

DAFTAR LAMPIRAN

Lampiran 1. Datasheet Sensor DHT22

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Lampiran 2. Datasheet Sensor MQ-135

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Lampiran 4. Datasheet Layar LED P10

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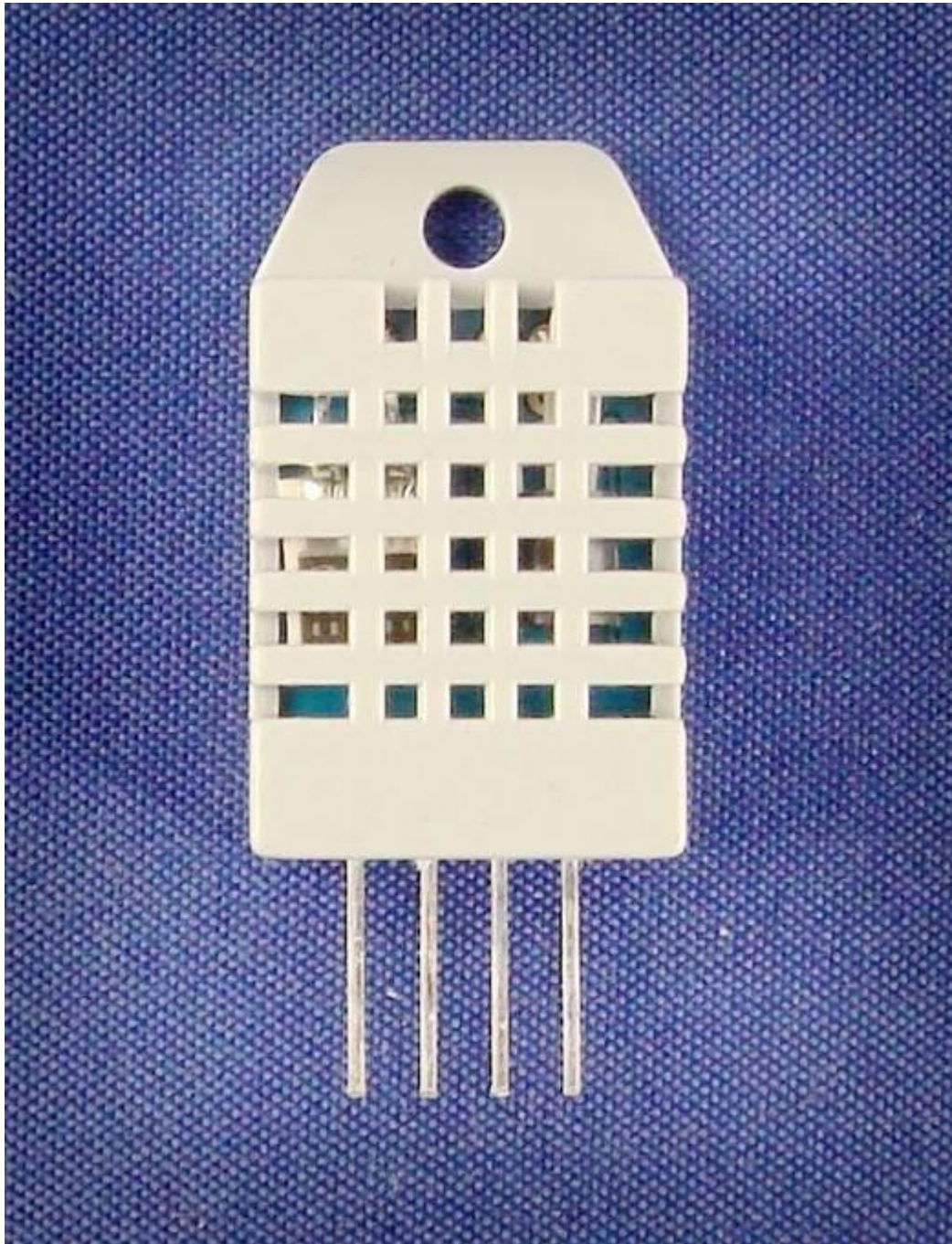
2025, from
<https://www.iled.com/class/INNOVAEditor/assets/YeniDatasheets/2120https://www.iled.com/class/INNOVAEditor/assets/YeniDatasheets/2120-2124p10tekrenk.pdf2124p10tekrenk.pdf>

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**Digital-output relative humidity & temperature sensor/module
DHT22 (DHT22 also named as AM2302)**



Capacitive-type humidity and temperature module/sensor

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1. Feature & Application:

- * Full range temperature compensated
- * Relative humidity and temperature measurement
- * Calibrated digital signal
- * Outstanding long-term stability
- * Extra components not needed
- * Long transmission distance
- * Low power consumption
- * 4 pins packaged and fully interchangeable

2. Description:

DHT22 output calibrated digital signal. It utilizes exclusive digital-signal-collecting-technique and humidity sensing technology, assuring its reliability and stability. Its sensing elements is connected with 8-bit single-chip computer.

Every sensor of this model is temperature compensated and calibrated in accurate calibration chamber and the calibration-coefficient is saved in type of programme in OTP memory, when the sensor is detecting, it will cite coefficient from memory.

Small size & low consumption & long transmission distance(20m) enable DHT22 to be suited in all kinds of harsh application occasions.

Single-row packaged with four pins, making the connection very convenient.

3. Technical Specification:

Model	DHT22
Power supply	3.3-6V DC
Output signal	digital signal via single-bus
Sensing element	Polymer capacitor
Operating range	humidity 0-100%RH; temperature -40~80Celsius
Accuracy	humidity +2%RH(Max +-5%RH); temperature <+-0.5Celsius
Resolution or sensitivity	humidity 0.1%RH; temperature 0.1Celsius
Repeatability	humidity +-1%RH; temperature +-0.2Celsius
Humidity hysteresis	+0.3%RH
Long-term Stability	+0.5%RH/year
Sensing period	Average: 2s
Interchangeability	fully interchangeable

Dimensions	small size 14*18*5.5mm; 22*28*5mm	big size
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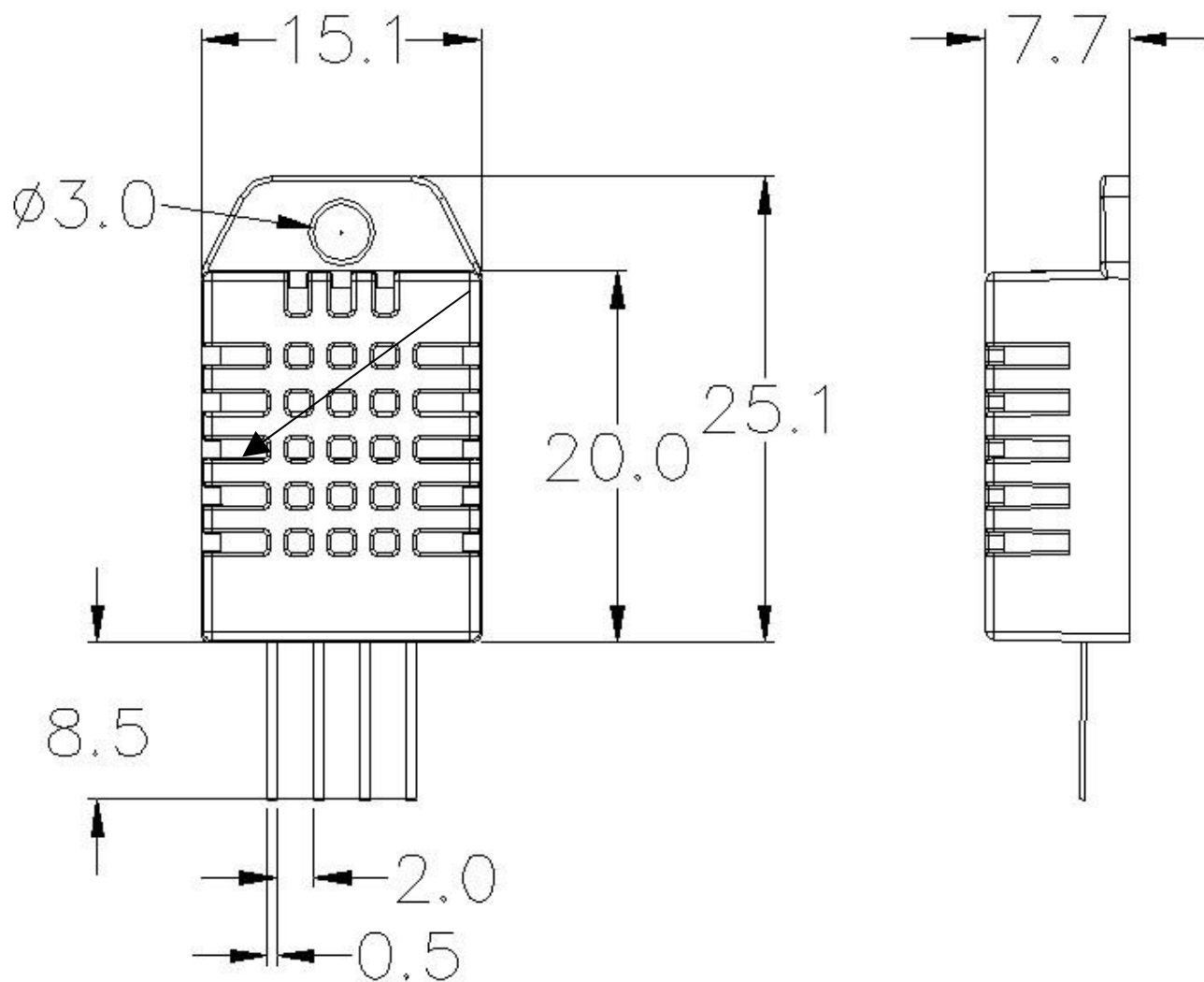
4. Dimensions: (unit----mm)

1) Small size dimensions: (unit----mm)



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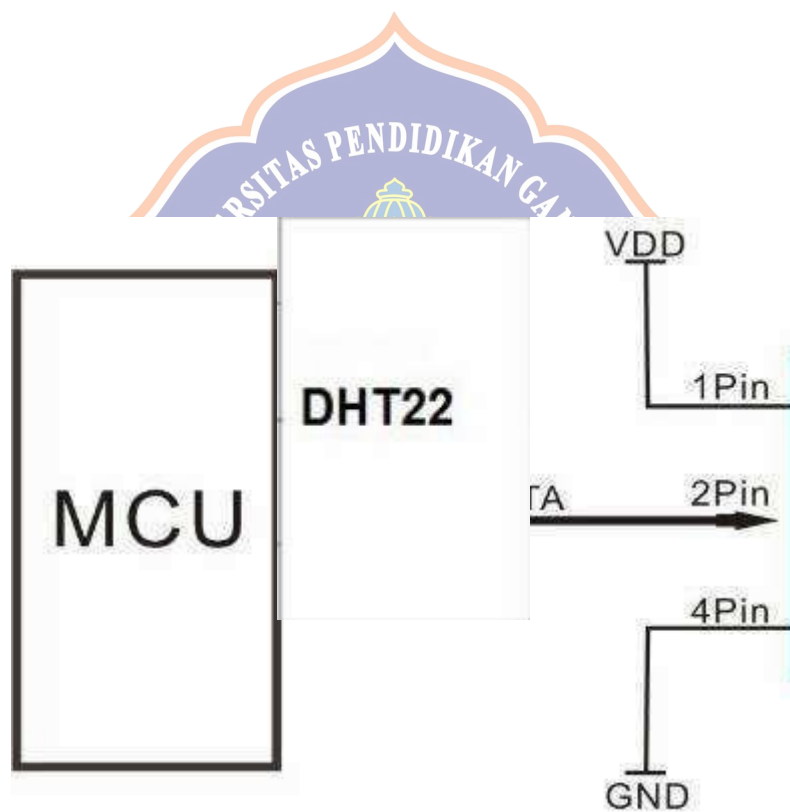
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Pin sequence number: 1 2 3 4 (from left to right direction).

Pin	Function
1	VDD----power supply
2	DATA--signal
3	NULL
4	GND

5. Electrical connection diagram:



3Pin---NC, AM2302 is another name for DHT22

6. Operating specifications:

(1) Power and Pins

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Power's voltage should be 3.3-6V DC. When power is supplied to sensor, don't send any instruction to the sensor within one second to pass unstable status. One capacitor valued 100nF can be added between VDD and GND for wave filtering.

(2) Communication and signal

Single-bus data is used for communication between MCU and DHT22, it costs 5mS for single time communication.

