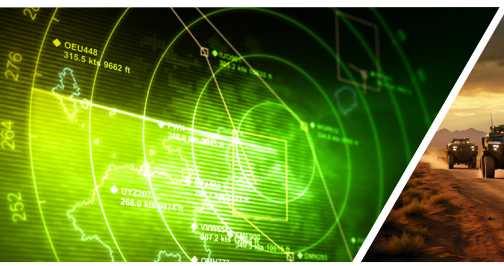
# GNSS Disciplined Oscillator Modules

## Product Line Brochure



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## Product Categories

Mezzanine Mount Modules

Board Mount Modules

Custom Solutions

## Applications

- Airborne
- Base Stations
- Manufacturing Testing
- Laboratory Testing
- UAV/UAS
- LTE and LTE Advanced (LTE-A)
- Radio Communications
- Radar Systems
- Navigation and Position Systems
- Vehicle Platforms
- MILSATCOM
- Time Synchronization

## MD-300 Harsh-Environment GNSSDO

### Summary

The MD-300 is our GNSSDO module for harsh environments, available in a small 1.5 × 2.5 inch footprint. The MD-300 has an embedded MEMS OCXO or TCXO as the local oscillator, enabling low g-sensitivity, high shock and vibration tolerance and low thermal transient response. Due to its Size, Weight and Power (SWaP) performance, the MD-300 is well-suited for applications like drones and manpacks.

### Features

- Internal MEMS-based OCXO or TCXO
- Embedded dual-band GNSS receiver
- Board-to-board or board-to-cable connector options
- Two external reference inputs
- LVDS RF and 1 PPS outputs
- One 10 MHz sine wave output into 50Ω
- Other output frequencies available
- Ultra-low g-sensitivity
- Ultra-low thermal transient response

### Specs

- Startup time: 10 seconds
- Operating Temperature: −40°C to 85°C
- Size: 2.5 in × 1.5 in
- G-sensitivity: 0.1 ppb/g
- Power consumption: 0.45W typical

### Model Options

- MD-300-YDE-OCXO-10M000000
- MD-300-WDE-TCXO-10M000000

| Part Number | Embedded Oscillator | GNSS Receiver Options | ADEV t = 1s | ADEV t = 10s | Phase Noise at 10 Hz | Phase Noise at 10 kHz |
|---|---|---|---|---|---|---|
| **MD-300** | OCXO | L1, L1/L2, L1/L5 | 5E-12 | 5E-12 | −110 | −154 |
| **MD-300** | TCXO | L1, L1/L2, L1/L5 | 3E-11 | 3E-11 | −106 | −145 |


## LM-010 LEO Satellite PPSDO

The LM-010 is a PPS disciplined module that provides precise timing for Low Earth Orbit (LEO) applications that demand radiation tolerance coupled with stability and holdover capability. As a standard platform module, the LM-010 provides both 1 PPS TTL and 10 MHz sinewave outputs that are disciplined to an external reference input. Internal to the module is a Microchip digitally corrected OCXO or a low-power CSAC SA-45 Chip Scale Atomic Clock (CSAC)

