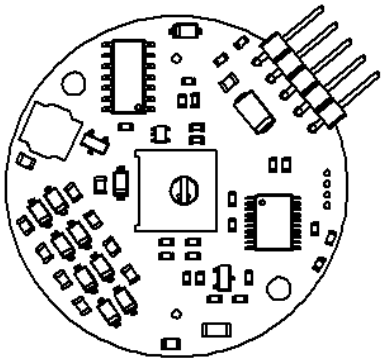
Climate Guard

CG_HV_GENERATOR-1v0

Modular high voltage generator for any Geiger counters

Technical details



1 Key features

Functional:

- Adjustment in a wide voltage range from 380V to 500V
- Pulse registration from the anode of the counter
- Universal connection via I2C or digital microcontroller input
- Support of two radiation intensity calculation algorithms
- Dynamic adjustment of the counting period
- Measurement of the total number of pulses
- Software-level support of change in I2C address
- Light indication of radiation level
- Compact circular form factor
- Logic level 3.3V, tolerant to 5V (do not need additional converter)
- Works with any counter operating at 380-500V

Electrical:

- Low supply voltage: 3.0-3.5V
- Maximum consumption current at high radiation: no more than 100 μA

Technical:

- Compact module dimensions: 40 mm x 40 mm x 7,1 mm
- Module weight: no more than 8g
- Operating temperature range: from -20°C to +60°C

2 Description

CG_HV_GEN is a universal high-voltage modular formfactor generator with adjustable output voltage and interface for reading Geiger counter raw impulses. A gas-discharge or mica Geiger-Müller counter can be used as a sensitive element.

The registered pulses can be read directly from a special output or via the I2C digital interface. 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. It is also possible to adjust the counter's sensitivity to ionizing radiation using I2C, which makes it possible to use any Geiger counters.

On board LED blinking when the module is launched indicates it has entered working mode.

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3 Device specification

3.1 Technical

Overall dimensions of the device - 40 mm x 40 mm x 7,1 mm. Weight - 8 g.

Parameter	Value			units
	Not less than	operational	Less than	
Supply Voltage	3,0	3,3	3,5	v
Max consumption current	-	30	100	μA
Anode voltage on gas-discharge counter	380	-	500	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: $RAD{=}N{\times}60min \times 60secPav \times dT$

Pav – average sensitivity of the SBM20-1 counter to gamma radiation from the source of Ra226,

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	%

Table 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). Logic level 3.3V. Compatible with 5V devices without a converter.

Address	Description	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 = 220 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	R/W	0x03-0x77	-
0x12-0x13	Sensor sensitivity	R/W	0-65535	imp/ µR
0x14	Indication LED control	R/W	0/1	-

Table 3 (register map)

4.2 Register description

4.2.1 Device ID

[address: 0x00, size: 8 бит, 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.

4.2.3 Radiation intensity (T < 123 sec)

[address: 0x03, size: 24 бит, 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 220 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 Counter sensitivity

[address: 0x12, size: 16 bit, access: R/W, Little-endian byte order (from least to most significant)]

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.

4.2.8 Indication LED control

[address: 0x14, size: 8 bit, access: R/W]

This register controls the indicator LED (located on the module board). By default, the LED is on. To enable the indication, write 1 into the register; to disable it, write 0. Any other values will be ignored.

4.3 Pulse output INT

4.3.1 Description

This output is designed to register pulses with an external device (controller). One registered pulse from the counter corresponds to one pulse on the INT output. The output can be connected to an interrupt input of an external device.

4.3.2 The order of work

The normal line level is ~0V. When a pulse is registered, the module raises the line to 3.3V for ~10 μs (this may depend on the installed Geiger counter) and then restores the low working line level.

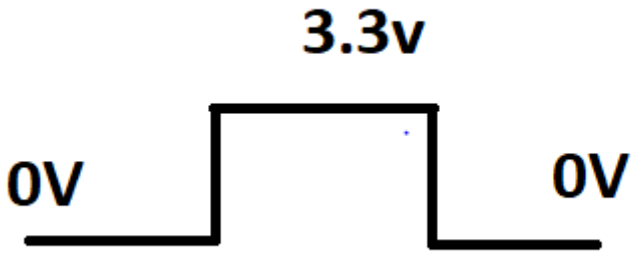


Figure 1 (pulse output work description)

5 Output Voltage Adjustment Procedure

⚠ **WARNING!** Always measure the actual voltage using insulated probes and a multimeter/voltmeter with a maximum measurement range of at least 600V. Adjusting the high voltage is done by turning the adjustment screw of the trimmer resistor RV1. The adjustment range is from 380V to 500V. The high voltage test point "400v" is located near resistor R5. See Figure 2.

