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NXP UG10207 Bidirectional Resonant DC-DC Reference Solution

Specifications

- **Product Name:** Bidirectional Resonant DC-DC Reference Solution
- **Manufacturer:** NXP Semiconductors
- **Revision:** 1.0
- **Date:** 10 February 2025

Product Usage Instructions

Kit Contents

The hardware kits include the bidirectional DC-DC power board and HVP-56F83783 expansion card. The expansion card is plugged into the power board, and the DSC MC56F83783 on the expansion card serves as the main controller for the system.

Other Hardware Requirements

- **Power Supply:** DC source up to 400 V/3 A for battery charge mode and up to 60 V/30 A for battery discharge mode.
- **Load:** DC electronic load up to 400 V/3 A for battery discharge mode and up to 60 V/30 A for battery charge mode.
- **Cable Assembly:** Double row wire cable.
- **PC:** To run the FreeMASTER graphical user interface with a USB-Mini-B connector for connection.
- **Universal Multilink or DSC Multilink:** Required to program the controller.

Software Installation

It is recommended to install the following software for working with the platform:

- **CodeWarrior IDE v11.2:** For editing, compiling, and debugging source code designs. SP1 for CodeWarrior v11.2 is required.
- **MCUXpresso Config Tools v15:** For graphical display of configurations.
- **Software Development Kit (SDK_2_13_1_MC56F83783):** Includes full source code under an open-source license.
- **FreeMASTER 3.2:** For measurement visualization and runtime configuration. Install CP210x drivers for USB to UART bridge communication.

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.

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.

Getting started

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

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.

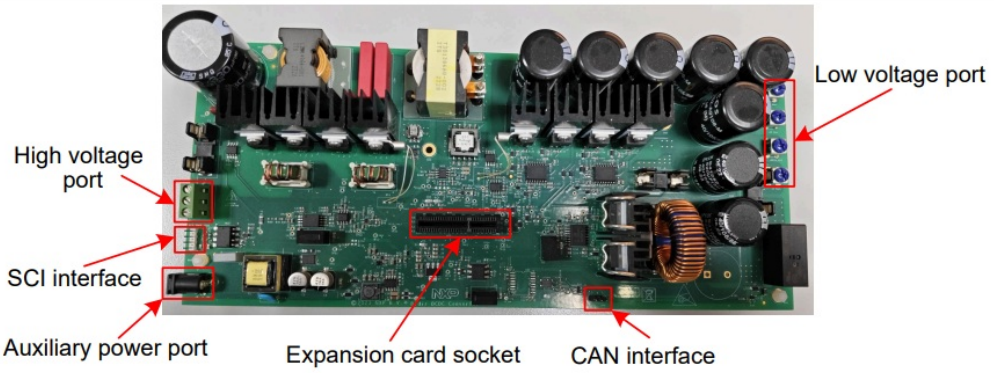

Figure 1. Bidirectional DC-DC power board

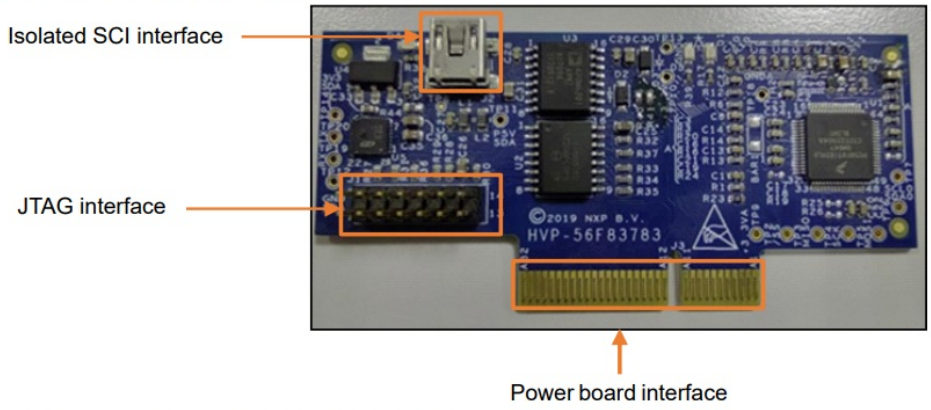

Figure 2. MCU control expansion card (HVP-56F83783)

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.

