EtherCAT® Inertial measurement

ONESERIES

PRODUCT DOCUMENTATION

SE1 | SE2 | SE3 | SE7 | SE8

GABLE

MASTERING MOTION

GABLE TECHNOLOGIES BV
Lintelerweg 10
7556 PD Hengelo,The Netherlands

Document information

Name	Date	Revision	Source
Gable-IMU™ ONE SERIES Product Documentation	19-02-2026	C.07	www.gable-imu.nl

Revision History

Revision number	Date	By	Description
A	08-01-2021	HCV	First release
B	10-06-2021	HCV	Updated figures and added order code description.
C	05-05-2022	SMB	Product name change and info for housed version.
C.01	27-06-2022	SMB	Minor (mounting) dimension chance of housing .
C.02	02-09-2022	SMB	Weight information added.
C.03	03-11-2022	SMB	Pin assignment fig.5 altered.
C0.4	17-05-2023	HCV	Minor changes product descriptions
C.05	03-09-2024	HCV / SMB	Updated specifications for accelerometer and gyroscope. Added SE7/SE8 information sections / Design update
C.06	03-02-2026	HCV	Added origin of measurement and updated PDO table to latest firmware
C.07	19-02-2025	HCV	Updated Command PDO description

Table of Contents

Table of Contents 3
List of Tables 5
List of Figures 6
1 General information 7
1.1 Remarks on the documentation 7
1.1.1 Target audience 7
1.1.2 Disclaimer 7
1.1.3 Trademarks 7
1.1.4 Copyright 7
1.2 Safety instructions 7
1.2.1 Safety regulations 7
1.2.2 Exclusion of liability 8
1.2.3 Personnel qualification 8
1.2.4 Description of symbols 8
1.3 Ordering information 8
1.4 ONE-SERIES architecture 9
1.5 ONE-SERIES variants 9
1.5.1 SE1 IMU 9
1.5.2 SE2 VRU/ AHT 9
1.5.3 SE3 AHRS 10
1.5.4 SE7 GNSS/INS 10
1.5.5 SE8 RTK/GNSS/INS 10
2 ONE-SERIES specifications 11
2.1 XSENS® MTi-1 series performance specifications 11
2.2 Individual component specifications 11
3 Wiring of the ONE-SERIES 13
3.1 General wiring information 13
3.1.1 Cabling conductor losses 13
3.2 EtherCAT® and power connection 13
3.2.1 Mating connectors for OEM-version 14
3.2.2 Mating connectors for HSD-version 14
3.2.3 Pin assignment 14
3.2.4 Mating connectors 15
3.3 LED indicators 15
3.4 GNSS connection (if applicable) 16
3.4.1 HSD (Housed) version and GNSS 16
3.4.2 OEM (PCB) version and GNSS 16
4 Mounting ONE-SERIES 17
4.1 Mounting of housed version (HSD) 17

4.1.1 Origin of measurement 17
4.2 Mounting of PCB version (OEM) 18
4.3 Cable assemblies and accessories 19
5 Electrical and mechanical specifications 21
5.1 Supply voltage and power consumption 21
5.2 Mechanical characteristics 21
5.3 Ingress protection (HSD variants) 21
6 Configuration and settings 22
6.1 PDO mappings 22
6.2 Sending commands to the ONE-SERIES for configuration 23
6.3 Filter profiles 24
7 Packaging information 26
7.1 Package content 26

List of Tables

Table 1: Ordering code ONE-SERIES 8
Table 2: Sensor fusion performance specifications 11
Table 3: ONE-SERIES gyroscope specifications 11
Table 4: ONE-SERIES accelerometer specifications 11
Table 5: ONE-SERIES magnetometer specifications 11
Table 6: ONE-SERIES orthogonality specifications 12
Table 7: EtherCAT® pin assignment 15
Table 8: Power pin assignment 15
Table 9: Mating connectors OEM-version 15
Table 10: Mating connectors HSD-version 15
Table 11: ONE-SERIES LED IDs and states 15
Table 12: Connectors and accessories 19
Table 13: Supply voltage range ONE-SERIES 21
Table 14: Power consumption ONE-SERIES 21
Table 15: Mechanical characteristics ONE-SERIES 21
Table 16: PDO mappings 22
Table 17: Example command to change filter setting 23
Table 18: Complete Xbus message to change filter type to ‘General/50’ 23
Table 19: Example Command to get both HR (High Rate) PDOs only 24
Table 20: Filter Profiles for ONE-SERIES-2 and ONE-SERIES-3 24
Table 21: Package contents 26

List of Figures

Figure 1: ONE-SERIES Architecture 9
Figure 2: Voltage drop vs conductor cross sections 13
Figure 3: Connectors on front side (PCB-version) 14
Figure 4: Connectors on front side (HSD-version) 14
Figure 5: Connector pin locations HSD-version 15
Figure 6: ONE-SERIES top view showing LED IDs and location 16
Figure 7: ONE-SERIES HSD drawing 18
Figure 8: ONE-SERIES OEM drawing 19
Figure 9: GradConn SMA cable assembly 20
Figure 10: Norcomp Vulcon series M5 cable assembly connectors 20
Figure 11: Multi-band active GNSS antenna 20

1 General information

This document provides information on the technical details and usage of the Gable-IMU™ ONE-SERIES. The ONE-SERIES are fully functional, easy to build-in Inertial Measurement Units (IMUs) which can be directly connected to or installed into an existing EtherCAT® network. ONE-SERIES are available in a housed version (HSD) or as a small footprint PCB-version (OEM). The Gable-IMU™ ONE-SERIES can also be easily integrated into an existing EtherCAT P® network. Please consult Gable Technologies for advice and/or support on these topics.

