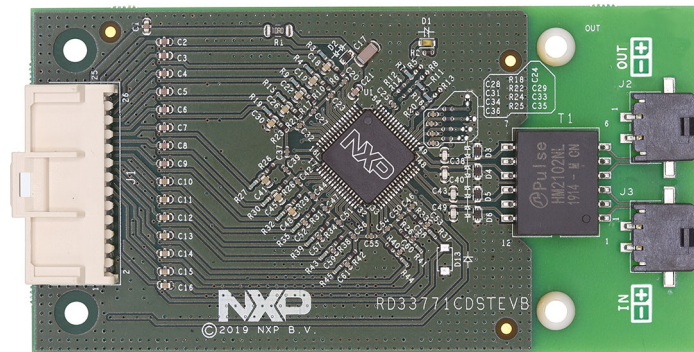


UM11343

RD33771CDSTEB featuring the MC33771C battery cell controller IC

Rev. 1.0 — 14 January 2020

User manual



aaa-036295

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1 Getting started

The 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 and system-in-package devices that use proven high-volume technology. NXP products offer longer battery life, a smaller form factor, reduced component counts, lower cost, and improved performance in powering state-of-the-art systems.

The tool summary page for RD33771CDSTEB is at nxp.com/RD33771CDSTEB. 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 RD33771CDSTEB.

1. Go to nxp.com/RD33771CDSTEB.
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. [5]

1.1 Kit contents/packing list

The kit contents include:

- Assembled and tested evaluation board/module in anti-static bag
- Cell terminal cable
- TPL cable
- Quick-start guide

1.2 Required equipment

To use this kit, you need:

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

2 Getting to know the hardware

2.1 Board overview

The RD33771CDSTEB serves as a hardware evaluation tool in support of NXP's MC33771C device. The MC33771C is a battery cell controller that monitors up to 14 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 RD33771CDSTEB is an ideal platform for rapid prototyping of MC33771C-based applications that involve current, voltage, and temperature sensing.

The RD33771CDSTEB 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 in conjunction with a transceiver physical layer transformer driver (MC33664) to convert MCU SPI data bits to pulse bit information for the MC33771C and vice versa.

2.2 Board features

This RD33771CDSTEB's main features 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

