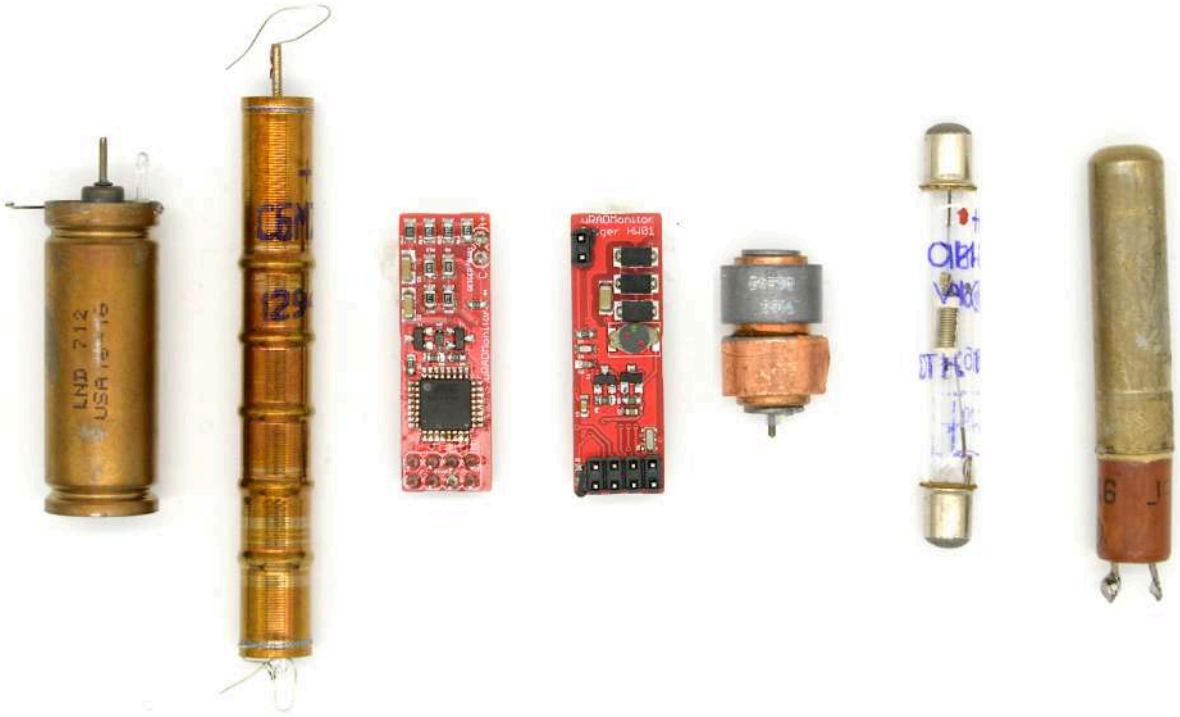
uRADMonitor® Geiger Module

Easy Radiation sensing

Geiger Muller digital tube driver with Serial Interface Output



Features

- Integrated digital High Voltage supply, with adjustable output
- Integrated , high frequency digital pulse counter
- Integrated digital clock with precise error correction using 14.7MHz built in resonator for milisecond accuracy
- Digital UART output for convenient integration to a host microcontroler
- Small size and weight 37x12x5 mm , only 2.9grams

Applications

- Radiation Sensors and Dosimeters
- Drones and Robots
- System Integrators
- DIY and Educational projects

