

Helping Customers Innovate, Improve & Grow



The MD-174 is a Vectron GNSS disciplined module. It is a fully integrated GNSS disciplined oscillator module in a compact surface mount 40 x 50 mm footprint. The module has an embedded 34 channel receiver that is both GPS and GLONASS compatible and provides a sinewave 10 MHz and HCMOS 1 pps output. An onboard OCXO provides stability in the unlocked mode. The module operates from -40 °C to +85 °C.

### Features

- Embedded GNSS Receiver - GPS and Glonass Compatible
- Field upgradeable for Galileo in 2017
- 1pps HCMOS output signal standard
- 10MHz sinewave output standard
- Modified NMEA (VSIP)
- Evaluation kit with software available
- -135 dBc/Hz phase noise at 10 Hz offset
- -170 dBc/Hz phase noise floor

### Applications

- Radar systems
- Digital Video Broadcast
- E911 Location Systems
- General Timing and Synchronization
- Military Radio

### Block Diagram

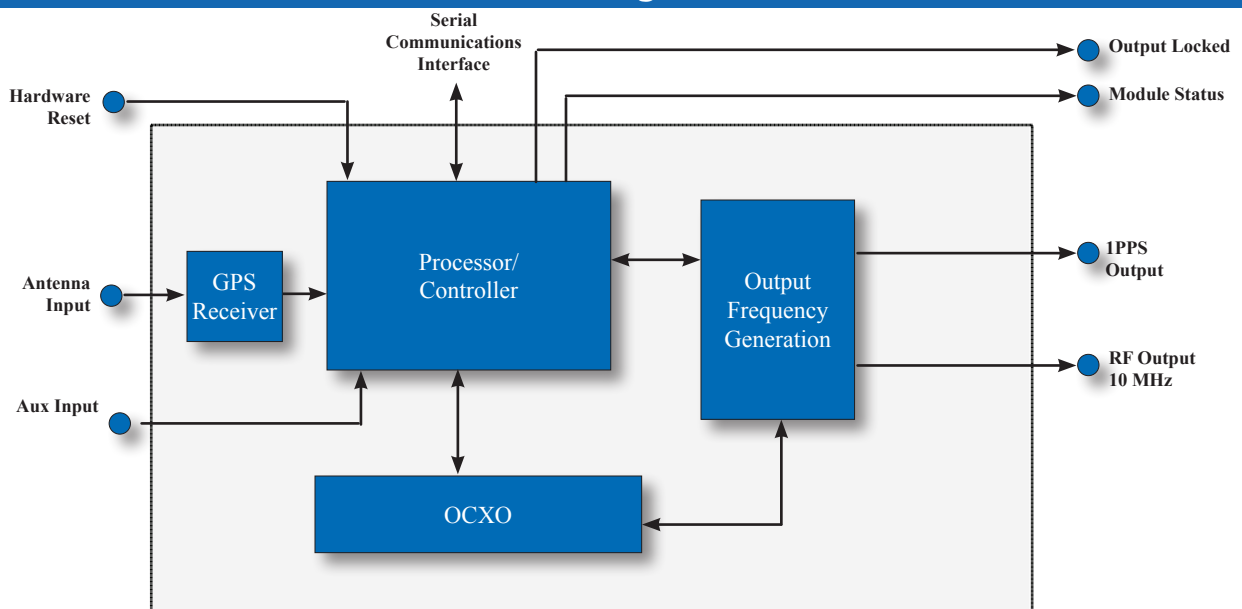


Figure 1. Functional Block Diagram

# Summary Specifications

## Hold Over Performance <sup>1</sup>

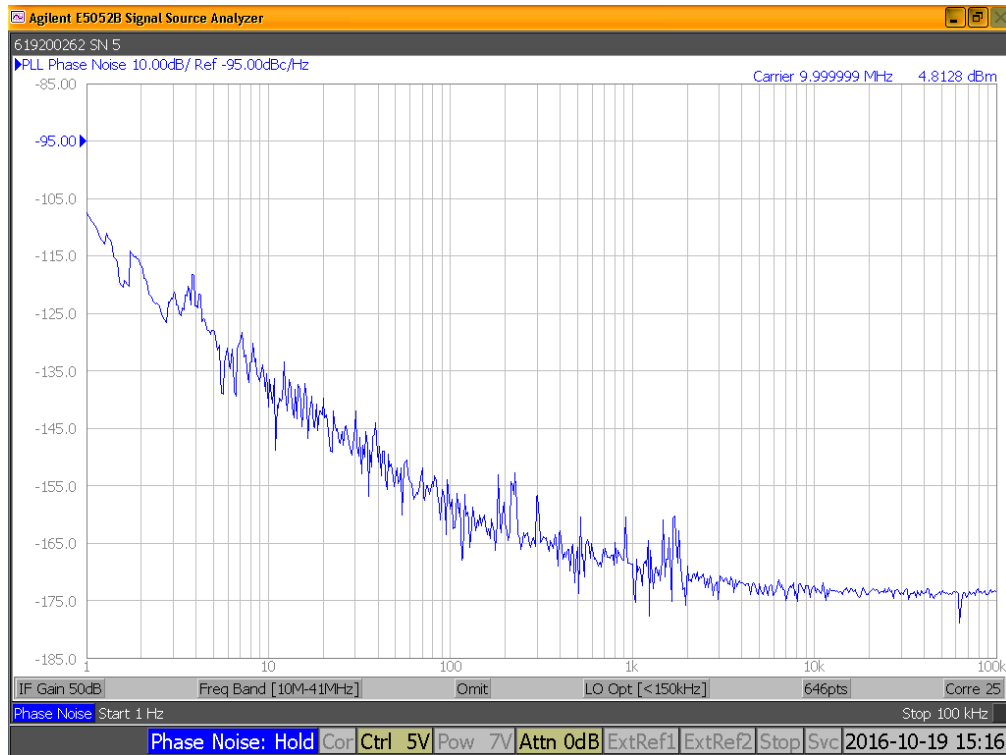
| Hold Over Time               | 10 min                                 | 1 hr                                   | 1 hr                                    | 4 hr                                   | 4 hr                                    | 24hr                                   | 24 hr                                   |
|------------------------------|--|--|---|--|---|--|---|
