AXTAL

ADVANCED XTAL PRODUCTS

a Q-TECH Company

Frequency Control Products for Space & New Space Applications

The Frequency Control Expert for over 20 Years

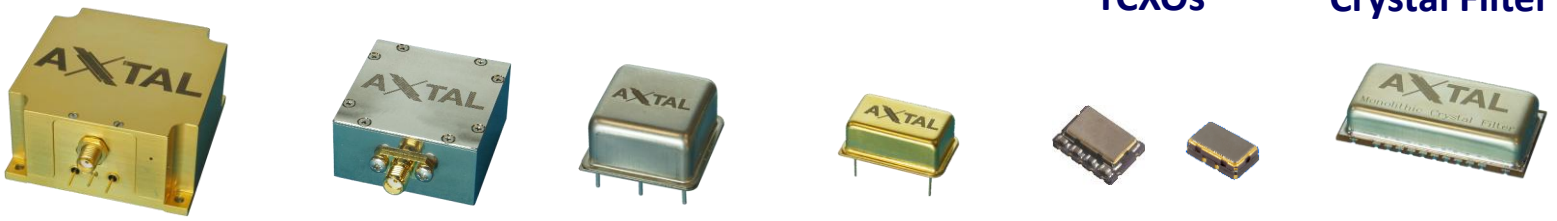
Who we are

- **“AXTAL”** stands for **”Advanced XTAL Products”**, where **"XTAL"** is a common abbreviation of "crystal“.
- **Founded in November 2003** by Bernd Neubig and Brigitte Neubig as fully privately owned company. Since 2023 the AXTAL GmbH is an independent subsidiary of **Q-Tech Corporation**, a US-based leading supplier of high-reliability crystal oscillators
- **Core Business** comprises advanced Frequency Control Products (FCP), i.e. mainly Crystal & SAW Oscillators and Frequency & Timing Modules used in demanding RF applications.
- **Main Product Focus** is on High-Reliability Oscillators and Frequency Control Modules with high electrical & environmental requirements.
- **Space Products** are designed and manufactured since **2011** and the class 1 OCXO series AXIOM6060 is listed on the ESA EPPL since 2014. AXTAL is strongly focusing on high level New Space products.
- **Full Value Chain** includes R&D, design, manufacturing, screening and testing of our products from samples to production quantities completely in-house. Quartz crystals are sourced from qualified long-term suppliers only.
- **No US Export Regulations (like ITAR)** apply for AXTAL products, which are 100% manufactured and tested in Germany or by European partners.

General Space Product Overview

- **Classical Space (Class 1): OCXOs** AXIOM6060 series, **VCXOs** AXIS45S series and **MCF Filters**.
- **New Space (High Level COTS): VCXOs** AXIS45SH series, **TCXOs** AXLE5032S & AXLE7050S series and **OCXOs** AXIOM70S, AXIOM75S & AXIOM3838S series *(more models under development).*
- **Joint New Space Portfolio** together with our parent company **Q-Tech Corporation**, that extends AXTAL's portfolio by adding **XOs** and the unique **MCXO**, which is an ultra-low power micro controller controlled crystal oscillator with OCXO stability.
- **Latest Space & New Space Brochures** can be found on **www.axtal.com** & **www.q-tech.com**.

USO OCXO | **New Space OCXOs** | **VCXOs** | **New Space TCXOs** | **Monolithic Crystal Filter**



AIRBUS DEFENCE & SPACE | TESAT SPACECOM PIONEERING WITH PASSION | LEONARDO | ThalesAlenia Space | esa | NORTHROP GRUMMAN | OHB

Space Product Categories

"Classical" Space Category:

- Highest grade products in regards of component selection, design, manufacturing and radiation hardness (typically 100 krad TID and SEE > 60 MeV, SEL immunity).
- Conventual approach to assure very high reliability and with focus on long GEO and extraplanetary missions >10 years.
- This highest quality grade results in high cost and very long lead times. But it is a must, where no compromise on reliability can be made.

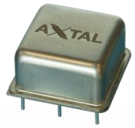
"New" Space Category:

- Space COTS (commercial-off-the-shelf) product class, where the design is based on specially selected commercial components and suitable semiconductor technology.
- New approach focuses on LEO & MEO and shorter missions with lower requirements for radiation hardness (typically <30 krad TID and SEE ≤60 MeV).
- This COTS grade allows much lower cost and lead times, while still maintaining a high level of reliability. Typical applications are LEO & MEO missions <7 years.

