



# User Guide

HR1200 Evaluation Kit (EVKT-1200)

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## Overview

### Introduction

The EVKT-1200 is an evaluation kit for the HR1200. A 240W evaluation board is designed with high power factor (PF) at light load (>0.95 at 20% load). The particular benefits for the board are the 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 to the application of PC, ATX power, notebook adapter, gaming and TV power supply. With the programming dongle and GUI software, circuit configurations of the digital PFC part can be easily customized which greatly increases design flexibility.

### Kit Contents

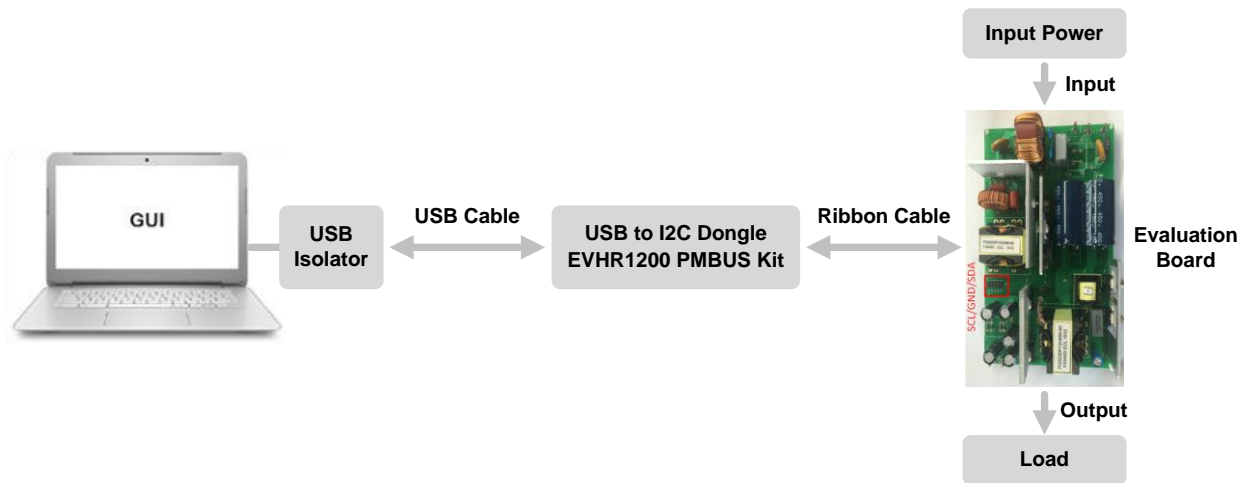
EVKT-1200-TSSOP Kit contents (items below can be ordered separately):

#	Part Number	Item	Quantity
1	EVHR1200-M-02A	Evaluation board (IC in TSSOP-28)	1
2	EVHR1200 PMBUS Kit-01A	USB to I2C programming dongle	1
		USB cable	1
3	T-USB Isolation Block-00A	Ribbon cable	1
		USB isolator	1
4	Tdrive-HR1200	USB flash drive that stores the GUI installation file and supplemental documents	1

EVKT-1200-SOIC Kit contents (items below can be ordered separately):

#	Part Number	Item	Quantity
1	EVHR1200-S-01C*	Evaluation board (IC in SOIC-28)	1
2	EVHR1200 PMBUS Kit-01A	USB to I2C programming dongle	1
		USB cable	1
3	T-USB Isolation Block-00A	Ribbon cable	1
		USB isolator	1
4	Tdrive-HR1200	USB flash drive that stores the GUI installation file and supplemental documents	1

EVHR1200-S-01C\*: can be commonly used for HR1201 by swapping the IC.



**Figure 1: EVKT-1200 Evaluation Kit Set-Up**

## Features and Benefits

The evaluation board is mainly designed to demonstrate the capabilities of MPS highly integrated controller HR1200. The HR1200 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. Besides, a high-voltage (HV) current source is integrated internally for start-up and X-cap discharge which are helpful to reduce related devices thus reduce power consumption at no load.

- ⚠ *Use **USB ISOLATOR** when in On-line Mode with AC input.*
- ⚠ *Make sure both **DONGLE** and **EVB BOARD** are reset every time before restarting 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 21.7 MB free
GUI Software	MPS Programmable Power GUI v3.2
EVB Size (L X W)	17.4 cm x 10.5 cm

## Section 1. Hardware Specifications

### 1.1 Personal Computer Requirements

The following must be minimally met to use the EVKT-1200.

