

Mini-Battery-Supervisor

User's guide

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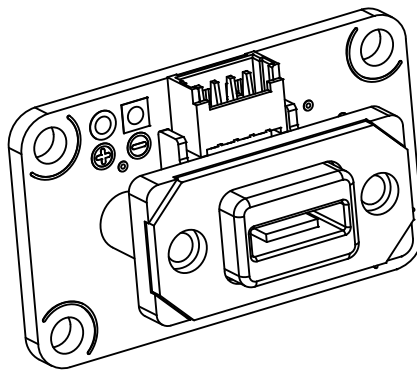
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1. Introduction

The Mini-Battery-Supervisor is a tiny circuit (30x18mm) which enables you to use a battery pack as power supply for low-power USB electronic appliances.

More precisely, the Mini-Battery-Supervisor has four purposes:

- It reduces the voltage provided by the battery to 5V, which is the maximal voltage expected by USB powered appliances;
- It monitors the battery voltage to cleanly cut the appliance power supply when the battery is fully unloaded, in order to protect the appliance and the battery;
- It makes it possible to connect simultaneously the battery and an external USB host to the appliance, for configuration and diagnosis purposes;
- It features a rugged panel-mount USB Micro-B connector, which can be integrated in the front panel of an enclosure for instance.

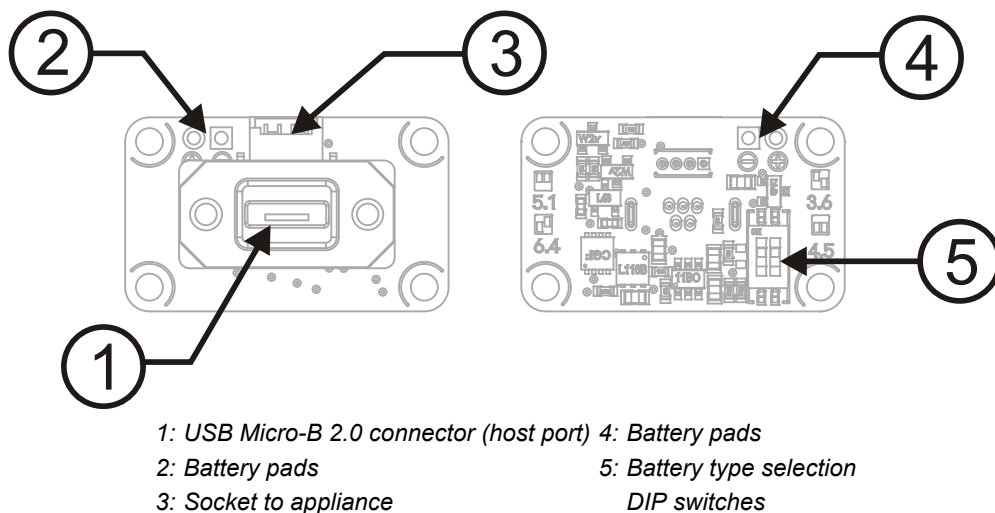


The Mini-Battery-Supervisor

Yoctopuce thanks you for buying this Mini-Battery-Supervisor and sincerely hopes that you will be fully satisfied with it. The Yoctopuce engineers have put a large amount of effort to ensure your Mini-Battery-Supervisor is easy to install anywhere. If you are nevertheless disappointed with this product, do not hesitate to contact Yoctopuce support.¹

