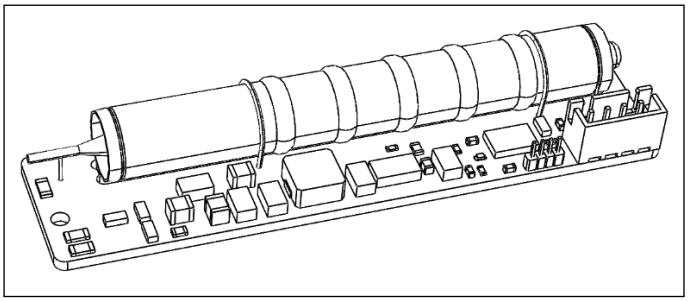
Climate Guard

RadSens-1v2

Modular dosimeter-radiometer based on Geiger counter SBM20-1

Technical details



1 Key features

- Functional:

  - Universal I2C connector

  - Support of two radiation intensity calculation algorithms

  - Dynamic adjustment of the counting time period

  - Measurement of the total number of impulses

  - Software-level support of change in I2C address

  - Autonomous utilization as a radiation indicator

- Electrical:

  - Low supply voltage 3.0 ... 3.5 V

  - Maximum current consumption at high radiation no more than 50 mA

- Technical:

  - Compact module dimensions 89mm x 21mm x 13.5mm

  - Fixed (vibration-resistant) counter location

  - Module weight no more than 12 g

  - Operating temperature range

  from -20 ° C to + 60 ° C

2 Description

RadSens – universal dosimeter-radiometer of a modular formfactor. A gas-discharge Geiger-Muller counter SBM20-1 is used as a sensitive element. It is also utilized in most household and professional dosimeters.

The device supports measurement and calculation of radiation intensity using two algorithms: with a dynamic range of counting time to detect local sources of pollution, and with a wide static time range for accurate measurement of the current background radiation noise. It is also possible to use the module without any additional devices just as an "indicator" of radiation, driven by the blinking frequency of the LED installed on the board.

Impulse registration, calculation algorithms and data transmission via I2C with a frequency of up to 400 kHz are implemented on an STM32 microcontroller installed on the board. The module supports software address change and enable / disable high-voltage converter to improve energy efficiency. It is also possible to adjust the counter's sensitivity to ionizing radiation using I2C, which makes it possible to use other counters with the same anode supply voltage within same module.

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3 Device Characteristics

3.1 Technical

Overall dimensions of the device with the installed counter: 89mm x 21mm x 13.5mm. Module weight: 12 grams.

Parameter	Value			Units
	Not less than	Operational	Less than	
Supply voltage	3.0	3.3	3.5	V
Maximum current consumption	-	20	50	мА
Anode voltage on the gas-discharge counter	380	400	440	V
Operating temperature range	-40	+20	+70	°C
Operating humidity range	0	60	98	%

Table 1 (technical characteristics)

3.2 Metrological

A Geiger counter SBM20-1 manufactured by SF JSC "NIITFA" decimal number TDMK.433217.008 and technical specs OD0.339.544TU is used as a main element. The following formula is used for calculation of the radiation intensity: $RAD = N \times \frac{60_{min} \times 60_{sec}}{P_{av} \times dT}$, где

Pav – average sensitivity of the SBM20-1 counter to gamma radiation from the source of Ra^{226},

dT – time interval,

N – number of impulses recorded during dT time,

RAD – value of radiation activity, μR / h.

Parameter	Value			Units
	Not less than	Operational	Less than	
Measured radiation range	14.4	-	144 000.0	μR / h
Number of impulses	0	-	65 535	imp
Sensitivity to gamma radiation Ra226	100	105	110	Imp / μR
Spread of relative sensitivity	-	-	±15	%

Tabble 2 (metrological characteristics)

4 Data interaction

4.1 Register map

Data exchange (setup and transmission of measured values) is carried out via the I2C interface at a frequency of up to 400 kHz. The sensor works in the Slave mode with the default address 0x66 (software level configuration)

Address	Name	R/W	Range	Units
0x00	Device ID	R	0x7D	-
0x01	Firmware version	R	0-255	-
0x02	<reserved>	-	-	-
0x03-0x05	Radiation intensity (measurement period T <123 sec.)	R	0 … 1 440 000	0.1* µR / h
0x06-0x08	Radiation intensity (measurement period T = 500 sec.)	R	0 … 1 440 000	0.1* µR / h
0x09-0x0A	Impulse counter (The value is cleared every time it is read)	R	0 … 65535	imp
0x0B-0x0F	<reserved>	-	-	-
0x10	Device address	W	0x03-0x77	-
0x11	HV generator	R/W	0/1	-
0x12-0x13	Sensor sensitivity	R/W	0-510	imp/ µR

Table 3 (data interaction register map)

4.2 Description of registers

4.2.1 Device ID

[address: 0x00, size: 8 bit, access: R]

Control register containing the product identifier. Defaulted to 0x7D. Used to control the device connection.

