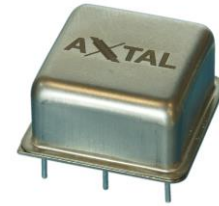


Specification	AXIOM75SL	Rev.: 2	Date: 2021-06-24
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**Oscillator type: Ultra-Low Phase Noise 10 MHz OCXO for Space Application (Space COTS version)**

**Features:**

- Lower cost Commercial Off-The-Shelf version (COTS)
- Dedicated for LEO applications
- Manufactured according to MIL-PRF-55310 Level "S"
- Radiation hardened – 10 krad(Si) total dose (TID)
- Radiation hardened – SEL immunity
- ITAR Free – Manufactured in Germany
- Ultra-Low Phase Noise
- High Frequency Stability and Very Low Aging
- Hermetical sealed THD package
- Short lead time



**Models:**

Item	Engineering Model (EM)	Flight Model (FM)	Lot Acceptance Test Model (LAT)
Quartz Crystal	Synthetic HiQ Quartz, SC-cut, HC-43/U	Synthetic HiQ Quartz, SC-cut, HC-43/U	Synthetic HiQ Quartz, SC-cut, HC-43/U
Electrical Components	COTS parts	COTS parts Automotive Grade and/or HighRel Heritage	COTS parts Automotive Grade and/or HighRel Heritage
Mechanical Components	Stainless steel package with Ni finish	Stainless steel package with Ni finish	Stainless steel package with Ni finish
Workmanship (Soldering)	IPC610 Class 3	ECSS-Q-ST-70-08C and ECSS-Q-ST-70-38C	ECSS-Q-ST-70-08C and ECSS-Q-ST-70-38C
Rad Hard	-	10 krad(Si) TID	10 krad(Si) TID
Acceptance Testing			
Screening	Testing according to IEC60679-1 and MIL-PRF-55310	X	X
Group-A		X	X
Group-B		X	X
Group-C		-	X

**Ordering Code:**

Model	Product category	Revision	Frequency [MHz]
AXIOM75SL	EM FM LAT	Rev.2	10.000

Example: AXIOM75SL-FM\_Rev.2 – 10.000 MHz

## **0. Contents:**

- 1. Electrical specification**
- 2. Mechanical specification**
- 3. Applicable documents**
- 4. General flow of manufacturing**
- 5. Acceptance Testing**
  - 5.1 Screening**
  - 5.2 Group A inspection**
  - 5.3 Group B inspection**
  - 5.4 Group C inspection**
  - 5.5 Electrical measurements**
- 6. Radiation**
- 7. Components, Materials and Processes**
- 8. Marking**
- 9. Data Documentation**
- 10. Handling, Packaging and Delivery**
- 11. Specification History**

## 1. Electrical specification

Parameter	Min.	Typ.	Max.	Unit	Condition
Nominal frequency (Note 3)	10.000			MHz	
<b>Frequency stability</b>					
Initial tolerance @ +25°C		±50	±100	ppb	V <sub>c</sub> @ VREF/2
vs. operating temperature range			±10	ppb	
vs. supply voltage variation			±5	ppb	V <sub>s</sub> ±5%
vs. load change			±5	ppb	R <sub>L</sub> ±10%
Long term (aging) per day		±0.1	±0.5	ppb	after 30 days operation
Long term (aging) 1 <sup>st</sup> year		±20	±50	ppb	after 30 days operation
<b>Frequency adjustment range</b>					
Electronic Frequency Control (EFC)	±0.4	±0.7		ppm	
EFC voltage V <sub>c</sub>	0	VREF/2	VREF	V	
EFC slope (Δf / ΔV <sub>c</sub> )	Positive				
EFC input impedance	100			kΩ	
<b>RF output</b>					
Signal waveform	Sine wave				
Load R <sub>L</sub>	50			Ω	±10%
Output level	+8	+10	+12	dBm	
Harmonics			-30	dBc	
Spurious			-90	dBc	
Warm-up time @ +25°C			3	min	Δf/f <sub>0</sub> < ±100 ppb
Phase noise			-105	dBc/Hz	@ 1 Hz
			-135	dBc/Hz	@ 10 Hz
			-150	dBc/Hz	@ 100 Hz
			-155	dBc/Hz	@ 1 kHz
			-160	dBc/Hz	@ ≥10 kHz
Short term stability (Allan deviation)		2·10 <sup>-12</sup> 2·10 <sup>-12</sup> 3·10 <sup>-12</sup>	5·10 <sup>-12</sup> 5·10 <sup>-12</sup> 1·10 <sup>-11</sup>		τ = 1 s τ = 10 s τ = 100 s
Reference voltage VREF output		5.0		V	Load ≥ 10 kΩ
Supply voltage V <sub>s</sub>	11.4	12.0	12.6	V	
Current consumption (steady state)			150	mA	@ +25°C
Current consumption (warm-up)			350	mA	
Operating temperature range	-20		+70	°C	