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

### 1.2 EVB Specifications

The EVHR1200-M-02A and EVHR1200-S-01C are evaluation boards for the HR1200 respectively in TSSOP-28 package and SOIC-28 package. For more information, please refer to the EVB datasheet.



**Figure 2: Evaluation Board**

Feature	Specification
Input AC Voltage	90Vac to 265Vac
Output Voltage	12V
Output Current	20A
EVB Size (L X W)	17.4 cm x 10.5 cm

### 1.3 EVHR1200 PMBUS Kit Specifications

EVHR1200 PMBUS Kit-01A refers to the USB to I2C programming dongle, which connects the EVB and the PC. It provides PMBus capabilities. Together with MPS GUI tools, it provides a quick and easy way to evaluate the performance of digital PFC part of HR1200. For more details, refer to *AN103-User Guideline\_HR1200 I<sup>2</sup>C Kit and GUI*.



**Figure 3: EVHR1200 PMBUS Kit-01A Dongle**

### 1.4 USB Isolator Specifications

T-USB Isolation Block-00A refers to the USB Isolator, which is needed between the I<sup>2</sup>C dongle and the computer USB port to protect the computer from the risk of short-circuit. For more details, refer to *AN103-User Guideline\_HR1200 I<sup>2</sup>C 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.

Note: In the near future, this software can be downloaded from the MPS website. For now, it is provided on a flash drive.

1. Plug the flash drive into the computer using any available USB port.
2. Browse to the folder containing the flash drive contents.
3. Double click the .exe file to open the set-up guide (see Figure 5).
4. Follow the prompts in the set-up guide.
5. Wait for status screen to verify that installation is complete (see Figure 6).

