UM11343
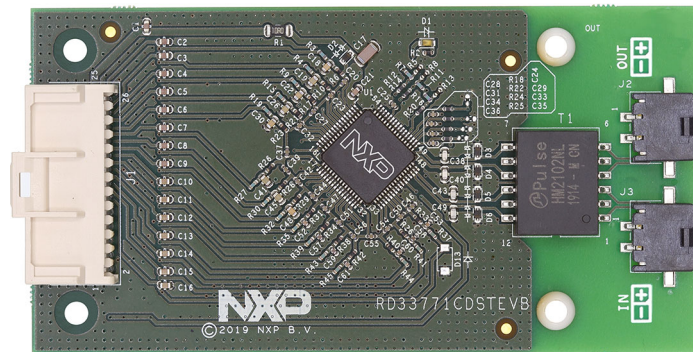## RD33771CDSTEVB featuring the MC33771C battery cell controller IC

Rev. 1.0 — 14 January 2020   **User manual**

aaa-036295

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 RD33771CDSTEVB is at nxp.com/RD33771CDSTEVB. 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 RD33771CDSTEVB.

1. Go to nxp.com/RD33771CDSTEVB.
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), suporting 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 RD33771CDSTEVB 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

UM11343
User manual

All information provided in this document is subject to legal disclaimers.

Rev. 1.0 — 14 January 2020

© NXP B.V. 2020. All rights reserved.

2 / 14

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 RD33771CDSTEVB is an ideal platform for rapid prototyping of MC33771C-based applications that involve current, voltage, and temperature sensing.

The RD33771CDSTEVB 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 RD33771CDSTEVB'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
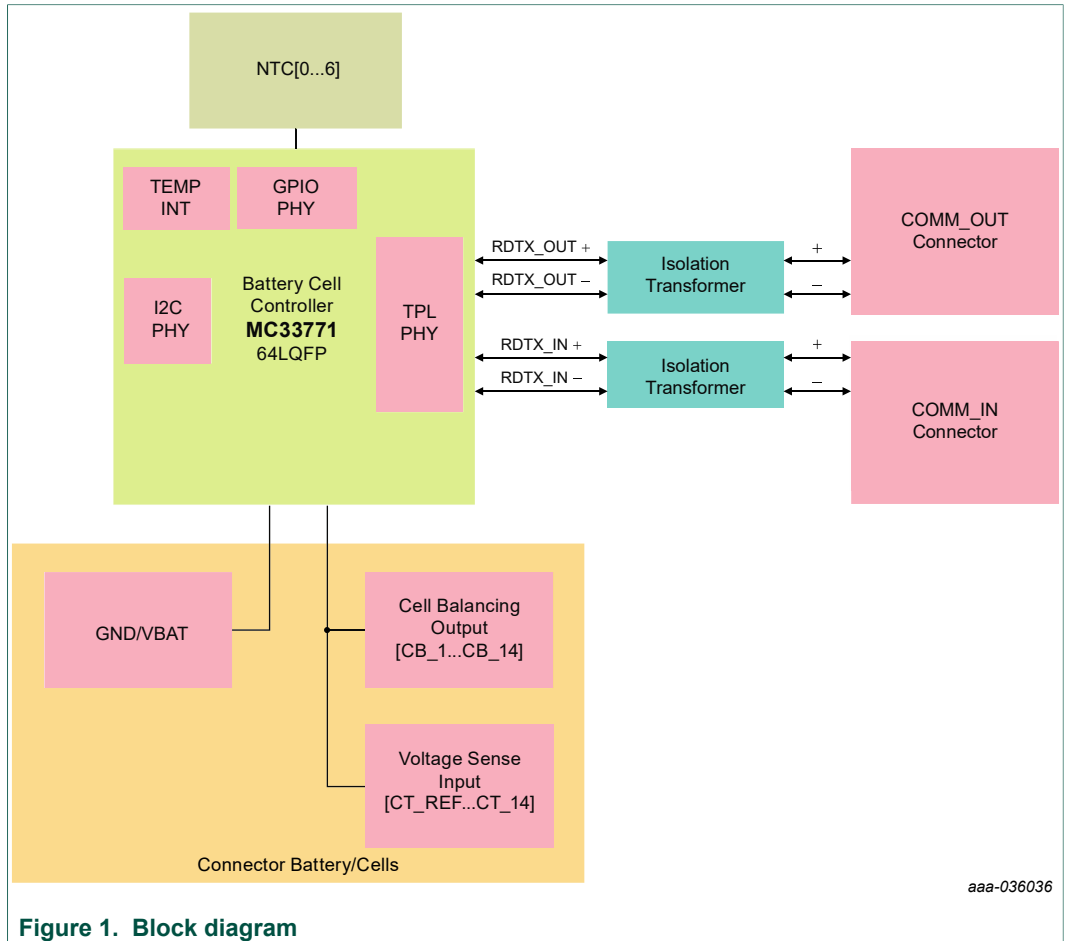
Figure 1. Block diagram

