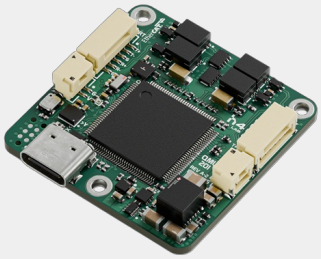

QMU201 Datasheet

Description:

H4-lab's QMU201 is the smallest EtherCAT® enabled inertial measurement unit that can be used for excellent orientation and motion detection in industrial, sports and medical applications, such as UAVs navigation and clinical research.
This new IMU offers 3-axis accelerometers and 3-axis gyros in a small footprint designed to integrate easily in your system. It is based on the latest MEMS technology, which is highly adaptive to various applications.

Potential Applications:

Industrial

- Stabilization, navigation and controls
- Detect vibration and impact forces

Medical

- Human movement science
- Activity recognition and motion capture

Sports

- Measure athletic performance
- Biomechanics research

Features and benefits:

- JST connector
- EtherCAT® communication
- Small footprint
- User friendly and easy to integrate

Technical specifications:

Feature	Value	Unit	Note
Mechanical			
Dimensions	36, 36, 7.3	mm	L,W,H
Weight	10	g	
Signal Specifications			
Accelerometer			
Full Range	±2/4/8/16	g	
Noise Dens.	65, 65, 70	$\mu g/\sqrt{Hz}$	X,Y,Z
ODR	25 - 8000	Hz	
Gyroscope			
Full Range	±15.526 - ±2000	°/s	
Noise Dens.	.0028	$°/s/\sqrt{Hz}$	
ODR	25 - 8000	Hz	
Electrical			
Voltage	5 - 58	V	DC
Power	960	mW	@24V
Interface	Full-Duplex 100BASE-TX EtherCAT®		

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1 Revision History

June 2025 Revision A: Added QMU201 matching connectors, corrected gyroscope specification tables to Full scale range: ± 1000°/s.
April 2026 Revision B: Added QMU201 REV1 specific PDO/SDO documentation.
August 2026 Revision C: Corrected communication interface speed.

2 Introduction

2.1 General Information

This document provides information relative to the QMU201 Inertial Measurement Unit (IMU) manufactured by h4 Inc. The QMU201 board is part of the QMU line, a family of IMUs produced by h4 Lab and emphasizing compactness and high data throughput.
EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

2.2 Typical Operating Conditions

It should be noted that, unless otherwise noted, the typical device's operating conditions in this datasheet are i) voltage input (Vin) equal to 24 V, and ii) ambient temperature (Ta) equal to 25 °C.

3 Detailed Specifications

3.1 QMU201 board specifications

QMU201			
Feature	Typical Value	Unit	Note
Overview			
Dimensions	36, 36, 7.3	mm	L,W,H
Weight	10	g	
Operating temperature range	-35 to +85	°C	
Electrical Specifications			
Supply Voltage	5-58	V	DC
Nominal Voltage	24	V	DC
Current Consumption	40	mA	@24V
Power	960	mW	@24V
Communication Interface	Full-Duplex 100BASE-TX	Mbit/s	EtherCAT®

3.2 Input Power Protection

The QMU201 incorporates a DFLS1100Q-7 Schottky diode for reverse polarity protection on the power input. A forward voltage drop of approximately 0.4 V should be accounted for when calculating the effective input voltage range. Input bypass capacitors of 4.7 µF and 22 nF are placed at the power input for supply decoupling.

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3.3 EtherCAT ESD Protection

The EtherCAT differential signal lines are protected by an SP3374NUTG transient voltage suppressor array, providing ESD protection in conformance with IEC 61000-4-2.

3.4 Accelerometer Manufacturer Specifications

The following specifications are based on the initial configuration of the integrated ICM-42688-P and are provided for reference only. Certain values are excerpted directly from the manufacturer's datasheet without independent validation by h4 Lab. While we believe this information to be accurate, the original ICM-42688-P datasheet serves as the definitive ground truth. If you notice any discrepancies, please notify us at contact@h4-lab.com.

