

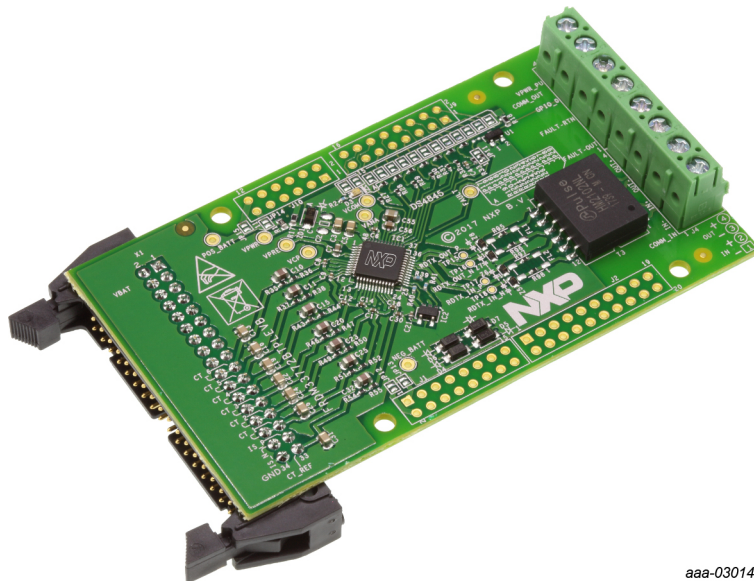
FRDM33772BTPLEVB

Featuring the MC33772B battery cell controller IC

Rev. 1.0 — 22 June 2018

User guide

1 FRDM33772BTPLEVB



aaa-030148



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3 Getting started

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The tool summary page for FRDM33772BTPLEVB is at nxp.com/FRDM33772BTPLEVB. The overview tab on this page provides an overview of the device, a list of device features, a description of the kit contents, links to supported devices and a **Get Started** section.

The **Get Started** section provides information applicable to using the FRDM33772BTPLEVB.

1. Go to nxp.com/FRDM33772BTPLEVB.
2. On the **Overview** tab, locate the **Jump To** navigation feature on the left side of the window.
3. Select the **Get Started** link.
4. Review each entry in the **Get Started** section.
5. Download an entry by clicking on the linked title.

After reviewing the **Overview** tab, visit the other related tabs for additional information:

- **Documentation:** Download current documentation.
- **Software & Tools:** Download current hardware and software tools.
- **Buy/Parametrics:** Purchase the product and view the product parametrics.

After downloading files, review each file, including the user guide, which includes setup instructions. If applicable, the Bill of Materials (BOM), supporting schematics, and layout are available via NXP DocStore. [6]

3.1 Kit contents/packing list

The kit contents include:

- Assembled and tested evaluation board/module in anti-static bag
- Quick-start guide

3.2 Required equipment

To use this kit, you need:

- A 3- to 6-cell battery pack, such as BATT-14AAAPACK, or a battery pack emulator, such as BATT-6EMULATOR

4 Getting to know the hardware

4.1 Board overview

The FRDM33772BTPLEVB serves as a hardware evaluation tool in support of NXP's MC33772B device. The MC33772B is a battery cell controller that monitors up to 6 lithium-ion battery cells. It is designed for use in both automotive and industrial

applications. The device performs ADC conversion on the differential cell voltages and currents. It is also capable of battery charge coulomb counting and battery temperature measurements. The FRDM33772BTPLEVB is an ideal platform for rapid prototyping of MC33772B-based applications that involve current, voltage, and temperature sensing.

The information is digitally transmitted to a microcontroller for processing. The evaluation board can be used in conjunction with a transceiver physical layer transformer driver (MC33664) to convert MCU SPI data bits to pulse bit information for the MC33772B and vice versa.

4.2 Board features

This FRDM33772BTPLEVB's main features are as follows:

- Daisy chain device connection
- LED indicator for operation mode
- Cell-balancing resistors
- Cell sense input with RC filter
- GPIO: digital I/O, wake-up inputs, convert trigger inputs, ratiometric analog inputs, analog inputs with absolute measurements
- EEPROM (connected to the IC with I²C interface) to store user-defined calibration parameters
- Fault detection pin report
- Current Measurement Input via external shunt

