UG10207

Bidirectional Resonant DC-DC Reference Solution

Rev. 1.0 — 10 February 2025 Application note

Document information

Information	Content
Keywords	UG10207, bidirectional, resonant, DC-DC reference solution, DC-DC
Abstract	This document details the steps to set up and test the bidirectional DC-DC reference platform.

1 Introduction

The bidirectional DC-DC reference platform is designed as an evaluation prototype providing a hardware reference design and a system enablement software.

This document details the steps to set up and test this platform.

2 Getting started

This section lists the kit contents, other hardware, and software.

2.1 Kit contents

The hardware kits consist of the bidirectional DC-DC power board and HVP-56F83783 expansion card. The HVP-56F83783 expansion card is plugged into the expansion card socket on the power board. The DSC MC56F83783 on the HVP-56F83783 is used as the main controller for the digital power system. The board schematic and layout are available on the bidirectional DC-DC reference design webpage.

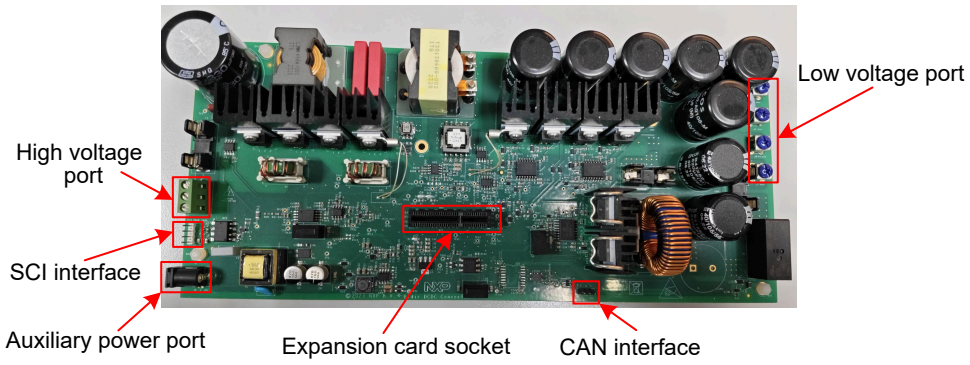

Figure 1. Bidirectional DC-DC power board

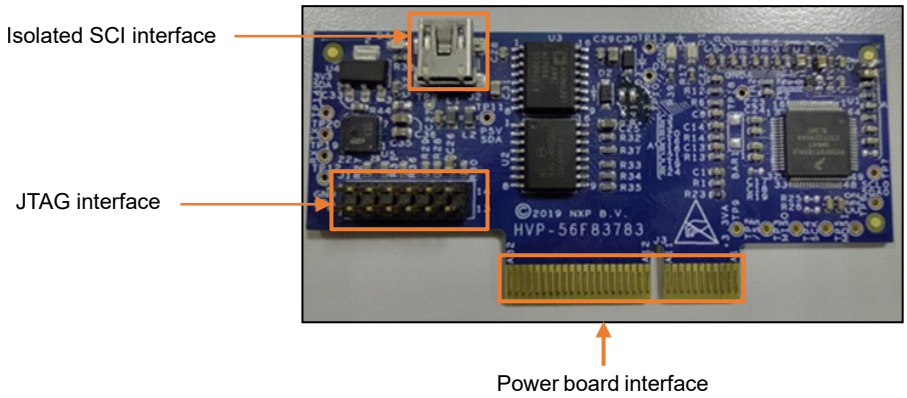

Figure 2. MCU control expansion card (HVP-56F83783)

2.2 Other hardware

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

1. Power supply: DC source up to 400 V/3 A for battery charge mode, DC source up to 60 V/30 A for battery discharge mode.

2. Load: DC electronic load up to 400 V/3 A for battery discharge mode, DC electronic load up to 60 V/30 A for battery charge mode
3. Cable assembly: double row wire cable.
4. A PC to run the provided graphical user interface (FreeMASTER) and USB-Mini-B connector for FreeMASTER connection.
5. A Universal Multilink or DSC Multilink to program the controller.

