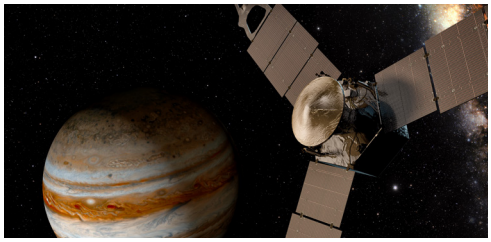
Clocks and Timing

MICROCHIP

# Vectron Space and High-Reliability Frequency-Control Solutions



www.microchip.com/timing

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# A Legacy of Space Innovation for Sixty Years

## Extensive Space Heritage

Microchip's Vectron state-of-the-art crystal manufacturing facility in Mt. Holly Springs, PA employs some of the most experienced frequency control personnel in the industry. Today, we draw on the expertise of these individuals to supply precision quartz crystals and blanks to our military, space, defense and commercial customers, utilizing state-of-the-art design, manufacturing and control systems to meet and exceed customer expectations for reliability, performance and value. Vectron brand oscillators, consist of products from several acquisitions, including Vectron International, McCoy Electronics and Oak Frequency Control.

When the world celebrated the 50th anniversary of the Apollo 11 moon landing in 2019, it was due in part to the McCoy Electronics frequency control products that were onboard the lander. Prior to the Apollo program, our products were onboard the United States' first successful space exploration mission in 1958.

## Solutions From Low Earth Orbit to Interstellar Space

For over six decades, Vectron's products have flown in hundreds of missions. Our products are currently in low earth orbit, geosynchronous orbit and on the Moon, Mars and Venus. Voyager 1, the furthest man made object from the earth, has frequency control products that have operated continuously for 42 years, and are aiding in the transmission of data from interstellar space, a distance of 13 billion miles. The following chart highlights some of the major programs that have used Vectron oscillators.

## Continuous Innovation

With over six decades of proven flight heritage, we draw on our experience and continue to innovate, providing state of the art designs, world class manufacturing and unparalleled customer service to assist your space mission success now and into the future.

## Highlights of Major Programs Using Vectron Oscillators

| | | | | |
|---|---|---|---|---|
| **1960s** | Apollo | Gemini | Pioneer | Intelsat |
| **1970s** | GPS | Viking | Nimbus | Voyager |
| **1980s** | Galileo | Milstar | Magellan | Space Shuttle |
| **1990s** | Centaur | Cassini-Huygens | Hubble Telescope | International Space Station |
| **2000s** | Mars Spirit | Mars Odyssey | New Horizons | Global Star II |
| **2010s** | Orion | GPS III | Galilieo | Atlas IV launch vehicle |

## AS-9100 Certified Facilities

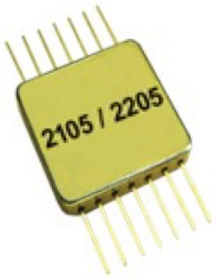
Our space and military hybrid manufacturing and test facilities are segregated from our commercial product areas with their own engineering, management and quality personnel providing a focused approach to giving our customers the best in quality and on-time deliveries.

Our people are our most valuable asset and production, engineering and management personnel provide us with experience unparalleled in our industry. Our most experienced production people are assigned to the space product lines providing a top quality product.

We have two Class 100,000 clean rooms totaling 9,350 sq ft for our hybrid production which are maintained to Class 10,000 and the many additional Class 100 Laminar Flow work centers provide us with the right environment to build products second to none in our industry. Given our clean room area with state-of-the-art manufacturing equipment and the industry's best people, we have a facility we are proud to show off to our many visitors.

## Space Qualified Frequency Control Products

Vectron crystal oscillators are carefully designed to handle the challenges of exo-atmospheric flights. Products are ruggedized to operate and survive the launch environments, and withstand radiation effects presented by low earth orbit to deep space exploration. Other non-crystal based products round out Microchip's space frequency-control products.



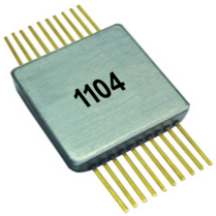
- Crystals
- Crystal Oscillators (XO)
- Temperature Compensated Crystal Oscillators (TCXO)
- Voltage Controlled Crystal Oscillators (VCXO)
- Voltage Controlled SAW Oscillators (VCSO)
- Oven Controlled Crystal Oscillators (OCXO)
- Evacuated Miniature Crystal Oscillators (EMXO)
- SAW filters
- Atomic Clocks

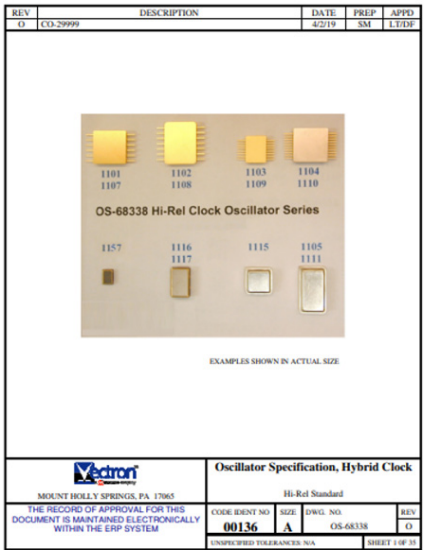
## Catalog Specifications for Space

Starting in 1958 and continuing for nearly 40 years, we were the recipient of your space oscillator Source Control Drawings (SCD).

