

SEA 9406

Multi GNSS High Precision module for CompactRIO™



Part No.: 60000097 (w/o sensor), 60000098 (w/ sensor)



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Getting Started

General



The safety ratings and specifications in this document are specific to the SEA 9406 module and may differ for other components in the system. To determine the safety ratings and specification of the entire system refer to each component in the system.

Before starting to work with the SEA 9406 module please read this document and the software manual carefully. If there are any questions about operating the module or if any term is not understood, please contact the vendor before using the module.



Ensure that you use the latest version of the manuals: Check the Support/Downloads area on the S.E.A. website <https://www.sea-gmbh.com> for updates and get the latest version if available.



Refer to the software manual for details on programming and integration of the SEA 9406 module.



Refer to the appropriate NI™ documentation for details on NI™ hardware.

We believe that all information in this manual is accurate. The document has been carefully reviewed for technical accuracy. In the event of techni-

cal or typographical errors, we reserve the right to make changes to subsequent editions of this document without prior notice to holders of this edition. The reader should consult the vendor if errors are suspected.

End User License Agreement (EULA)

Before operating the SEA 9406 and the provided software you have to agree to the terms and conditions (EULA). This agreement is part of the software installation procedure. In addition, the terms and conditions are available through the LabVIEW™ menu after installation (Tools > SEA > `product name` > Legal Information). If you do NOT agree you can send back the hardware and software package within a period of two weeks after delivery. In this case S.E.A. will refund the product price and shipping costs.

Safety Guidelines

To protect persons against any harm and the module from damage, the operation of the SEA 9406 module is only allowed according to the rules described in this document.

Operator Protection



Hot or Cold Surface The metallic surface of the module might become hot or cold as well. Touching the surface may result in bodily injury. Do not dismount the module from the chassis during operation. Wait until the module temperature has reached 20 °C.



Do not insert or remove the module from the system or connect/disconnect wires or connectors to/from the module unless power has been switched completely off. Make sure working in an ESD safe environment.



Do not open or disassemble the module or other hardware parts. Guarantee is void if the seal is broken!



Use only isolated power supplies made for use with CompactRIO systems (typically with a voltage of 12 VDC).



Keep the module and the antennas at least 1 meter away from human bodies during operation.

Safety Critical Applications



The module is not failure tolerant and therefore not suitable for use in safety critical applications.



Do not use the module for medical applications or any live supporting apparatus.



Do not solely use the module for geoposition determination, when a failure can be a danger for the environment, material or can possibly harm humans.

Hazardous Locations



The module is suitable for use in non hazardous locations only. Keep the module always away from hazardous locations and explosive areas.



Protect the module from thunderstorm and lightning strikes or other electrical hazards.



Use the module only in dry areas. Do not operate the module in bath areas, kitchens etc., where water or vapor can be getting in contact with the module or cables.

Hazardous Voltages

A voltage is hazardous when higher than 25 V_{RMS} or 60 VDC to earth ground according to IEC 60364-4-41 (SELV). If the module specifications allow to connect hazardous voltages to the module, take the following precautions, when connecting hazardous voltages to the module:



Make sure that only qualified personnel wires hazardous voltage adhering to local electrical standards.



Do not mix hazardous voltage circuits and human-accessible circuits on the same module.



The module must not be operated in high voltage areas.

Prerequisites

The SEA 9406 module is shipped with the following accessory:

- Printed hardware manual with operating instructions, safety guidelines and specifications

In order to operate the module the following components are required (not shipped with the module):

- CompactRIO™ system from NI™
- GNSS antenna – mandatory for operation, compatible antennas for various purposes are available from S.E.A. shop at shop.sea-gmbh.com
- SEA 9406 software driver – available as a free download from the support area at www.sea-gmbh.com

The SEA 9406 module can currently be operated in the following CompactRIO™ systems:

- Reconfigurable Chassis (RIO chassis)
- Expansion Chassis: all types



It is strictly recommended to use the module only in combination with accessories provided or recommended by S.E.A. to avoid incompatibility, malfunction or even damage of the components.

Connecting SEA 9406

The SEA 9406 is a GNSS module for stationary and mobile usage. It provides position data for global localization on earth as well as a precise time base for timing and synchronization purposes.

The module is designed to be operated in a FPGA-based RIO chassis only. It can be operated in any slot. Multiple modules can be operated in parallel (independently) inside a single RIO chassis. The power is supplied through the backplane from the RIO chassis.

