

MK2E2 Inertial Measurement Unit - User Manual

1. Features

- Low-Drift Gyroscopes ($0.5^\circ/\text{hr}$)
- Precision Optical Gyroscope on z-axis
- Low-Drift Accelerometers ($< 15 \mu g$)
- Interface: RS-422 or CAN-FD
- Power Usage: 2 W
- Voltage Range: +12 VDC to +34 VDC
- Dimensions¹: 78 x 63 x 36 mm
- Temperature Range: -40°C to $+85^\circ\text{C}$
- IP57 Rating (IP67 in process)



Figure 1: OSCP-MK2E2 Unit Illustration

2. Description

OSCP is developing a family of Optical Gyro-based Inertial Measurement Units (IMUs) featuring 11 degrees of freedom (DoF), including 1-axis Optical Gyroscope, 3-axis MEMS Gyroscopes, 3-axis MEMS Accelerometers, 3-axis TMR Magnetometers and 2-axis MEMS Inclometers. The MK2E2 is designed for demanding applications including autonomous heavy machinery, precision agriculture, construction, aerospace, defence, UAVs, marine navigation, and machinery health monitoring. The optical gyroscope enhances stability, making MK2E2 exceptionally resilient to challenges such as thermal drift, mechanical vibrations, and EMI, ensuring precise inertial sensing. Together, these sensing technologies provide robust motion data where reliability and stability are critical.

3. Functional Block Diagram

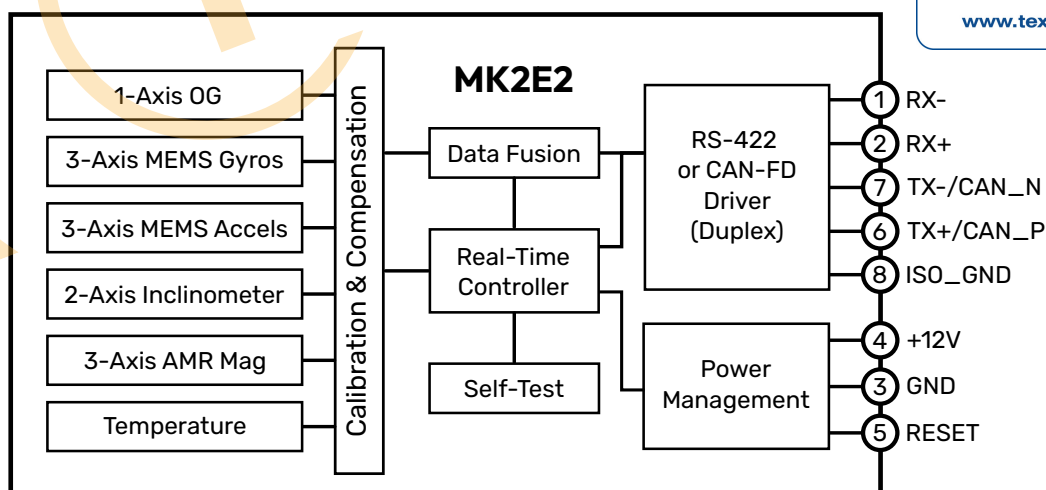


Figure 2: OSCP-MK2E2 Functional Block Diagram

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¹The width is slightly enlarged by the addition of a base to accommodate the mounting through-holes at the bottom of the IMU, for a total dimension of 78 x 80 x 36 mm.

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5. Revisions

PRELIMINARY - REV10 - 2026/08/21

- Increased High Operating Temperature Range and Case Temperature to +85°C.
- Added Certifications & Environmental Testing Section.
- Updated Illustration and Mechanical Drawings.
- Removed DRAFT Watermark.

DRAFT - REV09 - 2026/03/30

- Revised Generic Specifications for the Accelerometers.
- Revised Startup Frame and Debug Frames with Added Field for Heading Source.
- Added Clarification for CRC Computations and WRxxxxxxxxx Command.

DRAFT - REV08 - 2025/09/12

- Revised Generic Specifications for the Optical Gyroscope.
- Revised Startup Frame, GNSS frame and Debug Frames with Added Fields.
- Added AHRS Parameters Configuration.
- Added High-pass and Low-pass Filters on MEMS Gyroscopes and Accelerometers.
- Added Protocol Informations for the RS422-variant and CAN-FD variant.

DRAFT - REV07 - 2025/07/29

- Revised Generic Specifications like Weighth.
- Added Additionnal Information for the RST Pin.

DRAFT - REV06 - 2025/07/23

- Added the Order of the Quaternions.

DRAFT - REV05 - 2025/07/07

- Updated Power Consumption.

DRAFT - REV04 - 2025/07/02

- Harmonized Naming of the Product.
- Added Marking section.

DRAFT - REV03 - 2025/06/25

- Revised Technical Specifications.
- Added Mechanical Drawings section.
- Completed Euler Angles, Quaternions and Rotation Matrix sections.
- Included Several New Commands.
- Input and Output protocol changed for COBS.

DRAFT - REV02 - 2025/06/09

- Revised Generic Specifications like Dimensions and Weigth.

DRAFT - REV01 - 2025/04/10

- Initial Draft Version.

6. Abbreviations

Abbrev.	Full Name
ARW	Angle Random Walk
TMR	Tunnel Magneto Resistance
CAN	Controller Area Network
COBS	Consistent Overhead Byte Stuffing
DOF	Degrees of Freedom
DR	Dynamic Range
EF	Error Frame
GNSS	Global Navigation Satellite System

Abbrev.	Full Name
IMU	Inertial Measurement Unit
MEMS	Micro Electronic Mechanical Systems
OF	Operating Frame
OG	Optical Gyroscope
OM	Operating Mode
SF	Scale Factor
SUF	Startup Frame
VRW	Velocity Random Walk

7. Specifications

! Important Disclaimers

- Some specifications are still in a preliminary state and are subject to refinement.
- **All specifications are no longer guaranteed if the unit is opened.**

Table 1: IMU Specifications

Parameter	Min.	Typical	Max.	Unit	Case Temperature T_c
x-axis, y-axis, z-axis MEMS Gyroscopes					
Dynamic Range (Selectable)	± 125	$\pm 250, \pm 500, \pm 1000$	$\pm 2000, \pm 4000$	$^{\circ}/\text{sec}$	
Scale Factor Error	0.1	0.3	1.0	%	$-40^{\circ}\text{C} \leq T_c \leq +85^{\circ}\text{C}$
SF Non-Linearity Error		0.3		%	$-40^{\circ}\text{C} \leq T_c \leq +85^{\circ}\text{C}$
In-Run Bias Stability	0.5	< 1.0		$^{\circ}/\text{hr}$	$T_c = +25^{\circ}\text{C}$
Noise Density		0.001		$^{\circ}/\text{sec}/\sqrt{\text{Hz}}$	$T_c = +25^{\circ}\text{C}$
Angle Random Walk		0.06		$^{\circ}/\sqrt{\text{hr}}$	$T_c = +25^{\circ}\text{C}$
z-axis Optical Gyroscope					
Dynamic Range		± 250		$^{\circ}/\text{sec}$	
Scale Factor Error	0.3	0.5		%	$-40^{\circ}\text{C} \leq T_c \leq +70^{\circ}\text{C}$
SF Non-Linearity Error	0.5	1.0		%	$-40^{\circ}\text{C} \leq T_c \leq +70^{\circ}\text{C}$
In-Run Bias Stability	0.5	< 1.0		$^{\circ}/\text{hr}$	$T_c = +25^{\circ}\text{C}$
Noise Density		0.0007		$^{\circ}/\text{sec}/\sqrt{\text{Hz}}$	$T_c = +25^{\circ}\text{C}$
Angle Random Walk		0.03		$^{\circ}/\sqrt{\text{hr}}$	$T_c = +25^{\circ}\text{C}$
x-axis, y-axis & z-axis MEMS Accelerometers					
Dynamic Range (Selectable)	± 2	$\pm 4, \pm 8$	± 16	g	
Scale Factor Error		± 0.6		%	$-40^{\circ}\text{C} \leq T_c \leq +85^{\circ}\text{C}$
Cross-Axis Sensivity		± 0.5		%	$T_c = +25^{\circ}\text{C}$
In-Run Bias Stability		15		μg	$T_c = +25^{\circ}\text{C}$
Noise Density		15		$\mu g/\sqrt{\text{Hz}}$	$T_c = +25^{\circ}\text{C}$
Velocity Random Walk		0.008		$m/\text{sec}/\sqrt{\text{hr}}$	$T_c = +25^{\circ}\text{C}$
x-axis, y-axis & z-axis TMR Magnetometers					
Dynamic Range		± 20		G	
Scale Factor Error	1		3	%	$-40^{\circ}\text{C} \leq T_c \leq +85^{\circ}\text{C}$
SF Non-Linearity Error	0.5		1.0	%	$-40^{\circ}\text{C} \leq T_c \leq +85^{\circ}\text{C}$
RMS Noise	1.9		4.5	mG	$-40^{\circ}\text{C} \leq T_c \leq +85^{\circ}\text{C}$
Maximum Exposed Field	-2500		2500	G	$-40^{\circ}\text{C} \leq T_c \leq +85^{\circ}\text{C}$
Null Field Offset Accuracy	-20		+20	mG	$-40^{\circ}\text{C} \leq T_c \leq +85^{\circ}\text{C}$
x-axis & y-axis MEMS Inclinometers					
Dynamic Range (Selectable)	± 0.5	$\pm 1.0, \pm 2.0$	± 3.0	g	$T_c = +25^{\circ}\text{C}$
Scale Factor Error		± 2.0		%	$T_c = +25^{\circ}\text{C}$
Zero-g Level Offset Accuracy	-8		+8	mg	$T_c = +25^{\circ}\text{C}$