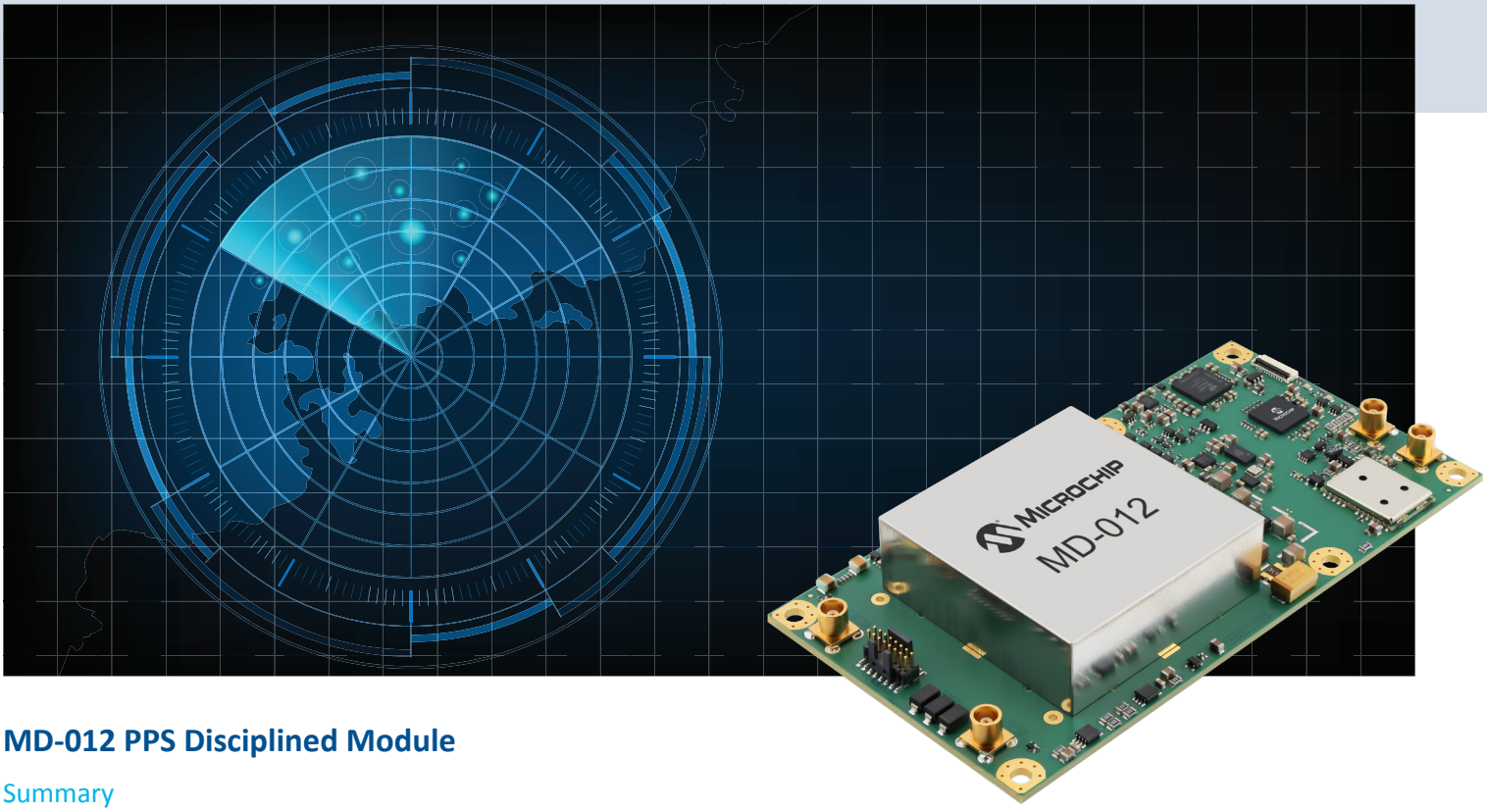
### Features

- 1 PPS to 75 MHz reference frequency input
- 1 PPS TTL output signal
- 10 MHz sine wave output
- Other RF output frequencies available (OCXO version only)
- Adaptive aging correction during holdover
- Serial communications interface
- Evaluation kit with software
- Radiation tolerant

### Specs

- Size: 2.95 in × 3.45 in
- Warmup time: 7 minutes
- Power: 2W steady state
- Aging: 0.9 ppb/month (CSAC), 30 ppb/month (OCXO)
- TID: 20 krad (CSAC), 50 krad (OCXO)
- SEL: 28 MeV-cm2/mg

| Part Number | Embedded Oscillator | ADEV t = 1s | ADEV t = 10s | Phase Noise at 10 Hz (dBc/Hz) | Phase Noise at 10 kHz (dBc/Hz) |
|---|---|---|---|---|---|
| **LM-010** | OCXO | 2.5E-11 | 5E-11 | −110 | −140 |
| **LM-010** | CSAC | 3E-10 | 1E-10 | −70 | −135 |




## MD-012 PPS Disciplined Module

### Summary

The MD-012 is one of our standard platform modules. This module can provide 1 PPS TTL,10 MHz sine wave and 10 MHz square wave outputs that are disciplined to an external reference input. This module has a built-in, digitally corrected OCXO and can be customized to meet specific customer requirements with different RF outputs and environmental hardening.

### Features

- 1 PPS TTL output signal
- 10 MHz sine wave and square wave outputs
- Other RF output frequencies available
- Adaptive aging correction during holdover
- Barometric pressure correction
- Serial communication interface
- 1 PPS to 75 MHz reference frequency input

### Specs

- Holdover (24 hours): 15E-7 s
- Power: 7.5W Steady State
- Supply Voltage: 12.0 $V_{DC}$
- Aging/Day: 0.06 ppb
- Temperature Stability: 0.4 ppb
- Size: 114 × 60 mm
- Temperature Range: −40°C to +85°C

| Part Number | Embedded Oscillator | GNSS Receiver Options | ADEV t=1s | ADEV t = 10s | ADEV t=100s | Phase Noise @ 10 Hz (dBc/Hz) | Phase Noise @ 100 Hz (dBc/Hz) | Phase Noise @ 1 kHz (dBc/Hz) |
|---|---|---|---|---|---|---|---|---|
| **MD-012** | OCXO | N/A | 5.00E-12 | 7.00E-12 | 6.00E-12 | −125 | −140 | −145 |

https://www.microchip.com/en-us/product/MD-012


## MD-013 GNSS Disciplined Module

### Summary

The MD-013 is one of our standard GNSSDO modules. This module can generate 1 PPS TTL, 10 MHz sine wave and 10 MHz square wave outputs that are disciplined to an embedded 72-channel Single-Band GNSS receiver, with the option to upgrade to a configurable L1/L2 or L1/L5 dual-band, multi-GNSS receiver. This module supports GPS, Galileo, BeiDou, and NavIC or an external reference input that can override the GNSS receiver as the reference. This module has a built-in, digitally corrected OCXO.

