UCS1002
Evaluation Board
User's Guide

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Object of Declaration: UCS1002 Evaluation Board

EU Declaration of Conformity

Manufacturer: Microchip Technology Inc.
                     2355 W. Chandler Blvd.
                     Chandler, Arizona, 85224-6199
                     USA

This declaration of conformity is issued by the manufacturer.

The development/evaluation tool is designed to be used for research and development in a laboratory environment. This development/evaluation tool is not a Finished Appliance, nor is it intended for incorporation into Finished Appliances that are made commercially available as single functional units to end users under EU EMC Directive 2004/108/EC and as supported by the European Commission's Guide for the EMC Directive 2004/108/EC (8th February 2010).

This development/evaluation tool complies with EU RoHS2 Directive 2011/65/EU.

This development/evaluation tool, when incorporating wireless and radio-telecom functionality, is in compliance with the essential requirement and other relevant provisions of the R&TTE Directive 1999/5/EC and the FCC rules as stated in the declaration of conformity provided in the module datasheet and the module product page available at www.microchip.com.

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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA

Derek Carlson

Derek Carlson
VP Development Tools

12-Sep-14
Date

NOTES:

UCS1002 EVALUATION BOARD USER'S GUIDE

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Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our website (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXXXXA", where "XXXXXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the UCS1002 Evaluation Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Web Site
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the UCS1002 Evaluation Board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the UCS1002 Evaluation Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with this user's guide and the board.
- **Chapter 3. "Hardware Description"** – Describes the UCS1002 Evaluation Board features and functionalities.
- **Chapter 4. "Software Description"** – Describes the interface that operates the UCS1002 Evaluation Board.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the UCS1002 Evaluation Board.
- **Appendix B. "Bill of Materials"** – Lists the parts used to build the UCS1002 Evaluation Board.

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CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	`file`.o, where `file` can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options] file [options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

RECOMMENDED READING

This user's guide describes how to use the UCS1002 Evaluation Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

- **UCS1002 Data Sheet -** *"Programmable USB Port Power Controller with Charger Emulation"* **(Revision 1.4 - 07-16-2013)**
- **AN 24.14 -** *"UCS1002 Fundamentals of Custom Charger Emulation"* **(DS20005234)**

THE MICROCHIP WEB SITE

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- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

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- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: http://www.microchip.com/support.

DOCUMENT REVISION HISTORY

Revision A (February 2016)

- Initial release of this document.

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NOTES:

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Chapter 1. Product Overview

1.1 INTRODUCTION

This document provides a description of the software and hardware used to evaluate the features of the UCS1002.

1.2 UCS1002 EVALUATION SYSTEM

The evaluation system has several components, as shown in Figure 1-1:

- Customer-provided Windows® PC
- UCS1002 Graphical User Interface program (GUI) and USB Bridge Driver
- UCS1002 Evaluation Board
- USB Cable for GUI communications (Standard-A plug to mini-B plug)
- 5V power source (V_S)
- Customer-provided portable device and OEM USB charging cable (with Standard-A plug at board's end)

FIGURE 1-1: *UCS1002 Evaluation System.*

UCS1002 EVALUATION BOARD USER'S GUIDE

Chapter 1. Product Overview

1.1 INTRODUCTION

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- USB Cable for GUI communications (Standard-A plug to mini-B plug)
- 5V power source (V_S)
- Customer-provided portable device and OEM USB charging cable (with Standard-A plug at board's end)
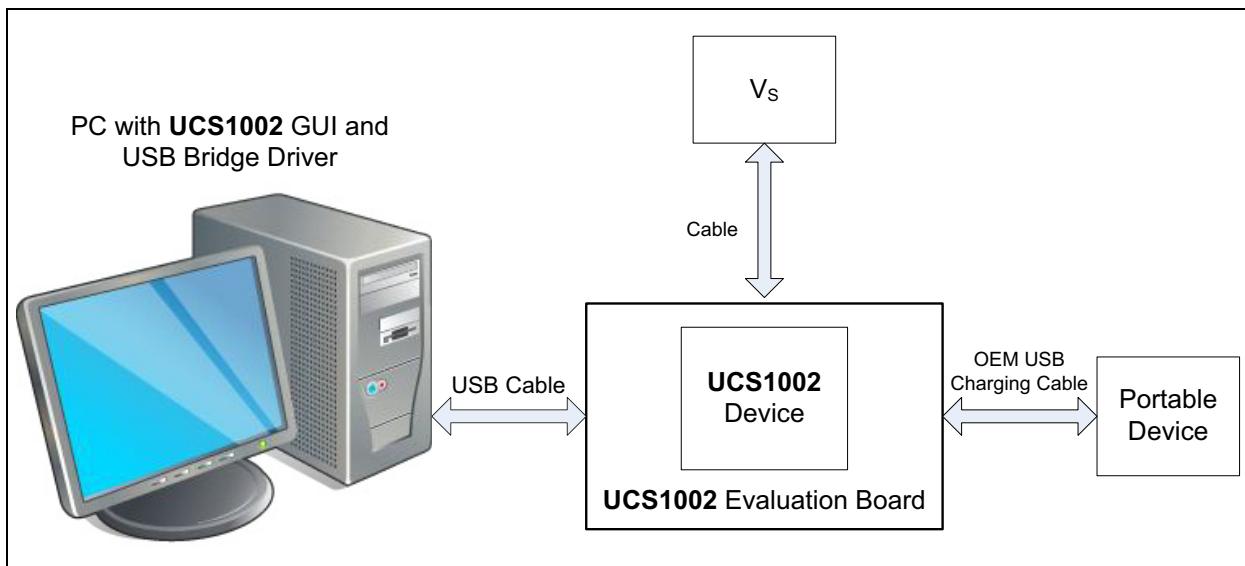
FIGURE 1-1: *UCS1002 Evaluation System.*

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A block diagram of the UCS1002 Evaluation Board is shown in Figure 1-2 below:

```
USB STD-B
RECEPTACLE          →
(Data and Power              UCS1002        →    USB STD-A
From/To Host)                                    RECEPTACLE
                                                 (To-From Device)
AUX Input (Power)   →
                                              →  AUX Power
Control/Status      ↔                            Output

Manual/Bridge       ↔
Configuration and
Status

USB MINI-B EVB      ↔        USB Bridge
RECEPTACLE
```
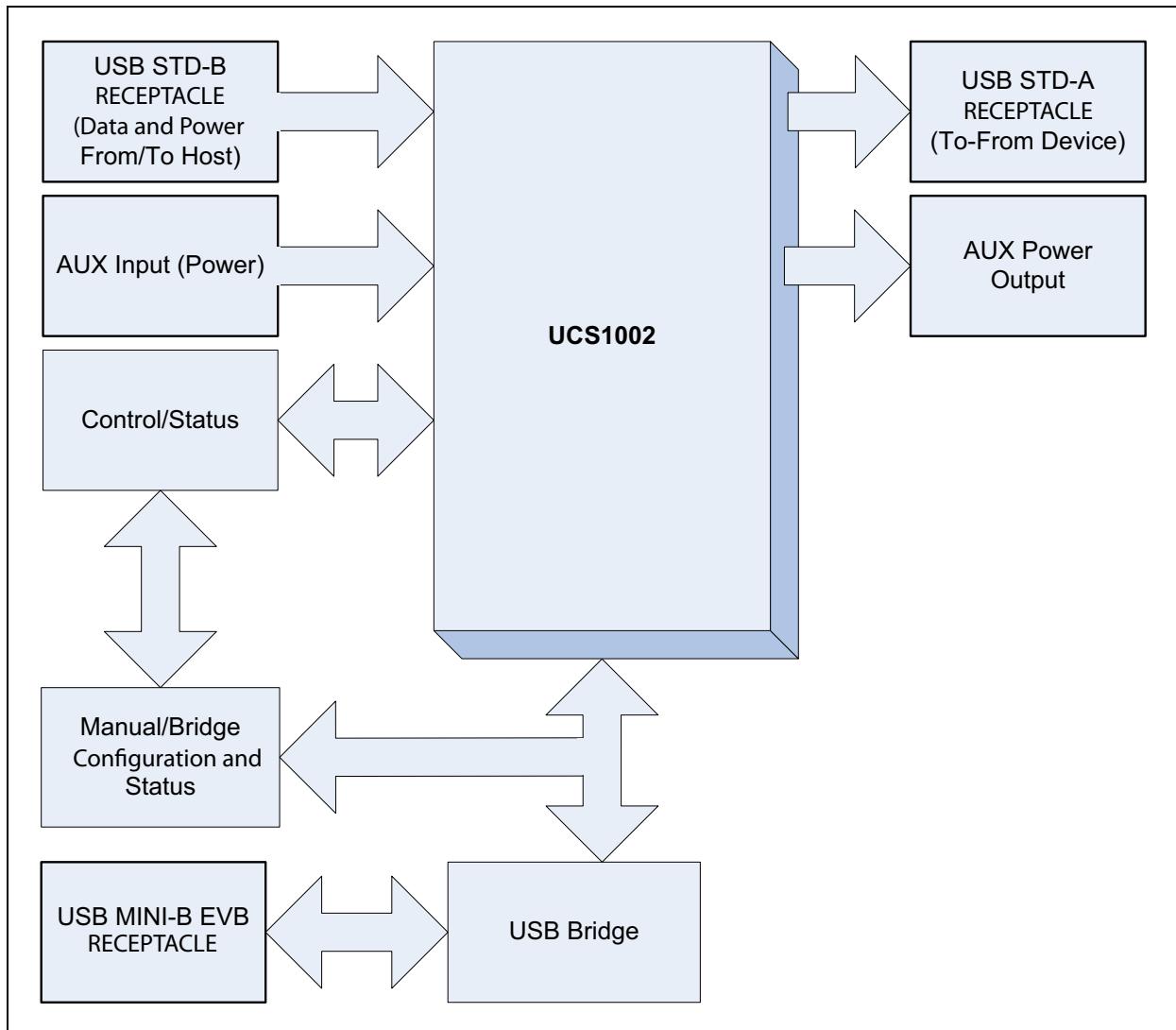
FIGURE 1-2:   *UCS1002 Evaluation Board Block Diagram.*

1.3   WHAT THE UCS1002 EVALUATION BOARD KIT CONTAINS

This UCS1002 Evaluation Board kit includes:

• UCS1002 Evaluation Board (ADM00497)
• Important Information Sheet
• 5V AC-DC Wall Adapter
• Standard-A plug to mini-B plug USB Cable

Chapter 2. Installation and Operation

2.1   INTRODUCTION

This chapter identifies the main connectors, LEDs, jumpers and test points that can be found on the UCS1002 Evaluation Board. It also explains the steps to install the board's graphical user interface and drivers.

2.2   CONNECTORS ON THE EVALUATION BOARD

Figure 2-1 shows the top of the evaluation board and highlights some components.
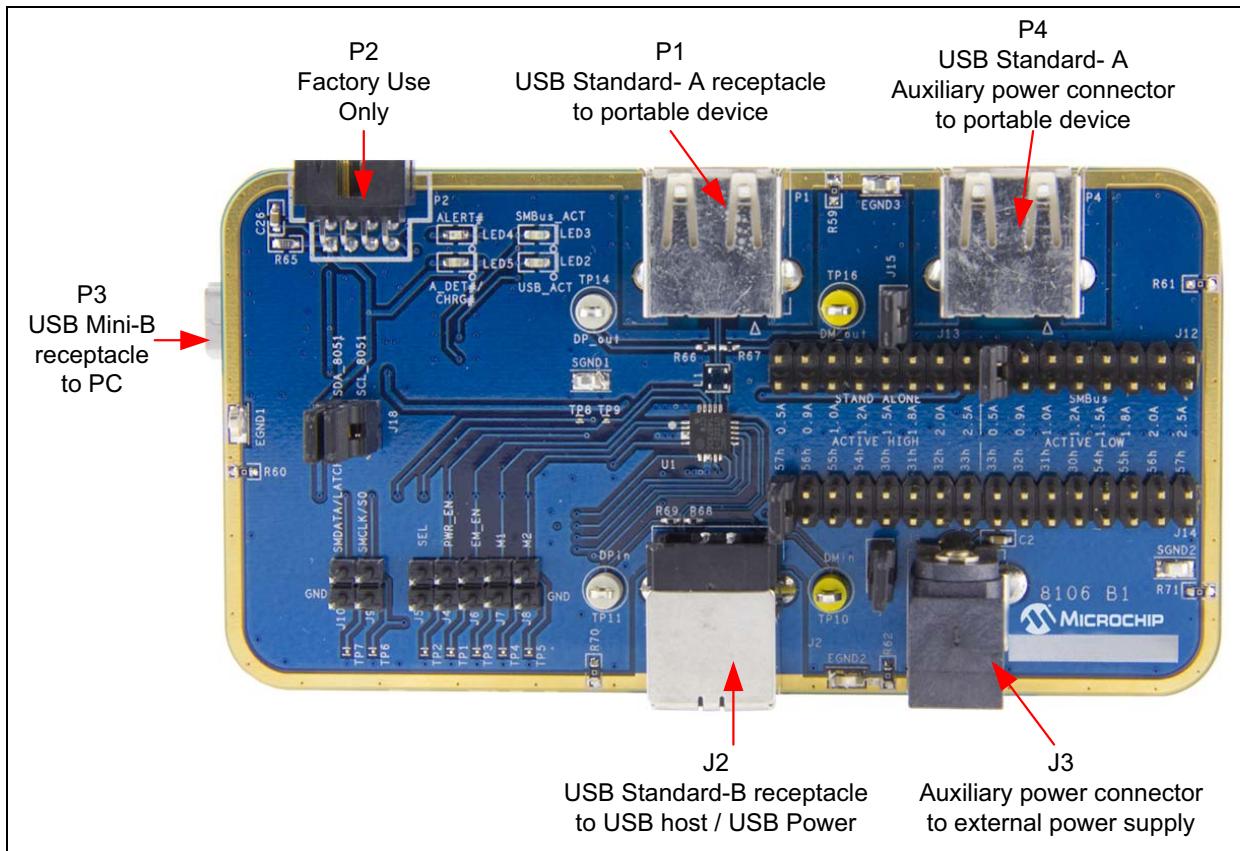
FIGURE 2-1:   *UCS1002 Evaluation Board Top View - Connectors.*

TABLE 2-1:   CONNECTORS DESCRIPTION

Designator	Connector Type	Description
U1		Populated with the UCS1002 device (pin 1 upper left)
J2	Right-Angle USB Standard-B Receptacle	This connects the evaluation board to the USB host (and also provides 5V power to the UCS1002 device V_S pins if J11 is installed).
J3	Right-Angle Power Supply	This connects directly to the UCS1002 V_S input pins.
P1	Right-Angle USB Standard-A Receptacle	This connects the board to the portable device.

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TABLE 2-1: CONNECTORS DESCRIPTION (CONTINUED)

Designator	Connector Type	Description
P2	Right-Angle Receptacle for Factory Use Only	This is a programming port for the 8051 microcontroller.
P3	Right-Angle USB Mini-B Receptacle.	This connects the board to the PC with the GUI software. It also provides 5V power to the evaluation board and to the V_{DD} pin on the UCS1002 device.
P4	Right-Angle USB Standard-A Receptacle	This connects directly to the UCS1002 V_{BUS} output pins. No data connection present. This is the power thief port.