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:

UM11343

All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2020. All rights reserved.

User manual **Rev. 1.0 — 14 January 2020**

4 / 14

Table 1. MC33771C device features

Device	Description	Features
MC33771C	Battery cell controller	• 9.6 V ≤ V_{PWR} ≤ 61.6 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 RD33771CDSTEVB allows the user to exercise all the functions of the MC33771C battery controller cell.
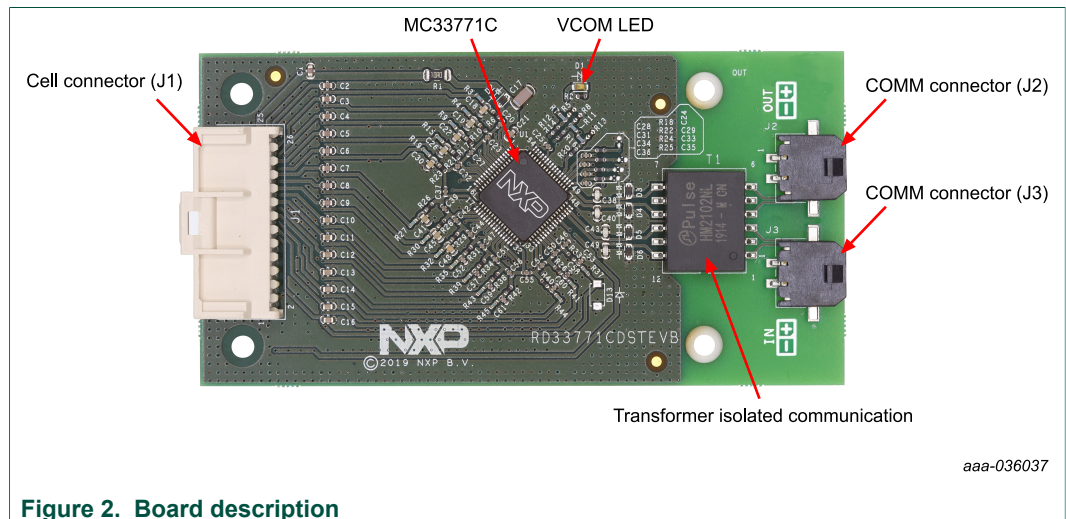
Figure 2. Board description

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

UM11343
User manual

All information provided in this document is subject to legal disclaimers.

Rev. 1.0 — 14 January 2020

© NXP B.V. 2020. All rights reserved.

