

## **gyroscope MPU6050**

Inertial Measurement Unit (IMU): MPU-6050

The MPU-6050 Inertial Measurement Unit (IMU) serves as the primary sensor for motion and orientation tracking, correcting for mechanical and environmental inaccuracies that cannot be managed by vision or distance sensors

### 1. Function and Integrated Components

The MPU-6050 is a sophisticated MotionTracking device that integrates a 3-axis gyroscope and a 3-axis accelerometer. It utilizes 16-bit Analog-to-Digital Converters (ADCs) for high-precision data capture

- Gyroscope (Angular Rate): Measures the rate of rotation around the X, Y, and Z axes. This is essential for detecting unwanted yaw (heading deviation) and precisely correcting the Ackermann steering angle. The range is user-programmable up to  $\pm 2000^\circ/\text{sec}$
- Accelerometer (Linear Acceleration): Measures linear acceleration and gravity, used to determine the robot's tilt angle (roll and pitch) and estimate linear distance traveled. The range is programmable up to  $\pm 16g$
- Digital Motion Processor (DMP): This integrated hardware unit processes complex 6-axis MotionFusion algorithms. Crucially, the DMP offloads computation from the Raspberry Pi by processing raw sensor data into clean, ready-to-use orientation information directly on the chip

### 2. System Integration and Power

The MPU-6050 communicates with the Raspberry Pi 4 using the efficient I2C serial communication protocol. This protocol is highly efficient, requiring a minimum number of dedicated GPIO pins

- Power: The module operates between 3V to 5V and is safely powered by the 5V} regulated output from the .LM2596 module

### 3. Role in Navigation

The IMU provides the core data for internal navigation (dead reckoning). Regardless of whether the system implements explicit sensor fusion with the ultrasonic sensors, the highly accurate angular rate and acceleration data are crucial for stabilizing the robot's movement and ensuring that the programmed path is maintained against physical disturbances

