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SYD DYNAMICS

TransducerM TM300 Series

Part Number: TM362 / TM362-P

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

Version	Date	Revision Info
V1.1.1 (P1)	March 30, 2023	TM362 and TM362-GP preview, pre-release version
V1.2.1 (R1)	June 10, 2023	Release version.

* 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 TM300 Series

SYD Dynamics TransducerM TM300 Series 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.

Products comparison as below[2]

		TM300 PRODUCT SERIES		
	FEATURES	**TransducerM TM352 / TM353**	**TransducerM TM362**	**TransducerM TM362-P**
Sensors	3-Axis: Gyroscope and Accelerometer	●	●	●
	3-Axis: Magnetometer	●	●	●
	Very high precision Z-Axis gyroscope	-	-	●
Features	Sensor Fusion	●	●	●
	Sensor Fusion Profiles	●	●	●
	Vibration Resistant	● (Medium Level[3])	● (Medium Level[3])	● (Medium Level[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	●	●	●
	Internal Update Rate (Typical)	250-400Hz	800Hz	800Hz
	Max Output Data Rate (ODR)	200Hz	200Hz	200Hz
	Precision ODR selectable by Hz	○	●	●
Typical Performance[4] (RMS Value)	Static Accuracy (Roll-Pitch)	0.5°	0.3°	0.3°
	Static Accuracy (Yaw)	1.0°	0.8°	0.8°
	Dynamic Accuracy (Roll-Pitch)	2.0°	0.8°	0.8°
	Dynamic Accuracy (Yaw, pure inertial) [5]	8.5° error every 25 minutes	2.6° error every 25 minutes	1.7° error every 25 minutes
Operation Condition	Temperature	-20-80°C	-20-80°C (Extended range optional)	-20-80°C
	Voltage	5V	5V	5V
	IP Rate	Up to IP67	Up to IP67	Up to IP67
Application		Commercial, Laboratory, Robotics, AGV	Commercial, Laboratory, Robotics, AGV	Commercial Laboratory, Robotics, AGV
Standard Warranty[6]		1-3 year	1-3 year	1-3 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] Medium level Vibration Resistant refers to below 10g continuous vibration, such as that from a flying drone or a running a vehicle.
[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, slopes, with fast and gentle accelerations and traffic light stops.
[6] Please contact your supplier for exact warrant period.

TransducerM TM362 / TM362-P Introduction

The TransducerM TM362 and TM362-P both belong to the TM300 series, which are designed to provide balanced performance versus costs. The TM362 has excellent dynamic and static performance in terms of Roll/Pitch/Yaw measurement in a compact design of 3.5cm cubic dimensions (exclude brackets and cable), with thermal calibration (standard, unless otherwise specified when ordering) of its gyroscopes and accelerometers.

The TM362-P, where the letter 'P' stands for Performance, inherits all TM362 features, differs in terms of having narrower Z-Axis gyroscopes measurement range but having better Yaw stability (much lower bias and coefficient drifting).

Application scope:

The TM362 / TM362-P are designed for use with ground vehicles, drones, robotics, which are non-safety critical consumer and industrial applications; in addition, the TM362-P makes it possible for use in such as marine or autonomous guided vehicle applications where turn-on bias drifting is of major concern. The TM362-P is more precise but also more fragile to shocks and impacts, and therefore should avoid dropping the sensor onto the ground.

TransducerM TM362 / TM362-P Specifications

Electronic and Physical Specification

Operating conditions

PARAMETER	MIN	TYPICAL	MAX	UNIT
Operating voltage	4.5	5.0	5.5	V
Current	80	84	90	mA
Power consumption	-	0.42	-	W
Power input	Recommended: Regulated 5V through CAN Bus / UART / USB interface			
Power input protection	Reverse voltage protection up to -5.5V Not immune to lightning transients			
Operation temperate range	-20	25	80	°C
Storage temperature range	-40	-	85	°C
Shock	-10	-	+10	g

Physical data

PARAMETER		UNIT
Size (L x W x H)	35 x 48 x 35 (Including Mounting Brackets) 35 x 35 x 35 (Excluding Mounting Brackets)	mm
Weight	76.5 (Typical, including cable and standard connector)	g
Compliance	RoHS IP67 (With SF12 connector, otherwise main body only)	
Casing material	Aluminum alloy, ABS	
Connectors	Molex 43020-0801 connector (Standard) SF12 or other water proof connectors (Optional)	

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) CAN 2.0B Standard and Extended ID (Configurable) USB 2.0 (Full speed, USB Virtual COM Port profile) *All communication interfaces can be accessed simultaneously	
Data rate	UART: 2400 ~ 921600 standard baudrate, 1M CAN 2.0B: 62.5K ~ 1M (Configurable) USB 2.0: Adaptive, full-speed	bps

