MD-013

**GNSS (GPS, GLONASS, Galileo)
Disciplined Oscillator Module**

MICROCHIP

Vectron™ Oscillators

Helping Customers Innovate, Improve & Grow

MD-013

The MD-013 is a Microchip standard platform module that provides 1 pps TTL,10 MHz sine wave and 10 MHz square wave outputs that are disciplined to an embedded 72 channel GNSS Receiver. In addition, an external reference input can override the internal receiver as the reference. Internal to the module is a Microchip digitally corrected OCXO.

Features

- **Embedded GNSS Receiver - GPS, GLONASS, Galileo**
- **1pps TTL output signal**
- **10MHz sinewave and square wave output**
- **Other RF output frequencies available**
- **Adaptive aging correction during holdover**
- **Barometric pressure correction**
- **Evaluation kit with software**
- **Serial Communications Interface**
- **NMEA 0183 V4.1**

Applications

- **Basestation Communication**
- **Digital Video Broadcast**
- **E911 Location Systems**
- **General Timing and Synchronization**
- **Military Radio**
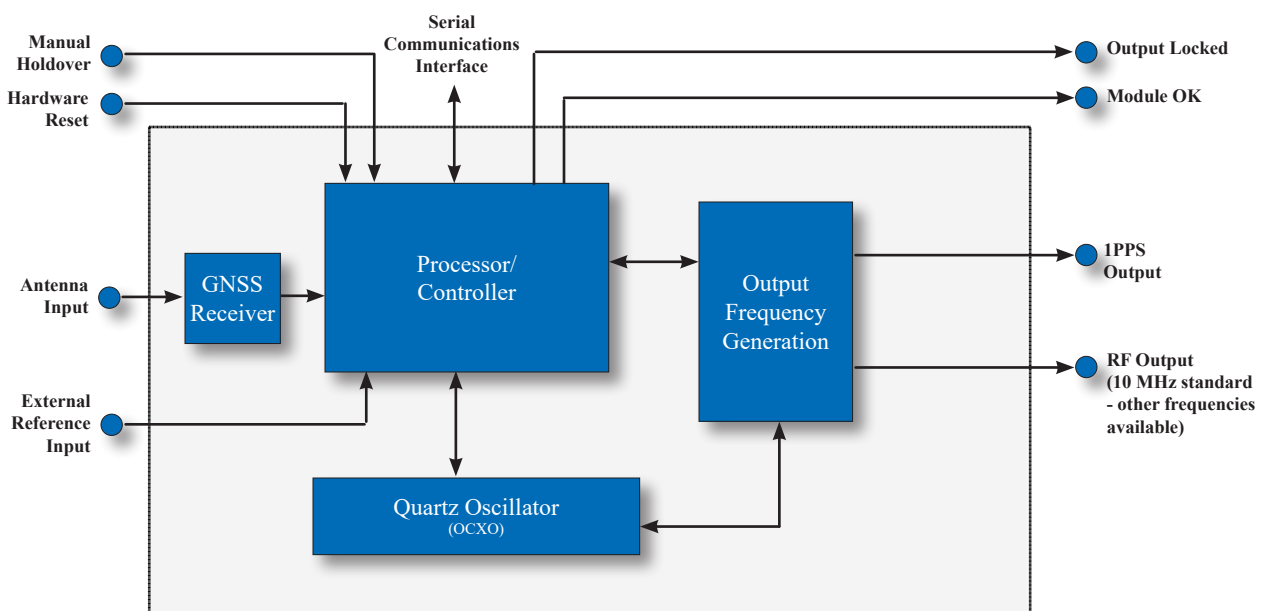- **Radar Systems**

Block Diagram

Figure 1. *Functional Block Diagram*

Summary Specifications

Comparitive Performance of Standard Modules		
Model	**Embedded Oscillator**	**Typical Uses**
MD-013	Digitally Assisted OCXO	Applications requiring 24 hour hold over as low as 1.5 us

Hold Over Performance [1]				
Hold Over Time	**10 min**	**1 hr**	**1 hr**	**24hr**
Hold Over Temperature Change	ΔT= 2 °C	ΔT= 2 °C	ΔT= 10 °C	ΔT= 2 °C
Model	**Maximum Accumulated Hold Over in us**			
MD-013	0.05	0.24	0.4	15E7 option: 1.5 40E7 option: 4.0