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.

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.

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.

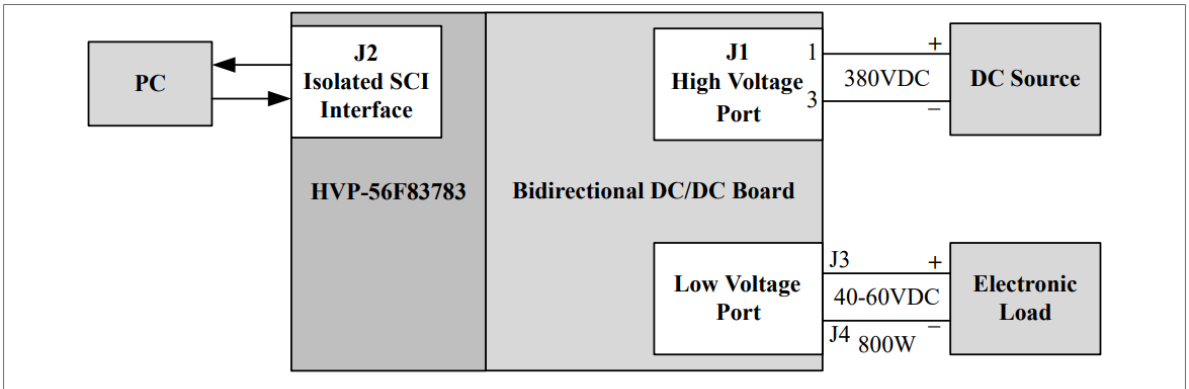

Figure 3. Hardware connections for the BCM mode

   - 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.

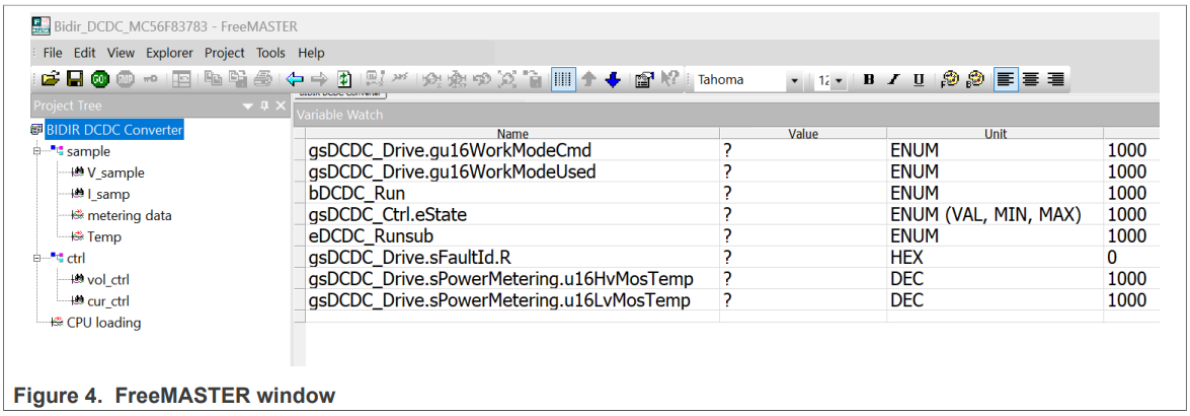

Figure 4. FreeMASTER window

  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.

