TELAIRE®

Application Note

SM-UART-04L
PM2.5 + PM10
Particulate Dust Sensor



SM-UART-04L Particulate Dust Sensor is designed for a wide range of air quality applications where fine particle dust needs to be measured. Applications include air quality meters and air purifiers for both residential and light industrial monitoring and control. The optical design leverages laser technology, which allows customers to achieve excellent performance with balanced reliability. SM-UART-04L is an ideal solution for industrial and consumer applications.

SM-UART-04L is a PM2.5 laser-based Particulate Dust Sensor that detects dust particle concentration in air by using an optical sensing method. A laser light emitting diode (laser LED) and a photo sensor are optically arranged in the device. The photo sensor detects the reflected laser LED light by dust particles in air. The dust sensor can detect small particles from large house dust, by the pulse pattern of the signal output.

Features

- Laser Optical Dust
  - High accuracy
  - Fast response
- PM2.5 Output
- PM10 Calculated Output
- ROHS and REACH Compliant
- UART Series Digital Output
- Compact in size
- Flexible mounting style
- Protected from EMC intrusion by metal case
- Wide detection range
- Average Time Before Re-calibration: 40,000 hrs

Applications

- Indoor Air Quality Monitoring
- Air Cleaners and Purifiers
- Air Conditioners and HVAC
- Outdoor Dust Monitoring (with additional protection)

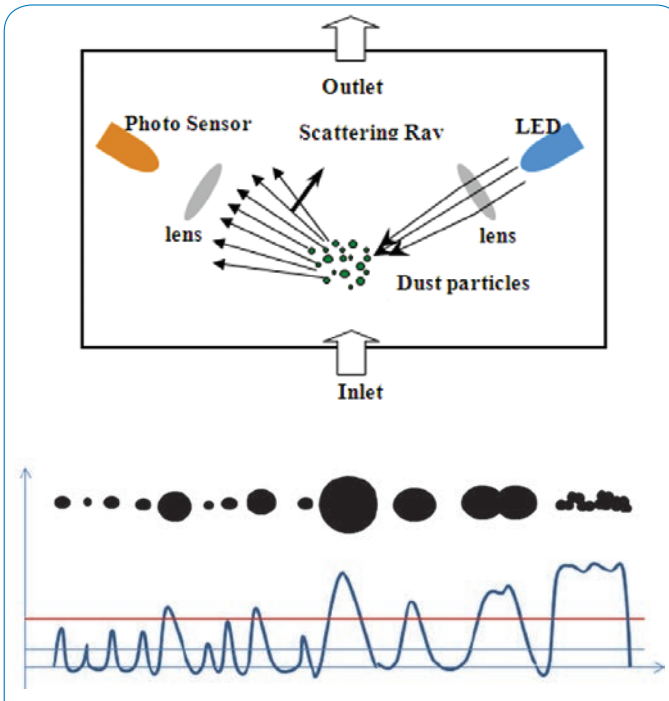
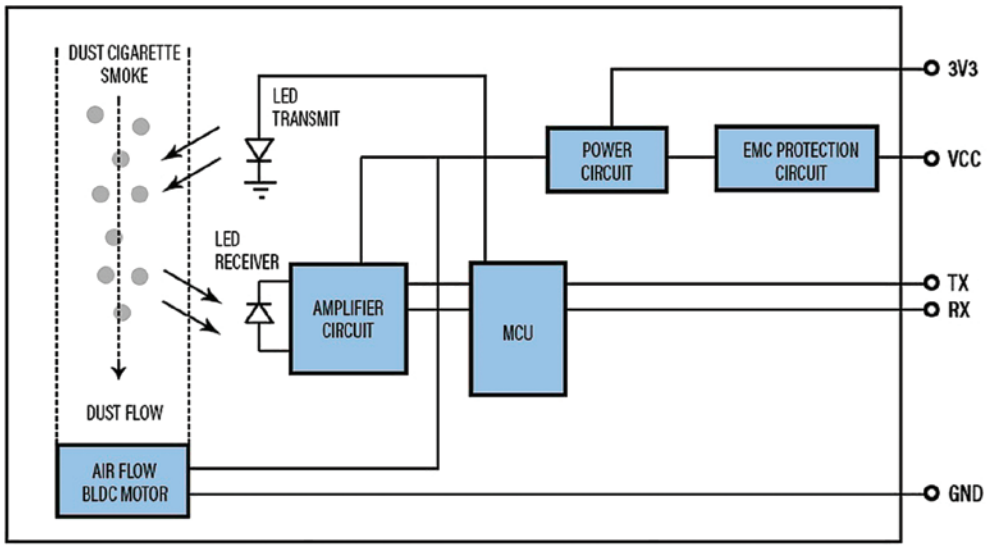