Parameter	Min.	Typical	Max.	Unit	Case Temperature T_c
Temperature Sensor					
Accuracy	± 0.5		± 1.0	$^{\circ}\text{C}$	$-40^{\circ}\text{C} \leq T_c \leq +125^{\circ}\text{C}$
GNSS (Optional)					
GNSS	BeiDou	Galileo, GLONASS	GPS, QZSS		
Supported Protocols	UBX	NMEA, RTCM	SPARTN		
Velocity Accuracy		0.05		m/sec	
Dynamic Heading Accuracy		0.3		$^{\circ}$	
Baseline Accuracy		0.01		m	
Cold Start		28		sec	
Timings					
Power-On Time			500	ms	$T_c = +25^{\circ}\text{C}$
Output Data Rate	0	100	500	Hz	
Baud Rate (RS422)		921600		baud	
Bitrate (CAN-FD)		1		Mbps	
Electrical					
Communication Protocol		RS-422 or CAN-FD			
Operating Voltage	12		34	V	$-40^{\circ}\text{C} \leq T_c \leq +85^{\circ}\text{C}$
Power Consumption		2		W	$-40^{\circ}\text{C} \leq T_c \leq +85^{\circ}\text{C}$
EMC		See Section 8			
Mechanical					
Operating Temperature	-40		$+85$	$^{\circ}\text{C}$	
Ingress Rating		IP57 ²			See Section 8
Vibration & Shock		See Section 8			
Dimensions		See Section 13		mm	
Weight		230		g	

²IP67 certification is in progress as of this revision.

8. Certifications & Environmental Testing

The MK2E2 has been validated by an independent ISO/IEC 17025 accredited laboratory.

Table 2: Certifications and Environmental Testing Results

Category	Result
Ingress Protection	
Rating	IP57 - IEC 60529:2019 (IP67 in progress)
Electromagnetic Compatibility	
Emissions	EN 55032 Class A, FCC Part 15, ICES-003
Immunity	EN 55035 / CISPR 35
Vibration & Shock	
Sine sweep	20 – 2000 Hz up to 8 g peak, all three axes
Shock	Half-sine up to 40 g peak, 11 ms, all three axes

i About vibration and shock

Units were tested **unpowered** and verified functional afterwards. These figures describe what the unit **survives**, not its performance during exposure.

9. Configurable Parameters

The OSCP-MK2E2 IMU offers several real-time configurable parameters, which can also be saved in non-volatile memory to maintain them at each start-up. Refer to Section 12 for how to configure them.

Table 3: Configurable Parameters

Parameter	Configuration	Comment
Output Data Rate	0 Hz, 100 Hz, 500 Hz	Operating mode.
Gyroscope Dynamic Range	$\pm 125, \pm 250, \pm 500$ °/sec $\pm 1000, \pm 2000, \pm 4000$ °/sec	Selectable range.
Accelerometer Dynamic Range	± 2 g, ± 4 g, ± 8 g, ± 16 g	Selectable range.
Inclinometer Dynamic Range	± 0.5 g, ± 1.0 g, ± 2.0 g, ± 3.0 g	Selectable range.
Enabled Frame Type	RAW EULER QUATERNION ROTATION MATRIX GNSS	Each type of frame can be enabled or disabled. Controller Overruns can occur.

10. Electrical

⚠ Precautions

- Do not power-up the device with reverse polarity.
- Do not exceed the input power-up voltage beyond +34 VDC.

10.1. Connections

In order to operate correctly, the IMU must be connected as shown in Figure 3, showing the example for the RS422 protocol. Figure 4 shows the example for the CAN-FD variant.

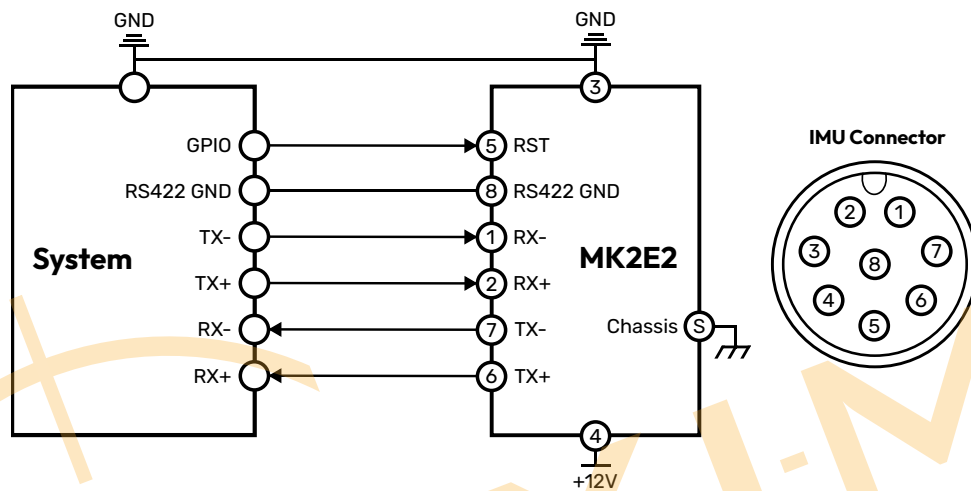


Figure 3: RS422 Electrical Connection Diagram, along with IMU connector pinout

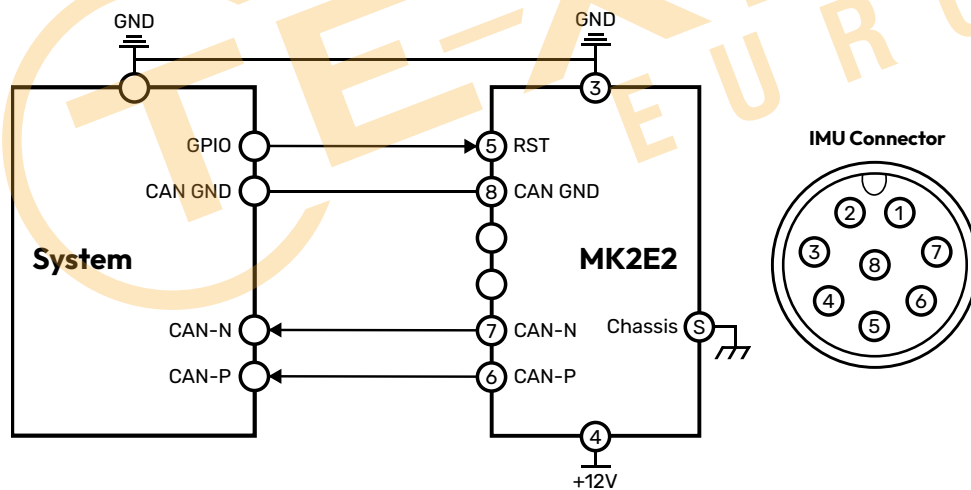


Figure 4: CAN-FD Electrical Connection Diagram, along with IMU connector pinout

i RST Pin

The **active-high** reset pin (number 5, wire color orange) can be **left floating** if unused.