2.3 Software

Installing software is recommended to work with this platform.

1. CodeWarrior IDE v11.2, for editing, compiling, and debugging of source code designs.
   Note: *SP1 for CodeWarrior v11.2 is required. Download (via the above link) CodeWarrior for MCU 11.2 SP1, the installation instructions are available at: How to install CodeWarrior service pack for DSC guide.*
2. MCUXpresso Config Tools v15, for graphical display of pin, clock, and peripheral configurations to facilitate modification.
3. Software Development Kit (SDK_2_13_1_MC56F83783), is complimentary and includes full source code under a permissive open source license for all hardware abstraction and peripheral driver software.
4. FreeMASTER 3.2, for measurement visualization and runtime configuration and tuning of the embedded software.
   Note: *To use the CP210x USB to UART bridge virtual COM port communication on HVP-56F83783, download and install the CP210x drivers.*

3 Platform assembly and operation

As a bidirectional DC-DC converter, electric energy could be transferred from high-voltage port to low-voltage port (Battery charge mode, BCM), or from low-voltage port to high-voltage port (Battery discharge mode, BDM). The hardware configurations and parameter configurations are different for different operating modes.

The following section describes how to run the converter in all working modes.

3.1 Battery charge mode (BCM)

- **Hardware connections**
  1. Plug HVP-56F83783 into the expansion card socket on the power board.
  2. To supply DC voltage, connect the DC source on the high-voltage port.
  3. Connect the load on the low voltage port.
  4. Connect isolated SCI interface J2 on HVP-56F83783 to the PC through a USB-Mini-B cable.

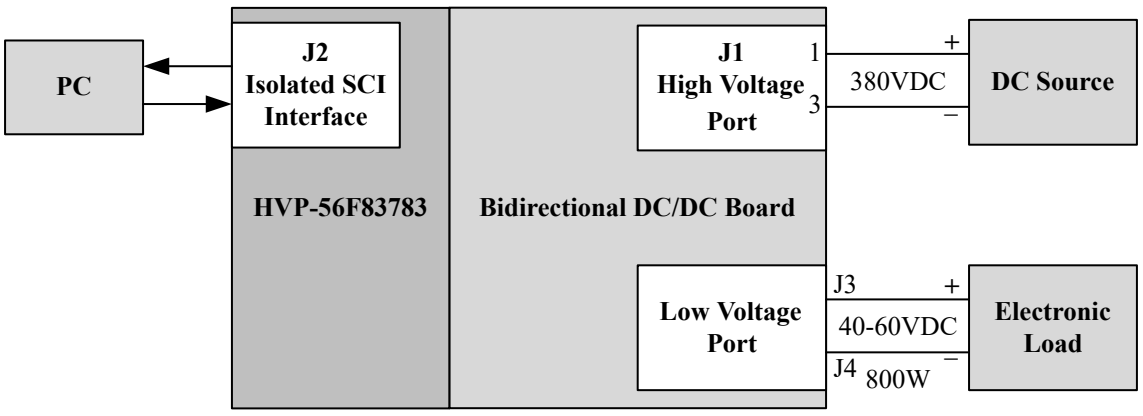

Figure 3. Hardware connections for the BCM mode

- **Powering the boards:** Power the platform by powering up the DC source.
- **Control and monitor the system with FreeMASTER:**
  1. Open the FreeMASTER project (`Bidir_DCDC_MC56F83783.pmpx`) with FreeMASTER. Figure 4 illustrates the FreeMASTER window.