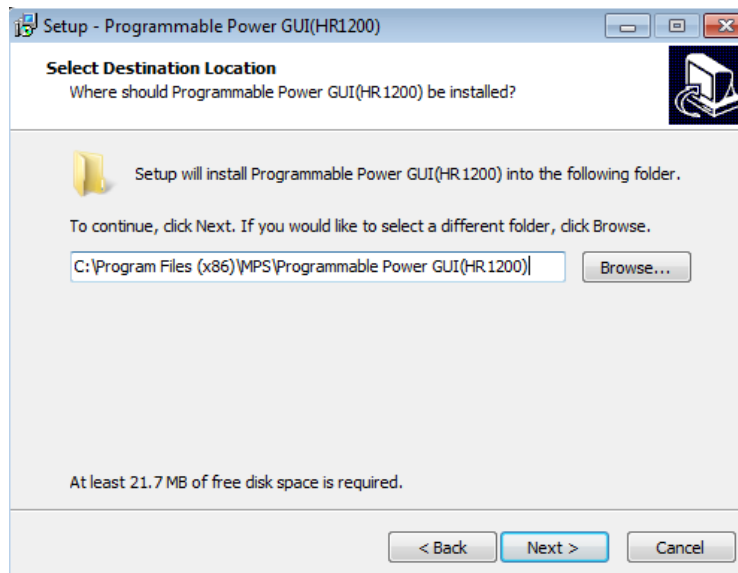


Figure 5: MPS I<sup>2</sup>C GUI Set-Up Guide



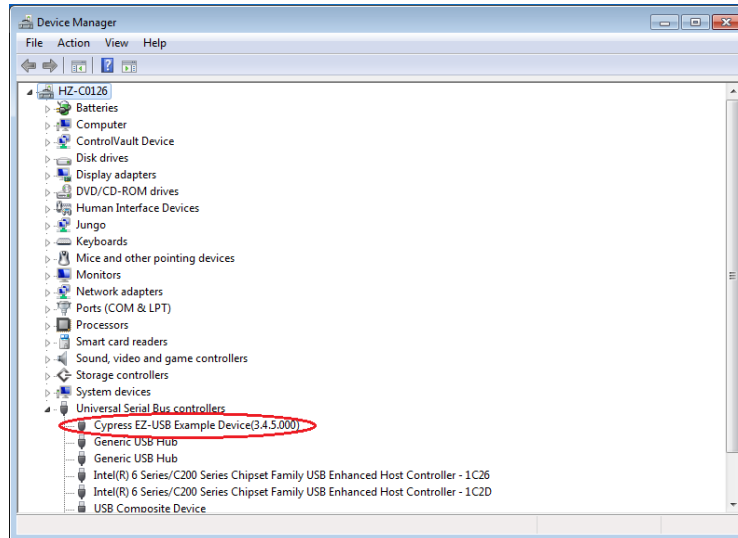
Figure 6: Driver Set-Up Success

## Section 3. Evaluation Kit Test Set-Up

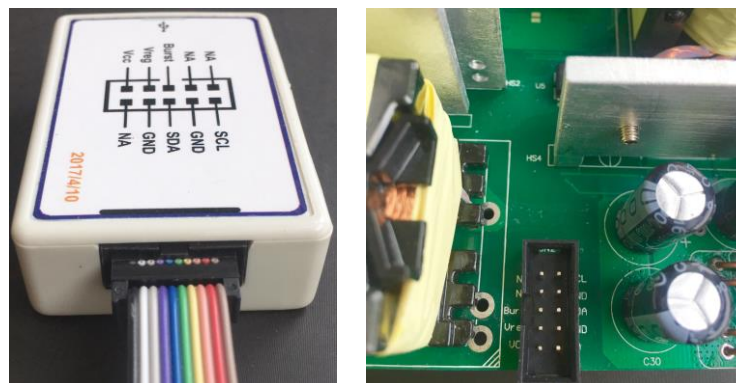
### 3.1 Hardware Set-Up

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

1. Connect the dongle to the computer USB port with an USB isolator.
2. After the dongle is recognized by the computer (see Figure 7), locate the proper wires to connect the EVB to the EVHR1200 PMBUS Kit-01A dongle.
3. Connect VCC, VREG, BURST, SCL, SDA, and GND (see Figure 8). If needed, refer to the datasheet for further clarification.



**Figure 7: Dongle Recognized by Computer**



**Figure 8: EVB to MPS I<sup>2</sup>C Dongle Wire Connection**

### 3.2 Powering up the EVB

The computer USB port can provide the I<sup>2</sup>C dongle with 5V DC voltage. Once the dongle connects successfully with both the PC and EVB, it can operate in two different modes.

**Off-line Mode:** No need to power up the EVB. The dongle detects that VCC is lower than 8V upon hooked up. It will provide power supply to VCC, VREG and send a pre-determined signal to BURST. Then the IC enters a dedicated test mode for programming.



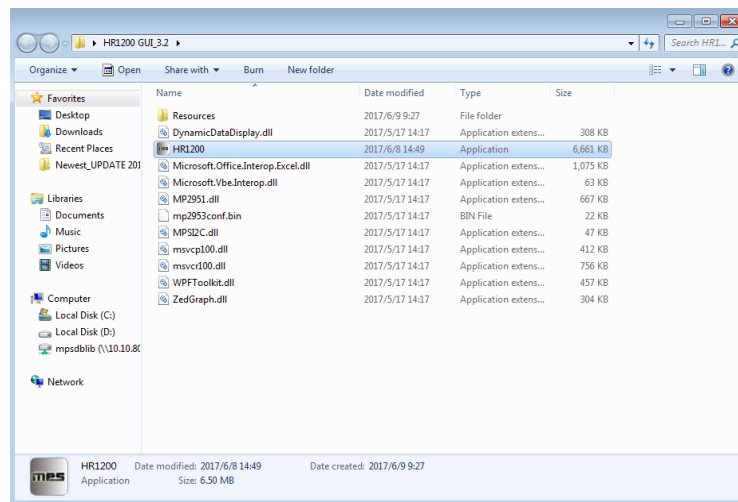
**On-line Mode:** Supply AC input to the EVB. The dongle detects that VCC is higher than 8V upon hooked up. It will only provide power supply to VCC. Then the IC works in normal operation. Specific steps are as follows:

1. Connect the positive and negative terminals of the load to 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 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 “HR1200” to start up the GUI (see Figure 9). Then the interface shown in Figure 10 will be seen.