Figure 1 : Detection Principle

Amphenol
Advanced Sensors

SM-UART-04L Particulate Dust Sensor

Block Diagram



Calibration

Calibration carried out with cigarette smoke per GB/T1880

Absolute Maximum Ratings

Absolute Maximum Ratings			
Parameter	**Symbol**	**Rating**	**Unit**
Supply Voltage	Vcc	0 to + 5.5	V
Operating Temperature	Topr	-10 to 50	°C
Storage Temperature	Tstg	-30 to 70	°C
Operating Humidity (1)	RHopr	0 to 95	%
Storage Humidity (1)	RHstg	0 to 95	%

1) Non-condensing

Electrical Characteristics

Parameter		Symbol	Min.	Typ.	Max.	Unit
Particle Size		D	0.3	2.5	10	um
Detection Range		D_{reg}	1	—	999	μg/m³
Resolution		R	—	1	—	μg /m³
Indication Error (2)	1 ~100 ug/m³	D_{err}	—	—	+/-10	μg /m³
	100~999 ug/m³		—	—	+/-10	%
Warm-Up Time		t_{wup} (2)	—	5	—	s
Response Time		t_{rsp} (2)	—	1	—	s
Laser Life (Average Time Before Re-Calibration)		T	—	40,000	—	hour
Supply Voltage		V_{CC}	4.8	5	5.2	V
Supply Voltage Ripple		V_{CC} Ripple	—	—	30	mV
Current Consumption		I_{CC} (2)	—	60	100	mA
Output (UART)		3.3V				

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

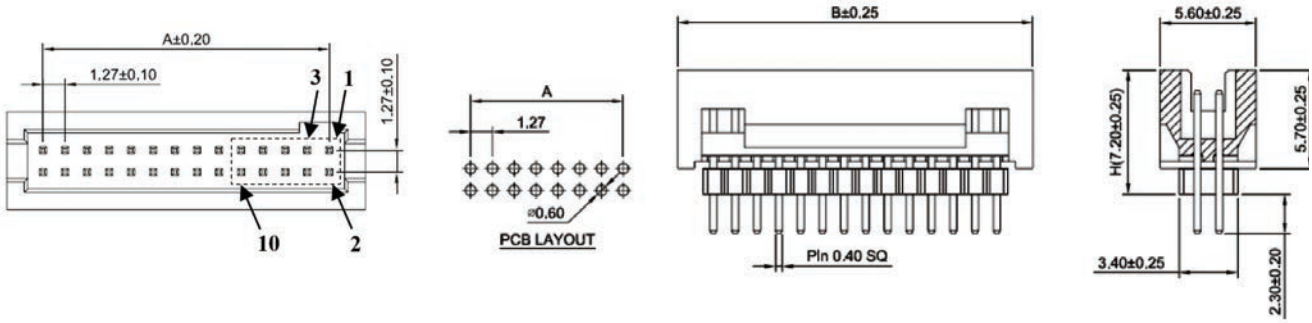
SM-UART-04L Particulate Dust Sensor

Connector

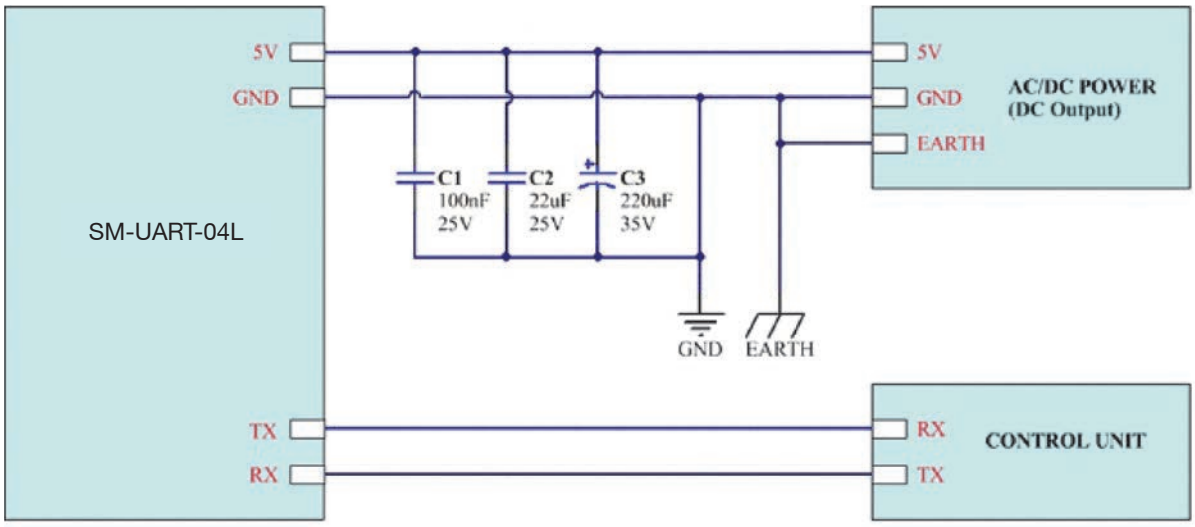
Sensor Connector:
CJT A1276WVA-N-2x5P-H72