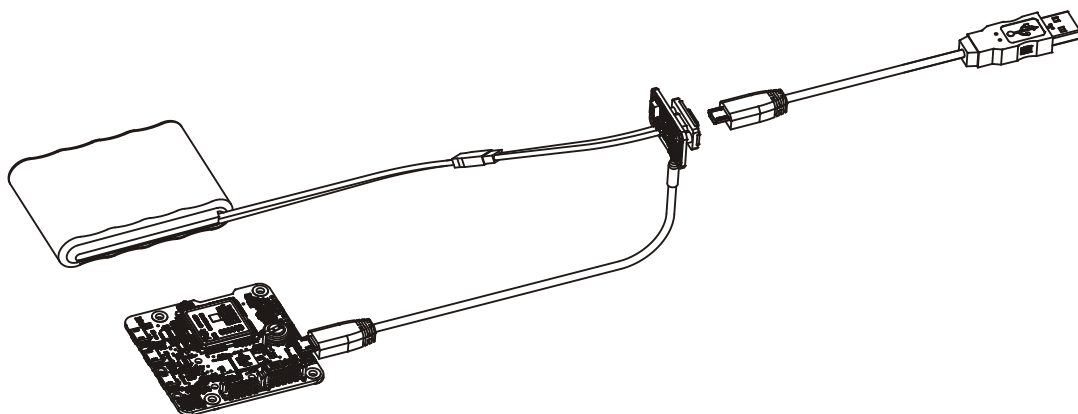
¹ support@yoctopuce.com

2. Presentation



2.1. Typical usage

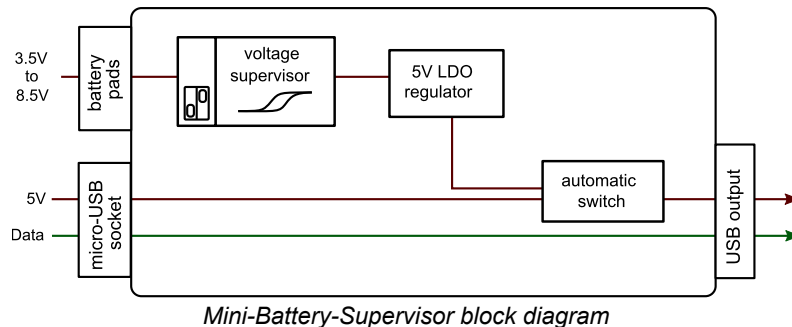
The Mini-Battery-Supervisor is intended to be mounted on the front panel of an enclosure, containing the appliance and its battery. This provides an easy access to the USB connector for diagnosis whenever needed. The battery is in a holder box and is connected to the Mini-Battery-Supervisor using a pair of wires. The appliance is connected to the Mini-Battery-Supervisor through the white 1.27mm (1.25mm) pitch connector, using a USB-MicroB-1.27-25 or 1.27-1.27-11 cable.



Typical usage of the Mini-Battery-Supervisor

2.2. Block diagram

The functions implemented by the Mini-Battery-Supervisor are described below:



2.3. Voltage supervisor

The Mini-Battery-Supervisor measures the voltage provided by the batteries in order to power off the appliance when the battery is empty, and to turn it on again when the battery has been replaced. In order to avoid for the appliance to turn on again by itself when the empty battery voltage rises as the load is removed, the turn-on voltage level is much higher than the turn-off limit. Two DIP switches make it possible to choose among four voltage limits, which have been carefully selected to match the most useful battery types:

Battery type	Turn-off level	Turn-on level
2S LiPo	6.45V	8.05V
4C Alkaline 5C NiMH	5.0V	6.25V
4C NiMH	4.5V	5.2V
1S LiPo	3.5V	4.05V

The voltage levels above are measured at the circuit input, and are defined with a tolerance of $\pm 0.05V$. Depending on the current consumption, on the length and on the section of the cable between the battery and the Mini-Battery-Supervisor, switching levels at the battery may be slightly higher. Similarly, the resulting voltage levels at the appliance will be lower, in particular due to the voltage dropout in the linear regulator (see below).

Caution: Due to the voltage dropout on the regulator, the first two power sources in the table above are the only ones that guarantee that at any time the power supply conforms to USB 2.0 specifications. When using 4C NiMH or 1S LiPo, the appliance receives a voltage lower than 4.5V, which may work with some appliances but not with all of them. Many Yoctopuce devices can work properly with 4C NiMH.

2.4. Voltage regulator

The Mini-Battery-Supervisor includes a regulator intended to bring down the battery voltage level to a value that is acceptable for USB appliances, i.e. no more than 5V. Given the tiny size of the Mini-Battery-Supervisor, we use a simple low-dropout (LDO) regulator, which lowers the voltage by dissipating the extra energy as heat. It is a valid solution for low-power appliances that stay in deep sleep during extended periods of time, but some limitations must be taken into account:

- When the battery voltage goes down to the 5V target voltage and below, the output voltage goes down as well and is always under the battery voltage, with a step down of approximately 1mV per mA. The Mini-Battery-Supervisor does not include any extra component to bring the voltage up to 5V.

