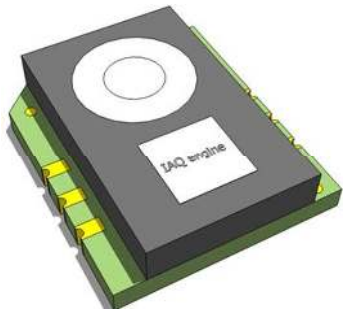
Manual iAQ-engine

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 I^2C 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

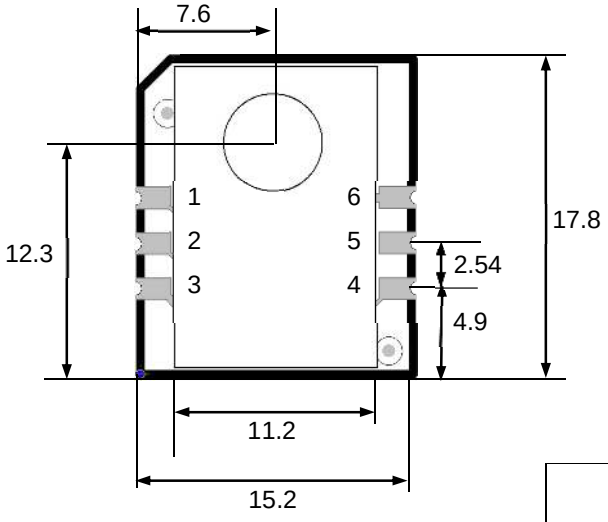


Figure 1: iAQ-engine sensor (dimensions in mm, Top View)

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^2C
	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℃
Temperature range storage	-25 to 50℃
Humidity range	5 to 95 %r.h., non-condensing

3 Sensor Features

Sensing technology	MEMS metal oxide sensor
Sensing range	I²C: 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

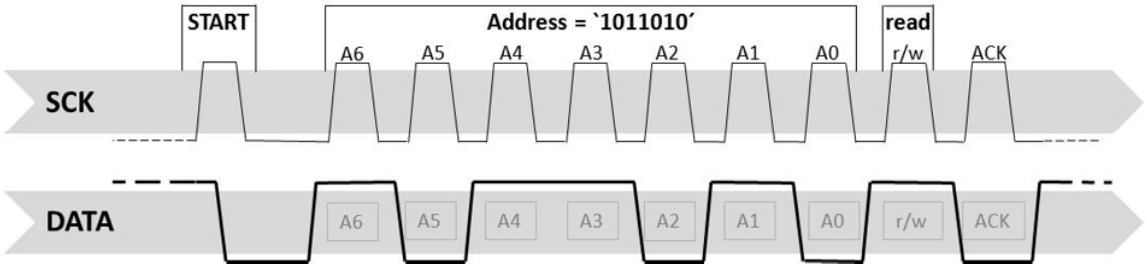


Figure 2: The first byte is send by the master, containing address (0x5A) and read/write bit. The slave sends an acknowledgement (ACK) by pulling the data line to low.

