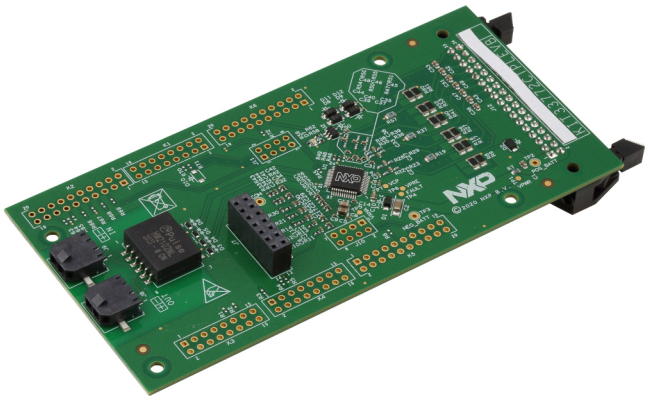
UM11562

KIT33772CTPLEVB Featuring the MC33772C battery cell controller IC

Rev. 1 — 12 March 2021 **User manual**



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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, mixedsignal, 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 KIT33772CTPLEVB is at nxp.com/KIT33772CTPLEVB. 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 KIT33772CTPLEVB.

1. Go to nxp.com/KIT33772CTPLEVB.
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. [6]

1.1 Kit contents/packing list

The kit contents include:

- Assembled and tested evaluation board/module in antistatic bag
- Quick-start guide
- One TPL cable

1.2 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

2 Getting to know the hardware

2.1 Board overview

The KIT33772CTPLEVB serves as a hardware evaluation tool in support of NXP's MC33772C device. The MC33772C 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 KIT33772CTPLEVB is an ideal platform for rapid prototyping of MC33772C-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 MC33772C and vice versa.

2.2 Board features

This KIT33772CTPLEVB'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 I^2C interface) to store user-defined calibration parameters
- Current Measurement Input via external shunt

