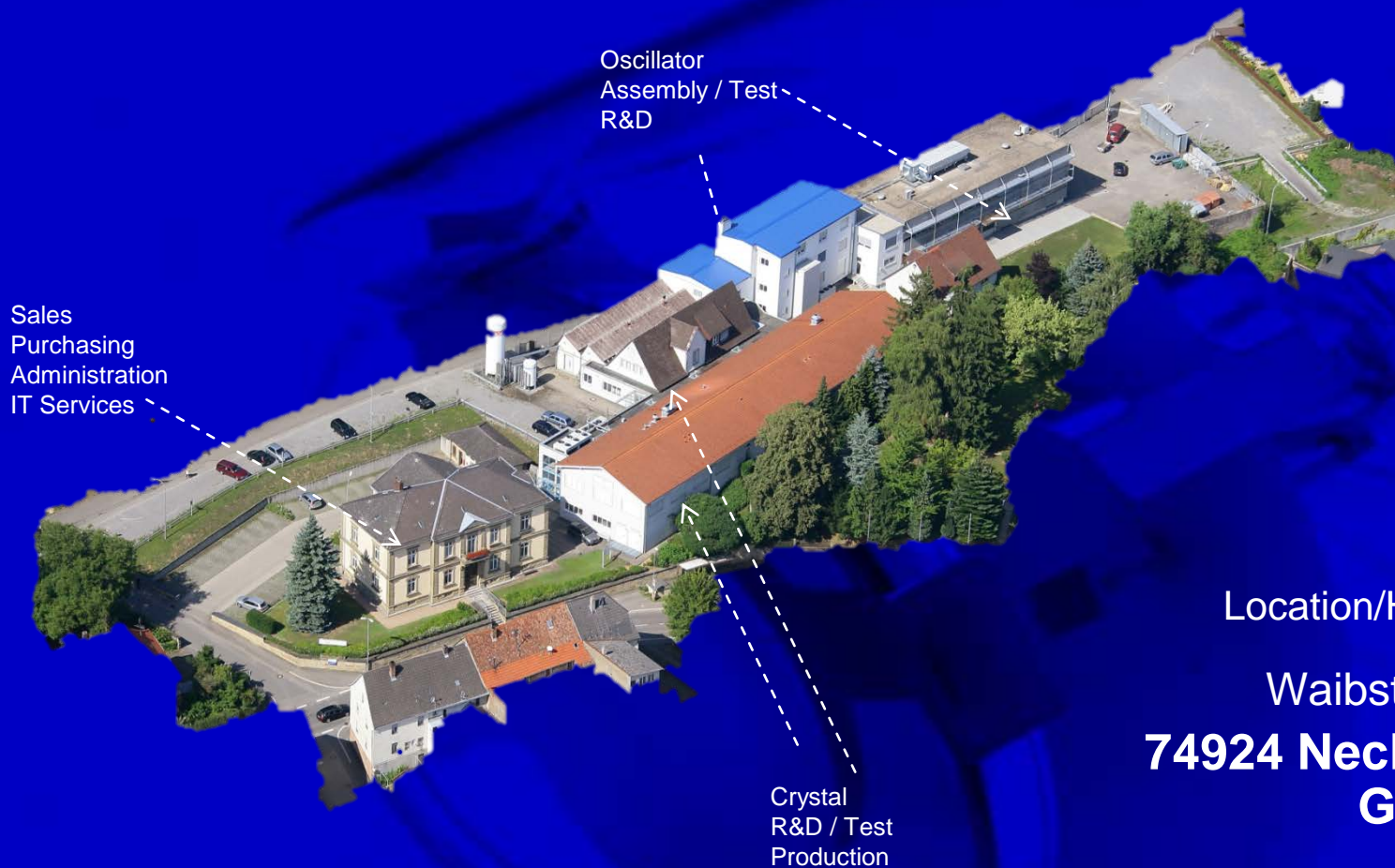


KVG Company Location



Location/Headquarter:

Waibstadter Str. 2-4
74924 Neckarbischofsheim
Germany

Ownership:

Manfred Klimm CEO (80%)
Gerd Krauskopf CTO (20%)



Quartz Crystal Technology GmbH

KVG Company Timeline

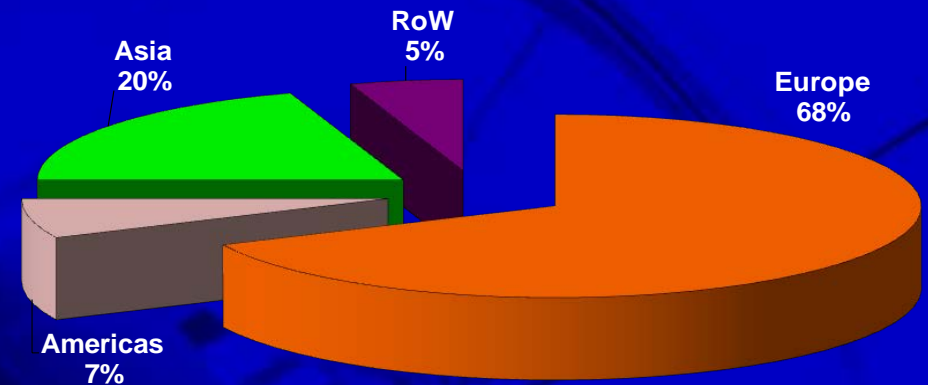
- **1946:** KVG was founded by Kurt Klingsporn
- **1964:** Start of Production of Crystal Filters
- **1970:** Direct Plating Technique using Passive Measurement
- **1983:** Manufacturing of Sensor Crystals
- **1986:** Surface Mount Technology (SMT) for Filters and Oscillators
- **1995:** Introduction of IM HFF Crystals
- **1997:** Acquisition of Precision Crystal Maker ‚Quarzkeramik‘
- **1998:** Implementation of ASIC Technology for TCXOs
- **2002:** private owned ‚KVG Quartz Crystal Technology GmbH‘
- **2005:** Introduction of Low Phase Noise OCXOs
- **2007:** Introduction of Low Phase Noise RF TCXOs
- **2010:** Introduction of Low G-Sensitivity OCXOs
- **2011:** ESA certificate of qualification for space crystals
- **2013:** DLR Qualification for crystal oscillators



