#### **BME688**



# BME688 Environmental Sensor 4-in-1

v1.0 2025-09-24

Rev. A

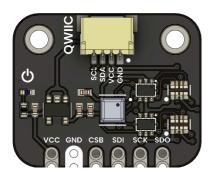
Professional electronic component

#### **PRODUCT OVERVIEW**

The BME688 Environmental Sensor 4-in-1 is a compact and highly integrated sensing solution based on Bosch Sensortec's advanced gas sensor technology. Designed for next-generation environmental monitoring, this module simultaneously measures four key parameters: temperature, relative humidity, barometric pressure, and gas presence, including volatile organic compounds (VOCs) and indoor air quality (IAQ) indicators. By combining multiple sensors in one package, the BME688 reduces design complexity and board space, making it especially suitable for size-constrained applications such as wearables, portable devices, and smart IoT nodes. The module features digital communication via I<sup>2</sup>C or SPI interfaces, ensuring seamless integration with microcontrollers and embedded platforms like Arduino, ESP32, and Raspberry Pi. Its ultra-low power consumption enables continuous monitoring in battery-operated systems, while its wide operating range and high accuracy support precise environmental data acquisition under dynamic conditions. Furthermore, the gas sensor includes support for Albased classification of gas mixtures using Bosch's BME Al-Studio, opening new possibilities for custom air quality applications.

#### **PRODUCT VIEWS**

#### **TOP VIEW**



Component placement and connectors

#### **BOTTOM VIEW**



Underside components and connections

### **KEY TECHNICAL SPECIFICATIONS**



#### **CONNECTIVITY**

Primary Interface: **GPIO (Interrupt)** 

Connector Type: JST 4-pin 1.0mm

Logic Levels: VCC-referenced (2V - 5.5V tolerant)

#### **KEY FEATURES**

#### **Relative Humidity**

Accurately measures ambient moisture for precise environmental monitoring.

#### **Excellent Temperature Stability**

Delivers consistent temperature readings even under varying conditions.

#### **Power Consumption:**

Optimized for low power usage, making it ideal for battery-operated devices.

#### Input Voltage via VCC Pin:

3.6-6.0 V (through onboard voltage regulator)

#### **Barometric Pressure**

Detects atmospheric pressure changes to support dynamic weather

#### **Gas Sensing**

Monitors a range of gases to help identify potential environmental hazards.

#### Interfaces:

I<sup>2</sup>C and SPI

#### ADDITIONAL TECHNICAL INFORMATION



#### **PARAMETER VALUE/DESCRIPTION** Operating Voltage 1.71V to 3.6V

-	
Supply Current	0.9 μA (sleep), 2.1 μA (ULP), ~920 μA (gas scan)
Operating Temperature	-40°C to +85°C
Relative Humidity Range	0% to 100% RH
Pressure Range	300 hPa to 1100 hPa
Gas Sensing	VOCs, IAQ index via integrated gas sensor
Interfaces	I <sup>2</sup> C and SPI (up to 3.4 MHz)
Package Size	$3.0 \times 3.0 \times 0.93 \text{ mm}^3$

