

Getting started with the STEVAL-ISB035V1 Li-Ion/Li-Po battery power management evaluation board based on STBC03

Introduction

The STEVAL-ISB035V1 is an evaluation board based on the STBC03 battery power management IC, integrating a linear charger for single-cell Li-Ion batteries with battery protection functions, an LDO regulator and two SPDT load switches.

The device uses a CC-CV algorithm to charge the battery; the fast-charge and pre-charge currents can be programmed using an external resistor.

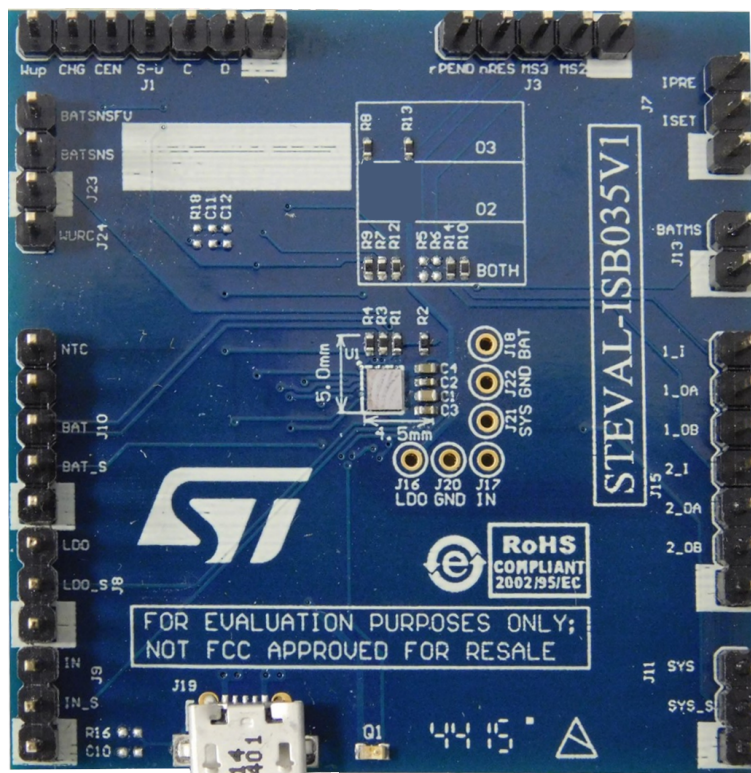
The input supply voltage is used to charge the battery and provide power to the LDO regulator. When a valid input voltage is not present and the battery is not empty, the device automatically switches to battery power.

When shutdown mode is activated, battery power consumption falls to less than 100 nA.

Two 3-Ω SPDT load switches with dedicated control input are embedded to intelligently manage overall system power consumption. The STEVAL-ISB035V1 can work in standalone mode, but several digital inputs can be used to control the STBC03 for full operation.

The STEVAL-ISB035V1 evaluation board provides full access to STBC03 functions through header connectors and can be supplied through a micro-AB USB connector.

Figure 1. STEVAL-ISB035V1 evaluation board



1 Board overview

The STEVAL-ISB035V1 evaluation board size is 50 mm x 50 mm.

The PCB is made by using FR4 glass epoxy support with 4 copper layers.

The device features:

- Charges single-cell Li-Ion/Li-Po batteries with CC-CV algorithm and charge termination
- Fast charge current programmable from 1 mA to 650 mA
- Pre-charge current programmable from 1 mA to 650 mA
- Adjustable floating voltage up to 4.45 V
- Integrated always-ON low quiescent LDO regulator
- Battery overcharge and over-discharge protections
- Overcurrent protection
- Shipping mode entry and exit inputs
- Integrated dual 3 Ω SPDT load switches
- Digital control inputs
- RoHS compliant

1.1 Input/output connector

The 7-pin CN1 input/output connector provides:

- Kelvin connection points for input and output voltage;
- enable signal input;
- double GND connection.