4.2.2 Firmware version

[address: 0x01, size: 8 bit, access: R]

The register for storing the current firmware version. Used to control and timely update software.

4.2.3 Radiation intensity (T < 123 sec)

[address: 0x03, size: 24 bit, access: R]

Contains the dynamic value of the ionizing gamma radiation intensity. When detecting a rapid change in radiation intensity (both up and down), it dynamically adjusts the counting period of the sliding window so that the range covers a time interval containing only actual data. Allows to use the device in the local pollution search mode. Refresh rate - 1 sec.

4.2.4 Radiation intensity (T = 500 sec)

[address: 0x06, size: 24 bit, access: R]

Contains the statistical value of the ionizing gamma radiation intensity. The counting period of the sliding window is 500 seconds. Allows accurate measurements of constant background radiation. Refresh rate - 1 sec.

4.2.5 Impulse counter

[address: 0x09, size: 16 bit, access: R]

Contains the accumulated number of impulses registered by the module from the last I2C data readout. The value is cleared every time it is read. Allows to directly process the impulses from the Geiger counter and implement other algorithms. The value is updated at the time of each impulse registration.

4.2.6 Device address

[address: 0x10, size: 8 bit, access: W]

The register is used to change the device address if several devices need to be connected to one line at the same time. Contains the value 0x66 by default. At the end of the recording, the new value is saved to the non-volatile memory of the microcontroller.

4.2.7 Generator HV

[address: 0x11, size: 8 bit, access: R/W]

High voltage converter control register. Is on by default. To turn on the HV generator, write 1 to the register and 0 to disable. Other values are ignored.

4.2.8 Counter sensitivity

[address: 0x12, size: 16 bit, access: R/W]

Contains the value of the Pav coefficient (see 3.2) used to calculate the radiation intensity. If necessary (for example, when installing a different type of counter), the required sensitivity value in imp / μR is entered into the register. The default value is 105 imp / μR. At the end of the recording, the new value is saved to the non-volatile memory of the microcontroller.

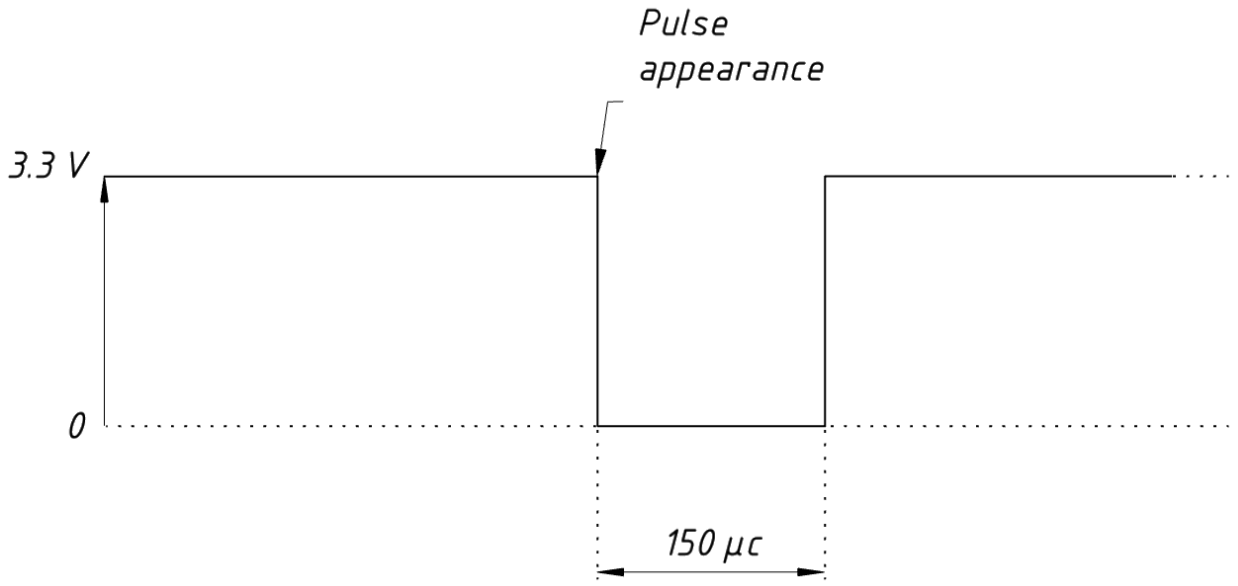
4.3 Pulse output

4.3.1 Description

The pulse output is designed to register pulses by an external device (controller) in real time.