Table 1 – Electrical Performance and Characteristics

### Notes:

- Terminology and test conditions are according to IEC60679-1 and MIL-PRF-55310 unless otherwise stated
- Classification (MIL-PRF-55310): Type 4 (OCXO), Class 1 (Discrete Technology), Product Level "S"
- Other frequencies on request

## Absolute Maximum Ratings

Parameter	Min.	Max.	Unit	Condition / Remark
Supply Voltage V <sub>s</sub>	-0.5	V <sub>s</sub> + 10%	V	V <sub>s</sub> to GND
Control Voltage V <sub>c</sub>	-0.5	15	V	V <sub>s</sub> to GND
Load R <sub>L</sub>	0	∞	Ω	Must not cause any damage
Operable temperature range	-40	+80	°C	Operation of unit without any damage
Storage temperature range	-55	+105	°C	-

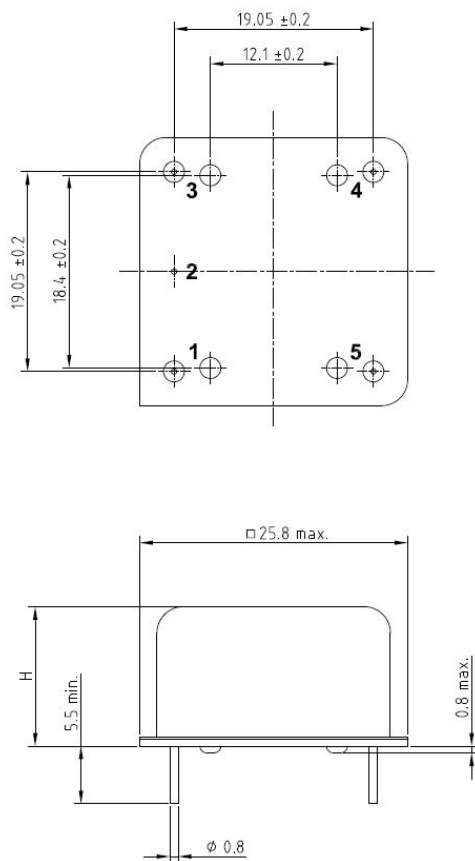
Table 2 – Maximum Ratings

## 2. Mechanical specification

Parameter	Min.	Typ.	Max.	Unit	Condition
Enclosure (see drawing) (LxWxH)	25.8x25.8x12.7 max.			mm	IEC 60679-3 CO 43
Weight			20	g	
Case material	Stainless steel			-	
Case finish	Cover: Stainless steel blank Header: Ni 8 μm			-	
Pins	Glass / Kovar SnPb solder dipped			-	

Table 3 – Mechanical specification

## Enclosure drawing



### Pin connections

Pin #	Symbol	Function
1	RF OUT	RF Output
2	GND	Ground
3	V <sub>C</sub>	Control Voltage (EFC)
4	VREF	Reference Voltage
5	V <sub>S</sub>	Supply Voltage

### 3. Applicable documents

The following specifications and standards are part of this specification:

ECSS-Q-ST-70-08C	The manual soldering of high-reliability electrical connections
ECSS-Q-ST-70-38C	High-reliability soldering for surface-mount and mixed technology
ESCC21300	Terms, Definitions, Abbreviations, Symbols and Units
ESCC21700	General Requirements for the marking of ESCC components
MIL-STD-55310	General specification for crystal-controlled oscillators
MIL-STD-202	Test Method Standard for electronic and electrical component parts
MIL-STD-883	Test Method Standard for Microcircuits
IEC 60679-1	Quartz crystal-controlled oscillators of assessed quality Part 1: Generic specification