Summary Performance Characteristics								
Model	**Warm Up Time (minutes)**	**Aging / day (ppb)[1]**	**Temperature Stability (ppb)[2]**	**Accuracy to UTC (+/-1σ) (ns)[2]**	**Frequency Accuracy (+/-) [3]**	**Warm up Power @ 25 °C (W)**	**Steady State Power @ 25 °C (W)**	**Voltage (V)**
MD-013	7	0.06	0.4	10	<1E-12	7.5	3.6	12

Phase Noise/ ADEV								
	-10 Hz	**-100 Hz**	**-1 kHz**	**-10 kHz**	**-100 kHz**	**ADEV (τ=1s)**	**ADEV (τ=10s)**	**ADEV (τ=100s)**
MD-013	-125	-140	-145	-145	-145	5E-12	7E-12	6E-12

Internal Receiver Characteristics		
Parameter		**Condition**
Type	Timing w/ Self-Survey	
Number of channels	72	
Frequency bands	GPS L1C/A	
	GLONASS L1OF	
	Galileo E1B/C	
	QZSS L1C/A	
	SBAS L1C/A	Disabled by default
Tracking capability	36 SVs	
Sensitivity	-167 dBm	Tracking (GPS & GLONASS)
	-148 dBm	Cold Acquisition (GPS & GLONASS)
	-160 dBm	Reacquisition (GPS & GLONASS)
Position Accuracy	2.5 meters CEP	GPS & GLONASS, static, -130 dBm, > 6 SVs
TTFF	25 seconds	Cold Start (GPS & GLONASS)

Specifications

GPS Antenna					
Parameter	**Min**	**Typical**	**Max**	**Units**	**Condition**
Antenna Bias Voltage	4.0	4.8	5.1	V_{DC}	
Antenna Current[6]		20	100	mA	

RF Output Waveform Characteristics (via MCX)					
Parameter	**Min**	**Typical**	**Max**	**Units**	**Condition**
Waveform	Sinewave				
Output Power	+3.0	+9.0	+11.0	dBm	50 Ohm
Harmonics			-30	dBc	50 Ohm
Spurious			-70	dBc	50 Ohm

RF Output Waveform Characteristics (via pin 8)					
Waveform	HCMOS				
High Level Output Voltage (V_{OH})	4.0		5.0	V_{DC}	<-0.5mA Load
Low Level Output Voltage (V_{OL})		0.0	0.4	V_{DC}	<0.5mA Load
Rise/Fall Time		3	5	nSec	15 pF
Duty Cycle	40	50	60	%	15 pF

1pps Output Characteristics (via MCX and pin 2)					
Parameter	**Min**	**Typical**	**Max**	**Units**	**Condition**
Waveform	TTL				
High-level output voltage (V_{OH})	3.0		5.0	V_{DC}	50 Ohms
Low-level output voltage (V_{OL})		0.0	0.4	V_{DC}	50 Ohms
Pulse Width	9.9	10	10.1	uSec	default setting, user programmable

External 1PPS Reference Input (Pin 1)					
Waveform	TTL				
High-Level Output Voltage (V_{OH})	2.0		5.0	V_{DC}	50 Ohms input impedance
Low-Level Output Voltage (V_{OL})		0.0	0.4	V_{DC}	
Pulse width	10			uSec	

Specifications

Lock Status Indicator (Pin 9)[4]					
Parameter	**Min**	**Typical**	**Max**	**Units**	**Condition**
Module Locked	4.5	5.0	5.5	V_{DC}	<5mA Load
Module Not Locked	0		0.5	V_{DC}	<5mA Load
Module Hardware OK Indicator (Pin 10)[5]					
Module Hardware OK	4.5	5.0	5.5	V_{DC}	<5mA Load
Module Hardware Failure	0		0.5	V_{DC}	<5mA Load
Module Hardware Reset (Pin 12)					
Reset Module	0		0.5	V_{DC}	10 kOhm internal pullup
Manual Holdover Set (Pin 11)					
Enter Manual Holdover	0		0.5	V_{DC}	5.6 kOhm internal pullup
Serial Communications Interface[7]					
Rx high-level input voltage (V_{IH})	4.5	5.0	5.5	V_{DC}	
Rx low-level input voltage (V_{IL})	-0.5		0.5	V_{DC}	
Tx high-level output voltage (V_{OH})	4.5	5.0	5.5	V_{DC}	
Tx low-level output voltage (V_{OL})	-0.5		0.5	V_{DC}	
Update rate		1		Hz	User configurable from 0 to 255 seconds
Communications Protocol		VSIP2/NMEA 0183 V4.1			See VSIP2 for Full Details
Supply Voltage (Pin 7,15,16)					
Supply voltage	+11.4	+12	+12.6	V_{DC}	
Absolute Maximum Ratings					
Supply voltage (VS)			15	V_{DC}	
Dc voltage on any I/O pin			5.5	V	
Output load	10			Ohms	
AC ripple			50	mVpk-pk	10Hz to 1MHz