4.3 Block diagram

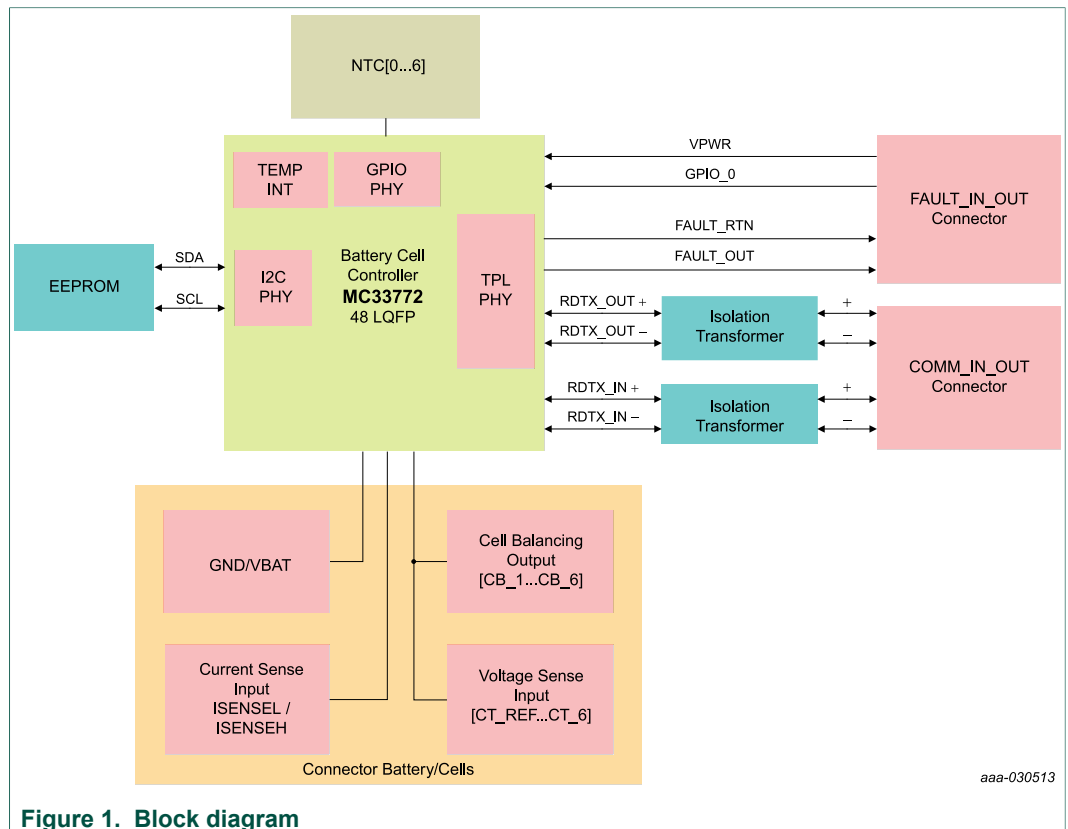


Figure 1. Block diagram

4.4 Device features

The MC33772B is a battery cell controller IC designed to monitor battery characteristics, such as voltage, current and temperature. The MC33772B contains all the circuit blocks necessary to perform synchronous battery cell voltage/current measurement, coulomb counting, cell temperature measurement and integrated cell balancing. The device supports the following functions:

Table 1. MC33772B device features

Device	Description	Features
MC33772B	Battery cell controller	<ul style="list-style-type: none"> • 5.0 V ≤ VPWR ≤ 30 V operation, 40 V transient • 3 to 6 cells management • 0.8 mV total cell voltage measurement error • Isolated 2.0 Mbps differential communication or 4.0 Mbps SPI • Addressable on initialization • Synchronized cell voltage/current measurement with coulomb count • Total stack voltage measurement • Seven GPIO/temperature sensor inputs • 5.0 V reference supply output with 5 mA capability • Automatic over/undervoltage and temperature detection routable to fault pin • Integrated sleep mode over/undervoltage and temperature monitoring • Onboard 300 mA passive cell balancing with diagnostics • Hot plug capable • Detection of internal and external faults, as open lines, shorts, and leakages • Designed to support ISO 26262 up to ASIL D safety system • Fully compatible with the MC33772 for a maximum of 14 cells • Qualified in compliance with AEC-Q100

4.5 Board description

The FRDM33772BTPLEVB allows the user to exercise all the functions of the MC33772B battery controller cell.

