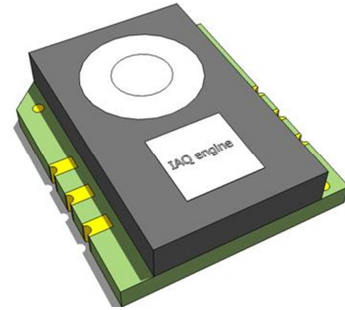


Manual iAQ-engine

Indoor Air Quality sensor

- Digital and analog I/O
- SMD type package



Product summary

iAQ-engine is used for measuring VOC levels that can be read out as a prediction via the I²C bus. The iAQ-engine can also control equipment directly by an analog output with a 0-5 V DAC.

The sensor itself is protected by a plastic cap and a filter membrane. The sensor module can be soldered directly to a host circuit board with selective soldering.

Dimensions

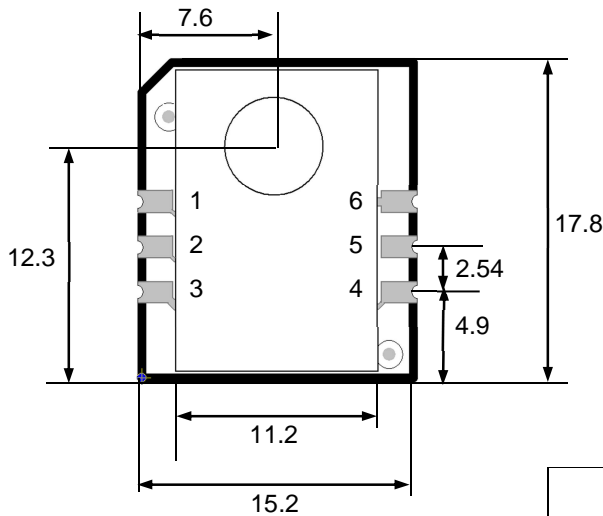


Figure 1: iAQ-engine sensor (dimensions in mm, Top View)

Pin	Name	Comment
1	PRED	Prediction I/O
2	SCL	Serial clock
3	GND	Ground
4	SDA	Serial data
5	NC	Not connected
6	VCC	+5V

Dimensions (approximate values)	PCB 15.24 x 17.78 mm
	HEIGHT PCB 1.7 mm
	HOOD 11.2 x 17.78 mm
	TOTAL HEIGHT 4.3 mm
Sensor position (approximate values)	7.6 x 12.3 mm Radius 3,5 mm
Weight	Approximately 1g
IP-Class	00
Connector	Card edge (cut via)

1 Electrical specifications

1.1 Power supply

Voltage	5.0 ± 0.25V, max. 20mV ripple
Power consumption	225mW @ 5.0VDC

Note: Module features a decoupling capacitor.

1.2 Communication

Output signal options	I ² C
	DAC (0-5)V
First functional reading after start up	15 minutes

→ For more communication details see chapter 4

2 Environmental

Temperature range operation	0 to 50°C
Temperature range storage	-25 to 50°C
Humidity range	5 to 95 %r.h., non-condensing

3 Sensor Features

Sensing technology	MEMS metal oxide sensor
Sensing range	I ² C: 450 – 65535 ppm CO ₂ equivalents (relative)
	DAC: 450 – 2000 ppm CO ₂ equivalents (relative)
Module	Automatic baseline correction

4 I²C Interface

4.1 Interface description

4.1.1 Physical interface

The physical interface is two-wire open drain SCL (clock) and SDA (data).

