Aivon Oy

Manual

BattSwitch

Battery switching device

AIVON OY

BattSwitch

Valimotie 13A
00380 Helsinki, Finland
www.aivon.fi

Table of Contents

Main features 2
Basic layout 3
Connections 3
Voltage regulator unit 5
Typical setup 7
Measurements 8
Specifications 11
Document revision history 11

BattSwitch

Battery switching device

Aivon BattSwitch is a switch that performs swapping between batteries in a battery pair. In any time, one pair member is being discharged by user and the other member is being recharged by a battery charger. With the help of a large storage capacitor the output voltage stays constant during swap. Thus, BattSwitch provides an "endless" and uninterruptible battery source that can be used in various applications, such as preamplifier powering in sensitive measurements.

Main features

- Two battery pairs providing two 12V endless battery outputs
    - Option for 4 or 6 battery pairs
    - Batteries (12V lead-acid) are selected and purchased by customer
    - Other battery types possible upon request
- One charger per each battery pair
    - Mounted inside or outside the enclosure
    - Chargers suitable for batteries are purchased by customer
- Mechanical toggle switch to operate the swapping
    - Led indicators show the battery (A or B) under discharge (other battery is automatically recharged if battery charger is connected)
- Screw terminal connectors for battery pairs, chargers (if external) and endless outputs (if external)
- Option for internal linear voltage regulators to form stable and constant voltage source of e.g. bipolar +/- 12V.
    - Banana (4mm) connectors in front panel
- Option for Raspberry Pi computer for remote control of the swapping
    - Wi-fi, LAN, and Bluetooth available. We can program the Pi upon request.
    - 9-pin D-connector in rear panel for customers own control wirings
- 19" rack mountable, 1U height
- 2.5mm 12Vdc barrel connector for powering the control electronics incl. relays. Separate ac/dc adapter provided with European wall plug. This voltage supply is only needed for swapping the batteries. If this supply is disconnected, BattSwitch will still provide output voltage from selected batteries and charge the other batteries.

Basic layout

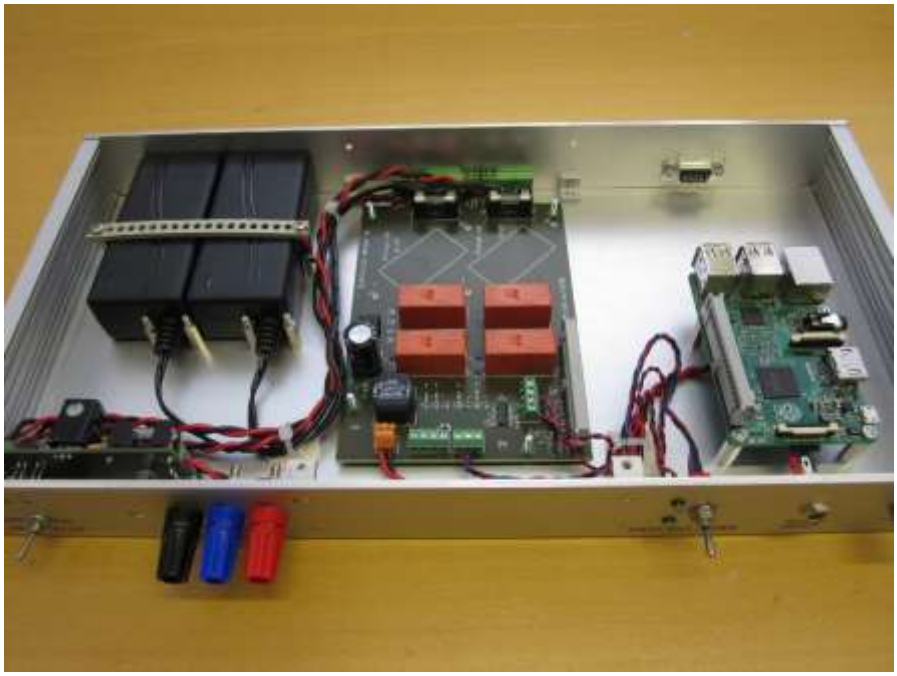

Figure 1: Upper left corner: two battery chargers. Lower left corner: Linear voltage regulator unit attached in front panel. Center: Main relay board. Storage capacitors removed for clarity. Right: Raspberry Pi computer. Upper right corner: spare connector (D9) for user wirings.

