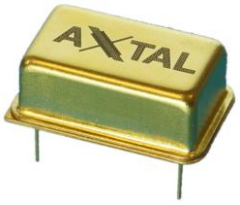
Specification	AXIS45S	Rev.: 1	Date: 2022-02-01

Oscillator type: **Low Noise 10~100 MHz VCXO for Space Application with sine wave output in DIL14/4-pin package**

Features:

- **Manufactured according to MIL-PRF-55310 Level "S"**
- **Radiation hardened – 100 krad(Si) total dose (TID)**
- **Radiation hardened – SEE insensitive**
- **Usage of space grade class 1 add-on components**
- **ITAR Free – Manufactured in Germany**
- **Low Phase Noise**
- **High Frequency Stability**
- **Hermetical sealed THD package**



Models:

Item	Engineering Model (EM)	Flight Model (FM)	Lot Acceptance Test Model (LAT)
Quartz Crystal	Synthetic HiQ Quartz	Synthetic HiQ Swept Quartz	Synthetic HiQ Swept Quartz
Electrical Components	COTS	HiRel Parts ECSS-Q-ST-60C class 1	HiRel Parts ECSS-Q-ST-60C class 1
Mechanical Components	Form Fit Function	Stainless steel package with Ni/Au finish	Stainless steel package with Ni/Au 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	-	100 krad(Si) TID	100 krad(Si) TID
Acceptance Testing			
Screening	Standard test procedure for non-space products	X	X
Group-A		X	X
Group B		X	X
Group C	-	-	X
DPA	-	-	On request

Ordering Code:

Model	Product category	Revision	Frequency [MHz]
AXIS45S	EM FM LAT	Rev.1	10~100

Example: AXIS45S-FM_Rev.1 – 80.000 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 (Aging)

5.4 Group C inspection

5.5 Electrical measurements

5.6 Destructive Physical Analysis (DPA)

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
Frequency range (Note 3)	10		100	MHz	
Frequency stability					
vs. operating temperature range			±10	ppm	ref. to $f_{nominal}$
vs. supply voltage variation (pushing)			±0.5	ppm	V_S ±5%
vs. load change (pulling)			±0.5	ppm	R_L ±5%
Long term (aging) 1st year			±0.5	ppm	@ +40°C
Long term (aging) over 10 years			±4	ppm	@ +40°C
Frequency adjustment range (Note 4)					
Electronic Frequency Control (EFC)	±15			ppm	
EFC voltage V_C	0		5	V	
EFC slope ($\Delta f / \Delta V_C$)		Positive			
EFC input impedance	100			kΩ	
RF output (Note 5)					
Signal waveform		Sine wave			
Load R_L		50		Ω	±5%
Output level	+3	+6		dBm	
Harmonics			-30	dBc	
Spurious			-90	dBc	
Phase noise		Please consult factory			
Supply voltage V_S	4.75	5.0	5.25	V	
Current consumption (steady state)			20	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 2 (VCXO), Class 1 (Discrete Technology), Product Level "S"
3. Other frequencies on request. No frequency multiplication.
4. Tuning range and tuning voltage can be matched to your requirements.
5. Output level and phase noise can be matched to your requirements. Phase noise depends on tuning range.

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
Storage temperature range	-40	+85	°C	-

