User Guide

HR1203 Evaluation Kit (EVKT-1203)

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Overview

Introduction

The EVKT-1203 is an evaluation kit for the HR1203. A 240W evaluation board is designed with a high power factor (PF) at light load (>0.95 at 20% load). The unique benefits for the board are its very low no-load power consumption (<150mW) and very high light-load efficiency (>90% at 10% load), which meets Energy using Product Directive (EuP) Lot 6 and Code of Conduct Version 5 Tier 2.

These features are suitable for applications including PCs, ATX power, notebook adapters, and gaming and TV power supplies. With the programming communication interface and GUI software, circuit configurations of the digital PFC part can be easily customized, greatly increasing design flexibility.

Kit Contents

EVKT-1203-TSSOP kit contents (items below can be ordered separately):

#	Part Number	Item	Quantity
1	EVHR1203-M-02A	Evaluation board (IC in TSSOP-28)	1
2	EVHR1203 PMBUS Kit-01A	USB to I²C programming communication interface	1
		USB cable	1
		Ribbon cable	1
3	T-USB Isolation Block-00A	USB isolator	1

EVKT-1203-SOIC kit contents (items below can be ordered separately):

#	Part Number	Item	Quantity
1	EVHR1203-Y-00A *	Evaluation board (IC in SOIC-28)	1
2	EVHR1203 PMBUS Kit-01A	USB to I²C programming communication interface	1
		USB cable	1
		Ribbon cable	1
3	T-USB Isolation Block-00A	USB isolator	1

EVHR1203-Y-00A *: can be commonly used for HR1204 by swapping the IC.

**Kit offers rapid application assessment and requires minimal external components*

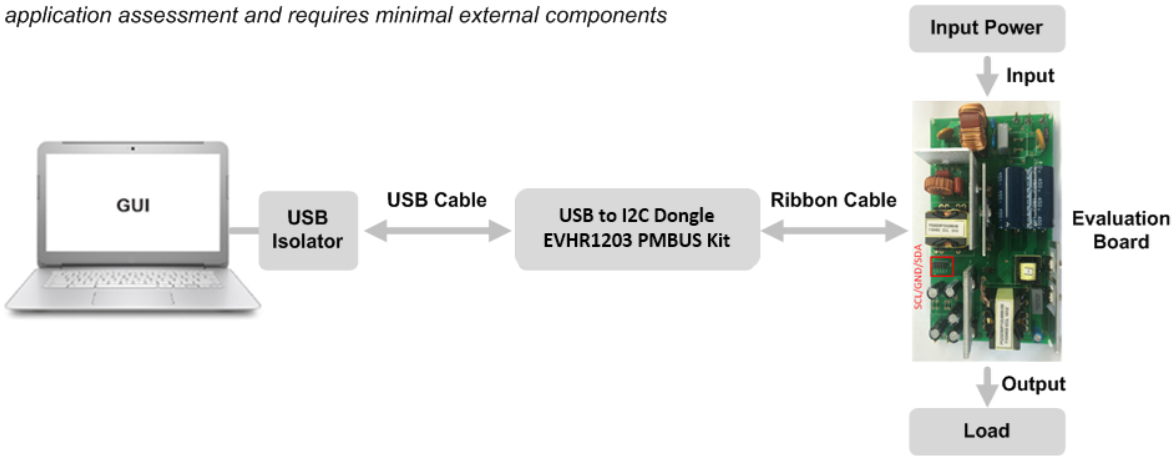


Figure 1: EVKT-1203 Evaluation Kit Set-Up

Features and Benefits

The evaluation board is mainly designed to demonstrate the capabilities of MPS's highly integrated HR1203 controller. The HR1203 is a high-performance combo controller that integrates an advanced digital PFC controller and a half-bridge LLC resonant controller.

The PFC part employs a patented average current control scheme, and can switch automatically between continuous conduction mode (CCM) and discontinuous conduction mode (DCM), according to the instantaneous condition of the input voltage and output load. With this feature, the IC exhibits excellent efficiency and high PF at light load. The LLC part implements an adaptive dead-time adjustment (ADTA) function to guarantee zero-voltage switching (ZVS) in different load conditions. In addition, a high-voltage (HV) current source is integrated internally for start-up and X-cap discharge, which helps reduce power consumption at no load.

⚠ Use the USB isolator when in online mode with AC input.

⚠ Make sure both the communication interface and EVB board are reset every time before restarting the GUI.

