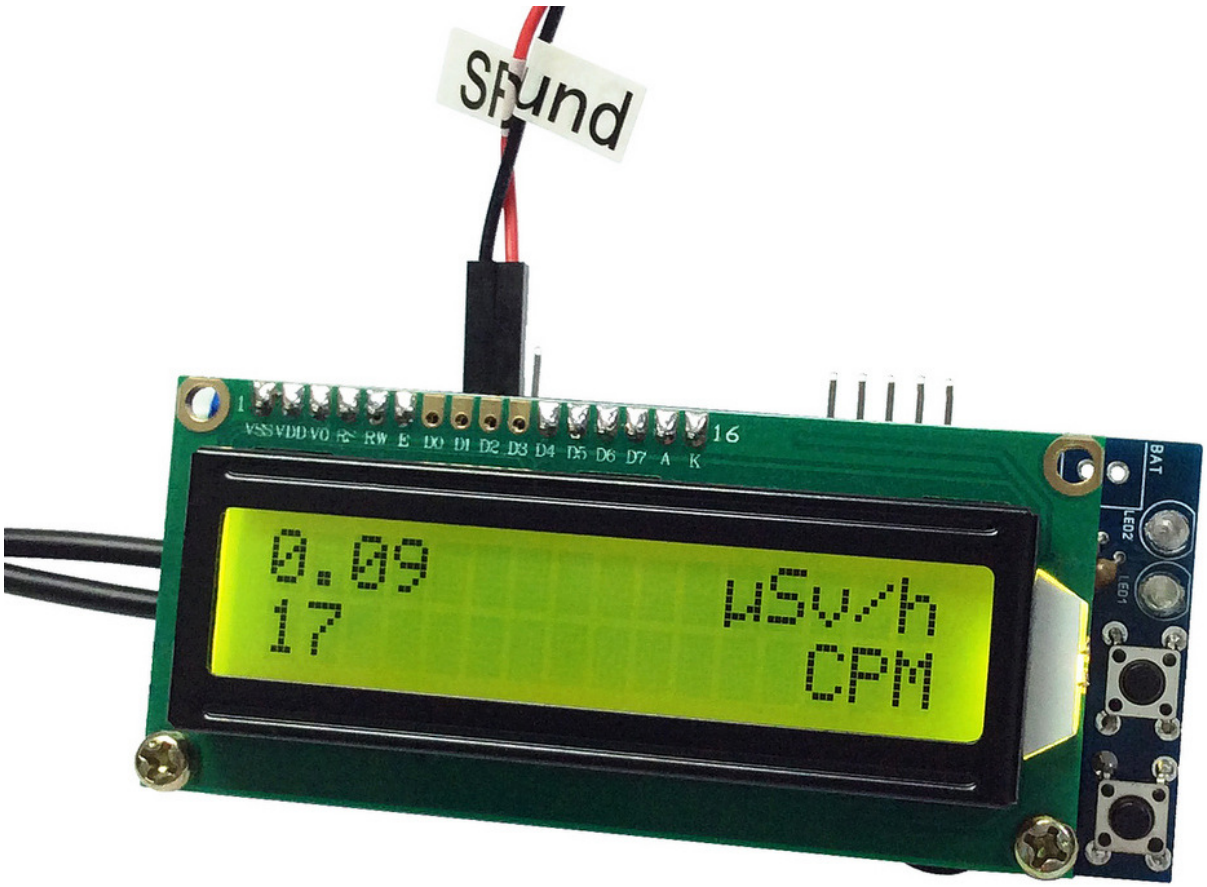
Arduino IDE Geiger Counter

DIY Kit ver. 2.00

RH-K-GK-2-A



http://rhelectronics.net

This is ver.2.00 second edition of Geiger project based on Arduino IDE manufactured by RH Electronics http://rhelectronics.net

The document you are reading is describes main board model with SKU RH-K-GK-2-A.

RH-K-GK-2-A: kit includes main board with LCD. This model compatible with 400V GM tubes and has full support of 500V GM tubes.
Take note, the project IS NOT PIN TO PIN COMPATIBLE with previous edition ver.1.00 RH-K-GK-1-A!

RH-K-GK-2-A High Voltage with PWM: improved version of High Voltage converter. Now it has true voltage feedback and HV regulation that fully controlled by precision microprocessor functions. HV output is set with jumper to select 450V or 500V output. **HV converter is able to drive 500V into 20Mega ohm resistive load.** With a good quality GM tube you can go up to maximum CPS counting with high activity radiation sources.

CPM counter with moving average and recalculation on rapid changes.

