SPECIFICATION

Product Name: Laser Particle Sensor Module

Item No.: PM2016

Version: V0.2

Date: June 25, 2021

Revision

No.	Version	Content	Date
1	V0.1	The first version	2019.03.01
2	V0.2	Update specification and protocol	2021.06.25

Laser Particle Sensor Module

PM2016

Applications

- Air purifier
- Air quality monitor
- Air conditioner
- Ventilation system
- Consumer electronic products

Description

PM2016 is a laser particle sensor module which uses light scattering principle. It measures and calculates the suspending particle number which is within unit volume on the air exactly and output particle mass concentration μg/m^3 directly via mathematical algorithm and scientific calibration.

Features

- The smallest size of available measurement: 0.3μm
- Real-time output particle mass concentration in μg/m^3 is available
- VOC, temperature and humidity measuring function is reserved
- High accuracy, high sensitive and quick response (≤8s)
- Small size, compact structure, easy to install

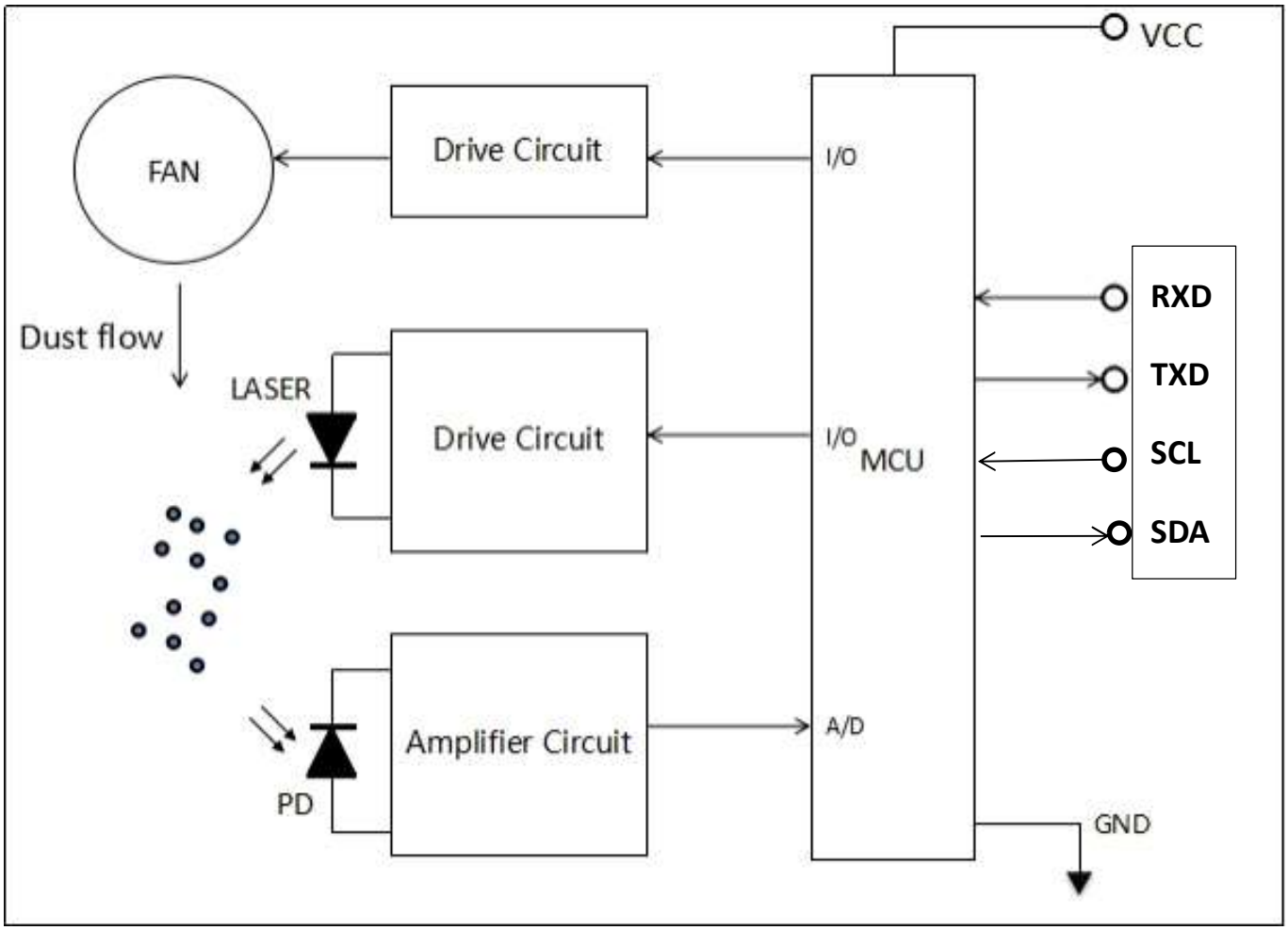
Working Principle

Sampling by the internal pressure which occurs by fan, when sampling particles pass through light beam (laser), there will be light scattering phenomenon. Scattered light will be converted into electrical signal (pulse) via photoelectric transformer. The bigger particles will obtain stronger pulse signal (peak value). Through peak value and pulse value quantity concentration of particles in each size can be calculate. Thus, real-time measured data is obtained through measuring quantity and strength of scattered light.

PM2016 Specifications

Laser Particle Sensor Specification	
Operating principle	Laser scattering
Measured particle range	0.3μm~10μm
Measurement range	0~1,000μg/m³
Resolution	1μg/m³
Working condition	-10°C ~ 60°C, 0-95%RH (non-condensing)
Storage condition	-40°C ~ 70°C, 0-95%RH (non-condensing)
Output performance[1]	Mass concentration PM1.0/PM2.5: 0~100μg/m³, ±10μg/m³ 101~500μg/m³, ±10% reading PM10: 0~100μg/m³, ±25μg/m³ 101~500μg/m³, ±25% reading (GRIMM, 25±2°C , 50 ±10%RH）
Response time	1second
Time to first reading	≤ 8 seconds
Power supply	DC 5V±0.1V, ripple wave＜100mV
Working current	⩽80mA
Dimensions	W40.7*H40.7*D12.2 mm
Weight	26.5g
Digital output	UART/IIC: 3.3V (5V compatible)
MTTF	128,000 hrs (continuous turn on)