5 / 14

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

UM11343

User manual **Rev. 1.0 — 14 January 2020**

6 / 14

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 RD33771CDSTEVB 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 RD33771CDSTEVB 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.
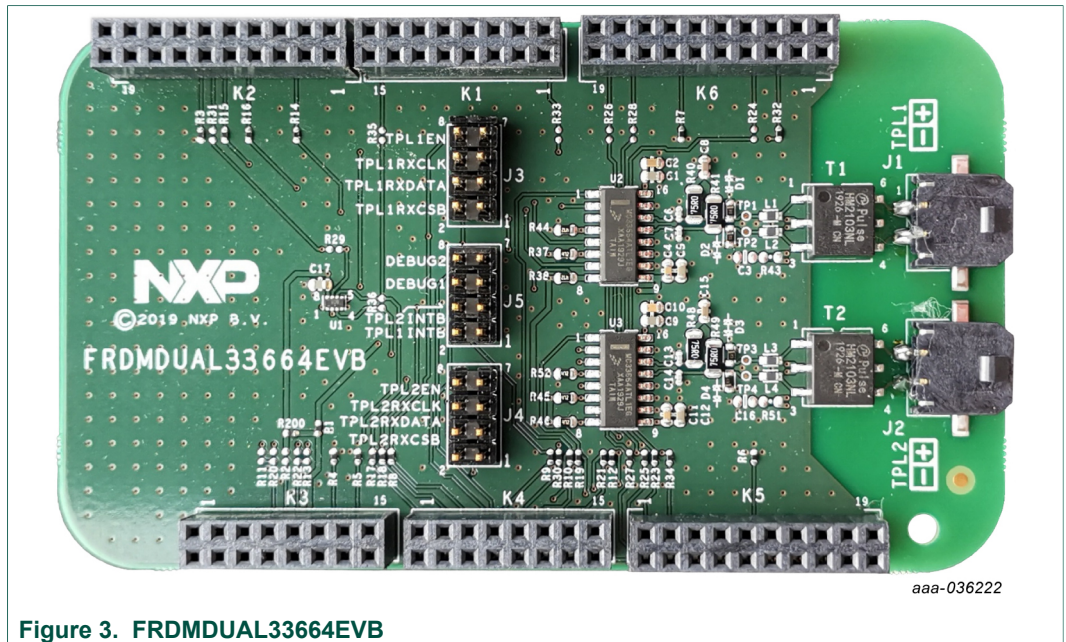
aaa-036222

Figure 3. FRDMDUAL33664EVB

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 RD33771CDSTEVB connector J1 using the provided supply cable. See Figure 4.
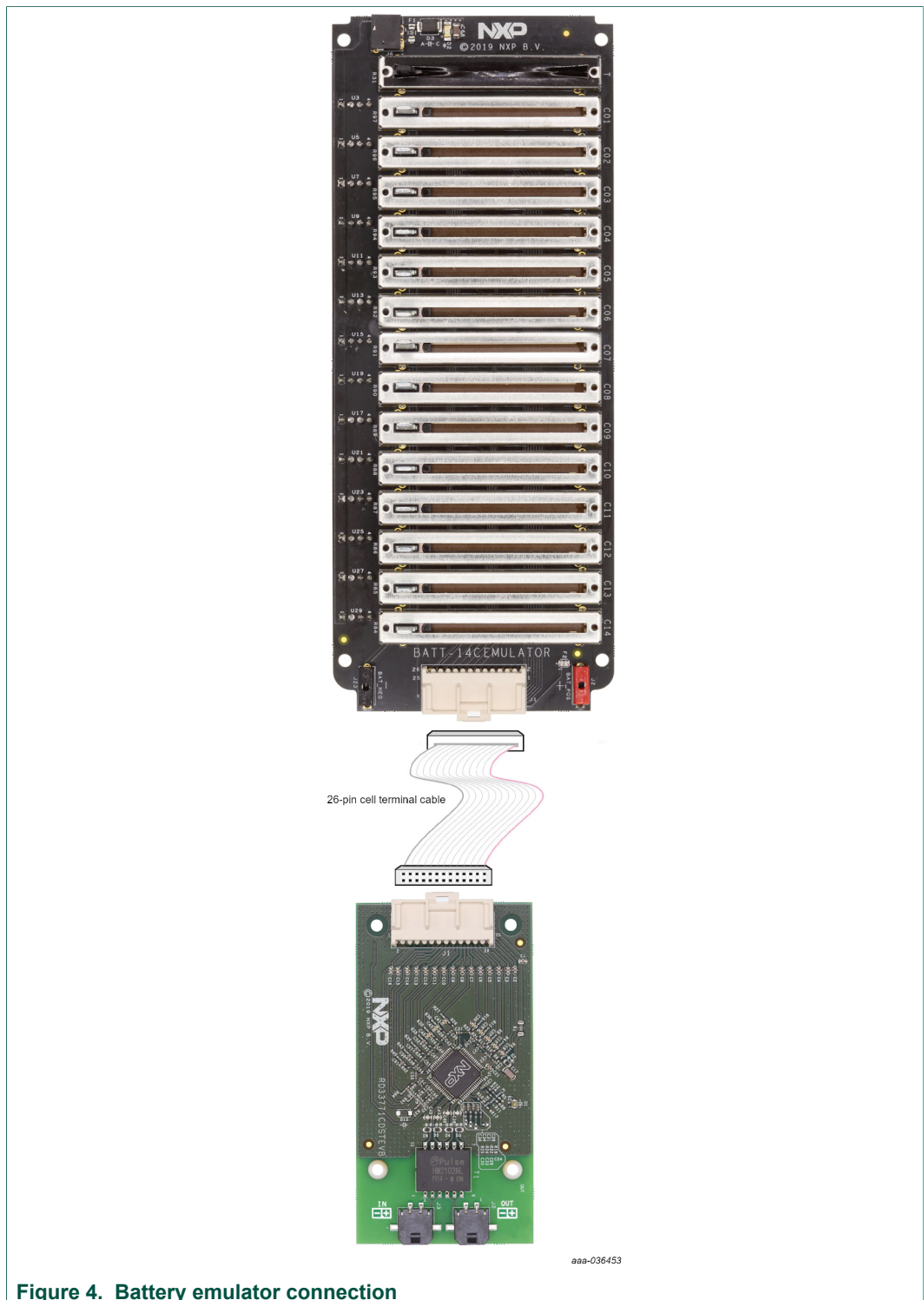
UM11343