In the late 1990s, the tables were turned when we created the OS-68338, a specification for high reliability clocks that allowed our customers to choose from common screening tests, component pedigrees and design analyses.

Today, Microchip's Vectron portfolio has seventeen high-reliability specifications. Please visit our website for a complete list of specifications.




## Advantages of Microchip's Vectron Catalog Specifications Include:

- No OEM SCD or custom part numbers required
- Ordering codes define EEE pedigree and QA level
- MIL-PRF-55310/38534 equivalent screening options
- Clearly defines radiation tolerance of active devices
- Multiple package, output and supply voltage options
- No additional platform qualification required
- Shorter leadtimes and lower overall cost
- Promotes design efficiencies (BOM creation and entry)
- Enables standard build/screen/test documentation
- Encourages hi-rel process consistency
- Procurement and manufacturing economies of scale
- Revisions posted "real-time" to Vectron website
- Quick design-in capability utilizing overage
- Design flight heritage

## Part Numbering Convention

A part number, including screening levels and component pedigree, can be directly configured from the specifications. While each catalog has slightly different part numbering options, the below example from OS-68338 provides a general overview.

**1104 R 10M00000 A F**

Model # (see section chart)

**Design Pedigree**
**E** = Enhanced Element Evaluation, 100 krad Class S die, Swept Quartz
**R** = 100 krad Class S die, Swept Quartz
**V** = 100 krad Class S die, Non-Swept Quartz
**X** = Class S die, Non-Swept Quartz
**B** = Class B die, Swept Quartz
**C** = Class B die, Non-Swept Quartz
**D** = Ruggedized COTS, Non-Swept Quartz

Frequency

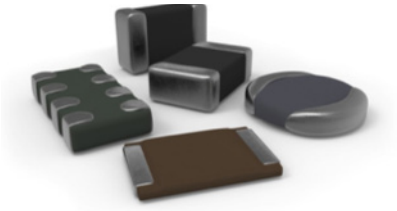
**Input Voltage**
**A** = 5.0V
**B** = 3.3V

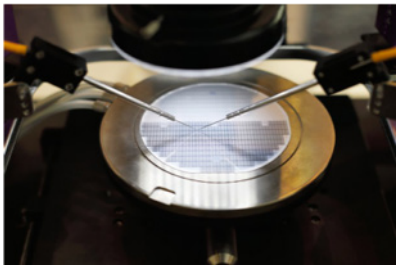
Screening Option per Table

## Component Pedigree

Microchip can tailor the component pedigree of the Vectron high-reliability oscillators to ensure program cost and leadtime requirements are met. Various combinations and options are included in most specifications. Please refer to the individual product specification for ordering options. These options include:

- Swept vs. Non Swept Quartz
- Enhanced Element Evaluation
- 300 krad, 100 krad or untested wafer lots
- Class S, B or Ruggedized COTS components





## Screening and Testing Options

Vectron oscillators are available with predefined screening options based upon MIL-PRF-38534 and MIL-PRF-55310, as well as Engineering Model (EM) option. The screening options include common test methods such as non-destruct bond pull, burn-in, thermal shock, fine and gross leak and PIND testing. Screening options vary slightly by specification.

Please visit our website to review the appropriate catalog specification.

- MIL-PRF-38534 Class K Screening
- Modified MIL-PRF-55310 Class B Screening & Group A QCI
- Modified MIL-PRF-55310 (Rev E) Class S Screening & Group A QCI
- Modified MIL-PRF-38534 Class K Screening, Group A QCI & 30-day Aging
- MIL-PRF-55310 Class B Screening & Groups A & B QCI
- MIL-PRF-55310 (Rev E) Class S Screening & Groups A & B QCI
- Modified MIL-PRF-55310 Class B Screening & Post BI Electrical
- MIL-PRF-55310 (Rev F) Class S Screening & Groups A & B QCI
- Engineering Model (EM)

## Test Capabilities

Our test and environmental laboratories enable us to offer you a broad range of device screening and qualification options. The primary test methods we use are defined in MIL-STD-202 and MIL-STD-883. For tests we are unable to conduct in-house, we subcontract to AS9100 certified test facilities. The below is a partial list of our capabilities.

