# PROJECT EQUIPMENT

## Computer Practicum EN - WIS - LES

Lecturer: Niki Hrovatin

# Requirements

Install the following software on your computers:

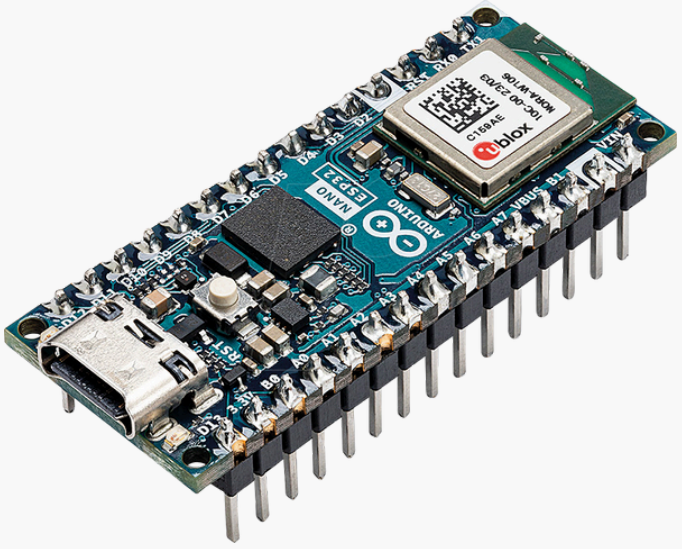
- Arduino Lab for MicroPython
- Package installer releases

Ensure that you have a google account (Gmail), we will use Google colab.

# Arduino Nano ESP32

**Our microcontroller:** a small programmable computer built around the ESP32-S3, with Wi-Fi and Bluetooth connectivity.

- **Programming:** MicroPython (Python for microcontrollers).
- **Sensors and modules:** mainly connected using **I²C**; one bus can connect multiple devices.
- **Onboard LEDs:** green power indicator, programmable yellow status LED and RGB LED.
- **RESET button:** restarts the board; also used for recovery/bootloader mode.
- **USB-C:** power, programming and serial communication.




**References:**

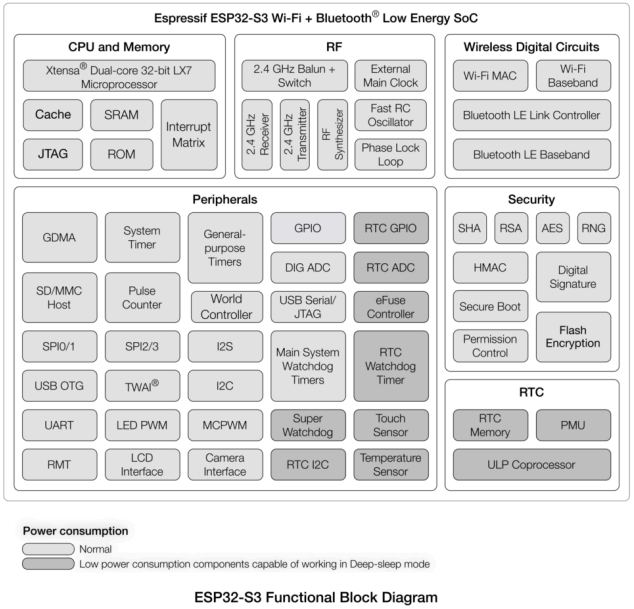
- Nano ESP32 datasheet
- MicroPython guide
- Arduino Micropython 101 Course

# Arduino Nano ESP32 - Microcontroller Module

The u-blox NORA-W106 module integrates the ESP32-S3 microcontroller, memory and wireless connectivity.




- Processor: Dual-core 32-bit Xtensa LX7, up to 240 MHz per core.
- Internal memory: 512 KB SRAM and 384 KB ROM.
- Additional memory: 8 MB PSRAM and 16 MB Flash.
- Wi-Fi: 2.4 GHz, IEEE 802.11 b/g/n (Wi-Fi 4).
- Bluetooth: Bluetooth 5.0 Low Energy (BLE).
- Operating voltage: 3.3 V.



ESP32-S3 Functional Block Diagram

# Arduino Nano ESP32 -- pinout

The pinout identifies the board's pins and their functions, including connections for sensors, actuators, power and communication.

