

theremino
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Theremino **System**

Electronics of the Ion Chamber

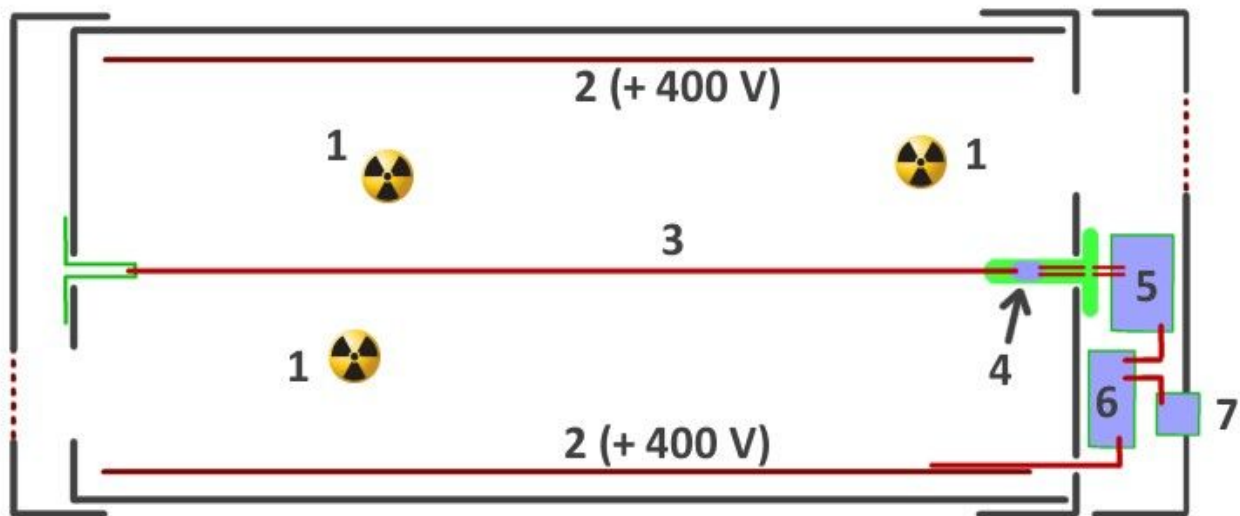
Preliminary Document



Making detailed pictures, takes a long time. It may take several weeks to have this document finished. We decided to publish it anyway, to give an idea on how the electronics are made.

Only the electrical diagrams are still available, without any explanation. The electronics experts can certainly begin the construction, all the important information is there already.

Functional Wiring Diagram

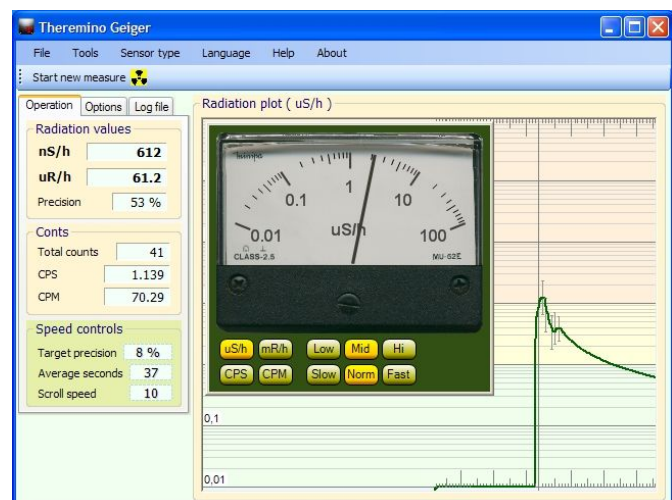


Each disintegration of Radon **(1)** ionizes the air and produces thousands of electron-ion pairs.

