Specification	**AXLE45SHM**	Rev.: 1	Date: 2026-06-06

Oscillator type: **Low Phase Noise 50~100 MHz TCXO in DIL14/4-pin package for Space Application (Space COTS – SnPb version without pure tin)**

Features:

- **Lower cost Commercial Off-The-Shelf version (COTS)**
- **Dedicated for LEO~MEO applications**
- **Manufactured according to MIL-PRF-55310 Level "S"**
- **Radiation hardened – 40 krad(Si) total dose (TID)**
- **Radiation hardened – SEL immune > 90 MeV**
- **ITAR Free – Manufactured in Europe**
- **Low Phase Noise**
- **High Frequency Stability**
- **Hermetical sealed DIL14/4-pin mm low profile package**
- **Full tin whisker mitigation – No pure tin used**

Models:

Item	Engineering Model (EM)	Flight Model (FM)	Note
Quartz Crystal	Synthetic HiQ Quartz, AT-cut	Synthetic HiQ Quartz, AT-cut	1
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	Hybrid manufacturing + IPC610 Class 3	Hybrid manufacturing + IPC610 Class 3	-
Rad Hard	-	40 krad(Si) TID	2
Acceptance Testing			
Screening	Test procedure as commercial models	X	3
Group-B		X	-
Group-C	-	On request	4

Notes:

1. Swept Quartz material available on request.
2. Tested up to 50 krad and SEE tested up to 125 MeV·cm²/mg
3. Screening procedure can be modified IAW customer requirements.
4. Group-C (LAT) can be performed based on customer requirements.

Ordering Code:

Model	Product category	Options	Revision	Frequency [MHz]
AXLE45SHM	EM FM	See table 1	Rev.1	50.000 ~ 100.000

Example: AXLE45SHM-FM-V_Rev.1 – 100.000 MHz

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11. Specification History

1. Electrical specification

Parameter	min.	typ.	max.	Unit	Condition
Frequency range (Note 3)	50		100	MHz	Multiplication x2
Standard frequencies (Note 3)	80.000 / 100.000			MHz	
Frequency stability					
Initial tolerance @ +25°C		±0.3	±1	ppm	V_C = 1.5 V
vs. operating temperature range		±0.3	±1	ppm	
vs. supply voltage variation (pushing)			±0.2	ppm	V_S ±5%
vs. load change (pulling)			±0.2	ppm	R_L ±5%
Long term (aging) 1st year			±1	ppm	@ +40°C
Long term (aging) 5 years			±3	ppm	@ +40°C
vs. radiation			±1.5	ppm	(Note 4)
Frequency adjustment range					
Electronic Frequency Control (EFC)	±5	±10		ppm	Option 1 = "V" (Note 5, 6)
EFC voltage V_C	0.5	1.5	2.5	V	
EFC slope (Δf / ΔV_C)	Positive				
EFC input impedance	100			kΩ	
RF output					
Signal waveform	Sine wave				
Load R_L	50			Ω	±5%
Output level	+5	+7	+9	dBm	
Harmonics		-40	-30	dBc	
Sub-harmonics (multiples of f_{nom}/2)		-50	-40	dBc	
Spurious			-90	dBc	
Phase noise	Please consult factory See table 1A				
Supply voltage V_S (Note 7)	3.15	3.3	3.45	V	
Current consumption			20	mA	
Operating temperature range	-40		+85	°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 5 (TCXO), Class 3 (Mixed Technology), Product Level "S"
3. Arbitrary frequency within specified frequency range on request. Frequency multiplication based on AXLE7050S series. Multiplication x3 with frequencies up to 150 MHz is available on request.
4. Radiation of 40 krad(Si) total dose (TID). Radiation low dose test of TCXO series was performed up to 50 krad. Please consult factory for radiation report and analysis.
5. For option 1 = "N" (No EFC) pin 1 can be left open.
6. Tuning range is sufficient to compensate for initial tolerance, temperature stability, pushing, pulling, min. of 5 years aging & radiation of 40 krad(Si)
7. Supply voltage up to 12 V is available on request.

Ordering Code

Model	Product category	Option 1 [EFC]	Revision	Frequency [MHz]
AXLE45SHM	EM FM	"N" = No EFC "V" = EFC	Rev.1	50.000 ~ 100.000

Examples: AXLE45SHM-FM-V_Rev.1 – 100.000 MHz

Typical phase noise performance

Offset	Frequency	Unit
	70 ~ 100 MHz	
1 Hz	-56	**dBc/Hz**
10 Hz	-83	**dBc/Hz**
100 Hz	-114	**dBc/Hz**
1 kHz	-135	**dBc/Hz**
10 kHz	-148	**dBc/Hz**
≥100 kHz	-150	**dBc/Hz**

Table 1A – Typical phase noise

Ultra-Low Noise Option:

The AXLE45SHM series can be optionally built with an MCF (monolithic crystal filter) stage, that results in very high sub-harmonic suppression of -60 dBc and a noise floor better than -165 dBc/Hz for offsets ≥50 kHz. Please consult factory about options and availability of specific frequencies.

