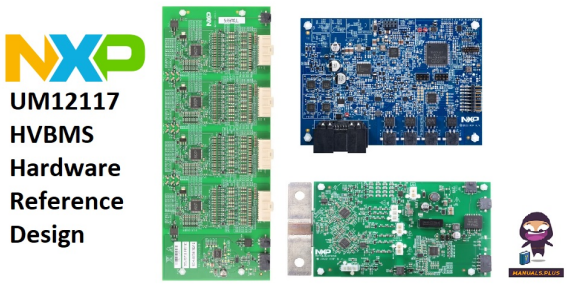

NXP UM12117 HVBMS Hardware Reference Design User Manual

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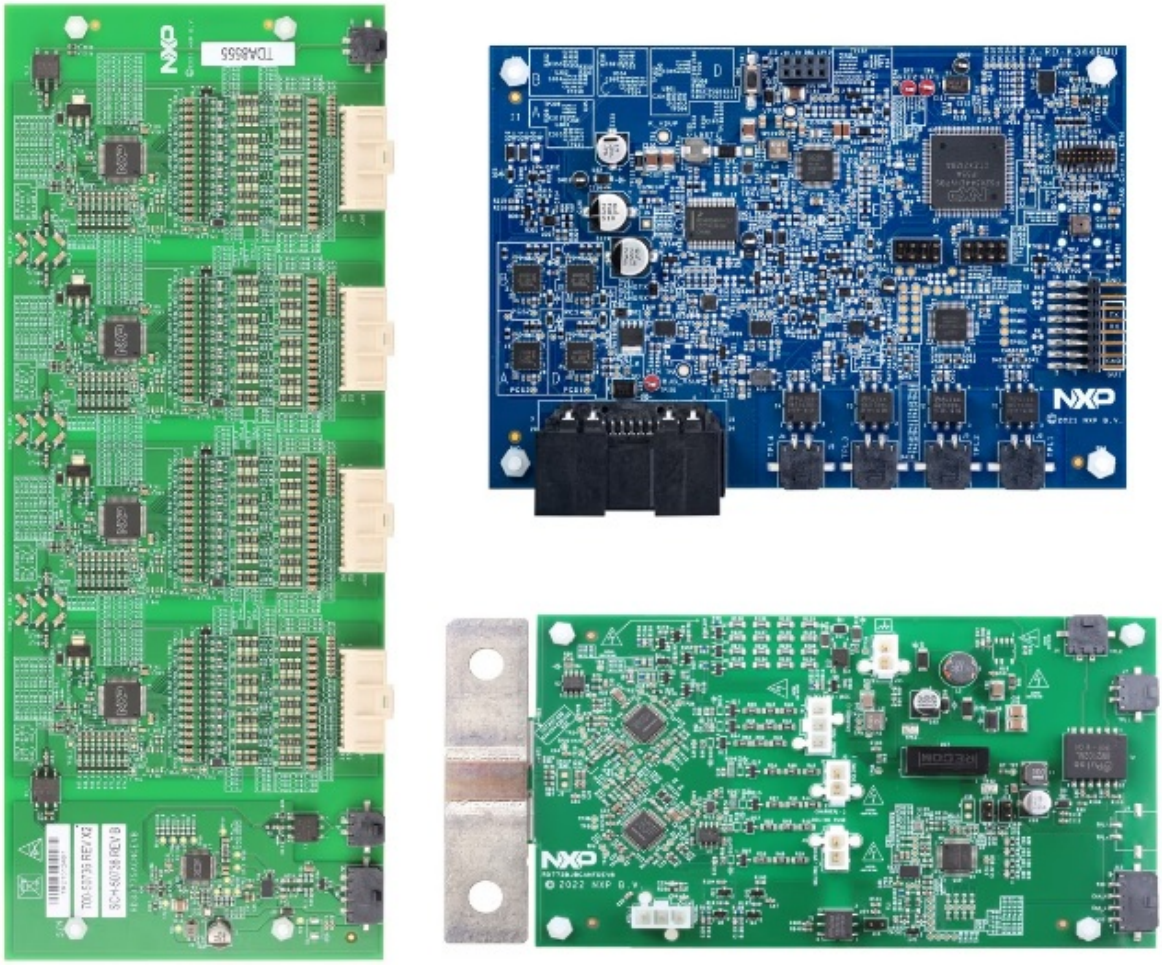
NXP UM12117 HVBMS Hardware Reference Design



Document information

Information	Content
Keywords	high-voltage battery management system, HVBMS, battery management unit, BMU, cell measurement unit, CMU, battery junction box, BJB, battery energy storage system, BES S, transistor-transistor logic, TTL, controller area network flexible data rate, CAN FD, electrical transport protocol link, ETPL, Joint Test Access Group, JTAG, graphical user int erface, GUI, recommended standard 485, RS-485
Abstract	This document aims to help getting started with the BESS1500BUN HVBMS hardware re ference design.

Important notice

source of I/O signals by connecting it to the host MCU or computer board via off-the-shelf cables. Final device in an application will be heavily dependent on proper printed circuit board layout and heat sinking design as well as attention to supply filtering, transient suppression, and I/O signal quality.

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Introduction

The RD-BESS1500BUN is an electrical transport protocol link (ETPL) based battery energy storage system (BESS) reference design bundle for 1500 V applications. This bundle has been designed for evaluation and development purposes. The RD-BESS1500BUN is composed of a hardware kit and several software packages. This document details the first startup steps to visualize the measurements performed by the system in a graphical user interface (GUI).

Kit content

The RD-BESS1500BUN bundle contains the following items:

- Battery management unit (BMU)
  - 1 RD-BESSK358BMU board
  - 1 power supply (24 V DC, 3.75 A)
  - 1 power cord
  - 1 ETPL cable
  - 1 RS-485 cable
  - 1 Ethernet cable
  - 1 controller area network (CAN) cable
  - 1 interlock cable
  - 1 contactors cable
  - 1 secure element antenna
  - 1 USB to RS-485 converter
- Cell monitoring unit (CMU)
  - 1 RDBESS774A3EVB board
  - 3 supply cables
  - 1 ETPL cable
- Battery junction box (BJB)
  - 1 RDBESS772BJBEVB board
  - 1 power cord
  - 6 high-voltage measurement cables
  - 2 thermal sensor cables
  - 1 chassis cable
  - 1 GND cable
  - 2 Hall sensor cables
  - 1 ETPL cable

    - 1 plexiglass cover
- Battery emulation kit
    - 1 BATT-18EMULATOR board
    - 1 power supply (5 V DC, 5 A)
- Links to the software and safety kits

Note: A BESS startup interface is available on the RD-BESS1500BUN website to visualize cell voltage measurements at first startup. This interface is a GUI matching with a binary file that is preflashed on the BMU.