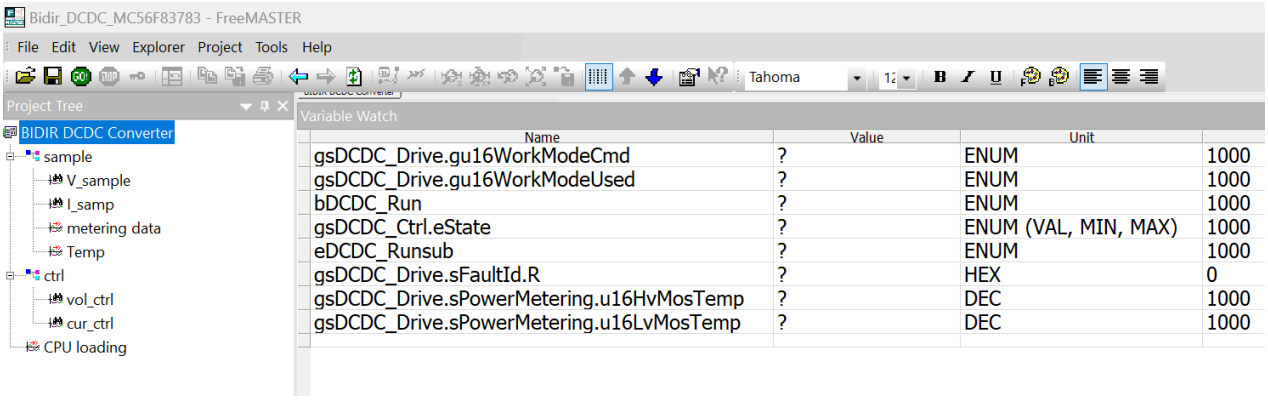

Figure 4. FreeMASTER window

  2. Enable the communication between the PC and HVP-56F83783.
  3. To set up the communication parameters, select **Project > Options**, under the **Comm** tab.
  4. Select the port used by CP210x and set the baud rate as 115200.