**Figure 9: GUI Start-up**



**Figure 10: GUI Start-up Interface**

2. Press “SCAN”, then following actions will be performed automatically.

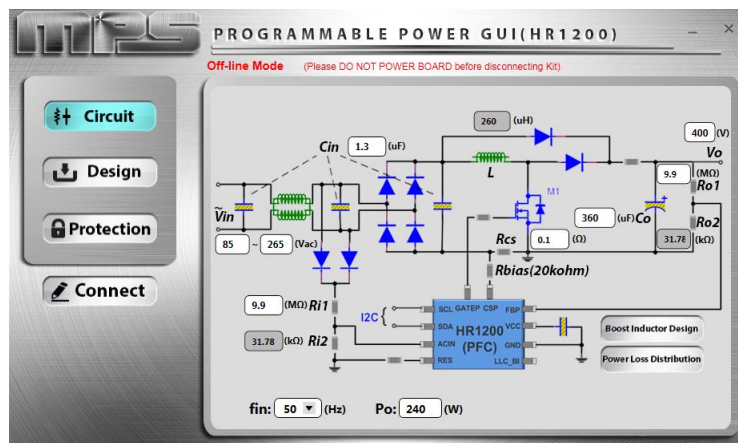
**A. Connection Check**

- a) If there is something wrong with the connection between the I<sup>2</sup>C dongle and USB port, following prompt box is displayed: “Please connect I<sup>2</sup>C Kit to USB port correctly.”
- b) If there is something wrong with the connection between the I<sup>2</sup>C dongle and EVB, following prompt box is displayed: “Please check whether Kit connects to EVB correctly.”
- c) If the dongle connects successfully with both the USB port and EVB, none prompt box will appear and it turns to **Action B**.

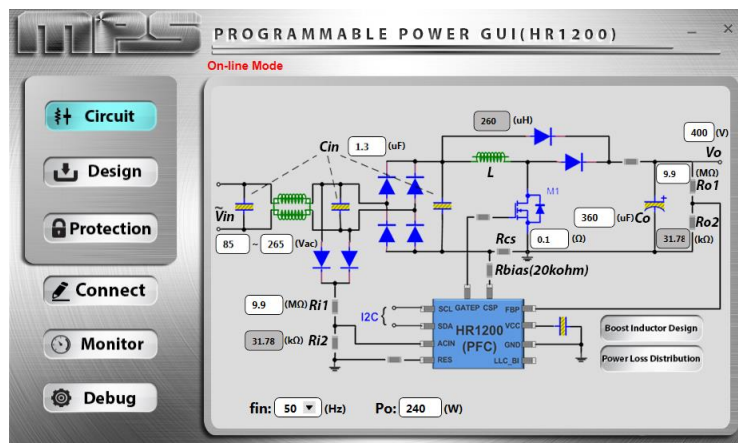
**B. Mode Recognition**

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

If VCC is detected higher than 8V, the IC enters **On-line Mode** (see Figure 12). Only fixed VCC is sent to EVB.



**Figure 11: Main Interface in Off-line Mode**



**Figure 12: Main Interface in On-line Mode**

- ⚠ **DO NOT CONNECT AC INPUT** in Off-line Mode.
- ⚠ **USE USB ISOLATOR** between dongle and USB port in On-line Mode.
- ⚠ **KEEP AC INPUT IN CONNECTION** in On-line Mode.
- ⚠ **DO NOT PLUG OR UNPLUG ANY DEVICE** in On-line Mode to prevent damaging EVB.

⚠ **RESET DONGLE and EVB** every time before you restart the GUI, i.e. detach dongle from USB port and make sure VCC of both dongle and EVB is fully discharged. Besides, in On-line Mode, bus bulk capacitor should be discharged lower than 10V to prevent false triggering before making connection again <sup>[1]</sup>.

- If connection is successful, proceed to Step 3. Otherwise, check connections between the EVB, dongle, and PC. Re-plug the USB cable and the ribbon cable. Then restart the GUI.

Parameters of the digital PFC part of the IC now can be configured by selecting various menu items on the GUI interface. You can also “import” your own design parameters.