Internal Architecture Description

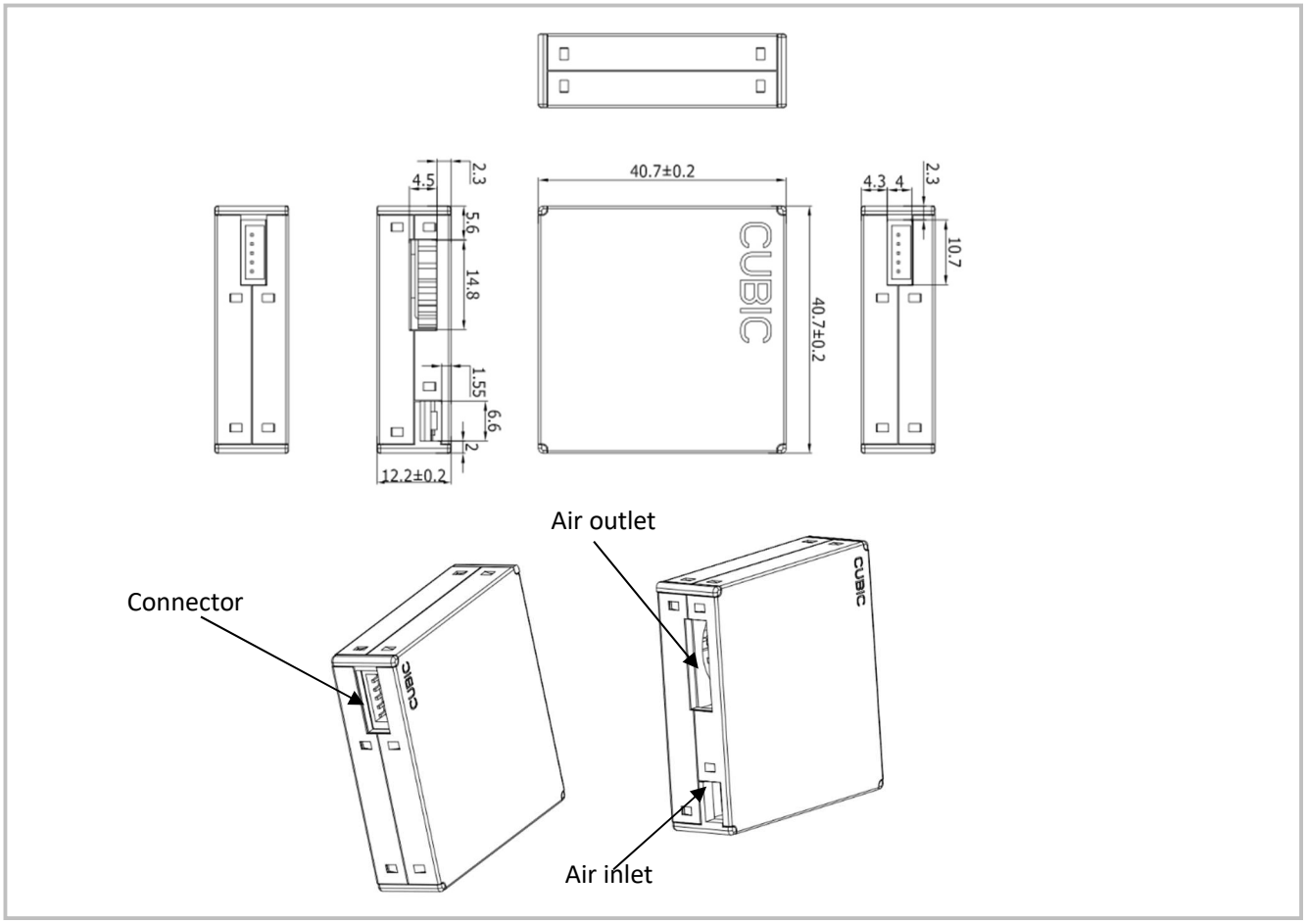


According to the above figure, the light source part of PM2016 is composed of a laser tube and a driving circuit. The detection part of the sensor is composed of light sensitive part which receives reflected light and amplifying circuit. Data processing and communication output are completed by microprocessor.

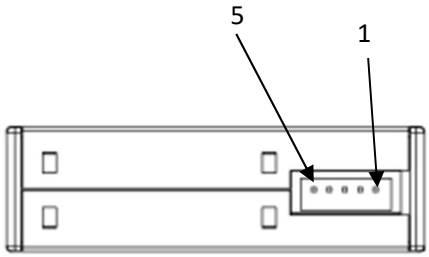
The gas flows into the module through the fan, when sampling particles pass through light beam (laser), there will be light scattering phenomenon, and scattered light will be converted into electrical signal (pulse) via light sensitive part. Electrical signal will be transformed into digital signals after amplifying circuit, smoothing and MCU processed.

Dimensions and Connector

1. Dimensions (Unit mm, tolerance ±0.2 mm)



2. I/O Connector Pin out

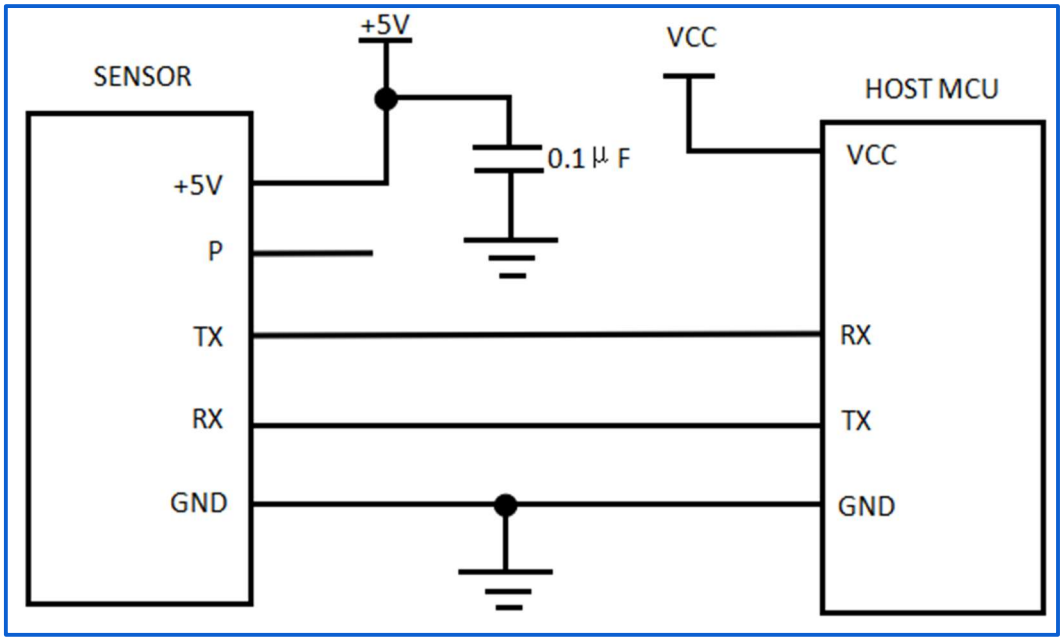


No.	Pin	Description
1	VCC	Power input (+5V)
2	RX/SDA	UART receiving/IIC data
3	TX/SCL	UART sending/IIC clock
4	P	Output mode exchange TTL level @3.3V High level or floating is UART communication mode, low level is IIC communication mode
5	GND	Power input (ground terminal)