Equivalent Connector:
Harwin, Inc. M50-3000545; Amphenol FCI 20021311-00010T4LF

Pin #	Pin Name	Description
1	5V	Input Supply Voltage
2	5V	Input Supply Voltage
3	GND	Ground
4	GND	Ground
5	RESET	Reset Pin @3.3V TTL, Low level reset
6	NC	—
7	RXD	UART Receiver @ 3.3V TTL
8	NC	—
9	TXD	UART Transceiver @ 3.3V TTL
10	SET/SLEEP	Working Mode Pin @ 3.3V TTL Floating or high level for normal working condition. Low level for dormancy mode.



Application Circuit



SM-UART-04L Particulate Dust Sensor

Communication Protocol - UART

UART Serial Configuration	
Baud Rate	9600 bps
Data Bits	8
Parity	None
Stop Bits	1

Communication Protocol - Default Output UART Frame Format

Head 1	0x42	
Head 2	0x4D	
H_Length	...	Length = 2 * 13 + 2 (Data+CS)
L_Length	...	
H_D1	...	PM1 = H_D1 * 256 + L_D1 ug/m3 (Standard Smoke, Calculated Value
L_D1	...	
H_D2	...	PM2.5 = H_D2 * 256 + L_D2 ug/m3 (Standard Smoke, Calibrated Value)
L_D2	...	
H_D3	...	PM10 = H_D3 * 256 + L_D3 ug/m3 (Standard Smoke, Calculated Value)
L_D3	...	
H_D4	...	PM1 = H_D4 * 256 + L_D4 ug/m3 (Environment, Calculated Value)
L_D4	...	
H_D5	...	PM2.5 = H_D5 * 256 + L_D5 ug/m3 (Environment, Calculated Value)
L_D5	...	
H_D6	...	PM10 = H_D6 * 256 + L_D6 ug/m3 (Environment, Calculated Value)
L_D6	...	
H_D7	...	
L_D7	...	
H_D8	...	
L_D8	...	
H_D9	...	
L_D9	...	
H_D10	...	
L_D10	...	
H_D11	...	
L_D11	...	
H_D12	...	
L_D12	...	
H_D13	...	Version number
L_D13	...	Error code 0b0ABCDEFG A = 1 Laser error B = 1 Laser alarm C = 1 High temperature alarm D = 1 Low temperature alarm E = 1 Fan error F = 1 Fan speed compensation start G = 1 Fan speed alarm
H_CS	...	CS = HEAD1 + HEAD2 + … + L_D13
L_CS	...	

* We recommend the customers use PM values with the standard smoke.

