SOLID2-L1

Battery switch with measurement of voltage, current and capacity, storage of min. / max. values, electronic switch, battery monitor and signal error detection. Duration up to 4A, peak 17A. For 5-6 NiMH or 2SLiPo.

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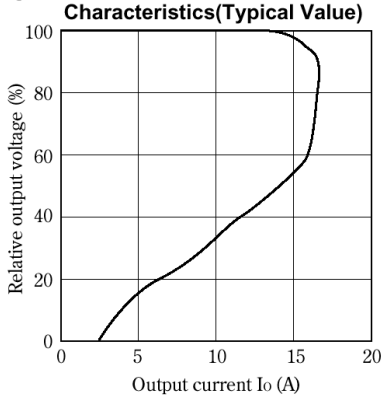
Generalities
This device sets new standards to the receiver power supplies with display regarding safety, performance, information and comfort. The company MICROSENS has got ten years of experience with RC electronics. MICROSENS products are especially used for demanding models.
SOLID2-L1 is a further development of the proven SOLID2.
The optional, generous display shows: instantaneous current/minimal voltage, instantaneous/maximum/average current, used up capacity, turn-on time and signal errors.

Safety
This is one of the safest systems available as a result of:
- Generously dimensioned battery switch with 2 x 15A peak. Revers voltage proof inputs
- Due to voltage regulator with foldback characteristic shortcircuit proof output. U_out adjustable from 5.5V to 7.0V.
- Due to ultra low dropout voltage from 0.35V at 4A only low increase in temperature. If there is too much heat generated, the output current will be reduced automatically.
- Red, flashing LED immediately indicates the failure of a battery.
- A weak battery can be spotted in advance due to the separate measurement of current and capacity of both batteries.
- There are two stages of warning concerning the battery: First red / green flashing, then red flashing. The very bright LED is well visible also at a passing flight.
- The current measurement can detect heavy servo gears.
- Electronic switch with pushbutton. Optimal security due to hardware control and software support. Pressing for a long time = switching on and off. Pressing for a short time = switching the menus. Pressing too shortly when turning on => the device turns off again. Pressing too shortly when turning off => the device remains switched on.
- The state remains the same even if
  - the pushbutton is secluded
  - the output voltage is shortcircuited
  - both batteries are disconnected
- Error supervision: Both, PPM and PCM receiver can be supervised. On switching off the LED shows also the amount of errors.
- The servo return voltage is limited with approximately 7,5V to protect the receiver.

Power
At a total weight of 54 g only including cable + display up to 4A constant current and 17A peak current (3s) are reached. When using heavy current one has to bear in mind as follows:

- **When using small or middle models without Servo Extender** you have to pay attention to the maximum permissible voltage of receiver and all servos. This is 6V for most receivers and standard sevos.
- **When using middle or large models with ServoExtender SOLID3** the output voltage can be set up to 7V. This is possible for all servos designed for 5 cell batteries. The receiver receives then regular 5,0V via SOLID3. The receiver is protected then against the dangerous servo return voltage.
- **Permissible constant current with 5 cell NiMH**
  - U_out 6.0V => 4.0 A
  - U_out 5.5V => 3.0 A
- **Permissible constant current with 2S LiPo**
  - U_out 7.0V => 4.0 A
  - U_out 6.5V => 3.0 A
  - U_out 6.0V => 2.0 A
  - U_out 5.5V => 1.5 A

Fig. 4 Overcurrent Protection Characteristics(Typical Value)



The declared values are guide numbers, which depend on the particular installation situation. Avoid overheating of the device's top higher then 70 °C to make sure that the electronics will have enough safety reserve.

Ultralow Dropout Voltage Technology
Below a voltage difference of about 0.7V between input and output a dropout voltage of only 0.25V / 1A and 0.35V / 4A is achieved through increase of the quiescent current from 15mA up to 90mA. With the appropriate output voltage at high current the power loss and heating up of the device are considerably reduced.