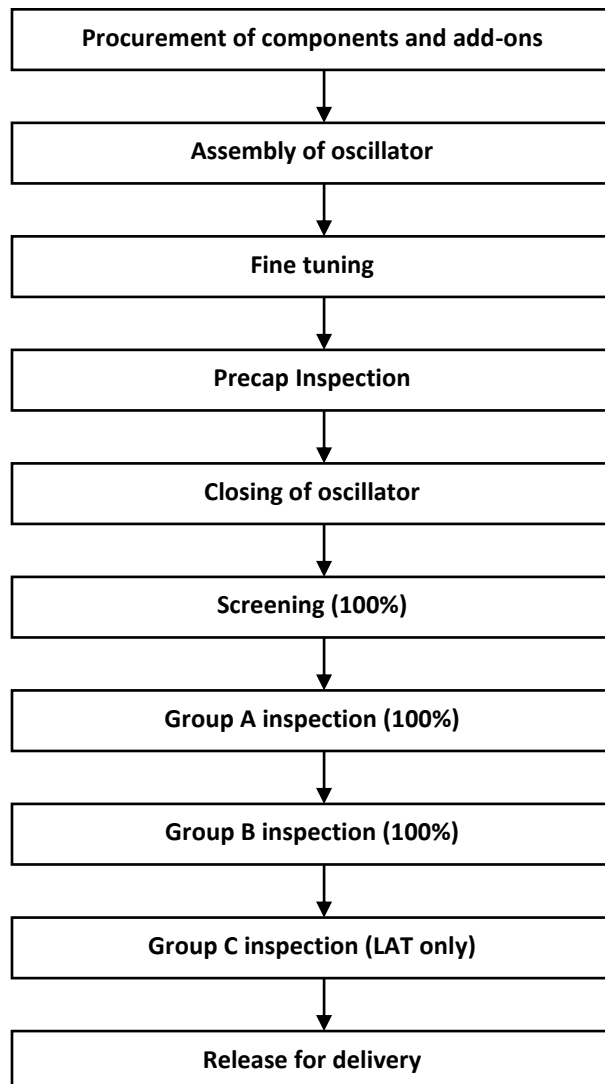
### Order of precedence

In the event of a conflict between the text of this specification and the references cited herein, the order of precedence shall be as follows:

- (1) Purchase order
- (2) Oscillator detail specification AXIOM75SL
- (3) Generic specification MIL-PRF-55310
- (4) Other documents

#### 4. General flow of manufacturing

The figure below shows the overall flow for manufacturing:



## 5. Acceptance Testing

### 5.1 Screening

Table 4 shows the screening procedure according to MIL-PRF-55310 Product level "S".

#	Test	Reference
1	Electrical measurements at room temperature (Initial)	IEC 60679-1 (see Table 1)
2	Random Vibration	MIL-STD-202, Method 214, Condition 1-B
3	Thermal Shock	MIL-STD-202, Method 107, Condition A-1
4	Electrical measurements at room temperature (Interim)	IEC 60679-1 (see Table 1)
5	Burn-in (load)	MIL-PRF-55310
6	Electrical measurements at room temperature (Final)	IEC 60679-1 (see Table 1)
7	Electrical measurements at high and low temperature	IEC 60679-1 (see Table 1)
8	Seal Test – Gross Leak	MIL-STD-202, Method 112, Condition D
9	Radiographic Inspection (Note 1)	MIL-STD-202, Method 209
10	External Visual Inspection	ESCC20500 / MIL-STD-883 Method 2009

**Table 4 – Screening procedure**

**Notes:**

1. May be performed at any point during the test sequence

Table 5 shows the detailed test conditions for each step in table 4.

#	Test	Test Condition
1	Electrical measurements at room temperature (Initial)	@ T <sub>amb</sub> = 25°C±3°C (unless otherwise stated) Table 11
2	Random Vibration	50~100 Hz +6 dB/Oct, 100~1000 Hz 0.04 g <sup>2</sup> /Hz, 1~2 kHz -6 dB/Oct RMS = 7.56 g, 5 minutes per axis
3	Thermal Shock	-40 to +80°C, 25 cycles, max. 5 minutes transfer time, 15 minutes dwell time
4	Electrical measurements at room temperature (Interim)	@ T <sub>amb</sub> = 25°C±3°C (unless otherwise stated) Table 11
5	Burn-in (load)	@ T = +85°C for 10 days (nominal V <sub>s</sub> and Load) Drift: Δf/f < ±1 ppm and ±5 % current consumption (steady state)
6	Electrical measurements at room temperature (Final)	@ T <sub>amb</sub> = 25°C±3°C (unless otherwise stated) Table 11
7	Electrical measurements at high and low temperature	@ T = -30°C, +25°C, +70°C with ±1°C tolerance Limits: See Table 1
8	Seal Test – Gross Leak	No bubbles allowed
9	Radiographic Inspection	1 view Y-direction (perpendicular to largest surface) 1 view 90° to Y-direction
10	External Visual Inspection	ESCC20500 / MIL-STD-883 Method 2009