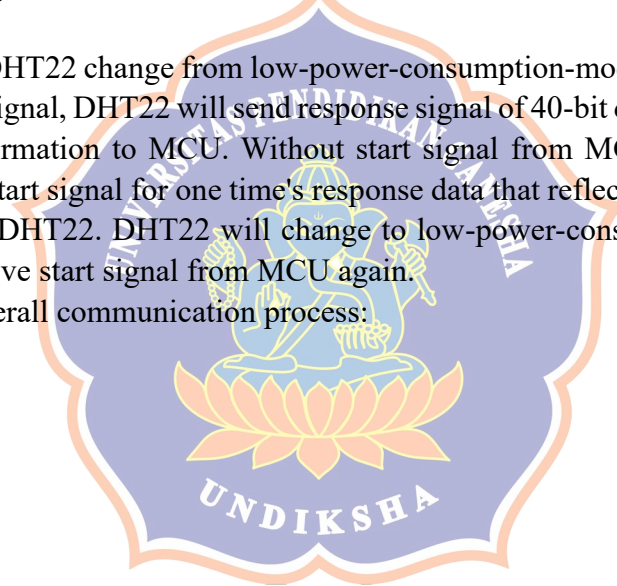
Data is comprised of integral and decimal part, the following is the formula for data.

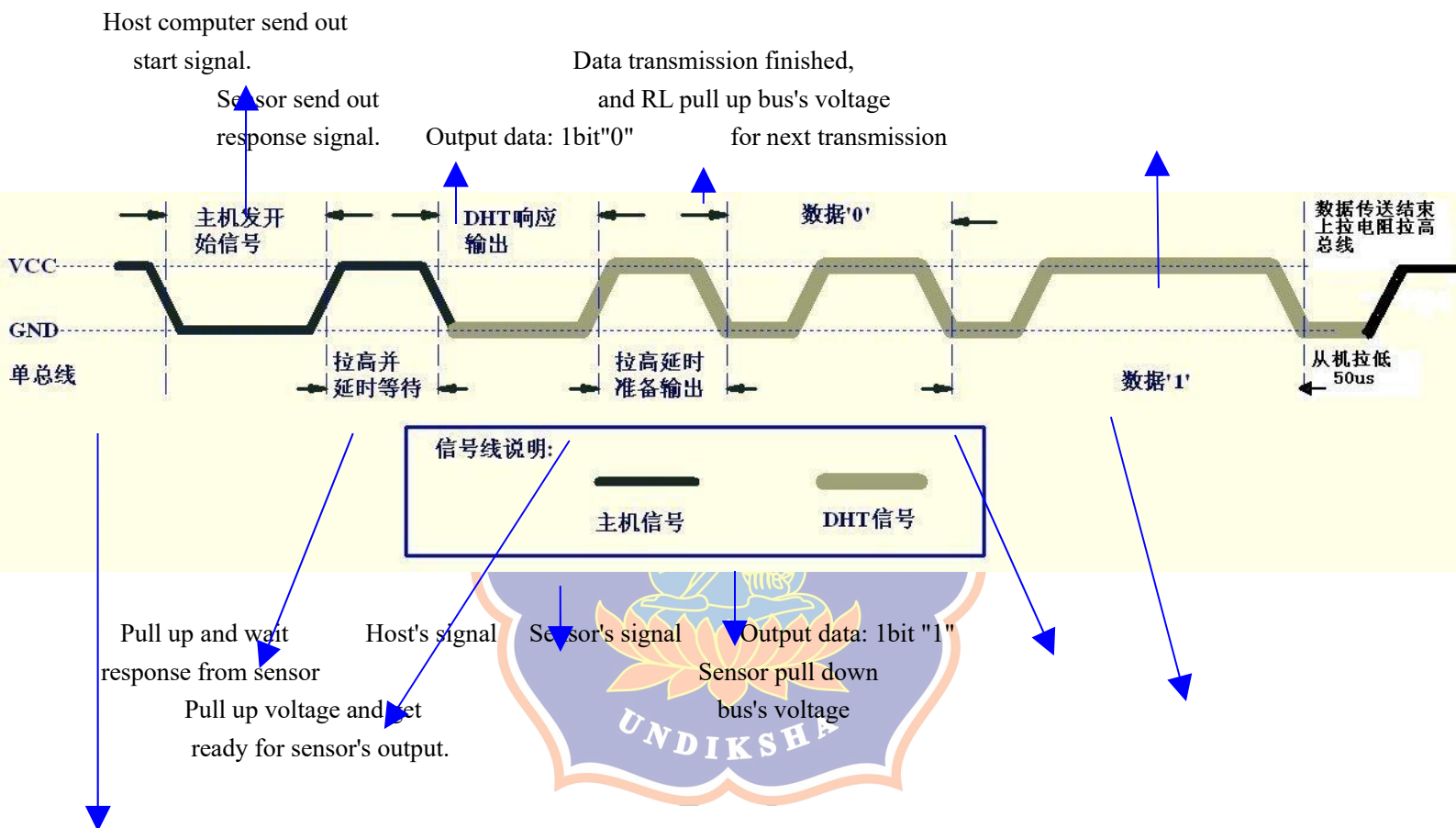
DHT22 send out higher data bit firstly!

DATA=8 bit integral RH data+8 bit decimal RH data+8 bit integral T data+8 bit decimal T data+8 bit check-sum If the data transmission is right, check-sum should be the last 8 bit of "8 bit integral RH data+8 bit decimal RH data+8 bit integral T data+8 bit decimal T data".

When MCU send start signal, DHT22 change from low-power-consumption-mode to running-mode. When MCU finishes sending the start signal, DHT22 will send response signal of 40-bit data that reflect the relative humidity and temperature information to MCU. Without start signal from MCU, DHT22 will not give response signal to MCU. One start signal for one time's response data that reflect the relative humidity and temperature information from DHT22. DHT22 will change to low-power-consumption-mode when data collecting finish if it don't receive start signal from MCU again.

1) Check bellow picture for overall communication process:





Single-bus output

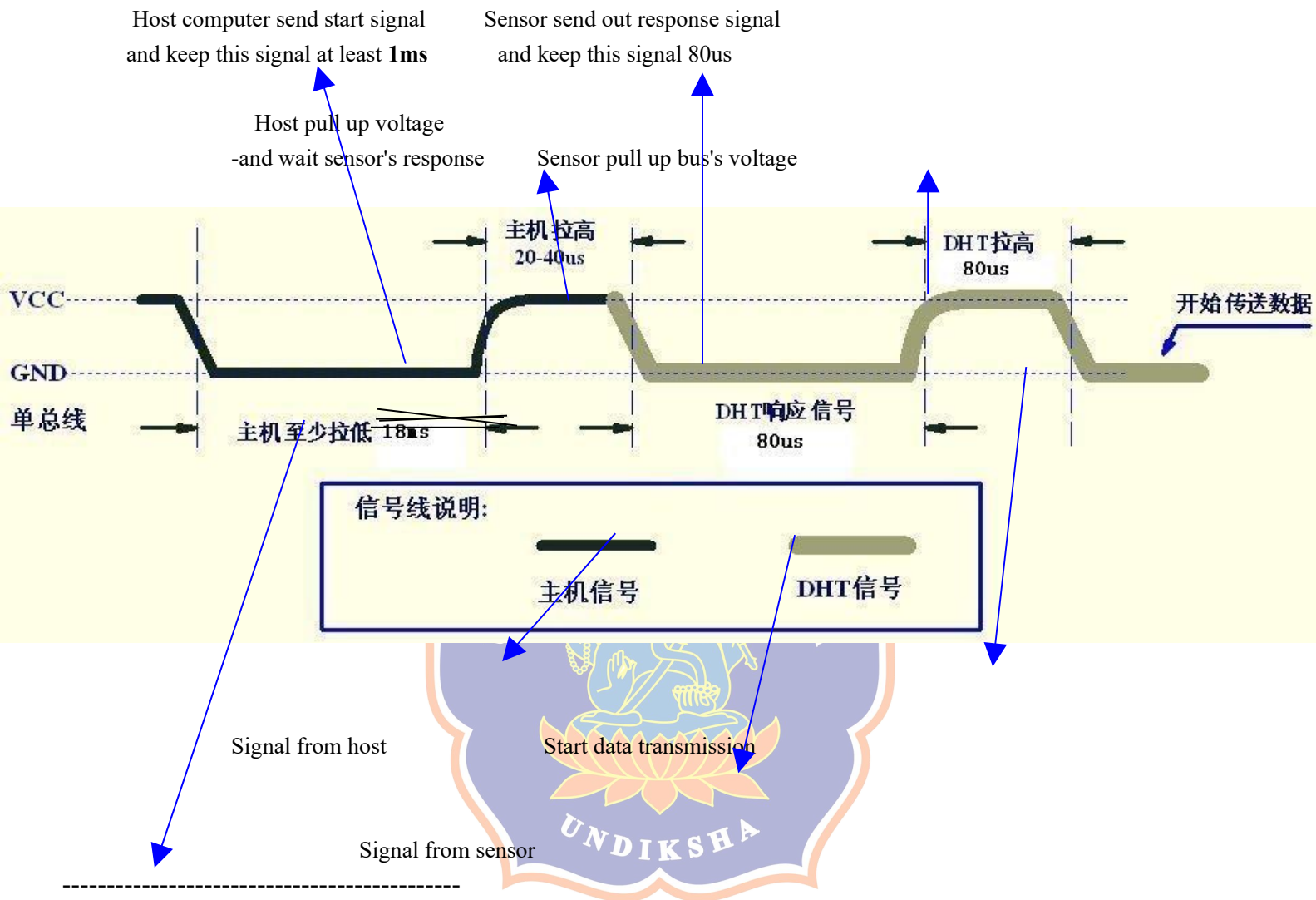
----2) Step 1: MCU send out start signal to DHT22

Data-bus's free status is high voltage level. When communication between MCU and DHT22 begin, program of MCU will transform data-bus's voltage level from high to low level and this process must beyond at least 1ms to ensure DHT22 could detect MCU's signal, then MCU will wait 20-40us for DHT22's response.

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Check bellow picture for step 1: -----

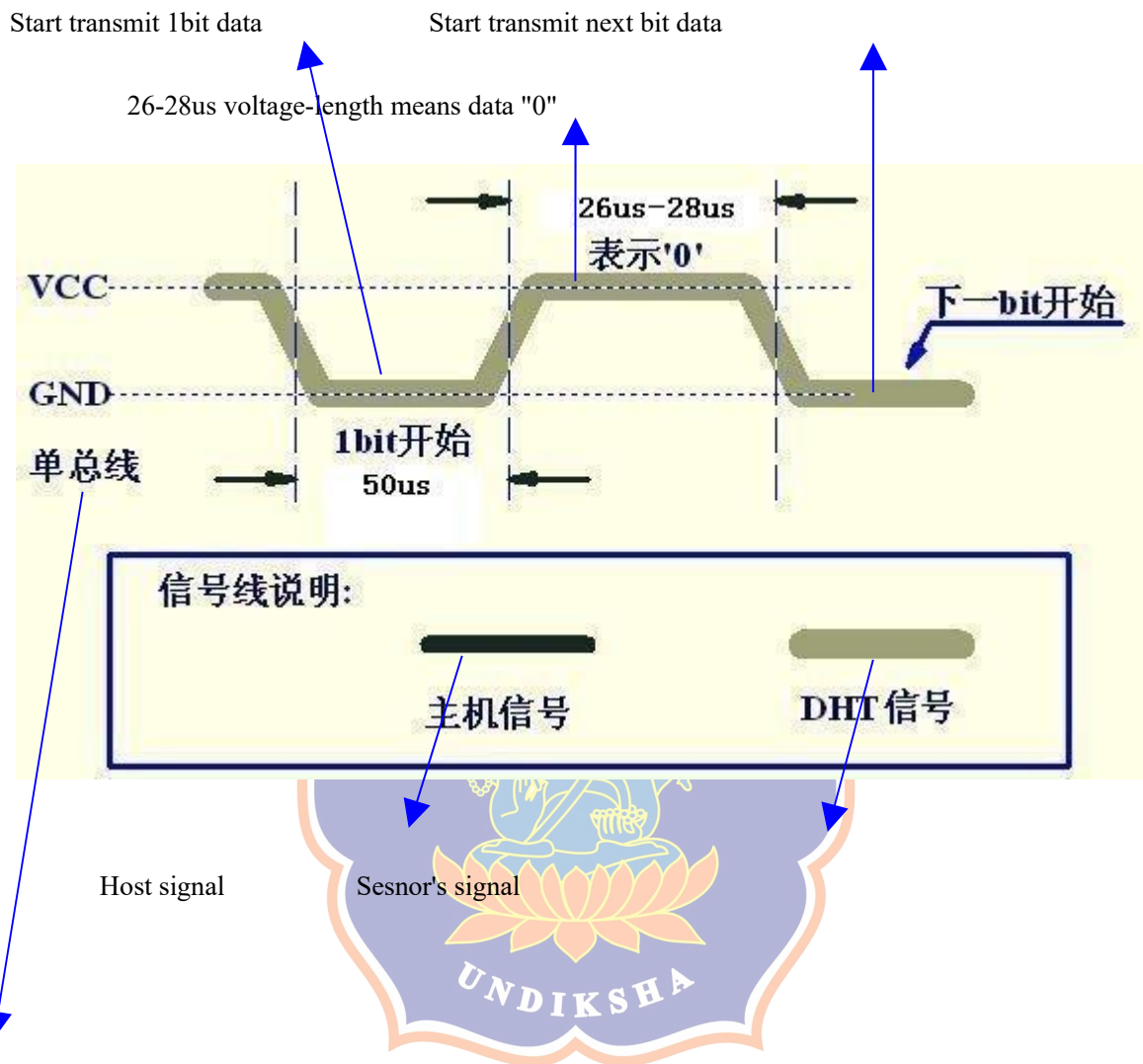


Single-bus signal

----- Step 2: DHT22 send response signal to MCU

When DHT22 detect the start signal, DHT22 will send out low-voltage-level signal and this signal last 80us as response signal, then program of DHT22 transform data-bus's voltage level from low to high level and last 80us for DHT22's preparation to send data.