2.3 Block diagram

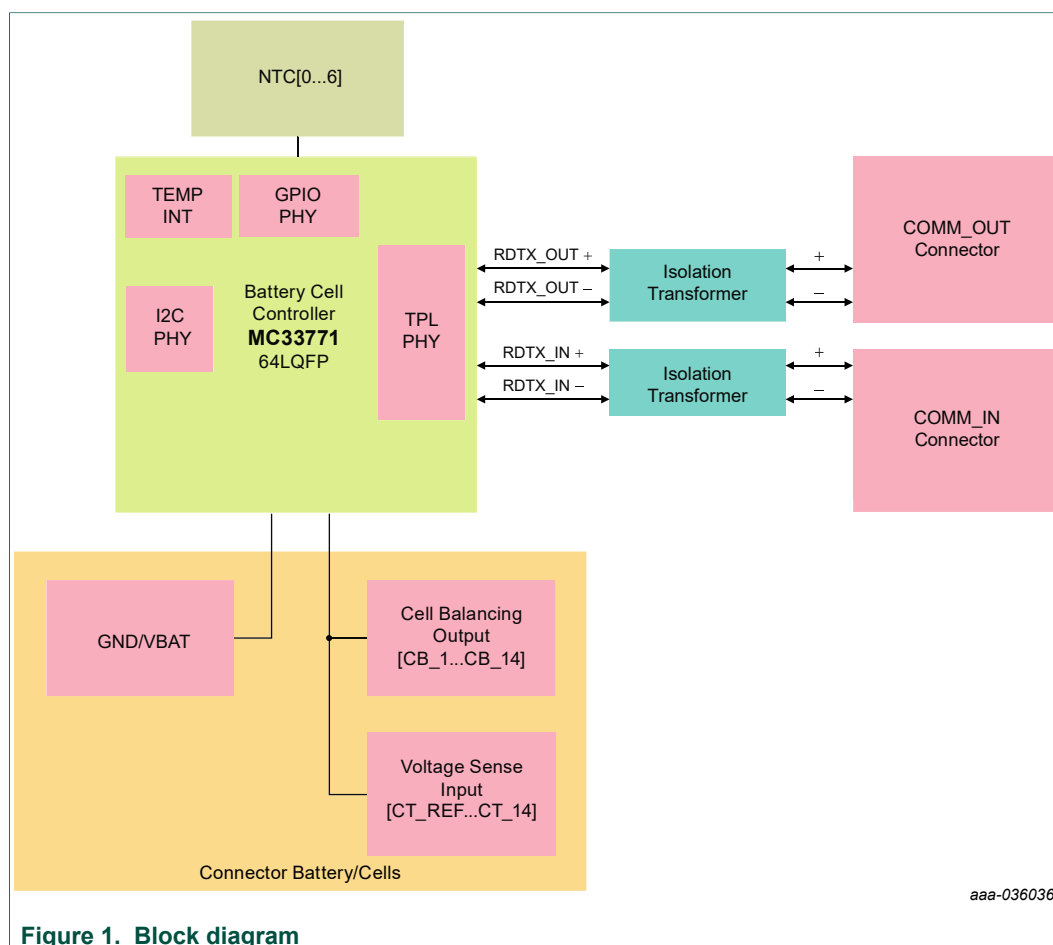


Figure 1. Block diagram

2.4 Device features

The MC33771C is a battery cell controller IC designed to monitor battery characteristics, such as voltage, current and temperature. The MC33771C 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. MC33771C device features

| Device | Description | Features |
|----------|-------------------------|---|
| MC33771C | Battery cell controller | <ul style="list-style-type: none"> • $9.6\text{ V} \leq V_{PWR} \leq 61.6\text{ V}$ operation, 75 V transient • 7 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 daisy chain • 0.8 mV maximum total voltage measurement error • Synchronized cell voltage/current measurement with coulomb count • 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 • Designed to support ISO 26262, up to ASIL D safety system • Qualified in compliance with AECQ-100 |

2.5 Board description

The RD33771CDSTEB allows the user to exercise all the functions of the MC33771C battery controller cell.

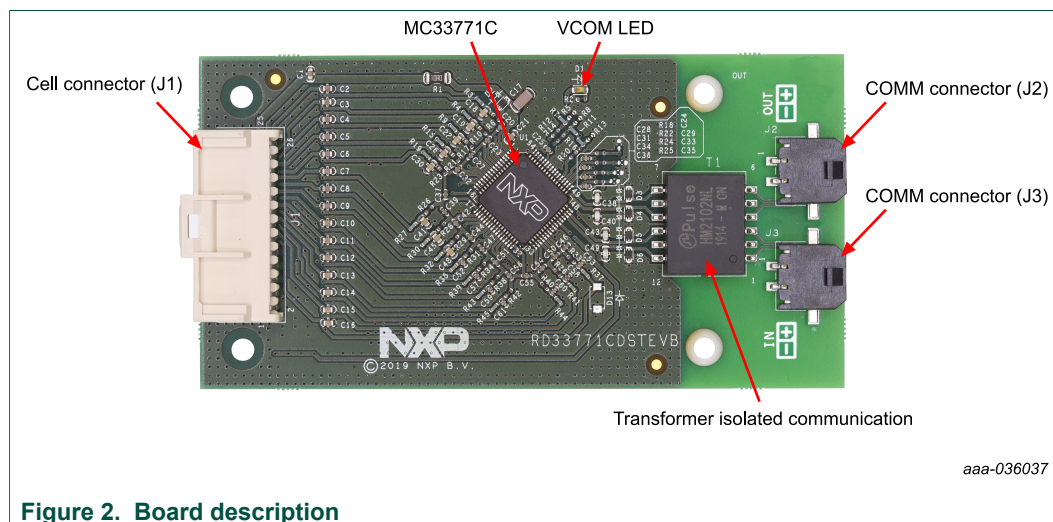


Figure 2. Board description

2.6 VCOM LED

The VCOM LED is located on the board as shown in [Figure 2](#).