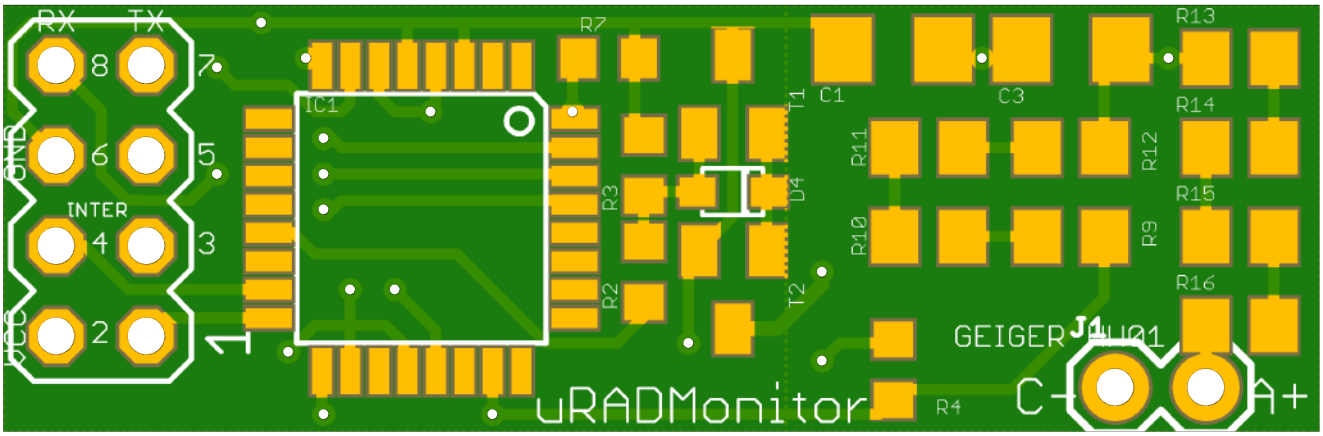
Description

The uRADMonitor® Geiger Module opens the easy path to Radiation Sensing! This is a compact radiation sensor board of only 37x12mm, fully digital and easy to integrate in any project. Is a complete Geiger-Muller tube driver module with UART communication to a host microcontroller. The module contains an adjustable, regulated, digital high voltage inverter (default set to 380V, max up to 1000V), a digital pulse counter, a precise - crystal based time counter and a serial communication interface. Add radiation sensing functionality to your project in no time, without having to worry about the complicated Geiger Counter electronics. You just get the CPM value on the serial port in seconds. Ideal for drones, robots and compact portable Radiation Dosimeters. A huge variety of Geiger tubes is supported, of various types and voltages.

Wiring diagram

This section will help you connect the module to your circuit. The board comes with two connectors that can be soldered to your main PCB . Alternatively, for quick tests, you can also use jumping wires.

Attention! The Geiger Tube terminals, marked C- and A+ are connected to the high voltage generator and can shock you. This is not dangerous, although the voltage is high, the current is very small, but may be unpleasant especially if you are not expecting it. Caution in handling must be exercise. We cannot be held responsible and accept no responsibility for the way the modules are handled and used.



There are two connectors that you will use. Connector one, an eight pin 2x4 header connector with male pins and Connector two, going directly to the Geiger tube which is a 2 pin header connector with male pins.

Design note: the connections from C- and A+ to your Geiger tube should be as short as possible, to reduce any extra capacitance. Careful design is recommended.

Pin number	Description	Parameters
2	VCC positive voltage + in to power the module	3.3V to 5V max
6	Ground	
7	Module UART TX, that periodically outputs the payload	9600bps
8	UART RX, for incoming configuration messages	9600bps
C-	Connect this to Geiger Tube Cathode (-)	high voltage
A+	Connect this to Geiger Tube Anode (+)	high voltage

Data protocol

The **uRADMonitor®** Geiger Module can be configured via UART commands, so consider bidirectional communication to/from your host microcontroller. On minimal designs where the default parameters are convenient, you can only use the Module's TX line only.

Design note: by default, the Geiger Module has no warmup time configured because it doesn't need it, and will start working immediately after it is powered up. The module supports intermitent power interruptions, if this is required by a power-saving design. The device can be controlled via a P-CH simple switch, to limit power consumption of the system. The only requirement is to keep the VCC power supply line (pin 2) in the right interval (3.3V to 5V) . A direct connection to a LiPo battery (4.2V) will work just fine , the module has an internal voltage reference and can use any random voltage value to work. Do not exceed 5V under any circumstances.