Gable Technologies B.V.
Website: www.gable-imu.nl

Email: info@gable.nl

1.1 Remarks on the documentation

1.1.1 Target audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards. It is essential that the documentation and the following notes and explanations are followed when installing and commissioning ONE-SERIES.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.
The responsible staff must ensure that the application or use of the devices described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

1.1.2 Disclaimer

The documentation has been prepared with care. The devices described are, however, constantly under development.
Gable Technologies reserves the right to revise and change the documentation at any point in time and without prior announcement. No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

1.1.3 Trademarks

Gable-IMU™ is a trademark of Gable Technologies B.V.
EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
EtherCAT P® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

XSENS® is a registered trademark of XSENS Technologies B.V. and/or its parent, subsidiaries and/or affiliates in The Netherlands, the USA and/or other countries.

1.1.4 Copyright

© Gable Technologies B.V., The Netherlands.
The reproduction, distribution and utilization of this document as well as the communication of its contents to others without express authorization are prohibited. Offenders will be held liable for the payment of damages. All rights reserved in the event of the grant of a patent, utility model or design.

1.2 Safety instructions

1.2.1 Safety regulations

The following safety instructions should be read and noted! Specific safety instructions can be found in subsections throughout this document.

1.2.2 Exclusion of liability

All the components are supplied in specific hardware and software configurations appropriate for the application. Hardware or software configuration modifications other than those described in this document are not permitted, and nullify the liability Gable Technologies B.V.

1.2.3 Personnel qualification

This description is only intended for trained specialists in control and automation familiar with the applicable national standards.

1.2.4 Description of symbols

In this documentation the following symbols are used with an accompanying safety instruction or note. Make sure to carefully read the instructions!

INFORMATION
This symbol indicates information that contributes to better understanding.

CAUTION
Makes the user alert to actions that could cause equipment damage, resulting in the equipment becoming unsafe, or to actions or operations that could have undesirable consequences.

WARNING
Makes the user aware of potentially hazardous events related to the ONE_SERIES that may result in permanent damage to the device and/or interfaced equipment.

1.3 Ordering information

When ordering Gable-IMU™ ONE SERIES, the following order code must be used. See Table 1
You can also use our online product finder at www.gable-imu.nl to find the product that suits your demand.
Please consult our sales department for production quantities, graduated prices and custom solutions.

Table 1: Ordering code ONE-SERIES

SE2	-	OEM	-	VE
VARIANT: SE1 SE2 SE3 SE7 SE8		**FORM:** HSD = Housed version OEM = PCB version		**INTERFACE:** VE = Vertical connectors RA = Right angle connectors NC = No connectors Blank = in case of HSD version

1.4 ONE-SERIES architecture

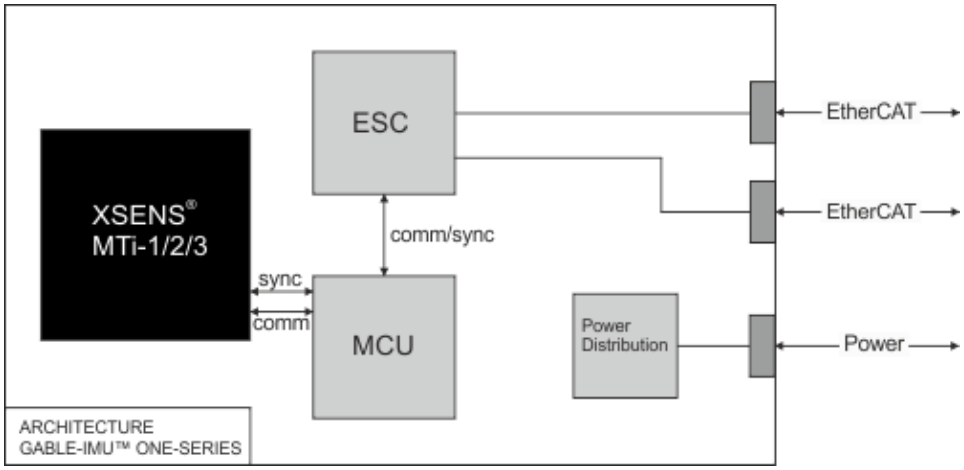

Figure 1: ONE-SERIES Architecture

The schematic representation in Figure 1: ONE-SERIES Architecture shows the architecture of the ONE-SERIES. The ONE-SERIES contains an XSENS®[1] MTi-1 series IMU with a 3-axis gyroscope, 3-axis accelerometer and 3-axis magnetometer. The MTi-1 series IMU is integrated in a fully functional EtherCAT slave which coordinates the communication between the EtherCAT network and the MTi-1 series IMU. This is realized using a state of art EtherCAT Slave Controller (ESC) and an industrial grade microcontroller (MCU).
Optimally estimated orientation, position and velocity are available with output data rates up to 100Hz. Gyroscope and acceleration data are available at data rates up to 800 and 1000 Hz respectively.

1.5 ONE-SERIES variants

The ONE-SERIES is available in several EtherCAT® ready variants:

- SE1 Inertial Measurement Unit (IMU)
- SE2 IMU + Vertical Reference Unit (VRU)
- SE3 IMU + VRU + Altitude and Heading Reference System (AHRS)
- SE5 Global Navigation Satellite System (GNSS) + Real Time Kinematic (RTK)
- SE7 IMU + VRU+ AHRS + GNSS + Inertial Navigation System (INS)
- SE8 IMU + VRU+ AHRS + GNSS + INS + RTK

Depending on your ONE-SERIES variant, output data can be different which is explained in the following sections. The specific variant can be found on the label placed on the housing or PCB.