The VCOM LED indicates when the device is in normal mode. Upon reset, the MC33771C 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.

2.7 Connectors

[Figure 2](#) shows the location of connectors on the board. The following tables 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 |

| Pin # | Name | Description |
|-------|------|----------------------------------|
| 2 | OUT– | Receive/transmit output negative |

Table 4. COMM connector (J3)

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

2.8 Temperature measurement

The RD33771CDSTEB offers seven GPIOs [GPIO_0...GPIO_6] for measuring external temperature with on-board or off-board NTCs. Four off-board NTC connections are available on J1 connector.

2.9 Cell terminal voltage measurement

The differential measurement of each cell terminal input is designed to function in conjunction with an external anti-aliasing filter.

2.10 Bus terminal communication

The transformers isolate communication between the MC33771C and the pack controller and between each MC33771C. 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). [\[5\]](#)

3 Accessory transceiver board

The RD33771CDSTEB 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.

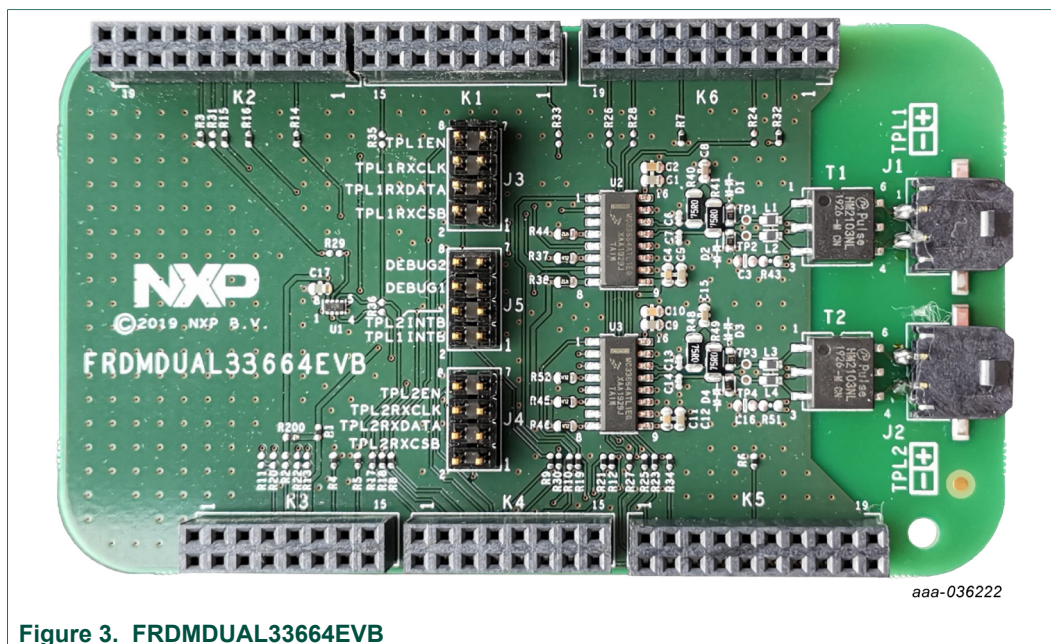


Figure 3. FRDMDUAL33664EBV

4 Configuring the hardware

4.1 Battery emulator connection

A minimum of 7 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 NTC. The emulator board can be connected to the RD33771CDSTEBV connector J1 using the provided supply cable. See [Figure 4](#).

