UM11943

RD33774CNC3EVB

Rev. 1 — 22 November 2023 User manual

Document information

Information	Content
Keywords	cell monitoring unit, CMU, CCMU, MC33665A, MC33774A, CAN FD, CAN
Abstract	User manual for the RD33774CNC3EVB, reference design centralized cell monitoring unit (CCMU) board based on MC33774A battery cell controller (BCC), interfacing with controller area network (CAN) or controller area network flexible data rate (CAN FD).

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2 Getting started

The NXP analog product development boards provide an easy-to-use platform for evaluating NXP products. The boards support a range of analog, mixed-signal, and power solutions. They 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.

This document provides guidelines to use the RD33774CNC3EVB.

2.1 Kit contents

The RD33774CNC3EVB kit contents include:

- An RD33774CNC3EVB
- An electrical transport protocol link (ETPL) daisy chain cable
- A power and CAN interface cable
- Three cell interface cables

2.2 Additional hardware

NXP offers the following board solutions to check the functionality of the devices and support the setup in testing the devices.

- BATT-18EMULATOR: 18-cell battery pack emulator

It is also possible to interface the RD33774CNC3EVB with the RD-K344BMU or RD-K358BMU as part of the HWRD-HVBMSCC hardware reference design.

3 Getting to know the hardware

3.1 Board overview

The RD33774CNC3EVB is a CCMU reference design, which can communicate directly with CAN or CAN FD.

The MC33665ATF4AE populated on the RD33774CNC3EVB is a gateway router that can route transport protocol link (TPL) messages with CAN or CAN FD communication protocol. The MC33774 is a battery cell controller from NXP to monitor the cell voltages, temperatures, and passive balance. The RD33774CNC3EVB can monitor up to 54 cells onboard, and can be daisy-chained using an external TPL port for a higher number of cells.

Note: *MC33665ATF4AE is used in RD33774CNC3EVB. Read any reference in this documentation to MC33665A as MC33665ATF4AE.*

3.2 Board features

The main features of RD33774CNC3EVB are:

- CAN or CAN FD communication up to 5 Mbit/s to MC33665A
- Onboard CAN transceiver TJA1443
- Configurable CAN communication and CAN FD arbitration speeds on CFG0 and CFG1 pins using SW1 dual inline package (DIP) switch
- Configurable CAN ID (ID0_STB_OD, ID1, ID2, and ID3) for MC33665A using SW1 DIP switch
- Three MC33774 battery cell controllers
- Voltage monitoring and passive cell balancing functionality for up to 54 cells
- Capacitive isolation for daisy chain communication of onboard MC33774 devices and for offboard daisy chain communication
- Transformer isolation from TPL port 0 of MC33665A to MC33774
- Flexible configuration: single chain with loopback or two independent daisy chains without loopback

3.3 Block diagram

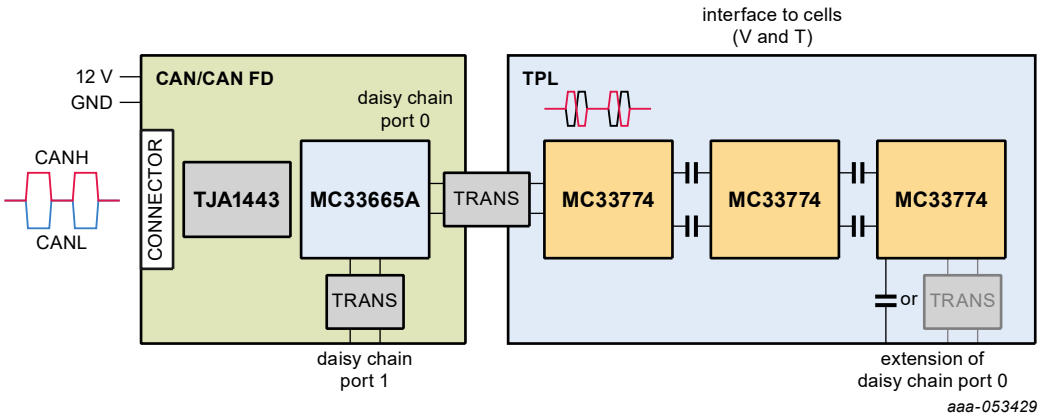

Figure 1. RD33774CNC3EVB block diagram

3.4 Board description

Figure 2 shows the sections for the gateway IC MC33665A and three MC33774 battery cell controllers. MC33665A and TJA1443 CAN transceiver interface circuit is part of the low-voltage section, which can be connected to 12 V and ground. It can communicate on low voltage with standard tools and control units with J25 connector. TPL port 0 of MC33665A is interfaced to the first MC33774 onboard with transformer isolation. TPL port 1 of MC33665A is interfaced to J2 for offboard communication with extra battery cell controllers or to support the loopback for BCC devices on daisy chain port 0.