Dose Rate counter with calibration through source code. Dose displayed in uSv/h units.

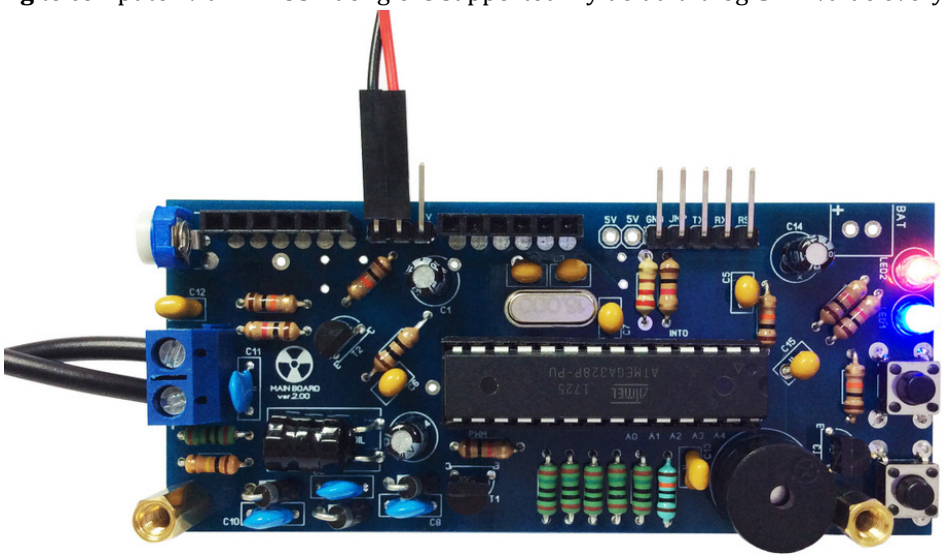
CPS counter mode with fast Bargraph Unique bargraph that allows usage on low activity sources and on high levels of detection. Intended to work with sensitive pancake GM tubes or externally supplied scintillation probes.

Buttons functions "B1" switch between CPM Dose Rate counter and CPS display with fast bargraph. "B2" button uses to mute buzzer.

Two LED's and Buzzer: one LED is used to visualize Geiger Counter. Second LED works as an alert warning. You can change configuration in software. Buzzer sounds as a nice old-style Geiger Counter clicker. You can mute sound for silent work.

Beginner friendly Arduino IDE: The kit comes with pre-programmed Atmega-328A microcontroller with installed Arduino UNO bootloader and loaded sketch of geiger.ino Please contact our support email to get the link for source code download if you need.

UART logging to computer via TTL-USB dongle is supported. By default it log **CPM** value every 10 seconds.



Soldering the Kit:

Kit assembling require decent soldering skills, if you not sure how to solder please consider purchasing soldered board.

Before you start soldering the main board please follow components list table. Main-Board parts are DIP through-hole easy to solder. Some components has polarity, please refer electrical circuit and pcb silkscreen.

Package includes printed electrical circuit. Keep it in front of you during the soldering for easy reference.

Remember, do clean solder work and install right components in the right place. It is always hard to unsolder components from the PCB. Use a solder with Rosin Core Flux. Take your time when performing solder work. It may take about 2 hours to complete the kit, depend on your skills.

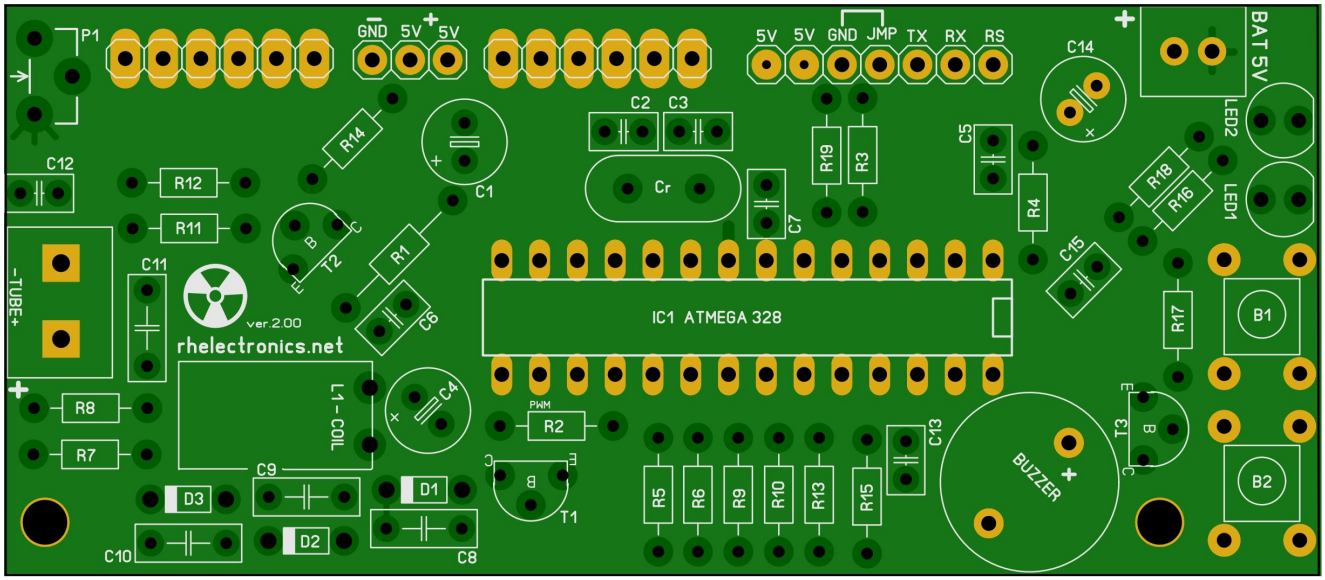
Do not apply too much solder. A good joint should look like:

We advise you to use 0.8mm or 1.00mm thickness lead solder wire with low melt point, such as:

60/40 – 186 Celsius (386 Fahrenheit)

63/37 – 183 Celsius (361 Fahrenheit)

After finishing soldering WASH PCB with Flux Remover or Isopropyl



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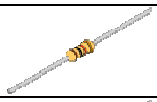
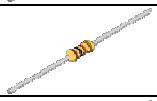
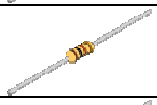
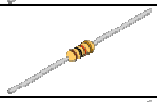
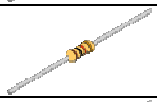
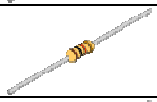
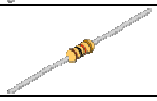
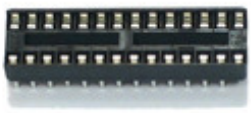
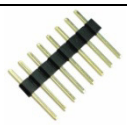
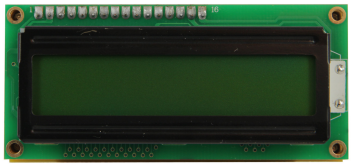
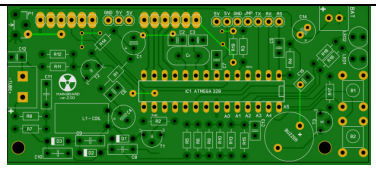
	R1	1	10 ohm	¼ W resistor
	R2,R3,R11,R16,R18	5	1K ohm	¼ W resistor
	R4,R12,R14,R17	4	10K ohm	¼ W resistor
	R19	1	220 ohm	¼ W resistor
	R7	1	100K ohm	¼ W resistor
	R15	1	100K ohm 1%	¼ W resistor
	R5,R6,R8,R9,R10,R13	6	10M ohm 1%	¼ W resistor
	P1	1	10K ohm	LCD contrast trimmer
	C5,C6,C7,C15	4	100nF	Ceramic Capacitor (104)
	C12,C13	2	100pF or 150pF	Ceramic Capacitor (101)
	C2,C3	2	22pF	Ceramic Capacitor (220)
	C8,C9,C10,C11	4	10nF	HV Capacitor
	C1,C4,C14	3	100uF	Electrolytic Capacitor, has polarity
	D1,D2,D3	3	1N4937	Fast Rectifier Diode, has polarity
	LED1,LED2	2	LED	3mm LED, has polarity

	**L1**	**1**	**10mH**	**Radial Inductor**
	**Cr**	**1**	**16MHz**	**Crystal HS-49S**
	**Buzzer**	**1**	**5V**	**Has polarity**
	**Socket**	**1**	**DIP 28**	**IC socket**
	**Connector**	**1**	**Terminal Block**	**Tube connector**
	**S1, S2**	**2**	**Tact Switch**	**B1, B2 Buttons**
	**Connector**	**2**	**6 Pin Female**	**LCD connector**
	**Connector**	**8 Pins**	**Male Right Angle**	**Peripheral connector**
	**Connecter**	**12 Pins**	**Male**	**LCD Connector**
	**Jumper Cup**	**1**	**Jumper**	**Switch PWM 450V/500V**
	**Standoff**	**2**	**M3**	**LCD Standoff**
	**Screw**	**4**	**M3**	**LCD Screw**
	**IC1**	**1**	**Atmega 328A**	**Microcontroller with Bootloader**