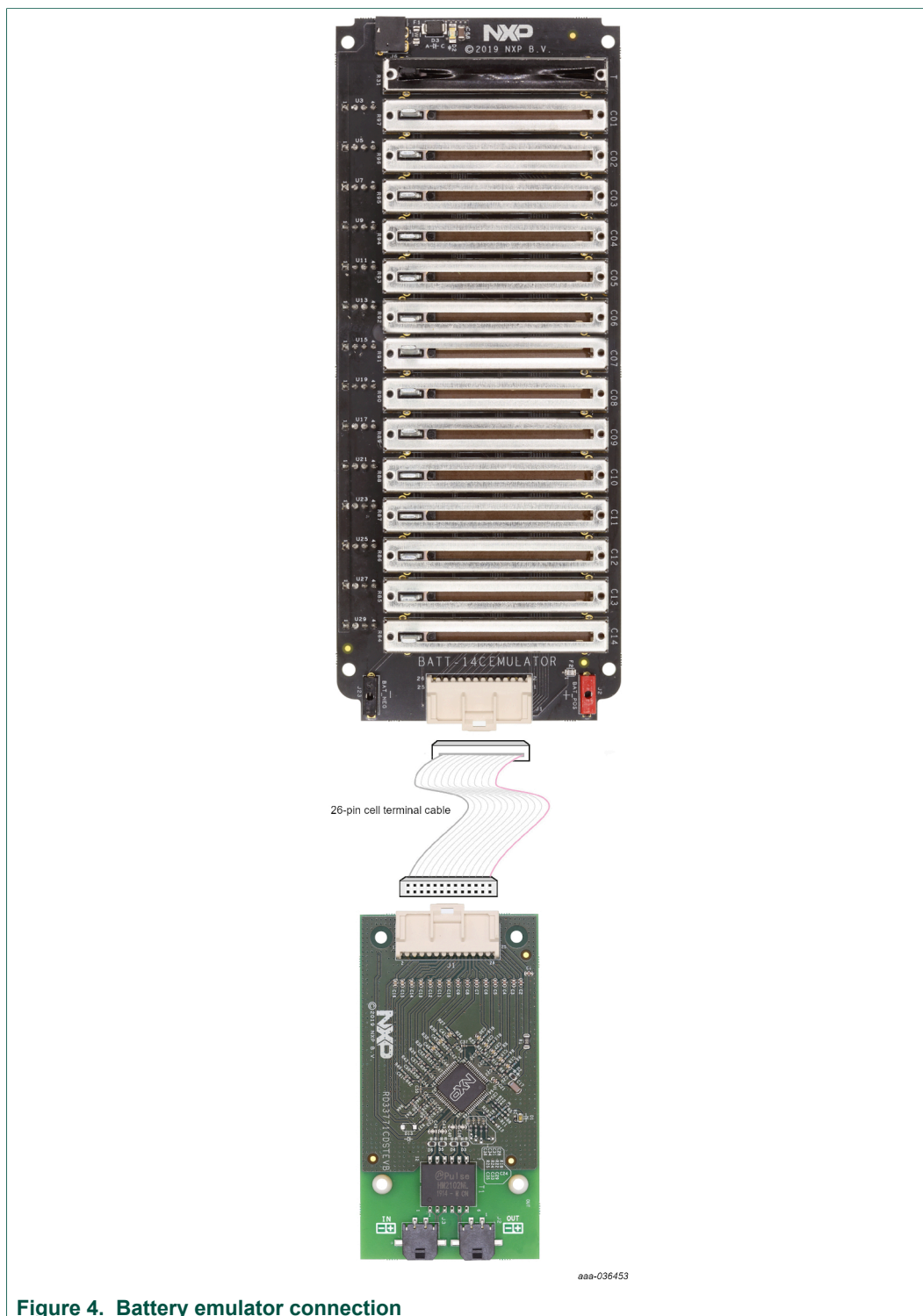


Figure 4. Battery emulator connection

4.2 TPL communication connection

In a high-voltage Isolated application with a daisy chain configuration, up to 63 RD33771CDSTEBV boards may be connected.

