

Communication Specifications

Model Name : Laser Type PM Sensor
Model NO. : SN-GCQB1
Issue Number : QB1-SSP-COMM-E0.0
Company : Panasonic Lighting Devices Co., Ltd.
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Customer Approval

Panasonic Lighting Devices Co., Ltd.		
Approved	Checked	Prepared
Date :	Date :	Date :

【Revision records】

Term	Date	Contents	Approved	Checked
0.0	2023.8.8	Draft issued		Sumisaki

Communication Specifications (I2C)

● Communication data format

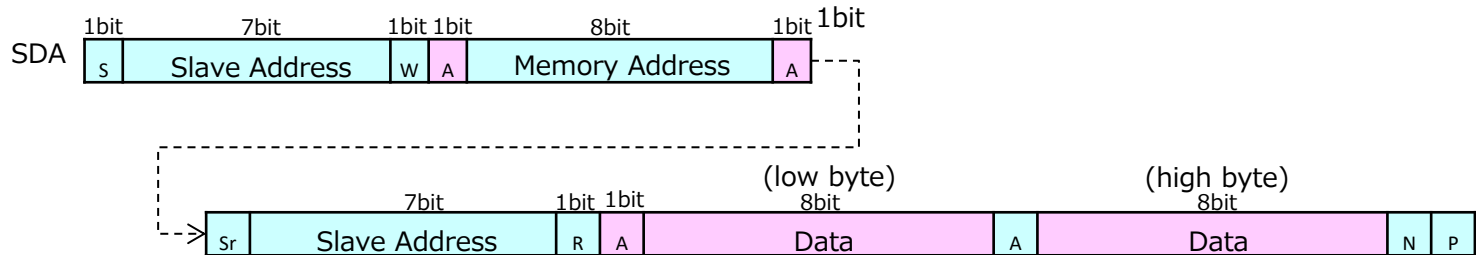
- I2C communication of this sensor complies with 400kbps (FastMode).
- The sensor communicates operate as a slave of the I2C communication.
- SCL terminal of I2C communication is responsible for communication operation from the master side.
- Data structure of I2C communication, the slave address is 7bit, and the memory address is 8bit.
- SCL terminal and the SDA terminal of I2C communication has been pulled up with a 10kΩ of resistance by the sensor internal voltage 3.3V.
- Data sequence of when the output data in I2C communication there is more than one byte, is arranged from low byte to upper byte, in mind "Little-Endian"
Data in each byte is output in the sequence of MSB → LSB.

■ I2C communication data format

※ Clock signal, which is transmitted from the master side (SCL) has been omitted.

□ Data from the master to the slave
□ Data from the slave to the master

◇ Data output (Read)



The length of the data will change depending on the contents to be output.

※Slave Address are set in "0x33".
※The data end is informed by "NACK".

