

UM12140

RDI7014DT1 featuring the BMI7014TA1 battery cell controller IC

Rev. 1 — 12 August 2024

User manual

Document information

Information	Content
Keywords	RDI7014DT1, hardware, evaluation, BMI7014TA1, battery-cell controller
Abstract	The RDI7014DT1 serves as a hardware evaluation tool in support of NXP's BMI7014TA1 device.



1 Introduction

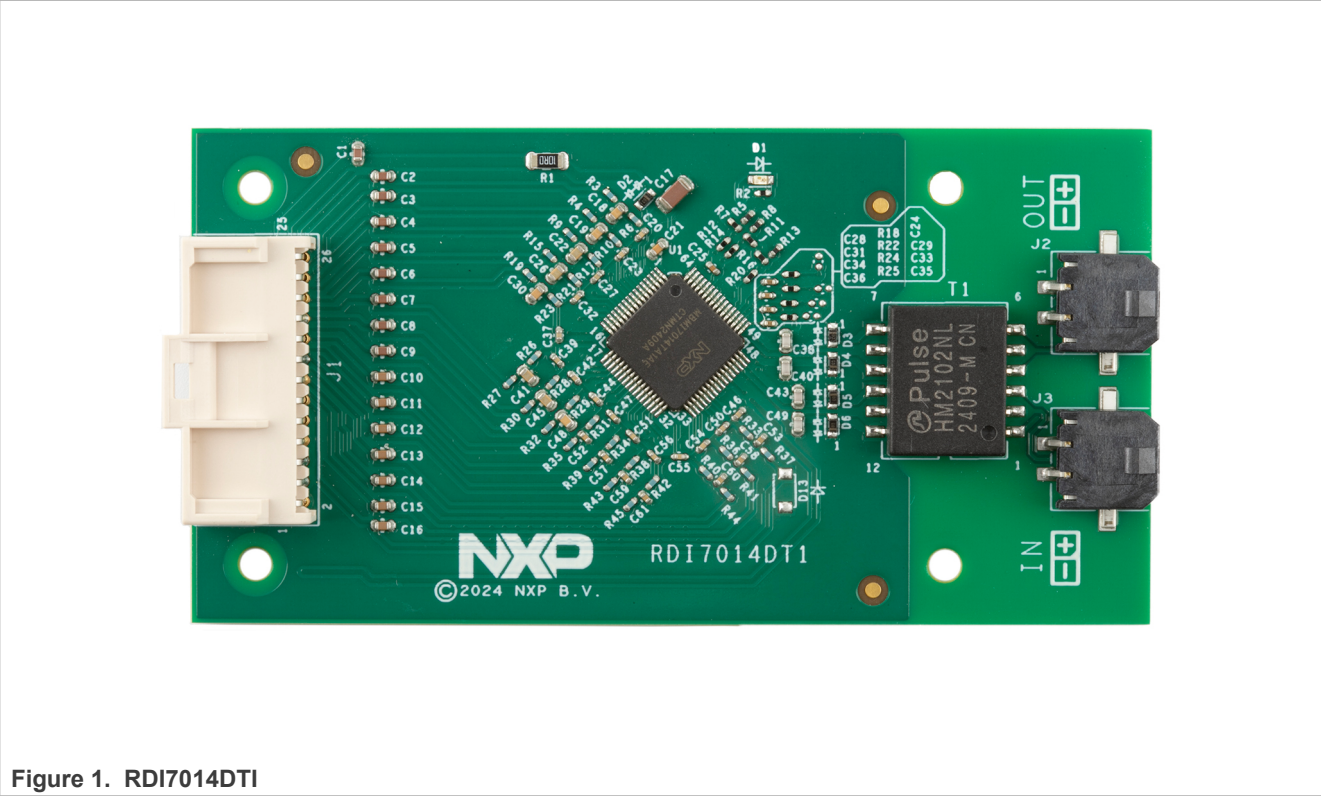


Figure 1. RDI7014DTI

NXP analog product development boards provide an easy-to-use platform for evaluating NXP products. These development boards support a range of analog, mixed-signal, and power solutions. These boards incorporate monolithic integrated circuits (IC) and system-in-package devices that use proven high-volume technology. NXP products offer long battery life, a small form factor, reduced component counts, low cost, and excellent performance in powering state-of-the-art systems.