Figure 1 shows the basic layout of two battery pair BattSwitch with internal chargers and linear voltage regulator unit providing +/- 12V. Raspberry Pi 2 (or Model 3) computer can be added to remotely control the swapping via wireless, LAN or Bluetooth.

Connections

The main relay board requires 12Vdc power. A toggle switch is used to control swapping. In "A" position, battery A is discharged and B is recharged. In "B" position the roles are interchanged. All batteries are swapped simultaneously. This voltage supply is only needed for swapping the batteries. If this supply is disconnected, BattSwitch will still provide output voltage from selected batteries and charge the other batteries.

Figure 2: Toggle switch for manual control and power input connector for ac/dc adapter.

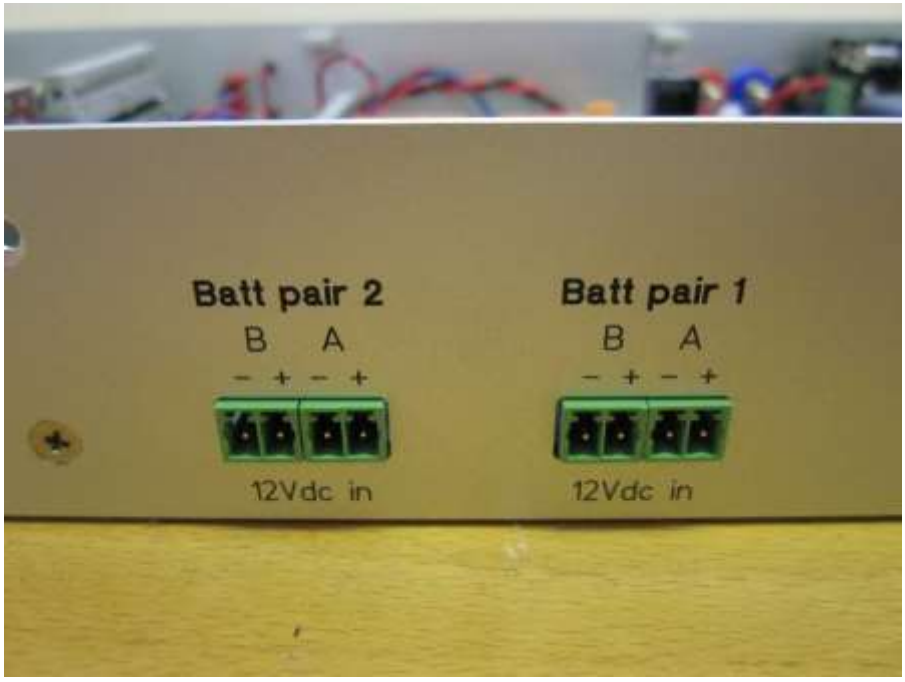

Figure 3: Battery connectors in rear panel. This model has place for two battery pairs.

Figure 4: Connectors for 230 VAC power cords with internal battery chargers.

Voltage regulator unit

A linear voltage regulator is used to provide constant and stable output voltage for the user. Two 12V battery pairs can be arranged in series to form a bipolar +/-12V regulated voltage (maximum current 0.5A). Also other voltages/currents are possible depending on number of available battery pairs. The output voltages (regulated or unregulated) are provided by the batteries and thus floating. They should be suitably grounded by the user. We also recommend grounding of the enclosure.

Figure 5: Voltage regulator connectors in front panel. Leds indicate the availability of sufficient battery voltage.

Figure 6: Voltage regulator unit with fuses. If there is no voltage at the regulator output but the leds are on (and regulator switch is on), check the fuses.

Typical setup

A typical setup contains BattSwitch, two battery pairs and two chargers. Raspberry Pi computer is connected to relay board via a ribbon cable that also delivers power to Pi.

Figure 7: Typical setup with four batteries (i.e. two battery pairs)

Figure 8: Connections for batteries and charger power cords.