Technical Datasheet - BME688

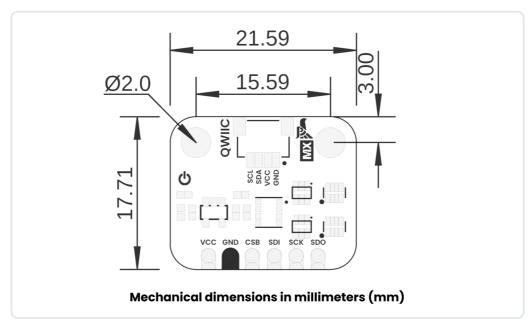


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PARAMETER	TECHNICAL DATA
Package dimensions	8-Pin LGA with metal3.0 x 3.0 x 0.93 mm <sup>3</sup>
Operation range (full accuracy)	Pressure: 3001100 hPaHumidity: 0100%Temperature: -4085°C
Supply voltage VDDIO	1.2 - 3.6 V
Supply voltage VDD	1.71 - 3.6 V
Interface	I <sup>2</sup> C and SPI
Average current consumption	$2.1~\mu A$ at $1~Hz$ humidity and temperature $3.1~\mu A$ at $1~Hz$ pressure and temperature $3.7~\mu A$ at $1~Hz$ humidity, pressure and temperature $90~\mu A$ at ULP mode for p/h/T & air quality $90~\mu A$ at LP mode for p/h/T & air quality $90~\mu A$ at LP mode for p/h/T & air quality $90~\mu A$ at LP mode for p/h/T & air quality $90~\mu A$ at LP mode for p/h/T & air quality $90~\mu A$ at LP mode for p/h/T & air quality $90~\mu A$ at LP mode for p/h/T & air quality $90~\mu A$ at LP mode for p/h/T & air quality $90~\mu A$ at
Gas sensor - F1 score for H₂S scanning	0.94
Gas sensor - Standard scan speed	10.8 s / scan
Gas sensor - Electric charge for standard scan	0.18 mAh (5 scans ~ 1 min)
Gas sensor - Response time (τ 33-63%)	< 1 s (for new sensors)
Gas sensor - Sensor-to- sensor deviation	+/- 15%
Gas sensor - Power consumption	< 0.1 mA in ultra-low power mode
Gas sensor - Output data processing	Major direct outputs: Index for Air Quality (IAQ), bVOC-& CO <sub>2</sub> -equivalents (ppm), Gas scan result (%) & many more (all listed in datasheet in Table 20: BSEC outputs)
Humidity sensor - Response time (τ0- 63%)	8 s
Humidity sensor - Accuracy tolerance	± 3 % relative humidity
Humidity sensor - Hysteresis	≤ 1.5 % relative humidity
Pressure sensor - RMS Noise	0.12 Pa (equiv. to 1.7 cm)
Pressure sensor - Sensitivity Error	± 0.25 % (equiv. to 1 m at 400 m height change)
Pressure sensor - Temperature coefficient offset	±1.3 Pa/K (equiv. to ±10.9 cm at 1°C temperature change)

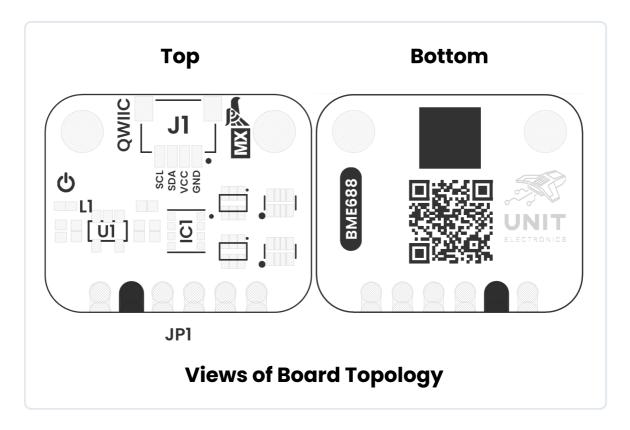
#### HARDWARE DOCUMENTATION

#### MECHANICAL DIMENSIONS



Physical dimensions and mounting specifications (measurements in millimeters)

#### SYSTEM TOPOLOGY

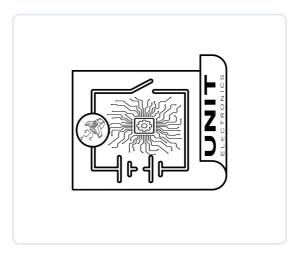


#### Connection topology and system integration diagram

Click image to open in full size

COMPONENT REFERENCE		
REF.	DESCRIPTION	
IC1	BME688 Environmental Sensor	
L1	Power On LED	
U1	AP2112K 3V3 Regulator	
JP1	2.54 mm Castellated Holes	
J1	QWIIC Connector (JST 1 mm pitch) for I2C	

#### CIRCUIT SCHEMATIC



Complete circuit schematic showing all component connections

**View Complete Schematic PDF** 

## **PIN DESCRIPTION**

Detailed pin assignment and electrical specifications

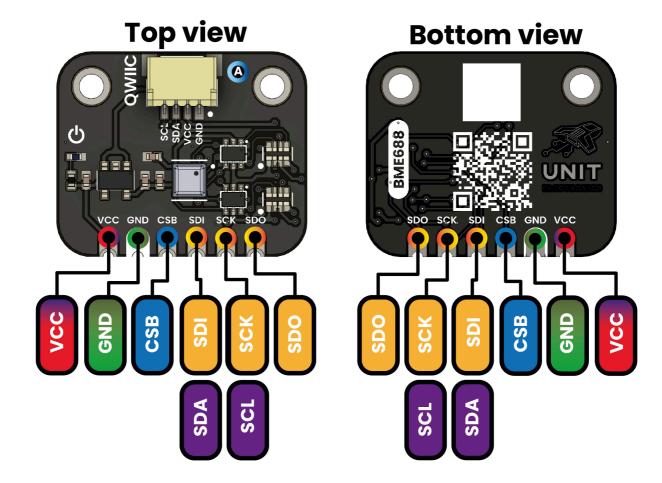
# PIN LABEL Power supply (3.3V or 5V) GND Ground SDA/SDI SCL/SCK I²C clock / SPI clock CSB Chip select (SPI, active low) SDO SPI data out

## PIN CONFIGURATION LAYOUT

Technical Datasheet - BME688

Physical connector layout and pin positioning

# **PINOUT**



## **Description:**



Complete pin configuration diagram showing all connectors, pin assignments, and electrical connections for proper integration

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