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

IMU Sensor and AHRS Specification

Gyroscope

PARAMETER	MIN	TYP	MAX	UNIT	DESCRIPTION
Measurement range (X, Y axis)	-1000	-	+1000	°/s	Model: TM362 and TM362-P
Measurement range (Z axis)	-1000	-	+1000	°/s	Model: TM362
	-400	-	+400	°/s	Model: TM362-P
Resolution	-	0.01	-	°/s	
Bandwidth	68	80	-	Hz	-3db
Noise	-	±0.20~±0.35	-	°/s	Peak-to-Peak (sampled at 100Hz)
Bias Stability (X, Y axis)	-	3.0	-	°/h	Constant temperature, measured by pure noise integration
Bias Stability (Z axis)	-	3.0	-	°/h	Constant temperature, measured by pure noise integration Model: TM362
	-	1.5	-	°/h	Constant temperature, measured by pure noise integration Model: TM362-P
Bias drift with temperature (X, Y axis)	-	±0.003	±0.008	°/s/°C	-5 ~ 60°C range, measured after QoS[1] index reaches 5
Bias drift with temperature (Z axis)	-	±0.003	±0.008	°/s/°C	Model: TM362
	-	±0.002	±0.004	°/s/°C	Model: TM362-P
Non-linearity	-	0.09	0.50	% FS	Model: TM362
	-	0.05	0.50	% FS	Model: TM362-P
G sensitivity	-	±0.01	-	°/s/g	

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

Accelerometer

PARAMETER	MIN	TYP	MAX	UNIT	DESCRIPTION
Measurement range	-10	-	+10	g	
Resolution	-	0.40	-	mg	
Bandwidth	70	80	-	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	Full temperature range
Non-linearity	-	0.500	-	% FS	Full temperature range, -1g ~ +1g range
Misalignment	-	<0.3	-	°	

Magnetometer

PARAMETER	MIN	TYP	MAX	UNIT	DESCRIPTION
Measurement Range	-1.3	-	+1.3	Gauss	
Resolution	-	0.001	-	Gauss	
Internal sampling rate	-	-	75	Hz	
Non-linearity	-	0.1	-	% FS	Full temperature range

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	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			

	FEATURE NAME	HIGHLIGHTS	
	Self-adapting filter	Improved heading accuracy	
	Digital Compass Calibration	Work as a digital compass	
	Thermal Calibration	Fine calibration	
Other features	Sensor networking	Multiple sensors on the CAN Bus	
	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 CAN Bus and at the same time the USB port can be used to acquire data or 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	<0.3°	<0.3°	<0.8°	RMS Error[1]
Dynamic accuracy (inertial)	<0.8°	<0.8°	2.6° error[1,3] every 25 minutes (TM362)	RMS Error[1,2]
			1.7° error[1,3] every 25 minutes (TM362-P)	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.

Software

IMU Assistant	Windows 7, 8, 8.1, 10, 11
Functionality	Sensor configuration, calibration, data visualization, data recording

The TransducerM with part number (i.e. order number) TM362 and TM362-P both have the same wire and connector configurations.

TransducerM TM362 / TM362-P with standard connector

The TransducerM TM362 / TM362-P have cable pre-installed, which is further connected to an 8-pin Molex 43020-0801 connector. Shown as below.
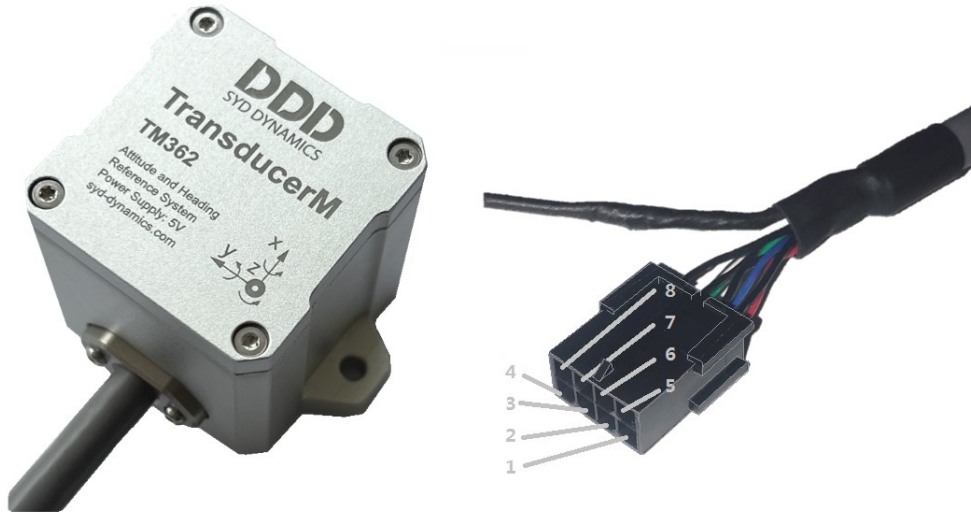

Figure 1: TransducerM TM362 / TM362-P cable and connector illustration

The default length of the cable is typically 10.5cm±1.0cm, including the Molex connector.