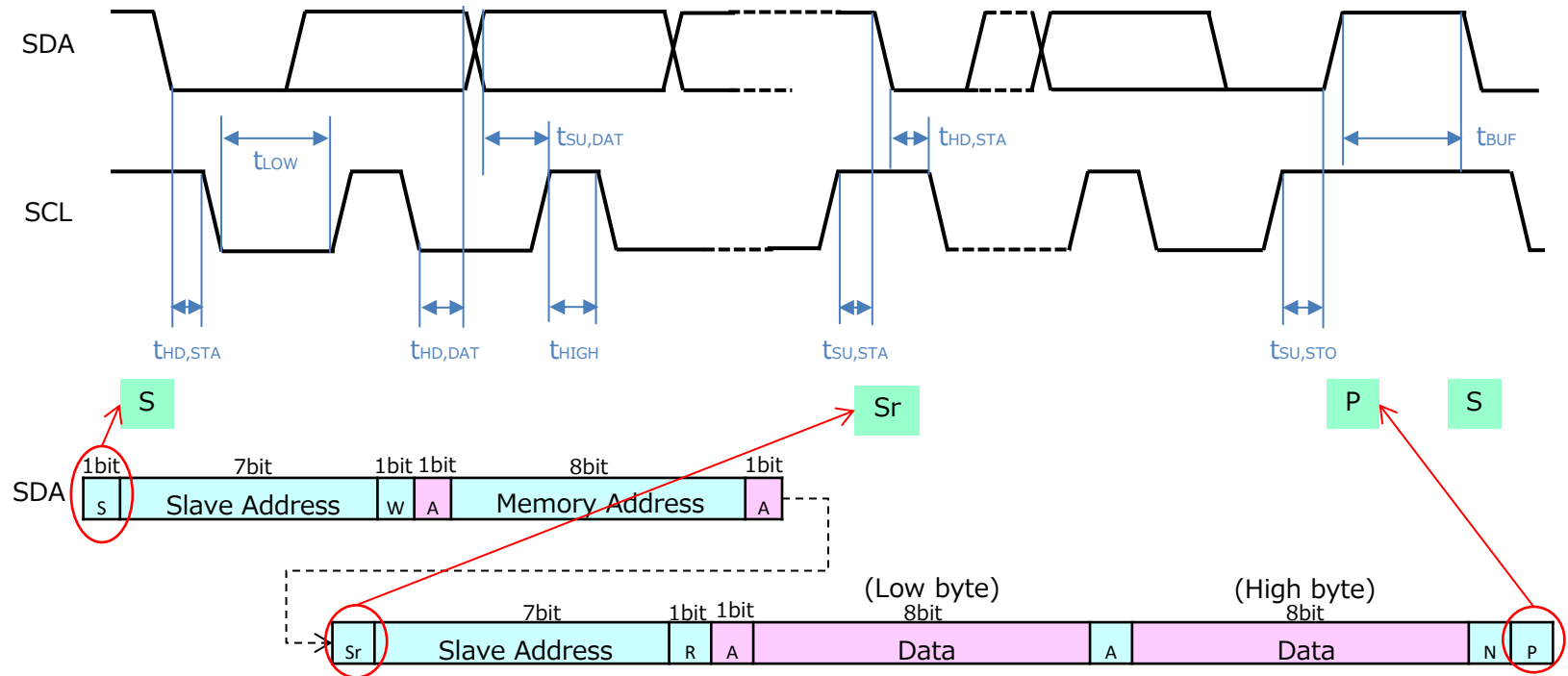
S : Start condition
Sr: repeat start condition
P : Stop condition
A : ACK
N : NACK
W/R : Write/Read

