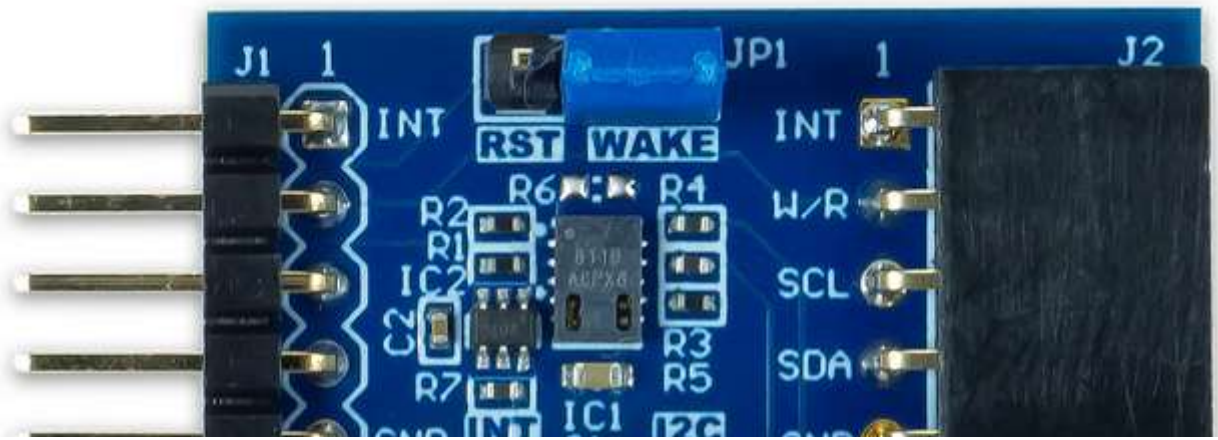
Pmod AQS Reference Manual

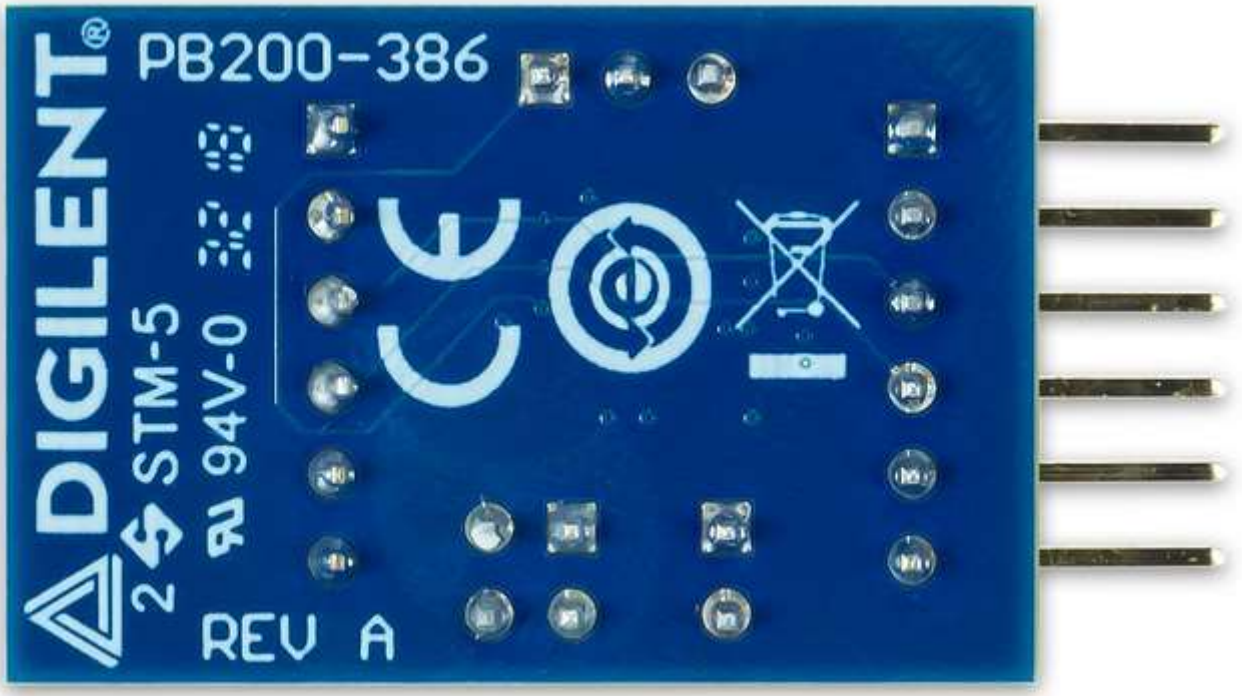
The Digilent Pmod AQS (Revision A) is a digital gas sensor for monitoring indoor air quality at low power. With the AMS CCS811 (https://reference.digilentinc.com/lib/exe/fetch.php?tok=8ef9a4&media=https%3A%2F%2Fams.com%2Fccs811), you can detect a wide range of Volatile Organic Compounds (VOCs) using the micro-hotplate technology enables a highly reliable solution for gas sensors with very fast cycle times.

