Microver Power Receiver – Datasheet

1. Datasheet of microver.ch Power Receiver

1.1. Introduction

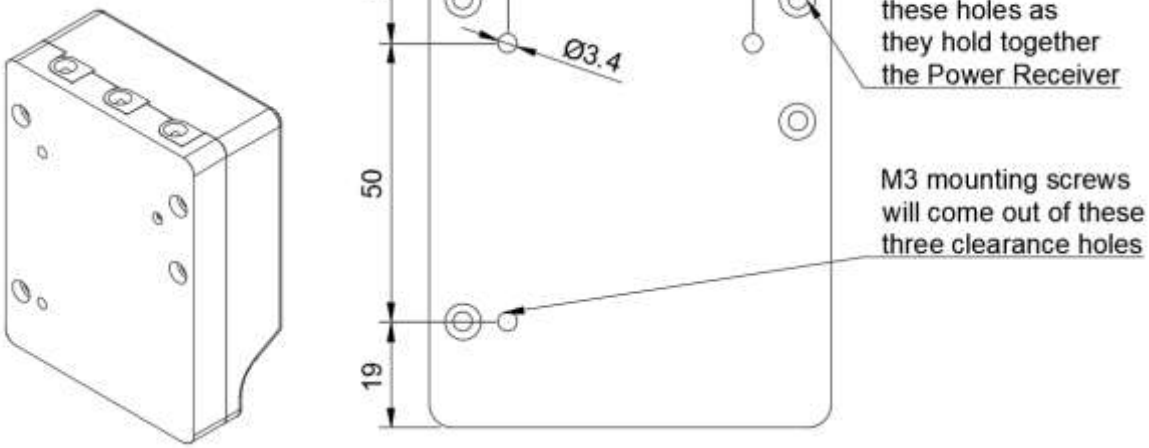
The microver.ch Power Receiver is a device used to interface with a standard 18.0V Makita Battery.



It has:

- 1x mechanical interface & electrical terminal block to connect to the Makita 18V Battery
- 3x clearance holes for M3x25 Socket Head Cap Screws to mount the Power Receiver
- 1x smart PMIC device to charge & discharge the battery over a usb-c port
- 1x 5x20mm glass fuse holder to hold a replaceable glass fuse
- 1x 10 Amps replaceable glass fuse to protect the battery from short circuits
- 3x 2.1mm DC Barrel Jacks for direct access to the battery

1.2. Mechanical Interface



1.3. USB-C Power Management Integrated Circuit (PMIC)

The power receiver has a circuit acting as a bidirectional USB-C charger and discharger. When plugged into the wall socket by USB-C, it charges the battery, when plugged into a device like a phone, raspberry Pi, Arduino or other USB-C device, it discharges the battery and powers the device.

USB-C Charging Mode

USB-C Discharging Mode

The power receiver is a smart device powered by a state-of-the-art PMIC (power management integrated circuit) like the ones in laptops and high-end power supplies. It can negotiate with the device over multiple protocols such as:

- USB-C 3.0A
- PD2.0 100W
- PD3.0
- Apple2.4A
- BC1.2DCP
- QC3.0 5V 9V 12V
- Samsung-AFC 5V 9V 12V 25W
- Huawei-FCP 5V 9V 12V 24W
- SCP 3.3-5.5V 5.0A 25W

It can supply up to:

- 3.00A at 5.00V or 15W
- 3.00A at 9.00V or 27W
- 3.00A at 12.00V or 36W
- 3.00A at 15.00V or 45W
- 5.00A at 20.00V or 100W

It will not hurt your device as it initially negotiates with it to make sure it can handle more than 5.00V or it defaults to giving it 5.00V which is the standard USB voltage.

1.3.1. Charging the Battery over USB-C

The Power Receiver also has a smart CC-CV circuit to charge a 5S lithium-Ion battery at the correct settings. It will charge the Makita 18V 2Ah battery at around 2 Amps during the CC (constant current) phase and then it will apply a little under 21.0 Volts during the CV (constant voltage) phase.

During this charging procedure, the red LED inside the two shells of the Power Receiver should be steadily blinking at a slow rate (around 1Hz).

The power brick plugged into the wall and the Power Receiver should both heat up to about 35 degrees Celcius as they are charging the battery.

The entire charging process from completely empty 18V 2Ah Makita battery to completely full one takes about 120 minutes but most of the charging (80%) is done in the first 60 minutes and once the battery is fully charged, the LEDs inside the Power Receiver should stop blinking and steadily shine red.

1.3.2. Powering a Device over USB-C

The Power Receiver can smartly power USB-C devices such as your phone, Raspberry Pi or other but it first needs to be plugged into the mains wall socket acting as a charger for the battery (even for 2-3 seconds) while it is connected to the battery and then it can be used as a power-bank to power devices.

If the battery is removed from the Power Receiver between the unplugging of the USB-C charger from the wall and the plugging-in of the device that you want to power over USB-C, the PMIC resets itself and becomes unable to act as a power bank. You need to:

1. Clip a battery back into the Power Receiver
2. Then go charge in in the wall socket for 2-3 seconds over the USB-C port
3. Then plug in your USB-C device without ever removing the battery

This is quite inconvenient as you cannot re-enable the Power Receiver as a power source unless you are close to a wall outlet… We believe this is a flaw in the Finite State Machine inside the PMIC but it may be a protection for something else that we did not consider.

