BME688



BME688 Environmental Sensor 4-in-1

v1.0 2025-07-29

Rev. A

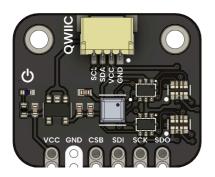
Professional electronic component

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 I²C 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

Interfaces: I2C, SPI

Qwiic + Pin Headers Connector:

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 tracking.

Gas Sensing

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

Interfaces:

I²C and SPI

TECHNICAL SPECIFICATIONS



*** TECHNICAL SPECIFICATIONS**

PARAMETER	TECHNICAL DATA	
Package dimensions	8-Pin LGA with metal3.0 x 3.0 x 0.93 mm ³	
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 ² 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 $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ in standard gas scan mode (gas scan mode & scan rate can be optimized on applications with BME AI studio)	
Gas sensor - F1 score for H ₂ S 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)	

PARAMETER	TECHNICAL DATA	
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 ₂ -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)	

SUPPORTS

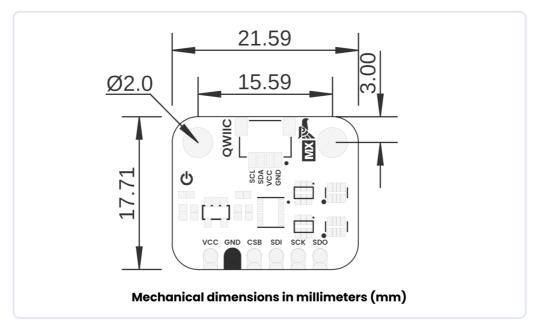
SYMBOL	I/O	DESCRIPTION	
VCC	Input	3.3V or 5V	
GND	GND	Common ground for all components	

TYPICAL APPLICATIONS

APPLICATION	DESCRIPTION	
Environmental Monitoring	Tracks air quality, humidity, temperature, and pressure in smart homes and industrial settings.	
IoT Devices	Integrates into IoT systems for real-time environmental data collection and analysis.	
Weather Stations	Enables accurate weather forecasting and monitoring in DIY weather station projects.	
Smart Agriculture	Monitors soil and air conditions to optimize crop growth and yield.	
Wearable Devices	Supports health and fitness wearables for environmental parameter monitoring.	

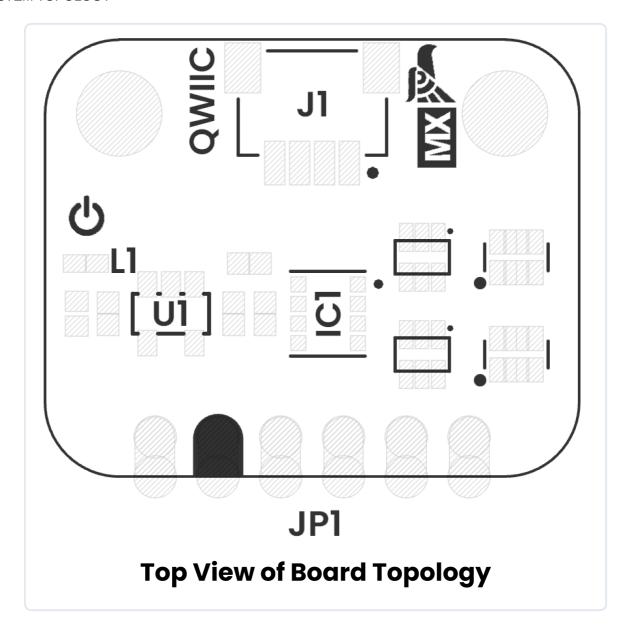
HARDWARE DOCUMENTATION

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

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

INTERFACE	SIGNALS / PINS	TYPICAL USE
UART	-	Unavailable
I ² C	SDA, SCL (CSB held high)	Default interface (Qwiic connector)
SPI	CSB = GND, SDI (MOSI), SCK, SDO (MISO)	High-speed alternative
USB	-	Unavailable on this module

CIRCUIT SCHEMATIC



Complete circuit schematic showing all component connections

View Complete Schematic PDF

PIN DESCRIPTION

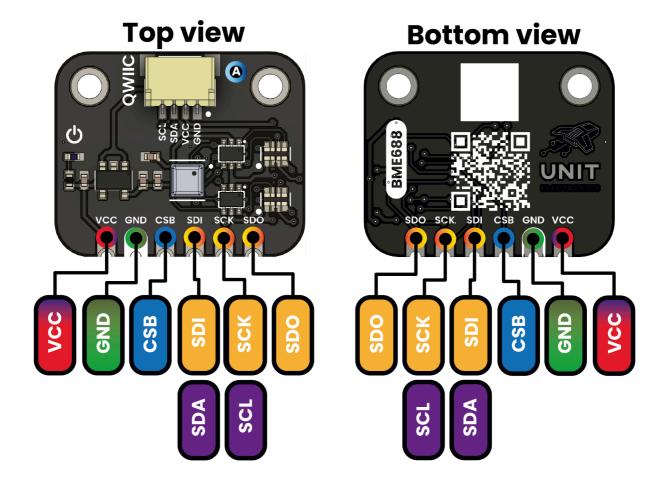
Detailed pin assignment and electrical specifications

SIGNAL DESCRIPTION FUNCTION NOTES Power Supply 3.3V or 5V Ground Common ground for all components **GROUP SUGGESTED USE AVAILABLE PINS** SPI CSB, SDI (MOSI), SDO (MISO), SCK High-speed SPI to read sensor data I²C SDA, SCL (via Qwiic connector) Standard I²C for configuration & data acquisition

PIN CONFIGURATION LAYOUT

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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