I²C Protocol

For Laser Particle Sensor Module PM2008

1. Brief introduction

This is an I²C protocol for PM2008 the sensor module is lower computer, which is not able to initiate communication automatically. Communication is initiated via main controlled board, which reads data and sends control commands.

Communication clock frequency <=100Khz

2. Communication common description

❖ **START:** start signal, send by main controlled board;

❖ **STOP:** stop signal, send by main controlled board;

❖ **ACK:** acknowledge signal, send by the sensor module if in bold; otherwise, send by main controlled board;

❖ **NACK:** non-acknowledge signal, send by the sensor module if in bold; otherwise, send by main controlled board;

❖ **Px:** receive and send data; send by the sensor module if in bold; otherwise, send by main controlled board.

3. Protocol detailed description

3.1 Send command data

Send by main controlled board: START+WRITE+**ACK**+P1+**ACK**+P2+**ACK……** +P7+**ACK**+STOP

Data	Byte content	Description
Device address	Sensor address and read/write command	This byte is 0x50 when write data (Sensor address is 0x28)
P1	0x16	Frame header
P2	Frame length	Number of byte, not including length of device address (From P1 to P7, 7 bytes in total)
P3	Data 1	Control command of the sensor as: Close measurement: 1 Open single measurement: 2 Set up continuously measurement: 3 (default mode) Set up timing measurement: 4 Set up dynamic measurement: 5 Set up calibration coefficient:6 Set up Warm mode:7
P4	Data 2, high byte	1. Set up measuring time: (setting range: 180 ~ 64800), unit: second
P5	Data 2, low byte	2. It should be 0xFF when setting to continuously measurement. 3. Calibration coefficient:(Range: 70~150, Corresponding: 0.7 ~ 1.5）
P6	Data 3	Reserved
P7	Data check code	Check code= (P1^P2^……^P6), ^ is exclusive OR. Short as "xor".

Read data command

Send by main controlled board: START+READ+**ACK**+**P1**+ACK+**P2**+ACK+……+**P32**+NACK+STOP

Data	Byte content	Description
Device address	Sensor address and read/write command	This byte is 0x51 when read data.
P1	0x16	Frame header
P2	Frame length	Number of byte, not including length of device address (From P1 to P32, 32 bytes in total)
P3	Sensor status	Close: 1, Testing: 2, Alarm:7, Data stable: 0x80 Other data is invalid. (Check 3.3 and 3.4 for detailed introduction of sensor status and every kinds of working mode)
P4	Data 1, high byte	The measuring mode of sensor as:
P5	Data 1, low byte	Single working mode: 2 Continuous working mode: 3 Dynamic working mode: 5 Warm mode:7 Timing working mode: >= 180 (means measuring time)
P6	Data 2, high byte	Calibration coefficient:(Range: 70 ~ 150, Corresponding: 0.7 ~ 1.5）
P7	Data 2, low byte	
P8	Data 3, high byte	PM1.0 concentration, unit: $\mu g/m^3$, GRIMM
P9	Data 3, low byte	
P10	Data 4, high byte	PM2.5 concentration, unit: $\mu g/m^3$, GRIMM
P11	Data 4, low byte	
P12	Data 5, high byte	PM10 concentration, unit: $\mu g/m^3$, GRIMM
P13	Data 5, low byte	
P14	Data 6, high byte	PM1.0 concentration, unit: $\mu g/m^3$, TSI
P15	Data 6. low byte	
P16	Data 7, high byte	PM2.5 concentration, unit: $\mu g/m^3$, TSI
P17	Data 7, low byte	
P18	Data 8, high byte	PM10 concentration, unit: $\mu g/m^3$, TSI
P19	Data 8, low byte	
P20	Data 9, high byte	Number of 0.3 μm, unit: pcs/0.1L
P21	Data 9, low byte	
P22	Data 10, high byte	Number of 0.5 μm, unit: pcs/0.1L
P23	Data 10, low byte	
P24	Data 11, high byte	Number of 1 μm, unit: pcs/0.1L
P25	Data 11, low byte	
P26	Data 12, high byte	Number of 2.5 μm, unit: pcs/0.1L
P27	Data 12, low byte	
P28	Data 13, high byte	Number of 5 μm, unit: pcs/0.1L
P29	Data 13, low byte	
P30	Data 14, high byte	Number of 10 μm, unit: pcs/0.1L
P31	Data 14, low byte	
P32	Data check code	Check code = (P1^P2^……^P31)

3.3 Description of sensor status

1. Status "1"
   Means sensor is closing.
2. Status "2"
   Means sensor is under measuring.
3. Status "7"
   Means the temperature is too high or too low, or fan speed is too high or too low.
4. Status "0x80"
   Means measuring data is stable.

3.4 Description of every kinds of working mode

1, Single working mode

The sensor will start measuring particles after receiving command of opening measuring, sensor status is 2. Measured value of last measurement will be output automatically in preheating. After preheating for 6 seconds, current measured data will be output. Measurement is to be completed in 36s. Sensors situation change to 0x80. Means data is stable, close measurement automatically.

After delivering the command of opening measurement, the main control board will start sending command of reading data, read current measured value of particles and sensor situation. Sensor situation is 2 during the measuring. The situation changes to 0x80 after finishing measuring in 36s. The data showed right now is final measured value.

2, Continuously measuring

When continuously measuring mode is open, sensor situation is 2. When PM1.0 is less than 5 $\mu g/m^3$, then measuring is close (situation changes to 0x80, only the laser diode turns off for 5 seconds) and outputs the last value in standby mode. After 5 seconds, the PM sensor resumes the measurement for 4 seconds , If PM1.0 measuring data within the 4sec is less than 5 $\mu g/m^3$, then measuring is close (situation changes to 0x80, only the laser diode turns off for 5 seconds). Otherwise, the sensor will go ahead testing until the PM1.0 measuring data is less than 5 $\mu g/m^3$.

3, Dynamic working mode

After sensors are in dynamic measuring mode, start measuring every 30sec. Measuring time is 3sec (Situation is 2 during these 3sec). If measuring data within the 3sec is like last time measured data (Judge condition as follow), then measuring is close (situation changes to 1, only the laser diode turns off). Otherwise, the sensor will go ahead testing for another 16sec (situation is 2 within the 16sec). Situation will be 0x80 after measuring finished.

Conditions to start completed 19s measurement under dynamic working mode
1, Change range is ＞±10 μg (When last measurement result ＜100 $\mu g/m^3$)
2, Change range is ＞±10% (When last measurement result ＞100 $\mu g/m^3$)

When dynamic measuring mode is set, there will be a completed 19sec measurement. Then it starts measuring every 30sec.

4, Timing working mode

After timing measuring mode is set, starting a completed 36s measuring every XX second. Situation is 2 during the measuring. And situation will change to 0x80 after finishing 36s measuring.

5, Warm mode

When sensors are in warm mode, the LD will close, and the FAN will stay open. The measuring data will keep the same with the last time measured data.

Note: No matter which mode, sensors will close particle measuring after receiving the command of closing measuring. Sensor situation is 1.