

# Low-cost Radiation Sensor Network

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## Abstract

A novel radiation sensor network has been developed for monitoring radioactive events in real-time. The sensor nodes consist of low-cost Geiger tubes which are read out using AVR microcontroller with a 2.4 GHz wireless interface. The receiver node is implemented with a Raspberry PI which provides the database interface and the network with other servers.

*Keywords:* Keyword1, Keyword2, Keyword3

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## 1. Introduction

## 2. Sensor Node Design and Implementation

A sensor node consists of a radiation sensor (i.e. Geiger tube), a power supply unit and readout circuit, a microcontroller and a wireless transceiver as shown in Figure 1. The microcontroller is a 8-bit RISC-based AVR (ATtiny2313) made by Atmel and is programmed in C for controlling Geiger tube high voltage, signal readout and wireless communication.

In the current design, we pick a Geiger tube (SBM-20) made by VNIITFA company in Russia. The stainless steel Geiger tube is filled with a mixture of Ne + Br<sub>2</sub> + Ar gases and has a dimension of 108 mm in length and 11 mm in diameter. Its operating high voltage is 350 - 475 volts (the recommended voltage is 400 volts). The tube life is about at least  $2 \times 10^{10}$  pulses and has a dead time of 190  $\mu$ s. The Geiger tube high voltage power supply is designed as a DC-to-DC boost converter as shown in Figure 2 for reducing both the cost and physical dimensions. The high voltage output can be programmed with the onboard microcontroller (ATtiny2313).

## 3. Receiver Node Design and Implementation

The receiver node consists of the same wireless transceiver and a host computer (i.e., Raspberry PI). An updated installation of Arch Linux and the "bcm2835" class (required for communication of GPIO pins) and the SPI connection seen in Figure 6 allow the mini computer to receive data.