1.5.1 SE1 IMU

The SE1 is an IMU that outputs calibrated 3D rate of turn, 3D acceleration and 3D magnetic field. The SE1 also outputs coning and sculling compensated orientation increments and velocity increments (Δq and Δv). Advantages over a simple gyroscope-accelerometer combo-sensor are the inclusion of synchronized magnetic field, on-board signal processing and the easy-to-use synchronization and communication protocol. The signal processing pipeline and the suite of output options allow access to the highest possible accuracy at an output data rate up to 1000 Hz. Moreover, the testing and calibration is already performed by XSENS® and results in a robust and reliable sensor module, which enables a short time to market for the users.
Source: XSENS® MTi-1 series Datasheet

1.5.2 SE2 VRU/ AHT

The SE2 is a 3D VRU. On top of the functionality of the SE1, its algorithm computes 3D orientation data with respect to a gravity referenced frame: drift-free roll, pitch and unreferenced yaw. Although the yaw is unreferenced, it is superior to only gyroscope integration as a result of advanced on-board sensor fusion. The 3D acceleration is also available as so-called free acceleration, which has the local-gravity subtracted. The drift in

[1] https://www.movella.com/products/sensor-modules

unreferenced heading can be limited by using the Active Heading Stabilization (AHS) functionality. The raw sensor signals are combined and processed at a high frequency to produce a real-time data stream with device's 3D orientation (roll, pitch and yaw) up to 100 Hz.
Source: XSENS® MTi-1 series Datasheet

1.5.3 SE3 AHRS

The SE3 supports all features of the SE1 and SE2, and in addition is a full magnetometer-enhanced AHRS. In addition to the roll and pitch, it outputs a true magnetic North referenced yaw (heading) and calibrated sensors data: 3D acceleration, 3D rate of turn, 3D orientation and velocity increments (Δq and Δv) and 3D earth-magnetic field data. The raw sensor signals are combined and processed at a high frequency to produce a real-time data stream with device's 3D orientation (roll, pitch and yaw) up to 100 Hz.
Source: XSENS® MTi-1 series Datasheet

1.5.4 SE7 GNSS/INS

Self-contained with advanced sensor fusion algorithms, the SE7 is a GNSS/INS (Global Navigation Satellite System/inertial navigation system) and can synchronize the inputs from its on-board accelerometer, gyroscope, and magnetometer with the data from the onboard GNSS receiver. The raw sensor signals are combined and processed at a high data rate of 100 Hz, to produce a real-time data stream with the device's 3D position, velocity, and orientation (roll, pitch, and yaw). Source: XSENS® MTi-1 series Datasheet

1.5.5 SE8 RTK/GNSS/INS

The SE8 is the smallest EtherCAT real-time kinematic (RTK)-enhanced motion tracking module of its kind. Self-contained with advanced sensor fusion algorithms, the SE7 is a GNSS/INS (Global Navigation Satellite System/inertial navigation system) and can synchronize the inputs from its on-board accelerometer, gyroscope, and magnetometer with the data from the onboard GNSS receiver. The raw sensor signals are combined and processed at a high data rate of 100 Hz, to produce a real-time data stream with the device's 3D position, velocity, and orientation (roll, pitch, and yaw).
Source: XSENS® MTi-1 series Datasheet

2 ONE-SERIES specifications

This section presents the performance and the sensor component specifications for the Gable-IMU™ ONE-SERIES, based on the performance of the XSENS® MTi-1 series IMU.

2.1 XSENS® MTi-1 series performance specifications

Each XSENS® MTi-1 series IMU, inside the Gable IMU ONE-SERIES, has passed the XSENS® calibration process individually. The XSENS® calibration procedure calibrates for many parameters, including bias (offset), alignment of the sensors with respect to the PCB and to each other, and gain (scale factor). All calibration values are temperature dependent and temperature calibrated. The calibration values are stored in the non-volatile memory of the XSENS® MTi-1.
In addition, some calibration parameters are continuously improved and/or re-estimated through the on-board sensor fusion algorithms during normal operation.
Source: XSENS® MTi-1 series Datasheet

Table 2: Sensor fusion performance specifications

Parameter	Condition	SE1 IMU	SE2 VRU	SE3 AHRS	SE7	SE8
Roll/Pitch	Static	N/A	0.5°	0.5°	0.5°	0.5°
	Dynamic	N/A	0.8°	0.8°	0.5°	0.5°
Yaw	Dynamic	N/A	Unreferenced	2°	1.5°	1.0°
Position (Horizontal)	Static/Dynamic	N/A	N/A	N/A	1 m CEP	1cm +1ppm[2] CEP
Position (Vertical)	Static/Dynamic	N/A	N/A	N/A	2 m CEP	0.1m + 1ppm[2] CEP
Velocity	Static/Dynamic	N/A	N/A	N/A	0.05 m/s	0.05 m/s

All above specifications are RMS values based on typical application scenarios.