Getting to know the hardware

Battery management unit

The BMU is the control part of the BESS. The BMU processes the data, decides, and commands the system. The RD-BESSK358BMU is the BESS reference design BMU for 1500 V applications. This BMU kit includes a power supply and five cables to interface with other parts of the BESS.

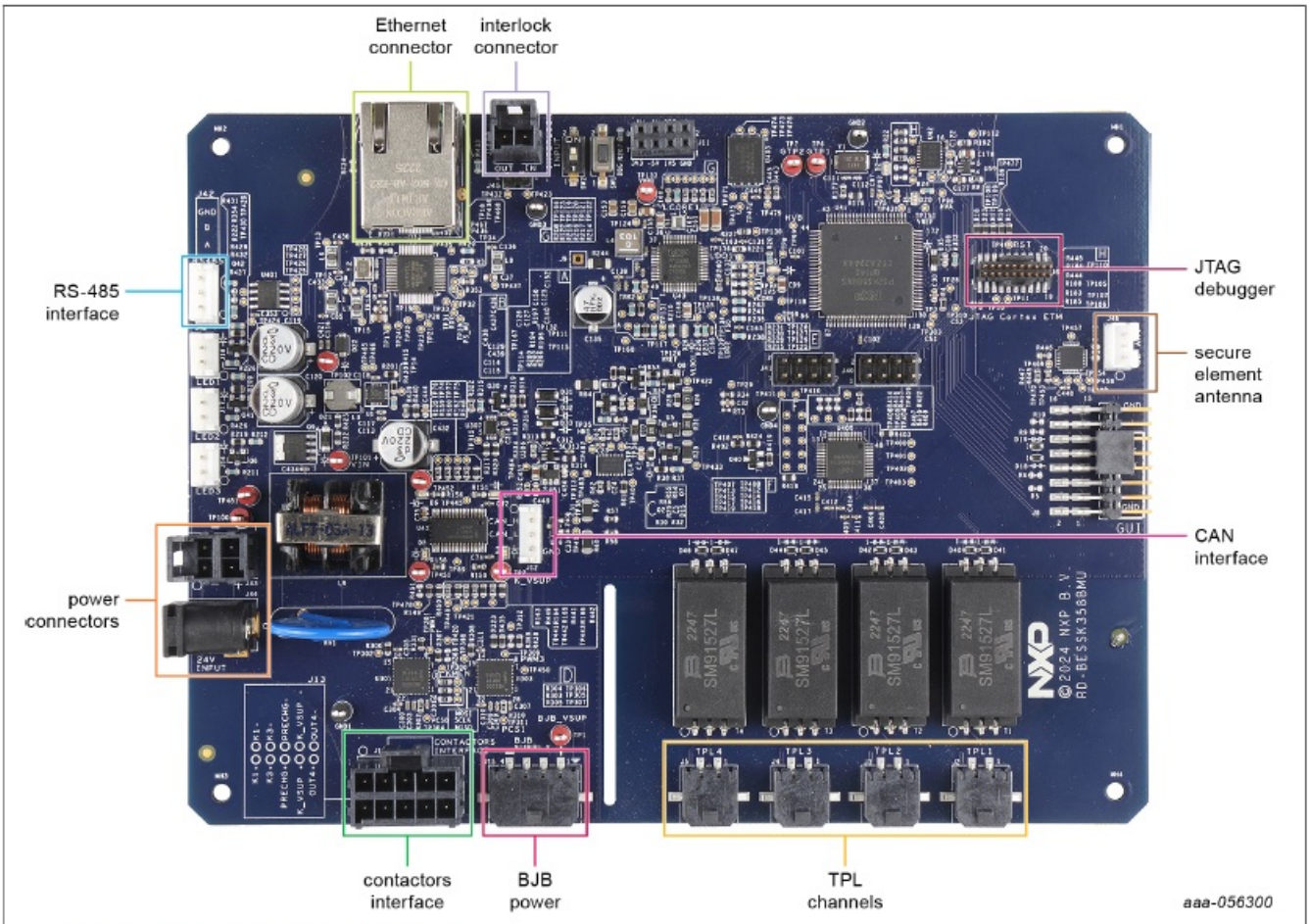

Figure 1. RD-BESSK358BMU interfaces

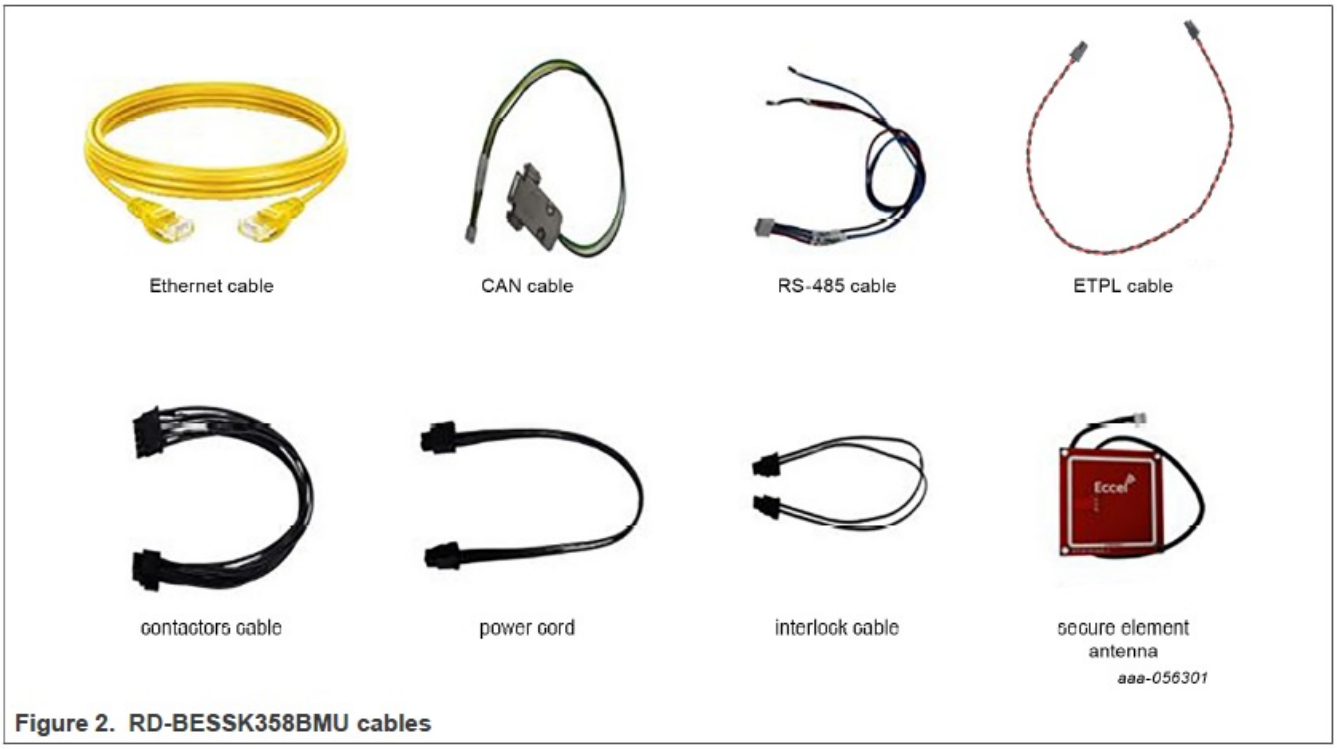

Figure 2. RD-BESSK358BMU cables

To learn more about the RD-BESSK358BMU, visit the website associated with this reference design, or read its **user manual**.