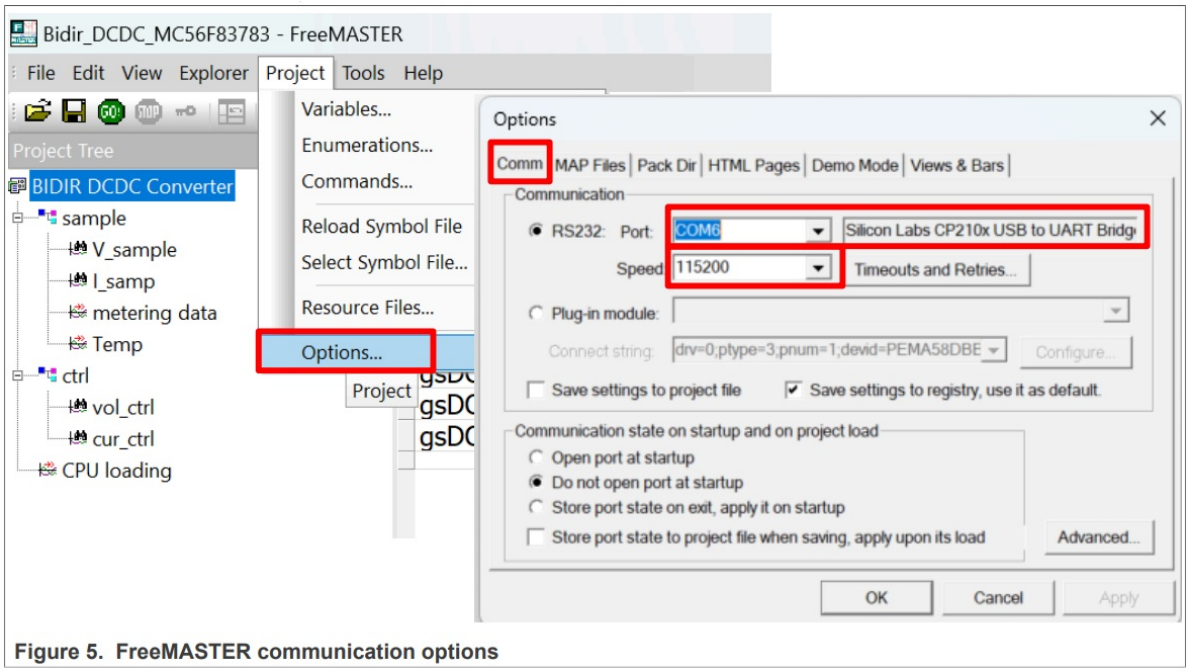

Figure 5. FreeMASTER communication options

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

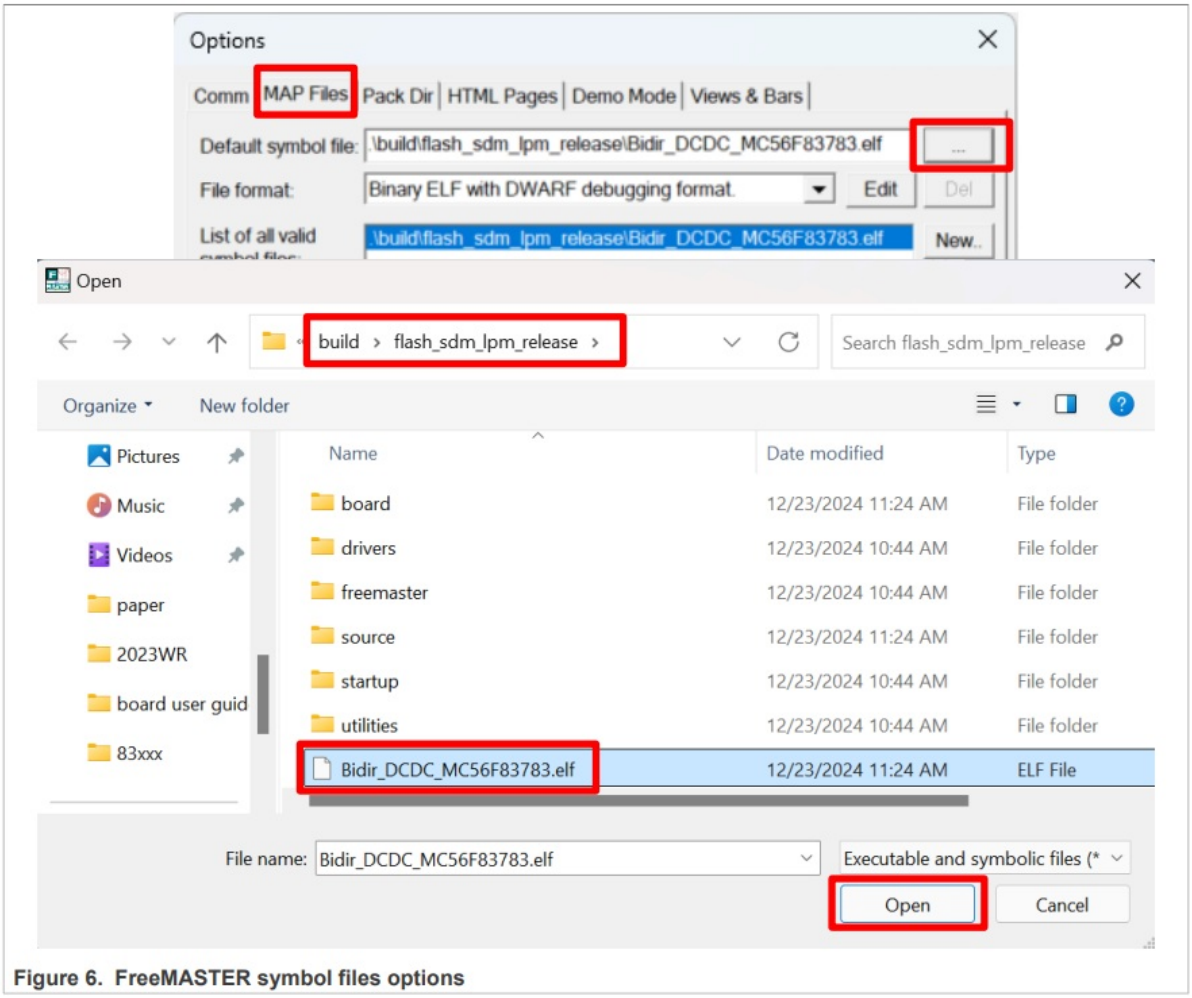

Figure 6. FreeMASTER symbol files options

6. Click OK and save the configuration.