2.2 Individual component specifications

Table 3: ONE-SERIES gyroscope specifications

Gyroscope Specifications[3]	Unit	Value
Standard full range	[°/s]	±2000
In-run bias stability	[°/h]	6
Bandwidth (-3dB)	[Hz]	230
Noise density	[°/s/√Hz]	0.003
g-sensitivity (calibrated)	[°/s/g]	0.001
Non-linearity	[%FS]	0.1
Scale Factor variation	[%]	0.5(typical) 1.5 (over life)

Table 4: ONE-SERIES accelerometer specifications

Accelerometer[3]	Unit	Value
Standard full range	[g]	±16
In-run bias stability	[µg]	40
Bandwidth (-3dB)	[Hz]	230
Noise density	[µg/√Hz]	70
Non-linearity	[%FS]	0.5

Table 5: ONE-SERIES magnetometer specifications

Magnetometer[3]	Unit	Value

[2] 1 ppm = 1 part per million, e.g. an additional 1 mm of error for every kilometer distance from the RTK base station. Position accuracies are assuming proper GNSS reception/circumstances.
[3] As XSENS® continues to update the MTi-1 series, these specifications are subject to change

	Standard full range	[G]	±8
	Non-linearity	[%]	0.2
	Total RMS noise	[mG]	0.5
	Resolution	[mG]	0.25

Table 6: ONE-SERIES orthogonality specifications

Parameter[3]		Unit	Value
	Non-orthogonality (accelerometer)	[°]	0.05
	Non-orthogonality (gyroscope)	[°]	0.05
	Non-orthogonality (magnetometer)	[°]	0.05
	Alignment (gyro to acc)	[°]	0.05
	Alignment (mag to acc)	[°]	0.1
	Alignment of acc to the MTi-board	[°]	0.2

3 Wiring of the ONE-SERIES

This section describes the mounting and wiring options for the ONE-SERIES.

3.1 General wiring information

3.1.1 Cabling conductor losses

Power cables cables should be designed in such a way that their length prevents a voltage drop which is too large for the ONE-SERIES to still operate reliably. Current draw from other nodes connected to the OUT port of the ONE-SERIES also need to be taken into account. At a control voltage Us of 24V, reliable operation cannot be guaranteed anymore when the voltage drop exceeds 12 V.
Figure **2** shows the different cable lengths and their relation to the voltage drop at a 3A current draw.

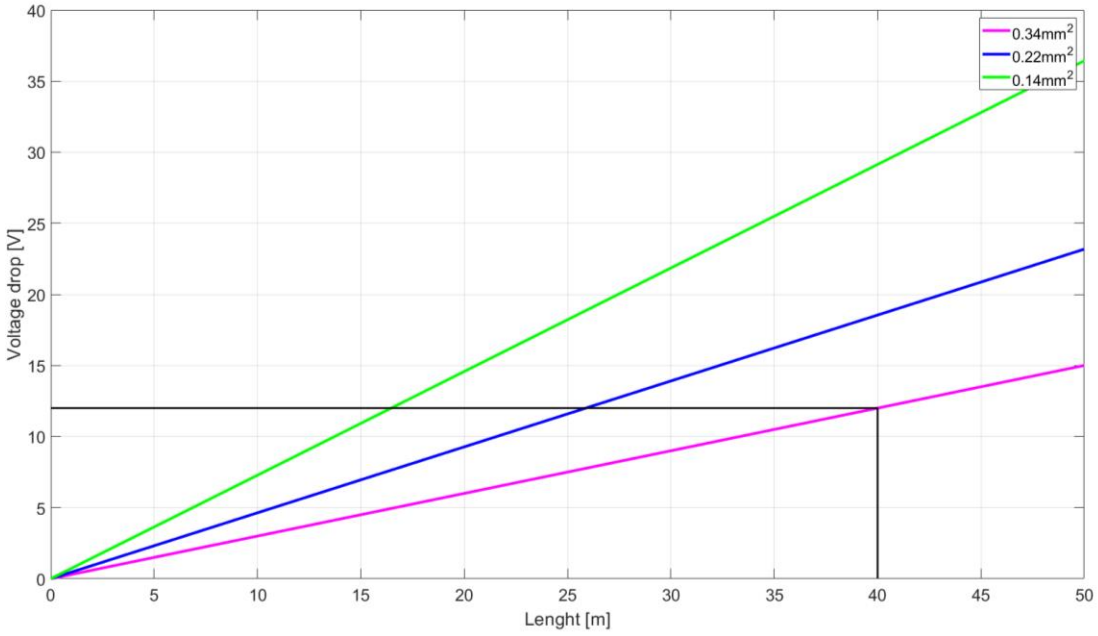

Figure 2: Voltage drop vs conductor cross sections

Example: A power cable of 40m with (copper) conductor cross section of 0.34mm^2 has a voltage drop of ~12V @ 3A.

3.2 EtherCAT® and power connection

CAUTION | Risk of damage to the device!

Bring the EtherCAT® system into a safe, powered down state before starting installation, disassembly or wiring of the ONE-SERIES.

3.2.1 Mating connectors for OEM-version

Figure 3: Connectors on front side (PCB-version)

The 3 connectors shown in Figure 3 are to be used for power and EtherCAT®. The leftmost connector is the power connector (3 pins), whereas the middle and rightmost connectors (4 pins) are EtherCAT® IN and EtherCAT® OUT respectively.

3.2.2 Mating connectors for HSD-version

Figure 4: Connectors on front side (HSD-version)

The three metal grey coloured connectors, shown in Figure 4, are to be used for power and EtherCAT® IN/OUT. The left most connector is the power connector (2 pins), whereas the middle and rightmost connectors (4 pins) are EtherCAT® IN and EtherCAT® OUT respectively. The gold plated SMA connector is only available for variants SE5, SE7 and SE8. It can be used to connect an external antenna to the internal GNSS receiver.