Information
M3:I_mom <I> menu3: instantaneous current in ampere
M4:I_max <I> menu4: maximal current in ampere
M5:I_avg <I> menu5: average current in ampere
M6:Cap <mAh> menu6: used up capacity in mAh
M7:Reset menu7: turnon time and amount of signal errors, turning off in this menu
=> Reset of saved values

Brief overview of menus:

- **M1:U_mom <V>** Menu1: instantaneous voltages in Volt
- **M2:U_min <V>** Menu2: minimal voltages in Volt
- **M3:I_mom <I>** Menu3: instantaneous currents in Ampere
- **M4:I_max <I>** Menu4: maximal currents in Ampere
- **M5:I_avg <I>** Menu5: average currents in Ampere
- **M6:Cap <mAh>** Menu6: used up capacity in mAh
- **M7:Reset** Menu7: turnon time and amount of signal errors, turning off in this menu
  => Reset of saved values

Conveniences

- The display, which is seperated from the electronics, can be positioned in a well visible place with sufficient brightness. It's extremely flat with only 3mm, the letters with 5mm can very well be read. There are 3 lines with 12 characters each. Without cable the weight is only 7g. It can be fixed with an adhesive tape.
- It is possible to mount a backlight, if it is, for example, installed in a dashboard.
- The display can even be plugged in after the flight. All saved and current values will be displayed.
- The menus are clearly designed, the 1keys make operation easy. After the last menu the first one occurs again.
- When turning on without change of the battery the last used menu occurs again.
- When turning on after the change of the battery all saved values are automatically resetted. They can also be resetted at an earlier stage by turning off in the resetmenu.
- Pushbutton + two color very bright LED can also be fixed at any spot.
- Pushbutton + two color very bright LED can also be fixed at any spot. The electronics can easily be fixed with an adhesive tape. Don't wrap in foam rubber.
- The device can any time be operated from outside of course, even to look through the menus.
- Measurement of voltage with 0,01V resolution at 10V range.
- Measurement of current with 0,01A resolution, 2X10A single area and 20A overall range.
- All values will be updated every second. This leads to a fast display of all current values.

Components

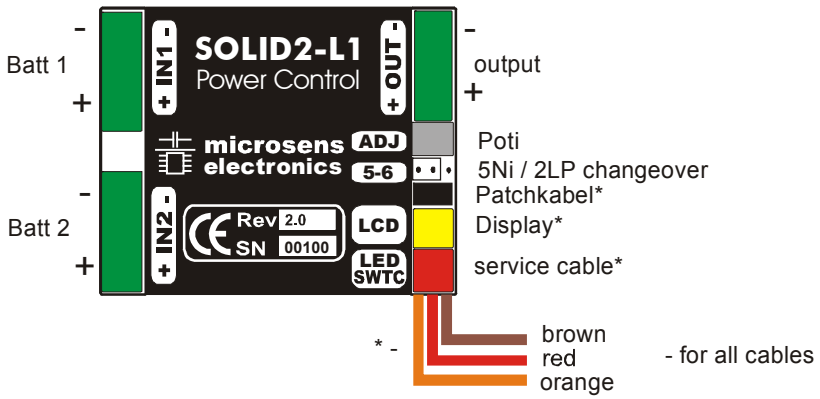
- Modul SOLID2-L1
- Cable set with operating cable with switch, twocolor LED and LED cover, patchcable for signal error detection
- Big display 3x12 characters with cable as accessories (or attachment). The battery switch can also be used without display.
- Appropriate batteries: 2 x NiMH with 5 or 6 cells, or 2S LiPo. It is recommended to use a cable cross section of at least 0,5mm ². Battery with MPX high current socket.
- Connection with receiver either via the optional receiver supply cable (MPX high current plug with 2x Graupner battery cable 0,35mm²) or via the servo extender SOLID3 with the SOLID3 connection cable.

