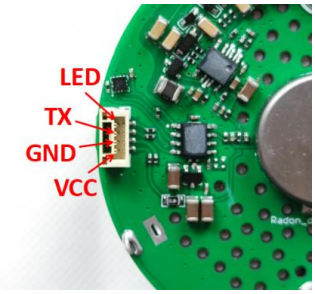
RM-75-Ion Instructions for use of ionization chamber module

1. Parameters

- Sensor type: 0.2L volume alpha ionization chamber pulse sensor
- Range of measuring: 2Bq/m³-20kBq/m³
- Accuracy: ±10%
- Sensitivity: 15.1cpm/1000Bq/m³
- Reliable data measurement time: About 1 hour
- Data update time: 10 minutes
- Working voltage: 3.3-5V (low noise linear power supply or lithium battery is recommended)
- Operating current: About 9mA(@3.6V)
- Data interface: UART(Baud 115200)
- UART data interval time: 10 seconds
- IO voltage: typical 3.0V (Compatible with 2.8-3.3V)
- Detection environment: -10~45℃ RH<80% (Out-of-range work data are not accurate)
- Dimensions and weight: Diameter 66mm , Height 85mm , About 80g

2. Hardware interface Definition



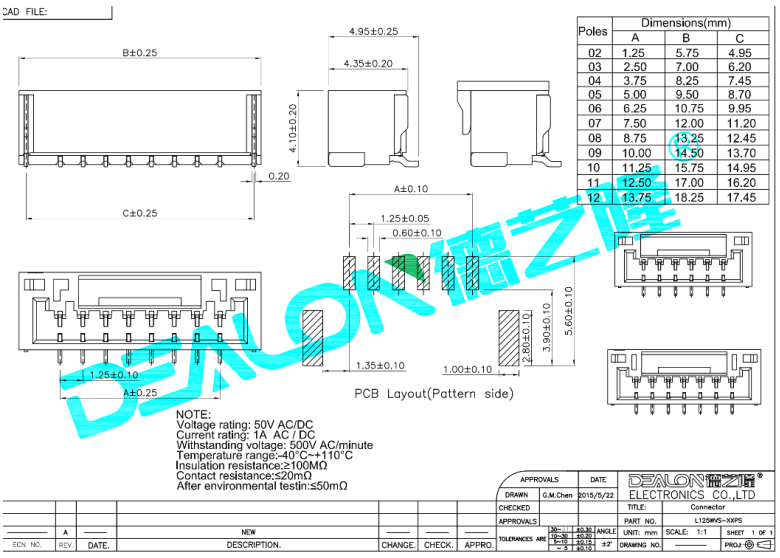
(1) VCC——→ Sensor power supply port, voltage range is 3.3-5V(low noise linear power supply or lithium battery power supply is recommended), note that it needs to use PMOS electronic switch through the MCU control.

(2) GND——→ Power negative pin, connected to power GND.

(3) TX——→ The sensor UART data output terminal reads the data by connecting this pin to the UART receiver of the MCU, and the level voltage is 3.0V.

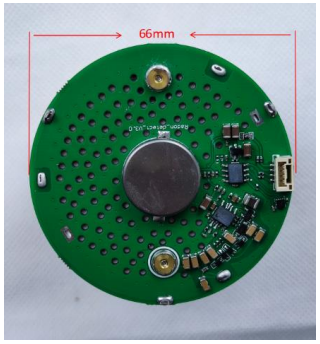
(4) LED——→ The output of sensor ionization pulse signal, default output 3.0V high level, when ionization discharge occurs in the ionization chamber, the pin output low level, can be connected to the LED, observe the LED flashing can intuitively understand the intensity of the ionization signal. (Note: The pin internal series 1KΩ output resistor)