Timing Definition

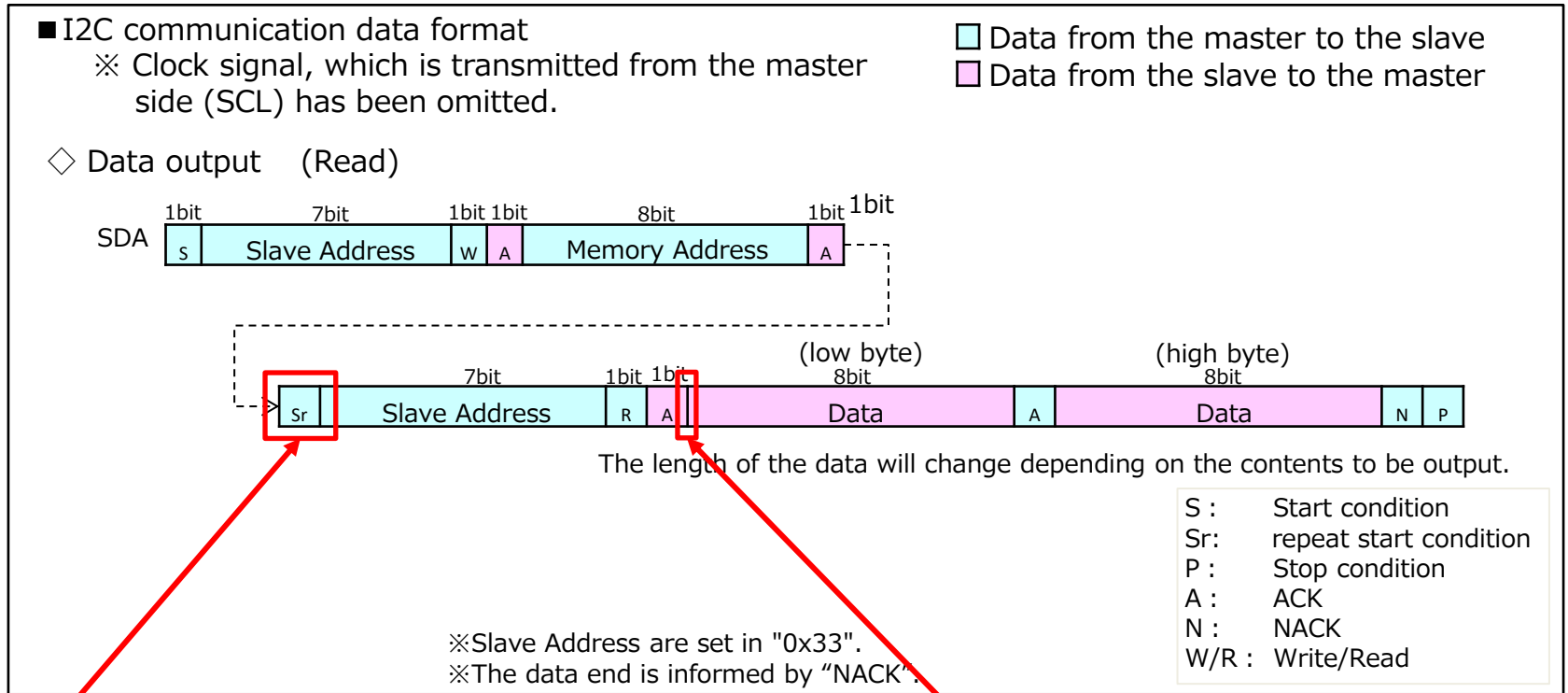
● Timing Definition

● I2C Fast-mode

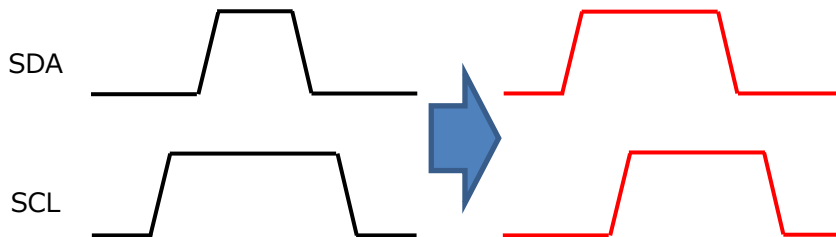
Symbol	Parameter	Min	Typ	Max	
fSCL	SCL clock frequency	100		400	kHz
tLOW	SCL clock low time	1.3			us
tHIGH	SCL clock high time	0.6			us
tSU,DAT	SDA set-up time	100			ns
tHD,DAT	SDA hold time	8		900	ns
tSU,STA	Repeated START condition set-up time	0.6			us
tHD,STA	(Repeated) START condition hold time	0.6			us
tSU,STO	STOP condition set-up time	0.6			us
tBUF	Bus free time between a STOP and START condition	1.3			us



Check point of I2C communication



Sr : Repeat start condition
 Be careful it should **NOT** be Stop condition



Put the wait more than 500μs before reading the data

Communication Acquired Data (I2C)

Mass-density value conversion data

- On the mass-density value in terms of output register, the mass-density conversion data is stored.
- The mass-density value conversion output register is updated every 1 seconds, can be read out the same data until the next update.

○ Register for PM1.0

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0x00	PM1.0_LL	R	M1[7]	M1[6]	M1[5]	M1[4]	M1[3]	M1[2]	M1[1]	M1[0]	0x00
0x01	PM1.0_LH	R	M1[15]	M1[14]	M1[13]	M1[12]	M1[11]	M1[10]	M1[9]	M1[8]	0x00
0x02	PM1.0_HL	R	M1[23]	M1[22]	M1[21]	M1[20]	M1[19]	M1[18]	M1[17]	M1[16]	0x00
0x03	PM1.0_HH	R	M1[31]	M1[30]	M1[29]	M1[28]	M1[27]	M1[26]	M1[25]	M1[24]	0x00