The terminal provided to connect the IMU is open wired on the other side of the IMU connector. Table 4 shows wire identification.

Otherwise, the IMU connector is **54-00251**, its mating connector is **50-00983** and a mating shielded cable assembly is **10-03817**. All are from *Tensility International Corp.*

Table 4: Wire Color Identification of the supplied open wired terminal.

Pin	Wire Color	Function Assignment	Comment
1	Red	RS422: RX-	Connected to user TX- (RS422)
2	Yellow	RS422: RX+	Connected to user TX+ (RS422)
3	Black	Ground	Power Ground
4	White	Power	12V Typical
5	Orange	Active-High Reset	Can be left floating. 3.3V, 5V Tolerant
6	Blue	RS422: TX+ / CAN-FD: P	Connected to user RX+ (RS422)
7	Green	RS422: TX- / CAN-FD: N	Connected to user RX- (RS422)
8	Purple	RS422 / CAN-FD: GND	Isolated Ground
Shell	Shield	-	-

11. Basic Operation

The OSCP-MK2E2 IMU is easy to operate. The unit will start performing 11-DOF measurements and transmit Operating Frames on the output interface, with no additional configuration required after power-up.

The IMU can operate in 3 different Operating Modes: **Idle (I)**, **Low (L)**, **Medium (M) Speed**.

Each mode is described in Table 5.

Table 5: Details of the OSCP-MK2E2 Inertial Measurement Unit Specifications

Features	Idle	Low	Medium
Startup Frame Length	40 bytes		
Raw Operating Frame Length	61 bytes		
Euler (AHRS) Operating Frame Length	25 bytes		
Quaternion (AHRS) Operating Frame Length	29 bytes		
Rot. Matrix (AHRS) Operating Frame Length	49 bytes		
GNSS Operating Frame Length	64 bytes		
Debug (User Configuration) Operating Frame 1 & 2	58 bytes		
Raw Operating Frame Output Data Rate	0 Hz	100 Hz	500 Hz
AHRS Operating Frame Output Data Rate	0 Hz	100 Hz	
GNSS Operating Frame Output Data Rate	0 Hz	1 Hz	
Gyroscope Update Data Rate	10 Hz	100 Hz	500 Hz
Accelerometer Update Data Rate	10 Hz	100 Hz	500 Hz
Magnetometer Update Data Rate	10 Hz	100 Hz	100 Hz
Inclinometer Update Data Rate	10 Hz	100 Hz	500 Hz

Features	Idle	Low	Medium
Temperature Update Data Rate		4 Hz	
GNSS Update Data Rate		1 Hz	

11.1. Output Protocol Specifications

The unit is available in two hardware configurations, supporting either RS422 or CAN-FD as the output protocol, referred to as variants.

11.1.1. RS422 Variant

The RS422 interface operates at **921600 baud, 8 data bits, no parity, 1 stop bit** (8N1).

i COBS Decoding & Encoding for the RS422 Variant

All communication with the IMU in the RS422 variant uses *COBS* (**Consistent Over-head Byte Stuffing**) encoding. It is mandatory to use this encoding for any data exchanged with the unit. This is not the case for the CAN-FD variant.

Please refer to the Section 11.5.1 section for decoding and encoding details, including guidance for C-based and Python-based platforms.

11.1.2. CAN-FD Variant

The CAN-FD (Flexible Data-Rate) variant offers the following specifications:

- **Arbitration bitrate:** 1 Mbps
- **Data bitrate:** 1 Mbps
- **Sample-point:** 0.96
- **Data sample-point:** 0.52
- **Extended frame length:** up to 64 bytes per frame

The following CAN identifiers are used by the IMU to exchange data:

- **CAN Message IDs:** 0x6F0 to 0x6FF
 - ▶ 0x6F0: Raw Operating Frame
 - ▶ 0x6F1: Euler Angles Operating Frame
 - ▶ 0x6F2: Quaternion Operating Frame
 - ▶ 0x6F3: Rotation Matrix Operating Frame
 - ▶ 0x6F4: GNSS Operating Frame
 - ▶ 0x6F5: Debug Operating Frame 1
 - ▶ 0x6F6: Debug Operating Frame 2
 - ▶ 0x6F7: Startup Frame
 - ▶ 0x6FC: Command from the User
 - ▶ 0x6FD: ASCII Response from the IMU

i Setup for Linux-based systems

For Linux-based systems, the *can0* interface can be configured with the following:

```
sudo ip link set can0 up type can bitrate 1000000 sample-point 0.96 dbitrates
1000000 dsample-point 0.52 fd on
```

i Details for CAN-FD in Python

In Python, the [python-can](#) package provides support for CAN-FD. As an example, using OSCP InertialGate, the interface *slcan* can be used.

11.2. State Diagram

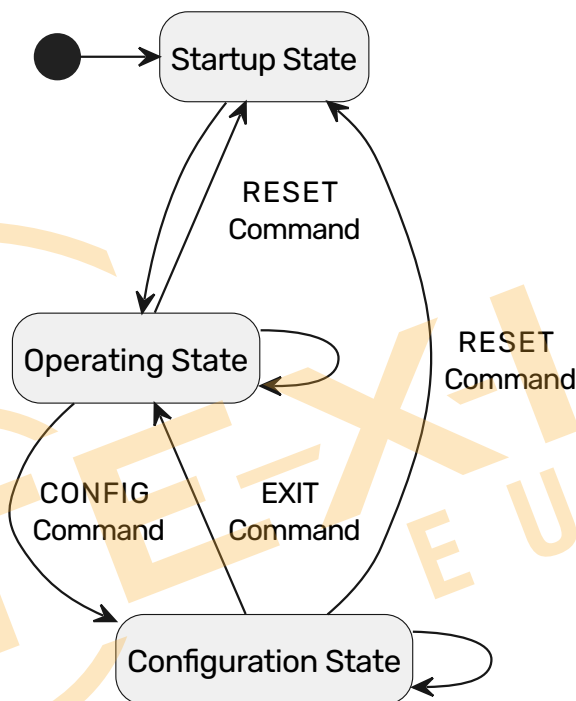


Figure 5: State Diagram of MK2E2 Real-Time Controller.

11.3. Startup Frame

After startup, the first frame sent by the IMU is a **40-byte** startup frame. It contains its current configuration, and can also be requested with a startup frame command when the IMU is in configuration state (Section 12.4). The description is given in the Table 6.