Table 1. Input/output connector: pin description

Connector	Pin number	Symbol	Signal name	Pin description
J1	2	D	CEN	Charger enable pin
	3	C	SD	Shutdown input signal
	4	S-w	SW_SEL2	Load switch 2 selection input
	5	CEN	CEN	Charger enable pin
	6	CHG	CHG	Charging/fault flag
	7	Wup	WakeUp	Shipping mode exit input pin
J3	2	MS2		
	3	MS3		
	4	nRES	BATMS_EN	EN battery voltage measurement
	5	rPEND	SW_SEL1	Load switch 1 selection input
J7	2	ISET	ISET	Fast-charge current programming resistor
	3	IPRE	IPRE	Pre-charge current programming resistor
J8	2	LDO	LDO	LDO output
	3	LDO_S	LDO_S	LDO output sensing (measurement)
J9	2	IN	IN	Input supply voltage
	3	IN_S	IN_S	Input supply voltage sensing (measurement)

Connector	Pin number	Symbol	Signal name	Pin description
J10	2	BAT_S	BAT_S	Battery sensing (measurement)
	3	BAT	BAT	Battery - positive terminal
	4	----	----	Pin floating
	5	NTC	NTC	Battery temperature monitor pin
J11	2	SYS	SYS	System output
	3	SYS_S	SYS_S	System output sensing (measurement)
J13	2	BATMS	BATMS	Battery voltage measurement pin
J15	2	1_I	SW1_I	Load switch SPDT1 input
	3	1_OA	SW1_OA	Load switch SDPT1 output A
	4	1_OB	SW1_OB	Load switch SPDT1 output B
	5	2_I	SW2_I	Load switch SPDT2 input
	6	2_OA	SW2_OA	Load switch SPDT2 output A
	7	2_OB	SW2_OB	Load switch SPDT2 output B
J19	VBUS	----	IN	Input supply voltage
J23	2	BATSNS	BAT	Battery voltage sensing
	3	BATSNSFV	BATSNSFV	Floating voltage sensing
J1, J3, J7, J8, J9, J10, J11, J13, J15, J23	1		GND	Ground connection

2 How to use the board

To use the STEVAL-ISB035V1 evaluation board, the first step is to connect the battery, then the input supply (e.g. USB).

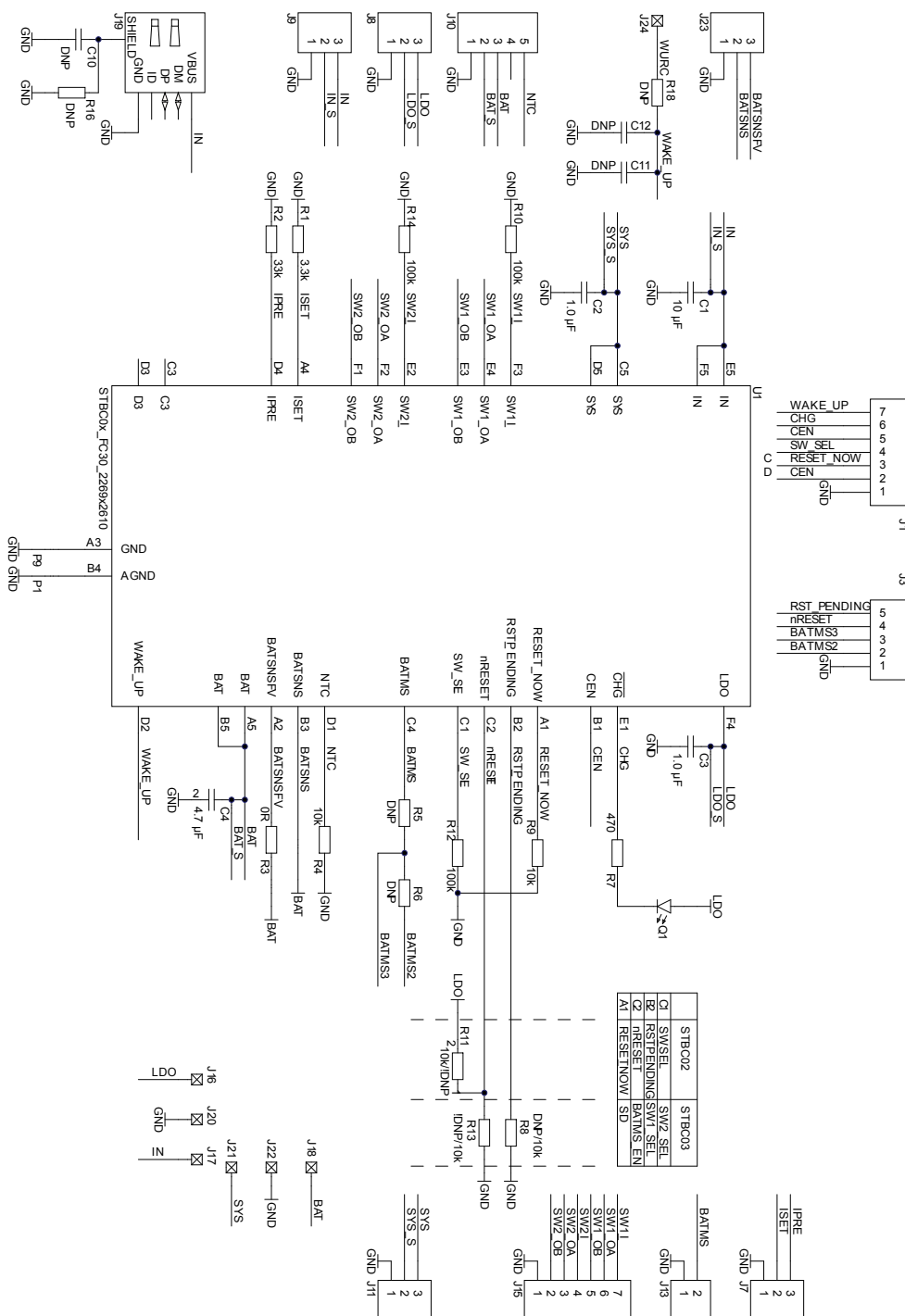
The board can work standalone, without embedded controller or configuring input pins.