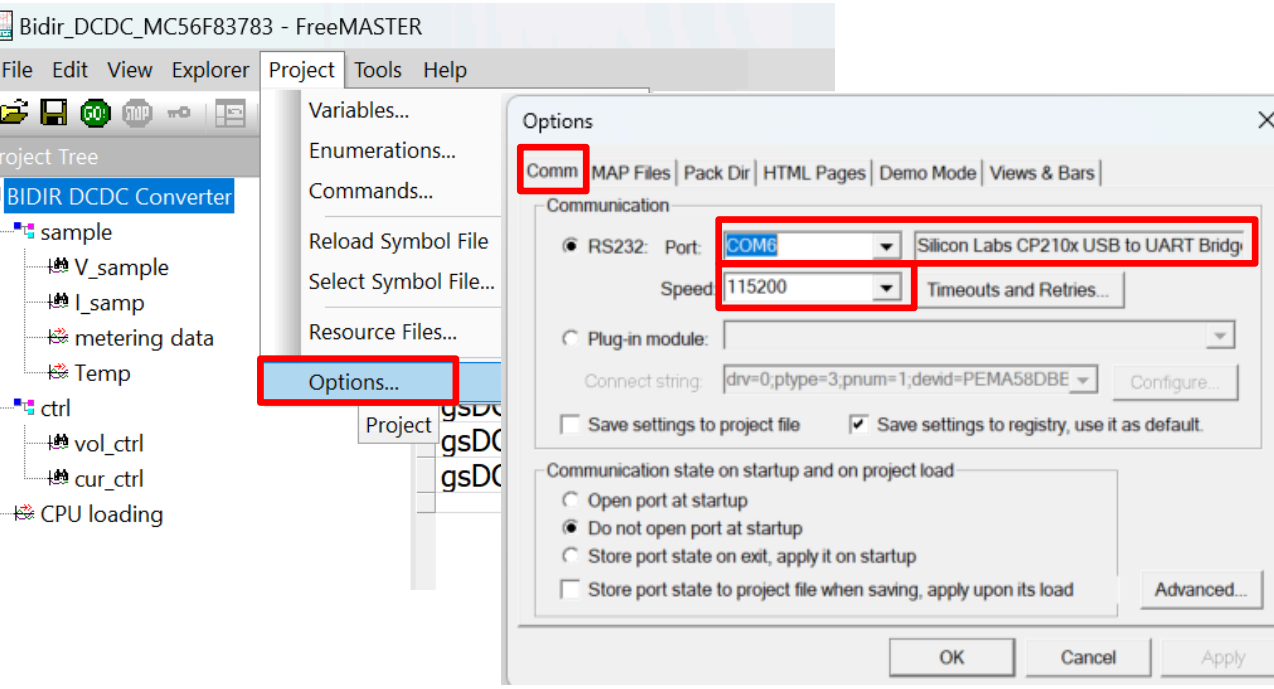

Figure 5. FreeMASTER communication options

  5. To select the correct symbol files, click the **…** button under the **MAP Files** tab.

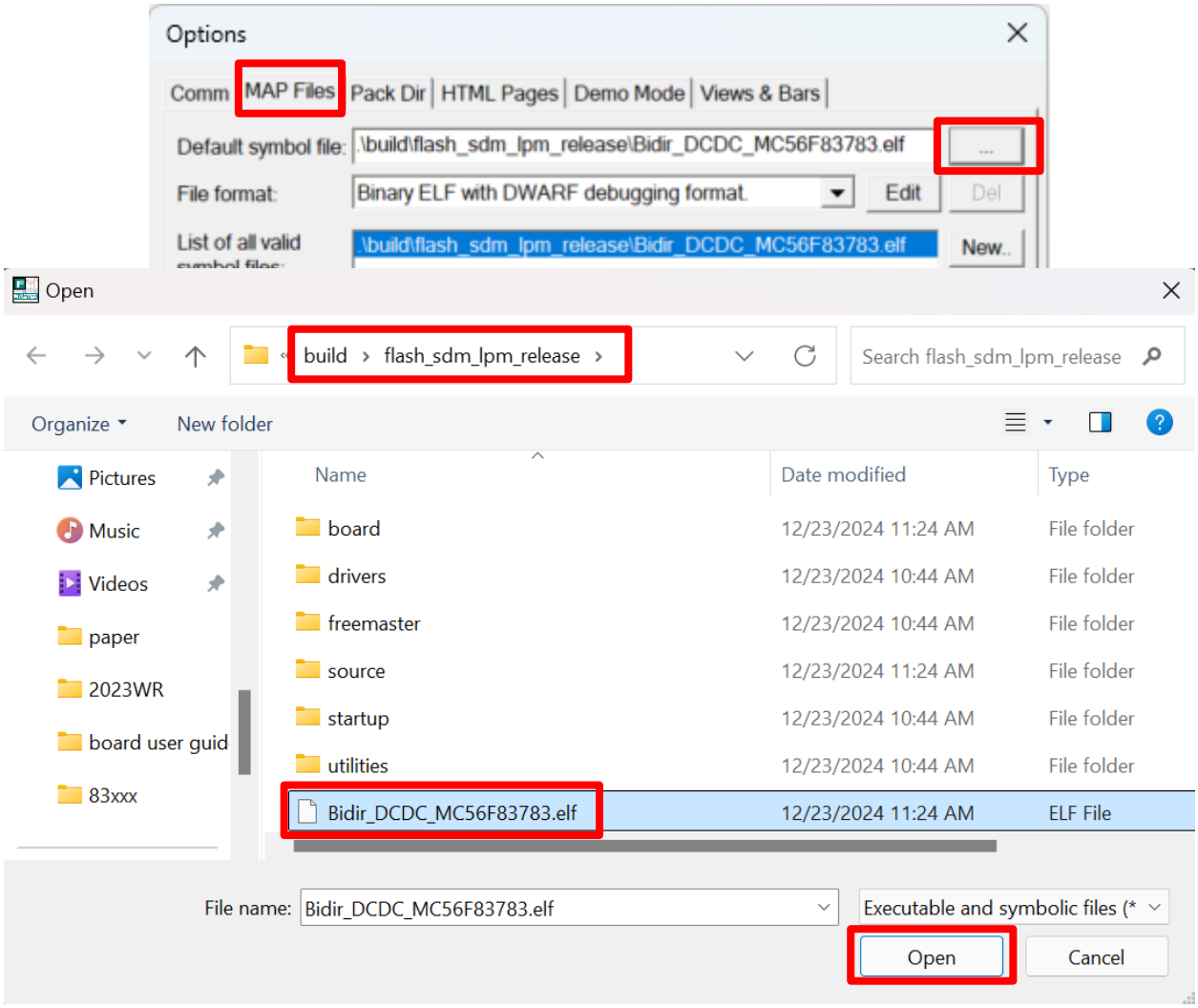

Figure 6. FreeMASTER symbol files options