ICM-42688-P Accelerometer Manufacturer Specifications			
Feature	Typical Value	Unit	Note
Accelerometer sensitivity			
Full-Scale Range	±8	g	[Default setting, see 4.1]
Sensitivity Scale Factor	4096	LSB/g	
Sensitivity Scale Factor Initial Tolerance	±0.5	%	
Sensitivity Change vs. Temperature	±0.005	%/°C	-40°C to +85°C
Non-Linearity	±0.1	%	Best fit straight line; , ±2g
Cross-Axis Sensitivity	±1	%	Board-level
Zero-G output			
Initial Tolerance	±20	mg	
ZRO Variation vs. Temperature	±0.15	mg/°C	-40°C to +80°C
Accelerometer other parameters			
Power Spectral Density	65, 65, 70	$\mu g/\sqrt{Hz}$	X, Y, Z, @ 10 Hz
RMS Noise	0.65, 0.65, 0.70	mg-rms	X, Y, Z, Bandwidth = 100 Hz
Gyroscope Mechanical Frequencies	27 ±2	KHz	
Low Pass Filter Response	500	Hz	
Output Data Rate	2000	Hz	[Default setting, see 4.1]

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3.5 Gyroscope Manufacturer Specifications

The following specifications are based on the initial configuration of the integrated ICM-42688-P and are provided for reference only. Certain values are excerpted directly from the manufacturer's datasheet without independent validation by h4 Lab. While we believe this information to be accurate, the original ICM-42688-P datasheet serves as the definitive ground truth. If you notice any discrepancies, please notify us at contact@h4-lab.com.

ICM-42688-P Gyroscope Manufacturer Specifications			
Feature	Typical Value	Unit	Note
Gyroscope sensitivity			
Full-Scale Range	±1000	°/s	[Default setting, see 4.1]
Sensitivity Scale Factor	32.8	LSB/(°/s)	
Sensitivity Scale Factor Initial Tolerance	±0.5	%	
Sensitivity Scale Factor Variation Over Temperature	±0.005	%/°C	0°C to +70°C
Non-Linearity	±0.1	%	Best fit straight line; 25°C
Cross-Axis Sensitivity	±1.25	%	Board-level
Gyroscope zero-rate output (ZRO)			
Initial ZRO Tolerance	±0.5	°/s	Board-level, 25°C
ZRO Variation vs. Temperature	±0.005	°/s/°C	0°C to +70°C
Gyroscope other parameters			
Rate Noise Spectral Density	0.0028	$°/s/\sqrt{Hz}$	@ 10 Hz
Total RMS Noise	0.028	°/s-rms	
Gyroscope Mechanical Frequencies	27 ±2	KHz	
Low Pass Filter Response	500	Hz	
Output Data Rate	2000	Hz	[Default setting, see 4.1]

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4 EtherCAT Object Dictionary Overview

The following tables detail the EtherCAT Object Dictionary used to configure and monitor the QMU201 IMU. The device utilizes Service Data Objects (SDOs) for initial setup and Process Data Objects (PDOs) for real-time data transmission.

4.1 Configurations (SDOs - 0x8000 & 0x8010)

Object indices `0x8000` and `0x8010` are used by the EtherCAT master to configure the operational parameters of the accelerometer and gyroscope. These registers allow you to set the Full-Scale Range (FSR) and the Output Data Rate (ODR) to suit your application's dynamic requirements. Additionally, you can write hardware-level offsets to these indices to fine-tune the sensor's calibration. To ensure your custom configuration persists after a power cycle, a value of `1` must be written to the `SaveConfig` sub-index (`0x06`).

1. Accelerometer Configuration (Object Index: 0x8000)				
Subindex	Parameter	Data Type	Access	Description
0x01	FSR (Full-Scale Range)	INT16	Read / Write	0 = ±16g 1 = ±8g (Default) 2 = ±4g 3 = ±2g
0x02	ODR (Output Data Rate)	INT16	Read / Write	0 = 25 Hz 1 = 50 Hz 2 = 100 Hz 3 = 200 Hz 4 = 1 kHz 5 = 2 kHz (Default) 6 = 4 kHz 7 = 8 kHz
0x03	Offset X	INT16	Read / Write	Hardware offset calibration for the X-axis.
0x04	Offset Y	INT16	Read / Write	Hardware offset calibration for the Y-axis.
0x05	Offset Z	INT16	Read / Write	Hardware offset calibration for the Z-axis.
0x06	SaveConfig	INT16	Read / Write	Write 1 to save parameters to the device flash.