Check bellow picture for step 2: -----



Single-bus signal

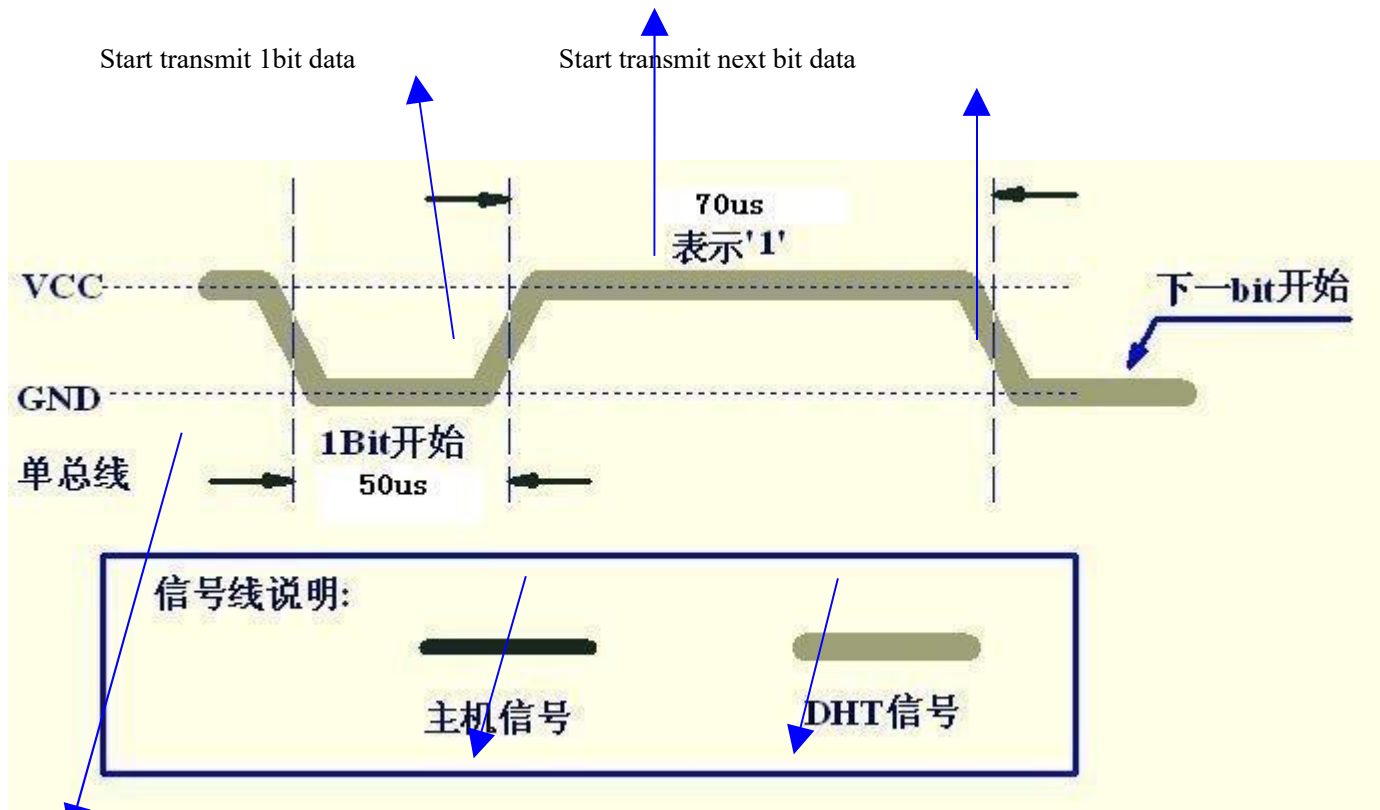
Step 3: DHT22 send data to MCU

When DHT22 is sending data to MCU, every bit's transmission begin with low-voltage-level that last 50us, the following high-voltage-level signal's length decide the bit is "1" or "0".

Check bellow picture for step 3: -----

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70us voltage-length means 1bit data "1"



Host signal

Sesnor's signal

Single-bus signal

If signal from DHT22 is always high-voltage-level, it means DHT22 is not working properly, please check the electrical connection status.

7. Electrical Characteristics:

Item	Conditio n	Mi n	Typic al	Ma x	Unit
Power supply	DC	3.3	5	6	V
Current supply	Measuri ng	1		1.5	mA
	Stand- by	40	Null	50	uA

Collecti ng period	Second		2		Seco nd
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*Collecting period should be : >2 second.



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8. Attentions of application:

(1) Operating and storage conditions

We don't recommend the applying RH-range beyond the range stated in this specification. The DHT22 sensor can recover after working in non-normal operating condition to calibrated status, but will accelerate sensors' aging.

(2) Attentions to chemical materials

Vapor from chemical materials may interfere DHT22's sensitive-elements and debase DHT22's sensitivity.

(3) Disposal when (1) & (2) happens

Step one: Keep the DHT22 sensor at condition of Temperature 50~60Celsius, humidity <10%RH for 2 hours; Step two: After step one, keep the DHT22 sensor at condition of Temperature 20~30Celsius, humidity >70%RH for 5 hours.

(4) Attention to temperature's affection

Relative humidity strongly depend on temperature, that is why we use temperature compensation technology to ensure accurate measurement of RH. But it's still be much better to keep the sensor at same temperature when sensing.

DHT22 should be mounted at the place as far as possible from parts that may cause change to temperature.

(5) Attentions to light

Long time exposure to strong light and ultraviolet may debase DHT22's performance.

(6) Attentions to connection wires

The connection wires' quality will effect communication's quality and distance, high quality shielding-wire is recommended.

(7) Other attentions

- * Welding temperature should be bellow 260Celsius.
- * Avoid using the sensor under dew condition.
- * Don't use this product in safety or emergency stop devices or any other occasion that failure of DHT22 may cause personal injury.

TECHNICAL DATA**MQ-135 GAS SENSOR****FEATURES**

Wide detecting scope Fast response and High sensitivity Stable and long life Simple drive circuit

APPLICATION

They are used in air quality control equipments for buildings/offices, are suitable for detecting of NH₃, NO_x, alcohol, Benzene, smoke, CO₂, etc.

SPECIFICATIONS**A. Standard work condition**

Symbol	Parameter name	Technical condition	Remarks
V _c	Circuit voltage	5V±0.1	AC OR DC
V _H	Heating voltage	5V±0.1	AC OR DC
R _L	Load resistance	can adjust	
R _H	Heater resistance	33Ω±5%	Room Tem
P _H	Heating consumption	less than 800mw	

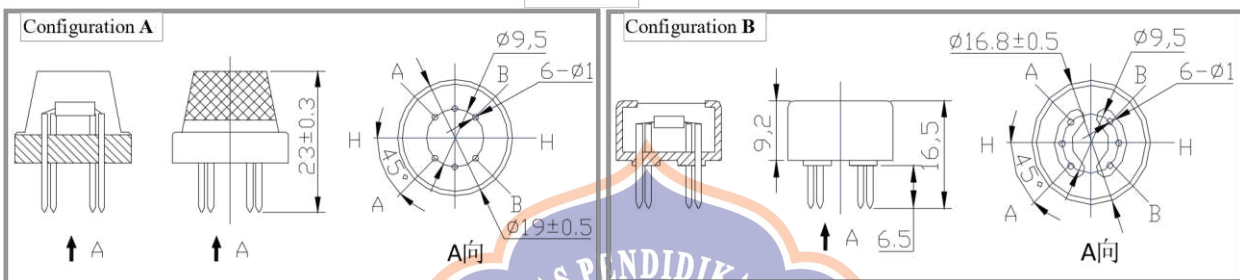
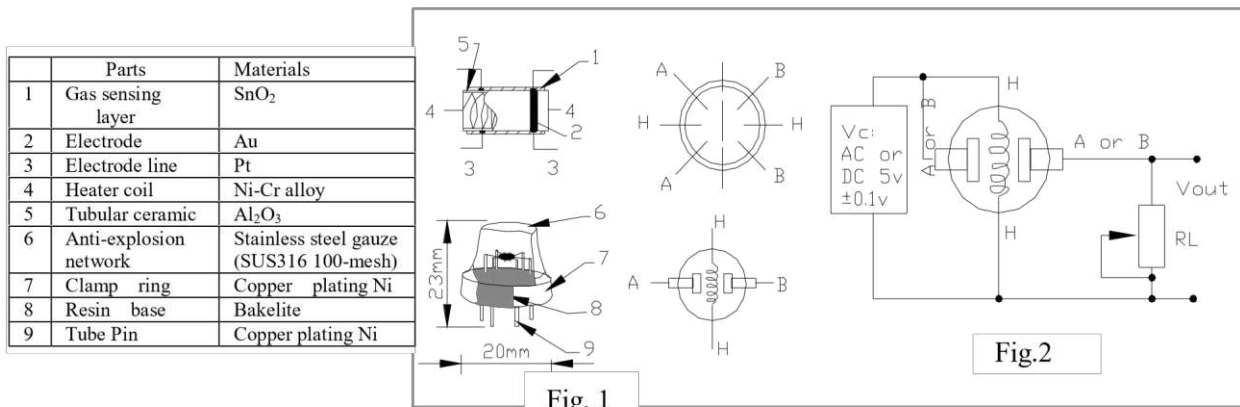
B. Environment condition

Symbol	Parameter name	Technical condition	Remarks
T _{ao}	Using Tem	-10°C-45°C	
T _{as}	Storage Tem	-20°C-70°C	
R _H	Related humidity	less than 95%Rh	
O ₂	Oxygen concentration	21%(standard condition) Oxygen concentration can affect sensitivity	minimum value is over 2%

C. Sensitivity characteristic

Symbol	Parameter name	Technical parameter	Ramark 2
Rs	Sensing Resistance	30KΩ-200KΩ (100ppm NH ₃)	Detecting concentration scope : 10ppm-300ppm NH ₃ 10ppm-1000ppm Benzene 10ppm-300ppm Alcohol
α (200/50) NH ₃	Concentration Slope rate	≤0.65	
Standard Detecting Condition	Temp: 20°C±2°C Vc:5V±0.1 Humidity: 65%±5% Vh: 5V±0.1		
Preheat time	Over 24 hour		

D. Structure and configuration, basic measuring circuit



Structure and configuration of MQ-135 gas sensor is shown as Fig. 1 (Configuration A or B), sensor composed by micro AL₂O₃ ceramic tube, Tin Dioxide (SnO₂) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of

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MQ-135

<http://www.hwsensor.com>

sensitive components. The enveloped MQ-135 have 6 pin ,4 of them are used to fetch signals, and other 2 are used for providing heating current.

