UM11748

MC33665A_CCMU_Demo user manual

Rev. 2 — 25 August 2022 User manual

Document information

Information	Content
Keywords	MC33665A, CANoe, CAN (FD), MC33775A
Abstract	MC33665A_CCMU_Demo user manual to set up in CANoe.

Revision history

Rev	Date	Description
2	20220825	minor text update, updated to MC33665A_CCMU_Demo_V2, removed section for RD33775ADSTEVB, title update from MC33665A CANoe tool user manual to MC33665A_CCMU_Demo user manual
1	20220620	initial version

1 Important notice

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NXP provides the product under the following conditions:

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2 Introduction

The MC33665A is a general-purpose battery management system (BMS) communication gateway IC for CAN (FD) to four transport protocol link (TPL) ports. The MC33665ATF4AE offers a CAN or CAN FD interface for communication with an MCU as defined in ISO 11898. The CAN physical layer is not included. An external CAN transceiver such as TJA1442 or TJA1443 of NXP or relevant transceivers must be used based on the application.

Note: *MC33665A referred in this document is a CAN (FD) variant with MC33665ATF4AE.*

Communication can be established to MC33665A (MC33665ATF4AE) with CAN or CAN FD protocol. CANoe is a software tool from Vector Informatik GmbH which is known in automotive industry. Goal of MC33665A_CCMU_Demo is to utilize the features of CANoe to communicate with MC33665A in extracting the cell voltages and temperatures from MC33775A BCCs designed by NXP.

This document describes how to set up the CANoe environment for MC33665A and use the workspace of MC33665A_CCMU_Demo to generate the voltage and temperature measurements.

- MC33665A: general-purpose BMS communication CAN (FD) gateway
- MC33775A: 14-channel Li-ion battery cell controller (ASIL D)

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

- https://www.nxp.com/FRDM665CANFDEVB
- https://www.nxp.com/RD33775ACNCEVB
- BATT-14CEMULATOR
- BATT-14EXTENDER

3 Demo prerequisites

Below is the list of devices or hardware required to run MC33665A_CCMU_Demo.

- A PC or laptop which meets minimum hardware and software requirements to install the CANoe (license version) from Vector
- CANoe tool with a valid license which is either installed in PC or in HW (dongle or relevant) connected to the PC. Note: MC33665A_CCMU_Demo is generated to support CANoe version 11, version 13, and version 15.
- Hardware to interface with PC (USB) to CAN (FD) (DB-9 or relevant connector); typically VN1610 or relevant which had CAN (FD) capability of data speeds up to 5 Mbit/s can be used
- RD33775ACNCEVB: centralized cell monitoring unit (CCMU) based on CAN (FD)
- Standard DC power supply which is minimum 25 W with 12 V output
- 14 cell slider battery pack emulator (BATT-14CEMULATOR)
- 14 cell battery pack extender board (BATT-14EXTENDER)

4 Software setup

To set up the CANoe software in a PC or laptop which is intended to use for demo, follow below steps.

- Install the CANoe tool from Vector. Follow the installation guidelines of CANoe. Note: Check the compatibility of MC33665A_CCMU_Demo for CANoe version and license.
- Download the MC33665A_CCMU_Demo available at https://www.nxp.com/MC33665A

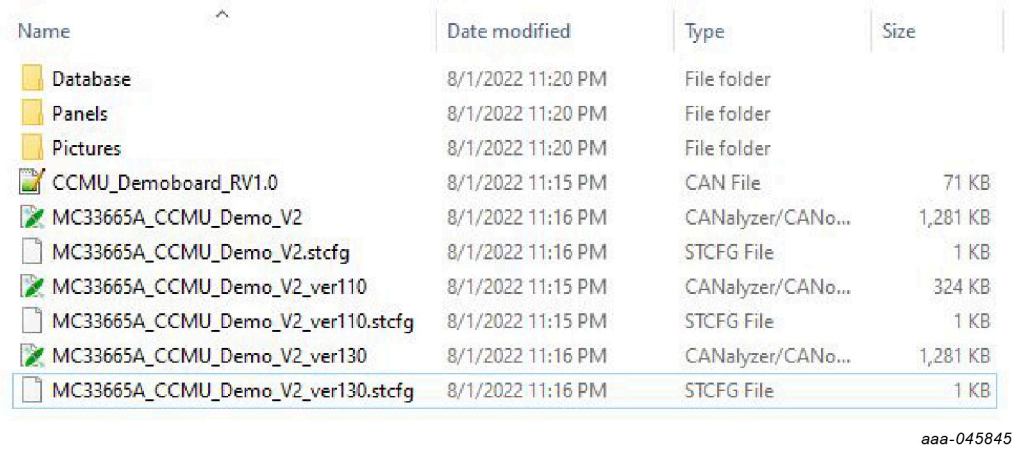

Figure 1. MC33665A_CCMU_Demo files

- **Database** folder has .dbc files to support communication with MC33665A and MC33775A. NXP_BMS_QPHY_V1.dbc file supports for MC33665A_CCMU_Demo.
- Two panels to support the MC33665A_CCMU_Demo are available in **Panels** folder.