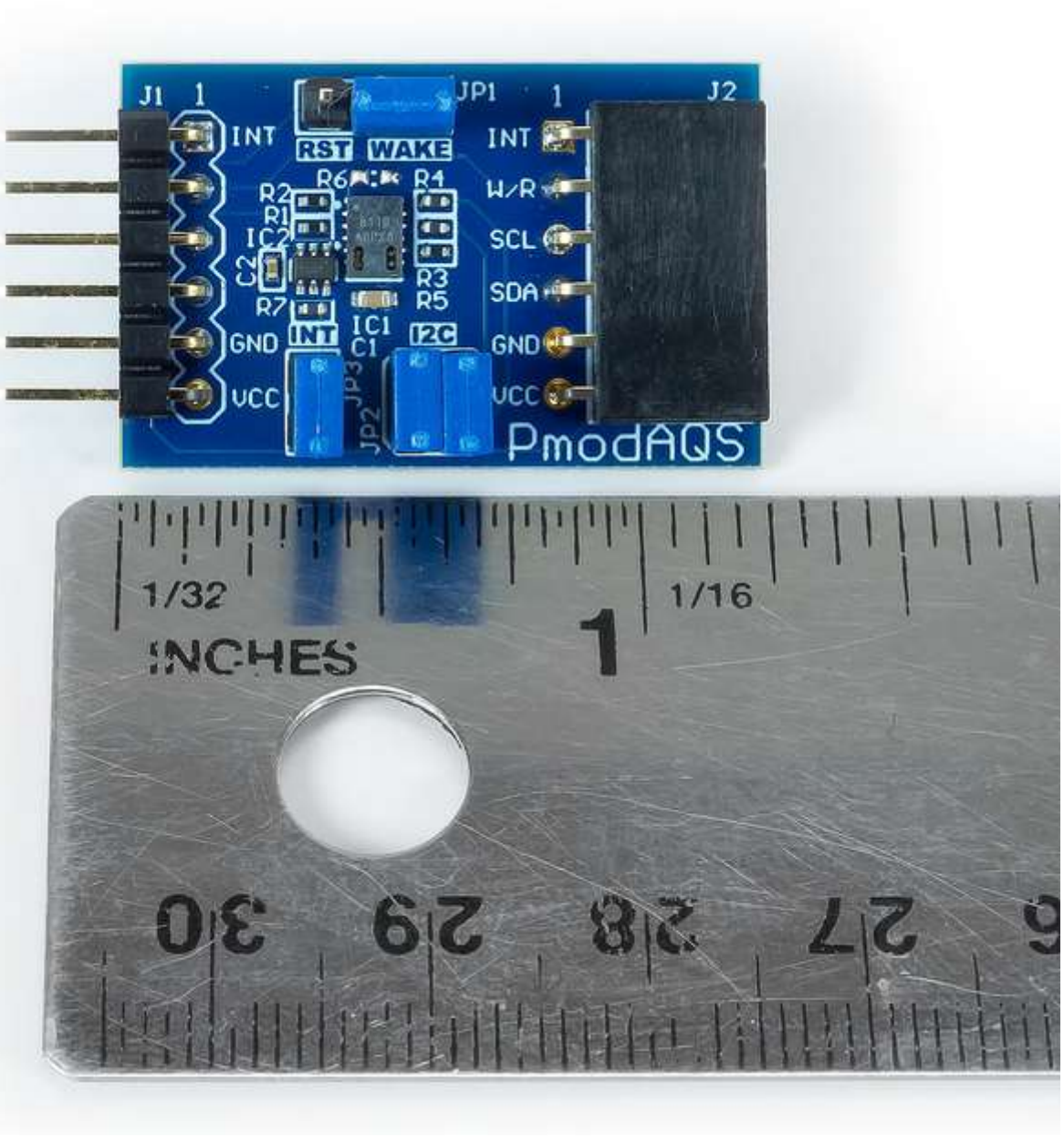
(https://reference.digilentinc.com/_media/reference/pmod/pmodaqs/pmod_aqs-obl.jpg)