Electric parameter measurement circuit is shown as Fig.2

E. Sensitivity characteristic curve

Fig.2 sensitivity characteristics of the MQ-135

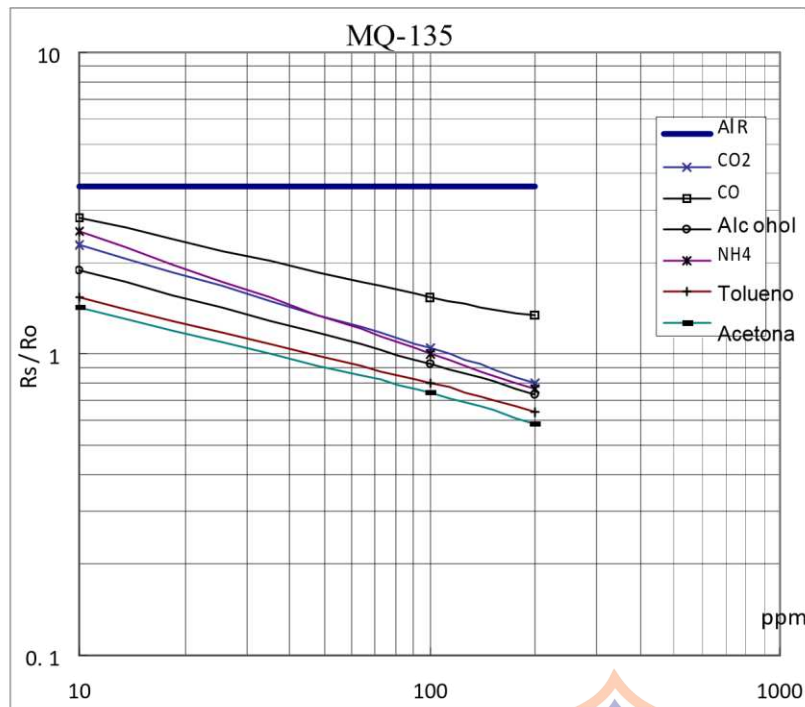


Fig.3 is shows the typical sensitivity characteristics of the MQ-135 for several gases. in their: Temp: 20°C、 Humidity: 65%、 O₂ concentration 21% RL=20k Ω

Ro: sensor resistance at 100ppm of NH₃ in the clean air.

Rs:sensor resistance at various concentrations of gases.

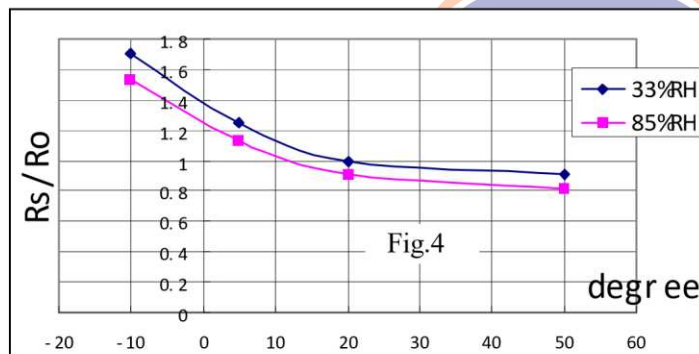


Fig.4 is shows the typical dependence of the MQ-135 on temperature and humidity.

Ro: sensor resistance at 100ppm of NH₃ in air at 33%RH and 20 degree.

Rs: sensor resistance at 100ppm of NH₃ at different temperatures and humidities.

SENSITIVITY ADJUSTMENT

Resistance value of MQ-135 is difference to various kinds and various concentration gases. So, When using this components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 100ppm NH₃ or 50ppm Alcohol concentration in air and use value of Load resistance that (R_L) about 20 KΩ (10KΩ to 47 KΩ).

When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.



Notification

1 Following conditions must be prohibited

1.1 Exposed to organic silicon steam

Organic silicon steam cause sensors invalid, sensors must be avoid exposing to silicon bond, fixture, silicon latex, putty or plastic contain silicon environment

1.2 High Corrosive gas

If the sensors exposed to high concentration corrosive gas (such as H_2S , SO_x , Cl_2 , HCl etc), it will not only result in corrosion of sensors structure, also it cause sincere sensitivity attenuation.

1.3 Alkali, Alkali metals salt, halogen pollution

The sensors performance will be changed badly if sensors be sprayed polluted by alkali metals salt especially brine, or be exposed to halogen such as fluorine.

1.4 Touch water

Sensitivity of the sensors will be reduced when splattered or dipped in water.

1.5 Freezing

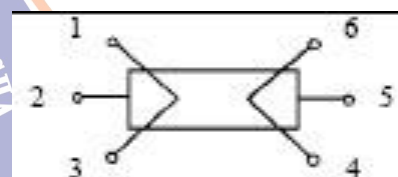
Do avoid icing on sensor's surface, otherwise sensor would lose sensitivity.

1.6 Applied voltage higher

Applied voltage on sensor should not be higher than stipulated value, otherwise it cause down-line or heater damaged, and bring on sensors' sensitivity characteristic changed badly.

1.7 Voltage on wrong pins

For 6 pins sensor, if apply voltage on 1, 3 pins or 4, 6 pins, it will make lead broken, and without signal when apply on 2, 4 pins



2 Following conditions must be avoided

2.1 Water Condensation

Indoor conditions, slight water condensation will effect sensors performance lightly. However, if water condensation on sensors surface and keep a certain period, sensor's sensitivity will be decreased.

2.2 Used in high gas concentration

No matter the sensor is electrified or not, if long time placed in high gas concentration, it will affect sensors characteristic.

2.3 Long time storage

The sensors resistance produce reversible drift if it's stored for long time without electrify, this drift is related with storage conditions. Sensors should be stored in airproof without silicon gel bag with clean air. For the sensors with long time storage but no electrify, they need long aging time for stability before using.

2.4 Long time exposed to adverse environment

No matter the sensors electrified or not, if exposed to adverse environment for long time, such as high humidity, high temperature, or high pollution etc, it will effect the sensors performance badly.

2.5 Vibration

Continual vibration will result in sensors down-lead response then repute. In transportation or assembling line, pneumatic screwdriver/ultrasonic welding machine can lead this vibration.

2.6 Concussion

If sensors meet strong concussion, it may lead its lead wire disconnected.

2.7 Usage

For sensor, handmade welding is optimal way. If use wave crest welding should meet the following conditions:

2.7.1 Soldering flux: Rosin soldering flux contains least chlorine

2.7.2 Speed: 1-2 Meter/ Minute

2.7.3 Warm-up temperature: $100 \pm 20^{\circ}\text{C}$

2.7.4 Welding temperature: $250 \pm 10^{\circ}\text{C}$

2.7.5 1 time pass wave crest welding machine

If disobey the above using terms, sensors sensitivity will be reduced.



Digital universal particle concentration sensor

PMS5003 series data manual

Writer	Zhou Yong	Version	V2.3
Verifier	Zheng Haoxin	Date	2016-06-01



Main characteristics

- ◆ Zero false alarm rate
- ◆ Real-time response
- ◆ Correct data
- ◆ Minimum distinguishable particle diameter :0.3 micrometer
- ◆ High anti-interference performance because of the patent structure of six sides shielding
- ◆ Optional direction of air inlet and outlet in order to adapt the different design

Overview

PMS5003 is a kind of digital and universal particle concentration sensor, which can be used to obtain the number of suspended particles in the air, i.e. the concentration of particles, and output them in the form of digital interface. This sensor can be inserted into variable instruments related to the concentration of suspended particles in the air or other environmental improvement equipments to provide correct concentration data in time.

Working principle

Laser scattering principle is used for such sensor, i.e. produce scattering by using laser to radiate suspending particles in the air, then collect scattering light in a certain degree, and finally obtain the curve of scattering light change with time. In the end, equivalent particle diameter and the number of particles with different diameter per unit volume can be calculated by microprocessor based on MIE theory. Please find the functional diagram of each part of sensor from Figure 1 as follows.

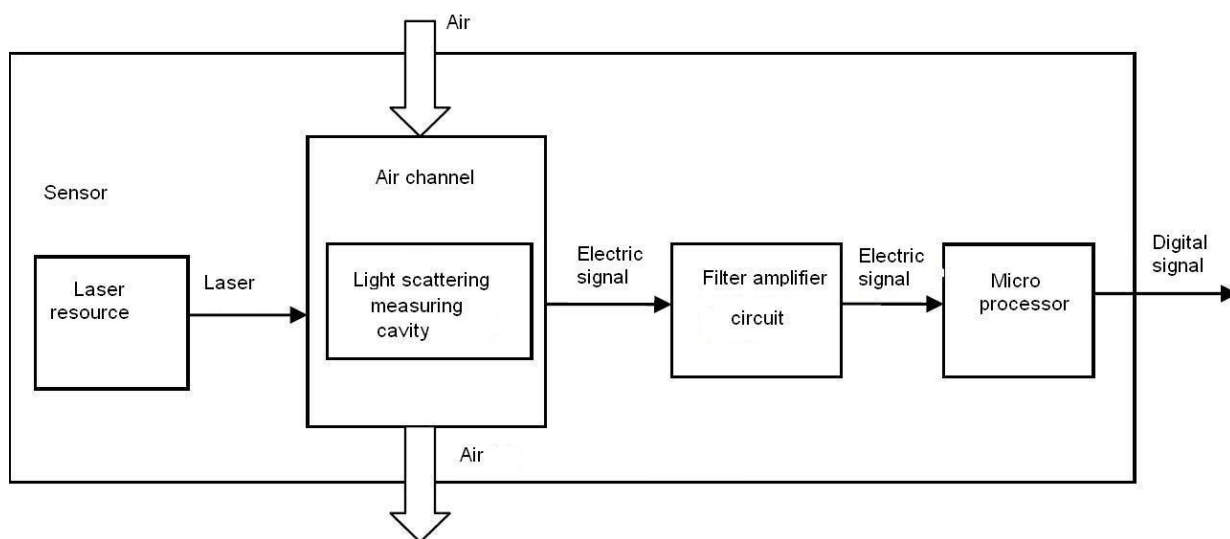


Figure 1 Functional block diagram of sensor

Technical Index

Parameter	Index	unit
Range of measurement	0.3~1.0 ; 1.0~2.5 ; 2.5~10	Micrometer (μm)
Counting Efficiency	50%@0.3 μm 98%@ $\geq 0.5\mu\text{m}$	
Effective Range (PM2.5 standard)	0~500	$\mu\text{g}/\text{m}^3$
Maximum Range (PM2.5 standard) *	≥ 1000	$\mu\text{g}/\text{m}^3$
Resolution	1	$\mu\text{g}/\text{m}^3$
Maximum Consistency Error (PM2.5 standard data)*	$\pm 10\% @ 100 \sim 500 \mu\text{g}/\text{m}^3$ $\pm 10 \mu\text{g}/\text{m}^3 @ 0 \sim 100 \mu\text{g}/\text{m}^3$	
Standard Volume	0.1	Litre (L)
Single Response Time	< 1	Second (s)
Total Response Time	≤ 10	Second (s)
DC Power Supply	Typ:5.0 Min:4.5 Max: 5.5	Volt (V)
Active Current	≤ 100	Milliampere (mA)
Standby Current	≤ 200	Microampere (μA)
Interface Level	L $< 0.8 @ 3.3$ H $> 2.7 @ 3.3$	Volt (V)
Working Temperature Range	-10~+60	$^{\circ}\text{C}$
Working Humidity Range	0~99%	
Storage Temperature Range	-40~+80	$^{\circ}\text{C}$

MTTF	≥ 3	Year (Y)
Physical Size	50×38×21	Millimeter (mm)

Note 1: Maximum range means that the highest output value of the PM2.5 standard data is not less than 1000.

Note 2: “PM2.5 standard data” is the “data2” in the appendix.

Pin Definition



Figure 2 Connector Definition

PIN1	VCC	Positive power 5V
PIN2	GND	Negative power
PIN3	SET	Set pin /TTL level@3.3V, high level or suspending is normal working status, while low level is sleeping mode.
PIN4	RX	Serial port receiving pin/TTL level@3.3V
PIN5	TX	Serial port sending pin/TTL level@3.3V
PIN6	RESET	Module reset signal /TTL level@3.3V, low reset.
PIN7/8	NC	

Output result

Mainly output as the quality and number of each particles with different size per unit volume, the unit volume of particle number is 0.1L and the unit of mass concentration is $\mu\text{g}/\text{m}^3$.

There are two options for digital output: passive and active. Default mode is active after power up. In this mode sensor would send serial data to the host automatically. The active mode is divided into two sub-modes: stable mode and fast mode. If the concentration change is small the sensor would run at stable mode with the real interval of 2.3s. And if the change is big the sensor would be changed to fast mode automatically with the interval of 200~800ms, the higher of the concentration, the shorter of the interval.