Kit Specifications

Features	Specification
Operating Input Voltage	90Vac to 265Vac
Operating Output Voltage	12V
Operating Output Current	20A
Operating Systems Supported	Windows XP, 7, and later
System Requirements	Minimum 21.7MB free
GUI Software	MPS programmable power GUI v3.3
EVB Size (LxW)	17.4cmx10.5cm

Section 1. Hardware Specifications

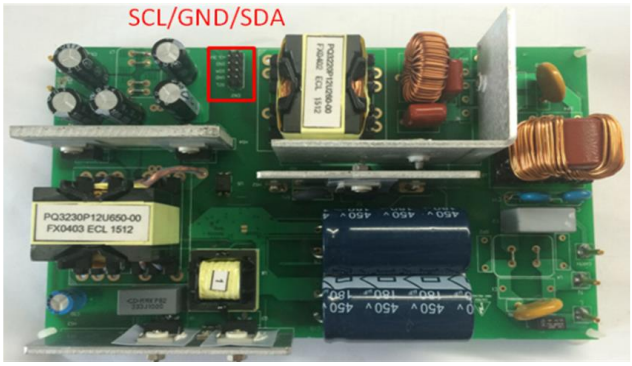
1.1 Personal Computer Requirements

The following must be met to use the EVKT-1203:

- Operating system of Windows XP, 7, or later
- Net Framework 4.0
- PC with a minimum of one available USB port
- At least 21.7MB of free space

1.2 EVB Specifications

The EVHR1203-M-02A and EVHR1203-Y-00A are evaluation boards for the HR1203, and are available in TSSOP-28 and SOIC-28 packages, respectively. For more information, refer to the EVB datasheet.



Feature	Specification
Input AC Voltage	90Vac to 265Vac
Output Voltage	12V
Output Current	20A
EVB Size (LxW)	17.4cmx10.5cm

Figure 2: Evaluation Board

1.3 EVHR1203 PMBUS Kit Specifications

The EVHR1203 PMBUS Kit-01A refers to the USB to I²C programming communication interface, which connects the EVB and the PC. It provides PMBus capabilities. Together with the MPS GUI, it provides a quick and easy way to evaluate the performance of the HR1203. For more details, refer to the *AN103-User Guideline_HR1203 I²C Kit and GUI*.

Figure 3: EVHR1203 PMBUS Kit-01A Communication Interface

1.4 USB Isolator Specifications

The T-USB Isolation Block-00A refers to the USB isolator, which is needed between the I²C communication interface and the computer USB port to protect the computer from the risk of short circuit. For more details, refer to *AN103-User Guideline_HR1203 I²C Kit and GUI*.

Figure 4: T-USB Isolation Block-00A Isolator

Section 2. Software Requirements

2.1 Software Installation Procedure

Programming occurs through the MPS GUI. Follow the instructions below to install the software:

1. Visit the MPS website at [URL] and download "_____" to a directory of your choice.
2. Extract the zip package and double-click the .exe file to open the set-up guide (see Figure 5). If a protection window comes up, click "More info," then click "Run anyway."
3. Follow the prompts in the set-up guide.
4. Wait for status screen to verify that installation is complete (see Figure 6).

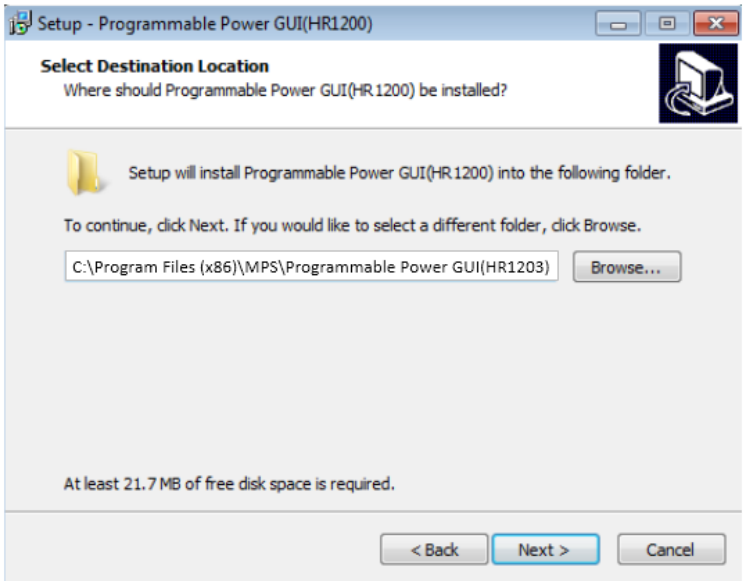


Figure 5: MPS I²C GUI Set-Up Guide

Figure 6: Driver Set-Up Success

Section 3. Evaluation Kit Test Set-Up

3.1 Hardware Set-Up

The hardware must be properly configured prior to use. Follow the instructions below to set up the EVB:

1. Connect the communication interface to the computer's USB port with a USB isolator.
2. After the communication interface is recognized by the computer (see Figure 7), locate the proper wires to connect the EVB to the EVHR1203 PMBUS Kit-01A communication interface.
3. Connect VCC, VREG, BURST, SCL, SDA, and GND (see Figure 8). If needed, refer to the datasheet for further clarification.

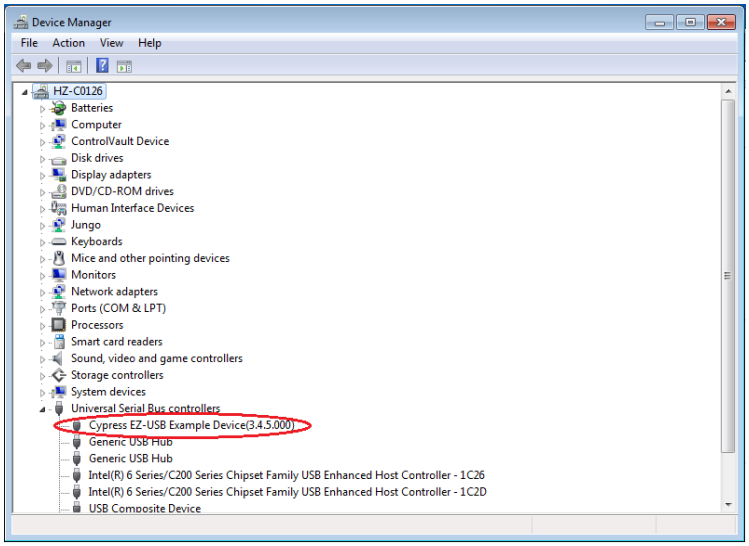


Figure 7: Communication Interface Recognized by Computer

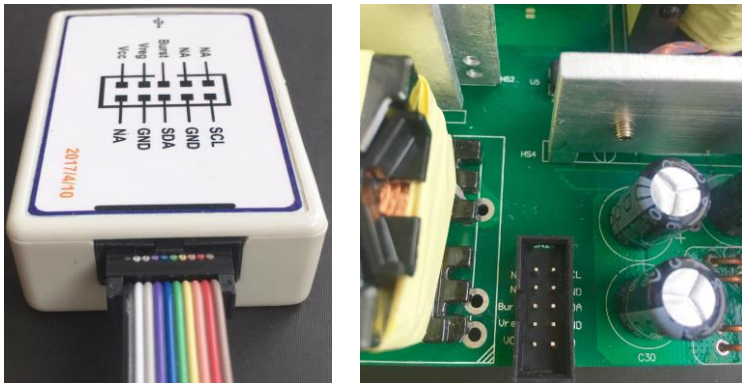


Figure 8: EVB to MPS I²C Communication Interface Wire Connection

3.2 Powering Up the EVB

The computer USB port can provide the I²C communication interface with 5V DC voltage. Once the communication interface connects successfully with both the PC and EVB, it can operate in two different modes.

Offline Mode: No need to power up the EVB. The communication interface detects that VCC is lower than 8V upon connection. It provides the power supply to VCC and VREG, and sends a predetermined signal to BURST. The IC then enters a dedicated test mode for programming.

Online Mode: Supply AC input to the EVB. The communication interface detects that VCC is higher than 8V upon connection. It only provides the power supply to VCC. Then the IC works in normal operation. To complete this process, follow the steps below:

1. Connect the positive and negative terminals of the load to the VOUT and GND pins of the EVB, respectively.
2. Preset the power supply output between 90Vac and 265Vac.
3. Connect the positive and negative terminals of the power supply output to the VIN and GND pins of the EVB, respectively.
4. Turn the power supply on.

3.3 Software Set-Up and Device Programming Instructions

After connecting the hardware according to Section 3.1, follow the steps below to use the GUI software:

1. Load the GUI folder and double-click “HR1203” to launch the GUI (see Figure 9). Figure 10 shows the interface that should appear.

