TELAIRE®

Application Note

SM-UART-01L+ Laser Dust Sensor

Telaire SM-UART-01L+ Laser Dust Sensor detects dust particle concentration in air by using an optical sensing method. A laser light emitting diode (LED) and a photosensor are optically arranged in the device. The photosensor detects the reflected laser LED light by dust particles in air. The dust sensor can detect small particles, such as cigarette smoke, and distinguish small particles, such as smoke from large house dust, by the pulse pattern of the signal output.

Features

- Fast response
- High accuracy
- Digital UART output
- Ultra-compact size

Applications

- Detection of dust in the air for Indoor air quality monitoring
- Air cleaners and air purifiers
- Air conditioners and HVAC
- Outdoor dust monitoring

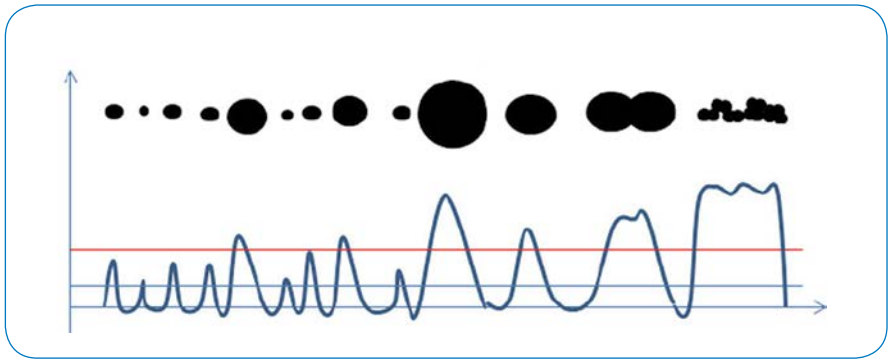

Figure 1 : Detection Principle

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Block Diagram

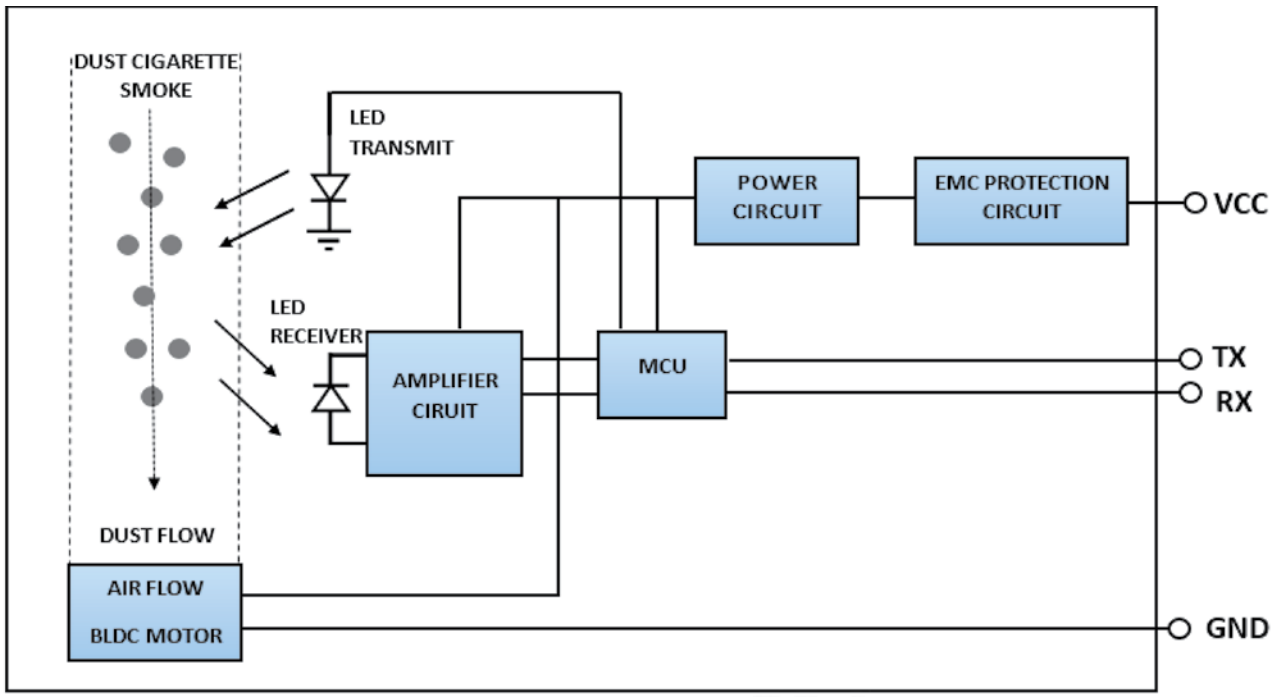

Figure 2 : Block Diagram

Electrical Characteristics

Absolute Maximum Ratings			
Parameter	**Symbol**	**Rating**	**Unit**
Supply Voltage	Vcc	4.8 to + 5.2	V
Operating Temperature	Topr	-10 to 50	°C
Storage Temperature	Tstg	-20 to 70	°C
Operating Humidity (1)	RHopr	35 to 85	%
Storage Humidity (1)	RHstg	35 to 85	%

Electro-optical Characteristics

Parameter		Symbol	Min	Typ	Max	Unit
Particle Size		D	0.3	2.5	10	um
Detection Range		Dreg	1	-	999	ug/m³
Resolution		R	-	1	-	ug/m³
Detection Error (2)	0 to 100 ug/m³	Derr	-	-	+/-15	ug/m³
	> 100 ug/m³		-	-	+/-15	%
Response Time		Trsp		10		s

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Operating Supply Voltage and Signal Output

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	Vcc	-	5	-	V