- **CCMU_Demoboard_RV1.0.can** is the communication access programming language (CAPL) file to support as node in MC33665A_CCMU_Demo_V2.
- MC33665A_CCMU_Demo_V2 is compatible for **CANoe 15**, MC33665A_CCMU_Demo_V2_ver130 is compatible for **CANoe 13**, and MC33665A_CCMU_Demo_V2_ver110 is compatible for **CANoe 11**. MC33665A_CCMU_Demo_V2 CANoe configuration files are forward compatible for latest CANoe version.
- Open the CANoe installed in PC or laptop. To run the full features of MC33665A_CCMU_Demo, select the available CANoe license. MC33665A_CCMU_Demo can work for CANoe versions 11 or above (select the appropriate MC33665A_CCMU_Demo file).
- Click the **File** tab on top left corner of CANoe tool → click **Open** → browse to the location of MC33665A_CCMU_Demo files shown in Figure 1 → select the compatible MC33665A_CCMU_Demo_V2 configuration file → click **open** button (on bottom right corner) to open the workspace in **CANoe**
- Workspace of MC33665A_CCMU_Demo_V2 in configuration tab consists of **Simulation Setup** window and **Trace** window as shown in Figure 2.

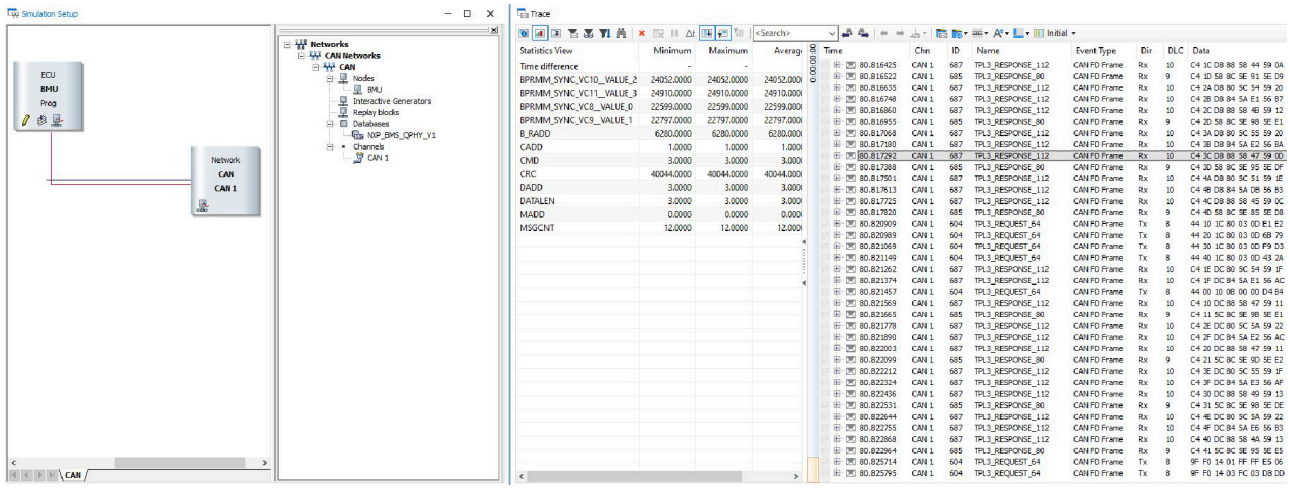

Figure 2. MC33665A_CCMU_Demo workspace

- Battery management unit (BMU) is the simulation node communicating to MC33665A and MC33775A with appropriate CAN or CAN FD messages on **CAN1** network. Based on Vector CAN hardware (such as VN1610), select the right CAN network in **Channels**, and select appropriate **CAN** network (CAN1 or CAN2 based on Vector CAN hardware).
- BMU node specification is preselected with CAPL file CCMU_Demoboard_RV1.0.can.

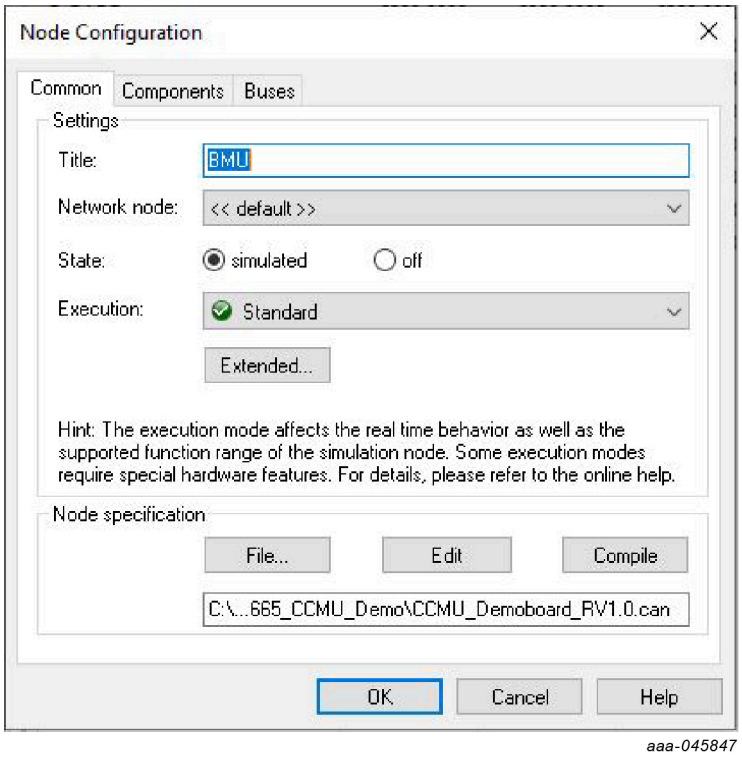

Figure 3. CANoe node configuration

- **NXP_BMS_QPHY_V1** database is connected to **Databases** in simulation setup to interpret the CAN or CAN FD messages. It supports both MC33665A (TPL2 and TPL3) and MC33775A (TPL3). NXP_BMS_QPHY_V1 database is compatible for CAN or CAN FD communication to MC33665ATF4AE with ID0_STB_OD, ID1, ID2, and ID3 pins set to zero.