Space Product Categories

Item	High Grade Products „Classical Space“	COTS Grade Products „New Space“
Standard	MIL-PRF-55310 „S“ / ESCC3503	MIL-PRF-55310 Level „B“ or „S“
Component/ Material Selection	ECSS-Q-ST-60C class 1 (Components) ECSS-Q-ST-70C / ECSS-Q-70-71 (Material) ECSS-Q-ST-70-11C (PCB) 100% Traceable components (PADs)	Specially selected and up-screened COTS parts (AEC-Q100/200 qualified parts or parts with proven reliability level/heritage) Traceability of critical components
Quartz crystal	Synthetic HighQ Swept Quartz IAW ESCC3501 Precap Inspection (on request)	Synthetic HighQ Quartz (swept material on request) Screening IAW MIL-PRF-3098 (optional)
Radiation hardness	Total dose (TID) up to 100 krad SEE up to 90 MeV, SEL immunity	Total dose (TID) up to 40 krad SEL immunity per design
Workmanship	ECSS-Q-ST-70-08C / ECSS-Q-ST-70-38C	J-STD-001 / IPC-A-610 (optionally ECSS)

„Classical Space“



„New Space“

Quartz Crystal

- **Key component**, which mainly determines frequency stability of the oscillator.
- **Assurance of radiation hardness** of the crystal is very critical for most oscillator types.
- **Two approaches (options)** for the crystal quality & material selection:
  - **Conventual "Classical Space" Approach:**
    Use of "**Swept**" Quartz material for resonators used in applications with high radiation levels.

    "Sweeping is a purification process that removes certain impurities and thereby improves the radiation sensitivity of quartz crystals."

    Manufacturing IAW ESC3501 or similar, PreCap inspection, screening & qualification (on request)
    → ***High radiation hardness & reliability, but high cost and long lead time***
  - **Space COTS "New Space" Approach:** Use of High-Q (>2.4 million) "pure z" Quartz material with low etch channel density used in applications with low and medium radiation levels. High-Q material can achieve very similar radiation hardness like Swept material. There are ongoing research projects and test data is available from AXTALs radiation tests.

    Screening to MIL-PRF-3098 Level "S" or custom specification
    → ***Good radiation hardness & reliability, significantly lower cost and lead time***
- **Tailored to mission requirements.** Space & New Space products can always be tailored to the mission requirements, where a mixture of above approaches is used.

Design & Manufacturing

- **Component selection** is critical and specifically made for the mission requirements. Radiation hardness is assured by using qualified components, rad-hard components by technology/design and/or radiation tests (TID & SEE) are performed for specially selected types.
- **Electrical design** is made to offer state-of-the-art performance, while also compensating any major deviations due to radiation effects (radiation hardness by design).
- **Mechanical design** is made to achieve a robust assembly, that can withstand very high levels of mechanical shock, vibration and a high number of thermal cycles.
- **Manufacturing** is done by experienced, trained and ESA certified (soldering) personnel. The production team holds soldering & inspection certificates of ECSS, IPC and J-STD standards.
- **Acceptance Testing** including Screening & Group A~C Inspections is performed in full compliance or based on the MIL-PRF-55310 Level “S”. Procedures can be tailored to the mission requirements.
- **Qualification** (LAT/QCI/Group-C) with optional DPA can be performed for all product categories.
- **Customer Inspections** like PreCap & Final Source (Buy-off) Inspections can be performed on-site.

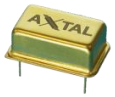
→ **Customization: AXTAL can fully customize all models to match the mission requirements!**

Space Products

Classical – Class 1

AXIOM6060 – Ultra-Low Noise OCXO 80~125 MHz

- Ultra-low noise and very high frequency stability
- Very high radiation hardness (TID 100 krad, SEE>90 MeV)
- Listed in ESA European Preferred Products List (EPPL) since 2014
- Can be customized – Lower frequencies available
- Heritage: GEO and extraplanetary missions

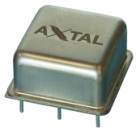


AXIS45S – Low Noise VCXO 10~100 MHz

- Low noise VCXO in small hermetically-sealed DIL14 package
- Very high radiation hardness (TID 100 krad, SEE>90 MeV)
- VCXO characteristic can be tailored to customer requirements
- Heritage: GEO and extraplanetary missions

MQF4021 – Monolithic Crystal Filter 10~100 MHz

- MCF with High filter slope and out-of-band attenuation
- Very high radiation hardness (TID 100 krad, SEE immune)
- Heritage: Mars mission



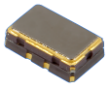
AXIS75S – Low Noise VCXO 100~200 MHz

- Low noise VCXO in hermetically-sealed 25x25 mm package
- Very high radiation hardness (TID 100 krad, SEE>90 MeV)
- VCXO characteristic can be tailored to customer requirements

★ ***New Product Release 2026***

Space Products

New Space



AXLE5032S – Low Noise & High Stability TCXO 10~50 MHz

- Low noise and high frequency stability
- High radiation hardness (TID 50 krad, SEL immune>90 MeV)
- Very small 5x3.2 mm ceramic package

AXLE7050S – Low Noise & High Stability TCXO 10~50 MHz

- Standard New Space TCXO model with best performance
- High radiation hardness (TID 50 krad, SEL immune>90 MeV)
- Small 7x5 mm ceramic package
- Heritage: LEO missions

AXLE7050S-PB – Low Noise & High Stability TCXO 10~50 MHz

- AXLE7050S series performance & characteristics
- Full tin whisker mitigation – no pure tin used
- Heritage: LEO missions

AXLE45S – Low Noise & High Stability TCXO 50~100 MHz

- AXLE7050S series performance & characteristics
- Frequency extension up to 100 MHz
- Low-profile hermetically-sealed DIL14 package