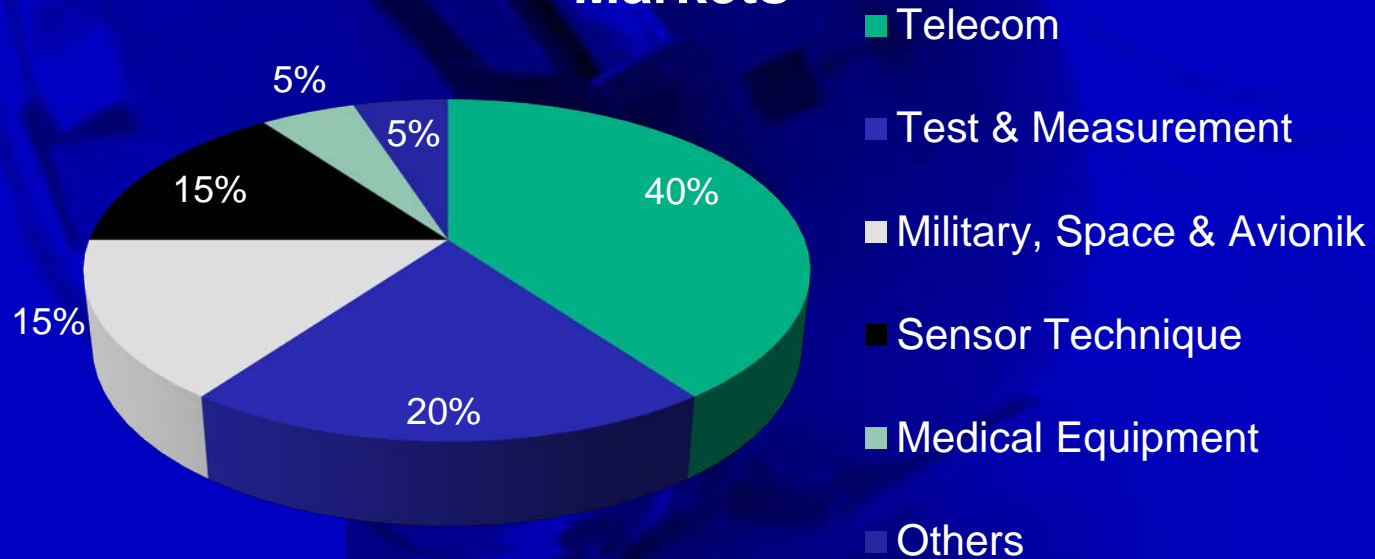
Quartz Crystal Technology GmbH

KVG Company Facts

- Employees: 90 Total
 - 25 Engineering,
 - 10 Sales & Administration
 - 55 Direct Labour
- Sales 2012: 9 Mio. EUR



Markets



KVG Sales Network

KVG Headquarter - Germany

Rep in UK:
Aspen Electronic

Rep in Korea:
Anywave Ltd.

Rep in France:
Giga-concept

Rep in Japan:
SpaceCrest Co. Ltd

KVG - Italy

Rep in China:
Prodak Ltd.

KVG North America

KVG China

Rep in Texas:
PEI Electronic Sales

Rep in SE Asia:
UPC Electronic

Rep in Spain:
Altaix Electrónica

Rep in Brazil:
Diamond Sales

Rep in S. Africa:
Actum Electronic

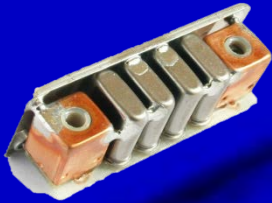
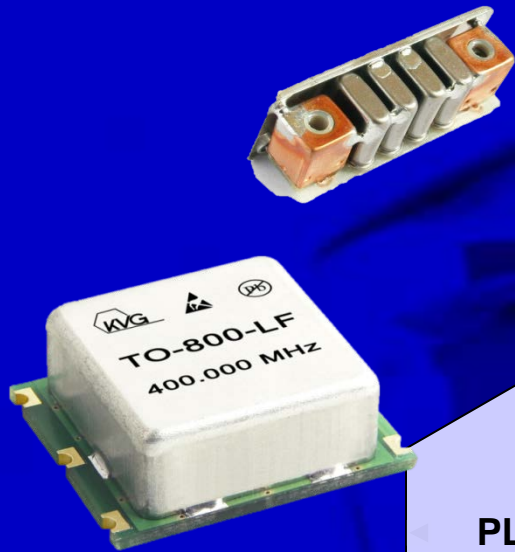
Rep in India:
Arrow Electronic

Rep in Israel:
Polaros Electronic Ltd.