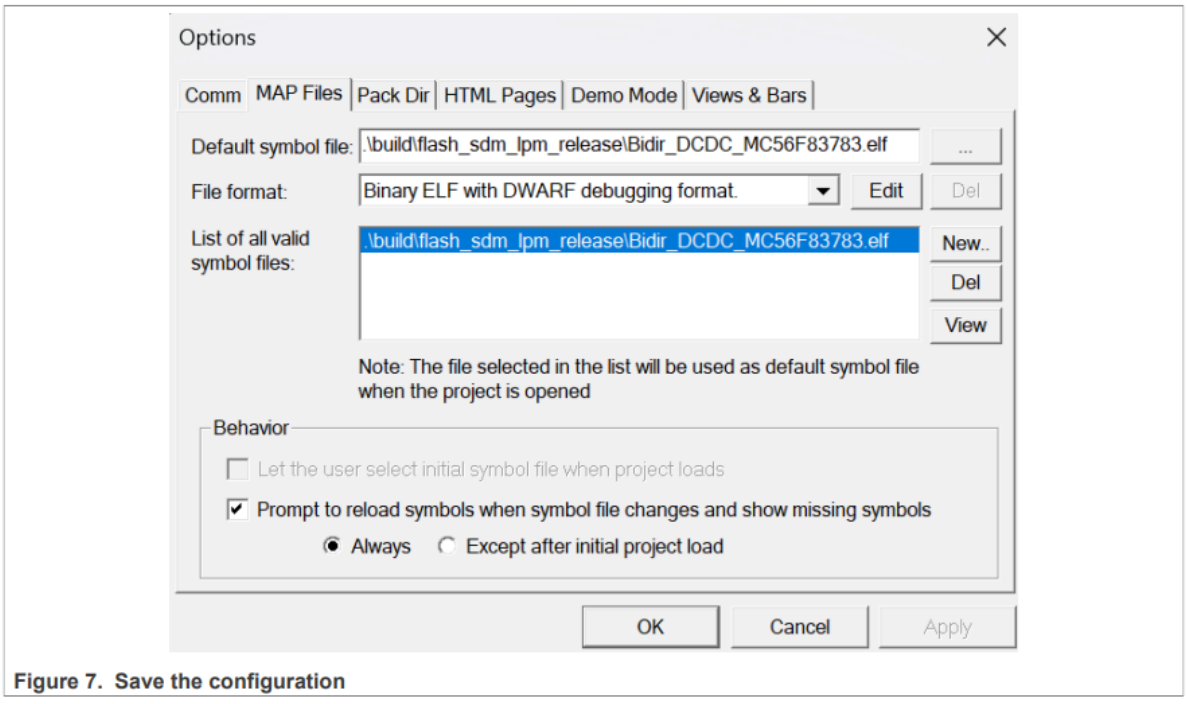

Figure 7. Save the configuration

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

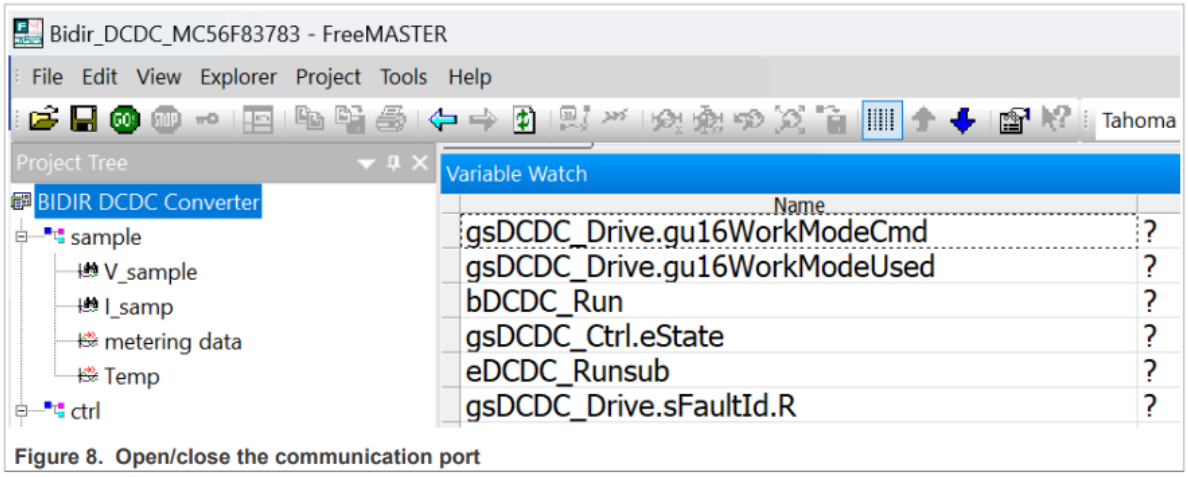

Figure 8. Open/close the communication port

