High Temperature Electronics

- Frequency Control Products
- Packaged Quartz Crystals
- Electronic Module Products
Our Strengths

A number of applications today require electronics to operate in extremely harsh environmental conditions. Operation temperatures of 150°C and higher are required for energy exploration as well as other emerging applications such as Geophysical Services, Avionics and Industrial Process Control. Environments like these require electronics designed and manufactured specifically to withstand such temperature extremes.

Extreme environment applications require electronic systems that are capable of surviving beyond the MIL-STD operating temperature range of -55°C to +125°C. Applications such as Deep Well Logging Tools (sensor, gauge and data acquisition etc.), Geothermal Logging, Light Weight Ground and Air Vehicles and Industrial Process Monitoring require robust electronic systems that can operate at 200°C and beyond. In addition, some of these applications also require survivability under high shock and vibration environments. Vectron’s expertise readily handles such harsh environments. For example, our custom engineered High-Temperature Electronic Modules have been qualified and deployed for 250°C+ “down-hole” drilling/exploration applications.

- Extending device reliability and operating life at the field
- Eliminating the need for auxiliary cooling techniques such as massive heat sinks or elaborate heat pipe designs
- Lighter weight and smaller sizes
- Integration of sensors and transducers along with electronics to operate reliably in high temperature environments

Technical Capabilities

- High Temperature Electronic Packaging (~55°C to 250°C)
- RF Electrical Design
- Substrate and PCB Layout Design for HI–REL applications
- Custom Metal and Ceramic (HTCC, LTCC) Package Design
- Multi–layer Thick–Film Substrate Fabrication (Al2O3, AlN, BeO)
- Hybrid Microcircuit Assembly and Test in Class 10K clean room environment
- CSP, Flip Chip & BGA Component Mounting
- Hermetic Package Sealing for HI–REL applications (Projection, Seam and Cold welds)
- Bare Die Procurement and Handling
- Quartz BAW Resonator Design & Fabrication (Round, Strip and HFF Inverted Mesa configurations)
- SAW Wafer Fabrication in Class 100 clean room environment
- Wafer deep etching technology for Wafer Level Packaging
- Process and Test Equipment Design
- Environmental MIL–PRF Screening
- Custom Process Equipment Design
- Physical Design Modeling and Finite Element Analysis

MIL-Spec Testing

<table>
<thead>
<tr>
<th>Name</th>
<th>MIL-Spec</th>
<th>Method</th>
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</thead>
<tbody>
<tr>
<td>Destructive bond pull test</td>
<td>MIL-STD-883</td>
<td>2011</td>
</tr>
<tr>
<td>Nondestructive bond pull test</td>
<td>MIL-STD-883</td>
<td>2023</td>
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<tr>
<td>Die shear testing</td>
<td>MIL-STD-883</td>
<td>2019</td>
</tr>
<tr>
<td>Temperature testing</td>
<td>MIL-PRF-55310</td>
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<tr>
<td>Thermal shock-manual/automated</td>
<td>MIL-STD-883</td>
<td>1011</td>
</tr>
<tr>
<td>Thermal shock-manual/automated</td>
<td>MIL-STD-202</td>
<td>107</td>
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<tr>
<td>Temperature cycling</td>
<td>MIL-STD-883</td>
<td>1010</td>
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<tr>
<td>Constant acceleration</td>
<td>MIL-STD-883</td>
<td>2001</td>
</tr>
<tr>
<td>Constant acceleration</td>
<td>MIL-STD-202</td>
<td>212</td>
</tr>
<tr>
<td>Fine/gross leak testing</td>
<td>MIL-STD-883</td>
<td>1014</td>
</tr>
<tr>
<td>Fine/gross leak testing</td>
<td>MIL-STD-202</td>
<td>112</td>
</tr>
<tr>
<td>PIND-particle impact noise detection</td>
<td>MIL-STD-883</td>
<td>2020</td>
</tr>
<tr>
<td>Vibration - random</td>
<td>MIL-STD-202</td>
<td>214</td>
</tr>
<tr>
<td>Vibration - sine</td>
<td>MIL-STD-202</td>
<td>204</td>
</tr>
<tr>
<td>Shock (half-sine &amp; sawtooth)</td>
<td>MIL-STD-202</td>
<td>213</td>
</tr>
<tr>
<td>Humidity</td>
<td>MIL-STD-202</td>
<td>106</td>
</tr>
<tr>
<td>Solderability</td>
<td>MIL-STD-883</td>
<td>2003</td>
</tr>
<tr>
<td>Solderability</td>
<td>MIL-STD-202</td>
<td>208</td>
</tr>
<tr>
<td>Lead integrity</td>
<td>MIL-STD-883</td>
<td>2004</td>
</tr>
<tr>
<td>Terminal strength</td>
<td>MIL-STD-202</td>
<td>211</td>
</tr>
</tbody>
</table>

*Complete MIL-STD and custom harsh environment screenings are available. Vectron works closely with customers to define screening requirements.