2.3 LEDS ON THE EVALUATION BOARD

Figure 2-2 shows the top of an EVB and highlights the LEDs.
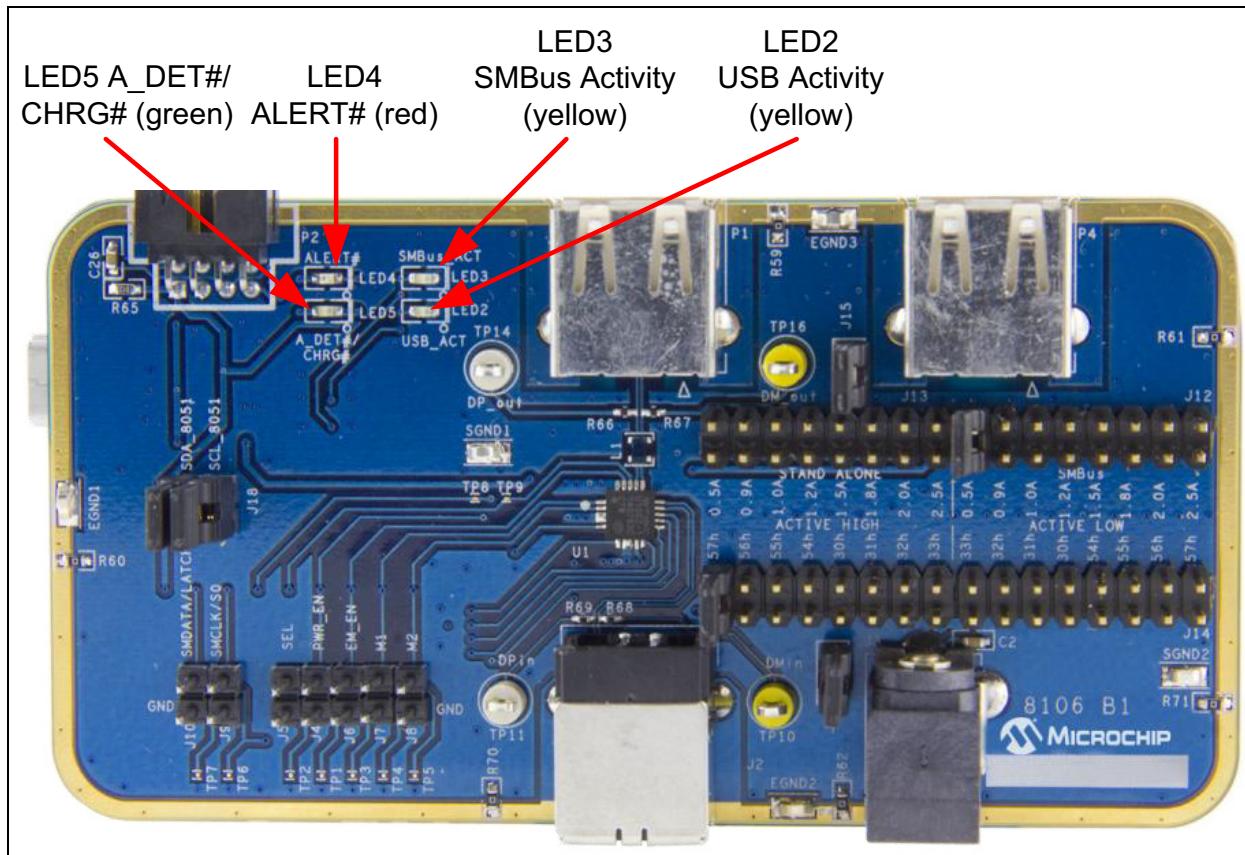
FIGURE 2-2: *Evaluation Board Top View - LEDs.*

TABLE 2-2: LEDS DESCRIPTION

Designator	Function	Description
LED2	USB Activity	When lit, this yellow LED means 5V power is applied to the USB bridge IC.
LED3	SMBus Activity	When flashing, this yellow LED indicates SMBus communication activity.
LED4	ALERT#	When lit, this red LED indicates an alert signal is active.
LED5	A_DET#/CHRG#	When lit, this green LED indicates a device is attached for the UCS1002.

2.4 JUMPERS ON THE EVALUATION BOARD

Figure 2-3 shows the top of an EVB and highlights the jumpers.

Note 1: J11 is Open Circuit if J3 has voltage applied
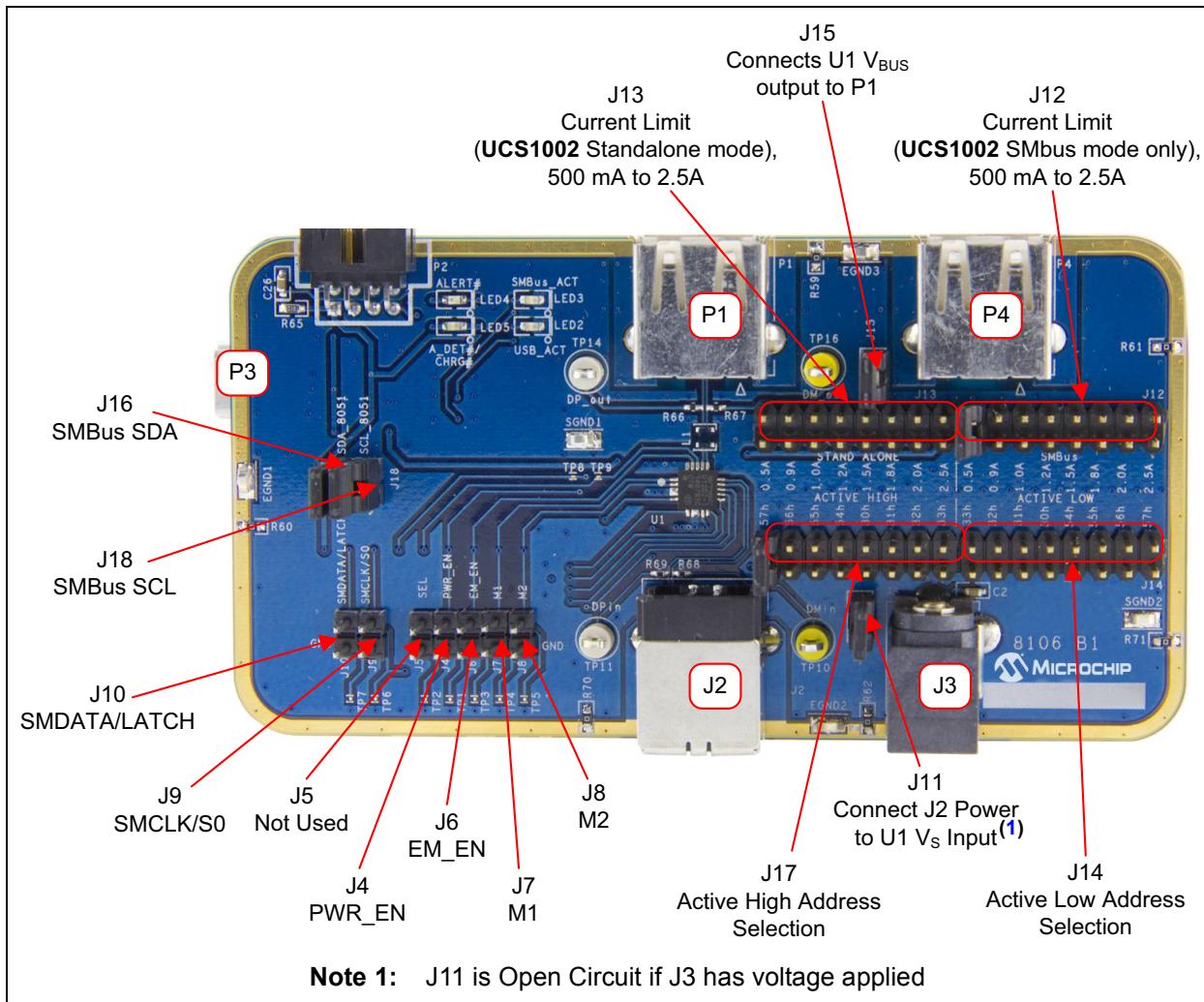
FIGURE 2-3: *Evaluation Board Top View - Jumpers.*

TABLE 2-3: JUMPERS DESCRIPTION

Designator	Assigned Pin	Description
J4	PWR_EN	When installed, this jumper will force a low at the PWR_EN pin.
J5	Not Used	The jumper is not used.
J6	EM_EN	When installed, this jumper will force a low at the EM_EN pin.
J7	M1	When installed, this jumper will force a low at the M1 pin.
J8	M2	When installed, this jumper will force a low at the M2 pin.
J9	SMCLK/S0	This jumper must be left off for SMBus communications to be enabled. If the UCS1002 is in Stand-Alone mode (as selected by using J13 instead of J12), Detect Power state will be enabled without the jumper installed.
J10	SMDATA/LATCH	If UCS1002 is configured in SMBus communication mode, this jumper must be left out. In Stand-Alone mode (as selected by using J13 instead of J12), this jumper will enable the "auto-retry" fault handler if installed, and the "Latch" fault handler if left out.

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TABLE 2-3:   JUMPERS DESCRIPTION (CONTINUED)

Designator	Assigned Pin	Description
J11	VS Input Selection	This jumper connects the 5V pin of connector J2 to the UCS1002 V_S power input pins. It MUST be left out if external power supply is connected to J3.
J12	Current Limit	When UCS1002 in SMBus mode, this jumper selects the current limit.
J13	Current Limit Stand-Alone	This jumper selects the current limit. This is used when the device is in Stand-Alone mode.
J14	Active Low Address	Active Low Address Selection. See device data Sheet for details. Only one jumper between J14 and J17 can be selected at a time.
J15	V_{BUS} Output	This jumper connects the 5V pin of connector P1 to the UCS1002 V_{BUS} power output pins. It should be left off if power is to be drawn only from auxiliary power output connector P4.
J16	SMBus SDA	If the UCS1002 is in SMBus mode (as selected by using J12 instead of J13), then this jumper must be populated to connect the data line to the USB bridge IC. Otherwise, the jumper must be left out.
J17	Active High Address	Active High Address Selection. See device data sheet for details. Only one jumper between J14 and J17 can be selected at a time.
J18	SMBus SCL	If the UCS1002 is in SMBus mode (as selected by using J12 instead of J13), then this jumper must be populated to connect the data line to the USB bridge IC. Otherwise, the jumper must be left out.

2.5   DATA TEST POINTS ON THE EVALUATION BOARD

Figure 2-4 shows the top of the board and highlights the USB data line test points.
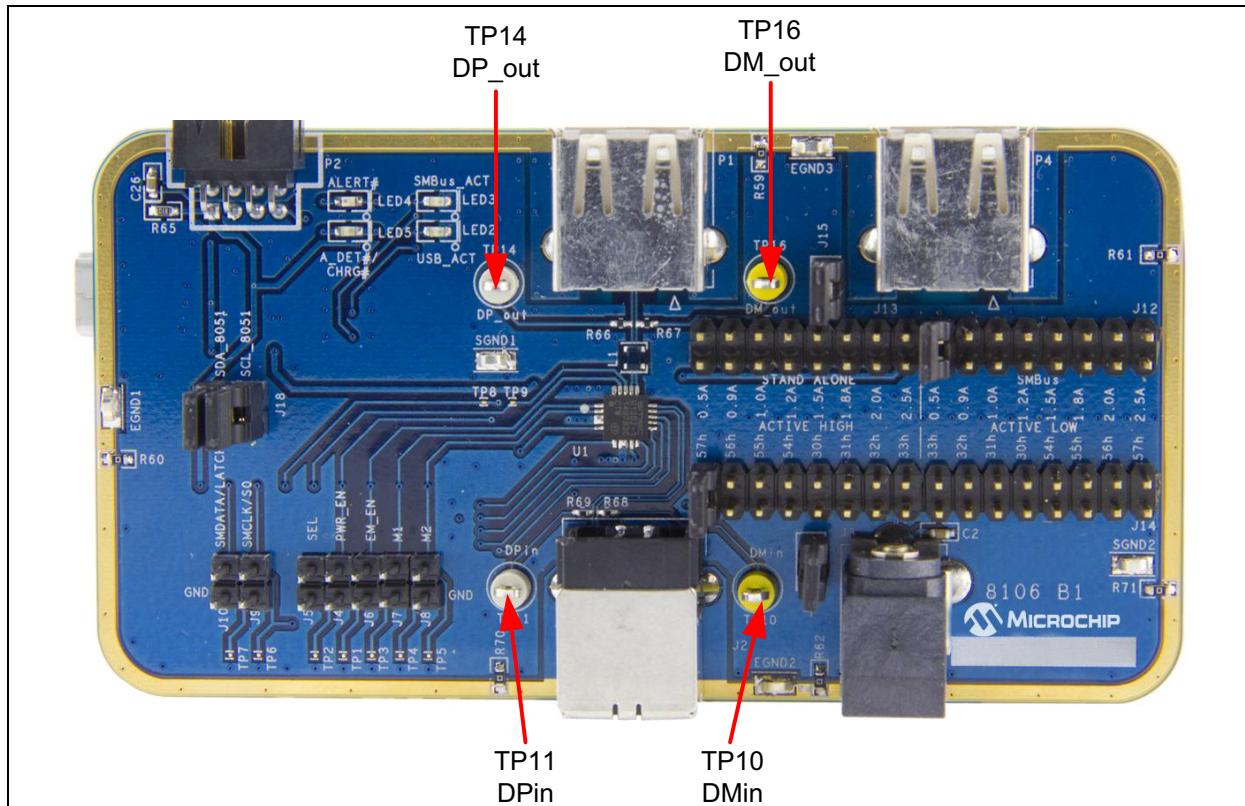
FIGURE 2-4:   Evaluation Board Top View - Data Test Points.

TABLE 2-4:

Designator	Assigned Pin	Description
TP10	DMin	This test point connects to the DMin data line through a 1 MΩ series resistor.
TP11	DPin	This test point connects to the DPin data line through a 1 MΩ series resistor.
TP14	DP_out	This test point connects to the DP_out data line through a 1 MΩ series resistor.
TP16	DM_out	This test point connects to the DM_out data line through a 1 MΩ series resistor.

2.6 GROUND TEST POINTS ON THE EVALUATION BOARD

Figure 2-5 shows the top of the board and highlights the ground test points.
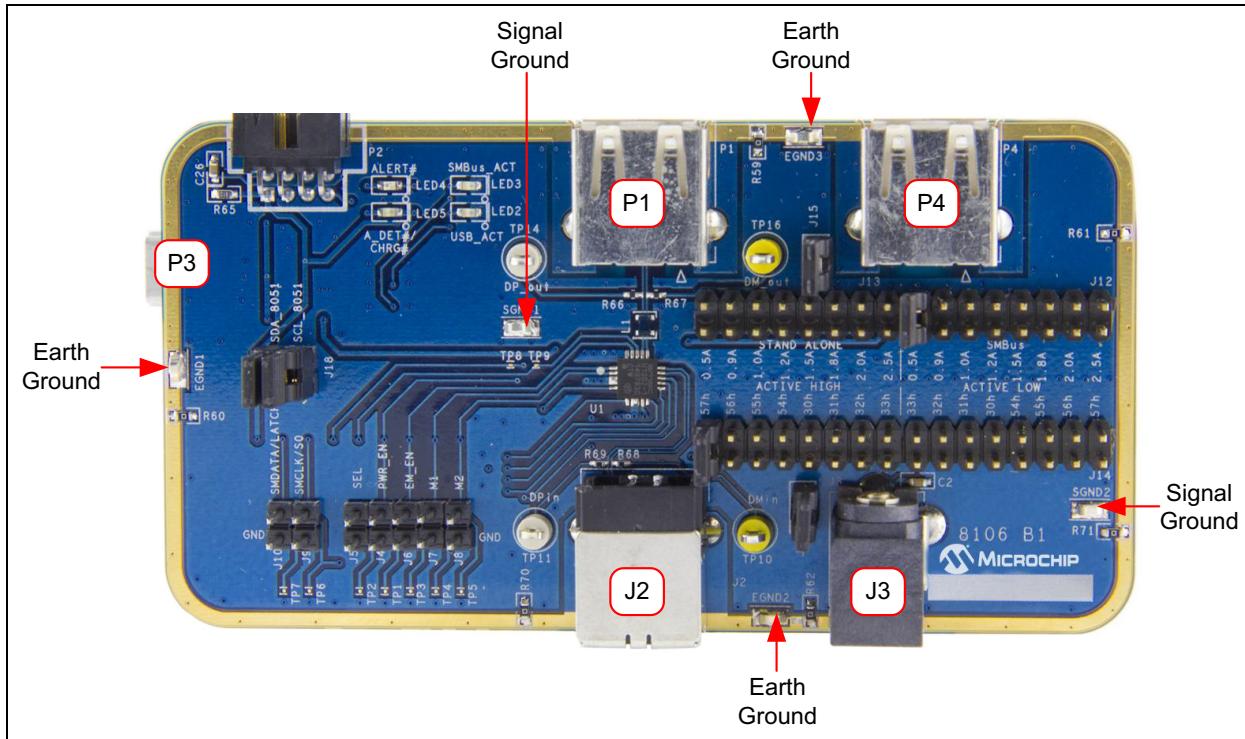
FIGURE 2-5: *Evaluation Board Top View - Ground Test Points.*

TABLE 2-5:

Designator	Test Point Type	Description
SGND1, SGND2	Signal Ground	These test points connect to the signal ground of the board. These are the ground reference for the UCS1002.
EGND1, EGND2, EGND3	Earth Ground	These test points connect to the earth ground of the board (the shield of the USB connectors).

2.7   SOFTWARE INSTALLATION

To begin using the UCS1002 Evaluation Board, software must be installed on a Windows®-based computer with a USB port.