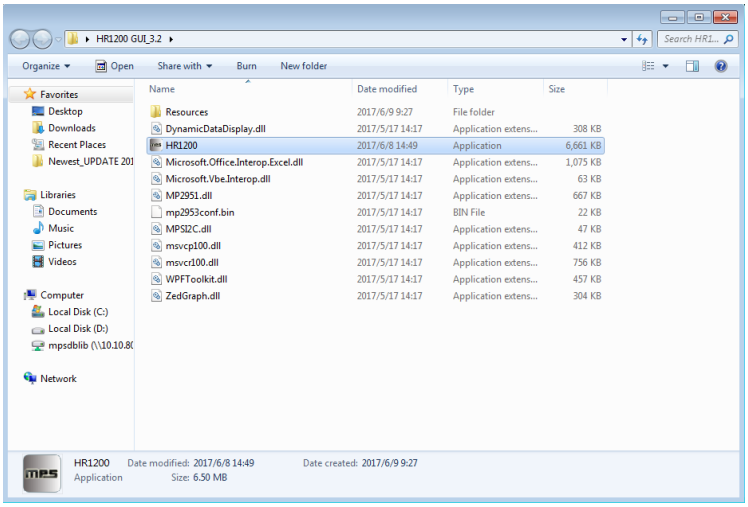


Figure 9: GUI Start-Up

Figure 10: GUI Start-Up Interface

2. Click “Scan,” and the following actions will be performed automatically.

A. Connection Check

a) If there is something wrong with the connection between the I²C communication interface and USB port, the following prompt box is displayed: “Please connect I²C kit to USB port correctly.”

b) If there is something wrong with the connection between the I²C communication interface and EVB, the following prompt box is displayed: “Please check whether kit is connected to EVB correctly.”

c) If the communication interface connects successfully with both the USB port and EVB, no prompt box will appear. Proceed to Action B.

B. Mode Recognition

a) If VCC is detected lower than 8V, the IC enters offline mode (see Figure 11). Fixed VCC, VREG and pre-determined BURST are sent to the EVB.

b) If VCC is detected higher than 8V, the IC enters online mode (see Figure 12). Only fixed VCC is sent to the EVB.

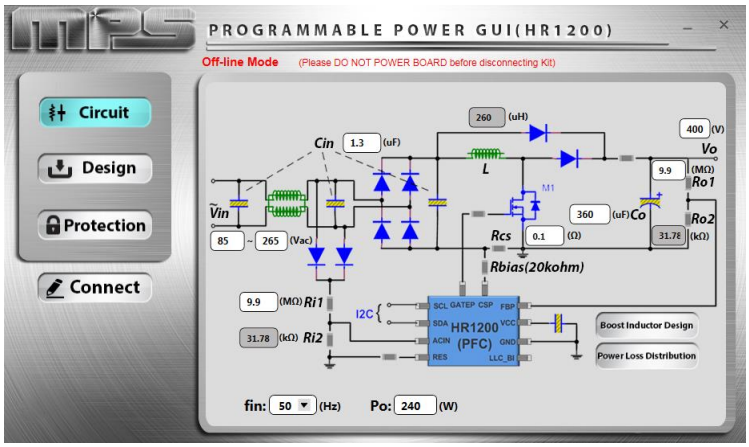


Figure 11: Main Interface in Offline Mode

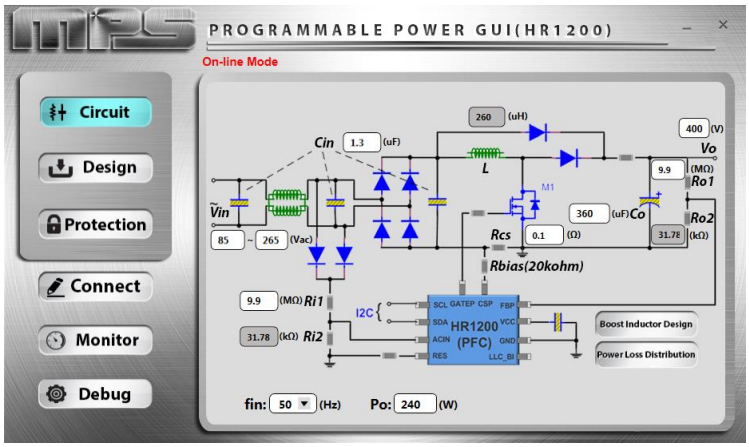


Figure 12: Main Interface in Online Mode

⚠ Do not connect AC input in offline mode.