## 4. Sensor Network Integration

## 5. Results and Summary

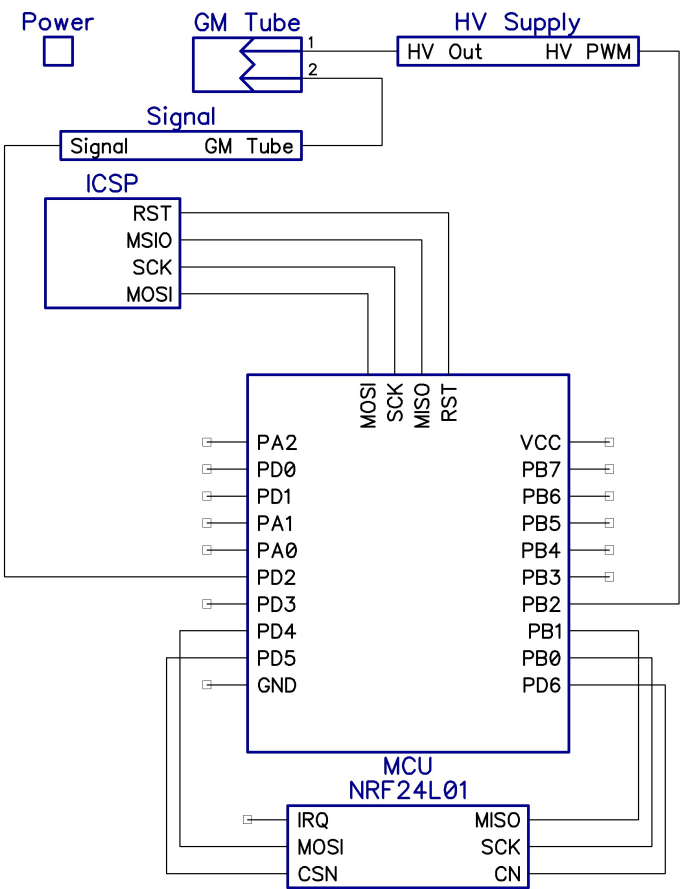


Figure 1. Sensor node assembly

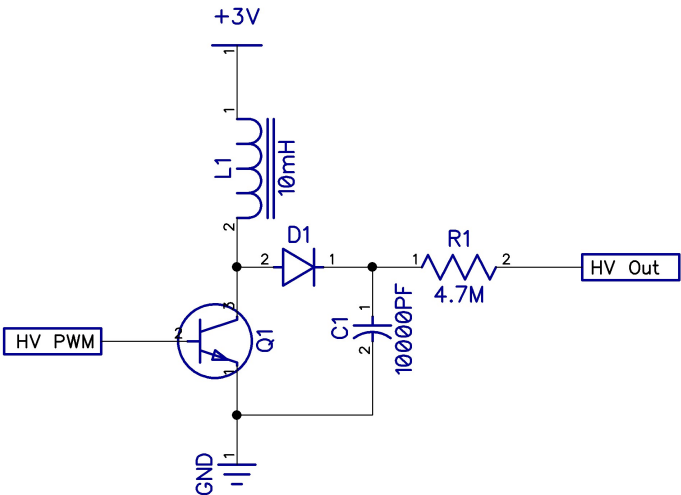


Figure 2. High voltage power supply circuit design for the Geiger tube.