Assembly Process

Vectron offers the flexibility of applying a wide range of manufacturing processes, allowing us to accomplish unique product requirements and delivery of the highest quality workmanship to our customers. Vectron manufactures products with robust assembly techniques, intense process control and process automation.

Our assembly processes include:

- **Thick-Film Substrate**
  - Al2O3, BeO, AlN, Multi-Layer
- **Component Attachment**
  - Flip Chip, Eutectic die mount, Epoxy die mount
- **Wirebonding**
  - Al and Au wirebonding
- **Hermetic Sealing with Metal and Ceramic Packages**
  - Projection, seam and cold welding
Our Heritage

With over 50 years experience in custom design and manufacturing of microelectronics, Vectron encompasses a blend of harsh environment electronic design and packaging expertise not common in the industry today. Our staff are experts in Hybrid Multi-Chip Modules, High Temperature and Harsh Environment Electronics for Deep Space to Deep Earth applications, Physical Design Modeling, Finite Element Analysis, RF/signal conditioning, oscillator and digital embedded system designs.

The Vectron Family Tree

- **1950's**
  - 1952-McCoy Electronics founded

- **1960's**
  - 1961-OAK buys McCoy
  - 1963-Cryptonics purchased
  - 1964-Delta F purchased

- **1980's**
  - 1987-Ovenaire/Crown purchased

- **1990's**
  - 1993-Spectrum Technology purchased
  - 1997-Piezo Crystal purchased
  - 1998-Telquartz purchased

- **2000's**
  - 2000-Corning buys OAK Freq. Control
  - 2000-Change name Corning Freq. Control
  - 2004 - CFC/Vectron merge - 2004
    - 2005-Acquisition of Rinde
    - 2005-Whitby Canada Facility sold
    - 2005-MEMS partnership with Discera

- **2010's**
  - 2012-Discera partnership dissolved
  - 2012-MEMS partnership with SiTime
  - 2014-Knowles Corp new parent company
  - 2014-AccuBeat partnership

- **1980's**
  - Vectron Labs founded-1986

- **1990's**
  - Dover buys Oscillatem-1985

- **2000's**
  - Dover buys Vectron Labs-1992
  - Vectron buys AT&T FCP-1995
  - Vectron buys Telefilter-1997
  - Vite is formed-1998

- **2010's**
  - CINOX acquired-2000
  - TEMEX SAW Fab purchased-2000
High Temperature Crystal Oscillators

Vectron offers several High Temperature Crystal Oscillator product platforms for extreme environment applications. Typical operating temperature range is from –55°C to +230°C. In addition, Vectron also offers 250°C High Temperature Crystal Oscillators for ultra HT applications to meet today’s and future downhole tools requirements. Vectron’s vertical integration in the following technical areas ensures the ability to design and manufacture state of the art High Temperature frequency control products:

- BAW & SAW quartz resonator design & fabrication
- RF oscillator circuit design
- High Temperature packaging expertise
- High Temperature assembly & test expertise
- Environmental screening
- RoHS compliant
- COO: USA
- ECCN: EAR99

### Oscillators Overview

<table>
<thead>
<tr>
<th>Product</th>
<th>Standard Frequency</th>
<th>Supply Voltage</th>
<th>Temperature Range</th>
<th>Package Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>PX-702</td>
<td>500kHz to 50MHz</td>
<td>1.8, 2.5, 3.3 or 5.0</td>
<td>-55 to 230°C</td>
<td>5 x 7 x 1.8 mm, SMD Ceramic Package</td>
</tr>
<tr>
<td>PX-570</td>
<td>500kHz to 40MHz</td>
<td>1.8, 2.5, 3.3 or 5.0</td>
<td>-55 to 230°C</td>
<td>8 x 8.5 x 2.9 mm, Leaded Ceramic Package</td>
</tr>
<tr>
<td>PX-420</td>
<td>500kHz to 40MHz</td>
<td>3.3 or 5.0</td>
<td>-55 to 230°C</td>
<td>0.5” x 0.5” x 0.2” 4 Pin ½DIP</td>
</tr>
<tr>
<td>PX-610</td>
<td>32kHz to 40MHz</td>
<td>1.8, 2.5, 3.3 or 5.0</td>
<td>-55 to 230°C</td>
<td>3 pin TO-39, 0.38” Dia x 0.185” H</td>
</tr>
<tr>
<td>VX-400</td>
<td>10MHz to 30MHz</td>
<td>3.3 or 5.0</td>
<td>-55 to 180°C</td>
<td>0.8” x 0.5” x 0.2” 4 Pin DIP</td>
</tr>
</tbody>
</table>

**PX-702** Small footprint High Temperature Ceramic SMD Crystal Oscillator product platform for extreme environment applications. In addition to its wide operating temperature range, the PX-702 HTXO is also ideal for high shock & vibration applications. It is also designed to exceed 3000g shock and 36g vibration levels of the demanding MIL-STD-883 requirements.