On the front side the module provides LEDs (1) to indicate the status of the module as well as sockets (2)–(5) to connect accessory, refer to Fig. 1.

The subsequent sections describe each interface in more detail.

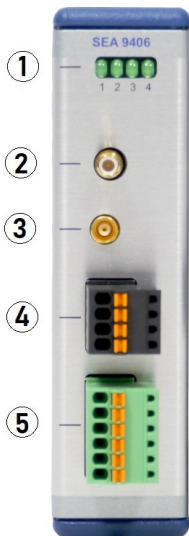


Fig. 1: Front Side

LEDs (1)

The LEDs on the front side indicate the status of the module. The meaning of each LED is described in the table below:

LED #	Meaning
1 – POWER	Backplane Power – is steady on when power (through the backplane connector) is present.
2 – TP/PPS	GNSS status – flashes with time pulse frequency when module receives valid GNSS data.
3 – RTK	RTK positioning status – indicates the status of the RTCM stream. OFF: no valid RTCM stream is received. FLASHING: valid RTCM stream is received, but RTK fixed mode is not (yet) achieved. ON: RTK fixed mode has been achieved.
4 – SENSOR-WT (opt.)	<u>Operates only if the sensor option is installed.</u> Wheel Tick sensor status – FLASHES with the frequency of the wheel tick signal (if below ~10 Hz), or const. ON, if frequency of the wheel tick above ~10 Hz.

Tab. 1: LEDs



All LEDs are OFF while *Sleep Mode* is active.



SYNC OUT (2)

This SMB socket (male) delivers a 5V-TTL-compatible Timepulse output signal (also known as Pulse-Per-Second or PPS). The Timepulse signal provides a short impulse (logical high level) at the beginning of each second. The Sync Output signal, however, can be customized by redirecting the original Timepulse signal to the FPGA, generating a custom signal and providing this signal at the SYNC OUT socket.

GNSS ANT (3)

This MCX socket (female) allows to connect an external GNSS antenna to the module. The usage of an adequate GNSS antenna is mandatory to receive valid GNSS data. Only active GNSS antennas with a supply voltage of 3.3 V and a maximum current of 50 mA are allowed. Antennas with differing specifications may destroy the module.

Select adequate antennas carefully for the intended use case. Mount the antennas mechanically properly at the desired location. Connect only antennas which are proven to work with these modules. Refer to the S.E.A. web shop at <https://www.sea-gmbh.com> for compatible antenna types.

If a roof antenna is used, the antenna has to be dismantled when lightning strikes are likely to happen. The module and any antenna or cabling is NOT protected against lightning strikes or any over-voltage. Do NOT operate the module or antenna during thunderstorms, and keep the antenna away from any kind of elevation.

COM (4)

This connector exposes a serial interface (RS-232) and can be used to provide an RCTM stream to the module. For this an NTRIP client software and an adequate NTRIP service are required. The NTRIP client has to be operated on a device providing a serial RS-232 interface, which needs to be connected to COM according to the following pinout:

PIN #	Meaning
1 – RX	Module's read line. Connect here the NTRIP client write line.
2 – TX	Module's write line. Connect here the NTRIP client read line.
3 – GND	Ground line
4 – Shield	Shield line

SENSOR-WT (opt.) (5)

Operates only if the sensor option is installed.

This connector allows to connect an external wheel tick sensor to improve performance in areas with poor satellite visibility i.e. tunnels.

PIN #	Meaning
1 – WT Sig.	Wheel Tick signal input. Provide a signal with approx. 50% duty cycle with 0 .. 24 VDC (>3 V = high level). Min. recommended pulse width: 10 μ s. For optimal performance the resolution should not exceed 5 cm.
2 – WT GND	Wheel Tick signal ground
3 – WT Shield	Wheel Tick signal shield. For use in environments with with interference and with shielded cables.
4 – DIR Sig.	Wheel Tick direction input. Provide a signal with 0 .. 24 VDC (>3 V = high level). The polarity is automatically initialized once the vehicle has reached the required minimum speed of 30 km/h.
5 – DIR GND	Direction signal ground
6 – DIR Shield	Direction signal shield. For use in environments with with interference and with shielded cables.

Backup Battery (opt.)

Available only if the battery is installed.