1. Download the software archive from the board's web page, unzip it and double-click the `Setup.exe`, to start the installation. Figure 2-6 shows the initial installation screen, which displays briefly as the setup program loads.
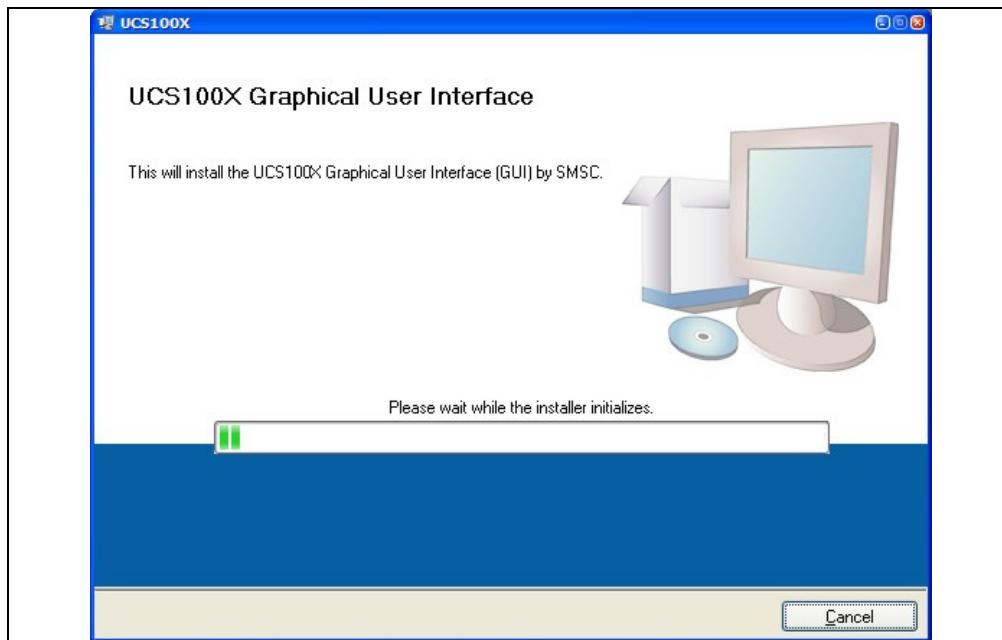
FIGURE 2-6:   *Software Installation – Initialize Window.*

2. Click **Next** in the Destination Directory window, as shown in Figure 2-7. For proper operation, the files must be installed in the default locations. The default location for the software files is `C:\Program Files\SMSC\UCS1002\`, while the default for the LabVIEW software is `C:\Program Files\National Instruments`.
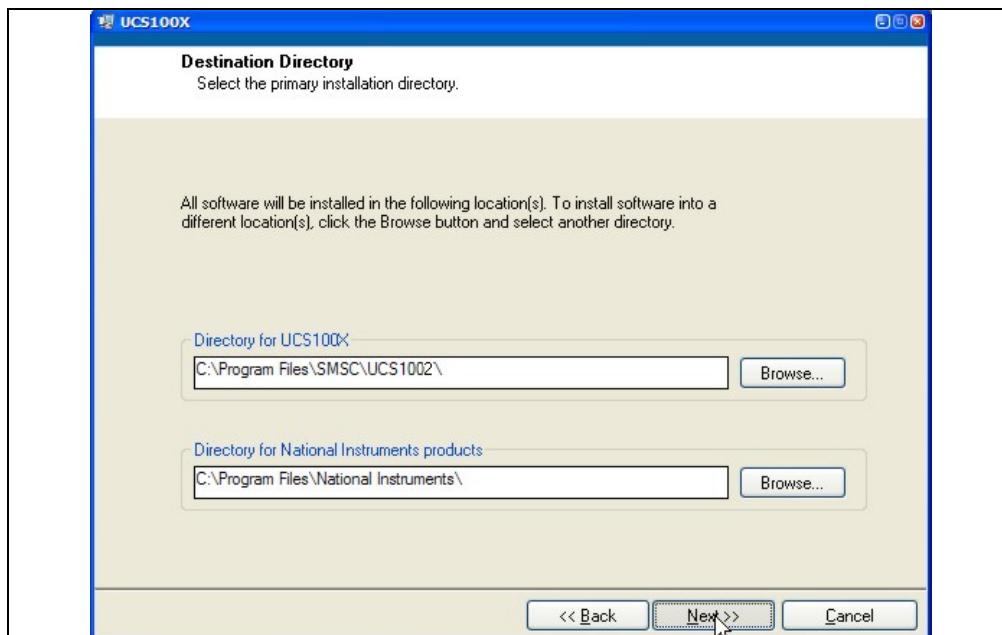
FIGURE 2-7:   *Software Installation – Setting the Destination Directory.*

3. Read and accept the license agreement, then click **Next**.
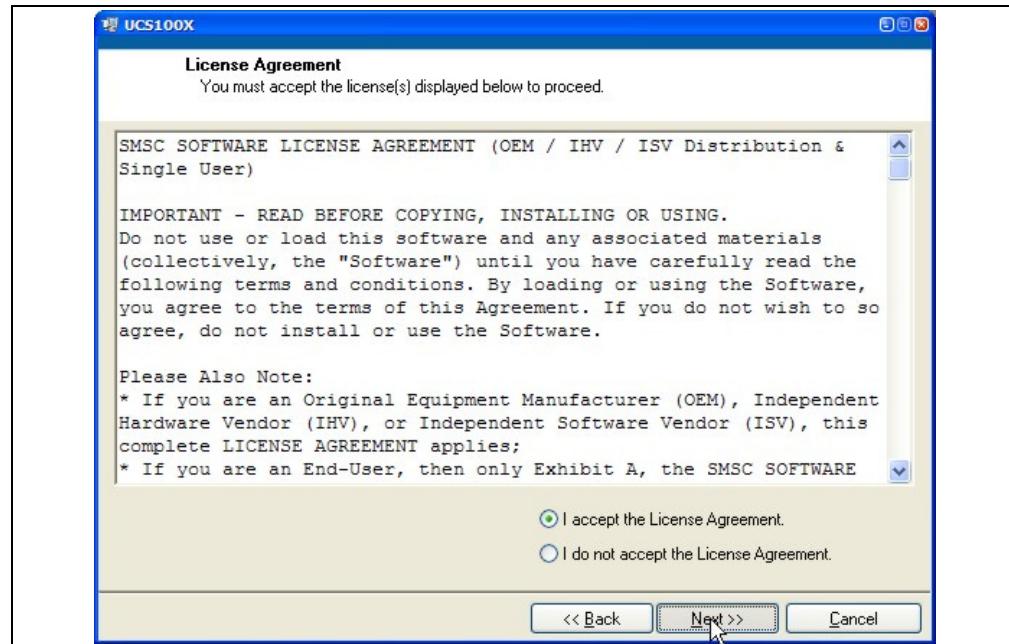
FIGURE 2-8: *Software Installation – Software License Agreement.*

4. To use the LabVIEW software, read and accept the license agreement, then click **Next**.
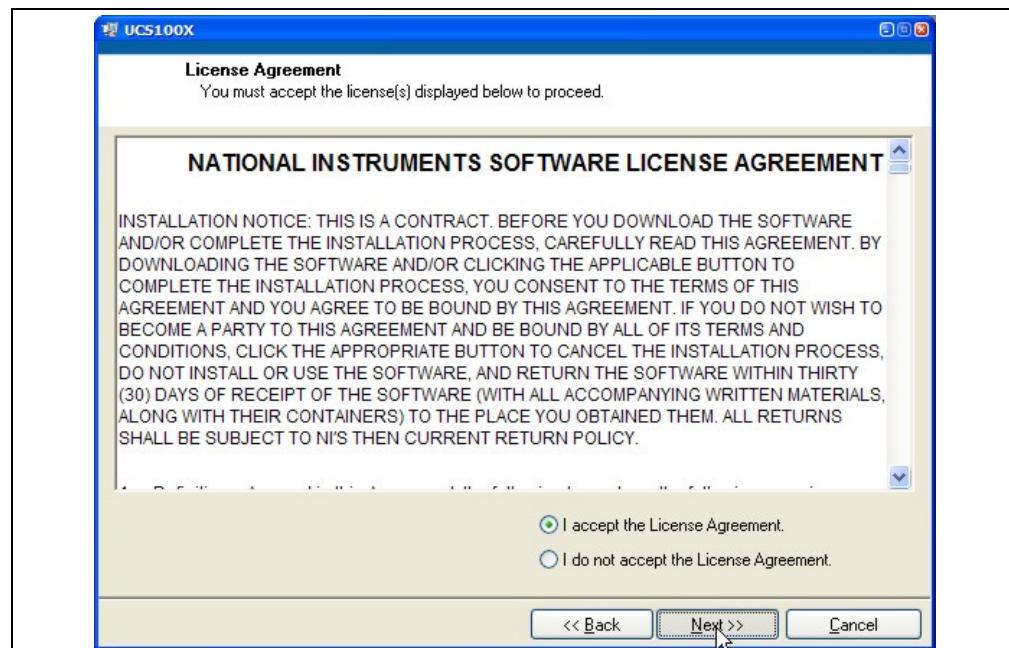
FIGURE 2-9: *Software Installation – LabVIEW License Agreement.*

On the next screens, hit **Next** and follow the on-screen instructions to complete the installation. When installation is complete, press **Finish**; the program will automatically run. If a screen appears requiring a restart for the changes to take effect, reboot your computer.

The UCS1002 interface will start with the SMBus communications.

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2.8 USB BRIDGE INSTALLATION

Connect the USB mini connector to the evaluation board and the standard USB connector to any available USB port on the PC. If the USB Bridge driver has not previously been installed on the selected USB port, the "Find New Hardware" wizard will pop up on the PC's screen. Follow the on-screen instructions to complete the installation process. The files will automatically be retrieved from the installation package. See Figures 2-10 through 2-14 for a step-by-step view of the installation.

> **Note:** If the installation of the driver is done on a Windows 7 PC, look for the `WIN7 Installation Note.pdf` that can be found in the Documentation folder included in the software installation package.

FIGURE 2-10:   *USB Bridge Driver Installation – Step 1.*
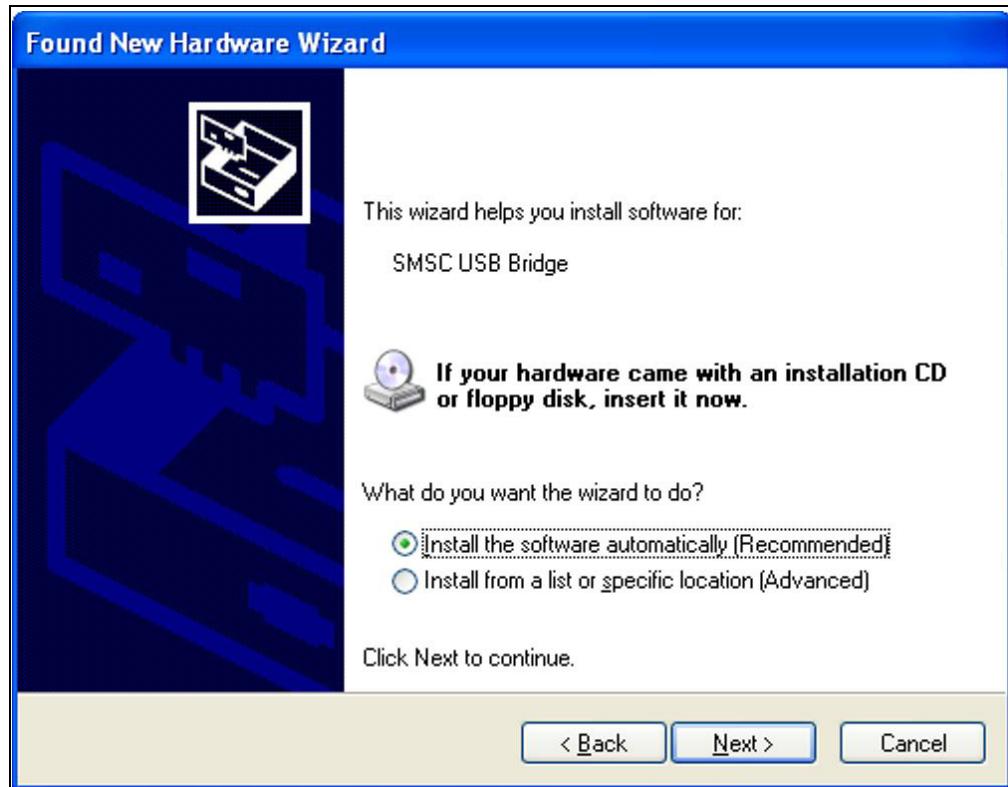
FIGURE 2-11:   *USB Bridge Driver Installation – Step 2.*
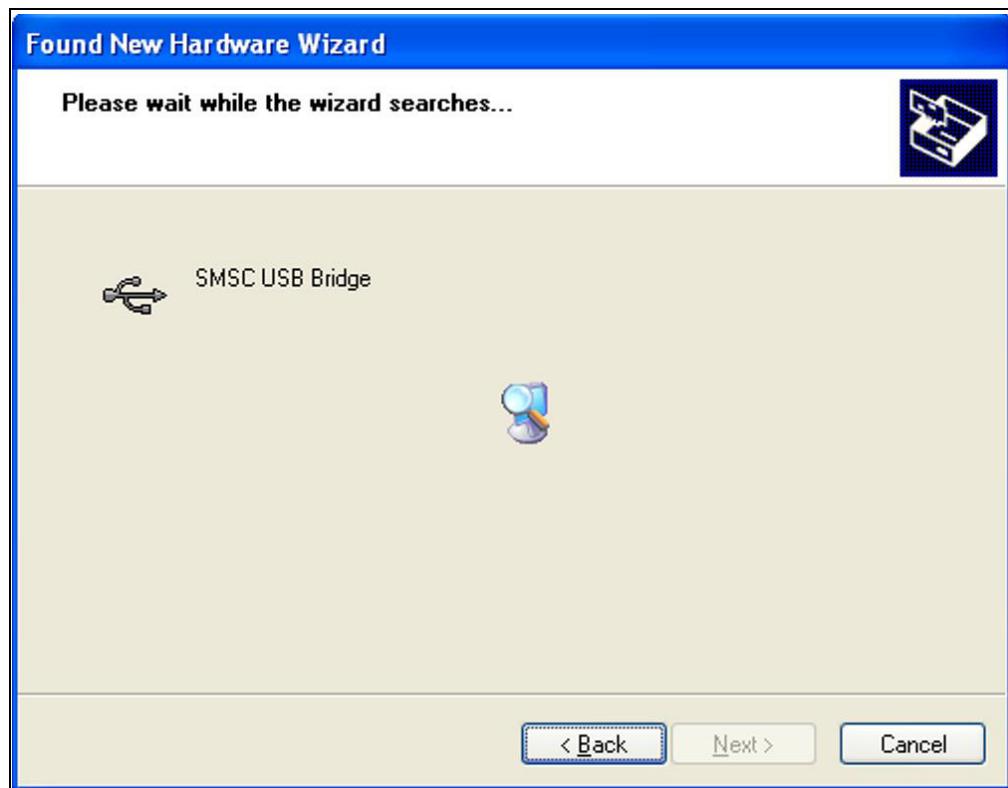
FIGURE 2-12:   *USB Bridge Driver Installation – Step 3.*

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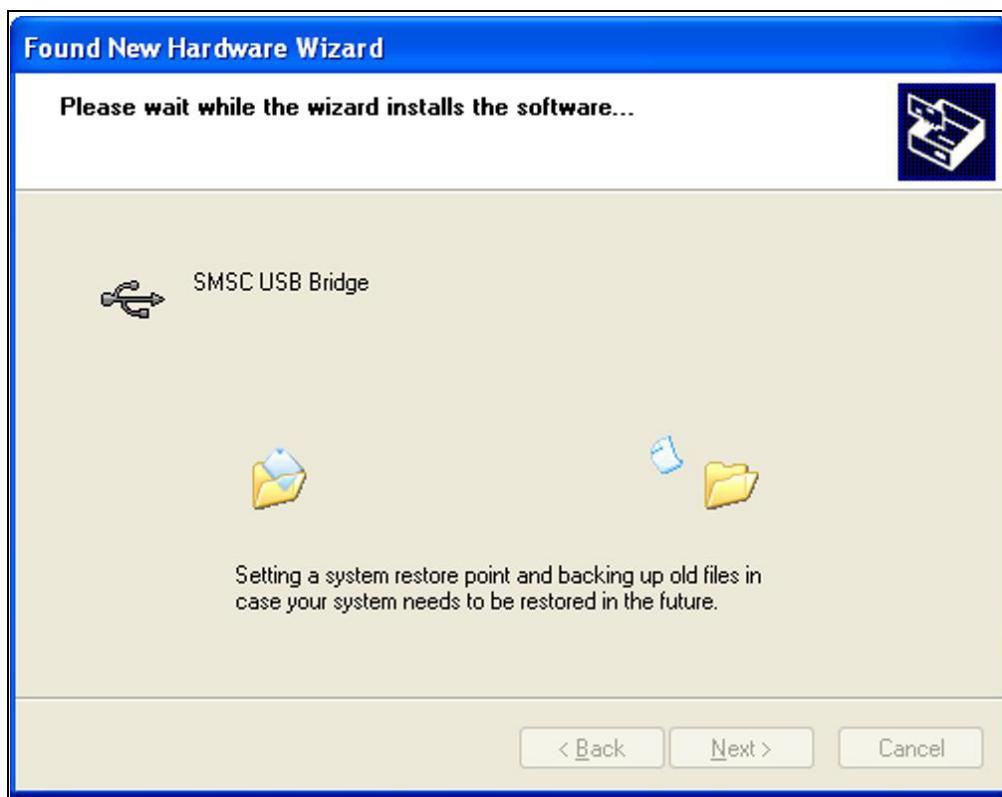
FIGURE 2-13:   USB Bridge Driver Installation – Step 4.
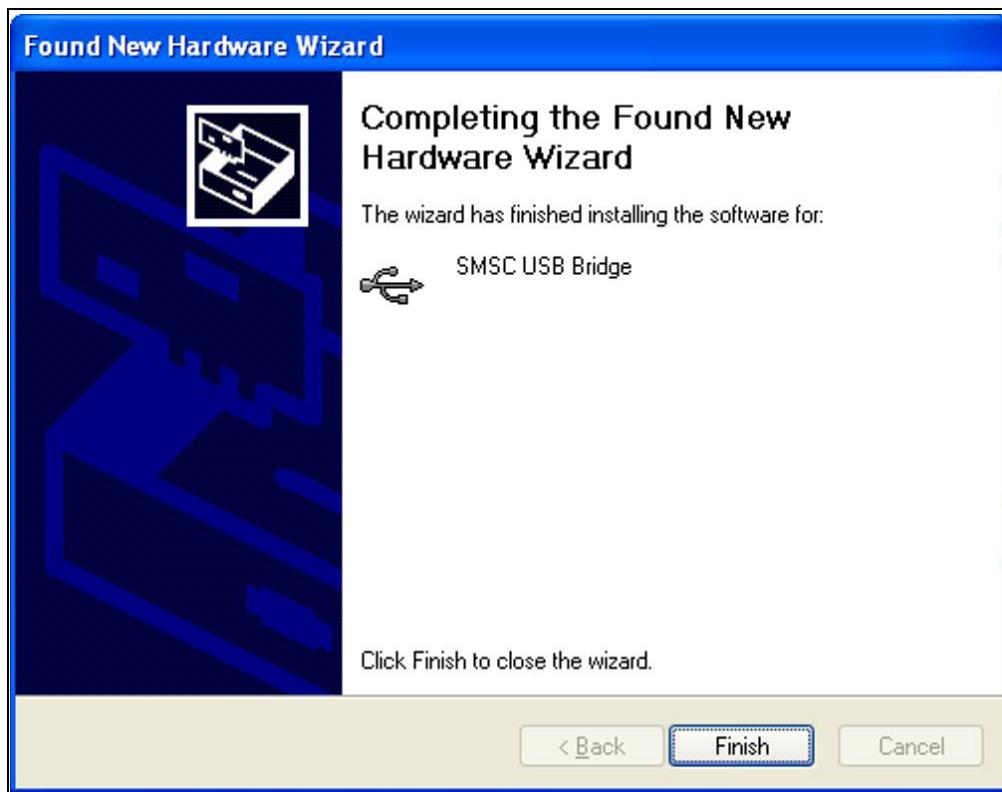
FIGURE 2-14:   USB Bridge Driver Installation – Step 5.