The red light inside the shells of the microver.ch Power Receiver will be on without blinking if it is successfully powering your external device over USB-C. If you run into the issue stated above, instead of being on without blinking, the red light will flash at about 1Hz and never power your device.

1.3.2.1. Voltage Range Protection over USB-C

The smart PMIC will protect the battery from going under the 15.0V limit or from charging above the 21.0[V] limit. It will cut out the power automatically, there is nothing the user has to worry about.

1.3.2.2. Over-current Protection over USB-C

The smart PMIC will negotiate the current with the device and never supply more than 5.0 Amps to a device which is much lower than the 10 Amps limit that the replaceable glass fuse inside the microver.ch Power Receiver unit uses to protect the battery from a short circuit due to a user mistake. Therefore there is no risk of over-current by using the USB-C port.

1.4. DC Barrel Jacks – Warning!!

The Power Receiver can also power devices over the three 2.1mm DC barrel jacks that are in the back of the device. Unfortunately, these DC Jacks are not connected to a smart circuit so it is up to the user to respect the capabilities of the Makita Batteries at the risk of :

- **Killing them due to an over-discharge (< 15.0 V)**
- Having them explode due to an improper charging with an unrecognized barrel jack charger
- Experiencing other unpleasant behaviours

1.4.1. Capabilities of the Makita 18V Batteries

1.4.1.1. Voltage

The Makita 18V 2Ah Li-ion batteries are meant to be used in the following voltage range:

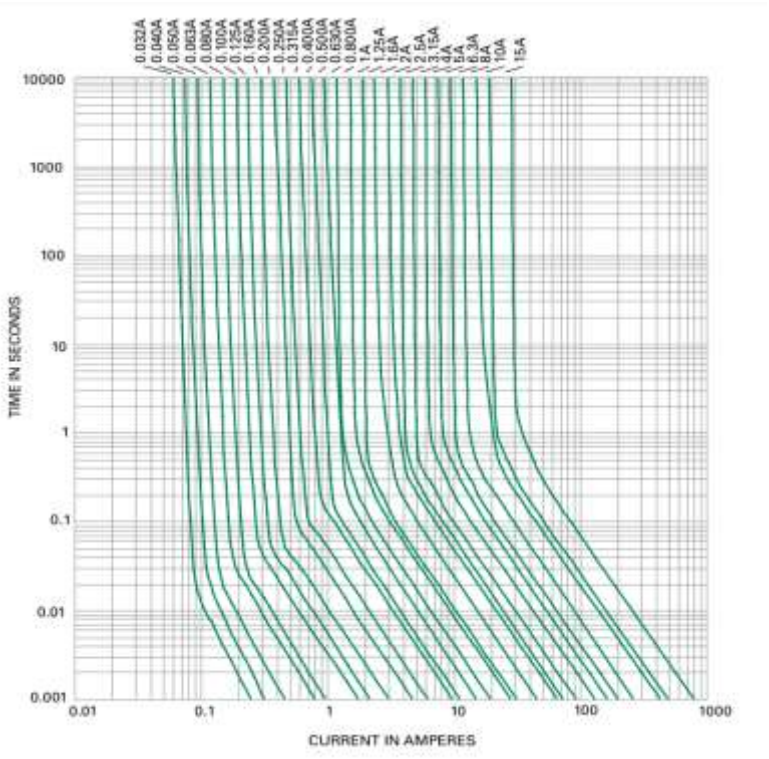
$$Voltage\ Range: \quad \mathbf{15.0[V]} - 21[V]$$

Discharging your battery past the $\mathbf{15.0[V]}$ can lead to permanently killing the battery as it will not be recognized by the charger anymore or it could kick in the Makita internal safety system that will permanently disable the battery (yet to be tested).

1.4.1.2. Current

The Makita 18V 2Ah Li-ion batteries can easily handle 8-9 Amps for about 12 minutes (tested many times) until they pass their 15.0[V] over-discharge limit at which point the user urgently needs to disconnect them.

The external 5x20mm glass fuse is rated for 10 Amps to protect the battery from short-circuits arising from misuse by the end-user. These should blow following the current-blow time graph below:



1.5. Replaceable Glass Fuse

A replaceable glass fuse of dimensions:

$$Fuse: \ 5\ x\ 20\ mm - 10\ Amps$$

Is used inside the microver.ch Power Receiver device to protect the Makita Batteries from mistakes that the user might make while developing his circuits.

This fuse should always be removed if the battery is connected to the Power Receiver and the user is working on a circuit, never work live on a circuit because one small slip when measuring a voltage will lead to as short circuit which will kill your motor drivers, your Arduinos and blow your battery fuse! Always make sure that:

1. your circuit is finished
2. your circuit has no short circuits between GND and VCC (check with a multimeter)
3. only then plug in the fuse (or the battery) to power it all up

If your fuse ever gets blown, changing it is very simple:

- Pull it out using pliers (don't squeeze too hard as it will shatter)
- Throw it away
- Push in a new fuse

Here is what a good and a bad fuse look like:

Good Fuse

Bad Fuse