Specifications

Environmental Conditions					
Parameter	**Min**	**Typical**	**Max**	**Units**	**Condition**
Operating temperature	-40		+85	˚C	
Humidity @ 40˚C			90	%	
Storage Temperature	-55		+125	˚C	
Physical Characteristics					
Weight			120	g	

Reliability

Microchip qualification includes aging various extreme temperatures, shock and vibration, temperature cycling, and IR reflow simulation. The MD-013 family is capable of meeting the following qualification tests:

Environmental Compliance	
Parameter	**Conditions**
Mechanical shock	MIL-STD-202, Method 213 condition B (75G, 6ms)
Mechanical vibration	MIL-STD-202, Method 204 condition A (10G peak, 10-500)
Resistance to solvents	MIL-STD-202, Method 215
Altitude	-2,500 to 27,900 feet

Although ESD protection circuitry has been designed into the MD-013 proper precautions should be taken when handling and mounting. Microchip employs a human body model (HBM) and a charged-device model (CDM) for ESD susceptibility testing and design protection

ESD Ratings		
Model	**Minimum**	**Conditions**
Human body model	1500 V	MIL-STD-833, Method 3015
Charged device model	1000 V	JEDEC, JESD22-C101

Package Outline
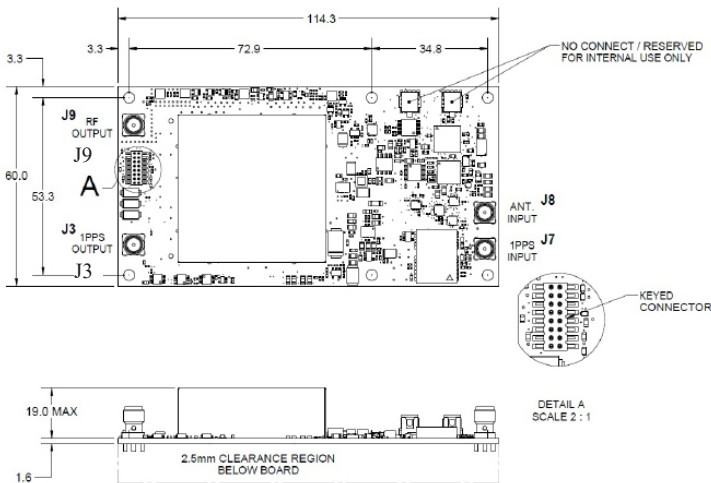
16 Pin I/O Connections		
Number	**Name**	**Description**
1	Ref In	External Reference Input
2	PPS Out	1 PPS Output
3	Ground	Ground
4	Ground	Ground
5	Rx	Serial Communications Receive
6	Tx	Serial Communications Transmit
7	Vcc	Power Supply
8	RF Out	RF HCMOS Output
9	Locked	Logic-high = Output locked to GPS
10	Module OK	Logic low = Failure with module operation
11	ManHold	Manual Holdover Input
12	Reset	Hardware reset
13	Ground	Ground
14	Ground	Ground
15	Vcc	Power Supply
16	Vcc	Power Supply

