Frequency Components - Field Sales Guide 2020

GOLLEDGE ATTENDEES

Sharon Miller – Sales Executive
Nigel Cole – Product Manager
Chris Watts – Chief Engineer

AGENDA

- **Field Sales Guide Covering:**
  - Technical principles: What are the different types of frequency products and what do they do?
  - Basic parameters
  - What to ask at the customer to select the right product?
- **Products for New Designs in 2020**
  - Highlight products and products for design in projects
- **Typical/target applications**
- **Q&A**

Frequency Product Type - Crystals

What are they?
AT-cut crystals are made of a thin slice of quartz with an electrode attached to each face. The electrode can be made of aluminium, silver, or gold (or some combination).

Tuning fork crystals (32.768kHz) as the name suggests are made from a tiny quartz two pronged fork. It has two electrodes (made of layers of silver and gold).

Both types of crystal are housed in hermetically sealed packages.

What do they do: They are resonators. The electrical signal applied across the electrodes is turned into a mechanical vibration. The mechanical vibration is turned back into an electrical signal. The mechanical structure resonates at a particular frequency (like a tuning fork or bell). That mechanical resonance appears as an electrical resonance across the electrodes (the electrical series resonance of the crystal).

Figure 1 - The crystal blank from a tuning fork type crystal

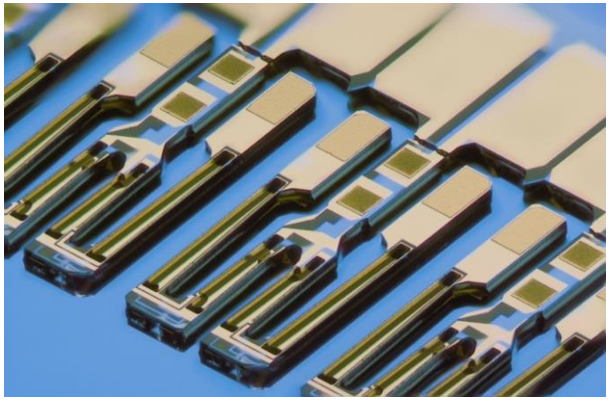


Figure 2 – Block circuit notation for a crystal

Crystals - What Product Characteristics to specify:

- **Frequency** - *Golledge crystals are available from 10.0kHz up to 315MHz*
- **Package size** - *packages as small as 1.2 x 1.0 x 0.35mm are available with the most economic package size being 3.2 x 2.5mm*
- **Calibration tolerance @25°C** (ppm)
- **Temperature stability** (ppm) – *not relevant for watch crystals (tuning forks)*
- **Operating temperature range**
- **Circuit condition** (pF)

Commercial Requirements – What to find out:

- **IC/Chipset number?** – *In many applications crystals will be used with a system on chip or IC*
- **New project or already in production?**
- **Project start time?**
- **Project life time?**
- **Estimate annual quantity** (EAQ)**?**
- **Target price?**
- **Current solution/competitor?**

Frequency Product Type - Oscillators

What are they?
The combination of a crystal and a silicon integrated circuit in the same package. Some older parts have a collection of discrete components in place of a single IC.

What do they do: Produces an electrical signal at a very precisely defined frequency. Oscillators provide a finished produce with the oscillator circuitry included.

Figure 3 - Oscillators are composed of an internal circuit and a crystal

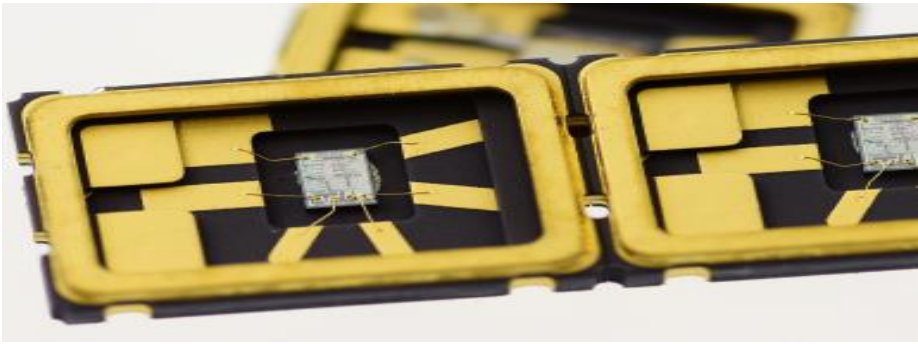
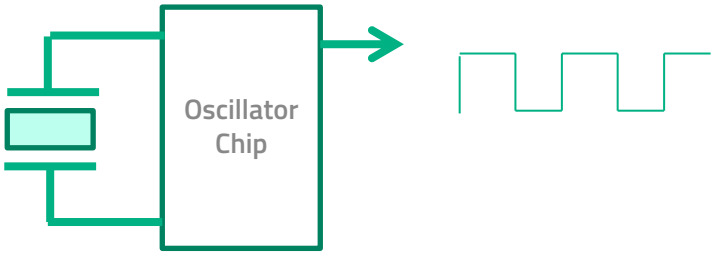


Figure 4 – Block diagram of an oscillator showing a crystal connected to an oscillator chip to generate an output



Oscillators - What Product Characteristics to specify:

- **Frequency** - *Golledge oscillators are available from frequencies of 10.0kHz up to 270MHz*
- **Package size** – *packages as small as 1.6 x 1.0 x 0.6mm are available, with the most economic package size being 3.2 x 2.5mm*
- **Frequency stability** – *Oscillators with stabilities as tight as ±2.5ppm are available*
- **Operating temperature range**
- **Supply voltage** (V)
- **Output** – *CMOS, LVDS and LV-PECL outputs are available*

Commercial Requirements – What to find out:

- **IC/Chipset number?** – *Some applications will specify an oscillator instead of a crystal to be used with a system on chip or IC*
- **New project or already in production?**
- **Project start time?**
- **Project life time?**
- **Estimate annual quantity** (EAQ)**?**
- **Target price?**
- **Current solution/competitor?**

Frequency Product Type – Temperature Compensated Oscillators (TCXOs)

What are they?
An oscillator with a temperature controlled tuning circuit added, that aims to cancel out the temperature variation of the oscillator.

What do they do: Produces an electrical signal at a very precisely defined frequency. Temperature compensated oscillators (TCXOs) possess greater frequency accuracy than a standard oscillator or crystal.

Figure 5 - GTXO-253 is one of Golledge's most popular TCXOs and measures just 2.5 x 2.0mm

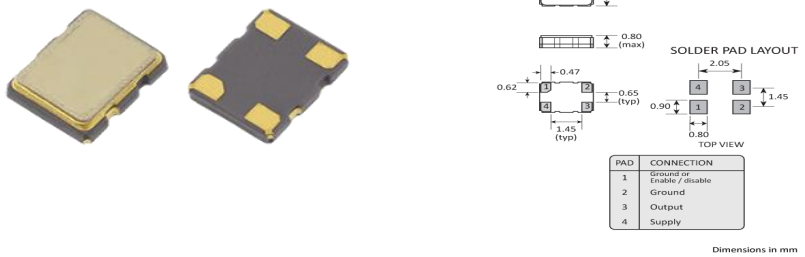
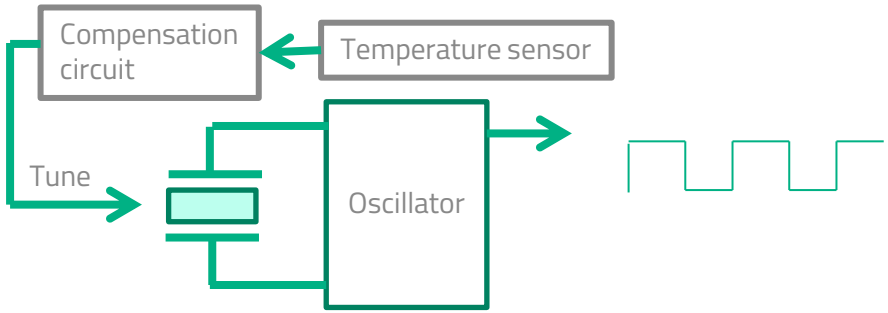


Figure 6 - The block diagram for a TCXO shows the additional temperature sensor and compensation circuit



TCXOs - What Product Characteristics to specify:

- **Frequency** - *Golledge TCXOs are available from frequencies of 32.768kHz up to 100MHz*
- **Package size** – *packages as small as 1.6 x 1.2 x 0.7mm are available, with the most economic package size being 2.5 x 2.0mm*
- **Frequency stability** – *TCXOs with stabilities as tight as ±0.5ppm are available*
- **Operating temperature range**
- **Supply voltage** (V)
- **Output** – *CMOS, and Clipped-Sine outputs are available*

Commercial Requirements – What to find out:

- **IC/Chipset number?** – *Some applications will specify a TCXO instead of a crystal to be used with a system on chip or IC*
- **New project or already in production?**
- **Project start time?**
- **Project life time?**
- **Estimate annual quantity** (EAQ)**?**
- **Target price?**
- **Current solution/competitor?**

Frequency Product Type – Voltage Controlled Oscillators (VCXOs)

What are they?
A tuneable version of the oscillator. Allows frequency tuning over a very small range.

What do they do: Produces an electrical signal which may be pulled over a very small range of frequencies. Voltage controlled oscillators (VCXOs) possess greater frequency flexibility than a standard oscillator.

Figure 7 - The voltage controlled oscillator GVXO-331 from Golledge measures just 3.2 x 2.5mm

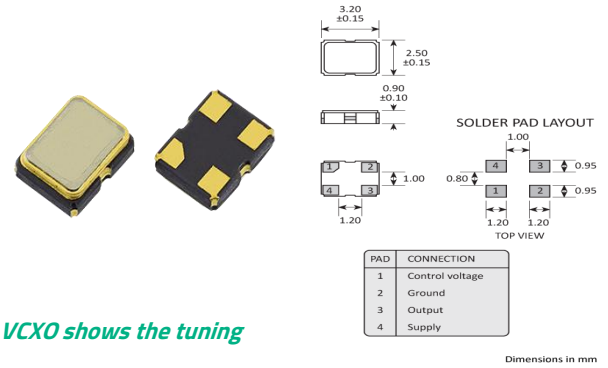
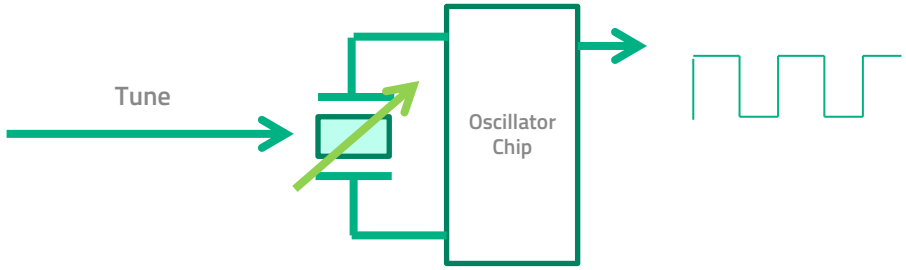


Figure 8 – The block diagram for a VCXO shows the tuning adjustment



VCXOs - What Product Characteristics to specify:

- **Frequency** - *Golledge VCXOs are available from frequencies of 1.0MHz up to 250MHz*
- **Package size** – *packages as small as 3.2 x 2.5 x 1.1mm are available*
- **Frequency Pullability** – *VCXOs with frequency pullability as wide as ±350ppm are available*
- **Frequency stability** – *VCXOs with stabilities as tight as ±25ppm are available*
- **Operating temperature range**
- **Supply voltage** (V)
- **Output** – *CMOS, ECL, PECL, LVDS and LV-PECL outputs are available*

Commercial Requirements – What to find out:

- **New project or already in production?**
- **Project start time?**
- **Project life time?**
- **Estimate annual quantity** (EAQ)**?**
- **Target price?**
- **Current solution/competitor?**

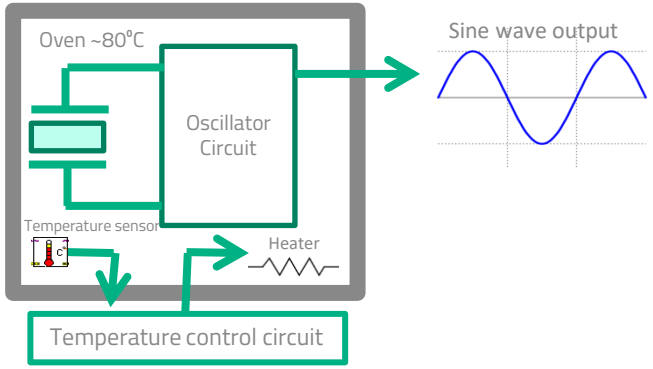
Frequency Product Type – Oven Controlled Oscillators (OCXOs)

What are they?
An oscillator inside a small oven that keeps it at a constant temperature, virtually eliminating frequency variation due to variation in outside temperature.