After it is powered up, the module will output on the TX line, **every 10 seconds,** a sequence of 17 bytes, containing the radiation dose in CPM and other technical parameters as follows:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Starting Byte	Starting Byte	Local time Byte 1 uint32_t (sec)	Local time Byte 2 uint32_t (sec)	Local time Byte 3 uint32_t (sec)	Local time Byte 4 uint32_t (sec)
0xB0	0xB1	0xXX	0xXX	0xXX	0xXX
Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
CPM Byte 1 uint32_t (cpm)	CPM Byte 2 uint32_t (cpm)	CPM Byte 3 uint32_t (cpm)	CPM Byte 4 uint32_t (cpm)	High voltageByte1 uint16_t (volts)	High voltageByte2 uint16_t (volts)
0xXX	0xXX	0xXX	0xXX	0xXX	0xXX
Byte 12	Byte 13	Byte 14	Byte 15	Byte 16	
Inverter DutyByte1 uint16_t (per mille)	Inverter DutyByte2 uint16_t (per mille)	Inverter FreqByte1 uint16_t (Hz)	Inverter FreqByte2 uint16_t (Hz)	CRC Checksum uint8_t	
0xXX	0xXX	0xXX	0xXX	0xXX	

The code to decode this payload is part of the Github project page. For convenience, here is the relevant part :
The Data Structure that you'll need:

```
class GEIGERMODULE {

    uint8_t buffer[17];
    uint8_t index;
    uint32_t timelocal, cpm;
    uint16_t voltage, duty, freq;

public:
    GEIGERMODULE() {
        timelocal = 0;
        cpm = 0;
        voltage = 0;
        duty = 0;
        freq = 0;
        index = 0;
    }
```

The serial data parser:

```
void GEIGERMODULE::parsedata() {
    timelocal = (buffer[2] << 24) |  (buffer[3] << 16) |  (buffer[4] << 8) | buffer[5];
    cpm = (buffer[6] << 24) |  (buffer[7] << 16) |  (buffer[8] << 8) | buffer[9];
    voltage =  (buffer[10] << 8) | buffer[11];
    duty =  (buffer[12] << 8) | buffer[13];
    freq =  (buffer[14] << 8) | buffer[15];
}
```

Timelocal is the number of seconds elapsed since the module was powered on.
CPM is the counts per minute radiation reading, computed from the tube pulse counter value and the internal clock.
Voltage is the high Voltage inverter output value in Volts. By default this is set to 380V and regulated automatically.
Duty, is the switching inverter PWM driver duty cycle . The duty cycle changes automatically, to keep the output voltage fixed on the target voltage.
Freq is the frequency of the PWM driver signal for the High Voltage inverter, in Hertz.

The checksum is used to make sure the data you receive is correct and uncorrupted. Should the CRC fail, discard the values until the next buffer of 17 bytes is received. To compute the CRC, you can use this code:

```
bool GEIGERMODULE::checksum() {
    if (index != 16) return false;
    uint8_t checksum = 0xFF;
    for (uint8_t i = 0; i < 16; i++)
        checksum -= buffer[i];
    return ((checksum +1) == buffer[16]) ;
}
```

To do an approximate conversion of the CPM values to equivalent dose rate in uSv/h , the tube type (geometry) must be take into account. Knowing the tube, you can use the following factors and the formula Dose_eq = CPM x Factor :