| In House | | | |
|---|---|---|---|
| Aging | g-Sensitivity | Mechanical Shock | Barometric Pressure |
| Humidity | RealTime X-Ray | Die Shear Testing | Frequency Slew Test |
| Phase Noise | Thermal Vacuum | Terminal Strength | Constant Acceleration |
| Life Testing | Salt Atmosphere | Fine Leak - Helium | Wirebond Pull Testing |
| Thermal Shock | Allan Deviation | Temperature Cycling | Band Width Modulation |
| Sine Vibation | Random Vibration | Moisture Resistance | Solderability/ Steam Age |
| Magnetic Field Sensitivity | | Particle Impact Noise Detection (PIND) | |
| Resistance to Soldering Heat | | X-ray Flourescence (Pure Tin termination Detection) | |
| **Outside Testing** | | | |
| Pyrotechnic Shock | | ElectroMagnetic Interference | |
| Fine/Gross Leak - Krypton | | Class S/K Element Evaluation | |
| Residual Gas Analysis (RGA) | | Destructive Part Analysis (DPA) | |
| TID/ELDRS | Single Event Effects | Neutron Fluence | Prompt Dose |

## Additional Design, Assembly, Test and Inspection Options

In addition to the options called out by the screening and component pedigree codes, additional testing, services, design and assembly options are available. These may require either an additional line on a purchase order or a customized part number. An example of additional options are listed below. Please contact Microchip if you have another requirement.

| | |
|---|---|
| Program Management | Failure Mode and Effect Analysis (FMEA) |
| Customer Defined SDRL | Process Identification Documentation (PID) |
| Component Traceability | Mean Time Between Failure Calculation (MTBF) |
| Long Term Aging Predictions | Custom Qualification Test Procedure and Review |
| Design Reviews (PDR/MRR/CDR) | Source Inspections (Pre Cap, Final, Government) |
| Worst Case Circuit Analysis (WCCA) | Part Stress and Derating Analysis |
| Custom Acceptance Test Procedure Generation and Review | |

## Full Customization and Build-to-Print Options

For programs with unique requirements that are not addressed by our catalog specifications, Microchip will work closely with you to develop a custom device or develop a compliance matrix to your Source Control Drawing (SCD). Microchip can develop unique packages per your drawings and is capable of meeting a broad range of custom requirements.

## Single-Ended Clock Oscillator (XO)

Full specifications are available that define the design, assembly and functional evaluation for a wide variety of TTL, CMOS and Sine XOs for various configurations. We invite you to download these from our website.

- 8 package choices
- Lead forming options
- ±15 ppm frequency accuracy at 25 °C
- ±50 ppm temperature stability –55°C to +125°C
- CMOS, TTL and Sine options
- 300 krad TID options
- 120 MeV-cm2/mg SEL options
- 90 MeV-cm2/mg SET options

### OS-68338

- CMOS and TTL clocks
- Output frequencies to 100 MHz
- 8 different package sizes including 5 × 7 mm

### DOC206379

- CMOS clock for deep space applications
- Output frequencies to 100 MHz
- 300 krad total ionizing dose

### M55310/16S

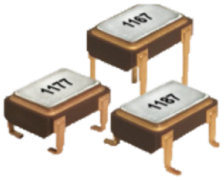
- DSCC MIL-PRF-55310 QPL oscillator
- S Level screening
- 375 kHz to 80 MHz

### DOC204900

- High frequency CMOS clock
- Output frequencies to 160 MHz
- 2.5V supply option

### DOC207975

- High frequency Sinewave clock
- Output frequencies to 500 MHz
- 300 krad Total Ionizing Dose



| Specification | Model Number | Lead Form Version | Output Logic | Number of RF outputs | Frequency Range (MHz) | Radiation Tolerance | | | Package | Dimensions (mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | TID | SET | SEL | | |
| | | | | | | kRad | MeV-cm2/mg | MeV-cm2/mg | | |
| OS-68338 | 1101 | 1121 | CMOS | 1 | 0.35 to 100 | 100 | 40 | 120 | 12-Lead Flatpack | 16.5 × 16.5 × 3.5 |
| | 1102 | 1122 | CMOS | 1 | 0.35 to 100 | 100 | 40 | 120 | 14-Lead Flatpack | 20.3 × 15.2 × 3.5 |
| | 1103 | 1119 | CMOS | 1 | 0.35 to 100 | 100 | 40 | 120 | 16-Lead Flatpack | 12.7 × 9.6 × 3 |
| | 1104 | 1120 | CMOS | 1 | 0.35 to 100 | 100 | 40 | 120 | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |
| | 1105 | | CMOS | 1 | 0.35 to 100 | 100 | 40 | 120 | 14-pin DIP | 22.8 × 13.7 × 5.1 |
| | 1107 | | TTL | 1 | 0.35 to 100 | 100 | 40 | 120 | 12-Lead Flatpack | 16.5 × 16.5 × 3.5 |
| | 1108 | | TTL | 1 | 0.35 to 100 | 100 | 40 | 120 | 14-Lead Flatpack | 20.3 × 15.2 × 3.5 |
| | 1109 | | TTL | 1 | 0.35 to 100 | 100 | 40 | 120 | 16-Lead Flatpack | 12.7 × 9.6 × 3 |
| | 1110 | | TTL | 1 | 0.35 to 100 | 100 | 40 | 120 | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |
| | 1111 | | TTL | 1 | 0.35 to 100 | 100 | 40 | 120 | 14-pin DIP | 22.8 × 13.7 × 5.1 |
| | 1115 | | CMOS | 1 | 0.35 to 100 | 100 | 40 | 120 | 4-pin 1/2 DIP | 12.7 × 12.75.08 |
| | 1116 | | CMOS | 1 | 0.35 to 100 | 100 | 40 | 120 | 4 J-Lead SMT | 14.0 × 8.9 × 4.8 |
| | 1117 | | TTL | 1 | 0.35 to 100 | 100 | 40 | 120 | 4 J-Lead SMT | 14.0 × 8.9 × 4.8 |
| | 1157 | | CMOS | 1 | 1.5 to 100 | 100 | 40 | 120 | 4 Pad LCC | 7 × 5 × 2 |
| | 1167 | 1177/1187 | CMOS | 1 | 1.5 to 100 | 100 | 40 | 120 | 4-Lead Ceramic DIP | 7 × 5 × 2 |
| DOC204900 | 1403 | 1419 | CMOS | 1 | 12 to 160 | 100 | 90 | 90 | 16-Lead Flatpack | 12.7 × 9.6 × 3 |
| | 1404 | 1420 | CMOS | 1 | 12 to 160 | 100 | 90 | 90 | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |
| DOC206379 | 1504 | 1520 | CMOS | 1 | 12 to 100 | 300 | 93 | 93 | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |
| DOC207975 | 1704 | 1720 | SINE | 1 | 10 to 200 | 300 | N/A | N/A | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |
| | 1719 | 1721 | SINE | 1 | 200 to 500 | 300 | N/A | N/A | 16-Lead Flatpack | 25.4 × 25.4 × 3.8 |
| MIL-PRF-55310 | M55310/16S | | TTL | 1 | .375 to 80 | 100 | 40 | 120 | 14-pin DIP | 22.8 × 13.7 × 5.1 |