Table 6: Full Description of a Startup Frame (S - 0b111)

Byte #	Description	Format
0	Misalignment Correction [7:6] Operating Mode [5:3] Frame Type [2:0] = 0b111	See Section 11.5.5 See Section 11.5.3 See Section 11.4.1

Byte #	Description	Format
1 – 10	Mark Number - fixed at OSCP-MK2E2	ASCII
11 – 12	Unit Number	16-bit unsigned integer
13	Software Major Version	8-bit unsigned integer
14	Software Minor Version	8-bit unsigned integer
15	Software Patch Version	8-bit unsigned integer
16	Enabled Frame Types	See Section 11.5.4
17	Accelerometer Dynamic Range [7:4] MEMS Gyroscope Dynamic Range [3:0]	See Section 11.5.10 See Section 11.5.8
18	Gyroscope High-Pass Filter [7:5] Gyroscope Low-Pass Filter [4:2] Gyroscope Filters [1:0]	See Section 11.5.9
19	Accelerometer High-Pass Filter [7:5] Accelerometer Low-Pass Filter [4:2] Accelerometer Filters [1:0]	See Section 11.5.11
20	AHRS Heading Source [7:6] AHRS Convention [5:4] Inclinometer Dynamic Range [3:0]	See Section 11.5.13 See Section 11.5.12
21 – 24	AHRS Gain	See Section 11.5.13
25 – 28	AHRS Acceleration Rejection	See Section 11.5.13
29 – 32	AHRS Magnetic Rejection	See Section 11.5.13
33 – 36	AHRS Recovery Trigger Period	See Section 11.5.13
37	Status byte	See Section 11.5.21
38 – 39	Cyclic Redundancy Check (CRC – 16)	See Section 11.5.2

11.4. Operating Frames

Once start-up has been completed, the IMU enters its main operating state and sends, at a given output data rate, the sensor readings in a frame that can contains **61-byte** (R), **25-byte** (E), **29-byte** (Q) or **49-byte** (M) depending the type of frame selected. Optionally, a GNSS frame of **64-byte** (G) can be requested as well.

Two **58-byte** Debug frames (D) are available to read back the current unit configuration.

11.4.1. Frame Type

Table 7: Description of available Frame Types

Frame Type	Description	Binary
<i>R</i>	Raw Operating Frame	0b000
<i>E</i>	Euler Angles Operating Frame	0b001
<i>Q</i>	Quaternions Operating Frame	0b010

Frame Type	Description	Binary
<i>M</i>	Rotation Matrix Operating Frame	0b011
<i>G</i>	GNSS Operating Frame	0b100
<i>D</i>	Debug Operating Frame 1	0b101
<i>D</i>	Debug Operating Frame 2	0b110
<i>S</i>	Startup Frame	0b111

11.4.2. Raw Operating Frame (R)

Table 8: Full Description of a Raw Operating Frame (R - 0b000)

Byte #	Description	Format
0	Misalignment Correction [7:6] Operating Mode [5:3] Frame Type [2:0] = 0b000	See Section 11.5.5 See Section 11.5.3 See Section 11.4.1
1	Frame Counter	See Section 11.5.6
2 – 9	Timestamp (ms)	64-bit unsigned integer
10 – 13	Gyroscope - x-axis (°/sec)	float32
14 – 17	Gyroscope - y-axis (°/sec)	float32
18 – 21	Gyroscope - z-axis (°/sec)	float32
22 – 25	Accelerometer - x-axis (<i>g</i>)	float32
26 – 29	Accelerometer - y-axis (<i>g</i>)	float32
30 – 33	Accelerometer - z-axis (<i>g</i>)	float32
34 – 37	Inclinometer - x-axis (mg)	float32
38 – 41	Inclinometer - y-axis (mg)	float32
42 – 45	Magnetometer - x-axis (μT)	float32
46 – 49	Magnetometer - y-axis (μT)	float32
50 – 53	Magnetometer - z-axis (μT)	float32
54 – 57	IMU Temperature (°C)	See Section 11.5.14
58	Status byte	See Section 11.5.21
59 – 60	Cyclic Redundancy Check (CRC – 16)	See Section 11.5.2

i Details

The gyroscope's *z-axis* output is sourced from the optical gyroscope when the measured rotation rate is below 250 °/sec. Above this threshold, the output automatically switches to the MEMS gyroscope to maintain accuracy up to the selected range.

11.4.3. Euler Angles Operating Frame (E)

Table 9: Full Description of a Euler Angles Operating Frame (E - 0b001)

Byte #	Description	Format
0	Misalignment Correction [7:6] Operating Mode [5:3] Frame Type [2:0] = 0b001	See Section 11.5.5 See Section 11.5.3 See Section 11.4.1
1	Frame Counter	See Section 11.5.6
2 – 9	Timestamp (ms)	64-bit unsigned integer
10 – 13	Euler - Roll	See Section 11.5.15
14 – 17	Euler - Pitch	See Section 11.5.15
18 – 21	Euler - Yaw	See Section 11.5.15
22	Status byte	See Section 11.5.21
23 – 24	Cyclic Redundancy Check (CRC – 16)	See Section 11.5.2

11.4.4. Quaternions Operating Frame (Q)

Table 10: Full Description of a Quaternions Operating Frame (Q - 0b010)

Byte #	Description	Format
0	Misalignment Correction [7:6] Operating Mode [5:3] Frame Type [2:0] = 0b010	See Section 11.5.5 See Section 11.5.3 See Section 11.4.1
1	Frame Counter	See Section 11.5.6
2 – 9	Timestamp (ms)	64-bit unsigned integer
10 – 13	Quaternion 0 – w	See Section 11.5.16
14 – 17	Quaternion 1 – x	See Section 11.5.16
18 – 21	Quaternion 2 – y	See Section 11.5.16
22 – 25	Quaternion 3 – z	See Section 11.5.16
26	Status byte	See Section 11.5.21
27 – 28	Cyclic Redundancy Check (CRC – 16)	See Section 11.5.2

11.4.5. Rotation Matrix Operating Frame (M)

Table 11: Full Description of a Rotation Matrix Operating Frame (M - 0b011)

Byte #	Description	Format
0	Misalignment Correction [7:6] Operating Mode [5:3] Frame Type [2:0] = 0b011	See Section 11.5.5 See Section 11.5.3 See Section 11.4.1
1	Frame Counter	See Section 11.5.6

Byte #	Description	Format
2 – 9	Timestamp (ms)	64-bit unsigned integer
10 – 13	Rotation Matrix M00	See Section 11.5.17
14 – 17	Rotation Matrix M01	See Section 11.5.17
18 – 21	Rotation Matrix M02	See Section 11.5.17
22 – 25	Rotation Matrix M10	See Section 11.5.17
26 – 29	Rotation Matrix M11	See Section 11.5.17
30 – 33	Rotation Matrix M12	See Section 11.5.17
34 – 37	Rotation Matrix M20	See Section 11.5.17
38 – 41	Rotation Matrix M21	See Section 11.5.17
42 – 45	Rotation Matrix M22	See Section 11.5.17
46	Status byte	See Section 11.5.21
47 – 48	Cyclic Redundancy Check (CRC – 16)	See Section 11.5.2

11.4.6. GNSS Operating Frame (G)

Table 12: Full Description of a GNSS Operating Frame (G - 0b100)

Byte #	Description	Format
0	Misalignment Correction [7:6] Operating Mode [5:3] Frame Type [2:0] = 0b011	See Section 11.5.5 See Section 11.5.3 See Section 11.4.1
1	Frame Counter	See Section 11.5.6
2 – 9	Timestamp (ms)	64-bit unsigned integer
10	GNSS Fix Type	See Section 11.5.18
11	Number of satellites used	8-bit unsigned integer
12 – 15	Longitude (°)	float32
16 – 19	Latitude (°)	float32
20 – 23	Height above ellipsoid (mm)	32-bit signed integer
24 – 27	Horizontal accuracy estimate (mm)	32-bit unsigned integer
28 – 31	Vertical accuracy estimate (mm)	32-bit unsigned integer
32 – 35	Velocity North (mm/sec) [NED Frame]	32-bit signed integer
36 – 39	Velocity East (mm/sec) [NED Frame]	32-bit signed integer
40 – 43	Velocity Down (mm/sec) [NED Frame]	32-bit signed integer
44 – 47	Speed Accuracy Estimate (mm/sec)	32-bit unsigned integer
48 – 51	Heading of Motion (°) [2D]	float32
52 – 55	Heading Accuracy Estimate (°)	float32

Byte #	Description	Format
56 – 59	Position DOP	float32
60	Last Correction Age [7:4] RESERVED [3:2] Invalid LLH [1] GNSS Fix OK [0]	See Section 11.5.19 -
61	Status byte	See Section 11.5.21
62 – 63	Cyclic Redundancy Check (CRC – 16)	See Section 11.5.2

11.4.7. Debug Operating Frame (D)

The Debug Operating Frame consists of two consecutive frames.