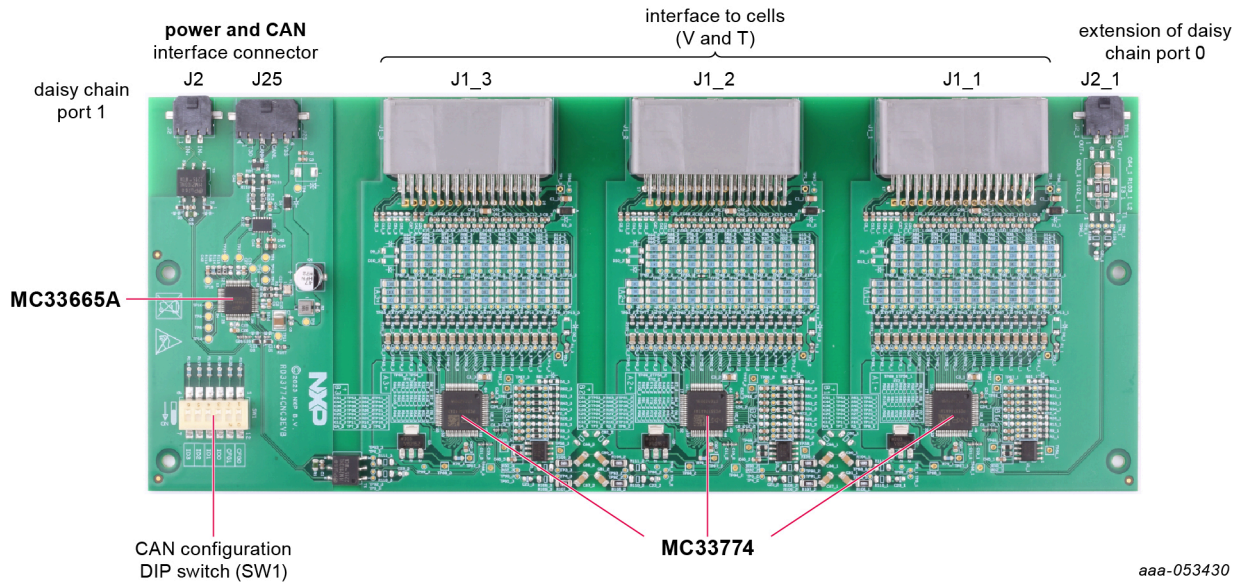

Figure 2. RD33774CNC3EVB description

MC33774 battery cell controllers are populated on the high-voltage section of the board. Galvanic isolation is maintained from high-voltage section of the board to low voltage with transformers. Maintaining the safety precautions of the lab and setup, cells emulators or relevant can be connected directly to J1_1, J1_2 and J1_3 connectors. Low-pass filters and passive cell balancing resistors are populated and interfaced from cell connections to MC33774. Features in MC33774 can be tested for 18 cell voltages, module voltage, and two printed-circuit board (PCB) temperature measurements and four external temperature measurements on this board. For more information, refer to the MC33774 data sheet. The full data sheet is available in 'Secure Files'.

TJA1443 is used as CAN transceiver for MC33665A. Split resistor termination is used for CAN termination (120 Ω). The common mode choke is depopulated onboard with bridge resistors to interface with TJA1443. Based on setup and requirements, the FL2 common mode choke can be populated onboard. Refer to the schematics of RD33774CNC3EVB for MC33665A CAN interface circuit. Figure 3 is a short extract to understand the CAN termination of RD33774CNC3EVB.