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2 Finding the kit resources and information on the NXP website

NXP Semiconductors provides online resources for this evaluation board and its supported device(s) on <http://www.nxp.com>.

The information page for the RDI7014DT1 evaluation board is at <http://www.nxp.com/RDI7014DT1>. The information page provides overview information, documentation, software and tools, parametrics, ordering information and a Getting Started tab. The Getting Started tab provides quick-reference information applicable to using the RDI7014DT1 evaluation board, including the downloadable assets referenced in this document.

3 Getting ready

The tool summary page for RDI7014DT1 is nxp.com/RDI7014DT1. 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 RDI7014DT1.

1. Go to nxp.com/RDI7014DT1.
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 the linked title.

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

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

After downloading the 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 Secure Files in NXP^[5].

3.1 Kit contents

- Assembled and tested evaluation board/module in an antistatic bag
- Cell-terminal cable
- TPL cable
- Quick Start guide

3.2 Additional hardware

- A 7-cell to 14-cell battery pack or a battery pack emulator, such as BATT-14CEMULATOR

4 Getting to know the hardware

4.1 Board overview

The RDI7014DT1 serves as a hardware evaluation tool that supports NXP's BMI7014TA1 device. The BMI7014TA1 is a battery-cell controller that monitors up to 14 Li-ion battery cells. It is designed for use in industrial applications. The device performs analog-to-digital conversion (ADC) on the differential cell voltages. It is also capable of battery temperature measurements. The RDI7014DT1 is an ideal platform for rapid prototyping of BMI7014TA1-based applications that involve voltage and temperature sensing.

The RDI7014DT1 includes a transformer enabling communication in a high-speed isolated communication network. The information is digitally transmitted to a microcontroller for processing. The evaluation board can be used with a transceiver physical layer (TPL) transformer driver (MC33664) to convert microcontroller unit serial peripheral interface (MCU SPI) data bits to pulse-bit information for the BMI7014TA1 and vice versa.

4.2 Board features

The main features of the RDI7014DT1 are as follows:

- Daisy-chain device connection
- LED indicator for operation mode
- Cell-balancing resistors
- Transformer isolation
- Cell-sense input with RC filter
- GPIO: digital I/O, wake-up inputs, convert trigger inputs, ratiometric analog inputs, analog inputs with absolute measurements