What do they do: Produces an electrical signal at a very precisely defined frequency. Oven controlled oscillators (OCXOs) possess much greater frequency stability than standard oscillators or temperature compensated oscillators. Engineers tend to specify an OCXO when low phase noise is required or a very low daily ageing rate is needed in addition to exceptional frequency accuracy.

Figure 9 - Oven controlled oscillators come in many different package types

Figure 10 – The block diagram of an OCXO shows the oven and temperature control units which act to maintain frequency stability



OCXOs - What Product Characteristics to specify:

- **Frequency** - *Golledge OCXOs are available from frequencies of 10.0kHz up to 120MHz*
- **Package size** – *OCXOs come a wide range of packages including DIL-14, chassis mounted and surface mount packages as small as 14 x 9.1 x 6.9mm are available*
- **Temperature stability** – *OCXOs with stabilities as tight as ±0.05ppm are available*
- **Operating temperature range**
- **Daily Ageing rate** – *Daily ageing rates as low as <2x10^{-10} are available*
- **Supply voltage** (V)
- **Output** – *CMOS and Sinewave outputs are available*
- **Phase noise** – *phase noise characteristics as low as -160dBc/Hz @ 10kHz are available*

Commercial Requirements – What to find out:

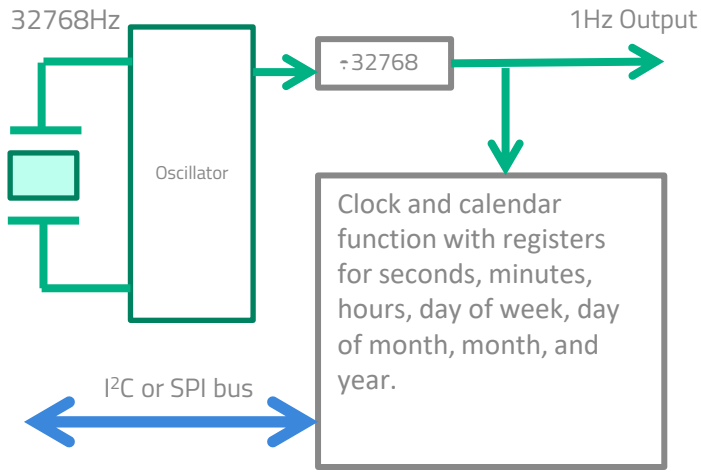
- **New project or already in production?**
- **Project start time?**
- **Project life time?**
- **Estimate annual quantity** (EAQ)**?**
- **Target price?**
- **Current solution/competitor?**

Frequency Product Type – Real Time Clocks (RTCs)

What are they?
RTC stands for Real Time Clock. Our RTCs consist of a clock chip and matching tuning fork crystal in a single compact surface mount package.

What do they do: Tells the time and date. RTCs also have alarms that can be set to the time and date of the users choosing. They communicate with a microcontroller via serial bus and an interrupt line. RTCs have a wide range of optional extra functions include battery backup (with backup battery charger), temperature compensation, event time stamps, low frequency clock output, and user RAM.

Figure 11 - RTCs have pad connections for many additional functions as shown in the block diagram for this component



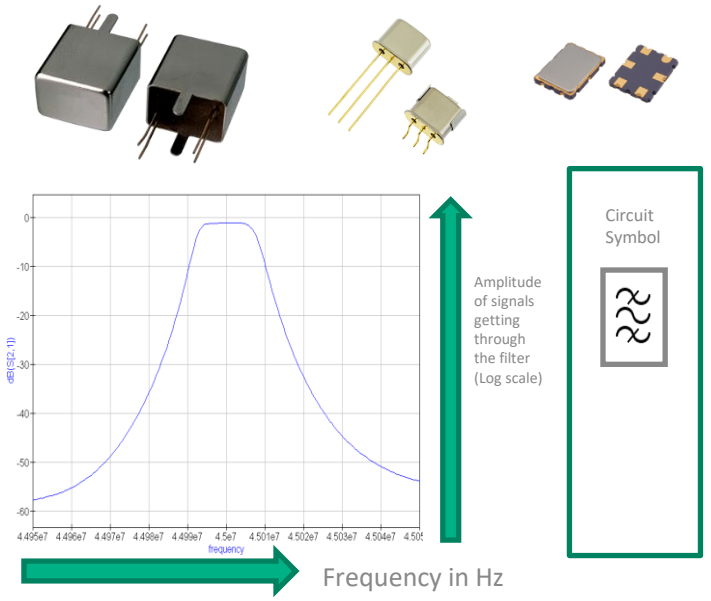
RTCs - What Product Characteristics to specify:

- **Frequency** - *RTCs are only available with frequency of 32.768kHz*
- **Package size** – *packages as small as 3.2 x 1.5 x 0.8mm are available*
- **Temperature stability** – *RTCs are available with temperature compensation (to ensure stability over a required temperature range such as -20 to +70°C) or without temperature compensation when stabilities will be specified at 25°C. Temperature stabilities as tight as ± 1ppm are available*
- **Required power consumption** – *this may be important to some projects using an RTC. Power consumptions as low as 45nA is available*
- **Operating temperature range**
- **Supply voltage** (V)
- **RTC interface** – *I²C (I2C) bus or SPI bus are available*

Commercial Requirements – What to find out:

- **New project or already in production?**
- **Project start time?**
- **Project life time?**
- **Estimate annual quantity** (EAQ)**?**
- **Target price?**
- **Current solution/competitor?**

Figure 12- Crystal filters come in a range of different package types and act to filter incoming signals



Frequency Product Type – Monolithic Crystal Filters

What are they?

Two or four resonators made on the same slice of quartz. Their vibrations couple through the quartz structure. There are electrodes for input, output, and ground.

Crystal filters with sharper cut-off can be made by combining monolithic filters in the same package. Filters with 8 resonators (referred to as 8 pole) made of 4 monolithic resonator pairs are available.

What do they do: Filter signals using a very specific centre frequency and steep passband characteristics.

Crystal Filters -
What Product Characteristics to specify:

- **Centre Frequency** - *Crystal filters are available with a range of commonly used centre frequencies from 10.7MHz up to 90MHz*
- **Package size** – *crystal filters are available in a range of package types including packages as small as 6.2 x 3.7 x 1.1mm*
- **Bandwidth @3dB** – *a range of passband widths are available, including as tight a 2kHz, and as wide as 30kHz around the centre frequency*
- **Operating temperature range**

Commercial Requirements – What to find out:

- **New project or already in production?**
- **Project start time?**
- **Project life time?**
- **Estimate annual quantity** (EAQ)**?**
- **Target price?**
- **Current solution/competitor?**

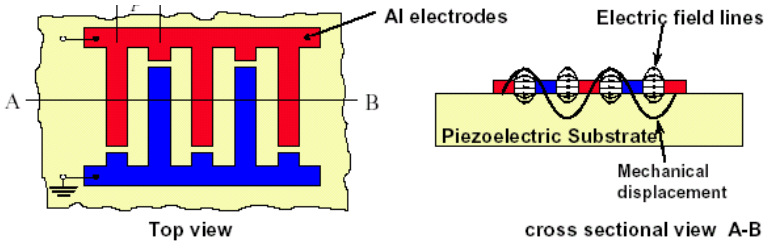
Frequency Product Type – SAW Resonators

What are they?
A slice of quartz with a pair of aluminium electrodes in an interdigital pattern on one side of the quartz and housed in a hermetic package.

What do they do: Behaves electrically similar to a crystal but with a resonance in the UHF frequency range which is specified by the series resonance. The temperature characteristics of a SAW resonator are similar to a tuning fork crystal.

Figure 13 - Older generations of SAW Resonators came in leaded packages but the newest generation measure just 3.0 x 3.0mm

Figure 14 – The electro-mechanical properties of a SAW resonator act to generate an RF signal through the piezoelectric effect



SAW Resonators -
What Product Characteristics to specify:

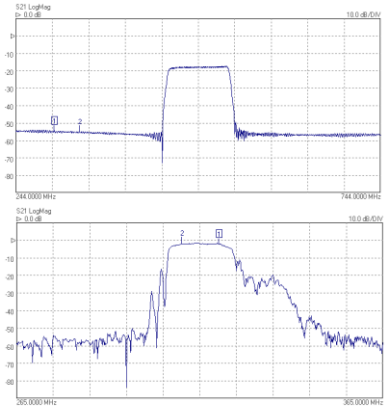
- **Frequency** - *SAW Resonators are available from frequencies of 245.76MHz up to 1.28GHz*
- **Package size** – *packages as small as 3.0 x 3.0 x 1.15mm are available*
- **Frequency tolerance** (kHz) – *SAW Resonators with frequency tolerances as tight as 25kHz are available*

Commercial Requirements – What to find out:

- **New project or already in production?**
- **Project start time?**
- **Project life time?**
- **Estimate annual quantity** (EAQ)**?**
- **Target price?**
- **Current solution/competitor?**

Frequency Product Type – SAW Filters

Figure 15 - SAW Filters provide excellent signal filtering characteristics in ultra-miniature packages, some measuring just 1.1 x 0.9mm



What are they?
SAW stands for Surface Acoustic Wave. The material used can be quartz, but is more commonly other piezoelectric materials with greater electric - mechanical conversion. As the name suggests these filters use ripples traveling on the surface of a substrate. The ripples are guided and reflected by complex patterns of aluminium fingers on the surface that passes ripples of a certain wavelength and rejects others. Some of the aluminium fingers also serve to connect the input and output electrical signals converting to/from the surface ripples.

What do they do: Filter signals up to very high centre frequencies, into the GHz range. SAW filters have a much wider range of bandwidths than crystal filters.

SAW Filters -
What Product Characteristics to specify:

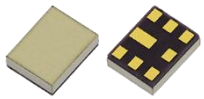
- **Centre Frequency** - *SAW filters are available with a range of commonly used centre frequencies in both the IF and RF ranges, from 35MHz up to 3.7GHz*
- **Package size** – *SAW filters are available in ultra-miniature packages as small as 1.1 x 0.9 x 0.5mm*
- **Bandwidth** – *a range of passband widths are available, including as tight a 2kHz, and as wide as 150MHz around the centre frequency*
- **Insertion loss** –*many projects require as low insertion loss as possible, our SAW filters are available with insertion losses as low as 2dB*

Commercial Requirements – What to find out:

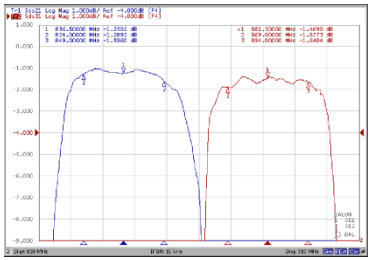
- **New project or already in production?**
- **Project start time?**
- **Project life time?**
- **Estimate annual quantity** (EAQ)**?**
- **Target price?**
- **Current solution/competitor?**

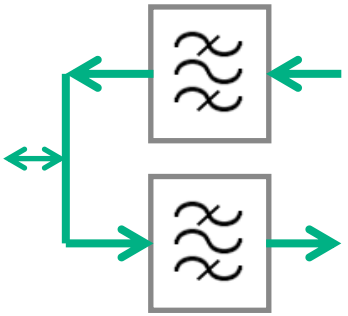
Figure 16 - Ultra-miniature SAW Duplexers provide filtering for both transmit (Tx) and receive (Rx) signals, in one tiny package

Frequency Product Type – SAW Duplexers



What are they?
A pair of SAW filters with different passband frequencies in a single package. The connections at one side of the two filters are tied together.





What do they do: Splits a signal path in two depending in frequency. Often used to connect a transmitter and receiver to a single antenna when the transmitter and receiver operate on different frequencies. The two filters are designed such the each does not affect the passband performance of the other.