Supply Ripple Voltage	Vripple	-	-	30	mV
Current Consumption	Icc	-	-	100	mA
Signal Output (RX, TX)	L<0.8 @ 3.3V, H>2.7 @ 3.3V				

1) Non-condensing 2) Testing at T=25°C, RH=40-60%

Notes

Connection of Case and GND

The metal case connects with GND in sensor. **Do not remove the metal case**.

Cleaning

Do Not Clean. Cleaning may cause the device to not work properly.

Dust Adhesion

The dust adhered to the inside of the sensor through a hole may reflect into the detecting space which consists of emitter and detector light axis.

Please take the structure and the mechanism of the equipment into consideration to avoid the influence of adhered dust. If the dust is adhered, please consider the maintenance, such as vacuuming or blowing off the dust by air.

In addition, please pay attention to structure and placing location of the application to avoid any adhesive particle, such as oil, to get into the sensor. If it sticks to the optical part, malfunction may occur.

Resolution

Please do not disassemble the device. Even if the device is reassembled, it may not satisfy the specification.

Noise Influence

If the sensor is located close to a noise generator (ex. Electric dust collector, etc., such as an electric dust collector), the sensor output may be affected by leaded noise. In addition, the noise from the power supply line may affect the sensor output. When designing the system, please consider the effect from noise.

Vibration Influence

The sensor may change its value under mechanical oscillation. Before usage, please make sure that the device works normally in the application.

Incident Light Influence

Please locate the sensor in a dark place to avoid any influence from outer light.