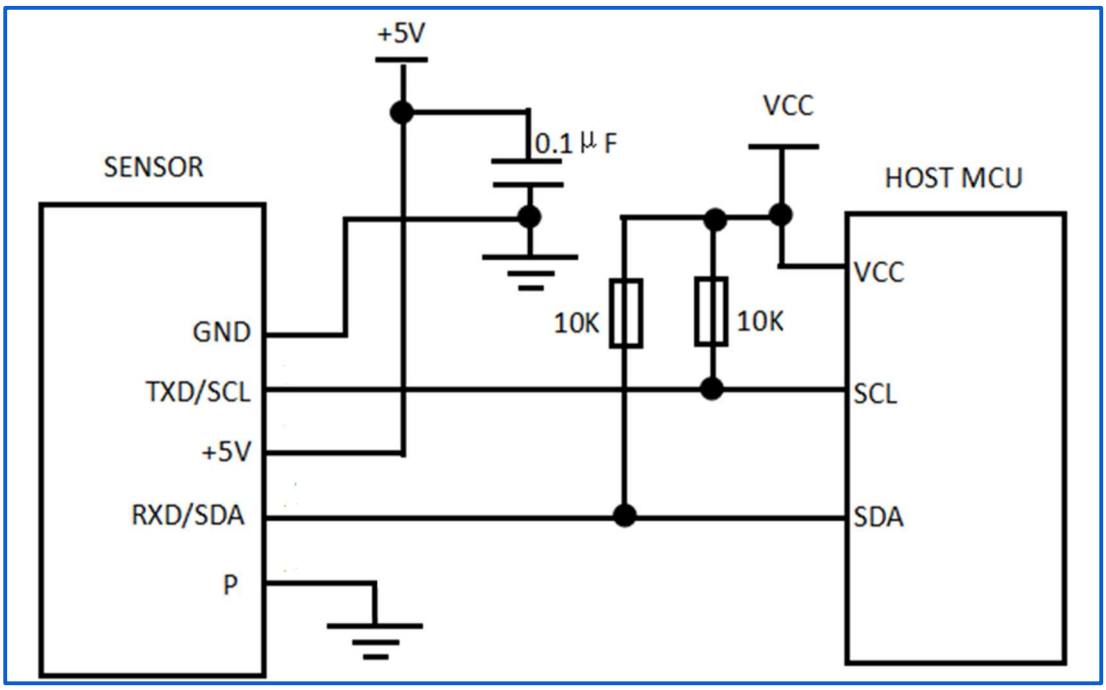
Item	Part Number	Pitch
Connector	CJT A1501WR-S-5P	1.5 mm

Typical Application Circuit

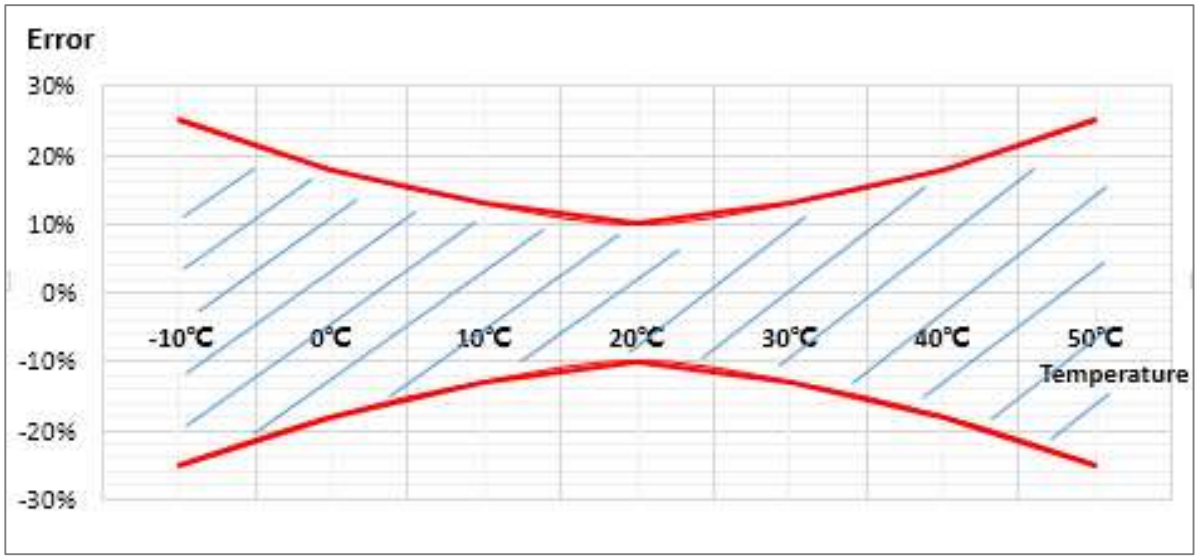
Case 1. UART Application



Case 2. I²C Application



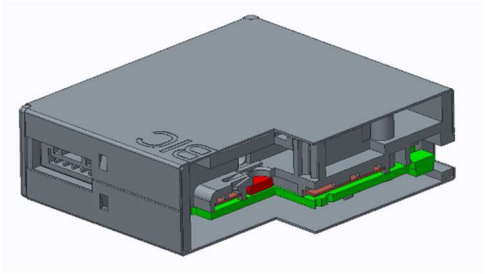
Temperature Influence



Particle measured error: under 25±2℃, 50±10%RH, 0~1000μg/m³, consistency and accuracy of PM1.0/PM2.5 is ±10% reading or ±10μg/m³, whichever is larger (GRIMM 11-A, Cigarette+A1 Dust)

User Attention

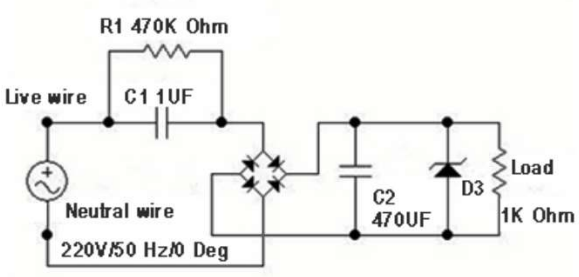
▪It is for household electronics products. For application of medical, mining, disaster preparedness, which needs high security and high dependence, this sensor is not suitable.
▪ Please do not use it in bad dusty environment and close sampling port.
▪ Avoid using the sensor under situation with strong magnetic, such as situation close to stereo speaker, microwave oven, induction cooking.
▪When installing to system, make sure the inlet and outlet is unobstructed, and cannot be touched against by large air stream. There are two sides cannot be put downwards (As below pictures), In case of dust deposition on the surface of sensitive device, dust deposition will affect accuracy of sensor.