The strong electric field present in the chamber, quickly attracts the ions towards the central electrode **(3)** and the electrons towards the coating **(2)**. In a few milliseconds, all the electrons and positive ions produced by the disintegration, pass through the FET **(4)** and the high voltage generator **(6)**, recombining in the amplifier **(5)**

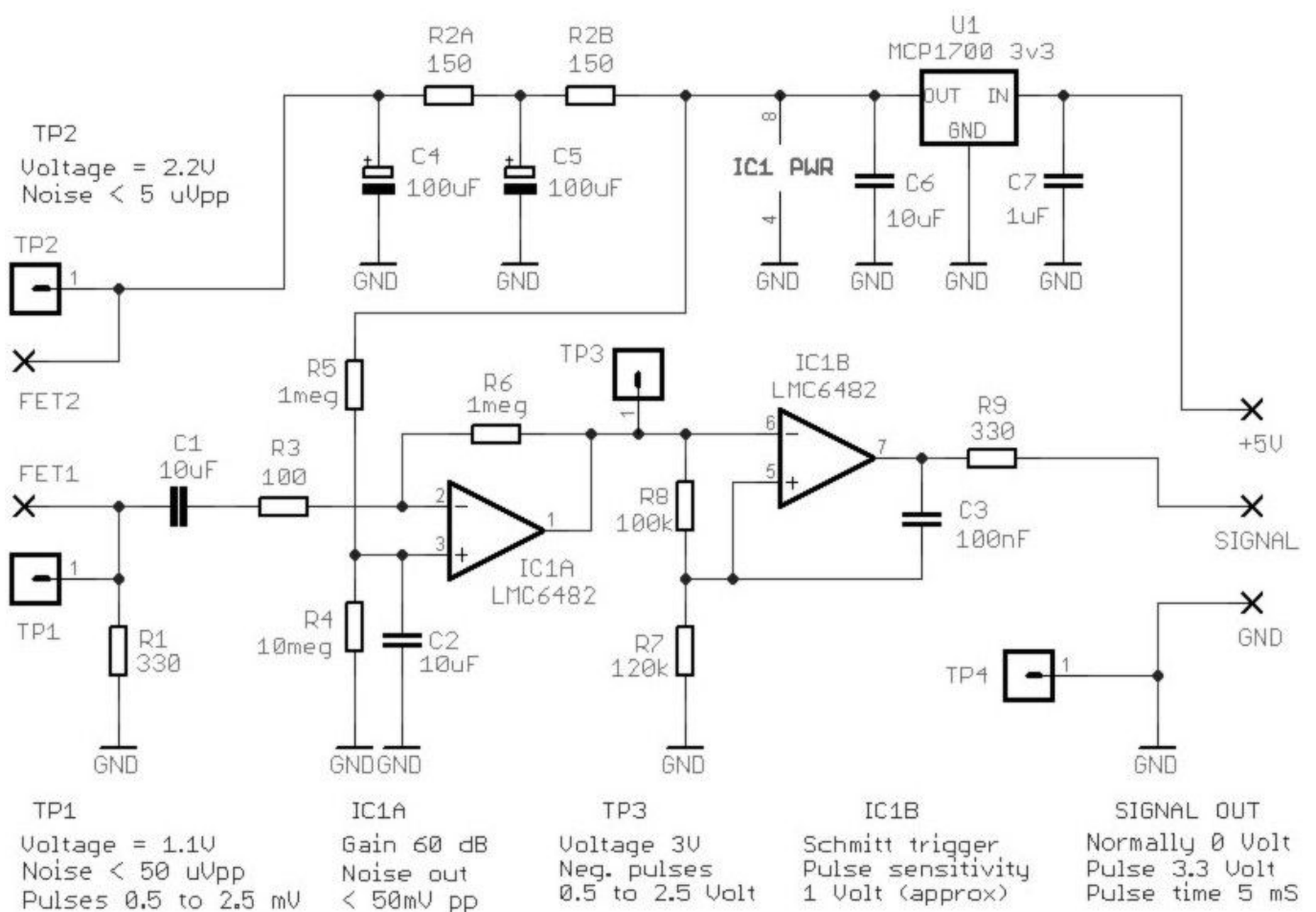
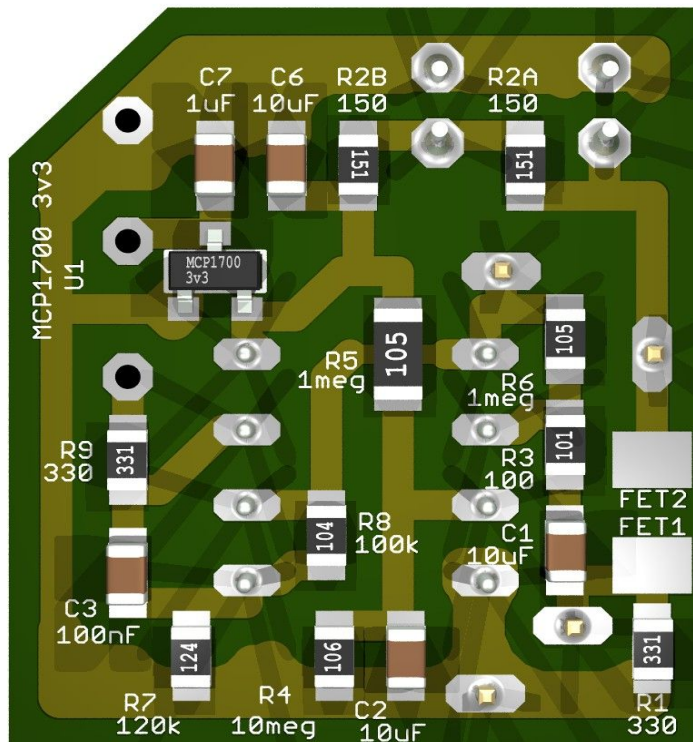
The amplifier and pulse width discriminator **(5)** discard low energy pulses (less than 2 MeV), focusing on the alpha disintegrations, produced by radon and its descendants.