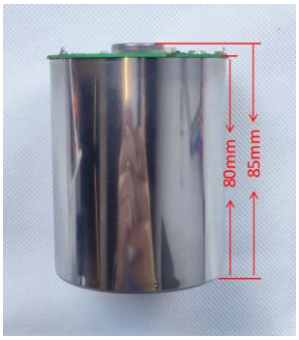
3. Package diagram of SMD socket

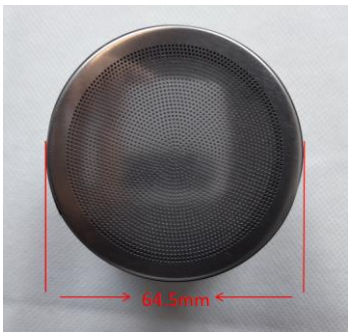


Poles	Dimensions(mm)		
	A	B	C
02	1.25	5.75	4.95
03	2.50	7.00	6.20
04	3.75	8.25	7.45
05	5.00	9.50	8.70
06	6.25	10.75	9.95
07	7.50	12.00	11.20
08	8.75	13.25	12.45
09	10.00	14.50	13.70
10	11.25	15.75	14.95
11	12.50	17.00	16.20
12	13.75	18.25	17.45

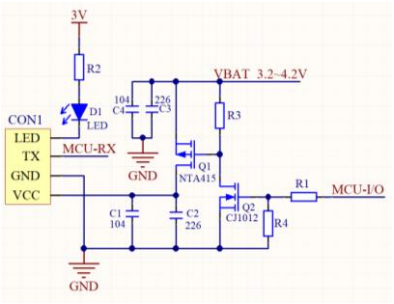
4. External dimension drawing







5. Host control interface diagram



(1) It can be connected to the MCU host by using the SMD socket and connection cable we matched.

(2) D1 can use LED as an ionization pulse indicator function, this port is effective at low level.
The LED pull-up voltage is recommended to be 3.0V and shall not exceed 3.3V.

(3) The VCC-powered MOSFET Q1 is PMOS(internal resistance less than 0.5R), Q2 is NMOS, and MCU-IO can control the power supply of the sensor to power reset.
Multiple filter capacitors are required to reduce the power supply noise and ripple voltage

(4) The VCC supply voltage range is recommended to use 3.3-4.2V lithium battery power supply, or 3.6V output voltage LDO to power the VCC, The VCC limit voltage must not exceed 5.5V, otherwise there is a risk of damage.

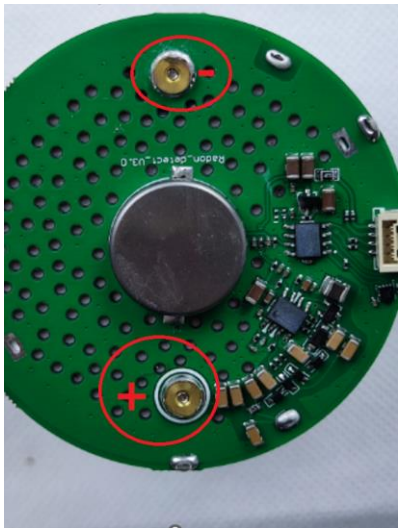
6. Notes

(1) There are air holes at the top and bottom of the ionization chamber. It is necessary to reserve corresponding air holes in the design of the shell, and it is necessary to cover the air holes of the shell with a 60g/m² density of non-woven fabric filter for primary dust filtration. (Although we designed high-density dust filters for the top and bottom of the ionization chamber, the shell primary filter had to be added)