- The energy dissipated by the regulator is limited to 1W. Therefore, the maximum continuous tolerated current is **500mA for batteries up to 6.5V** and **250mA up to 8.5V** (2 LiPo cells). Peaks up to 1.5A are however acceptable.

The regulator is driven by the voltage supervisor and entirely disconnected when the power-down level is reached, in order to reduce the current consumption to the very minimum in order to protect the battery. The values below have been measured at the time when the power-down level is reached:

Battery type	Quiescent current
2S LiPo	95uA
4C Alkalines 5C NiMH	75uA
4C NiMH	78uA
1S LiPo	60uA

Moreover, in order to ensure that the appliance is powered off properly, and to reduce the risk of flash memory corruption that a progressive power *brown-out* would cause, the output voltage is actively pulled to 0V as soon as the voltage regulator is shut down.

2.5. Automatic power switch

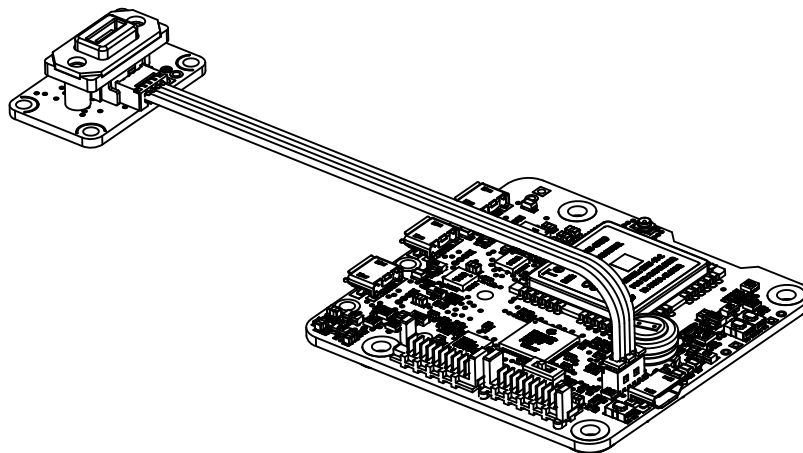
When a USB host is connected to the panel-mount USB Micro-B connector, the power source is automatically switched to this source. In this way, regardless of the battery state, it is possible to communicate with the appliance over the USB cable. The switch from one power source to the other does not cause any power cut on the appliance.

The ground wire (GND) of the USB host and of the battery are connected together. The supply lines however are switched and protected to prevent current from flowing back from one source to the other.

Note that this USB power switching feature is in itself a good reason for using the Mini-Battery-Supervisor even without any battery, for instance when a USB appliance needs to be powered from a fixed power supply but that an USB connection is occasionally required.

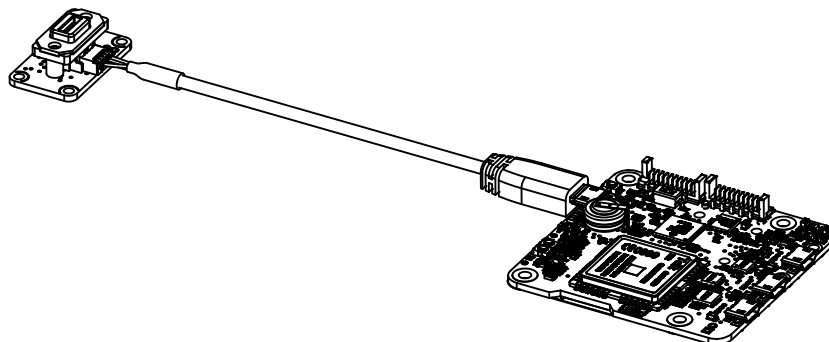
3. Connections

In order to make it possible to use the Mini-Battery-Supervisor in small enclosures, the connection to the appliance is made using a small 1.27mm (1.25mm) pitch connector. If the appliance also has pads for a 1.27mm connector, as all Yoctopuce devices do, then you can use a [1.27-1.27-11](https://www.yoctopuce.com/EN/products/accessories-and-connectors/1-27-1-27-11) cable, available on the Yoctopuce web shop ¹.



