AVR455: ATAVRSB201 User's guide

Features

- **ATmega16HVA smart battery chip evaluation and development kits.**
  - **ATAVRSB201-1 for Single Series Li-Ion Cell applications.**
  - **ATAVRSB201-2 for 2 Series Li-Ion Cell applications.**
- **High-side N-FETs.**
- **10 mΩ sense resistor current measurements with the 18-Bit CC-ADC.**
- **Input filters for cell voltages to the 12-bit voltage ADC.**
- **All components on one side.**
- **Four layer PCB with the reference design part implemented on two layers.**
- **Balancing FETs.**
- **Polarity safety FET.**
- **Holes for mounting of pin headers or wires.**
- **ISP connector for programming via SPI, and debugging via debugWIRE interface.**

1 Introduction

The ATAVRSB201-1/SB201-2 kits are evaluation and development kits for the new Atmel AVR® smart battery device ATmega16HVA. This device is made for battery packs with 1 series or 2 series lithium ion and lithium polymer cells, and feature autonomous battery protection as well as very accurate voltage, current and temperature monitoring capabilities. The device provides the means to protect the battery pack and surroundings from hazardous conditions and gain the most from the batteries.

The kits consist of both hardware and firmware, with hardware documented here and firmware in application note AVR456. The boards have an edge connector for connection to ATAVRSB200 Smart battery Evaluation kit, but can for development purposes also be used alone.

Figure 1-1. SB201-1 Kit.

8-bit AVR® Microcontrollers

Application Note

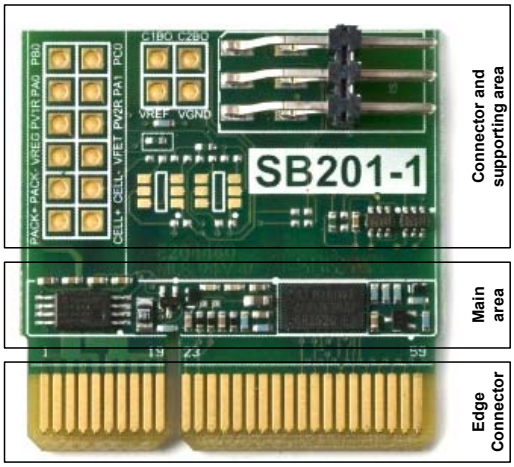
Rev. 8131A-AVR-10/08

2 Hardware

The SB201-1 and SB201-2 have a common PCB and only differ in which components are mounted and the silk screen. They will be commonly referred to as SB201 in this document unless differences exist.

The SB201 consist of three parts, the edge connector, the main area and the connector and support area. The main area contains all the circuitry needed in a battery pack design.

Figure 2-1. SB201 Block layout.



2.1 Main area

The main area contain the ATmega16HVA device, charge and discharge N-FETs, 10mΩ sense resistor, decoupling capacitors, filter capacitors/resistors for the voltage and current ADCs and ESD protection.

2.2 Connector and support area

The connector area contains holes for two pin headers with 2x6 and 2x2 pins, to give access to several signals and device pins as shown in Table 2-1 and Table 2-2. Pin headers with 2.54mm spacing or wires can be soldered in here. A connector for in-circuit programming is mounted. Lastly the area contains cell balancing and a board ID system, which are described in more details in the next subsections.

Table 2-1. Signals that can be found on the 2x6 pin header holes.

Name	Description
PACK+	Battery-pack positive input/output. Also connected to BATT pin.
PACK-	Battery-pack negative input/output (ground).
CELL+	Cell stack positive terminal.
CELL-	Cell stack negative terminal.
VFET	VFET pin.
VREG	Regulator output. Connected to VCC.

Name	Description
PV1R	Cell1 positive input.
PV2R	Cell2 positive input.
PA0	PA0 pin.
PA1	PA1 pin.
PB0	PB0 pin.
PC0	PC0 pin. Used for 1-wire SW-UART. Includes ESD protection.

Table 2-2. Signals that can be found on the 2x2 pin header holes.

Name	Description
C1BO	Cell1 Balancing On input.
C2BO	Cell2 Balancing On input.
VREF	VREF.
VGND	VREF ground.

ISP programming via SPI interface. Table 2-3 shows connections. Alternative pin names are also noted.