Typical Circuit

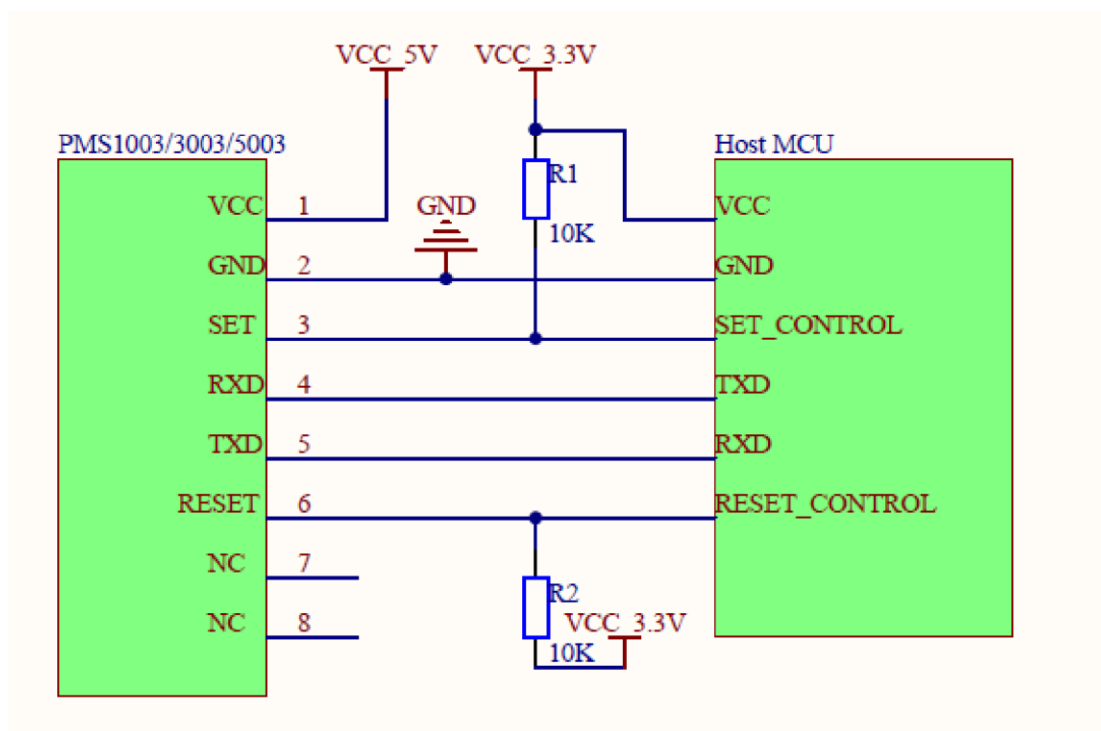


Figure 3 Typical Circuit



Typical Output Characteristic

Definition of axis Y: PM2.5 concentration, unit: $\mu\text{g}/\text{m}^3$

Definition of axis X: number of samples, unit: time

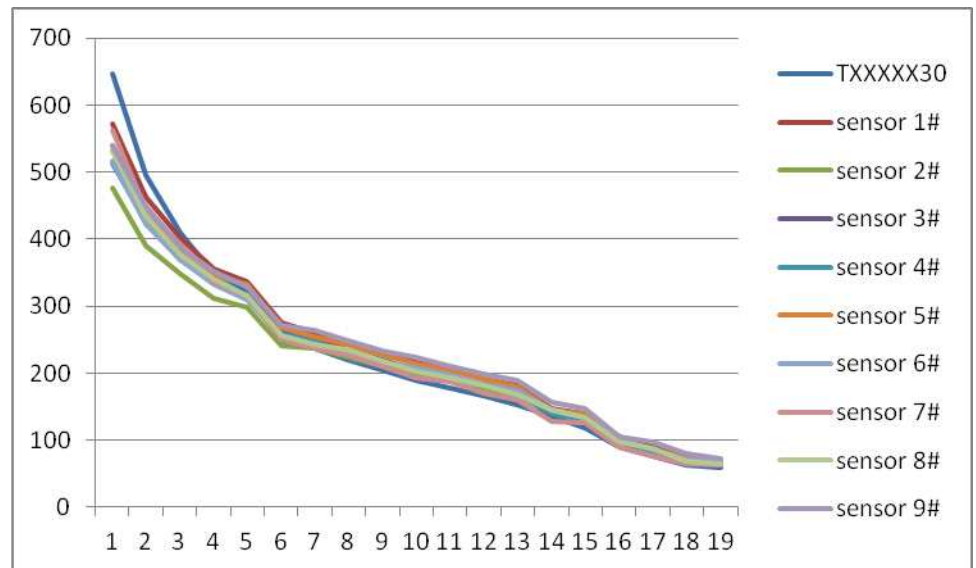


Figure 4-1 Consistency at 20°C

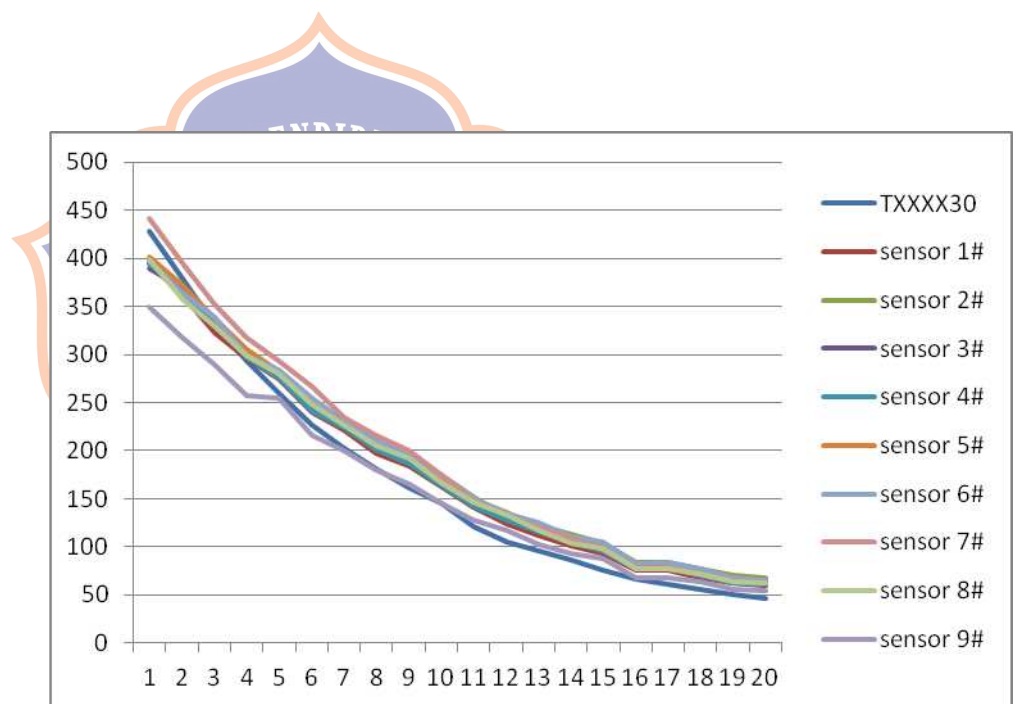


Figure 4-2 Consistency at 43°C

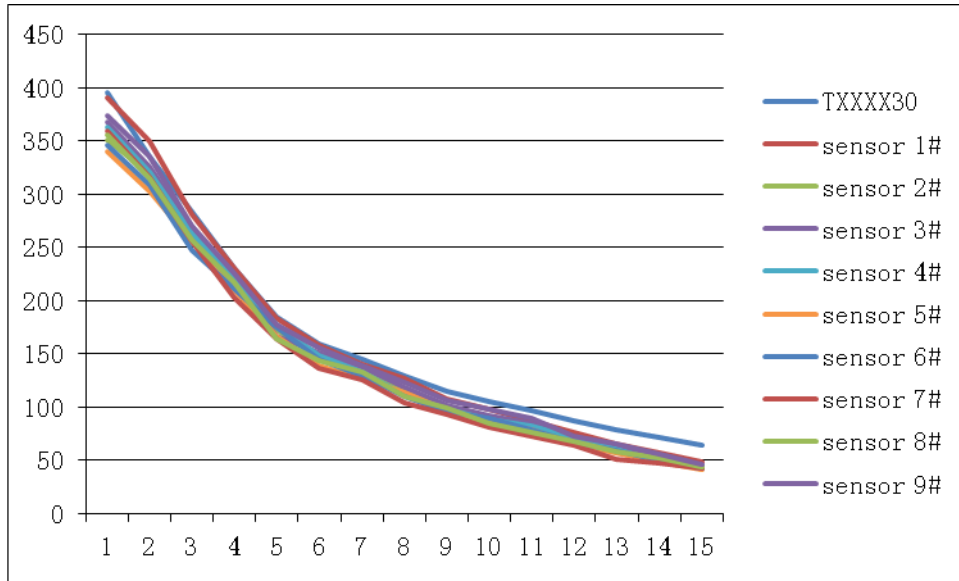


Figure 4-3 Consistency at -5°C

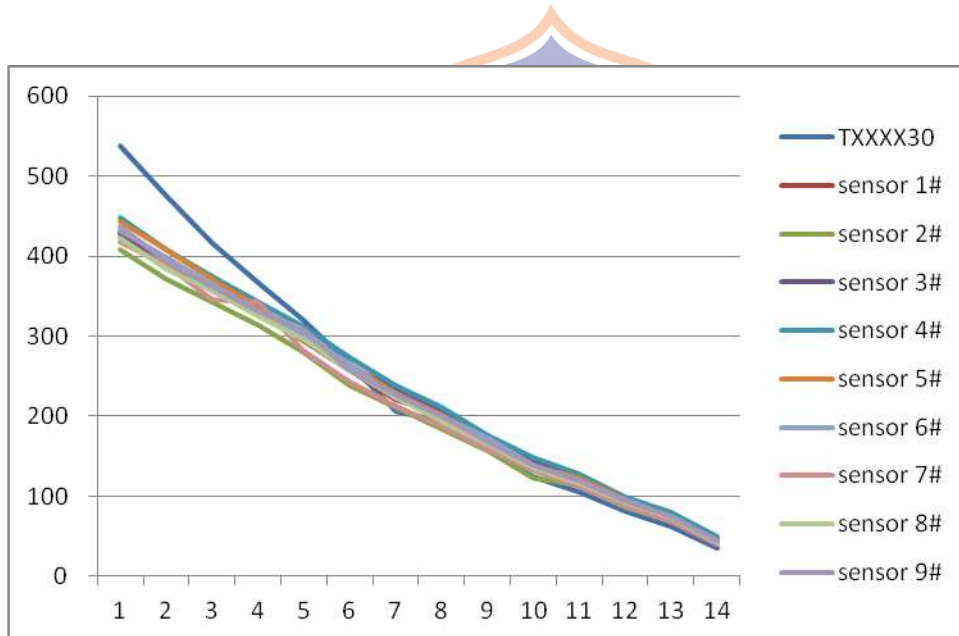


Figure 4-4 Consistency after 30 days' running

Relationship of Temperature and Consistency

Definition of axis Y: Maximum Error Modulus(%)

Definition of axis X: Temperature(°C)

