_L$ $\Delta R/R$	Para. 2.3.1 -2   +2 Para. 2.3.1 -10   +10 or (1)   or (1) -1   +1		$\times 10^{-6}$ % $\Omega$
Vibration					
Initial Measurements	Resonance Frequency Resonance Resistance	$f_r$ or $f_L$ $R_r$ or $R_L$	Para. 2.3.1 Para. 2.3.1		
Final Measurements	Resonance Frequency Resonance Frequency Drift Resonance Resistance Resonance Resistance Drift	$f_r$ or $f_L$ $\Delta f/f$ $R_r$ or $R_L$ $\Delta R/R$	Para. 2.3.1 -2   +2 Para. 2.3.1 -10   +10 or (1)   or (1) -1   +1		$\times 10^{-6}$ % $\Omega$

Test Reference per ESCC No. 3501	Characteristics	Symbols	Limits		Units
			Min	Max	
<b>Climatic Sequence</b>					
Dry Heat Initial Measurements	Resonance Frequency	$f_r$ or $f_L$	Para. 2.3.1		
	Resonance Resistance	$R_r$ or $R_L$	Para. 2.3.1		
Final Measurements	Resonance Frequency	$f_r$ or $f_L$	Para. 2.3.1		$\times 10^{-6}$
	Resonance Frequency Drift	$\Delta f/f$	-2	+2	
	Resonance Resistance	$R_r$ or $R_L$	Para. 2.3.1		%
	Resonance Resistance Drift	$\Delta R/R$	-10 or (1) -1	+10 or (1) +1	
Cold Final Measurements	Resonance Frequency	$f_r$ or $f_L$	Para. 2.3.1		$\times 10^{-6}$
	Resonance Frequency Drift (2)	$\Delta f/f$	-2	+2	
	Resonance Resistance	$R_r$ or $R_L$	Para. 2.3.1		%
	Resonance Resistance Drift (2)	$\Delta R/R$	-10 or (1) -1	+10 or (1) +1	
Damp Heat (Remaining Cycles) Final Measurements	Resonance Frequency	$f_r$ or $f_L$	Para. 2.3.1		$\times 10^{-6}$
	Resonance Frequency Drift (2)	$\Delta f/f$	-2	+2	
	Resonance Resistance	$R_r$ or $R_L$	Para. 2.3.1		%
	Resonance Resistance Drift (2)	$\Delta R/R$	-10 or (1) -1	+10 or (1) +1	
	Insulation Resistance	$R_i$	500	-	$\Omega$ $M\Omega$
<b>Rapid Change of Temperature</b>					
Final Measurements	Resonance Frequency	$f_r$ or $f_L$	Para. 2.3.1		$\times 10^{-6}$
	Resonance Frequency Drift (2)	$\Delta f/f$	-2	+2	
	Resonance Resistance	$R_r$ or $R_L$	Para. 2.3.1		%
	Resonance Resistance Drift (2)	$\Delta R/R$	-10 or (1) -1	+10 or (1) +1	

Test Reference per ESCC No. 3501	Characteristics	Symbols	Limits		Units
			Min	Max	
Life					
Initial Measurements (0 hours)	Resonance Frequency Resonance Resistance	$f_r$ or $f_L$ $R_r$ or $R_L$	Para. 2.3.1 Para. 2.3.1		
Daily Measurements (Note 3)	Resonance Frequency	$f_r$ or $f_L$	Para. 1.4.3(b): Ageing		
Intermediate Measurements (500 hours) (Note 4)	Resonance Frequency	$f_r$ or $f_L$	Para. 2.3.1		$\times 10^{-6}$
	Resonance Frequency Drift	$\Delta f/f$	-2	+2	
	Resonance Resistance	$R_r$ or $R_L$	Para. 2.3.1		
	Resonance Resistance Drift	$\Delta R/R$	-10 or (1)	+10 or (1)	
Intermediate (Note 4) and Final Measurements (1000 hours) (Notes 5, 6)	Resonance Frequency	$f_r$ or $f_L$	Para. 2.3.1		$\times 10^{-6}$
	Resonance Frequency Drift	$\Delta f/f$	-2.5	+2.5	
	Resonance Resistance	$R_r$ or $R_L$	Para. 2.3.1		
	Resonance Resistance Drift	$\Delta R/R$	-10 or (1)	+10 or (1)	
Final Measurements (2000 hours) (Note 5)	Resonance Frequency	$f_r$ or $f_L$	Para. 2.3.1		$\times 10^{-6}$
	Resonance Frequency Drift	$\Delta f/f$	-3	+3	
	Resonance Resistance	$R_r$ or $R_L$	Para. 2.3.1		
	Resonance Resistance Drift	$\Delta R/R$	-10 or (1)	+10 or (1)	
			-1	+1	$\Omega$

**NOTES:**

1. Whichever is greater.
2. The final measurements from the previous test shall be used as initial values.
3. Only applicable to components with OCXO as the intended application (see Para. 1.4.3). Daily measurements with a minimum of 4 measurements recorded per week. The daily measurements of Resonance Frequency shall be extrapolated to verify the specified Ageing requirement (see Para. 1.4.3).
4. Intermediate Measurements at 500h and 1000h shall not be performed on components with OCXO as the intended application.
5. 1000 hours intermediate measurements and 2000 hours final measurements are applicable to Qualification Testing, and to Periodic Testing for renewal of qualification after lapse.
6. 1000 hours final measurements are applicable to Periodic Testing for extension of qualification.

**APPENDIX A**  
**AGREED DEVIATIONS FOR RAKON (F)**

ITEMS AFFECTED	DESCRIPTION OF DEVIATIONS
Para. 2.1.1, Deviations from the Generic Specification: Deviations from Screening Tests - Chart F3	Mechanical Shock: shall not be performed.
	Radiographic Inspection: shall not be performed.