Absolute Maximum Ratings

Parameter	Min.	Max.	Unit	Condition / Remark
Supply Voltage V_S	-0.5	4.5	V	V_S to GND
Control Voltage V_C	-0.5	4.5	V	V_S to GND
Load R_L	0	∞	Ω	Must not cause any damage
Operable temperature range	-50	+95	°C	Operation of unit without any damage
Storage temperature range	-55	+105	°C	-

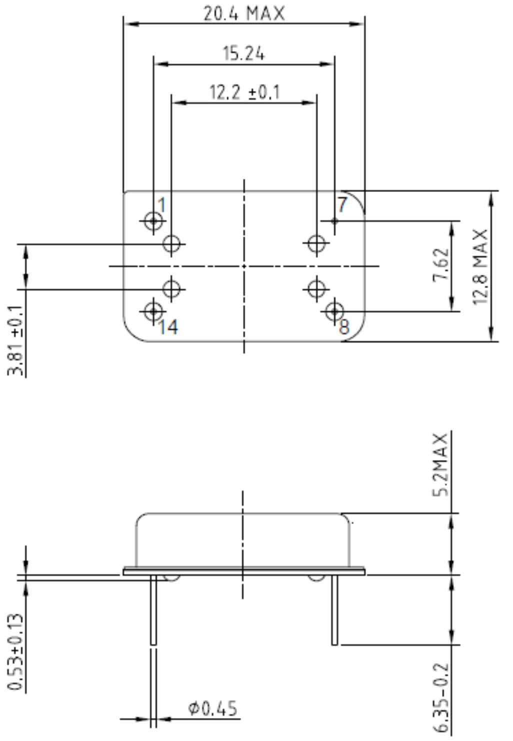
Table 2 – Maximum Ratings

2. Mechanical specification & Handling

Parameter	Min.	Typ.	Max.	Unit	Condition
Enclosure (see drawing) (LxWxH)	20.4x12.8x5.2 max.			mm	IEC 60679-3 CO 02
Weight			5	g	
Case	Stainless steel			-	
Case finish	Cover: Stainless steel blank Header: Ni 8 µm			-	
Pins	Glass / Kovar Sn63Pb37 solder dipped			-	
Moisture Sensitivity Level	MSL 1			-	IPC/JEDEC J-STD-020C
Cleaning	Washable			-	

Table 3 – Mechanical specification & Handling

Enclosure drawing



Pin connections

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

* For option 1 = “N” (no EFC) pin 1 can be left open

Note: SMD version is available on request. Please consult factory.

3. Applicable documents

The following specifications and standards are part of this specification:

IPC-A-610	Acceptability of Electronic Assemblies
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

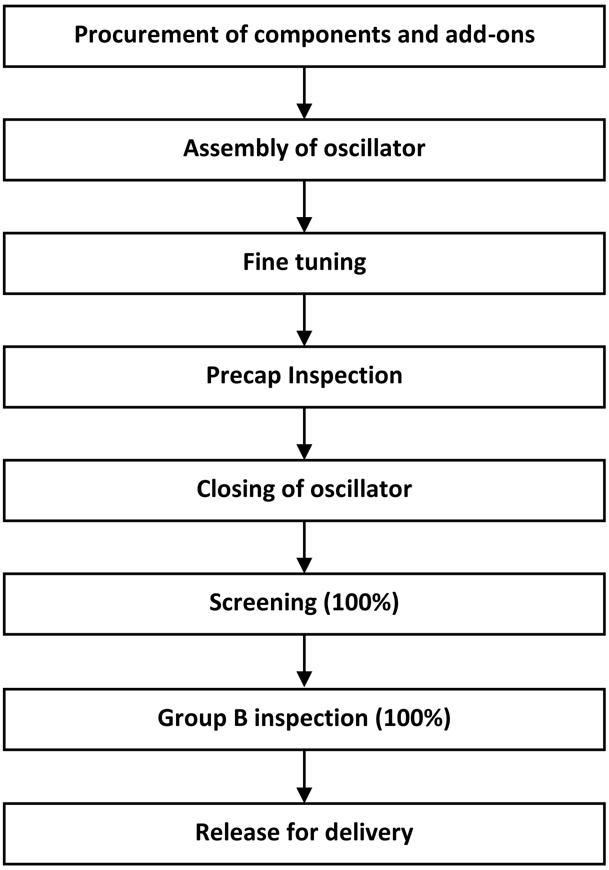
(2) Oscillator detail specification AXLE45SHM

(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 – Fine Leak [*2]	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
2. Fine leak test is performed for the crystal, which is a 100% test during crystal manufacturing

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 – Fine Leak	MIL-STD-202, Method 112, Condition D
5	Electrical measurements vs. temperature	@ T = T_{MIN} to T_{MAX}, 5°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 10 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 = 3.3 V, R_L = 50 Ω	X	X	Table 1
2	Output level	IEC 60679-1	V_S = 3.3 V, R_L = 50 Ω	X	X	Table 1
3	Current consumption	IEC 60679-1	V_S = 3.3 V, R_L = 50 Ω	X	X	Table 1
4	Tuning range	IEC 60679-1	V_S = 3.3 V, R_L = 50 Ω	-	X	Table 1
5	Phase noise	IEC 60679-1	V_S = 3.3 V, R_L = 50 Ω	-	X	Table 1
6	Output spectrum	IEC 60679-1	V_S = 3.3 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 oscillator is based on a Space COTS approach and the radiation performance has been verified by a radiation test (Co 60) up to 50 krad(Si) and a SEE test up to 125 MeV·cm^2/mg. The oscillator is SEL immune and didn’t show any other destructive events during the radiation tests. Radiation reports and analysis are available on request.

7. Components, Materials and Processes

The oscillators 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.
- The manufacturing is done in mixed technology. Soldering is done in accordance with IPC-A-610.
- No pure tin is used inside the oscillator, as package or lead finish (full tin whisker mitigation).
- 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	06.06.2026	First issue	HH	HH