Setting

You only have to set 5cell operation or 2S-LiPo with the jumper. Place the jumper correctly for selection of the battery: On the outside for 6 cell NiMH or 2S-LiPo, on the inside for 5 cells NiMH (standard).

- 5-cell operation : 1. warning RED / GREEN at 5,5V 2. warning RED FLASHING at 5,0V 5,0V
- 2S-LiPo operation: 1. warning RED / GREEN at 7,2V 2. warning RED FLASHING at 6,6V

The selected setting is visible in the welcome menu under POWER_ON 5Ni or 2LP



The selected setting is visible in the welcome menu under POWER_ON 5Ni or 2LP 6,00V.
When using 6 cells NiMH or 2SliPo it is recommended to use higher output voltage, if there are high constant currents.

Operation
After plugging in the first receiver battery the LED lights up green for a moment to show that the electronics is activated.
Power On Press the pushbutton for some time (at least 2s) for switching on. If you press too shortly it will be switched off again.
Welcome Menu:

POWER ON 5Ni	5N for 5 cell operation, 2L for 6 cell NiMH or 2S-LiPo
MICROSENS	
SOLID2-L1 V01	V01 is the current software version

The menu is displayed as long as the pushbutton is pressed. The first measurement menu will be displayed after about 2s.
Scrolling By pressing the pushbutton shortly (about 0,5s) you can shift from one menu to the next. As a response the LED will go out while pressing. After menu 7 menu 1 will occur again.

Power Off by pressing for a long time (>2s). If you turn off with menu M7:RESET, all saved values will be reseted. Otherwise the values are kept saved until both receiver batteries are disconnected. When turning on after turning off without resetting the same measurement menu will occur after the welcome menu.

Please note: It is characteristic that both receiver batteries will need 2 mA each, even after turning off. At the end of the flightday both batteries should be disconnected. It doesn´t make any difference though during the flightday. To enable a low dropoutvoltage at high currents, a complete disconnection is not necessary.
The batteries and the SOLID2L1have to be disconnected when charging!

Measurement of voltage and current
- At the same time 3 voltages and 2 currents will be measured 16 times within 15ms.
- Sliding software filter with 120ms time constant form stable measurement values with 10bit resolution.
- These software scaled measurement values are used
  for the current values U1, U2, Uout, I1, I2, Iout
  for the values that are to be saved U1_min, U2_min, Uout_min, I1_max, I2_max, Iout_max.
  I1 and I2 are added up every second and out of it the mean values I1_avg, I2_avg and Iout_avg are calculated.
- 120ms is a practical value for the electronics and particularly for the mechanics.
  Too short measurement intervalls lead to higher unsteadiness.
- The display will be updated every second.
- Type. Measurement Accuracy.+/1% plus +/0.01V or +/0.01A for all measurement values.

Measurement of capacity
- Will be calculated through running current measurement every 1s and the flight time in seconds via software.
- Typical measurement accuracy +/1% plus +/1mAh, max. 64000mAh

Measurement of time
- Resolution 1s, presented in minutes and seconds. Max. 1000 minutes (=16:40 h), above > 999:59 is shown.
- Typical measurement accuracy +/1%.

Signal error detection :
- Resolution +/0,1 ms. No error, if the controlled impulse is between 0,8ms .. 1,5ms.

The impulse lenghth of one channel is checked. Menu7 RESET displays a * at the beginning of the lowest line if there is an error and the value n-ERR will be increased by 1.

* errors n_ERR

The easiest way is to use a switching channel. Place the switch in a way that under normal conditions there is no * displayed. In case you use a receiver with Failsafe, program it in such a way that the star is visible on the display. If there is no switching channel available set it to the tow release switch, spoiler switch, landing gear switch or similar with a Y-lead. The actions will also be counted but as no real errors this is to subtract. When turning off the LED will flash with a red light up to 7 times, depending on the amount of errors.

Description of menus:

Menu M1: **Current Voltages.** All values in Volt. Resolution 0.01V, max. measurement range 10V.