2.3 Block diagram

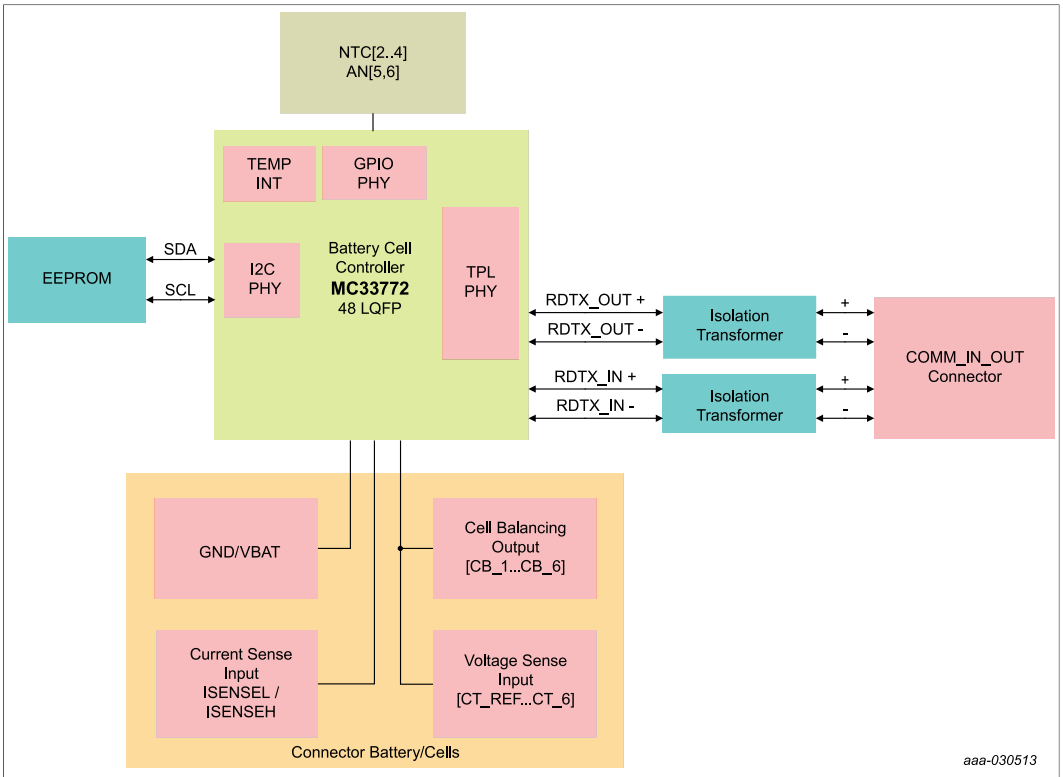

Figure 1. Block diagram

2.4 Device features

The MC33772C is a battery cell controller IC designed to monitor battery characteristics, such as voltage, current and temperature. The MC33772C 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. MC33772C device features

Device	Description	Features
MC33772C	Battery cell controller	• 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 • Averaging of cell voltage measurements • 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 MC33771C for a maximum of 14 cells • Qualified in compliance with AEC-Q100

2.5 Board description

The KIT33772CTPLEVB allows the user to exercise all the functions of the MC33772C battery controller cell.

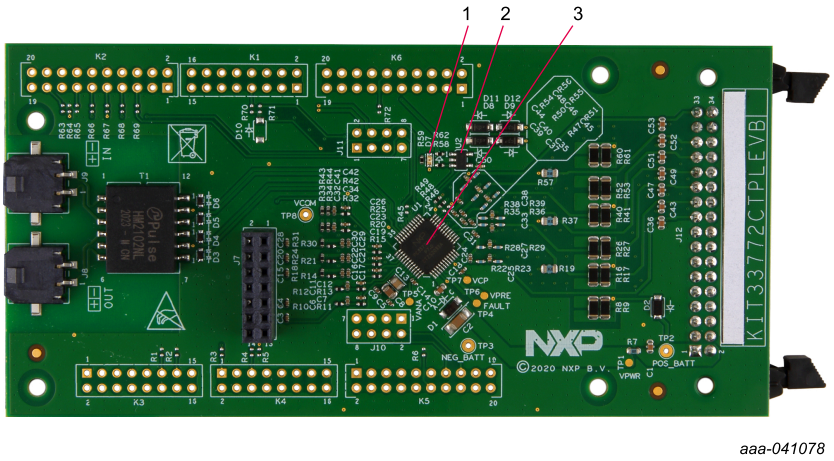

Figure 2. Board description

The VCOM LED indicates when the device is in normal mode. Upon reset, the MC33772C enters into INIT 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 after the 60 s timeout (VCOM off). Depending on the device settings, the VCOM LED may flash 0.1...8 seconds during cyclic acquisition.

Table 2. Board description

Number	Label	Name	Description
1	D7	VCOM LED	Indicates whether the device is in normal mode or in low-power mode
2	U2	24LC01BT-I/OT	IC memory EEPROM
3	U1	MC33772C	Battery cell controller IC

2.6 External EEPROM

The KIT33772CTPLEVB has an integrated gateway communication link to an external local EEPROM. The I2C-bus communication interface of the MC33772C 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 MC33772C registers. For more information on using an external EEPROM with the MC33772C device, see the MC33772C data sheet.

2.7 Test-point definitions

Figure 3 shows the location of the test points on the board.

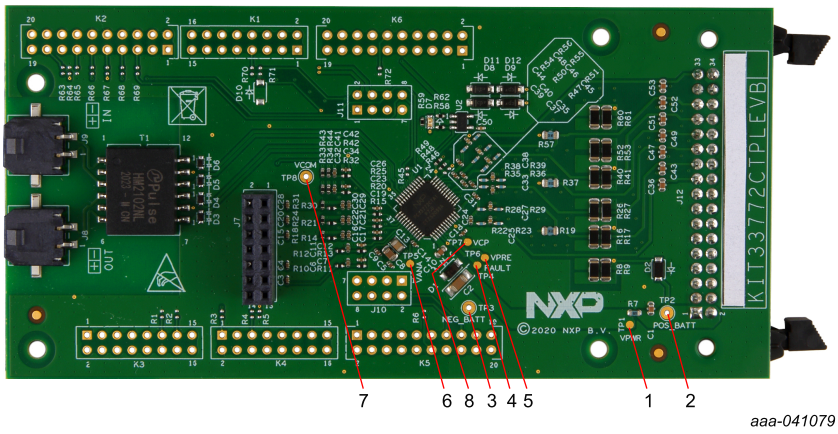

Figure 3. Test points

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

Number	Label	Signal name	Description
1	TP1	VPWR	Power input to the device
2	TP2	POS_BATT	Battery positive
3	TP3	NEG_BATT	Battery negative
4	TP4	FAULT	Device FAULT output pin