The charger is dedicated to Li-Ion batteries, in the range of 0 (dead battery) to 4.5 V (overcharged battery).

The input operating supply voltage is 4.5 to 5.5 V_{DC}.

3 Schematic diagram

Figure 2. STEVAL-ISB035V1 circuit schematic



4 Bill of materials

Table 2. STEVAL-ISB035V1 bill of materials

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
1	1	C1	10 μ F 6.3 V $\pm$ 20% 0402 X5R	Ceramic capacitor	TDK	C1005X5R0J106M050BC
2	1	C2, C3	1.0 μ F 6.3 V $\pm$ 10% 0402 X5R	Ceramic capacitors	TDK	C1005X5R0J105
4	1	C4	4.7 μ F 6.3 V $\pm$ 10% 0402 X5R	Ceramic capacitor	TDK	C1005X5R0J475
5	0	C10, C11, C12, R5, R6, R11, R16, R18		Ceramic capacitor Resistors		NOT ASSEMBLED
6	2	J1, J15	2.54 mm pitch	Connector header 7POS	Any	Any
7	6	J3, J7, J8, J9, J11, J23	2.54 mm pitch	Connector header 3POS	Any	Any
8	1	J10	2.54 mm pitch	Connector header 5POS	Any	Any
9	1	J13	2.54 mm pitch	Connector header 2POS	Any	Any
10	1	J19		Micro USB connector	Molex	47589-0001
11	1	J24	2.54 mm pitch	Connector header 1POS	Any	Any
12	1	Q1	SMD 0603	Green LED	Any	Any
13	1	R1	3.3 k Ω 0.0625 W $\pm$ 1% 0402 SMD	Resistor	Any	Any
14	1	R2	33 k Ω 0.0625 W $\pm$ 1% 0402 SMD	Resistor	Any	Any
15	1	R3	0 R 0.0625 W $\pm$ 1% 0402 SMD	Resistor	Any	Any
16	1	R7	470 Ω 0.0625 W $\pm$ 1% 0402 SMD	Resistor	Any	Any
17	4	R4, R8, R9, R13	10 k Ω 0.0625 W $\pm$ 1% 0402 SMD	Resistors	Any	Any
18	3	R10, R12, R14	100 k Ω 0.0625 W $\pm$ 1% 0402 SMD	Resistors	Any	Any
19	1	U1	WLCSP 2.27 x 2.62 mm, 30 balls	Li-Ion linear battery charger with LDO and load switches	ST	STBC03JR