The output connector **(7)** can be connected directly to a standard PIN connector. A Theremino_Master module is used, providing the power for the ion chamber and sending the counts to Theremino_Geiger software, via USB.

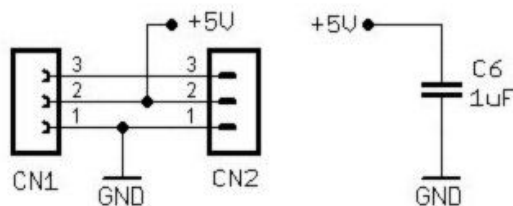
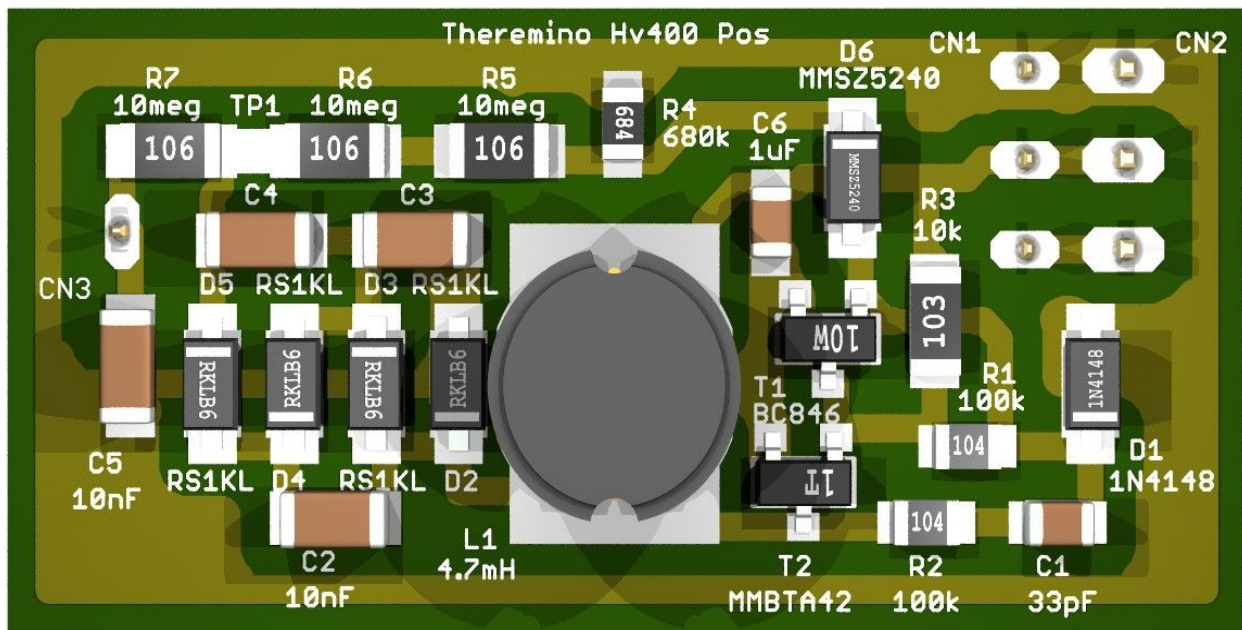