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2. Gyroscope Configuration (Object Index: 0x8010)				
Subindex	Parameter	Data Type	Access	Description
0x01	FSR (Full-Scale Range)	INT16	Read / Write	0 = ±2000 dps 1 = ±1000 dps (Default) 2 = ±500 dps 3 = ±250 dps 4 = ±125 dps 5 = ±62.5 dps 6 = ±31.25 dps 7 = ±15.526 dps
0x02	ODR (Output Data Rate)	INT16	Read / Write	0 = 25 Hz 1 = 50 Hz 2 = 100 Hz 3 = 200 Hz 4 = 1 kHz 5 = 2 kHz (Default) 6 = 4 kHz 7 = 8 kHz
0x03	Offset X	INT16	Read / Write	Hardware offset calibration for the X-axis.
0x04	Offset Y	INT16	Read / Write	Hardware offset calibration for the Y-axis.
0x05	Offset Z	INT16	Read / Write	Hardware offset calibration for the Z-axis.
0x06	SaveConfig	INT16	Read / Write	Write 1 to save parameters to the device flash.

Configuration Notes

- **ODR Mapping:** The ODR integer (0 to 7) corresponds directly to the internal hardware frequencies. The faster ODR will dictate the IMU cycle time.
- **Applying Offsets:** Offsets written to `0x03`, `0x04`, and `0x05` are applied directly to the raw sensor data before being transmitted via the `0x6000` TxPDO. Ensure you utilize the SaveConfig (`0x06`) sub-index if you require these offsets to persist across power cycles.

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4.2 Real-Time Data (PDO - 0x6000)

Object index `0x6000` defines the Transmit Process Data Object (TxPDO). This is the cyclical data payload transmitted continuously from the QMU201 to the master controller during standard operation. It contains the live sensor readings, internal system temperatures, and vital diagnostic information such as cycle counters and high-resolution timestamps.

Process Data: IMU Data (TxPDO) (Object Index: 0x6000)				
Subindex	Parameter	Data Type	Access	Description
0x01	TimeStamp	UINT64	Read Only	64-bit timestamp. [μs]
0x02	Accelerometer X	INT16	Read Only	Raw X-axis accelerometer data.
0x03	Accelerometer Y	INT16	Read Only	Raw Y-axis accelerometer data.
0x04	Accelerometer Z	INT16	Read Only	Raw Z-axis accelerometer data.
0x05	Gyroscope X	INT16	Read Only	Raw X-axis gyroscope data.
0x06	Gyroscope Y	INT16	Read Only	Raw Y-axis gyroscope data.
0x07	Gyroscope Z	INT16	Read Only	Raw Z-axis gyroscope data.
0x08	Imu Temp	INT16	Read Only	Internal IMU temperature data. [°C]
0x09	Board Temp	INT16	Read Only	Internal board temperature data. [°C]
0x0A	CycleCounter	UINT16	Read Only	Cycle counter for diagnostic tracking.
0x0B	CycleTime	UINT16	Read Only	Measured cycle time. [μs]

5 EtherCAT communication software examples

All code examples can be found on the h4-lab github page.
An EtherCAT discovery and testing Python script is provided in the h4-py-ethercat repository.

