

# I<sup>2</sup>C on Sunrise SE-11

Table of contents:

1. I <sup>2</sup> C .....	2
1.1. I <sup>2</sup> C settings .....	2
1.2. I <sup>2</sup> C register map.....	2
2. References .....	5
3. Examples .....	6

## 1. I<sup>2</sup>C

I<sup>2</sup>C is a communication protocol invented by Philips Semiconductor. It is commonly used for intra-board low speed communications [3].

### 1.1. I<sup>2</sup>C settings

The communication speed limit is 100kbit/s for the I<sup>2</sup>C communication, slave address is 104 and of 7 bits for this sensor. Continuous read/write operations are supported.

Because the sensor is in sleep mode most of the time reading of a dedicated wake up register is needed to ensure stable communication. After reading the wake up register (0x30) the sensor will stay awake until a register have been successfully read from or written to the sensor. Therefore please follow the procedure below when communicating with the sensor.

- 1) Read register 0x30 for 1 byte (sensor will wake up)
- 2) Delay 12 ms
- 3) Normal I<sup>2</sup>C read/write procedure
- 4) Delay 12 ms
- 5) Repeat 1) if any other read/write operations to perform

A successful regular I<sup>2</sup>C communication (read/write registers) will turn the sensor into low power mode.

### 1.2. I<sup>2</sup>C register map

I<sup>2</sup>C registers are categorised into two groups, which are read only registers shown in Table 3 and read/write registers shown in Table 4, respectively.

Table 3 : I<sup>2</sup>C register (read only)

Reg#	Addr.	Name	Description (read only registers)																																		
Reg1	0x00	ErrorStatus0 Hi																																			
			<table><tr><th>Bit</th><th>Error description</th><th>Suggested action</th></tr><tr><td>0</td><td>Reserved</td><td></td></tr><tr><td>1</td><td>Reserved</td><td></td></tr><tr><td>2</td><td>Reserved</td><td></td></tr><tr><td>3</td><td>Reserved</td><td></td></tr><tr><td>4</td><td>Reserved</td><td></td></tr><tr><td>5</td><td>Reserved</td><td></td></tr><tr><td>6</td><td>Reserved</td><td></td></tr><tr><td>7</td><td>Reserved</td><td></td></tr></table>								Bit	Error description	Suggested action	0	Reserved		1	Reserved		2	Reserved		3	Reserved		4	Reserved		5	Reserved		6	Reserved		7	Reserved	
Bit	Error description	Suggested action																																			
0	Reserved																																				
1	Reserved																																				
2	Reserved																																				
3	Reserved																																				
4	Reserved																																				
5	Reserved																																				
6	Reserved																																				
7	Reserved																																				
Reg2	0x01	ErrorStatus0 Lo																																			
			<table><tr><th>Bit</th><th>Error description</th><th>Suggested action</th></tr><tr><td>0</td><td>Fatal error</td><td>Try to restart sensor by power on/off. Contact local distributor.</td></tr><tr><td>1</td><td>I2C communication error I2C error.</td><td>Try to restart sensor by power on/off. Check wires, connectors and I2C protocol implementation. Contact local distributor.</td></tr><tr><td>2</td><td>Internal I2C operation error Indicates instable communication on sensors local I2C bus.</td><td>Try to restart sensor by power on/off. Contact local distributor.</td></tr><tr><td>3</td><td>Calibration error Indicate that calibration failed (ABC, zero, background or target calibration).</td><td>Try to repeat calibration, ensure environment is stable during calibration.</td></tr><tr><td>4</td><td>Self diagnostics error</td><td>Try to restart sensor by power on/off. Contact local distributor.</td></tr><tr><td>5</td><td>Out of range Indicate that measured concentration is not within sensors measurement range</td><td>Perform suitable CO<sub>2</sub> calibration (zero, background or target calibration). Contact local distributor.</td></tr><tr><td>6</td><td>Memory error Error during memory operations</td><td>Try to restart sensor by power on/off. Contact local distributor.</td></tr><tr><td>7</td><td>External I2C error I2C error</td><td>Try to restart sensor by power on/off. Check wires, connectors and I<sup>2</sup>C protocol implementation. Contact local distributor.</td></tr></table>								Bit	Error description	Suggested action	0	Fatal error	Try to restart sensor by power on/off. Contact local distributor.	1	I2C communication error I2C error.	Try to restart sensor by power on/off. Check wires, connectors and I2C protocol implementation. Contact local distributor.	2	Internal I2C operation error Indicates instable communication on sensors local I2C bus.	Try to restart sensor by power on/off. Contact local distributor.	3	Calibration error Indicate that calibration failed (ABC, zero, background or target calibration).	Try to repeat calibration, ensure environment is stable during calibration.	4	Self diagnostics error	Try to restart sensor by power on/off. Contact local distributor.	5	Out of range Indicate that measured concentration is not within sensors measurement range	Perform suitable CO <sub>2</sub> calibration (zero, background or target calibration). Contact local distributor.	6	Memory error Error during memory operations	Try to restart sensor by power on/off. Contact local distributor.	7	External I2C error I2C error	Try to restart sensor by power on/off. Check wires, connectors and I <sup>2</sup> C protocol implementation. Contact local distributor.
Bit	Error description	Suggested action																																			
0	Fatal error	Try to restart sensor by power on/off. Contact local distributor.																																			
1	I2C communication error I2C error.	Try to restart sensor by power on/off. Check wires, connectors and I2C protocol implementation. Contact local distributor.																																			
2	Internal I2C operation error Indicates instable communication on sensors local I2C bus.	Try to restart sensor by power on/off. Contact local distributor.																																			
3	Calibration error Indicate that calibration failed (ABC, zero, background or target calibration).	Try to repeat calibration, ensure environment is stable during calibration.																																			
4	Self diagnostics error	Try to restart sensor by power on/off. Contact local distributor.																																			
5	Out of range Indicate that measured concentration is not within sensors measurement range	Perform suitable CO <sub>2</sub> calibration (zero, background or target calibration). Contact local distributor.																																			
6	Memory error Error during memory operations	Try to restart sensor by power on/off. Contact local distributor.																																			
7	External I2C error I2C error	Try to restart sensor by power on/off. Check wires, connectors and I <sup>2</sup> C protocol implementation. Contact local distributor.																																			
Reg3	0x02		Reserved																																		
Reg4	0x03		Reserved																																		