SAW Duplexers -
What Product Characteristics to specify:

- **Tx (Transmit) and RX (Receive) Frequencies** - *SAW Duplexers are available with a range of Tx and Rx frequency options to suit most communication bands including LTE. Frequencies are available from as low as 313MHz up to 2.6GHz*
- **Package size** – *SAW Duplexers are available in ultra-miniature packages as small as 1.8 x 1.4 x 0.54mm*
- **Bandwidth** – *a range of passband widths are available, including as tight a 200kHz, and as wide as 70MHz around the centre frequency*
- **Insertion loss** –*many projects require as low insertion loss as possible, our SAW filters are available with insertion losses as low as 2dB*
- **Operating temperature range**

Commercial Requirements – What to find out:

- **New project or already in production?**
- **Project start time?**
- **Project life time?**
- **Estimate annual quantity** (EAQ)**?**
- **Target price?**
- **Current solution/competitor?**

Any Questions?

Precision timing makes the difference

We've been providing world-leading service for over 25 years

Frequency Products For New Designs in 2020

Golledge

Surface Mount Quartz Crystals – 32.768kHz

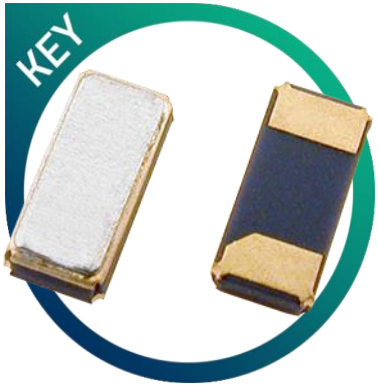
Watch crystals for commercial and industrial applications - Key Product

Available in a range of packages and pad configurations, Golledge watch crystals always offer the most competitive solution

GSX-315

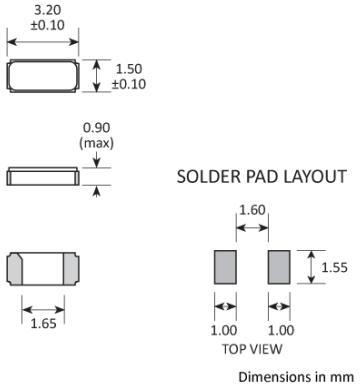
Miniature SM 32.768kHz Watch Crystal

Our most popular 32.768kHz solution, the GSX-315 watch crystal offers highly competitive pricing and low power consumption in a miniature vacuum sealed ceramic package.



Key Points

- Compatible with CM315/FC135
- Industry standard 3.2 x 1.5mm footprint
- Board area = 4.8mm^2
- Highly competitive
- Core stock



Configure your GSX-315 here

Surface Mount Quartz Crystals – 32.768kHz

Watch crystals for commercial and industrial applications

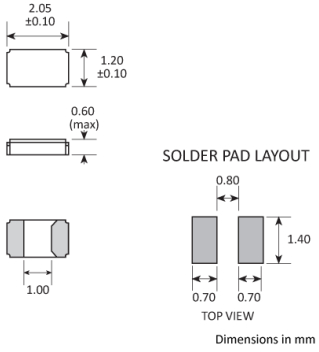
Available in a range of packages and pad configurations, Golledge watch crystals always offer the most competitive solution

GWX-2012

Ultra- Miniature SM 32.768kHz Crystal

Access the GWX-2012 datasheet here

- Suitable for high volume applications
- 2.05 x 1.2mm footprint
- Board area = 2.4mm^2
- Ultra-low profile, just 0.6mm high
- Vacuum sealed for high stability

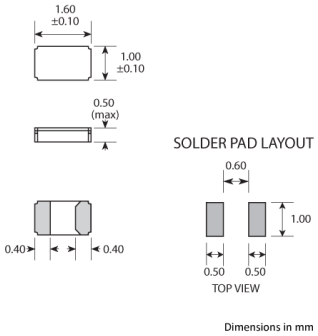


GWX-1610

Miniature SM 32.768kHz Crystal

Access the GWX-1610 datasheet here

- Competitive pricing for volume applications
- Ultra low profile - 0.5mm high
- Light weight miniature package with tiny 1.6 x 1.0mm footprint
- Vacuum sealed for high stability



GSX-200

Access the GSX-200 datasheet here

- Highly suitable as drop in replacement for existing designs
- Large stocks available
- No longer recommended for new designs

Surface Mount Quartz Crystals – 32.768kHz

Automotive Solutions

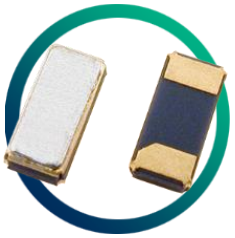
Available in a range of packages and pad configurations, Golledge watch crystals always offer the most competitive solution

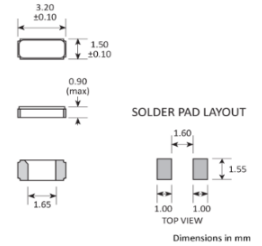
GRX-315

Automotive Watch Crystal (AEC-Q200)

Access the GRX-315 datasheet here

- AEC-Q200 qualified with PPAP available
- 3.2 x 1.5mm footprint
- Low cost for volume applications
- Low power consumption



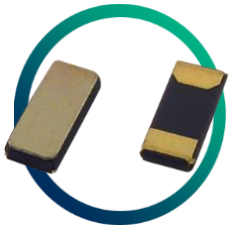


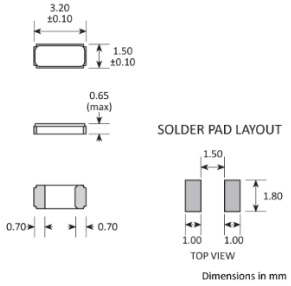
CM7V-T1A

Miniature SM 32.768kHz Crystal with AEC-Q200

Access the CM7V-T1A datasheet here

- High shock and vibration resistance
- 3.2 x 1.5mm footprint
- Board area = 4.8mm^2
- Extended temperature range option



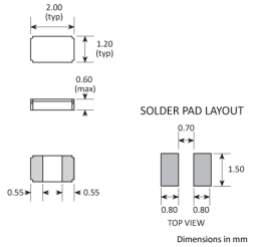


CM8V-T1A

Ultra-Miniature 2012 SM AEC-Q200 Crystal

Access the CM8V-T1A datasheet here

- Ultra-low profile of 0.6mm
- 2.0 x 1.2mm footprint
- Board area = 2.4mm^2
- Extended temperature range option



Surface Mount Quartz Crystals – 32.768kHz

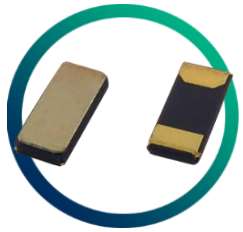
Solutions for Harsh Environments

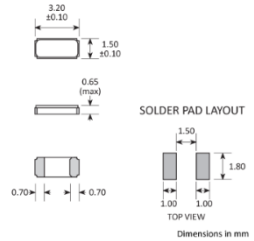
Available in a range of packages and pad configurations, Golledge watch crystals always offer the most competitive solution

CM7V-T1A/M

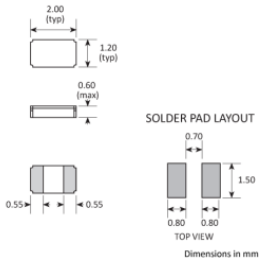
Ultra-Miniature SM 32.768kHz Crystal

Configure your CM7V-T1A/M here





- High shock and vibration resistance
- 3.2 x 1.5mm footprint
- Extended temperature range of -55 to +125°C available
- Low power consumption



CM8V-T1A/M

Ultra-Miniature SM 32.768kHz Crystal

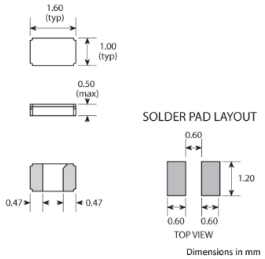
Configure your CM8V-T1A/M here

- High shock and vibration resistance
- 2.0 x 1.2mm footprint
- Board area = 2.4mm^2
- Extended temperature range of -55 to +125°C available

CM9V-T1A

Ultra-Miniature 1610 Package SM 32.768kHz Crystal

Access the CM9V-T1A datasheet here



- Ultra-low profile of 0.5mm
- High shock and vibration resistance
- Extended temperature range available
- Board area of just 1.6mm^2

Surface Mount Quartz Crystals – Commercial/Industrial

High frequency crystals for commercial/industrial applications – Key Product

With exceptionally competitive pricing available and an ultra-miniature package

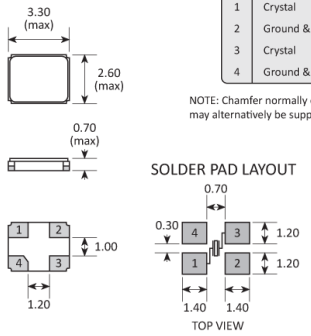
GSX-333

3.2 x 2.5mm High Frequency SM Crystal with Tight Specifications

The GSX-333 miniature surface mount crystal is available from 8.0 ~ 125.0MHz. Fundamental mode available up to 54.0MHz, and 3rd overtone from 54.0MHz upwards.

Key Points

- Metal lid can be grounded to minimise EMI
- Seam sealed for excellent long-term stability
- Ultra-miniature for maximum space saving
- Ideal for Bluetooth / Wireless applications



PAD	CONNECTION
1	Crystal
2	Ground & lid
3	Crystal
4	Ground & lid

NOTE: Chamfer normally on pad 4, but may alternatively be supplied on pad 1.

Dimensions in mm

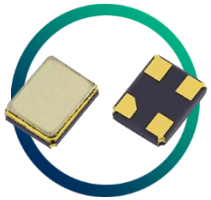
Configure your GSX-333 here

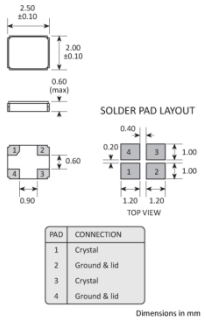
Golledge

Surface Mount Quartz Crystals – Commercial/Industrial

High frequency crystals for commercial / industrial applications

With exceptionally competitive pricing available and packages as small as 1.2 x 1.0mm





GSX-323

12.0 ~ 54.0MHz Miniature SM Crystal

Access the GSX-323 datasheet here

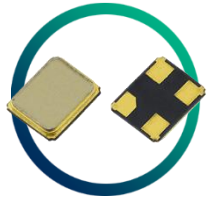
- Ideal for Bluetooth/Wireless applications
- 2.5 x 2.0mm footprint
- Board area = 5.0mm^2
- Seam sealed for excellent stability

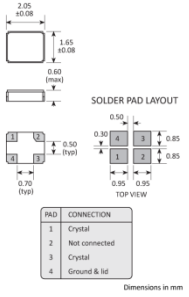
GSX-223

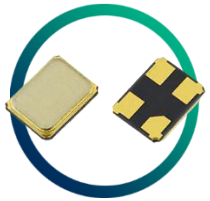
16.0 ~ 50.0MHz Ultra-Miniature SM Crystal

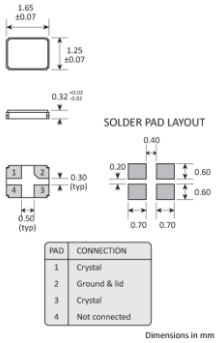
Access the GSX-223 datasheet here

- Ultra-miniature for maximum space saving
- 2.0 x 1.2mm footprint
- Board area = 2.4mm^2
- Seam sealed for long term stability









GSX-213

Ultra-Miniature SM Crystal for NFC, Smartcard etc.