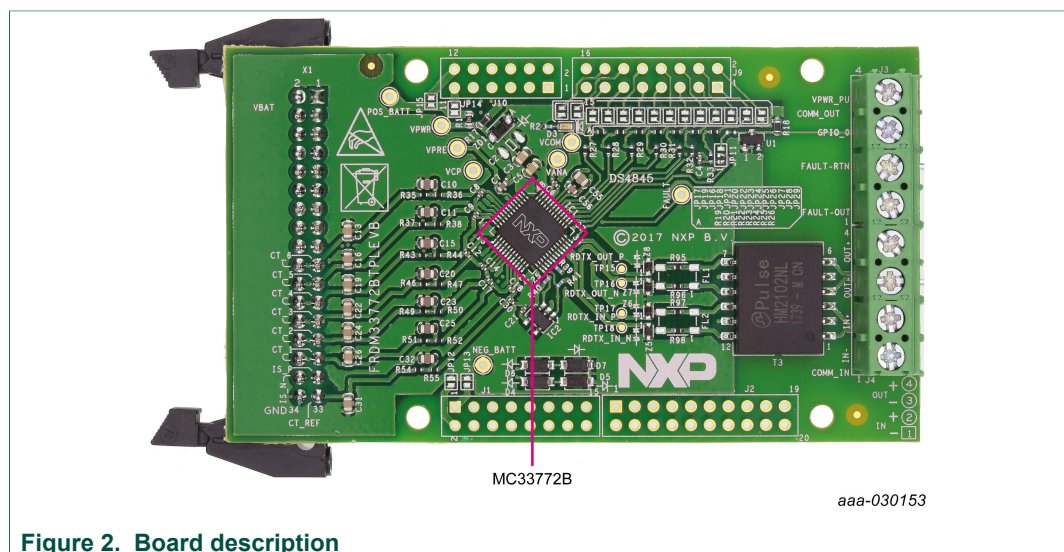
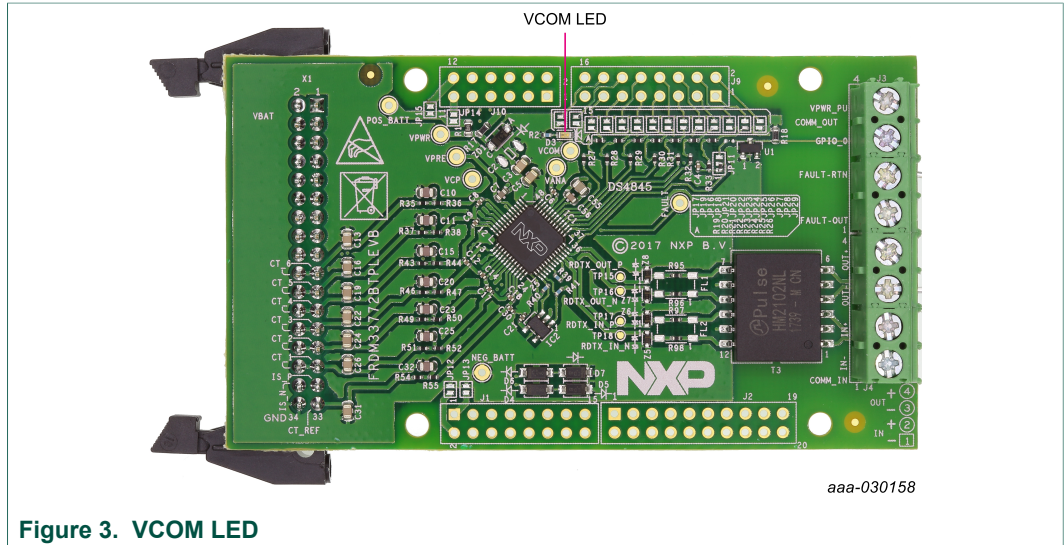


Table 2. Board description

Name	Description
MC33772B	Battery-cell controller IC

4.6 VCOM LED

The VCOM LED is located on the board as shown in [Figure 3](#).



The VCOM LED indicates when the device is in normal mode. Upon reset, the MC33772B enters into normal mode (VCOM turns on). If there is no activity on the bus after a timeout period of 60 seconds, the device enters low-power idle mode (VCOM turns off). Once the device is initialized, if no communication occurs on the TPL bus after one second, the device resets and the LED turns off (VCOM off). Depending on the device settings, the VCOM LED may flash 0.1...8 seconds during cyclic acquisition.

4.7 Test-point definitions

[Figure 4](#) shows the location of the test points on the board.