Using a 1.27-1.27-11 cable to connect the appliance.

If the appliance is powered by a USB A or USB Micro-B 2.0 cable and if your enclosure is large enough, you can simply use a [USB-A-1.27-25](https://www.yoctopuce.com/EN/products/usb-cables/usb-a-1-27-25)² cable or a [USB-MicroB-1.27-25](https://www.yoctopuce.com/EN/products/usb-cables/usb-microb-1-27-25)³ cable. This saves you the work of soldering a 1.27mm connector.



Using a USB-MicroB-2.17-25 cable to connect the appliance.

¹ <https://www.yoctopuce.com/EN/products/accessories-and-connectors/1-27-1-27-11>

² <https://www.yoctopuce.com/EN/products/usb-cables/usb-a-1-27-25>

³ <https://www.yoctopuce.com/EN/products/usb-cables/usb-microb-1-27-25>

3.1. Fixing

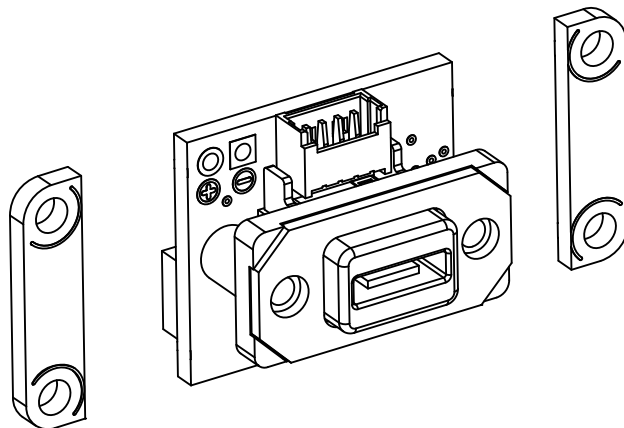
If you want to integrate the Mini-Battery-Supervisor to an enclosure, the typical solution is to cut in the enclosure front panel an opening corresponding to the USB Micro-B connector according to the template provided at the end of this manual, and to affixate the Mini-Battery-Supervisor with screw directly on the panel. Be aware that the panel mount screw of this USB Micro-B connector are not metric screw but imperial #2-56 screw. They are provided together with the Mini-Battery-Supervisor.

The exact reference of the USB Micro-B connector is article MUSB-K552-30, manufactured by Amphenol ICC. In order to protect it from dust, you can add the MUSB2K15015BP dust cover, available from major electronic component retailers.

In case you do not want to make the USB connector visible, you can also fix the Mini-Battery-Supervisor within your enclosure or on another circuit, using the four fixing points on the corners of the PCB. They are designed for M2.5 screw, with a head no larger then 4.5mm. In order to avoid damaging the components under the PCB, use M2.5 threaded spacers between the Mini-Battery-Supervisor and the fixing plane. You can find a set of M2.5 screw and spacers on Yoctopuce web shop under the reference [Fix-2.5mm](https://www.yoctopuce.com/EN/products/accessories-and-connectors/fix-2-5mm)⁴.

3.2. Minimal size

If you opt for the panel-mount solution to fix the Mini-Battery-Supervisor and if you need to reduce its size to the very minimum, you can split the two side bands of the circuit using a simple plier: the PCB had a V-break cut to make this simple and risk-free. This removes the extra fixing holes and the DIP switch legend, but the circuit length is shortened to 21mm instead of 30mm.