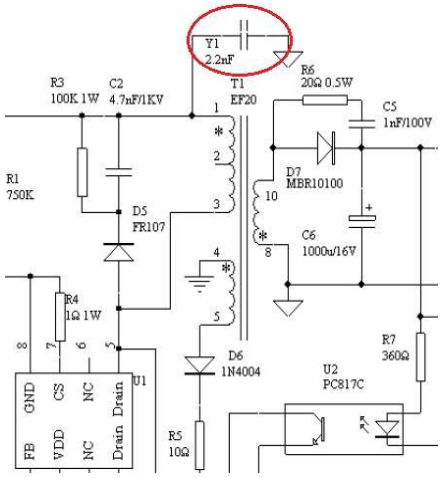
Inner crossing section drawn

Recommend installation

▪The metal case of sensor connects with the DC ground of inner circuit directly, which will cause safety problem if touching with DC ground. To avoid this problem, Sensor should be internally installed and no permit for touching sensor before power off.
▪There is no high pressure transient protection circuit of the sensor. The power supply of the sensor should be stable 5V and low noise. Please refer to the working current in specification table.
▪If use RC decrease voltage, metal case will contact with live or earth line of 220VAC, special protection is needed.



▪If isolated switch power supply is adopted to obtain DC power, please control the capacitance between the DC ground and the AC ground below 2.2nF and withstand voltage reaches to 3KV.



▪The sensor itself is safe to use. What you should be cautious is the safety of power supply and structure design on the sensor.

▪This product is defined as 3R laser product according to 《GB7247.1-2012 laser product safety》 with laser radiation inside. Please avoid direct illumination on the eye. The warning label is as below.

UART Communication Protocol 1

1. General Statement

1) The data in this protocol is all hexadecimal data. For example,“46” for decimal [70].
2) [xx] is for single-byte data (unsigned, 0-255); for double data, high byte is in front of low byte.
3) Baud rate: 9600; Data Bits: 8; Stop Bits: 1; Parity: No
4) After power on the sensor, command shall be sent within 4 seconds.

2. Format of Serial Communication Protocol

Sending format of software:

Start Symbol	Length	Command	Data 1	……	Data n.	Check Sum
HEAD	LEN	CMD	DATA1	……	DATAn	CS
11H	XXH	XXH	XXH	……	XXH	XXH

Detail description on protocol format:

Protocol Format	Description
Start symbol	Sending by software is fixed as [11H], module respond is fixed as [16H]
Length	Length of frame bytes= data length +1 (including CMD+DATA)
Command	Command
Data	Data of writing or reading, length is not fixed
Check sum	Cumulative sum of data = 256- (HEAD+LEN+CMD+DATA)

3. Command Table of Serial Protocol

Item No.	Function Description	Command
1	Read particle measurement result	0x0B
2	Open/close particle measurement	0x0C
3	Set up and read particle calibrated coefficient	0x07
4	Read software version number	0x1E
5	Read serial number	0x1F

4. Detail Description of UART Protocol

4.1 Read Particle Measurement Result

Send: 11 02 0B 07 DB

Response: 16 35 0B DF1- DF52 [CS]

Function: Read concentration of particle and particles number.

Note: Read particle concentration (ug/m3) and particles number (pcs/0.1L)

PM1.0 GRIMM mass concentration = DF1*256^3 + DF2*256^2 + DF3*256^1 + DF4

PM2.5 GRIMM mass concentration = DF5*256^3 + DF6*256^2 + DF7*256^1 + DF8

PM10 GRIMM mass concentration = DF9*256^3 + DF10*256^2 + DF11*256^1 + DF12
DF13~DF24: Reserved
Particles number >0.3um = DF25*256^3 + DF26*256^2 + DF27*256^1 + DF28
Particles number >0.5um = DF29*256^3 + DF30*256^2 + DF31*256^1 + DF32
Particles number >1.0um = DF33*256^3 + DF34*256^2 + DF35*256^1 + DF36
Particles number >2.5um = DF37*256^3 + DF38*256^2 + DF39*256^1 + DF40
Particles number >5.0um = DF41*256^3 + DF42*256^2 + DF43*256^1 + DF44
Particles number >10um = DF45*256^3 + DF46*256^2 + DF47*256^1 + DF48

DF49: Alarm of sensor module working condition:

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Alarm definition	1: Laser diode short circuit		1: Laser diode open circuit	1: dust accumulation	1: low working temperature	1: high working temperature	1: Fan at low revolving speed	1: Fan at high revolving speed

DF50, DF51, DF52: Reserved
Note: Part of reserved bit is used for Cubic internal testing and not related to function.

4.2 Open/Close Particle Measurement

Send: 11 03 0C DF1 1E CS
Response: 16 02 0C DF1 CS
Function: Open/ close particle measurement

Note:
1. When sending command, DF1=02 means opening measurement, DF1=01 means closing measurement;
2. When receiving response, DF1=02 means measuring opened, DF1=01 means measuring closed;

4.3 Set up and Read Particle Calibrated Coefficient

Send: 11 02 07 DF1 [CS] // Set up particle calibrated coefficient
Send: 11 01 07 E7 // Read particle calibrated coefficient
Response: 16 02 07 DF1 [CS]
Function: Read/set up particle calibrated coefficient

Note:
1. Range 70~150 Corresponding coefficient: 0.7~1.5

Description:
1. When there is difference between standard device, calibrated coefficient can be set to correct the final value.
2. When calibrated coefficient is set, the value of PM1.0, PM2.5, and PM10 will be all corrected by this coefficient.

4.4 Read Software Version Number

Send: 11 01 1E D0
Response: 16 0E 1E DF1~DF13 [CS]
Function: Read software version
Note:

Software version="DF1~DF13"
Should change the HEX code to ASCII code.

Example:
HEX code: 16 0E 1E 50 4D 20 56 31 2E 32 36 2E 35 2E 32 38 E9
ASCII code: PM V1.26.5.28

4.5 Read Serial Number

Send: 11 01 1F CF
Response: 16 0B 1F DF1 DF2 DF3 DF4 DF5 DF6 DF7 DF8 DF9 DF10 CS
Function: Read serial number

Note:
Serial number = (DF1*256+DF2), (DF3*256+DF4), (DF5*256+DF6), (DF7*256+DF8), (DF9*256+DF10)

Example:
Response: 16 0B 1F 00 00 00 7E 09 07 07 0E 0D 72 9E
Serial number: 126 2311 1806 3442

UART Communication Protocol 2

1. General Statement

1) The data in this protocol is all hexadecimal data. For example, “46” for decimal [70].
2) Baud rate: 115200; Data Bits: 8; Stop Bits: 1; Parity: No.
3) After power on the sensor for at least 4 seconds, the sensor can work with this protocol.