Input/Output pins:

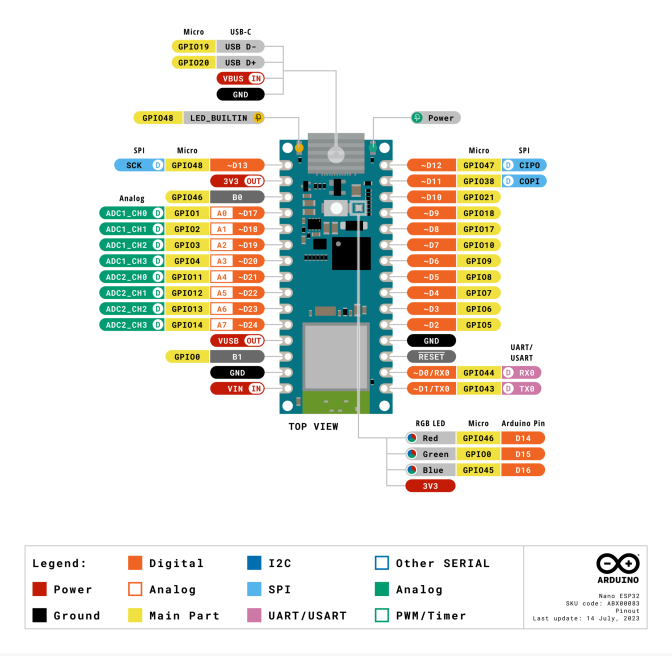
- 14 digital pins (D0–D13): read or generate digital signals (HIGH/LOW).
- 8 analog input pins (A0–A7): measure analog voltages using a 12-bit ADC.
- PWM: generates pulse-width-modulated output signals for controlling devices such as LEDs and motors.

Communication interfaces:

- $I^2C$: A4 (SDA), A5 (SCL) — connect multiple sensors using two signal wires.
- SPI: D11 (COPI), D12 (CIPO), D13 (SCK) — high-speed communication with peripherals.
- UART: D0 (RX), D1 (TX) — asynchronous serial communication.
- Other supported interfaces: $I^2S$ (digital audio) and TWAI/CAN.

Power and electrical characteristics:

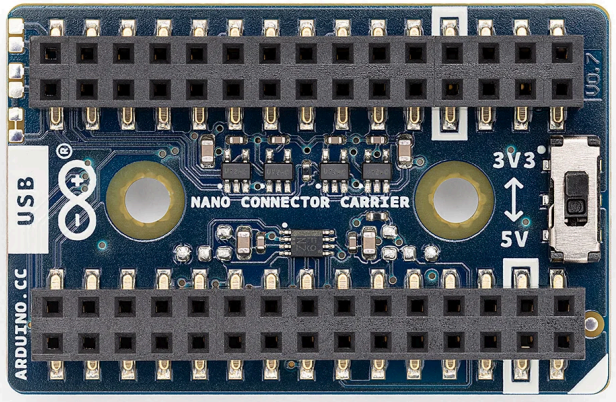
- Logic voltage: 3.3 V — GPIO pins are not 5 V tolerant.
- Power pins: 3V3, GND, VIN and VBUS.
- Analog input pins can also function as digital GPIO pins.

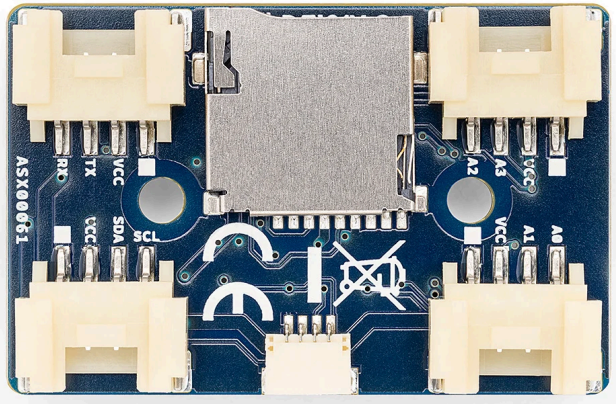


# Arduino Nano Connector Carrier

**Expansion board** for connecting sensors and storing experiment data.

- **1 Qwiic connector:** 3.3 V I$^2$C; compatible with Qwiic and Modulino modules.
- **4 Grove connectors:** 2 analog/digital, 1 I$^2$C and 1 UART (serial) connector.
- **microSD card slot:** store measurements as files (for example, `.csv`) without leaving a computer connected.
- **Voltage selection switch:** select **3.3 V** for the Nano ESP32; it also sets the Grove connector supply voltage.
- **Connection:** Qwiic and Grove allow quick attachment of compatible modules without breadboards.