5 PCB layout

Figure 3. STEVAL-ISB035V1 PCB layout: top side

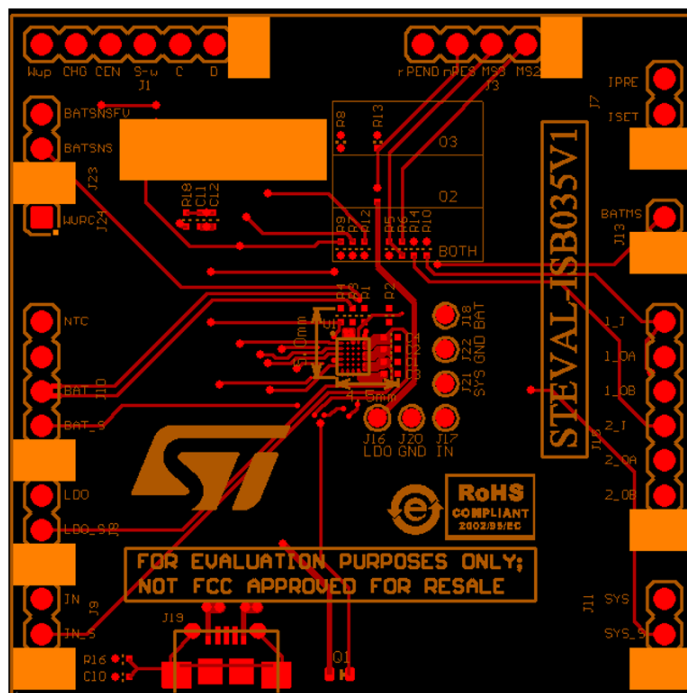
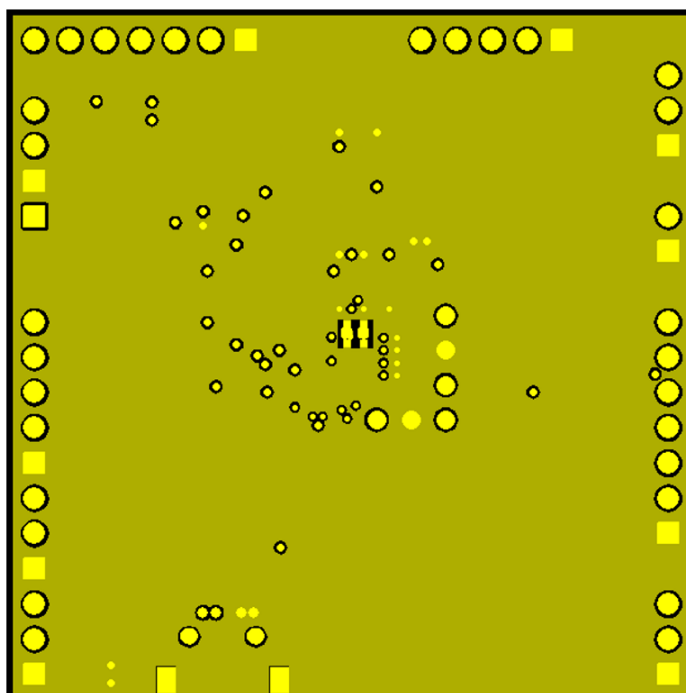