Chapter 3. Hardware Description

3.1 UCS1002 DEVICE

The UCS1002 device provides a single USB port power switch for precise control of up to 2.5A continuous current with overcurrent limiting, dynamic thermal management, latch/auto-recovery upon fault, selectable active low or high enable, undervoltage and overvoltage lockout, and back-drive protection.

USB Charging Port profiles are integrated into the UCS1002 to ensure compliance to multiple standards. In addition to power switching and USB Charging Port profiling, the UCS1002 provides automatic and configurable USB data line handshaking to enable charging of USB-IF Battery Charging 1.2 (CDP or DCP modes), Chinese Telecommunications Industry Standard YD/T 1591-2009, Apple® Inc., RIM® and many other mobile devices.

The UCS1002 provides a device attachment detection output, as well as a dedicated alert output, with current monitoring and charge rationing for controlled delivery of current regardless of a host's power state. When the limit is reached, the UCS1002 will perform the user programmed behavior (report and disconnect is the default).

3.2 EVALUATION BOARD POWER SOURCE

The UCS1002 Evaluation Board requires a single USB cable to operate. USB bus voltage is provided to the on-board indicator LEDs and the USB Bridge. This bridge regulates the +5V USB power to +3.3V used by the board's circuitry.

3.3 V_S 5V POWER SOURCE

A 5V power source is needed for V_S to charge the portable device. This can come from a PC USB port (limited to 500 mA) through a USB cable with a Standard-B plug end into the evaluation board, or from the 5V wall adapter provided (up to 2.5A).

3.4 USB-TO-SMBUS BRIDGE

The USB-to-SMBus bridge is based on an 8051 microcontroller with integrated USB-to-SMBus interfaces, as well as internal flash and RAM. During board manufacture, firmware is loaded into the bridge that provides the interface between the USB and the SMBus. Power is sourced to the microcontroller from the USB interface. To evaluate the UCS1002, the USB bridge is used to buffer the ALERT# and A_DET# outputs from the device.

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3.5   DIRECT SMBUS CONNECT OPTION

It is also possible to connect an external SMBus master to the UCS1002 Evaluation Board. Remove the jumpers on J16 and J18 and connect the SMBus master to Pin 1 of the appropriate header. The USB connection on P3 must remain attached to provide +3.3V for the chip and indicator LEDs. Note that ground must be connected to one of the test point grounds on the EVB. See Figure 3-1 for connector pins.
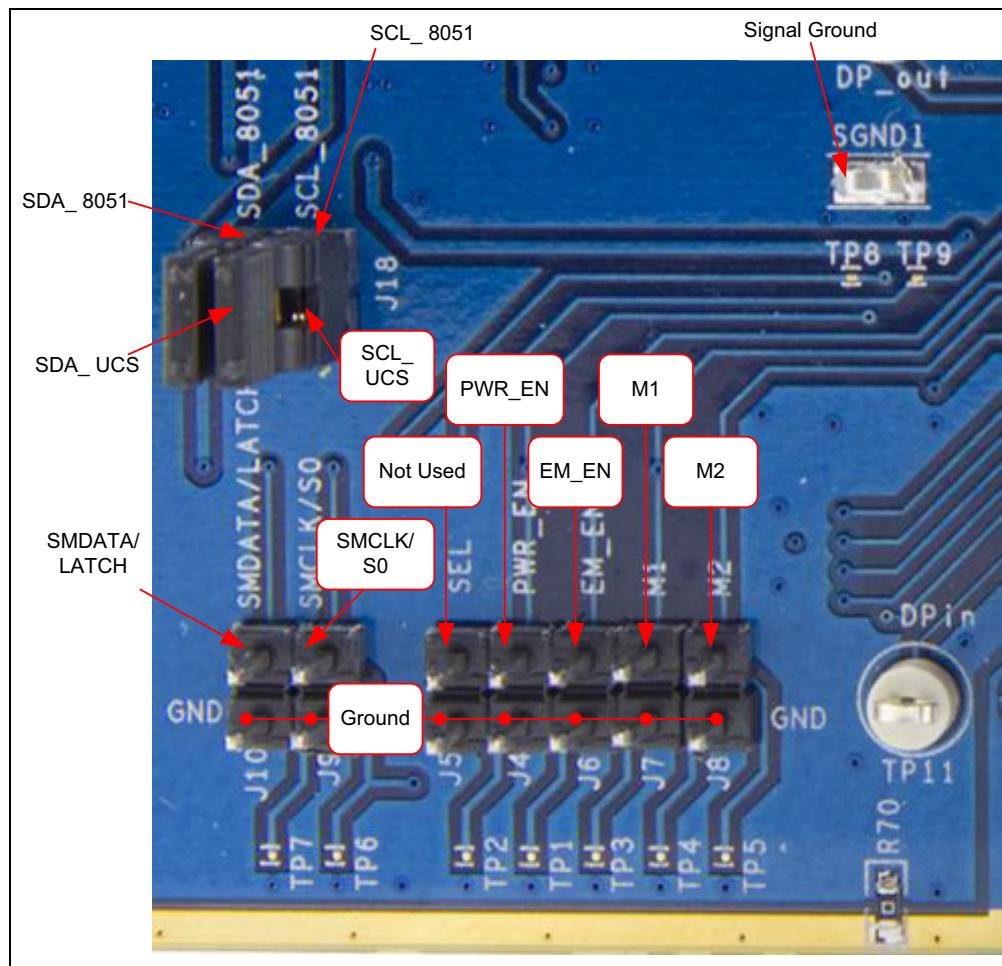
FIGURE 3-1:   *UCS1002-to-SMBus Bridge Jumpers.*

3.6   LED INDICATORS

The UCS1002 Evaluation Board has LED status indicators, as listed in Table 3-1.

TABLE 3-1:   LED STATUS INDICATORS

LED No.	Signal	OFF	GREEN	RED	YELLOW
2	USB Activity	No activity on USB port	N/A	N/A	Activity on USB port
3	SMBus Activity	No Activity within USB-SMBus bridge	N/A	N/A	Activity within USB-SMBus bridge
4	ALERT#	ALERT pin is not asserted	N/A	ALERT pin is asserted	N/A
5	A_DET#/CHRG#	No device attached	A device is detached	N/A	N/A

Hardware Description

3.7 JUMPER SETTINGS

The UCS1002 Evaluation Board has pin headers and jumper configurations to evaluate the features of the UCS1002, as listed in Table 3-2.

TABLE 3-2: JUMPER SETTINGS

Pin Header	Label	Default Position	Alternate position
J4	PWR_EN	No jumper = signal high	Jumpered = signal low
J5	N/A	N/A	N/A
J6	EM_EN	No jumper = signal high	Jumpered = signal low
J7	M1	Jumpered = signal low	No jumper = signal high
J8	M2	Jumpered = signal low	No jumper = signal high
J9	SMCLK/S0	Open for SMBus communications	See data sheet for standalone operation
J10	SMDATA/LATCH	Open for SMBus communications	See data sheet for standalone operation
J11	J11	No jumper = voltage input to power switch coming from auxiliary power input (J3)	Jumper = voltage input to power switch coming from host (J2)
J12	SMBus	Jumpered pins select the corresponding resistor which selects the I_{LIM} setting.	
J13	STAND ALONE	Applicable only in Stand-Alone mode. Jumpered pins select the corresponding resistor which selects the ILIM setting.	
J14	ACTIVE LOW	No jumper selected, see J17	Install 1 jumper (J14 or J17) to select an SMBus address
J15	J15	Jumper = voltage output from power switch going to the portable device (P1)	No jumper = voltage output from power switch going to auxiliary power output (J16)
J16	SDA_8051	Jumpered = SMBus via 8051	No jumper = external SMBus host
J17	ACTIVE HIGH	Jumper = 15-16 installed = address 57h	Install 1 jumper (J14 or J17) to select an SMBus address.
J18	SCL_8051	Jumpered = SMBus via 8051	No jumper = external SMBus host

3.8 TEST POINTS

The UCS1002 Evaluation Board provides test points for ground reference and signal access, as listed in Table 3-3.

TABLE 3-3: TEST POINTS

Test Point	Signal Function Monitored
1	PWR_EN
2	N/A
3	EM_EN
4	M1
5	M2
6	SMCLK/S0
7	SMDATA/LATCH
8	ALERT#
9	A_DET#/CHRG#
10	DMin
11	DPin
14	DP_out

TABLE 3-3: TEST POINTS (CONTINUED)

Test Point	Signal Function Monitored
16	DM_out
SGND1	Signal Ground
SGND2	Signal Ground
EGND1	Earth Ground
EGND2	Earth Ground
EGND3	Earth Ground

Chapter 4. Software Description

4.1 OVERVIEW

To get the graphical interface and the evaluation board running, follow these instructions:

1. Start the UCS1002 GUI software: from the Windows Start menu, select *Programs > SMSC > UCS1002*.

2. Connect the USB mini connector end of the cable to the board and the standard USB connector of the cable to any available USB port on the PC. The USB Activity LED should light, indicating that the board is getting power.

The UCS1002 Evaluation Board interface (Figure 4-1), consists of Five tabs (**Main**, **Configuration & General Status**, **Custom Charging**, **Register Set** and **Demo**) as well as the right side sections that are always visible (**Panel Controls**, **Pin State & Attach Status** and **Active Mode Selection**).
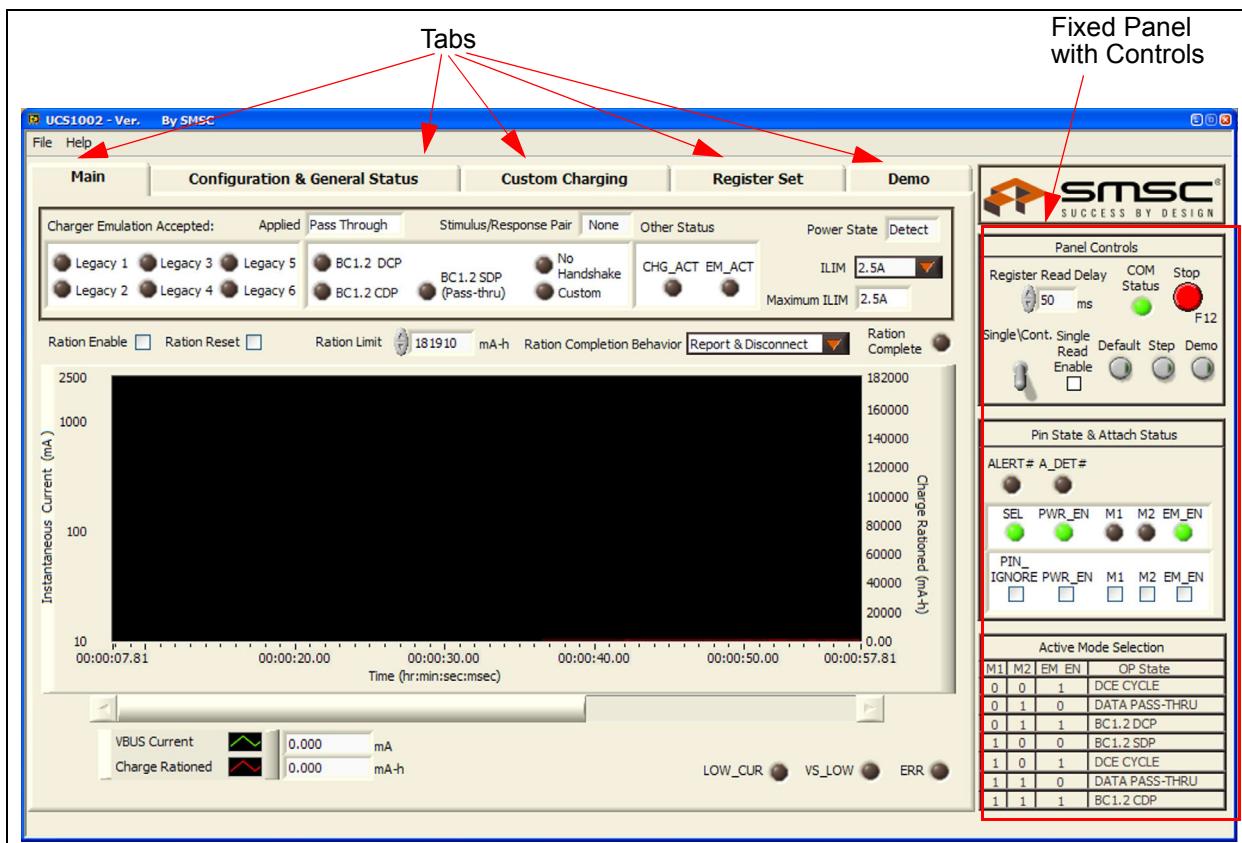
FIGURE 4-1:   *UCS1002 Evaluation Board Initial Window.*

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4.1.1 Tips for Using the EVB GUI

• For many controls on the GUI panel, placing the mouse cursor over a control will pop up context help that indicates the register address or gives a description. In addition, a context help window can be displayed by clicking the Help menu and then selecting Show Context Help. Display speed varies by system.

• After a power up of the evaluation board, the default settings are loaded. Users can save setting configurations to user-named files which can be reloaded at any time for quick reconfiguration (see **Section 4.3.4.4 "Configuration Save and Load"**).

• The GUI cannot be used to demonstrate UCS1002 behavior in Stand-Alone mode since SMBus communication is required.

4.1.2 GUI Abbreviations

Abbreviation	Description
BC	Battery Charging
CDP	Charging Downstream Port
DBP	Dead Battery Provision
DC	Dedicated Charger
DCE	Dedicated Charger Emulation
DCP	Dedicated Charging Port
EM	Emulation
EM_EN	Emulation Enable
M1	Mode Control Pin Number One
M2	Mode Control Pin Number Two

4.1.3 Keyboard Shortcuts

Some GUI controls have keyboard shortcuts, as shown in Table 4-1.

TABLE 4-1: UCS1002 EVALUATION BOARD GUI KEYBOARD SHORTCUTS

GUI Control	Shortcut	Control Description
Run	CTRL + R	**Section 4.2.1.1 "Stop and Run Buttons"**
Stop	F12	**Section 4.2.1.1 "Stop and Run Buttons"**

4.2   INTERFACE DESCRIPTION AND OPERATION

4.2.1   Panel Controls

The Panel Controls section on the right side of the GUI, shown in Figure 4-2, affects GUI operation. This section is always displayed.
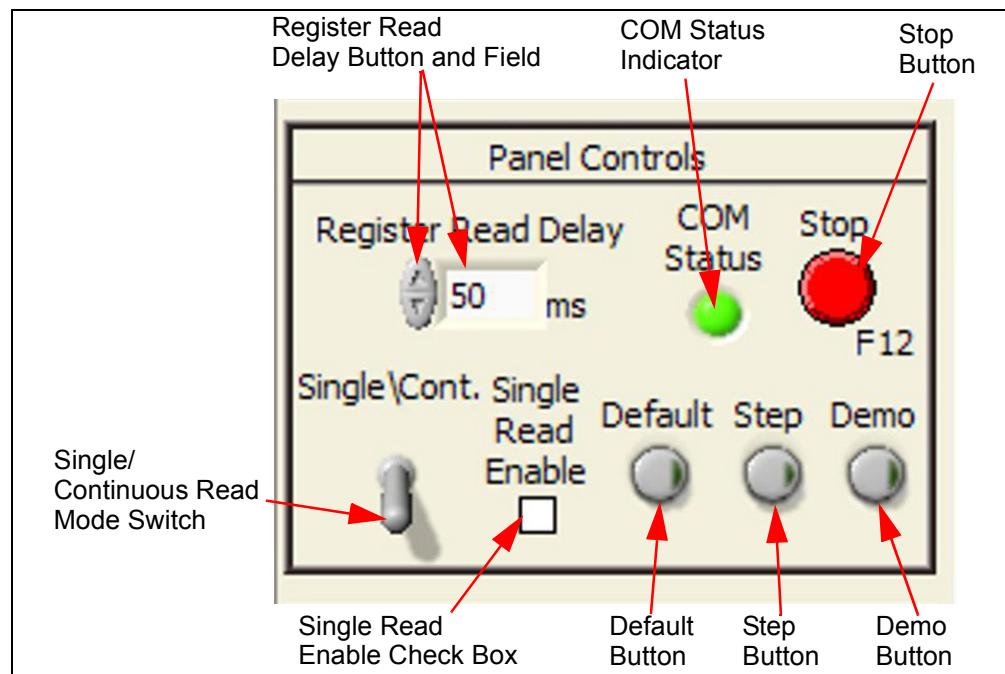
FIGURE 4-2:   Panel Controls.

