PCBA-DBM-Eco Module Datasheet

Accurate I²C Sound Level Sensor Module for Budget Applications

The PCBA-DBM-Eco module is a tiny, low-power sound level sensor that brings the accuracy and capability of a handheld sound meter to embedded applications.

This module can connect with any host MCU over I²C and performs accurate A-weighted decibel level measurements while consuming very little power.

These features make the PCBA-DBM-Eco an excellent addition to systems that do not have the MCU capability to perform DSP tasks or Single Board Computers (SBCs) where DSP tasks take away valuable CPU time.

For ease of use, the module is available in two configurations – unsoldered 0.1″ headers or with a soldered JST-XH 2.5mm pitch connector (as seen in this picture).

We also provide accessories like die-cut 3M gasket tape and adhesive IP67 acoustic membranes for using with this sensor.

Contents

Features

- Designed with reference to IEC 61672-1 Class 2
- Wide measurement range: **30 dB to 115 dB**
- **Two decimal point** reading precision
- High accuracy: **±1dB** at 1 kHz, 94 dB SPL
- Works with 1.8V, 3.3V, and 5V I²C bus levels
- 400 kHz I²C interface
- Active Mode: **2.2 mA @ 3.3V**
  Sleep Mode: 10 µA @ 3.3V
- **Factory-checked** to ensure accuracy
- **Min/Max** tracking with **level interrupts**

Applications

- IoT sensor nodes and networks
- Battery-powered devices
- Smart Home appliances
- Indoor/outdoor noise monitoring

Pin Configuration and Functions

The PCBA-DBM-Eco can be ordered with unsoldered 0.1″ headers or with a JST-XH 2.5mm pitch connector. Both configurations use the pinout shown below.

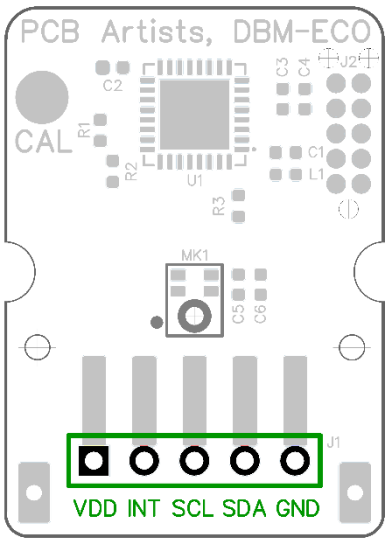

Figure 1: PCBA-DBM-Eco Pinout

Pin	Name	Type	Description
1	VDD	Ground	Power supply input pin (1.8V or 3.3V)
2	INT	O[1][2]	Interrupt output (active-low)
3	SCL	I/O[1][2]	I²C interface SCL line
4	SDA	I/O[1][2]	I²C interface SDA line
5	GND	Power	Power ground

[1] Open-drain pin; pull-ups must be added as per host device requirements

[2] 5V tolerant pin

Mechanical Dimensions

The module is based on a 0.8 mm thick PCB.

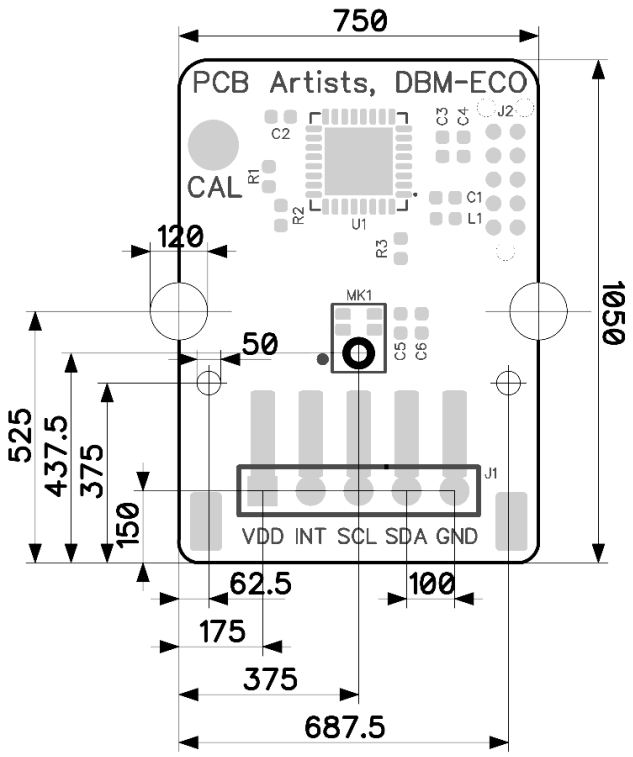

Figure 2: PCBA-DBM-Eco Dimensions (unit: mil)