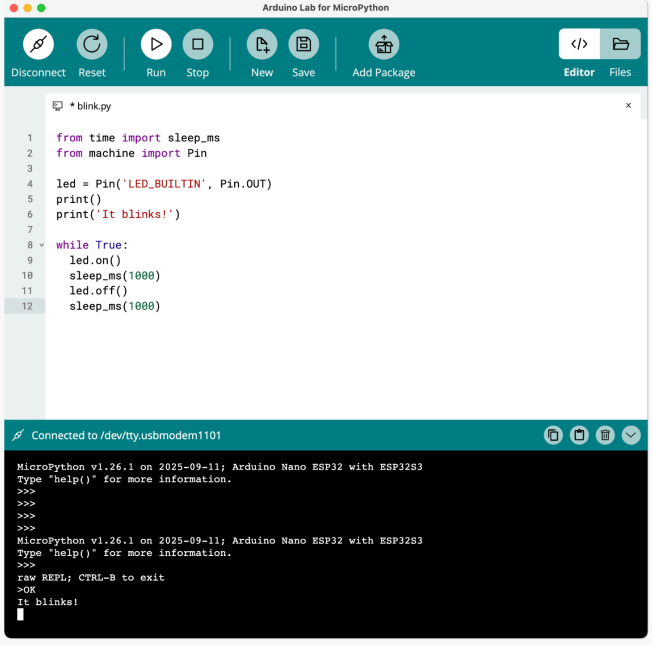




**References:** Carrier datasheet (PDF) · Getting started

# Software — Arduino Lab for MicroPython

**Desktop editor** for writing and running MicroPython code on the Arduino Nano ESP32.

- Edit and run Python scripts on the connected board.
- Use the **REPL** to enter commands and view printed measurements.
- Transfer files between the computer and the microcontroller.




**Official page:** Arduino Lab for MicroPython

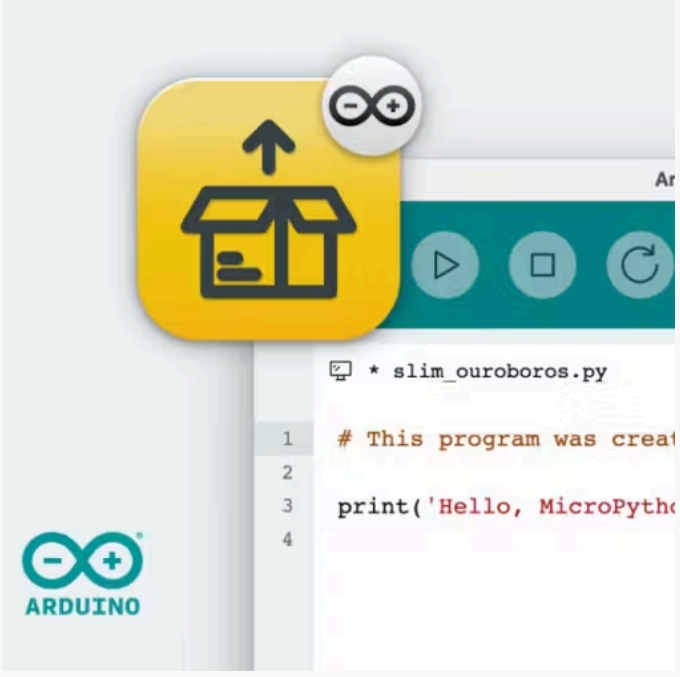
# Software — MicroPython Package Installer

**Package manager** for adding ready-made Python libraries to the microcontroller.

- Find compatible MicroPython packages.
- Download and install packages onto the connected Arduino board.
- Use libraries for sensor readout, calculations and data handling instead of writing everything from scratch.