2. Format of Serial Communication Protocol

Sending format of software:

Start Symbol	Address	Command	Length	TX Data n.	Check Sum	Stop Symbol
Start	ADR	CMD	LEN	DATAn	CS	Stop
0x7E	0xXX	oxXX	0xXX	DF1-DFn	0xXX	0x7E

Receiving format of software:

Start Symbol	Address	Command	State	Length	RX Data n.	Check Sum	Stop Symbol
Start	ADR	CMD	State	LEN	DATAn	CS	Stop
0x7E	0xXX	0xXX	0xXX	0xXX	DF1-DFn	0xXX	0x7E

Start and Stop Byte (0x7E):
The 0x7E character is sent at the beginning and at the end of the frame to signalize frame start and stop. If this byte (0x7E) occurs anywhere else in the frame, it must be replaced by two other bytes (byte-stuffing). This also applies to the characters 0x7D, 0x11 and 0x13. Use Table 5 for byte-stuffing.

Original data byte	Transferred data bytes
0x7E	0x7D, 0x5E
0x7D	0x7D, 0x5D
0x11	0x7D, 0x31
0x13	0x7D, 0x33

Example: Data to send = [0x43, 0x11, 0x7F] → Data transmitted = [0x43, 0x7D, 0x31, 0x7F].

Address
The slave device address is always 0.

Command
In the sending frame the command tells the device what to do with the transmitted data. In the receiving frame, the slave just returns the received command.

Length
Length of the “TX Data” or “RX Data” field (before byte-stuffing).

State
The receiving data frame contains a state byte, which allows the master to detect communication and execution errors. The first bit is reserved for future use.

b7	b6						b0
Error flag	Execution error code						

Status byte structure.

The first bit (b7) indicates that at least one of the error flags is set in the Device Status Register.

Device Status Register

The Device Status Register is a 32-bit register that contains information about the internal state of the module. Bit 21, bit 4 and bit 5 are defined as below, other bits are reserved.

Bit 21 is for FAN SPEED

0: Fan speed is ok; 1: Fan speed is too high or too low.

• During the first 3 seconds after starting the measurement (fan start-up) the fan speed is not checked.

• Apart from the exception mentioned above, the fan speed is checked once per second in the measurement mode. If it is out of range twice in succession, the SPEED-bit is set.

• At very high or low ambient temperatures, the fan may take longer to reach its target speed after start-up. In this case, the bit will be set. As soon as the target speed is reached, this bit is cleared automatically.

• If this bit is constantly set, this indicates a problem with the power supply or that the fan is no longer working properly.

Bit 5 is for LASER

0: Laser current is ok; 1: Laser is switched on and current is out of range.

• The laser current is checked once per second in the measurement mode. If it is out of range twice in succession, the LASER-bit is set.

• If the laser current is back within limits, this bit will be cleared automatically.

• A laser failure can occur at very high temperatures outside of specifications or when the laser module is defective.

Bit 4 is for FAN

0: Fan works as expected; 1: Fan is switched on, but the measured fan speed is 0 RPM.

• The fan is checked once per second during measurement. If 0 RPM is measured twice in succession, the FAN bit is set.

• The FAN-bit will not be cleared automatically.

• A fan failure can occur if the fan is mechanically blocked or broken.

The execution error code signalizes all errors which occur while processing the frame or executing the command. The following table shows the error codes which can be reported from the device. Note that some of these errors are system internal errors which require additional knowledge to be understood. In case of a problem, they will help clients to localize and solve the issue.

Error code		Meaning
dec	hec	
0	0x00	No error
1	0x01	Wrong data length for this command (too much or little data)
2	0x02	Unknown command
3	0x03	No access right for command
4	0x04	Illegal command parameter or parameter out of allowed range
40	0x28	Internal function argument out of range
67	0x43	Command not allowed in current state

Reference table for error codes.

Data

The data has a usable size of [0…255] bytes (original data, before byte-stuffing). The meaning of the data content depends on the command.

Checksum

The checksum is built before byte-stuffing and checked after removing stuffed bytes from the frame. The checksum is defined as follows:

1. Sum all bytes between start and stop (without start and stop bytes).
2. Take the LSB of the result and invert it. This will be the checksum.

For a sending frame use Address, Command, Length and Data to calculate the checksum.

For a receiving frame use Address, Command, State, Length and Data to calculate the checksum.

Example (sending frame without start/stop and without byte-stuffing):

Adr	CMD	L	Tx Data 2 Bytes	CHK
0x00	0x00	0x02	0x01, 0x03	0xF9

The checksum is calculated as follows:

Adr	CMD	L	Data 0	Data 1	Sum	LSB of Sum	Inverted(=Checksum)
0x00	0x00	0x02	0x01	0x03	0x06	0x06	0xF9

3. Command Table of Serial Protocol

CMD	Function Description	Read/ Write/ Execute
0x00	Start Measurement	Execute
0x01	Stop Measurement	Execute
0x03	Read Measurement Value	Read
0xD2	Read device status register	Read
0xD3	Reset	Execute

4. Detail Description of UART Protocol

4.1 Start Measurement (CMD: 0x00)

Starts the measurement. After power up, the module is in Idle-Mode. Before any measurement values can be read, the Measurement-Mode needs to be started using this command.

Sending Data:

Byte #	Datatype	Description
0	unit8	Subcommand, this value must be set to 0x01
1	unit8	Measurement output format: 0x03: Big-endian IEEE754 float values 0x05: Big-endian unsigned 16-bit integer values

Receiving Data:

No data.

Send: 7E 00 00 02 01 03 F9 7E

Response: Empty response frame: 7E 00 00 00 00 FF 7E

Function: Start measurement and output IEEE754 float values.

4.2 Stop Measurement (CMD: 0x01)

Stops the measurement13. Use this command to return to the initial state (Idle-Mode).

Sending Data:

No data.

Receiving Data:

No data.

Send: 7E 00 01 00 FE 7E

Response: 7E 00 01 00 00 FE 7E

4.3 Read Measured Values (CMD: 0x03)

Reads the measured values from the module. This command can be used to poll for new measurement values. The default measurement interval is 1 second. If no new measurements are available, the module returns an empty response frame. If new measurement values are available, the response frame contains the measurement results. The data format depends on the selected output format, see 4.1 for Measurement output formats selection, and details of output format below:

IEEE754 float values

Byte 0~Byte 3: PM1.0 mass concentration [µg/m³]
Byte 4~Byte 7: PM2.5 mass concentration [µg/m³]
Byte 8~ Byte 11: PM4.0 mass concentration [µg/m³]
Byte 12~ Byte 15: PM10 mass concentration [µg/m³]
Byte 16~ Byte 19: Number Concentration PM0.5 [#/cm³]
Byte 20~ Byte 23: Number Concentration PM1.0 [#/cm³]
Byte 24~ Byte 27: Number Concentration PM2.5 [#/cm³]
Byte 28~ Byte 31: Number Concentration PM4.0 [#/cm³]
Byte 32~ Byte 35: Number Concentration PM10 [#/cm³]
Byte 36~ Byte 39: Typical Particle Size [µm]

Unsigned 16-bit integer values

Byte 0~ Byte 1: PM1.0 mass concentration [µg/m³]
Byte 2~ Byte 3: PM2.5 mass concentration [µg/m³]
Byte 4~ Byte 5: PM4.0 mass concentration [µg/m³]
Byte 6~ Byte 7: PM10 mass concentration [µg/m³]
Byte 8~ Byte 9: Number Concentration PM0.5 [#/cm³]
Byte 10~ Byte 11: Number Concentration PM1.0 [#/cm³]
Byte 12~ Byte 13: Number Concentration PM2.5 [#/cm³]
Byte 14~ Byte 15: Number Concentration PM4.0 [#/cm³]
Byte 16~ Byte 17: Number Concentration PM10 [#/cm³]
Byte 18~ Byte 19: Typical Particle Size [µm]

Sending Data:

No data.