Figure 4. STEVAL-ISB035V1 PCB layout: bottom side



6 STBC03: block diagram and ballout

Figure 5. STBC03 block diagram

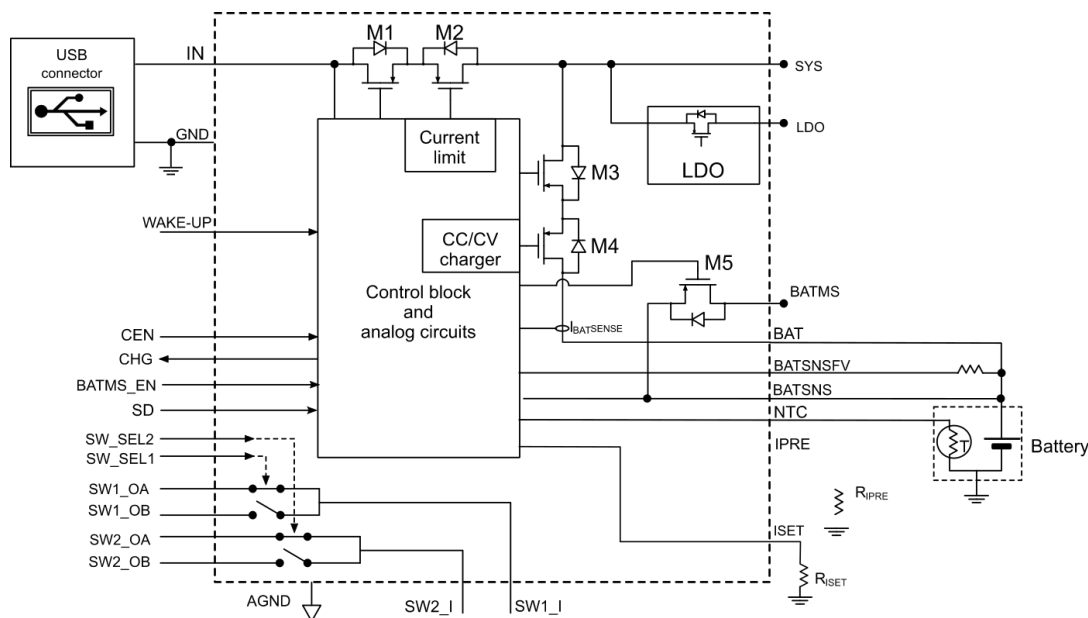


Figure 6. STBC03 pin configuration top through view

	1	2	3	4	5
A	A1 SD	A2 BATSNSFV	A3 GND	A4 ISET	A5 BAT
B	B1 CEN	B2 SW_SEL1	B3 BATSNS	B4 AGND	B5 BAT
C	C1 SW_SEL2	C2 BATMS_EN	C3 NC	C4 BATMS	C5 SYS
D	D1 NTC	D2 WAKE_UP	D3 NC	D4 IPRE	D5 SYS
E	E1 CHG	E2 SW_I	E3 SW1_OB	E4 SW1_OA	E5 IN
F	F1 SW2_OB	F2 SW2_OA	F3 SW1_I	F4 LDO	F5 IN

Table 3. Ball description

Bump Name	Bump Name	Description
Power	IN	E5-F5 Input supply voltage. Bypass this pin to ground with a 2.2 μ F capacitor
	BAT	A5-B5 Battery - positive terminal. Bypass this pin to GND with a 4.7 μ F ceramic capacitor
	SYS	C5-D5 System output. Bypass this pin to ground with a 2.2 μ F ceramic capacitor
	LDO	F4 3.1 V LDO output. Bypass this pin to ground with a 1 μ F ceramic capacitor
	NTC	D1 Battery temperature monitor pin
	AGND	B4 Analog Ground
	GND	A3 GROUND
Prog	ISSET	A4 Fast-charge current programming resistor
	IPRE	D4 Pre-charge current programming resistor
Sensing	BATMS	C4 Battery voltage measurement pin
	BATSNS	B3 Battery voltage sensing. Connect as close as possible to the battery positive terminal
	BATSNSFV	A2 Floating voltage sensing. Connect as close as possible to the battery positive terminal
Digital I/Os	CEN	B1 Charger enable pin. Active high. 500 k Ω internal pull-up (to LDO)
	CHG	E1 Charging/fault Flag. Active low (open drain output)
	WAKE-UP	D2 Shipping mode exit input pin. Active high. 500 k Ω internal pull-down
	SW_SEL2	C1 Load switches 2 selection input (See functional table; referred to LDO level)
	BATMS_EN	C2 Battery monitor enable input (refer to LDO level)
	SW_SEL1	B2 Load switches 2 selection input (See functional table; referred to LDO level)
	SD	A1 Shutdown input signal (refer to LDO level). When low, the STBC03 exits ship mode. It cannot be left floating.
Switch Matrix	SW1_I	F3 Load switch SPDT1 input (connect to 1.8 to 5 V range)
	SW1_OA	E4 Load switch SPDT1 output A (enabled/disabled PMOS)
	SW1_OB	E3 Load switch SPDT1 output B (enabled/disabled PMOS)
	SW2_I	E2 Load switch SPDT2 input (connect to 1.8 to 5 V range)
	SW2_OA	F2 Load switch SPDT2 output A (enabled/disabled PMOS)
	SW2_OB	F1 Load switch SPDT2 output B (enabled/disabled PMOS)
	NC	C3-D3 Not connected

Decoupling capacitors are recommended on inputs and output pins for noise minimization. These switches are not voltage regulated.

A General handling precautions

- Do not modify or manipulate the board and the device when the board is powered and/or connected to the load;
- Do not supply the board with a DC source higher than the device maximum voltage;
- Any equipment or tool used for any manipulation of the semiconductor devices or board modification should be connected to ground to avoid ESD;
- The connectors and cables must be plugged and removed when the board is not supplied;
- Antistatic tools are recommended.

Revision history

Table 4. Document revision history

Date	Version	Changes
28-Sep-2017	1	Initial release.
04-Apr-2018	2	Updated Figure 1 . STEVAL-ISB035V1 evaluation board, Table 1 . Input/output connector: pin description, Figure 6 . STBC03 pin configuration top through view and Table 3 . Ball description.

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