⚠ Use the USB isolator between the communication interface and USB port in online mode.

⚠ Keep AC input in connection in online mode.

⚠ Do not plug or unplug any device in online mode, to prevent damaging the EVB.

⚠ Reset the communication interface and EVB every time before you restart the GUI, i.e. detach the communication interface from the USBport and make sure the VCCs for both the communication interface and EVB are fully discharged. In online mode, the bus bulk capacitor should be discharged below 10V to prevent false triggering before being connected again [(1)].

3. If connection is successful, proceed with Step 3. Otherwise, check the connections between the EVB, communication interface, and PC. Re-plug the USB cable and the ribbon cable into the computer. Then restart the GUI.

   Parameters of the digital PFC part of the IC can be configured by selecting various menu items on the GUI interface. Users can also import their own design parameters.

   Most GUI panels are the same in offline mode and online mode. These panels include the following:

   ### A. Circuit Panel

   This panel configures EVB inputs, outputs and several key design parameters (see Figure 11).

   ### B. Design-Basic Panel

   This panel controls the working state of the PFC and LLC part separately and configures some basic parameters (see Figure 13).

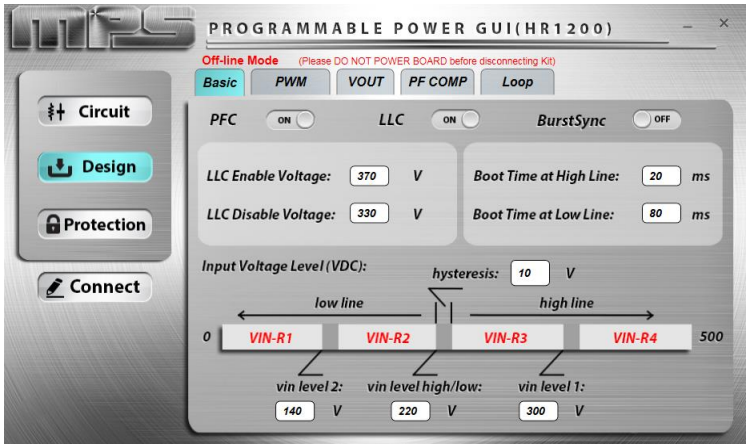


Figure 13: Design-Basic Panel

C. Design-PWM Panel

This panel configures parameters related to the PWM switching of the PFC (see Figure 14).

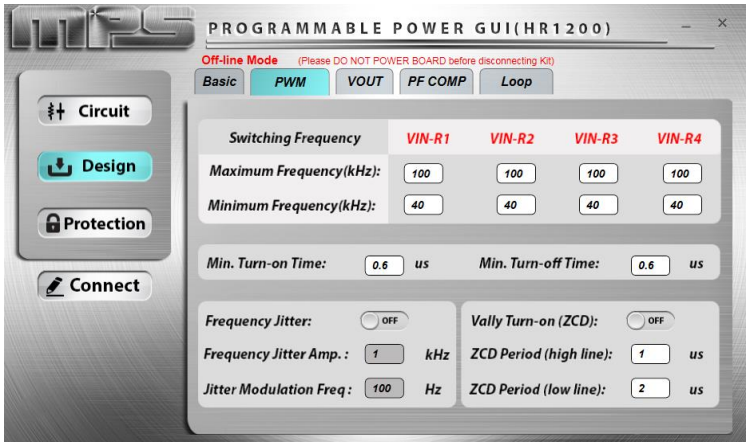


Figure 14: Design-PWM Panel

D. Design-VOUT Panel

This panel configures the PFC output voltage according to different input ranges and output power, to realize efficiency optimization.

When Adaptive Output Voltage is enabled, there are eight adjustable PFC output voltages. When Adaptive Output Voltage is disabled, the PFC output voltage can only be set according to high-line or low-line input (see the red box in Figure 15).

