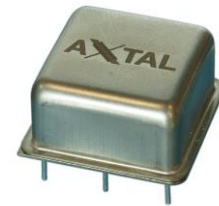


Specification	AXIOM70SL	Rev.: 2	Date: 2022-02-02
----------------------	------------------	---------	------------------

Oscillator type: Ultra-Low Phase Noise 10 MHz OCXO with HCMOS output 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)
- 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	-	10 krad(Si) TID
Acceptance Testing		
Screening	Test procedure as commercial models	X
Group-B		X

Ordering Code:

Model	Product category	Revision	Frequency [MHz]
AXIOM70SL	EM FM	Rev.2	10.000

Example: AXIOM70SL-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 B inspection**
 - 5.3 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	
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) 1 st year		±20	±50	ppb	after 30 days operation
Frequency adjustment range					
Electronic Frequency Control (EFC)	±0.5	±0.8		ppm	
EFC voltage V _c	0	VREF/2	VREF	V	
EFC slope (Δf / ΔV _c)	Positive				
EFC input impedance	100			kΩ	
RF output					
Signal waveform	HCMOS				
Load R _L	15			pF	±10%
Symmetry (duty cycle)	40		60	%	@ V _s /2
Rise & decay time			5	ns	@ 10% ~ 90% V _s
Spurious			-90	dBc	
Warm-up time @ +25°C			3	min	Δf/f ₀ < ±100 ppb
Phase noise @ 10 MHz		-105	-100	dBc/Hz	@ 1 Hz
		-135	-130	dBc/Hz	@ 10 Hz
		-155	-150	dBc/Hz	@ 100 Hz
		-163	-155	dBc/Hz	@ 1 kHz
		-165	-155	dBc/Hz	@ ≥10 kHz
Short term stability (Allan deviation)		3·10 ⁻¹²	5·10 ⁻¹²		τ = 1 s
		3·10 ⁻¹²	5·10 ⁻¹²		τ = 10 s
		4·10 ⁻¹²	1·10 ⁻¹¹		τ = 100 s
Reference voltage VREF output		4.0		V	Load ≥ 10 kΩ
Supply voltage V _s	4.75	5.0	5.25	V	
Current consumption (steady state)			250	mA	@ +25°C
Current consumption (warm-up)			600	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

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	-

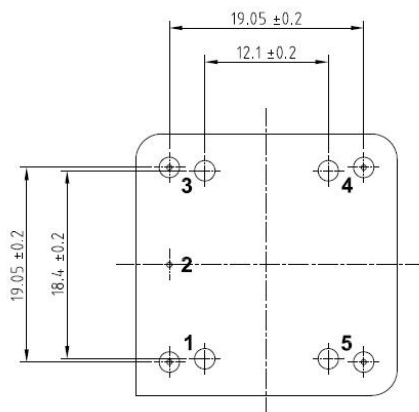
Table 2 – Maximum Ratings

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			-	

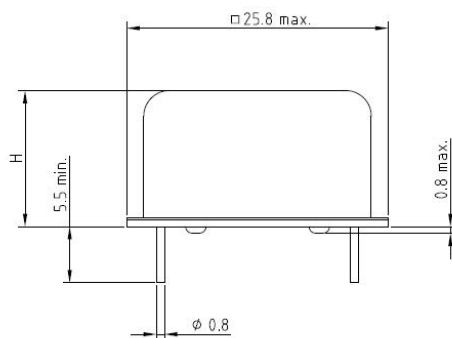
Table 3 – Mechanical specification

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

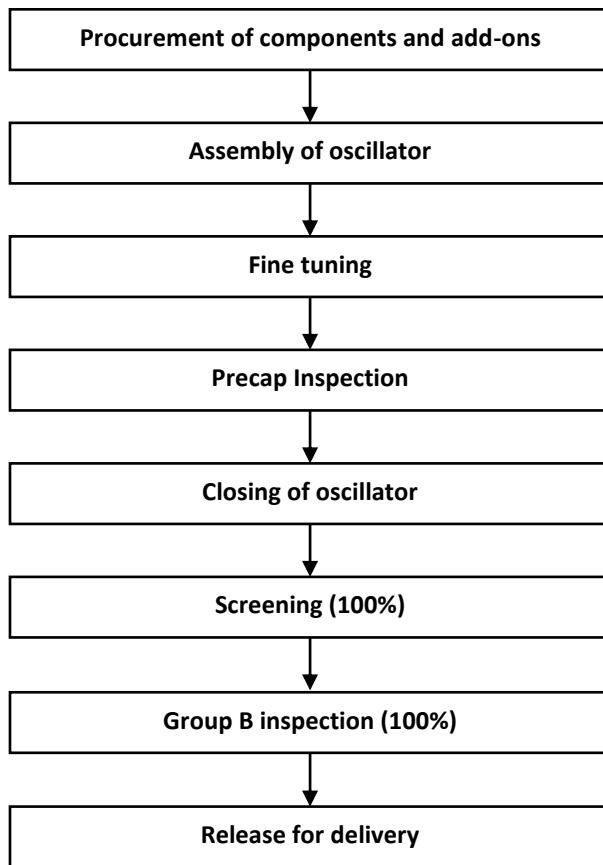
Order of precedence

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 AXIOM70SL
- (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:

- 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	@ $T_{amb} = 30^{\circ}\text{C} \pm 3^{\circ}\text{C}$ for 30 days (nominal V_S and Load) Frequency measurement every hour Limits Aging: See Table 1
2	Electrical measurements at room temperature (Final)	@ $T_{amb} = 25^{\circ}\text{C} \pm 3^{\circ}\text{C}$ (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 $T_{amb} = 25^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and after a sufficient stabilization time.

#	Parameter	Test Method	Conditions	Initial	Final	Limits
1	Initial frequency	IEC 60679-1	$V_S = 5\text{ V}$, $R_L = 15\text{ pF}$	X	X	Table 1
2	Output level	IEC 60679-1	$V_S = 5\text{ V}$, $R_L = 15\text{ pF}$	X	X	Table 1
3	Current consumption (steady state)	IEC 60679-1	$V_S = 5\text{ V}$, $R_L = 15\text{ pF}$	X	X	Table 1
4	Current consumption (warm-up)	IEC 60679-1	$V_S = 5\text{ V}$, $R_L = 15\text{ pF}$	X	X	Table 1
5	Tuning range		$V_S = 5\text{ V}$, $R_L = 15\text{ pF}$	-	X	
6	Phase noise	IEC 60679-1	$V_S = 5\text{ V}$, $R_L = 15\text{ pF}$	-	X	Table 1
7	Harmonics	IEC 60679-1	$V_S = 5\text{ V}$, $R_L = 15\text{ pF}$	-	X	Table 1
8	Spurious	IEC 60679-1	$V_S = 5\text{ V}$, $R_L = 15\text{ pF}$	-	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 10 krad(Si). The OCXO is based on a Space COTS approach, where the OCXO design incorporates mixed semiconductor technology (bipolar & CMOS) for the active components. Thus, no explicit levels for SEL or SET can be guaranteed. The radiation performance can be verified by a TID / SEE radiation test 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)

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	27.02.2022	Major update: screening & inspection procedures updated, various data added and updated	HH	HH
2	D1	02.02.2022	Minor correction table "Models"	HH	HH