Cell monitoring unit

- The CMU is the cell-sensing part of the battery management system (BMS). The CMU precisely monitors cell voltages and environmental temperatures to ensure safe battery operation. The CMU also enables fast cell-balancing.
- The RDBESS774A3EVB is the BESS reference design CMU for ETPL-based architectures based on the MC33774A battery cell controller. This CMU kit includes four cables to interface with other parts of the BESS.

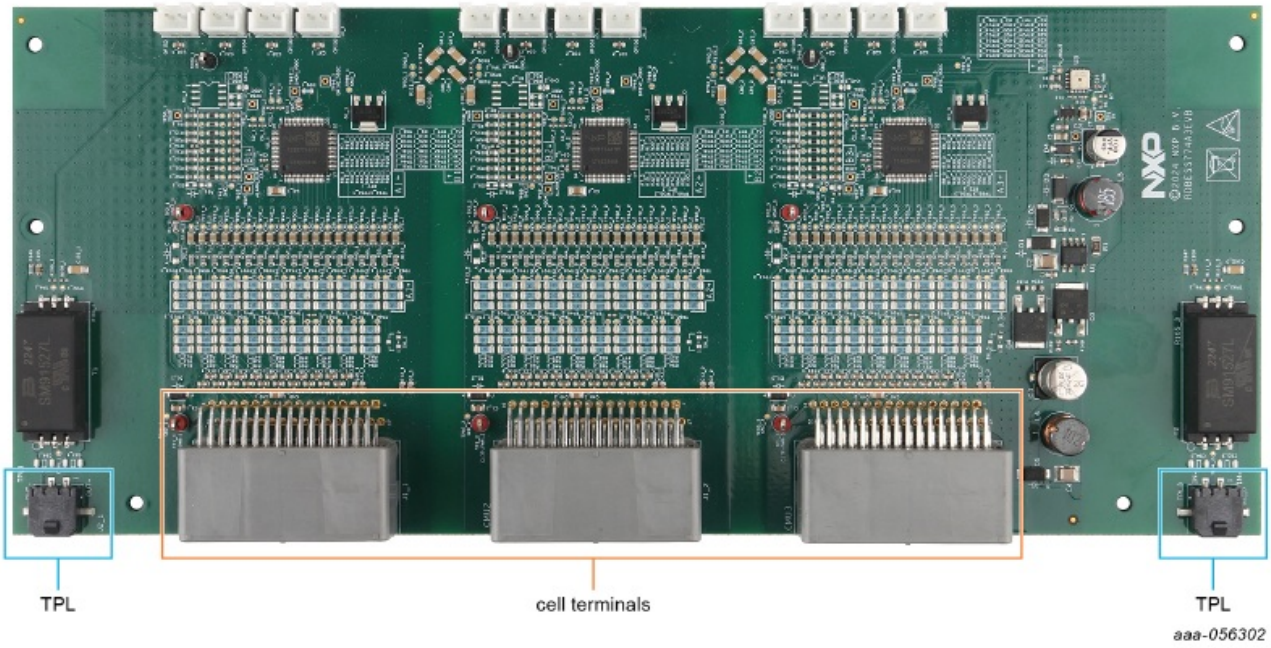

Figure 3. RDBESS774A3EVB interfaces

Figure 4. RDBESS774A3EVB cables

To learn more about the RDBESS774A3EVB, visit the website associated with this reference design, or read its **user manual**.

Battery junction box

- The BJB is the pack-level sensing part of the BESS. The BJB measures high voltages. This measurement allows monitoring the connections of the contactors to the inverter and the charger. The BJB also precisely measures the system current and monitors the battery to chassis isolation.
- The RDBESS772BJBEVB is the 1500 V BESS reference design BJB for ETPL-based architectures. This BJB kit includes 11 cables to interface with other parts of the BESS.