Reg5	0x04		Reserved
Reg6	0x05		Reserved
Reg7	0x06	Filtered CO2 Hi	CO <sub>2</sub> value
Reg8	0x07	Filtered CO2 Lo	CO <sub>2</sub> value
Reg9	0x08	Unfiltered CO2 Hi	Unfiltered CO <sub>2</sub> value
Reg10	0x09	Unfiltered CO2 lo	Unfiltered CO <sub>2</sub> value

Table 4 : I<sup>2</sup>C Registers (read/write)

Reg#	Addr.	Name	Description (read/write registers)
Reg1	0x80		Reserve
Reg2	0x81	ABC Status	0x08: ABC calibration; 0x04: Other types of calibration
Reg3	0x82	SCR Hi	See below
Reg4	0x83	SCR Lo	Special Command Register SCR=0x00FF: System reset SCR=0x7C05: Target calibration SCR=0x7C06: Background calibration SCR=0x7C07: Zero calibration
Reg5	0x84	Calc Target Hi	Calibration target value (High byte)
Reg6	0x85	Calc Target Lo	Calibration target value (Low byte)
Reg7	0x86	CO2 Value Override	Override value (High byte)
Reg8	0x87	CO2 Value Override	Override Value (Low byte)
Reg9	0x88	ABC Time Hi	Time passed in hours for ABC calibration (High byte)
Reg10	0x89	ABC Time Lo	Time passed in hours for ABC calibration (Low byte)
Reg11	0x8A	Calc Para0 Hi	Calibration parameter0
Reg12	0x8B	Calc Para0 Lo	Calibration parameter0
Reg13	0x8C	Calc Para1 Hi	Calibration Parameter1
Reg14	0x8D	Calc Para1 Lo	Calibration Parameter1
Reg15	0x8E	Calc Para2 Hi	Calibration Parameter2
Reg16	0x8F	Calc Para2 Lo	Calibration Parameter2
Reg17	0x90	Calc Para3 Hi	Calibration Parameter3
Reg18	0x91	Calc Para3 Lo	Calibration Parameter3
Reg19	0x92		Reserve
Reg20	0x93	Start Meas	Start to measure when 1 is written to the register in single measurement mode
Reg21	0x94		Reserve

Reg22	0x95	Meas Mode	Measurement mode (0: continuous measurement mode, 1: single measurement mode) (System reset required after configuration)
Reg23	0x96	Meas Period Hi	Measurement Period in seconds, ranged from 2 to 65535 (High byte)
Reg24	0x97	Meas Period Lo	Measurement Period in seconds, ranged from 2 to 65535 (Low byte)
Reg25	0x98	Meas Num Hi	Number of measurements: recommended to be less than five times of Meas Period and ranged from 1 to 32767 (High byte)
Reg26	0x99	Meas Num Lo	Number of measurements: recommended to be less than five times of Meas Period and ranged from 1 to 32767 (Low byte)
Reg27	0x9A	ABC period Hi	Time in hours to perform ABC calibration (High byte)
Reg28	0x9B	ABC period Lo	Time in hours to perform ABC calibration (Low byte) (System reset required after configuration of ABC period)
Reg29	0x9C	Clear ErrorStatus0	Write any numbers to this register to clear the ErrorStatus 0
Reg30	0x9D	Clear ErrorStatus 0	Write any numbers to this register to clear the ErrorStatus 0

Note:

- 1) In single measurement mode, backup Reg9 to Reg18 to the host before shutting down the sensor and write Reg9 to Reg18 back to the sensor after power on. This is for a proper background calibration. In addition, ABC Time must be supplied to the sensor correctly by the host in single measurement mode.

