



TransducerM **TM200 Series**

Part Number: TM210-G / TM210-GP

TransducerM TM210-G and TM210-GP are Z-Axis gyroscopes with fine calibration



Version	Date	Revision Info
V1.1.1 (P1)	April 5, 2023	TM210-G and TM210-GP specs version 2023, pre-release version.
V1.1.2 (P2)	April 6, 2023	Integrate Data Format section.
V1.1.9 (P3)	May 5, 2023	Pre-release of specs chapter 1-4.
V1.2.4 (R1)	June 10, 2023	Release version. Caution and USB Port notes updated. Format adjustment.
V1.2.5 (R2)	Aug 14, 2023	Release version. Fix static accuracy data description.

* This document is non-public and is only for intended recipients.
* Actual product might be different from the photo illustrated.
* Specifications are subject to change without notice.

General Introduction to TransducerM TM200 Series

SYD Dynamics TransducerM TM200 Series consists of Attitude and Heading Reference System (AHRS) and Z-Axis Gyroscope products.

- ◆ **Model no. TM200** is a complete solution for motion sensing applications, capable of providing computed data for determining orientation of an object in 3D space.
 Out-of-box, it provides orientation data in terms of Euler angles, Quaternion, and, most commonly used Roll/Pitch/Yaw all of which can be computed with the reference to world frame (based on Earth’s magnetic field and gravity direction). It can also output calibrated raw sensor data, including angular rate, acceleration and magnetometer measurement^[1]. Magnetometer is equipped with 'Active Magnetic Field Compensator' to detect and remove disturbances and ensure stable heading.
- ◆ **Model no. TM210-G** and **TM210-GP** are Z-Axis gyroscopes.

Products comparison as below^[2]

FEATURES		TM200 PRODUCT SERIES		
		TransducerM TM200	TransducerM TM210-G	TransducerM TM210-GP
Sensors	3-Axis: Gyroscope and Accelerometer	●	-	-
	3-Axis: Magnetometer	●	-	-
	High precision Z-Axis gyroscope	-	●	-
	Very high precision Z-Axis gyroscope	-	-	●
Features	Sensor Fusion	●	-	-
	Sensor Fusion Profiles	●	-	-
	Vibration Resistant	● (Basic ^[3])	●(Basic ^[3])	● (Basic ^[3])
	Configuration GUI	●	●	●
	Run-time calibration API	-	●	●
	Digital Compass Function	-	-	-
	Essential Factory Calibration	●	●	●
	Thermal Calibration	-	○	●
Interfaces	UART	●	●	●
	CAN Bus	-	-	-
	USB	-	●	●
Output	Calibrated Raw Data Output	●	●	●
	Roll, Pitch, Yaw Output	●	● (Yaw only)	● (Yaw only)
	Internal Update Rate (Typical)	250-370Hz	800Hz	800Hz
	Max Output Data Rate (ODR)	100-200Hz	200Hz	200Hz
	Precision ODR selectable by Hz	-	●	●
Typical Performance ^[4]	Static Accuracy (Roll-Pitch)	0.7° RMS	-	-
	Static Accuracy (Yaw)	2.0° RMS	<5.0°/h	<3.0°/h
	Dynamic Accuracy (Roll-Pitch)	2.5° RMS	-	-
	Dynamic Accuracy (Yaw, pure inertial) ^[5]	-	3.5° error every 25 minutes	2.1° error every 25 minutes
Operation Condition	Temperature	0-70°C	-10-70°C (Extended range optional)	-10-70°C (Extended range optional)
	Voltage	5V	5V	5V
	IP Rate	Up to IP50	Up to IP50	Up to IP50
Application	Consumer, Education, Hobby, Laboratory	Commercial, Laboratory, Robotics, AGV	Commercial, Laboratory, Robotics, AGV	
Standard Warranty ^[6]	1 year	1-3 year	1-3 year	

● Standard ○ Optional – Not Available

- [1] For accelerometers and magnetometers, they are calibrated to ‘units’ and are accurate in terms of vector direction but not their absolute values. E.g. accelerometers may output (0.0, 0.0, -1.0) meaning Z-axis is relatively equal to earth gravity magnitude, and the sensor is placed horizontally with Z-axis pointing to the sky.
- [2] Specifications are subject to change without notice.
- [3] Basic level Vibration Resistant refers to mild vibrations, such as that from an autonomous guided vehicle (AGV), a gently moving robot arm or a cloud deck, etc.
- [4] According to tests mostly in laboratory environment, typical performance. Actual performance may vary.
- [5] Typical city car driving dynamic condition, including sharp and slow turning, with fast and gentle accelerations and traffic light stops.
- [6] Please contact your supplier for exact warrant period.