### Features
- Continuous operating temperature range -55°C to 230°C
- Low jitter and phase noise
- 1.8Vdc, 2.5Vdc, 3.3Vdc or 5Vdc operation
- Tight temperature stability
- Design for high shock & vibration to exceed 3000g shock & 36g vibration
- Output frequency 500 kHz to 50 MHz standard
- Standard 5 x 7 x 1.8 mm SMD package

**PX-570** High Temperature Crystal Oscillator product platform for extreme environment applications. Typical operating temperature range is from -55°C to +230°C (Tighter temperature stability is available) with a frequency stability of ± 250 ppm over the entire operating temperature range.

### Features
- Continuous operating temperature range -55°C to 230°C
- Low jitter and phase noise
- 1.8Vdc, 2.5Vdc, 3.3Vdc or 5Vdc operation
- Compliant crystal mount for high shock & vibration
- Output frequency 500kHz to 40MHz standard
- 8.0mm x 8.5mm x 2.9mm ceramic leaded package
- 3 lead forming options
PX-420 High Temperature Crystal Oscillator product platform for extreme environment applications. Typical operating temperature range is from -55°C to +230°C with a frequency stability of ± 250 ppm over the entire operating temperature range.

**Features**
- Continuous operating temperature range -55°C to 230°C
- Low jitter and phase noise
- 3.3Vdc or 5Vdc operation
- Compliant crystal mount for high shock & vibration
- Output frequency 500kHz to 40MHz standard
- Standard 4 pin ½ DIP package
- Custom HT temperature sensing oscillator available

PX-610 High Temperature Crystal Oscillator product platform for extreme environment applications. In addition to its wide operating temperature range, the PX-610 HTXO is also ideal for high shock & vibration applications. The footprint of the PX-610 design is based on an industry standard TO-39 package.

**Features**
- Continuous operating temperature range -55°C to 230°C
- Low jitter and phase noise
- 1.8Vdc, 2.5Vdc, 3.3Vdc or 5Vdc operation
- Compliant crystal mount for high shock & vibration
- Output frequency 32kHz to 40MHz standard
- 0.380” diameter x 0.185” high resistance welded 3 pin TO-39 package

VX-400 High Temperature Voltage Control Crystal Oscillator product platform for extreme environment applications. Typical operating temperature range is from -55°C to +180°C with an absolute pull range of ±50 ppm.

**Features**
- Continuous operating temperature range -55°C to 180°C
- Low jitter and phase noise
- 3.3Vdc or 5Vdc operation
- Compliant crystal mount for high shock & vibration
- Output frequency 10MHz to 30MHz standard
- Standard 4 pin DIP package
Real Time Clocks

Real Time Clocks Overview

<table>
<thead>
<tr>
<th>Product</th>
<th>Standard Frequency</th>
<th>Supply Voltage</th>
<th>Temperature Range</th>
<th>Package Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>HM-4201-RTCM1 Real Time Clock Module</td>
<td>32.768kHz</td>
<td>2.7 to 3.6</td>
<td>-20 to 180°C</td>
<td>0.5” x 0.5” x .2” - 8 Pin ½DIP</td>
</tr>
<tr>
<td>32.768kHz XO for Real Time Clock Applications</td>
<td>32.768kHz</td>
<td>1.8, 2.5, 3.3 or 5.0</td>
<td>-55 to 200°C</td>
<td>5 x 7 x 1.8 mm - SMD 8 x 8.5 x 2.9 mm - Leaded 0.5” x 0.5” x .2” - ½DIP</td>
</tr>
</tbody>
</table>

HM-4201-RTCM1-(Real Time Clock Module)
+180°C High Temp Real Time Clock/Calendar Module with Build-In 32.768KHz Crystal Oscillator. Timing, Calendar and Alarm functions can be set via I2C BUS. The entire HT RTC Module is fully operational from 2.7V to 3.6V. The Timing/Calendar function is operational down to 1.8V range.