## Differential High Reliability XOs

For higher frequency and longer trace lengths, differential XOS are designed to maintain signal integrity. Available in both LVDS and LVPECL, and built in fan out buffers.

- 3 package choices
- Lead forming options
- ±15 ppm frequency accuracy at 25°C
- ±50 ppm temperature stability –55°C to +125°C
- LVPECL and LVDS options
- 300 krad TID options
- 120 MeV-cm2/mg SEL options
- 84 MeV-cm2/mg SET options

### DOC203679

- LVDS clock
- Single, dual or quad differential pairs
- Output frequencies to 200 MHz

### DOC206903

- LVDS clock for deep space applications
- Output frequencies to 200 MHz
- 300 krad total ionizing dose

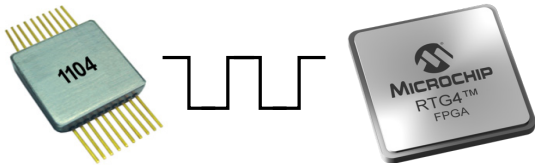
### DOC203810

- High frequency LVPECL clock
- Output frequencies to 700 MHz
- 50 krad ELDRs

| Specification | Model Number | Lead Form Version | Output Logic | Number of RF outputs | Frequency Range (MHz) | Radiation Tolerance | | | Package | Dimensions (mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | TID | SET | SEL | | |
| | | | | | | kRad | MeV-cm2/mg | MeV-cm2/mg | | |
| DOC203679 | 1203 | 1219 | LVDS | 1 pair | 50 to 200 | 300 | 67 | 120 | 16-Lead Flatpack | 12.7 × 9.6 × 3 |
| | 1204 | 1220 | LVDS | 1 pair | 12 to 200 | 100 | 84.96 | 100 | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |
| | 1208 | 1240 | LVDS | 2 pairs | 12 to 200 | 100 | 84.96 | 100 | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |
| | 1216 | 1280 | LVDS | 4 pairs | 12 to 200 | 300 | 67 | 120 | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |
| DOC203810 | 1304 | 1320 | LVPECL | 1 pair | 100 to 200 | 50 (ELDRS) | – | – | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |
| | 1308 | 1340 | LVPECL | 2 pairs | 100 to 200 | 50 (ELDRS) | – | – | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |
| | 1319 | 1321 | LVPECL | 1 pair | 200 to 700 | 50 (ELDRS) | – | – | 16-Lead Flatpack | 25.4 × 25.4 × 3.8 |
| DOC206903 | 1604 | 1620 | LVDS | 1 pair | 12 to 200 | 300 | 67 | 120 | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |
| | 1608 | 1640 | LVDS | 2 pairs | 12 to 200 | 300 | 67 | 120 | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |
| | 1616 | 1680 | LVDS | 4 pairs | 12 to 200 | 300 | 67 | 120 | 20-Lead Flatpack | 16.5 × 16.5 × 3.8 |

## RTG4 SERDES Reference Clocks

Microchip's Vectron High-Reliability Space Clock Oscillators are the only oscillators fully characterized for use as the SERDES reference clocks for the Microchip RTG4 radiation-hardened FPGA. Please visit the Microchip website to download the application note AN3216.