TransducerM TM210-G and TM210-GP Introduction

The TransducerM TM210-G / TM210-GP are designed as Z-Axis gyroscope capable of outputting calibrated Z-Axis angular rate and Yaw angle (heading angle). The robust and simplistic design, with cost in mind, makes both models suitable for use with inertial guidance of Autonomous Guided Vehicles (AGV), or used as a stand-alone gyroscope for simple mechanical sensing and control (such as experimental two-wheel balancing vehicles, and model helicopter tail angle sensing).

Both models provide the following output:

Yaw angle (heading angle) with range of 0-360 degrees.

Z-axis rotation rate in rad/s or °/s unit.

Both models are carefully factory calibrated for rotation rate and heading output. Both models are not tilt compensated, which means the measured data is about the rotation and heading angle in the sensor frame around the Z-Axis, regardless of how they are installed on the vehicle. If tilt compensation is required, you may choose our product offerings with 3D sensing capabilities (such as TM200, TM352, TM362, TM362-P, TM510 etc.)

The TM210-G is more robust to vibrations, while TM210-GP is more precise but relatively fragile to sudden shock and impacts.

TransducerM TM210-G and TM210-GP Specifications

1. Electronic and Physical Specification

Operating conditions

PARAMETER	MIN	TYPICAL	MAX	UNIT
Operating voltage	4.7	5.0	5.5	V
Current		80		mA
Power consumption		0.4		W
Power input	Recommended: Regulated 5V through UART / USB interface			
Power input protection	Reverse voltage protection up to -5.5V Not immune to lightning transients			
Operation range (Default thermal calibrated temperature range)	-10	25	70	°C
Storage temperature range	-40	-	85	°C
Shock	-8	-	+8	g

Physical data

PARAMETER	UNIT
Size (L x W x H)	35 x 48 x 24 (Including Mounting Brackets) 35 x 35 x 24 (Excluding Mounting Brackets)
Weight	46.6 (Typical, excluding cable and connector)
Compliance	RoHS IP50
Casing material	Aluminum alloy, PCB
Connectors	UART: PH2.0-5PIN connector USB: Micro USB 2.0 connector

System parameters		
Start-up time (cold ¹ , use dynamic boot mode)	3.2	seconds
Start-up time (cold ¹ , use static boot mode)	10 ~ 30 (Default is 30 seconds, configurable)	seconds
Communication interface	UART (TTL 3.3V compatible with TTL 5.0V) USB 2.0 (Full speed, Virtual COM Port) *Both communication interfaces can be accessed simultaneously	
Data rate	UART: Default is 115200, Configurable: 2400 ~ 921600 standard baudrate and 1Mbps USB 2.0: Adaptive, full-speed	bps

1. The cold start-up means to power on the TransducerM from power-off state (differs from hot-reboot without disconnecting the power supply)

2. IMU Sensor and Output Specification


Gyroscope					
PARAMETER	MIN	TYP	MAX	UNIT	DESCRIPTION
Measurement range	-1000	-	+1000	°/s	Model: TM210-G
	-400	-	+400	°/s	Model: TM210-GP
Resolution	-	0.01	-	°/s	
Bandwidth	68	-	-	Hz	-3db
Noise	-	±0.20~±0.35	-	°/s	Model: TM210-G Peak-to-Peak (sampled at 100Hz)
	-	±0.03	-	°/s	Model: TM210-GP Peak-to-Peak (sampled at 100Hz)
Bias Stability	-	<5.0	-	°/h	Constant temperature, measured by pure noise integration Model: TM210-G
	-	<3.0	-	°/h	Constant temperature, measured by pure noise integration Model: TM210-GP
Bias drift with temperature	-	±0.004	±0.008	°/s/°C	Model: TM210-G -10 ~ 60°C range, measured after QoS ¹ index reaches 5 Please also refer to notes ²
	-	±0.002	±0.004	°/s/°C	Model: TM210-GP -10 ~ 60°C range, measured after QoS ¹ index reaches 5 Please also refer to notes ²
Non-linearity	-	0.10	-	% FS	Model: TM210-G
	-	0.06	-	% FS	Model: TM210-GP
G sensitivity	-	±0.01	-	°/s/g	

1. QoS index is a reading from the output data package indicating system status and performance.
 2. When explicitly notified, which is usually a result of cost concerns, it is possible to order non-thermal-calibrated version, upon which the field here will no longer be applicable, and the parameters shown in the rest of this datasheet only applies to 22.5°C, or the temperature specified on the product material.