4.2.1.1   STOP AND RUN BUTTONS

Pressing the **Stop** button, shown in Figure 4-2, interrupts GUI software communication with the evaluation board. When this button is clicked, the **Run** button appears under an extended menu bar, as shown in Figure 4-3.
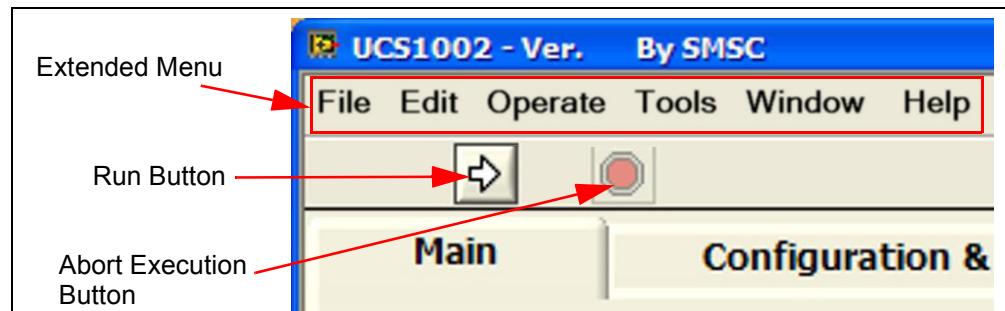
FIGURE 4-3:   Stop and Run Button.

4.2.1.2   RUN BUTTON

To restart communications between the software and the evaluation board, click the **Run** button. This button disappears when communication resumes.

> **Note:**   Stopping and restarting the GUI do not affect register settings. To restore default register settings, disconnect power from the board, then reconnect power.

To close the program, press the **Close** (**X**) button on the upper right corner of the window.

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4.2.1.3   COM STATUS INDICATOR

The **COM Status** indicator shows the status of communications over the SMBus. During normal operation, COM Status is green. If SMBus communications fail, COM Status turns red (or alternates red and green).

4.2.1.4   REGISTER READ DELAY

The **Register Read Delay** sets the GUI control panel update speed. It affects the speed that the software reads the registers, but will not affect the device's sampling time. The default is 50 ms. This number can range from 0 to 5000 ms in increments of 25 ms.

4.2.1.5   SINGLE/CONTINUOUS READ

The panel defaults to continuous register reads (toggle switch in down position, as shown in Figure 4-2). To stop continuous register reads, check the "Single Read Enable" box. In order to capture the register values at a given time, click the switch, which will briefly flip to Single Read.

4.2.1.6   DEFAULT

When this button is pressed, it loads the defaults to all registers of the UCS1002.

4.2.1.7   STEP

When selected, **Step** will go through the Emulation Profiles in sequence, from Legacy 1 through 6, then BC1.2 DCP, and finally Custom. The actual DCE cycle is slightly different. For more information, see product's data sheet.

4.2.1.8   DEMO

The **Demo** button enables an automated routine to cycle through a user-defined set of profiles and selects the highest current profile. This feature emulates an external controller and is not part of the UCS1002 device.

4.2.2   Pin State and Attach Status Panel

The Pin State & Attach Status section on the right side of the GUI, shown in Figure 4-4, provides a quick graphical status reference and allows physical control pin override. This section is always displayed.
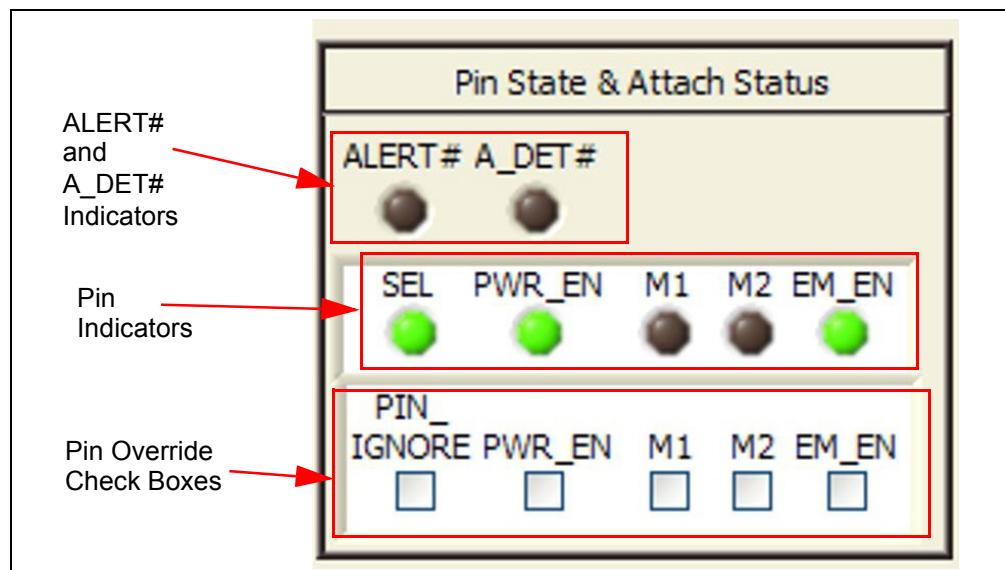
FIGURE 4-4:   *Pin State and Attach Status.*

4.2.3 Pin State & Attach Status Panel

4.2.3.1 ALERT# AND A_DET# INDICATORS

When the ALERT# and A_DET# indicators are green, the signals at the device's respective pin are low and the corresponding condition has occurred (alert or device attached, respectively). When the indicators are dark, the pin states are high.

4.2.3.2 PIN INDICATORS

The pin indicators (SEL, PWR_EN, M1, M2 and EM_EN) shown in Figure 4-4 are green if the signal on the corresponding pin on the UCS1002 device is high, and dark if the signal is low. If the "Pin Ignore" box is checked (see **Section 4.2.3.3 "Pin Override"**), these indicators will reflect the GUI overrides for these pins.

4.2.3.3 PIN OVERRIDE

For evaluation convenience, the GUI can override the setting of the following pins on the UCS1002 device: PWR_EN, M1, M2 and EM_EN. Check the "Pin Ignore" box (see Figure 4-4) to enable pin override. Then, check in the corresponding pin box to set the value high.

Note 1: Pin override does not affect the actual signal on the pin. It only affects the register values.

2: The SEL pin is only read once by the UCS1002 at power up, so there is no pin override for it. To close the port power switch, the PWR_EN state must match the SEL state (e.g., SEL = high and PWR_EN = high).

4.2.4 Active Mode Selection

The Active Mode Selection section on the right side of the GUI, shown in Figure 4-5, provides a quick reference regarding operating state based on the values of M1, M2 and EM_EN. This section is always displayed.

Active Mode Selection			
M1	M2	EM_EN	OP State
0	0	1	DCE CYCLE
0	1	0	DATA PASS-THRU
0	1	1	BC1.2 DCP
1	0	0	BC1.2 SDP
1	0	1	DCE CYCLE
1	1	0	DATA PASS-THRU
1	1	1	BC1.2 CDP

FIGURE 4-5:   *Charger Emulation Selection.*

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4.3   TABS DESCRIPTION

4.3.1   Main Tab

The **Main** tab (Figure 4-6) shows key parameters related to the port power switch, including the maximum current limit, the present current limit (always equal to or less than maximum current limit), and power state (e.g. detect, active, error, etc.). When a portable device has been successfully attached, the screen shows the power state change from Detect to Active and shows the various handshakes applied. Once it is determined that the device is charging, the screen shows which emulation profile was successful, and the graph shows the charging current. Optionally, the user may monitor the charge delivered or ration the charge delivered to the attached device.
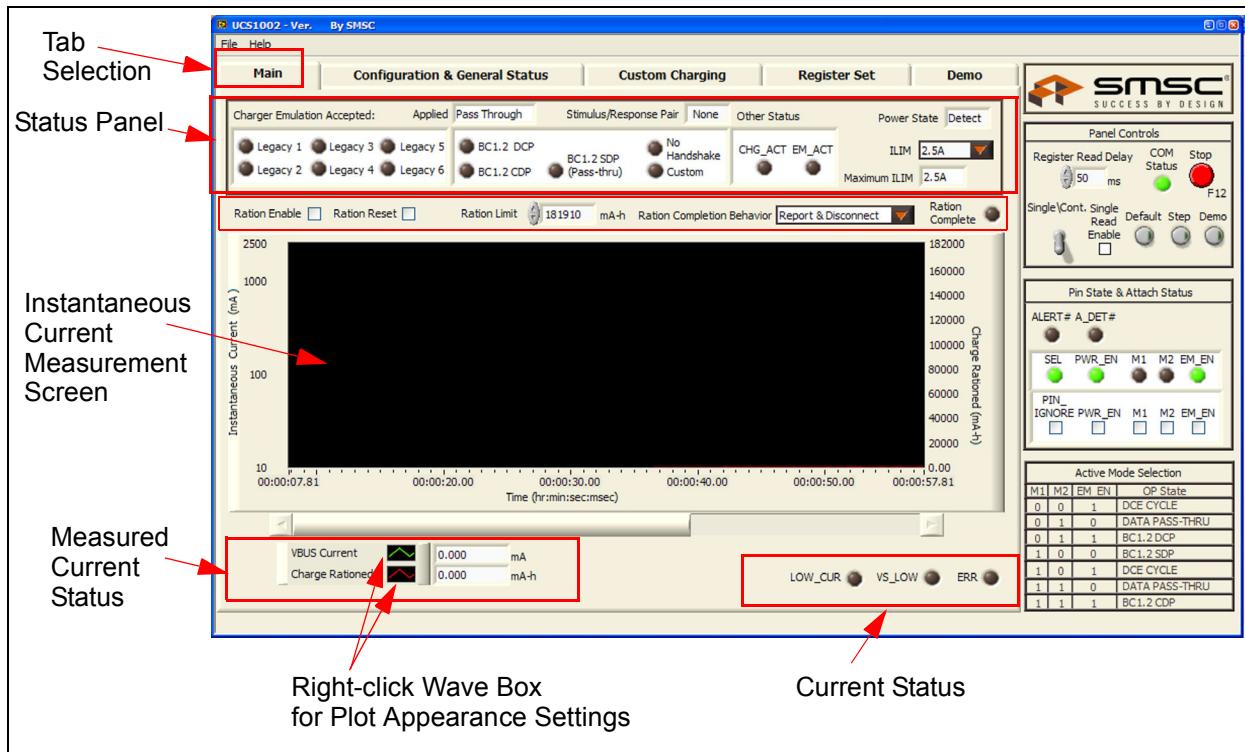
FIGURE 4-6:   *Main Tab Window Overview.*

4.3.1.1   DEDICATED CHARGER EMULATION (DCE) CYCLE

As shipped, the UCS1002 is ready to function as a dedicated charger, which will be applied when there is an attach detection. To view this behavior, perform the following:

1. Connect V_S to the evaluation board (see **Section 3.7 "Jumper Settings"**). The VS_LOW indicator on the bottom of the **Main** Tab must be dark. If the color is red, the voltage is not high enough to charge a portable device.
2. Connect a portable device to the board. Use the OEM USB charging cable that comes with the portable device.
3. The UCS1002 should detect an attachment, switch to the Active Power state, apply an emulation profile and deliver a charge. Figure 4-7 shows the interface after charging has started.
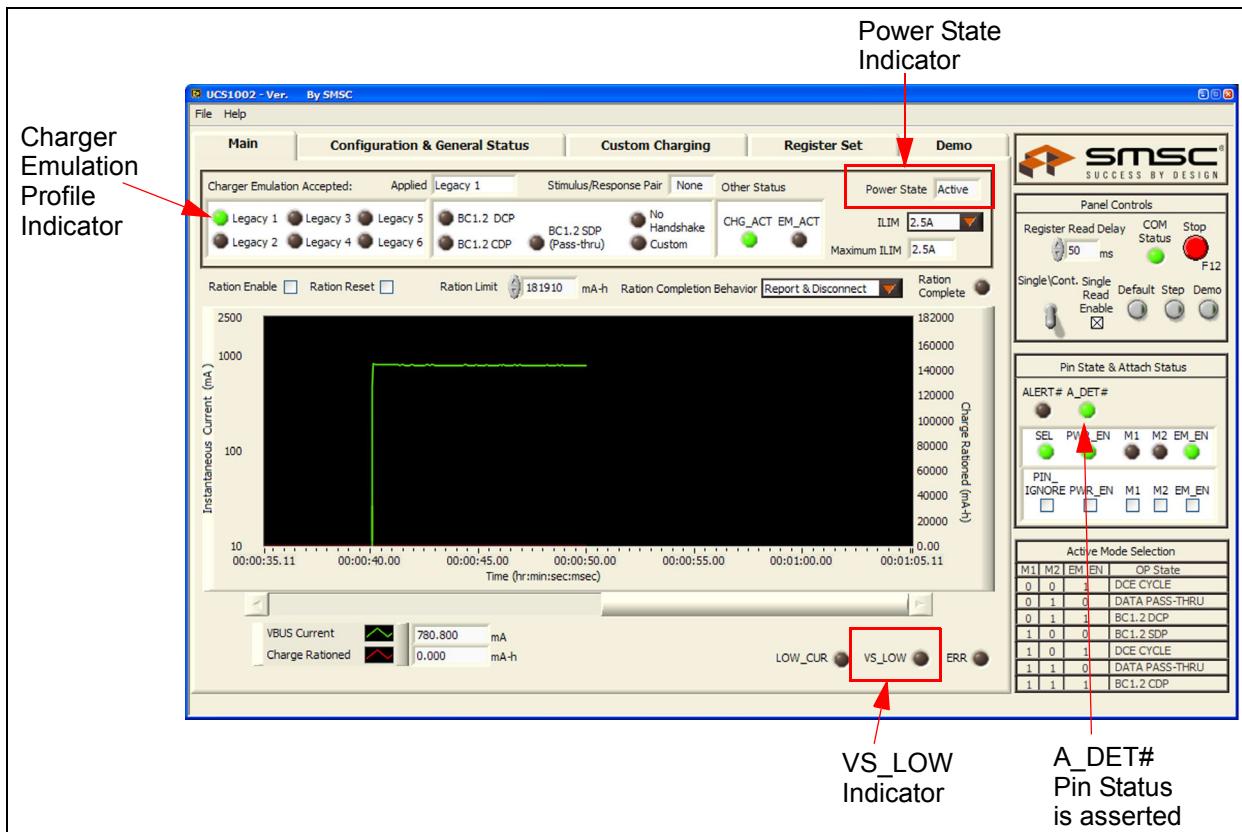
FIGURE 4-7: *Main Tab - Charging Started.*

4. Disconnect the portable device from the board.

The UCS1002 should detect a removal, switch to the Detect power state and stop delivering a charge. Figure 4-8 shows the interface after a removal was detected.
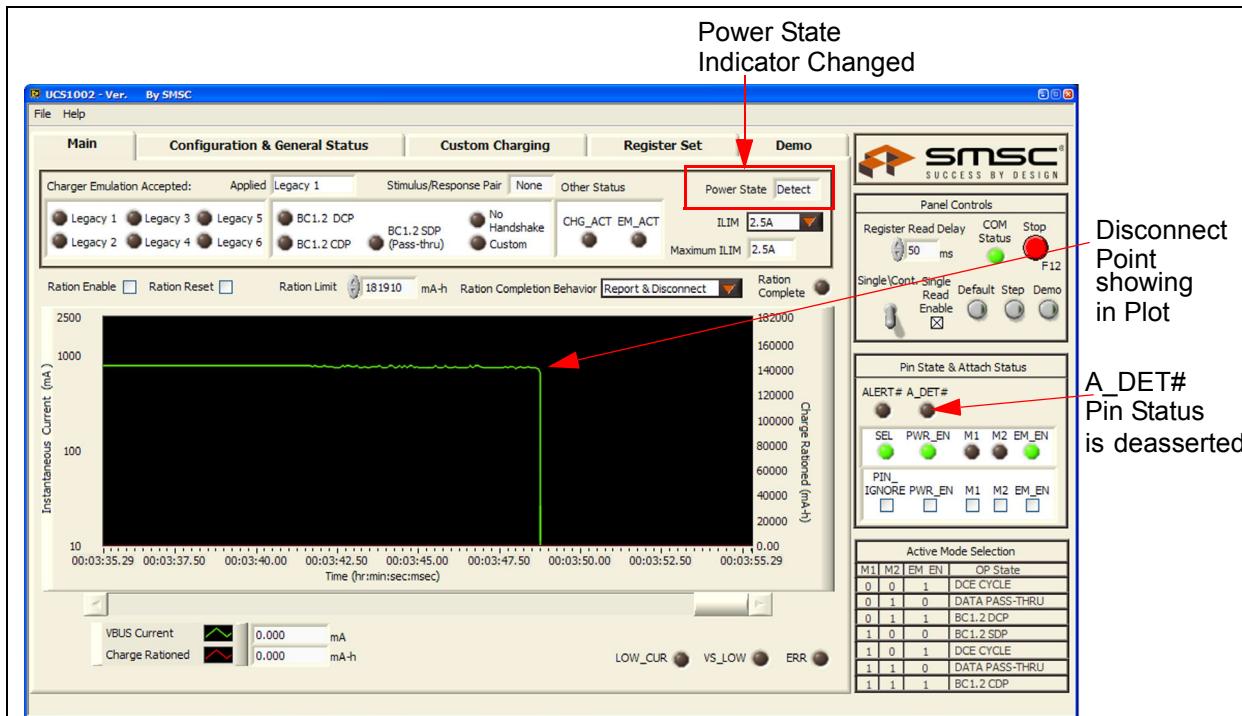
FIGURE 4-8: *Main Tab - Removal Detected.*

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4.3.1.2 CHARGING DOWNSTREAM PORT (CDP)

The CDP charging profile is based on the "*USB Battery Charging Specification v1.x*". When a BC1.x-compliant portable device attachment is detected, the UCS1002 and the portable device do handshaking based on the standard. If handshaking is successful, charging occurs up to the set current limit.