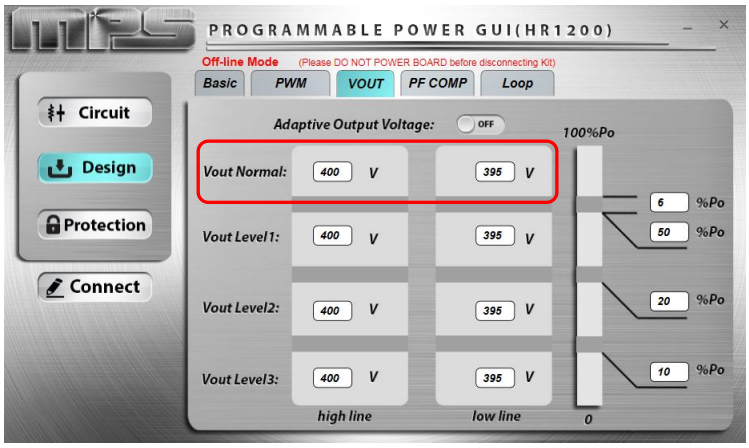


Figure 15: Design-VOUT Panel

E. Design-PF COMP Panel

This panel configures the PF compensation parameters, which can improve the PF of the PFC stage. Compensation can be controlled in different degrees according to different input ranges (see Figure 16).

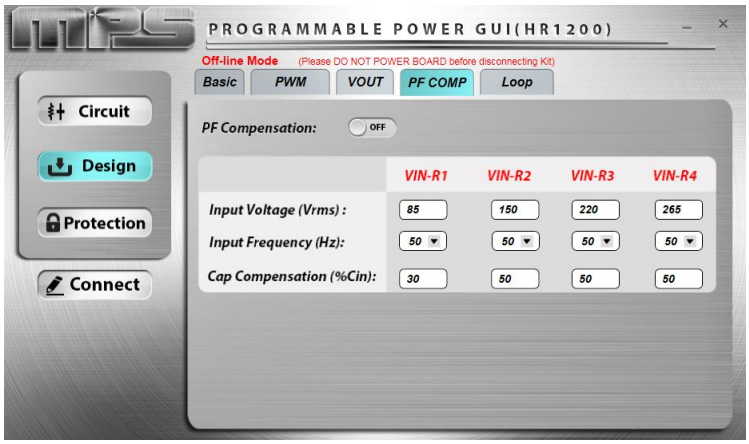


Figure 16: Design-PF COMP Panel

F. Design-Loop Panel

This panel can determine the load point to enter burst mode by configuring Burst Mode Load. Kp and Ki of closed-loop control can also be set (see Figure 17).

If Set-Up Mode is set to “Auto,” Kp and Ki are kept at their defaults.

If Set-Up Mode is set to “Manual,” Kp and Ki can be changed. Related bode plots are drawn to help check gain and phase margin of the loop.

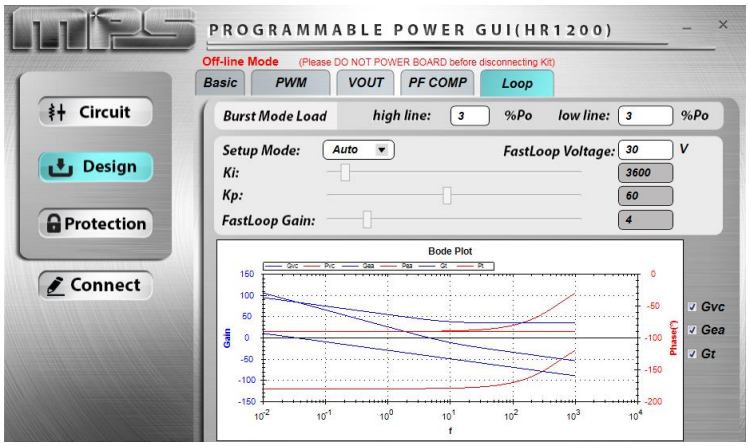


Figure 17: Design-Loop Panel

G. Protection Panel

This panel configures AC brown-in/brown-out voltage and several protection parameters, including OVP, OCP, and OC limit (see Figure 18).

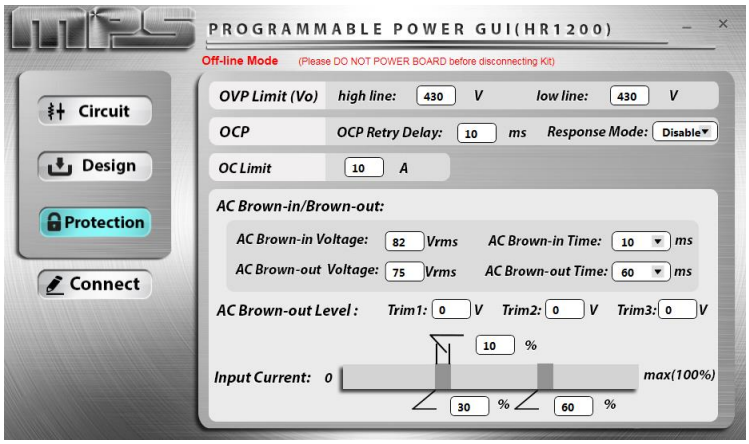


Figure 18: Protection Panel

H. Monitor Panel (online mode)

This panel monitors the status of the IC in online mode. Figure 19 shows how a user can check the input/output of the PFC stage and determine the fault state.