| Hold Over Temperature Change | $\Delta T = 2\text{ }^{\circ}\text{C}$ | $\Delta T = 2\text{ }^{\circ}\text{C}$ | $\Delta T = 10\text{ }^{\circ}\text{C}$ | $\Delta T = 2\text{ }^{\circ}\text{C}$ | $\Delta T = 10\text{ }^{\circ}\text{C}$ | $\Delta T = 2\text{ }^{\circ}\text{C}$ | $\Delta T = 10\text{ }^{\circ}\text{C}$ |
| Model                        | Maximum Accumulated Hold Over in us    |  |   |  |   |  |   |
| MD-1740-DXE-DAOC-10M0000000  | 0.3                                    | 1.8                                    | 7.2                                     | 8.0                                    | 20                                      | 15                                     | 30                                      |

## Summary Performance Characteristics

| Model                       | Warm Up Time (minutes) | Aging / day (ppb) <sup>1</sup> | Temperature Stability (ppb) | Module Height (mm) | Accuracy to UTC (+/-1 $\sigma$ ) (ns) <sup>2</sup> | Accuracy (+/-) <sup>3</sup> | Warm up Power @ 25 $^{\circ}\text{C}$ (W) | Steady State Power @ 25 $^{\circ}\text{C}$ (W) | Voltage (V)                   |
|-----------------------------|------------------------|--------------------------------|-----------------------------|--------------------|--|-----------------------------|---|--|-------------------------------|
| MD-1740-DXE-DAOC-10M0000000 | 5                      | 0.5                            | 5                           | 25                 | 20   | 1E-12                       | 4.5                                       | 2.8  | 5.0 V analog/<br>3.3V digital |