J1
1
INT
RST
WAKE
JP1
INT
W/R
SCL
SDA
GND
VCC
PmodAQS


J1
1
INT
RST
WAKE
JP1
1
J2
INT
W/R
SCL
SDA
R6
R4
R2
R1
IC2
C2
R7
R3
R5
IC1


GND
VCC
JP3
JP2
C1
GND
VCC
PmodAQS


DIGILENT®
PB200-386
STM-5
94V-0
REV A



Features

- Optimized low-power modes

- Integrated MCU with ADC ()
- The Total Volatile Organic Compound (TVOC) output range is from 0ppb to 1187ppb.
- 10-bit measurement resolution
- 6-pin Pmod connector with I²C interface
- Pass-through Pmod host port for daisy chaining

Functional Description

The Pmod AQS is designed to digitally report the Volatile Organic Compounds (VOCs) upon request by the host board. Up to 10-bits of resolution collected by allowing for longer conversion times. Micro-hotplate technology which enables a highly reliable solution for gas sensors, very fast cycle times and a significant reduction in average power consumption.

Specifications

Parameter	Min	Typical	Max	Units
Power Supply Voltage	1.8		3.3	V
Serial Clock Frequency	10	100	400	kHz ()
Parameter	**Value**			**Units**
eCO2 output range	400-8192			ppm
TVOC output range	0-1187			ppb
Sleep Mode Current Draw at 1.8V	19			uA

Interfacing with the Pmod

The Pmod AQS communicates with the host board via the I²C protocol (https://reference.digilentinc.com/pmod/communication_protocols/i2c). By first sending the 7-bit I²C address of 1011011 (0x5B) and then a read/write bit (high/low logic level, respectively), followed by the register address of interest at a maximum clock frequency of 400 kHz (), users can both configure and read from the Pmod AQS. Header J2 (https://reference.digilentinc.com/reference/pmod/pmodaqs/start#j2_pinout) on the Pmod AQS passes through all of the signals present on the main Header J1 (https://reference.digilentinc.com/reference/pmod/pmodaqs/start#j1_pinout) to allow for the daisy chaining of multiple I²C compatible modules.

Application Register Map

Application registers for the Pmod AQS

Address	Register	R/W	Size	Description
0x00	STATUS	R	1 byte	Status register
0x01	MEAS_MODE	R/W	1 byte	Measurement mode and conditions register
0x02	ALG_RESULT_DATA	R	up to 8 bytes	Algorithm result. The most significant 2 bytes contain a ppm estimate of the equivalent CO_2 (eCO_2) level, and the next two bytes contain a ppb estimate of the total VOC level.
0x03	RAW_DATA	R	2 bytes	Raw ADC data values for resistance and current source used.
0x05	ENV_DATA	W	4 bytes	Temperature and humidity data can be written to enable compensation
0x06	NTC	R	4 bytes	Provides the voltage across the reference resistor and the voltage across the NTC resistor – from which the ambient temperature can be determined.
0x10	THRESHOLDS	W	5 bytes	Thresholds for operation when interrupts are only generated when eCO_2 ppm crosses a threshold
0x11	BASELINE	R/W	2 bytes	The encoded current baseline value can be read. A previously saved encoded baseline can be written.
0x20	HW_ID	R	1 byte	Hardware ID. The value is 0x81
0x21	HW Version	R	1 byte	Hardware Version. The value is 0x1X
0x23	FW_Boot_Version	R	2 bytes	Firmware Boot Version. The first 2 bytes contain the firmware version number for the boot code.
				Firmware Application Version. The first 2 bytes contain

0x24	FW_App_Version	R	2 bytes	the firmware version number for the application code
0xE0	ERROR_ID	R	1 byte	Error ID. When the status register reports an error its source is located in this register
0xFF	SW_RESET	W	4 bytes	If the correct 4 bytes (0x11 0xE5 0x72 0x8A) are written to this register in a single sequence the device will reset and return to BOOT mode.

(https://reference.digilentinc.com/_detail/reference/pmod/pmodaqs/application_register_map.jpg?id=reference%3Apmod%3Apmodaqs%3Areference-manual)

Quick data acquisition

Here is the series of commands to acquire relative humidity and temperature data from the Pmod AQs in pseudo I²C code.