The cable definition is as follows.

TransducerM TM362/TM362-P Cable Definition *(8-pin-cable with Molex 43020-0801 connector)*			
Pin Number	**Wire Color**	**Name / Function**	**Comments**
1	**Red**	**VCC 5V**	Input voltage range: 4.5V ~ 5.5V, recommend stable 5.0 V supply.
2	**Blue**	**TXD**	TXD is running at TTL 3.3V and is compatible with TTL 5.0V.
3	**Green**	USB DM	USB 2.0 D- The USB interface is running Virtual COM Port profile.
4	**White**	**CAN-L**	CAN 2.0 interface. The internal CAN Bus transceiver meets the CAN serial communication physical layer standard defined in ISO 11898. There is **no termination resistor** inside TransducerM.
5	**Black** (twisted-pair with red)	USB DP	USB 2.0 D+ The USB interface is running Virtual COM Port profile.
6	**Black** (twisted-pair with blue)	**RXD**	RXD is running at TTL 3.3V and is compatible with TTL 5.0V.
7	**Black** (twisted-pair with green)	**GND**	
8	**Black** (twisted-pair with white)	**CAN-H**	CAN 2.0 interface. The internal CAN Bus transceiver meets the CAN serial communication physical layer standard defined in ISO 11898. There is **no termination resistor** inside TransducerM.

Adapter cable

TransducerM TM362 / TM362-P may be shipped with adapter cable. The adapter cable makes it easier to connect TransducerM to other devices for temporary use and tests.

The adapter cable is shown as below. Two kinds of 2.54mm housings are provided: six 1-pin housings and one 5*2-pin housing. You may

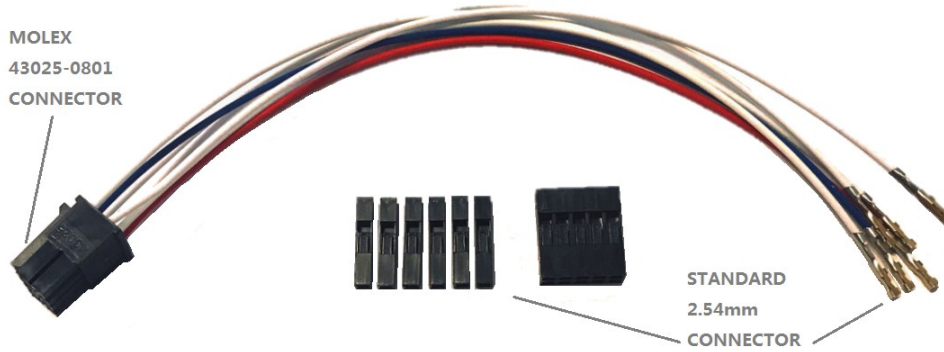decide by yourself to choose a convenient way to connect the cable to your devices.

Figure 2: TransducerM TM362 / TM362-P adapter cable and connector illustration

Here is an example to connect TransducerM to PC through a USB-UART adapter (for test purpose, please note that the TransducerM TM362/TM362-P also has a native USB COM port), for reading sensor data and configuring TransducerM using the GUI software *ImuAssistant*.