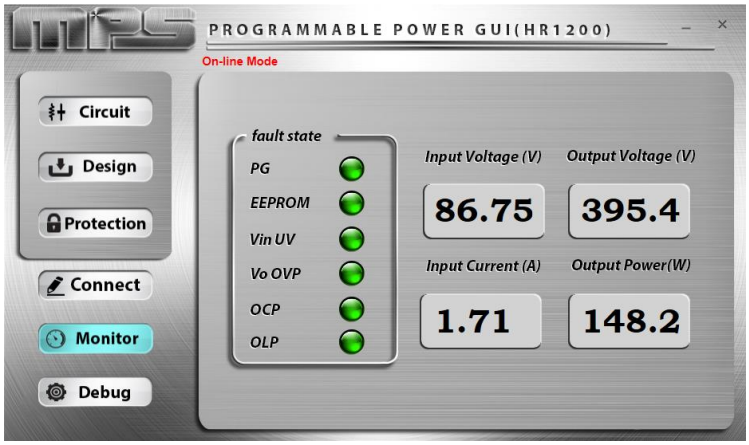


Figure 19: Monitor Panel (Online Mode)

For more details about GUI panels, refer to *AN103-User Guideline_HR1203 I²C Kit and GUI*.

4. Go to the Connect Panel to program the IC after all parameters have been configured (see Figure 20).

Figure 20: Connect Panel

Click “Program” to program all the panel parameters to EEPROM of the IC. When programming is finished, the EEPROM data is read out and compared with original written values to complete a self-check. If something is wrong, a corresponding prompt box pops up. If everything goes well, a dialogue box reads: “Programmed successfully.”

Click “Export” to save all the panel parameters in a Microsoft Excel spreadsheet.

Click “Import” to load data from an external Excel spreadsheet into the GUI panels. Ensure the external Excel spreadsheet has the same form as the one exported from the GUI.

In online mode (except the Connect Panel), a special “Debug” button controls the turning on and turning off of the real-time programming function (see Figure 21).

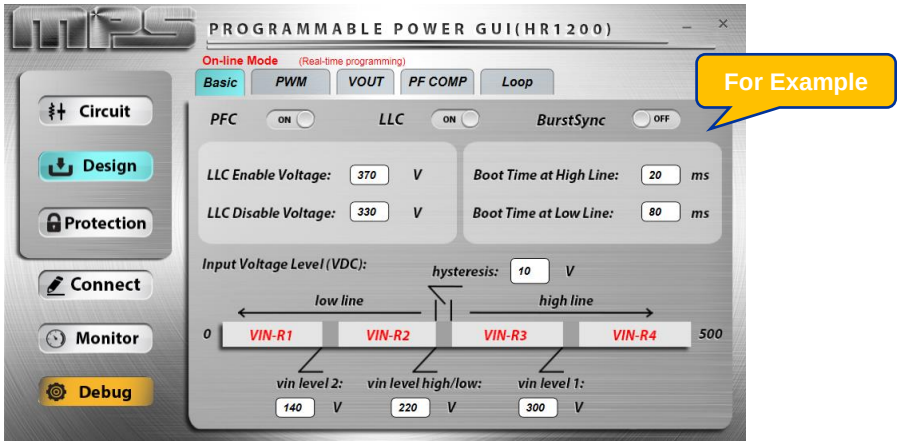


Figure 21: Debug Button (Online Mode)

Real-Time Programming:

Click “Debug” to light the button up in orange. This means the real-time programming function is turned on, and any single change in any panel can programmed to the chip in real-time by clicking “Enter” immediately. Under this condition, the “Import” function is disabled.

Click “Debug” again to turn off the real-time programming function. The color of the button should return to gray.

⚠ Real-time programming is a risky programming mode. If you make a change in a data box and click “Enter,” then all panel parameters, not only the changed one, will be programmed to the chip. Therefore it is strongly recommended to repeatedly confirm panel parameters before clicking “Enter.”

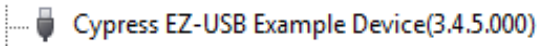
⚠ Do not forget to click “Enter” in real-time programming. Otherwise, the data change in GUI will not be updated to the chip.