To select the CDP port power profile, M1, M2 and EM_EN must all be high. This can be done by removing the jumpers for these pins (J7, J8 and J6 respectively) or by using the pin override in the GUI (see **Section 4.2.3.3 "Pin Override"**).

4.3.1.3 PASS-THROUGH

Data Pass-Through does not apply any type of charger emulation. When selected, it closes the USB high-speed data switch and supplies current up to the current limit.

To select Data Pass-Through, M1, M2 and EM_EN can be set to any one of the two DATA PASS-THRU combinations (`010` and `110`), as shown in Figure 4-9. This can be done by setting the jumpers for these pins (J7, J8, and J6 respectively - see **Section 3.7 "Jumper Settings"**) or by using the pin override in the GUI (see **Section 4.2.3.3 "Pin Override"**).

FIGURE 4-9:   *Data Pass-Through Selection Options.*

4.3.1.4 CURRENT MONITORING AND CHARGE RATIONING

To view current monitoring and current rationing, perform the following on the **Main** tab:

1. Set a Ration Limit. The ration limit is expressed in mAh (electric charge).
2. Set rationing behavior. The Ration Completion Behavior defaults to "Report & Disconnect". Once the ration limit is reached, portable device charging will cease, the ALERT# pin will assert and the `Ration Complete` bit will be set. If you do not want the system to behave in this fashion, select one of the other three options from the Ration Completion Behavior drop-down list: Report, Report & Sleep or Take No Action.
3. Connect V_S to the evaluation board (see **Section 3.7 "Jumper Settings"**). The VS_LOW indicator on the bottom of the **Main** tab must be dark. If the VS_LOW indicator is red, the voltage is not high enough to charge a portable device.
4. Connect a portable device to the evaluation board. Use the OEM USB charging cable that comes with the portable device.
5. Enable rationing by checking the Ration Enable check box on the **Main** tab.
6. Watch the GUI as the device starts charging. Figure 4-10 shows the interface after the ration limit was reached (for "Report & Disconnect" behavior setting).

> **Note:** As shown in Figure 4-10, the green trace is the instantaneous current, while the red diagonal line is the charge being delivered in mAh. Both are also presented in numeric format in the bottom left boxes. Trace color and characteristics can be changed by clicking on the waveform boxes to the left of these numerical values.
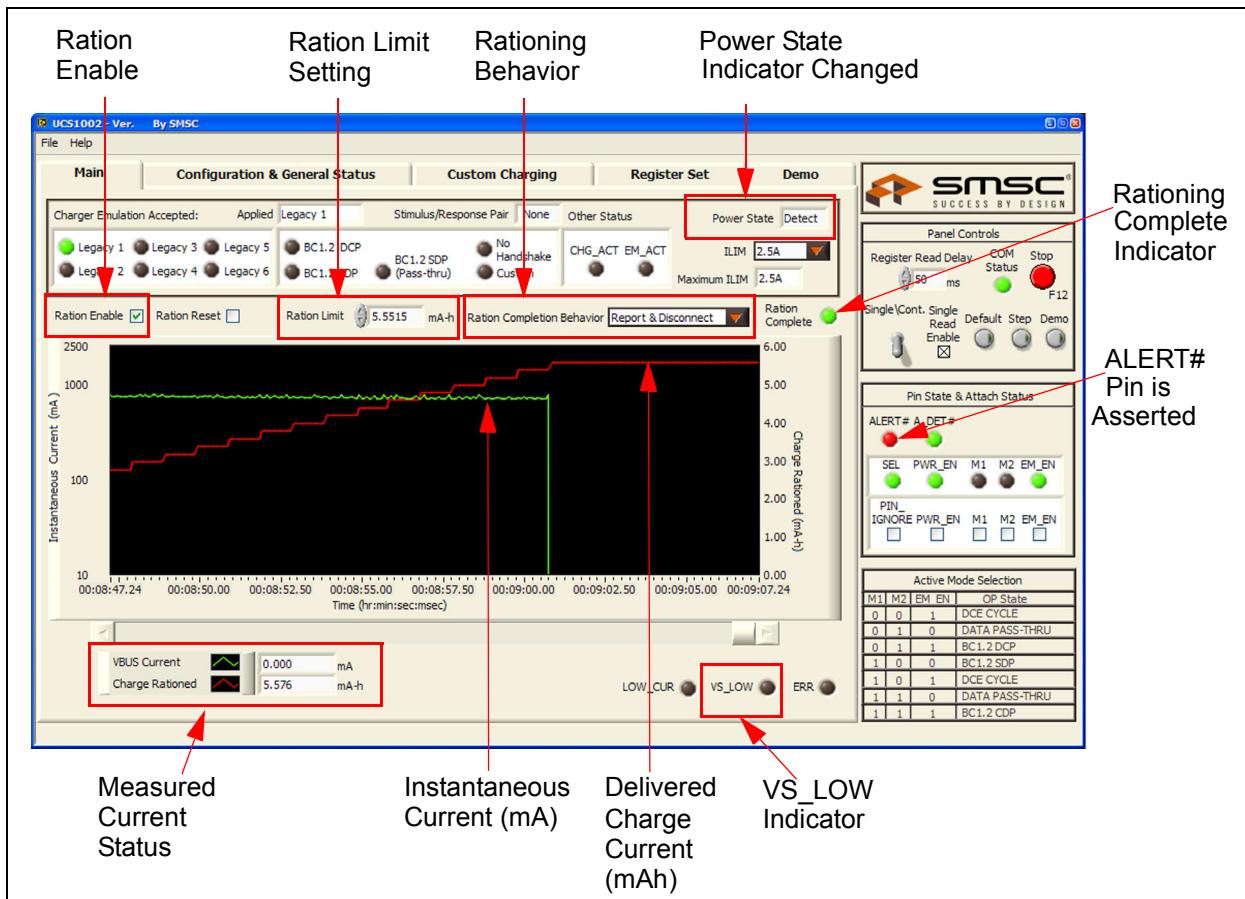
FIGURE 4-10: *Main Tab - Ration Limit Reached.*

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4.3.2 Configuration and General Status Tab

The **Configuration & General Status** tab (Figure 4-11) includes various status indicators and configuration controls. Items are grouped by function, detailed in the following sections.
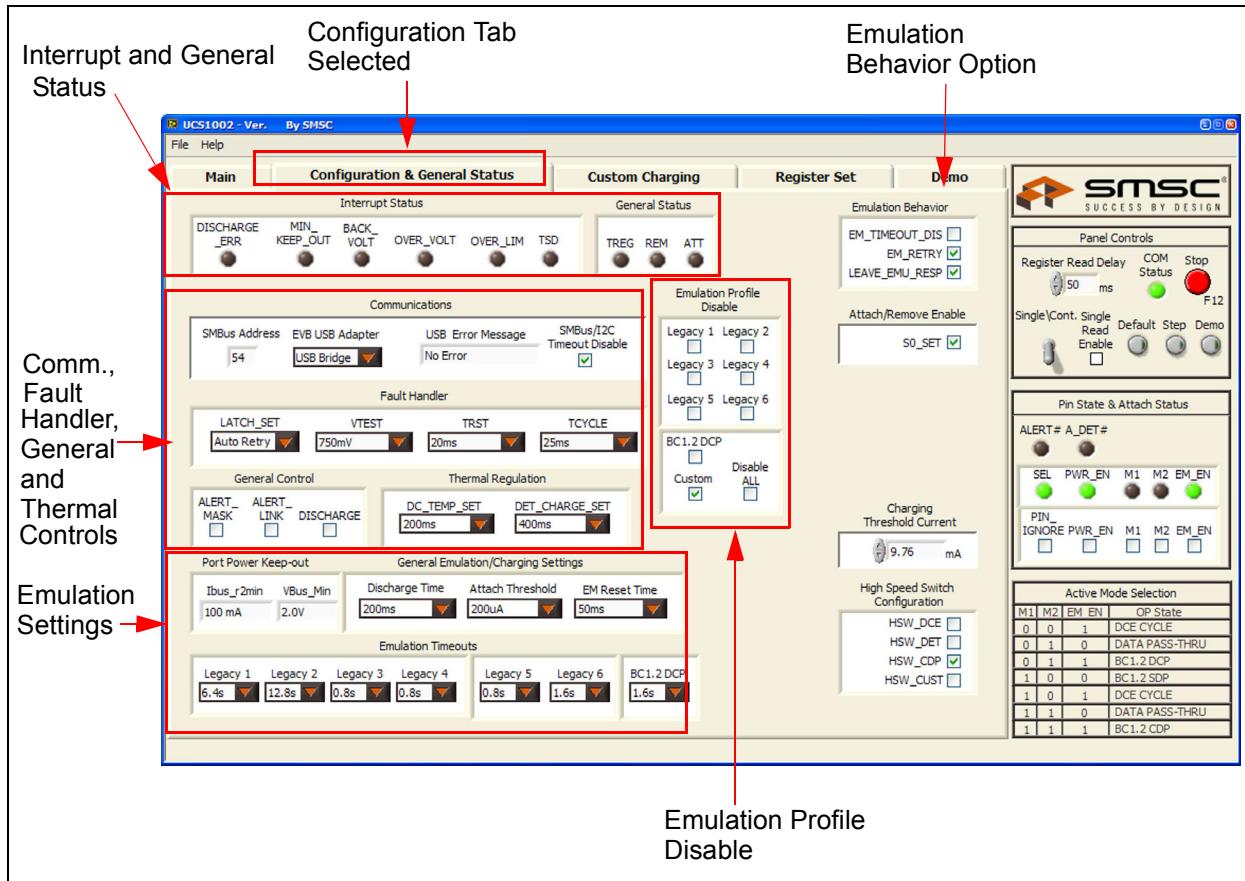
FIGURE 4-11: *Configuration & General Status Tab.*

4.3.2.1 INTERRUPT STATUS

The indicators in the Interrupt Status section turn green when the corresponding bit is high and are dark when the bit is low.

4.3.2.2 GENERAL STATUS

Indicators in the General Status section turn green when the corresponding bit is high and are dark when the bit is low.

4.3.2.3 EMULATION BEHAVIOR

Check the necessary check box to enable the corresponding emulation behavior.

4.3.2.4 COMMUNICATIONS

Controls related to SMBus and USB communications.

4.3.2.5 EMULATION PROFILE DISABLE

Check the Profiles boxes to disable them. They will not be used during emulation. Selecting "Disable ALL" will toggle all profile check boxes.

4.3.2.6   ATTACH/REMOVE ENABLE

Click the S0_SET box to remove the check mark and disable the function.

4.3.2.7   FAULT HANDLER

These are controls related to fault handling.

4.3.2.8   GENERAL CONTROL

Controls for general parameters.

4.3.2.9   THERMAL REGULATION

Controls for thermal and detection delay parameters.

4.3.2.10   PORT POWER KEEP-OUT

Displays values for the port power parameters.

4.3.2.11   GENERAL EMULATION/CHARGING SETTINGS

Controls for emulation and charging.

4.3.2.12   EMULATION TIMEOUTS

Sets the emulation timeout period for each profile. These timeout periods are not used if the EM_TIMEOUT_DIS control in the Emulation Behavior section is checked.

4.3.2.13   CHARGING THRESHOLD CURRENT

Controls charging threshold current setting.

4.3.2.14   HIGH SPEED SWITCH CONFIGURATION

Controls the high-speed switch parameters.

4.3.3   Custom Charging Tab

The **Custom Charging** tab (Figure 4-12) provides the means for users to create custom charger emulator configurations. These configurations include signaling on the USB data lines, as well as what method of current limiting to employ (Constant Current or Trip). For more information, refer to the UCS1002 Data Sheet and AN24.14 - *"UCS1002 Fundamentals of Custom Charger Emulation"* (DS20005234).
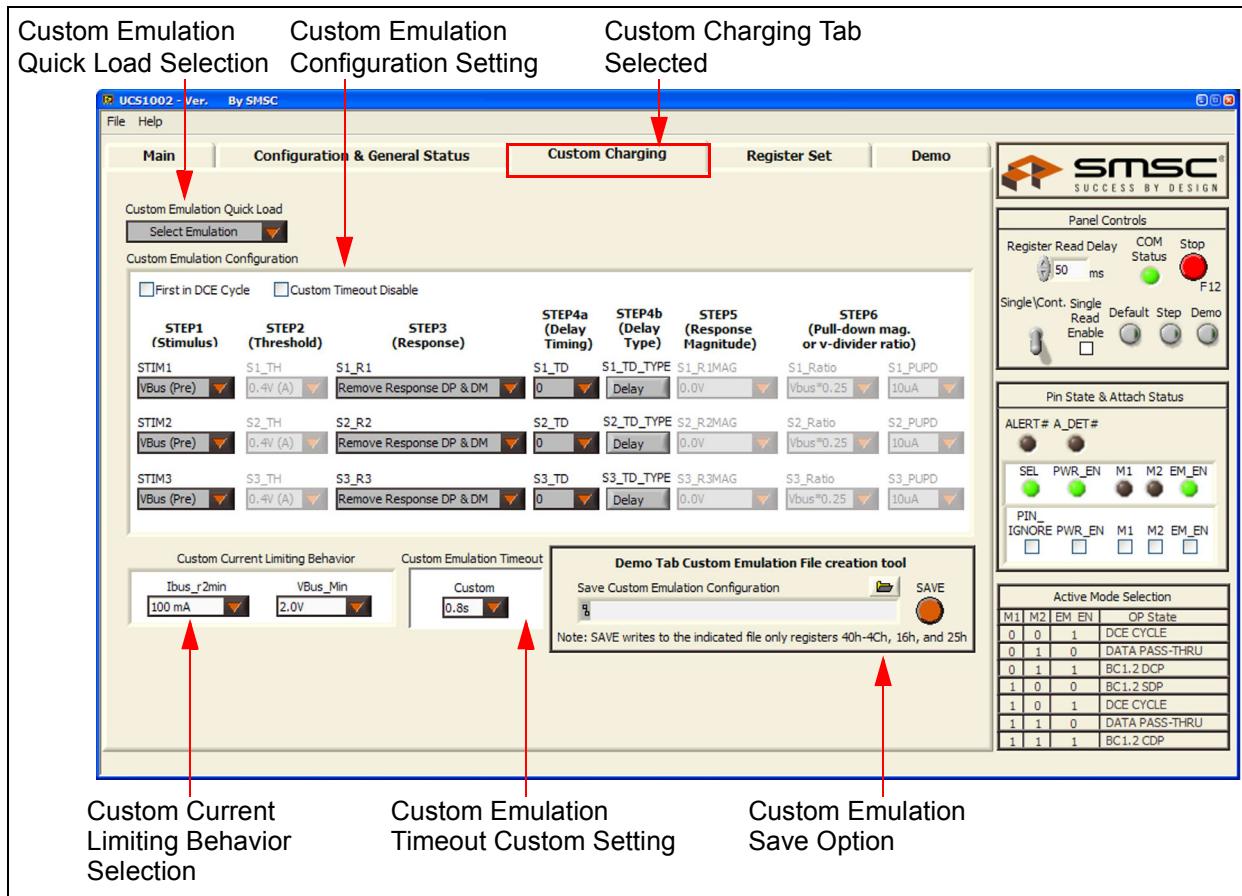
FIGURE 4-12:   Custom Charging Tab.

4.3.3.1   CUSTOM EMULATION CONFIGURATION

Creating a custom emulation profile is a two-part process of entering the appropriate stimulus-response pairs in the provided fields, as well as the desired current limiting behavior (after emulation is applied and the portable device starts to draw current).