Table 13: Full Description of a Debug Operating Frame 1 (D - 0b101)

Byte #	Description	Format
0	Misalignment Correction [7:6] Operating Mode [5:3] Frame Type [2:0] = 0b101	See Section 11.5.5 See Section 11.5.3 See Section 11.4.1
1	Frame Counter	See Section 11.5.6
2 – 5	MEMS Gyroscope X Bias – GXB	See Section 11.5.20
6 – 9	MEMS Gyroscope Y Bias – GYB	See Section 11.5.20
10 – 13	MEMS Gyroscope Z Bias – GZB	See Section 11.5.20
14 – 17	Optical Gyroscope Z Bias – GOB	See Section 11.5.20
18 – 21	Accelerometer X Bias – AXB	See Section 11.5.20
22 – 25	Accelerometer Y Bias – AYB	See Section 11.5.20
26 – 29	Accelerometer Z Bias – AZB	See Section 11.5.20
30 – 33	Inclinometer X Bias – IXB	See Section 11.5.20
34 – 37	Inclinometer Y Bias – IYB	See Section 11.5.20
38 – 41	Magnetometer X Hard Iron – MXB	See Section 11.5.20
42 – 45	Magnetometer Y Hard Iron – MYB	See Section 11.5.20
46 – 49	Magnetometer Z Hard Iron – MZB	See Section 11.5.20
50	Gyroscope High-Pass Filter [7:5] Gyroscope Low-Pass Filter [4:2] Gyroscope Filters [1:0]	See Section 11.5.9
51	Accelerometer High-Pass Filter [7:5] Accelerometer Low-Pass Filter [4:2] Accelerometer Filters [1:0]	See Section 11.5.11
52 – 54	RESERVED	-
55	Status byte	See Section 11.5.21

Byte #	Description	Format
56 – 57	Cyclic Redundancy Check (CRC – 16)	See Section 11.5.2

Table 14: Full Description of a Debug Operating Frame 2 (D - 0b110)

Byte #	Description	Format
0	Misalignment Correction [7:6] Operating Mode [5:3] Frame Type [2:0] = 0b110	See Section 11.5.5 See Section 11.5.3 See Section 11.4.1
1	Frame Counter	See Section 11.5.6
2 – 5	Magnetometer XX Soft Iron – MXX	See Section 11.5.20
6 – 9	Magnetometer YX Soft Iron – MYX	See Section 11.5.20
10 – 13	Magnetometer ZX Soft Iron – MZX	See Section 11.5.20
14 – 17	Magnetometer XY Soft Iron – MXY	See Section 11.5.20
18 – 21	Magnetometer YY Soft Iron – MY Y	See Section 11.5.20
22 – 25	Magnetometer ZY Soft Iron – MZY	See Section 11.5.20
26 – 29	Magnetometer XZ Soft Iron – MXZ	See Section 11.5.20
30 – 33	Magnetometer YZ Soft Iron – MYZ	See Section 11.5.20
34 – 37	Magnetometer ZZ Soft Iron – MZZ	See Section 11.5.20
38 – 41	AHRS Gain	See Section 11.5.13
42 – 45	AHRS Acceleration Rejection	See Section 11.5.13
46 – 49	AHRS Magnetic Rejection	See Section 11.5.13
50 – 53	AHRS Recovery Trigger Period	See Section 11.5.13
54	AHRS Heading Source [7:4] AHRS Convention [3:0]	See Section 11.5.13 See Section 11.5.13
55	Status byte	See Section 11.5.21
56 – 57	Cyclic Redundancy Check (CRC – 16)	See Section 11.5.2

11.5. Using IMU Data

This section presents a more advanced description of some of the fields present in both Startup Frame (Table 6) and Operating Frames (Section 11.4) to exploit IMU output.

11.5.1. RS422 Frame Decoding & Encoding - COBS (Consistent Overhead Byte Stuffing)

All frames transmitted by the IMU in the RS422 variant are encoded using *COBS* (Consistent Overhead Byte Stuffing) to ensure reliable frame boundary detection. Each encoded frame is terminated with a 0x00 byte, which serves as the frame delimiter. Users must decode each frame using the *COBS* algorithm before interpreting the data. Any 0x00 byte received marks the end of a complete *COBS*-encoded frame and should not be included in the decoding process. This is not required for the CAN-FD variant.

! COBS Encoding

All commands or data sent to the IMU in the RS422 variant must also be *COBS*-encoded and terminated with a 0x00 byte. This ensures proper frame detection and parsing on the IMU side. Make sure to apply the same *COBS* encoding method when sending any configuration or control commands to the device in the RS422 variant.

i Details for COBS Decoding and Encoding in C

On C-based platforms, the `cobs-c` library can be used to decode and encode data frames. After detecting a 0x00 byte (frame delimiter), the preceding bytes can be decoded using `cobs_decode()` function provided by the library to retrieve the original data. Similarly, any data to be sent to the IMU should be passed through `cobs_encode()` and followed by a 0x00 delimiter.

i Details for COBS Decoding and Encoding in Python

In Python, the `cobs` package provides `cobs.decode()` and `cobs.encode()` functions. Incoming data can be split on 0x00 and decoded, while outgoing commands should be *COBS*-encoded using `cobs.encode()`, with a 0x00 byte appended to the result before transmission.

11.5.2. Integrity Verification

Each type of frame contains a 16-bit Cyclic-Redundancy Check to verify the integrity of the data received and perform error-detection. The short 16-bit binary sequence, known as the CRC, is computed using the polynomial **0xD175** and sent with each block of data. Its “explicit + 1” form for computation is **0x1A2EB**. It has a hamming distance of **4**.

It's important to note that the CRC is calculated on the entire frame, without the CRC itself. Once calculated, the latter can be compared with the transmitted one to validate data integrity or reject the frame.

11.5.3. Operating Mode

As the Operating Mode is encoded as a 3-bit unsigned integer, Table 15 shows the mapping between binary representation, ASCII and true value.

Table 15: Mapping of IMU Operating Modes

True Value	ASCII	Binary
<i>Idle</i>	<i>I</i> (0x49)	0b000
<i>Low Speed</i>	<i>L</i> (0x4C)	0b001
<i>Medium Speed</i>	<i>M</i> (0x4D)	0b010
<i>Reserved</i>	RESERVED	0b011 to 0b111

11.5.4. Enabled Frame Types

As the enabled frame types are encoded as an 8-bit unsigned integer, Table 16 shows the mapping between each bit (and its corresponding index) and the frame type. A value of 1 at position N indicates that frame with index N is enabled, while a value of 0 means disabled.

Table 16: Mapping of Enabled Frame Types

Enable Frame Type	Description	Binary (Index)
R	Enabling Raw Operating Frame	0b00000001 (0)
E	Enabling Euler Angles Operating Frame	0b00000010 (1)
Q	Enabling Quaternions Operating Frame	0b00000100 (2)
M	Enabling Rotation Matrix Operating Frame	0b00001000 (3)
G	Enabling GNSS Operating Frame	0b00010000 (4)
Reserved	RESERVED	0b11100000 (5-7)

Table 17 gives some examples of the data format used.

Table 17: Enabled Frame Type Data Format Examples

Enabled Frames	Decimal	Binary	Indexes
$R + E$	3	0b00000011	1 0
$Q + G$	20	0b00010100	4 2

11.5.5. Misalignment Correction

This field shows whether the misalignment correction algorithm for the gyroscopes and accelerometers is active. A value of 0 means the correction is disabled, while a value of 1 means it is enabled. This helps confirm if the sensor data is being adjusted for any known misalignment.