Receiving Data:

If no new measurement values are available: no data.

Function: Read concentration of particle and particles number.

Note: Read particle concentration (ug/m3) and particles number (pcs/ml)

Example:

Send: 7E 00 03 00 FC 7E

Response:

Empty response frame:

7E 00 03 00 00 FC 7E

Or response frame with new measurement values:

7E 00 03 00 28 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 D4 7E

4.5 Read Device Status Register (0xD2)

Use this command to read the Device Status Register. For more details, note the explanations given in previous part Device Status Register.

Sending Data:

Byte #	Datatype	Description
0	unit8	0: Do not clear any bit in the Device Status Register after reading. 1: Clear all bits in the Device Status Register after reading.

Receiving Data:

Byte #	Datatype	Description
0~3	big-endian, uint32	Device Status Register
4	uint8	Reserved for future use

Send: 7E 00 D2 01 00 2C 7E

Response: 7E 00 D2 00 05 00 00 00 00 00 28 7E

4.5 Device Reset (CMD: 0xD3)

Soft reset command. After calling this command, the module is in the same state as after a Power-Reset. The reset is executed after the host receiving response frame.

Sending Data:

No data.

Receiving Data:

No data.

Example:

Send: 7E 00 D3 00 2C 7E

Responds: 7E 00 D3 00 00 2C 7E

I²C Communication Protocol

1. Brief Introduction

a. I² C address: 0x69

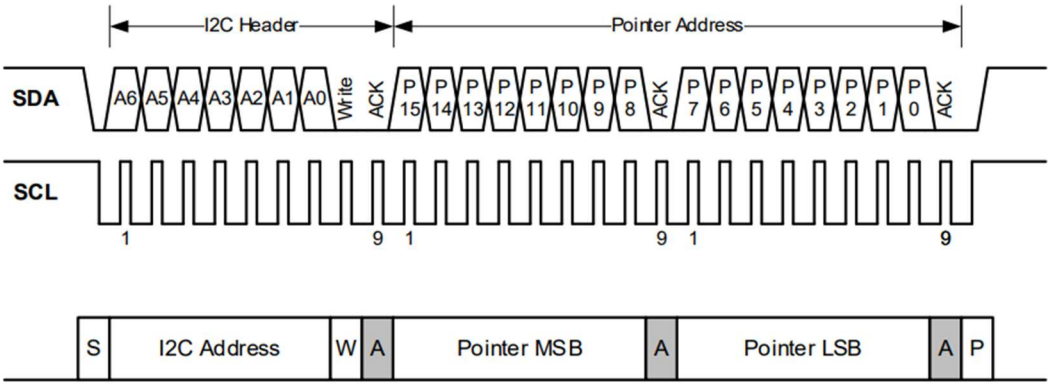
b. Max. speed: standard mode, 100 kbit/s

c. Clock stretching: not used

2. Communication Description

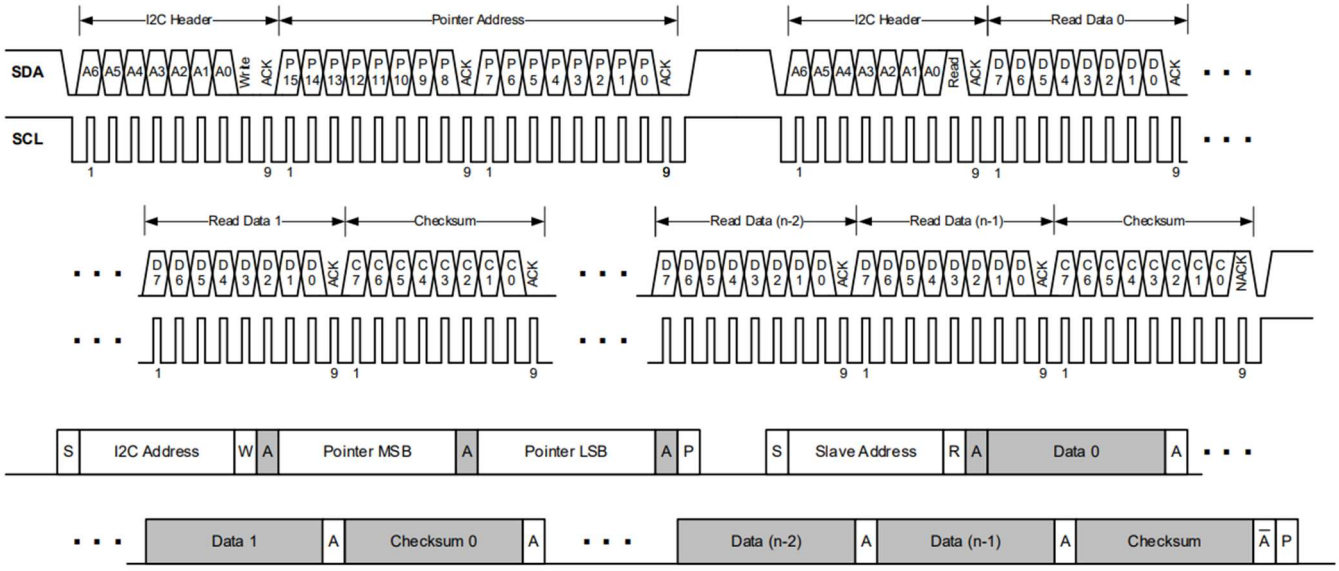
2.1 Transfer Types

Set Pointer: Sets the 16-bit address pointer without writing data to the sensor module. It is used to execute commands, which do not require additional parameters;