Access the GSX-213 datasheet here

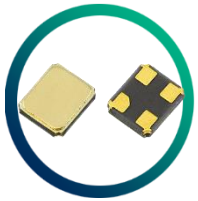
- Available from 24.0 ~ 60.0MHz
- 1.92mm^2 board area
- 1.6 x 1.2mm footprint
- Ideal for NFC applications
- Excellent ageing characteristics

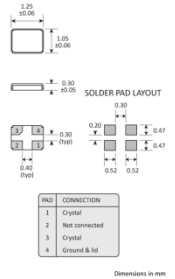
GSX-113

Super-Miniature SM Crystal with Low ESR

Assess the GSX-113 datasheet here

- 1.2 x 1.0mm footprint
- Fundamental mode up to 80MHz
- Available from 32.0 ~ 80.0MHz
- Board area = 1.2mm^2

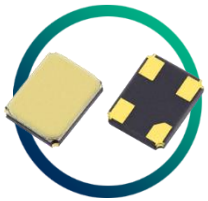


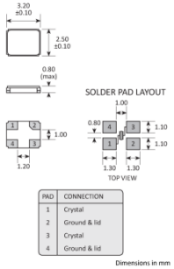


Surface Mount Quartz Crystals – Automotive

High frequency crystals for Automotive applications

Packages as small as 1.6 x 1.2mm and exceptionally competitive pricing available





GRX-330

Ultra-Miniature SM 12.0 ~ 48.0MHz Crystal

Access the GRX-330 datasheet here

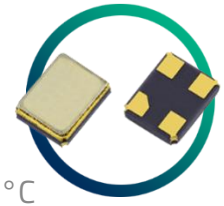
- AEC-Q200 qualified with PPAP available
- 3.2 x 2.5mm footprint
- Board area = 8.0mm^2
- Extended temperature range of -40 to +125°C

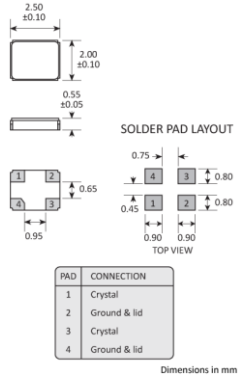
GRX-320

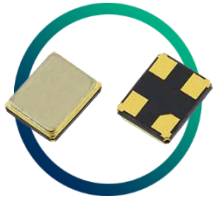
Ultra-Miniature SM 12.0 ~ 40.0MHz Crystal

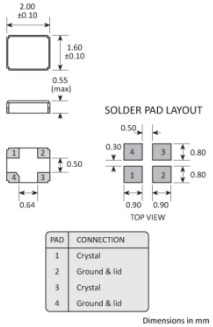
Access the GRX-320 datasheet here

- AEC-Q200 qualified with PPAP available
- 2.5 x 2.0mm footprint
- Board area = 5.0mm^2
- Extended temperature range of -40 to +125°C









GRX-220

16.0 ~ 40.0MHz Ultra- Miniature SM Crystal

Access the GRX-220 datasheet here

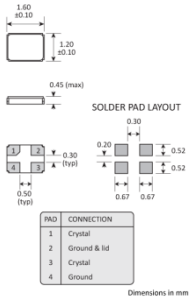
- AEC-Q200 qualified with PPAP available
- 2.0 x 1.6mm footprint
- Board area = 3.2mm^2
- Temperature range of -40 to +125°C available

GRX-210

Ultra- Miniature SM Crystal For Automotive

Access the GRX-210 datasheet here

- Available from 24.0 ~ 40.0MHz
- 1.6 x 1.2mm footprint
- AEC-Q200 qualified with PPAP available
- Temperature range of -40 to +125°C available



Golledge

Surface Mount Quartz Crystals – High Frequency

Crystals for high frequency applications

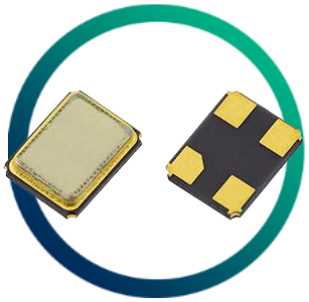
Packages as small as 2.0 x 1.6mm and exceptionally competitive pricing available

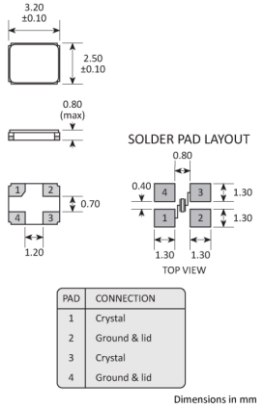
GSX-338

Ultra-Miniature High Frequency SM Crystal

Access the GSX-338 datasheet here

- Fundamental mode up to 315MHz
- Plasma etched inverted mesa process
- Wide pulling range (fundamental mode)
- 3.2 x 2.5mm footprint
- Small and medium quantities also available





PAD	CONNECTION
1	Crystal
2	Ground & lid
3	Crystal
4	Ground & lid

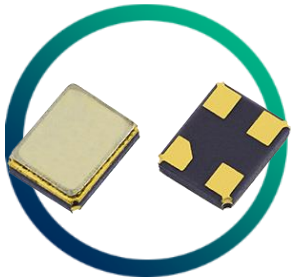
Dimensions in mm

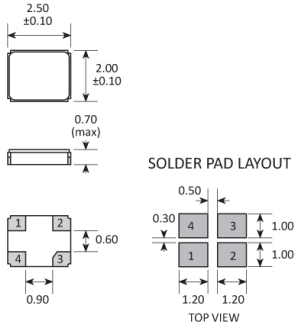
GSX-328

16.0 ~ 315MHz Miniature SM Crystal

Access the GSX-328 datasheet here

- Fundamental mode up to 315MHz
- Plasma etched inverted mesa process
- Wide pulling range (fundamental mode)
- 2.5 x 2.0mm footprint
- Small and medium quantities also available





PAD	CONNECTION
1	Crystal
2	Ground & lid
3	Crystal
4	Ground & lid

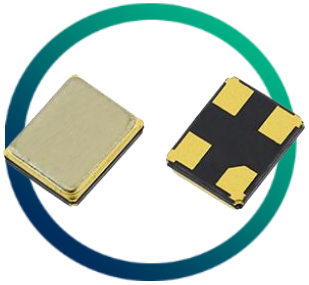
Dimensions in mm

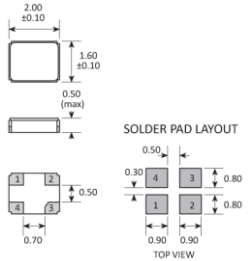
GSX-228

20.0 ~ 315MHz Miniature SM Crystal

Access the GSX-228 datasheet here

- Fundamental mode up to 315MHz
- Plasma etched inverted mesa process
- Wide pulling range (fundamental mode)
- 2.0 x 1.6mm footprint
- Small and medium quantities also available





PAD	CONNECTION
1	Crystal
2	Ground & lid
3	Crystal
4	Ground & lid

Dimensions in mm

Surface Mount Quartz Crystals – Harsh Environments

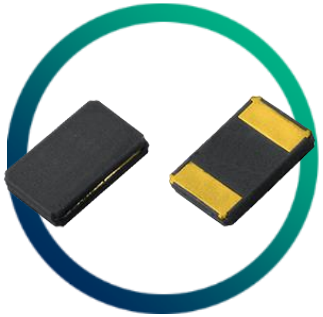
High frequency crystals for harsh environments

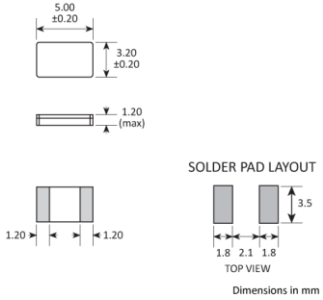
Extreme stability and high shock and vibration resistance

CC2A

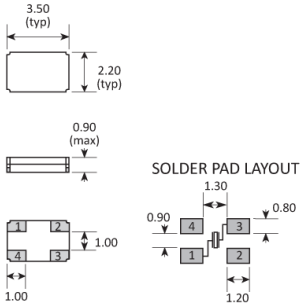
SM Crystal Suitable For Harsh Environments

Access the CC2A range here



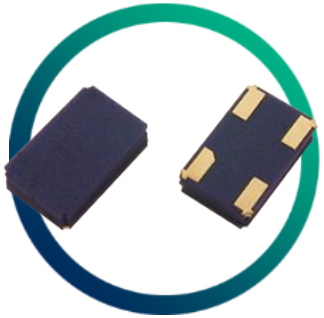


- Available from 12.0 ~ 70.0MHz
- High shock and vibration resistance
- 5.0 x 3.2mm footprint
- Wide range of frequencies available
- Extreme temperature ranges available, including as wide as -55 to +200°C



PAD	CONNECTION
1	Crystal
2	Not connected
3	Crystal
4	Not connected

Dimensions in mm



CC6A

Miniature SM Crystal Suitable For Harsh Environments

Access the CC6A range here

- Available from 16.0 ~ 70.0MHz
- High shock and vibration resistance
- 3.5 x 2.2mm footprint
- Wide range of frequencies available
- Extreme temperature ranges available, including as wide as -55 to +200°C

Surface Mount Oscillators– 32.768kHz

Low frequency oscillators for commercial and industrial applications

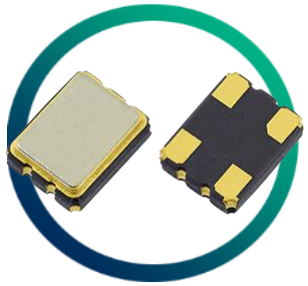
Wide supply voltage and operating temperature ranges available

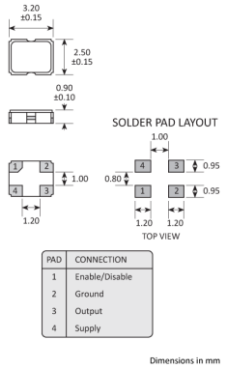
GFO-3301

SM Miniature Oscillator

Access the GFO-3301 datasheet here

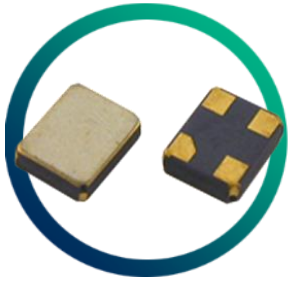
- Low power consumption
- 3.2 x 2.5mm footprint
- Board area = 8.0mm^2
- Extended temperature range of -40 to +80°C available

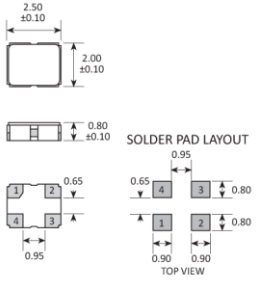




PAD	CONNECTION
1	Enable/Disable
2	Ground
3	Output
4	Supply

Dimensions in mm





PAD	CONNECTION
1	Enable/Disable
2	Ground
3	Output
4	Supply

Dimensions in mm

GAO-3201

Ultra-miniature SM Oscillator

Access the GAO-3201 datasheet here

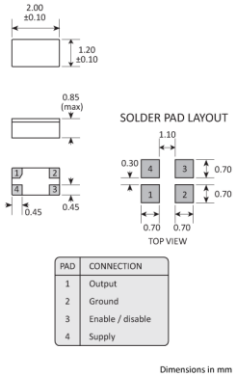
- Suitable for high volume applications
- 2.5 x 2.0mm footprint
- Board area = 5.0mm^2
- Ultra-low profile, just 0.8mm high
- Tight stability over operating temperature range

OM7605C8

Ultra-miniature SM Oscillator

Access the OM7605C8 datasheet here

- High shock and vibration resistance
- 2.0 x 1.2mm footprint
- Board area = 2.4mm^2
- Extended temperature range of -40 to +85°C available



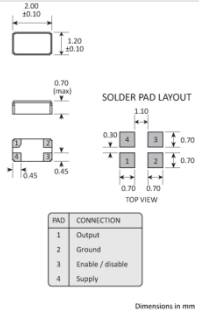
PAD	CONNECTION
1	Output
2	Ground
3	Enable / disable
4	Supply

Dimensions in mm

Surface Mount Oscillators– 32.768kHz & 100kHz

Low Frequency Oscillators for Automotive Applications

Wide supply voltage and operating temperature ranges available



OM7604C7

Ultra-miniature 32.768kHz Oscillator for Automotive

Access the OM7604C7 datasheet here

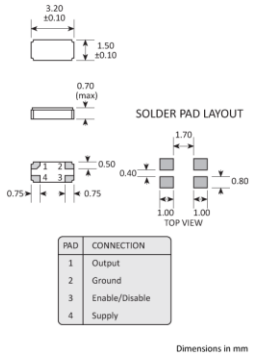
- Ultra-low power consumption
- Tight frequency tolerance
- 3.2 x 1.5mm footprint
- High shock and vibration resistance
- Industrial and extended temperature ranges

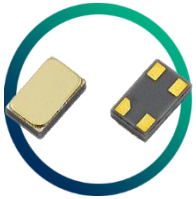
OM7605C8

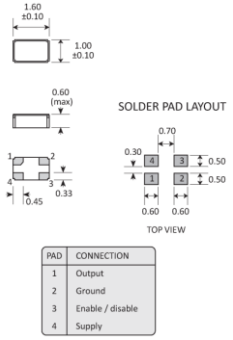
Ultra-miniature 32.768kHz Oscillator for Automotive

Access the OM7605C8 datasheet here

- Ultra-low power consumption
- Tight frequency tolerance
- High shock and vibration resistance
- Industrial and extended temperature ranges
- 2.0 x 1.2mm footprint