Measurements

We added 10 mF electrolytic capacitors to store battery charge during swapping. We also discharged the "endless" output via 2 x 10 Ohm resistors in series. In reality, the raw battery voltage is about 13V and thus the discharge rate was 0.65 A. The following figures show the voltage across one 10 Ohm resistor. Multiply by two the get the full voltage.

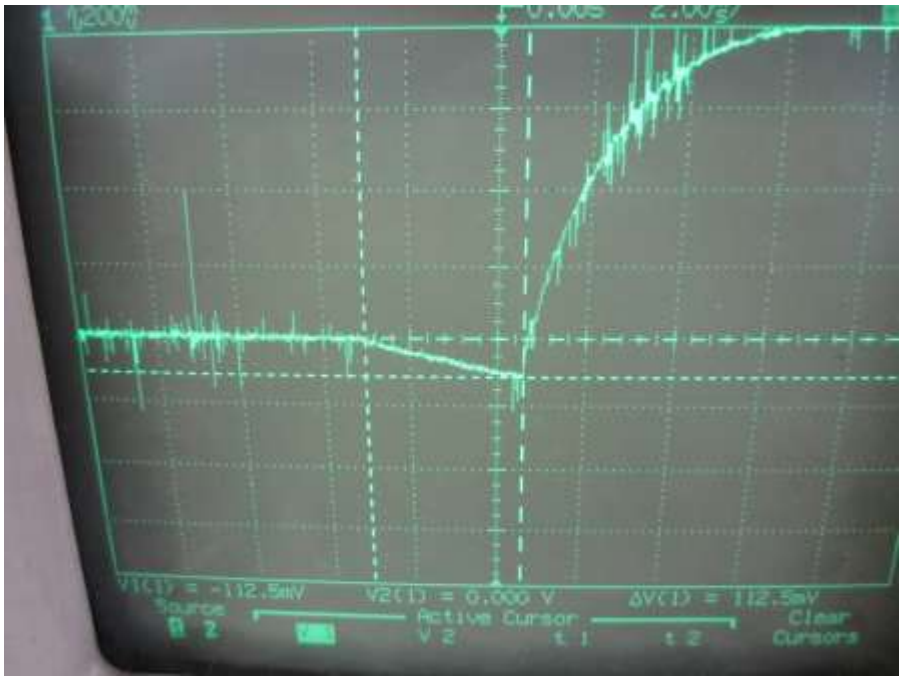

Figure 9: Swapping from A position to B position. Starting from initial level of battery A (about 0.5 x 12.6V) the output voltage drops 113 mV during a swap that lasts 4 ms. After this, the other battery B is powering the output. The final level is higher because battery B was recharged before the swap and thus its voltage is initially higher. Y-scale is 200 mV / division. In long timescale, the output voltage will slowly drop to about 12.5 V and below. The duration depends on the capacity of the batteries and the discharge rate. E.g. 12 Ah batteries can provide 0.5A for 24 hours.