### Features

- Embedded GNSS receiver
- Single-band and dual-band receiver options available
- 1 PPS TTL output signal
- 10 MHz sine wave and square wave outputs
- Other RF output frequencies available
- Adaptive aging correction during holdover
- Barometric pressure correction
- Serial communications interface
- NMEA 0183 V4.1

### Specs

- Holdover (24 hours): 15E-7 s
- Power: 7.5W Steady State
- Supply Voltage: 12.0 $V_{DC}$
- Aging/Day: 0.06 ppb
- Temperature Stability: 0.4 ppb
- Size: 114 × 60 mm
- Temperature Range: −40°C to +85°C

| Part Number | Embedded Oscillator | GNSS Receiver Options | ADEV t=1s | ADEV t=10s | ADEV t = 100s | Phase Noise @ 10 Hz (dBc/Hz) | Phase Noise @ 100 Hz (dBc/Hz) | Phase Noise @ 1 kHz (dBc/ Hz) |
|---|---|---|---|---|---|---|---|---|
| **MD-013** | OCXO | L1<br>L1/L2<br>L1/L5 | 5.00E-12 | 7.00E-12 | 6.00E-12 | −125 | −140 | −145 |

https://www.microchip.com/en-us/product/MD-013


## MD-013 ULTRA CLEAN GNSS Disciplined Module

### Summary

The MD-013 ULTRA CLEAN is our highest performance standard GNSSDO module. This module is designed around a high-performance OCXO that enables the module to have ultra-low phase noise and ADEV outputs. This module can generate 1 PPS TTL, 10 MHz sine wave and 10 MHz square wave outputs that are disciplined to an embedded 72-channel single-band GNSS receiver, with the option to upgrade to a configurable L1/L2 or L1/L5 dual-band, multi-GNSS receiver. This module supports GPS, Galileo, BeiDou, and NavIC or an external reference input that can override the GNSS receiver as the reference.

### Features

- Ultra-high-performance OCXO
- Embedded GNSS receiver
- Single-band and dual-band receiver options available
- 1 PPS TTL output signal
- 10 MHz sine wave and square wave outputs
- Adaptive aging correction during holdover
- Barometric pressure correction
- Serial communications interface
- NMEA 0183 V4.1

### Specs

- Holdover (24 hours): 40E-7 s
- Power: 5.0 W Steady State
- Supply Voltage: 12.0 $V_{DC}$
- Aging/Day: 0.2 ppb
- Temperature Stability: 1.0 ppb
- Size: 114 × 60 mm
- Temperature Range: −40°C to +85°C

| Part Number | Embedded Oscillator | GNSS Receiver Options | ADEV t = 1s | ADEV t = 10s | ADEV t = 100s | Phase Noise @ 1 Hz (dBc/Hz) | Phase Noise @ 10 Hz (dBc/Hz) | Phase Noise @ 100 Hz (dBc/Hz) | Phase Noise @ 1 kHz (dBc/Hz) | Phase Noise @ 10 kHz (dBc/Hz) |
|---|---|---|---|---|---|---|---|---|---|---|
| **MD-013 ULTRA CLEAN** | OCXO | L1<br>L1/L2<br>L1/L5 | 3.00E-13 | 6.00E-13 | 9.00E-13 | −118 | −140 | −155 | −160 | −164 |


## MD-014 Disciplined Atomic Oscillator Module

### Summary

The MD-014 is one of our standard disciplined atomic clock modules. This module can generate 1 PPS TTL, 10 MHz sine wave and 10 MHz square wave outputs from an on-board, low-power SA65 Chip Scale Atomic Clock (CSAC), a high-stability SA53 Miniature Atomic Clock (MAC) or a high-stability SA-55 MAC. The atomic clock is disciplined to an external reference input supporting frequencies from 1 Hz/1 PPS to 120 MHz.