11.5.6. Frame Counter

Frame Counter is continuously counts transmitted frames. This counter is an unsigned 8-bit binary counter, with values in the $[0, 255]$. It automatically wrap-around.

11.5.7. Timestamp

The timestamp is transmitted directly within an Operating Frame of type R , E , Q , M , G with an unsigned 64-bit binary that can be read directly as the value in ms. It describes the time at which the frame is formed, relative to the last IMU power-up.

11.5.8. MEMS Gyroscope Dynamic Range

As the MEMS Gyroscope Dynamic Range is encoded as a 4-bit unsigned integer, Table 18 shows the mapping between binary representation, ASCII and true value.

Table 18: Mapping of MEMS Gyroscope Dynamic Ranges

True Value	ASCII	Binary
± 250 °/sec	0250 (0x30323530)	0b0000
± 4000 °/sec	4000 (0x34303030)	0b0001
± 125 °/sec	0125 (0x30313235)	0b0010
± 500 °/sec	0500 (0x30353030)	0b0100
± 1000 °/sec	1000 (0x31303030)	0b1000
± 2000 °/sec	2000 (0x32303030)	0b1100

11.5.9. MEMS Gyroscope Filters

Table 19 shows the Gyroscope Filters configuration mapping. Table 20 shows the Gyroscope Low-Pass mapping. **Register IDs** are **GFI** and **GLP** (Section 12.12).

Table 19: Mapping of MEMS Gyroscope Filters field

Configuration	Decimal	Binary
Filters disabled	0	0b00
Low-pass filter enable	1	0b01
High-pass filter enable	2	0b10
Low-pass and high-pass filters are enabled	3	0b11

Table 20: Mapping of MEMS Gyroscope Low-Pass Filter field

Cutoff for Low - Medium ODR	Decimal	Binary
33 Hz - 222 Hz	0	0b000
33 Hz - 186 Hz	1	0b001
33 Hz - 140 Hz	2	0b010
33 Hz - 260 Hz	3	0b011
34 Hz - 96 Hz	4	0b100
31 Hz - 49 Hz	5	0b101
19 Hz - 25 Hz	6	0b110
11.6 Hz - 12.6 Hz	7	0b111

Table 21 shows the Gyroscope High-Pass mapping. **Register ID** is **GHP** (Section 12.12).

Table 21: Mapping of MEMS Gyroscope High-Pass Filter field

Cutoff	Decimal	Binary
16 mHz	0	0b000
65 mHz	1	0b001
260 mHz	2	0b010
1.04 Hz	3	0b011

11.5.10. Accelerometer Dynamic Range

As the Accelerometer Dynamic Range is encoded as a 4-bit unsigned integer, Table 22 shows the mapping between binary representation, ASCII and true value.

Table 22: Mapping of Accelerometer Dynamic Ranges

True Value	ASCII	Binary
± 2 g	02 (0x3032)	0b0000
± 16 g	16 (0x3136)	0b0001
± 4 g	04 (0x3034)	0b0010
± 8 g	08 (0x3038)	0b0011

11.5.11. Accelerometer Filters

Table 23 shows the Accelerometer Filters configuration mapping. **Register ID** is **AFI** (Section 12.12).

Table 23: Mapping of MEMS Accelerometer Filters field

Configuration	Decimal	Binary
Filters disabled	0	0b00
Low-pass filter enable	1	0b01
High-pass filter enable	2	0b10

Table 24 shows the Accelerometer Low-Pass and High-Pass mapping. **Register IDs** are **ALP** and **AHP** (Section 12.12).

Table 24: Mapping of Accelerometer Low-Pass and High-Pass Filters fields

Cutoff for Low - Medium ODR	Decimal	Binary
26 Hz - 208.25 Hz	0	0b000
10.4 Hz - 83.3 Hz	1	0b001
5.2 Hz - 41.65 Hz	2	0b010
2.3 Hz - 18.5 Hz	3	0b011
1.04 Hz - 8.33 Hz	4	0b100
0.52 Hz - 4.17 Hz	5	0b101
0.26 Hz - 2.08 Hz	6	0b110
0.13 Hz - 1.04 Hz	7	0b111

11.5.12. Inclinometer Dynamic Range

As the Inclinometer Dynamic Range is encoded as a 2-bit unsigned integer, Table 25 shows the mapping between binary representation, ASCII and true value.

Table 25: Mapping of Inclinometer Dynamic Ranges

True Value	ASCII	Binary
± 0.5 g	0.5 (0x302E35)	0b00
± 3.0 g	3.0 (0x332E30)	0b01
± 1.0 g	1.0 (0x312E30)	0b10
± 2.0 g	2.0 (0x322E30)	0b11

11.5.13. AHRS Configuration

The AHRS configuration consists of six parameters that control the algorithm behind the AHRS frames (Euler, Rotation Matrix, Quaternions). Table 26 presents these parameters.

Table 26: AHRS Configuration Parameters

Register ID	Name	Type	Description
FCO	<i>Earth Axis Convention</i>	2-bit unsigned integer	0 : NWU, 1: ENU, 2: NED
FHS	<i>Heading Source</i>	2-bit unsigned integer	0 : None, 1: Internal magnetometer, 2: <i>RESERVED</i>
FGA	<i>Gain</i>	float32	Determines the influence of the gyroscope relative to other sensor. 0.5 by default.
FAR	<i>Acceleration Rejection</i>	float32	Threshold (in degrees) used by the acceleration rejection feature. 10.0 deg by default.
FMR	<i>Magnetic Rejection</i>	float32	Threshold (in degrees) used by the magnetic rejection feature. 10.0 deg by default.
FRT	<i>Recovery Trigger Period</i>	32-bit unsigned integer	Acceleration and magnetic recovery trigger period (seconds). 5 sec by default.

11.5.14. IMU Temperature Data

This temperature value is best for observing relative changes in the thermal environment, since it represent a coarse temperature inside the IMU. The reading is simply encoded as a *float32* (also known as *FP32*) and can be read directly as the temperature in °C.

The internal temperature is roughly 13°C higher than external temperature.

11.5.15. Euler Angles

Euler angles represent orientation as a sequence of three rotations about the principal axes. In the ZYX convention, the rotation is applied in the following order: yaw (z-axis), pitch (y-axis), and roll (x-axis). This format is intuitive and commonly used to express orientation

in AHRS systems. However, Euler angles are susceptible to singularities such as gimbal lock, where two axes align and one degree of freedom is lost, potentially affecting stability in certain configurations.

11.5.16. Quaternions

Quaternions offer a compact and singularity-free representation of 3D orientation using four components. Widely used in AHRS implementations, quaternions enable smooth and stable orientation tracking even during fast or complex motion. They are well-suited for sensor fusion and real-time computation but require conversion to Euler angles or rotation matrices for human interpretation. The order of the quaternions is (w, x, y, z) .

11.5.17. Rotation Matrix

Rotation matrix is an alternative way to represent the orientation using a 3×3 orthonormal matrix that defines the transformation relative to a fixed coordinate system. While precise, they are more computationally intensive to maintain compared to quaternions.

11.5.18. GNSS Fix Type

Each GNSS frame contains a GNSS fix type byte to indicate the health of the current navigation solution. This makes it easy to give a confidence level to the current data. Table 27 gives the mapping of the field.

Table 27: Interpreting GNSS Fix Type Byte

True Value	Decimal	Binary
No GNSS Fix	0	0b000
Dead Reckoning Fix only	1	0b001
2D GNSS Fix	2	0b010
3D GNSS Fix	3	0b011
GNSS + Dead Reckoning Combined	4	0b100
Time Only Fix	5	0b101

11.5.19. GNSS Last Correction Age

Each GNSS frame contains a last correction age field to indicate the age of the most recently received correction. Table 28 gives the mapping of the field.

