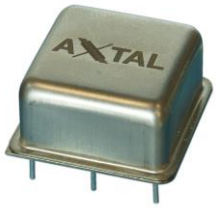
Specification	AXIOM75SL	Rev.: 4	Date: 2022-02-02

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 – 40 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)
Quartz Crystal	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
Mechanical Components	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
Rad Hard	-	40 krad(Si) TID
Acceptance Testing		
Screening	Test procedure as commercial models	X
Group-B		X

Ordering Code:

Model	Product category	Revision	Frequency [MHz]
AXIOM75SL	EM FM	Rev.4	10.000

Example: AXIOM75SL-FM_Rev.4 – 10.000 MHz

0. Contents:

1. Electrical specification

Parameter	Min.	Typ.	Max.	Unit	Condition
Nominal frequency (Note 3)		10.000		MHz	
Frequency stability					
Initial tolerance @ +25°C		±50	±100	ppb	V_C @ VREF/2
vs. operating temperature range			±10	ppb	
vs. supply voltage variation			±5	ppb	V_S ±5%
vs. load change			±5	ppb	R_L ±10%
Long term (aging) per day		±0.1	±0.5	ppb	after 30 days operation
Long term (aging) 1st year		±20	±50	ppb	after 30 days operation
vs. radiation			±400	ppb	(Note 5)
Frequency adjustment range					
Electronic Frequency Control (EFC)	±0.4	±0.7		ppm	(Note 4, 5)
EFC voltage V_C	0	VREF/2	VREF	V	
EFC slope ($\Delta f / \Delta V_C$)		Positive			
EFC input impedance	100			kΩ	
EFC modulation bandwidth			10	Hz	Filtered EFC input
RF output					
Signal waveform		Sine wave			
Load R_L		50		Ω	±10%
Output level	+8	+10	+12	dBm	
Output level change vs. radiation			±1	dB	(Note 5)
Harmonics			-30	dBc	
Spurious			-90	dBc	
Warm-up time @ +25°C			3	min	$\Delta f/f_0 < \pm 100$ ppb
Phase noise @ 10 MHz (Note 5)			-105 -135 -150 -155 -160	dBc/Hz dBc/Hz dBc/Hz dBc/Hz dBc/Hz	@ 1 Hz @ 10 Hz @ 100 Hz @ 1 kHz @ ≥10 kHz
Short term stability (Allan deviation)		$2\cdot10^{-12}$ $2\cdot10^{-12}$ $3\cdot10^{-12}$	$5\cdot10^{-12}$ $5\cdot10^{-12}$ $1\cdot10^{-11}$		τ = 1 s τ = 10 s τ = 100 s
Reference voltage VREF output		10.0		V	Load ≥ 10 kΩ
Supply voltage V_S	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:

1. Terminology and test conditions are according to IEC60679-1 and MIL-PRF-55310 unless otherwise stated
2. Classification (MIL-PRF-55310): Type 4 (OCXO), Class 1 (Discrete Technology), Product Level "S"
3. Other frequencies on request
4. Tuning range is sufficient to compensate for initial tolerance, temperature stability, load & supply change, aging over 10 years and change due to radiation.
5. Radiation of 40 krad(Si) total dose (TID). Radiation low dose test of OCXO series was performed up to 50 krad. Please consult factory for radiation report. Better frequency stability and lowest phase noise degradation vs. radiation is available with swept or pre-irradiated Quartz material on request.

Absolute Maximum Ratings

Parameter	Min.	Max.	Unit	Condition / Remark
Supply Voltage V_S	-0.5	V_S + 10%	V	V_S to GND
Control Voltage V_C	-0.5	15	V	V_S to GND
Load R_L	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	-

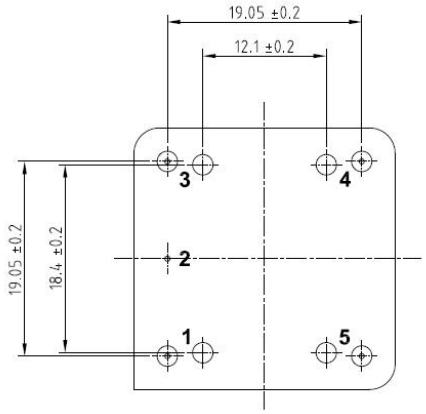
Table 2 – Maximum Ratings

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		-	

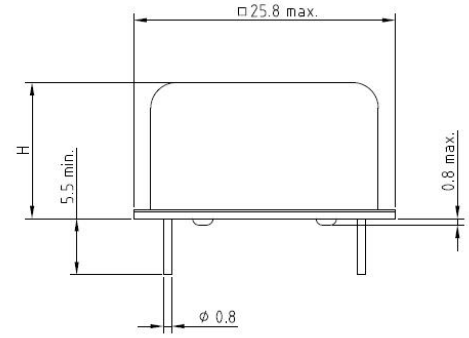
Table 3 – Mechanical specification

Enclosure drawing



Pin connections

Pin #	Symbol	Function
1	RF OUT	RF Output
2	GND	Ground
3	V_C	Control Voltage (EFC)
4	VREF	Reference Voltage
5	V_S	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