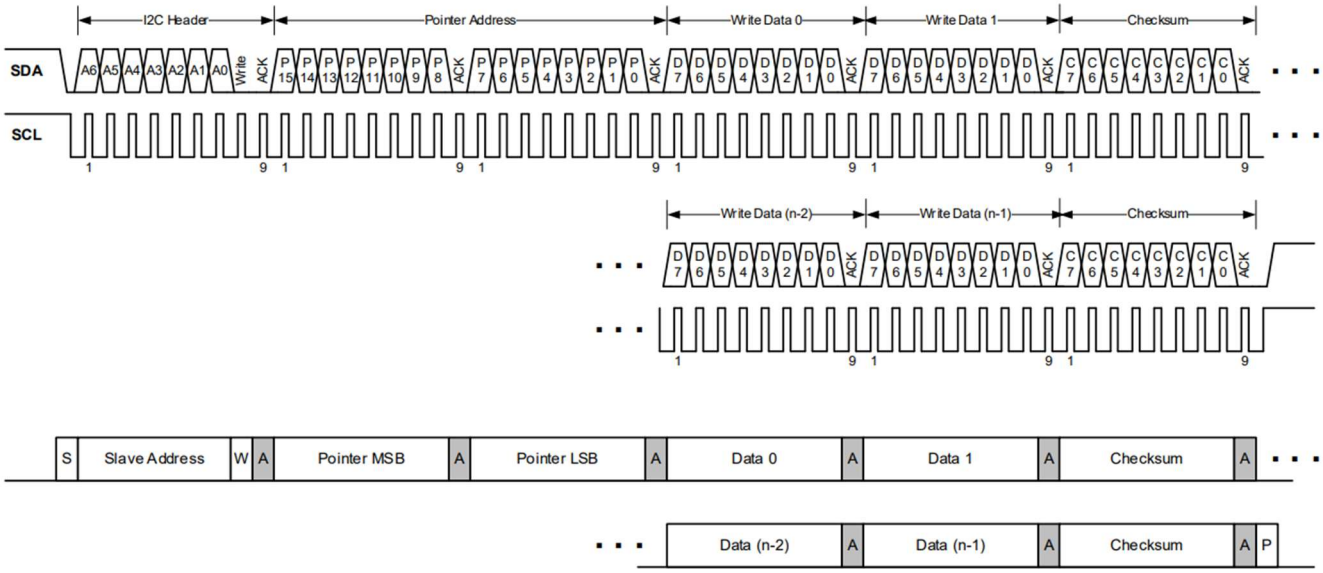


Set Pointer & Read Data: Sets the 16-bit address pointer and read data from sensor module. It is used to read sensor module information or measurement results. The data is ready to read immediately after the address pointer is set. The sensor module transmits the data in 2-byte packets, which are protected with a checksum.

It is allowed to read several times in succession without setting the address pointer again. This reduces the protocol overhead for periodical reading of the measured values.



Set Pointer & Write Data: Sets the 16-bit address pointer and writes data to the sensor module. It is used to execute commands, which require additional parameters. The data must be transmitted in 2-byte packets which are protected by a checksum.



2.2 Checksum Calculation

The Read and Write Commands transmit the data in 2-byte packets, followed by an 8-bit checksum. The checksum is calculated as follows:

Property	Value
Name	CRC-8
Protected Data	Read and/ or write data
Width	8 bit
Polynomial	0x31(x^8 + x^5 + x^4 + 1)
Initialization	0xFF
Reflect Input	false
Reflect Output	false
Final XOR	0x00
Example	CRC(0xBEEF) = 0x92

```
uint8_t CalcCrc(uint8_t data[2])  {
 uint8_t crc = 0xFF;
 for(int i = 0; i < 2; i++)  {
  crc ^= data[i];
  for(uint8_t bit = 8; bit > 0; --bit)  {
    if(crc & 0x80)  {
     crc = (crc << 1) ^ 0x31u;
    } else { crc = (crc << 1);
    }
  }
 } return crc;
}
```

Please note that the checksums are used only for the 2-byte data packets. The command code itself already contains a 3-bit CRC and therefore no checksum must be appended to it.

3. Protocol Detailed Description

3.1 I²C Commands

The following table shows an overview of the available I2C commands：

Address Pointer	Command Name	Transfer Type
0x0010	Start Measurement	Set Pointer & Write Data
0x0104	Stop Measurement	Set Pointer

0x0202	Read Data-Ready Flag	Set Pointer & Read Data
0x0300	Read Measured Values	Set Pointer & Read Data
0xD206	Read Device Status Register	Set Pointer & Read Data
0xD210	Clear Device Status Register	Set Pointer
0xD304	Reset	Set Pointer

3.2 Start Measurement (0x0010)

Starts the measurement. After power up, the module is in Idle-Mode. Before any measurement values can be read, the Measurement-Mode needs to be started using this command.

Transfer Type: Set Pointer & Write Data

Pointer Address: 0x0010

Write Data:

Byte #	Description
0	**Measurement Output Format** 0x03: Big-endian IEEE754 float values 0x05: Big-endian unsigned 16-bit integer values
1	Dummy byte, insert 0x00
2	Checksum for bytes 0, 1

3.3 Stop Measurement (0x0104)

Stops the measurement. Use this command to return to the initial state (Idle-Mode).

Transfer Type: Set Pointer

Pointer Address: 0x0104

3.4 Read Data-Ready Flag (0x0202)

This command can be used for polling to find out when new measurements are available. The pointer address only has to be set once. Repeated read requests get the status of the Data-Ready Flag.

Transfer Type: Set Pointer & Read Data

Pointer Address: 0x0202

Read Data:

Byte #	Description
0	unused, always 0x00
1	Data-Ready Flag 0x00: no new measurements available 0x01: new measurements ready to read
2	Checksum for bytes 0, 1

3.5 Read Measured Values (0x0300)

Reads the measured values from the sensor module and resets the “Data-Ready Flag”. If the sensor module is in Measurement-Mode, an updated measurement value is provided every second and the “Data-Ready Flag” is set. If no synchronized readout is desired, the “Data-Ready Flag” can be ignored. The command “Read Measured Values” always returns the latest measured values.

Transfer Type: Set Pointer & Read Data

Pointer Address: 0x0300

The data format depends on the selected output format when start measurement, see 3.2 Measurement Output Format. Note that after every two bytes, the checksum of the previous two bytes is transferred.

Read Data:

IEEE754 float values

Byte 0~Byte 5: PM1.0 mass concentration [µg/m³]
Byte 6~Byte 11: PM2.5 mass concentration [µg/m³]
Byte 12~ Byte 17: PM4.0 mass concentration [µg/m³]
Byte 18~ Byte 23: PM10 mass concentration [µg/m³]
Byte 24~ Byte 29: Number Concentration PM0.5 [#/cm³]
Byte 30~ Byte 35: Number Concentration PM1.0 [#/cm³]
Byte 36~ Byte 41: Number Concentration PM2.5 [#/cm³]
Byte 42~ Byte 47: Number Concentration PM4.0 [#/cm³]
Byte 48~ Byte 53: Number Concentration PM10 [#/cm³]
Byte 54~ Byte 59: Typical Particle Size [µm]

Unsigned 16-bit integer values

Byte 0~ Byte 2: PM1.0 mass concentration [µg/m³]
Byte 3~ Byte 5: PM2.5 mass concentration [µg/m³]
Byte 6~ Byte 8: PM4.0 mass concentration [µg/m³]
Byte 9~ Byte 11: PM10 mass concentration [µg/m³]
Byte 12~ Byte 14: Number Concentration PM0.5 [#/cm³]
Byte 15~ Byte 17: Number Concentration PM1.0 [#/cm³]
Byte 18~ Byte 20: Number Concentration PM2.5 [#/cm³]
Byte 21~ Byte 23: Number Concentration PM4.0 [#/cm³]
Byte 24~ Byte 26: Number Concentration PM10 [#/cm³]
Byte 27~ Byte 29: Typical Particle Size [µm]

3.6 Read Device Status Register (0xD206)

Use this command to read the Device Status Register, which is a big-endian unsigned 32-bit integer value.

