EMP-µSensor V1.x

DEVICE : EMP µSensor V1.x

FEATURES : Detecting high energy ElectroMagnetic Pulses

APPLICATIONS : Detecting lightning and other types of high energy discharges

QUICK STARTERS
- For pin-connections, check page 3
- For reference schematics, check page 7
- Cadsoft Eagle library available at : https://www.smdking.com/PDF/smdking.lbr

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INFO

With 4 years of thorough research and testing several prototypes at SMDking, we proudly present the expansion for the product-range of EMP-sensors : EMP µ Sensor (EMP micro Sensor).
This tiny sensor can be used for a variety of use :

- **Outdoor events**
  Early warning system for any outdoor sports, like golf, football, soccer, hockey, tennis etc.

- **Domotics**
  Warningsystem for upcomming storms , in order to shut down / activate devices or closing windows etc.

- **Scientific experiments**
  Detecting EMP's for analysis-purposes, like locating the impact of lighting by multiple sensors, or figuring out how lighting works.

- **Photography**
  The sublime way to catch a lighting-event by camera, when triggered by this EMP-sensor. Can also be used as trigger for other events, like activating multiple flash-lights.

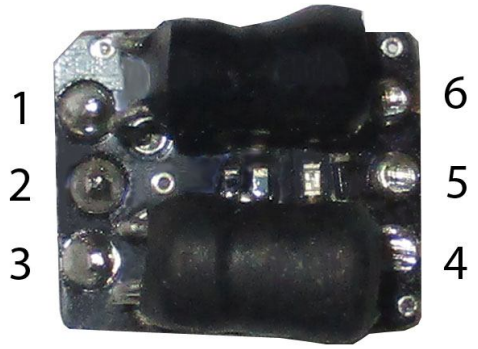
- **Arduino experiments**
  For the hobbyists who are interested in weather-conditions or detecting other types of EMP-sources.

- **Weather stations**
  Next to rain,- barometric,- temperature,- moisture-sensors, a lighting detector can be included.

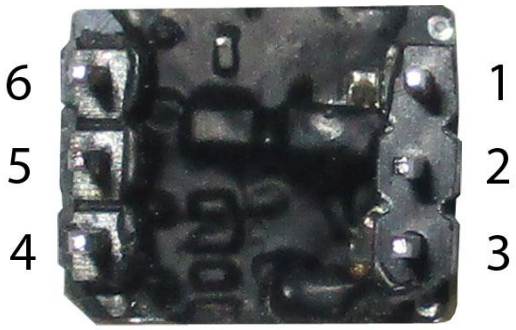
SPECIFICATIONS

Package	: DIP-6 (2x3 pins)	
Input Voltage (Vcc)	: 3.3V to 5.0V DC	
Input Current	: 27 µA to 3.5 mA at 3.0V / 142 µA to 5 mA at 5V DC	
Dimensions (incl pins)	: 12.5 x 10.5 x 15 mm / 0.49 x 0.41 x 0.59 inch (W x L x H)	
Weight	: 1.4 gram / 0.05 ounce	
Pinning	: 1 = Antenna (marking)	6 = Vcc (3.3V to 5 V DC)
	2 = NC	5 = Digital inverted output (sourcing < 12.5 mA)
	3 = Gnd	4 = Analog output
Detection range	: Lighting upto 30 km / 20 miles away	

PINNING



TOP view



BOTTOM view

Pin 1 : Antenna. Connect an antenna to pick up EMPs. Should be at least 70 cm (27.5 inch)

Pin 2 : NC (Not connected). Pin has no function

Pin 3 : Ground, or some call it 0V.

Pin 4 : Analog output. When no EMP is detected, a continuous signal (at Vcc level) will be generated. When minor / low energy EMP activity is detected, the signal will drop / fluctuate slightly.
When high energy EMP is detected, the signal will drop significantly.

Pin 5 : Digital Output. This pin can be used as a trigger-function for high energy EMP's. When no or low activity is detected the pin will remain at Gnd-level (0 Volts). When a strong analog signal is detected, a digital high peek signal (Vcc level) will be generated.
A small delay may occur, compared to the analog signal output (min. 0 ns, max : 750 ns).