4.3.3.1.1   Example

Settings shown in Figure 4-12 will apply the Legacy 1 stimulus pair. This includes a voltage divider on DP and on DM with the values shown in the STEP 5 column.

If the portable device draws bus current greater than the charging threshold being used, it will always operate in Current Limiting Trip mode (with trip point based on the current limit setting).

4.3.3.2   CUSTOM CURRENT LIMITING BEHAVIOR

The second part of creating custom profiles is to specify the behavior of current limiting and minimum voltage output. This is accomplished using the Ibus_r2min and Vbus_Min drop-down lists, as shown in Figure 4-13.
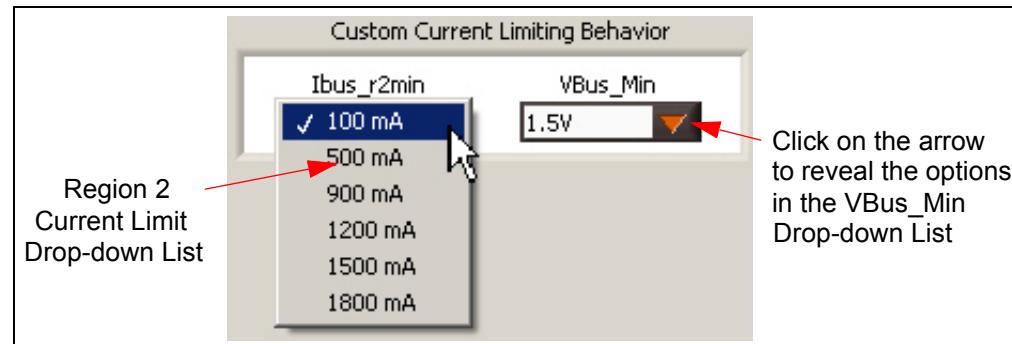
FIGURE 4-13:   *Current-Voltage Behavior Selection.*

4.3.3.3   CUSTOM EMULATION QUICK LOAD

The Custom Emulation Quick Load drop-down menu allows single-click loading of the Custom Emulation Configuration registers. Simply select the profile to load from the menu and registers 41h – 4Ch will be loaded with that profile. Emulation Timeout will also be loaded based on the settings of the corresponding Emulation Timeout on the **Configuration & General Status** tab.

4.3.3.4   SAVE CUSTOM EMULATION CONFIGURATION

Customs Emulation Configuration allows for a quick way to save to a file the necessary registers to configure the UCS1002 for a custom profile. Enter the path and press the **SAVE** button. Files will be overwritten if duplicate file names are used.

Registers 40h – 4Ch (Custom Emulation Configuration - **Custom Charging** tab), 16h (Emulation Behavior - **Configuration** tab), 19h (ILIM - **Main** tab), 25h (High Speed Switch Configuration - **Configuration** tab) and 51h (Custom Current Limiting Behavior - **Custom Charging** tab) will be saved in a two-column format. Comments can be added at the end of the file for documentation.

4.3.4 Register Set Tab

The **Register Set** tab (Figure 4-14) allows viewing and updating of the UCS1002 registers, identifies the device on the evaluation board and manages configuration files.
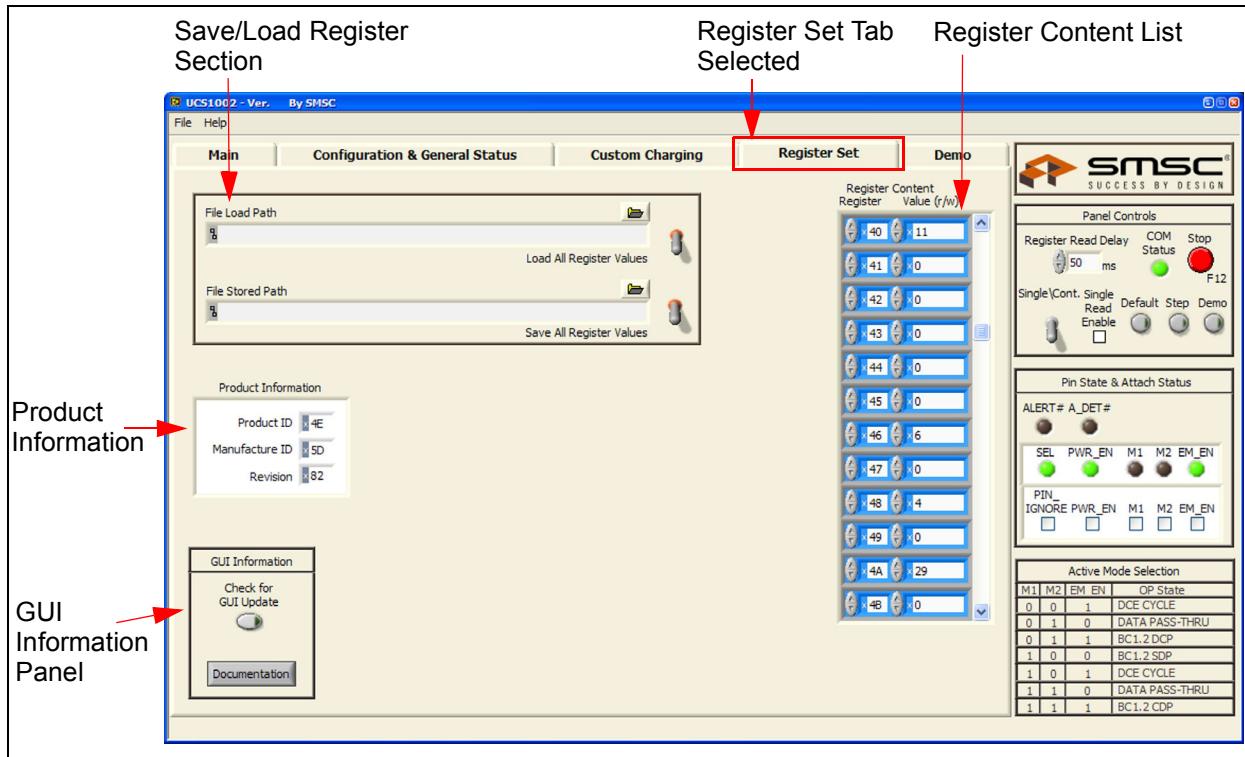
FIGURE 4-14: *Register Set Tab.*

4.3.4.1 REGISTER CONTENT

Register Content shown in Figure 4-14 is a scrollable list of the UCS1002 registers and the current value. It is important to note that not all addresses are physical memory locations on the device; these registers will read '0'. Likewise, some registers shown that are undocumented in the data sheet may contain data. Editing these registers can cause unexpected results.

To update a register value, locate the register address in the left column, type the new value in the corresponding cell in the right column and press **Enter** on the keyboard or click outside the editable field to complete the action.

4.3.4.1.1 Numbering Systems Views

The Register Content section allows values to be displayed using different numbering systems: Decimal, Hex, Octal, Binary or SI Notation. To view a value using a different numbering system, click the indicator (x) to the left of the value in the cell (Figure 4-15).
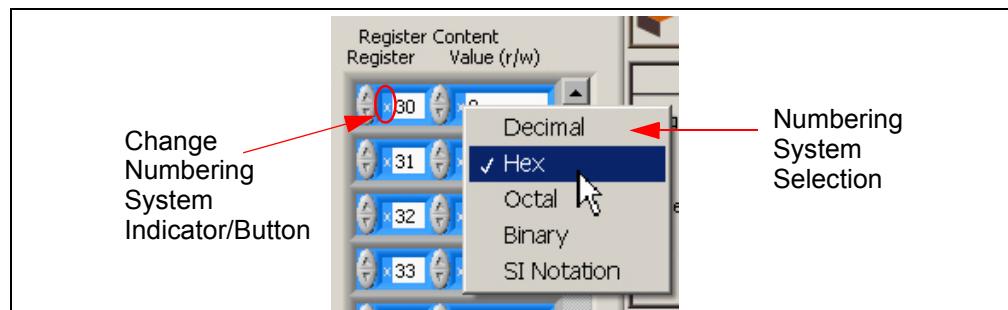
FIGURE 4-15: *Numbering System Indicators.*

4.3.4.2   PRODUCT INFORMATION

Product Information panel shows the values of three registers (FDh, FEh and FFh) which identify the device on the evaluation board.

4.3.4.3   GUI INFORMATION

Check for GUI Update requires an Internet connection. When this button is pressed, it will check if the current version is up to date and will automatically download a `.zip` file if out of date.

The **Documentation** button will launch a Windows file viewer, opening the local folder containing the current evaluation board documentation.

4.3.4.4   CONFIGURATION SAVE AND LOAD

The **Register Set** tab contains controls (Figure 4-16) which save the settings currently configured in the UCS1002 to allow quick reconfiguration at any time.
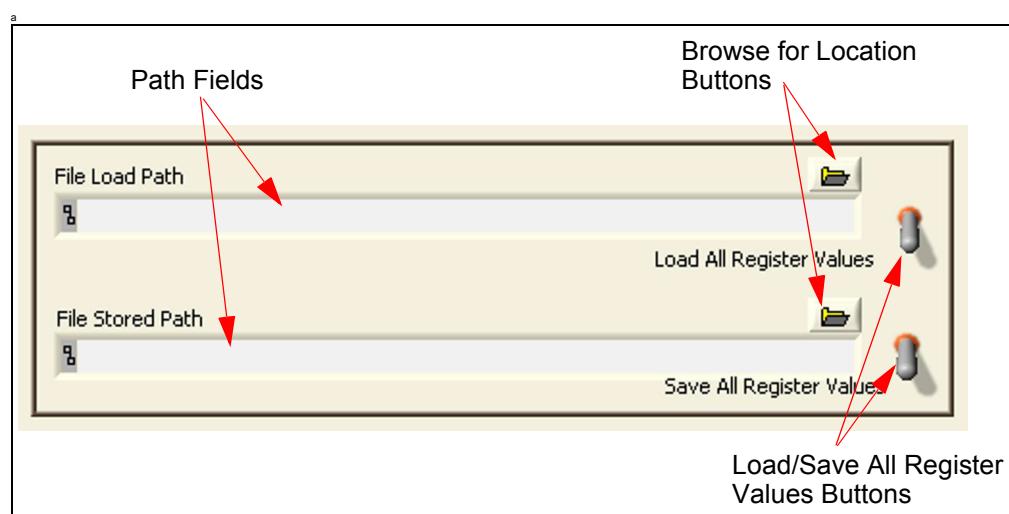
FIGURE 4-16:   *Save/Load Section.*

To save configuration settings, configure the UCS1002 as desired, then display the **Register Set** tab. Type a path in the "File Stored Path" field or press the **Browse** button to select the folder where the configuration file will be saved. The file should be named with the `.txt` extension or with a similar text file format. Once a file name and location has been chosen, click the **Save All Register Values** switch and the file is saved.

Note: If a file with the same name already exists, it will be overwritten and the old data will be lost.

The data is saved in two columns separated by tabs. The first column is the register address and the second column is the register data.

Once a file is saved, it can be recalled at any time by selecting the file in the "File Load Path" field and by clicking the **Load All Register Values** switch.

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4.3.5 Demo Tab

The **Demo** tab (Figure 4-17) demonstrates external controller logic to apply custom emulation profiles and optimize charging current. This feature uses the LabView engine to step through the selected files and store the current drawn by the device. Several options are available to customize the operation of the demo and explore the potential of the UCS1002.
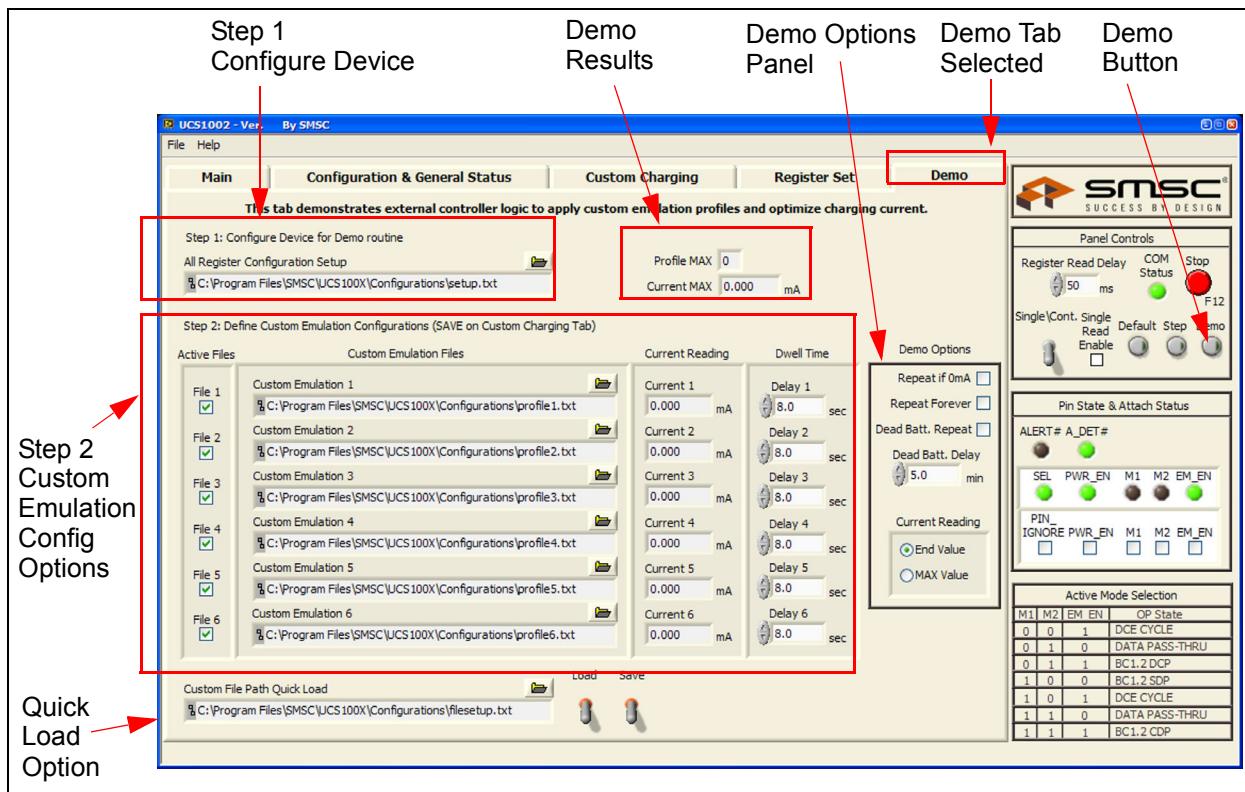
FIGURE 4-17:   Demo Tab.

4.3.5.1   STEP 1: CONFIGURE DEVICE FOR DEMO ROUTINE

The first step in preparing to run the Demo feature is to configure the device to the desired starting configuration. A file has been preloaded at installation and is ready to be used, or a new configuration can be created. Each time the **Demo** button (in the **Panel Control** section) is toggled, the `Setup.txt` file will be loaded.

4.3.5.2   STEP 2: DEFINE CUSTOM EMULATION CONFIGURATIONS

At installation, a set of files are preloaded on the user's system (`profile1.txt` – `profile6.txt`) with the default profiles of the UCS1002. These files can be changed easily by using the **Custom Charging** tab.

4.3.5.2.1   Active Files

Check the corresponding check box to activate the desired profile in the demo routine.

4.3.5.2.2   Custom Emulation Files

This column contains the full path to the profile file to be loaded. This file should contain registers 40h – 4Ch, 16h and 25h. This file can be created with the GUI on the **Custom Charging** tab.

4.3.5.2.3   Current Reading

This column displays the current being drawn from the attached device. If End Value is selected (from the Demo Options section, Current Reading features), this will update continuously. If MAX Value is selected, this will store the highest value of current during the dwell time.

4.3.5.2.4   Dwell Time

Dwell Time column defines the amount of time from PWR_EN set to PWR_EN unset. The default is 8 seconds, which has been found to work with most devices and profiles. Each profile can have a different Dwell Time.

4.3.5.3   DEMO OPTIONS

TABLE 4-2:   DEMO OPTIONS DESCRIPTION

Options	Description
Repeat if 0 mA	When this option is set, it will repeat if all of the profiles read 0 mA, i.e. no device connected.
Repeat Forever	When set, it will repeat the set of files until unchecked.
Dead Batt. Repeat	When set, it will start the demo after the initial cycle after the specified Dead Batt. Delay time. This is useful when the battery is completely discharged and the device OS is unable to handshake with UCS1002.
Dead Batt. Delay	This option is defined in minutes. Minimum is 0 minutes, maximum is 10 minutes.
Current Reading	Select either the End Value (last value before PWR_EN set low) or MAX Value (highest value during Dwell Time).

4.3.5.4   CUSTOM FILE PATH QUICK LOAD

When starting the UCS1002 interface, the file paths are reset to a default path. If desired, the user may save the files in an alternate location. This quick load feature saves the paths of the `Setup.txt` and all six profile locations to quickly return or change files with one click.

4.3.5.5   RUNNING THE DEMO

Once the files and settings are configured as desired, enable the Demo routine by pressing the **Demo** switch within the Panel Controls area. The routine begins and the results are displayed in Profile MAX and Current MAX. By default, the Demo routine will enable the profile that is indicated by Profile MAX.

• **Profile MAX**: Stores the profile of the highest value of current draw.
• **Current MAX**: Stores the highest current associated with the Profile MAX #.