Number	Label	Signal name	Description
5	TP6	VPRE	VPRE pre-regulator output voltage
6	TP5	VANA	Precision analog supply output voltage
7	TP7	VCOM	VCOM output regulator
8	TP8	VCP	VCP charge pump output voltage

2.8 Connectors

Figure 4 shows the location of connectors on the board. The following tables list the pinouts for each connector.

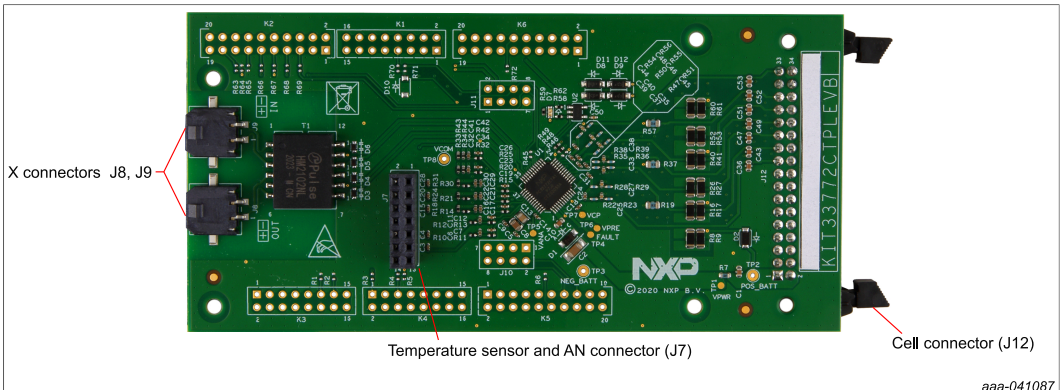

Figure 4. Connectors

Note: *K1, K2, K3, K4, K5 and K6 not used; J10, J11 not used*

The following tables describe the pins for the connectors.

Table 3. Cell terminal connector (J12)

Pin #	Connection	Description
J12-1 J12-2	 VBAT	 MC33772C Power supply - Positive Battery
J12-19 J12-20	CT_6 CB_6	Cell pin 6 input with external LPF filter Cell balance driver. Terminate to cell 6 cell balance resistor
J12-21 J12-22	CT_5 CB_6:5_C	Cell pin 5 input with external LPF filter Cell balance driver. Terminate to cell 6 and 5 cell balance resistor
J12-23 J12-24	CT_4 CB_4	Cell pin 4 input with external LPF filter Cell balance driver. Terminate to cell 4 cell balance resistor
J12-25 J12-26	CT_3 CB_4:3_C	Cell pin 3 input with external LPF filter Cell balance driver. Terminate to cell 4 and 3 cell balance resistor
J12-27 J12-28	CT_2 CB_2	Cell pin 2 input with external LPF filter Cell balance driver. Terminate to cell 2 cell balance resistor
J12-29 J12-30	CT_1 CB_2:1_C	Cell pin 1 input with external LPF filter Cell balance driver. Terminate to cell 2 and 1 cell balance resistor
J12-31	ISENSE_P	Current measurement input+ with external RC filter
J12-32	ISENSE_N	Current measurement input- with external RC filter

Table 3. Cell terminal connector (J12)*...continued*

Pin #	Connection	Description
	CT_REF	Cell pin REF input with external LPF filter
J12-33	CB_1	Cell balance driver. Terminate to cell 1 cell balance resistor
J12-34	GND	Negative battery

Table 4. Temperature sensor and AN connector (J7)