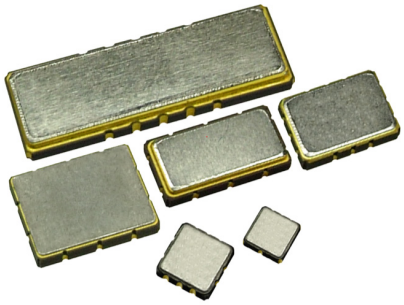



| Signal Type | RTG4 Reference Clock Input | Clock Type | Vectron Brand Clock | Radation Tolerance (krad) | Supply Voltage (V) | Maximum Frequency (MHz) |
|---|---|---|---|---|---|---|
| Differential | LVDS25_ODT | LVDS | DOC203679 | 100 | 3.3 | 200 |
| | | | DOC206903 | 300 | 3.3 | |
| | LVDS25_ODT | LVPECL | DOC203810 | 50 (ELDRS) | 3.3 | 700 |
| | LVDS25 | LVDS | DOC203679 | 100 | 3.3 | 200 |
| | | | DOC206903 | 300 | 3.3 | |
| | LVDS33 | Do Not Use | | | | |
| | LVPECL33 | | | | | |
| Single Ended | LVCMOS33 | CMOS | OS-68338 | 100 | 3.3 | 100 |
| | | | DOC204900 | 100 | 3.3 | 160 |
| | | | DOC206379 | 300 | 3.3 | 100 |
| | LVCMOS25 | | DOC204900 | 100 | 2.5 | 160 |

## Precision Crystals

In addition to oscillators, Microchip provides sealed crystal resonators specifically designed for space applications. Crystals are plated in a Class 100 environment and sealed in a fully integrated cold weld vacuum seal system.

- Microchip patented QRM design
- g-Sensitivity down to 1E-10/g
- Swept quartz for space applications
- 100% phase noise screening options
- Active or passive pre-aging
- Multiple packaging options in industry standard footprints
- Frequencies up to 225 MHz
- MIL-PRF-3098 and ESA-3501 equivalents



## SAW Filters

Microchip offers SAW filters for space and high reliability applications. Most SAW filters are custom designed for customer applications, but many of our standard filters can also be built and screened for space requirements.

- Frequency range 30 MHz to 2.7 GHz
- Low loss, loss reduced and precision high loss filters available
- Shape factors as low as 1.03
- Through hole, connectorized and SMD packaging
- Hermetic sealing options
- Butterworth, Chebyshev, Reactance Filters and various FIR and IIR types

## High-Reliability Temperature-Compensated Crystal Oscillators (TCXO)

Microchip's Vectron Space TCXOs provide temperature stabilities as tight as ±0.5 ppm with 100 krad TID performance. Options incude multiple package configurations, (including the world's smallest space qualified TCXO), a variety of temperature stability and ranges, multiple screening options and a proven flight history. Microchip's two general specifications, DOC200103 and DOC207139, provide engineers with a fast path to mission success.

- 5 package choices
- Lead forming options
- 4-point mount crystals
- CMOS, LVDS and Sine options
- Multiple supply voltage options
- 300 krad total ionizing dose options

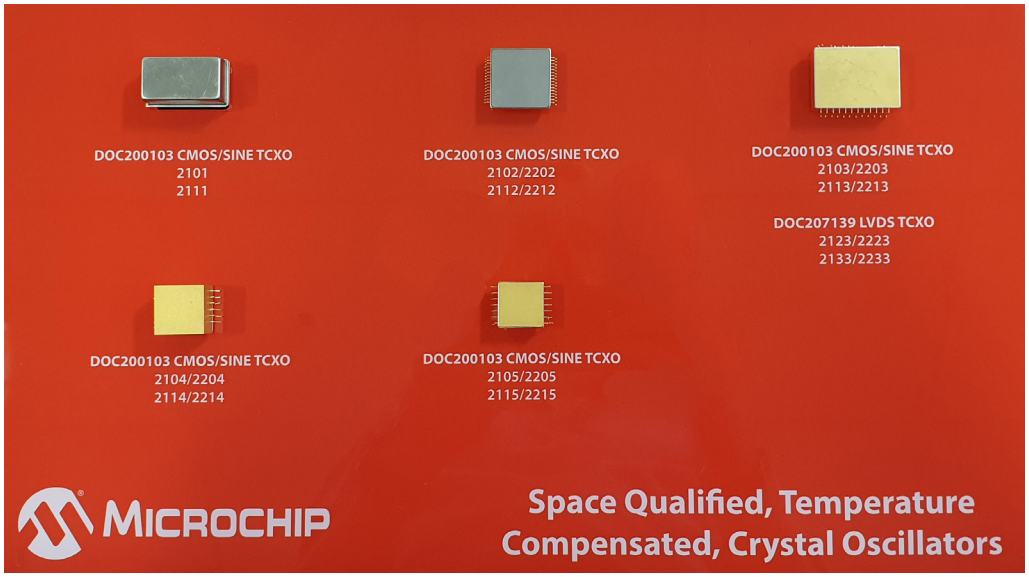
### DOC200103

- CMOS and Sine TCXOs
- Output frequencies to 500 MHz
- 5 different package configurations