**Table 5 – Detailed test conditions for screening procedure**

## 5.2 Group A inspection

Table 6 shows the Group A inspection procedure.

Test	Reference	Test condition
Group A inspection	MIL-PRF-55310, Clause 4.7.1.4	Table V, Product level "S"

Table 6 – Group A inspection procedure

**Notes:**

- Electrical measurements performed during screening are not repeated during Group A inspection

## 5.3 Group B inspection (Aging)

Table 7 shows the Group B inspection procedure.

#	Test	Reference
1	Aging test	MIL-PRF-55310, Clause 4.7.1.5 Product level "S"
2	Electrical measurements at room temperature (Final)	IEC 60679-1 (see Table 1)

Table 7 – Group B inspection procedure

Table 8 shows the detailed test conditions for each step in table 7.

#	Test	Test Condition
1	Aging test	@ T <sub>amb</sub> = 30°C±3°C for 30 days (nominal V <sub>s</sub> and Load) Frequency measurement every hour Limits Aging: See Table 1
2	Electrical measurements at room temperature (Final)	@ T <sub>amb</sub> = 25°C±3°C (unless otherwise stated) Table 11

Table 8 – Detailed test conditions for Group B inspection procedure



## 5.4 Group C inspection

Table 9 shows the Group C inspection procedure.

#	Test	Reference
1	Random Vibration	MIL-STD-202, Method 214, Condition G
2	Mechanical Shock	MIL-STD-202, Method 213, Condition C
3	Thermal Shock	MIL-STD-202, Method 107, Condition B-1
4	High Temperature Storage	Detail specification
5	Electrical measurements at room temperature (Final)	IEC 60679-1 (see Table 1)
6	Seal Test – Gross Leak	MIL-STD-202, Method 112, Condition D
7	External Visual Inspection	ESCC20500 / MIL-STD-883 Method 2009

**Table 9 – Group C inspection procedure**

**Notes:**

1. Group C inspected LAT parts are end of life and shall not be used as flight models

Table 10 shows the detailed test conditions for each step in table 9.

#	Test	Test Condition
1	Random Vibration	50~100 Hz +6 dB/Oct, 100~1000 Hz 0.4 g <sup>2</sup> /Hz, 1~2 kHz -6 dB/Oct RMS = 23.9 g, 3 minutes per axis
2	Mechanical Shock	100 g, 6 ms, half sine, 3 shocks per axis
3	Thermal Shock	-55 to +125°C, 25 cycles, max. 5 minutes transfer time, 15 minutes dwell time
4	High Temperature Storage	24 hours at +85°C, min. 2 hours at T <sub>amb</sub>
5	Electrical measurements at room temperature (Final)	@ T <sub>amb</sub> = 25°C±3°C (unless otherwise stated) Table 11
6	Seal Test – Gross Leak	No bubbles allowed
7	External Visual Inspection	ESCC20500 / MIL-STD-883 Method 2009

**Table 10 – Detailed test conditions for Group C inspection procedure**

## 5.5 Electrical measurements

Table 11 shows all electrical measurements with its respective conditions and limits, which are performed for all models. If not otherwise stated all measurements are performed at  $T_{amb} = 25^{\circ}\text{C} \pm 3^{\circ}\text{C}$  and after a sufficient stabilization time.