1. Power on the Pmod AQS and wait at least 15 ms.
2. Call the device ID with a write bit

```
I2CBegin(0x5B); //device ID 0x81 with a write (0) bit
```

3. Wait to receive an ACK from the Slave Device
4. Write the device address that you want to talk to

```
I2CWrite(0x01); //address 0x01 corresponds to the Meas_mode
```

5. Wait to receive an ACK from the Slave Device
6. Delay at least 12.85 ms (6.35 ms for the Temperature Sensor and 6.50 ms for the Humidity Sensor)
7. Read 4 bytes from the temperature and humidity registers (two 8 byte samples from each, MSB then LSB)

```
I2CReadMultiple(4); //read four bytes, sending an ACK to the slave after each byte received and a NACK after the last byte
```

8. Read up to 8 bytes from the Alg_result_data register (two 8 byte samples MSB then LSB for eCO2 and two 8 byte samples MSB then LSB for VOC)

```
I2CReadMultiple(8)); //read up to 8 bytes, sending an ACK to the slave after each byte received and a NACK after the last byte
```

Pinout Table Diagram

Header J1			Header J2			Jumper Blocks		
Pin	**Signal**	**Description**	**Pin**	**Signal**	**Description**	**Jumper**	**State**	**Description**

1	IO/INT ()	IO or Interrupt	1	IO/INT ()	IO or INterrupt	JP1	Enable Left	Set to RST
2	WAKE/RST	WAKE or RESET	2	WAKE/RST	WAKE or RESET	JP1	Enable Right	Set to WAKE
3	SCL	Serial Clock	3	SCL	Serial Clock	JP2	Both Enabled	2.2 kΩ resistors enabled on the SDA and SCL lines
4	SDA	Serial Data	4	SDA	Serial Data	JP2	Both Disabled	2.2 kΩ resistors disabled on the SDA and SCL lines
5	GND ()	Power Supply Ground	5	GND ()	Power Supply Ground	JP3	Enabled	IO/INT () enabled
6	VCC ()	Power Supply (1.8V/3.3V)	6	VCC ()	Power Supply (1.8V/3.3V)			

The PmodAQS Jumper setting when using the Demo's are JP1: *WAKE Enabled*, JP2: *Both Enabled*, JP3: *Enabled*.

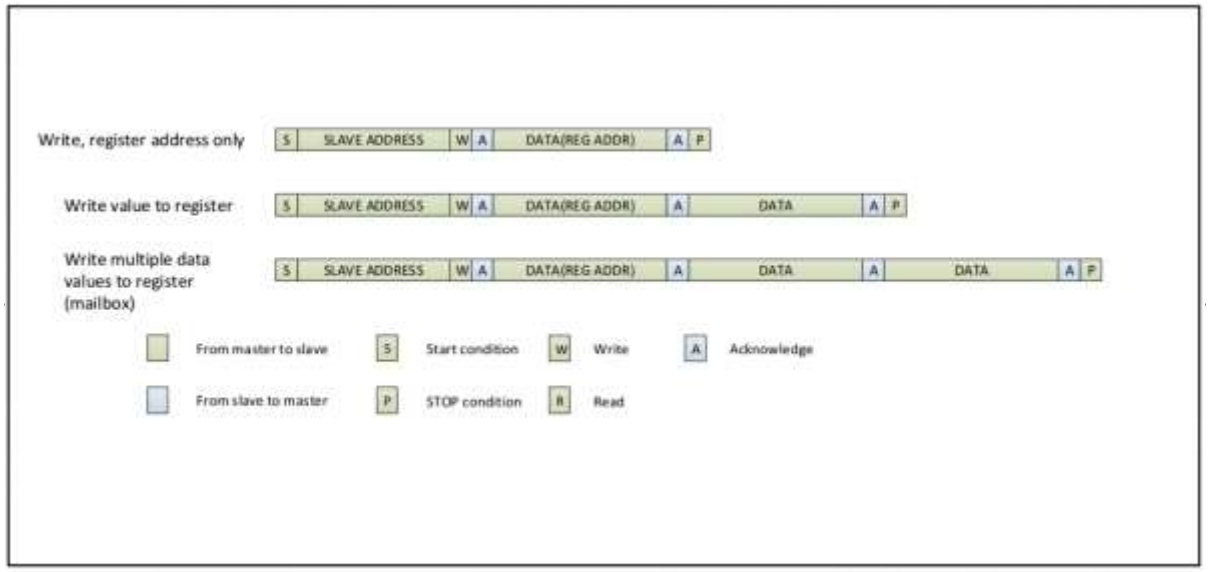
The Pmod AQS is an ideal Pmod to use in long term Air quality application. As a very low power Pmod between measurements, long term data to measure VOC changes in an environment can easily be collected.

Any external power applied to the Pmod AQS must be within 1.8 V and 3.3 V to ensure that the on-board chips operate correctly; however, it is recommended that Pmod is operated at 3.3 V.