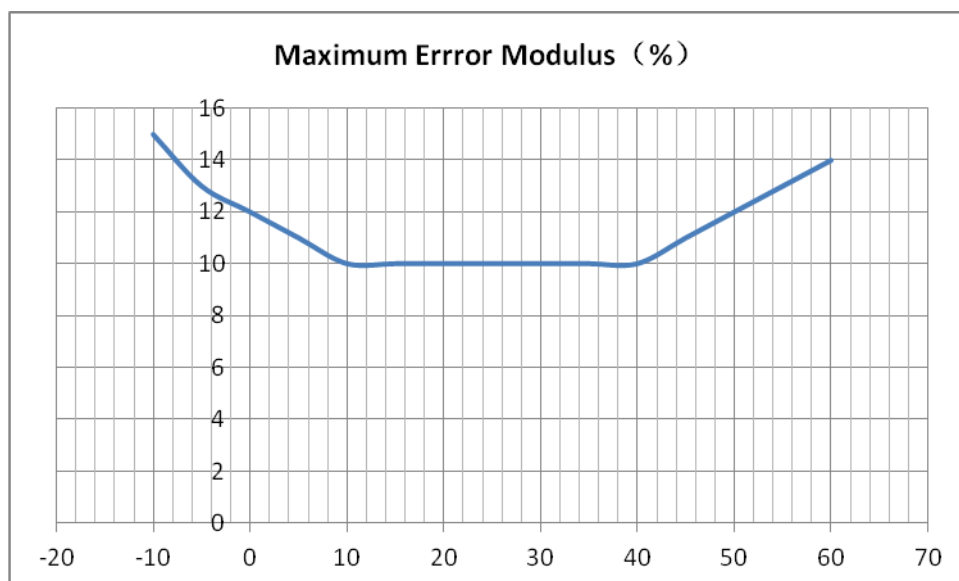


Figure 5 Consistency Vs Temperature

Endurance Characteristics

No	Item	Test Method	Characteristics	n C
1	Long Running	1. 10 m ² closed Lab, 20~25°C, humidity 30%~70%, particle generator and air cleaner 2. DC 5V power supply 3. Check consistency after 720 hours' running	10 samples during 0~500μ g/m ³ 0~100μ g/m ³ Maximum Error≤ ±15μ g/m ³	n=30 C=0
2	High Temperature Operation	1. 10 m ² constant temperature Lab 2. 43°C, humidity 70%, 3. particle generator and air cleaner 4. DC 5V power supply 5. Check consistency	100~500μ g/m ³ Maximum Error≤ ±15% FAN does not screeched	n=10 C=0
3	Cold Operation	1. 10 m ² constant temperature Lab 2. -5°C, humidity 30% 3. , 4. , 5. ,		n=10 C=0

		particle generator and air cleaner DC 5V power supply Check consistency		
4	Vibration	1. 10 m ² closed Lab., 20°C, humidity 50% , particle generator and air cleaner 2. 3. 4. DC 5V power supply and check consistency 5. 6. 7. Frequency : 50Hz. acceleration : 9.8/ S ² . . Direction : X、Y、Z . Vibration Amplitude : ±2mm. Time : X、Y、Z -way, Per 1 hour	10 samples during 0~500μ g/m ³ 0~100μ g/m ³ Maximum Error≤ ±10μ g/m ³	n=5 C=0
5	High Temperature and Humidity Storage	1. Constant temperature cabinet 2. 70°C, humidity 90%~95, 3. Check consistency after 500 hours' storage	10 samples during 0~500μ g/m ³ 0~100μ g/m ³ Maximum Error≤ ±10μ g/m ³	n=10 C=0
6	Cold Storage	1. Constant temperature cabinet 2. -30°C, humidity 90%~95, 3. Check consistency after 500 hours' storage	100~500μ g/m ³ Maximum Error≤	n=10 C=0

			±10%	
7	Variation of	4. 10 m ² closed Lab., 20°C, humidity		n=5
	Power Supply	50%, particle generator and air cleaner Power varies as the cycles of 4.5V to 5.5V ,then 5.5V to 4.5V with the pace of 0.1V/min for 2 hours. 5. Check consistency during 6. Variation	FAN does not screeched	C=0
8	Power On-Off Cycle	1. 10 m² closed Lab., 20°C, humidity 50% 2. , particle generator and air cleaner DC 5V power supply, keep On-Off frequency 0.5Hz for 72 hours and check consistency		n=10 C=0
9	Sleep Set On-Off Cycle	1. 10 m² closed Lab., 20°C, humidity 50% 2. , particle generator and air cleaner DC 5V power supply, keep Sleep Set Pin		n=10 C=0

		High-Low frequency 0.5Hz for 72 hours and check consistency		
10	Laser On-Off Cycle	1. 10 m ² closed Lab,, 20°C, humidity 50% 2. , particle generator and air cleaner keep laser On-Off frequency 50Hz for 240 hours and check consistency		n=10 C=0
11	Salt Spray	5% industrial salt water, hydrolysis spray 100 hours, clean with purified water and store for 48 hours	No rust and discoloration of metal parts	n=1 C=0

Circuit Attentions

- 1) DC 5V power supply is needed because the FAN should be driven by 5V. But the high level of data pin is 3.3V. Level conversion unit should be used if the power of host MCU is 5V.
- 2) The SET and RESET pins are pulled up inside so they should not be connected if without usage.
- 3) PIN7 and PIN8 should not be connected.
- 4) Stable data should be got at least 30 seconds after the sensor wakeup from the sleep mode because of the fan's performance.

Installation Attentions

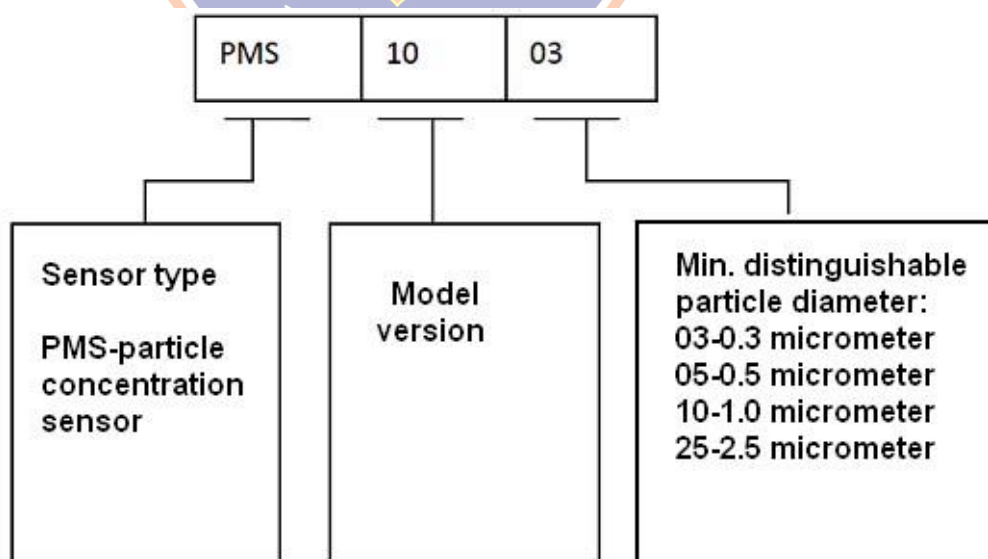
- 1) Metal shell is connected to the GND so be careful not to let it shorted with the other parts of circuit except GND.

- 2) The best way of install is making the plane of inset and outset closely to the plane of the host. Or some shield should be placed between inset and outset in order to prevent the air flow from inner loop.
- 3) The blowhole in the shell of the host should not be smaller than the inset.
- 4) The sensor should not be installed in the air flow way of the air cleaner or should be shielded by some structure.
- 5) The sensor should be installed at least 20cm higher than the grand in order to prevent it from blocking by the floc dust.
- 6) Do not break up the sensor.
- 7) M2 self-tapping strew should be used to fix the sensor but it should not be deeper than 5mm into the sensor.

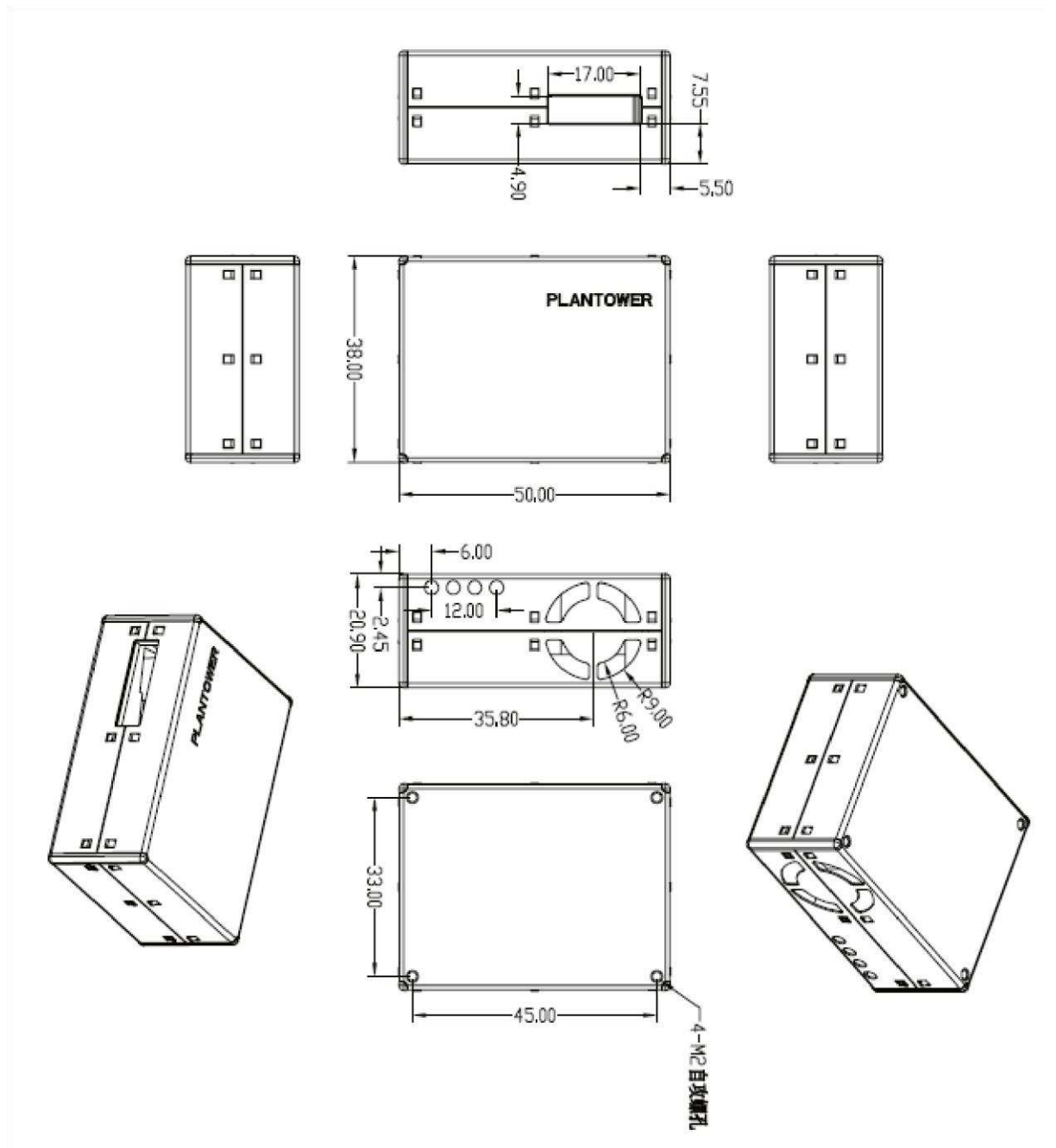
Other Attentions

- 1) Only the consistency of all the PM sensors of PLANTOWER is promised and ensured. And the sensor should not be checked with any third party equipment.
- 2) The sensor is usually used in the common indoor environment. So some protection must be added if using in the conditions as followed:
 - a) The time of concentration $\geq 300\mu\text{g}/\text{m}^3$ is longer than 50% of the whole year or concentration $\geq 500\mu\text{g}/\text{m}^3$ is longer than 20% of the whole year.
 - b) Kitchen
 - c) Water mist condition such as bathroom or hot spring.
 - d) outdoor

Part Number Definition



Physical Size (mm)



Appendix I : PMS5003 transport protocol-Active Mode

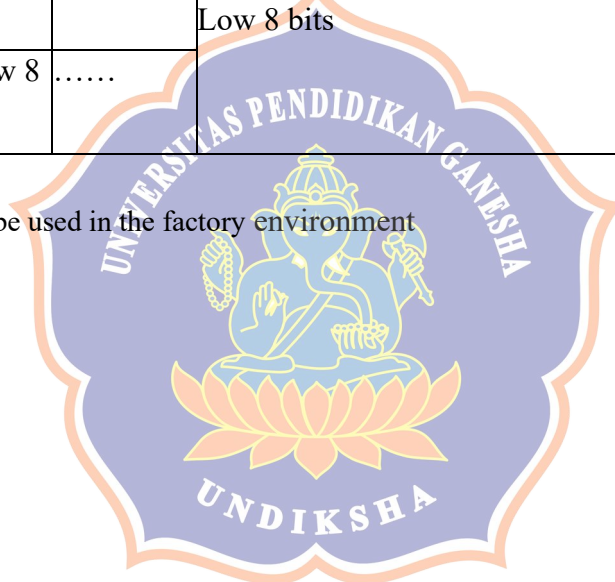
Default baud rate : 9600bps Check bit : None Stop bit : 1 bit 32

Bytes

Start character 1	0x42	(Fixed)
Start character 2	0x4d	(Fixed)
Frame length high 8 bits	.....	Frame length=2x13+2(data+check bytes)
Frame length low 8 bits	.....	
Data 1 high 8 bits	.....	Data 1 refers to PM1.0 concentration unit $\mu\text{g}/\text{m}^3$ (CF=1, standard particle) *
Data 1 low 8 bits	.....	
Data 2 high 8 bits	.....	Data 2 refers to PM2.5 concentration unit $\mu\text{g}/\text{m}^3$ (CF=1, standard particle)
Data 2 low 8 bits	.....	
Data 3 high 8 bits	.....	Data 3 refers to PM10 concentration unit $\mu\text{g}/\text{m}^3$ (CF=1, standard particle)
Data 3 low 8 bits	.....	
Data 4 high 8 bits	.....	Data 4 refers to PM1.0 concentration unit $\mu\text{g}/\text{m}^3$ (under atmospheric environment) *
Data 4 low 8 bits	.....	
Data 5 high 8 bits	.....	Data 5 refers to PM2.5 concentration unit $\mu\text{g}/\text{m}^3$ (under atmospheric environment)
Data 5 low 8 bits	.....	
Data 6 high 8 bits	.....	Data 6 refers to concentration unit (under atmospheric environment) $\mu\text{g}/\text{m}^3$
Data 6 low 8 bits	.....	
Data 7 high 8 bits	.....	Data 7 indicates the number of particles with diameter beyond 0.3 μm in 0.1 L of air.
Data 7 low 8 bits	.....	
Data 8 high 8 bits	.....	Data 8 indicates the number of particles with diameter beyond 0.5 μm in 0.1 L of air.
Data 8 low 8 bits	.....	
Data 9 high 8 bits	.....	Data 9 indicates the number of particles with diameter beyond 1.0 μm in 0.1 L of air.
Data 9 low 8 bits	.....	