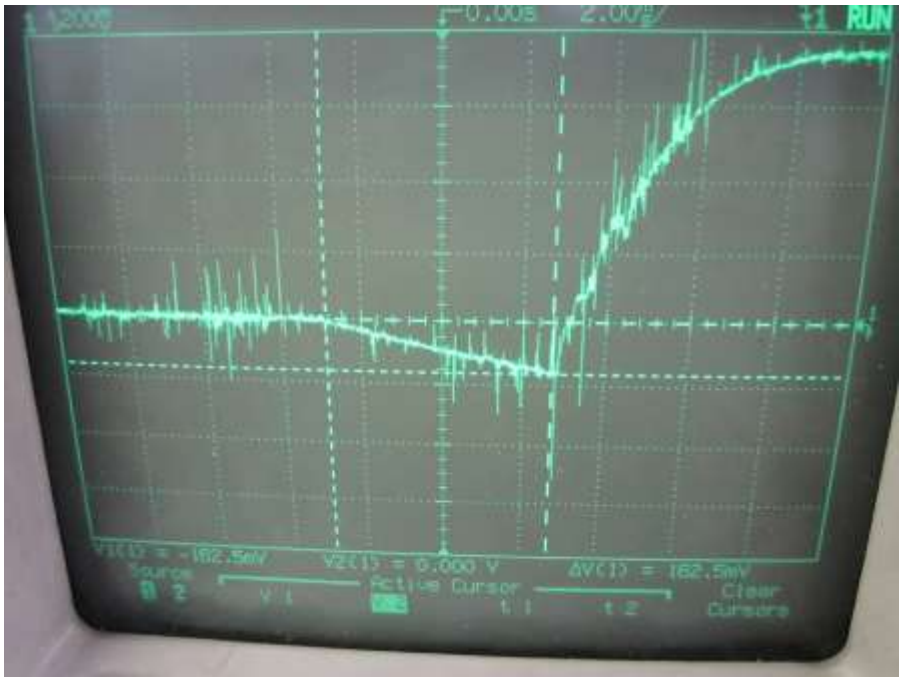

Figure 10: Swapping from B position to A position. Starting from initial level of battery B (about 0.5 x 12.6V) the output voltage drops 163 mV during a swap that lasts 6 ms. After this, the other battery A is powering the output. The final level is higher because battery A was recharged before the swap and thus its voltage is initially higher.

We conclude that with storage capacitors the BattSwitch provides endless and uninterruptible voltage source that can be further regulated to meet the needs of the user. During the swap, the unregulated voltage output drops about 330 mV even if it is discharged by 0.65 Amperes. If the discharge rate is less, the voltage drop is smaller by the same ratio. If followed by voltage regulator that has low enough dropout voltage **the regulated output will not drop at all**.

Without storage capacitors the output voltage goes to zero during the swap as shown in the following figure.

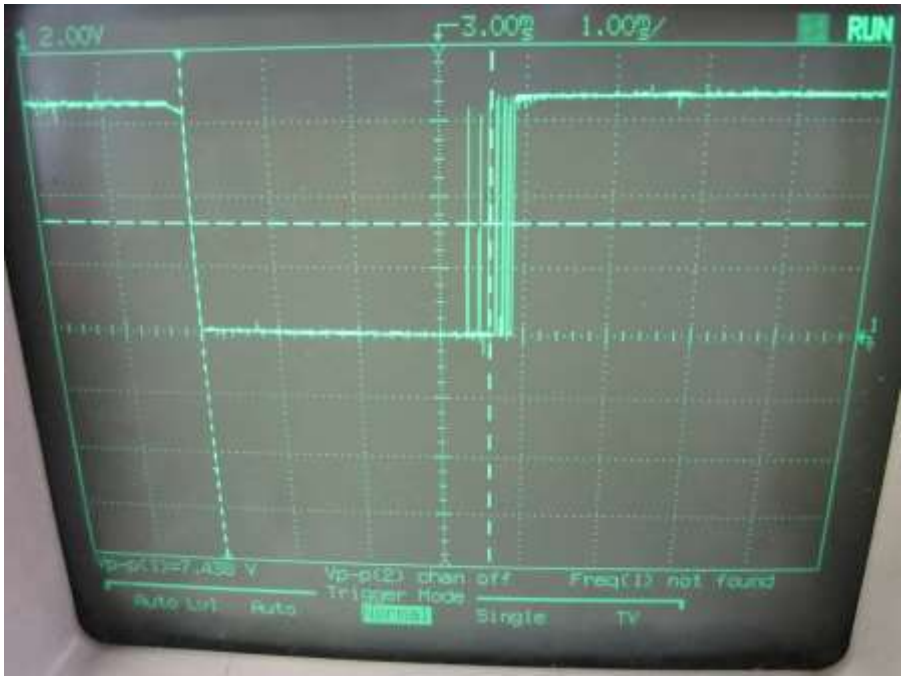

Figure 11: Without storage capacitors. Switching from A to B lasts 4 ms but the output voltage drops immediately to zero. This interrupts the power supply and may disturb sensitive measurements. Y-scale is 2 Volts / division.

Specifications

Enclosure

Material	Anodized aluminum.

Physical dimensions

Enclosure dimensions (Width x height x depth)	483 mm x 50 mm x 200 mm
Weight (w/o batteries)	1.5 kg

Document revision history

Date	Version	Description	Author
9.5.2016	0.1	Initial draft	JSP