## Atomic Oscillator Models

### MD-014-0001 SA-65 CSAC

- Applications requiring fast startup, low power and 1.5 µs holdover up to 24 hours

### MD-014-0002 SA-53 MAC

- Applications requiring high stability and 950 ns holdover for up to 24 hours

### MD-014-0003 SA-55 MAC

- Applications requiring high stability and 300 ns holdover for up to 24 hours

### Features

- 1 PPS TTL output signal
- 5.0V TTL standard and 3.3V LVTTL
- 10 MHz sine wave and square wave outputs
- Other RF output frequencies available
- Adaptive aging correction during holdover
- Barometric pressure correction
- Serial communications interface

### Specs

- Holdover (48 hours): 12 µs (MD-014-0001), 900 ns (MD-014-0002 & MD-014-0003)
- Power: 9W Steady State
- Warmup Time: 6 minutes
- Supply Voltage: 12.0 $V_{DC}$
- Monthly Aging: 9E-10
- Temperature Stability: 5E-10
- Size: 114 × 60 mm
- Temperature Range: −40°C to +80°C

| Part Number | Embedded Oscillator | GNSS Receiver Options | ADEV t = 1s | ADEV t = 10s | ADEV t = 100s | Phase Noise @ 10 Hz (dBc/Hz) | Phase Noise @ 100 Hz (dBc/Hz) | Phase Noise @ 1 kHz (dBc/Hz) |
|---|---|---|---|---|---|---|---|---|
| **MD-014** | CSAC/MAC | N/A | 3.00E-11 | 1.00E-11 | 3.00E-12 | −87 | −114 | −130 |

https://www.microchip.com/en-us/product/MD-014

## MD-015 GNSS Disciplined Atomic Oscillator Module

The MD-015 is our GNSS disciplined atomic clock module. This module can generate 1 PPS TTL, 10 MHz sine wave and 10 MHz square wave outputs from an onboard low-power SA65 Chip Scale Atomic Clock (CSAC), a high-stability SA53 Miniature Atomic Clock (MAC) or a high-stability SA-55 MAC. The atomic clock onboard the module is disciplined to an embedded 72-channel multi-constellation Single-Band GNSS receiver with the option to upgrade to a configurable L1/L2 or L1/L5 dual-band, multi-GNSS receiver that supports GPS, Galileo, BeiDou, and NavIC or an external reference input supporting input frequencies from 1 Hz/1 PPS to 120 MHz.


## Atomic Oscillator Models


MD-015-0001 SA-65 CSAC

- Applications requiring fast start up, low power and 1.5 µs holdover up to 24 hours

MD-015-0002 SA-53 MAC

- Applications requiring high stability and 950 ns holdover for up to 24 hours

MD-015-0003 SA-55 MAC

- Applications requiring high stability and 300 ns holdover for up to 24 hours

### Features

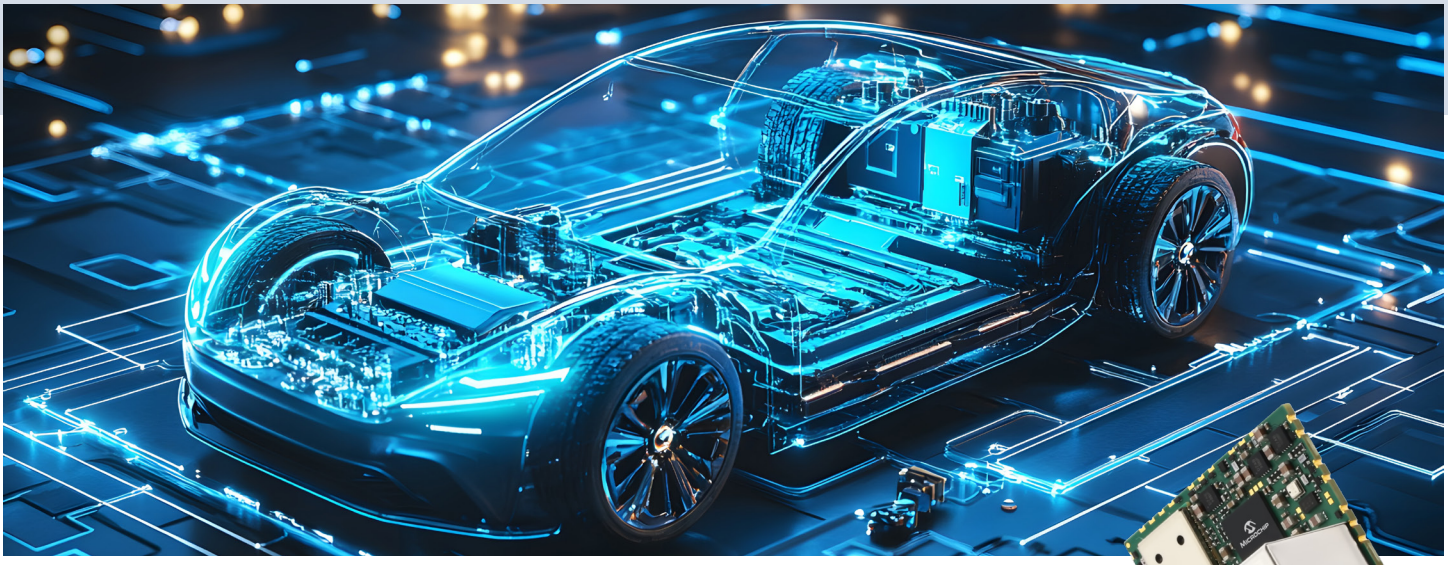
- Embedded GNSS receiver—GPS, Galileo, BeiDou, and NavIC
- Single-band and dual-band receiver options
- 1 PPS TTL output signal
- 5.0V TTL standard and 3.3V LVTTL
- 10 MHz sine wave and square wave outputs
- Other RF output frequencies available
- Adaptive aging correction during holdover
- Barometric pressure correction
- Serial communications interface