Table 28: GNSS Last Correction Age Byte

Description	Decimal	Binary
Not available	0	0b0000
Age between 0 and 1 second	1	0b0001
Age between 1 (inclusive) and 2 seconds	2	0b0010
Age between 2 (inclusive) and 5 seconds	3	0b0011
Age between 5 (inclusive) and 10 seconds	4	0b0100
Age between 10 (inclusive) and 15 seconds	5	0b0101
Age between 15 (inclusive) and 20 seconds	6	0b0110
Age between 20 (inclusive) and 30 seconds	7	0b0111
Age between 30 (inclusive) and 45 seconds	8	0b1000
Age between 45 (inclusive) and 60 seconds	9	0b1001
Age between 60 (inclusive) and 90 seconds	10	0b1010
Age between 90 (inclusive) and 120 seconds	11	0b1011
Age greater or equal than 120 seconds	≥ 12	$\geq 0b1100$

11.5.20. User Calibration

There are 21 registers that allow users to adjust the calibration to match their specific setup. Each value is interpreted as a float32 and transferred to and from the IMU using an 8-character hexadecimal representation of a 32-bit floating-point number.

The exact registers available are the following:

Register ID	Register Full Name	Register ID	Register Full Name
GXB	<i>MEMS Gyroscope X Bias</i>	MXB	<i>Magnetometer X Hard Iron</i>
GYB	<i>MEMS Gyroscope Y Bias</i>	MYB	<i>Magnetometer Y Hard Iron</i>
GZB	<i>MEMS Gyroscope Z Bias</i>	MZB	<i>Magnetometer Z Hard Iron</i>
GOB	<i>Optical Gyroscope Z Bias</i>	MXX	<i>Magnetometer XX Soft Iron</i>
AXB	<i>Accelerometer X Bias</i>	MYX	<i>Magnetometer YX Soft Iron</i>
AYB	<i>Accelerometer Y Bias</i>	MZX	<i>Magnetometer ZX Soft Iron</i>
AZB	<i>Accelerometer Z Bias</i>	MXY	<i>Magnetometer XY Soft Iron</i>
IXB	<i>Inclinometer X Bias</i>	MYY	<i>Magnetometer YY Soft Iron</i>
IYB	<i>Inclinometer Y Bias</i>	MZY	<i>Magnetometer ZY Soft Iron</i>
—	<i>RESERVED</i>	MXZ	<i>Magnetometer XZ Soft Iron</i>
—	<i>RESERVED</i>	MYZ	<i>Magnetometer YZ Soft Iron</i>
—	<i>RESERVED</i>	MZZ	<i>Magnetometer ZZ Soft Iron</i>

Regarding the calibration biases, the correction follows the mathematical model below:

$$\text{sensor}_{\text{out}} = \text{sensor}_{\text{cal}} - \text{bias}_{\text{user}}$$

For magnetometer compensation, the following matrix-vector operations are applied:

$$\begin{pmatrix} \text{mag}_{\text{out}_x} \\ \text{mag}_{\text{out}_y} \\ \text{mag}_{\text{out}_z} \end{pmatrix} = \begin{pmatrix} M_{xx} & M_{yx} & M_{zx} \\ M_{xy} & M_{yy} & M_{zy} \\ M_{xz} & M_{yz} & M_{zz} \end{pmatrix} \left(\begin{pmatrix} \text{mag}_{\text{cal}_x} \\ \text{mag}_{\text{cal}_y} \\ \text{mag}_{\text{cal}_z} \end{pmatrix} - \begin{pmatrix} M_{xb} \\ M_{yb} \\ M_{zb} \end{pmatrix} \right)$$

11.5.21. Status byte

Each frame contains a status byte to indicate the health of the IMU and of the current readings. This byte is sticky, meaning that every time a new frame is formed, it is reset to 0x00. This makes it easy to distinguish between persistent and temporary errors. Table 29 gives the meaning of each of the 8 bits. Note that a status byte of 0x00 indicates that everything is working fine.

Table 29: Interpreting Status Byte

Bit #	Description	Meaning
0	OSCP IMU Overrun Error Bit	0: OK, 1: KO
1	MEMS Sensors Error Bit	0: OK, 1: KO
2	MEMS Inclinometer Error Bit	0: OK, 1: KO
3	TMR Magnetometer Error Bit	0: OK, 1: KO
4	Temperature Sensor Error Bit	0: OK, 1: KO
5	GNSS Error Bit	0: OK, 1: KO
6	Optical Gyroscope Error Bit	0: OK, 1: KO
7	<i>Reserved for future use</i>	0: OK, 1: KO

12. Commands

The user can use either the RS-422 or the CAN-FD interface, depending on the variant, to transmit commands to the IMU in ASCII format. Below is an exhaustive and descriptive list of the available commands.

Remember that, for the RS422 variant, commands must be COBS-encoded and terminated with a 0x00 byte before transmission. Refer to Section 11.5.1 if needed.

12.1. Enter Configuration State

Table 30: Syntax of the “Enter Configuration State” command

Command	IMU State	IMU Response
CONFIG<CR><LF>	Operating State	IMU switches to Configuration State.

12.2. Exit to Operating State

Table 31: Syntax of the “Exit to Operating State” command

Command	IMU State	IMU Response
<i>EXIT</i> <CR><LF>	Configuration State	IMU switches to Operating State.

12.3. Soft-Reset

Table 32: Syntax of the “Soft-Reset” command

Command	IMU State	IMU Response
<i>RESET</i> <CR><LF>	All	IMU resets (switches to Startup State, from software).

12.4. Get a Startup Frame

Table 33: Syntax of the “Get a Startup Frame” command.

Command	IMU State	IMU Response
<i>SUF</i> <CR><LF>	Configuration State	IMU sends a SUF with its current configuration.

12.5. Get an Operating Frame

Table 34: Syntax of the “Get an Operating Frame” command

Command	IMU State	IMU Response
<i>OF</i> <Frame Type*><CR><LF>	Configuration State	IMU performs and transmits an OF.

Details

Frame Type parameter must be encoded with: **R**, **E**, **Q**, **M**, **G**, or **D** only. For example, to receive a GNSS Operating Frame from the IMU, if available, send *OFG*<CR><LF>.

12.6. Change Operating Mode

Table 35: Syntax of the “Change Operating Mode” command

Command	IMU State	IMU Response
<i>OM</i> <Operating Mode*><CR><LF>	Configuration State	IMU changes its OM.

Details

Operating Mode parameter must be encoded with: **I**, **L**, or **M** only. For example, to configure the IMU to Medium Speed, send *OMM*<CR><LF>.

12.7. Change Operating Frame Types

Table 36: Syntax of the “Enable & Disable Operating Frame Type” commands

Command	IMU State	IMU Response
<i>EOFT</i> <Frame Type*><CR><LF>	Configuration State	IMU enables selected OF type.
<i>DOFT</i> <Frame Type*><CR><LF>	Configuration State	IMU disables selected OF type.

i Details

Frame Type parameter must be encoded using one of the following characters: **R**, **E**, **Q**, **M**, or **G**. For example, to enable the Euler Angles frame, send *EOFTE*<CR><LF>. If the Rotation Matrix frame is no longer needed, send *DOFTM*<CR><LF>.

12.8. Change Dynamic Range of MEMS Gyroscopes

Table 37: Syntax of the “Change Dynamic Range of MEMS Gyroscopes” command

Command	IMU State	IMU Response
<i>DRG</i> <Range*><CR><LF>	Configuration State	Updates gyroscopes DR.

i Details

Range parameter must be encoded with: **0125**, **0250**, **0500**, **1000**, **2000** or **4000** only. For example, to configure MEMS gyroscopes with a DR of 250°/sec, send *DRG0250*<CR><LF>.

12.9. Change Dynamic Range of Accelerometers

Table 38: Syntax of the “Change Dynamic Range of Accelerometers” command

Command	IMU State	IMU Response
<i>DRA</i> <Range*><CR><LF>	Configuration State	Updates accelerometers DR.

i Details

Range parameter must be encoded with: **02**, **04**, **08** or **16** only. For example, to configure accelerometers with a DR of 4g, send *DRA04*<CR><LF>.