5 Hardware setup

MC33665A_CCMU_Demo is built to work in CANoe from Vector. Demo can work with specific preconditions in hardware which are listed below.

- Vector CAN hardware tools (such as VN1610) must be interfaced to board which has MC33665A CAN (FD) variant (MC33665ATF4AE). **ID0_STB_OD, ID1, ID2, and ID3** pins of MC33665A must be set to zero.
- MC33665A_CCMU_Demo is compatible to support up to four MC33775A battery cell controller (BCC) devices on TPL port 0 of MC33665A.
- RD33775ACNCEVB can be used for the demo. If there is a customer-specific hardware based on MC33665A, check if CAN transceiver supports CAN FD baud rate requirements of MC33665A_CCMU_Demo.
- Before starting the demo, check the termination of CAN transceiver and make sure it is matching to the CAN bus impedance requirements (60 Ω).
- CFG0 and CFG1 pins on MC33665A must be aligned with setup in CANoe configuration.

Table 1. CFG pins of MC33665A

CFG1	CFG0	Data rate
0	0	250 kbit/s
0	1	500 kbit/s
1	0	1 Mbit/s
1	1	reserved

- Any changes to CFG0 and CFG1 pins on MC33665A should be reflected for CAN baud rate settings (shown in Figure 4) in CANoe workspace (MC33665A_CCMU_Demo_V2) → network hardware configuration. See Table 1 and CFG0 and CFG1 pin settings of MC33665A on RD33775ACNCEVB before updating the **Network Hardware Configuration**.