Electrical Characteristics

Absolute Maximum Ratings

Stresses beyond those listed below may cause permanent damage to the device.
These are stress ratings only and functional operation of the device at these conditions is not implied. Exposure to the absolute maximum ratings conditions for extended periods may affect device reliability.

Parameter	Min	Typ	Max	Unit
Supply Voltage (V_{DD})	-0.3	-	3.6	V
Voltage on SCL and SDA Pins	-0.3	-	V_{DD} + 4.0	V
Voltage on INT Pin	-0.3	-	V_{DD} + 4.0	V
Sink Current by any I/O	-	-	20	mA
Storage Temperature	-55	-	+150	°C
Sound Pressure Level	-	-	160	dB SPL

Recommended Operating Conditions

Parameter	Min	Typ	Max	Unit
Supply Voltage (V_{DD})	1.65	-	3.6	V
Voltage on SCL and SDA Pins	-0.3	-	V_{DD} + 2.0	V
Voltage on INT Pin	-0.3	-	V_{DD} + 2.0	V
Operating Temperature	-40	-	85	°C

Power Consumption

Current consumption does not depend on acoustic input signal characteristics or loudness.
Average current consumption in various operating modes at T_A = 25°C are listed below.

Parameter	Min	Typ	Max	Unit
Active Mode Current (average[1]), V_{DD} = 1.8V	-	2.1	-	mA
Active Mode Current (average[1]), V_{DD} = 3.3V	-	2.2	-	mA
Sleep Mode Current (average), V_{DD} = 1.8V	-	8	-	uA
Sleep Mode Current (average), V_{DD} = 3.3V	-	10	-	uA

[1] The module contains a total of 15 µF in decoupling capacitors on VDD. In ultra-low power applications, it may be important to consider inrush limiting if the system power supply cannot withstand a power-up inrush current of 80 mA for 0.2 milliseconds.

I²C Interface

Parameter	Min	Typ	Max	Unit
Clock Speed	-	100	400	kHz
SCL and SDA Pull-ups	1	4.7	10	kOhm
I²C Activation Time after Reset/Power-on	10	12	15	ms
Valid Acoustic Data after Reset/Power-on	-	50	60	ms
Reading Update Period (L_A, L_{Amax}, L_{Amin})	-	30	-	ms

Acoustic Characteristics

The PCBA-DBM-Eco module only outputs time-weighted, A-weighted sound levels with two digits of precision. Time weighting is fully configurable between no weighting to 65,536 milliseconds, with the default being 1 second (“slow” mode as per IEC 61672-1 literature).

Characteristics listed here are measured with 1 kHz sine tone at T_A = 25°C, V_{DD} = 3.3V, RH = 50% unless noted otherwise.

Measurement Characteristics

Parameter	Min	Typ	Max	Unit
Accuracy (1 kHz, 94 dB SPL Reference)	-	±1	-	dB SPL
Noise Floor (A-weighted)	-	30	-	dB SPL
Linear Operating Range (A-weighted)	30	-	115	dB SPL
Acoustic Overload Point (A-weighted)	-	116	-	dB SPL
Time weighting	0	-	65,535	ms
Directionality	-	Omni	-	-

Sampling Characteristics

Parameter	Min	Typ	Max	Unit
Sampling Rate	-	16.0	-	kHz
Sampling Rate Drift	-	-	1	%
Flat Response Range	20	-	8000	Hz
High-pass filter cutoff (-3 dB point)	-	15	-	Hz
Anti-aliasing filter attenuation (after Nyquist @ 8kHz)	-	-48	-	dB/octave