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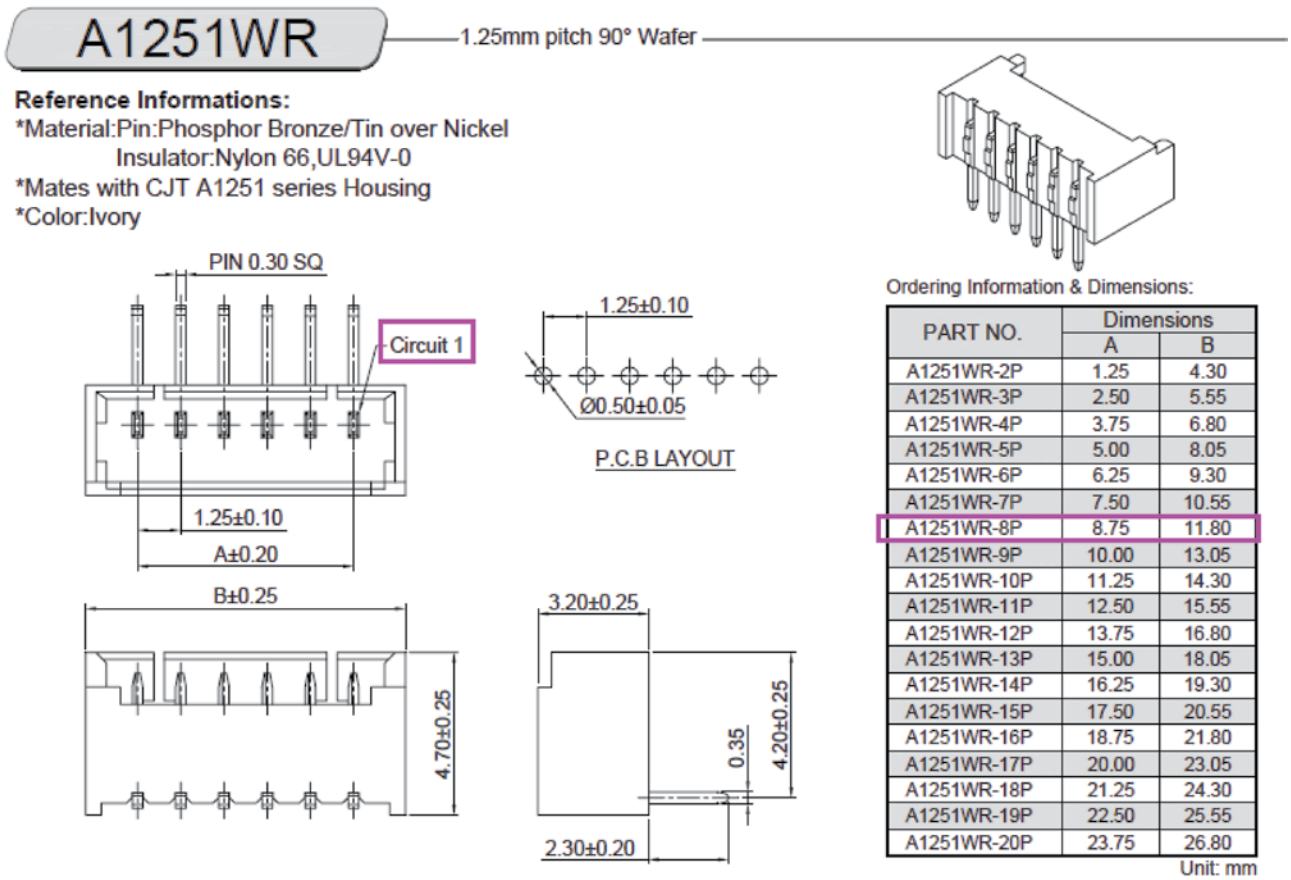
Connector

Standard Connector			
Part No.	**Symbol**	**Description**	**Maker**
Connector	A12512WR-8P	1.25mm pitch	CJT
Housing	A1251H-8P		
Terminal	A1251-TP		
Alternate Connectors	10114826-00008LF		Amphenol FCI
	440146-8		TE



PART NO.	Dimensions	
	A	B
A1251WR-2P	1.25	4.30
A1251WR-3P	2.50	5.55
A1251WR-4P	3.75	6.80
A1251WR-5P	5.00	8.05
A1251WR-6P	6.25	9.30
A1251WR-7P	7.50	10.55
A1251WR-8P	8.75	11.80
A1251WR-9P	10.00	13.05
A1251WR-10P	11.25	14.30
A1251WR-11P	12.50	15.55
A1251WR-12P	13.75	16.80
A1251WR-13P	15.00	18.05
A1251WR-14P	16.25	19.30
A1251WR-15P	17.50	20.55
A1251WR-16P	18.75	21.80
A1251WR-17P	20.00	23.05
A1251WR-18P	21.25	24.30
A1251WR-19P	22.50	25.55
A1251WR-20P	23.75	26.80

Figure 3 : Standard connector reference

Pin Configuration

Number	Symbol	Pin Description
PIN 1	NC	Not connected
PIN 2	NC	Not connected
PIN 3	NC	Not connected
PIN 4	TXD	UART Transceiver @ 3.3V TTL
PIN 5	RXD	UART Transceiver @ 3.3V TTL
PIN 6	NC	Not connected
PIN 7	GND	Ground
PIN 8	VCC	Input supply voltage