○ Register for PM 2.5

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0x04	PM2.5_LL	R	M2[7]	M2[6]	M2[5]	M2[4]	M2[3]	M2[2]	M2[1]	M2[0]	0x00
0x05	PM2.5_LH	R	M2[15]	M2[14]	M2[13]	M2[12]	M2[11]	M2[10]	M2[9]	M2[8]	0x00
0x06	PM2.5_HL	R	M2[23]	M2[22]	M2[21]	M2[20]	M2[19]	M2[18]	M2[17]	M2[16]	0x00
0x07	PM2.5_HH	R	M2[31]	M2[30]	M2[29]	M2[28]	M2[27]	M2[26]	M2[25]	M2[24]	0x00

○ Register for PM10

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0x08	PM10_LL	R	M10[7]	M10[6]	M10[5]	M10[4]	M10[3]	M10[2]	M10[1]	M10[0]	0x00
0x09	PM10_LH	R	M10[15]	M10[14]	M10[13]	M10[12]	M10[11]	M10[10]	M10[9]	M10[8]	0x00
0x0A	PM10_HL	R	M10[23]	M10[22]	M10[21]	M10[20]	M10[19]	M10[18]	M10[17]	M10[16]	0x00
0x0B	PM10_HH	R	M10[31]	M10[30]	M10[29]	M10[28]	M10[27]	M10[26]	M10[25]	M10[24]	0x00

- The mass-density value conversion data is the 4-byte data in 32bit.
The sensor output a 1000 times the value. With reading as a 16-bit variable signed and by 1/1000, the mass-density value data is output.
Output example) 15.370 ⇒ 15370 ⇒ 0011 1100 0000 1010 ⇒ 0x3C0A

Communication Acquired Data (I2C)

Particle count data

- The particle count data during 20 sec is stored.
- The particle count data is updated every 1 seconds, can be read out the same data until the next update.

○ Register 1 for particle count (0.3-0.5 μ m)

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0x0C	0.5_L	R	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]	0x00
0x0D	0.5_H	R	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]	0x00

○ Register 2 for particle count (0.5-1.0 μ m)

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0x0E	1.0_L	R	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]	0x00
0x0F	1.0_H	R	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]	0x00

○ Register 3 for particle count (1.0-2.5 μ m)

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0x10	2.5_L	R	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]	0x00
0x11	2.5_H	R	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]	0x00

○ Register 4 for particle count (2.5-5.0 μ m)

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0x14	5.0_L	R	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]	0x00
0x15	5.0_H	R	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]	0x00

○ Register 5 for particle count (5.0-7.5 μ m)

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0x16	7.5_L	R	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]	0x00
0x17	7.5_H	R	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]	0x00

○ Register 6 for particle count (7.5-10.0 μ m)

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0x18	10.0_L	R	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]	0x00
0x19	10.0_H	R	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]	0x00

Communication Acquired Data (I2C)

Temperature and humidity sensor data

- The Temperature and humidity sensor data is updated every 1 seconds, can be read out the same data until the next update.

○ Register for Temperature (unit : 0.001°C)

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0xF0	TEMP_LL	R	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]	0x00
0xF1	TEMP_LH	R	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]	0x00
0xF2	TEMP_HL	R	[23]	[22]	[21]	[20]	[19]	[18]	[17]	[16]	0x00
0xF3	TEMP_HH	R	[31]	[30]	[29]	[28]	[27]	[26]	[25]	[24]	0x00

○ Register for Humidity (unit : 0.001%RH)

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0xF8	HUMI_LL	R	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]	0x00
0xF9	HUMI_LH	R	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]	0x00
0xFA	HUMI_HL	R	[23]	[22]	[21]	[20]	[19]	[18]	[17]	[16]	0x00
0xFB	HUMI_HH	R	[31]	[30]	[29]	[28]	[27]	[26]	[25]	[24]	0x00

Communication Acquired Data (I2C)

Gas sensor data

- The Gas sensor data is updated every 3 seconds, can be read out the same data until the next update.