Measurement Linearity

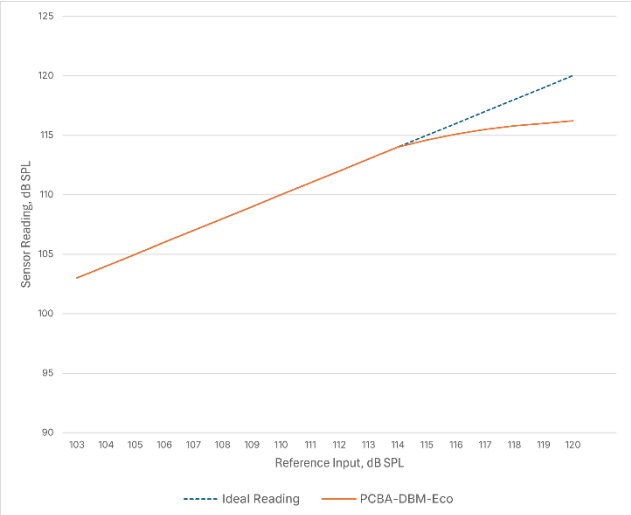

Figure 3: PCBA-DBM-Eco Measurement Linearity

The PCBA-DBM-Eco operates linearly in the range of 30 dB(A) SPL to 115 dB(A) SPL. Linear operation is defined by measurement linearity tolerance of ±0.5 dB SPL when subjected to a test tone of 1 kHz.

Beyond 115 dB(A) SPL, linearity degrades significantly, and it is recommended that the host system treat a reading over 115.0 dB SPL as the “overload point” for the sensor.

Linearity characteristics of the sensor are shown in Figure 3: PCBA-DBM-Eco Measurement Linearity.

A-Weighting Curve

The sensor uses an A-weighting curve as specified in IEC 61672. The exact A-weighting characteristics of the sensor derived by measuring its frequency response at one-third octave points between 20 Hz to 8 kHz are shown in Figure 4: A-weighting Frequency Response.

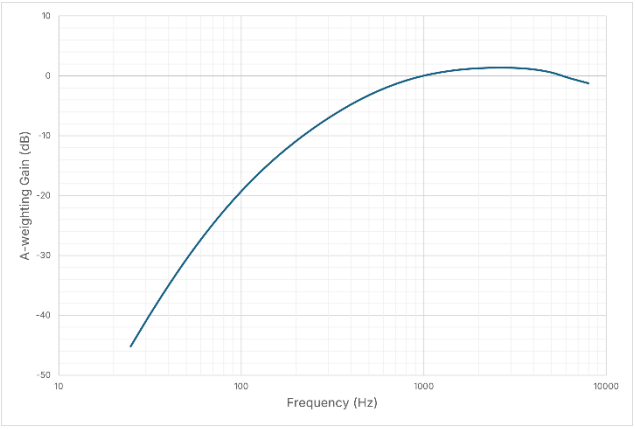

Figure 4: A-weighting Frequency Response

Module Features

The PCBA-DBM-Eco offers a variety of features that are discussed in detail below.

Sensor Identification

Every sensor module comes pre-programmed with a 32-bit “unique ID” that may be used as an identifier for that sensor module. The UID is not sequential.

Note that the UID is only 32-bits and is therefore not guaranteed unique for every sensor ever manufactured. UID may be used to track sensor changes and combined with other unique data to form a device identifier. Precaution is warranted if using the UID alone as a device identifier in large-scale projects.

Communication Diagnostics

A scratchpad register is provided for the host MCU to write any value to the register and then read it back to verify communication.

The SCRATCH register can also be used to diagnose if the module was reset. A reset, power cycle, or wake from sleep will always restore the scratchpad register to its default contents.

Frequency Weighting

The module supports A-weighting implementation as per IEC 61672 Class 2 guidelines. Accurate A-weighting curve has been implemented in the range of 20 Hz to 8 kHz with reference to the IEC standard.

The PCBA-DBM-Eco module does not support other frequency weighting schemes.

Time Weighting

The module implements time weighting as described in IEC 61672-1. Time weighting is applied as an exponential function of the time constant set by TAVG_H and TAVG_L registers. Time weighting is applied to the square of instantaneous sound pressure levels (NOT the instantaneous decibel values).