4.3 Block diagram

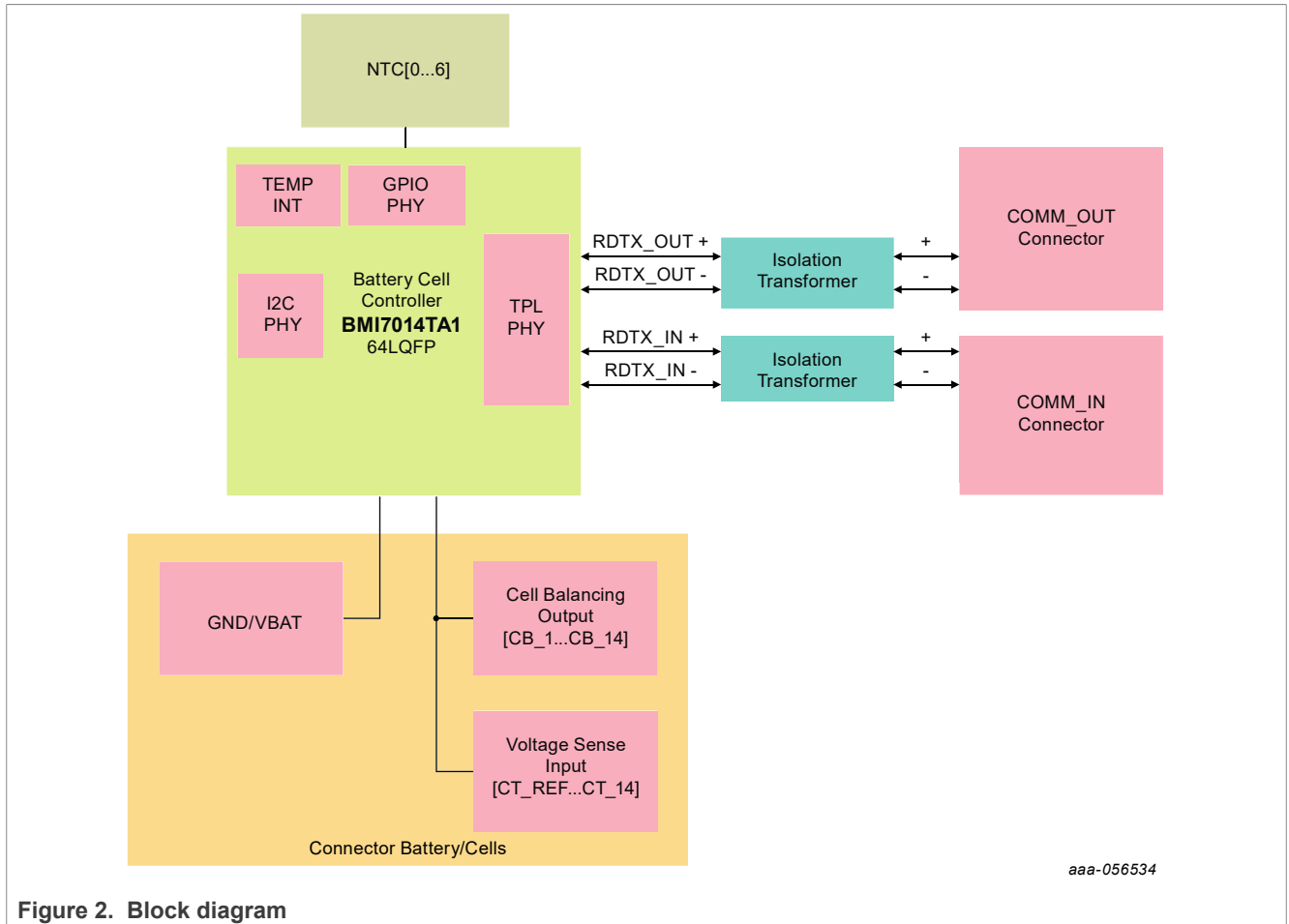


Figure 2. Block diagram

4.4 Device features

The BMI7014TA1 is a SMARTMOS Li-ion battery-cell controller IC family designed for industrial applications, such as energy storage systems (ESS) and uninterruptible power supply (UPS) systems.

The device performs ADC conversions of the differential cell voltages and battery temperature measurements.

The information is transmitted to the MCU using one of the microcontroller interfaces (SPI or transformer physical layer (TPL)) of the IC.

The BMI7014TA1 supports the following functions:

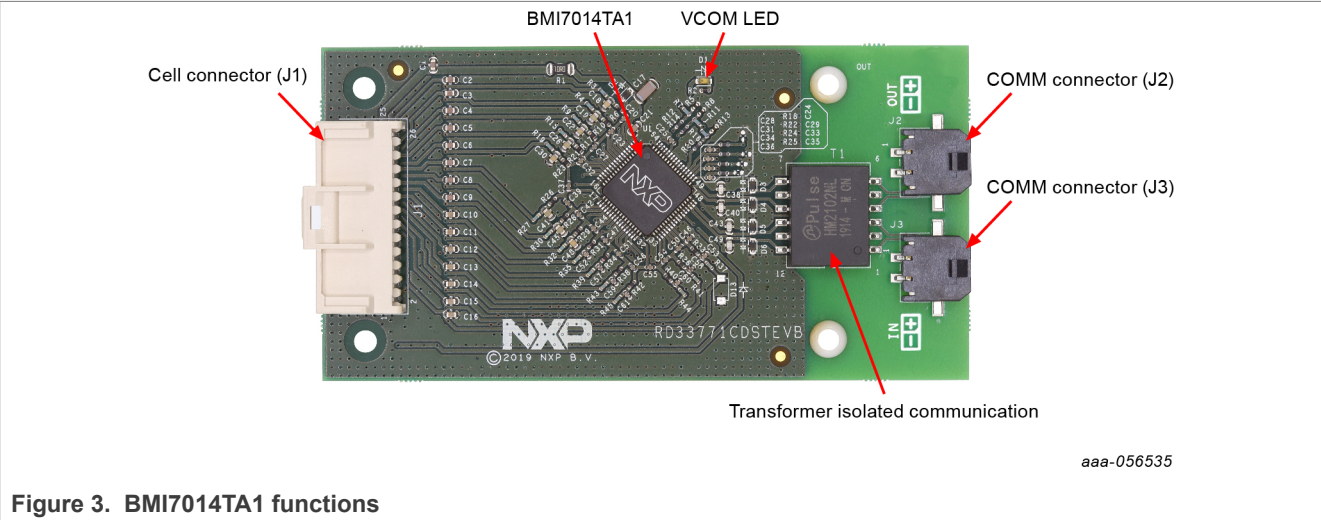
RDI7014DT1 featuring the BMI7014TA1 battery cell controller IC