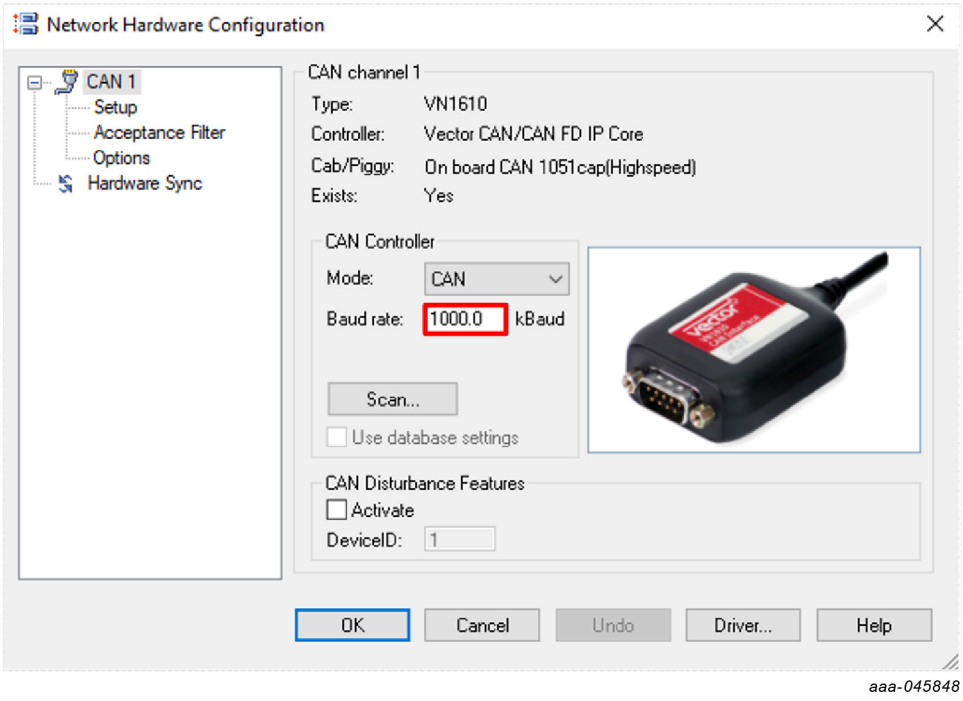

Figure 4. CAN HW baud rate

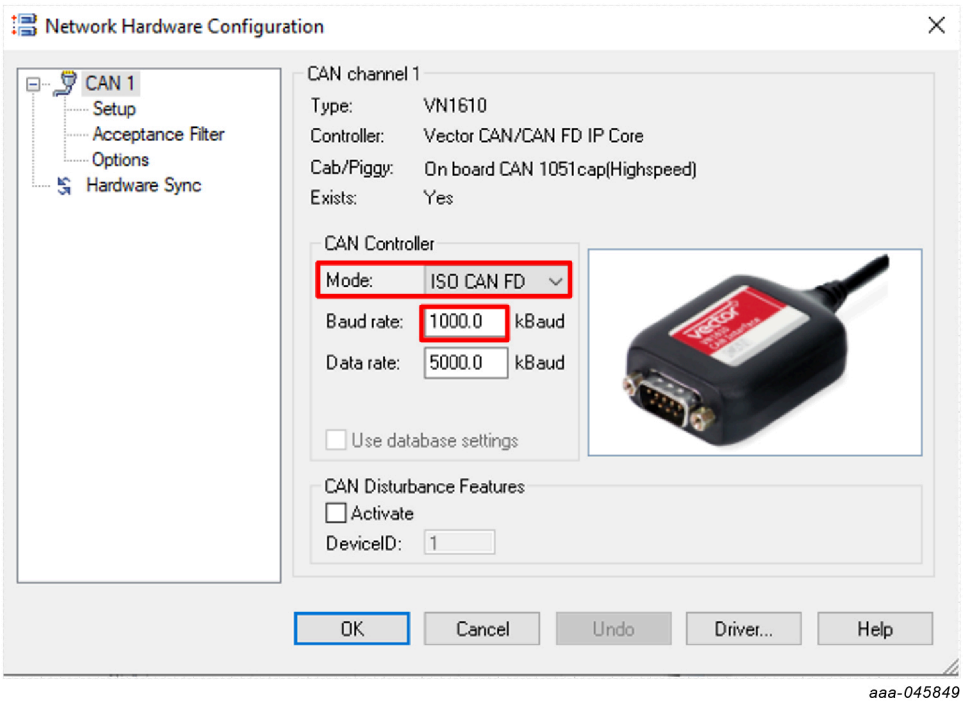

Figure 5. CAN FD arbitration baud rate

MC33665A_CCMU_Demo can work with different CAN FD hardware settings (arbitration baud rate: set by CFG pins of MC33665A; data baud rate: 1 Mbit/s, 2 Mbit/s, 5 Mbit/s possible to set in CCMU panel).

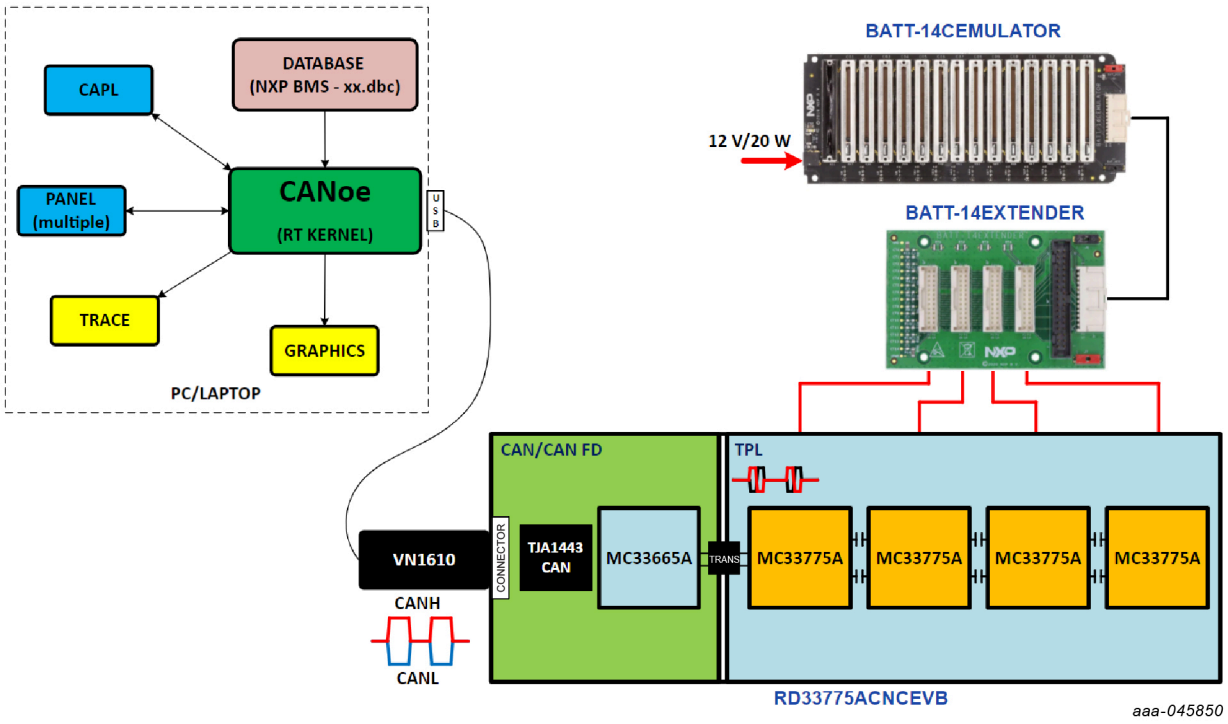

Figure 6. CANoe CCMU setup

- Figure 6 shows the block diagram of setup for MC33665A_CCMU_Demo with CCMU board. RD33775ACNCEVB also known as CCMU can be interfaced from laptop with Vector CAN hardware (such as VN1610).
- Cell interface connections can be connected to external cell emulators.
- Check the voltages of CFG0, CFG1, ID0_STB_OD, ID1, ID2, ID3 pins of MC33665A populated on the RD33775ACNCEVB before starting the demo.
- Install 120 Ω resistor for CAN communication in above setup. Ignore the same if there is an additional termination in network which is not part of the setup shown above.
- To set up and run the demo, follow the safety precautions guided by lab manager or supervisor.
- Follow the user manual of boards for setup and smooth operation of demo.

6 Running CANoe demo

MC33665A_CCMU_Demo can be run from a PC or laptop which is installed with CANoe (as per prerequisites specified in Section 3). Make sure that the relevant hardware is available with interconnection guidelines of boards. Follow below **steps** in installing and running the MC33665A_CCMU_Demo.