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

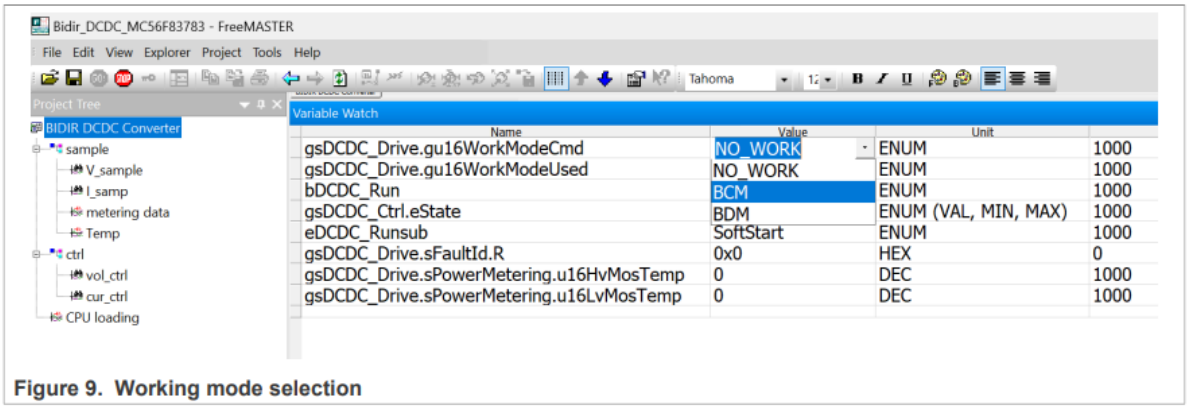

Figure 9. Working mode selection

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

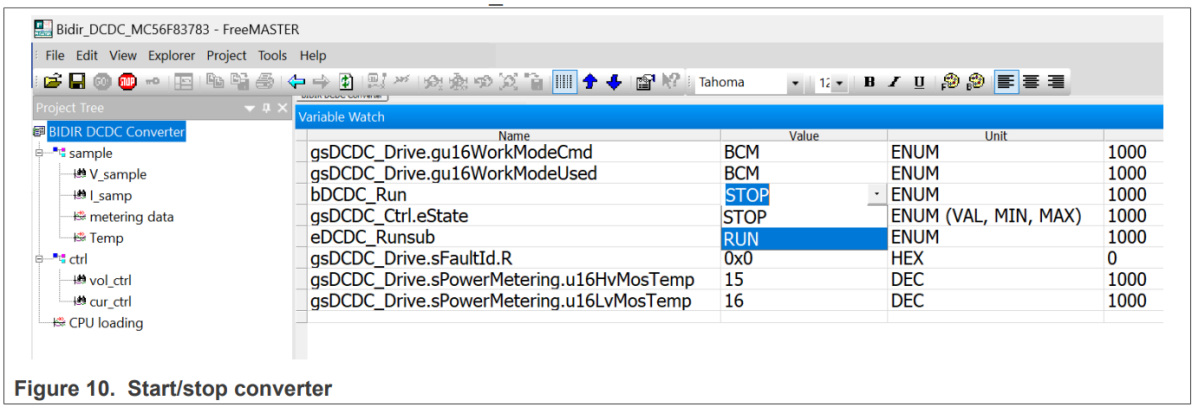

Figure 10. Start/stop converter