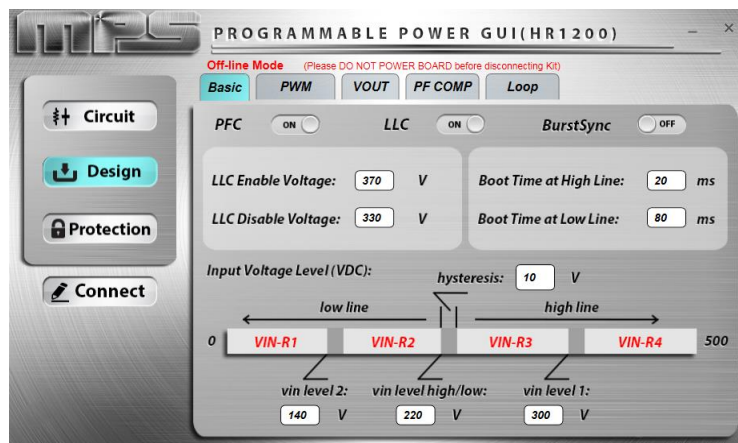
Most GUI panels in Off-line Mode and On-line Mode are the same. Here take Off-line Mode as an example first.

### A. Circuit panel

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

### B. Design-Basic panel

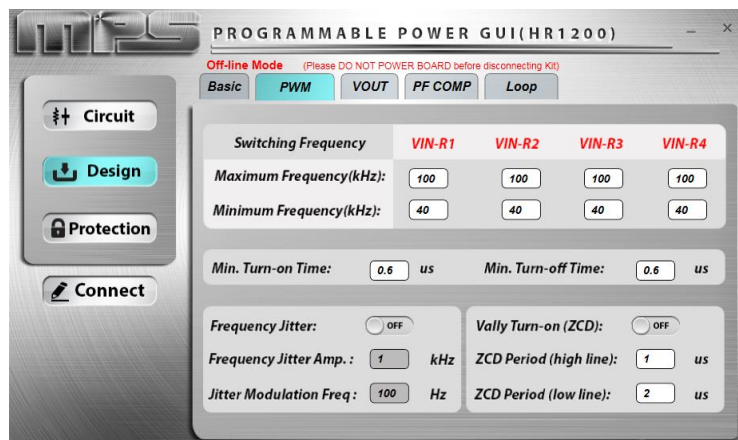
This panel can control the working state of the PFC and LLC part separately and configure some basic parameters (see Figure 13).



**Figure 13: Design-Basic Panel**

### C. Design-PWM panel

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

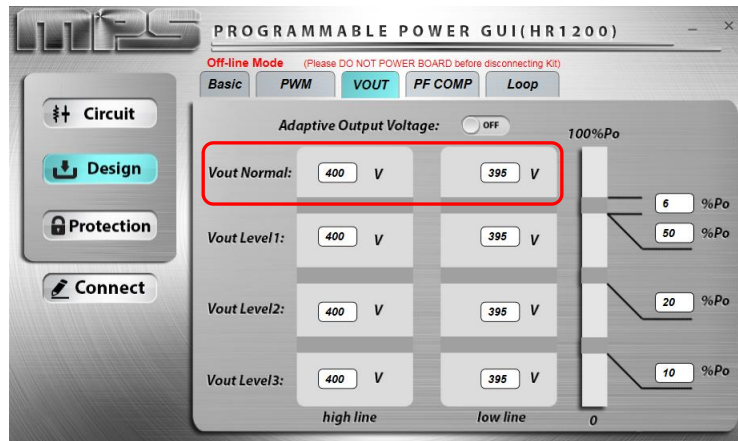


**Figure 14: Design-PWM Panel**

### D. Design-VOUT panel

This panel can configure 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 only can be set according to high-line or low-line input as shown in Figure 15 with red box.