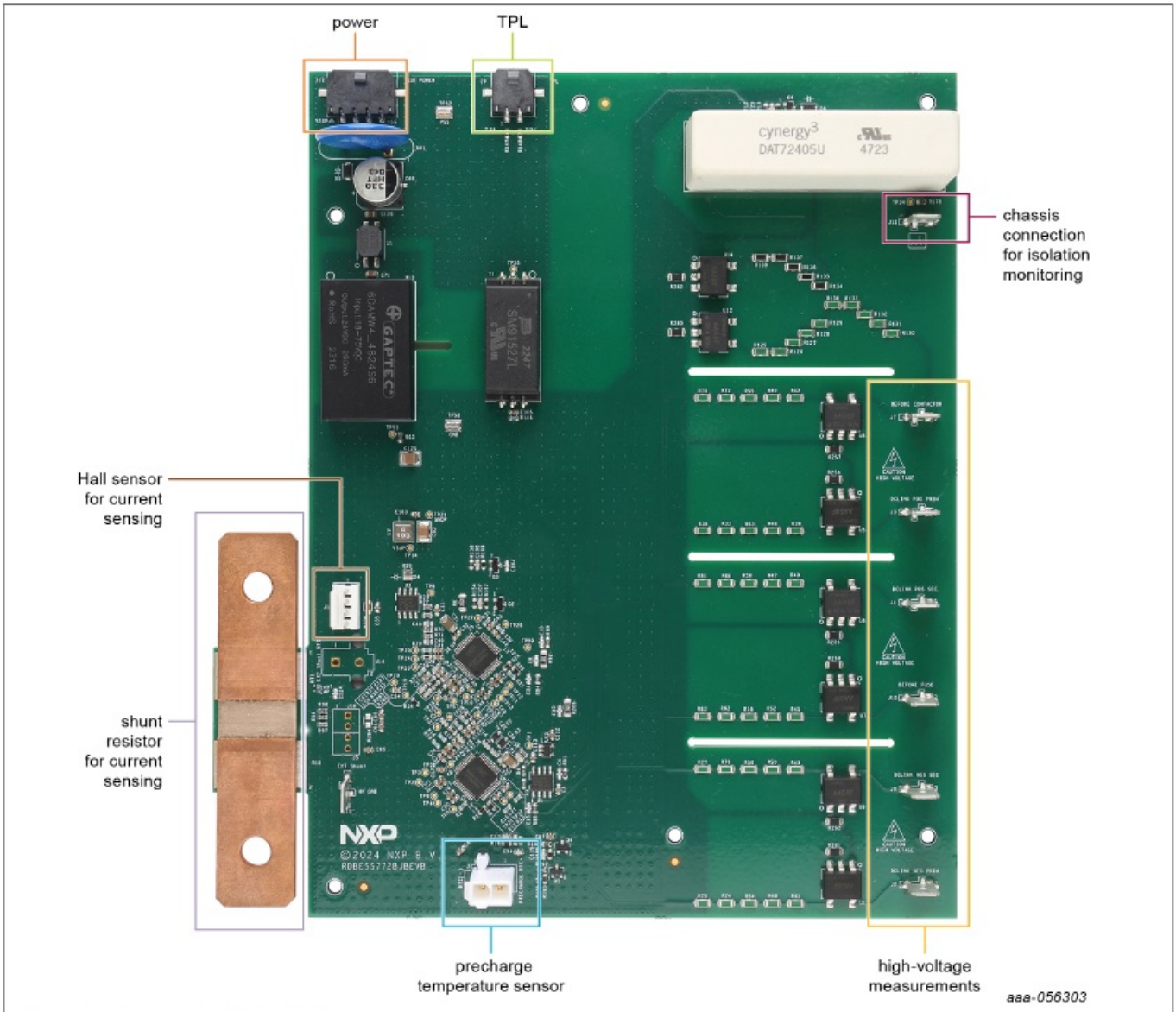

Figure 5. RDBESS772BJBEVB interfaces

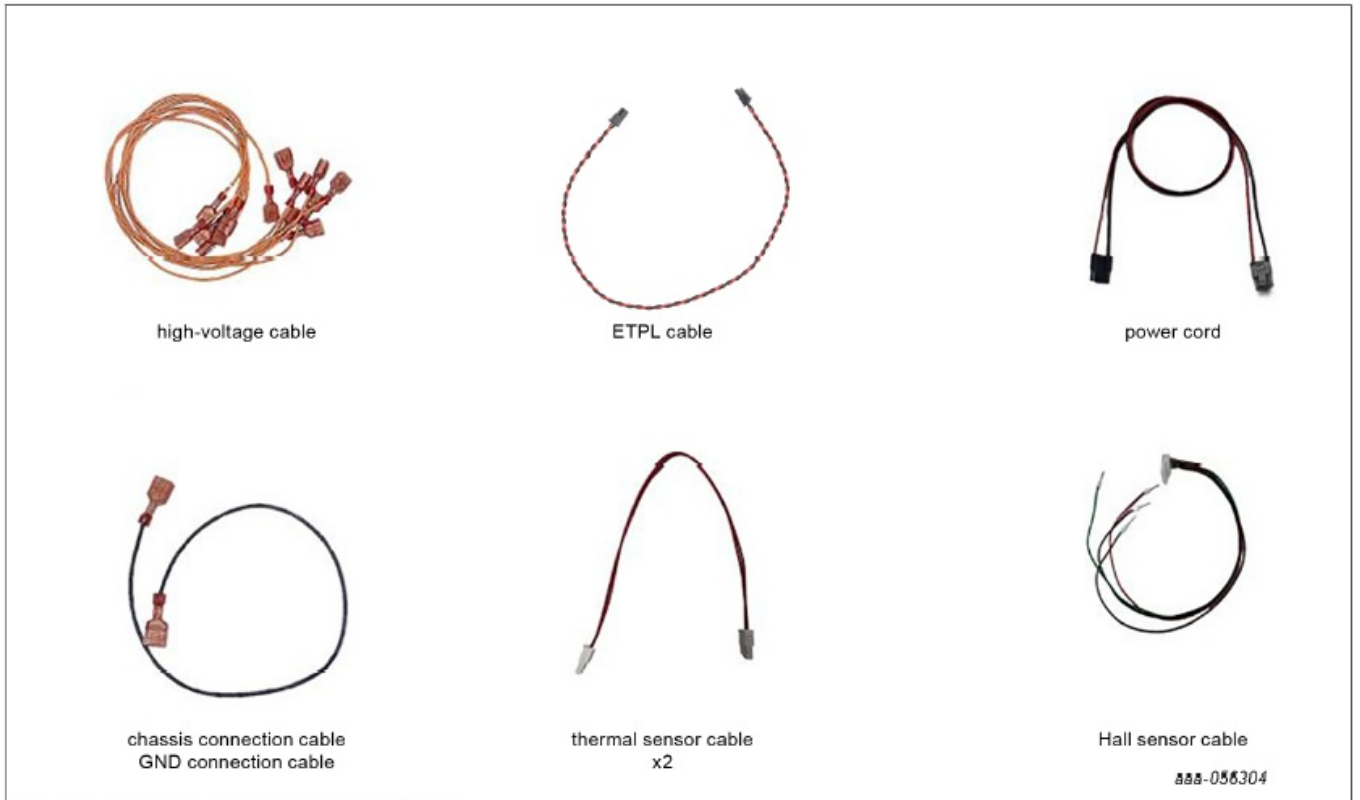

Figure 6. RDBESS772BJBEVB cables

To learn more about the RDBESS772BJBEVB, visit the website associated with this reference design, or read its **user manual**.

Battery emulation

- To emulate cell voltages and temperatures, the RD-BESS1500BUN contains a **BATT-18EMULATOR** battery emulator.