A single Master can feed up to six ion chambers, with connections of hundreds of meters long, collecting all of the data. Some of the six chambers, may also be replaced with Geiger probes for Alpha, Beta and Gamma rays or with environmental sensors, for millimeters of rain, temperature or humidity.

Diagram of the amplifier

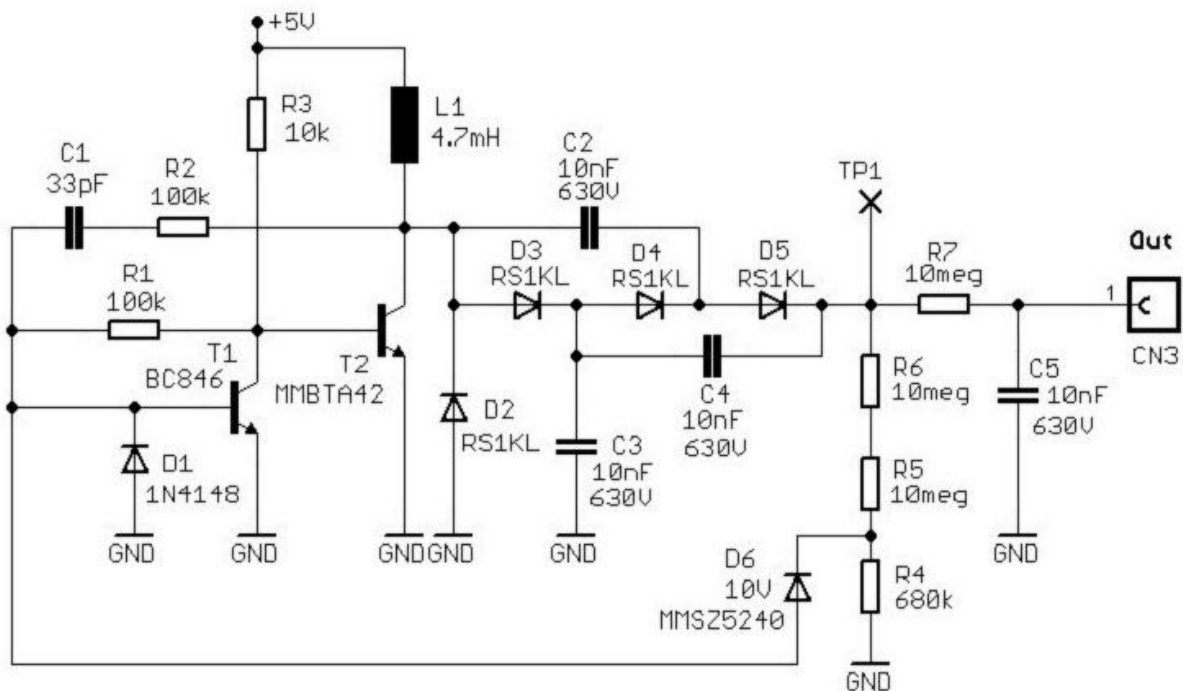


Scheme of the high voltage generator



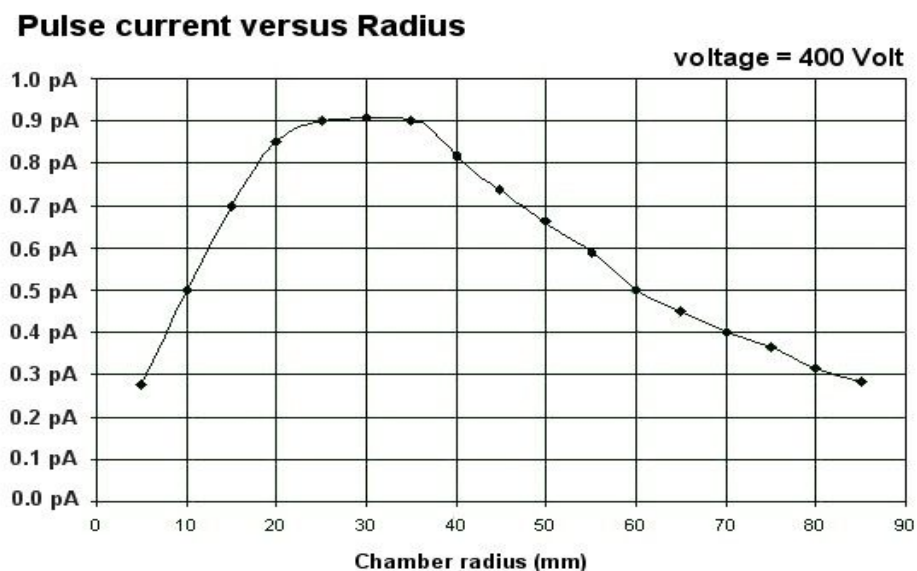
Theremino - Hv400_Pos

Supply voltage: 3.5 to 6V
Supply current: 3 to 5mA



Room size and electric field

The literature on ion chambers, indicates that to obtain the maximum electrical signal, the radius of the ion chamber, must be of at least 30 millimeters (comparable to the average path of the alpha rays in the air) while the electric field, must be of at least 100 volts per centimeter. These two parameters, are clearly visible in the next picture.



To check this we have done the following test:

Chamber voltage (1)	Pulse Volt/cm (2)	Pulse voltage	Rise time
10 Volt	2	0.4 Volt	20 mS
20 Volt	4	0.6 Volt	15 mS
50 Volt	10	1.1 Volt	8 ms
100 Volt	20	1.2 Volt	4 mS
150 Volt	30	1.5 Volt	3 mS
200 Volt	40	1.5 Volt	2 mS
300 Volt	60	1.6 Volt	2 mS
500 Volt	100	1.8 Volt	1 mS
800 Volt	160	1.9 Volt	1 mS