1. Set up the PC or laptop which is used to install and run the MC33665A_CCMU_Demo. Complete the procedure specified in Section 4 before starting the MC33665A_CCMU_Demo.
2. Set up the hardware as specified and shown in Section 5. Make sure that the preconditions of hardware setup are done appropriately before finalizing and running the setup. Power on the hardware by checking the interconnections of setup.
   a. Vector HW USB to PC → DB-9 connector CAN interface to RD33775ACNCEVB
   b. Power supply (12 V/20 W) to BATT-14CEMULATOR → cell interface connection of BATT-14CEMULATOR to BATT-14EXTENDER → four cell interface cables from BATT-14EXTENDER to RD33775ACNCEVB
3. Start CANoe installed in PC or laptop. Set up the workspace as described in Section 4. Set up the CAN channel as per the Vector CAN hardware (VN1610 as shown in Figure 7) connected to board populated with MC33665A CAN (FD).
4. Open the hardware → network hardware to set the initial baud rate for CAN communication matching to CFG0 and CFG1 settings of MC33665A in RD33775ACNCEVB

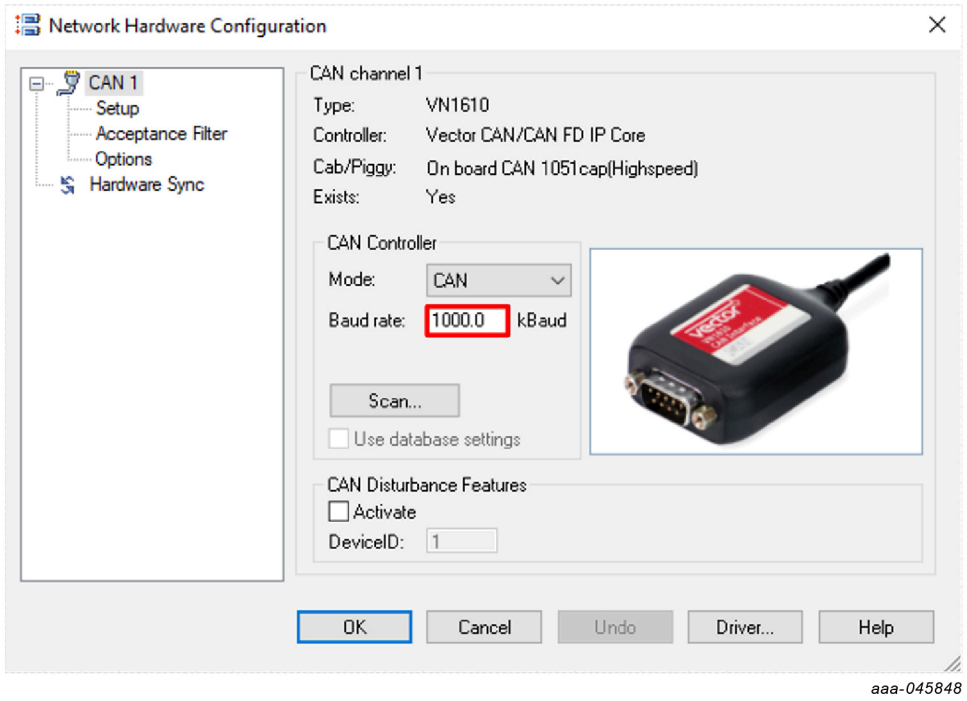

Figure 7. Initial CAN settings

5. Click the 'Start' button on left top corner of CANoe tool to run the initial configuration of MC33665A with CAN and set the CAN FD baud rate. Initial settings for CAN FD data baud rate to MC33665A is set as 2 Mbit/s. CFG0 and CFG1 pins of MC33665A sets arbitration baud rate for CAN FD.
6. Update the initial CAN FD settings in CANoe. Select the **Hardware** → click **Network Hardware** → change the mode to **ISO CAN FD** and update the data rate to **2000 kBd** → press **OK**