**Download:** Package installer releases

**Important:** an available *Arduino/C++ library* is not necessarily compatible with *MicroPython*.



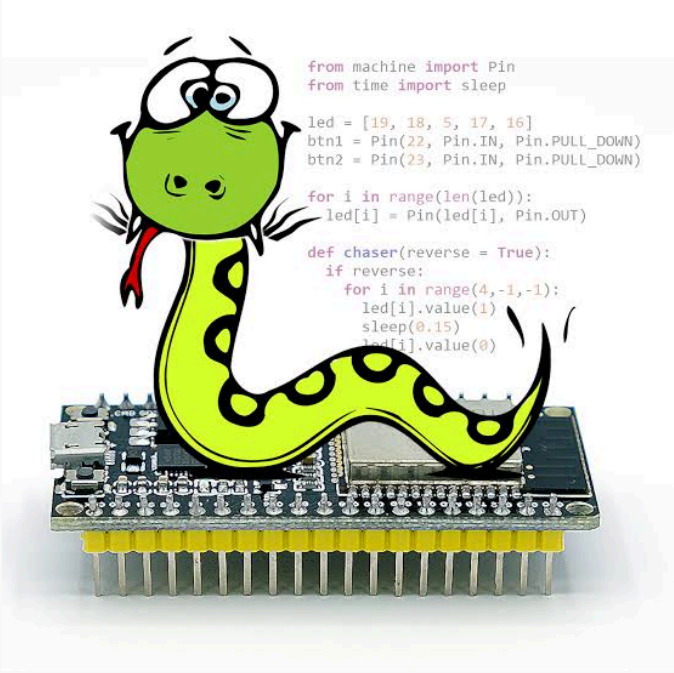
# Micropython / Python tutorials

**Python tutorials:**

- https://www.learnpython.org/en/Welcome
- https://futurecoder.io/

**Mycropython tutorials:**

- Arduino Python crash course



# Temperature & humidity — SHT45

**Full module:** Adafruit SHT45 Precision Temperature & Humidity Sensor (Product 5665)

**Measures:** Air temperature · Relative humidity

**Available units:** 2

**Complexity:** Easy

**Documentation**

- **Module:** Module guide / schematic
- **Sensing component:** Sensirion SHT45 (SHT4x series) — datasheet



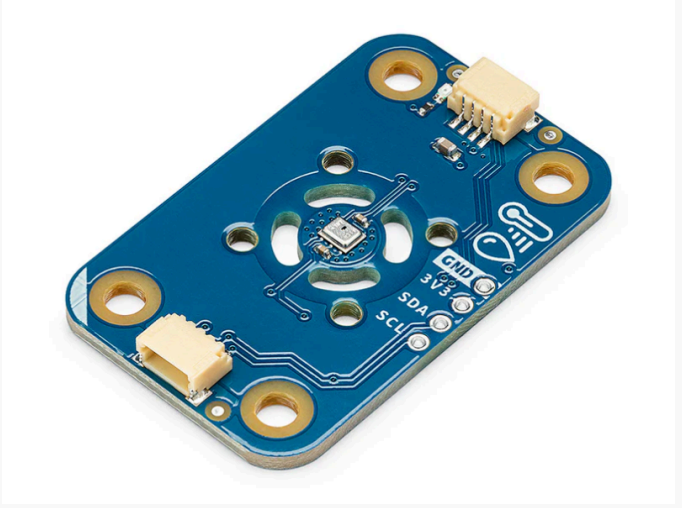
# Temperature & humidity — Thermo

**Full module:** Arduino Modulino Thermo (ABX00103)

**Measures:** Air temperature · Relative humidity

**Available units:** 3

**Complexity:** Easy




**Documentation**

- **Module:** Module datasheet (PDF)
- **Sensing component:** Renesas HS3003 (HS3xxx series) — datasheet

# Atmospheric conditions — LPS22HB

**Full module:** Adafruit LPS22HB Pressure Sensor Breakout (Product 4633)

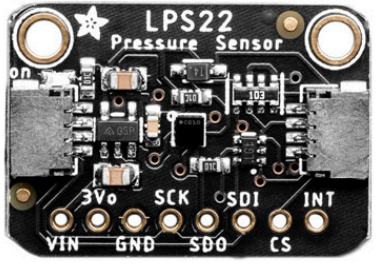
**Measures:** Atmospheric pressure · Temperature

**Available units:** 1

**Complexity:** Easy

**Documentation**

- **Module:** Module guide / schematic
- **Sensing component:** STMicroelectronics LPS22HB — datasheet



# Air quality — ENS160

**Full module:** Adafruit ENS160 MOX Gas Sensor — STEMMA QT / Qwiic (Product 5606)

**Measures:** $CO_2$ · VOC · Air quality index

**Available units:** 1

**Complexity:** Medium

**Documentation**

- **Module:** Module guide / schematic
- **Sensing component:** ScioSense ENS160 — datasheet