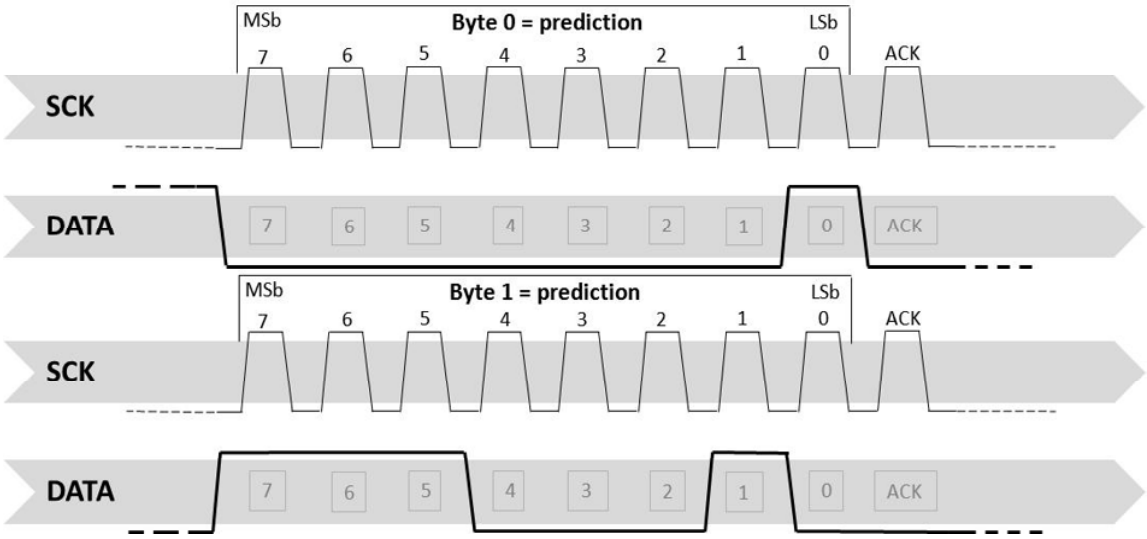


Figure 3: The slave will answer by sending bytes with MSB first. Byte0 and byte1 contain the prediction value. All bytes are Acknowledged by the master.

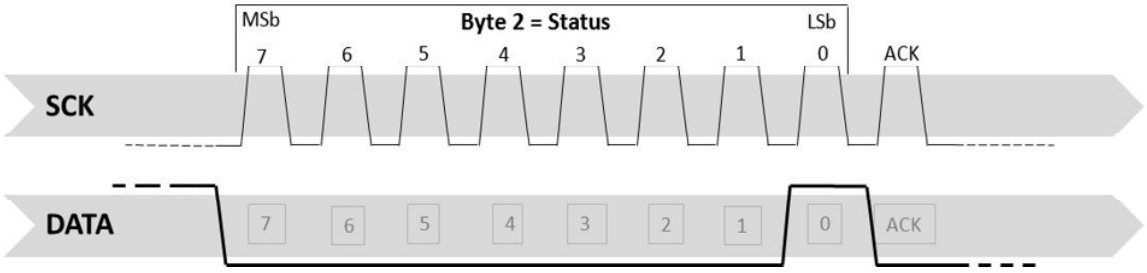


Figure 4: The third byte contains the information of the iAQ-engine module state, in this case status = 1. The master answeres with an Acknowledge.