Table 1. BMI7014TA1 device features

Device	Description	Features
BMI7014TA1	Battery-cell controller	• 9.6 V ≤ V_{PWR} ≤ 61.6 V operation, 75 V transient • Seven cells to 14 cells management • Isolated 2.0 Mbps differential communication or 4.0 Mbps SPI • Addressable on initialization • Bidirectional transceiver to support up to 63 nodes in a daisy chain • 0.8 mV maximum total voltage measurement error • Averaging of cell-voltage measurements • Total stack voltage measurement • Seven GPIO/temperature sensor inputs • 5.0 V at 5.0 mA reference supply output • 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 • Qualified in compliance with AECQ-100

4.5 Board description

The RDI7014DT1 allows the user to exercise all the functions of the BMI7014TA1 battery controller cell.



4.6 VCOM LED

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

The VCOM LED indicates when the device is in Normal mode. Upon reset, the BMI7014TA1 enters 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 Connectors

Figure 3 shows the location of the connectors on the board. Table 2, Table 3, and Table 4 list the pinouts for each connector.

Table 2. Cell connector (J1)

Pin	Connection	Description
1	GND	NTC connection (-)
2	NTC3	NTC connection (+)
3	GND	NTC connection (-)
4	NTC2	NTC connection (+)
5	GND	NTC connection (-)
6	NTC1	NTC connection (+)
7	GND	NTC connection (-)
8	NTC0	NTC connection (+)
9	GND	negative battery
10	GND	negative battery
11	CELL_1	Battery cell1P connection
12	CELL_REF	Battery cell1M connection
13	CELL_3	Battery cell3P connection
14	CELL_2	Battery cell2P connection
15	CELL_5	Battery cell5P connection
16	CELL_4	Battery cell4P connection
17	CELL_7	Battery cell7P connection
18	CELL_6	Battery cell6P connection
19	CELL_9	Battery cell9P connection
20	CELL_8	Battery cell8P connection
21	CELL_11	Battery cell11P connection
22	CELL_10	Battery cell10P connection
23	CELL_13	Battery cell13P connection
24	CELL_12	Battery cell12P connection
25	VBAT	positive battery
26	CELL_14	Battery cell14P connection

Table 3. COMM connector (J2)

Pin #	Name	Description
1	OUT+	Receive/transmit output positive
2	OUT-	Receive/transmit output negative

Table 4. Table 4. COMM connector (J3)

Pin #	Name	Description
1	IN+	Receive/transmit input positive
2	IN–	Receive/transmit input negative

4.8 Temperature measurement

The RDI7014DT1 offers seven GPIOs [GPIO_0...GPIO_6] for measuring external temperature with onboard or offboard NTCs. Four offboard negative temperature coefficient (NTC) connections are available on the J1 connector.

4.9 Cell-terminal voltage measurement

The differential measurement of each cell-terminal input is designed to function with an external antialiasing filter.