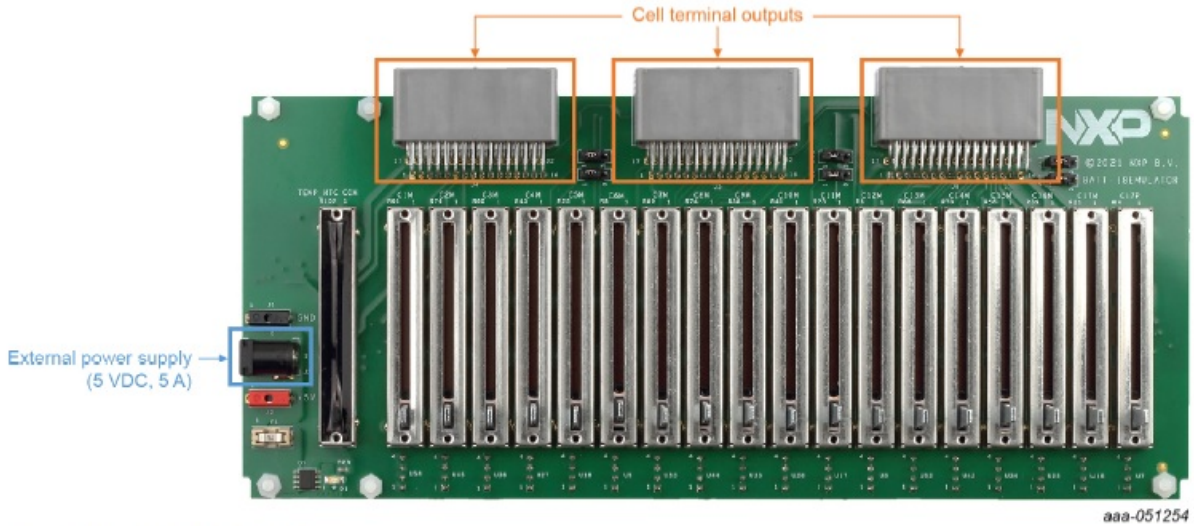

Figure 7. BATT-18EMULATOR interfaces

Polycarbonate structure

- To mount the bundle boards, the RD-BESS1500BUN contains an optional polycarbonate structure.

Figure 8. Polycarbonate structure

First Startup

Hardware requirements

In addition to the kit contents, the following hardware is beneficial when working with this kit.

- A PC, to run the provided GUI and program the RD-BESSK358BMU board.
- A Joint Test Access Group (JTAG) debugger to program the RD-BESSK358BMU board. The recommended debugger is **PEmicro multilink FX**.

Software requirements

In addition to the kit contents, the following software is beneficial when working with this kit.

- BMS monitor GUI V1.0 for measurement visualization and actuators control

Powering and connecting the system

To connect and power up the system, complete the following steps.

Connections of the boards

- Unpack all boards and cables from the kit
- Connect the power cord to the RD-BESSK358BMU (J44)
- Connect the Ethernet cable to the RD-BESSK358BMU (J1)
- Connect the controller area network flexible data rate (CAN FD) cable to the RD-BESSK358BMU (J12)
- Connect the contactor cable to the RD-BESSK358BMU (J13)
- Connect the interlock cable to the RD-BESSK358BMU (J14)
- Connect the CMU
    - Connect the first ETPL cable to the RD-BESSK358BMU (J2) and the RDBESS774A3EVB (J2_1)
    - Connect the second ETPL cable to the RD-BESSK358BMU (J3) and the RDBESS774A3EVB (J2_3)
    - Connect the three supply cables to the RDBESS774A3EVB (J1_1, J1_2, and J1_3) and the BATT-18EMULATOR (J4, J5, and J6)
- Connect the BJB
    - Connect the ETPL cable between the RD-BESSK358BMU (J4) and the RDBESS772BJBEVB (J9)
    - Connect the BJB supply cable between the RD-BESSK358BMU (J15) and the RDBESS772BJBEVB (J12)

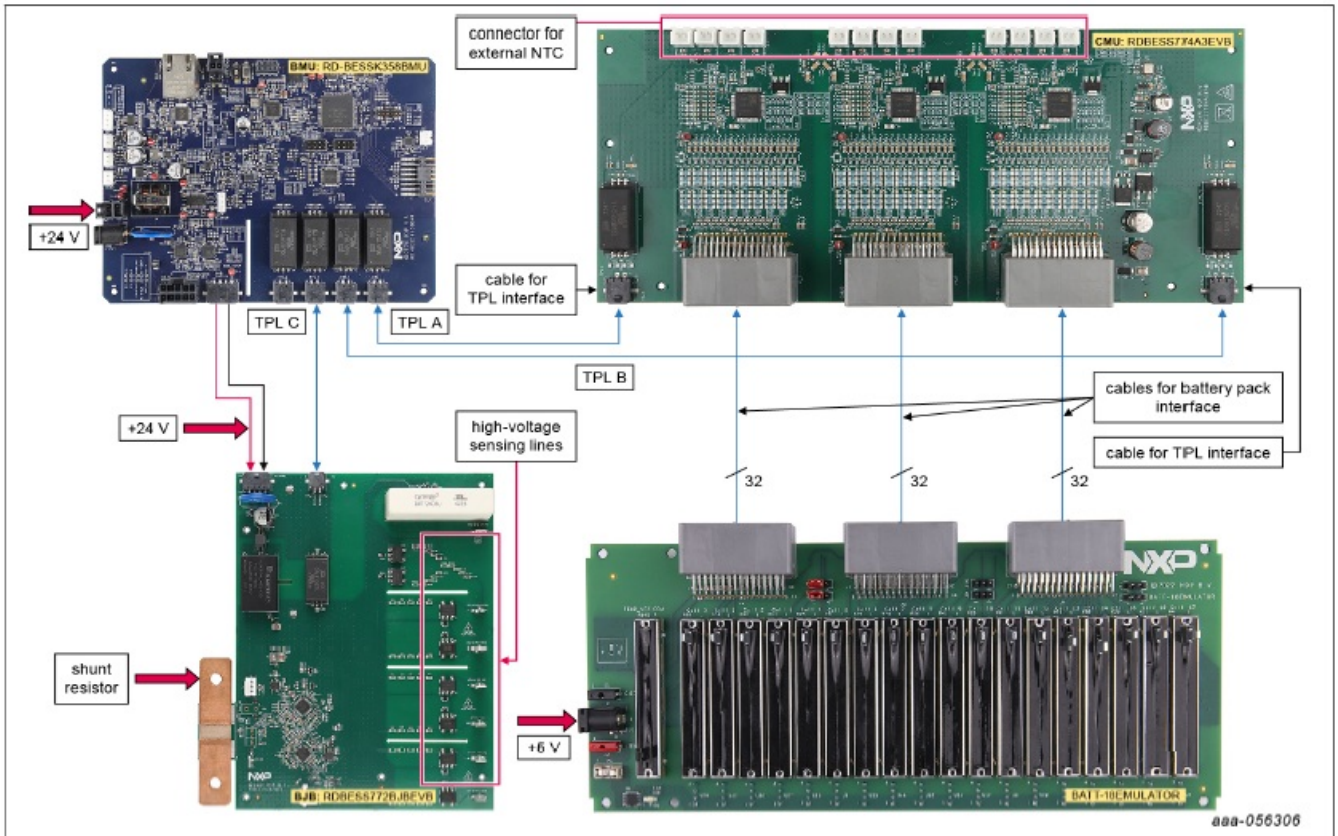

Figure 9. RD-BESSK358BMU interfaces

Powering the boards

- Power the CMU by powering the BATT-18EMULATOR using the provided power supply (J3)
- Power the BMU by connecting the provided power supply to the power connector (J44)