Pull-up resistors	External pull-up resistor required
Clock speed	100kHz
Clock stretching	Bus master clock stretching support is required

4.1.2 Clock stretching

Clock stretching pauses a transaction by holding the clock line low. The transaction cannot continue until the line is released to high again. Although the module could send the bytes of data at a fast rate, it could happen that the module is busy at the request time. It can then hold the clock line low after reception and acknowledgement of a byte to force the master into a wait state until the iAQ-engine module is ready for the next byte transfer in a type of handshake procedure. (See official I²C specification and user manual UM10204, http://www.nxp.com/documents/user_manual/UM10204.pdf)

4.1.3 Address

Standard 7 bit I²C address for iAQ-engine is **decimal 90** or **hexadecimal 0x5A**. The addressing byte includes the read/write bit at the lowest significant bit. The communication with the iAQ-engine starts with **0xB5** for reading data.

	Address							R/W
Bit	7	6	5	4	3	2	1	0
data	1	0	1	1	0	1	0	1

Table 1: Addressing byte for the iAQ-engine

4.2 Interface protocol

The standard I²C specification is used for the iAQ-engine interface protocol. The I²C bus master should request 7 bytes. These seven bytes include information about the indoor air quality value, the iAQ-engine status and the resistance of the sensor. If there is a need just for the indoor air quality value and the status, the master should request three bytes from the iAQ-engine. All bytes are reported back as shown in the following table. A graphical description for a standard I²C communication with the iAQ-engine module is shown in figure 2 – figure 5.

Byte	Name	Data type	Typical/example value	Explanation / notes
0-1	pred	uint16	450	Prediction [ppm]
2	status	uint8	0	0x00: OK (data valid) 0x01: BUSY (re-read multi byte data!) 0x80: ERROR (if constant:replace sensor)
3-6	resistance	int32	256431	Sensor resistance [Ohm]

Table 3: Read data from the iAQ-engine

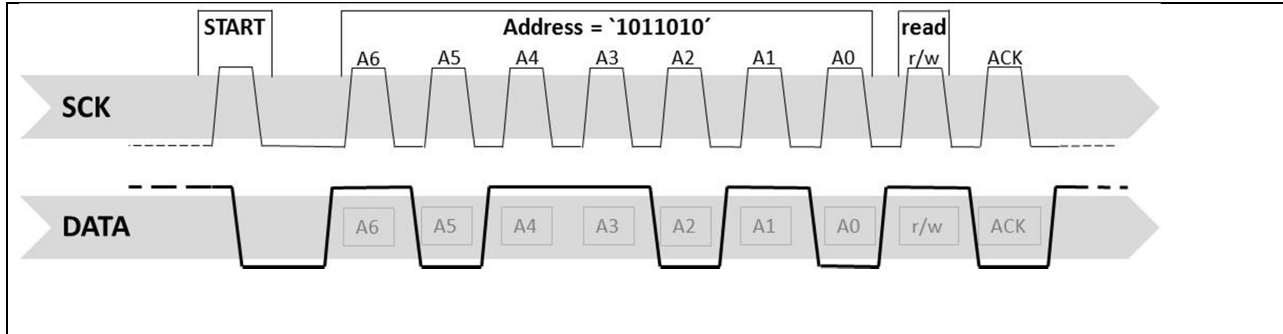


Figure 2: The first byte is send by the master, containing address (0x5A) and read/write bit. The slave sends an acknowledgement (ACK) by pulling the data line to low.