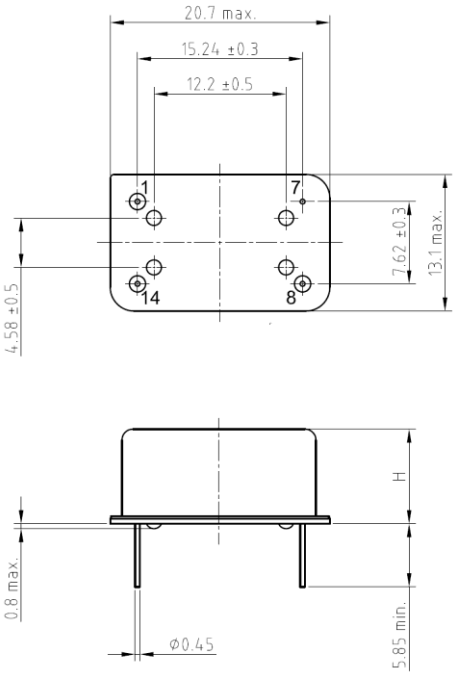
Table 2 – Maximum Ratings

2. Mechanical specification

Parameter	Min.	Typ.	Max.	Unit	Condition
Enclosure (see drawing) (LxWxH)		20.7x13.1x7.5 max.		mm	IEC 60679-3 CO 02
Weight			5	g	
Case material		Stainless steel		-	
Case finish		NiAu plated		-	
Pins		Glass / Kovar NiAu plated		-	
PCB and add-ons		No pure tin (>97%)			

Table 3 – Mechanical specification

Enclosure drawing



Pin connections

Pin #	Symbol	Function
1	V_C	Control Voltage (EFC)
7	GND	Ground, Case
8	RF OUT	RF Output
14	V_S	Supply Voltage

3. Applicable documents

The following specifications and standards are part of this specification:

ECSS-Q-ST-60C	Electrical, Electronic and Electromechanical (EEE) Components
ECSS-Q-ST-70-08C	Manual soldering of high-reliability electrical connections
ECSS-Q-ST-70-38C	High-reliability soldering for surface-mount and mixed technology
ECSS-Q-ST-70-11C	Procurement of printed circuit boards
ECSS-Q-70-71A	Data for selection of space materials and processes
ESCC21300	Terms, Definitions, Abbreviations, Symbols and Units
ESCC21700	General Requirements for the marking of ESCC components
ESCC23500	Requirements for Lead Materials and Finishes for components for space application
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

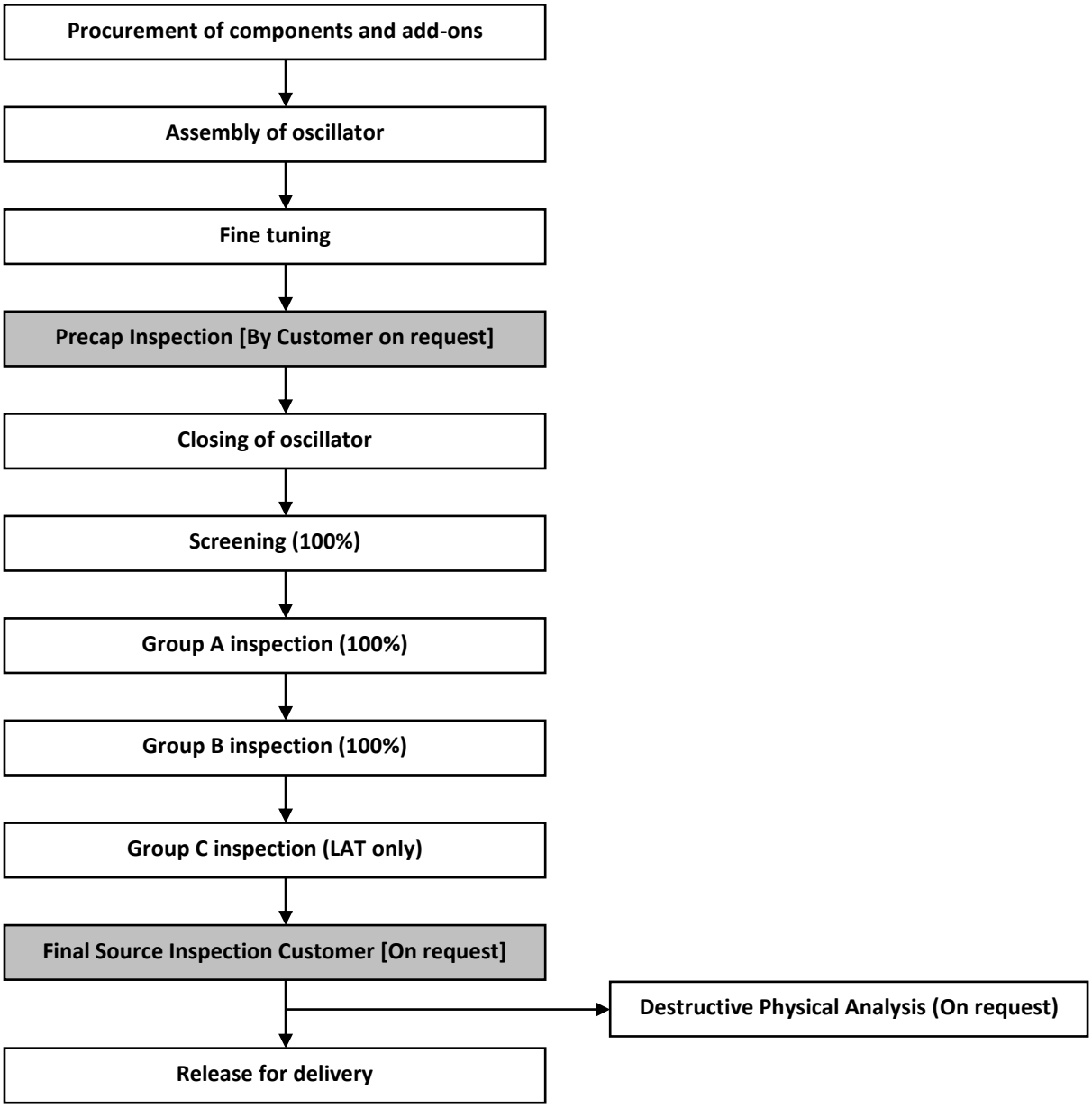
(2) Oscillator detail specification AXIS45S