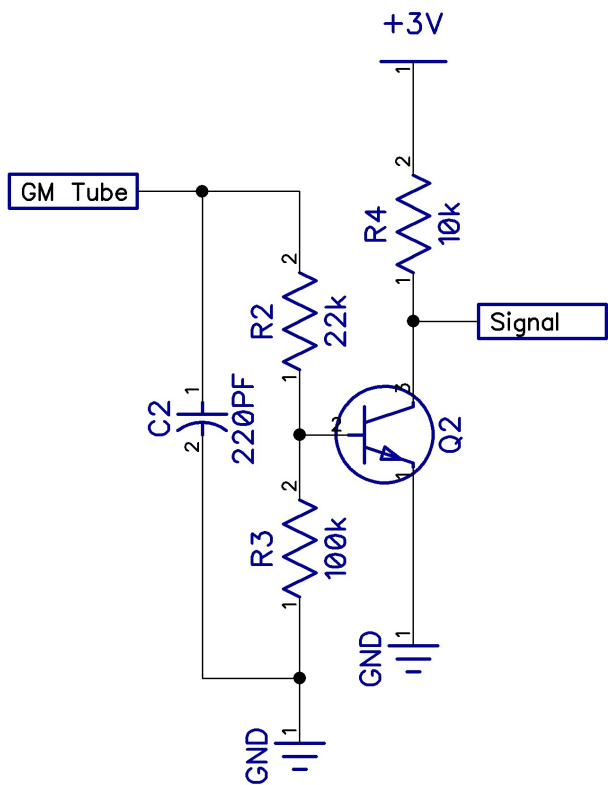


Figure 3. Digital signal output

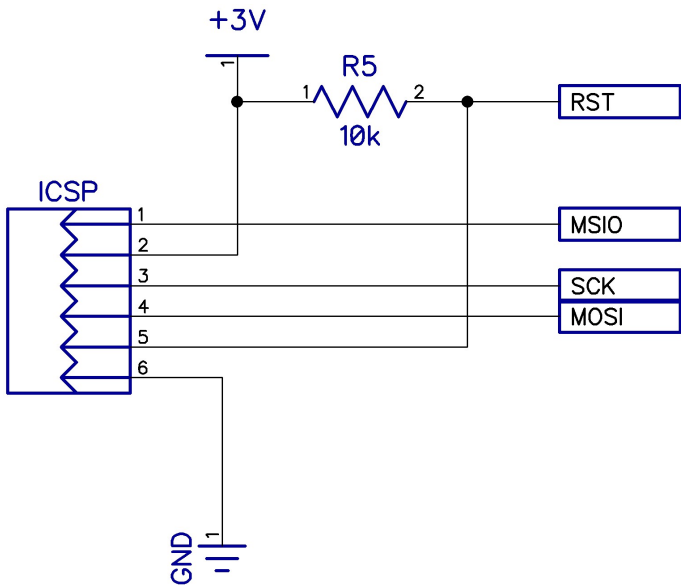


Figure 4. Header

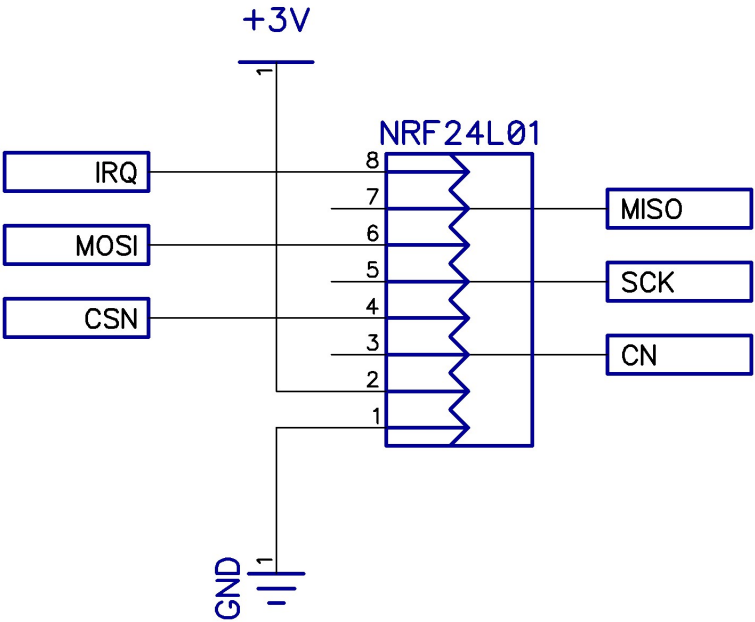


Figure 5. Wireless module interface circuit.

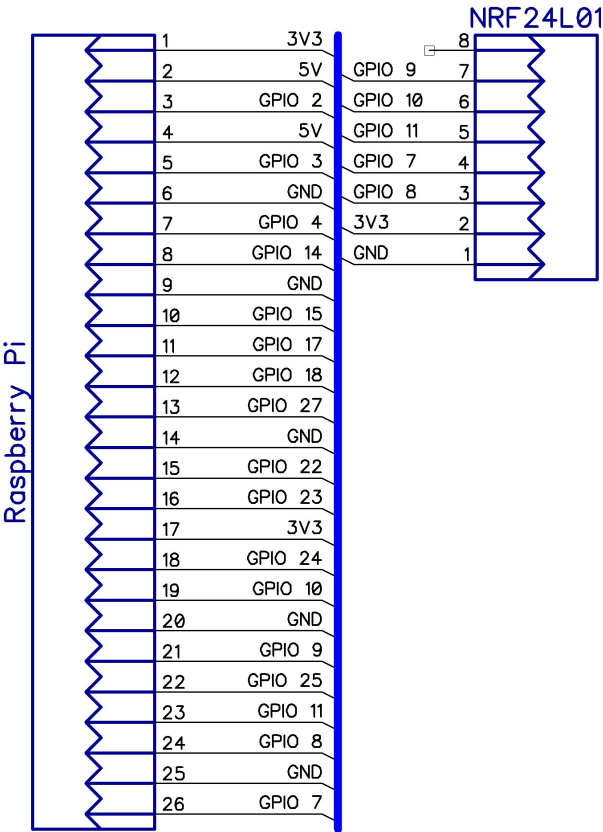


Figure 6. Wireless module interface with Raspberry PI.

## **References**

- [1] J. van der Geer, J.A.J. Hanraads, R.A. Lupton, J. Sci. Commun. 163 (2000) 5159.
- [2] W. Strunk Jr., E.B. White, The Elements of Style, third ed., Macmillan, New York, 1979.

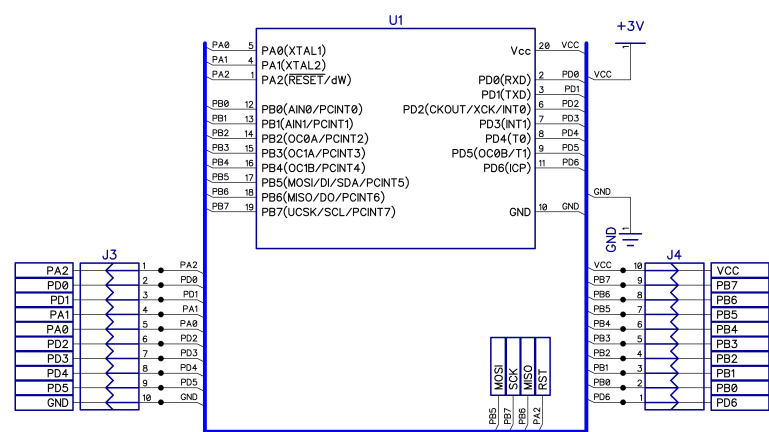


Figure .7. Atmel Microcontroller of the sensor node.

Schematic Diagrams