3.2.3 Pin assignment

For the OEM version, the location of pin number 1 can be found in Figure 8. The pin location for the HSD-version can be found in Figure 5.

Figure 5: Connector pin locations HSD-version

Table 7: EtherCAT® pin assignment

Pin	Signal	Voltage
1	Rx+	-
2	Rx-	-
3	Tx+	-
4	Tx-	-
Housing	None	-

Table 8: Power pin assignment

Pin	Signal	Voltage
1	Vs	5 - 24V
2	PR	0V (GND)
3	N.C.	-
Housing	None	-

3.2.4 Mating connectors

The following connectors from Molex®[4] can be used to connect to the ONE-SERIES to a power supply and EtherCAT® network. See Table 9 in case of the OEM-version and Table 10 in case of the HSD version.

Table 9: Mating connectors OEM-version

Connector	Molex® Number	Type	Amount
Pico-Clasp Female plug	5019390300	Power connector	1
Pico-Clasp Female plug	5019390400	EtherCAT connector	2

Table 10: Mating connectors HSD-version

Connector	Number	Manufacturer	Remark
Male connector M5 Vulcon™ series 2P	851-002-103R001	NORCOMP	Solder pin assembly, IP67
Male connector M5 Vulcon™ series 4P	851-004-103R001	NORCOMP	Solder pin assembly, IP67

3.3 LED indicators

The ONE-SERIES has 5 LEDs to inform the user about the status of the device. In the following table the different LEDs and their function are explained. The LED locations of the OEM-version are shown in Figure 6. The LED locations of the HSD-version are labelled on the casing, see Figure 4.

Table 11: ONE-SERIES LED IDs and states

LED	Color	State
IN	Green	Flashing: EtherCAT communication
OUT	Green	Flashing: EtherCAT communication
PWR	Green	On: Power ok
RUN	Green	Off: Device in INIT/unknown state
		On: Device in Run mode

[4] https://www.molex.com

ERR	Red	Flashing: Device in SAFEOP or PREOP state Off: ok Flashing: Internal communication error

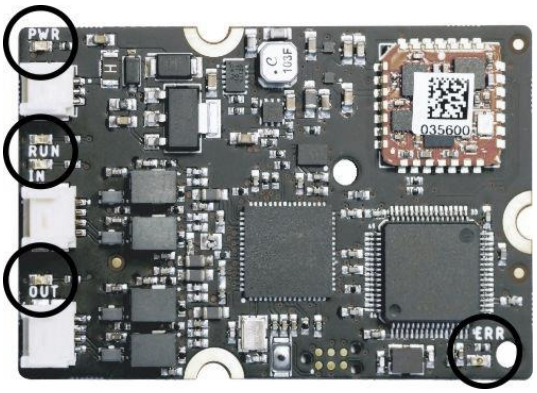

Figure 6: ONE-SERIES top view showing LED IDs and location

3.4 GNSS connection (if applicable)

3.4.1 HSD (Housed) version and GNSS

If applicable, any standard SMA mating connector can be used to attach to the internal GNSS receiver of the SE5 and SE7 HSD versions.

3.4.2 OEM (PCB) version and GNSS

On request, a cable assembly with PCB to SMA panel mount connector, Figure 9, is available for the SE5 and SE7 OEM versions. Any standard SMA mating connector can be used to connect to this SMA panel mount connector.

4 Mounting ONE-SERIES

CAUTION | Risk of mechanical damage to the device!

Follow the mounting instructions and recommendations to prevent damage and undesirable effects.

4.1 Mounting of housed version (HSD)

The housed variant of the ONE-SERIES is supplied with two hexagon head bolts DIN 916 A2 M2.5x5 (Allen key 2) which need to be used to fix the sensor to another system or device. The dimensions and location of the mounting holes can be found in Figure 7.

- On request M5 cable assembly connectors can be provided for power and signal (RJ45) in diverse lengths, please refer to Table 12.

4.1.1 Origin of measurement

The origin of measurement of the housed version can be found in Figure 7 and is dimensioned to its mounting holes.

CAUTION | Risk of mechanical damage to the device!

Tighten the M2.5 bolts with a maximum tightening torque of 0.4 Nm.

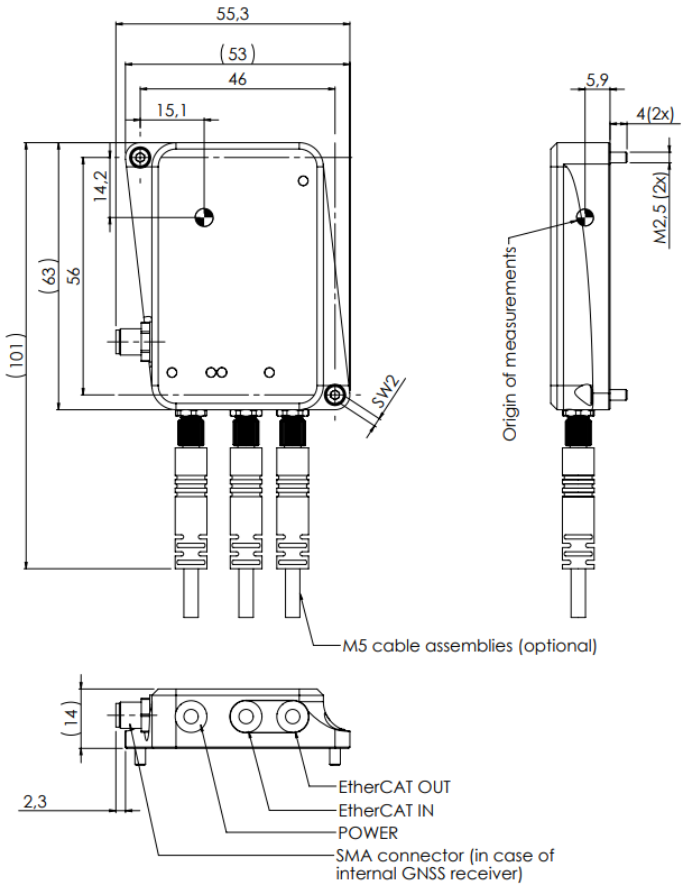

Figure 7: ONE-SERIES HSD drawing

4.2 Mounting of PCB version (OEM)

CAUTION | Risk of mechanical damage to the device!