### Specs

- Holdover (48 hours): 12 µs (MD-014-0001), 900 ns (MD-014-0002 and MD-014-0003)
- Power: 9W Steady State
- Warmup Time: 6 minutes
- Supply Voltage: 12.0 $V_{DC}$
- Monthly Aging: 9E-10
- Temperature Stability: 5E-10
- Size: 114 × 60 mm
- Temperature Range: −40°C to +80°C

| Part Number | Embedded Oscillator | GNSS Receiver Options | ADEV t = 1s | ADEV t = 10s | ADEV t = 100s | Phase Noise @ 10 Hz (dBc/Hz) | Phase Noise @ 100 Hz (dBc/Hz) | Phase Noise @ 1 kHz (dBc/Hz) |
|---|---|---|---|---|---|---|---|---|
| **MD-015** | CSAC/MAC | L1<br>L1/L2<br>L1/L5 | 3.00E-11 | 1.00E-11 | 3.00E-12 | −87 | −114 | −130 |

https://www.microchip.com/en-us/product/MD-015




## MD-175 High Stability GNSS Disciplined Oscillator Module

### Summary

The MD-175 is a fully integrated GNSS disciplined oscillator module in a compact, surface-mount 40 × 50 mm footprint. The module can generate sine wave or 10 MHz CMOS and 1 PPS HCMOS outputs and can be disciplined to an embedded 72-channel receiver that supports GPS, GLONASS and Galileo. An on-board precision OCXO provides high stability in unlocked mode and enables excellent holdover. The module can also operate over a temperature range of −40°C to +85°C.

### Features

- Embedded GNSS receiver—GPS, Galileo, GLONASS and BeiDou
- 1 PPS LVCMOS output signal
- 10 MHz sine wave RF output
- Other RF output frequencies available
- Serial communication interface
- NMEA 0183 V4.1
- Adaptive aging correction during holdover
- Barometric pressure correction

### Specs

- Holdover (24 hours): 15E-7
- Power: 2.0W Steady State
- Supply Voltage: 5.0 $V_{DC}$
- Aging/Day: 0.06 ppb
- Temperature Stability: 0.4 ppb
- Size: 40 × 50 mm
- Temperature Range: −40°C to +85°C

## MD-175 Model Options

- MD-1750-DAE-15E7-10M0000000 – 15E-7 24-Hour Holdover, CMOS RF Output
- MD-1750-DEE-15E7-10M0000000 – 15E-7 24-Hour Holdover, Sinewave RF Output
- MD-1750-DAE-40E7-10M0000000 – 40E-7 24-Hour Holdover, CMOS RF Output
- MD-1750-DEE-40E7-10M0000000 – 40E-7 24-Hour Holdover, Sinewave RF Output

| Part Number | Embedded Oscillator | GNSS Receiver Options | ADEV t = 1s | ADEV t = 10s | Phase Noise @ 10 Hz (dBc/Hz) | Phase Noise @ 100 Hz (dBc/Hz) | Phase Noise @ 1 kHz (dBc/Hz) |
|---|---|---|---|---|---|---|---|
| **MD-175** | OCXO | L1 | 5.00E-12 | 1.00E-11 | −125 | −140 | −145 |

https://www.microchip.com/en-us/product/MD-175

## MD-176 High-Stability PPS Disciplined Oscillator Module


### Summary

The MD-176 is a fully integrated disciplined oscillator module in a compact, surface-mount 40 × 50 mm footprint. The module provides a sine wave or 10 MHz CMOS and 1 PPS HCMOS output. An on-board precision OCXO provides high stability in the unlocked mode, enabling excellent holdover capability. The module operates over a temperature range of −40°C to +85°C.