### DOC207139

- LVDS TCXOs
- Output frequencies to 200 MHz
- Single or Dual Pair complimentary outputs

| Specification | Model Number | Lead Form Version | Output Logic | Number of RF outputs | Frequency Range (MHz) | Radiation Tolerance | | | Package | Dimensions (mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | TID | SET | SEL | | |
| | | | | | | kRad | MeV-cm2/mg | MeV-cm2/mg | | |
| DOC200103 | 2101 | | CMOS | 1 | .3 to 100 | 100 | 40 | 120 | 24-pin DDIP | 35.3 × 20.7 × 10.8 |
| | 2102 | 2202 | CMOS | 1 | .3 to 100 | 100 | 40 | 120 | 32 Lead Flatpack | 25.4 × 25.4 × 5.1 |
| | 2103 | 2203 | CMOS | 1 | .3 to 100 | 100 | 40 | 120 | 24 Lead Flatpack | 35.6 × 25.9 × 7.6 |
| | 2104 | 2204 | CMOS | 1 | .3 to 100 | 100 | 40 | 120 | 14 Lead Flatpack | 20.0 × 20.0 × 12.7 |
| | 2105 | 2205 | CMOS | 1 | .3 to 100 | 100 | 40 | 120 | 14 Lead Flatpack | 19.5 × 19.5 × 6.6 |
| | 2111 | | Sine | 1 | 10 to 225 | 100 | N/A | N/A | 24-pin DDIP | 35.3 × 20.7 × 10.8 |
| | 2112 | 2212 | Sine | 1 | 10 to 150 | 100 | N/A | N/A | 32 Lead Flatpack | 25.4 × 25.4 × 5.1 |
| | 2113 | 2213 | Sine | 1 | 10 to 500 | 100 | N/A | N/A | 24 Lead Flatpack | 35.6 × 25.9 × 7.6 |
| | 2114 | 2214 | Sine | 1 | 10 to 150 | 100 | N/A | N/A | 14 Lead Flatpack | 20.0 × 20.0 × 12.7 |
| | 2115 | 2215 | Sine | 1 | 10 to 150 | 100 | N/A | N/A | 14 Lead Flatpack | 19.5 × 19.5 × 6.6 |
| DOC207139 | 2123 | 2222 | LVDS | 1 pair | 12 to 200 | 300 | 67 | 120 | 24 Lead Flatpack | 35.6 × 25.9 × 7.6 |
| | 2133 | 2233 | LVDS | 1 pair | 12 to 200 | 300 | 67 | 120 | 24 Lead Flatpack | 35.6 × 25.9 × 7.6 |




| Operating Temperature Range (°C) | Frequency Stability (ppm) |
|---|---|
| 0 to 50 | ±0.5 |
| 0 to 50 | ±1 |
| 0 to 70 | ±1 |
| 0 to 70 | ±2 |
| 0 to 70 | ±5 |
| –20 to +70 | ±1 |
| –20 to +70 | ±2 |
| –20 to +70 | ±5 |
| -–40 to +85 | ±2 |
| –40 to +85 | ±4 |
| –40 to +85 | ±5 |
| –55 to +105 | ±10 |

## High Reliability Voltage Controlled Crystal Oscillators (VCXO)

Vectron VCXOs are crystal based frequency tunable oscillators. VCXOs are ideal for phase-locked loop or frequency modulation applications.

## High Reliability Voltage Controlled SAW Oscillators (VCSO)

VCSOs extend the upper frequency range of Vectron's tunable oscillator offering to 1.5 GHz with a –165 dBc/Hz noise floor and no subharmonics.

- 8 package choices
- Lead forming options
- CMOS, LVDS, LVPECL and Sine options
- Absolute pull range 20 ppm minimum

### DOC204898

- LVPECL output VCXO
- Output frequencies to 700 MHz

### DOC204899

- LVDS output VCXO
- Output frequencies to 200 MHz

### DOC206218

- CMOS output VCXO
- Output frequencies to 100 MHz

### DOC206559

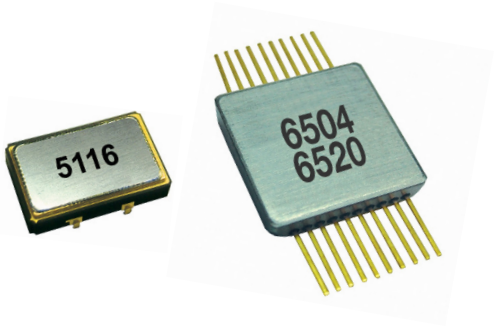
- Sine output VCSO
- Output frequencies to 1500 MHz
- 300 krad Total Ionizing Dose