Notes:
• RF and 1pps input and output connectors are MCX type (SMA, SMB, MMCX connectors require additional part numbers).
• Keyed connector is Samtec FTSH-108-01LDVK type.
• Dimensions: mm
• Module height in part number is the sum of oscillator height, board, and clearance
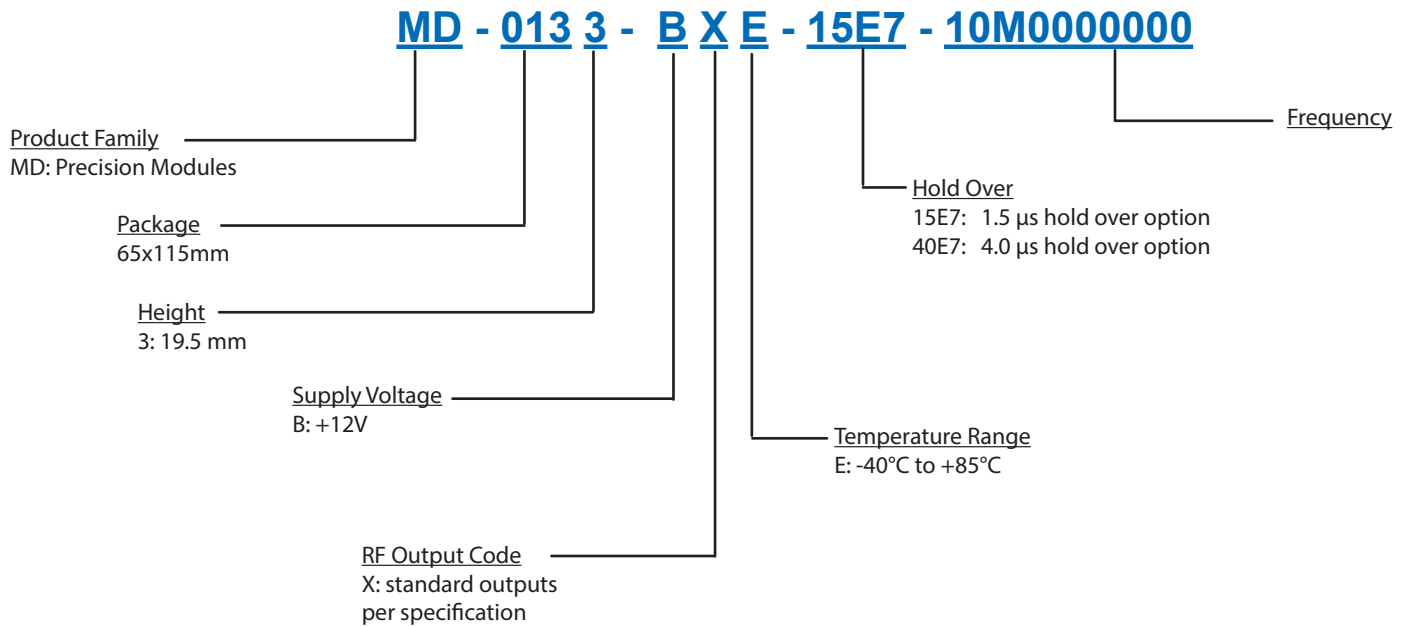
Accessories

Microchip Partnumber	Description
MD-013-EK	MD-013X-XXX-XXXX Module with Evaluation Kit

Ordering Information Instructions

Customization to unique customer requirements is available and is common for this level of integration. Common customizations include alternate output frequencies, temperature ranges, differing values and methods of hold over specification, and holdover optimization in the frequency domain. The table below lists exisiting combinations available as of the date of publication of this data sheet. Please contact the factory for additional options.

Ordering Information

MD - 013 3 - B X E - 15E7 - 10M0000000

Product Family
MD: Precision Modules

Package
65x115mm

Height
3: 19.5 mm

Supply Voltage
B: +12V

RF Output Code
X: standard outputs
per specification

Temperature Range
E: -40°C to +85°C

Hold Over
15E7: 1.5 µs hold over option
40E7: 4.0 µs hold over option

Frequency

Available Models	
MD-0133-BXE-15E7-10M0000000	MD-0133-BXE-40E7-10M0000000

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.
2) After customer applies correct offset using cable delay command while locked, after 24 hours of locked operation
3) ADEV at τ=86400s while locked to GPS, after 24 hours of locked operation
4) The status locked indicator is intended to indicate when the module is fully locked to a reference.
5) The Hardware OK indicator is intended to indicate when the module is operating properly without any failures, including hardware, software or parameter out of range.
6) Antenna over current flag will be set if maximum current is exceeded. Circuit has overcurrent protection.
7) The Rx pin is the serial interface input and the Tx pin is the serial interface output. The serial interface shall operate at 115,200 baud with eight (8) data bits, one (1) stop bit and no parity.

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