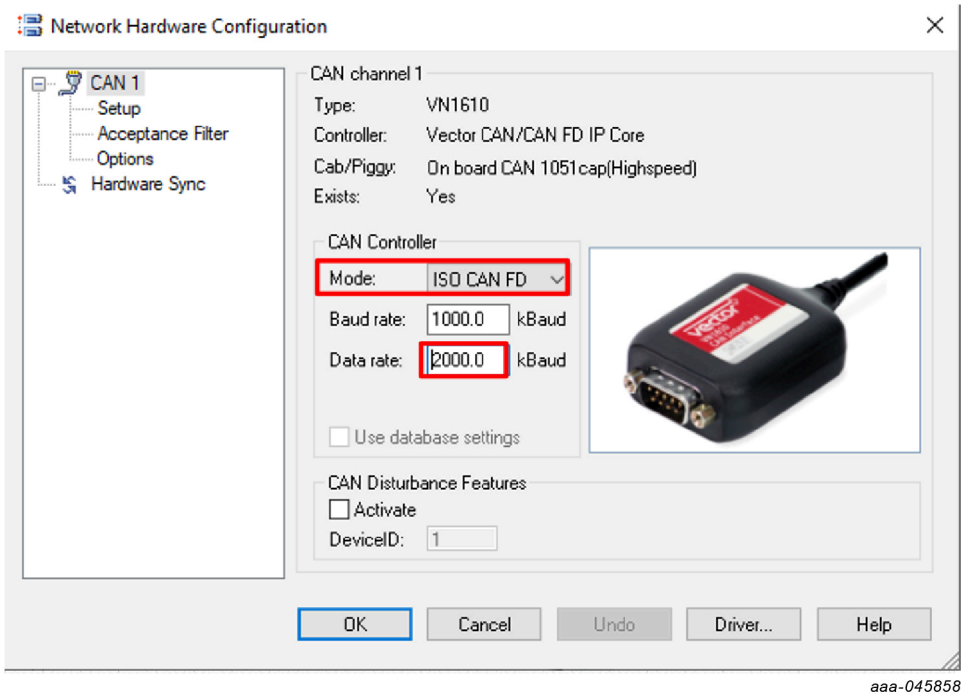

Figure 8. Initial CAN FD settings

7. Click the **START** button to run the setup in CAN FD with updated data baud rate settings. CAN or CAN FD traffic can be monitored and logged using 'Trace' window as shown in Figure 11
8. Panels can be used to visualize the data from RD33775ACNCEVB to run and control the MC33665A_CCMU_Demo. Select **Home** → click **Panel** drop down menu → select and click **Add Panel** → select the location of files stored in Figure 1 → open **Panels** folder → select the **NXP_CCMU_CANFD** → press **Open**

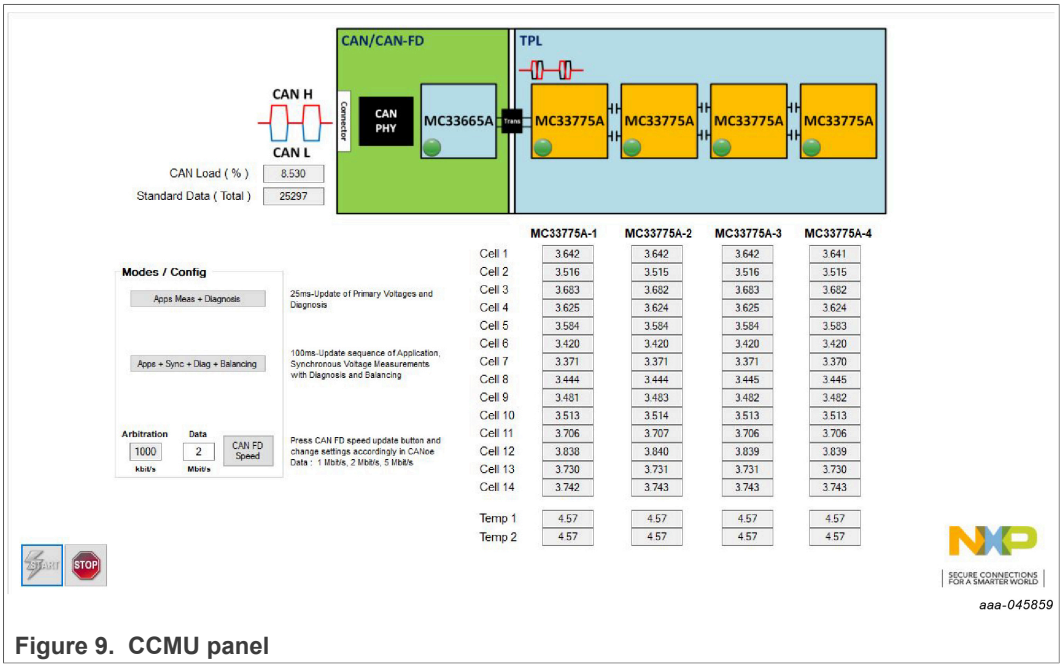

Figure 9. CCMU panel

9. **CCMU panel** gives overview of CAN bus statistics, with two demo sequences and update CAN FD settings. VC0 to VC13 primary cell voltages of MC33775A can be

seen as Cell 1 to Cell 14 on the CCMU panel. AN0 and AN1 of MC33775A can be seen as Temp 1 and Temp 2 on the panel.

10. As shown in CCMU panel (Modes / Config) in Figure 9, demo can run in two sequences to communicate and monitor the onboard MC33775A battery cell controllers. **Apps + Sync + Diag + Balancing** is a sequence which executes application measurements of primary cell voltages, sync measurements of both primary cell voltages and secondary cell voltages, overvoltage and undervoltage measurements along with balancing of cells for every **100 ms**. **Apps Meas + Diagnosis** is a sequence which runs for every **25 ms** to run and update application measurements of primary cell voltages with undervoltage, overvoltage measurements of four MC33775A battery cell controllers.
11. **CAN Load** (%) gives a reference for bus loading on CAN bus used for communication (channels CAN1 or CAN 2) calculated by CANoe tool. **Standard Data** (total) gives the log of complete CAN/CAN FD messages on bus.
12. CAN FD communication from CANoe to RD33775ACNCEVB can be done at different data baud rates. Enter the appropriate data speeds (1 Mbit/s, 2 Mbit/s or 5 Mbit/s) in CCMU panel. Press **CAN FD Speed** button to update the settings from CANoe (CCMU panel) to MC33665A on RD33775ACNCEVB. Note: Demo stops running while updating CAN FD speed to MC33665A.
13. Update the same data speed entered on CCMU panel to CANoe configuration. Select **Hardware** → press **Network Hardware** → update **Data rate** same as provided in CCMU panel→ click **OK** → press the **START** in CANoe or on panel to resume the demo at updated CAN FD baud rates.
14. **Analysis** tab in MC33665A_CCMU_Demo_V2 gives options to analyze the traffic to evaluate the performance of MC33665A and MC33775A.