6. Click **OK** and save the configuration.

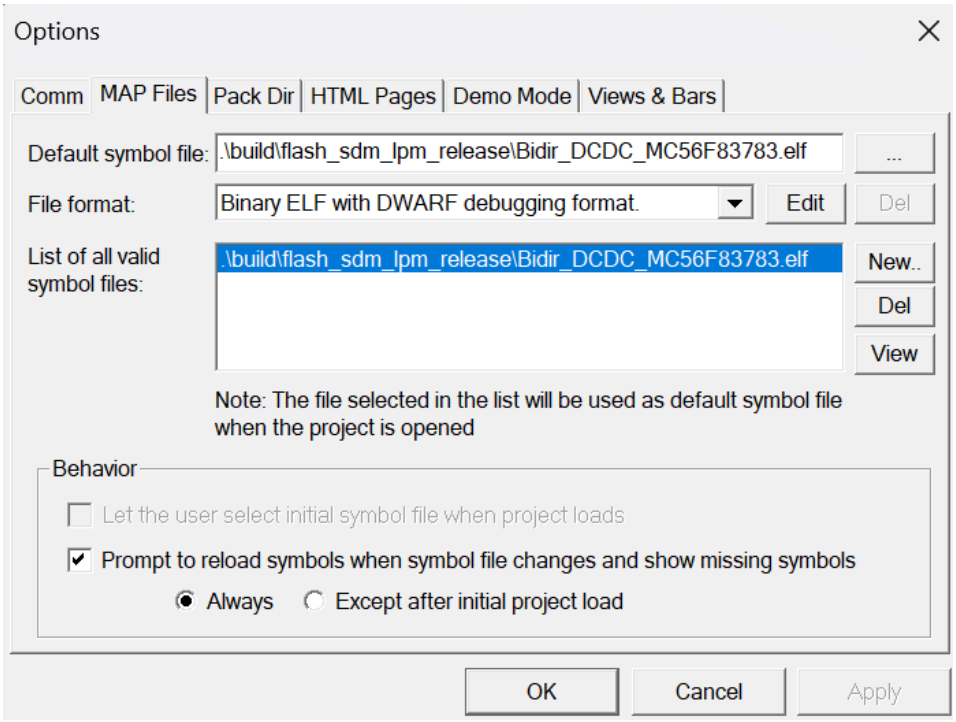

Figure 7. Save the configuration

7. Click the **Go** icon and start the communication. Once the communication is established, click the **Stop** icon to close the communication port.