Pin 6 : V+. To activate the sensor, it requires a powersource, like an DC-adapter, battery (i.e. Li-ion 18650) or even a Lithium coin-cell (i.e. CR2032). The maximum Voltage (DC) the sensor can operate at, is set to 5V DC.

Important note :
For mounting to a PCB (Printed Circuit Board) do not use wave of hot-air soldering. Use sockets, low temperature solder or electro-conductive glue.

LOCATION at PCB

Body marking (1)

The location of pin 1 is marked by a tiny triangular "cut-off" and a white triangle marker in this corner.

Antenna (2)

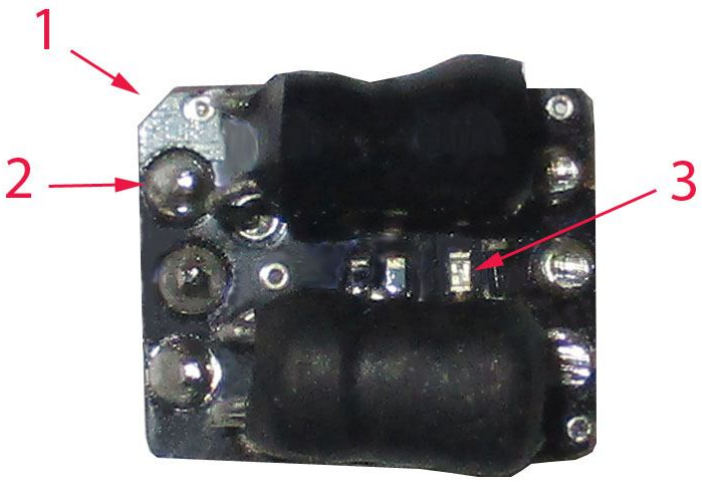
This sensor does ***not*** contain an integrated antenna. This means, it requires an external antenna to be connected to. The minimum length for such antenna is 70 cm (27.5 inches).

For experimentation purposes, you might consider:
- a longer antenna
- different width of antenna (core diameter)

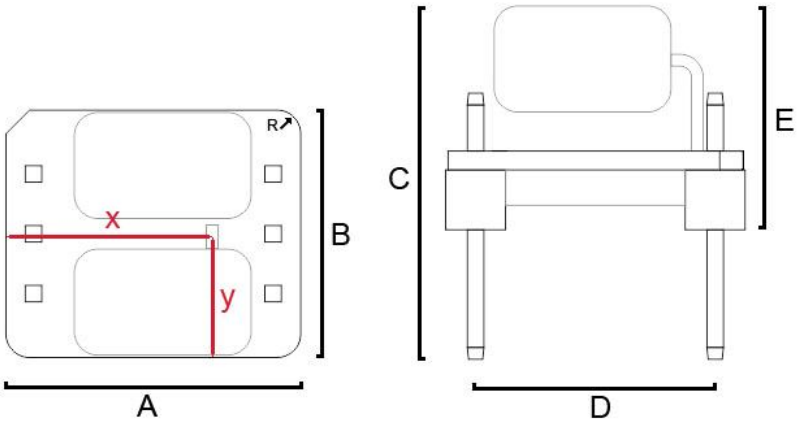
As far as been tested by a single straight wire-antenna, it will act as an omnidirectional receiver for EMPs. This means, the direction the antenna is pointing to, will have no effect, concerning more or less sensitivity.
Important note : We've not performed tests for (more) complex designed antennas.

Flash-LED (3)

A very small but bright emitting LED is integrated onboard. When a high energy EMP is detected, a bright onboard LED will blink. It will blink synchronous with the pattern of the detected EMP.