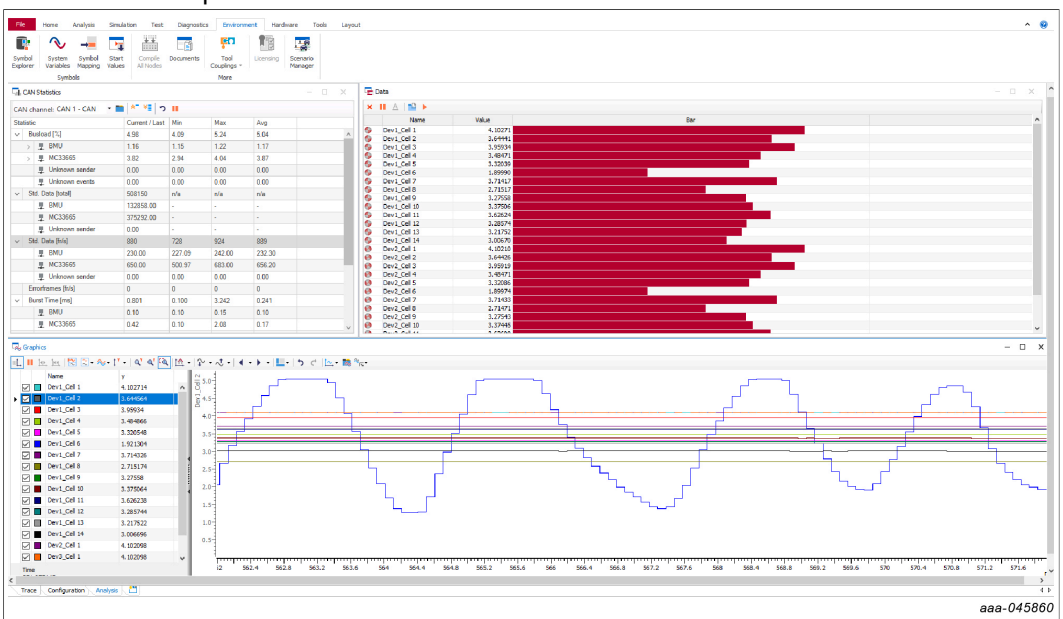

Figure 10. CCMU demo analysis

15. **Graphics** and **Data** windows offer different visualization and facilities to log the cell voltages and temperatures from MC33775A. **CAN Statistics** window provides the information of CAN bus performance based on CANoe features and configuration. Key pointers to check are Busload (%) and types of requests made in BMU with relevant responses from MC33665A.

16. BATT-14CEMULATOR can be used effectively to emulate the cell voltage behavior which can be visualized in Graphics window (data extracted from MC33775A and MC33665A).
17. **Trace** window in CANoe offers to see the log of CAN or CAN FD messages on the selected CAN channel (CAN1 or CAN2).