5. Close the GUI. Since the panel parameters restore default values every time restarting the GUI, it is better to save current panel parameters before exiting.
6. If in online mode, disconnect AC input then reset the communication interface and EVB (1).
   If in offline mode, reset the communication interface and EVB (1).

Note:

1) **To reset communication interface:** Ensure that the VCC of the communication interface is fully discharged.
   To reset EVB: For offline mode, ensure that the EBV VCC is fully discharged. For online mode, ensure that the EVB VCC is fully discharged and the bus bulk capacitor is discharged below 10V.
   VCC fully discharged: VCC discharged below 2V. The discharge time may vary with different application designs.

3.5 Troubleshooting Tips

Common Faults	Troubleshooting
Communication interface driver is not properly installed	Manual installation is required. Follow the steps below: 1. Install the correct ".exe" file according to the Windows operating system. 32-bit: \EVKT-USBI2C-02 USB Driver\USBXpressInstaller_x86.exe 64-bit: \EVKT-USBI2C-02 USB Driver\USBXpressInstaller_x64.exe 2. Connect the communication interface to the PC with a USB cable. 3. Find "Cypress EZ-USB Example Device" in the Device Manager. 
Prompt box: "Please connect I^2C kit to USB port correctly"	1. Connection failed. Check and reconnect the communication interface with USB port. 2. Communication interface or EVB not reset. Detach the communication interface from the USB port and fully discharge both the communication interface and EVB VCCs. Ensure the bulk capacitor is discharged below 10V. Then reconnect.
Prompt box: "Please check whether kit connects to EVB correctly"	1. Connection failed. Check and reconnect the communication interface with EVB. 2. Communication interface or EVB not reset. Detach the communication interface from the USB port and fully discharge both the communication interface and EVB VCCs. Ensure the bulk capacitor is discharged below 10V. Then reconnect.
Prompt box: "Open memory failed"	1. Communication failed with the EEPROM of the chip. Something may be wrong with the EVB or the chip. 2. Communication interface or EVB not reset. Detach the communication interface from USB port and fully discharge both the communication interface and EVB VCCs. Ensure the bulk capacitor is discharged below 10V. Then reconnect.
Prompt box: "Communication failed"	Communication lost with the EEPROM of the chip. 1. End the GUI process. 2. Reset both the communication interface and EVB. 3. Reconnect the communication interface following the correct steps. 4. Restart the GUI.
Displayed as online mode in the GUI but without AC input	Communication interface or EVB not reset. Detach the communication interface from the USB port and fully discharge both the communication interface and EVB VCCs. Ensure the bulk capacitor is discharged below 10V. Then reconnect.

Communication interface not recognized by the computer	1. Communication interface or EVB not reset. Detach the communication interface from the USB port and fully discharge both the communication interface and EVB VCCs. Ensure the bulk capacitor is discharged below 10V. Then reconnect. 2. Driver installation problems. Re-install. 3. USB port damaged. Try another port. 4. Restart computer. 5. Communication interface damaged. Try another communication interface.
GUI or computer crash	1. End the GUI process. 2. Reset both the communication interface and EVB. 3. Reconnect the communication interface following the correct steps. 4. Restart the GUI.
Prompt box: “Import Error”	1. Nonstandard form of external Excel spreadsheet. 2. Microsoft Excel needs to be updated.
Prompt box: “Export Error”	Microsoft Excel needs to be updated.

Section 4. Ordering Information

The components of the evaluation kit can be ordered separately, depending on user needs.

Part Number	Description
EVKT-1203-TSSOP	Complete evaluation kit
Contents of EVKT-1203-TSSOP	
EVHR1203-M-02A	Evaluation board (IC in TSSOP-28)
EVHR1203 PMBUS Kit-01A	Includes one USB to I^2C programming communication interface, one USB cable, and one ribbon cable
T-USB Isolation Block-00A	USB isolator

Part Number	Description
EVKT-1203-SOIC	Complete evaluation kit
Contents of EVKT-1203-SOIC	
EVHR1203-Y-00A *	Evaluation board (IC in SOIC-28)
EVHR1203 PMBUS Kit-01A	Includes one USB to I^2C programming communication interface, one USB cable, and one ribbon cable
T-USB Isolation Block-00A	USB isolator

EVHR1203-Y-00A *: can be commonly used for HR1204 by swapping the IC.