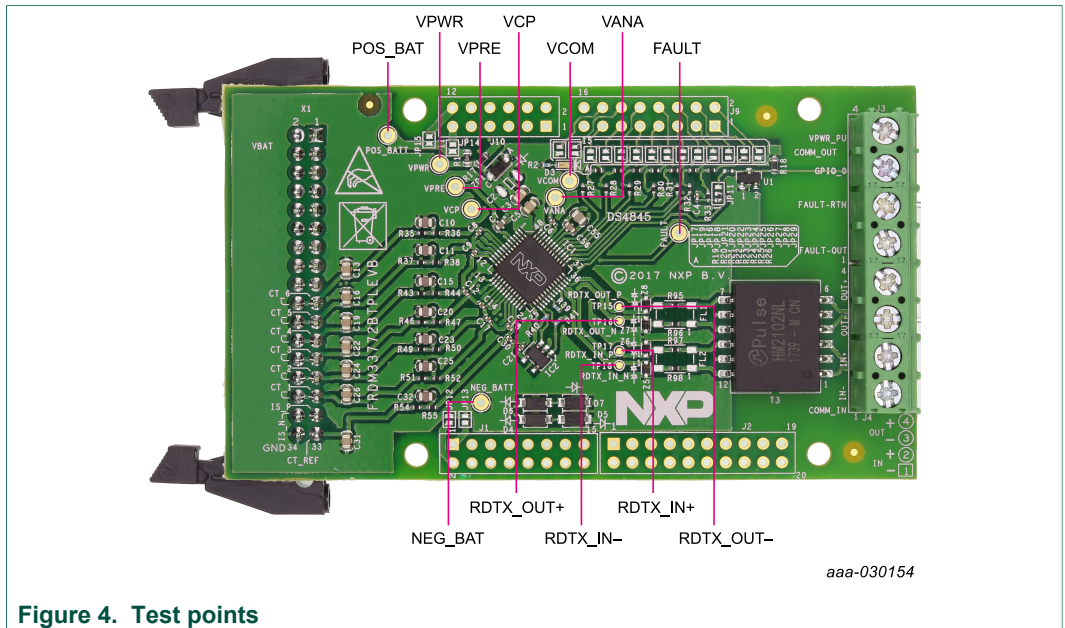


Figure 4. Test points

The following test points provide access to various signals to and from the board.

Table 3. Test points

Test-point name	Signal name	Description
RTDX_IN_N	SI/RTDX_IN-	Measures the isolated pulse communication
RTDX_IN_P	SCLK/RTDX_IN+	
RTDX_OUT_N	RTDX_OUT-	
RTDX_OUT_P	RTDX_OUT+	
FAULT	FAULT	Measures the fault detection sent by the device
NEG_BAT	GNDREF	Ground reference of the device
POS_BAT	V _{BAT}	Positive V _{BAT}
VCOM	VCOM	Communication regulator output
VPWR	VPWR	Power input to the device
VANA	VANA	Precision ADC analog supply output
VCP	VCP	VCP regulator output
VPRE	VPRE	VPRE regulator output

4.8 Connectors

Figure 5 shows the location of connectors on the board. The following tables list the pinouts for each connector.

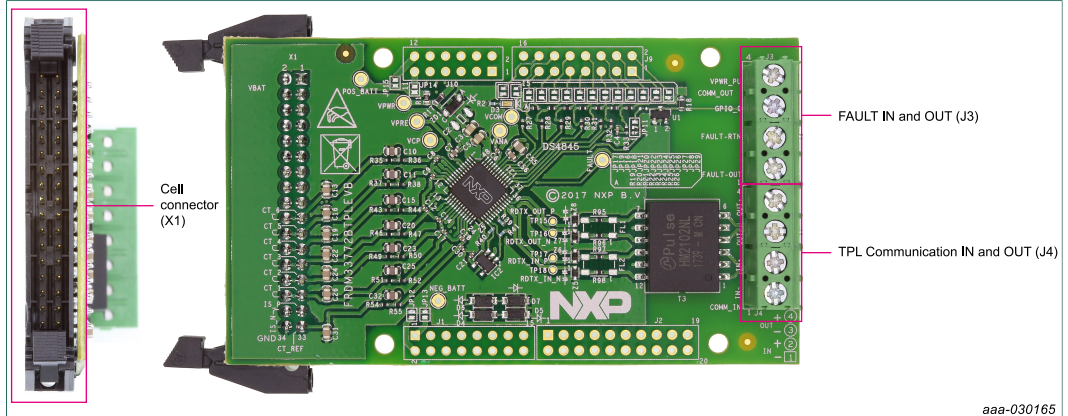


Figure 5. Connectors

aaa-030165

Table 4. Cell connector (X1)

Pin #	Connection	Description
X1-2	VBAT	MC33772B Power supply
X1-19	CT_6	Cell pin 6 input with external LPF resistor.
X1-20	CB_6	Cell balance driver. Terminate to cell 6 cell balance load resistor
X1-21	CT_5	Cell pin 5 input with external LPF resistor.
X1-22	CB_6:5_C	Cell balance 6:5 common. Terminate to cell 6 and 5 common pin
X1-23	CT_4	Cell pin 4 input with external LPF resistor.
X1-24	CB_5/CB_4	Cell balance driver. Terminate to cell 5 and 4 cell balance load resistor
X1-25	CT_3	Cell pin 3 input with external LPF resistor.
X1-26	CB_4:3_C	Cell balance 4:3 common. Terminate to cell 4 and 3 common pin
X1-27	CT_2	Cell pin 2 input with external LPF resistor.
X1-28	CB_3/CB_2	Cell balance driver. Terminate to cell 3 and 2 cell balance load resistor
X1-29	CT_1	Cell pin 1 input with external LPF resistor.
X1-30	CB_2:1_C	Cell balance 2:1 common. Terminate to cell 2 and 1 common pin
X1-31	ISENSE_P	Current measurement input+ with external filter RC
X1-32	ISENSE_N	Current measurement input- with external filter RC
X1-33	CT_REF CB_1	Cell pin REF input with external LPF resistor. Cell balance driver. Terminate to cell 1 cell balance load resistor.
X1-34	GND	Negative_Battery

4.9 External EEPROM

The FRDM33772BTPLEVB has an integrated gateway communication link to an external local EEPROM. The MC33772B's I²C Communication Interface manages communication with the EEPROM.