4.10 Bus-terminal communication

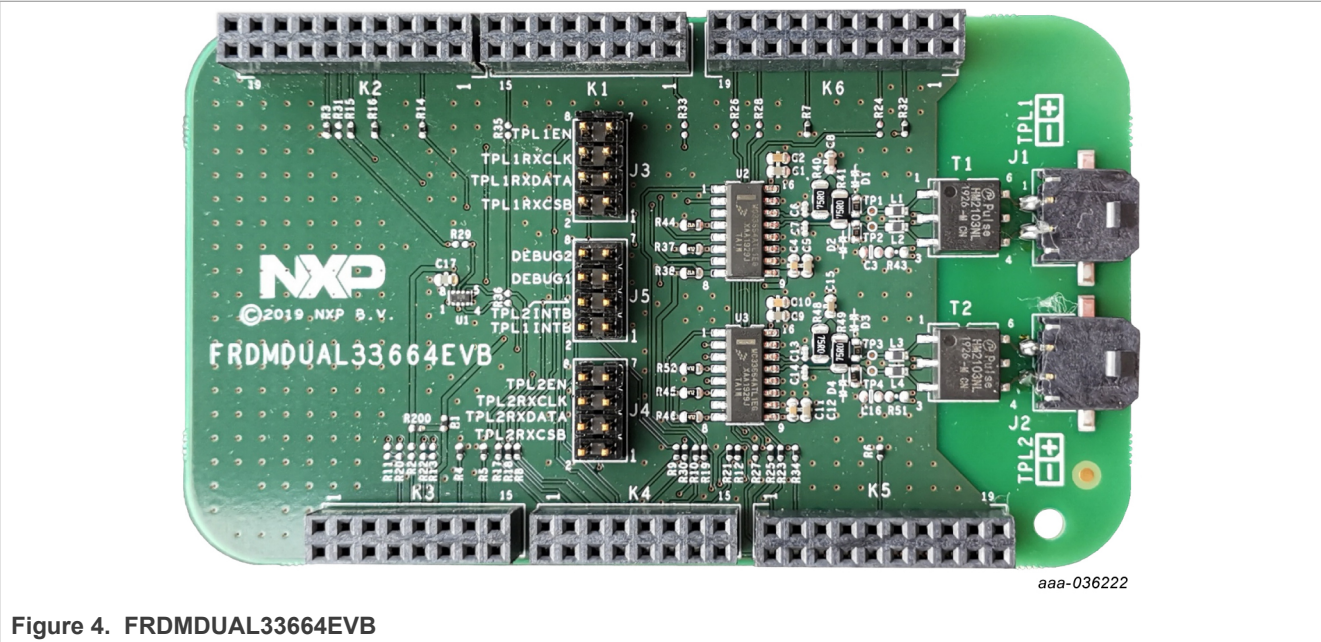
The transformers isolate communication between the BMI7014TA1 and the pack controller and between each BMI7014TA1. They are protected against ESD. There are significant advantages to using transformers for isolation and communication:

- High degree of voltage isolation
- Communication rates of 2.0 MHz with 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) [\[5\]](#).

5 Accessory transceiver board

The RDI7014DT1 kit is designed for use with the FRDMDUAL33664EVB in high-voltage, isolated applications that provide a SPI-to-high-speed isolated communication interface. The FRDMDUAL33664EVB includes two MC33664 isolated network, high-speed transceivers allowing loopback connection. MCU SPI data bits are directly converted to pulse-bit information.



6 Configuring the hardware

6.1 Battery-emulator connection

A minimum of seven cells and a maximum of 14 cells can be monitored. NXP provides a 14-cell battery emulator board, BATT-14CEMULATOR. This board provides an intuitive way to change the voltage across any of the 14 cells of an emulated battery pack and four voltage outputs to emulate four external NTCs. The emulator board can be connected to the RDI7014DT1 connector J1 using the provided supply cable. See [Figure 5](#).