OM7605C9

Ultra-miniature 32.768kHz Oscillator for Automotive

Access the OM7605C9 datasheet here

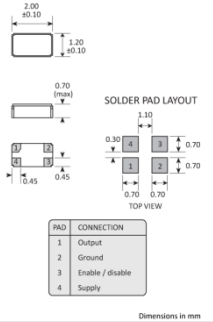
- Ultra-low power consumption
- Tight frequency tolerance
- 1.6 x 1.0mm footprint
- High shock and vibration resistance
- Industrial and extended temperature ranges

OM0100C8

Ultra-miniature 100kHz Oscillator for Automotive

Access the OM0100C8 datasheet here

- Ultra-low power consumption
- Operable from 1.6~5.5V
- High shock and vibration resistance
- 2.0 x 1.2mm footprint



Golledge

Surface Mount Oscillators– 32.768kHz & 100kHz

Low Frequency Oscillators for Material Sensitive Applications

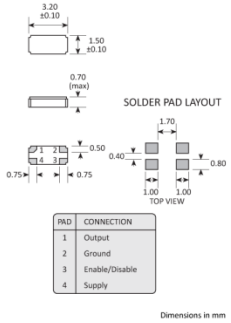
Wide supply voltage and operating temperature ranges available

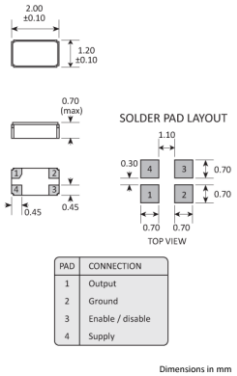
OV7604C7

Miniature Fully Ceramic SM Oscillator

Access the OV7604C7 datasheet here

- Ultra low power consumption
- Fully ceramic package
- Ultra-miniature 32.768kHz oscillator
- Tight frequency tolerance
- Industrial and extended temperature ranges
- High shock and vibration resistance





OV7605C8

Miniature Fully Ceramic SM Oscillator

Access the OV7605C8 datasheet here

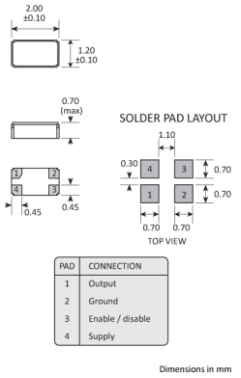
- Ultra low power consumption
- Ultra-miniature 32.768kHz oscillator
- Tight frequency tolerance
- Optional AEC-Q200 qualification
- High shock and vibration resistance
- Fully ceramic package

OV0100C8

Miniature Fully Ceramic SM Oscillator

Access the OV0100C8 datasheet here

- Ultra low power consumption
- Ultra-miniature 100kHz oscillator
- Optional AEC-Q200 qualification
- High shock and vibration resistance
- Ultra-miniature fully ceramic package



Golledge

Surface Mount Oscillators– Low Frequency

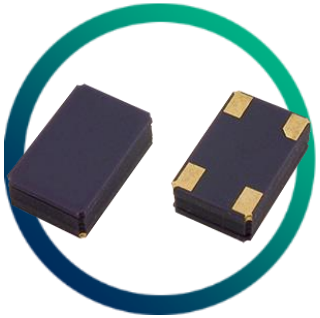
Low frequency oscillators for harsh environments

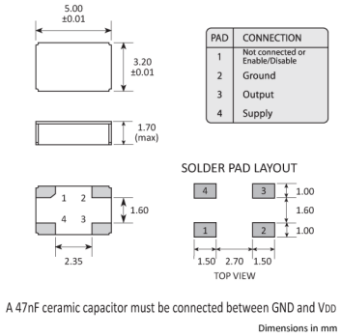
Wide supply voltage and operating temperature ranges available

MCSO2xxx

Miniature Fully Ceramic SM Oscillator

Access the MCSO2xxx range here





A 47nF ceramic capacitor must be connected between GND and VDD

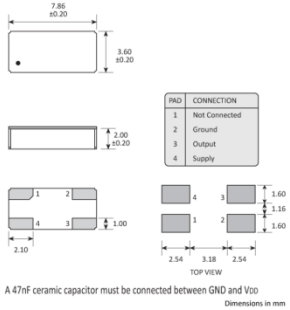
Dimensions in mm

- Available from 10.0kHz
- Suitable for Avionics, Down-hole, Geothermal etc.
- Extreme temperature ranges up to 210°C
- High stability & low ageing under extremes
- High shock & vibration resistance
- Optional tinned pads (Ag/Cu/Sn)

MCSO1xxx

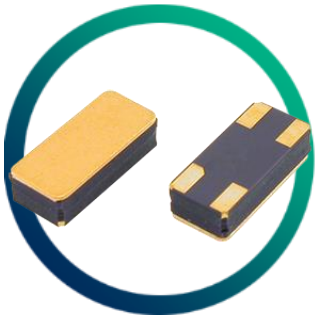
Miniature Low Frequency SM Oscillator

Access the MCSO1xxx range here



A 47nF ceramic capacitor must be connected between GND and VDD

Dimensions in mm

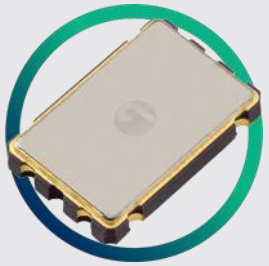


- Available from 10.0kHz
- Suitable for Avionics, Down-hole, Geothermal etc.
- Extreme temperature ranges up to 200°C
- High stability & low ageing under extremes
- High shock & vibration resistance
- Optional tinned pads (Ag/Cu/Sn)

Surface Mount Oscillators – Commercial/Industrial

Competitively priced oscillators suitable for commercial applications - Key Product

Highly competitive pricing with tight frequency stability and low current consumption



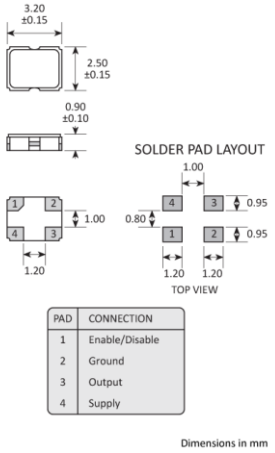
GXO-3301

High Stability SM Oscillator

The GXO-3301 oscillator features tight frequency stability and low current consumption as standard and is available with a range of supply voltage options.

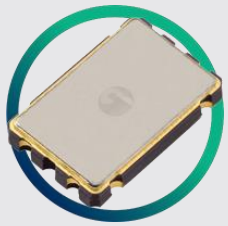
Key Points

- High stability for WiMAX, LAN etc.
- Low current consumption
- 3225 Miniature ceramic package with metal lid
- Enable / disable tristate function
- Competitive pricing
- Available from 625kHz ~ 78.0MHz



Configure your GXO-3301 here

Surface Mount Oscillators – Commercial/Industrial



Competitively priced oscillators suitable for commercial applications

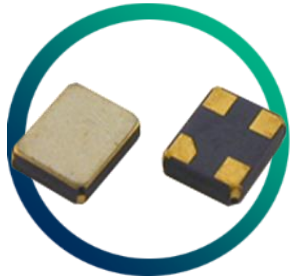
Frequencies up to 200MHz with highly competitive pricing

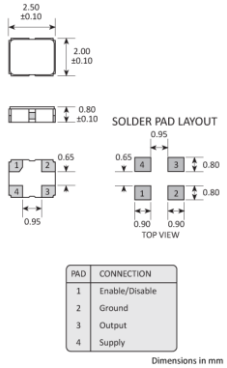
GXO-3201

Miniature CMOS Oscillator with Low Jitter

Access the GXO-3201 family here

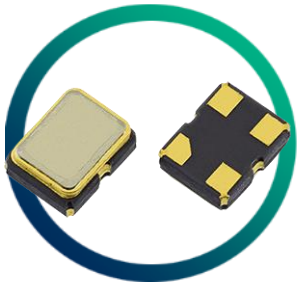
- Low current consumption
- Enable / disable tristate function
- Miniature 2.5 x 2.0mm ceramic package with metal lid
- Competitive pricing
- Available from 750kHz ~ 50.0MHz

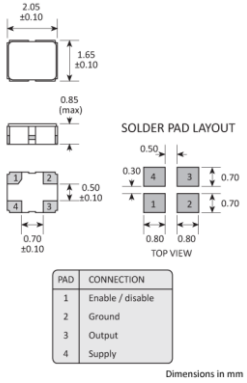




PAD	CONNECTION
1	Enable/Disable
2	Ground
3	Output
4	Supply

Dimensions in mm





PAD	CONNECTION
1	Enable / disable
2	Ground
3	Output
4	Supply

Dimensions in mm

GXO-2201

Miniature CMOS Oscillator with Low Jitter

Access the GXO-2201 family here

- Competitive pricing for high volumes
- Miniature 2.0 x 1.6mm ceramic package with metal lid
- 1.8V, 2.5V and 3.3V voltage supply options
- Enable / disable tristate function
- Available from 1.5 ~ 54.0MHz

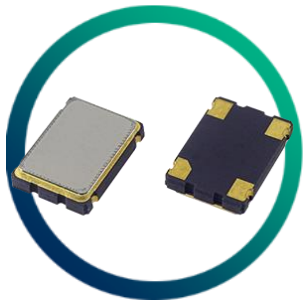
GXO-7531/U108

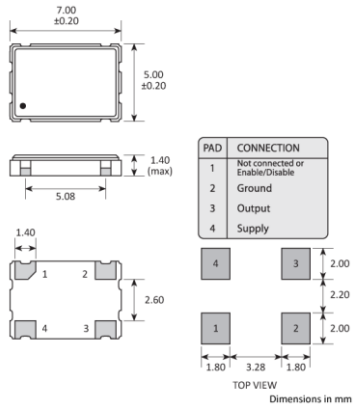
Versatile Oscillators with Many Available Frequencies

Access the GXO-7531

Access the GXO-U108

- Very wide range of available frequencies from 12.0kHz ~ 200MHz
- 7.5 x 5.0mm footprint
- High drive capabilities up to 50pF
- Power saving variants available





PAD	CONNECTION
1	Not connected or Enable/Disable
2	Ground
3	Output
4	Supply

Dimensions in mm

Surface Mount Oscillators – Harsh Environments

High frequency components and those suitable for harsh environment

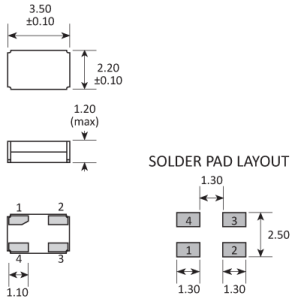
Extended temperature ranges and high shock and vibration resistance

MCSO6xxx

Miniature Low Jitter Oscillators For Harsh Environments

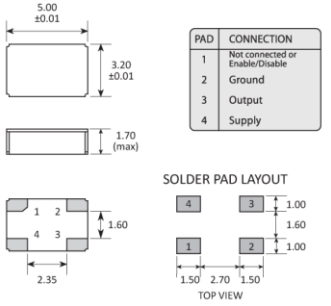
Access the MCSO6xxx range here

- Miniature 3.5 x 2.2mm package
- Available from 10.0kHz ~ 155MHz
- Suitable for Avionics, Down-hole, Geothermal and more
- Extreme temperature ranges available up to 210°C
- High stability & low ageing under extremes
- High shock & vibration resistance
- Optional tinned pads (Ag/Cu/Sn)



PAD	CONNECTION
1	Not connected or Enable/Disable
2	Ground
3	Output
4	Supply

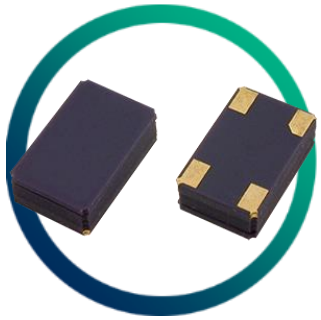
Dimensions in mm



PAD	CONNECTION
1	Not connected or Enable/Disable
2	Ground
3	Output
4	Supply

A 47nF ceramic capacitor must be connected between GND and V_{DD}

Dimensions in mm



MCSO2xxx

Low Jitter Oscillators For Harsh Environments

Access the MCSO2xxx range here

- Available from 10.0kHz ~ 225MHz
- Suitable for Avionics, Down-hole, Geothermal and more
- Extreme temperature ranges available up to 210°C
- High stability & low ageing under extremes
- High shock & vibration resistance
- Optional tinned pads (Ag/Cu/Sn)