After a reset, the EEPROM is not enabled. When the EEPROM is enabled, the device can load the EEPROM calibration parameters into the MC33772B registers.

4.10 GPIO configuration

The FRDM33772BTPLEVB offers seven customizable GPIOs [GPIO_0...GPIO_6] for measuring external temperature with on-board or off-board NTCs. The off-board NTC connection is described in [Section 6.5 "Off-board NTC configuration"](#).

4.11 Cell terminal voltage measurement

The differential measurement of each cell terminal input is designed to function in conjunction with an external low path filter.

4.12 Fault detection

The FRDM33772BTPLEVB uses an optocoupler to detect a fault that is dependent on user defined internal or external faults.

The fault signal can be chained between EVBs and can be made available on the controller inputs. With two FRDM33772BTPLEVB boards, the fault is chained as shown in [Section 6.4 "Fault chain connection"](#).

4.13 Current sensing

The FRDM33772BTPLEVB supports current sense function with off-board shunt resistor. The off-board shunt resistor shall be connected between X1-31 (IS_P) and X1-32 (IS_N). On-board current sensing filter and protection circuits can be found in EVB schematic shared via NXP DocStore (NDA required).

4.14 Bus terminal communication

The transformers isolate communication between the MC33772B and the pack controller and between each MC33772B. They are protected against ESD. There are significant advantages to using transformers for isolation and communication:

- High degree of voltage isolation
- Communication rates of 2.0 MHz with very low radiated emissions
- Ability to force the secondary signals to be true differential reducing radiated emissions
- Ability to loop the network back to the pack controller

Detailed schematic, component selection, and layout recommendations can be obtained from the NXP DocStore (NDA required). [\[6\]](#)

5 Accessory transceiver board

The FRDM33772BTPLEVB kit is designed for use with the FRDM33664BEVB in high-voltage isolated applications that provide a SPI-to-high-speed isolated communication interface. The FRDM33664BEVB includes an MC33664 isolated network high speed transceiver. MCU SPI data bits are directly converted to pulse bit information.

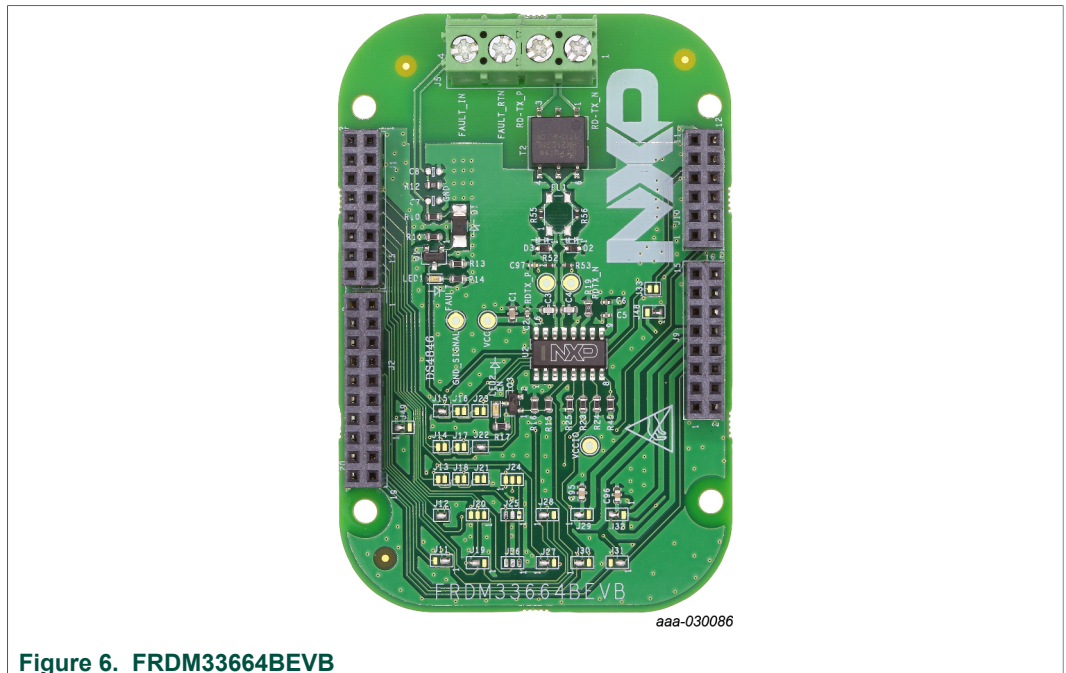


Figure 6. FRDM33664BEVB

6 Configuring the hardware

6.1 Battery stack connection

A minimum of 3 cells and a maximum of 6 cells can be monitored. NXP provides a 6-cell battery emulator board, BATT-6EMULATOR. This board provides an intuitive way to change the voltage across any of the 6 cells of an emulated battery pack as well as the voltage across an emulated current sense shunt resistor. In addition, a battery pack (BATT-14AAAPACK, in [Figure 7](#)) using AAA batteries is available to support FRDM33772BTPLVVB.