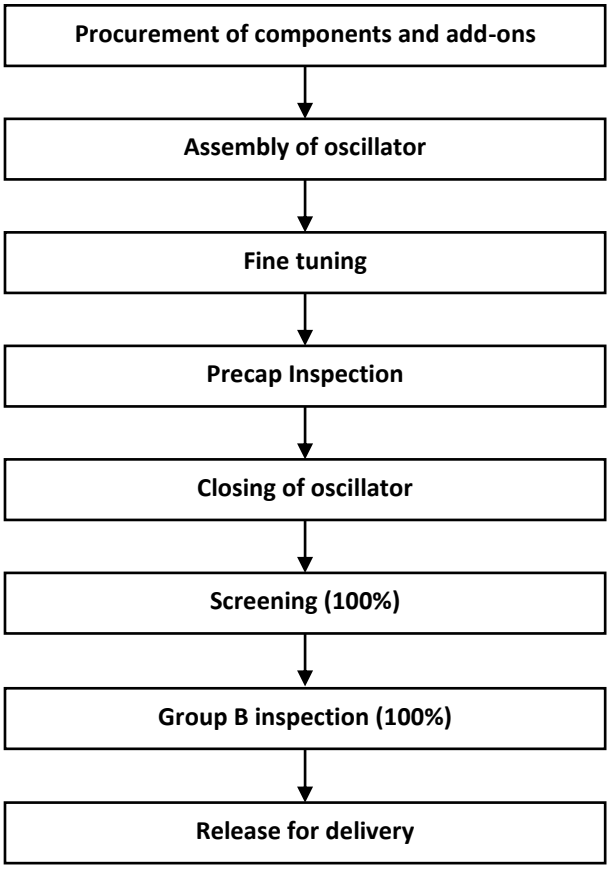
(2) Oscillator detail specification AXIOM75SL

(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	Thermal Shock	MIL-STD-202, Method 107, Condition A-1
3	Burn-in (load) *1	MIL-PRF-55310
4	Seal Test – Gross Leak	MIL-STD-202, Method 112, Condition D
5	Electrical measurements vs. temperature	IEC 60679-1 (see Table 1)
6	Electrical measurements at room temperature (Final)	IEC 60679-1 (see Table 1)
7	External Visual Inspection	ESCC20500 / MIL-STD-883 Method 2009

Table 4 – Screening procedure

Notes:

1. Burn-in can be performed at any step after assembly and is usually performed as pre-aging procedure

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

#	Test	Test Condition
1	Electrical measurements at room temperature (Initial)	@ T_{amb} = 25°C±3°C (unless otherwise stated) Table 8
2	Thermal Shock	-40 to +80°C, 25 cycles, max. 5 minutes transfer time, 15 minutes dwell time
3	Burn-in (load)	@ T = +85°C for 10 days (nominal V_S and Load)
4	Seal Test – Gross Leak	No bubbles allowed
5	Electrical measurements vs. temperature	@ T = -30 to +70°C, 10°C steps with ±1°C tolerance Limits: See Table 1
6	Electrical measurements at room temperature (Final)	@ T_{amb} = 25°C±3°C (unless otherwise stated) Table 8
7	External Visual Inspection	ESCC20500 / MIL-STD-883 Method 2009

Table 5 – Detailed test conditions for screening procedure

5.2 Group B inspection (Aging)

Table 6 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 6 – Group B inspection procedure

Notes:

1. Group B inspection may be performed before or after screening procedure. Final electrical measurements are only performed once after completion of screening and Group B inspection.

Table 7 shows the detailed test conditions for each step in table 6.

#	Test	Test Condition
1	Aging test	@ T_{amb} = 30°C±3°C for 30 days (nominal V_S and Load) Frequency measurement every hour Limits Aging: See Table 1
2	Electrical measurements at room temperature (Final)	@ T_{amb} = 25°C±3°C (unless otherwise stated) Table 8

Table 7 – Detailed test conditions for Group B inspection procedure

5.3 Electrical measurements

Table 8 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°C ± 3°C and after a sufficient stabilization time.

#	Parameter	Test Method	Conditions	Initial	Final	Limits
1	Initial frequency	IEC 60679-1	V_S = 12 V, R_L = 50 Ω	X	X	Table 1
2	Output level	IEC 60679-1	V_S = 12 V, R_L = 50 Ω	X	X	Table 1
3	Current consumption (steady state)	IEC 60679-1	V_S = 12 V, R_L = 50 Ω	X	X	Table 1
4	Current consumption (warm-up)	IEC 60679-1	V_S = 12 V, R_L = 50 Ω	X	X	Table 1
5	Tuning range			-	X	
6	Phase noise	IEC 60679-1	V_S = 12 V, R_L = 50 Ω	-	X	Table 1
7	Harmonics	IEC 60679-1	V_S = 12 V, R_L = 50 Ω	-	X	Table 1
8	Spurious	IEC 60679-1	V_S = 12 V, R_L = 50 Ω	-	X	Table 1

Table 8 – Electrical measurements

6. Radiation

The oscillator is capable of meeting all electrical performance requirements after exposure to a total ionizing dose (TID) of 40 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 has been verified by a radiation test (Co 60) up to 50 krad(Si) and the radiation report is available 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 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) Certificate of Conformity (CoC)

(2) 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
3	D0	05.08.2021	VREF and tuning voltage range changed	HH	ME
4	D0	27.01.2022	Major update: screening & inspection procedures updated, radiation level increased and various radiation data added, various other updates	HH	BN
4	D1	02.02.2022	Minor correction table “Models”	HH	HH