1. Connect adapter cable's pin1(***VCC***) to USB-UART adapter ***5V***;

2. Connect adapter cable's pin7(***GND***) to USB-UART adapte ***GND***;

3. Connect adapter cable's pin2(***TXD***) to USB-UART adapte ***RXD***;

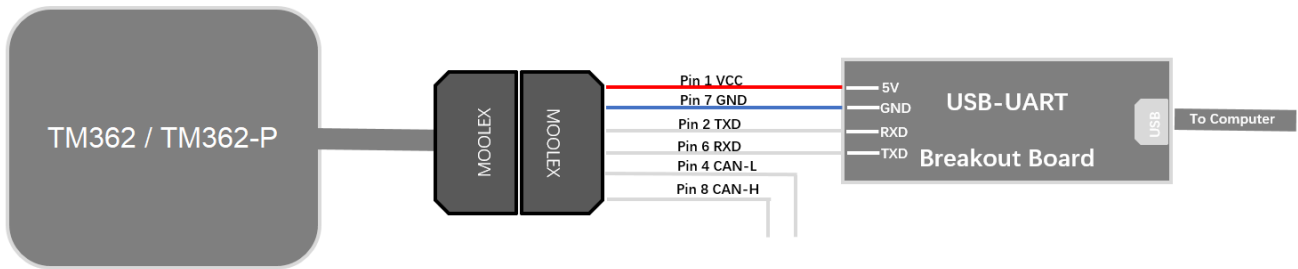4. Connect adapter cable's pin6(***RXD***) to USB-UART adapte ***TXD***.

Figure 3: Connect to USB-UART adapter

* Note: USB-UART Breakout Board can be ordered separately.

Mechanical Drawing

The following figure shows the 2D mechanical drawing of the TransducerM TM362 / TM362-P. Unit: millimeter [inch].

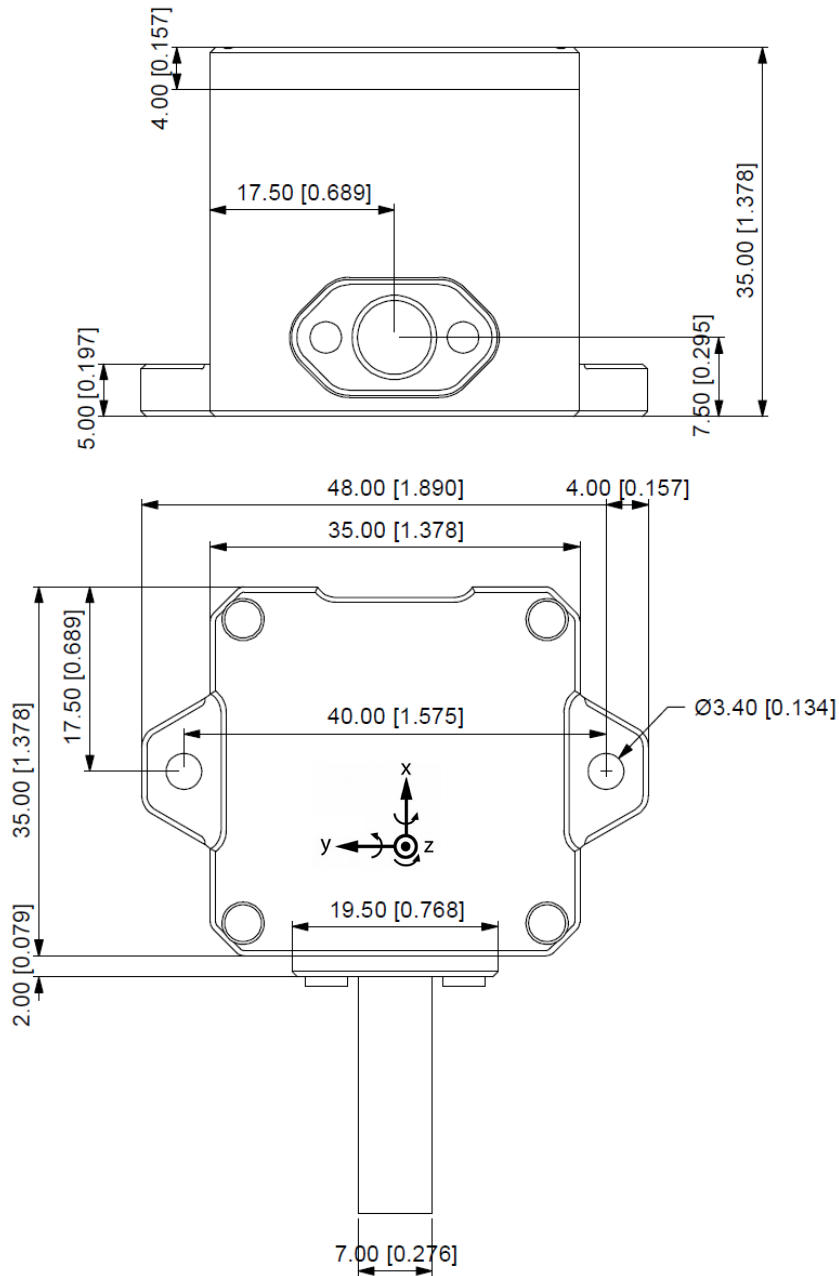*Figure 1: TransducerM TM362 / TM362-P Mechanical Drawing*
Unit: millimeter [inch]