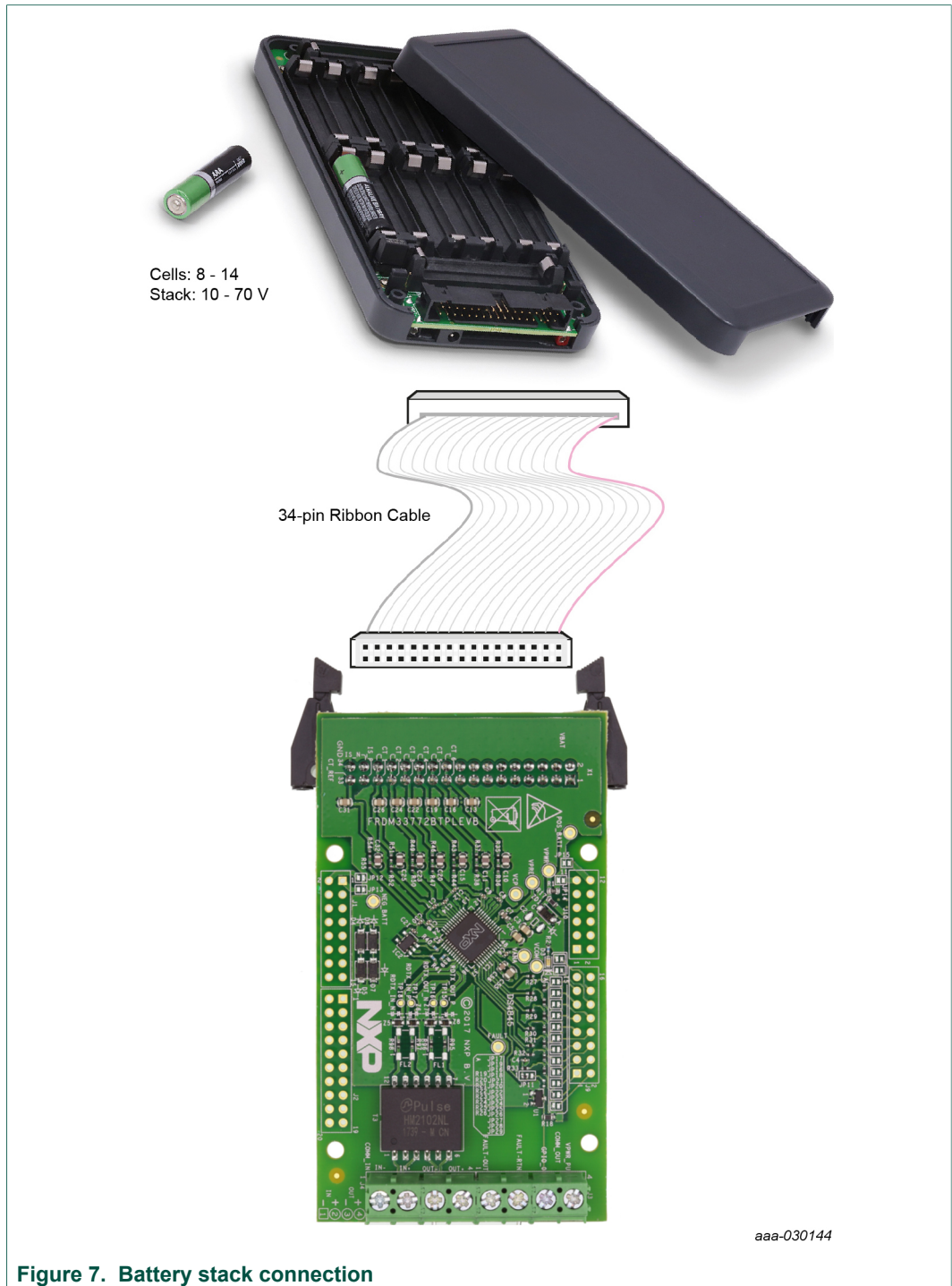


Figure 7. Battery stack connection

6.2 Jumper connection

One hand-soldered jumper (JP11) on the EVB is used to set the GPIO0 pin input. In position 1-2 (default), the NTC (NTC0) is connected to GPIO0 pin of the MC33772B. This input can be used as analog input. If the jumper is placed in position 2-3, the GPIO0 can be used as fault input for fault daisy chain function (need to populate R26 with a 10 k resistor).