It is recommended to tighten the PCB fasteners hand tight (0.2 Nm) to prevent damage to the PCB.

CAUTION | Risk of mechanical damage to the device!

A static free-workstation must be used when handling the ONE-SERIES OEM .

The PCB version of the ONE-SERIES can be mounted according to the dimensions per drawing of Figure 8 and the following instructions:

- Ensure a static free-workstation before unpacking and handling the PCB and electronic components. A electro static discharge (ESD) can damage electronic components.
- The ONE-SERIES OEM should be mounted to another system or device using three non-ferro M3 fasteners with a head diameter less than or equal to 5.6 mm.
- The dimensions and location of the mounting holes can be found in Figure 8.

- On request, Molex® Pico-Clasp to Norcomp M5 Panel mount connectors can be provided. Please install the panel mount connectors according to Norcomp specifications part number 851-004-103R001.
- On request, a GradConn IP67 SMA cable assembly can be provided, Figure 9, to connect to the internal GNSS receiver of variants SE5 and SE7. The assembly consists out of a SMA panel mount connector with a 200mm cable and I-PEX MHF 4L LK plug that can be connected to the PCB. Please consult the manufacturer information for mounting instructions of the SMA panel connector. Part number CAB442RF.

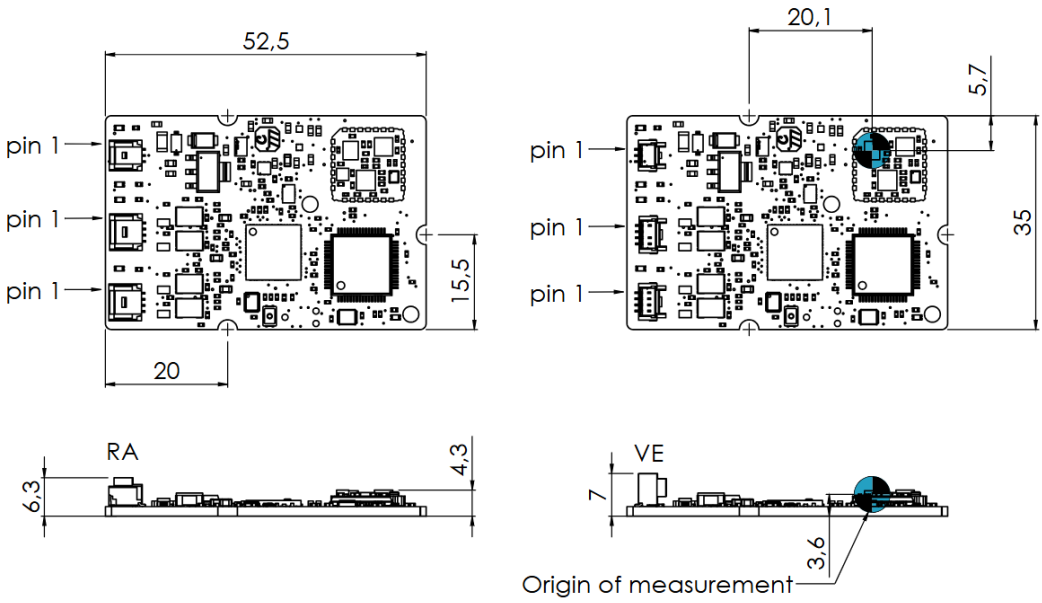

Figure 8: ONE-SERIES OEM drawing

4.3 Cable assemblies and accessories

The following cable assemblies and accessories are recommended and can be ordered directly from the specified manufacturer and/or through Gable Technologies BV see Table 12.

Table 12: Connectors and accessories

Item	Manufact.	Order code	Req. QTY SE1/2/3 OEM	Req. QTY SE1/2/3 HSD	Req. QTY SE5/7/8 OEM	Req. QTY SE5/7/8 HSD
Molex® Pico-Clasp to M5 panel mount connector (signal cable assembly)	Gable Technologies	4pPic-4pM5pan	2		2	
Molex® Pico-Clasp to M5 panel mount connector (power cable assembly)	Gable Technologies	3pPic-2pM5pan	1		1	
M5 mating connector to RJ45 (signal cable assembly 500mm)	Gable Technologies	4pM5plug-RJ45	2	2	2	2
M5 mating connector with flying lead (power cable assembly 500mm), Figure 10	Gable Technologies	2pM5plug	1	1	1	1

PCB to SMA panel mount cable assembly 200mm, Figure 9	GradConn	CAB442RF			1	
Multi-band active GNSS antenna IP67 with SMA connector, Figure 11	Ublox	ANN-MB-00-00			1	1

Figure 9: GradConn SMA cable assembly

Figure 10: Norcomp Vulcon series M5 cable assembly connectors

Figure 11: Multi-band active GNSS antenna

5 Electrical and mechanical specifications

This section describes the electrical operating conditions and mechanical specifications of the ONE-SERIES variants.