All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2020. All rights reserved.

User manual **Rev. 1.0 — 14 January 2020**

8 / 14

Figure 4. Battery emulator connection

4.2 TPL communication connection

In a high-voltage Isolated application with a daisy chain configuration, up to 63 RD33771CDSTEVB boards may be connected.

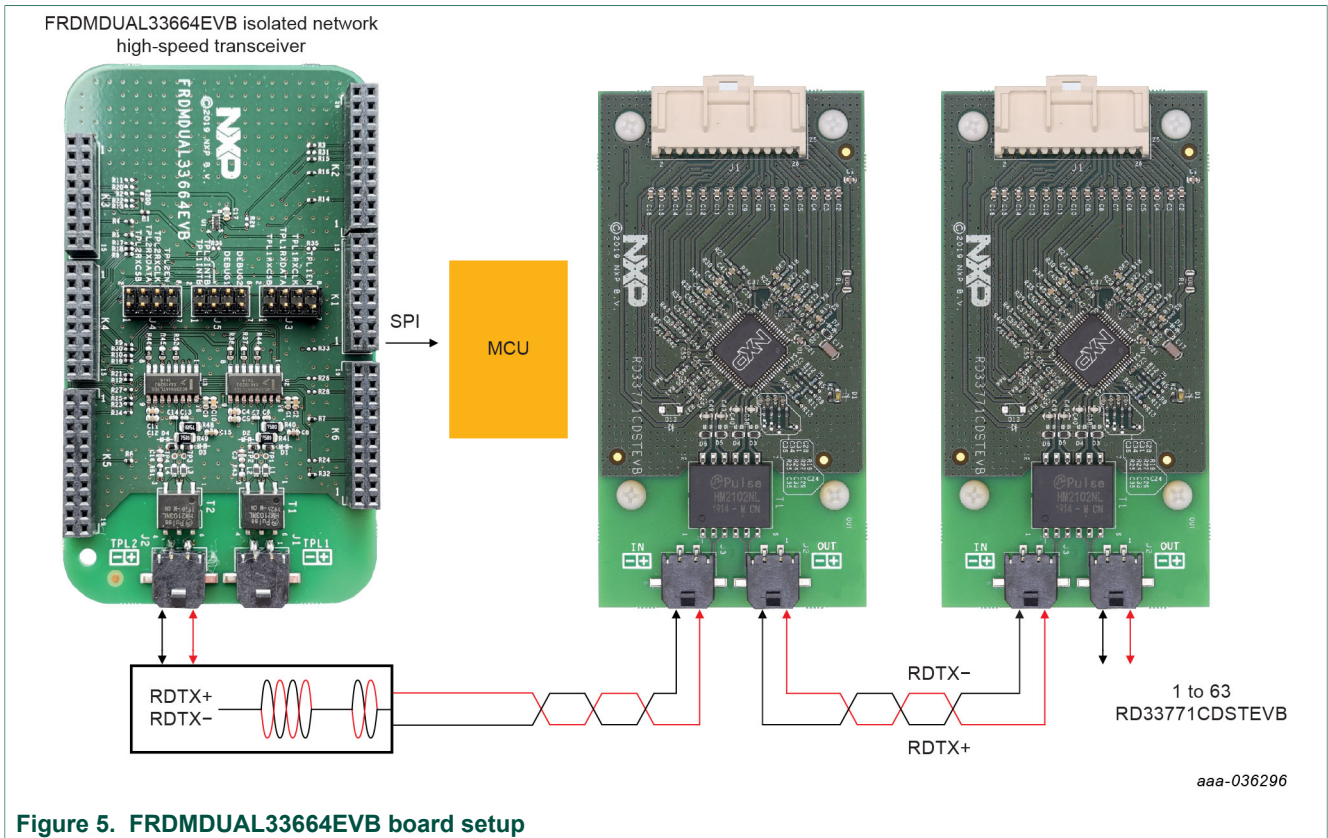The TPL connections use the COMM connectors (J2, J3).