○ Register for IAQ (unit : 0.001level)

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0xE4	IAQ_LL	R	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]	0x00
0xE5	IAQ_LH	R	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]	0x00
0xE6	IAQ_HL	R	[23]	[22]	[21]	[20]	[19]	[18]	[17]	[16]	0x00
0xE7	IAQ_HH	R	[31]	[30]	[29]	[28]	[27]	[26]	[25]	[24]	0x00

○ Register for TVOC (unit : 0.001mg/m³)

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0xE0	TVOC_LL	R	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]	0x00
0xE1	TVOC_LH	R	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]	0x00
0xE2	TVOC_HL	R	[23]	[22]	[21]	[20]	[19]	[18]	[17]	[16]	0x00
0xE3	TVOC_HH	R	[31]	[30]	[29]	[28]	[27]	[26]	[25]	[24]	0x00

○ Register for eCO2 (unit : 0.001ppm)

address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Initial value
0xE8	ECO2_LL	R	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]	0x00
0xE9	ECO2_LH	R	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]	0x00
0xEA	ECO2_HL	R	[23]	[22]	[21]	[20]	[19]	[18]	[17]	[16]	0x00
0xEB	ECO2_HH	R	[31]	[30]	[29]	[28]	[27]	[26]	[25]	[24]	0x00

Communication Acquired Data (I2C)

Sensor status information

- The sensor status information is stored.
- The status information is updated every 1 seconds, can be read out the same data until the next update.

○ Register for sensor status information

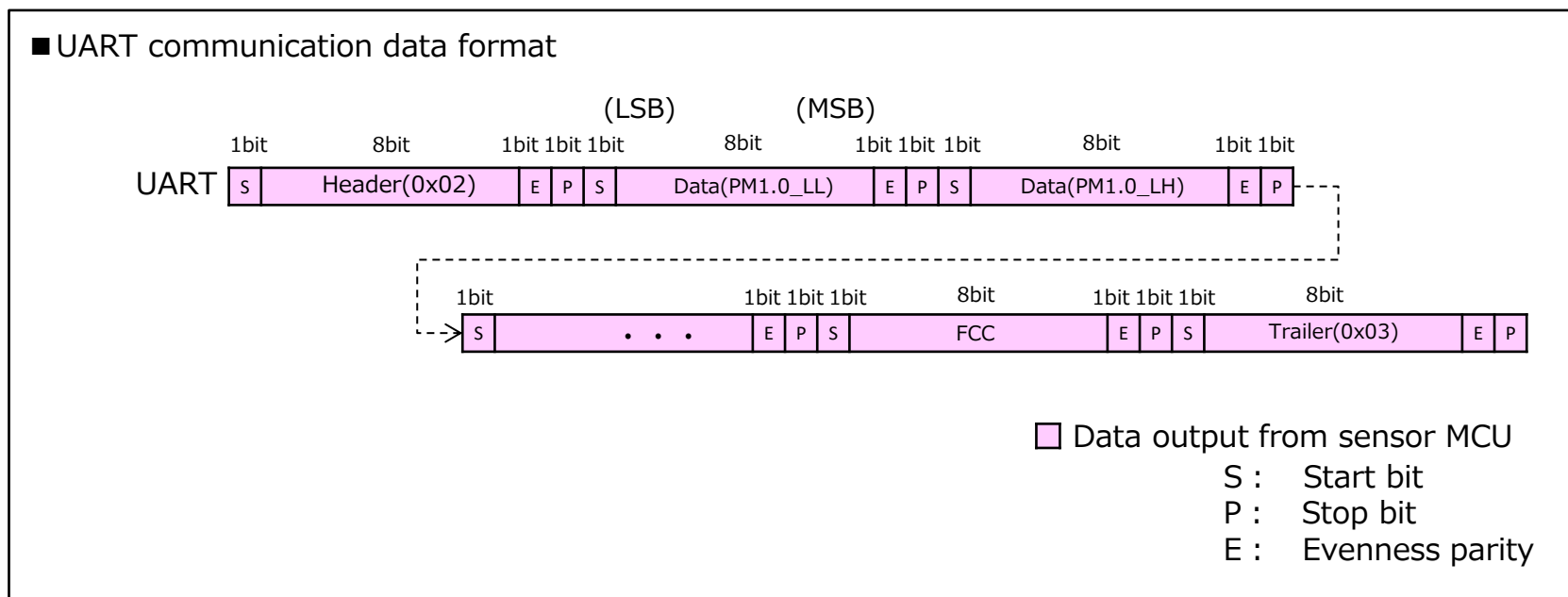
address	register	R/W	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x26	STATE	R	Gas sensor status[7]	Temperature and Humidity sensor status[6]	PD status[5][4]		LD operational status[3][2]		Fan operational status[1][0]	