Monitoring the system using the BMS monitor GUI V1.0

- Open the BMS monitor GUI V1.0 (BMS_Monitor.exe)
- Connect an Ethernet cable from the PC to the RD-BESSK358BMU (J1)
- Configure the PC with a static IP
    - Using the Windows search bar, search for view network connections
    - Click and open view network connections
    - Select the Ethernet connection and open its properties. Again, for the Ethernet status window click properties

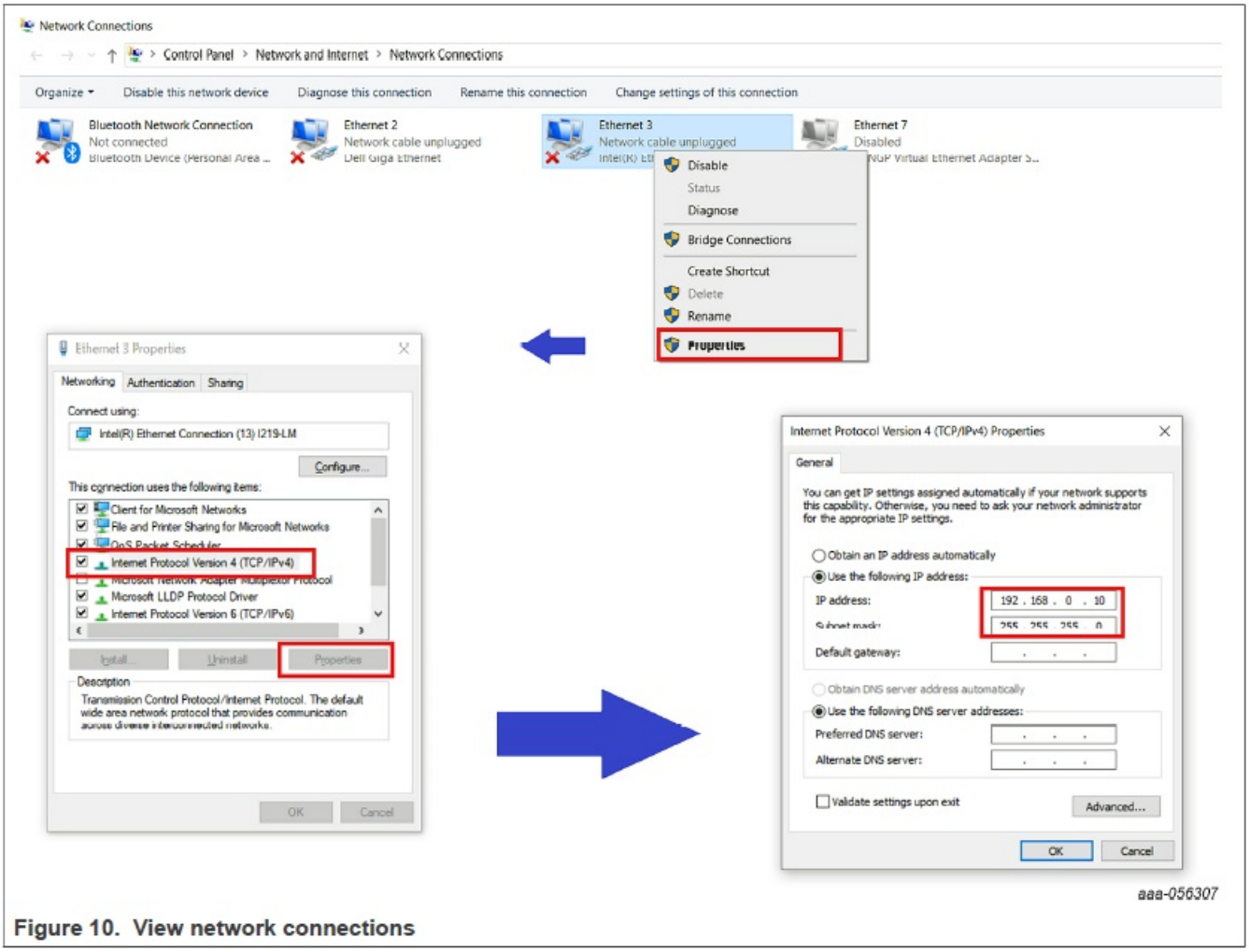

Figure 10. View network connections

For the Ethernet properties window, select Internet protocol version 4 (TCP/IPv4), then double click on it, or click properties.
Follow Figure 11, the IP address can range from 192.168.0.1 to 192.168.0.255, except for 192.168.0.200, which is the IP of the BMU.

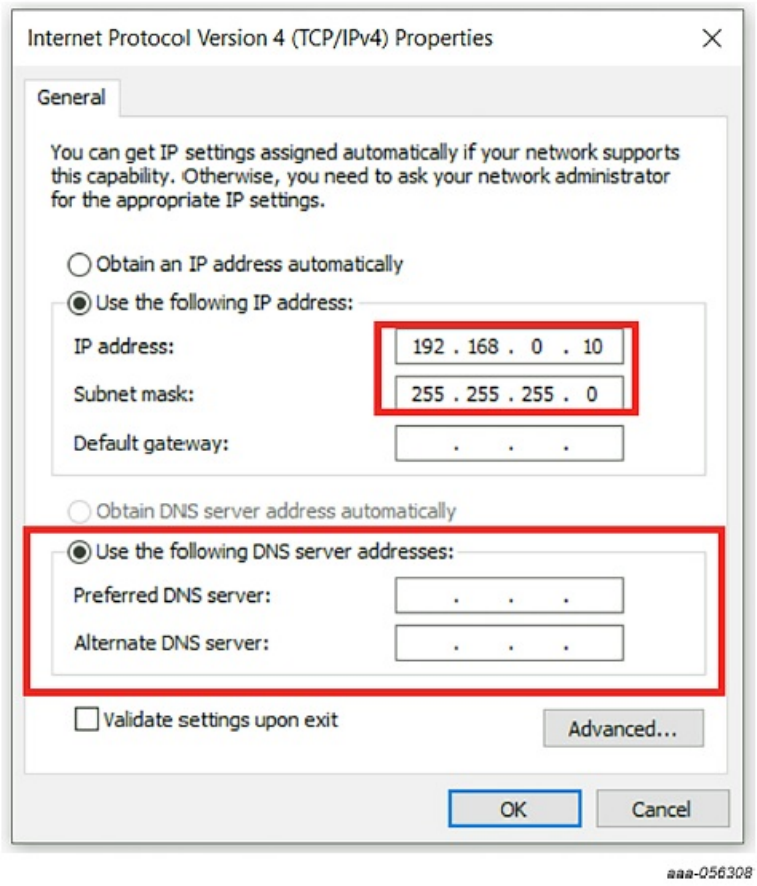

Figure 11. Static IP configuration

Use the same subnet mask, as in Figure 11.