Transfer Type: Set Pointer & Read Data

Pointer Address: 0xD206

Read Data:

Byte #	Description
0, 1	Most Significant Byte
2	Checksum for bytes 0, 1
3, 4	Least Significant Byte
5	Checksum for bytes 3, 4

Device Status Register

The Device Status Register is a 32-bit register that contains information about the internal state of the module. Bit 21, bit 4 and bit 5 are defined as below, other bits are reserved.

Bit 21 is for FAN SPEED

0: Fan speed is ok; 1: Fan speed is too high or too low.

• During the first 3 seconds after starting the measurement (fan start-up) the fan speed is not checked.

• Apart from the exception mentioned above, the fan speed is checked once per second in the measurement mode. If it is out of range twice in succession, the SPEED-bit is set.
• At very high or low ambient temperatures, the fan may take longer to reach its target speed after start-up. In this case, the bit will be set. As soon as the target speed is reached, this bit is cleared automatically.
• If this bit is constantly set, this indicates a problem with the power supply or that the fan is no longer working properly.

Bit 5 is for LASER

0: Laser current is ok; 1: Laser is switched on and current is out of range.
• The laser current is checked once per second in the measurement mode. If it is out of range twice in succession, the LASER-bit is set.
• If the laser current is back within limits, this bit will be cleared automatically.
• A laser failure can occur at very high temperatures outside of specifications or when the laser module is defective.

Bit 4 is for FAN

0: Fan works as expected; 1: Fan is switched on, but the measured fan speed is 0 RPM.
• The fan is checked once per second during measurement. If 0 RPM is measured twice in succession, the FAN bit is set.
• The FAN-bit will not be cleared automatically.
• A fan failure can occur if the fan is mechanically blocked or broken.

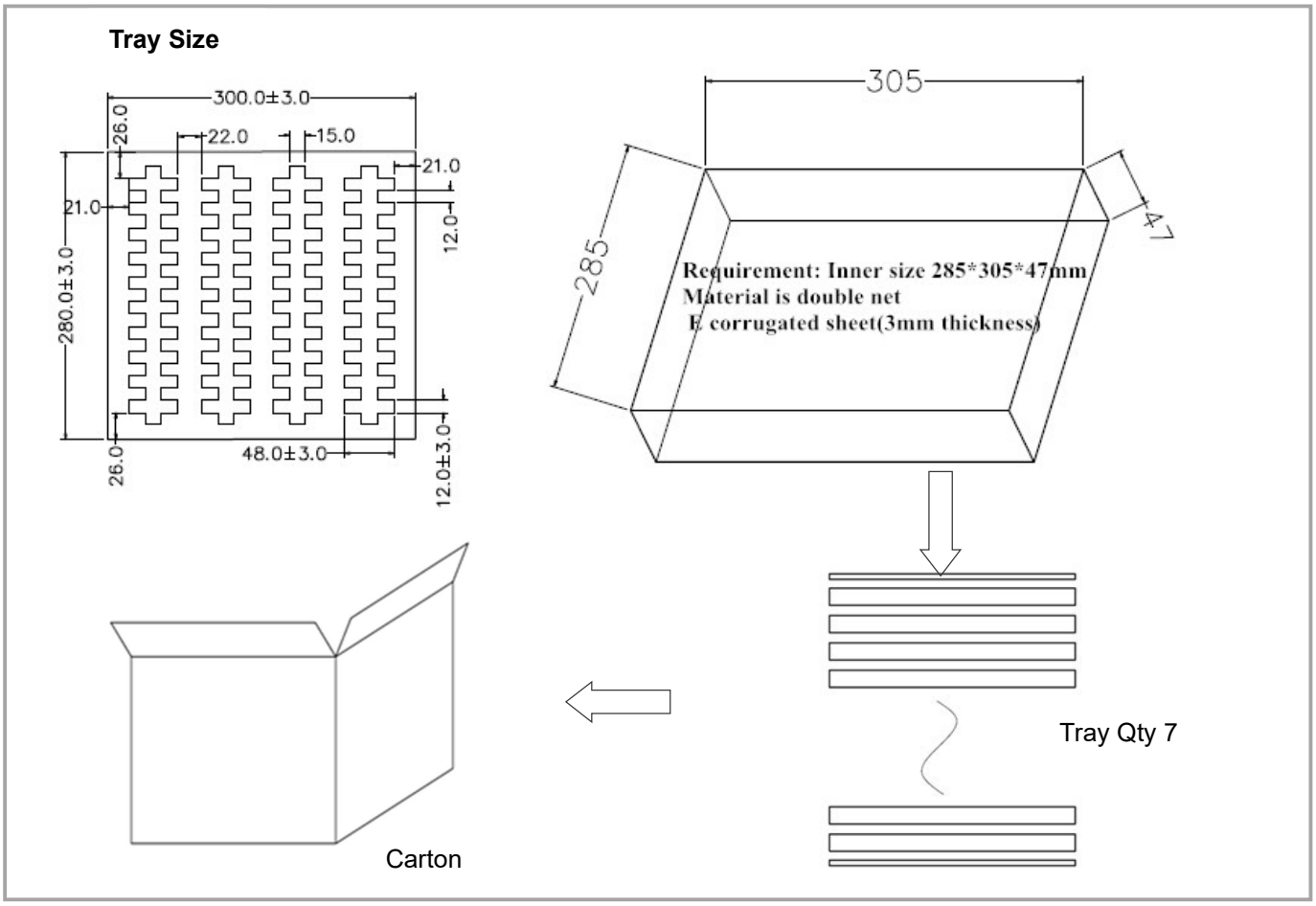
3.7 Clear Device Status Register (0xD210)

Clears the device status register. For more details note part 3.6.
Transfer Type: Set Pointer & Read Data
Pointer Address: 0xD210

3.8 Device Reset (0xD304)

Device software reset command. After calling this command, the module is in the same state as after a power reset.
Transfer Type: Set Pointer
Pointer Address: 0xD304

Package Information



Sensor per Tray	Tray Qty	Sensor per	Carton Dimensions	Packing Material
40 pcs	7 layers	280 pcs	395*310*330 mm	Red anti-static EPE

After-Sales Services and Consultancy

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