# APDS-9960 Pro
# Professional Gesture Recognition Module

## Description

The APDS-9960 Pro is a professional grade gesture recognition module designed for ease-of-use, compatibility and perfect balance between high detection rate and the lowest rate of false positive detection. It can recognize linear gestures and rotary gestures, while providing estimated values of gesticulation speed and angle.

**Table 2. Technical specification**

| | |
|---|---|
| Size | 30 x 30 x 20 mm |
| Operating voltage | 3.6 to 6 V |
| Operating temperature | 0 to 60 °C |
| I²C | 400 kHz, configurable address |
| SPI | Master/slave modes |
| USART | 9600 bps / 115200 bps |
| USB | USB FS (HID/VCP modes) |
| GPIO | 16 outputs for gesture recognition events |

## Applications

- Smart home and automotive systems
- Audio mixers and control surfaces
- Broadcast studio equipment
- DJ controllers
- Musical instrument effects processors
- Gaming machines and toys
- Robotics
- Industrial and laboratory equipment

## Supported gestures

- Measures speed and angle of hand motion
- Recognizes Rotary knob / Airwheel gestures
- Fine finger motion tracking

## Features

- Extended proximity range up to 2m
- Good performance with no tuning required
- Individual GPIO output for each gesture
- Multiple interfaces: I2C, SPI, USART, USB

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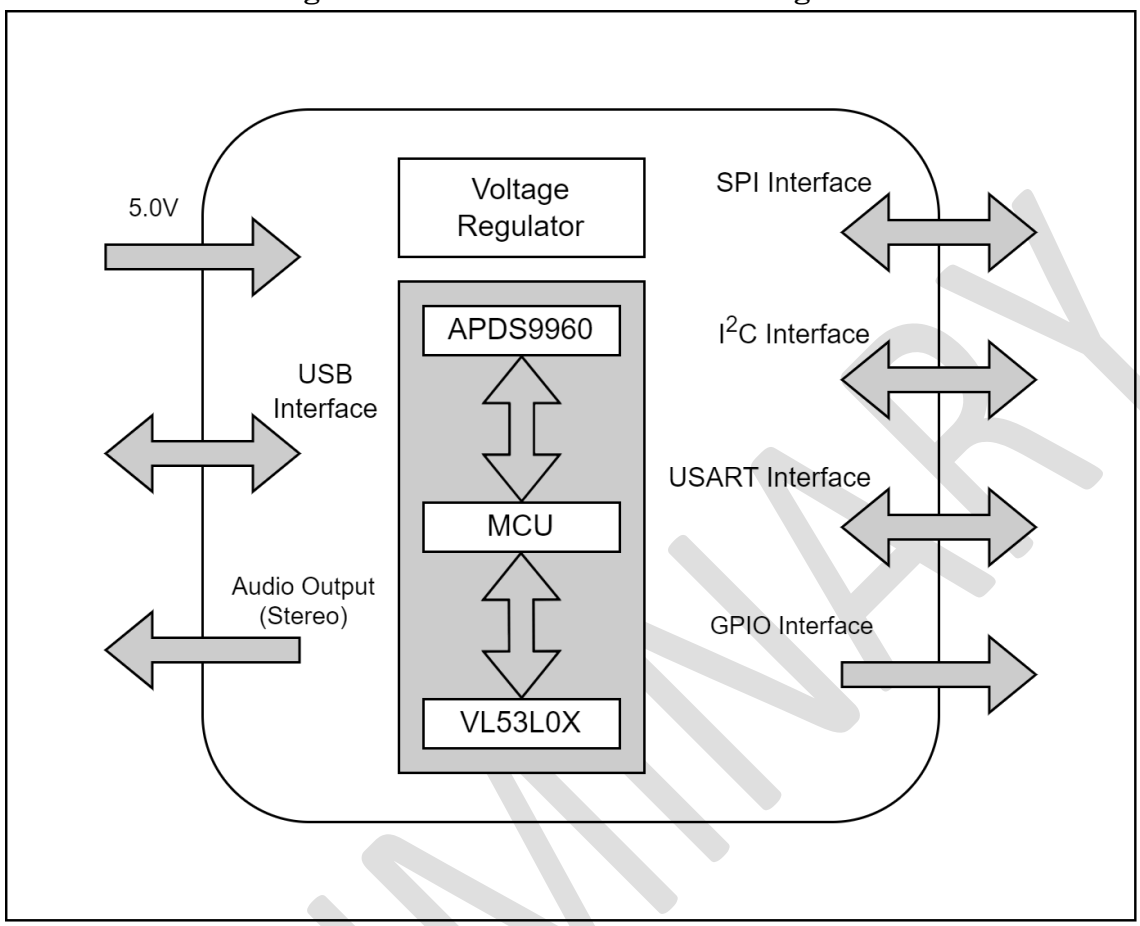
**Figure 1. APDS-9960 Pro block diagram**




## Device pinout

The APDS-9960 Pro module provides five digital interfaces (SPI, I²C, USART, GPIO, USB) and single analog audio output interface. There is no limitation on simultaneous use of these interfaces. Interfaces are not galvanically isolated and care must be taken to maintain voltage levels within specified levels.