## 2. References

- [3] I2C-Bus specification and Manual Rev 6, NXP semiconductors

### 3. Examples

Read CO2:

Start 0xD0 0x30 Start 0xD1 0xFF Stop

Delay 12 ms

Start 0xD0 0x06 Start 0xD1 0xFF 0xFF Stop

Set measurement mode to continuous mode:

Start 0xD0 0x30 Start 0xD1 0xFF Stop

Delay 12 ms

Start 0xD0 0x95 0x00 Stop

Set the measurement period to 2 seconds and number of measurements to 4:

Start 0xD0 0x30 Start 0xD1 0xFF Stop

Delay 12 ms

Start 0xD0 0x96 0x00 0x02 0x00 0x04 Stop

Bytes marked 0xFF in the examples above are bytes sent from the sensor to the I2C master.

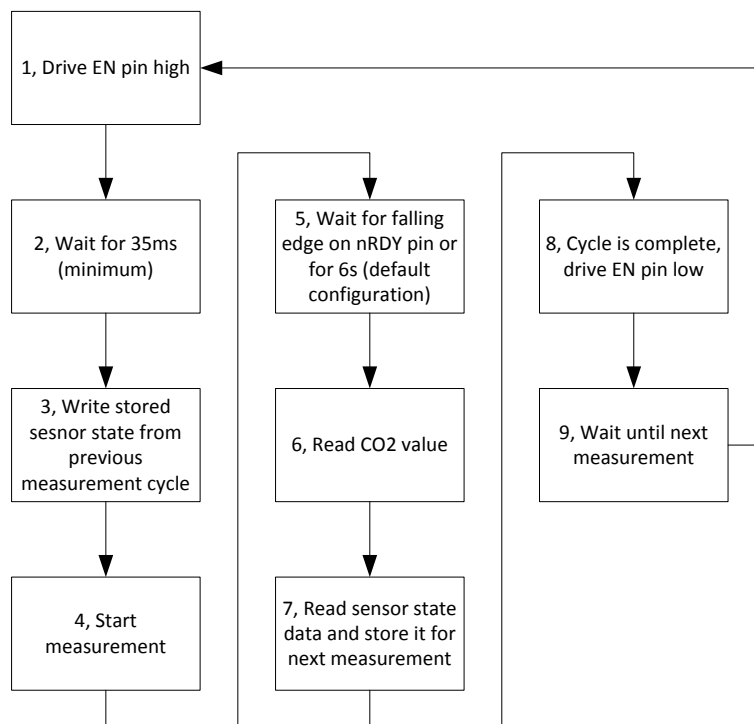


Figure 1, Communication sequence for single measurement mode

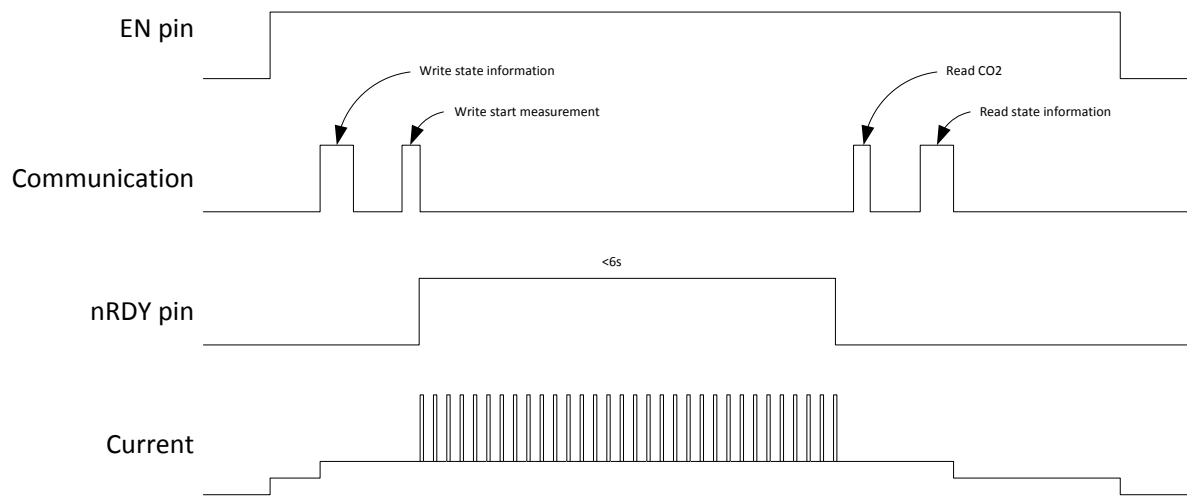


Figure 2, Timing diagram for single measurement mode

**GasLab, Inc.**  
 131 Business Center Drive Ste. A3  
 Ormond Beach, FL 32174

E-mail: [Info@GasLab.com](mailto:Info@GasLab.com)

[www.GasLab.com](http://www.GasLab.com)