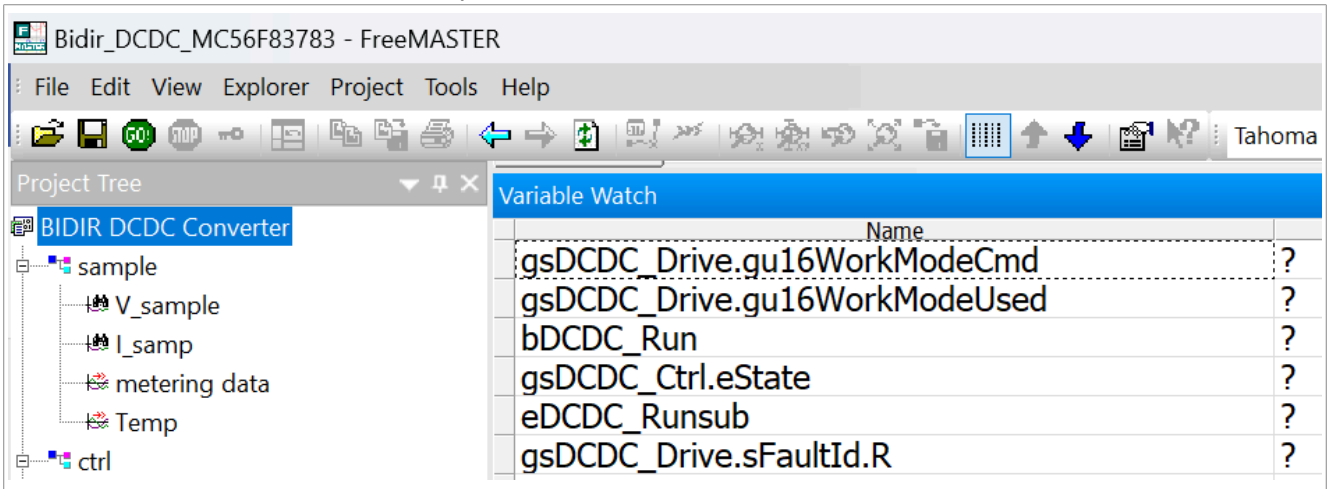

Figure 8. Open/close the communication port

8. After the FreeMASTER communication is established, click the drop-down menu of the `gsDCDC_Drive.gu16WorkModeCmd` command and select BCM.