- Gas sensor status [7]
 - 0 : Normal status
 - 1 : Abnormal
- Temperature and Humidity sensor status [6]
 - 0 : Normal status
 - 1 : Abnormal
- PD status [5][4]
 - 0 : Normal status
 - 1 : Normal status (within -80% against initial value), with S/W correction
 - 2 : Abnormal (below -90% against initial value), loss of function
 - 3 : Abnormal (below -80% against initial value), with S/W correction
- LD operational status [3][2]
 - 0 : Normal status
 - 1 : Normal status (within -70% against initial LOP), with S/W correction
 - 2 : Abnormal (below -90% against initial LOP) or no LOP, loss of function
 - 3 : Abnormal (below -70% against initial LOP), with S/W correction
- Fan operational status [1][0]
 - 0 : Normal status
 - 1 : Normal status (1,000rpm or more), with S/W correction
 - 2 : In initial calibration
 - 3 : Abnormal (below 1,000rpm), out of control

Communication Specifications (UART TTL)

● Communication data format

- UART communication complies with 9,600bps.
- The transmitted data packet contains "start bit"(1bit), "data"(8bit), "evenness parity"(1bit) & "stop bit"(1bit), and the data are transmitted by LSB first.
- The data frame contains "header"(1 byte), "data"(several byte), "FCC"(1 byte) & "trailer"(1 byte).
- The header transfers 0x02(start of text).
- Then the data "PM1.0", "PM2.5", "PM10" with each 32bit, 4byte will be output sequentially.
Each data will be updated every 1 sec.
- Output 1 byte XOR on FCC
- The trailer transfers 0x03(end of text).



Communication Specifications (UART output data)

Data	Register name	Value	Note
1	STX	0x02	Fixed value
2	PM1.0_LL	-	Register for PM1.0 (unit : 0.001ug/m ³)
3	PM1.0_LH	-	
4	PM1.0_HL	-	
5	PM1.0_HH	-	
6	PM2.5_LL	-	Register for PM2.5 (unit : 0.001ug/m ³)
7	PM2.5_LH	-	
8	PM2.5_HL	-	
9	PM2.5_HH	-	Register for PM10 (unit : 0.001ug/m ³)
10	PM10_LL	-	
11	PM10_LH	-	
12	PM10_HL	-	
13	PM10_HH	-	Register 1 for particle count (0.3-0.5μm)
14	0.5_L	-	
15	0.5_H	-	Register 2 for particle count (0.5-1.0μm)
16	1.0_L	-	
17	1.0_H	-	Register 3 for particle count (1.0-2.5μm)
18	2.5_L	-	
19	2.5_H	-	Register 4 for particle count (2.5-5.0μm)
20	5.0_L	-	
21	5.0_H	-	Register 5 for particle count (5.0-7.5μm)
22	7.5_L	-	
23	7.5_H	-	Register 6 for particle count (7.5-10.0μm)
24	10.0_L	-	
25	10.0_H	-	Register for IAQ (unit : 0.001 level)
26	TVOC_L	-	
27	TVOC_H	-	Register for TVOC (unit : 0.001mg/m ³)
28	ECO2_L	-	
29	ECO2_H	-	Register for eCO2 (unit : 1ppm)
30	IAQ_L	-	
31	IAQ_H	-	Register for Temperature (unit : 0.1°C)
32	TEMP_L	-	
33	TEMP_H	-	Register for Humidity (unit : 0.1%RH)
34	HUMI_L	-	
35	HUMI_H	-	Register for sensor status
36	STATUS	-	
37	FCC	-	XOR between data 2~36
38	EXT	0x03	Fixed value