Surface Mount Oscillators – Special Applications

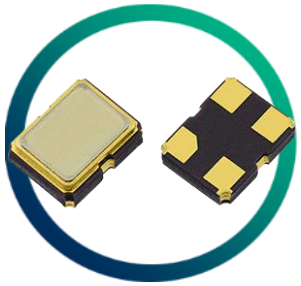
High frequency and tight stability oscillators

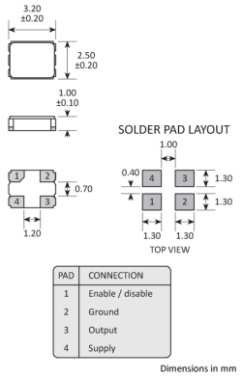
Packages as small as 2.5 x 2.0mm with exceptionally low jitter characteristics

GXO-3300

High Frequency, Tight Stability Oscillator

Access the GXO-3300 family here

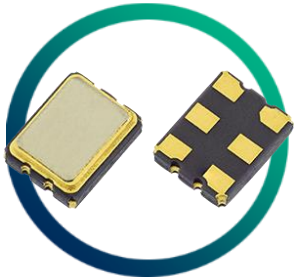


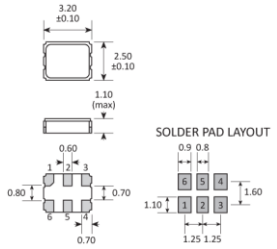


PAD	CONNECTION
1	Enable / disable
2	Ground
3	Output
4	Supply

Dimensions in mm

- Available from 10.0 ~ 160MHz
- High precision with tight stability options
- Wide operating temperature ranges
- High frequency fundamental - no multiplier
- Low & medium volumes also available
- Enable / disable tristate function





PAD	CONNECTION
1	Enable / disable
2	Not connected
3	Ground
4	Output 1 (Q)
5	Output 2 ($\overline{Q}$)
6	Supply

Dimensions in mm

GXO-L31

LVDS Oscillator for High Speed Data Transfer

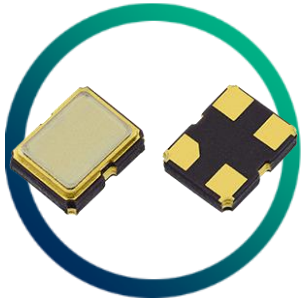
Access the GXO-L31 family here

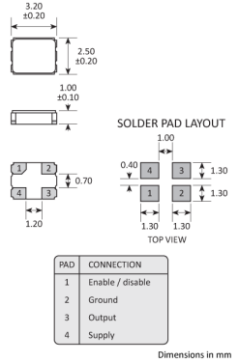
- Available from 40.0 ~ 250MHz
- Differential outputs
- RMS phase jitter 0.3ps
- Low current consumption (20mA max.)
- Multiplier-free design
- Enable / disable tristate function

GXO-3306

3225 Package Ultra-Low Jitter Oscillator

Access the GXO-3306 family here





PAD	CONNECTION
1	Enable / disable
2	Ground
3	Output
4	Supply

Dimensions in mm

- Available from 16.0 ~ 50.0MHz
- Excellent phase noise & jitter characteristics of 0.04ps typical
- Enable / disable tristate function
- Small and medium quantities also available

Temperature Compensated Oscillators – TCXOs

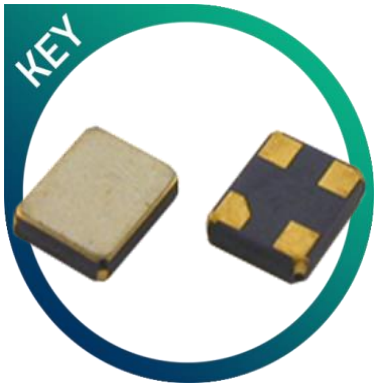
Tight stability in miniature surface mount packages – Key Product

Ultra-miniature package and stability options as tight as ±0.5ppm

GTXO-253

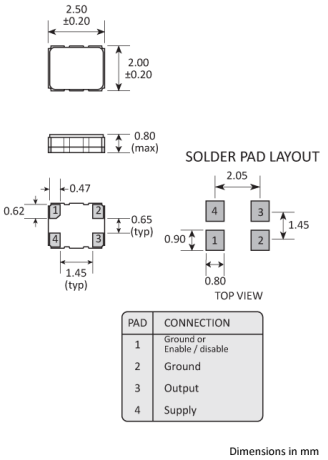
1.8V ~ 3.6V Ultra-tight Stability TCXO

The GTXO-253T temperature compensated oscillator is ideally suited for many applications, featuring frequency stability as tight as ±0.5ppm, fast start up time of 3ms maximum, and a miniature 2.5 x 2.0mm package.



Key Points

- ±0.5ppm frequency stability option
- Supply voltage from 1.8V ~ 3.6V
- Low power consumption
- Miniature SM package
- Clipped sine output
- Available from 10.0 ~ 52.0MHz

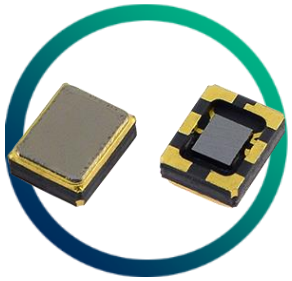


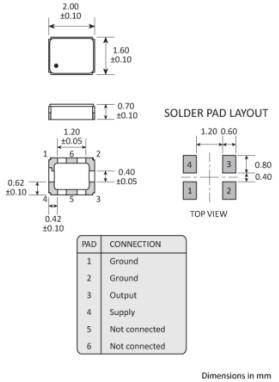
Explore the GTXO-253 options here

Temperature Compensated Oscillators – TCXOs

Tight stability in miniature surface mount packages

Frequencies available up to 70MHz with stabilities as tight as ±0.5ppm





PAD	CONNECTION
1	Ground
2	Ground
3	Output
4	Supply
5	Not connected
6	Not connected

Dimensions in mm

GTXO-203

Ultra-miniature 2.0 x 1.6mm Footprint TCXO

Access the GTXO-203 family here

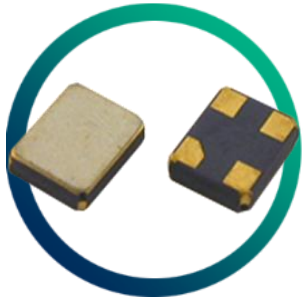
- Ideally suited for wearable applications
- Supply voltages from 1.8V ~ 3.6V
- Low power consumption
- Clipped sine output
- Excellent frequency stability
- Available from 10.0 ~ 70.0MHz

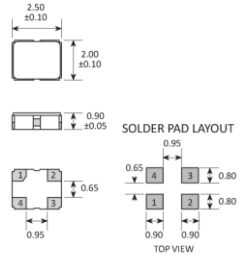
GTXO-C25

SM TCXO with excellent phase noise characteristics

Access the GTXO-C25 family here

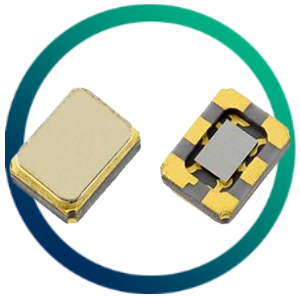
- Low power consumption
- Enable / disable tristate function
- CMOS output
- Excellent frequency stability
- 4.0 ~ 54.0MHz

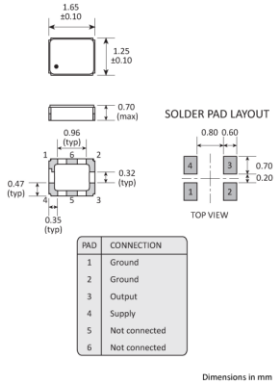




PAD	CONNECTION
1	Enable/Disable
2	Ground
3	Output
4	Supply

Dimensions in mm





PAD	CONNECTION
1	Ground
2	Ground
3	Output
4	Supply
5	Not connected
6	Not connected

Dimensions in mm

GTXO-163

Ultra-miniature 1.6 x 1.2mm Footprint TCXO

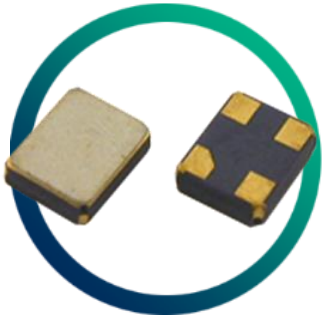
Access the GTXO-163 family here

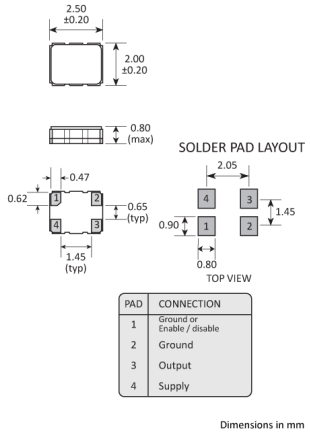
- Available at frequencies from 16.0 ~ 52.0MHz
- Clipped sine output
- Excellent frequency stability options of ±0.5ppm available
- Operable from 1.8 ~ 3.6V

TCXOs - Automotive

Tight stability in miniature surface mount packages

With stabilities as good as ±0.5ppm and optional AEC-Q200 qualification





PAD	CONNECTION
1	Ground or Enable / disable
2	Ground
3	Output
4	Supply

Dimensions in mm

GTXO-253

1.8V ~ 3.6V Ultra-tight Stability TCXO

Access the GTXO-253 family here

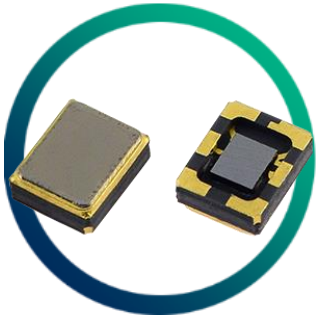
- ±0.5ppm frequency stability option
- Supply voltage from 1.8V ~ 3.6V
- Low power consumption
- Miniature SM package
- Available from 10.0 ~ 52.0MHz
- Clipped sine output

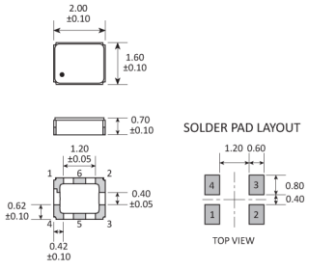
GTXO-203

Ultra-miniature 2.0 x 1.6mm Footprint TCXO

Access the GTXO-203 family here

- Ideally suited for wearable applications
- Supply voltages from 1.8V ~ 3.6V
- Low power consumption
- Miniature SM package
- Excellent frequency stability
- Available from 10.0 ~ 70.0MHz
- Clipped sine output





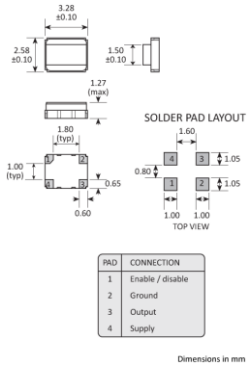
PAD	CONNECTION
1	Ground
2	Ground
3	Output
4	Supply
5	Not connected
6	Not connected

Dimensions in mm

TCXOs– Special Applications

High frequency and tight stability oscillators

Miniature SM packages with exceptional stability and pullability options



GTXO-94

32.768kHz CMOS TCXO

Access the GTXO-94 range here

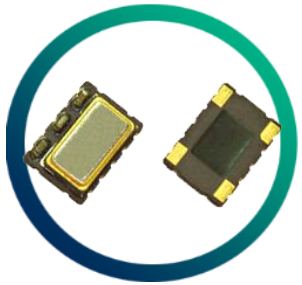
- 32.768kHz
- Extremely low current consumption
- ±5ppm frequency stability
- 1.8V, 2.5V, 3.0V and 3.3V supply options