# Air quality — SGP40

**Full module:** Adafruit SGP40 VOC Sensor Breakout — STEMMA QT / Qwiic (Product 4829)

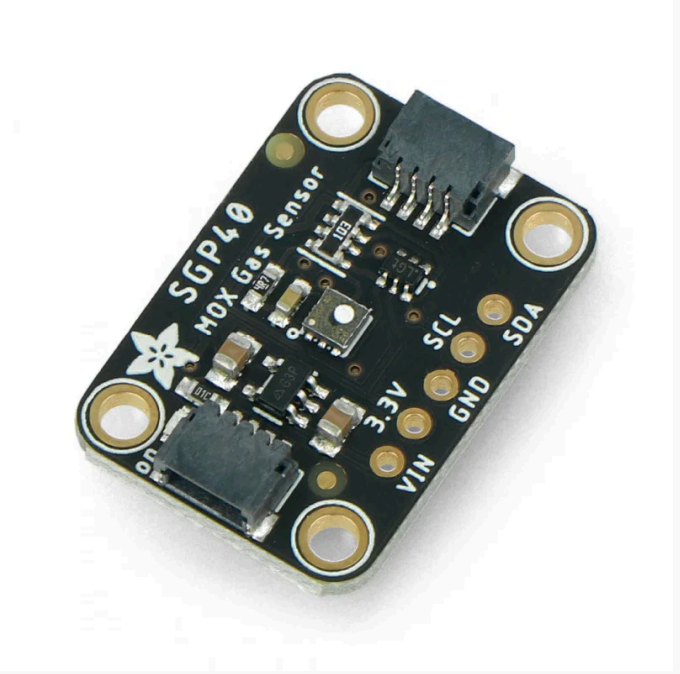
**Measures:** VOC

**Available units:** 1

**Complexity:** Hard

**Documentation**

- **Module:** Module guide / schematic
- **Sensing component:** Sensirion SGP40 — datasheet



# Soil conditions — Soil moisture

**Full module:** SparkFun Qwiic Soil Moisture Sensor (SEN-24409)

**Measures:** Soil moisture

**Available units:** 2

**Complexity:** Medium

**Documentation**

- **Module:** Module schematic (PDF)
- **Sensing component:** Conductive PCB probe (controlled by ATtiny85) — no separate sensor datasheet



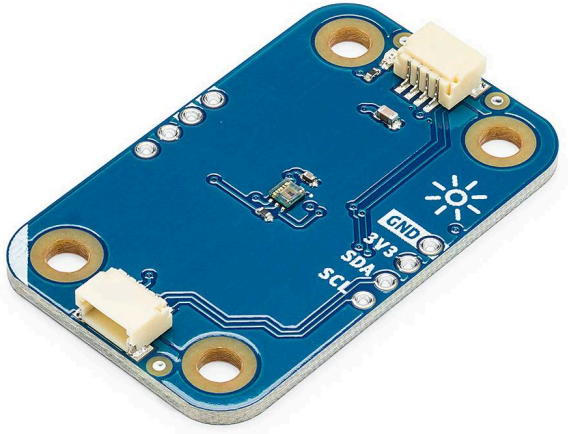
# Light & color — Modulino Light

**Full module:** Arduino Modulino Light (ABX00111)

**Measures:** Illuminance · Red, green, blue & infrared light

**Available units:** 3

**Complexity:** Medium




**Documentation**

- **Module:** Module datasheet (PDF)
- **Sensing component:** Lite-On LTR-381RGB-01 — datasheet

# Light & ultraviolet — LTR390

**Full module:** Adafruit LTR390 UV Light Sensor — STEMMA QT / Qwiic (Product 4831)

**Measures:** Ultraviolet light · ALS (Ambient Light Sensor)

**Available units:** 3
**Complexity:** Medium

**Documentation**

- **Module:** Module guide / schematic
- **Sensing component:** Lite-On LTR-390UV-01 — datasheet