Quartz Crystal Technology GmbH

KVG Quartz Crystal Products



PLL-Modules

Crystal Filters
&
Discriminators

Precision
Crystal Oscillator
(P)XO

QUARTZ
CRYSTALS

Voltage Controlled
Crystal Oscillator
VCXO



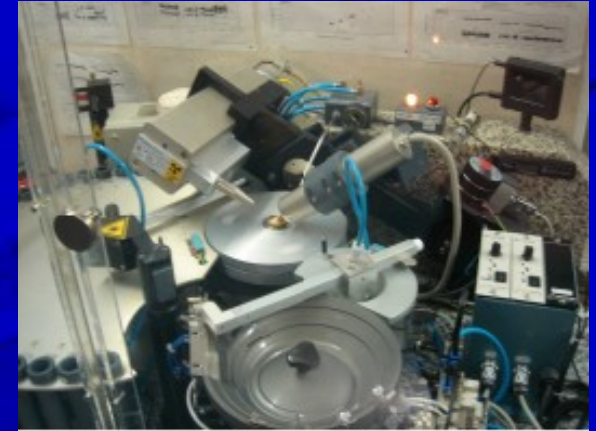
Oven
Controlled
Crystal
Oscillator
OCXO

Temperature
Compensated
Crystal
Oscillator
TCXO



- **Quartz Crystal Manufacturing**

- Production Facility: 750 sqm
- Cutting Machines for Crystal Bars
- Various Grinding, Lapping and Polishing Machines
- 200 sqm Clean Room (up to class 1000)
- Base Plating, Mass Plating and Single Plating
- Resistance- and Coldweld Sealing Process
- 15 x Temp. Measurement Systems



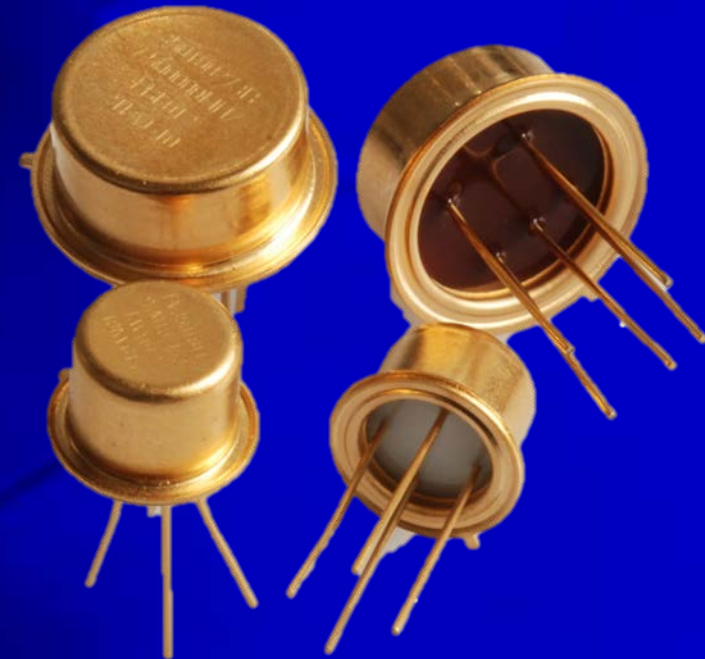
- **Oscillator Manufacturing**

- Production Facility: 800 sqm
- SMD Line: Two Pick and Place Machines
- 12 x Temp. Chambers (max. Range -40°C to $+105^{\circ}\text{C}$)
- 10.000 OCXO Active Aging Plugs
- Trimming Lasers