(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 – Fine Leak and Gross Leak	MIL-STD-202, Method 112, Condition C (fine leak) and Condition D (gross leak)
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_{amb} = 25°C±3°C (unless otherwise stated) Table 12
2	Random Vibration	50~100 Hz +6 dB/Oct, 100~1000 Hz 0.04 g^2/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_{amb} = 25°C±3°C (unless otherwise stated) Table 12
5	Burn-in (load)	@ T = +85°C for 10 days (nominal V_S and Load) Drift: $\Delta f/f$ < ±1 ppm and ±5 % current consumption (steady state)
6	Electrical measurements at room temperature (Final)	@ T_{amb} = 25°C±3°C (unless otherwise stated) Table 12
7	Electrical measurements at high and low temperature	@ T = -20°C to +70°C / 5K steps with ±1°C tolerance Limits: See Table 1
8	Seal Test – Fine Leak and Gross Leak	Fine leak: max. $2 \cdot 10^{-7}$ atm·cm^3/s He after 2 hours Gross leak: 125°C, 20 sec, 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

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

#	Test	Test Condition
1	Visual and mechanical inspection	MIL-PRF-55310, paragraph 4.8.1

Table 7 – Detailed test conditions for Group A inspection

Notes:

1. Electrical measurements performed during screening are not repeated during Group A inspection

5.3 Group B inspection (Aging)

Table 8 shows the Group B inspection procedure.

#	Test	Reference
1	Aging test	MIL-PRF-55310, Clause 4.8.35
2	Electrical measurements at room temperature (Final)	IEC 60679-1 (see Table 1)

Table8 – Group B inspection procedure

Table 9 shows the detailed test conditions for each step in table 8.

#	Test	Test Condition
1	Aging test	@ T = 70°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 12

Table 9 – Detailed test conditions for Group B inspection procedure

5.4 Group C inspection

Table 10 shows the Group C inspection procedure.

#	Test	Reference
1	Random Vibration	MIL-STD-202, Method 214, Condition 1-J
2	Mechanical Shock	MIL-STD-202, Method 213, Condition F
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 – Fine Leak and Gross Leak	MIL-STD-202, Method 112, Condition C (fine leak) and Condition D (gross leak)
7	External Visual Inspection	ESCC20500 / MIL-STD-883 Method 2009

Table 10 – Group C inspection procedure

Notes:

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

Table 11 shows the detailed test conditions for each step in table 10.