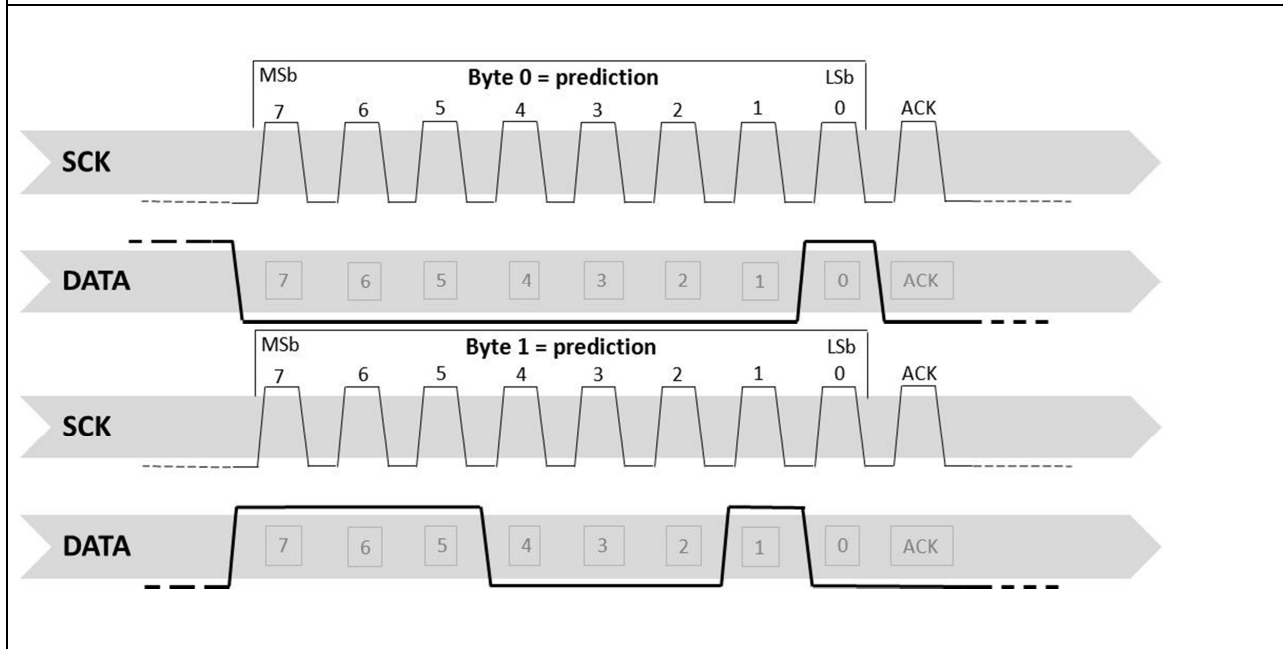


Figure 3: The slave will answer by sending bytes with MSB first. Byte0 and byte1 contain the prediction value. All bytes are Acknowledged by the master.

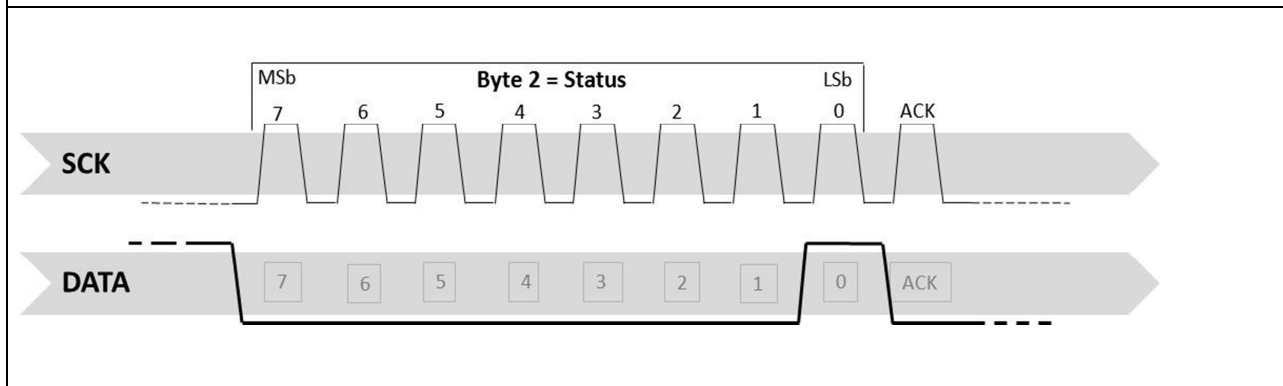


Figure 4: The third byte contains the information of the iAQ-engine module state, in this case status = 1. The master answers with an Acknowledge.