Display **M1:U_mom <V>**
Batt1 Batt2
Out

Menu M2: **Minimal Voltages.** All values in Volt. Resolution 0.01V, max. measurement range 10V.

Display **M2:U_min <V>**
Batt1 Batt2
Out

Menu 3**: Instantaneous Currents.** All values in Ampere. Resolution 0.01A, max. measurement range Batt1, Batt2 10A, sum 20A.

Display **M3:I_mom <A>**
Batt1 Batt2
Summarized current

Menu 4: **Maximal Currents.** All values in Ampere. Resolution 0.01A, max. measurement range Batt1, Batt2 10A, sum 20A.

Display **M4:U_max <A>**
Batt1 Batt2
Summarized current

Menu 5: **Averaged Currents.** All values in ampere. Resolution 0.01A, max. measurement range Batt1, Batt2 10A, sum 20A.

M5:I_avg <A>
Batt1 Batt2
Summarized current

Menu 6**: Taking Capacity.** All values in mAh. Resolution 1mAh, max. measurement range 65000mAh.

M6:Cap <mAh>
Batt1 Batt2
Summarized capacity

Menu 7: **Reset**. Turn on time in minutes and seconds. Maximum 1000 minutes.
Number of error sequences. Maximum 65000.
If you turn off using this menu, all saved values will be resetted.

M7:Reset
Power on time t_ON
Amount of errors #ERR

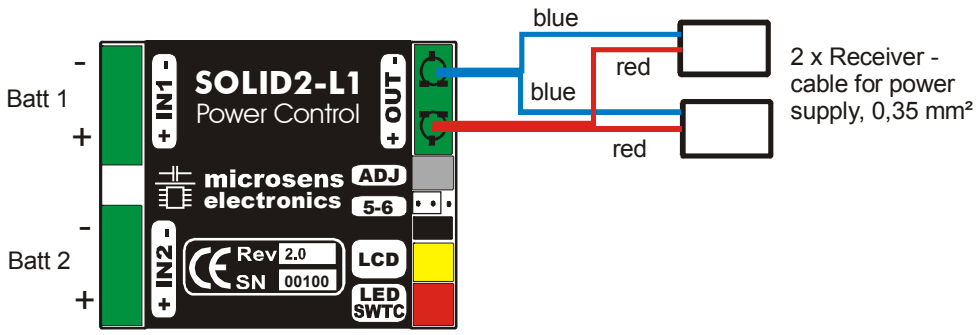
Conditions of Warranty
The guarantee is valid for a period of 24 months from the date of sale. In case you have lost the original receipt we will in all fairness refer to the manufacturing date via the serial number.
For damaging aftereffects there is no guarantee..
There is also no guarantee

- if cables have been nipped off or soldered
- if the housing has been opened
- if an overvoltage damage occured because the battery has not been disconnected from the electronics when charging