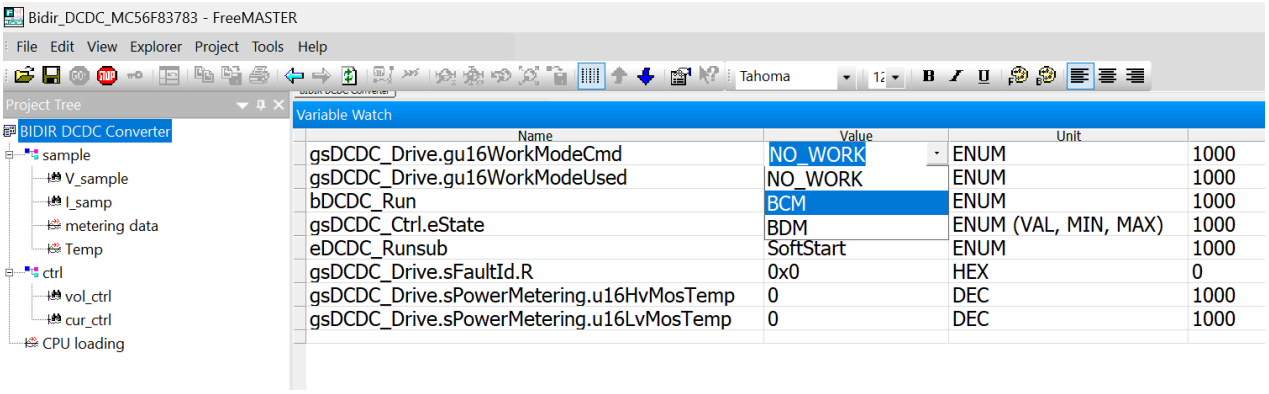

Figure 9. Working mode selection

9. Click the drop-down menu of the `bDCDC_Run` command and start/stop the converter.

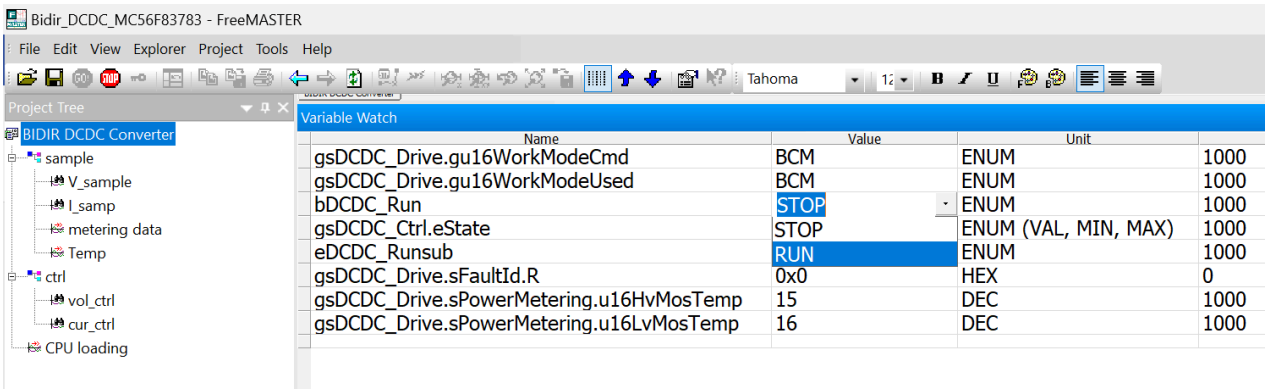

Figure 10. Start/stop converter

10. The low voltage port voltage ranges from 40 V to 60 V. You could change the low voltage port voltage by changing the macro: **VLV_BCM_REF** (`Bidir_DCDC_MC56F83783 > source > bidir_dcdc_ctrl.h`). The default low voltage port voltage is 56 V.

```
/* BCM mode */
#define VLV_BCM_REF             56.0
```

Figure 11. Low voltage port voltage reference setting

3.2 Battery discharge mode (BDM)

- **Hardware connections**
  1. Plug HVP-56F83783 into the expansion card socket on the power board.
  2. To supply DC voltage, connect the DC source on the low-voltage port.
  3. Connect the load on the high-voltage port.
  4. Connect the isolated SCI interface J2 on HVP-56F83783 to the PC through a USB-Mini-B cable.

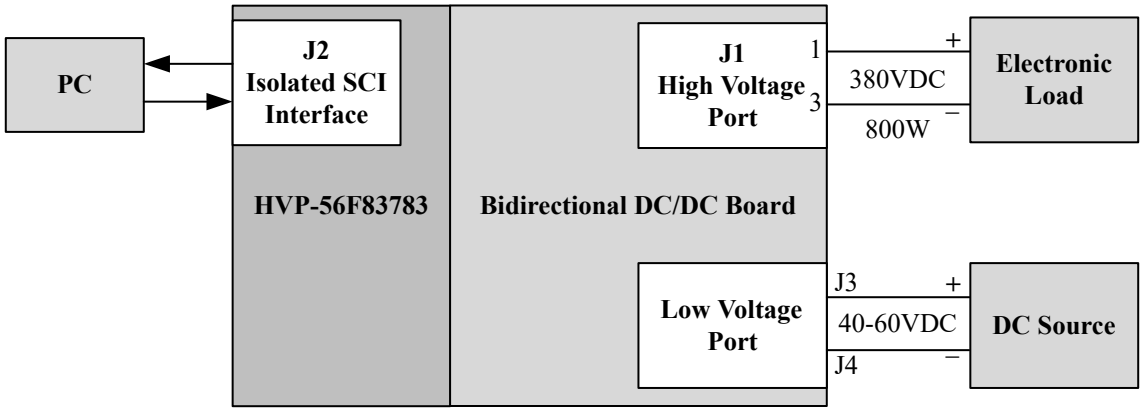

Figure 12. Hardware connections for the BDM mode

- **Powering the boards:** Power the platform by powering up the DC source.
- **Control and monitor the system with FreeMASTER:**
  1. Open the FreeMASTER project (`Bidir_DCDC_MC56F83783.pmpx`) with latest FreeMASTER and enable the communication between the PC and HVP-56F83783.
  2. After the communication is established, click the drop-down menu of the `gsDCDC_Drive.gu16WorkModeCmd` command and select BDM.