★ ***New Product Release 2026***

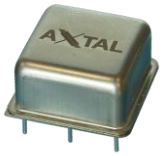
Space Products

New Space

AXIS45SH – Low Noise VCXO 10~200 MHz

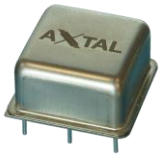
- Low noise VCXO in small hermetically-sealed DIL14 package
- Wide frequency range
- High radiation hardness (TID 50 krad, SEL immune / SET insensitive)
- VCXO characteristic can be tailored to customer requirements
- Heritage: LEO missions

AXIOM70SL – Ultra-Low Noise & High Stability OCXO 10 MHz



- Ultra-low noise & very high frequency stability
- 10 MHz OCXO with **HCMOS** output
- Lower guaranteed radiation hardness (TID 10 krad, SEE sensitive)
- Hermetically-sealed 25x25 mm package
- Heritage: LEO missions

AXIOM75SL – Ultra-Low Noise & High Stability OCXO 10 MHz

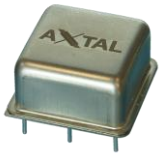


- Ultra-low noise & very high frequency stability
- 10 MHz OCXO with **Sine Wave** output
- High radiation hardness (TID 50 krad, SEL immune / SET insensitive)
- Hermetically-sealed 25x25 mm package
- Heritage: LEO missions

Space Products

New Space

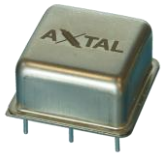
AXIOM75SH – Ultra-Low Noise & High Stability OCXO 80~130 MHz



- Ultra-low noise & very high frequency stability
- OCXO with **Sine Wave** output – Standard frequencies 100 & 120 MHz
- High radiation hardness (TID 50 krad, SEL immune / SET insensitive)
- Hermetically-sealed 25x25 mm package
- Heritage: LEO~GEO missions

★ *Connectorized Version Coming Soon*

AXIOM75SHM – Ultra-Low Noise & High Stability OCXO 130~400 MHz



- Ultra-low noise & very high frequency stability
- OCXO with **Sine Wave** output – Wide frequency range (multiplication)
- High radiation hardness (TID 50 krad, SEL immune / SET insensitive)
- Hermetically-sealed 25x25 mm package
- Heritage: LEO missions

AXIOM3838S – Ultra-Low Noise & High Stability OCXO 10 MHz

- Ultra-low noise & very high frequency stability
- 10 MHz OCXO with **Sine Wave** output
- High radiation hardness (TID 50 krad, SEL immune / SET insensitive)
- SMA connectorized package
- Heritage: LEO missions

Space Heritage & Customers

AIRBUS DEFENCE & SPACE

LOCKHEED MARTIN

BAE SYSTEMS

TESAT SPACECOM
PIONEERING WITH PASSION

Honeywell AEROSPACE TECHNOLOGIES

FRONTGRADE

ThalesAlenia Space
a Thales / Leonardo company

NORTHROP GRUMMAN

DSO

LEONARDO

esa

CASC 中国航天

CESIUM ASTRO
SPACE & DEFENSE SYSTEMS

OHB

Hanwha Aerospace

Radboud University Nijmegen

SI SATREC INITIATIVE

antwerpspace
An OHB Company

INNOFLIGHT

REDWIRE

KARI Korea Aerospace Research Institute

MAX-PLANCK-INSTITUT FÜR GRAVITATIONSPHYSIK (Albert-Einstein-Institut)

AXTAL is serving the global Space market for 15 years and has meanwhile a long (New) Space Heritage. See a selection of some critical missions below:

- Feng Yun 2G – Geostationary Weather Satellite
- LARA/ExoMars Mission (ESA) – Mars Lander and Rover
- NCLE (NL-China Low Frequency Explorer) Earth-Moon L2 Orbit
- ACES (Atomic Clock Ensemble in Space) – ISS
- TAS Italy PLATiNO Platform
- Airbus D&S OneSat
- LEO Mega Constellation
- Wide variety of LEO missions

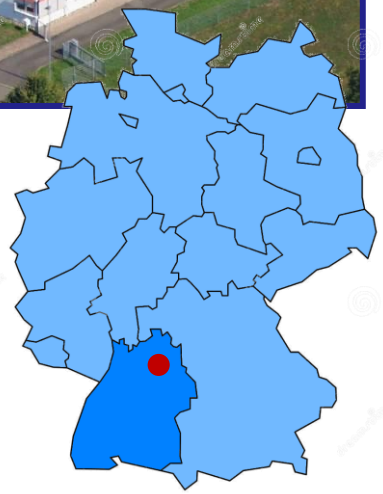
A lot more and constantly growing!

Thank you!

AXTAL GmbH

Facility & Administration:
(Billing & shipping address)
Roemerring 9
D-74821 Mosbach
Germany

AXTAL is currently planning to expand and will move to a newly build facility in 2026 with more than 3 times the current space.



Our Parent Company:

Q-TECH Corporation
High-Reliability Crystal Oscillators

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