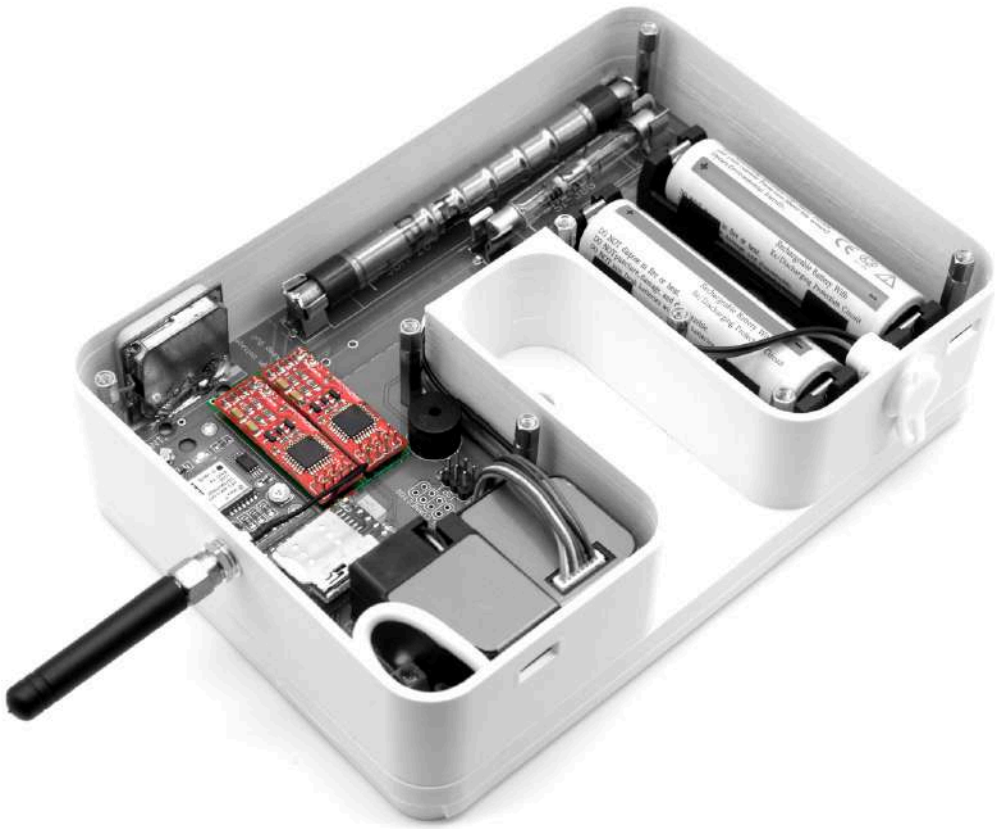
```
float aux_detectorFactor(uint8_t param) {
    switch (param) {
        case GEIGER_TUBE_SBM20:     return 0.006315; // CPM 19
        case GEIGER_TUBE_SI29BG:    return 0.010000; // CPM 12
        case GEIGER_TUBE_SBM19:     return 0.001500; // CPM 80
        case GEIGER_TUBE_LND712:    return 0.005940; // CPM 20.20
        case GEIGER_TUBE_SBM20M:    return 0.013333; // CPM 9
        case GEIGER_TUBE_SI22G:     return 0.001714; // CPM 70
        case GEIGER_TUBE_STS5:      return 0.006666; // CPM 18
        case GEIGER_TUBE_SI3BG:     return 0.631578; // CPM 0.19
        case GEIGER_TUBE_SBM21:     return 0.048000; // CPM 2.5
        case GEIGER_TUBE_SBT9:      return 0.010900; // CPM 11
        case GEIGER_TUBE_SI1G:      return 0.006000; // CPM 20
        case GEIGER_TUBE_SI8B:      return 0.001108; //
        case GEIGER_TUBE_SBT10A:    return 0.001105; //
        case GEIGER_TUBE_J305:      return 0.008120;
        case GEIGER_TUBE_M4011:     return 0.006623;
        default: 0;
    }
}
```

Usage conditions

- **Power supply**
  Use a noise-free supply between 3.3V to 5V . Do not exceed 5V as you will damage the module
- **Precautions**
  Do not expose the module to environments with high humidity without proper additional protection.

Examples

The uRADMonitor® B1 , our solar powered, autonomous Radiation Sensor, uses two Geiger Modules to drive two Geiger tubes for redundancy:



Warranty

uRADMonitor® Geiger Module A4 is covered by a 12 months warranty for any defects in material or workmanship, under normal use.