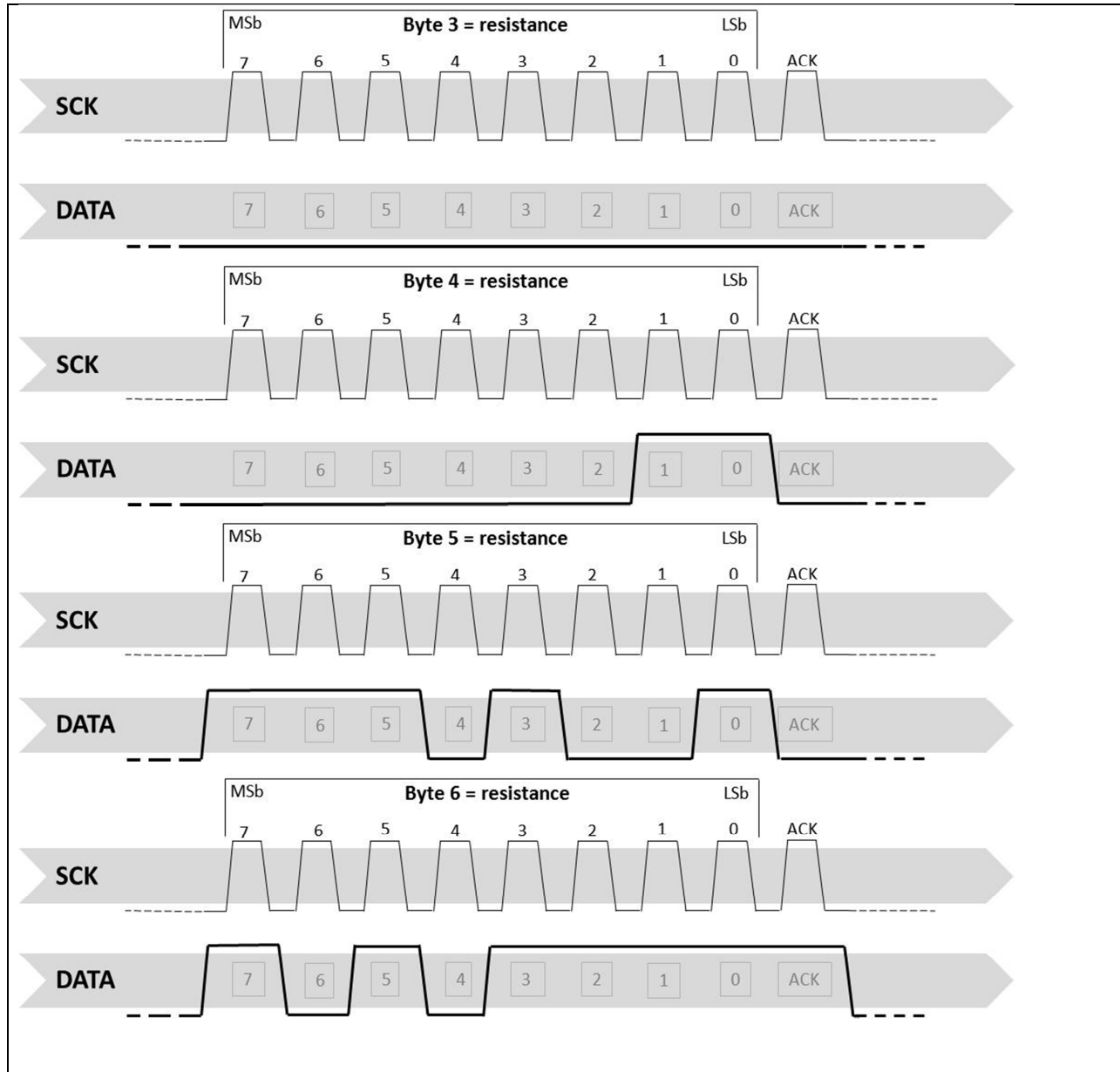


Figure 5: The last four bytes contain the resistance value. For the calculation of the resistance only byte4, byte5 and byte 6 are relevant, because byte3 is zero .After the last requested byte, the master sends a not Acknowledge.