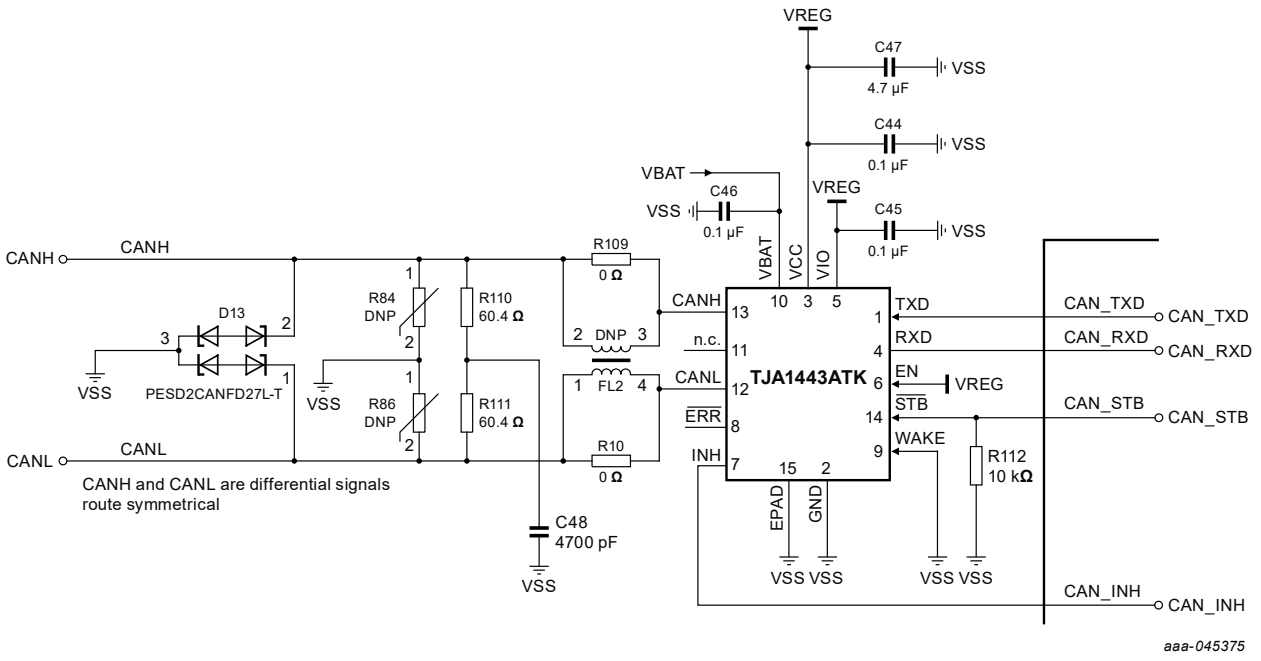

Figure 3. CAN transceiver interface

Check the need of external 120 Ω termination when interfacing CAN tools to RD33774CNC3EVB. If necessary, populate R84 and R86 with 60 Ω resistors.

CFG0, CFG1, ID0_STB_OD, ID1, ID2, and ID3 pins are important for communicating with the MC33665A via CAN or CAN FD. CFG0 and CFG1 are used for setting baud rate for CAN or arbitration baud rate for CAN FD. ID0_STB_OD, ID1, ID2, and ID3 are used to set the CAN ID for communicating with the MC33665A. Refer to the data sheet of the MC33665A before setting the CAN ID. See Table 2 for CFG0 and CFG1 pin settings and Table 3 for ID pins settings.

Configuration of the respective CFG and CAN ID pins of MC33665A to HIGH or LOW can be one by modifying the state of their related pin on the SW1 DIP switch.

Table 1. SW1 DIP switch pin allocation

DIP switch row number	Signal	Signal LOW	Signal HIGH
1	CFG0	switch on	switch off
2	CFG1	switch on	switch off
3	ID0_STB_OD	switch on	switch off
4	ID1	switch on	switch off
5	ID2	switch on	switch off
6	ID3	switch on	switch off

Table 2. CFG pins of MC33665A

CFG1	CFG0	Baud rate (CAN or CAN FD arbitration)
0	0	250 kbit/s
0	1	500 kbit/s
1	0	1 Mbit/s (used as default in HWRD-HVBMSCC software example)
1	1	do not use

Table 3. CAN ID pins of MC33665A

CAN ID	Pin ID0_STB_OB	Pin ID1	Pin ID2	Pin ID3
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
Reserved for broadcast	1	1	1	1

3.5 Connectors

RD33774CNC3EVB has J25, which is a low-voltage connector for power and CAN. J1_1, J1_2, J1_3, J2, and J2_1 are connectors to be considered as part of high voltage based on test setup.