#	Parameter	Test Method	Conditions	Initial / Interim	Final	Limits
1	Initial frequency	IEC 60679-1	$V_S = 12\text{ V}, R_L = 50\ \Omega$	X	X	Table 1
2	Output level	IEC 60679-1	$V_S = 12\text{ V}, R_L = 50\ \Omega$	X	X	Table 1
3	Current consumption (steady state)	IEC 60679-1	$V_S = 12\text{ V}, R_L = 50\ \Omega$	X	X	Table 1
4	Current consumption (warm-up)	IEC 60679-1	$V_S = 12\text{ V}, R_L = 50\ \Omega$	X	X	Table 1
5	Tuning range	IEC 60679-1	$V_S = 12\text{ V}, R_L = 50\ \Omega$	-	X	Table 1
6	Phase noise	IEC 60679-1	$V_S = 12\text{ V}, R_L = 50\ \Omega$	-	X	Table 1
7	Harmonics	IEC 60679-1	$V_S = 12\text{ V}, R_L = 50\ \Omega$	-	X	Table 1
8	Spurious	IEC 60679-1	$V_S = 12\text{ V}, R_L = 50\ \Omega$	-	X	Table 1
9	Short-term stability (ADEV)	IEC 60679-1	$V_S = 12\text{ V}, R_L = 50\ \Omega$	-	X	Table 1
10	Warm-up @ +25°C	IEC 60679-1	$V_S = 12\text{ V}, R_L = 50\ \Omega$	-	X	Table 1

Table 11 – Electrical measurements

## 6. Radiation

The oscillator is capable of meeting all electrical performance requirements after exposure to a total ionizing dose (TID) of 10 krad(Si). The OCXO is based on a Space COTS approach, where the OCXO design incorporates only bipolar technology for the active components, making the OCXO SEL immune. The possible SET effects cannot degrade the oscillator performance due to the used circuitry. The radiation performance can be verified by a radiation test (Co 60) on request.

## 7. Components, Materials and Processes

The FM and LAT models are built on the basis of the following requirements for components, materials and processes:

- All add-on components are specially-selected commercial off-the-shelf (COTS) versions. The used active components are automotive qualified in accordance with AEC-Q100/200 and/or have a long HighRel heritage (>10 years, several thousand pieces, no failure) in many products with MIL-PRF-55310 Product Level "B" or "S".
- The crystal is made of synthetic high Q quartz material with low inclusion density and low etch channel density (according to IEC 60758). The quartz crystal has a hermetically sealed package.
- Soldering is done by ESA approved personal in accordance with ECSS-Q-ST-70-08C (manual soldering) and ECSS-Q-ST-70-38C (surface mount and mixed technology).
- No pure tin is used inside the oscillator, as package or lead finish.
- The printed circuit board (PCB) is commercially procured.
- The marking is resistant to Zestron VD, Isopropyl alcohol (99% pure) and Ethyl alcohol (99.5% pure), tested in accordance with ESCC24800.

## 8. Marking

The marking of the parts is accordance with ESCC21700. The content is as follows:

- (1) Company Logo AXTAL
- (2) Part number AXTAL (according to order code)
- (3) Part number Customer (on request)
- (4) Nominal frequency
- (5) Serial number
- (6) Date Code

## 9. Data Documentation

### General

With each delivery the following data documentation package is supplied:

- (1) Cover sheet
- (2) Certificate of Conformity (CoC)
- (3) Test data (full report of all inspections)

The following additional documents can be delivered on request:

- Declared Component List
- Equipment List (Testing & Measuring)
- Product Reliability Analysis (MTBF calculation)
- Radiation Report

### Certificate of Conformity

The certificate includes the following content:

- Full company information (Logo, Name, Address)
- Type and specification (part number and revision)
- Nominal frequency
- Number of purchase order
- Lot identification
- Range of serial numbers
- Number of delivered parts
- Authorized signature in behalf of manufacturer (including stamp and date)

## 10. Handling, Packaging and Delivery

- Some add-ons are susceptible to damage by electrostatic discharge. Therefore, suitable ESD precautions for handling during use and manufacturing must be employed.
- In order to minimize the risk of damage, all kinds of shock during handling and manufacturing must be avoided.
- The parts are packaged in a way to ensure adequately safeguarding against mechanical and electrical injury and deterioration due to humidity.
- The primary package is labeled as ESD sensitive component.

## 11. Specification History

Rev.	Drawing	Date [dd.mm.yyyy]	Remarks	Author	Checked
1	D0	16.02.2018	First issue	HH	BN
2	D0	23.06.2021	Various parameters and information updated	HH	BN
2	D1	24.06.2021	Minor editorial changes	HH	BN