## Power pins

The module has multiple power pins. Three adjacent +5v pins (D1,D2,D3) and three adjacent ground pins (D4,D5,D6) can be used for providing power to the module and for sharing power with other devices.

## GPIO pins

The module has 16 GPIO active-high output pins. Low-to-high voltage transition on pins A1 to A6 indicates recognized gesture type. Logical levels on pins A7, A8 provides recognized gesture speed value. Logical levels on pins C1, C2 provide rough proximity value. Pins C3 to C8 are reserved to be used as user configurable outputs. GPIO outputs can be used to drive external MOSFET transistors to imitate simple mechanical switch behavior.

**Table 2. Linear gesture pins**

| Pin | A1 | A2 | A3 | A4 | Gesture |
|---|---|---|---|---|---|
| Logical level | H | - | - | - | LEFT |
| | - | H | - | - | RIFGT |
| | - | - | H | - | DOWN |
| | | - | - | H | UP |
| | H | - | H | - | 45° UP-LEFT |
| | - | H | H | - | 45° UP-RIGHT |
| | H | - | - | H | 45° DOWN-LEFT |
| | - | H | - | H | 45° DOWN-RIGHT |

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**Table 3. Rotary gesture pins**

| Pin | A5 | A6 | Gesture |
|---|---|---|---|
| Logical level | H | - | CLOCKWISE |
| | - | H | COUNTER-CLOCKWISE |

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**Table 4. Motion speed pins**

| Pin | A7 | A8 | Motion |
|---|---|---|---|
| Logical level | - | - | VERY SLOW |
| | H | - | SLOW |
| | - | H | FAST |
| | H | H | VERY FAST |

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**Table 5. Proximity pins**

| Pin | C1 | C2 | Distance |
|---|---|---|---|
| Logical level | - | - | NOT IN RANGE |
| | H | - | FAR |
| | - | H | MIDDLE |
| | H | H | CLOSE |

## SPI interface

In slave mode, SPI interface (pins B1 to B4) can be used for configuring the sensor and for gesture data readout.

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In master mode, SPI interface can be used to control external screen for providing visual feedback.

## I²C interface

In slave mode, I²C interface (pins B6, B6) can be used for configuring the sensor and for gesture data readout.

In master mode, I²C interface can be used to control external screen for providing visual feedback.

## USART interface

USART interface (pins B7, B8) can be used for configuring the sensor and for gesture data readout.

## USB Interface

In HID mode, USB interface can be used for configuring the sensor and for sending control signals to operating systems similarly to Mouse, Keyboard or Joystick.

In VCP mode, USB interface can be used for configuring the sensor and for gesture data readout.

## AUDIO interface

Audio output interface (pins D7, D8) can be used for providing audio-feedback and entertainment applications.

Preliminary

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**Figure 2. APDS-9960 Pro pinout**