### DOC206906

- LVPECL VCSO
- Output frequencies to 1000 MHz

### DOC207753

- CMOS or Sine outputs VCXO
- Output frequency to 675 MHz




| Specification | Model Number | Lead Formed Version | Osciilator Type | Output Logic | Frequency Range (MHz) | Absolute Pull Range (ppm) | Package | Dimensions (mm) |
|---|---|---|---|---|---|---|---|---|
| **DOC204898** | 5319 | 5321 | VCXO | LVPECL | 25 to 700 | 20 | 16-lead flatpack | 25.4 × 25.4 × 3.8 |
| **DOC204899** | 5219 | 5221 | VCXO | LVDS | 25 to 200 | 20 | 16-lead flatpack | 25.4 × 25.4 × 3.8 |
| **DOC206218** | 5116 | | VCXO | CMOS | 1 to 100 | 50/30 | 4 J-Lead SMT | 14.0 × 8.9 × 4.8 |
| **DOC206559** | 6504 | 6520 | VCSO | Sine | 300 to 1500 | 20 | 20-lead flatpack | 16.5 × 16.5 × 3.8 |
| **DOC206906** | 6304 | 6320 | VCSO | LVPECL | 300 to 1000 | 20 | 20-lead flatpack | 16.5 × 16.5 × 3.8 |
| **DOC207753** | 5101 | | VCXO | CMOS | .3 to 100 | 20 | 24-pin DDIP | 35.3 × 20.7 × 10.8 |
| | 5102 | 5202 | VCXO | CMOS | .3 to 100 | 20 | 32-Lead Flatpack | 25.4 × 25.4 × 5.1 |
| | 5103 | 5203 | VCXO | CMOS | .3 to 100 | 20 | 24-Lead Flatpack | 35.6 × 25.9 × 7.6 |
| | 5104 | 5204 | VCXO | CMOS | .3 to 100 | 20 | 14-Lead Flatpack | 20.0 × 20.0 × 12.7 |
| | 5105 | 5205 | VCXO | CMOS | .3 to 100 | 20 | 14-Lead Flatpack | 19.5 × 19.5 × 6.6 |
| | 5111 | | VCXO | Sine | 10 to 300 | 20 | 24-pin DDIP | 35.3 × 20.7 × 10.8 |
| | 5112 | 5212 | VCXO | Sine | 10 to 150 | 20 | 32-Lead Flatpack | 25.4 × 25.4 × 5.1 |
| | 5113 | 5213 | VCXO | Sine | 10 to 675 | 20 | 24-Lead Flatpack | 35.6 × 25.9 × 7.6 |
| | 5114 | 5214 | VCXO | Sine | 10 to 150 | 20 | 14-Lead Flatpack | 20.0 × 20.0 × 12.7 |
| | 5115 | 5215 | VCXO | Sine | 10 to 150 | 20 | 14-Lead Flatpack | 19.5 × 19.5 × 6.6 |

## High Stability Space Frequency References

For temperature stabilities better than 500 ppb, Vectron brand oscillators and other Microchip products provide multiple solutions depending on size, power, radiation and stability requirements.

## Oven Controlled Crystal Oscillator (OCXO)

OCXOs are oscillators combined with an oven maintaining the crystal unit at a precise temperature over the operating temperature range. The OCXO is the most accurate of all crystal oscillators.

## Evacuated Miniaturized Crystal Oscillator (EMXO)

An EMXO is a unique miniaturized oven controlled oscillator in an evacuated cavity. This design provides a small physical size, low profile, low-power consumption, fast warm-up and tight temperature stabilities

## Space Chip Scale Atomic Clock (CSAC)

The space CSAC is a low power cesium atomic clock that has been qualified for low earth orbit applications, capable of achieving sub 1 ppb temperature stabilities.

- Stability options to ±0.3 ppb
- Power options as low as 120 mW
- Radiation tolerance up to 300 krad
- Screening options available