- For the DNS server, you can leave it empty, or select ‘Obtain DNS server address automatically’.
- Finally click OK
- Back to the desktop application, after opening the app, you see the image as shown in Figure 12.

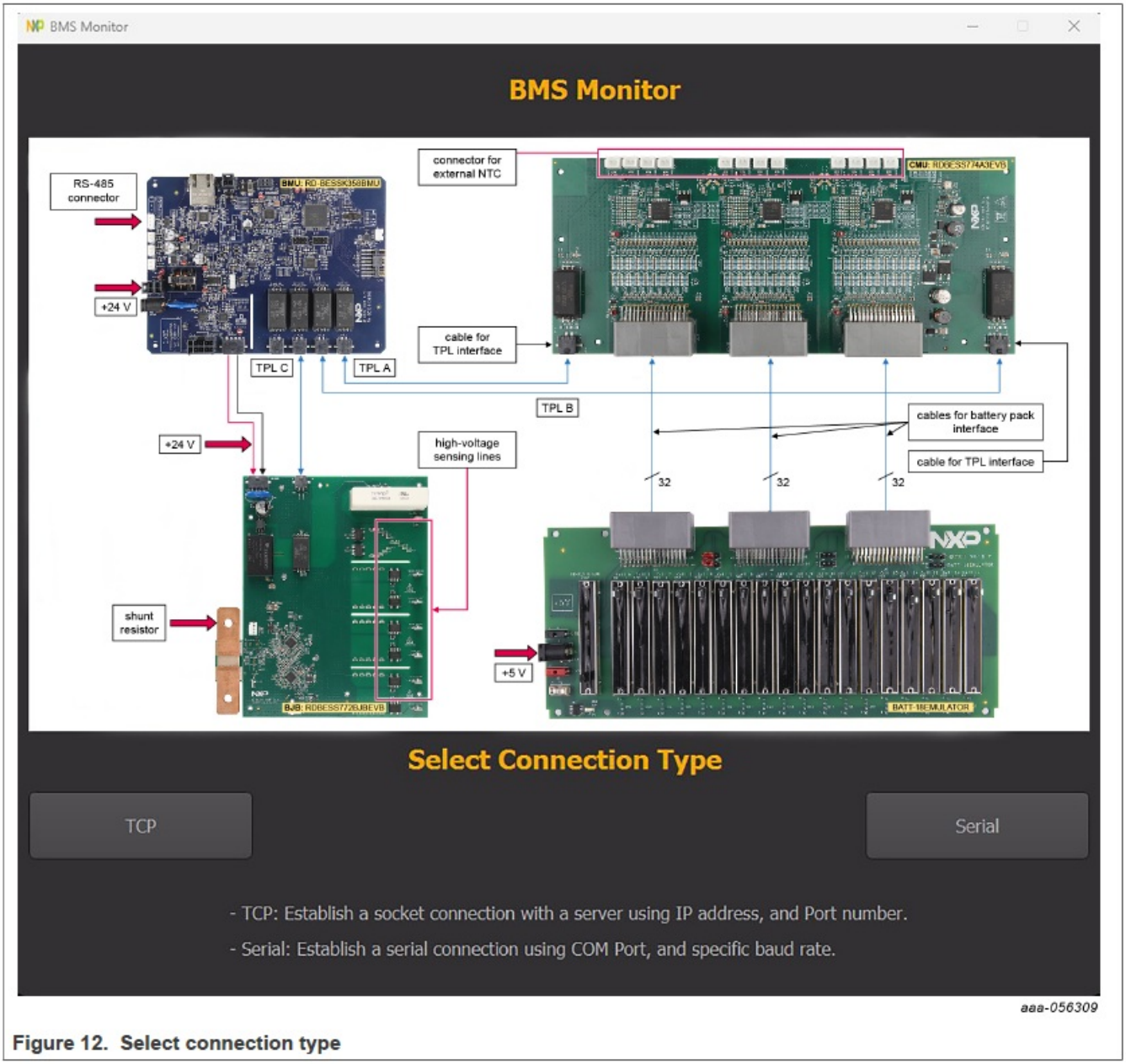

Figure 12. Select connection type

- In the BMS monitor GUI V1.0, click TCP
- Enter the BMU IP address, which is 192.168.0.200. This address is the same for all BMUs.
- Enter the port number, which is 5001
- Click connect to move to the general settings page.