## Phase Noise/ ADEV

|           | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | ADEV $\tau=1\text{s}$ | ADEV $\tau=10\text{s}$ |  |  |
|-----------|-------|--------|-------|--------|---------|-----------------------|------------------------|--|--|
| at 10 MHz | -135  | -155   | -165  | -170   | -170    | 1E-11                 | 5E-11                  |  |  |



# Specifications

| Internal Receiver Characteristics            |                              |         |     |                 |  |
|--|------------------------------|---------|-----|-----------------|--|
| Parameter                                    |                              |         |     |                 | Condition  |
| Type   | Timing w/ Auto Position Lock |         |     |                 |  |
| Number of channels                           | 34                           |         |     |                 |  |
| Frequency band                               | GPS L1 C/A                   |         |     |                 |  |
|  | SBAS L1 C/A                  |         |     |                 | WAAS, MSAS, EGNOS, GAGAN   |
|  | GLONASS L1 OF                |         |     |                 |  |
|  | Galileo                      |         |     |                 | Firmware update will be required                                 |
| Tracking capability                          | 12 satellites                |         |     |                 |  |
| sensitivity tracking                         | -161 dBm                     |         |     |                 |  |
| sensitivity acquisition                      | -147 dBm                     |         |     |                 |  |
| Position Accuracy                            | < 2.5 m CEP                  |         |     |                 | Open sky. 24 hours   |
| TTFF   | <5 seconds                   |         |     |                 | HOT (current almanac, position, time and ephemeris)              |
|  | <35 seconds                  |         |     |                 | Warm (current almanac, position, time)                           |
|  | < 35 seconds                 |         |     |                 | Cold (no data)   |
| GPS Antenna                                  |                              |         |     |                 |  |
| Parameter                                    | Min                          | Typical | Max | Units           | Condition  |
| Antenna Input Voltage <sup>4</sup>           | 2.6                          | 3.1     | 5.5 | V <sub>DC</sub> | 3.3 or 5V antenna operation supported - pin 6                    |
| Antenna Current                              |                              | 20      | 100 | mA              | see protocol for under current flag and short circuit protection |
| RF Output Waveform Characteristics           |                              |         |     |                 |  |
| Waveform                                     | Sinewave                     |         |     |                 |  |
| Load   |                              | 50      |     | Ω               |  |
| Output Power                                 | +3                           | +5      | +7  | dBm             |  |
| Harmonics                                    |                              |         | -30 | dBc             |  |
| Spurious                                     |                              |         | -80 | dBc             |  |
| 1pps Output Characteristics                  |                              |         |     |                 |  |
| Parameter                                    | Min                          | Typical | Max | Units           | Condition  |
| Waveform                                     | LVCMOS                       |         |     |                 |  |
| High-level output voltage (V <sub>OH</sub> ) | 3.0                          |         | 3.4 | V <sub>DC</sub> | > 100 Ohms   |
| Low-level output voltage (V <sub>OL</sub> )  |                              | 0.0     | 0.4 | V <sub>DC</sub> | > 100 Ohms   |
| Pulse Width                                  |                              | 10      |     | us              |  |
| Aux 1pps input Characteristics               |                              |         |     |                 |  |
| Parameter                                    | Min                          | Typical | Max | Units           | Condition  |
| Waveform                                     | LVCMOS, TTL                  |         |     |                 |  |
| High-level input voltage (V <sub>IH</sub> )  | 2.4                          |         | 5   | VDC             | 15 pF  10kOhm  |
| Low-level input voltage (V <sub>IL</sub> )   |                              | 0.0     | 0.3 | VDC             | 15 pF  10kOhm  |