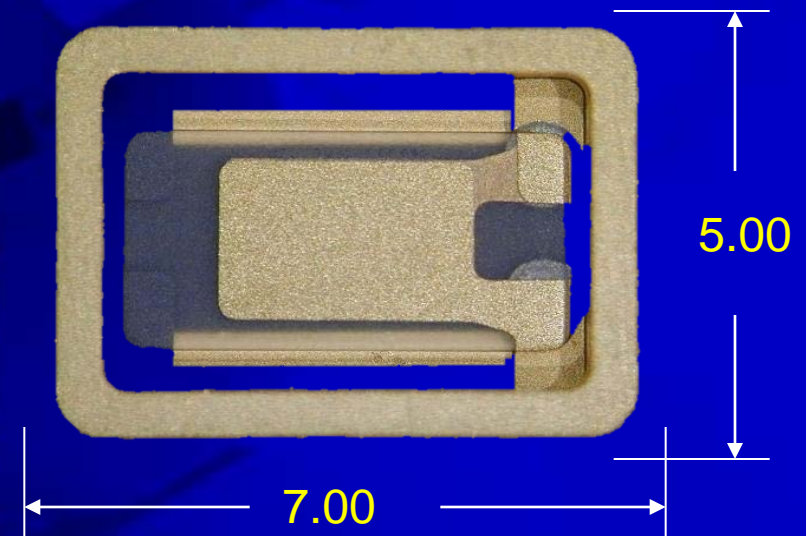
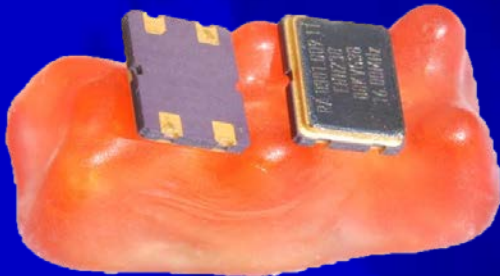
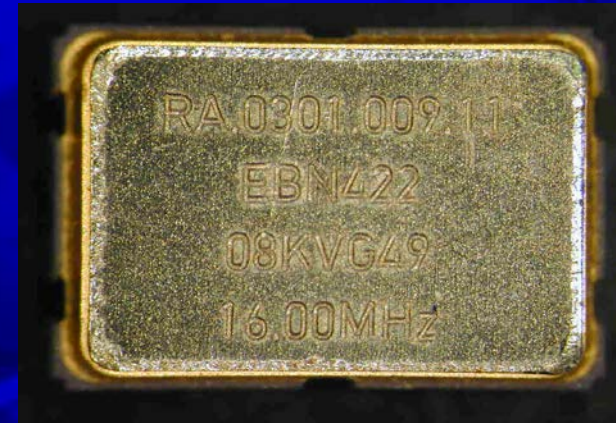
Space Quartz Crystal Domain

- Qualified acc. to ESCC Generic Specification No. 3501
- Detail Specifications
 - TYPE T807 (TO-5) package: ESCC 3501/001, /008, /011 und /012
 - TYPE T1507 (TO-8) package: ESCC 3501/002, /009, /017 und /019
 - TYPE 101 (leadless ceramic SMD-package 5 x 7 mm): ESCC 3501/013
- Frequency ranges:
 - T807 (TO-5) : 8.0 – 140 MHz
 - 8.0 - 30.0 MHz; fund. mode
 - 30.0 – 90.0 MHz; 3. OT
 - 50.0 – 140.0 MHz; 5. OT
 - T1507 (TO-8): 2.5 – 26 MHz
 - 2.5 – 13.0 MHz fund.
 - 10.0 – 26.0 MHz; 3. OT
 - TYPE 101: 10 – 20 MHz fund. mode
- Temperature range: -55 °C min. to +125 °C max.



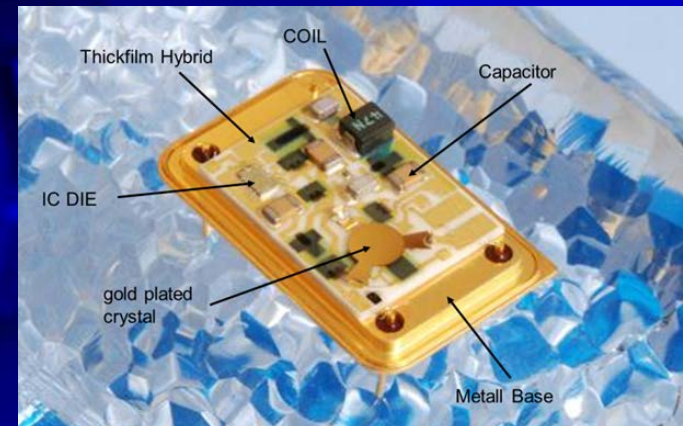
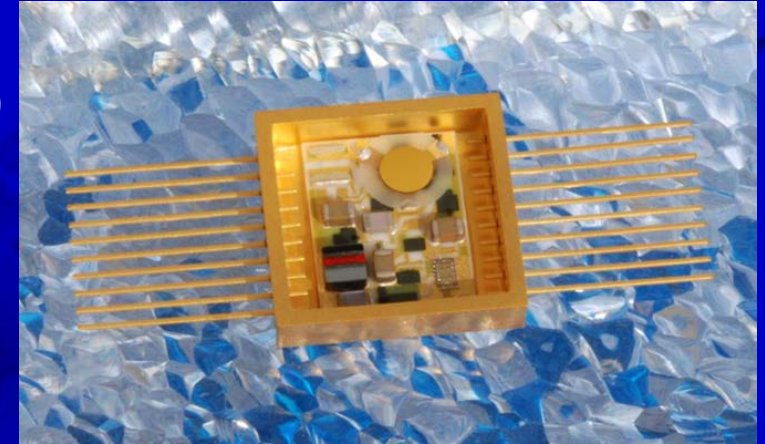
HiRel SMD Quartz Crystal