4.2.1 Prediction

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
-------	-------	-------	-------	-------	-------	-------

The first two bytes contain the prediction value, which gives the information about the indoor air quality. The value is a CO₂ equivalent and the calculation is shown in the following example.

Equation 1 :

4.2.2 Status Flag

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
-------	-------	-------	-------	-------	-------	-------

The third byte indicates status of the module.

- 0x00: OK
- 0x01: BUSY
- 0x80: ERROR

If status is OK the data is valid. If the status is BUSY, the data integrity is not guaranteed for variables of size > 8 bits, because the module may be updating a part of the variable.

If the status is ERROR constantly (or very frequently) this indicates that the module is reading non-realistic values, and the sensor element is probably defective.

4.2.3 Resistance

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
-------	-------	-------	-------	-------	-------	-------

The next four bytes contain the sensor resistance in Ohm. The fourth byte of the int32 variable is 0.

Equation 2:

4.3 Typical applications

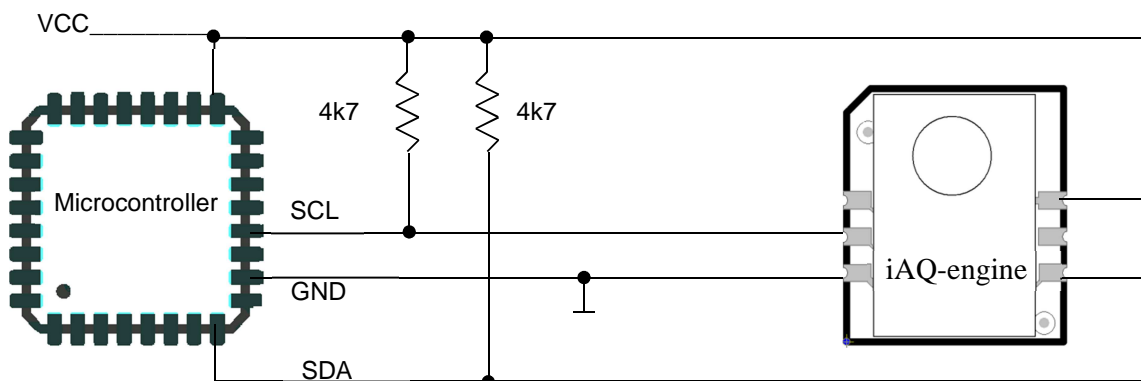


Figure 6: Simple microcontroller application

4.4 Recommended footprint

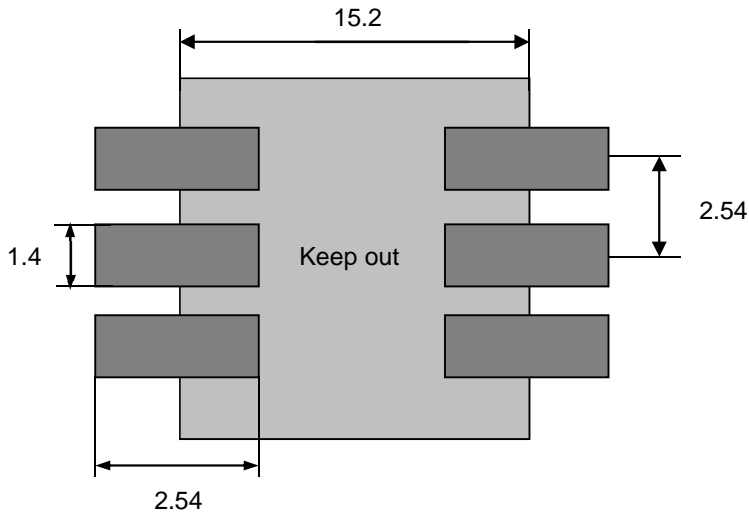


Figure 7: Recommended footprint (standard)

4.5 Ordering information

Order code	Comment
60-0100	iAQ-engine

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