MPU6050 Sensor IC (Based on Datasheet)

The **MPU6050** is a compact, low-power, 6-axis **MotionTracking device** developed by **InvenSense (now TDK)**. It integrates a **3-axis gyroscope** and a **3-axis accelerometer**, along with a **Digital Motion Processor (DMP)**, making it ideal for motion-based applications in consumer electronics, robotics, and wearable devices.

Core Components

- **3-Axis Gyroscope**: Measures angular velocity (rotation) around the X, Y, and Z axes.
    - **Selectable Ranges**: ±250, ±500, ±1000, ±2000 °/s
    - **16-bit ADC** for precise digital output
- **3-Axis Accelerometer**: Detects linear acceleration and tilt.
    - **Selectable Ranges**: ±2g, ±4g, ±8g, ±16g
    - Also uses **16-bit ADC**
- **DMP (Digital Motion Processor)**: Offloads motion computations (like gesture detection, orientation) from the host MCU, saving processing time and power.

Key Features

- **Low Power Consumption**:
    - Full operation (gyro + accel + DMP): ~3.9 mA
    - Standby/sleep modes available for energy efficiency
- **FIFO Buffer (1024 Bytes)**:
    - Stores sensor data to reduce need for constant MCU polling
    - Enables burst reading to save power
- **Temperature Sensor**:
    - Built-in digital-output sensor for die temperature monitoring
- **I^2C Interface (MPU6050 only)**:
    - Communicates with host controller at up to 400 kHz

- Logic level set by **VLOGIC** pin (1.71V–VDD)

Electrical and Mechanical Specs

- **Supply Voltage (VDD)**: 2.375V to 3.46V
- **Logic Voltage (VLOGIC)**: 1.71V to VDD
- **Package**: QFN (24-pin), 4×4×0.9 mm
- **Shock Tolerance**: Up to 10,000g
- **Operating Temperature**: –40°C to +85°C

Applications

- Smartphones & tablets (gesture, tilt, gaming input)
- Robotics and drones (stabilization, navigation)
- VR/AR headsets
- Fitness & health trackers
- Self-balancing vehicles
- Motion-based user interfaces (e.g., 3D remotes, wearables)

I^2C and Auxiliary Sensors

- Supports **external 3-axis magnetometer** via **auxiliary I^2C** to create a **9-axis fusion system**
- Can work in:
  - **I^2C Master Mode**: Reads data from external sensors
  - **Pass-Through Mode**: Lets MCU talk directly to external sensors

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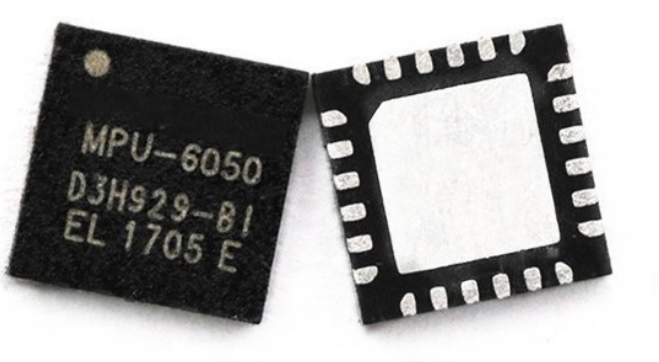
Summary

The **MPU6050** offers an all-in-one solution for motion sensing with high precision and minimal overhead on the system processor. Its combination of gyroscope, accelerometer, FIFO buffer, and DMP in a tiny package makes it a go-to choice for motion-enabled systems.



Reference:

- MPU-6000/MPU-6050 Product Specification
  Title: *MPU-6000 and MPU-6050 Product Specification*
  Document Number: PS-MPU-6000A-00
  Revision: 3.4
  Release Date: August 19, 2013
  Publisher: InvenSense Inc. (now part of TDK)
  File name: 2410121707_TDK-InvenSense-MPU-6050_C24112.pdf
  Pages Referenced: 1–52

HX9193-XXGB-N Linear Regulator (Based on Datasheet)

The **HX9193-XXGB-N** is a **high-precision, low-dropout (LDO) linear voltage regulator** developed using CMOS technology. It is designed to provide a **stable and noise-free DC voltage output** — even in space-constrained and low-power systems. This makes it ideal for portable electronics, battery-powered devices, and RF applications.