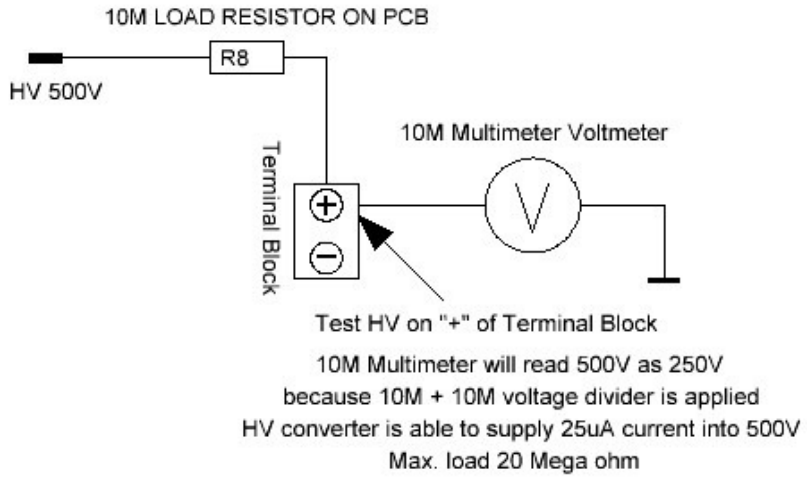
	**T1**	**1**	**MPSA44 KSP44**	**HV NPN Transistor, has polarity**
	**T2,T3**	**2**	**2N3904**	**NPN Transistor, has polarity**
	**LCD**	**1**	**16x2**	**HD44780**
	**PCB**	**1**	**89x38mm**	**Main Board**

High Voltage check and setup:

Jumper ON: for 500V tube
Jumper OFF: for 400V tube

Initial PWM setup is located in configurator.h file, change it if you need. Default settings should work fine. We are NOT recommend to setup HV above 600V for this kit, for your safety.

To measure high voltage you can use 10M multimeter or 100M high impedance probe. 100M is recommended. The kit has installed 10M tube load resistor, so if you apply 10M multimeter on terminal block output then the whole chain will work as a voltage divider. It mean 500V will read as 250V.



However, if you use 100M or 1G probe then you can recalculate correct display value as:

Vout = Vread* ((Rdivider + Rvoltmeter)/Rvoltmeter)

Geiger Tube settings:

Set in configurator.h file:

// GM Tube setting
#define FACTOR_USV 0.0057 // Sieverts Conversion Factor, known value from tube datasheet

TUBE	HV value	Jumper	Gamma Factor	Max.Tested CPM
SBM-20 / STS - 5	400V	OFF	0.0057	300K
SBM - 19	400V	OFF	0.0021	unknown
SI29-BG	400V	OFF	0.0082	unknown
SBT-11A	400V	OFF	0.0031	450K
SBT-9	400V	OFF	0.0117	unknown
SI-180G	400V	OFF	unknown	230K
LND-712	500V	ON	0.0081	300K
LND-7312	500V	ON	0.0030	550K

The maximum tested CPM value is for reference only, tested with Strontium-90 Yttrium-90 radiation source. Gamma factor is for gamma radiation dose rate only and not applicable for beta/alpha. These values are default, but calibration may be required for scientific measurements.

Many samples of old stock tubes has gas discharge defect that not allow to use these tubes at maximum count rate load. We have in stock tested samples of SBM-20 tube. If you purchase your tube through third side suppliers we cannot guarantee correct count rate.

Troubleshooting:

With correct soldering preformed, the kit should work fine and no need special adjustments. However, if you have technical issues please review this chapter:

1. Check with printed circuit and installation diagram that you soldered everything correctly and with proper polarity.
2. Wash the PCB with flux remover or isoprophyl, remove solder dust with antistatic brush
3. Check that you connect 5V power with correct polarity
4. Adjust LCD contrast with 10K trimmer
5. If processor does not start: **A.** check that 22pF are not mixed with 100nF or 100pF **B.** replace 16MHz crystal **C.** try to re-program the chip
6. If tube has no count: **A.** check jumper position for correct setup 450V or 500V. **B.** check high voltage as described below. **C.** replace the tube

Warranty:

The kit is intended for educational purpose only, do not rely on it in real hazardous situations. Electrical circuit evolved with high voltage, you are fully responsible for any possible high voltage injury, use at your own risk.
We recommend this board only for experienced makers who know how to use electrical boards with high voltage.

Support contacts and source files:

If you need source files or have technical issues please contact us by email with your order number:
support@rhelectronics.net

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