- Approved acc. to ESCC 3501, LAT1
 - ceramic packaged SMD crystal
 - small size 7 mm x 5 mm
 - high reliability



Space Oscillators Domain

- according to draft 'Generic Specification for Crystal Controlled Oscillators'
 - **DLR-RF-PS-STD-007**
- Package: DIP-14 (4-Pins) & SMD Flat Pack (20 leads)
- Oscillator types:
 - Clock Oscillator (XO)
 - Voltage Controlled Crystal Oscillator (VCXO)
- Supply voltage: +5 V
- Frequency ranges:
 - XOs: 10 MHz to 25 MHz (Fund.); 25 MHz to 75 MHz (3rd OT)
75 MHz to 90 MHz (5th OT)
 - VCXOs: 10 MHz to 30 MHz
- Frequency stability: $\leq \pm 100$ ppm (overall, incl. 18 years aging)
- Temperature ranges:
 - XOs: -55 °C min. to +125 °C max.
 - VCXOs: -55 °C min. to +105 °C max.



Two Oscillators Package Types

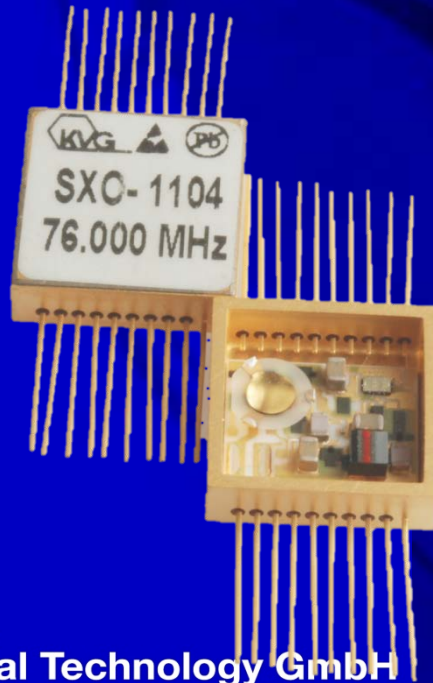
4-pin DIP-14 Package

- 20.32 x 12.7 x 5.0 mm
- hermetically vacuum sealed
- Class 2 oscillator
- rugged metal can package with gold-plated base, cover and leads
- for thruhole assembly
- hybrid technology
- swept crystal blank available



20 leads Flat Pack

- small sized SMD part
- robust gold plated Kovar package
- only 15.8 x 15.8 x 4.6 mm
- class 2 oscillator
- hybrid technology
- hermetically sealed
- backfilled with dry nitrogen



Space Parts Roadmap

- **Space TCXOs:**

Design phase: Q1/Q2-2014

Evaluation phase: Q3/Q4-2014

Qualification phase: Q1/Q2-2015



- **Space OCXOs:**

Design phase: Q1/Q2-2016

Evaluation phase: Q3/Q4-2016

Qualification phase: Q1/Q2-2017