6.3 TPL communication connection

In a high-voltage Isolated application with a daisy chain configuration, up to 15 FRDM33772BTPLEVB boards may be connected.

The TPL connections use the COMM (J4) connector.

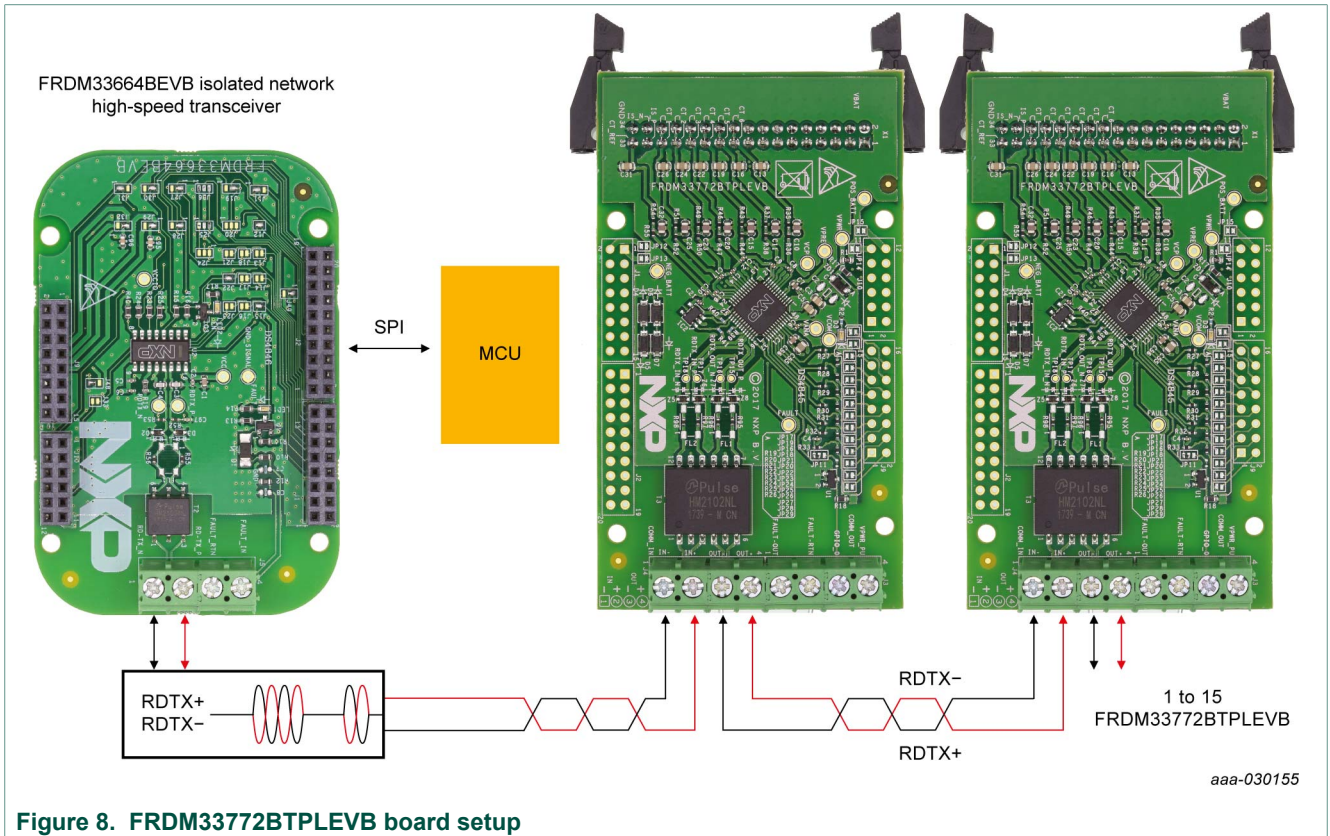


Figure 8. FRDM33772BTPLEVB board setup

6.4 Fault chain connection

The FAULT chain connection is optional. When used, it connects through the FAULT (J3) connector.