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

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.

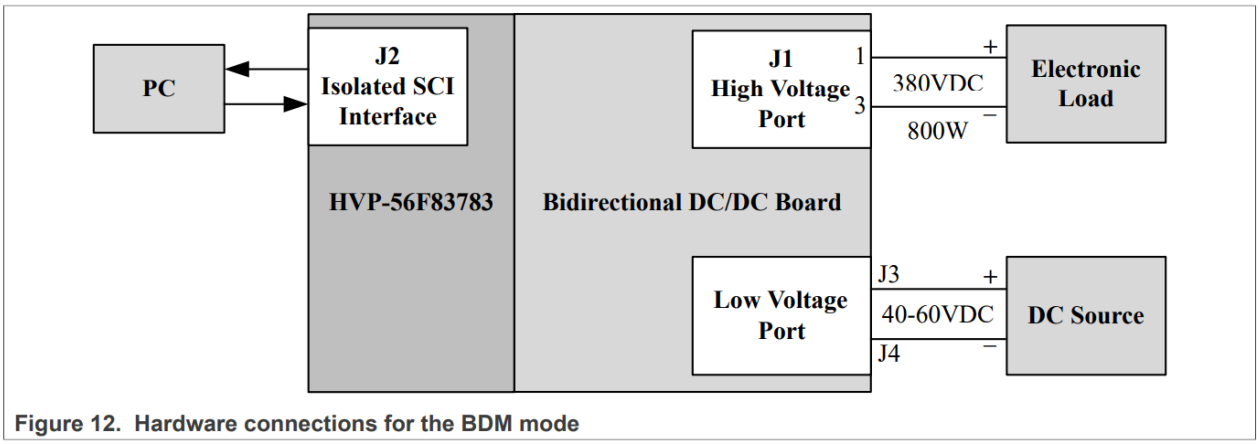

Figure 12. Hardware connections for the BDM mode

- 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.

