Radon Sensor RD200M

datasheet ver 1.3

Features

- Pulsed Ionization Chamber type
- Sensitivity : 30cph/pCi/l (0.81cph/Bq/m^3)
- Measurement Range : 0.1~255pCi/l
  (From 1st May, 2017) 0.1 ~ 9,400Bq/m^3
- Precision : ±10% at 10pCi/l (370Bq/m^3)
- Accuracy : ±10% at 10pCi/l (970Bq/m^3)
- Each sensor individually calibrated
- 10min data update
- Supply voltage & current : DC 12V, 60mA
- UART interface for MCU & Arduino
- Built in vibration sensor for prevent error detection

DESCRIPTION

The RD200M is the new innovative fastest radon sensor, which has the highest sensitivity, 30 cph/pCi/l on the market today. This sensor is optimized for the IAQ monitor, Air purifier, Radon detector and Auto ventilation system. A breakthrough in FTLAB's patent technology which received a New Excellent Technology certification in 2015, the RD200M uses a dual probe structured pulsed ionization chamber and a special high impedance differential amplifier circuit to offer the highest signal to noise ratio. It effectively detects the secondary charges which were generated from collisions with air and α -particle caused by Radon or Radon's progeny. The accuracy and precision of the RD200M both are ±10% at 10pCi/l, which has been tested by the international standard Radon Testing Laboratory in KTL. Each sensor has been individually calibrated by equipments which are already calibrated to traceable international standards.

APPLICATIONS

- IAQ (indoor air quality) monitor
- Air purifier
- IoT Radon sensor
- Radon Detector
- Automatic ventilation system
- Radon mitigation system

Pin Descriptions

Pin No	name	Description
1	Tx	TTL out level 3.3V
2	Rx	TTL in level 3.3V
3	+12V	VCC input
4	GND	Ground

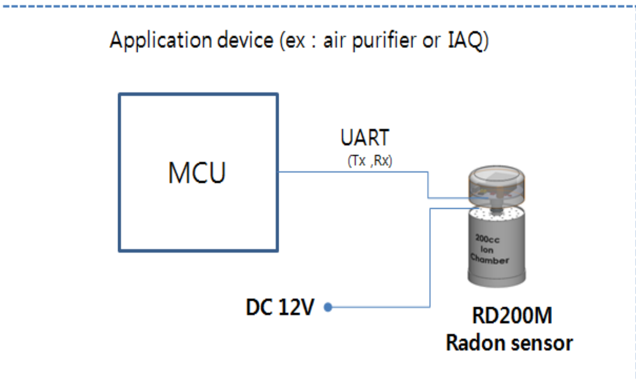


Fig. 1 Typical Application configure

Radon Sensor RD200M

datasheet ver 1.3

ABSOLUTE MAXIMUM RATING

Parameter	Symbol	Rating	unit
Supply voltage	Vcc	-0.3 to 15	V
I/O terminal voltage	V_IO	-0.3 to 5	V
Storage temperature	Ts	-20 ~ 85	ºC
ESD rating		±2	kV