**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).



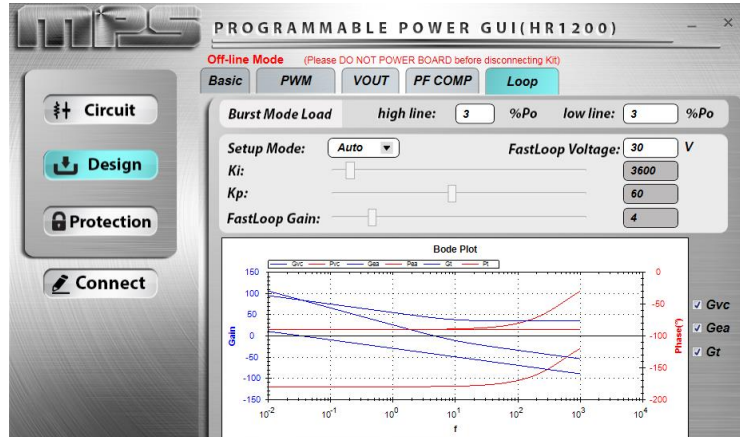
**Figure 16: Design-PF COMP Panel**

### F. Design-Loop panel

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

If *Setup Mode* is set as “Auto”, Kp and Ki are kept as defaults.

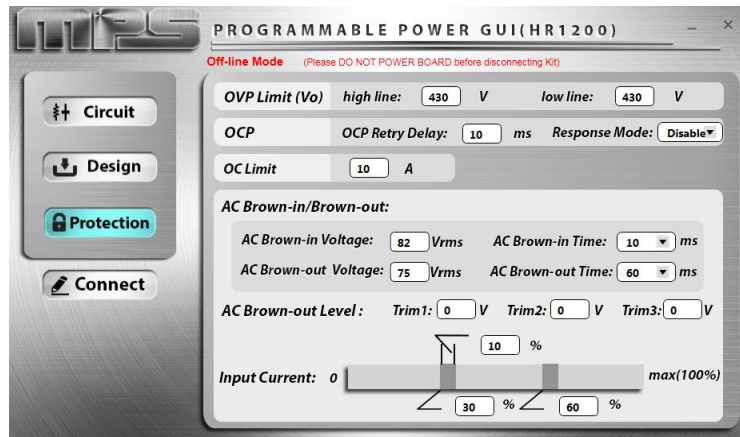
If *Setup Mode* is set as “Manual”, Kp and Ki can be changed. Related bode plots are drawn to help check gain and phase margin of the loop.



**Figure 17: Design-Loop Panel**

**G. Protection panel**

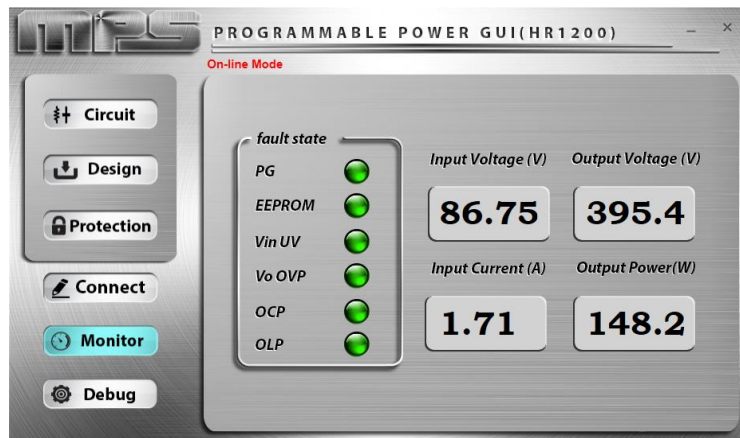
This panel configures AC brown-in/brown-out voltage and several protection parameters including OVP, OCP, OC limit, etc (see Figure 18).



**Figure 18: Protection Panel**

**H. Monitor panel (On-line Mode)**

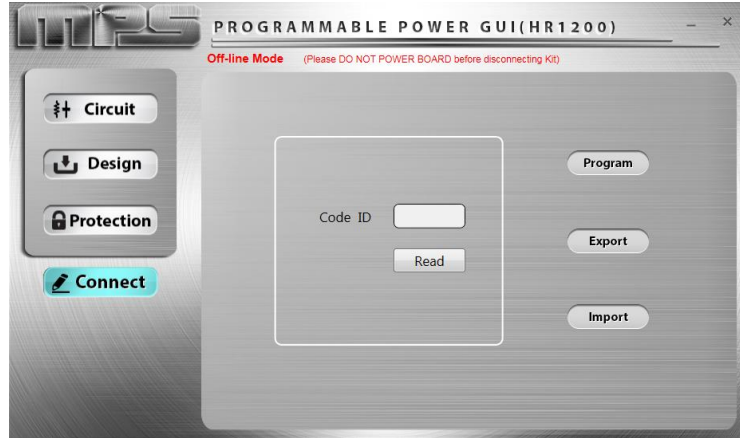
This panel provides the function of monitoring the status of the IC in On-line Mode. As shown in Figure 19, you can check the input/output of the PFC stage and know the fault state.