Module output				
PARAMETER	MIN	TYP	MAX	UNIT
Update rate	780	800	820	Hz

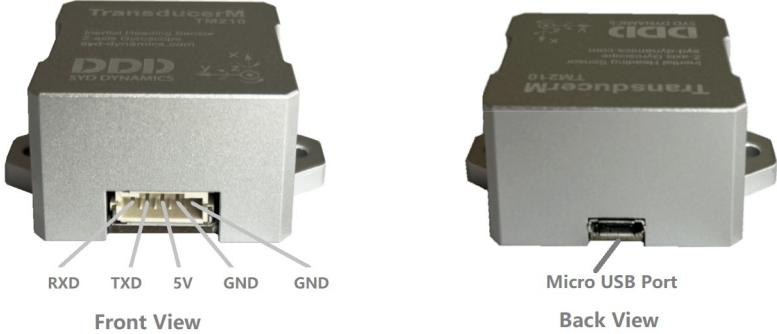


Output rate (depending on configurations)	200, 100, 50, 25, 10, 5, 1		Hz
Output format	(1) Calibrated Z-Axis gyroscope rotation rate data in rad/s or °/s, (2) Yaw angle (Heading angle) in degrees, (3) Time stamp and sensor status indication.		
Other features	FEATURE NAME	HIGHLIGHTS	
	Run-time static calibration	Remove gyroscope bias when installed on a ground vehicle and when the vehicle is parked even in a noisy environment, such as without stopping the vehicle engine idling.	
	Fine factory calibration	Improved heading accuracy.	
	Easy debug	Access the sensor with UART and at the same time the USB port can be used to acquire data or connect to ImuAssistant GUI application and monitor its output or change sensor configurations.	
PERFORMANCE	YAW		
Resolution	0.01°		
Rotation rate output range	±1000 °/s (TM210-G) ±400 °/s (TM210-GP)		
Angle range	0° ~ 360°		
Dynamic accuracy (inertial)	3.5° error every 25 minutes (TM210-G)		RMS Error ^{1, 2, 3}
	2.1° error every 25 minutes (TM210-GP)		
Static accuracy (inertial)	< 5.0° every hour		Absolute Error ⁴

1. According to test results mostly in laboratory environment.
 2. Typical city car driving dynamic condition on flat surface, including sharp and slow turning, with fast and gentle accelerations and traffic light stops.
 3. **** Important **** Removing the tilt angle between the sensor frame and the vehicle frame during installation will significantly improve TM210-G and TM210-GP heading accuracy as the gyroscopes are non-tilt compensated.
 4. Typical hourly drifting on yaw angle when sitting the TM210-G and TM210-GP stationary.

Software	
IMU Assistant	Windows 7, 8, 8.1, 10, 11
Functionality	<p>Sensor configuration, calibration, data visualization, data recording</p>  <p>Note: The sensor behavior may deviate from the descriptions herein after changing configurations. (Certain features may be turned on or off and therefore the sensor performance may appear differently).</p>

3. Wire Definition

The TransducerM TM210-G / TM210-GP features a UART port and a USB 2.0 port, and the definition of the UART port is indicated also on the housing at the bottom.

Hardware Interface		PH2.0-5PIN
Picture of the Interface		
Serial Port	Pin Definition	<p>Please refer to the indication on the picture above for the pin-to-pin definition of the PH2.0-5PIN UART Port (From left to right: RXD, TXD, 5V power supply, and two GNDs)</p> <p>Note: TXD and RXD are running at TTL 3.3V and are compatible with TTL5.0V The two GNDs are internally linked together and thus plays the same role.</p>
	PH2.0-5PIN plug	 <p>This photo shows a typical PH2.0-5PIN plug with cable.</p>
	Caution	<p>Please carefully check power supply (5V and GND) and apply correct voltage.</p> <p> Avoid connecting the sensor module together with servos / motors using the same power supply, as power surge may happen and consequently damage the sensor. For use in environment with strong electromagnetic interference, anti-surge for power supply and signal isolation are required (e.g. apply Transient Voltage Suppressors (TVS) to power supply, and apply photoelectric isolation to signals).</p>
USB Port	Micro USB 2.0 Port	<p>Follows the USB 2.0 standard. The port is running USB 2.0 Virtual COM Port profile and when connecting to a PC, it appears as a serial COM port.</p> <p>Virtual COM Port Driver:</p> <ol style="list-style-type: none"> (1) The driver is automatically loaded from kernel module for mainstream Linux OS or alike, such as the Ubuntu OS, and appears as /dev/ttyUSBx or /dev/ttyACMx, this is also the case for most embedded Linux systems. To access the serial port, You may need to add your system users to the dialout group to ensure sufficient permissions to access the serial port normally. For example: <code>sudo usermod -a -G dialout <username></code> (2) The driver may require automatic search and installation with a Windows PC when connecting the TransducerM for the first time (Internet connection may be required, otherwise search and download the offline driver manually).