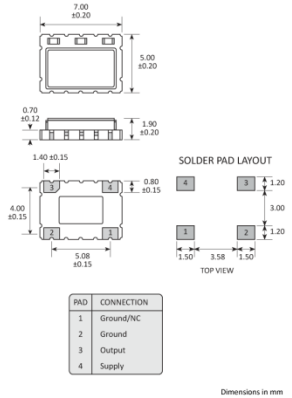
GTXO-73

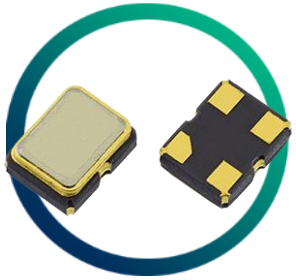
Stratum 3 TCXO with Clipped Sine Output

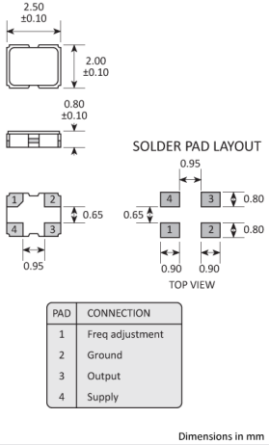
Access the GTXO-73 range here

- Stratum 3 compliant and available at frequencies from 5.0 ~ 52.0MHz
- ±4.6ppm stability over 20 years
- Miniature 7050 SM package
- 3.3V & 5V supply voltage options









GTXO-251V

VCTCXO with Tight Stability and Wide Pullability

Access the GTXO-251V datasheet here

- Specifically designed for AIS projects
- Wide voltage control range of ±15 ~ ±25ppm, 1.5V ±1.0V
- Great frequency stability of ±0.5ppm available
- Miniature 2520 SM package
- Available from 16.0 ~ 52.0MHz

Voltage Controlled Oscillators – VCXOs

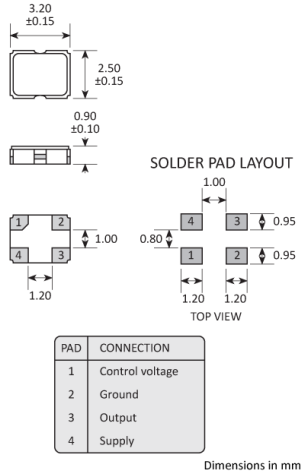
Gain control with our wide range of VCXOs – Key Product

Wide frequency pullability and a range of operating supply voltages

GVXO-331

Surface Mount VCXO

GVXO-331 voltage controlled oscillators are available over a frequency range of 1.50 to 64.440MHz and offer the engineer wide frequency pullability and operating supply voltage options of 1.8V, 2.8V and 3.3V.



Key Points

- Low current consumption
- Three supply voltage options
- Miniature SM package
- Competitive pricing

Explore the GVXO-331 range here

Voltage Controlled Oscillators – VCXOs

Gain control with our wide range of VCXOs

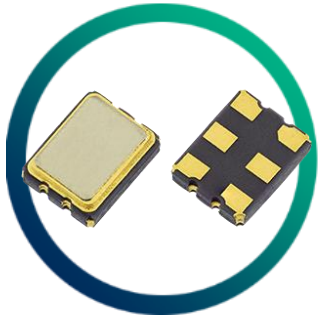
Wide frequency pullability and a range of operating supply voltages

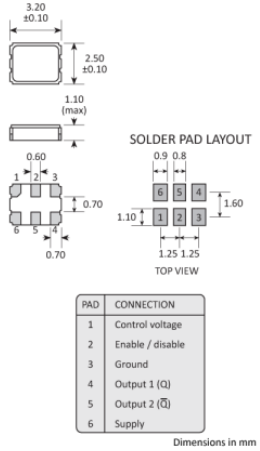
GVXO-L33L (E33L)

VCXO with Low Phase Jitter up to 250MHz

Access the GVXO-L33L

Access the GVXO-E33L





PAD	CONNECTION
1	Control voltage
2	Enable / disable
3	Ground
4	Output 1 (Q)
5	Output 2 ($\overline{Q}$)
6	Supply

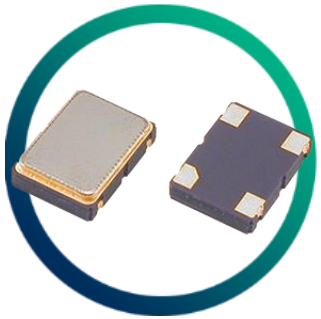
Dimensions in mm

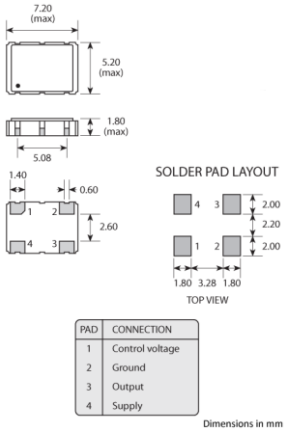
- Complementary LVDS or LV-PECL outputs
- Multiplier-free design
- Enable / disable tristate function
- Designed for high speed data transfer
- Great phase jitter performance of 1ps typ. (12kHz ~ 20MHz)

GVXO-753

Cost Effective Voltage Controlled Oscillator

Access the GVXO-753 family here





PAD	CONNECTION
1	Control voltage
2	Ground
3	Output
4	Supply

Dimensions in mm

- 7.0 x 5.3mm footprint
- Cost effective for volume applications
- Operating temperature ranges as wide as -40 to +85°C
- Available from 1.5 ~ 54.0MHz
- 6 pad version also available with enable/disable tristate functionality

VCXOs – Harsh Environments

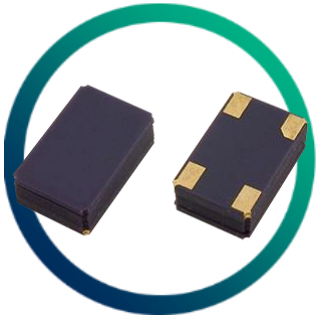
Gain control with our wide range of VCXOs

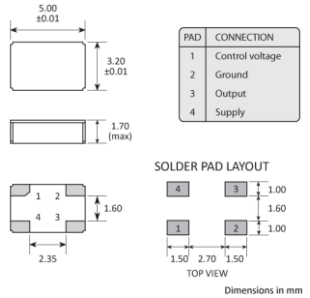
High shock and vibration resistance and extreme operating temperature ranges

VCXO2EV

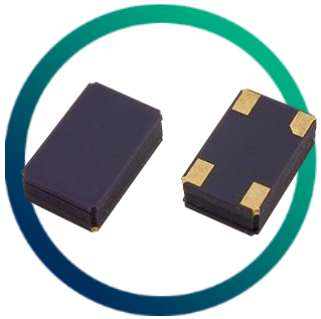
CMOS VCXO for Harsh Environments

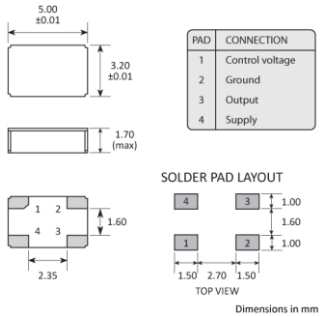
Access the VCXO2EV here





- Suitable for Avionics, Down-hole, Geothermal etc
- Extreme temperature ranges up to 210°C
- High stability & low ageing under extremes
- High shock & vibration resistance
- Low current consumption
- Available from 5.0 ~ 40.0MHz





VCXO2HV

High Frequency VCXO with Military Temperature Range

Access the VCXO2HV here

- Military temperature range -55 to +125°C
- Fundamental crystal for low phase noise
- High shock & vibration resistance
- Optional tinned pads (Ag/Cu/Sn)
- Available from 5.0 ~ 170MHz

Real Time Clock Modules - RTCs

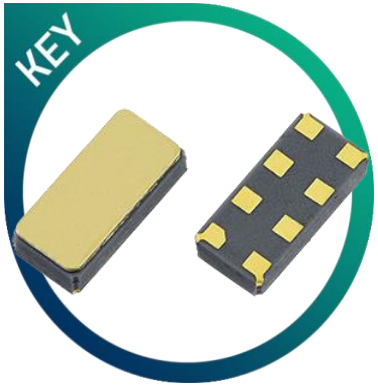
Offering Engineers an All-in-one Solution

Miniature package with exceptionally low current consumption

RV-3028-C7

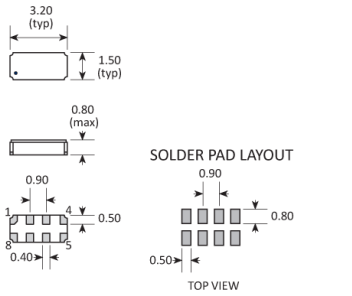
Ultra-low Power I²C RTC Module

The RV-3028-C7 boasts ultra-low current consumption of only 40nA, ideal for many applications requiring low power components, including IoT, wearables, portable devices, healthcare, metering, industrial and automotive.



Key Points

- Ultra-Low power consumption of 40nA
- Built-in crystal
- Wide operating voltage of 1.1 ~ 5.5V
- Battery switch over
- AEC-Q200 compliant option



PAD	CONNECTION	PAD	CONNECTION
1	Serial data (SDA)	5	Ground (VSS)
2	Frequency output (CLKOUT)	6	Interrupt output ($\overline{INT}$)
3	Supply voltage (VDD)	7	Event input (EVI)
4	Clock output enable (CLKOE)	8	Serial clock input (SCL)

Dimensions in mm

Configure your RV3028C7 here

Golledge

Real Time Clock Modules - RTCs

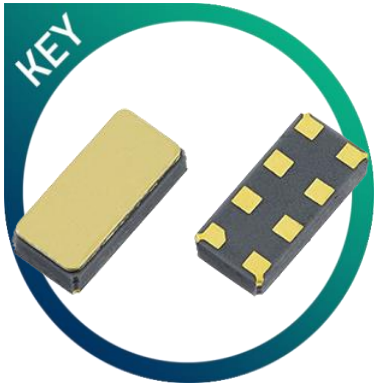
Offering Engineers an All-in-one Solution

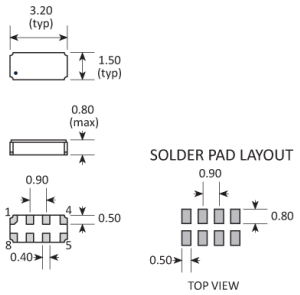
Temperature compensated for maximum stability

RV-8803-C7

RTC I²C bus High Accuracy

The RV-8803-C7 is a high accuracy, ultra-low power real-time-clock module with embedded 32.768kHz Crystal. High accuracy and high stability is achieved by a factory calibrated, temperature compensated DTCXO giving time-accuracy of ±3.0ppm across the temperature range from -40°C to +85°C.





Key Points

- High accuracy via digital temperature compensation
- Built-in crystal for adjustment-free operation
- Time stamp event input function
- I²C-Bus interface (up to 400kHz)
- 240nA power consumption
- AEC-Q200 compliant option

PAD	CONNECTION	PAD	CONNECTION
1	Serial data (SDA)	5	Ground (VSS)
2	Frequency output (CLKOUT)	6	Interrupt output ($\overline{INT}$)
3	Supply voltage (VDD)	7	Event input (EVI)
4	Clock output enable (CLKOE)	8	Serial clock input (SCL)

Dimensions in mm

Configure your RV8803C7 here

Golledge

Monolithic Crystal Filters

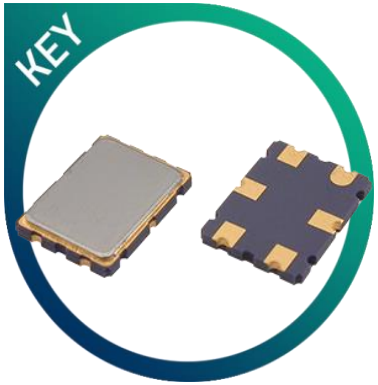
Highly accurate filtering at low frequencies

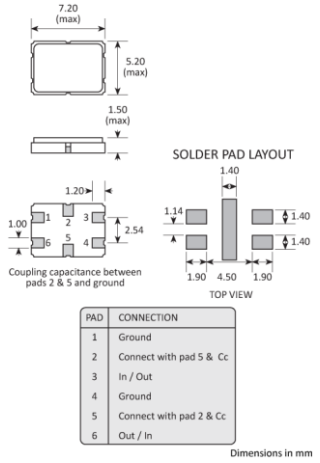
Tiny surface mount space-saving packages available

GSF-75

4-Pole SM Crystal in One Miniature SM Package

The GSF-75 range of crystal filters combines 4-pole functionality within one miniature surface mount package. A range of bandwidths and centre frequencies are available with low insertion loss.