**Figure 19: Monitor Panel (On-line Mode)**

For more details about GUI panels, please refer to *AN103-User Guideline\_HR1200 I<sup>2</sup>C Kit and GUI*.

4. Go to **Connect panel** to program the IC after all of the parameters have been configured. **Connect panel** is as shown in Figure 20.



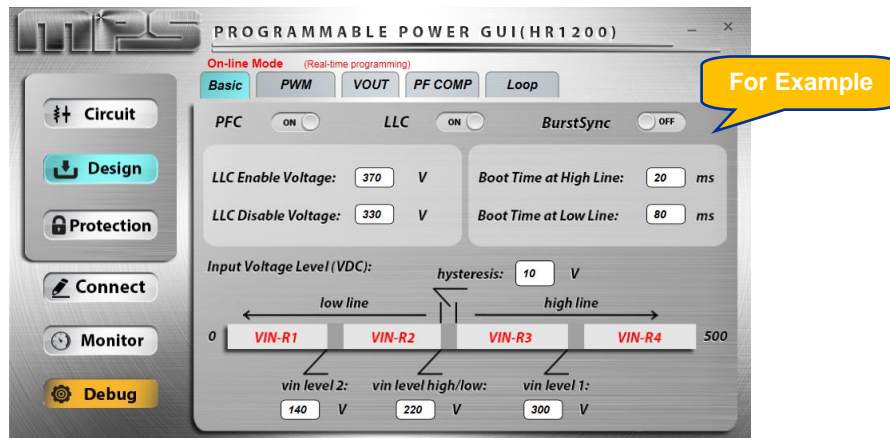
**Figure 20: Connect Panel**

Press “Program” to program all the panel parameters to EEPROM of the IC. Every time finishing programming, the EEPROM data are read out and compared with original written values to realize self-check. If something is wrong, a corresponding prompt box will pop up. If everything goes well, following prompt box is displayed: **“Program successfully.”**

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

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

For On-line Mode, except **Connect panel**, a special **“Debug”** button is set. It controls the turning-on and turning-off of the **“real-time programming”** function (see Figure 21).



**Figure 21: Debug Button (On-line Mode)**

**Real-time programming:**

Press **“Debug”** to light the button up in orange. Then the function of real-time programming is turned on. It means any single change in any panel is programmed to the chip in real time by pressing ENTER immediately. Under this condition the “Import” function is disabled.

Press “**Debug**” again to turn off real-time programming function. Then the color of the button restores to gray.

⚠ **REAL-TIME PROGRAMMING IS A RISKY PROGRAMMING MODE.** *If you make a change in a data box and press ENTER, then all the panel parameters not only the changed one will be programmed to the chip. So, PLEASE REPEATEDLY CONFIRM PANEL PARAMETERS before pressing ENTER.*

⚠ **DO NOT FORGET TO PRESS ‘ENTER’** under real-time programming. Otherwise, the data change in GUI will not be updated to the chip.

5. Close the GUI. As the panel parameters restore default values every time restarting the GUI, it is better to save current panel parameters before exiting.
6. If in On-line Mode, disconnect AC input then reset dongle and EVB <sup>[1]</sup>.  
If in Off-line Mode, reset dongle and EVB <sup>[1]</sup>.

**Notes:**

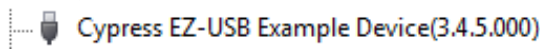
[1] **Reset Dongle:** make sure the VCC of dongle is fully discharged.

**Reset EVB:** Off-line Mode-----make sure the VCC of EVB is fully discharged.

On-line Mode-----make sure the VCC of EVB is fully discharged and the bus bulk capacitor is discharged lower than 10V.

**VCC Fully Discharged:** VCC has ever been discharged lower than 2V. The discharge time may vary with different application designs.