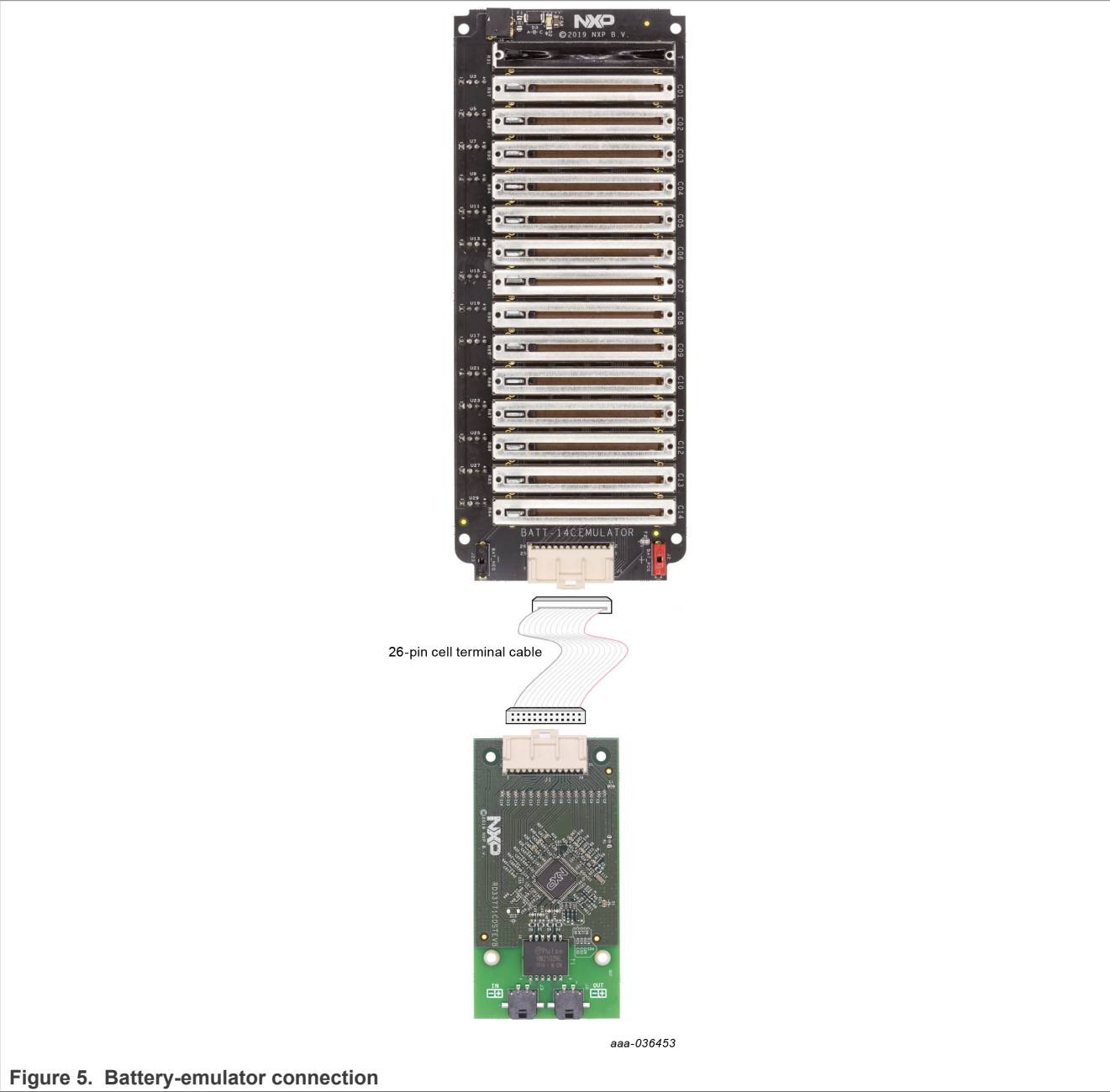


Figure 5. Battery-emulator connection

6.2 TPL communication connection

In a high-voltage, isolated application with a daisy-chain configuration, up to 63 RDI7014DT1 boards may be connected.

The TPL connections use the COMM connectors (J2, J3).

