DDD
SYD DYNAMICS

TransducerM *TM200 Series*

Part Number / Order Number: TM210

TransducerM TM210 is an attitude and heading reference system (AHRS) with 9-axis IMU

Version	Date	Revision Information
V1.1.1 (P1)	Apr 16, 2024	Creation. Derived from TM210-G-GP V125-R1.
V1.1.2 (P1)	May 31, 2024	Correct errors, optimize the layout, and change the cover product photo.
V1.1.3 (P1)	June 7, 2024	Update format using new template.
V1.1.4 (R)	Oct 4, 2024	Type-C becomes standard USB interface option.
V1.1.5 (R)	Oct 29, 2024	Performance data correction. Update introduction and comparison table.
V1.1.6 (R)	Nov 05, 2024	Update series introduction.

* 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.

TransducerM TM200 Series Introduction

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

- **Model no. TM210 and TM200** are AHRS products with 3-axis gyroscopes, 3-axis accelerometers and 3-axis magnetometers, capable of providing computed data for determining orientation of an object in 3D space.

  The orientation data is provided in terms of Roll/Pitch/Yaw, and, commonly used Quaternion, all of which can be computed with the reference to the world frame (based on local magnetic field and gravity direction). They can also output calibrated raw sensor data, including 3D angular rate, acceleration and magnetometer measurement[1]. Magnetometer is equipped with 'Active Magnetic Field Compensator', and together with robust sensor fusion with vibration resistance, to output stable attitude results.

- **Model no. TM210-G and TM210-GP** are Z-Axis gyroscopes.

Products comparison outlined as below [2]

	FEATURES	TM2xx Series (a.k.a TM200 Series)		
		TransducerM TM200	**TransducerM TM210**	**TransducerM TM210-G**
Sensors	3-Axis: Gyroscope	●	●	● (Yaw Only)
	3-Axis: Accelerometer	●	●	-
	3-Axis: Magnetometer	●	●	-
Features	Sensor Fusion	●	●	-
	Sensor Fusion Profiles	●	●	-
	Vibration Resistant	● (Basic[3])	● (Basic[3])	● (Basic[3])
	Configuration GUI	●	●	●
	Run-time static calibration API	-	●	●
	Digital Compass Function	-	●	-
	Essential Factory Calibration	●	●	●
	Thermal Calibration	-	○ (Optional)	●
Interfaces	UART	●	●	●
	CAN Bus	-	-	-
	USB (Type-C or Micro)	-	●	●
Output	Calibrated Raw Data Output	●	●	●
	Roll, Pitch, Yaw Output	●	●	● (Yaw only)
	Internal Update Rate (Typical)	250-370Hz	800Hz	800Hz
	Max Output Data Rate (ODR)	100-200Hz	800Hz	200Hz
	Precision ODR selectable by Hz	-	●	●
Typical Performance [4]	Static Accuracy (Roll-Pitch)	0.7° RMS	<0.4° RMS	-
	Static Accuracy (Yaw, pure inertial)	-	<5.5°/h	<5.0°/h
	Dynamic Accuracy (Roll-Pitch)	2.5° RMS	<1.0° RMS	-
	Dynamic Accuracy (Yaw, pure inertial)[5]	<10° error every 25 minutes	2.6° error every 25 minutes	2.1° ~ 3.5° error every 25 minutes
Operation Condition	Temperature	0~70°C	-40~85°C	-10~70°C (-40~85° 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
	Stand Warranty[6]	1 year	1 year	1 year
	Extended Warranty	-	○	○

● Standard   ○ Optional   − Not Available

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[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 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 Introduction

The TransducerM TM210 is a product designed with both cost and reliability in mind. The TM210 offers good dynamic and static performance in roll/pitch/yaw measurements, along with excellent yaw stability.

The TransducerM TM210 has a customization option named TM210-T1 (where the suffix "T1" represents thermal calibration range) inherits all the features of the TM210, with the difference being a wider temperature calibration range than the TM210. The TM210-T1 is calibrated from 0°C to 70°C for high-temperature operating environments while the standard TM210 is calibrated by 22.5°C.

Application Range:

The TM210 is designed for consumer and industrial-grade applications in non-safety critical systems such as ground vehicles, drones, and robots.