### Features

- 1 PPS LVCMOS output signal
- 10 MHz sine wave RF output
- Other RF output frequencies available
- Serial communication interface
- NMEA 0183 V4.1
- Adaptive aging correction during holdover
- Barometric pressure correction

### Specs

- Holdover (24 hours): 15E-7
- Power: 2.0W Steady State
- Supply Voltage: 5.0 $V_{DC}$
- Aging/Day: 0.06 ppb
- Temperature Stability: 0.4 ppb
- Size: 40 × 50 mm
- Temperature Range: −40°C to +85°C

## MD-176 Model Options

- MD-1760-DAE-15E7-10M0000000 – 15E-7 24 Hour Holdover, CMOS RF Output
- MD-1760-DEE-15E7-10M0000000 – 15E-7 24 Hour Holdover, Sinewave RF Output
- MD-1760-DAE-40E7-10M0000000 – 40E-7 24 Hour Holdover, CMOS RF Output
- MD-1760-DEE-40E7-10M0000000 – 40E-7 24 Hour Holdover, Sinewave RF Output

| Part Number | Embedded Oscillator | GNSS Receiver Options | ADEV t = 1s | ADEV t = 10s | Phase Noise @ 10 Hz (dBc/Hz) | Phase Noise @ 100 Hz (dBc/Hz) | Phase Noise @ 1 kHz (dBc/Hz) |
|---|---|---|---|---|---|---|---|
| **MD-176** | OCXO | N/A | 5.00E-12 | 1.00E-11 | −125 | −140 | −145 |

https://www.microchip.com/en-us/product/MD-176


## MD-177 Low-Phase-Noise PPS Disciplined Oscillator Module

### Summary

The MD-177 is a fully integrated disciplined oscillator module in a compact, surface-mount 40 × 50 mm footprint. The module provides a 10 MHz sine wave RF output and 1 PPS HCMOS output. An on-board low-noise OCXO provides low-phase-noise RF outputs. The module operates over a temperature range of −40°C to +85°C.

### Features

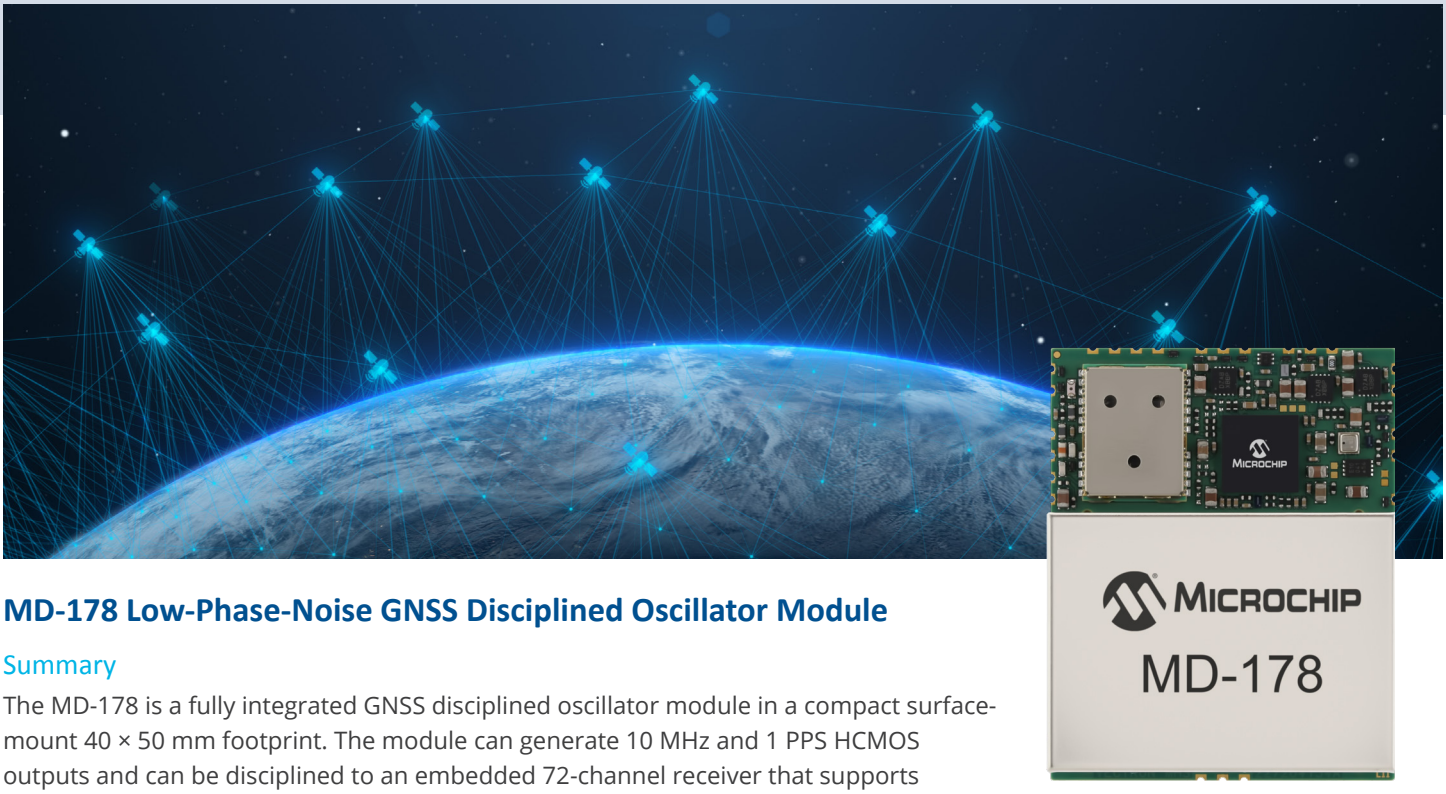
- 1 PPS to 75 MHz reference input
- 1 PPS LVCMOS output signal
- 10 MHz sine wave RF output
- Other RF output frequencies available
- Adaptive aging correction during holdover
- Barometric pressure correction
- Serial communication interface