4. Mechanical Drawing

The following figure shows the 2D mechanical drawing of TransducerM TM210-G and TM210-GP.

The TM210-G and the TM210-GP shares the same mechanical dimension.

Unit: mm [inch]

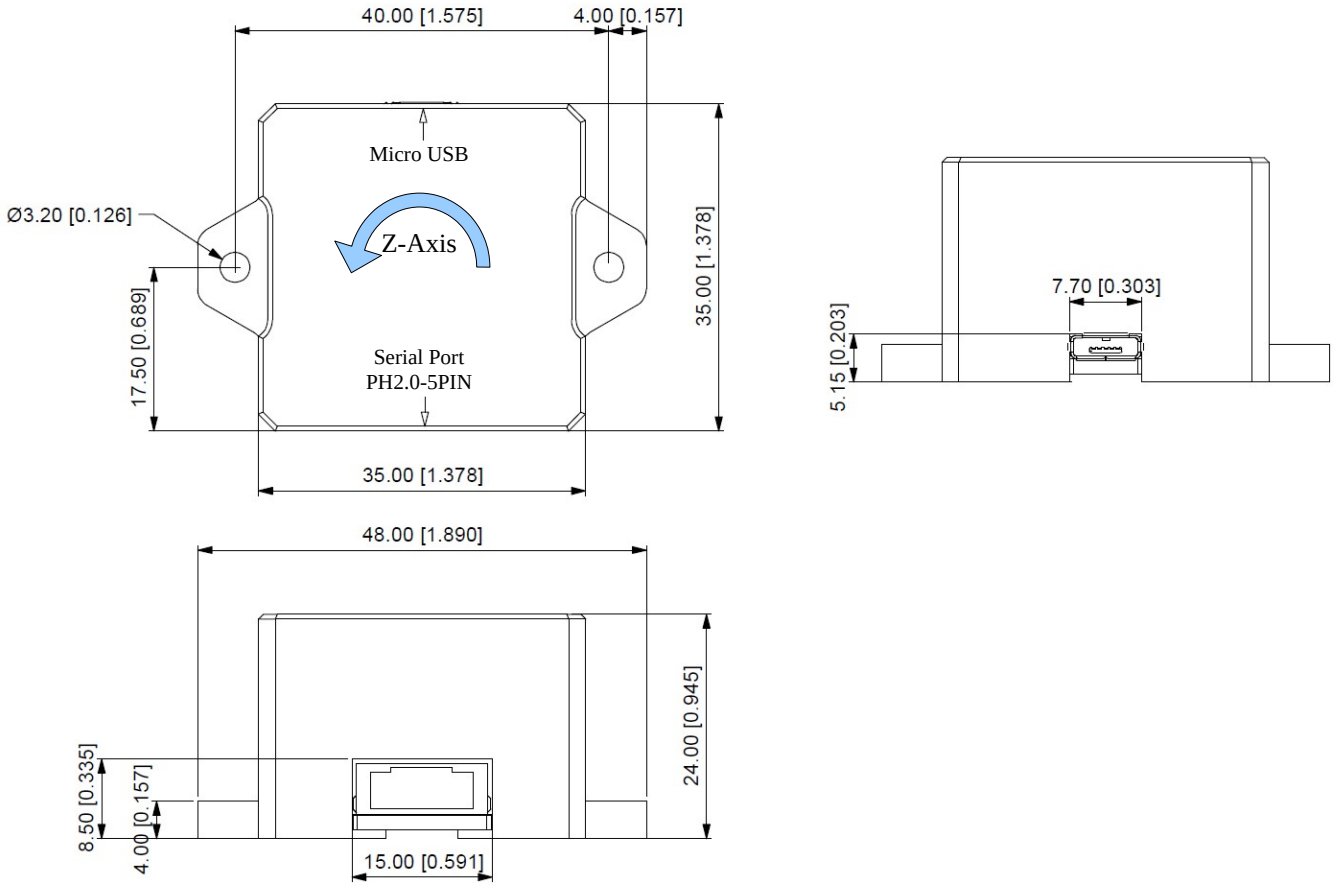


Figure 1: TransducerM TM210-G / TM210-GP Mechanical Drawing
Unit: mm [inch]