Table 2-3. ISP connector (J111) signals

Name	Pin no	Description
MISO	1	Serial data out. (PB3)
VCC	2	Supply voltage
SCK	3	Serial clock. (PB1)
MOSI	4	Serial data in. (PB2).
RESET	5	Reset signal (active low)
GND	6	Ground

2.2.1 Polarity safety FET

A voltage negative to ground connected on the input (charger with reverse polarity) will pull the source of the discharge FET to negative voltage and with the ground potential on the gate the FET will likely be turned on. Since the diode of the Charge FET will conduct a discharge current, a large current will in this case flow out of the battery cell(s) with the ATmega16HVA unable to stop it. A FET (Q2) on the pack input which pulls the source of the discharge FET to the negative input voltage is included in the design to avoid this situation. This is an optional part in a design but included in the main area.

2.2.2 Board ID system

A board identification system is included to allow the SB200 to recognize which board is inserted. The wiring and thus response of this is different between SB201-1 and SB201-2. The board ID system is not relevant for stand-alone usage of the SB201 or designs with the ATmega16HVA.

2.2.3 Single cell mode capacitors

The capacitors connected to CF1P/N and CF2P/N allow step up operation of the regulator. It is used for powering the device from 1.8V to approximately 3.6V input voltage and would normally not be needed in 2-cell applications as the input voltage should then not go that low, but it is included to allow the same PCB layout to be used for both SB201-1 and SB201-2.

Please see the voltage regulator section in the data sheet for details of regulator operation. In a regular design one would only include the capacitors for a 1-cell design.

2.2.4 Cell balancing

The SB201-2 contains cell-balancing FETs, while this circuitry is un-mounted on SB201-1. Cell balancing is controlled by PB2 and PB3 on SB201-2, and if PB2/PB3 are desired used for other tasks the 0Ω resistors R21/R22 connecting them to the cell balancing should be removed.

2.3 Edge connector

The edge connector provides a quick and secure connection to the demonstration board SB200.

3 Connecting batteries to SB201

The SB201-1 is made for 1 series Cell battery pack, while the SB201-2 is made for 2 series cells battery packs. The connections are described in the following subsections.

WARNING:

Li-Ion batteries must be handled with care as they may pose a safety hazard if treated incorrectly. It is important that the development of Li-Ion battery applications are done by people that are skilled and knowledgeable of correct use and handling of such batteries.

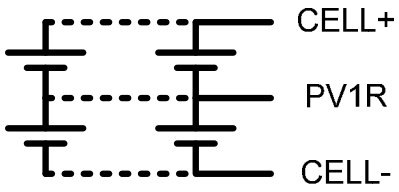
3.1 2-cell application SB201-2

For applications with 2 series cells, connect cells as shown in Figure 3-1: Positive terminal of upper cell to CELL+, negative terminal of upper cell and positive of lower cell to PV1R, and finally negative terminal of lower cell to CELL-.

Load or charge the batteries trough PACK+ and PACK-.

To start the part and thus possibly open the FETs, a charge condition must be initiated by a charger.

Figure 3-1. Connection of 2-cells in series packs to SB201-2.



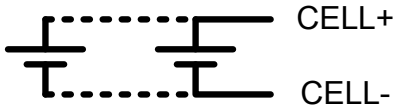
3.2 1-cell application SB201-1

The SB201-1 for 1-cell in series applications, connect the cell as shown in Figure 3-2: Positive terminal of cell to CELL+ and negative terminal to CELL-.

Load or charge the battery through PACK+ and PACK-.

To start the part and thus possibly open the FETs, a charge condition must be initiated by a charger.

Figure 3-2. Connection of 1-cells packs to SB201-1.

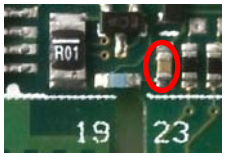


4 Programming

The board can be programmed with STK®500, STK600, AVRISPmkI/mkII, JTAGICE mkII and AVR Dragon™ via the ISP socket. See the ATmega16HVA datasheet and AVR Studio® help for connections.

5 Debugging

ATmega16HVA features on-chip debugging via debugWIRE interface, with either JTAGICEmkII or AVR Dragon. To enable debugging the capacitor (C10) on the reset line needs to be removed, as this stabilization of the Reset pin prevents communication through debugWIRE.



Please notice that debugWIRE must be enabled via the ISP interface if not enabled, and disabled after debugging to enable ISP again. This is described in AVR Studio help. Leaving the ATmega16HVA with DWEN-fuse on will increase current consumption.

6 Powering up the SB201

Please see the ATmega16HVA datasheet for how to wake the device from Power Off mode, and thus enable programming and/or operation. The SB200 provides this functionality automatically and manually.

7 Considerations when using SB201 in SB200

WARNING:

Connecting SB201-1 in a SB200 with Cell2 mounted will result in the destruction of tracks as PV2R and PV1R is shorted through a 0 Ω resistor (R9) on SB201-1. Make sure you use correct board with correct number of cells.