12.10. Change Dynamic Range of Inclinometers

Table 39: Syntax of the “Change Dynamic Range of Inclinometers” command

Command	IMU State	IMU Response
<i>DRI</i> <Range*><CR><LF>	Configuration State	Updates inclinometer DR.

i Details

Range parameter must be encoded with: **0.5**, **1.0**, **2.0** or **3.0** only. For example, to configure inclinometer with a DR of 1g, send *DR1.0<CR><LF>*.

12.11. Change Misalignment Correction Status

Table 40: Syntax of the “Enable & Disable Misalignment Correction” commands

Command	IMU State	IMU Response
<i>EMCORR<CR><LF></i>	Configuration State	IMU enables the misalignment correction.
<i>DMCORR<CR><LF></i>	Configuration State	IMU disables the misalignment correction.

12.12. Write User Calibration Register, Update AHRS & Filters Configurations

Table 41: Syntax of the “Write User Calibration Register, Update AHRS & Filters” command

Command	IMU State	IMU Response
<i>WR<Reg*><Value*><CR><LF></i>	Configuration State	Updates specified register.

i Details

Reg parameter must be encoded using one of the following three-character codes: **GXB, GYB, GZB, GOB, AXB, AYB, AZB, IXB, IYB, MXB, MYB, MZB, MXX, MYX, MZX, MXY, MYY, MZY, MXZ, MYZ, MZZ, FCO, FHS, FRT, FGA, FAR, FMR, GFI, GLP, GHP, AFI, ALP, or AHP**.

i Details

Value parameter must be encoded as exactly 8 hexadecimal characters following the type of the register such as 32-bit floating-point value (float32) for calibration register and *FGA, FAR, FMR*, or unsigned 32-bit for the rest. For example, to configure the user gyroscope x-axis bias with an offset of 1.0, send *WRGXB3F800000<CR><LF>*. Another example, to configure the fusion heading source with the internal magnetometer which is 1, send *WRFHS00000001<CR><LF>*.

12.13. Save Current Configuration to Flash Memory

Table 42: Syntax of the “Save Current Configuration to Flash Memory” command

Command	IMU State	IMU Response
<i>SAVE<CR><LF></i>	Configuration State	IMU saves its current configuration.

12.14. Restore to Factory Settings

Table 43: Syntax of the “Restore to Factory Settings” command

Command	IMU State	IMU Response
<i>REFS</i> <CR><LF>	Configuration State	IMU is reset to factory settings.

12.15. Response to a Recognized Command

When a recognized command is executed while the IMU is in Configuration State, the following commands indicate succesful or failed execution by sendig a human-readable ASCII message terminated by <CR><LF>: *CONFIG*, *OM*, *EOFT*, *DEOFT*, *EMCORR*, *DMCORR*, *WR*, *DRG*, *DRA*, *DRI*, *SAVE*, and *REFS* (only if failed for the latter).

12.16. Undefined Command

When a command is not recognized or incorrectly formatted in Configuration State, the IMU responds with a human-readable ASCII error message terminated by <CR><LF>. A message not recognized in Operating State will simply be ignored without any response.



13. Mechanical Drawings

Here's a mechanical drawing of the enclosure with the mounting through-holes, and side-views showing the connector location. All units are in mm.

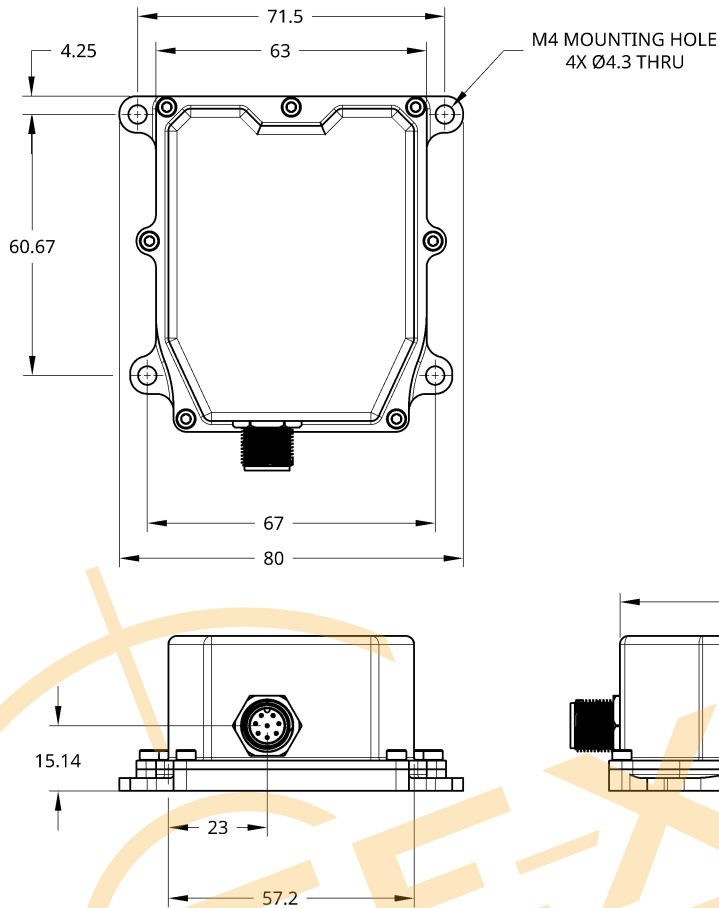


Figure 6: Mechanical Drawings of the enclosure, with a top, a front and a side view

14. Marking

The top of the package is marked with a decal indicating the orientation axes of the unit.



Figure 7: Axis orientation decal indicating the positive X, Y, and Z directions.

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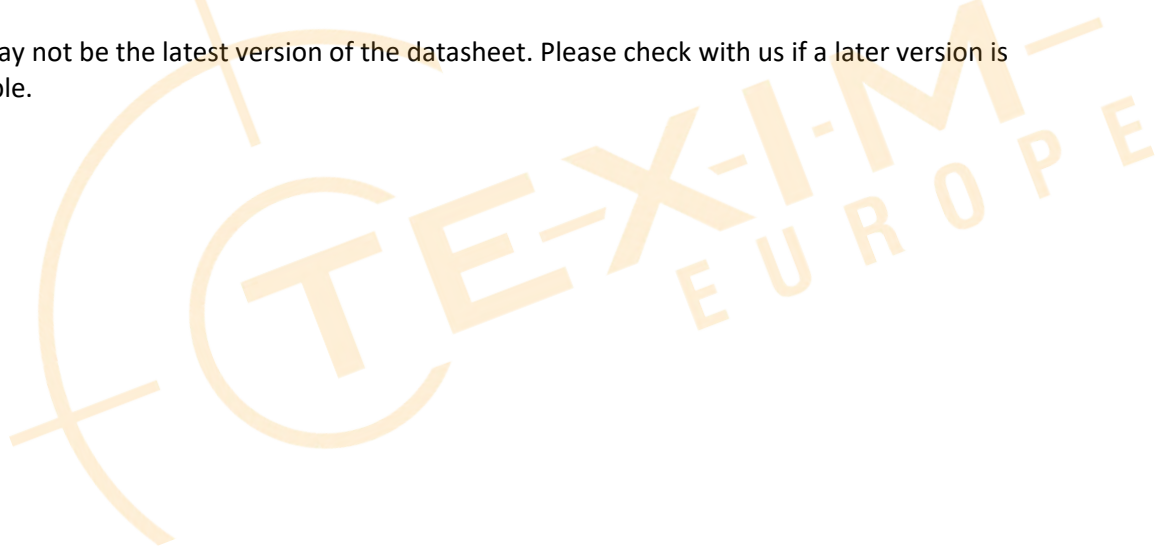
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Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time.

All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts.

Please contact us if you have any questions about the contents of the datasheet.

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