# Light & spectrum — AS7343

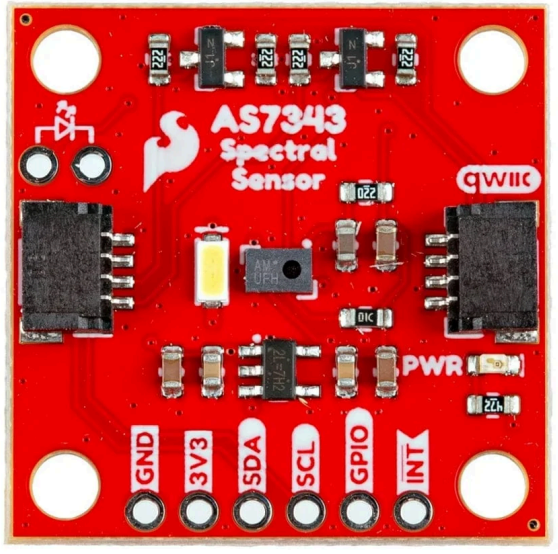
**Full module:** SparkFun Qwiic Spectral Sensor — AS7343 (SEN-23220)

**Measures:** Visible & near-infrared spectral light

**Available units:** 1
**Complexity:** Hard

**Documentation**

- **Module:** Module schematic (PDF)
- **Sensing component:** ams OSRAM AS7343 (14-channel) — datasheet



# Distance — VL53L4CD

**Full module:** Adafruit VL53L4CD Time-of-Flight Distance Sensor (Product 5396)

**Measures:** Object distance · Proximity

**Available units:** 1

**Complexity:** Medium

**Documentation**

- **Module:** Module guide / schematic
- **Sensing component:** STMicroelectronics VL53L4CD — datasheet

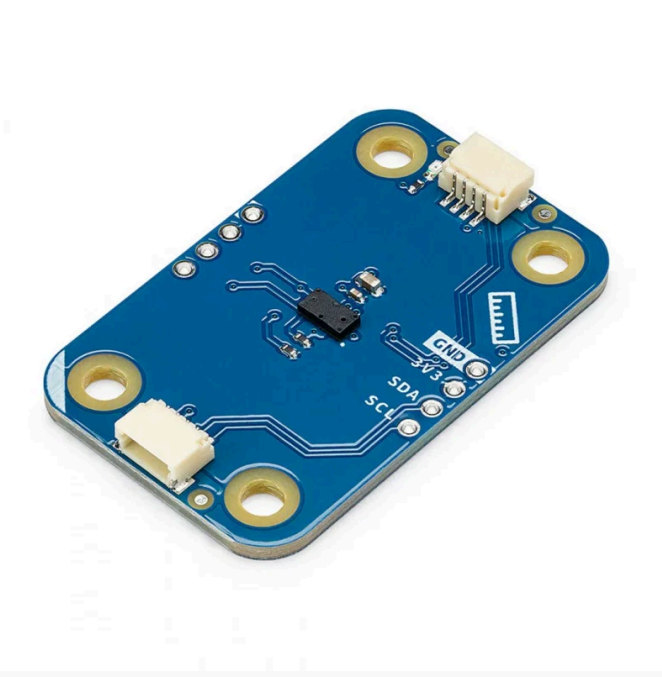


# Distance — Modulino Distance

**Full module:** Arduino Modulino Distance (ABX00102)

**Measures:** Object distance · Proximity

**Available units:** 1 **Complexity:** Easy




**Documentation**

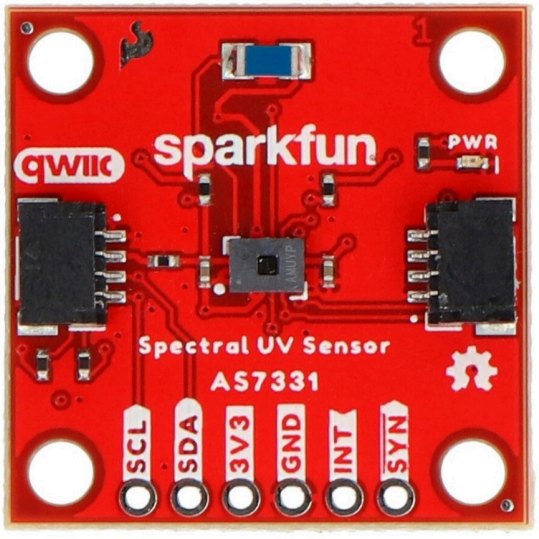
- **Module:** Module datasheet (PDF)
- **Sensing component:** STMicroelectronics VL53L4CD — datasheet