Features
- Output frequency 32.768kHz
- Continuous operating temperature range -20°C to 180°C
- 2.7V to 3.6V operation
- Design for high shock & vibration
- Low current consumption of 100uA

32.768kHz XO-(for Real Time Clock Applications)
Is a High Temperature Low Power Real Time Clock Crystal Oscillator (HT RTC XO) product platform for extreme environment applications. Comparing with traditional RTC solution with 32.768KHz tuning folk resonator design, Vectron HT RTC XO solution provides unsurpassed reliability with long lifetime at elevated temperature and exceptional temperature stability performance for high temperature, high shock & vibration applications.

Features
- Output frequency 32.768kHz
- Continuous operating temperature range -55°C to 200°C
- 1.8V, 2.5V, 3.3V or 5.0V operation
- Design for high shock & vibration
- Offer three standard product footprints
- Low current consumption option available
High Temperature Packaged Quartz Crystals

Vectron International’s high temperature quartz crystal resonators are designed and manufactured for continuous operation in harsh environmental conditions at extreme temperatures as low as -55°C and as high as +250°C. Several different crystallographic orientations are offered for a wide range of applications. The resonators are available in all industry standard package styles with all internal components designed for outstanding performance in extreme environmental conditions.

**Key Features**
- Frequencies from 2.20 MHz to 225 MHz
- Standard Operating Temperature Range: -55°C to 250°C
- AT, SC, FC, AC and IT-cuts
- RoHS & WEEE compliant packaging
- Shock; 100g, 6ms
- Vibration; 20g, 10 to 2kHz
- Temp sensor crystals Y-cut (~85ppm/°C) or AC-cut (~20ppm/°C)
- Radiation Hardened Swept quartz available for space applications

**Applications**
- Downhole
- Oil & Gas Exploration
- Geothermal
- Avionics
- Industrial Turbines
- Marine Diesel
- Heavy Equipment

**Packaged Quartz Crystals Overview**

<table>
<thead>
<tr>
<th>Product</th>
<th>Freq. Range (MHz)</th>
<th>Low Profile</th>
<th>High Shock</th>
<th>Package Type</th>
<th>Height (in)</th>
<th>Quartz Cuts</th>
</tr>
</thead>
<tbody>
<tr>
<td>XR-R (HC35/TO-5)</td>
<td>4 to 225</td>
<td>●</td>
<td>●</td>
<td>Thru-hole</td>
<td>0.155 - 0.265</td>
<td>AT/SC/IT</td>
</tr>
<tr>
<td>XR-U (HC37/TO-8)</td>
<td>2.5 to 140</td>
<td>●</td>
<td>●</td>
<td>Thru-hole</td>
<td>0.200 - 0.265</td>
<td>AT/SC/IT</td>
</tr>
<tr>
<td>XR-B (HC43)</td>
<td>2.2 to 210</td>
<td></td>
<td></td>
<td>Thru-hole, SMD</td>
<td>0.440 - 0.530</td>
<td>AT/SC/IT</td>
</tr>
<tr>
<td>XR-A (HC49)</td>
<td>2.2 to 210</td>
<td></td>
<td></td>
<td>Thru-hole, SMD</td>
<td>0.440 - 0.530</td>
<td>AT</td>
</tr>
<tr>
<td>XR-P (SM1/SQ580)</td>
<td>4.2 to 30</td>
<td>●</td>
<td>●</td>
<td>SMD</td>
<td>8.2 x 8.2 x 2.5 mm</td>
<td>AT</td>
</tr>
</tbody>
</table>

**XR-U (HC37/TO8)**
- Features
  - Robust 4 point blank mount
  - Ultra-High vacuum seal for low aging performance

**XR-B (HC43)**
- Features
  - Robust design for harsh environments
  - Ultra-High vacuum seal for low aging performance
  - Lead forming for surface mount available

**XR-P (SM1/SQ580)**
- Features
  - Robust 4 point blank mount
  - Surface Mount or Hybrid Wirebonded applications
  - Lowest profile packaging option

**XR-R (HC35/TO5)**
- Features
  - Robust 4pt blank mount
  - Ultra-High vacuum seal for low aging performance
  - MIL-PRF-3098 equivalents

**XR-A (HC49)**
- Features
  - Robust design for harsh environments
  - MIL-PRF-3098 equivalents
  - Lead forming for surface mount available

**Temperature Curves**

- XR-R (HC35/TO5)
- XR-U (HC37/TO8)
- XR-B (HC43)
- XR-P (SM1/SQ580)
**World-Wide Locations**

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- **VI Hudson, Corporate Headquarters**
  267 Lowell Road, Suite 102
  Hudson, NH 03051
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  Mount Holly Springs, PA 17065
  Tel: 1.717.486.3411
  Fax: 1.717.486.5920

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  Cincinnati, OH 45232
  Tel: 1.513.542.5555
  Fax: 1.513.542.5146

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