> **Note:**   The **Demo** tab does not need to be visible to activate the Demo routine.

4.4 TROUBLESHOOTING

Table 4-3 identifies possible problems and their solutions to troubleshoot the UCS1002 software.

TABLE 4-3: TROUBLESHOOTING THE INTERFACE - COMMON PROBLEMS

Problem	Solution
GUI Controls Unresponsive After Installation	Restart the computer. In some cases, a restart is required after installation.
GUI Freezes	If the GUI freezes for unknown reasons, communications cannot be stopped and the program cannot be closed, disconnect the USB cable from the evaluation board, then close the program. Reconnect the board, then restart the GUI.
Random Panel Display	When a board is not connected to the PC running the GUI, the panel will be in an all-zero register-displayed state. This also occurs when SMBus communications are disconnected. The panel display is not meaningful. Connect the board and establish SMBus communications. If this still does not work, there is a problem with the connection. The cable or the USB port may be defective.
Device Is Not Charging or Not Charging Optimally	• Check if the current limit jumper is set appropriately. • The current source may not have high enough capacity from V_S. • Run the Demo routine to determine highest current profile.

Appendix A. Schematic and Layouts

A.1   INTRODUCTION

This appendix contains the following schematics and layouts for the UCS1002 Evaluation Board:

- Board – Schematic
- Board – Top Silk
- Board – Top Solder Mask
- Board – Top Copper
- Board – 2nd Layer Copper
- Board – 3rd Layer Copper
- Board – Bottom Copper
- Board – Bottom Solder Mask
- Board – Bottom Silk

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VDD_5V   +3.3V_8051

R42 ZERO 1/10W   R33 ZERO 1/10W DNP

PWR_EN
R3 10.0k 1/10W   J4 HDR_1x2   TP1

SEL
R4 10.0k 1/10W   J5 HDR_1x2   TP2
DNP

EM_EN
R5 10.0k 1/10W   J6 HDR_1x2   TP3

M1
R6 10.0k 1/10W   J7 HDR_1x2   TP4

M2
R7 10.0k 1/10W   J8 HDR_1x2   TP5

SMCLK/S0
R8 2.2k 1/10W   J9 HDR_1x2   TP6
R10 ZERO 1/10W DNP

SMDATA/LATCH
R9 2.2k 1/10W   J10 HDR_1x2   TP7

ALERT#
R1 10.0k 1/10W   TP8

A_DET#/CHRG#
R2 10.0k 1/10W   TP9

R26 ZERO 1/10W
R12 10.0k 1/10W
R13 12.0k 1/10W
R14 15.0k 1/10W
R15 18.0k 1/10W
R16 22.0k 1/10W
R17 27.0k 1/10W
R18 33k 1/10W

J12   COMM_SEL/ILIM
0.5A 1 2
0.9A 3 4
1.0A 5 6
1.2A 7 8
1.5A 9 10
1.8A 11 12
2.0A 13 14
2.5A 15 16
HDR_2x8

UCS1001-X: DNP any components in this section

R43 ZERO 1/10W
R44 10.0k 1/10W
R45 12.0k 1/10W
R46 15.0k 1/10W
R47 18.0k 1/10W
R48 22.0k 1/10W
R50 27.0k 1/10W
R49 33k 1/10W

J14   SEL
AL_57h 1 2
AL_56h 3 4
AL_55h 5 6
AL_54h 7 8
AL_30h 9 10
AL_31h 11 12
AL_32h 13 14
AL_33h 15 16
HDR_2x8

UCS1001-X: Only R43 and J14 header (pins 1-2) installed in this section.

R19 47.0k 1/10W
R20 56.0k 1/10W
R21 68.0k 1/10W
R22 82.0k 1/10W
R23 100k 1/10W
R24 120k 1/10W
R25 150k 1/10W

J13   COMM_SEL/ILIM
0.5A_SA 1 2
0.9A_SA 3 4
1.0A_SA 5 6
1.2A_SA 7 8
1.5A_SA 9 10
1.8A_SA 11 12
2.0A_SA 13 14
2.5A_SA 15 16
HDR_2x8

VDD_5V

R51 47.0k 1/10W
R52 56.0k 1/10W
R53 68.0k 1/10W
R54 82.0k 1/10W
R55 100k 1/10W
R56 120k 1/10W
R57 150k 1/10W

J17   SEL
AH_33h 1 2
AH_32h 3 4
AH_31h 5 6
AH_30h 7 8
AH_54h 9 10
AH_55h 11 12
AH_56h 13 14
AH_57h 15 16
HDR_2x8

VDD_5V

UCS1001-X: Only J17 pins 1-2 installed in this section.

ALERT#   R36 ZERO 1/10W   ALERT_8051
A_DET#/CHRG#   R37 ZERO 1/10W   A_DET#/CHRG#_8051
PWR_EN   R38 ZERO 1/10W   PWR_EN_8051
EM_EN   R39 ZERO 1/10W   EM_EN_8051
M1   R40 ZERO 1/10W   M1_8051
M2   R41 ZERO 1/10W   M2_8051
DNP

+3.3V_8051
C8 0.1uF 50V   C9 1.0uF 50V

ALERT#   LED4 Red
A_DET#/CHRG#   LED5 Green
R30 2k 1/10W
R31 330 1/16W
+3.3V_8051

R34 33 1/10W
SMDATA/LATCH
SMCLK/S0
R35 33 1/10W
DNP UCS1001-X

J16 HDR_1x2
J18 HDR_1x2

SDA_8051
SCL_8051
USB_ACT
SM_ACT

USB ACT   LED2 Yellow   R28 330 1/16W
SMBus ACT   LED3 Yellow   R29 330 1/16W DNP UCS1001-X

U3 USB Bridge

VDD 10
P0.0 6
P0.1
P0.2
P0.3
P0.4
P0.5
P0.6/XTAL1
P0.7/XTAL2
P1.0 46
P1.1 45
P1.2 44
P1.3 43
P1.4
P1.5
P1.6
P1.7
P2.0 38
P2.1
P2.2
P2.3
P2.4
P2.5
P2.6
P2.7

P3.0 30 ALERT_8051
P3.1 29 A_DET#/CHRG#_8051
P3.2 28 PWR_EN_8051
P3.3 27 EM_EN_8051
P3.4 26 M1_8051
P3.5 25 M2_8051
P3.6 24 ALERT# LED
P3.7 23 A_DET#/CHRG#_LED

P4.0
P4.1
P4.2
P4.3
P4.4
P4.5
P4.6
P4.7

C2D 7
C2CK/RST
VREGIN 12
VBUS 9
D- 8
D+ 7
GND

C8051F340

+3.3V_8051
R65 1.00k 1/10W   R64 1.00k 1/10W
P2
R63 1.00k 1/10W
HDR_2x4
PRGM

+3.3V_8051
C26 1.0uF 16V

R32 ZERO 1/10W   VDD_5V

P3
VBUS 2
D- 3
D+ 4
ID 5
GND 6
SHIELD1
SHIELD2
SHIELD3
SHIELD4
To GUI Computer
USB mini B SMD

C13 0.1uF 50V   C14 10uF 10V   D6 DIODE 5V / 260W
R71 ZERO 1/10W DNP

R59 ZERO 1/10W   R61 ZERO 1/10W
R60 ZERO 1/10W   R62 ZERO 1/10W DNP

AUX Power Input
J3
VS 1
3
C2 0.1uF 50V
Power_Jack

J2   To/From Host
VCC 1
D+ 3
D- 2
GND 4
SHLD1 5
SHLD2 6
USB-B
C1 0.1uF 50V
R70 ZERO 1/10W DNP

J11 HDR_1x2   VIN

VDD_5V
R69 1M 1/16W   R68 1M 1/16W
R11 ZERO 1/10W
C5 0.1uF 50V   C6 1.0uF 50V

AUX Power Output
P4
VCC 1
D- 2
D+ 3
GND 4
SHLD1 5
SHLD2 6
USB-A
C12 470pF 50V
D2 DIODE 5V / 260W
VBUS ONLY
R58 ZERO 1/10W DNP

U1
VS1 7
VS2 8
VDD 9
DPIN 14
DMIN 15
PWR_EN 10
EM_EN 19
M1 1
M2 2
SMDATA / LATCH 11
SMCLK / S0 12
COMM_SEL / ILIM 6
FLG 21
GND 20

VBUS1 3
VBUS2 4
DPOUT 17
DMOUT 16
A_DET# / CHRG# 18
ALERT# 13
SMDATA/LATCH
SMCLK/S0
COMM_SEL/ILIM
SEL

UCS1002

C3 0.01uF 16V   C4 10uF 10V

SGND1 TEST_POINT   SGND2 TEST_POINT   EGND3 TEST_POINT

SGND1   SGND2   EGND

VBUS   J15 HDR_1x2
L1 CM-Choke 330mA / 90ohm
DP_OUT
DM_OUT
C15 150uF 10V/100 mOhm

R67 1M 1/16W   R66 1M 1/16W
D1 DIODE 5V / 260W   D5 TVS Diode 5V   D4 TVS Diode 5V
R27 ZERO 1/10W

TEST_POINT Yellow   TEST_POINT White
TP16   TP14

VOUT   P1
VCC 1
D- 2
D+ 3
GND 4
SHLD1 5
SHLD2 6
USB-A
To Portable Device (ESD Test Location)
C11 470pF 50V

EGND1 TEST_POINT   EGND2 TEST_POINT
EGND   EGND

TP11 TEST_POINT White   TP10 TEST_POINT Yellow

Schematic and Layouts

A.3 BOARD – TOP SILK

A.4 BOARD – TOP SOLDER MASK

UCS1002 Evaluation Board User's Guide

A.5   BOARD – TOP COPPER

## A.6   BOARD – 2ND LAYER COPPER

A.6   BOARD – 2ND LAYER COPPER

A.7   BOARD – 3RD LAYER COPPER

A.8   BOARD – BOTTOM COPPER

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A.9   BOARD – BOTTOM SOLDER MASK

A.10   BOARD – BOTTOM SILK

Appendix B. Bill of Materials

TABLE B-1: BILL OF MATERIALS (BOM)

Qty.	Reference	Description	Manufacturer	Part Number
4	B1 – B4	Bumper Black 3705.19" cylinder	Richco®, Inc.	RBS-35BK
5	C1, C2, C5, C8, C13	Capacitor ceramic 0.1 µF 50V 10% X7R 0603	Murata Electronics®	GRM188R71H104KA93D
1	C3	Capacitor ceramic 0.01 µF 16V 10% X7R 060	Panasonic® - ECG	ECJ-1VB1C103K
2	C4, C14	Capacitor tantalum low ESR 10 µF 10V 10% S	AVX Corporation	TPSA106K010R0900
2	C6, C9	Capacitor ceramic 1.0 µF 50V Y5V 0805	TDK Corporation	C2012Y5V1H105Z
2	C11, C12	Capacitor ceramic 470 pF 50V 10% X7R 0603	Murata Electronics	GRM188R71H471KA01D
1	C15	Capacitor tantalum low ESR 150 µF 10V 10% SMD	AVX Corporation	TPSD157K010R0100
1	C26	Capacitor ceramic 1.0 µF 16V DC 10% X5R 06	Panasonic - ECG	ECJ-1VB1C105K
3	D1, D2, D6	TVS 260W 5.0V Unidirect. SOD-523	Diodes® Incorporated	T5V0S5-7
2	D4, D5	TVS Zener Bidirectional 5V SOD-882	NXP Semiconductors	PESD5V0X1BL
5	EGND1 – EGND3, SGND1, SGND2	Test Point	Keystone Electronics Corp.	5015
1	J2	Receptacle, USB, Style B, right angle	TE Connectivity, Ltd.	292304-1
1	J3	Connector power jack 5.5 MM X, 2.5A, RA	Switchcraft®	RAPC722X
10	J4, J6, J11, J15, J16, J18	Header, 1 X 2, 0.1 inch, vertical	Molex®	22-28-4020
1	J5	Header, 1 X 2, 0.1 inch, vertical - **DO NOT POPULATE**	Molex	22-28-4020
4	J12 – J14, J17	Header, 2 X 8, 0.1 inch, vertical	Samtec, Inc.	TSW-108-07-L-D
1	L1	Choke Common mode 330MA 90OHM	Murata Electronics	DLW21HN900SQ2L
2	LED2, LED3	LED Yellow 0603	Stanley Electric Co., Ltd.	AY1111C-TR
1	LED4	LED Red Clear 0603 SMT	Lite-On®, Inc.	LTST-C190CKT
1	LED5	LED Green SMT	Stanley Electric Co., Ltd.	BG1111C-TR
2	P1, P4	Receptacle, USB, Style B, right angle	FCI	87520-0010BLF
1	P2	Connector header 8 POS 2MM RT ang. Gold	Molex	87833-0820
1	P3	Connector Recept. USB Mini B R/A 5 POS SMD	Molex	54819-0572
1	PCB	UCS1002 Evaluation Board - Printed Circuit Board	Microchip Technology Inc.	PCB-8106-B0

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

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TABLE B-1:   BILL OF MATERIALS (BOM) (CONTINUED)

Qty.	Reference	Description	Manufacturer	Part Number
8	R1 – R3, R6 – R7, R12, R44	Resistor 10.0 K Ohm 1/10W 1% 0603	Yageo Corporation	RC0603FR-0710KL
1	R4	Resistor 10.0 K Ohm 1/10W 1% 0603 - **DO NOT POPULATE**	Yageo Corporation	RC0603FR-0710KL
2	R8, R9	Resistor 2.2 K Ohm 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ222V
12	R10, R33, R38 – R41, R58 – R62, R70 – R71	Resistor Zero Ohm 1/10W 5% 0603 - **DO NOT POPULATE**	Yageo Corporation	RC0603JR-070RL
7	R11, R26, R27, R32, R36 – R37, R42	Resistor Zero Ohm 1/10W 5% 0603	Yageo Corporation	RC0603JR-070RL
2	R13, R45	Resistor 12.0 K Ohm 1/10W 1% 0603	Yageo Corporation	RC0603FR-0712KL
2	R14, R46	Resistor 15.0 K Ohm 1/10W 1% 0603 SMD	Yageo Corporation	RC0603FR-0715KL
2	R15, R47	Resistor 18.0 K Ohm 1/10W 1% 0603	Yageo Corporation	RC0603FR-0718KL
2	R16, R48	Resistor 22.0 K Ohm 1/16W 1% 0603 SMD	Yageo Corporation	RC0603FR-0722KL
2	R17, R50	Resistor 27.0 K Ohm 1/16W 1% 0603 SMD	Vishay Intertechnology, Inc.	CRCW060327K0FKEA
2	R18, R49	Resistor 33 K Ohm 1/10W 1% 0603	Yageo Corporation	RC0603FR-0733KL
2	R19, R51	Resistor 47.0 K Ohm 1/10W 1% 0603 SMD	Yageo Corporation	RC0603FR-0747KL
2	R20, R52	Resistor 56 K Ohm 1/10W 5% 0603 SMD	Yageo Corporation	RC0603JR-0756KL
2	R21, R53	Resistor 68.0 K Ohm 1/10W 1% 0603 SMD	Yageo Corporation	RC0603FR-0768KL
2	R22, R54	Resistor 82.0 K Ohm 1/10W 1% 0603 SMD	Yageo Corporation	RC0603FR-0782KL
2	R23, R55	Resistor 100 K Ohm 1/10W 1% 0603	Yageo Corporation	RC0603JR-07100KL
2	R24, R56	Resistor 120 K Ohm 1/10W 1% 0603 SMD	Yageo Corporation	RC0603FR-07120KL
2	R25, R57	Resistor 150 K Ohm 1/10W 1% 0603 SMD	Yageo Corporation	RC0603FR-07150KL
3	R28, R29 R31	Resistor 330 Ohm 1/16W 3300PPM 5% 0603	Panasonic - ECG	ERA-V33J331V
1	R30	Resistor 2.00 K Ohm 1/10W 1% 0603 SMD	Yageo Corporation	RC0603FR-072KL
2	R34, R35	Resistor 33 Ohm 1/10W 5% 0603	Yageo Corporation	RC0603JR-0733RL
3	R63 – R65	Resistor 1.00 K Ohm 1/10W 1% 0603 SMD	Yageo Corporation	RC0603FR-071KL
4	R66 – R69	Resistor 1.00 M Ohm 1/16W 1% 0402 SMD	Yageo Corporation	RC0402FR-071ML
13	S1 – S13	Connector shunt 0.1" w/ handle	TE Connectivity, Ltd.	881545-2

Note 1:   The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

TABLE B-1:   BILL OF MATERIALS (BOM) (CONTINUED)

Qty.	Reference	Description	Manufacturer	Part Number
2	TP10, TP16	Test Point loop compact Yellow	Keystone Electronics Corp.	5009
2	TP11, TP14	Test Point loop compact Green	Keystone Electronics Corp.	5121
1	U1	UCS1002 – Programmable USB Port Power Controller with Charger Emulation	Microchip Technology Inc.	**UCS1002**
1	U3	IC 8051 MCU Flash 64K 48 TQFP	Silicon Laboratories® Inc.	C8051F340-GQ
1	—	5V AC-DC > 500 mA wall adapter with positive center 2.1mm I.D. x 5.5mm O.D. x 10mm Female cord plug	Phihong USA Corporation	PSAA20R-050

Note 1:   The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

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