## Specifications

| Lock Status Indicator                           |   |         |       |                  |  |
|---|---|---------|-------|------------------|--|
| Parameter                                       | Min   | Typical | Max   | Units            | Condition                              |
| Module Locked                                   | 90  |         | 100   | %V <sub>CC</sub> |  |
| Module Not Locked                               | 0   |         | 20    | %V <sub>CC</sub> |  |
| Module Hardware OK Indicator                    |   |         |       |                  |  |
| Module Hardware OK                              | 90  |         | 100   | %V <sub>CC</sub> |  |
| Module Hardware Failure                         | 0   |         | 20    | %V <sub>CC</sub> |  |
| Module Hardware Reset                           |   |         |       |                  |  |
| Reset Module                                    | 0   |         | 0.5   | V <sub>DC</sub>  | 2 kOhm internal pullup                 |
| Serial Communications Interface                 |   |         |       |                  |  |
| Rx high-level input voltage (V <sub>IH</sub> )  | 2.8   |         |       | V <sub>DC</sub>  |  |
| Rx low-level input voltage (V <sub>IL</sub> )   | -0.5  | 0.0     | 0.5   | V <sub>DC</sub>  |  |
| Tx high-level output voltage (V <sub>OH</sub> ) | 3.15  | 3.3     |       | V <sub>DC</sub>  |  |
| Tx low-level output voltage (V <sub>OL</sub> )  | -0.2  | 0.0     | 0.2   | V <sub>DC</sub>  |  |
| Update rate                                     |   | 1       |       | Hz               |  |
| Communications Protocol                         | Vectron Binary/NMEA 0183                      |         |       |                  | See VSIP Command List for Full Details |
| Pulse width <sup>7</sup>                        | 10  |         |       | uSec             |  |
| Supply Voltage                                  |   |         |       |                  |  |
| Supply voltage (V <sub>CC</sub> )               | +4.75   | +5.0    | +5.25 | V <sub>DC</sub>  |  |
| Supply voltage (Dig V <sub>CC</sub> )           | +3.0  | +3.3    | +3.4  | V <sub>DC</sub>  |  |
| Absolute Maximum Ratings                        |   |         |       |                  |  |
| Supply voltage (V <sub>CC</sub> )               |   |         | 6     | V <sub>DC</sub>  |  |
| Dc voltage on any I/O pin                       |   |         | 3.9   | V <sub>DC</sub>  |  |
| Output load                                     | 100   |         |       | Ohms             |  |
| AC ripple                                       |   |         | 50    | mVpk-pk          | 10Hz to 1MHz                           |
| Environmental Conditions                        |   |         |       |                  |  |
| Parameter                                       | Min   | Typical | Max   | Units            | Condition                              |
| Operating temperature                           | see ordering information for available ranges |         |       |                  |  |
| Humidity @ 40°C                                 |   |         | 90    | %                |  |
| Storage Temperature                             | -55   |         | +125  | °C               |  |
| Physical Characteristics                        |   |         |       |                  |  |
| Weight  |   |         | 120   | g                |  |
| g-sensitivity                                   |   | 1       |       | ppb/g            | 10 to 1000 Hz                          |