Pin #	Connection	Description
J7-2	NTC2_P input	GPIO2 pin thru low pass filter for NTC acquisition
J7-4	NTC3_P input	GPIO3 pin thru low pass filter for NTC acquisition
J7-6	NTC4_P input	GPIO4 pin thru low pass filter for NTC acquisition
J7-12	AN5	GPIO5 pin thru low pass filter for absolute measurement
J7-14	AN6	GPIO6 pin thru low pass filter for absolute measurement
J7- odd	GND	Odd pins connected to GND; other not connected

Table 5. COMM connector (J8)

Pin #	Connection	Description
J8-1	OUT+	Receive/transmit output positive
J8-2	OUT–	Receive/transmit output negative

Table 6. COMM connector (J9)

Pin #	Connection	Description
J9-1	IN+	Receive/transmit input positive
J9-2	IN–	Receive/transmit input negative

2.9 GPIO configuration

The MC33772C has seven GPIOs pins available for external connections. On the KIT33772CTPLEVB, those pins are allocated as follows:

- GPIO0 and GPIO1 are connected to onboard NTCs for EVB temperature measurement
- GPIO2 to GPIO4 are available for off-board temperature measurement through connector J7 and external NTCs
- GPIO5 and 6 are available for absolute analog measurement through connector J7

2.10 Current sensing

The KIT33772CTPLEVB supports current sense function with off-board shunt resistor. The off-board shunt resistor shall be connected between J12-31 (ISENSE_P) and J12-32 (ISENSE_N). Onboard current sensing filter and protection circuits can be found in EVB schematic shared via NXP DocStore (NDA required). Refer to the MC33772C datasheet regarding the maximum voltage that can be applied on these pins.

2.11 Bus terminal communication

The transformers isolate communication between the MC33772C and the pack controller and between each MC33772C. 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]

3 Accessory transceiver board

The KIT33772CTPLEVB kit is designed for use with the FRDMDUAL33664BEVB in highvoltage isolated applications that provide a SPI-to-high-speed isolated communication interface. The FRDMDUAL33664BEVB includes two MC33664 isolated network high speed transceivers allowing loopback connection. MCU SPI data bits are directly converted to pulse bit information.

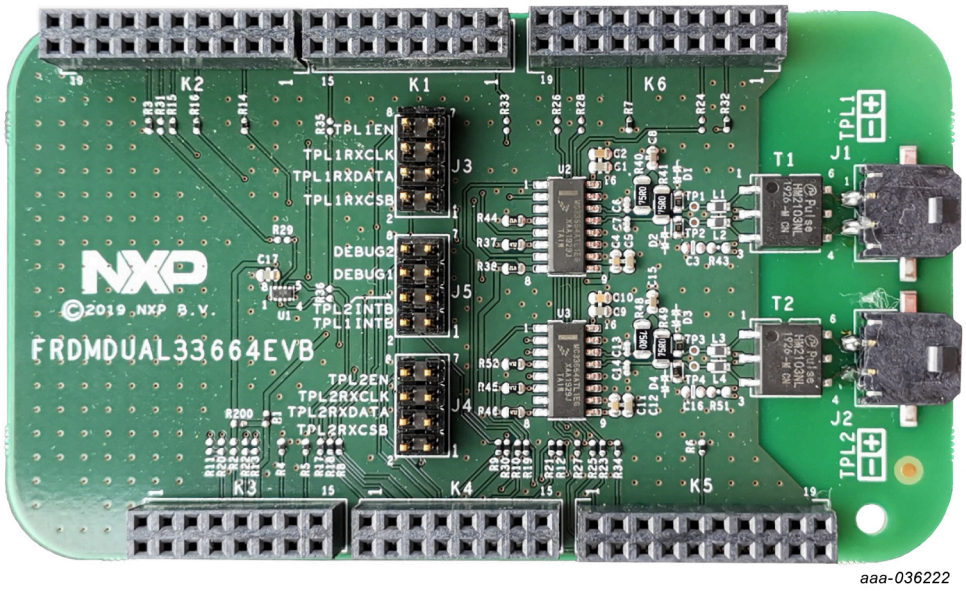

Figure 5. FRDMDUAL33664BEVB

3.1 Battery emulator connection

The KIT33772CTPLEVB supports the use of a battery cell emulator such as the BATT-6EMULATOR board and BATT-14AAAPACK from NXP.