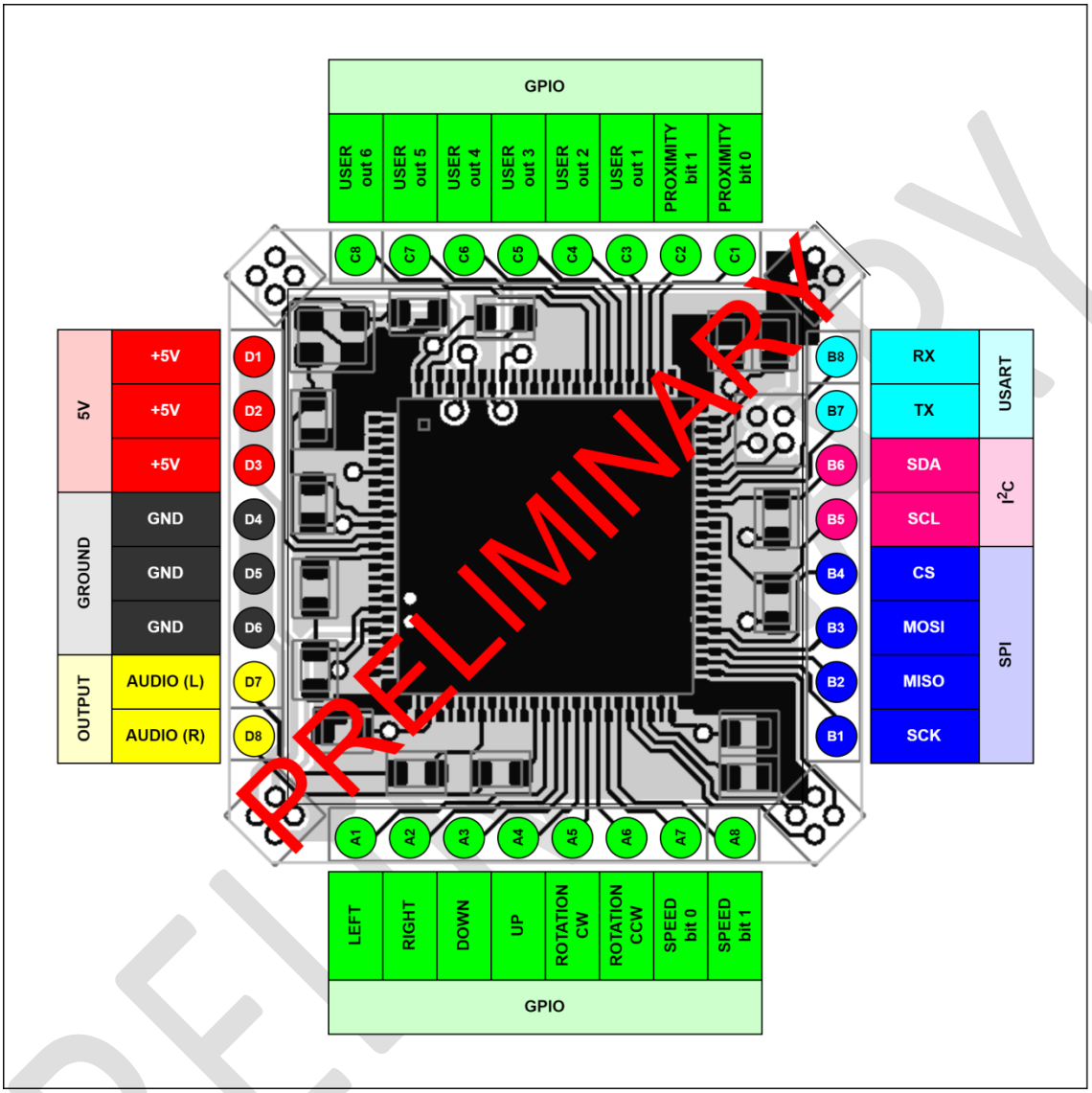

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**Table 6. APDS-9960 Pro pin description**

| Pin | Marking | Name | Type | Description |
|---|---|---|---|---|
| 1 | A1 | GPIO_A1 | O | LEFT |
| 2 | A2 | GPIO_A2 | O | RIGHT |
| 3 | A3 | GPIO_A3 | O | DOWN |
| 4 | A4 | GPIO_A4 | O | UP |
| 5 | A5 | GPIO_A5 | O | ROTATION CW |
| 6 | A6 | GPIO_A6 | O | ROTATION CCW |
| 7 | A7 | GPIO_A7 | O | SPEED bit 0 |
| 8 | A8 | GPIO_A8 | O | SPEED bit 1 |
| 9 | B1 | SPI_SCK | I/O | SPI clock |
| 10 | B2 | SPI_MISO | I/O | SPI MISO |
| 11 | B3 | SPI_MOSI | I/O | SPI MOSI |
| 12 | B4 | SPI_CS | I/O | SPI chip select |
| 13 | B5 | I2C_SCL | I/O | $I^2C$ serial clock |
| 14 | B6 | I2C_SDA | I/O | $I^2C$ serial data |
| 15 | B7 | USART_TX | O | USART transmit |
| 16 | B8 | USART_RX | I | USART receive |
| 17 | C1 | GPIO_C1 | O | PROXIMITY bit 0 |
| 18 | C2 | GPIO_C2 | O | PROXIMITY bit 1 |
| 19 | C3 | GPIO_C3 | O | USER out 1 |
| 20 | C4 | GPIO_C4 | O | USER out 2 |
| 21 | C5 | GPIO_C5 | O | USER out 3 |
| 22 | C6 | GPIO_C6 | O | USER out 4 |
| 23 | C7 | GPIO_C7 | O | USER out 5 |
| 24 | C8 | GPIO_C8 | O | USER out 6 |
| 25 | D1 | $V_{DD}$ | POWER | Power |
| 26 | D2 | $V_{DD}$ | POWER | Power |
| 27 | D3 | $V_{DD}$ | POWER | Power |
| 28 | D4 | GND | GND | Ground |
| 29 | D5 | GND | GND | Ground |
| 30 | D6 | GND | GND | Ground |
| 31 | D7 | AUDIO (L) | Analog out | Left channel |
| 32 | D8 | AUDIO (R) | Analog out | Right channel |

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