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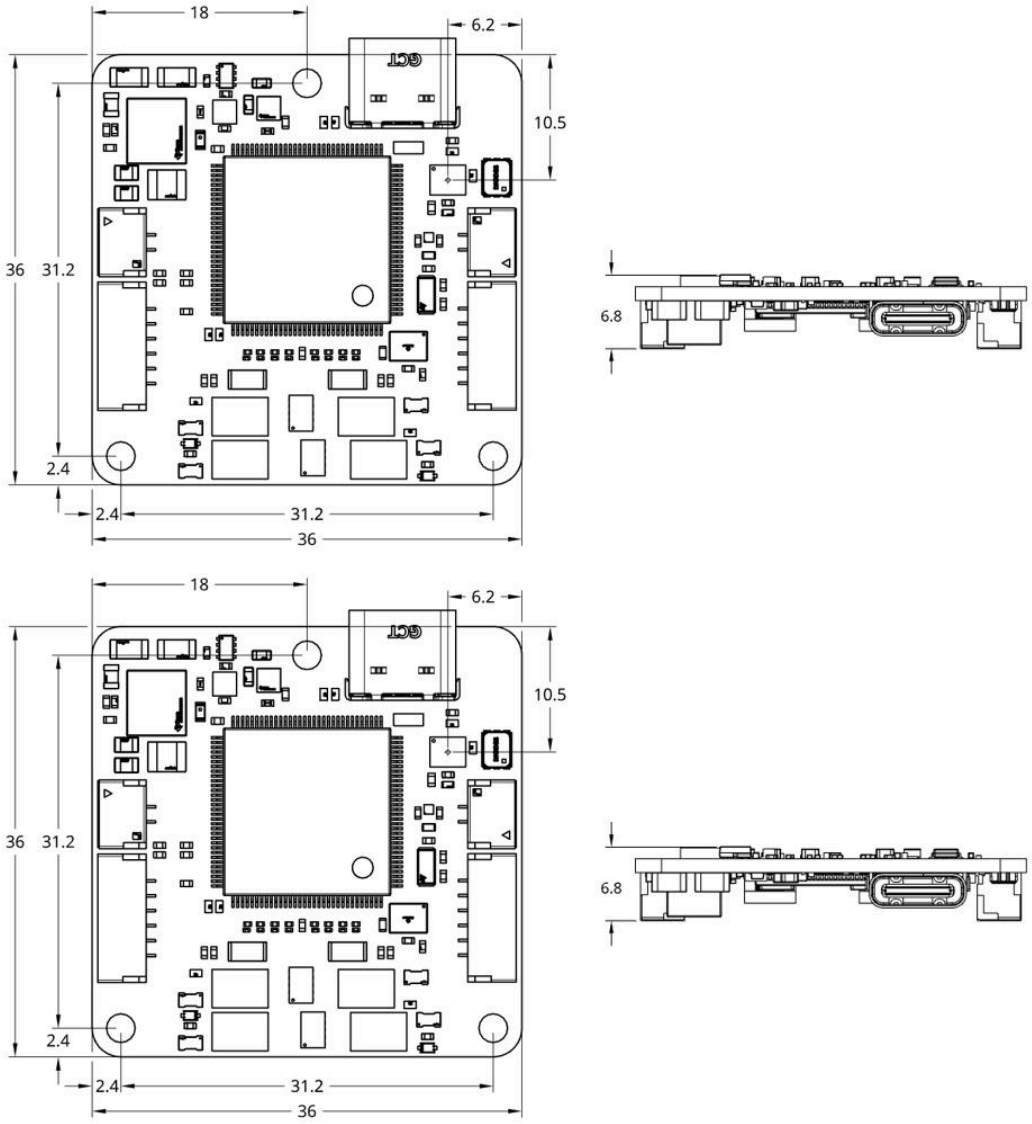
6 Mechanical drawing



The QMU201 uses the SM06B-GHS-TB (for EtherCAT) and SM02B-GHS-TB (for power) connectors.
Respective mating connectors are the following: GHR-06V-S, GHR-02V-S.

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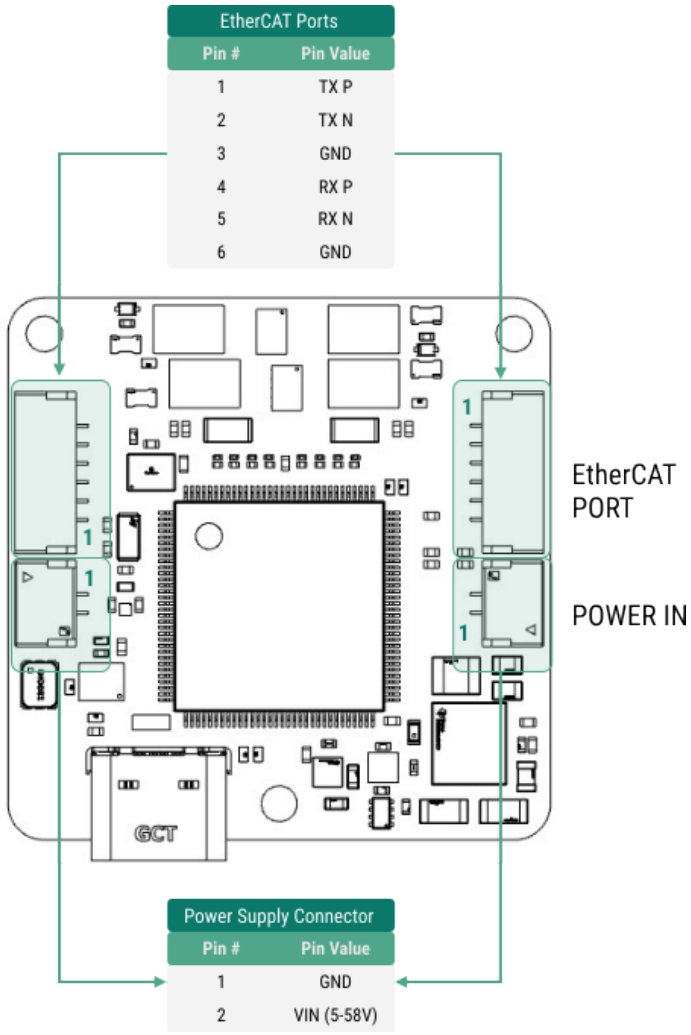
7 Electrical pinout



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