Timing Diagram

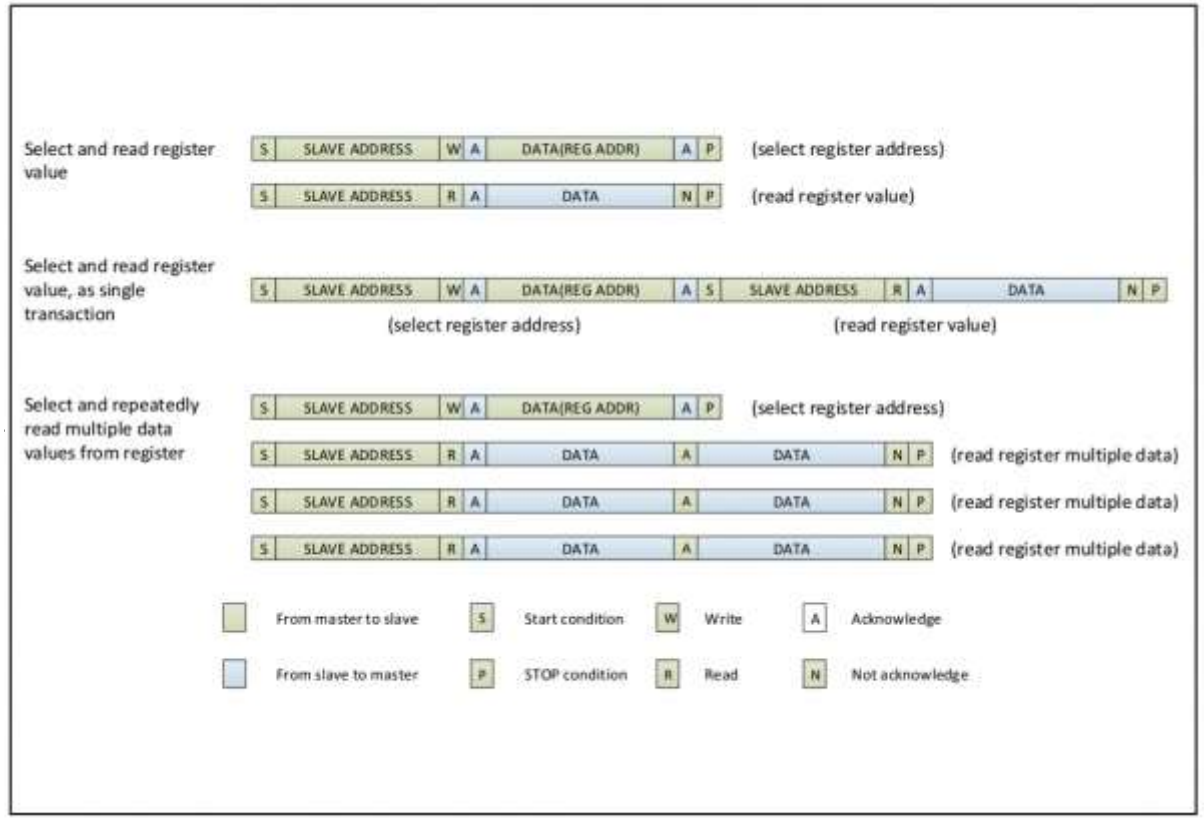
A sample diagram for writing to and reading from the Pmod AQS taken from the CCS811 datasheet are provided below:

Example writing to the Pmod AQS



(https://reference.digilentinc.com/_detail/reference/pmod/pmodaqs/write_register_pmodaqs.jpg?id=reference%3Apmod%3Apmodaqs%3Areference-manual)

Example reading from the Pmod AQS



(https://reference.digilentinc.com/_detail/reference/pmod/pmodaqs/read_register_pmodaqs.jpg?id=reference%3Apmod%3Apmodaqs%3Areference-manual)

Physical Dimensions

The pins on the pin header are spaced 100 mil apart. The PCB is 1.25 inches long on the sides parallel to the pins on the pin header and 0.8 inches long on the sides perpendicular to the pin header.

Additional Information

The schematics of the Pmod AQS are available here (https://reference.digilentinc.com/_media/reference/pmod/pmodaqs/pmodaqs_sch.pdf). Additional information about the VOCs Gas sensor including communication modes and specific timings of the chip can be found in the datasheet here (https://ams.com/ccs811).

Example code and more specific information on how to use the Pmod AQS can be found on its Resource Center (https://reference.digilentinc.com/reference/pmod/pmodaqs/start#additional_resources).

If you have any questions or comments about the Pmod AQS, feel free to post them under the appropriate section ("Add-on Boards") of the Digilent Forum (https://forum.digilentinc.com/).

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do=showtag&tag=reference-manual), doc (https://reference.digilentinc.com/tag/doc?do=showtag&tag=doc)

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