Data 10 high 8 bits	.....	Data 10 indicates the number of particles with diameter beyond 2.5 um in 0.1 L of air.
Data 10 low 8 bits	.....	
Data 11 high 8 bits	.....	Data 11 indicates the number of particles with diameter beyond 5.0 um in 0.1 L of air.
Data 11 low 8 bits	.....	
Data 12 high 8 bits	.....	Data 12 indicates the number of particles with diameter beyond 10 um in 0.1 L of air.
Data 12 low 8 bits	.....	
Data 13 high 8 bits	.....	Data 13 Reserved
Data 13 low 8 bits	.....	
Data and check high 8 bits	.....	Check code=Start character 1+ Start character 2+.....+data 13 Low 8 bits
Data and check low 8 bits	.....	

Note: CF=1 should be used in the factory environment



Appendix II : PMS5003 transport protocol-Passive Mode

Default baud rate : 9600bps Check bit : None

Stop bit : 1 bit

Host Protocol

Start Byte 1	Start Byte 2	Command	Data 1	Data 2	Verify Byte 1	Verify Byte 2
0x42	0x4d	CMD	DATAH	DATAL	LRCH	LRCL

1. Command Definition

CMD	DATAH	DATAL	说明
0xe2	X	X	Read in passive mode
0xe1	X	00H-passive 01H-active	Change mode
0xe4	X	00H-sleep 01H-wakeup	Sleep set

2. Answer

0xe2: 32 bytes , same as appendix I

3. Verify Bytes :

Add of all the bytes except verify bytes.

Data Sheet

P5 Single Color LED Display



General Information:

The P5 single color is a high brightness, lower power consumption, long life time display module. Designed for semi-outdoor use.

Features:

- 1/4 duty scan drive
- Brightness:3500nits to 4500nits
- Max Power Consumption: 20W
- DC 5V Voltage Input
- Constant Voltage Drive
- IP65 Waterproof
- 1W Pixel Configuration
- High Viewing Angle
- High Contrast Ratio with a perfect louver/cover

Electrical and Software Characteristics

Table 1: Screen Characteristics

Code	Color	PixeLPitch	Density	Brightness	LED Pixel Size	Drive Mode	Size(mm)
2120	Red	5mm	36x16	2500mcd	512	¼ Scan	32x16
2121	Yellow	5mm	36x16	5000mcd	512	¼ Scan	32x16
2122	Blue	5mm	36x16	2500mcd	512	¼ Scan	32x16
2123	Green	5mm	36x16	9000mcd	512	¼ Scan	32x16
2124	White	5mm	36x16	8500mcd	512	¼ Scan	32x16

Table 2: Electrical Characteristics

Code	Color	Current (max)	Voltage (max)	Average Power	Power (max)
2120	Red	4A	5V	8W-10W	20W
2121	Yellow	4A	5V	8W-10W	20W
2122	Blue	4A	5V	8W-10W	20W
2123	Green	4A	5V	8W-10W	20W
2124	White	4A	5V	8W-10W	20W

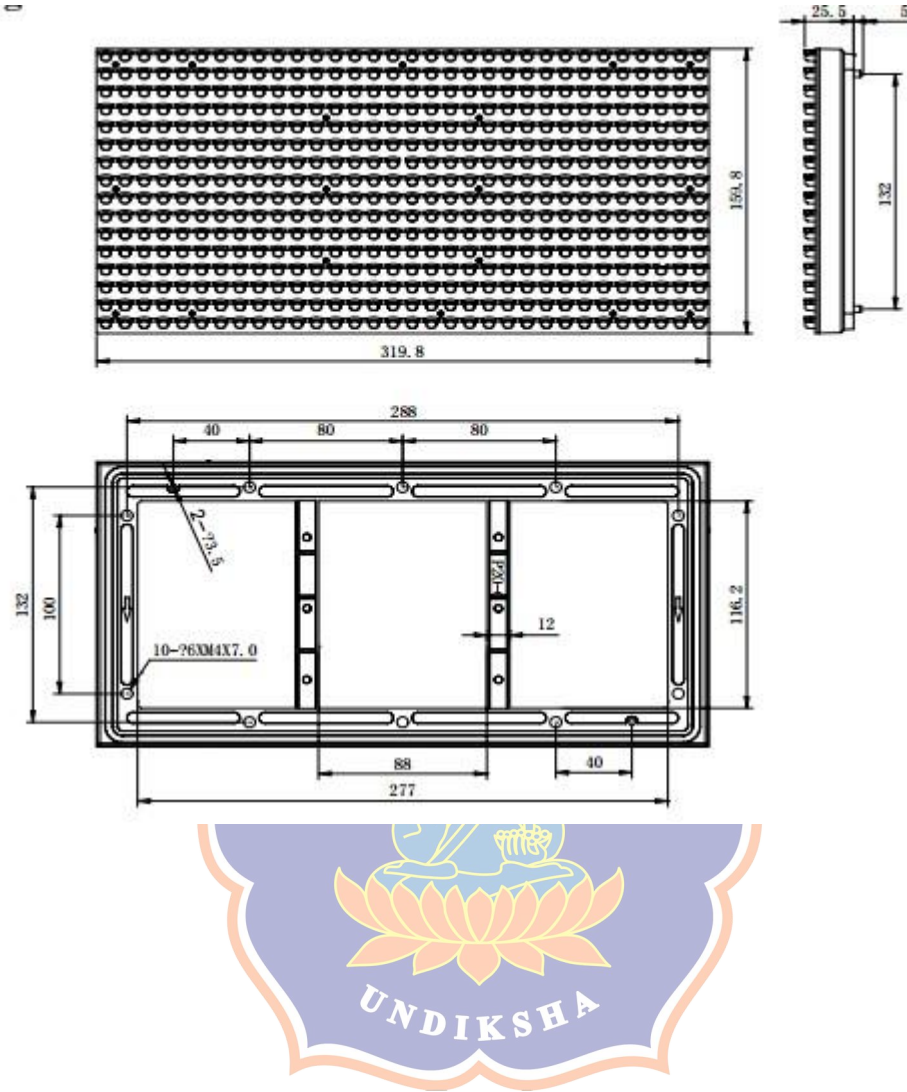
Important Notes:

- LEDs and parts, are very weak against external impact. LEDs and Parts may be damaged due to contact of tools or your casing of the products to the products. When handling the products, please pay special attention.
- The products are not designed to tolerate against solvent. Please pay special attention not to attach any organic solvent such as thinner, to the products.
- The products apply high density LSIs that are very weak to static electricity. while handling the products, please wearing an earth band to make human body electrification lower than 100V. Especially, cloths made by chemical fiber are likely to be electrified several thousand voltages of static electricity and it may destroy the circuits.
- Please wear clean gloves when handling the products as sweat or sebum attached with hands may corrode the products and it may be cause the breakdown.
- Once products are exposed to UV rays for long time, the colors of LED and PCB/Housing may change the color.
- Please do not to touch the edges with module or metals as a part of circuit patterns may be exposed around the PCBs.
- In case looking the products through sunglasses or finder of camera, the color would be different as you sense by looking by eyes, and an accurate evaluation may be difficult to be made.

Activity Conditions :

- The shapes of dots covering over LED dies are different from each other somehow, therefore, while condition of non-lighting may see some pattern
- The aging characteristics of LED may given luminous intensity differ between frequent and infrequent lighting areas. Difference will be more obvious at fixed emitting area.
- The brightness of LED become dimming once unit's temperature increases. Please note that the brightness may vary depending on the lighting rate and lighting time per product

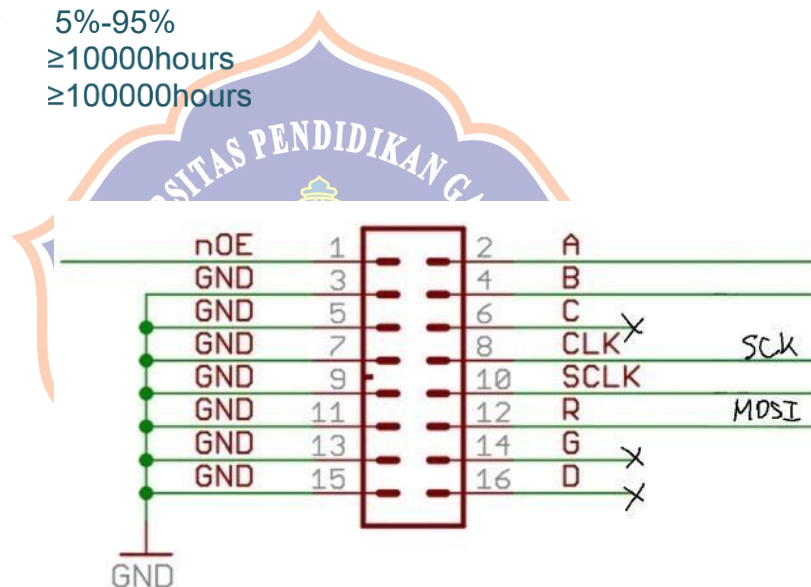
Technical Drawing:

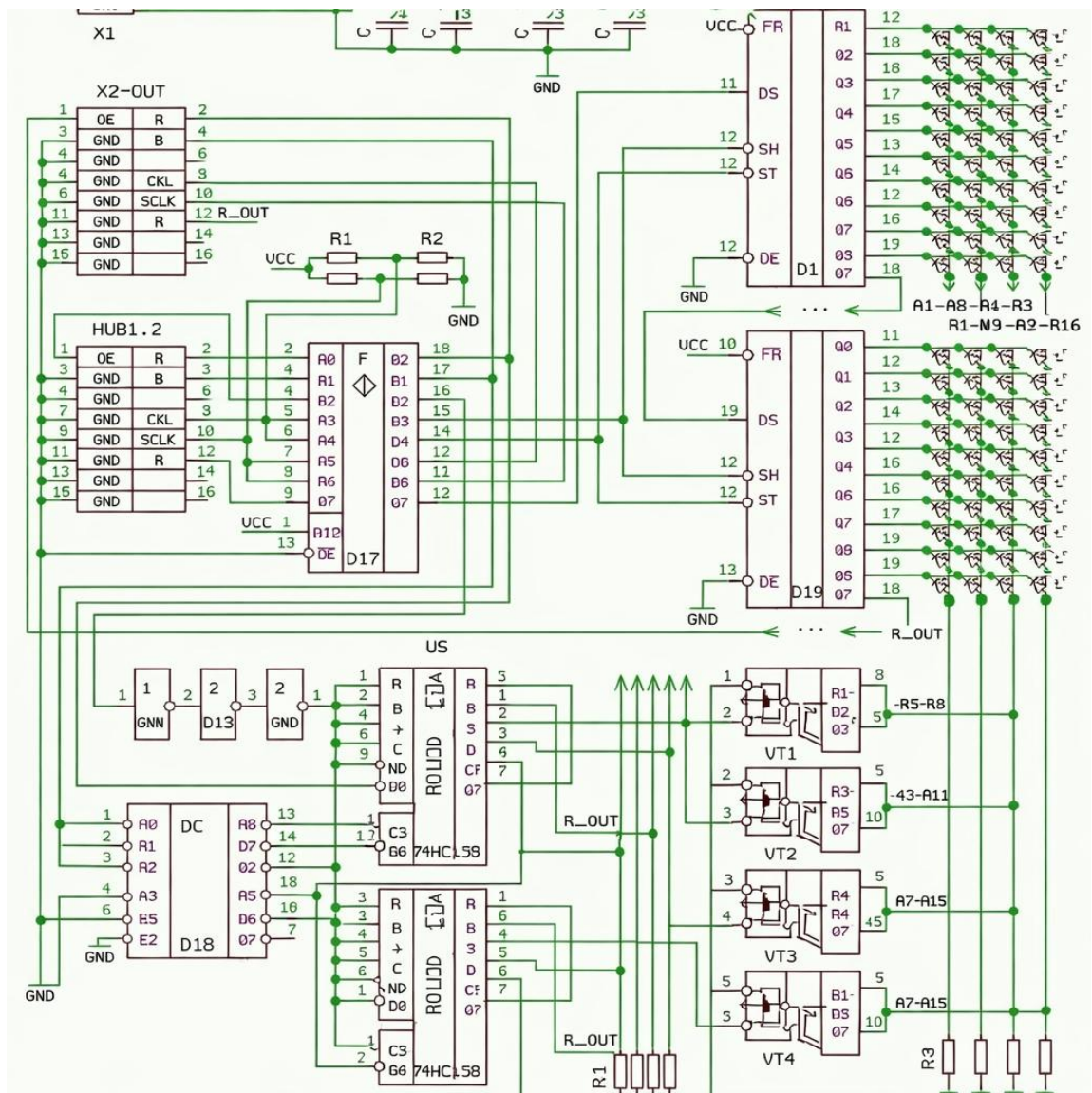


Specification

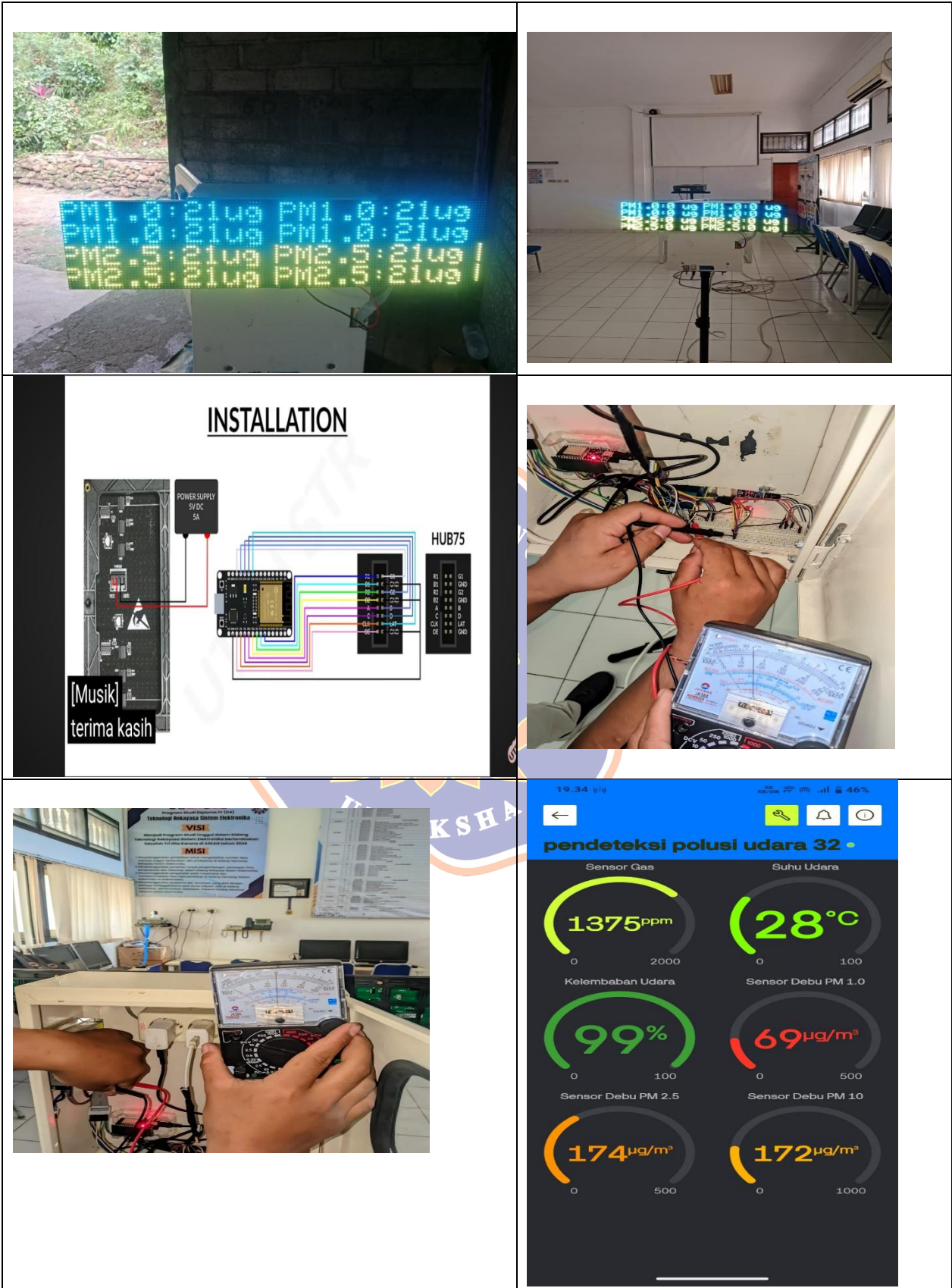
Semi-outdoor P5 led display module

Item	Specification
Pixel Pitch	5mm
Pixel LED	SMD
Pixel Density	10000 pixel/m ²
Pixel Configuration	1 Red
Module Size	320mm × 160mm
Brightness	1,600mcd
Best Viewing Angle	110°H/120°V
Drive Mode	Constant Current drive 1/4 scan
Drive IC	74HC595
Working Voltage	V _{dc} 5V
Environment	Storage: -40°C~ +90°C
Temperature	Operation: -30°C ~ +60°C
Blind Spot Rate	Less than.0001
Working Humidity	5%-95%
MTBF	≥10000hours
Lifespan	≥100000hours



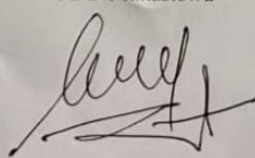
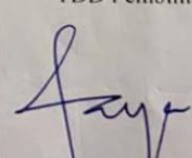


Lampiran 2. Dokumentasi Perancangan, Pengujian dan Hasil Alat





Lampiran 3. Form Bimbingan

 KEMENTERIAN PENDIDIKAN, KEBUDAYAAN, RISET, DAN TEKNOLOGI UNIVERSITAS PENDIDIKAN GANESHA FAKULTAS TEKNIK DAN KEJURUAN Alamat : Jalan Udayana No. 11 Singaraja Telepon-Fax: (0362) 22570 Kode Pos. 81116 Website : www.undiksha.ac.id 		
FORMULIR BIMBINGAN TUGAS AKHIR		
Nama	:	Putu mulyadi Artawan
Nim	:	9255021002
Prodi	:	Teknologi Rekayasa Sistem Elektronika
Pembimbing	:	I Wayan Sutarya S.T.M.T
Judul	:	Sistem Deteksi Polusi udara Pelebaran menggunakan ESP8266 berbasis IoT dengan tampilan LED PS
Pembahasan Mahasiswa : menambahkan satuan untuk masing-masing sensor		
Pembahasan Pembimbing : Tambahkan satuan dari sensor MQ135, DHT22 PMS 5003.		
Hari/Tgl	TDD Mahasiswa	TDD Pembimbing
Senin / 20/11/2025.	 Putu mulyadi A.	 I Wayan Sutarya S.T.M.T



KEMENTERIAN PENDIDIKAN, KEBUDAYAAN,
RISET, DAN TEKNOLOGI
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Telepon-Fax: (0362) 22570 Kode Pos. 81116
Website : www.undiksha.ac.id



FORMULIR BIMBINGAN TUGAS AKHIR

Nama	:	Putu MULYADI Artawan
Nim	:	2255021002
Prodi	:	Teknologi Rekayasa Sistem Elektronika
Pembimbing	:	Dr. Made Sinto Gita Karma
Judul	:	Sistem deteksi polusi udara percontaan menggunakan ESP32 Berbasis IoT dengan tampilan LED PS

Pembahasan Mahasiswa :

Melaksanakan perakitan alat / wiring untuk bisa menampilkan data ke LED PS

Pembahasan Pembimbing :

Melaksanakan perakitan wiring alatnya agar bisa hidup dan menampilkan data hasil dari pembacaan sensor MQ135, DHT22, PMS 5003 ke LED PS.

Hari/Tgl	TDD Mahasiswa	TDD Pembimbing
Rabu / 10/12/2025	 Putu Mulyadi Artawan	 Dr. MD. Sinto Gita Karma



KEMENTERIAN PENDIDIKAN, KEBUDAYAAN,
RISET, DAN TEKNOLOGI
UNIVERSITAS PENDIDIKAN GANESHA
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Alamat : Jalan Udayana No. 11 Singaraja
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Website : www.undiksha.ac.id



FORMULIR BIMBINGAN TUGAS AKHIR

Nama	:	Putu Mulyadi ^o Artaawan
Nim	:	8255021002.
Prodi	:	Teknologi Rekayasa Sistem Elektronika
Pembimbing	:	Dr. Made Santo Gita Karma.
Judul	:	Sistem Deteksi Polusi Udara Perumahan menggunakan ESP32 Berbasis IoT dengan Tampilan LED P5
Pembahasan Mahasiswa :		
Pembuatan program ESP32 agar bisa berhasil di up.		
Pembahasan Pembimbing :		
Pembuatan program ESP32 guna bisa berhasil di Upload.		
Hari/Tgl	TDD Mahasiswa	TDD Pembimbing
Senin / 1 desember / 2025	 Putu mulyadi Artaawan	 Dr. MD. Santo Gita Karma



FORMULIR BIMBINGAN TUGAS AKHIR

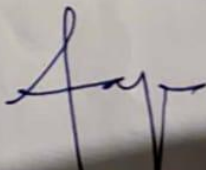
Nama	:	Putu Mulyadi Artawan
Nim	:	9255021002
Prodi	:	Teknologi Rekayasa Sistem Elektronika
Pembimbing	:	I Wayan Sutaya S.T.M.T
Judul	:	Sistem deteksi Polusi Udara Perkotaan menggunakan ESP 82 Berbasis IOT dengan Tampilan LED PS

Pembahasan Mahasiswa :

Pembahasan hasil ~~data~~ tentang letak tulisan pada Tabel, gambar,

Pembahasan Pembimbing :

membimbing agar memperhatikan letak penulisan urut, gambar dan tabel agar sesuai dengan buku Panduan.

Hari/Tgl	TDD Mahasiswa	TDD Pembimbing
Senin / 5 / 01 / 2026	 Putu Mulyadi A.	 I Wayan Sutaya S.T.M.T

RIWAYAT HIDUP



Putu Mulyadi Artawan, lahir di Tegallingsah, 27 Januari 2003. Penulis lahir dari pasangan suami istri Bapak Gede Pasek dan Luh Redani. Penulis berkebangsaan Indonesia dan beragama Hindu. Kini penulis beralamat di Jalan Banjar Dinas Bukit Sari RT 005 Desa Tegallingsah, Kecamatan Sukasada, Kabupaten Buleleng, Provinsi Bali.

Penulis menyelesaikan studi di SD Negeri 2 Tegallingsah, dan lulus pada tahun 2016. Kemudian penulis melanjutkan di SMP Negeri 4 Sukasada, dan lulus pada tahun 2019. Pada tahun 2022, penulis lulus dari SMK Negeri 3 Singaraja jurusan Teknik Instalasi Tenaga Listrik dan melanjutkan ke Diploma IV Program Studi Teknologi Rekayasa Sistem Elektronika di Universitas Pendidikan Ganesha. Penulis sampai saat ini masih mengerjakan Tugas Akhir yang berjudul “Sistem Deteksi Polusi Udara Perkotaan Menggunakan ESP32 Berbasis IoT dengan Tampilan Layar LED P5”.



PERNYATAAN KEASLIAN TULISAN

Dengan ini saya menyatakan bahwa karya tulis yang berjudul “Sistem Deteksi Polusi Udara Perkotaan Menggunakan ESP32 Berbasis IoT dengan Tampilan Layar LED P5” beserta seluruh isinya adalah benar-benar karya sendiri dan saya tidak melakukan penjiplakan dan pengutipan dengan cara-cara yang tidak sesuai dengan etika yang berlaku dalam keilmuan. Atas pernyataan ini, saya siap menanggung risiko/sanksi yang dijatuhkan kepada saya apabila kemudian ditemukan adanya pelanggaran atas etika keilmuan dalam karya atau ada klaim terhadap keaslian karya.

Singaraja ,8 Januari 2026

Yang membuat pernyataan,



Putu Mulyadi Artawan