5.1 Supply voltage and power consumption

Power is supplied to the fieldbus, the processor logic, the inputs and the sensors from the power connector. The permissible input voltage range is shown in Table 13. The ONE-SERIES are over- and reverse voltage protected.

Table 13: Supply voltage range ONE-SERIES

Symbol	Minimal	Typical	Maximal	Unit
Us	6	24	26	V

Table 14: Power consumption ONE-SERIES

Variant	Typical	Unit	Description
SE1/2/3	1.2	W	At 24V
SE7/8	2.1	W	At 24V

CAUTION | Risk of electrical damage to the device!

It is highly recommended to prevent hot connecting the ONE-SERIES to a live power supply. First install all cabling in a proper manner and according to local regulations before powering up the power supply.

5.2 Mechanical characteristics

Table 15: Mechanical characteristics ONE-SERIES

Variant	Weight	Dimensions	Ingress Protection
SE1/2/3-OEM	10 grams	52,5x35x6,9 mm (approx. 2.07×1.38×0.27 inches)	None
SE7/8-OEM	17 grams	52,5x35x9.5 mm (approx. 2.07×1.38×0.37 inches)	None
SE1/2/3-HSD	35 grams	63x53x13 mm (approx. 2.48×2.09×0.51 inches)	IP67
SE7/8-HSD	42 grams	63x55,3x13 mm (approx. 2.48×2.18×0.51 inches)	IP67

5.3 Ingress protection (HSD variants)

The ONE-SERIES HSD variant has a two part machined lightweight housing. It is made from high performance plastic. It is completely sealed to achieve an ingress protection as stated in Table 15.

Note: Warranty rights will be lost immediately after attempts to open the housing or otherwise tamper with it.

6 Configuration and settings

The EtherCAT® communication between the ONE-SERIES and the EtherCAT® master goes through its PDO's (No CoE parameters).

6.1 PDO mappings

The PDO mappings for each ONE-SERIES can be found in Table 16.

Table 16: PDO mappings

PDO	Data format	Usage
Quaternions[5]	Structure with {qw, qx, qy, qz} each field being a REAL.	The *Quaternion fields* can be mapped to EtherCAT master inputs of matching data format.
Euler Angles[5]	Structure with {ex, ey, ez} each field being a REAL.	The *Euler Angles* can be mapped to EtherCAT master inputs of matching data format.
Gyroscope	Structure with {gx, gy, gz} each field being a REAL.	The *Gyroscope fields* can be mapped to EtherCAT master inputs of matching data format.
Acceleration	Structure with {ax, ay, az} each field being a REAL.	The *Acceleration fields* can be mapped to EtherCAT master inputs of matching data format.
MagneticField	Structure with { magX, magY, magZ} each field being a REAL.	The *MagneticField fields* can be mapped to EtherCAT master inputs of matching data format.
GyroscopeHR	Structure with { gxHR - REAL, gyHR - REAL, gzHR - REAL, SampleTimeFine - UDINT}.	The *GyroscopeHR fields* can be mapped to EtherCAT master inputs of matching data format. These signals are available at rates up to 1000Hz (not synchronized to the internal XSENS® clock). See Table 16 and 22 MT_Low-Level_Documentation.pdf.
AccelerationHR	Structure with { axHR - REAL, ayHR - REAL, azHR - REAL, SampleTimeFine}.	The *AccelerationHR fields* can be mapped to EtherCAT master inputs of matching data format. These signals are available at rates up to 800Hz (not synchronized to the internal XSENS® clock). See Table 16 and 22 MT_Low-Level_Documentation.pdf.
Temperature	Field being REAL.	The *Temperature* field can be mapped to an EtherCAT master input of matching data format.
Timestamp	Structure with {PacketCounter - UINT, SampleTimeFine - UDINT}.	The *Timestamp* fields be mapped to EtherCAT master inputs of matching data format.
FilterProfile	Field being USINT.	The *FilterProfile* field can be mapped to an EtherCAT master input of matching data format.
IMUstatus	Structure with: { CRC errors – UDINT, Wakeup – BIT, Communication_Errors – UDINT, StatusWord - UDINT}	The *Status fields* can be mapped to EtherCAT master inputs of matching data format. *CRC errors*: Number of CRC errors due to invalid XBus[6] frame CRC. *Wakeup*: Sensor is ready to use *Communication_Errors*: Number of communication error(s) bewteen the XSENS® IMU and the microcontroller.

[5] Not available for the IMU Module-1

[6] XBus: XSENS® digital data bus system.

Command	Field being USINT.	The *Command* field is part of a XBus message used to configure the XSENS® IMU, and can be mapped to an EtherCAT master output with matching data format. The following (not complete) preconfigured messages are defined: 0 – Default return value 1 – Custom/Xbus message 6 – Config mode 7 – Measurement mode 8 – Software Reset 12 – Request Device ID of the onboard IMU
DataIn	Array with entries being USINT.	The *DataIn* Array is part of a XBus message used to configure the XSENS® IMU, and can be mapped to EtherCAT master inputs with matching data format.
DataOut	Array with entries being USINT.	The *DataOut* Array is part of a XBus message used to configure the XSENS® IMU, and can be mapped to EtherCAT master outputs with matching data format.

6.2 Sending commands to the ONE-SERIES for configuration

This section describes the commands which need to be send over EtherCAT® to change for example the filter settings or output data for the ONE-SERIES.