(1) chamber radius = 50 mm

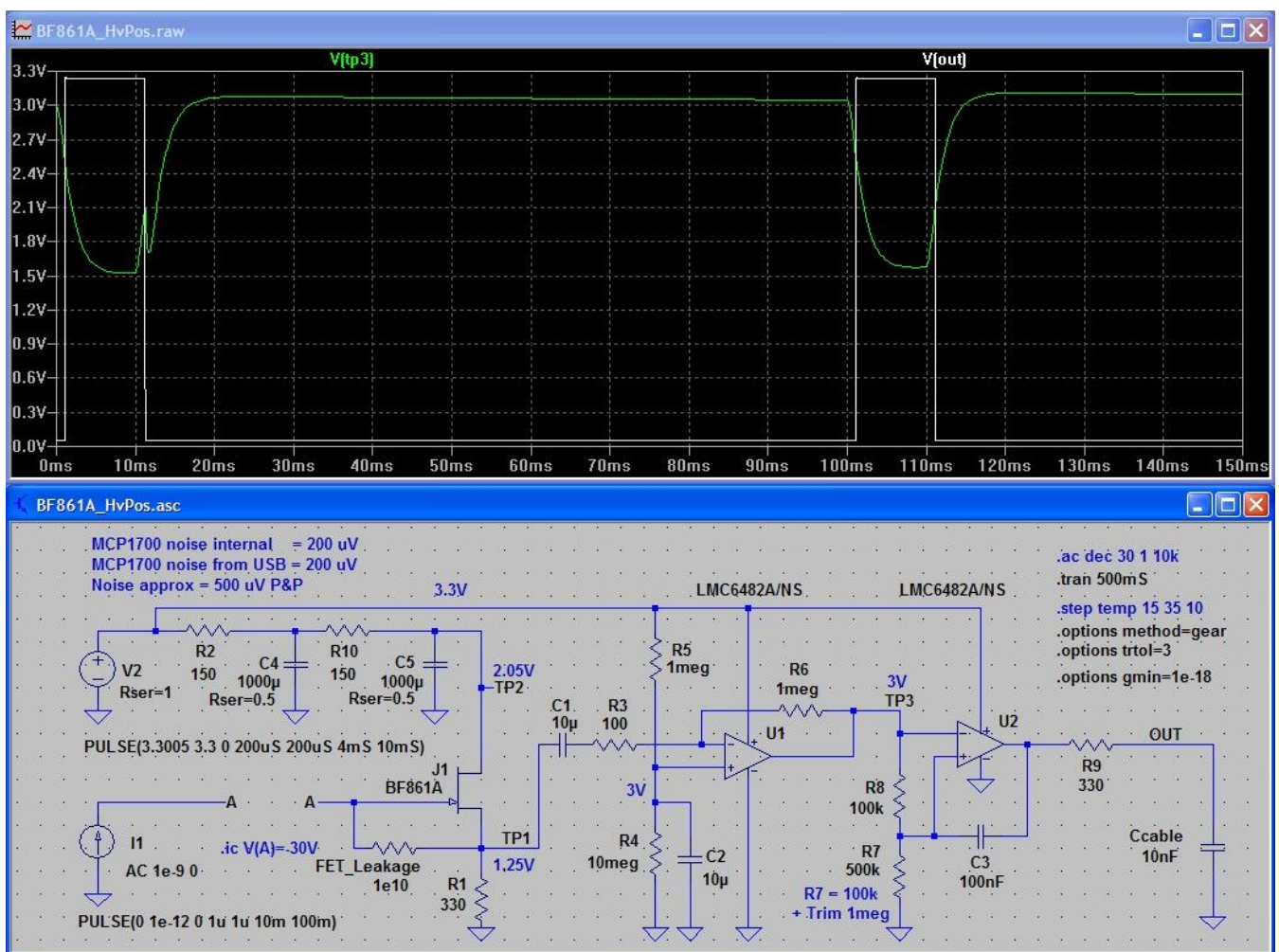
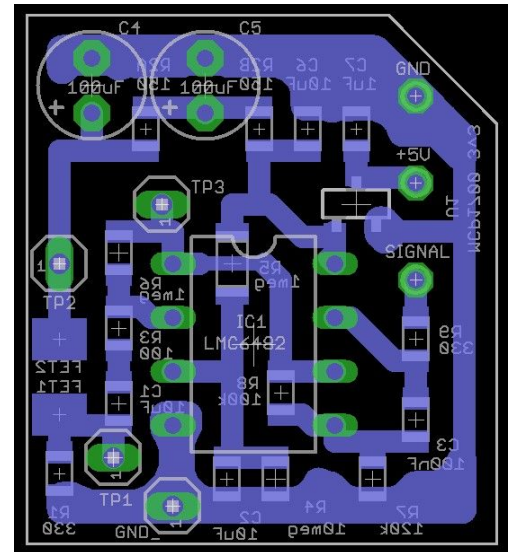
(2) voltage amplified by 1000

As we decided to use an electric field of 100 volts per centimeter, being the radius of our chamber 4 cm, the voltage should be around 400 volts.

Simulations and printed circuits

In the file: "Theremino_IonChamber_PCB.zip" are available wiring diagrams and PCB in Eagle format, Eagle3D renderings and electrical simulations in LTSpice format.

The latest version of this file can be downloaded here:
www.theremino.com/files/Theremino_IonChamber_PCB.zip



Under construction