### Specs

- Holdover (24 hours): 100E-7
- Power: 2.0W Steady State
- Supply Voltage: 5.0 $V_{DC}$
- Aging/Day: 0.2 ppb
- Temperature Stability: 1.0 ppb
- Size: 40 × 50 mm
- Temperature Range: −40°C to +85°C

| Part Number | Embedded Oscillator | GNSS Receiver Options | ADEV t = 1s | ADEV t = 10s | Phase Noise @ 10 Hz (dBc/Hz) | Phase Noise @ 100 Hz (dBc/Hz) | Phase Noise @ 1 kHz (dBc/Hz) | Phase Noise @ 10 kHz (dBc/Hz) |
|---|---|---|---|---|---|---|---|---|
| **MD-177** | OCXO | N/A | 5.00E-12 | 1.00E-11 | −135 | −155 | −165 | −170 |

https://www.microchip.com/en-us/product/MD-177




## MD-178 Low-Phase-Noise GNSS Disciplined Oscillator Module

### Summary

The MD-178 is a fully integrated GNSS disciplined oscillator module in a compact surface-mount 40 × 50 mm footprint. The module can generate 10 MHz and 1 PPS HCMOS outputs and can be disciplined to an embedded 72-channel receiver that supports GPS, GLONASS and Galileo. An on-board low-noise OCXO provides low-phase-noise RF outputs. The module can operate over a temperature range of −40°C to +85°C.

### Features

- Embedded GNSS receiver—GPS, Galileo, GLONASS and BeiDou
- 1 PPS LVCMOS output signal
- 10 MHz sine wave RF output
- Other RF output frequencies available
- Serial communication interface
- NMEA 0183 V4.1
- Adaptive aging correction during holdover
- Barometric pressure correction

### Specs

- Holdover (24 hours): 100E-7
- Power: 2.0W Steady State
- Supply Voltage: 5.0 $V_{DC}$
- Aging/Day: 0.2 ppb
- Temperature Stability: 1.0 ppb
- Size: 40 × 50 mm
- Temperature Range: −40°C to +85°C

| Part Number | Embedded Oscillator | GNSS Receiver Options | ADEV t = 1s | ADEV t = 10s | Phase Noise @ 10 Hz (dBc/Hz) | Phase Noise @ 100 Hz (dBc/Hz) | Phase Noise @ 1 kHz (dBc/Hz) | Phase Noise @ 10 kHz (dBc/Hz) |
|---|---|---|---|---|---|---|---|---|
| **MD-178** | OCXO | L1 | 5.00E-12 | 1.00E-11 | −135 | −155 | −165 | −170 |

https://www.microchip.com/en-us/product/MD-178


## MD-261 Small Form Factor GPS Disciplined Oscillator Module

### Summary

The MD-261 is a fully integrated GNSS disciplined oscillator module in a compact, surface-mount 25 × 20 mm package. The module provides 10 MHz and 1 PPS HCMOS outputs and has an embedded 26-channel receiver that is GPS and GLONASS compatible. An onboard OCXO or high-precision TCXO is available. The module operates from −40°C to +85°C and can provide a holdover of 1.5 µs for more than 4 hours over a ±2°C temperature window. An evaluation kit with operating software is available for development purposes.

### Features

- Embedded GNSS receiver−GPS and GLONASS compatible
- 1 PPS HCMOS output signals
- 10 MHz HCMOS output signals
- 1 PPS external reference input
- Other output frequencies available
- Modified NMEA (VSIP)
- Holdover to 1.5 µs over 4 hours, 8 µs over 24 hours

### Specs

- Holdover (24 hours): 80E-7 s
- Power: 1.5W or 0.43W Steady State
- Supply Voltage: 5.0 $V_{DC}$
- Aging/Day: 0.2 ppb
- Temperature Stability: 1.0 ppb
- Size: 20 × 25 mm
- Temperature Range: −40°C to +85°C