4.3.2 The order of work

The operating level of the line is 3.3 V. When registering a pulse, the module lowers the line to 0 for 150 microseconds, then restores the high operating level of the line.



Schema 1 (pulse output work description)

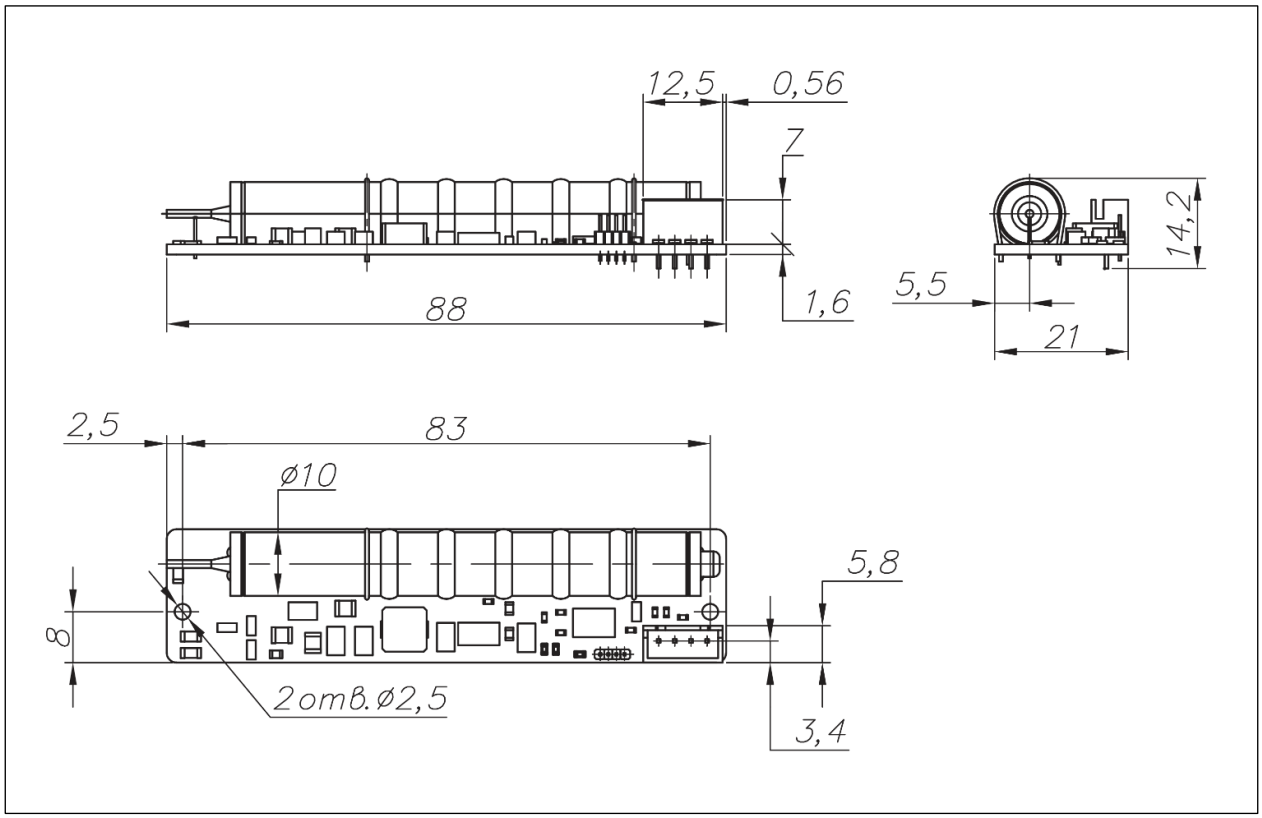
5 Connection socket

The board has a "XH-4A" connector, the counterpart: "xh2.54-4p". The pinout of the connector is shown in the table below.

Contact	Name	Description
1	VCC	Supply voltage 3.0 V ... 3.5 V
2	GND	Ground (common wire)
3	I2C-SCL	I2C serial clock line
4	I2C-SDA	I2C serial data line
5	INT	Pulse output

Table 4 (connection socket)

6 Device drawing



7 Reference

Contact and additional information are presented in the table below.

Description	Link
Manufacturer website	http://climateguard.ru/
Module library	https://github.com/climateguard/RadSens
Telegram community	https://t.me/climateguard_community

Table 5 (Reference)