### 3.5 Troubleshooting Tips

Common Faults	Trouble Shooting
Dongle driver is not properly installed.	<p>Manual installation is required. Follow the steps below:</p> <ol style="list-style-type: none"> <li>1. Install the correct “.exe” file according to the windows operation system. 32-bit: <a href="#">\EVKT-USBI2C-02 USB Driver\USBXpressInstaller_x86.exe</a> 64-bit: <a href="#">\EVKT-USBI2C-02 USB Driver\USBXpressInstaller_x64.exe</a></li> <li>2. Connect the dongle to the PC with a USB cable.</li> <li>3. Find “Cypress EZ-USB Example Device” in the Device Manager. </li> </ol>
Prompt box: “Please connect I2C Kit to USB port correctly.”	<ol style="list-style-type: none"> <li>1. Connection failed. Check and reconnect dongle with USB port.</li> <li>2. Dongle or EVB not reset. Detach dongle from USB port and fully discharge VCC of both dongle and EVB. Make sure the bulk capacitor is discharged lower than 10V. Then reconnect.</li> </ol>
Prompt box: “Please check whether Kit connects to EVB correctly.”	<ol style="list-style-type: none"> <li>1. Connection failed. Check and reconnect dongle with EVB.</li> <li>2. Dongle or EVB not reset. Detach dongle from USB port and fully discharge VCC of both dongle and EVB. Make sure the bulk capacitor is discharged lower than 10V. Then reconnect.</li> </ol>
Prompt box: “Open memory failed.”	<ol style="list-style-type: none"> <li>1. Communication failed with the EEPROM of the chip. Something may be wrong with EVB or the chip.</li> <li>2. Dongle or EVB not reset. Detach dongle from USB port and fully discharge VCC of both dongle and EVB. Make sure the bulk capacitor is discharged lower than 10V. Then reconnect.</li> </ol>
Prompt box: “Communication failed.”	<p>Lose communication with the EEPROM of the chip. End GUI process → Reset both dongle and EVB → Reconnect dongle following right steps → Restart GUI</p>
Displayed as On-line Mode in the GUI but without AC input.	Dongle or EVB not reset. Detach dongle from USB port and fully discharge VCC of both dongle and EVB. Make sure the bulk capacitor is discharged lower than 10V. Then reconnect.
Dongle not recognized by the computer.	<ol style="list-style-type: none"> <li>1. Dongle or EVB not reset. Detach dongle from USB port and fully discharge VCC of both dongle and EVB. Make sure the bulk capacitor is discharged lower than 10V. Then reconnect.</li> <li>2. Driver installation problems. Re-install.</li> <li>3. USB port damaged. Try other port.</li> <li>4. Restart computer.</li> <li>5. Dongle damaged. Try other dongle.</li> </ol>
GUI or computer crash.	End GUI process → Reset both dongle and EVB → Reconnect dongle following right steps → Restart GUI
Prompt box: “Import Error.”	<ol style="list-style-type: none"> <li>1. Nonstandard form of external Excel spreadsheet.</li> <li>2. <i>Microsoft Excel</i> needs to be updated.</li> </ol>
Prompt box: “Export Error.”	<i>Microsoft Excel</i> needs to be updated.



## Section 4. Ordering Information

The components of the evaluation kit can be ordered separately according to specific needs.

Part Number	Description
EVKT-1200-TSSOP	Complete evaluation kit
<b>Contents of EVKT-1200-TSSOP</b>	
EVHR1200-M-02A	Evaluation board (IC in TSSOP-28)
EVHR1200 PMBUS Kit-01A	Includes one USB to I2C programming dongle, one USB cable and one ribbon cable
T-USB Isolation Block-00A	USB isolator
Tdrive-HR1200	USB flash drive that stores the GUI installation file and supplemental documents

Part Number	Description
EVKT-1200-SOIC	Complete evaluation kit
<b>Contents of EVKT-1200-SOIC</b>	
EVHR1200-S-01C*	Evaluation board (IC in SOIC-28)
EVHR1200 PMBUS Kit-01A	Includes one USB to I2C programming dongle, one USB cable and one ribbon cable
T-USB Isolation Block-00A	USB isolator
Tdrive-HR1200	USB flash drive that stores the GUI installation file and supplemental documents

EVHR1200-S-01C\*: can be commonly used for HR1201 by swapping the IC.

**Order directly from [MonolithicPower.com](http://MonolithicPower.com) or our distributors.**

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