The BATT-6EMULATOR is a six-cell battery emulator board that provides an intuitive way to change the voltage across any of the six cells and four voltage outputs in order to emulate four external NTCs.

The emulator board can be connected to the KIT33772CTPLEVB J12 connector using the provided supply cable.

To utilize the KIT33772CTPLEVB in combination with the BATT-6EMULATOR, a graphical user interface is available at https://www.nxp.com/webapp/Download?colCode=KIT3377xC_APPSP&appType=license.

3.2 TPL communication connection

In a high-voltage Isolated application with a daisy chain configuration, up to 63 KIT33772CTPLEVB boards may be connected.

The TPL connections use the COMM connectors, J8 and J9.

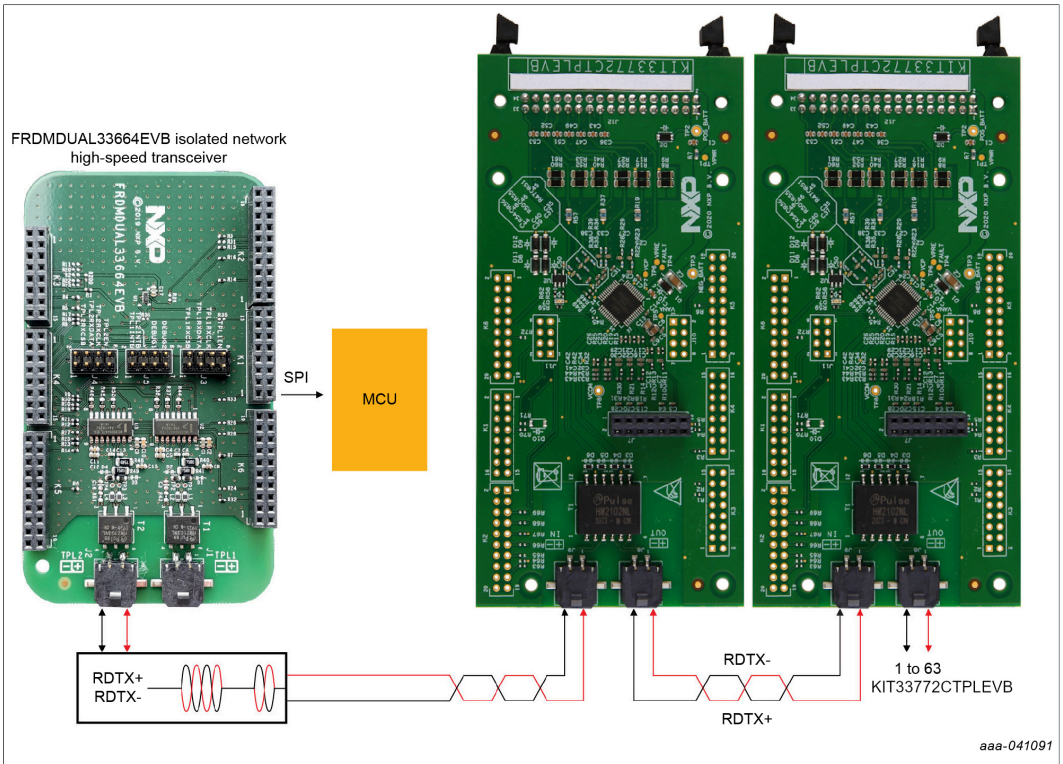

Figure 6. KIT33772CTPLEVB board setup

4 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 7. Bill of materials

Part number	Description
BATT-6EMULATOR	6-cell slider battery pack emulator kit with shunt for current sense
BATT-14AAAPACK	Configurable battery pack to supply the MC33772 EVB
FRDMDUAL33664BEVB	EVB for MC33664ATL Isolated Network High-Speed Transceiver

5 References

[1] Board summary page — nxp.com/KIT33772CTPLEVB

[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

6 Revision history

Revision history

Rev	Date	Description
1	20210312	Initial release

7 Legal information

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