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

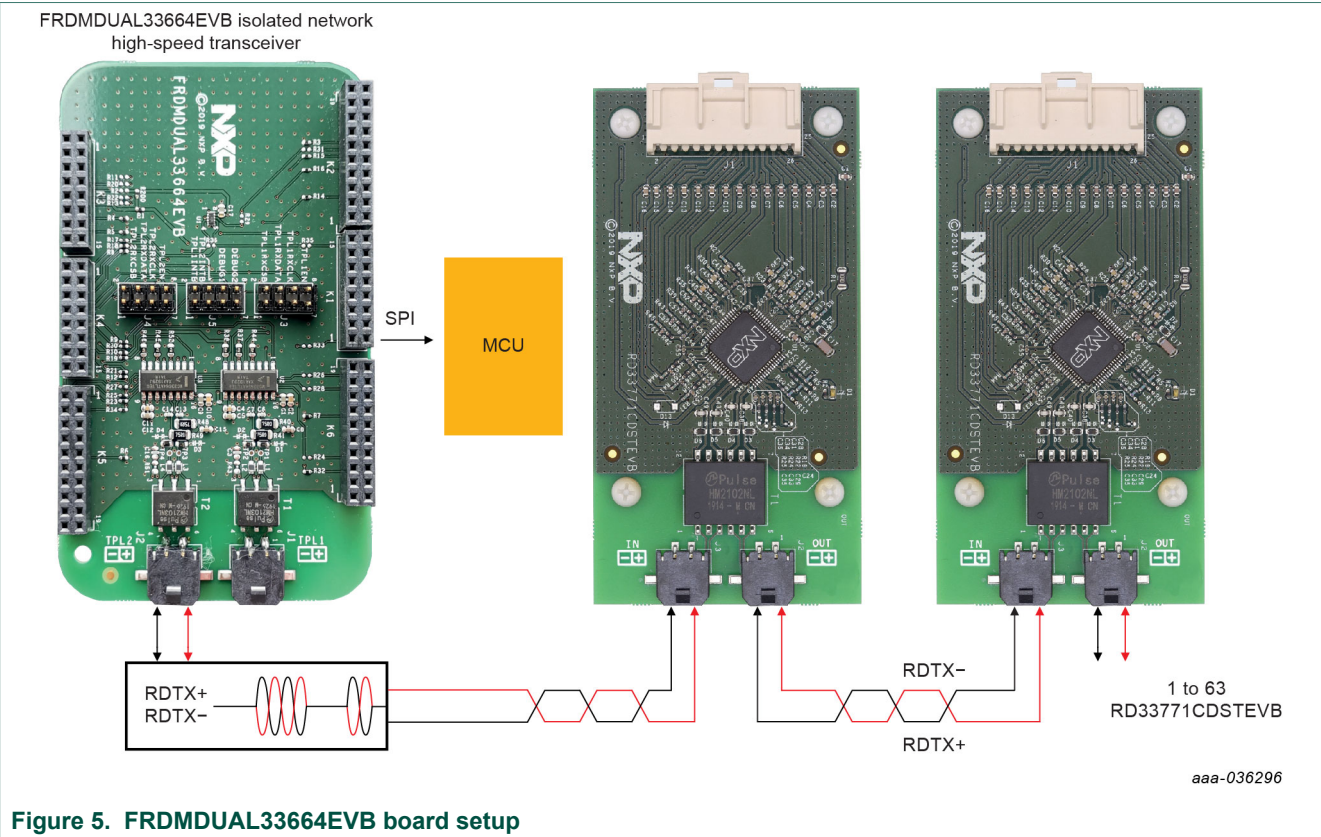


Figure 5. FRDMDUAL33664EVB board setup

5 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 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 |

6 References

- [1] Board summary page — nxp.com/RD33771CDSTEVB
- [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] NXP DocStore — docstore.nxp.com

7 Revision history

Table 6. Revision history

| Rev | Date | Description |
|-------|----------|-----------------|
| v.1.0 | 20200114 | Initial release |

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