BME688



BME688 Environmental Sensor 4-in-1

v1.0

2025-09-30 Rev. A

Professional electronic component

PRODUCT OVERVIEW

The BME688 Environmental Sensor 4-in-1 is a compact module that integrates temperature, humidity, barometric pressure, and gas sensing (including VOCs and IAQ) in a single package. Based on Bosch Sensortec technology, it offers digital I²C/SPI interfaces for easy integration with platforms like Arduino, ESP32, and Raspberry Pi. Its low power consumption and small size make it ideal for wearables, portable devices, and IoT applications. The sensor also supports AI-based gas classification via Bosch's BME AI-Studio, enabling advanced air quality monitoring.

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

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

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 ² C and SPI (up to 3.4 MHz)
Package Size	$3.0 \times 3.0 \times 0.93 \text{ mm}^3$



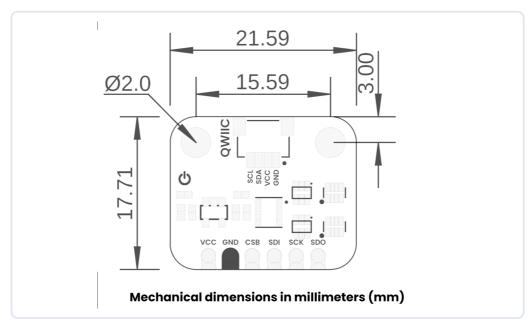
PARAMETER	TECHNICAL DATA
Package dimensions	8-Pin LGA with metal3.0 x 3.0 x 0.93 mm ³
Operation range (full accuracy)	Pressure: 3001100 hPaHumidity: 0100%Temperature: -4085°C
Supply voltage VDDIO	1.2 - 3.6 V
Supply voltage VDD	1.71 - 3.6 V
Interface	I ² C and SPI
Average current consumption	$2.1~\mu A$ 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 $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at LP mode for p/h/T & air quality $90.9~\mu A$ at L
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)
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-& CO2-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)

🌞 TECHNICAL SPECIFICATIONS

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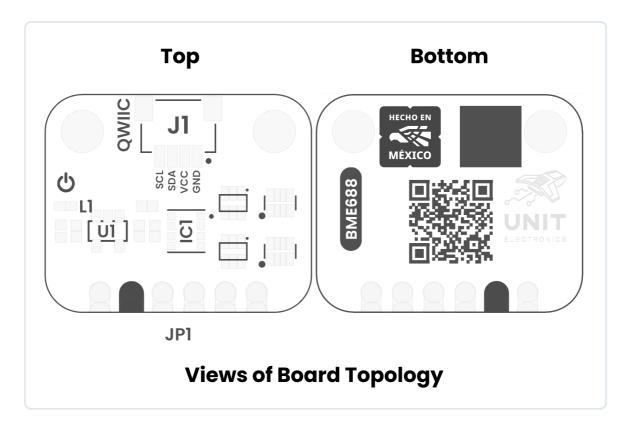
HARDWARE DOCUMENTATION

MECHANICAL DIMENSIONS



Physical dimensions and mounting specifications (measurements in millimeters)

SYSTEM TOPOLOGY



Connection topology and system integration diagram

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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	
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CIRCUIT SCHEMATIC



Complete circuit schematic showing all component connections

View Complete Schematic PDF

PIN DESCRIPTION

Detailed pin assignment and electrical specifications

SIGNAL DESCRIPTION	
PIN LABEL	DESCRIPTION
VCC	Power supply (3.3V or 5V)
GND	Ground
SDA/SDI	I ² C data / SPI data in
SCL/SCK	I ² C clock / SPI clock
CSB	Chip select (SPI, active low)
SDO	SPI data out
PIN LABEL	DESCRIPTION
VCC	Power supply (3.3V or 5V)
ONE	
GND	Ground
SDA/SDI	Ground I ² C data / SPI data in
SDA/SDI	I ² C data / SPI data in
SDA/SDI SCL/SCK	I ² C data / SPI data in I ² C clock / SPI clock

PIN CONFIGURATION LAYOUT

Physical connector layout and pin positioning



Pin Configuration Layout

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

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