#	Test	Test Condition
1	Random Vibration	50~100 Hz +6 dB/Oct, 100~1000 Hz 1.0 g^2/Hz, 1~2 kHz -6 dB/Oct RMS = 37.8 g, 3 minutes per axis
2	Mechanical Shock	1500 g, 0.5 ms, half sine, 3 shocks per axis
3	Thermal Shock	-65 to +125°C, 25 cycles, max. 5 minutes transfer time, 15 minutes dwell time
4	High Temperature Storage	24 hours at -35°C, 24 hours at +70°C, min. 2 hours at T_{amb}
5	Electrical measurements at room temperature (Final)	@ T_{amb} = 25°C±3°C (unless otherwise stated) Table 12
6	Seal Test – Fine Leak and Gross Leak	Fine leak: max. $2 \cdot 10^{-7}$ atm·cm^3/s He after 2 hours Gross leak: 125°C, 20 sec, no bubbles allowed
7	External Visual Inspection	ESCC20500 / MIL-STD-883 Method 2009

Table 11 – Detailed test conditions for Group C inspection procedure

5.5 Electrical measurements

Table 12 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 / Interim	Final	Limits
1	Initial frequency	IEC 60679-1	V_S = 5.0 V, R_L = 50 Ω	X	X	Table 1
2	Output level & spectrum	IEC 60679-1	V_S = 5.0 V, R_L = 50 Ω	X	X	Table 1
3	Current consumption	IEC 60679-1	V_S = 5.0 V, R_L = 50 Ω	X	X	Table 1
4	Tuning range	IEC 60679-1	V_S = 5.0 V, R_L = 50 Ω	X	X	Table 1
5	Phase noise	IEC 60679-1	V_S = 5.0 V, R_L = 50 Ω	-	X	Table 1

Table 12 – Electrical measurements

5.6 Destructive Physical Analysis (DPA)

The destructive physical analysis (DPA) inspects and verifies the internal design, materials, construction and workmanship of the part and extents the lot acceptance test (LAT). The part is disassembled and inspected with the procedure given in table 13.

#	Test	Reference / Condition
1	External Visual Inspection	MIL-STD-883, Method 2009
2	Radiographic Inspection	MIL-STD-202, Method 209
3	Marking Resistance Test	ESCC24800
4	Opening procedure / Disassembly	Decapsulation tools
5	Microsection of add-on components	Embedded in 2-component epoxy, evacuated, no plating
6	Internal Visual Inspection	MIL-STD-883, Method 2013
7	Passive Element Shear Test	MIL-STD-883, Method 2019
8	SEM Inspection add-on components	MIL-STD-883, Method 2018

Table 13 – DPA procedure

Notes:

1. Test order is not sequential
2. LAT part is fully destructed after analysis

6. Radiation

The oscillator is capable of meeting all electrical performance requirements after exposure to a total ionizing dose (TID) of 100 krad(Si). The oscillator is SEE insensitive and SEL immune as only bipolar technology is used. The radiation capability can be verified by a radiation analysis in accordance with handbook ECSS-Q-HB-30-01A.

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 compliant with the requirements of ECSS-Q-ST-60C class 1.
- All active components and the quartz crystal have a hermetically sealed package.
- All active components are radiation tolerant. The crystal is made of synthetic swept quartz material.
- 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).
- All used materials are in accordance with ECSS-Q-ST-70-71A. The lead material and finishes are according to ESCC23500. No pure tin is used inside the oscillator, as package or lead finish.
- The printed circuit board (PCB) is procured in accordance with ECSS-Q-ST-70-11C.
- The case material is made of stainless steel (cover and base) with NiAu finish. The pins are made of Kovar with NiAu finish.
- 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 Laser 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:

- Equipment list (Testing & Measuring)
- Declared component list
- Product Reliability Analysis (MTBF)
- Radiation Analysis

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	01.02.2022	First issue	HH	HH