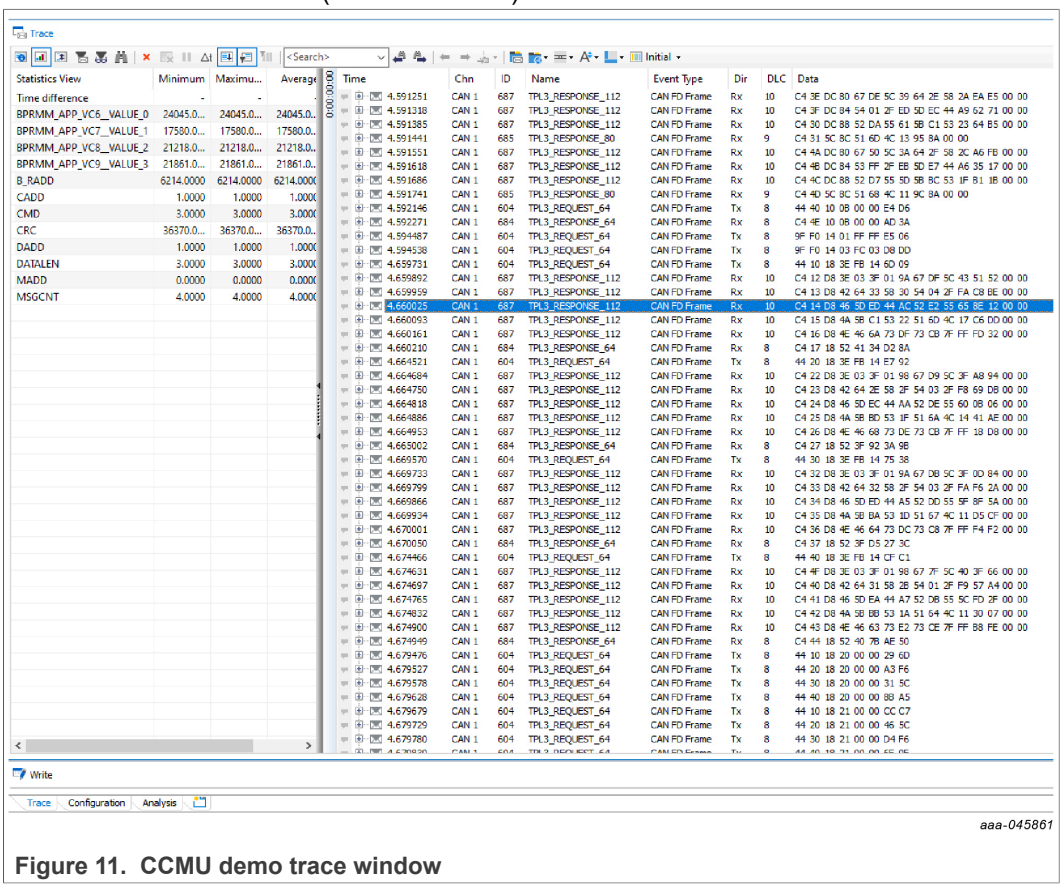

Figure 11. CCMU demo trace window

18. Figure 11 shows the data for cell voltages for a given CADD, DADD, RADD, MADD, and relevant TPL message information. Trace window is used to check the timing of requests and responses from MC33665A.
19. **Device** panel can be used to see the performance of individual MC33775A. Select **Home** → click **Panel** drop down menu → select and click **Add Panel** → select the location of files stored in Figure 1 → open **Panels** folder → select the **NXP_Device_Panel** panel file → press **Open**

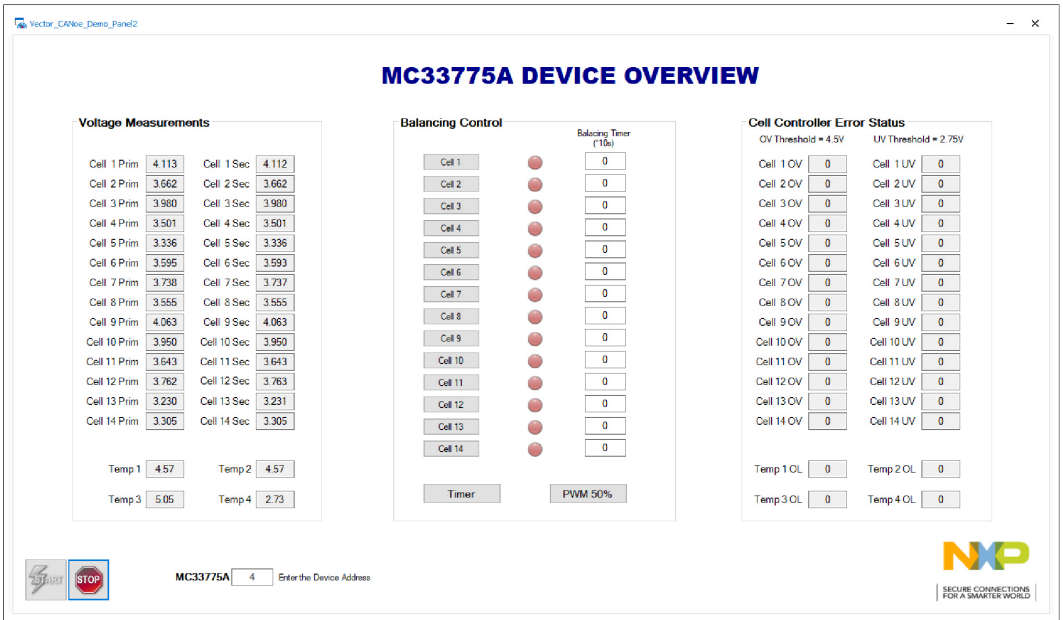

Figure 12. Device panel

20. Enter the device address 1 to 4 in order to monitor the respective MC33775A populated on RD33775ACNCEVB. Note: In RD33775ACNCEVB, typically device address is allocated sequentially to MC33775A connected on TPL port 0 of MC33665A. First MC33775A connected on TPL port 0 of MC33665A is assigned with device address 1 whereas the last onboard device has device address 4. In case of ongoing demo session press the **STOP** button and press the **START** button to update the panel with new device address, else press **START** button to run the **Device** panel with new device address.
21. Selected primary cell voltages and secondary cell voltages are updated in the **Device** panel based on refresh rate selected on CCMU panel.
22. **Device Panel** provides an option to perform the balancing function in MC33775A selected in device address. Enter the number (limited to single digit for demo) in 'Balancing Timer'. If the entered value is **1**, the respective balancing resistor is on for 10 s (multiplication factor for balancing timer for a respective balancing control cell).
23. Enter the number (limited to single digit for demo) in balancing timer for respective cells → press **Timer** or **PWM 50 %** to start the balancing function of a particular cell selected for MC33775A. **Timer** function gives a command for **ALWAYS ON** until the timer runs out, whereas **PWM 50 %** turns on balancing resistor with 50 % duty cycle until the timer runs out.
24. Cell undervoltage and overvoltage flags of a selected MC33775A are read and updated in **Device Panel** in Cell Controller Error Status section.
25. **Important:** Upon **Reset** or **Power ON** of RD33775ACNCEVB during the running session of the demo, start the MC33665A_CCMU_Demo procedure from step **4** and continue at least until step **6** to set up the initial configuration and update settings to MC33665A (the initial data settings for CAN FD is 2 Mbit/s)

7 References

[1] Product summary page for MC33665A http://www.nxp.com/MC33665A

[2] Product summary page for TJA144x http://www.nxp.com/TJA144x

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