1. Check the operating voltage of your Geiger counter in the user manual.
2. Without connecting the Geiger counter, apply a 3.3V supply to the module.
3. Connect the voltmeter to the test points "hv-" ("-" of the voltmeter) and "400v" ("+" of the voltmeter).
4. Adjust the trimmer screw of resistor RV1 to achieve the desired voltage level.

Note: When measuring the voltage between points "hv+" and "hv-," the voltage displayed on the voltmeter will be lower due to the load resistor in the circuit. Perform the measurement only between points "hv+" and "400v."

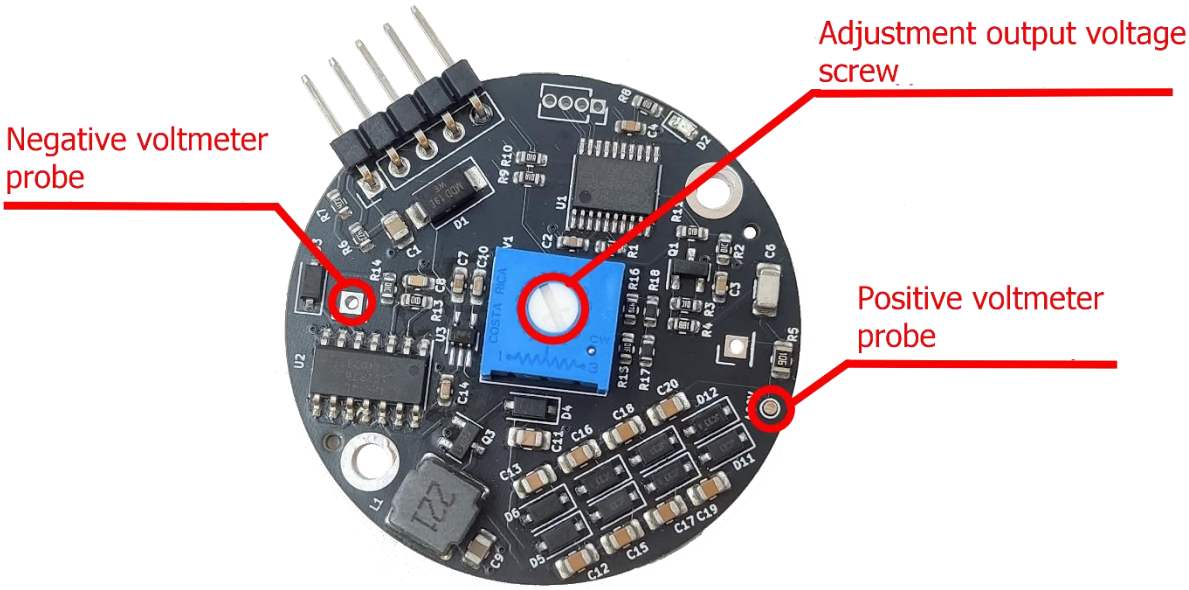


Figure 2 (adjustment of output voltage)

6 Anode Resistor R5

Depending on the model of the Geiger counter you are using, it may be necessary to replace the anode resistor R5. By default, the module comes with a 10MΩ resistor, which is suitable for most common tubes, including SBM and SBT counters.

If necessary, the resistor can be replaced with another SMD resistor of size 0805.

7 Connecting the Geiger Counter

Before connecting the gas-discharge counter, disconnect the module from the external power supply. Solder the anode of the gas-discharge counter to the "hv+" point, and the cathode to the "hv-" point. The connection points are indicated on the silkscreen of the printed circuit board. See Figure 3.