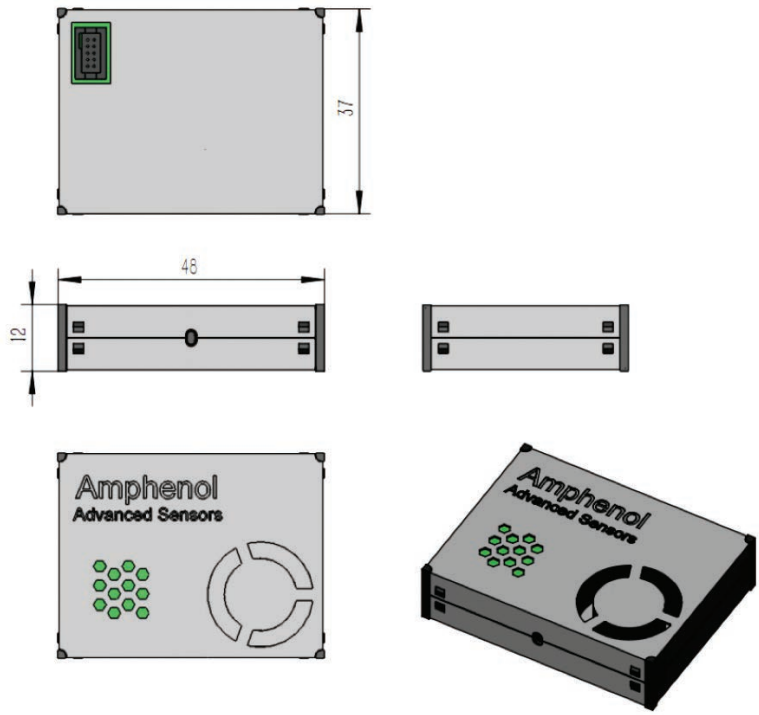
SM-UART-04L Particulate Dust Sensor

Response Mode - Command Frame

Head 1	Head 2	CMD	D1	D2	CRC1	CRC2
0x42	0x4D	CMD	DATAH	DATAL	LRCH	LRCL

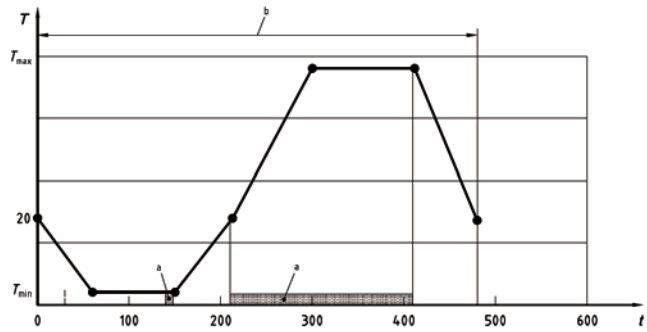
CMD	DATAH	DATAL	Description	Response
0xE2	X	X	Get reading	Same format as above table
0xE1	X	0x00 – Ask-answer mode 0x01 – Direct output mode	Output mode switch	0x42 0x4D 0x00 0x04 0xE1 0x00 0x01 0x74 0x42 0x4D 0x00 0x04 0xE1 0x01 0x01 0x75
0xE4	X	0x00 – Standby mode 0x01 – Working mode	Standby control	0x42 0x4D 0x00 0x04 0xE4 0x00 0x01 0x77