### OX-249

- Output frequencies to 100 MHz
- 300 krad total ionizing dose

### EX-219

- Output frequencies to 120 MHz
- 0.7W power consumption

### 9700

- ±4 ppb stability –40°C to 65°C
- –140 dBc/Hz at 10 Hz offset

### 9800

- Output frequencies to 125 MHz
- ±25 ppb stability –40°C to 65°C

### 9500

- STS for $\tau$=1 to 100 s < 3E-13
- ±0.3 ppb stability –24°C to 60°C

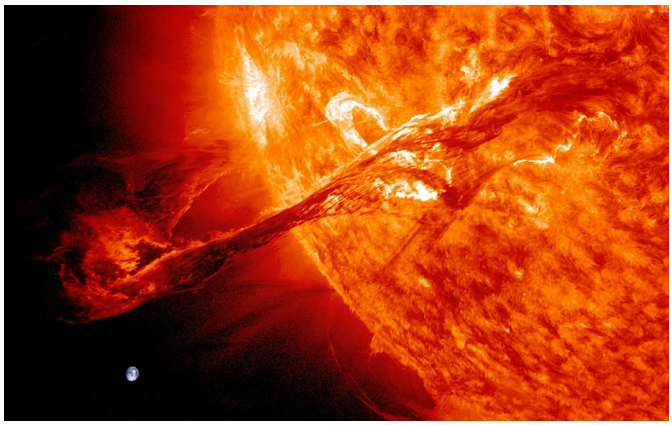
### SA.45s Space CSAC

- 120 mW power consumption
- ±0.5 ppb stability –10°C to 70°C


| Model | Type | Frequency Range (MHz) | Operating Temperature Range (°C) | Temperature Stability (ppb) | Output Logic | Phase Noise (typical) | | | Radiation (TID) (krad) | Power (W) | Footprint (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 10 Hz | 100 kHz | carrier | | | |
| | | | | | | dBc/Hz | dBc/Hz | MHz | | | |
| **EX-219** | EMXO | 10 to 120 | –40 to +85 | 100 | CMOS, Sine | –120 | –155 | 10 | 100 | 0.7 | 26.1 × 23.6 × 9.7 |
| **OX-249** | OCXO | 10 to 100 | –40 to +85 | 100 | CMOS, Sine, LVDS | –108 | –163 | 10 | 300 | 1.5 | 35.3 × 20.3 × 9.5 |
| **9700** | OCXO | 4 to 60 | –40 to +65 | 4 | TTL, Sine, LVDS | –140 | –160 | 10 | 100 | 1.3 | 34.2 × 34.2 × 33.2 |
| **9800** | OCXO | 40 to 125 | –20 to +70 | 25 | Sine | –100 | –160 | 50 | 100 | 1.3 | 34.2 × 34.2 × 33.2 |
| **9500** | OCXO | 4 to 100 | –24 to +60 | 0.3 | TTL or LVDS | –145 | –160 | 5 | 100 | 2.9 | 227 × 98.3 × 83.2 |
| **SA.45s Space** | CSAC | 10 | –10 to +70 | 0.5 | CMOS | –70 | –140 | 10 | 20 | 0.12 | 40.6 × 35.3 × 11.4 |

## Radiation Summary

Deploying electronics into space greatly increases the radiation exposure to the components. High energy particles from solar flares and cosmic rays disrupt the lattice structures of the devices. These disruptions can lead to frequency shifts, temporary glitches, or complete device failure. For any space program, understanding the mission profile is critical to ensuring the correct radiation level devices are chosen. When required, Vectron Space Oscillators are either radiation hardened by component design, including swept quartz, or tested for specific tolerance levels. The table below summarizes the Total Ionizing Dose rating. For single event effects (SET, SEU, SEL, SEGR) please refer to the reference document or contact Microchip.



| Total Ionizing Dose Summary (krad) | | | | |
|---|---|---|---|---|
| **20** | **50 (ELDRS)** | **100** | | **300** |
| **Low Earth Orbit** | **Geosynchronous Orbit** | | | **Deep Space Exploration** |
| **CSAC** | **Clocks** | **Clocks** | **VCXO** | **Clocks** |
| Sa.45 Space | DOC203810 | OS-68338 | DOC206218 | DOC206379 |
| | **VCXO** | DOC203679 | DOC207753 | DOC206903 |
| | DOC204898 | DOC204900 | **EMXO** | DOC207975 |
| | **VCSO** | MIL-PRF-55310 | EX-219 | **VCSO** |
| | DOC206906 | **TCXO** | **OCXO** | DOC206559 |
| | | DOC200103 | 9700 | **OCXO** |
| | | DOC207139 | 9800 | OX-249 |
| | | | 9500 | |

## General Notes of Interest

### Class S per MIL-PRF-55310

Microchip is one of only two companies approved for Class S oscillators per MIL-PRF-55310. We pride ourselves in having this unique approval. However, there are times when the offering under MIL-PRF-55310 does not fit your needs. For these occasions, Microchip has available specifications for each oscillator type which will completely specify an oscillator for a space environment without you having to produce their own SCD. Many of our best space customers have adopted this unique Microchip approach because it saves them much time and money. Our specifications are provided at no cost to you and allows for many choices or grades of oscillators through the part number building process. You can order engineering units without extensive testing all the way up to top level Class S or Class K screened parts and many levels in between. Contact our MIL/Space application engineers to discuss your needs and to get copies of our specifications.

### Mounting Points on Crystal Blanks

The extreme shock and vibration levels experienced during the launch of all spacecraft is of special interest to all engineers. The most fragile component used in oscillators and fi lters is the quartz crystal. Many OEM's specifying crystal oscillators and filters for space use have adopted the policy of mandating either a 3- or 4-point mounting structure for all quartz crystals. Microchip uses the 4-point crystal mount for all space platforms except the Model 1118 which uses a 3-point crystal mount.

### Lead Forming

Lead forming is available on some packages such as flatpacks. Tools for this purpose have previously been manufactured and the resultant formed lead dimensions are available by contacting your Microchip Applications Engineer. Note that no testing can be done after the leads are formed as this will change the critical dimensions achieved by the bending operation.

## Support

Microchip is committed to supporting its customers in developing products faster and more efficiently. We maintain a worldwide network of field applications engineers and technical support ready to provide product and system assistance. For more information, please visit www.microchip.com:

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## Training

If additional training interests you, Microchip offers several resources including in-depth technical training and reference material, self-paced tutorials and significant online resources.

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