# Human presence — STHS34PF80

**Full module:** SparkFun Qwiic Human Presence and Motion Sensor — STHS34PF80 (SEN-22494)

**Measures:** Human presence · Motion · Infrared radiation · Ambient temperature

**Available units:** 1
**Complexity:** Medium




**Documentation**

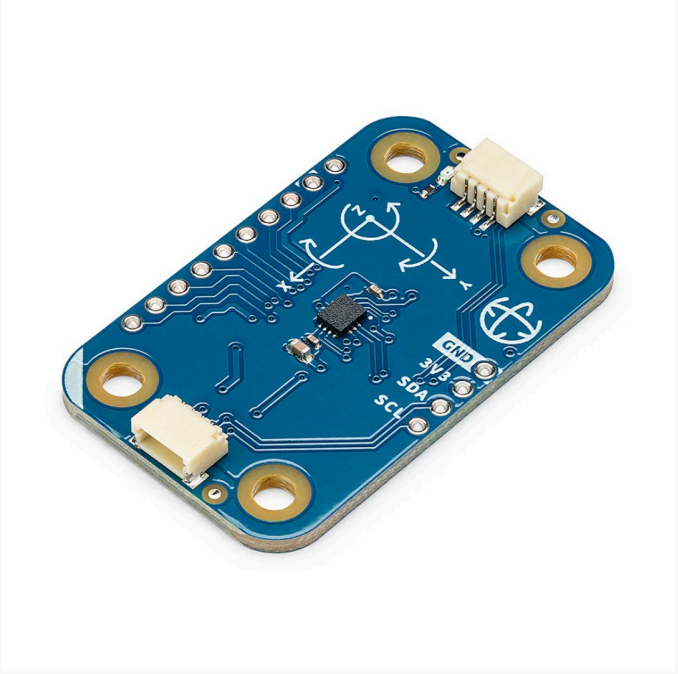
- **Module:** Module schematic (PDF)
- **Sensing component:** STMicroelectronics STHS34PF80 — datasheet

# Motion & orientation — Movement

**Full module:** Arduino Modulino Movement (ABX00101)

**Measures:** 3-axis acceleration · 3-axis angular velocity

**Available units:** 3
**Complexity:** Hard




**Documentation**

- **Module:** Module datasheet (PDF)
- **Sensing component:** STMicroelectronics LSM6DSOXTR (LSM6DSOX series) — datasheet

# User input — Buttons

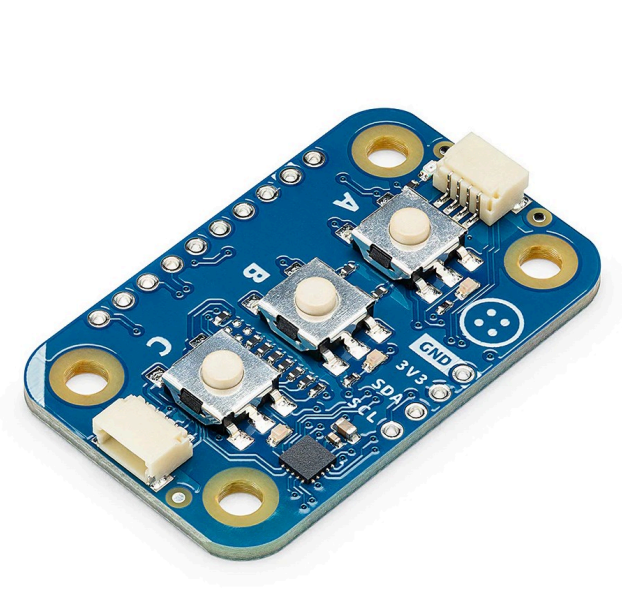
**Full module:** Arduino Modulino Buttons (ABX00110)

**Detects:** Three pushbutton states

**Available units:** 1 **Complexity:** Easy

**Documentation**

- **Module:** Module datasheet (PDF)
- **Sensing component:** Three mechanical pushbuttons; three indicator LEDs — no separate sensor datasheet



# User input — Knob

**Full module:** Arduino Modulino Knob (ABX00107)

**Detects:** Rotation steps & direction · Pushbutton state

**Available units:** 1
**Complexity:** Easy




**Documentation**

- **Module:** Module datasheet (PDF)
- **Sensing component:** Bourns PEC11J-9215F-S0015 rotary encoder — datasheet