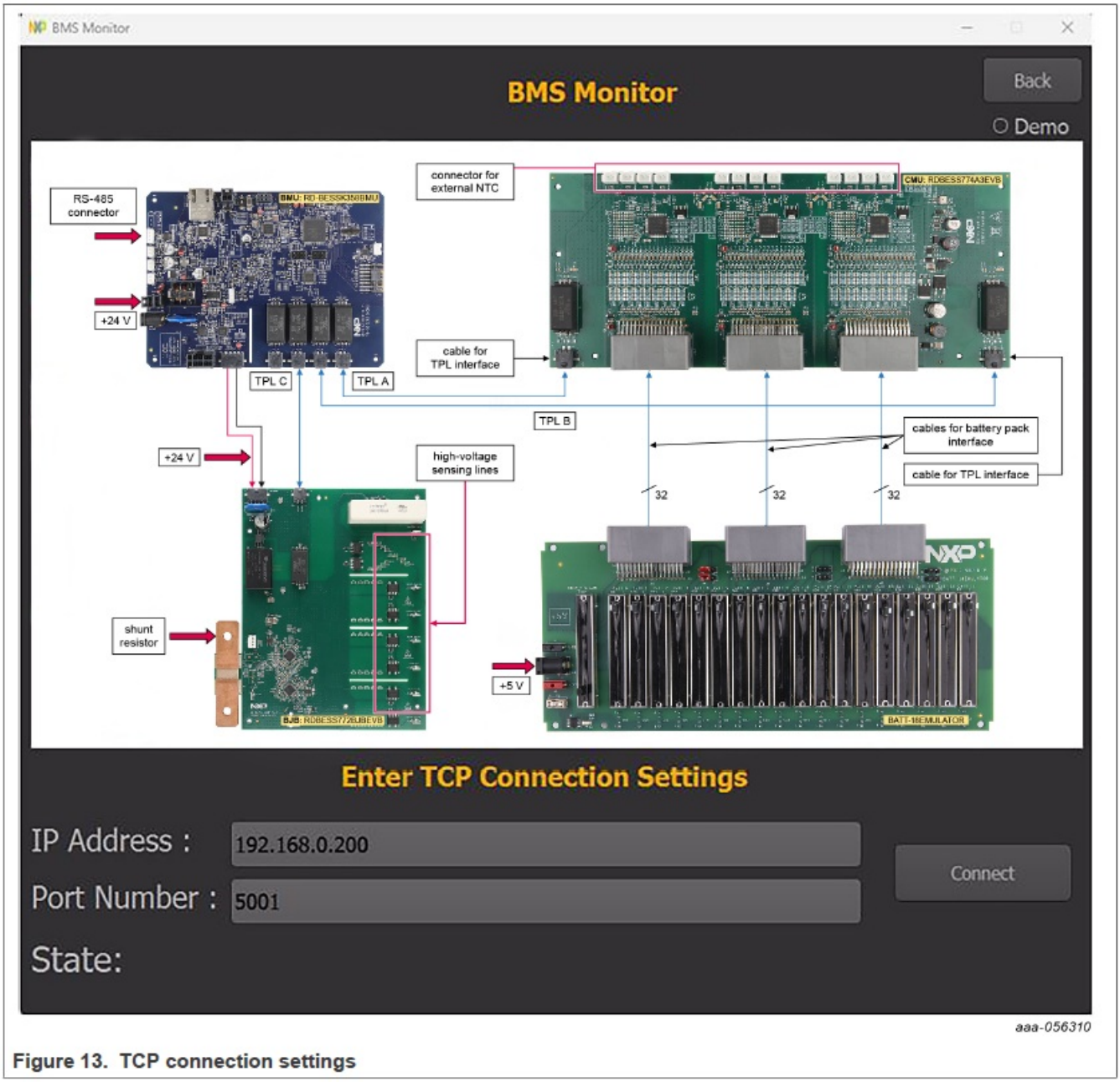

Figure 13. TCP connection settings

General settings

- Enter the default BMU address, which is 1. Choose a different address for each BMU.
- Enter the default reading interval, which is 1.
- The reading interval defines how often the application receives new readings from the BMU.
- Define the CMU configuration. Select ‘3 Cells Monitoring Chip (CMC)’.
- Click ‘Next’

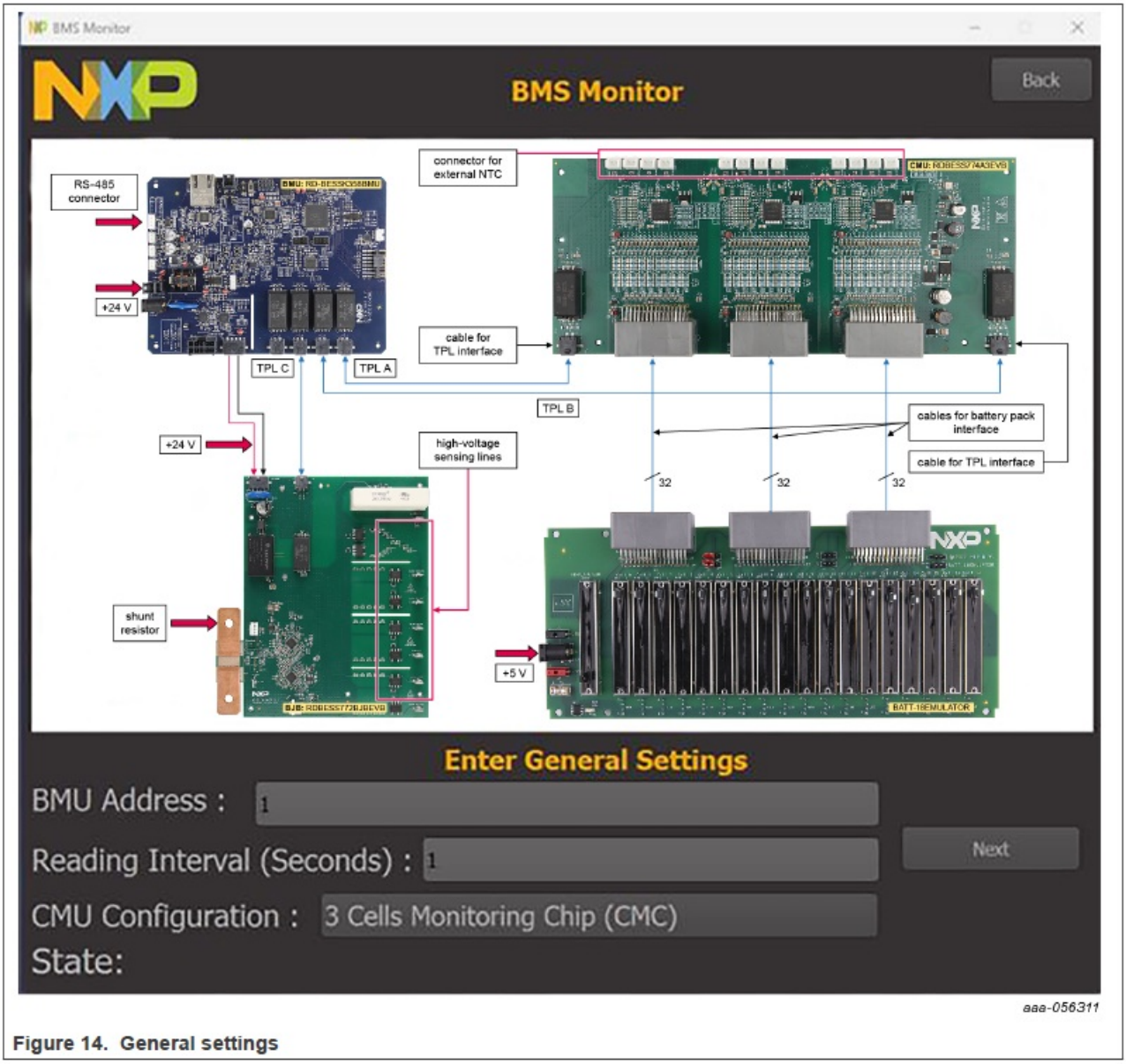

Figure 14. General settings

Programming the system

- To install the development setup and start programming with the BESS reference design, refer to the software section of the **RD-BESS1500BUN** website.

References

1. Battery management unit website: **RD-BESSK358BMU**
2. Cell monitoring unit website: **RDBESS774A3EVB**
3. Battery junction box website: **RDBESS772BJBEVB**
4. Battery cell emulator webpage: **BATT-18EMULATOR**
5. Bundle webpage: **RD-BESS1500BUN**

Revision history

Table 1. Revision history

Document ID	Release date	Description
UM12117 v.1	1 July 2024	• Initial version

FAQ

Frequently Asked Questions

- **Q:** What is the purpose of the RD-BESS1500BUN bundle?
  - **A:** The bundle is a reference design for a 1500 V Battery Energy Storage System (BESS) for evaluation and development purposes.
- **Q:** How can I visualize cell voltage measurements using the system?
  - **A:** Visit the RD-BESS1500BUN website for a graphical user interface (GUI) that matches with a preflashed binary file on the BMU.

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References

- **User Manual**