RECOMMENDED OPERATING CONDITIONS

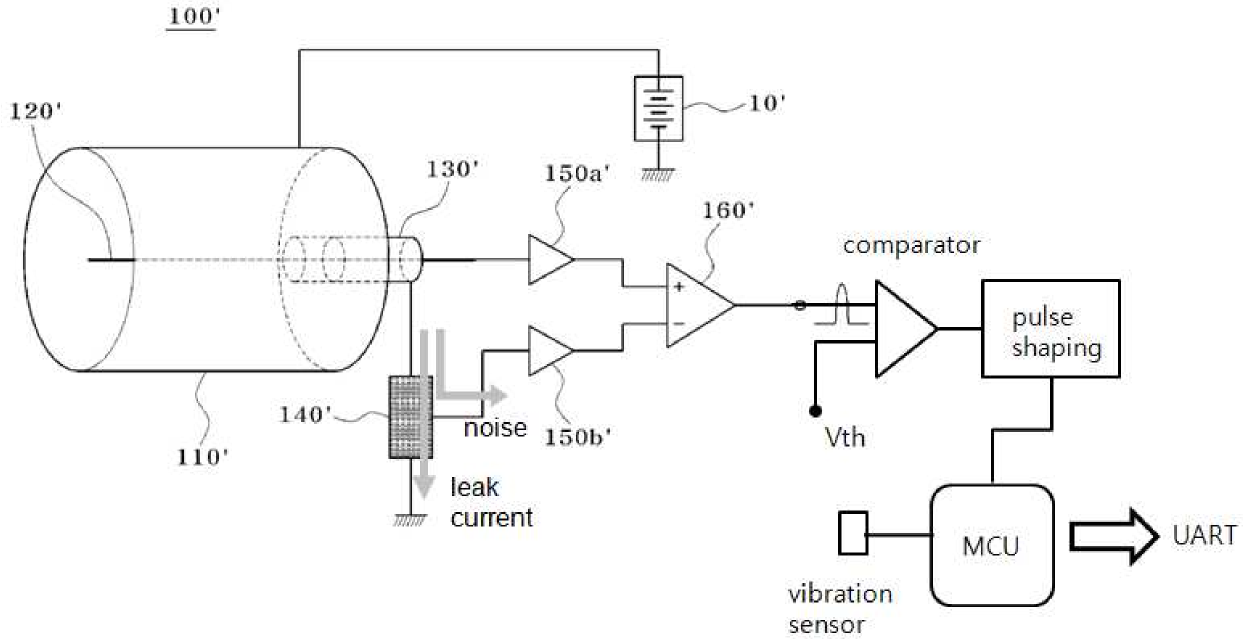
Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	Vcc	11.5	12.0	12.5	V
Operating temperature	Ta	10	25	40	ºC
Operating humidity	RH	0	10 to 65	90	%

ELECTRICAL CHARACTERISTICS

(Ta=25ºC, Vcc=12V)

Parameter	Symbol	conditions	Min	Typ	Max	Unit
current consumption	I_{cc}		55	60	65	mA
Base noise level of analog output	V_{n_pp}		20	35	50	mV
α-decay signal peak	V_p	background test	1.0	2.5	4.0	V
α-decay signal pulse width	T_w	FWHM	50	300	600	ms
Threshold voltage	V_{th}	reference voltage for comparator		1.0		V
UART	Tx, Rx	MODBUS		19200		Baud rate

FUNCTIONAL BLOCK DIAGRAM



* Influences of Gamma ray and X-ray are removed by LPF.
* When the vibration is sensing, MCU cancel the detection signal during 1sec.
* Internal supply voltage, Vdd is 3.3V by LDO for digital part.
* Ionization chamber is positively biased.

FUNCTIONAL CHARACTERISTICS*

(Ta=25ºC, Vcc=5V)

Parameter	Symbol	conditions	Min	Typ	Max	Unit
Measurement range			0.1	-	255	pCi/l
Sensitivity*	K	1hour step data average during 10hours at test chamber 8~12pCi/l	28	30	32	cph/pCi/l
Accuracy*	δ		±5	±7	±10	%
Precison*	ε		±6	±8	±10	%
Minimum error	δ_{min}	background test	-	±0.4	±0.5	pCi/l

* All test has been carried out from the international standard Radon Testing Laboratory of KTL

THEORY of OPERATION

α-particle which is generated during the α-decay of Radon or its progeny, creates the thousand of ± charged particles by collisions with air. These secondary charges might be detected by a special high input impedance circuit and pulsed ionization chamber, so we can measure the Radon concentration in the room by this way. But it is usually very hard. Because it is very noisy signal caused by high input impedance of detection circuit and ionization chamber.
The RD200M detects effectively these secondary charges using the 200cc class, dual probe structured pulsed ionization chamber and a special amplifier circuit shown in functional block diagram developed by FTLAB's patent technology. The improved detection signal is shown in Figure 2. From the statistical method based on detected pulse counts and interval of these alpha decay, it can be measured the indoor Radon concentrations directly.