Dimensions

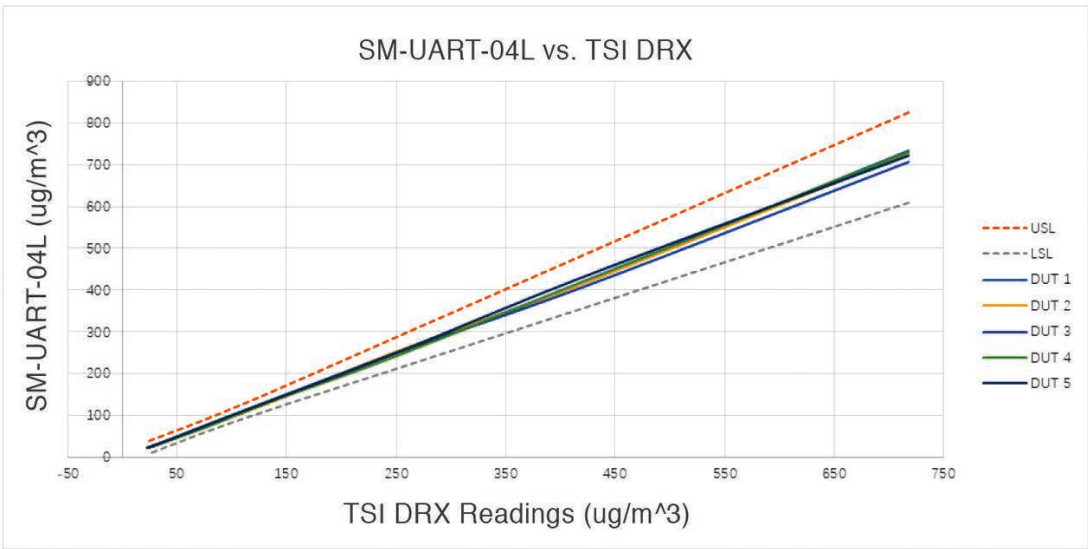


SM-UART-04L Particulate Dust Sensor

Reliability

1	Drop	Drop it unintentionally from 100 cm height down to the hard wooden board three times at random direction
2	High Temp. Storage	Leave in the atmosphere 70°C for 96 hours
3	Low Temp. Storage	Leave in the atmosphere -30°C for 72 hours
4	High Temp. Operation	Operate it in the atmosphere of 50°C for 96 hours
5	Low Temp. Operation	Operate it in the atmosphere of -10°C for 72 hours
6	Temperature Cycle	Repeat 30 times in the following cycle Key T temperature, °C t time, min a Operating mode 3.2 (see ISO 16750-1) b One cycle. 
7	Operating Volt. Range	VCC = 4.8V/5.0V/5.2V Verify Indication Error within SPEC (0~1000ug/m3)
8	Slow Decrease & Increase of Supply Voltage	Decrease the supply volt. from the minimum supply voltage 4.8V to 0V, then increase it from 0V to 5.2V, applying a change rate in equal steps of not more than 200 mV/min. Test dust concentration is 250 +/- 50 ug/m3
9	Short Circuit Protection	Connect all pins to the pins next to them for a duration of 60s with power supplied and all other pins remain open. Class C satisfied
10	Reliability - Operating	TA=25°C, RH=30~70%, VCC=5V Continuously operate 720h. Verify Indication Error within SPEC (0~1000ug/m3)
11	Reliability – ON/OFF	10s ON/10s OFF, operate for 72h. Verify Indication Error within SPEC (0~1000ug/m3)
12	Salt Spray	According to GB/T 2423.17-93, spray 5% NaCl solution in salt mist box at 35°C for 24 hours, then clean with water after test

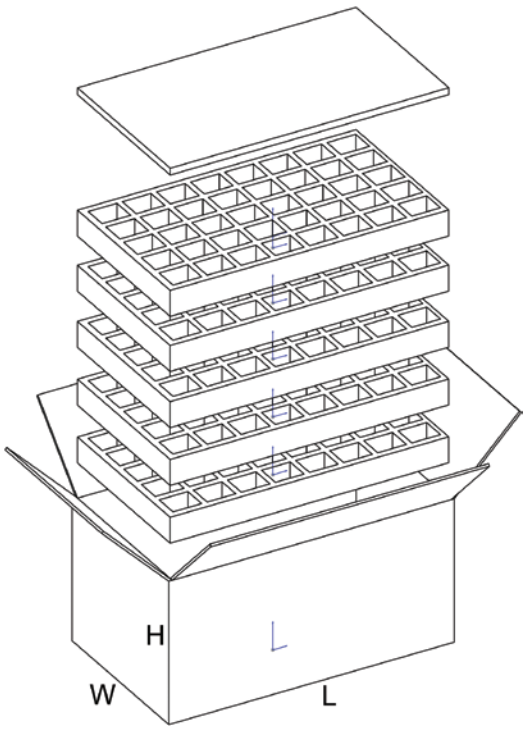
Data Consistency



SM-UART-04L Particulate Dust Sensor

Packing Specifications

Length (L)	Width (W)	Height (H)	Inner Qty	Total Qty	Weight
418.2mm	295mm	210mm	5 layer	200 pcs	5kg max



Application Notes

Grounding

The metal case is internally connected to GND. Do not strip the metal case.

Maintenance

The product is designed to be maintenance free.

Do not attempt to disassemble the device. There are no user-servicable parts in the module. Disassembly will invalidate warranty.

Electro-Magnetic (EM) Noise

Excessive electro-magnetic (EM) noise may degrade sensor performance. Shield sensor from EM noise in application.

Vibration

Excessive vibration may degrade sensor's performance. Please keep sensor far from vibration in application.

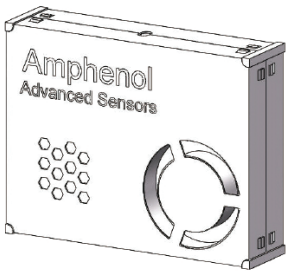
Ambient Light

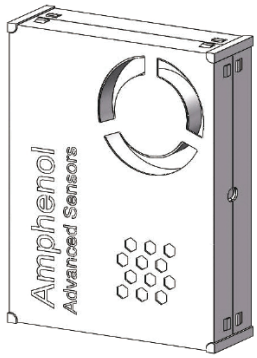
Excessive ambient light may degrade sensor performance. Keep sensor far from intense direct light.

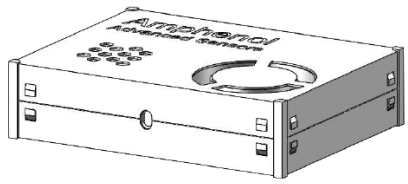
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Mounting Orientation

Please take sensor mounting orientation into consideration to avoid the influence of adhered dust. The sensor is installed vertically as the best of below:







In addition, please avoid any adhesive particle (fur, oil, etc). If particles adhere to optical part, malfunction may occur.

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