The value of L_A in dB SPL is calculated by using this time- and frequency- weighted acoustic data and referencing the resulting value to reference sound pressure of 1 Pa.

For maximum flexibility, the time constant can be programmed to any value between 0 ms (no weighting) to 65,535 ms.

“Fast” (T = 125) and “slow” (T = 1000) mode time weighting commonly available in handheld sound level meters can be implemented by setting time weighting constant of 125 and 1000 ms respectively.

When a sound input is suddenly switched off, “Fast” mode results in a level decay rate of 34.7 dB/s.
Similarly, “slow” mode results in a level decay rate of 4.3 dB/s.
These decay rates are according to IEC 61672-1.

Maximum and Minimum Level Tracking

The module tracks maximum or minimum levels with two decimals of precision (denoted as L_{Amax} and L_{Amin}) by continuously monitoring instantaneous LA levels. The LA_MAX and LA_MIN registers track these values.

The LA_MAX and LA_MIN registers can be reset to restart tracking and clear old values.

Interrupts

The module can generate L_A level-triggered interrupts on the INT pin based on programmable lower and upper noise level thresholds. This feature can be utilized in applications where the host MCU sleeps to conserve power.

When the INT pin goes low, the host MCU can check the LA_MAX and LA_MIN registers to record the levels that caused the interrupt, reset them and the INT pin and go back to sleep.

The host MCU can clear the interrupt pin by writing to the RESET register.

The INT pin can also be used as a sync mechanism to stream readings from the sensor. To synchronize data transfer with the sensor, the upper threshold value can be set to 0. This results in an interrupt every time a new reading is available. The host MCU can then read the new value and clear the INT pin. This is useful in applications where unique sound level data must be logged without losing any unique data point.

Low Power Mode

In applications where power consumption must be optimized, the module offers a low-power mode that can be entered by writing to the CONTROL register.

To wake up the module from low power mode, the host MCU must write to the RESET register to reset the module. The module performs a self-reset to wake up and can then be used as usual.

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I²C Interface and Registers

I²C Communication Protocol

The sensor module acts as an I2C slave device addressable at 7-bit I2C address of 0x48.

All common modes of I2C register read and write operations are supported, including multi-byte reads and writes with auto-increment. When multiple bytes are written/read by the I2C master after setting a register address, the sensor auto-increments the internal register pointer. The register pointer wraps around and restarts from 0 after the last available register is written/read.

Single Byte Read

I²C Start → Dev Addr | Write → Register Address → I²C Restart → Dev Addr | Read → Read 1 byte → I²C Stop

Single Byte Write

I²C Start → Send Dev Addr | Write → Register Address → Write 1 byte → I²C Stop

Multiple Byte Read

I²C Start → Dev Addr | Write → Register Address → I²C Restart → Dev Addr | Read → Read *n* bytes → I²C Stop

Multiple Byte Write

I²C Start → Send Dev Addr | Write → Register Address → Write *n* bytes → I²C Stop

I²C Register Map

The PCBA-DBM-Eco module presents 20 bytes as I²C registers for communication with the sensor.

Writing to R/O (read-only) registers has no effect. Reading from W/O (write-only) registers will always read 0x00. Reserved register bits should not be set, and the value read from them is not defined.

Address	Name	R/W	Reset Value	Description
0x00	VERSION	R/O	0x10	Version Register
0x01 – 0x04	UNIQUE_ID	R/O	UID	Unique Device ID
0x05	SCRATCH	R/W	ND[1]	Scratchpad Register
0x06	CONTROL	R/W	0x00	Control Register
0x07	TAVG_HIGH	R/W	0x03	Weighting Time (high byte)
0x08	TAVG_LOW	R/W	0xE8	Weighting Time (low byte)
0x09	RESET	R/W	0x00	Reset Register
0x0A, 0x0B	LA	R/O	ND[1]	L_A, Sound Level Reading in dB(A) SPL
0x0C, 0x0D	LA_MAX	R/O	ND[1]	$L_{A(max)}$, Maximum Observed L_A Reading
0x0E, 0x0F	LA_MIN	R/O	ND[1]	$L_{A(min)}$, Minimum Observed L_A Reading
0x10	THR_MIN	R/W	45’d	Lower L_A Threshold
0x11	THR_MAX	R/W	85’d	Upper L_A Threshold
0x12, 0x13	-	W/O	0x00	Reserved