# Reliability

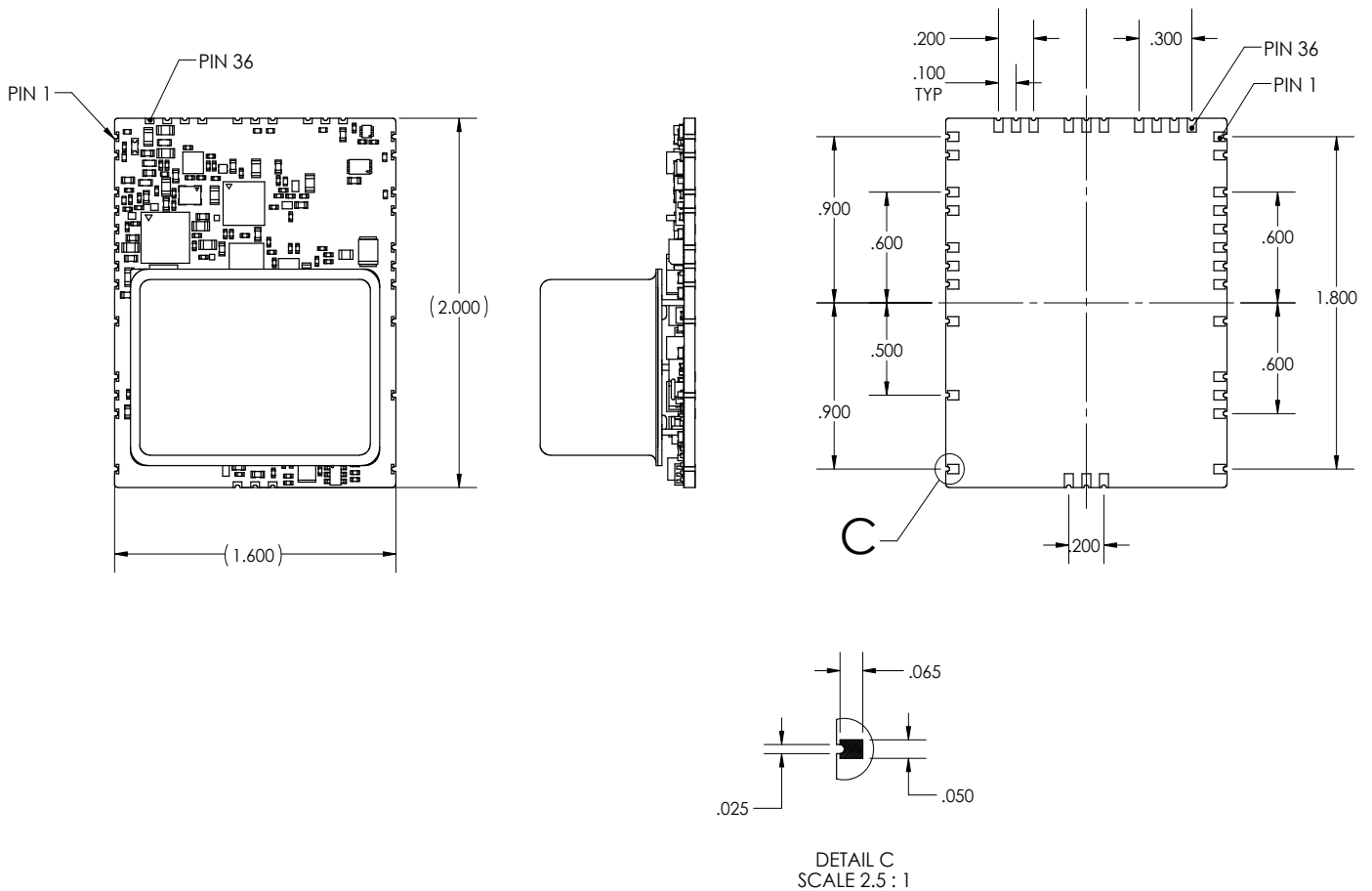
VI qualification includes aging various extreme temperatures, shock and vibration, temperature cycling, and IR reflow simulation. The MD-171 family is capable of meeting the following qualification tests:

| Environmental Compliance |                                     |
|--------------------------|-------------------------------------|
| Parameter                | Conditions                          |
| Mechanical shock         | MIL-STD-202, Method 213 condition B |
| Mechanical vibration     | MIL-STD-202, Method 204 condition A |
| Resistance to solvents   | MIL-STD-202, Method 215             |

Although ESD protection circuitry has been designed into the MD-171 proper precautions should be taken when handling and mounting. VI employs a human body model (HBM) and a charged-device model (CDM) for ESD susceptibility testing and design protection evaluation.

| ESD Ratings          |         |                          |
|----------------------|---------|--------------------------|
| Model                | Minimum | Conditions               |
| Human body model     | 1500 V  | MIL-STD-883, Method 3015 |
| Charged device model | 1000 V  | JEDEC, JESD22-C101       |