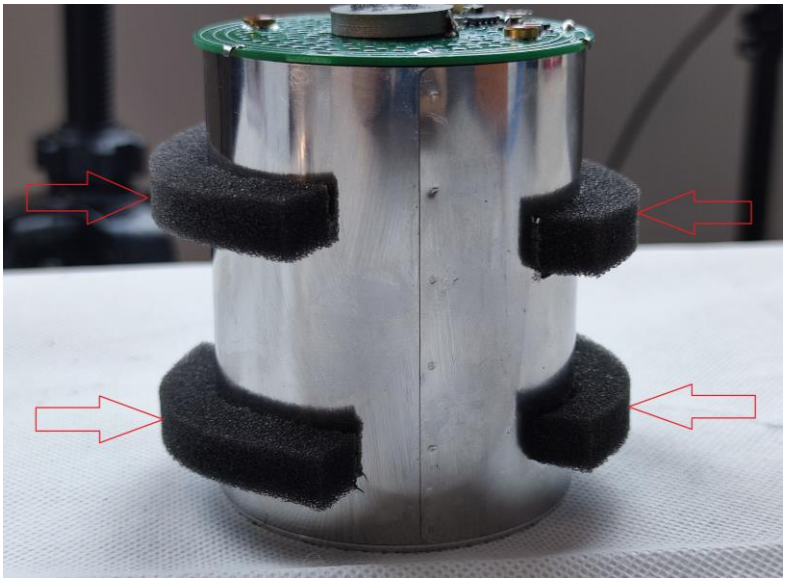
(2) When the air humidity is higher than 80%, the ionization chamber sensor cannot provide correct data results, so it is necessary to add a temperature and humidity sensor on the host side, such as Sensirion's SHT40 is a good choice. When the humidity of the device cavity exceeds 80%, it indicates that the data is invalid.

Another solution is to place desiccants or drying tubes in the air holes at the bottom of the shell, which can appropriately reduce the humidity of the air entering the ionization chamber. To ensure that the humidity of the ionization chamber is below 80%, the desiccants should be replaced regularly (1-2 days). We have experimented with the diameter of 1-5mm particles of silica gel desiccant, molecular sieve desiccant, calcium chloride desiccant moisture absorption effect is very good, can not use powder desiccant.

(3) The capacitor on the PCB of the sensor has a high voltage of about 400V. Do not touch it directly by hand. It is recommended to use the voltmeter to bridge the two ends of the red ring nut in the following figure for more than 5 seconds after the power is cut off, and then touch it after the residual voltage is discharged, so as to prevent the high voltage from connecting to the low voltage area and causing equipment damage. (Although the voltage on the PCB is high but the output current is small, it usually does not cause serious harm to the human body, but there will be strong electric shock pain, such as the electric shock sensation of the spark plug of the lighter on the human body)



(4) Ionization chamber is sensitive to vibration, strong vibration will lead to large errors in measurement results, it is recommended not to use screws for rigid connection during installation and fixation, as shown in the following figure, flexible sponge can be used for extrusion fixation to improve the anti-vibration level



7. Data protocol

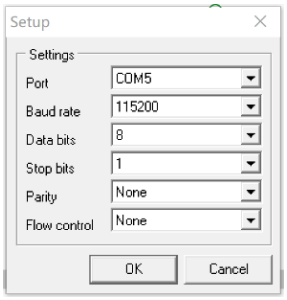
Please refer to the Setup diagram for UART data parameters, and the data frame length is 28Byte.

When the sensor is powered on, it outputs a "Welcome" string in ASCII format and then automatically reports data frames every 10 seconds.

Radon concentration data are only updated every 10 minutes.

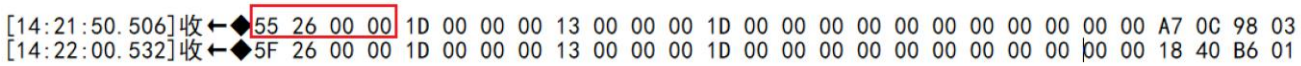
The user can determine whether the sensor is faulty or offline through the 10-second interval data frame.

The data structure is sent in Little-Endian mode, with low bytes on the left and high bytes on the right。



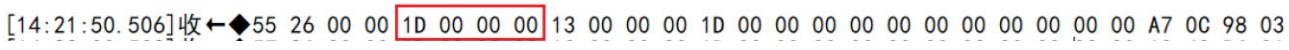
(1) Running time: composed of 32bit unsigned int data, the time is automatically accumulated after the device is powered on, the time accuracy is ±1.5%, can not be used for precise timing.