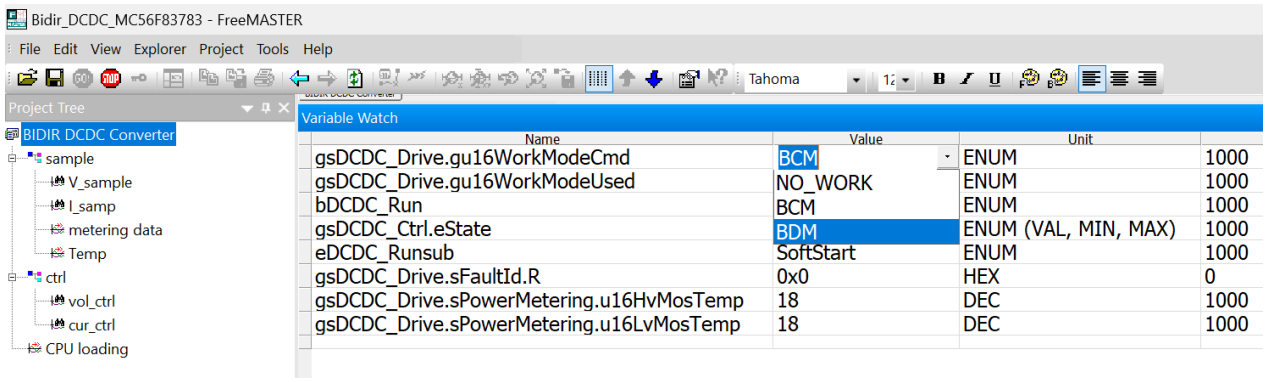

Figure 13. Working mode selection

3. Click the drop-down menu of the `bDCDC_Run` command and start/stop the converter.

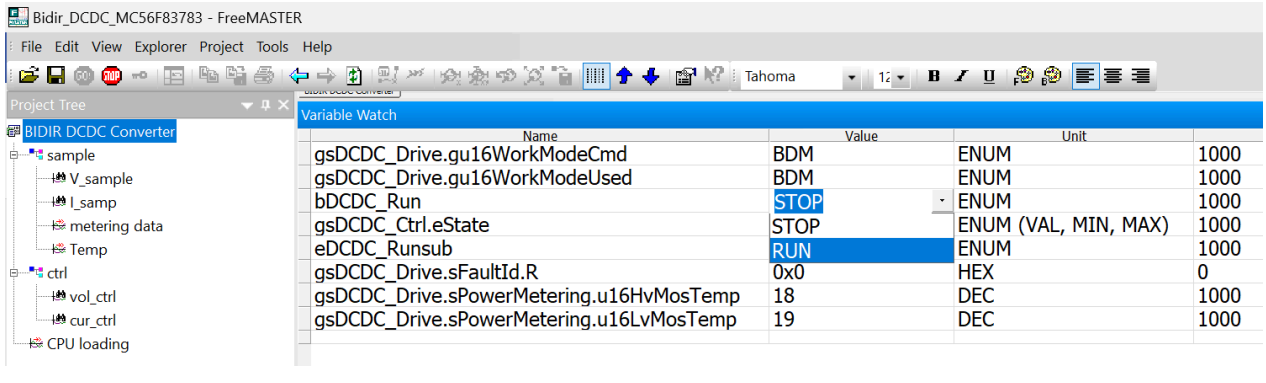

Figure 14. Start/stop converter

4 References

For more information on the DC-DC converter design using MC56F83783, refer to the following documents:

- Bidirectional Resonant DC-DC Converter Design using MC56F83783 (document AN14333)
- Getting started with the Bidirectional DC-DC converter.

5 Revision history

Table 1 lists the revisions to this document.

Table 1. Revision history

Document ID	Release date	Description
UG10207 v.1.0	10 February 2025	Initial public release

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Tables

Figures

Contents