TYPICAL ANALOG OUTPUT CHARACTERISTICS

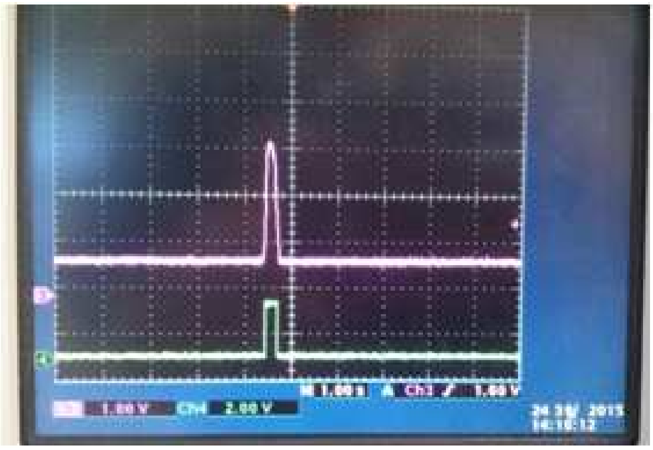
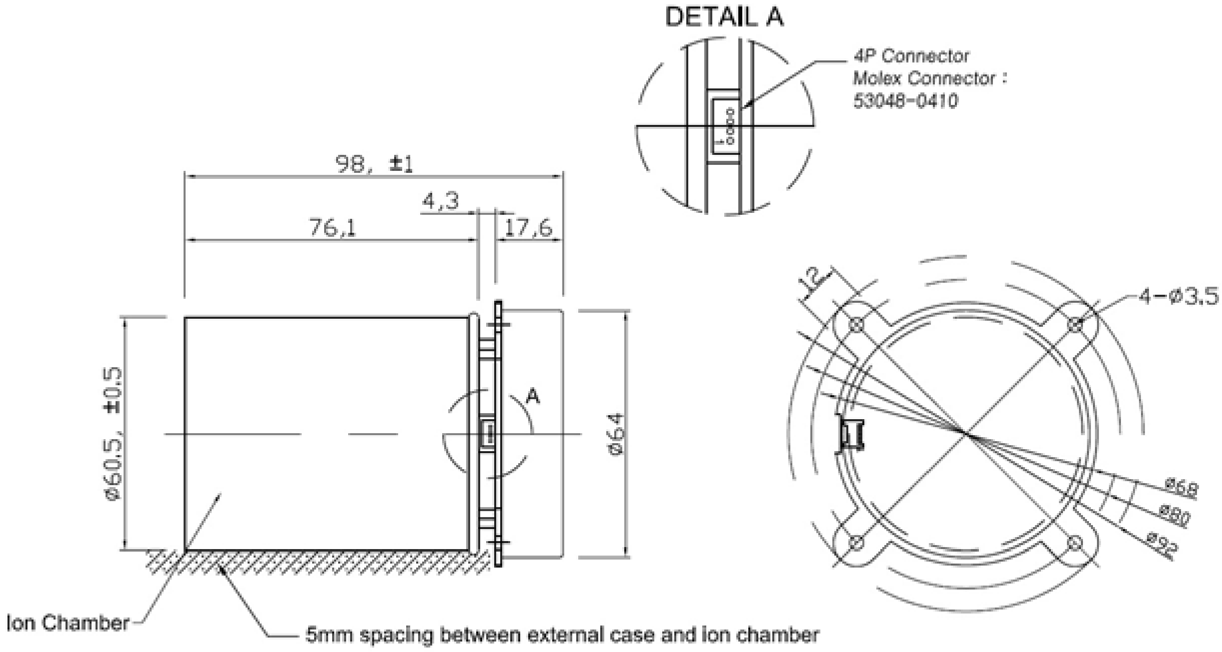


Fig. 2 Typical α-decay signal (up) from detection circuit and converted trigger signal (down) (1s/div, 1V/div)

GENERAL GEOMETRY of RD200M



* The ϕ64 metal cap is connected with PCB ground but ionization chamber is positively biased.
* When fixing the sensor, use the 4 pieces ϕ3.5 holes. If it is needed for fixing the ionization chamber, use dielectric material like a plastic tie cable.

4P connector Pin(J_out) Descriptions

Pin No	Name	Description
1	Tx	TTL out level 3.3V
2	Rx	TTL in level 3.3V
3	+12V	VCC input
4	GND	Ground

ABOUT HEPA FILTER

Fig. 3 Ionization chamber with & without HEPA filter

* The H12 class circular HEPA filter with a diameter of 56mm is used for protection of micro dust. It is packaged separately.
* When this filter is not used, the RD200M measures the radiation dose caused by Radon and Radioactive dust causing α-decay. In this case, the result is usually greater about 0.5~2pCi/l than the no filter case. If this filter is used, the RD200M measure Radon concentration only.
* When the RD200M is used for IAQ or Air purifier, it is recommended not to use this filter.
* When the RD200M is used for Radon Detector as a instrument, the HEPA filter must be used.
* It is recommended a silicone adhesive when attaching the HEPA filter in the front of the metal mesh.