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Application Circuit

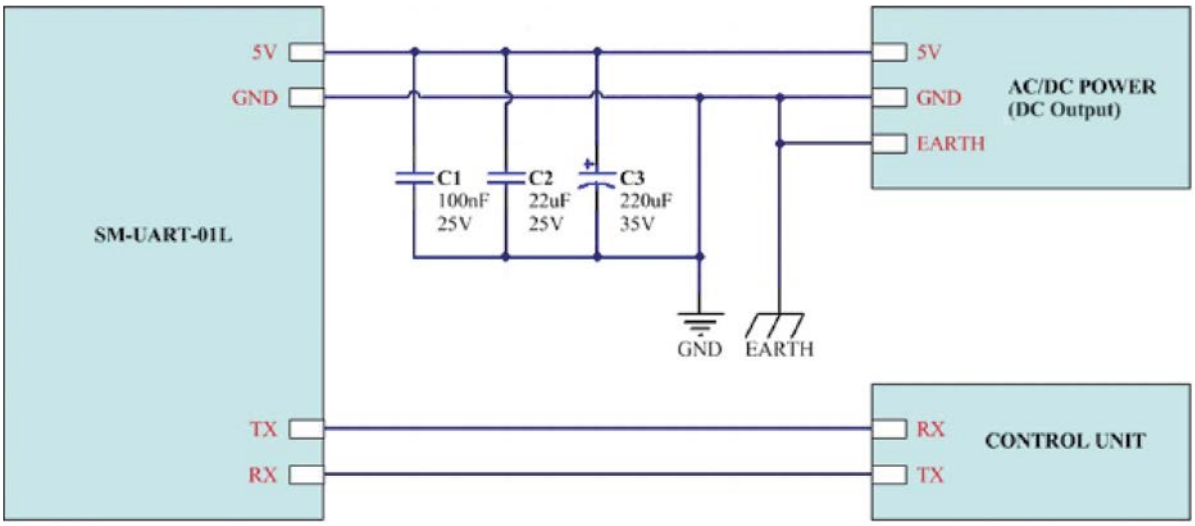

Figure 4 : Application circuit

Communication Protocol

Parameter	Rating
Baud Rate	9600
Data Bits	8
Parity	None
Stop Bits	1

SM-UART-01L+ uses the Modbus protocol for all communication. It is important to note that for Modbus over serial lines the user must include CRC fields at the end of the Modbus communication.

Modbus Request (UART)		
0x20	Byte 1:	Slave address, default 0x20
0x0C	Byte 2:	Function code
0x00	Byte 3:	Not used
0x00	Byte 4:	Not used
0x00	Byte 5:	Not used
0x00	Byte 6:	Not used
xx	Byte 7:	CRC (LSB)
xx	Byte 8:	CRC (MSB)

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Modbus Reply (UART)		
0x20	Byte 1:	Slave address, default 0x20
0x0C	Byte 2:	Function code
0xData1	Byte 3:	Flag Bit of FAN, 0x00 means normal, 0x01 means abnormal
0x00	Byte 4:	Not used
0x00	Byte 5:	Not used
0x00	Byte 6:	Not used
0xData5	Byte 7:	PM1 MSB of 16-bit data
0xData6	Byte 8:	PM1 LSB of 16-bit data
0xData7	Byte 9:	PM2.5 MSB of 16-bit data
0xData8	Byte 10:	PM2.5 LSB of 16-bit data
0xData9	Byte 11:	PM10 MSB of 16-bit data
0xData10	Byte 12:	PM10 LSB of 16-bit data
xx	Byte 13:	CRC (MSB)
xx	Byte 14:	CRC (LSB

PM1 = 0xData5 * 256 + 0xData6
PM25 = 0xData7 * 256 + 0xData8
PM10 = 0xData9 * 256 + 0xData10

For example:

Request: 20 0C 00 00 00 00 17 7A (in HEX, last 2 bytes are CRC)
Reply: 20 0C xx xx xx xx xx xx 00 7D xx xx xx xx (in HEX, last 2 bytes are CRC)
PM2.5 reading is calculated as follows:

0x00 * 256 + 0x7D = 125 ug/m3

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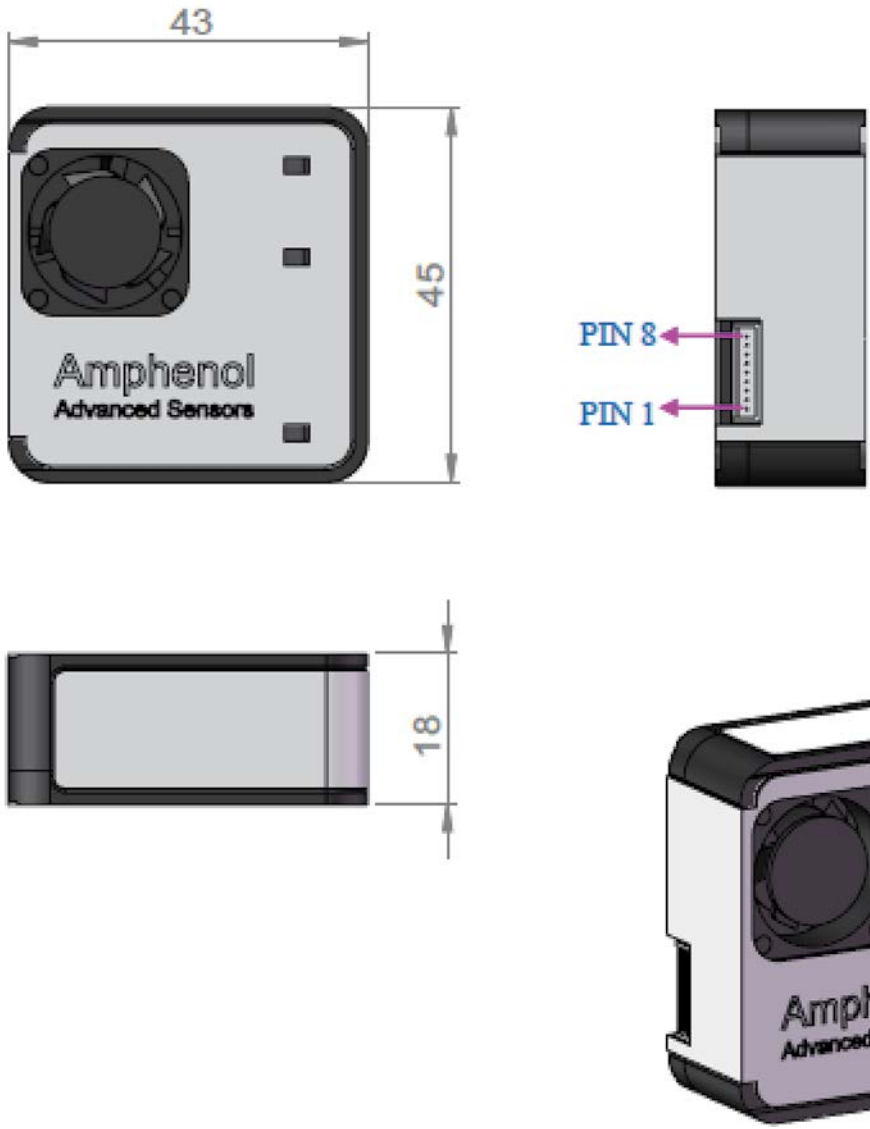

PIN1	NC
PIN2	NC
PIN3	NC
PIN4	TXD
PIN5	RXD
PIN6	NC
PIN7	GND
PIN8	VCC

Figure 5 : SM-UART-01L+ Dimensions

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Reliability Specifications

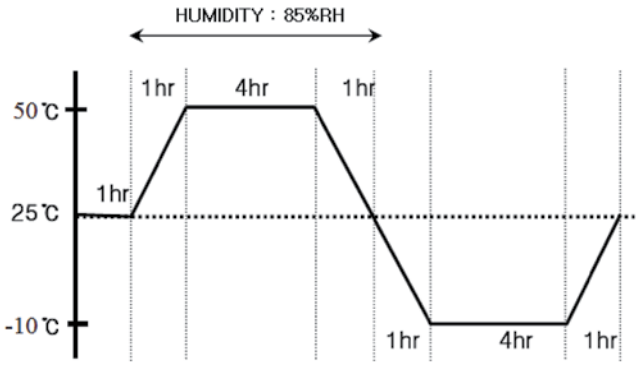
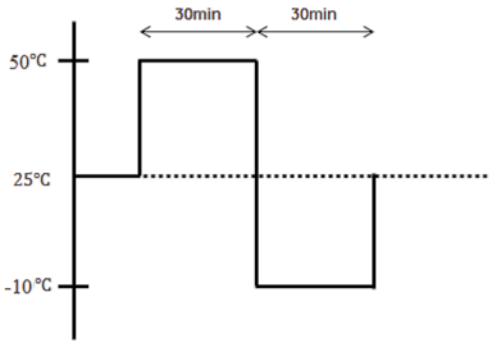
1	Drop	Drop it unintentionally from 100cm height down to the hard wooden board three times at random direction	No damage after testing. N=5, C=0
2	High Temp. Storage	Leave in the atmosphere 70°C for 96 hours	
3	Low Temp. Storage	Leave in the atmosphere -20°C for 96 hour	
4	High Temp. Operation	Operating in the atmosphere of 50°C for 96 hours	
5	Low Temp. Operation	Operating in the atmosphere of -10°C for 96 hours	
6	Thermal Cycle	Repeat 20 times in the following cycle. 	
7	Thermal Shock	Repeat 20 times in the following cycle. 	
8	Mechanical Vibration	Frequency range : 5 Hz to 500 Hz sinusoidal Change of frequency : 1 oct/min Amplitude : 10mm Acceleration : 20 m/S2 Cross-over frequency : 13 Hz Testing time per spatial axis (X,Y,Z) : 2 h	