For example, the hexadecimal value of 0x00002655 in the red box in the following figure is converted to 9813 in decimal, indicating that the device ran for 9813 seconds.



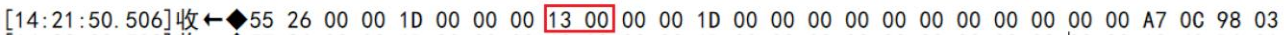
(2) Cumulative radon concentration average: A 32-bit unsigned int data that is the cumulative average of long-term integration calculations after the device is powered on. This value will be calculated for a long time as long as the device is powered on.

For example, the hexadecimal 0x0000001D in the red box in the figure below represents a decimal value of 29, which means that the cumulative average of radon concentration is 29 Bq/m³



(3) Last 10 minutes radon concentration: 16 bits of unsigned short data in the range 0-65565, updated every 10 minutes.

For example, the hexadecimal value 0x0013 in the red box in the figure below is converted to a decimal value of 19, which means that the radon concentration in the last 10 minutes is 19 Bq/m³.



(4) This data reserves data bits for the protocol and has no meaning.

[14:21:50.506]收←◆55 26 00 00 1D 00 00 00 13 00 00 00 1D 00 00 00 00 00 00 00 00 00 00 A7 0C 98 03

(5) Last 1-hour radon concentration value: 16bit unsigned short data, this data range 0-65565, updated every 10 minutes.
For example, the hexadecimal conversion 0x001D in the red box below is converted to the decimal value 29, which means that the radon concentration in the last one hour is 29 Bq/m³

[14:21:50.506]收←◆55 26 00 00 1D 00 00 00 13 00 00 00 1D 00 00 00 00 00 00 00 00 00 00 A7 0C 98 03

(6) Radon concentration value for the last 12 hours: 16bit unsigned short data, the data range 0-65565, updated every 10 minutes.

[14:21:50.506]收←◆55 26 00 00 1D 00 00 00 13 00 00 00 1D 00 00 00 00 00 00 00 00 00 00 A7 0C 98 03

(7) Last 24 hours radon concentration: 16 bits of unsigned short data in the range 0-65565, updated every 10 minutes.

[14:21:50.506]收←◆55 26 00 00 1D 00 00 00 13 00 00 00 1D 00 00 00 00 00 00 00 00 00 00 A7 0C 98 03

(8) Last 48 hours radon concentration: 16 bits of unsigned short data in the range 0-65565, updated every 10 minutes.

[14:21:50.506]收←◆55 26 00 00 1D 00 00 00 13 00 00 00 1D 00 00 00 00 00 00 00 00 00 00 A7 0C 98 03

(9) This data reserves data bits for the protocol and has no meaning.

[14:21:50.506]收←◆55 26 00 00 1D 00 00 00 13 00 00 00 1D 00 00 00 00 00 00 00 00 00 00 A7 0C 98 03

(10) Last 96 hours radon concentration: 16 bits of unsigned short data in the range 0-65565, updated every 10 minutes.

[14:21:50.506]收←◆55 26 00 00 1D 00 00 00 13 00 00 00 1D 00 00 00 00 00 00 00 00 00 00 A7 0C 98 03

(11) CRC check data: 32-bit unsigned int data, Crc-32 (Ethernet) polynomial 0x4C11DB7 is used for the CRC check of the first 24 bytes of the data frame

X32 + X26 + X23 +X22 +X16 + X12 + X11 + X10 +X8 + X7 + X5 + X4 + X2 + X +1

[14:21:50.506]收←◆55 26 00 00 1D 00 00 00 13 00 00 00 1D 00 00 00 00 00 00 00 00 00 00 A7 0C 98 03

(In practice, it is also possible not to use the CRC check, for example, reading two consecutive frames to achieve data verification is also a simpler way)