The resistor (R24) connecting the PV2R and CELL+ should be removed on SB201 to facilitate correct current measurements through the jumper position, as otherwise some of the current may flow through the PV2R connection.

8 Specifications

Max continuous current: +/-3A.

Max input voltage: 9V.

Table 8-1. Power consumption.

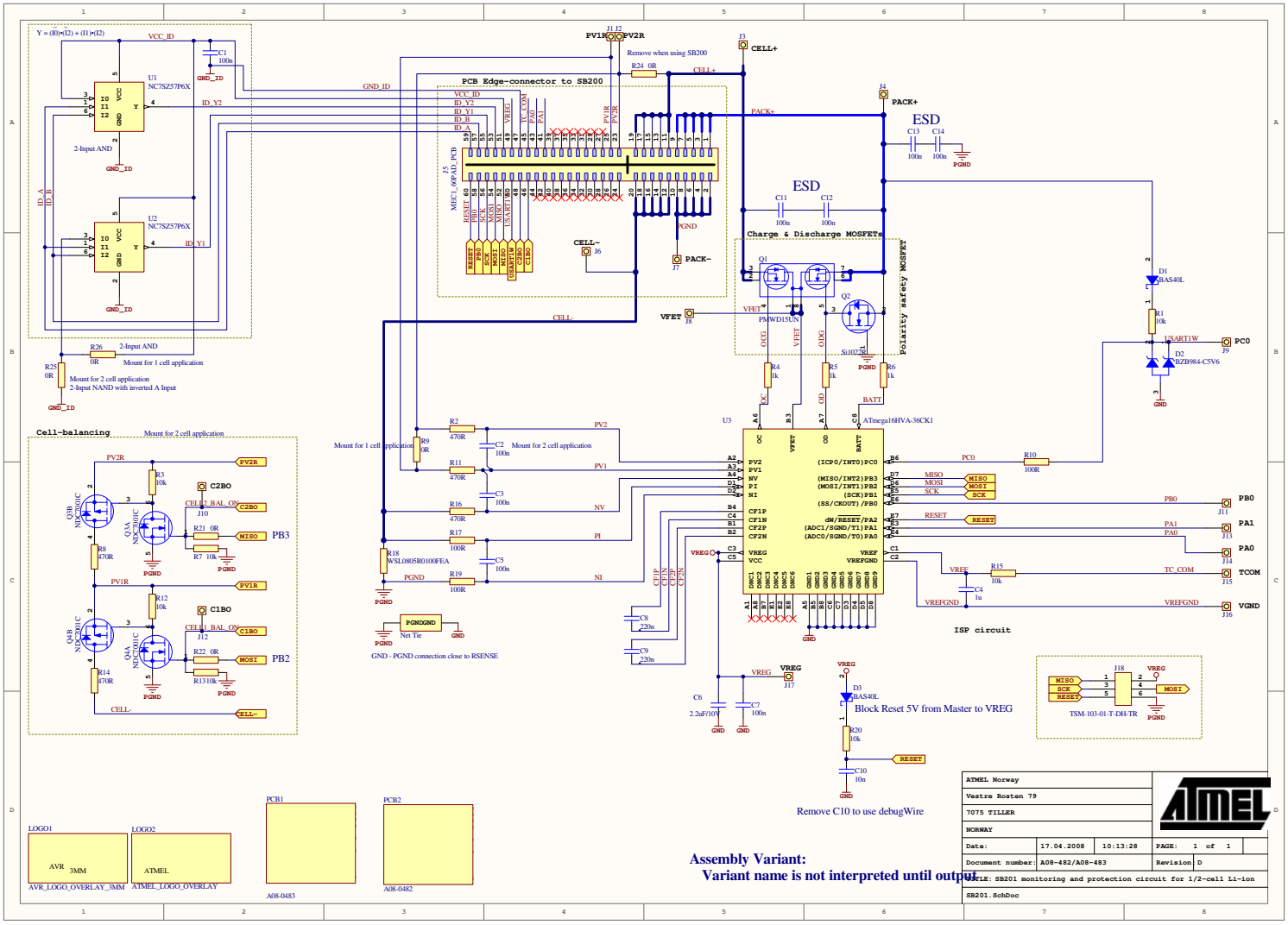
Frequency [MHz]	Active mode [mA]	Idle mode [mA]	Power save [µA]
1	1.00	0.38	30

Application current consumption is dependant on the firmware, and if communications are active as the ATmega16HVA has no hardware UART. AVR455 showed a typical current consumption of 160uA for SB201-1 in a 1-cell application.