Figure 6 : Reliability Specifications

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Appendix

CRC CALCULATION IN C LANGUAGE:

```
UINT16_T CRC16 (UINT8_T *PUCHMSG, UINT8_T U8_LENGTH) /* THE FUNCTION RETURNS THE CRC
AS A UNSIGNED SHORT TYPE */
 {
 UINT16_T U16_REG_CRC = 0XFFFF;
 UINT8_T I, J = 0;
 UINT8_T U8_TEMP_REG = 0;
 FOR (I=0; I<U8_LENGTH; I++)
 {
 U16_REG_CRC ^= *PUCHMSG++;
 FOR (J = 0; J < 8; J++)
 {
 IF (U16_REG_CRC & 0X0001)
 {
 U16_REG_CRC = U16_REG_CRC >> 1 ^ 0XA001;
 }
 ELSE
 {
 U16_REG_CRC >>= 1;
 }
 }
 }
 U8_TEMP_REG = U16_REG_CRC >> 8;
 RETURN (U16_REG_CRC<<8 | U8_TEMP_REG);
 }
```

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Packing Specification

Length (L)	Width (W)	Height (H)	Inner Qty.	Total Qty.	Weight
345mm	285mm	180mm	5 layers	100 pcs	Max. 5kg

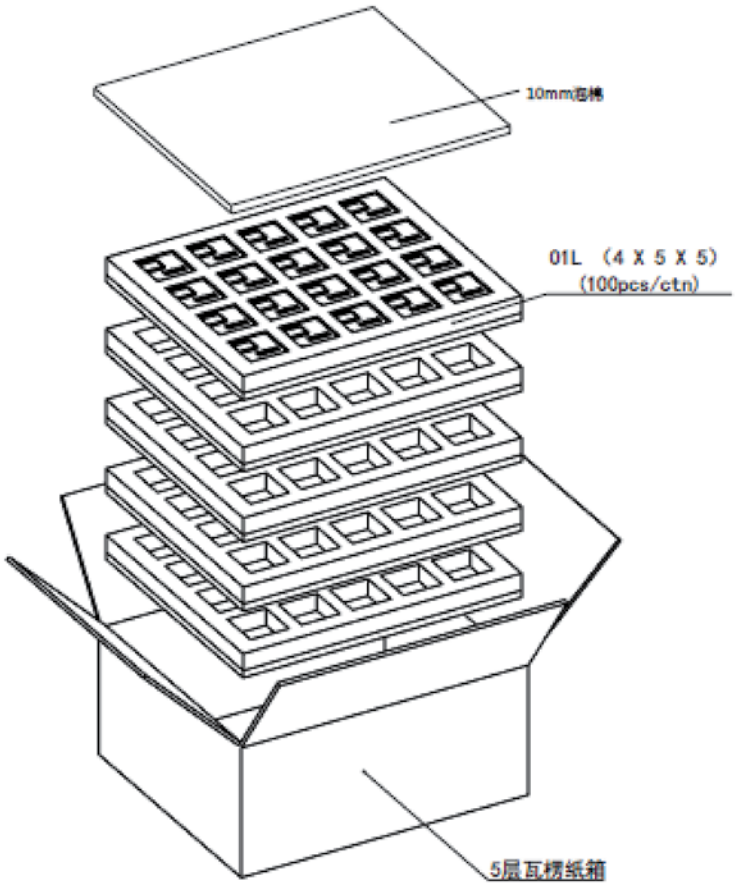

Figure 7 : Packing Specifications

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