The internal backup battery provides the following features:

- Stores the last GNSS almanac.

This feature significantly speeds up the availability of the first valid GNSS data after a power-up, because the module does not need to collect the GNSS almanac again, which can take several seconds or minutes. This option requires that the location of the GNSS antenna did not change significantly since the last switch-off.

The battery is designed as a maintenance-free component and is hence not considered to be replaced during a module's lifetime. Therefore it is recommended to take some measures to extend the battery's lifetime:



The battery should not be discharged below a minimum limit to avoid its damage. Therefore do not store the module with installed battery for long time periods. An acceptable store period is between 2 and 6 weeks depending on the battery condition and the storage conditions (temperature, humidity...). As a general rule: a storage period of 4 weeks is achievable under normal environmental conditions, when the battery was fully charged before.

Sleep Mode

This module supports a low-power sleep mode. In sleep mode typically there is no communication with the module and the power consumption is minimized. The system thermal dissipation may decrease. Refer to the *Specifications* section for more information about power consumption and thermal dissipation. The sleep mode can be enabled by software.

Specifications

The following specifications are typical for the nominal temperature of 20 °C unless otherwise noted.

GNSS Characteristics		w/o Sensor	w/ Sensor
GNSS	BeiDou, Galileo, GLONASS, GPS / QZSS		
Frequency Bands	L1C/A, L2C, L1OF, L2OF, E1B/C, E5b, B1I, B2I		
Time-To-First-Fix			
Cold start, w/o battery	s	24	26
Cold start w/ battery		3	3
Max. Update Rate	Hz	20	
Position Accuracy			
Horizontal w/o RTK	m	1.5 ¹	
Horizontal w/ RTK		< 0.2 (up to 0.01)	
Max. Altitude	m	2000	
Max. Speed	km/h	500	
Timepulse Accuracy	ns	±30	

1 CEP, 50%, 24 hour static, -130 dBm, SEP: < 3.5 m

Timepulse Logic Low High	VDC	0 to 0.3 0.7 to 5
Ext. Sensor (only if sensor option installed)		
WheelTick Signal Form		50% duty cycle
Wheel Tick Signal Logic Low High	VDC	0 3 to 34
Wheel Tick Direction Logic Low High	VDC	0 3 to 34
Int. Sensor (only if sensor option installed)		
Accelerometer		3 axis (x, y, z)
Gyroscope		3 axis (x, y, z)
Power Requirements¹		
Operating Voltage (cRIO chassis)	VDC	5

- 1 The exact power consumption is dependant on the active communication standard as well as the antenna and reception quality.

Operating Current Typical Sleep Mode	mA	86 ¹ < 1
Physical Characteristics		
Weight	g	ca. 150
Dimensions	mm	88 x 23 x 88
Environmental Conditions		
Operating Temperature w/ battery (w/o battery)	°C	- 20 to +60 (- 40 to +85)
Storage Temperature w/ battery (w/o battery)	°C	- 20 to +60 (- 40 to +85)
Ingress Protection ²		IP 30
Operating humidity	% ³	10 to 90

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- 1 With active GNSS-Patch antenna connected to the module.
 - 2 with connected power cable
 - 3 RH, noncondensing

Shock and Vibration		
Operating Vibration Random (IEC 60068-2-64) Sinusoidal (IEC 60068-2-6)	Hz	5 g _{rms} , 10 to 575 5 g, 10 to 575
Operating Shock (IEC 60068-2-27)		15 g, 11 ms half sine, 30 g, 11 ms half sine, 50 g, 3 ms half sine (10 shocks at 6 orientations)

Tab. 2: Specifications

Certifications

For EMC compliance, it is only allowed to operate the SEA 9406 with original and shielded antenna cabling. For further information about antennas and cabling please refer to our website: www.sea-gmbh.com



This product is conform with the following European Union directives:

- 2014/53/EU (RED)
- 2011/65/EU (RoHS 2) with its amendment 2015/863/EU (RoHS 3)

The conformity is assessed in accordance with the following standards:

- EN 301 489-1 v2.2.3 (2019-11) (EMC)
- EN 301 489-19 v2.1.1 (2019-4) (EMC)
- EN 62368-1:2014 (Safety) + AC:2015 + A11:2017
- EN 303 413 v1.2.1 (2021-4) (Radio)
- EN IEC 63000:2019-05 (RoHS)

Contact and Support

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