Key Points

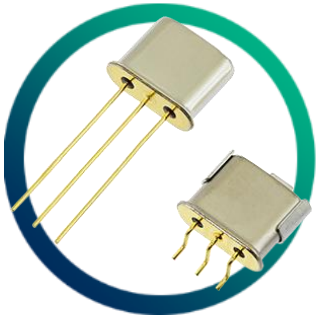
- 4-pole filter in one package
- Frequencies from 19.655 ~ 75.0MHz available
- Custom specifications available
- Miniature SM package

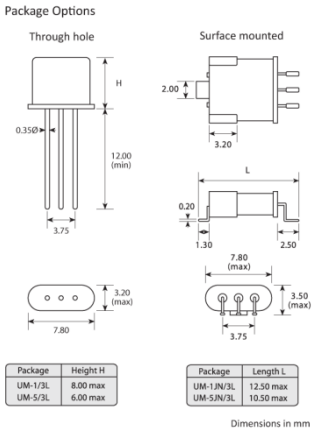
Access the GSF-75 range of crystal filters here

Monolithic Crystal Filters

Highly accurate filtering at low frequencies

Tiny surface mount space-saving packages available





GMCF-45

Crystal Filters with Centre Frequency 45MHz

Access the GMCF-45 range here

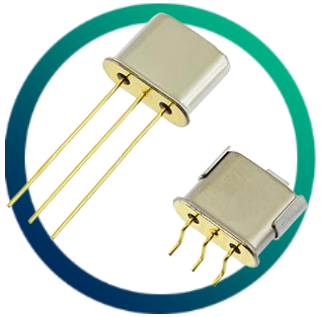
- Multiple package options including through-hole and leaded packages
- 2, 4, 6 and 8-pole options available
- Wide range of bandwidths
- Low insertion loss

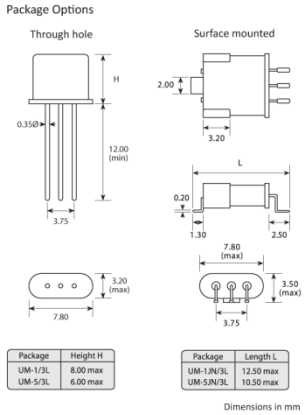
GMCF-21

Crystal Filters with Centre Frequency 21.4MHz

Access the GMCF-21 range here

- Multiple package options including through-hole and leaded packages
- 2, 4, 6 and 8-pole options available
- Wide range of bandwidths
- Low insertion loss





Oven Controlled Oscillators - OCXOs

Highly accurate signal fidelity and fantastic aging and stability characteristics

Check out our range of OCXOs when you need the very best

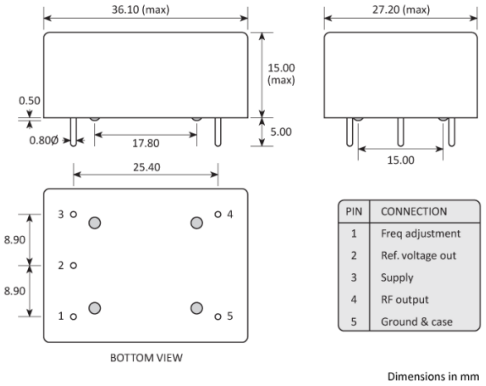
HCD380 and HCD381

High Frequency OCXO with Ultra-low Phase Noise

The HCD380 oven controlled oscillator with sine wave output and HCD381 with CMOS are available up to very high frequency of 100MHz with low phase noise.

Key Points

- -160dBc/Hz noise floor @ 10kHz
- Frequencies up to 100MHz
- No multiplier
- Standard European IEC CO-08 pin-out
- Custom options available



Configure your HCD380 here

Configure your HCD381 here

Golledge

Oven Controlled Oscillators - OCXOs

Highly accurate signal fidelity and fantastic aging and stability characteristics

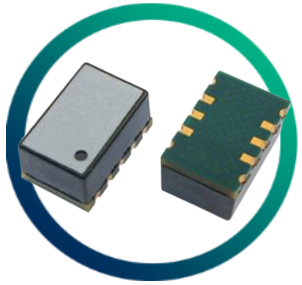
Check out our range of OCXOs when you need the very best

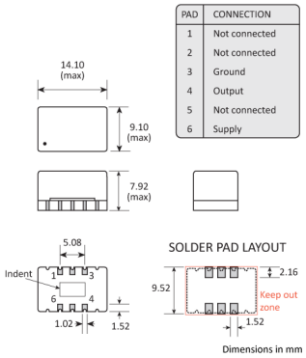
GOXO-149

3.3V Surface Mount OCXO from 10.0 ~ 80.0MHz

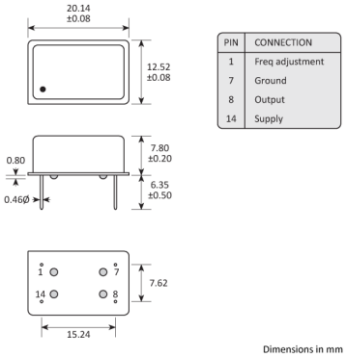
Access the GOXO-149 datasheet here

- Miniature SM package - 50% smaller footprint than DIL-14
- Ideally suited for base stations, VSAT etc
- Outstanding phase noise characteristics
- 3.3V supply
- LVCMOS output





PAD	CONNECTION
1	Not connected
2	Not connected
3	Ground
4	Output
5	Not connected
6	Supply



PIN	CONNECTION
1	Freq adjustment
7	Ground
8	Output
14	Supply

SCOCXOHS

Sine Output OCXO with Excellent Stability

Access the SCOCXOHS family here

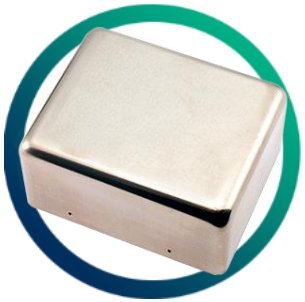
- Excellent phase noise performance @ 100MHz
- -160dBc noise floor @ 10.0MHz
- Fundamental mode frequencies up to 120MHz
- Compact 14-pin DIL package (SMD optional)
- High shock and vibration resistance
- Available from 10.0 ~ 120MHz

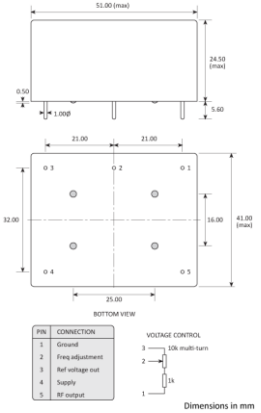
HCD660

High Performance OCXO with Sine Output

Access the HCD660 datasheet here

- Temperature stability down to ±1ppb
- Single 12V supply (12V ~ 30V optional)
- Standard European pin-out
- Available at frequencies from 5.0 ~ 20.0MHz



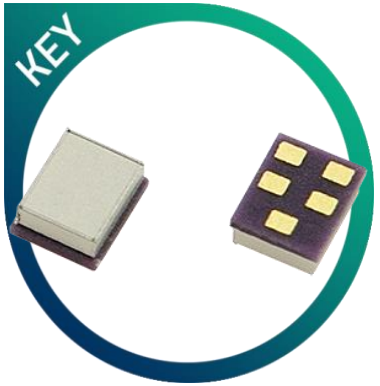


PIN	CONNECTION
1	Ground
2	Freq adjustment
3	Ref voltage out
4	Supply
5	RF output

Surface Acoustic Wave Devices – SAWs

We have one of the widest available ranges of SAW products
Powerful filtering up to 3.7GHz

SAW Filters – GSRF & GSIF



Filters available for each major application covering most LTE bands
Our SAW filter range includes over 1300 different components, with frequencies available from 35MHz to 3.7GHz. A wide range of passband widths are available with low insertion losses.

Key Points

- Surface mount packages as small as 1.1 x 0.9mm available
- Low insertion loss
- Range of available bandwidths
- Frequencies covering most LTE bands

Search our SAW Filter range here

Surface Acoustic Wave Devices – SAWs

We have one of the widest available ranges of SAW products

SAW Resonators

High Value SAW Resonators

With ultra-miniature surface mount packages available in a range of industry-standard footprints, our range of SAW resonators present a high value option for engineers.

Key Points

- Industry standard footprints
- Large range of frequencies
- Commonly used frequencies available from stock
- Suitable for airborne communications and ISM band applications among others
- Present a high level of value
- Frequencies available from 245MHz ~ 1.28GHz

Search our SAW Resonator range here

Surface Acoustic Wave Devices – SAWs

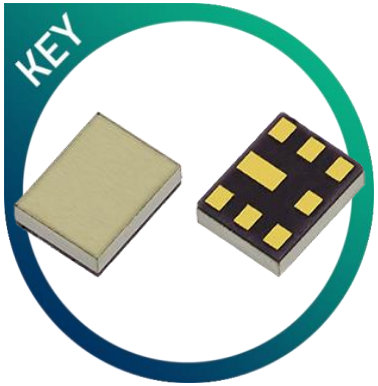
We have one of the widest available ranges of SAW products

Powerful filtering up to 2.7GHz

SAW Duplexers

Cutting Edge SAW Duplexers in Ultra-Miniature Packages

The Golledge range of SAW duplexers offer engineers space-saving through component reduction and ultra-miniature packages, as small as 1.8 x 1.4mm.



Key Points

- Space saving through component reduction
- Industry standard footprints
- Packages from 1.8 x 1.4mm available
- Low insertion attenuation
- Typical insertion loss of <3dB
- Ultra-miniature for maximum space saving
- Suitable for use within the Cellular, CDMA, WCDMA, and LTE bands

Search our SAW Duplexer range here

Any Questions?

Frequency Components – **Example Current Applications**

Smart Metering

Clients Elster/Honeywell, EDMI
32.768 kHz GSX-315 12.5pF
12.0 MHz GSX-333/332EF crystal
32.0 MHz GSX-333/122NF crystal
55.20 MHz GSX-333 crystal
31.250 MHz GTXO-253/JS TCXO
869.0 MHz SAW Filter
423.0 MHZ SAW filter

Fire Detection and Security

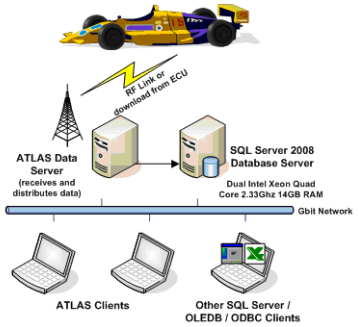
Pyronix/Jablotron Detectors, Sensors and Sounders and Paxton IS Access Control
32.7680 kHz GSX-315 7pF
16.0 MHz GSX-333/112NF
24.0 MHz GSX-333/1P2NF 9pF crystal
25.0 MHz GSX49-4/232DF
27.120 MHz GSX-333/112AF 10pF
30.0 MHz GSX-323/112AF 10pF
52.0 MHz GSX-333/112MF 8pF
50.0 MHz GXO-3201 ±50ppm 3.3V
869.0 MHz SAW Filter

Frequency Components – **Example Current Applications**

RF Monitoring and Telemetry Equipment

HWM Water

13.56 MHz GSX-333 crystal
51.033333 MHz UM1 ±5ppm crystal
32.0 MHz GTXO-253T TCXO
433.0 MHz SAW Filter
32.768 kHz GSX-315



Marine Automatic Identification System (AIS)

Weatherdock using an CML microcircuits design

38.8550 MHz and 29.2550 MHz GSF-75 Monolithic filter
19.20 MHz TCXO GTXO-91
159.1625 MHz SAW filter TA0395A

Retail: Shelf Edge Labels (SEL)

Display data, SES Imagotag

32.768 kHz GSX-315 ±20ppm 12.5pF
24.0 MHz GSX-333/1P2NF 9pF crystal
26.0 MHz GSX-333/1NBNF 9pF crystal

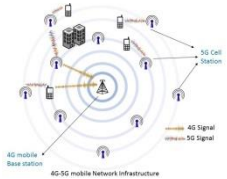
Frequency Components – **Target Applications For 2020**

Automotive, including Autonomous Vehicles




IoT and Smart Infrastructure, including Smart Rail

5G Infrastructure and 5G Devices

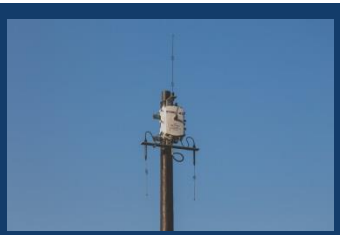
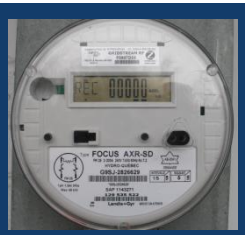




Marine and AIS

Asset and Wildlife Trackers and UWB Technology



Smart Metering

THANK YOU

Q&A