Table 17: Example command to change filter setting

Step	EtherCAT® Message	Result	Comment
Go to config mode	Send: ***Command*** = 6	Acceleration, Gyroscope etc. will stop being updated (freeze)	-
Set Filter[7]	*Send in one cycle:* ***Command*** *= 1* ***DataOut[1]*** *= 100 (MID)* ***DataOut[2] = 2 (Data length)*** ***DataOut****[3] = 0* ***DataOutn****[4] = 50, 51, 52, 53 or 54 (See filter options Mti-1, page 48 low level communication protocol)*	**DataIn[3]** should show '101'	-
Reset sensor	Send: ***Command*** = 8	**FilterProfile** should show the new filter type (for example 50 or 51). See Table 20 for all available filters.	Sensor is being reset and starts in measurement mode again.

An XSENS® XBus message also consist of header bytes (Preamble and BID) and a CRC byte, but these will be generated internally by the ONE-SERIES and should not be included in any message. Only the light blue fields (see Table 18) should be send combined with the correct *Command* (see Table 17).

Table 18: Complete Xbus message to change filter type to 'General/50'

Preamble	BID	MID	DataLength	Data	CRC

[7] The command to change for example the filter settings need to be send in one EtherCAT frame.

0xFA	0xFF	0x64 (Decimal 100)	0x02 (Decimal 2)	0x32 (Decimal 50)	0x69

The default configuration of the ONE-SERIES does not include the *GyroscopeHR* and *AccelerationHR* PDOs. This is because the time synchronized and processed data at 100Hz is most commonly used. These PDOs can be activated separately by sending the correct command (see Table 19). To have both the processed data and the *GyroscopeHR* and *AccelerationHR* PDOs a message similar to the message in Table 15 needs to be send including the other PDO identifiers (MT_LowLevelCommunicationProtocol_Documentation.pdf).

Table 19: Example Command to get both HR (High Rate) PDOs only

Step	EtherCAT® Message	Result	Comment
Go to config mode	Send: ***Command*** = 6	Acceleration, Gyroscope etc. will stop being updated (freeze)	-
Set PDOs[8]	Send in one cycle: ***Command*** *= 1* *DataOut[1] = 192 (MID)* *DataOut[2] = 8 (Data length)* ***DataOut[3…….10]*** *= [128, 64, 0, 0 ,64, 64, 0, 0]*	***DataIn[3]*** should show '193' as a response to **MID** '192'.	-
Go to measurement mode	Send: ***Command*** = 7	Only the *GyroscopeHR* and *AccelerationHR* PDOs are active.	Sensor is being reset and starts in measurement mode again.

6.3 Filter profiles

SE2 and SE3 can be used with several filter settings depending on the environment and application. TABLE 20 provides guidelines on selecting appropriate filter settings for your specific application or use case.

Table 20: Filter Profiles for ONE-SERIES-2 and ONE-SERIES-3

Name	Number	Device	Typical applications
General	50	SE3	Suitable for most applications.
High magnetometer dependence	51	SE3	Heading corrections strongly rely on the magnetic field measured and should be used when the magnetic field is homogeneous.
Dynamic	52	SE3	Assumes that the motion is highly dynamic.
North referenced	53	SE3	Assumes a good Magnetic Field Mapping (MFM) and a homogeneous magnetic field. Given stable initialization procedures and observability of the gyro bias, after dynamics, this filter profile will trust more on the gyro solution and the heading will slowly converge to the disturbed magnetic field over the course of time.
VRU general	54	SE3 SE2	Magnetometers are not used to determine heading. Consider using this filter in environments that have a heavily disturbed magnetic field or when the application only requires unreferenced heading (See also section 4.3 of the XSENS® MTi-1 series datasheet).

[8] The command to change for example the configuration settings need to be send in one EtherCAT® frame.

General/General_RTK	11/14	SE7/SE8	Yaw is North referenced (when GNSS is available). Altitude (height) is determined by combining static pressure, GNSS altitude and accelerometers. The barometric baseline is referenced by GNSS, so during GNSS outages, accuracy of height measurements is maintained.
GeneralNoBaro/GeneralNoBaro_RTK	12/15	SE7/SE8	Very similar to the general filter profile except for the use of barometer.
GnerealMag/GeneralMag_RTK	13/16	SE7/SE8	Bases its yaw estimate mainly on magnetic heading and GNSS measurements. A homogeneous or magnetic field calibration is essential for good performance

An example for setting the filter to can be found in section6.2.

7 Packaging information

The Gable-IMU™ ONE-SERIES are packaged and shipped as single or multiple units.

7.1 Package content

The following contents are shipped (content quantities are for a single unit)

Table 21: Package contents

Variant	Content	Qty	Information
SE1/SE2/SE3-OEM-VE/RA	– ONE-SERIES PCB (Pre-installed vertical or right-angle connectors)	1	
	– *On request connector set and/or accessories.*	→	4.3 Cable assemblies and accessories
SE7/SE8-OEM-VE/RA	– ONE-SERIES PCB Assembly (Including GNSS board) (Pre-installed vertical or right-angle connectors)	1	
	– *On request connector set and/or accessories.*	→	4.3 Cable assemblies and accessories
SE1/2/3-HSD	– ONE-SERIES in IP67 housing	1	
	– Bag with 2 hexagon socket head screws	1	
	– *On request connector set and/or accessories.*	→	4.3 Cable assemblies and accessories
SE7/8-HSD	– ONE-SERIES in IP67 housing	1	
	– Bag with 2 hexagon socket head screws	1	
	– *On request connector set and/or accessories.*	→	4.3 Cable assemblies and accessories