What It Does

An LDO regulator ensures that a steady voltage is delivered to sensitive components, even if the supply voltage slightly drops or fluctuates. The HX9193 series achieves this with:

- **Low dropout voltage** (as little as 35 mV at 10 mA)
- **Low noise and fast transient response**
- **Efficient shutdown mode** to save power when not needed

Key Technical Features

FEATURE	DESCRIPTION
OUTPUT VOLTAGE OPTIONS	Fixed values between **1.8V to 5.0V** (e.g., HX9193-33GB-N = 3.3V output)
OUTPUT ACCURACY	±2.5% (typical)
MAX OUTPUT CURRENT	Up to **300 mA**
QUIESCENT CURRENT	Only **25 µA** (very power-efficient)
SHUTDOWN CURRENT	Only **0.1 µA** via **CE (Chip Enable) pin**
DROPOUT VOLTAGE	~35 mV @ 10 mA, ~280 mV @ 100 mA
RIPPLE REJECTION	**75 dB PSRR** @ 1 kHz — ideal for RF noise-sensitive devices
TEMPERATURE STABILITY	±290 ppm/°C

Package & Pinout

- Available in:
  - **SOT23-5** (small, compact)
  - **SOT89-5** (higher power dissipation)
- Compatible with **ceramic capacitors**
- No **bypass capacitor** needed — saves space and cost

Pin Functions:

Pin	Name	Function
1	VIN	Input voltage
2	GND	Ground
3	CE	Enable/disable control
4	NC	No connection
5	VOUT	Regulated output

Applications

- **Smartphones and mobile phones**
- **Bluetooth & RF modules**
- **Digital cameras and camcorders**
- **Battery-operated devices**
- **Wearable electronics and IoT gadgets**

The fast load response and stable voltage make it ideal for devices with frequent power level changes or RF circuits sensitive to noise.

Operational Limits

- **Input Voltage**: 1.8V – 7.0V
- **Output Current**: Max 300 mA
- **Operating Temp**: –20°C to +60°C
- **Storage Temp**: –40°C to +125°C
- **Max Power Dissipation**:
    - SOT23-5: 200 mW
    - SOT89-5: 300 mW

Note: Exceeding absolute ratings can cause permanent damage.

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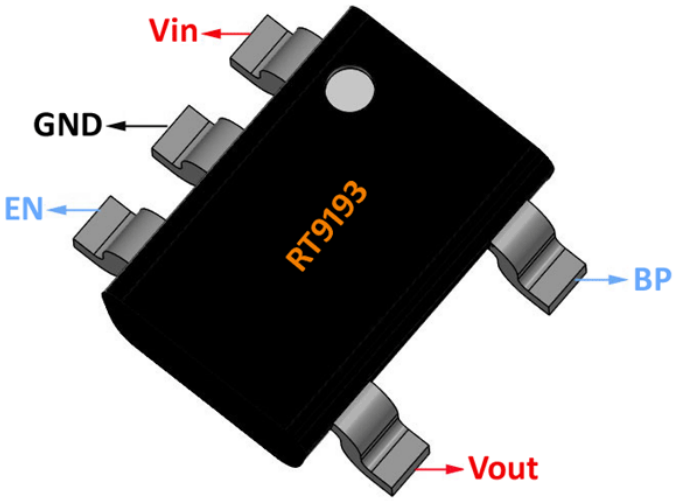

Reference:

- HX9193-XXGB-N Product Datasheet

  Title: *HX9193-XXGB-N系列产品规格书*

  Publisher: Shenzhen Huaqing Electronics Co., Ltd.
  Document Contents: Electrical characteristics, functional description, pin configuration, absolute maximum ratings, application circuits, and packaging information.
  Language: Chinese
  File name: e2c199f2-496b-4291-882b-5596e2dba88e.pdf
  Version Pages: 1–5