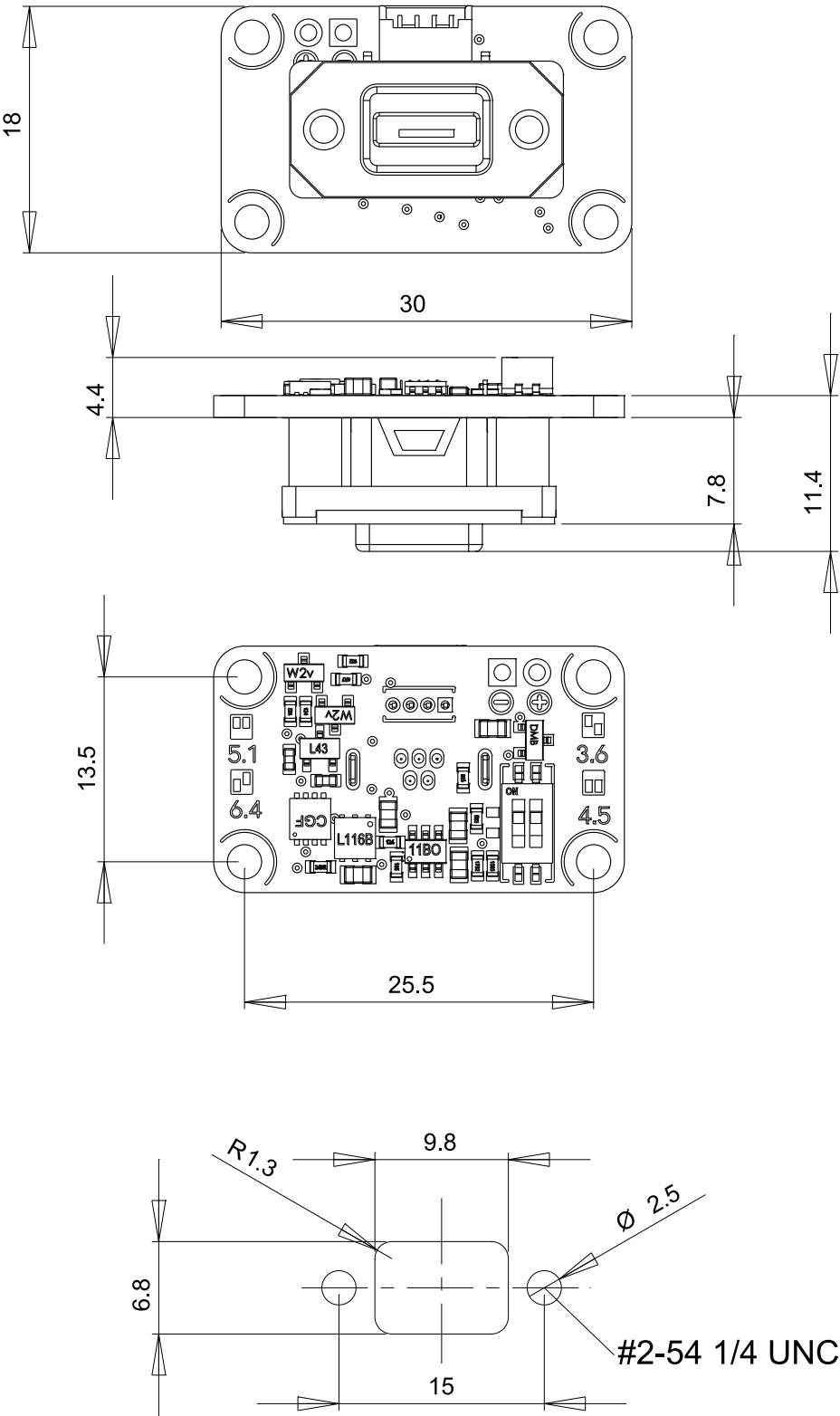
How to make the Mini-Battery-Supervisor as small as possible.

⁴ <https://www.yoctopuce.com/EN/products/accessories-and-connectors/fix-2-5mm>

4. Characteristics

You can find below a summary of the main technical characteristics of your Mini-Battery-Supervisor module.

USB connector	micro-B
Thickness	16 mm
Width	18 mm
Length	30 mm
Weight	7 g
Max Current (continuous)	500 mA
Max Current (peak)	1.5 A
Voltage threshold	3.5 / 4.5 / 5 / 6.4 V
IEC protection class	class III
Normal operating temperature	5...40 °C
Extended operating temperature	-40...85 °C
RoHS	Yes



Recommanded panel cutout
Découpe recommandée de la façade

All dimensions are in mm
Toutes les dimensions sont en mm

Mini-Battery-Supervisor