9 Schematics

The schematics for SB201-1 and SB201-2 are provided in the .zip-file that can be downloaded from Atmel AVR Application notes. A small version of the common schematic is provided here.

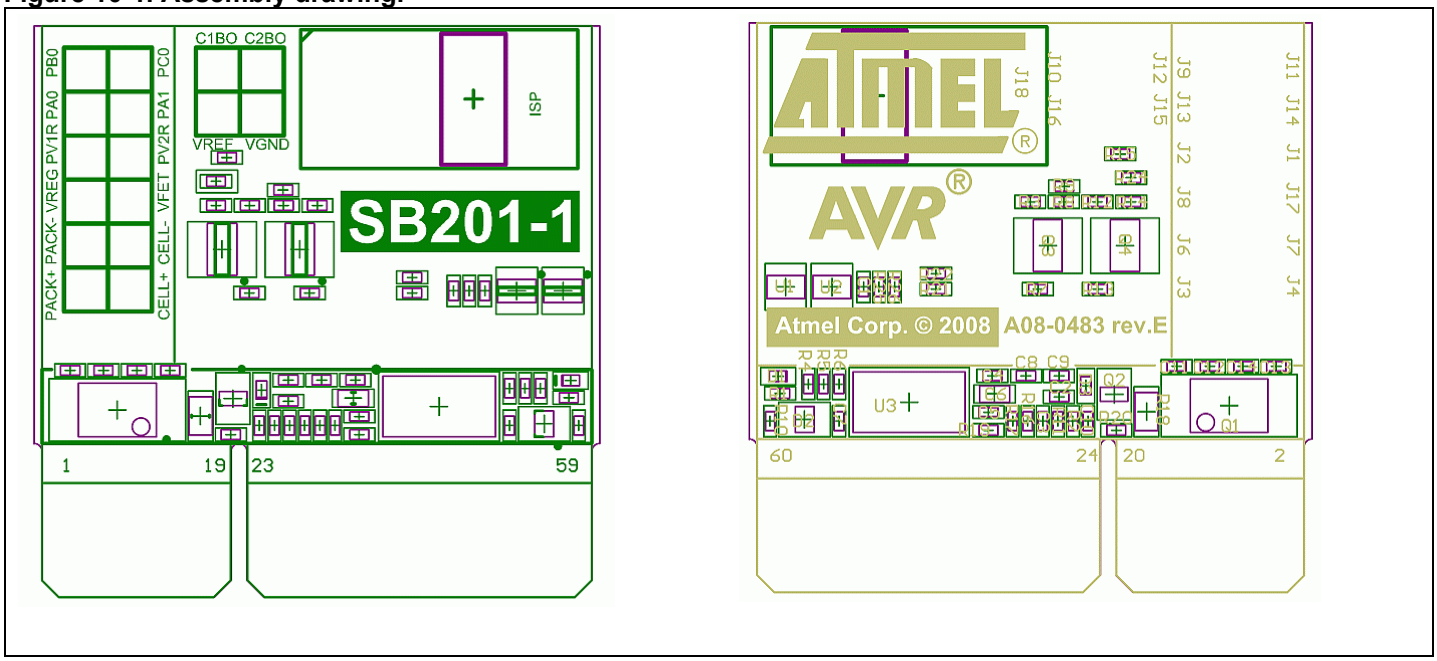
Figure 9-1. Schematics for SB201.



10 Component Placement

Component placement for SB201-1 and SB201-2 are provided in the .zip-file that can be downloaded from Atmel AVR Application notes. A small version of SB201-1 is shown here.

Figure 10-1. Assembly drawing.



11 Bill of Materials (BOM)

The BOM is provided in the .zip file that can be downloaded from Atmel AVR Application notes. The difference between SB201-1 and SB201-2 is that the SB201-2 provides cell balancing circuitry. Otherwise the SB201-1 has a 0 Ω resistor connecting PV2 and PV1, and the board identification has a different resistor mounting.b

12 EVALUATION BOARD/KIT IMPORTANT NOTICE

This evaluation board/kit is intended for use for **FURTHER ENGINEERING, DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY.** It is not a finished product and may not (yet) comply with some or any technical or legal requirements that are applicable to finished products, including, without limitation, directives regarding electromagnetic compatibility, recycling (WEEE), FCC, CE or UL (except as may be otherwise noted on the board/kit). Atmel supplied this board/kit "AS IS," without any warranties, with all faults, at the buyer's and further users' sole risk. The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies Atmel from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge and any other technical or legal concerns.

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