UM11343

All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2020. All rights reserved.

User manual

Rev. 1.0 — 14 January 2020

9 / 14

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

8 Legal information

8.1 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

8.2 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors. In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory. Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification. Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products. NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Suitability for use in automotive applications — This NXP Semiconductors product has been qualified for use in automotive applications. Unless otherwise agreed in writing, the product is not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Evaluation products — This product is provided on an "as is" and "with all faults" basis for evaluation purposes only. NXP Semiconductors, its affiliates and their suppliers expressly disclaim all warranties, whether express, implied or statutory, including but not limited to the implied warranties of non-infringement, merchantability and fitness for a particular purpose. The entire risk as to the quality, or arising out of the use or performance, of this product remains with customer. In no event shall NXP Semiconductors, its affiliates or their suppliers be liable to customer for any special, indirect, consequential, punitive or incidental damages (including without limitation damages for loss of business, business interruption, loss of use, loss of data or information, and the like) arising out the use of or inability to use the product, whether or not based on tort (including negligence), strict liability, breach of contract, breach of warranty or any other theory, even if advised of the possibility of such damages. Notwithstanding any damages that customer might incur for any reason whatsoever (including without limitation, all damages referenced above and all direct or general damages), the entire liability of NXP Semiconductors, its affiliates and their suppliers and customer's exclusive remedy for all of the foregoing shall be limited to actual damages incurred by customer based on reasonable reliance up to the greater of the amount actually paid by customer for the product or five dollars (US$5.00). The foregoing limitations, exclusions and disclaimers shall apply to the maximum extent permitted by applicable law, even if any remedy fails of its essential purpose.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

Security — While NXP Semiconductors has implemented advanced security features, all products may be subject to unidentified vulnerabilities. Customers are responsible for the design and operation of their applications and products to reduce the effect of these vulnerabilities on customer's applications and products, and NXP Semiconductors accepts no liability for any vulnerability that is discovered. Customers should implement appropriate design and operating safeguards to minimize the risks associated with their applications and products.

8.3 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

SafeAssure — is a trademark of NXP B.V.

Tables

Figures

UM11343
User manual

All information provided in this document is subject to legal disclaimers.

Rev. 1.0 — 14 January 2020

© NXP B.V. 2020. All rights reserved.

13 / 14

Contents