TransducerM TM210 Specifications

1. Physical and Electrical Parameters

Operating Coordination

PARAMETERS	MIN	TYP	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 -15V Not immune to lightning transients (For industrial applications, please ensure proper protection and isolation.)			
Operation Range	-40	22.5	85	°C
Calibration Temperature (TM210)	-	22.5	-	°C
Thermal Calibration Temperature Range (TM210-T1)	5	-	65	°C
Vibration	-10	-	+10	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)	mm
Weight	46.6 (Typical, excluding cable and connector)	g
Compliance	RoHS IP50	
Casing Material	Aluminum alloy, PCB	
Connector	UART： PH2.0-5 PIN connector USB： Type-C USB 2.0 connector	

System Parameters

Start-up time (cold[1], use Auto 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，Type-C interface，Virtual COM Port) *Both communication interfaces can be accessed simultaneously	

Data Rate	UART：2400~921600, 1Mbps standard baud rate, 250kbps, 500kbp and baud rate customization. *The ImuAssistant GUI configuration software allows for higher baud-rate but use with caution as the signal may easily be corrupted using bare UART cable wiring.) * Use with caution with baud rate customization and do not try strange baud rates as not all baud rates are fully tested, some may bring the module to irrecoverable state. Consult tech support before trying. 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 AHRS Specification

Gyroscope

PARAMETER	MIN	TYP	MAX	UNIT	DESCRIPTION
Measurement Range	-1000	-	+1000	°/s	X, Y, Z axis
Resolution	-	0.01	-	°/s	
Bandwidth	68	-	-	Hz	-3db
Noise	-	±0.20~±0.35	-	°/s	Peak-to-Peak (sampled at 100Hz)
Bias Stability	-	<5.5	-	°/h	Constant temperature, measured by pure noise integration
Bias drift with temperature	-	±0.004	-	°/s/°C	5~65°C range, measured after QoS[1] index reaches 5, for TM210-T1
Non-linearity	-	0.10	-	% FS	
G sensitivity	-	±0.01	-	°/s/g	

1. QoS index is a reading from the output data package indicating system status and performance.

Accelerometer

PARAMETER	MIN	TYP	MAX	UNIT	DESCRIPTION
Measurement range	-10	-	+10	g	X, Y, Z axis
Resolution	-	0.40	-	mg	
Bandwidth	70	-	-	Hz	-3db
Noise	-	≤12	-	mg	Peak-to-Peak (sampled at 100Hz)
Noise Density	-	190	-	ug/√Hz	
Bias instability	-	0.05	-	mg	Allan Variance
Bias drift with temperature	-	<5.5	-	mg	At or within the specified calibration temperature range
Non-linearity	-	0.500	-	% FS	-1g ~ +1g range （At or within the specified calibration temperature range）
Misalignment	-	<0.3	-	°	

Magnetometer

PARAMETER	MIN	TYP	MAX	UNIT	DESCRIPTION
Measurement Range	-1.3	-	+1.3	Gauss	X, Y, Z axis
Resolution	-	0.001	-	Gauss	
Internal sampling rate	-	-	75	Hz	
Non-linearity	-	0.1	-	% FS	

Module Output				
PARAMETER	**MIN**	**TYP**	**MAX**	**UNIT**
Update rate	780	800	820	Hz
Output Data Rate (ODR) （User configurable）	800, 400, 200, 100, 50, 25, 10, 5, 1 * Recommend 921600bps or 1Mbps for UART when 400Hz or higher ODR is requested from UART. * Recommend 460800bps for UART when 200Hz ODR is requested from UART. * When 200Hz or higher ODR is selected, the ImuAssistant GUI application may require higher computer performance to refresh the data in the set frequencies.			Hz
Output format	(1) Roll/Pitch/Yaw (heading), Quaternion, Gravity direction, Calibrated raw sensor data: 3-axis rotation rate, 3-axis linear acceleration sensor reading, 3-axis magnetometer data; (2) Timestamps and sensor status indications.			

Other features	**FEATURE NAME**	**HIGHLIGHTS**		
	Self-adapting filter	Improved heading accuracy.		
	Digital Compass API	Work as a digital compass when API is called.		
	Thermal Calibration	Optional thermal calibration. Fine calibration within the calibration temperature range.		
	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.		
	Easy debug	Access the sensor with UART and USB at the same time. The USB port can be used to acquire data or to connect to the ImuAssistant GUI application and monitor its output in real-time, logging measured data, or changing sensor configurations.		

PERFORMANCE	ROLL	PITCH	YAW	
Resolution	0.01°	0.01°	0.01°	
Angle range	-180° ~ 180°	-90° ~ 90°	0° ~ 360°	
Static accuracy	<0.4°	<0.4°	<0.8°	RMS Error[1]
Dynamic accuracy （Inertial）	<0.9°	<0.9°	2.6° error[1,3] every 25 minutes	RMS Error[1,2]

1. According to test results in mostly laboratory environment, actual performance may vary depending on the motion dynamics.
2. Roll and Pitch error includes error introduced by communication latency at 115200 bps.
3. Typical city car driving dynamic condition, including sharp and slow turning, slopes, with fast and gentle accelerations and traffic light stops, tested when QoS reaches 5.

Software	
IMU Assistant	Windows 7, 8, 8.1, 10, 11
Functionality	Sensor configuration, user calibration, data visualization, data recording ⚠ Note: Adjusting the module configuration may cause certain sensor behaviors to differ from what's described in this document. (Some features may be enabled or disabled, which affects sensor performance.)

3. Cable Definition

TransducerM TM210 features a UART port and a USB 2.0 port; the definition is shown as below. The definition of the UART port is also labeled on the bottom of the housing.