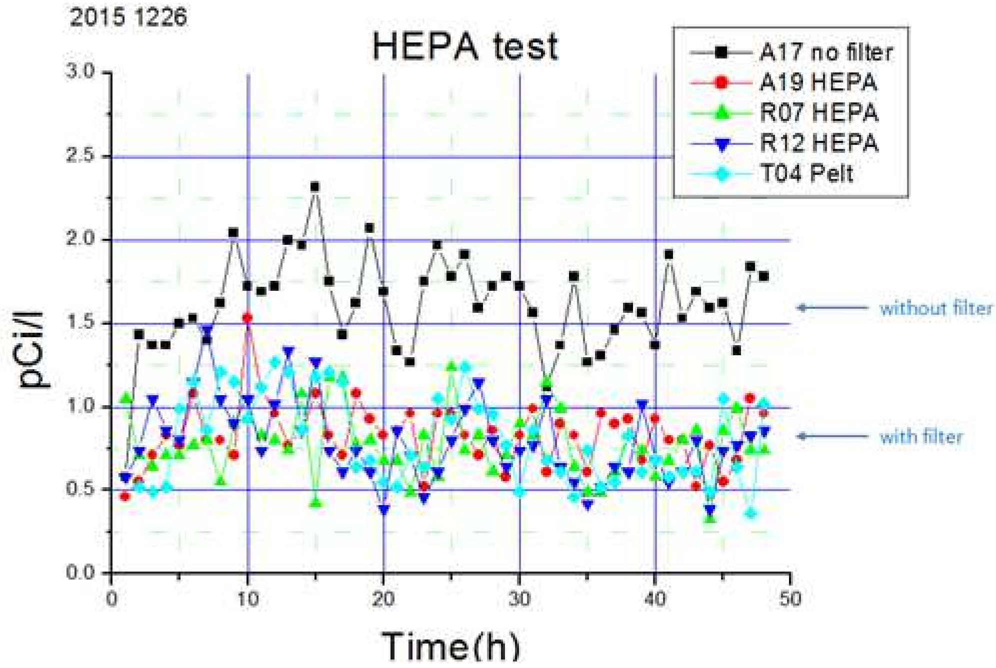


Fig. 4 Typical results of RD200M with and without HEPA filter in 0.5~2.0pCi/l

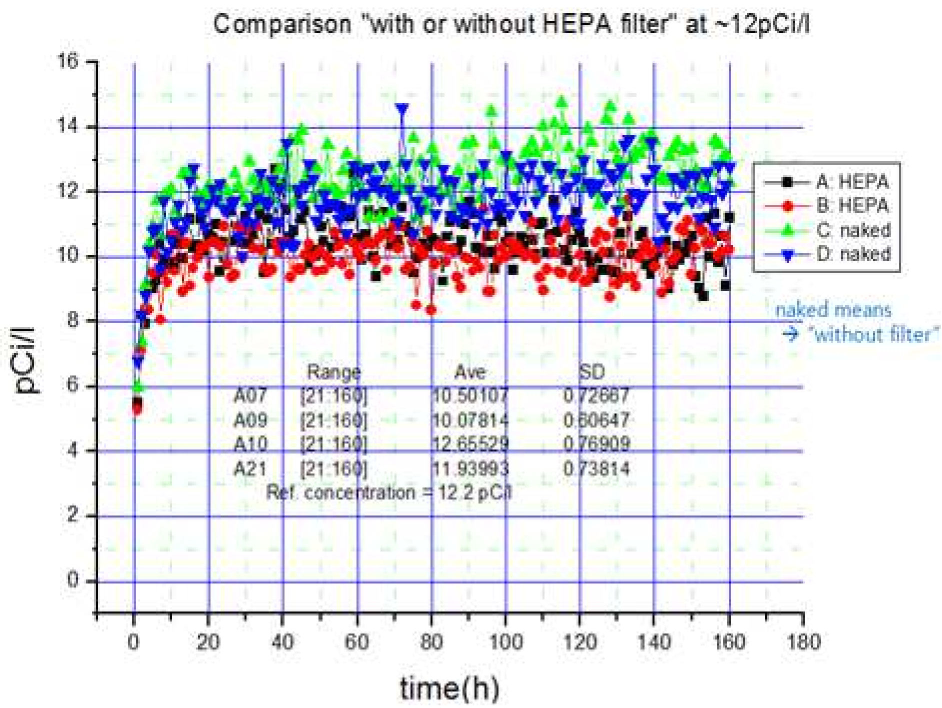


Fig. 4 Typical results of RD200M with and without HEPA filter in 10~12pCi/l

UART INTERFACE

Command List - Request (Host -> RD200M)

CMD	Description	Data size (byte)	Request data (byte)
0x01	Request all data	0	-
0xA0	Reset	0	-
0xA1	Set data transfer period (Send to host RD200M data to each transfer period automatically.)	1	minute

Command List - Response (RD200M -> Host)

CMD	Description	Data size (byte)	Response data	
0x10	Read all data (Respose to request '0x01' command or to each transfer period automatically.)	4	Data 1 (status)	0x00: Power On ~ 200sec 0x01: 200sec to 1hour 0x10: Measuring time is within 30min and radon count over is 10. (warning status) 0x02: after 1hour 0xE0: Detect vibrations
			Data 2	Minutes of measuring time
			Data 3	Integer of measured value
			Data 4	Decimal of measured value

Command Syntax

STX	CMD	Data size	Data 1 ... Data N (N = Data size)	Checksum (0xFF - (CMD+Size+Data0+ ... +DataN))
0x02	1 byte	1 byte	1 byte * N	1 byte

UART Example

* Request

STX	CMD	Data size	Checksum
0x02	0x01	0x00	0xFE

a. 0x02 : STX
b. 0x01 : Request all data command
c. 0x00 : Data size is 0 bytes
d. 0xFE : Checksum (=0xFF - (0x01+0x00))

* Response

STX	CMD	Data size	Data 1	Data 2	Data 3	Data 4	Checksum
0x02	0x10	0x04	0x01	0x1E	0x01	0x15	0xB6

a. 0x02 : STX
b. 0x10 : Read all data command
c. 0x04 : Data size is 4 bytes
d. 0x01(Data1) : RD200M status 1, it is '200sec to 1hour' after start
e. 0x1E(Data2) : Minutes of measured time, $1E_{(16)} = 30_{(10)}$
f. 0x01(Data3) : Integer of measured value, $1_{(16)} = 1_{(10)}$