DIMENSIONS



TOP view FRONT view SIDE view

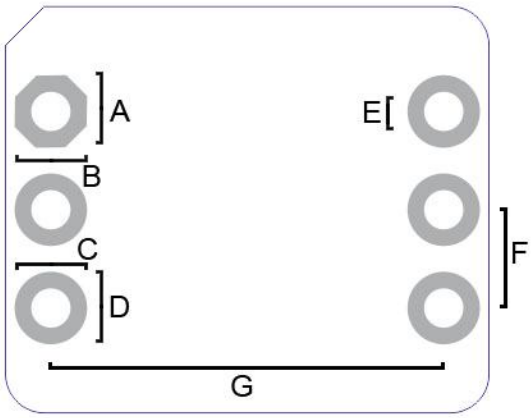
Code	Description	mm	inch
A	Sensor length	12.5	0.492
B	Sensor width	10.5	0.413
C	Sensor height	15.2	0.600
D	Pins width	10.16	0.400
E	Component height	8.8	0.346
F	Center of pin-row	5.25	0.207
G	Pins thickness	0.7	0.028
H	Pins pitch	2.54	0.100
R	Radius corner	1.0	0.039
X	LED X-location	8.75	0.344
Y	LED Y location	5.15	0.202

NOTE : In general, the tolerance is 2%. For "E" it is +/- 1.0 mm [0.04 inch].

SUGGESTED PCB PATTERN

Code	Description	mm	inch
A	Width (octagon)	1.9	0.075
B	Length (octagon)	1.9	0.075
C	Width (circle)	1.9	0.075
D	Length (circle)	1.9	0.075
E	Drill (diameter)	1.0	0.040
F	Pitch (vertical)	2.54	0.100
G	Pitch (horizontal)	10.16	0.040

NOTE : The octagon shape is suggested as indicator for pin 1



TOP view

DETAILS ABOUT "DIGITAL PIN"

At the right, you see measurements, while lighting took place, while the sensor was powered at 5V DC.

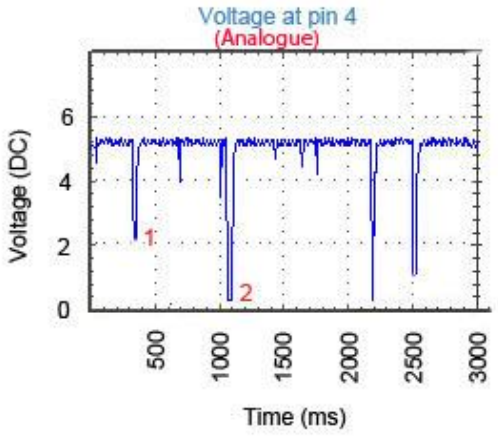
Please, keep the following in mind :

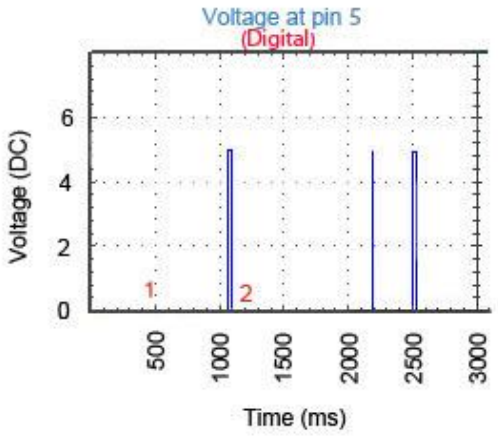
A) for reliable detection of EMPs, a Voltage-drop of nearly 0.7 * Vcc is required at pin "Analogue".

B) if Vcc is 5 Volts, than 0.7 * Vcc = 3.5 Volts.

C) pin "Digital" will shift level when "Analogue" pin is at or below (5 - 3.5 =) 1.5 V

Vcc is the Voltage you use to power the sensor.





Examples to help understanding.

At the right you can see an actual read-out by an oscilloscope at pin "Analogue" (pin 4) and at pin "Digital" (pin 3).

Example 1)

A *low* or *medium* EMP is detected, and pin "analogue" will drop to 2 Volts.
5 Volts - 2 Volts = 3.0 Volts. This 3 volts is less than the minimum required drop of 3.5 Volts. Pin "Digital" will stay at 0 Volts.