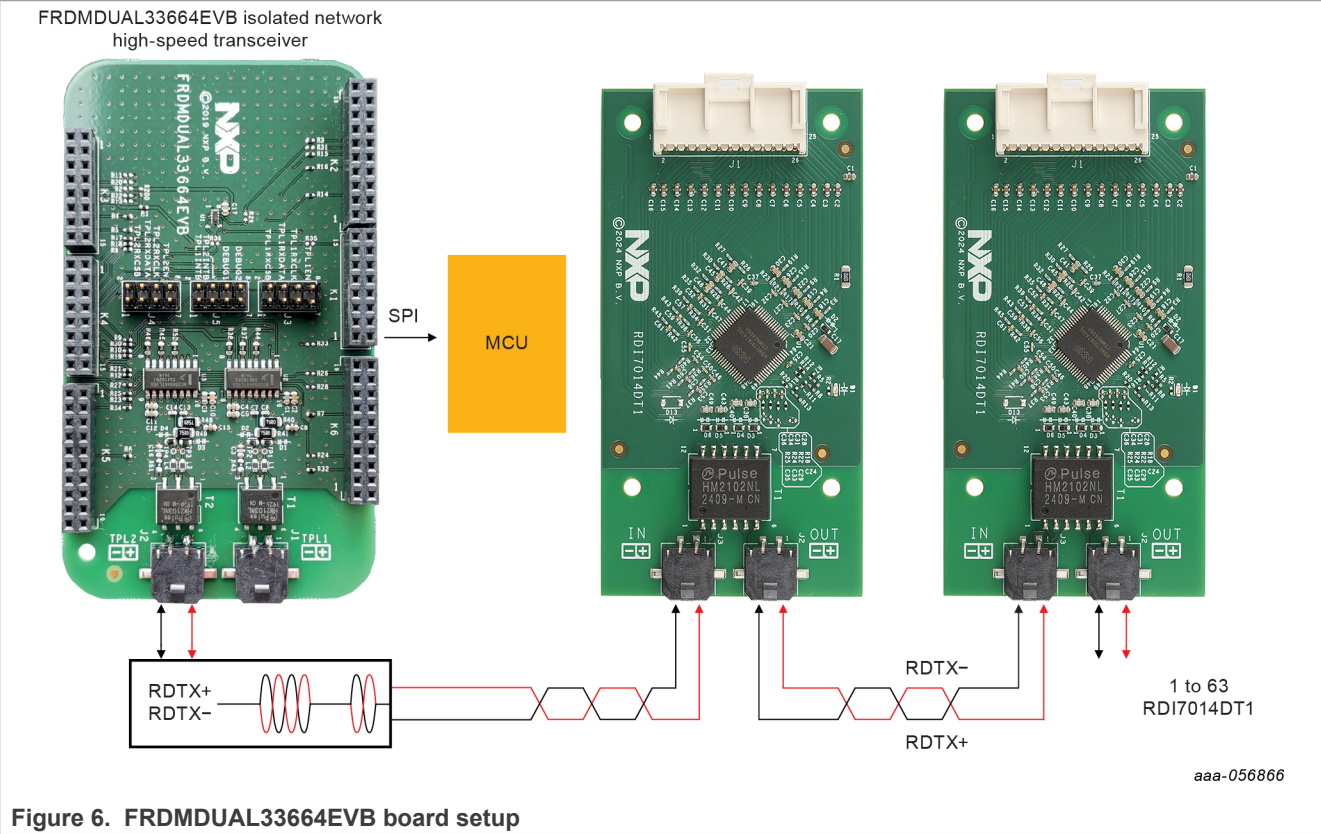


Figure 6. FRDMDUAL33664EVB board setup

7 Available accessories

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

Table 5. Bill of materials

Part number	Description
BATT-14CEMULATOR	14-cell slider battery pack emulator kit with shunt for current sense
FRDMDUAL33664EVB	EVB for MC33664ATL isolated network high-speed transceiver

8 References

1. **Board summary page** — nxp.com/RDI7014DT1
2. **Product summary page** — nxp.com/BATTERY-CELL-CONTROLLERS
3. **Tool summary page** — nxp.com/FRDMDUAL33664EVB
4. **Tool summary page for battery emulators** — nxp.com/BATT-14CEMULATOR
5. **Secure files on NXP.com** — docstore.nxp.com

9 Revision history

Table 6. Revision history

Document ID	Release date	Description
UM12140 v.1.0	12 August 2024	Initial version

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