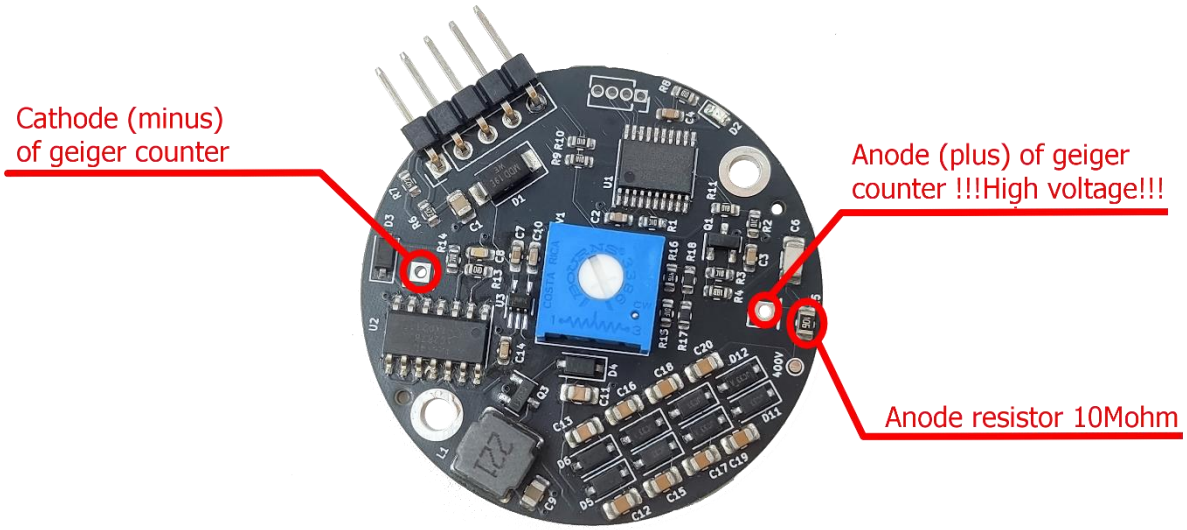


Figure 3 (Connection of Geiger counter)

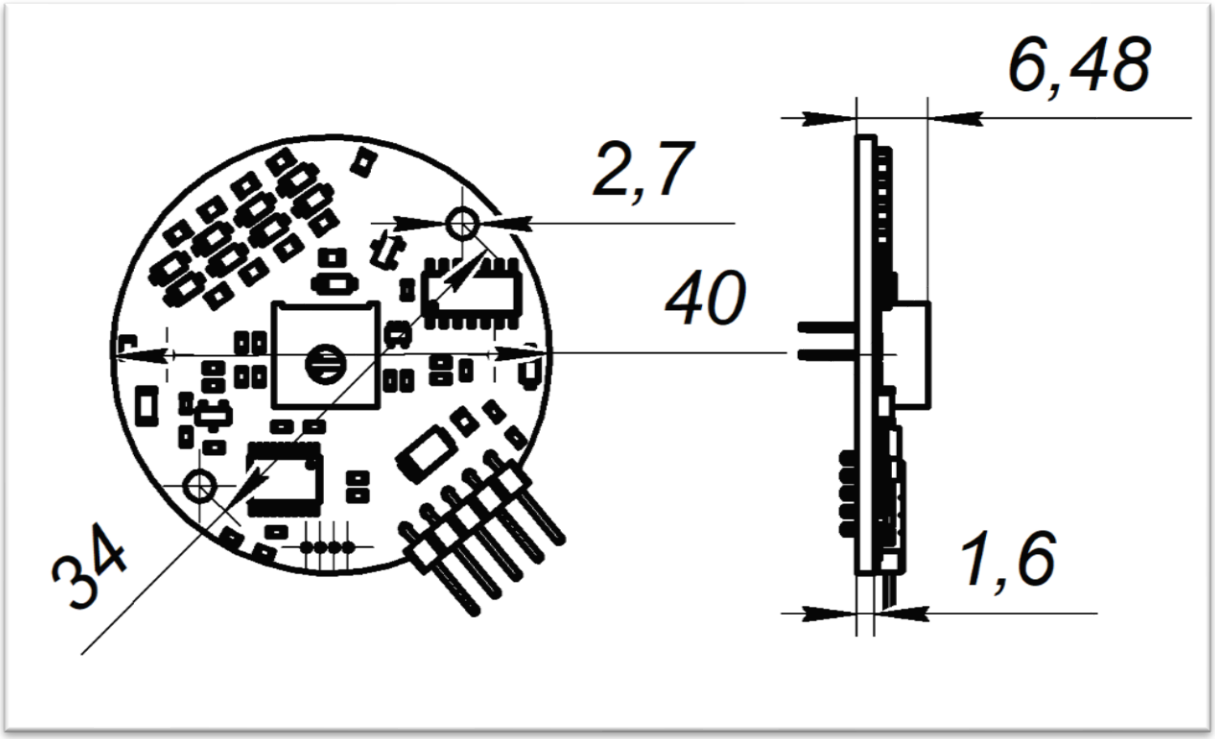
8 Connection socket

The module is equipped with a standard "Arduino" connector "PLS-5," with the mating part "PBS-5." The pinout of the connector is listed 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	Registered pulses output (see section 4.3.2)

Table 4 (connection socket)

9 Device drawing



10 Reference

Contact and additional information are presented in the table below.

Description	Link
Manufacturer's Website	http://climateguard.info/
Library for working with the module	https://github.com/climateguard/CG-hv-gen
Telegram community	https://t.me/climateguard_community