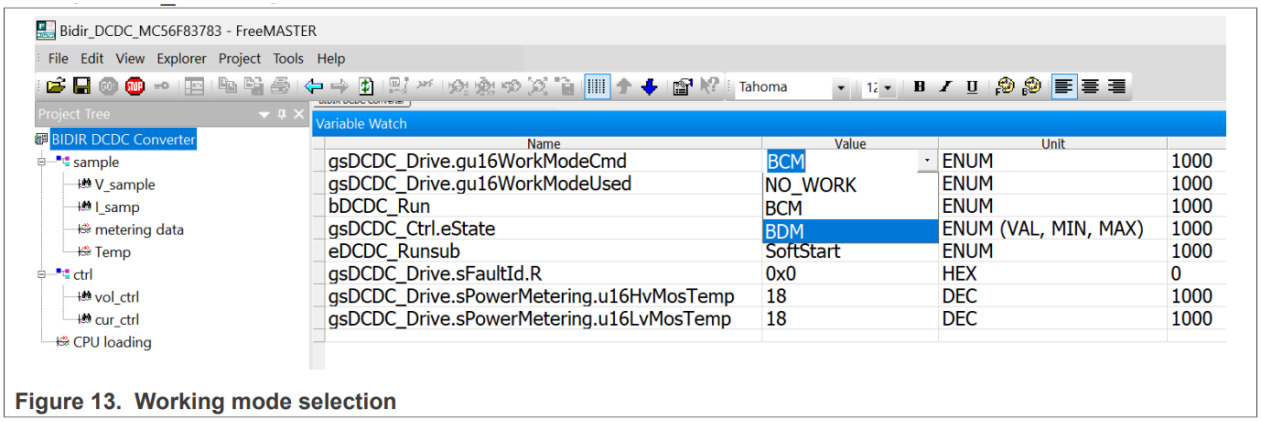

Figure 13. Working mode selection

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

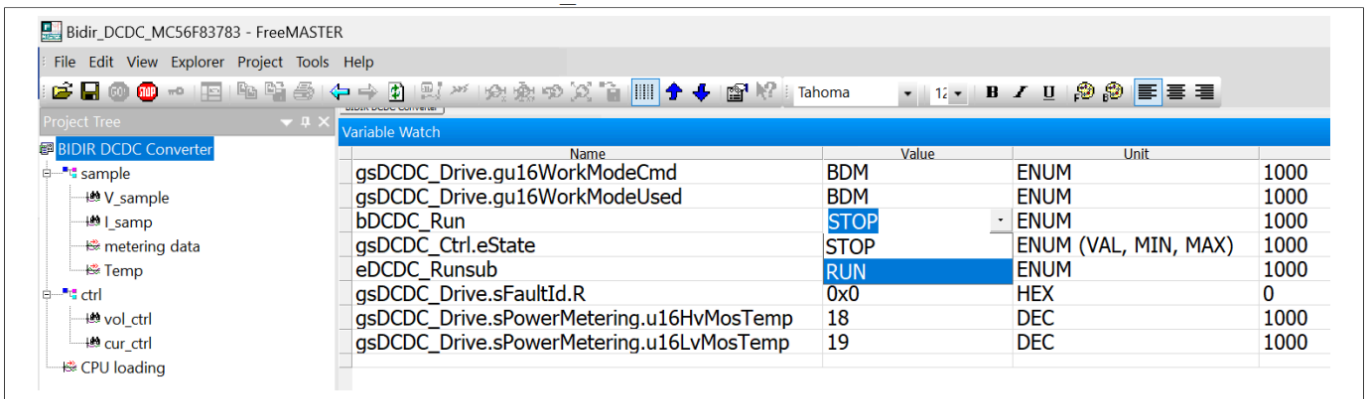

Figure 14. Start/stop converter

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.

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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Document feedback
Date of release: 10 February 2025
Document identifier: UG10207

Frequently Asked Questions

Q: Can I use a power supply with different specifications than those mentioned?
A: It is recommended to use a power supply within the specified voltage and current limits to ensure proper functioning and safety of the system.

Q: Do I need to install all the listed software for the platform to work?
A: Installing the recommended software tools will enable you to fully utilize the features of the bidirectional DC-DC reference solution. However, you may choose to install only the essential software depending on your requirements.

Documents / Resources

	NXP UG10207 Bidirectional Resonant DC-DC Reference Solution [pdf] Instruction Manual UG10207, HVP-56F83783, UG10207 Bidirectional Resonant DC-DC Reference Solution, Bidirectional Resonant DC-DC Reference Solution, Resonant DC-DC Reference Solution, Reference Solution

References

- User Manual

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Bidirectional Resonant DC-DC Reference Solution, HVP-56F83783, NXP, Reference Solution, Resonant DC-DC Reference Solution, UG10207, UG10207 Bidirectional Resonant DC-DC Reference Solution

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