# Package Outline

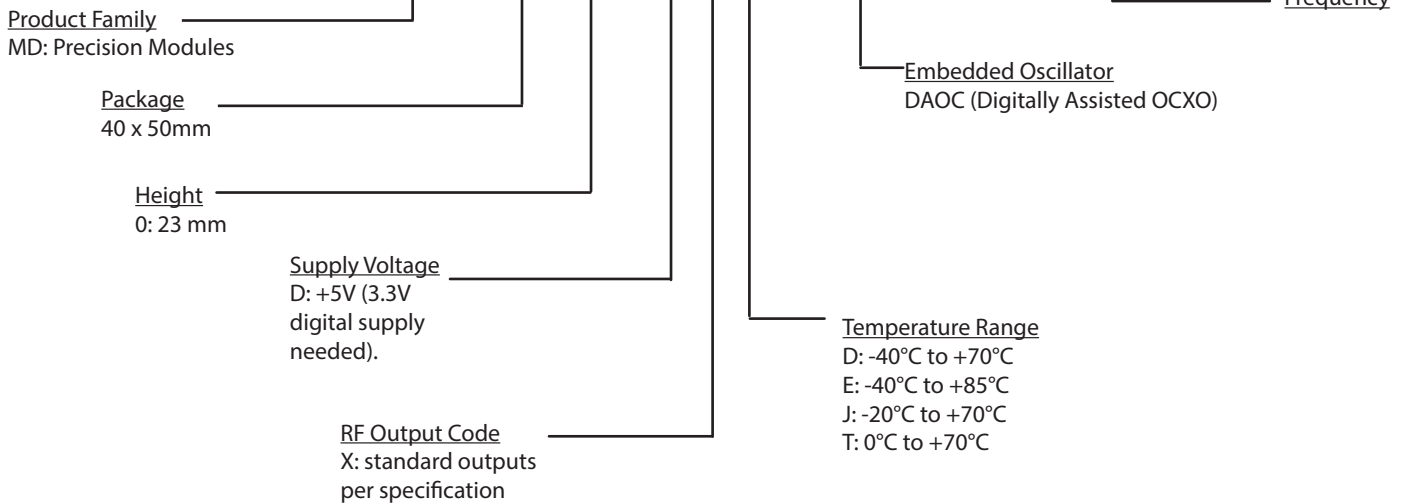


## Pin Configuration

| 36 Pin I/O Connections |         |                                      |
|------------------------|---------|--------------------------------------|
| Number                 | Name    | Description/comment                  |
| 1                      | PPS_OUT | 1 pps output                         |
| 2                      | REF_IN  | Reference input                      |
| 3,5,7,20,26,36         | D_GND   | Digital Ground                       |
| 4                      | ANT_IN  | Antenna                              |
| 6                      | VCC_ANT | Antenna Supply                       |
| 8,27                   | D_VCC   | Digital 3.3V supply                  |
| 9,12,13,14,16,17,18,19 | A_GND   | Analog Ground                        |
| 10,11                  | A_VCC   | Analog 5.0V supply                   |
| 15                     | RF_OUT  | Sinewave or CMOS (see ordering code) |
| 21,22,29,32,33,34,35   | N/C     | Do not connect - leave floating      |
| 23                     | RX_IN   | Data in - internal pull up           |
| 24                     | TX_OUT  | data out                             |
| 25                     | AUXIO   |                                      |
| 28                     | MOD_RST | Pull up - active low                 |
| 30                     | STATUS  | pull down                            |
| 31                     | LOCK    | pull down                            |

## Ordering Information

### MD - 174 0 - DX E - DAOC - 10M0000000



## Notes

- 1) Holdover and aging performance is after 7 days of power-on time. Temperature and aging rates are when device is not locked. Performance measured in still air. 1
- 2) After customer applies offset corrected using cable delay command while locked, after 24 hours of locked operation
- 3) Allan Variance at  $\tau=86400s$  while locked, after 24 hours of locked operation
- 4) Antenna supply pin at pin 21 is an input voltage from customer. Vectron couples the DC input voltage to the rf signal of the GPS signal. The customer does not need to provide any additional blocking or coupling circuitry.

## For Additional Information, Please Contact

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