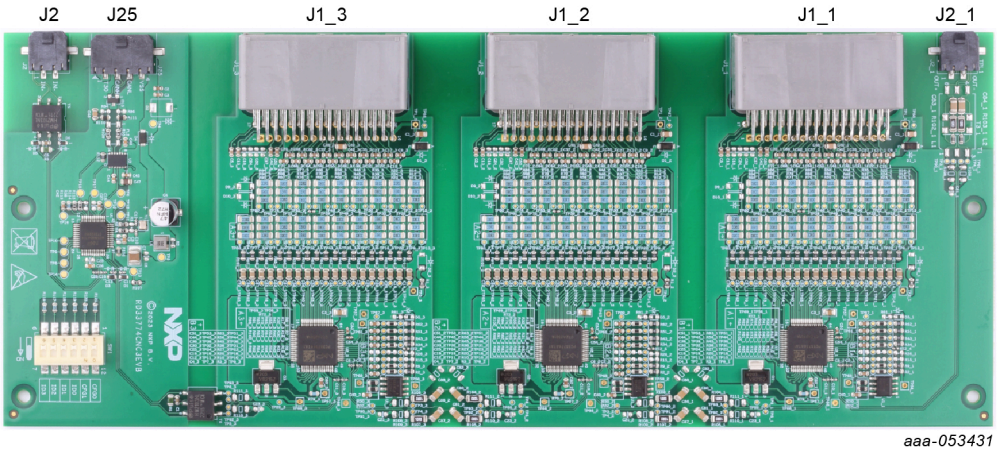

Figure 4. RD33774CNC3EVB connectors

Pin configuration of connectors is shown in Table 4 to Table 7.

Table 4. Power and CAN connector - J25

Pin number	Connection	Description
1	VBAT	connection to 12 V
2	CANH	used for CANH interface for external communication
3	CANL	used for CANL interface for external communication
4	GND	ground connection for MC33665A and interface boards

Table 5. Daisy chain TPL port 1 - J2

Pin number	Connection	Description
1	TPL1_P	daisy chain port 1 positive
2	TPL1_N	daisy chain port 1 negative

Table 6. Cell terminal and temperature - J1_1, J1_2 and J1_3

Pin number	Connection	Description
1	GND_x	temperature measurement ground; NTC8 for MC33774
2	GND_x	temperature measurement ground; NTC7 for MC33774
3	GND_x	temperature measurement ground; NTC2 for MC33774
4	GND_x	temperature measurement ground; NTC1 for MC33774
5	GND_x	ground for MC33774
6	C1M_x	cell 1 negative measurement for MC33774
7	C3M_x	cell 3 negative measurement for MC33774
8	C5M_x	cell 5 negative measurement for MC33774
9	C7M_x	cell 7 negative measurement for MC33774
10	C9M_x	cell 9 negative measurement for MC33774

Table 6. Cell terminal and temperature - J1_1, J1_2 and J1_3...*continued*

Pin number	Connection	Description
11	C11M_x	cell 11 negative measurement for MC33774
12	C13M_x	cell 13 negative measurement for MC33774
13	C15M_x	cell 15 negative measurement for MC33774
14	C17M_x	cell 17 negative measurement for MC33774
15	n/a	not connected
16	C17P-PWR_x	cell 17 positive for MC33774; used for powering
17	NTC8_x	temperature measurement; NTC8 for MC33774
18	NTC7_x	temperature measurement; NTC7 for MC33774
19	NTC2_x	temperature measurement; NTC2 for MC33774
20	NTC1_x	temperature measurement; NTC1 for MC33774
21	GND_1	ground for MC33774
22	C0M_x	cell 0 negative measurement for MC33774
23	C2M_x	cell 2 negative measurement for MC33774
24	C4M_x	cell 4 negative measurement for MC33774
25	C6M_x	cell 6 negative measurement for MC33774
26	C8M_x	cell 8 negative measurement for MC33774
27	C10M_x	cell 10 negative measurement for MC33774
28	C12M_x	cell 12 negative measurement for MC33774
29	C14M_x	cell 14 negative measurement for MC33774
30	C16M_x	cell 16 negative measurement for MC33774
31	C17P_x	cell 17 positive measurement for MC33774
32	n/a	not connected

Table 7. Daisy chain TPL port 0 extension - J2_1

Pin number	Connection	Description
1	TPL1_P	daisy chain port 0 extension positive from third MC33774
2	TPL1_N	daisy chain port 0 extension negative from third MC33774

4 Configuring the hardware

4.1 Standalone test setup

RD33774CNC3EVB can be used in different setup configurations to check the performance of the MC33665A and the MC33774. Figure 5 is a minimal hardware setup to check most of the functions and features built in RD33774CNC3EVB. The BATT-18EMULATOR board can emulate a multicell (18 cells) battery pack that can be easily connected to up to three BCC evaluation boards from NXP (check connector pin configuration). Cell terminal and temperature (J1_1, J1_2 and J1_3) interface cable from RD33774CNC3EVB are compatible to the BATT-18EMULATOR.