## MD-261 Model Options

- MD-2610-DAE-15E7-10M0000000 – 15E-7 24-Hour Holdover, CMOS RF Output
- MD-2610-DEE-15E7-10M0000000 – 15E-7 24-Hour Holdover, Sinewave RF Output
- MD-2610-DAE-40E7-10M0000000 – 40E-7 24-Hour Holdover, CMOS RF Output
- MD-2610-DEE-40E7-10M0000000 – 40E-7 24-Hour Holdover, Sinewave RF Output

| Part Number | Embedded Oscillator | GNSS Receiver Options | ADEV t = 1s | ADEV t = 10s | Phase Noise @ 10 Hz (dBc/Hz) | Phase Noise @ 100 Hz (dBc/Hz) | Phase Noise @ 1 kHz (dBc/Hz) |
|---|---|---|---|---|---|---|---|
| **MD-261** | OCXO | L1 | 3E-11<br>5E-10 | 5E-11<br>5E-10 | −120<br>−90 | −145<br>−140 | −150<br>−55 |

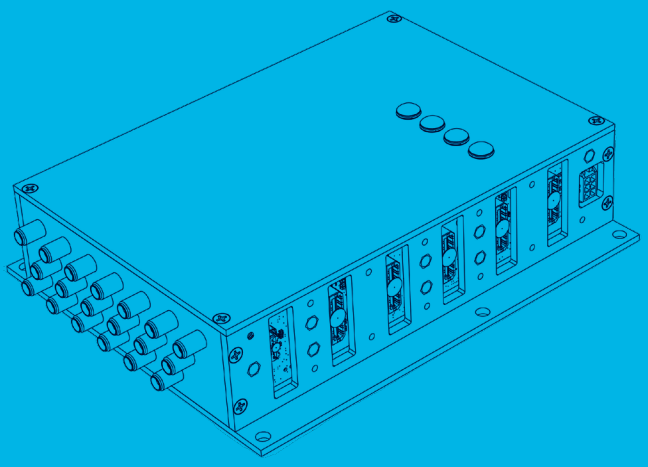
https://www.microchip.com/en-us/product/MD-261


## Custom Solutions

Along with our standard off-the-shelf modules, we also offer custom capabilities. We can design, develop and adjust our modules and solutions to fit your specific application requirements. Our expertise in the manufacturing and design of crystal oscillators, atomic clocks, PNT systems and algorithms can be applied in a custom level solution. Our capabilities include:

- Multiple form factors—low Size, Weight, Power and Cost (SWaP-C),
- Board mount, mezzanine, custom enclosures, tactical form factors, rackmount
- Ruggedization—high shock/vibration, board coatings and low g-sensitivity
- Multiple frequency outputs up to 100 MHz
- Ultra-low phase noise and Allan Deviation (ADEV) options
- Combination of atomic and quartz oscillators
- Multiple inputs
- Embedded receivers and oscillators
- Custom firmware
- GNSS, M-Code and alternate-constellation receivers available

*Contact factory for more information on custom solutions



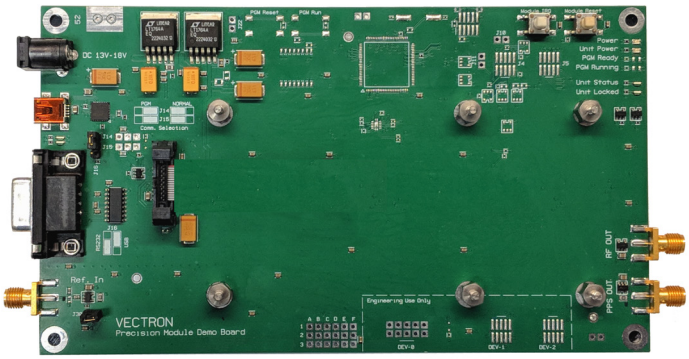
## Evaluation Kits

Our evaluation kits are intended to provide and quick and easy connection to the GNSSDO modules for configuration and monitoring. There two different evaluation kits, one for the mezzanine mount modules and one for the board-mount modules.

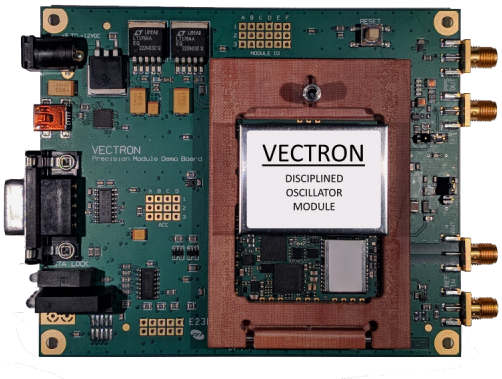
### Features:

- LED indicators for module status
- Easy power hook-up using “wall-wart” style power supply
- Easy connection to any laptop or desktop computer via USB
- Microchip VDOM3 monitoring software

MD-17X Series Evaluation Kit




MD-01X Series Evaluation Kit





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