g. 0x15(Data4) : Decimal of measured value, $15_{(16)} = 21_{(10)}$
h. 0xB6 : Checksum (=0xFF - (0x10+0x04+0x01+0x1E+0x01+0x15))
--> Measuring time is 30min
--> Measured value is 1.21 (pCi/L)

* More informations and example code refer to application note. (www.radonftlab.com)

NOTE

1. Ionization chamber and metal cap

The ionization chamber is positively biased. So do not touch the ionization chamber and metal mesh part. It has a high internal impedance up to several MΩ, so it is not dangerous for human safety if touched. When fixing the sensor, use the 4 pieces ϕ3.5 holes. If it is needed for fixing the ionization chamber, use dielectric material like a plastic tie cable. The ϕ64 metal cap is connected with PCB ground of sensor. So it can be touched external case body or ground.

2. Electric noise influence

If the sensor is located close to noise generator (ex. hair dryer, high voltage discharger, high power RF transceiver, etc.), the sensor output may be affected by leaded noise. On top of that noise from power supply line also may affect the sensor output. When designing the system, please consider the effect from noise.

3. Vibration influence

The sensor may be influenced its output signal by mechanical shock or oscillation. So this sensor was designed to measure in a stational condition, not moving. Before usage, please make sure that the device works normally in the application.

4. When the sensor is moisturized at RH 100%, this product does not keep its proper function. Please design the application so that moisturization of the module does not happen.

5. Cleaning

When cleaning the sensor, please use proper electronic PCB cleaner.