Example 2)

A *high* EMP is detected, and pin"Analogue" will drop to 0.2 Volts.
5 Volts - 0.2 Volts = 4.8 Volts. This 4.8 Volts is more than the minimum required drop of 3.5 Volts. Pin "Digital" will generate a pulse of 5 Volts.

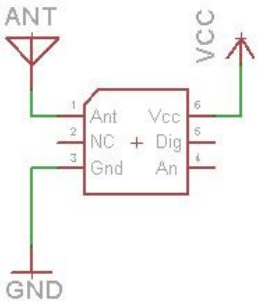
Good to know

- In general, pin "Digital" (pin 5) will respond with a delay of minimum of **0 ns** and a maximum of 7**50 ns**. This implies it can be used as a pretty fast trigger-function for activating external electronic devices.

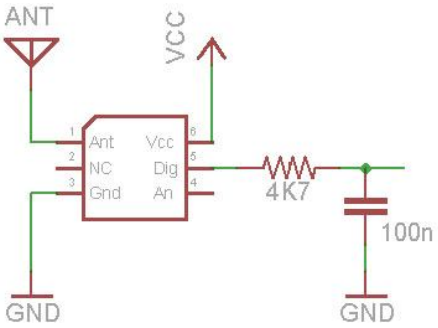
- The length of the pulse will have an identical length as the duration of the detected EMP. In some case it might require additional electronics to generate a delay.

REFERENCE SCHEMATICS

Basic setup

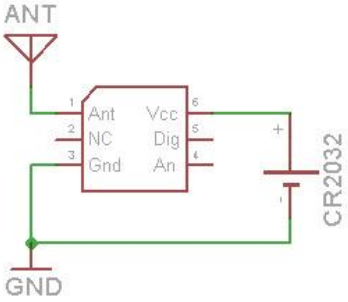


Stretching signal



NOTE : Capacitor-value (100nF) can be modified

Battery operated

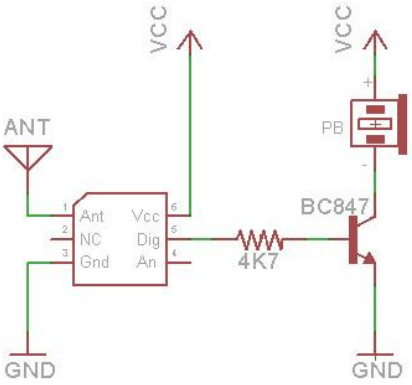


Battery as powersource, the following options can be used :

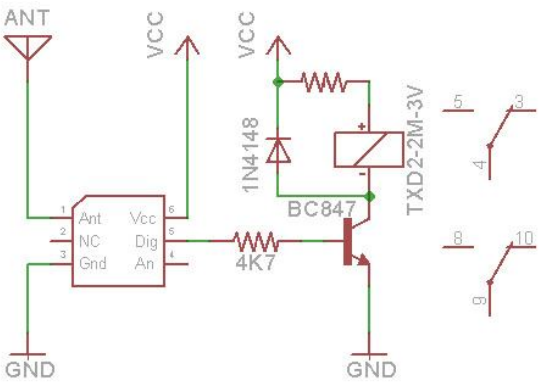
-2 pieces 1.5V (*) in serial connection, or
- 3 pieces 1.5V (*) in serial connection, or
- 1 piece 3V coin-cell, or
- 1 piece rechargeable Li-Ion (3.7V),
- any other battery which supplies at least 3V to 5 Volts

(*) AA, AAA, AAAA, button-cell are some examples.

Adding an external active piezo buzzer



Adding a relay



NOTES : - BC847 transistor can be replaced by any suitable transistor.
- BC847 transistor can be replaced by N-channel MOSFET.In such case resistor 4K7 Ω in schematic should be modified to a much lower value (i.e. 220 Ω). Also a pull-down resistor is advised (3K3 Ω)

Manufacturer : SMDKing
Datasheet : EMP µSensor V1
Version : 1.1
Date of release : 24th of january, 2019