Hardware Interface	PH2.0-5PIN
Picture of the Interface	 RXD TXD 5V GND GND **Type-C or Micro USB** (Type-C becomes standard for TM210 manufactured since October 2024) **Front View** **Back View**

Serial Port	Pin Definition	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 identical GNDs) 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.
	PH2.0-5PIN plug	 This photo shows a typical PH2.0-5PIN plug with cable.
	Caution	⚠️ Please carefully check power supply (5V and GND) and apply correct voltage. 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).
USB Port	USB 2.0 Port (Type-C or Micro USB)	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. Virtual COM Port Driver: (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. For example: sudo usermod -a -G dialout <username> (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 the TransducerM TM210.

Note: 1. The TransducerM TM210-T1 shares the same mechanical dimension.

2. The USB port is Type-C by default for TransducerM TM210 manufactured since October 2024.
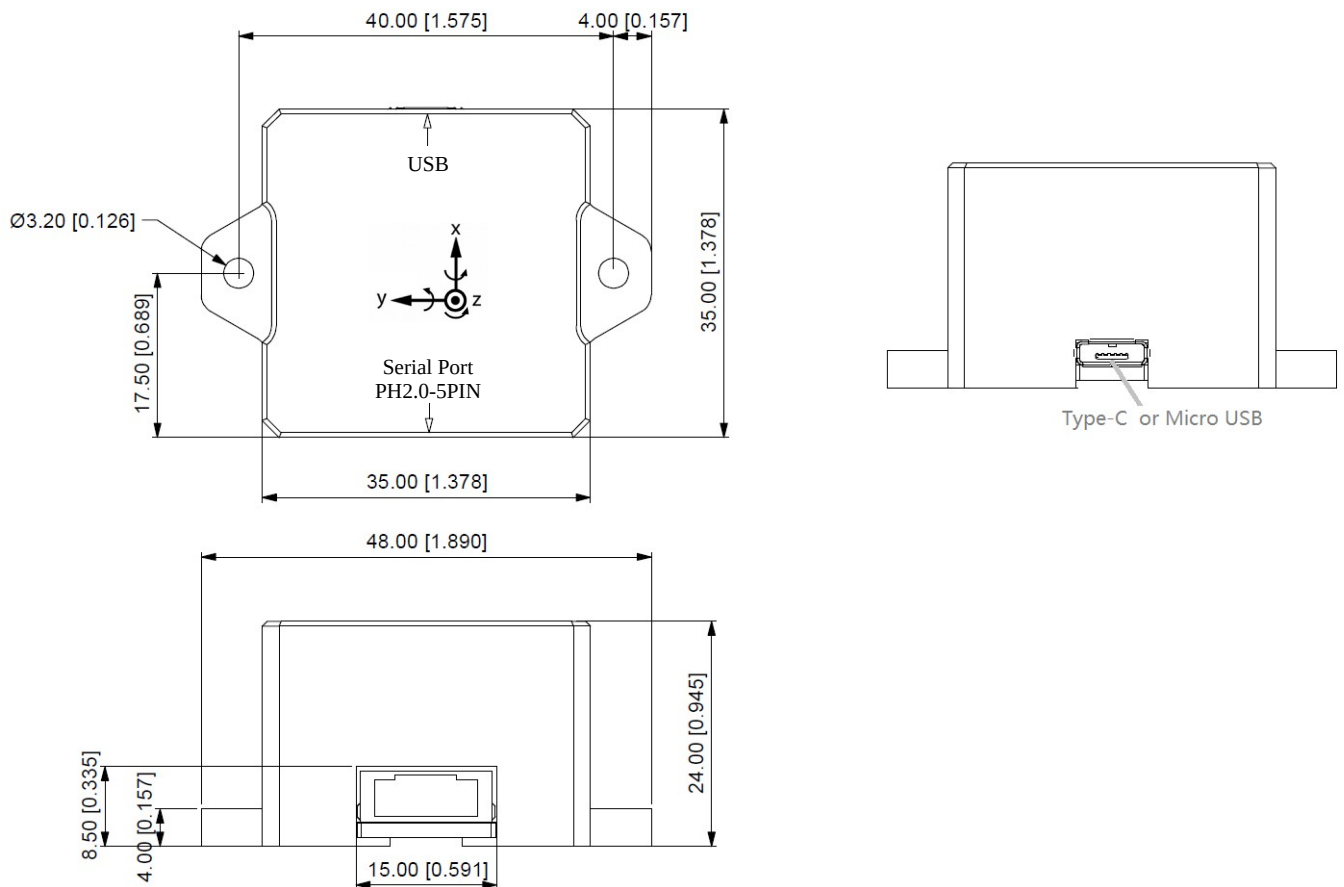

Unit: mm [inch]

Figure 1: TransducerM TM210 Mechanical Drawing and Axis Definition
Unit: millimeter [inch]