ND[1] - Not Defined

I²C Maximum Data Throughput

The PCBA-DBM-Eco integrates an ARM Cortex-M4F MCU for acoustic signal processing. The MCU time is shared between I²C interface data transfer and signal processing routines. If I²C communications take up an unreasonably large portion of MCU time due to frequent unnecessary data read/writes to the sensor, the sensor may self-reset.

The module updates readings and processes input registers once every 30 ms. In practice, reading at a higher frequency does not offer any benefit as the register values will remain unchanged between reads.

The I²C interface can withstand reading of all output data registers (register 0x0A onwards) repeatedly every 5 ms. This is guaranteed to not cause a spurious module resets.

I²C Register Descriptions

Registers available in the PCBA-DBM-Eco module are documented below.

VERSION Register

ADDRESS	DEFAULT VALUE	ACCESS
0x00	0x10 for PCBA-DBM-Eco module	Read-Only

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
HW_VER [7:4]				FW_VER [3:0]			

HW_VER [7:4] — **Hardware version number**
4-bit hardware type identifier for the sensor

FW_VER [3:0] — **Firmware version number**
4-bit firmware type identifier for the sensor

ID3, ID2, ID1, ID0 Registers

ADDRESS	DEFAULT VALUE	ACCESS
0x01, 0x02, 0x03, 0x04	-	Read-Only

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
ID [7:0]							

ID [7:0] — **Unique ID bytes**
Registers 0x01 through 0x04 form the 32-bit unique sensor ID

SCRATCH Register

ADDRESS	DEFAULT VALUE	ACCESS
0x05	0x01	Read/Write

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
SCRATCH [7:0]							

SCRATCH — **Scratchpad register**
Scratchpad byte for debugging I2C communication link between host and device.
Host may read or write any value to this register at any time.
The default value is a "(minor) firmware version identifier" for our internal reference.

CONTROL Register

ADDRESS	DEFAULT VALUE	ACCESS
0x06	0x00	Read/Write

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	**INT_EN**	**PCON**

SLEEP — **Power control**
Write 1 to enter sleep mode. Writing 0 has no effect.
In sleep mode, measurement is paused and I2C is active to detect further communication.
The module wakes up and self-resets to default values on any valid I2C transaction with the module.

INT_EN — **Interrupt enable**
Set this bit to enable interrupt pin function.
The module drives the INT pin low when there is a pending interrupt.

TAVG_H Register

ADDRESS	DEFAULT VALUE	ACCESS
0x07	3'd	Read/Write

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Tavg_high [7:0]							

Tavg_high — **High byte of averaging/weighting time constant**
High byte of the time weighting constant (in milliseconds) used for exponential time averaging (weighting).
NOTE: TAVG_L register must be written after TAVG_H for activating the new weighting time.

TAVG_L Register

ADDRESS	DEFAULT VALUE	ACCESS
0x08	232'd	Read/Write

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Tavg_low [7:0]							

Tavg_low — **Low byte of averaging/weighting time constant**
Low byte of the time weighting constant (in milliseconds) used for exponential time averaging (weighting).
Set [Tavg_high:Tavg_low] = 125 for "fast mode" measurement
Set [Tavg_high:Tavg_low] = 1,000 for "slow mode" measurement
Set [Tavg_high:Tavg_low] = 0 for instantaneous measurements
NOTE: TAVG_L register must be written after TAVG_H for activating the new averaging time.

RESET Register

ADDRESS 0x09		DEFAULT VALUE 0x00			ACCESS Read/Write		
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	**SYS_RST**	-	-	-	**CLR_MAX_MIN**	**CLR_INT**

CLR_INT	**Clear interrupt pin** Write 1 to clear the active-low interrupt GPIO. This bit is self-clearing.
CLR_MAX_MIN	**Clear max/min data** Write 1 to clear LA_MAX and LA_MIN registers (maximum and minimum decibel values). This bit is self-clearing.
SYS_RST	**System reset** Set this bit to reset the sensor. All registers are reset to their default values. This bit is self-clearing.