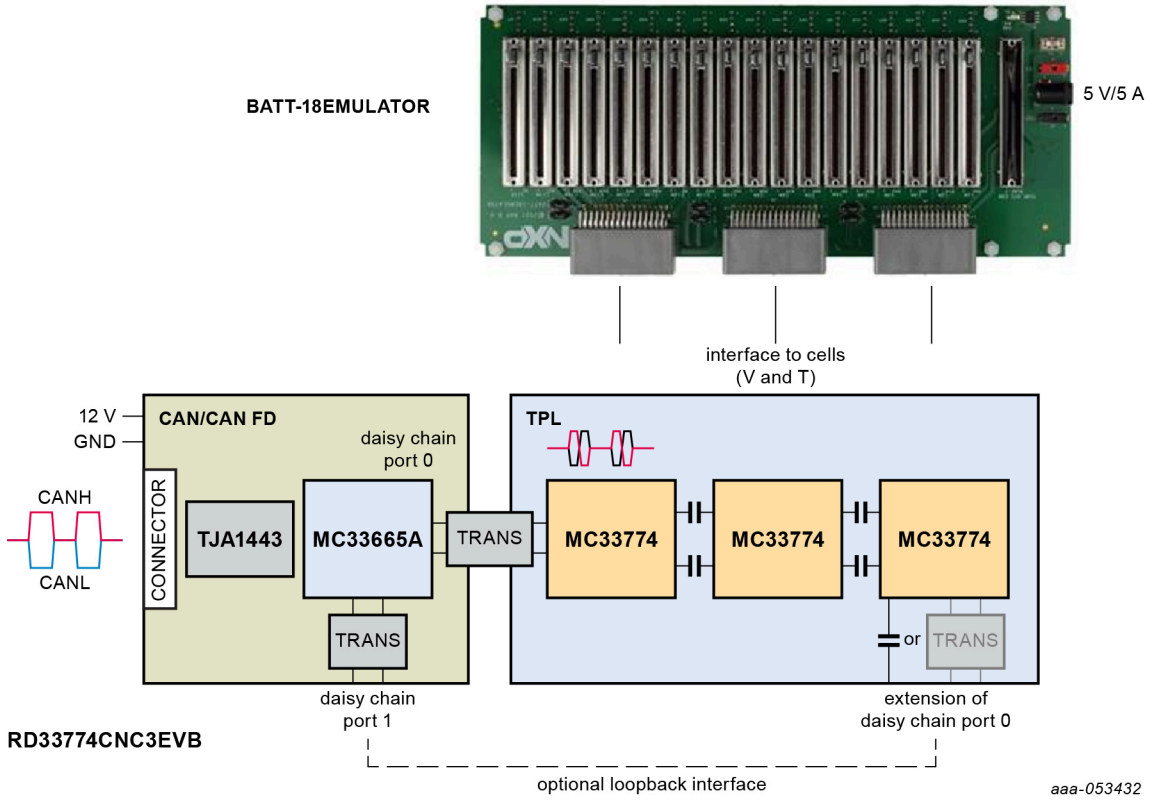

Figure 5. RD33774CNC3EVB test setup

The J25 connector can be used to power the MC33665A and communicate with CAN or CAN FD to the RD33774CNC3EVB. CAN tools can be interfaced to J25 for establishing CAN or CAN FD communication with RD33774CNC3EVB.

- Set up the communication to RD33774CNC3EVB using the data sheets of the MC33665A and the MC33774
- Refer to Section 3.4 to set the CFG0, CFG1, ID0_STB_OD, ID1, ID2, and ID3 based on external CAN (FD) communication
- Based on test requirements, extra external MC33774 BCC boards can be connected to RD33774CNC3EVB
  - Connect to J2_1 as extension to daisy chain port 0 from third MC33774
  - Connect to J2 as second daisy chain of BCC devices connected to port 1 of MC33665A
- Connect 5 V to BATT-18EMULATOR and 12 V to RD33774CNC3EVB after crosschecking the interface connections and boards based on test plan

4.2 RD33774CNC3EVB as part of the HWRD-HVBMSCC

RD33774CNC3EVB is part of a hardware reference design for high voltages: HWRD-HVBMSCC. To use the RD33774CNC3EVB in this environment, refer to the HWRD-HVBMSCC user manual and website.

5 Available accessories

Table 8. Accessories

Part number	Description
BATT-18EMULATOR	18-cell battery pack emulator
BATT-TPLCABLE20	TPL, two-wire, twisted, 20 cm long cable
BATT-TPLCABLE50	TPL, two-wire, twisted, 50 cm long cable
BATT-18CTCABLE30	cell terminal (CT) cable, 18 cells, 30 cm long

6 Revision history

Table 9. Revision history

Document ID	Release date	Description
UM11943 v.1	22 November 2023	initial version

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