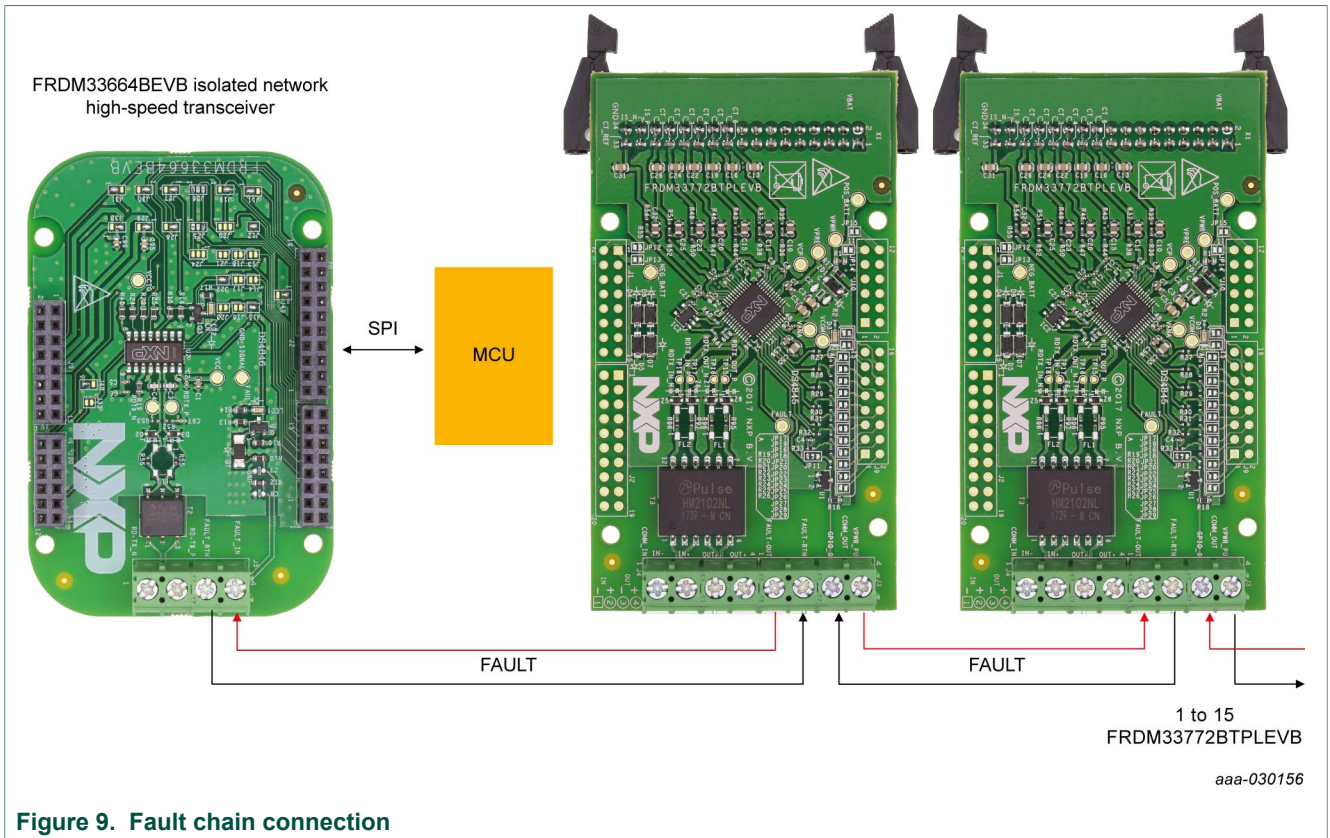


Figure 9. Fault chain connection

6.5 Off-board NTC configuration

FRDM33772BTPLEVB supports off-board NTC, please follow the instruction in [Table 5](#).

Table 5. Off-board NTC configuration

	Remove	Short	Short	Connect off-board NTC between
NTC0	NTC0	JP28	JP29	J9 1–2
NTC1	NTC1	JP26	JP27	J9 3–4
NTC2	NTC2	JP24	JP25	J9 5–6
NTC3	NTC3	JP22	JP23	J9 7–8
NTC4	NTC5	JP20	JP21	J9 9–10
NTC5	NTC4	JP18	JP19	J9 11–12
NTC6	NTC6	JP16	JP17	J9 13–14

7 Available accessories

Note: NXP does not assume liability, endorse, or warrant components from external manufacturers are referenced in circuit drawings or tables. While NXP offers component recommendations in this configuration, it is the customer's responsibility to validate their application.

Table 6. Bill of materials

Part number	Description
M50-9101742	34-pin ribbon cable
BATT-6EMULATOR	6-cell slider battery pack emulator kit with shunt for current sense
FRDM33664BEVB	EVB for MC33664ATL Isolated Network High-Speed Transceiver

8 References

- [1] Board summary page — nxp.com/FRDM33772BTPLEVB
- [2] Product summary page — nxp.com/BATTERY-CELL-CONTROLLERS
- [3] Tool summary page — nxp.com/FRDM33664BEVB
- [4] Tool summary page for BATT-14AAAPACK battery pack — nxp.com/BATT-14AAAPACK
- [5] Tool summary page for battery emulators — nxp.com/BATT-6EMULATOR
- [6] NXP DocStore — docstore.nxp.com

9 Revision history

Table 7. Revision history

Rev	Date	Description
v.1.0	20180622	Initial release

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