LA Registers

ADDRESS 0x0A, 0x0B	DEFAULT VALUE -	ACCESS Read-Only
Register 0x0A	**Integer part of L_A**	
Register 0x0B	**Decimal part of L_A**	
L_A	**A-weighted sound level in decibels (dB SPL)** This pair of registers contain the latest A-weighted and time-weighted sound pressure level observed by the module. This register pair is refreshed once every 30 ms. Sound level of 94 dB SPL is equivalent to 1 Pa of sound pressure at 1 kHz sine wave. Value of L_A in dB SPL = reg(0x0A) + reg(0x0B)/100 e.g. if reg(0x0A) = 34, reg(0x0B) = 72, L_A = 34.72 dB SPL	

LA_MAX Registers

ADDRESS 0x0C,0x0D	DEFAULT VALUE -	ACCESS Read-Only
Register 0x0C	**Integer part of $L_{A(max)}$**	
Register 0x0D	**Decimal part of $L_{A(max)}$**	
LA_MAX	**Maximum observed L_A value** Contains the maximum decibel value recorded since a clear operation was performed. NOTE: A power cycle or system reset clears the LA_MAX value. LA_MAX value can also be cleared by setting the CLR_MAX_MIN bit of the RESET register. Value of $L_{A(max)}$ in dB SPL = reg(0x0C) + reg(0x0D)/100 e.g. if reg(0x0C) = 34, reg(0x0D) = 72, $L_{A(max)}$ = 34.72 dB SPL	

LA_MIN Registers

ADDRESS 0x0E, 0x0F	DEFAULT VALUE -	ACCESS Read-Only
Register 0x0E	**Integer part of $L_{A(min)}$**	
Register 0x0F	**Decimal part of $L_{A(min)}$**	
LA_MIN	**Minimum observed L_A value** Contains the minimum decibel value recorded since a clear operation was performed. NOTE: A power cycle or system reset clears the LA_MIN value. LA_MIN value can also be cleared by setting the CLR_MAX_MIN bit of the RESET register.	

THR_MIN Register

ADDRESS 0x10		DEFAULT VALUE 45'd			ACCESS Read/Write		
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
THR_MIN [7:0]							

THR_MIN	**Lower-level threshold for L_A** Lower threshold for decibel value, under which INT pin goes low if enabled.

THR_MAX Register

ADDRESS 0x11		DEFAULT VALUE 85'd			ACCESS Read/Write		
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
THR_MAX [7:0]							

THR_MAX	**Upper-level threshold for L_A** Upper threshold for decibel value, over which INT pin goes low if enabled.

Data Privacy Declaration

This module processes acoustic signals exclusively through on-board digital signal processing techniques that have been developed in-house by PCB Artists OPC Private Limited. Raw acoustic data is processed internally by the module in sub-millisecond frames to derive acoustic parameters and the audio data is immediately discarded. No legible audio data is ever stored on the module.

This module

- Does NOT record or store audio data in any form
- Does NOT transmit audio data over any interface
- Does NOT retain any acoustic data of length longer than 30 milliseconds

IEC 61672-1 Class 2 Compliance Note

This module has been designed and characterized with reference to the IEC 61672-1 Class 2 frequency weighting, time-weighting and tolerance specifications. Internal test results indicate that the sensor module's A-weighted frequency response and measurement accuracy closely follow Class 2 tolerance limits across typical operating conditions.

However, this product has NOT undergone formal third-party certification and does not carry an official IEC 61672-1 Class 2 type approval. The test data presented in this datasheet is provided for reference and characterization purposes only and should NOT be interpreted as a declaration of conformity.

In practical use with proper installation, this sensor will produce readings consistent with handheld Class 2 sound level meters under normal acoustic conditions. This module is intended for indicative measurement, monitoring, and screening applications where certified instrumentation is NOT required.

This sensor is NOT recommended for use in legally binding noise assessments, regulatory enforcement, or any application where type-approved instrumentation is mandated by law.

Document Change Log

- March 29, 2026: Initial Release