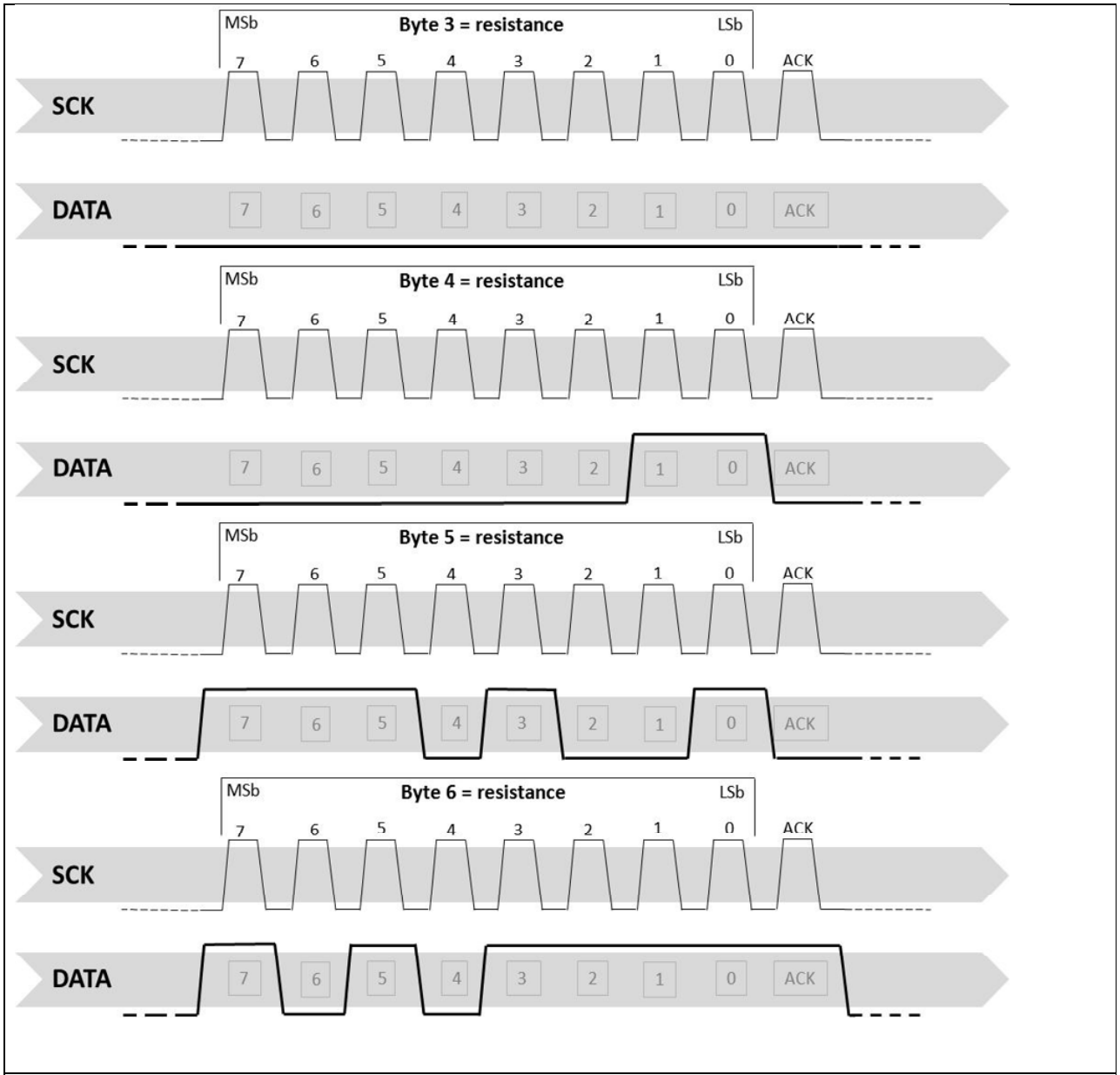


Figure 5: The last four bytes contain the resistance value. For the calculation of the resistance only byte4, byte5 and byte 6 are relevant, because byte3 is zero .After the last requested byte, the master sends a not Acknowledge.

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 CO_2 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

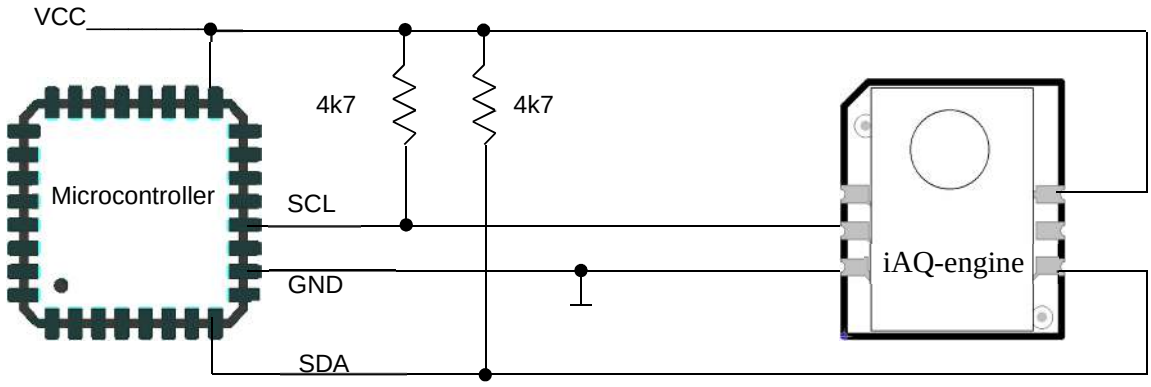


Figure 6: Simple microcontroller application

4.4 Recommended footprint

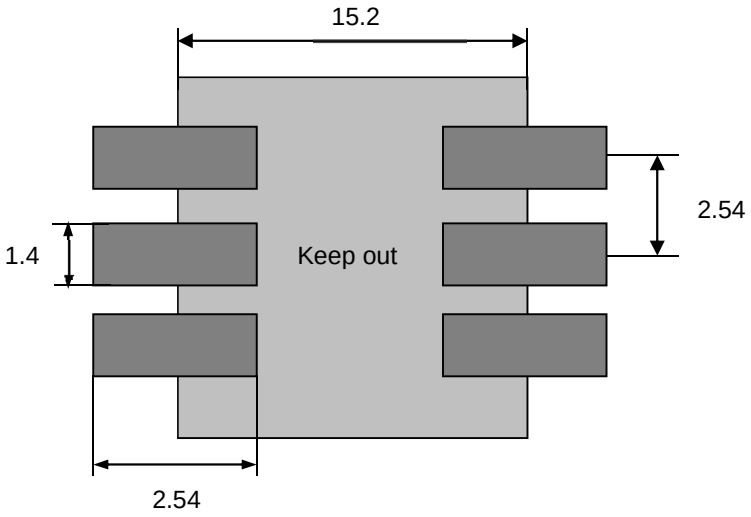


Figure 7: Recommended footprint (standard)

4.5 Ordering information

Order code	Comment
60-0100	iAQ-engine

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