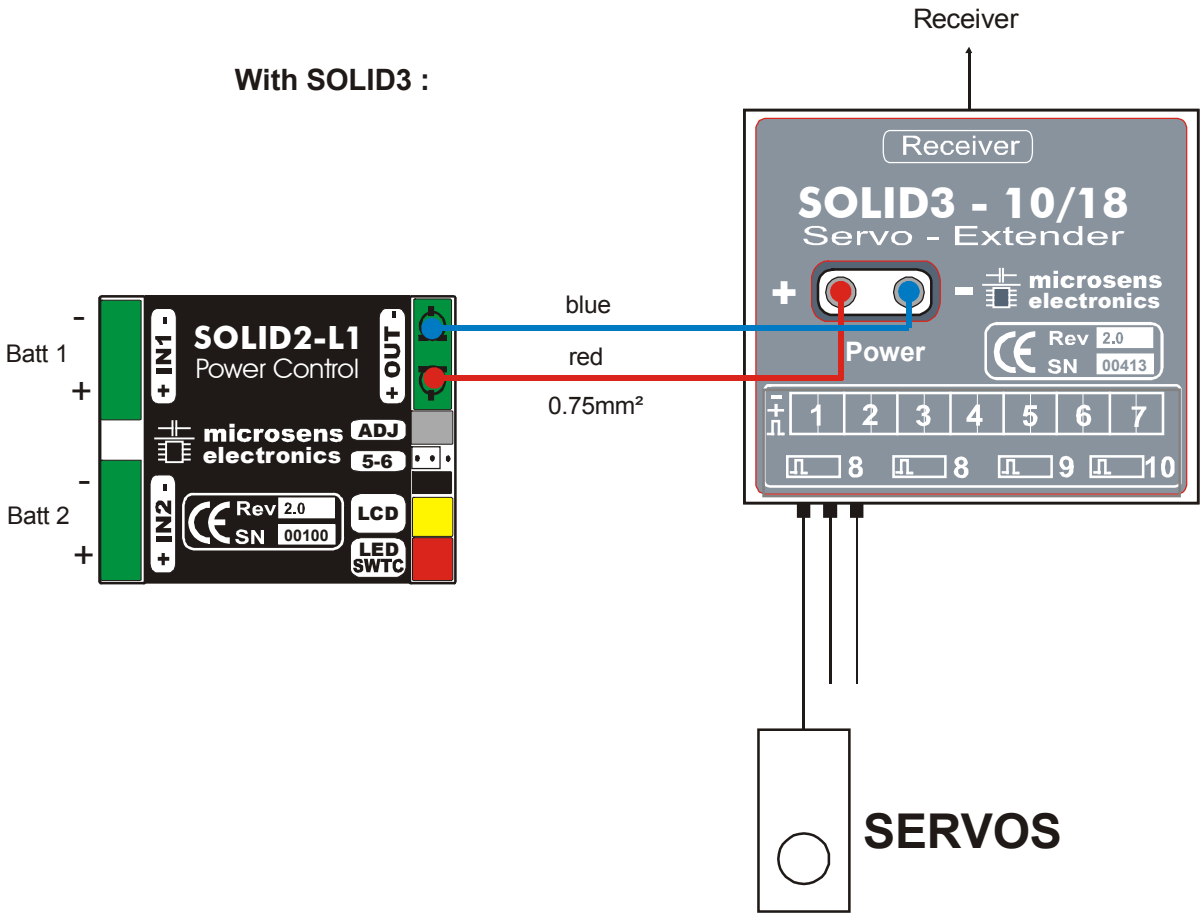
Software Updates
You get software updates free of charge for 12 months. You only have to enclose a flat rate of 5.EUR
for the postage. After a period of 12 months you will have to pay 5.EUR for the update + 5.EUR for the postage.

Typical Applications

Without SOLID3 :



With SOLID3 :



Technical Data

Voltages
- Inputs suitable for 5NiMH cells or 2S-LiPo (8,4V). Absolut limit value 10V. Reverse voltage proof inputs.
- Not permissible for 7NiMH or 3S-LiPo.
- Output voltage infinitely variable from 5,5V .. 7,0V. Output shortcircuit proof.
- 0.01V resolution, 10V range, +/1% accuracy.

Currents
- Duration up to 4A, peak 17A (3s). Everything is measureable for the whole range.
- Current consumption 15mA without LED. With LED up to 45mA.
- With activated Ultra Low Dropout control up to 90mA without LED.
- 0.01A resolution, 2x10A range, +/1% accuracy.

Measurement of capacity up to 64000 mAh, 1mAh resolution, +/1% accuracy

Measurement of capacity up to 64000 mAh, 1mAh resolution, +/1% accuracy

Dimension, Weight
- Electronics 54 x 41 x 15 mm / 34g
- Operating cable, length of cable 30cm / 8g
- Display 46 x 33 x 3, length of cable 30cm / 12g

CE marking:
The device absolutely meets the current standards for EMC immunity to EN 6100061 and EMC emissions to EN 6100063.

MICROSENS is registered at the Austrian Patent Office as a registered trade mark for electronics and model flight.