ISL94202EVKIT1Z GUI

The ISL94202 is a Li-ion battery monitor IC that supports from three to eight series connected cells. It provides complete battery monitoring and pack control. The ISL94202 provides automatic shutdown and recovery from out-of-bounds conditions and automatically controls pack cell balancing.

The internal configuration EEPROM makes the ISL94202 a highly configurable stand-alone device.

This document describes the Microsoft Excel based GUI created to provide a way for you to perform both demonstration and evaluation of the ISL94202. While this document does help to familiarize you with how to interact with the ISL94202 using the GUI, the *ISL94202 Datasheet* should be used for further details about the device.

Note on MS Office Installation

The evaluation kit hardware and software requirements differ depending on which version of MS Office is installed. If the 64-bit version of MS Office is installed, the GUI versions including 64B in the filename must be used in combination with ISO-DONGLE1Z Rev. B. The Rev. B dongle can only be used with the 64B GUIs. This combination also operates on PCs with the 32-bit version of MS Office installed.

Previous versions of the GUIs and Rev. A of the ISO-DONGLE1Z must be used together. These only operate on 32-bit versions of MS Office.

Key Features

- Communicates with the ISL94202 I^2C port using a USB to I^2C conversion dongle
- Provides the ability to evaluate all important features of the ISL94202
- Complete EEPROM programming capability included
- Customizable Excel Visual Basic for applications source code is included

Specifications

The evaluation GUI is compatible with released versions of the ISL94202 and ISL94203 devices, evaluation kits, and dongles. The EEPROM programming portion of the GUI is compatible with files created by the legacy GUI and ISL94202 EEPROM Programming GUI.

- V_{BAT}/V_{DD} = 4V to 36V
- I^2C clock frequency (SCL) = 400kHz

Ordering Information

Part Number	Description
ISL94202IRTZ	ISL94202 48 Ld TQFN
ISL94202EVKIT1Z	ISL94202 evaluation kit, includes dongle
ISO-DONGLE1Z	Rev. A - Isolated USB to I^2C conversion dongle (32-bit MS Office only) Rev. B - Isolated USB to I^2C conversion dongle

Related Information

For a full list of related documents, visit our website:

- ISL94202EVKIT1Z, ISL94202, ISL94203 device pages

Contents

1. Functional Description

The ISL94202 evaluation GUI allows you to communicate with an ISL94202 device to evaluate the features of the device. The evaluation GUI also contains a simplified demonstration GUI, which provides a straight-forward way of understanding some key features of the ISL94202.

The GUI was implemented using Microsoft Excel and Visual Basic for Applications to be both portable and customizable given the included source code. GUI operation does not require Excel or VBA expertise, but customization of the GUI does.

Note: Many of the instructions in this document refer to changing the device thresholds to trigger a fault or another action. In most of these cases (such as cell voltage thresholds), the power supply voltage can also be changed to trigger the action. In all cases, the thresholds can be set as desired and then the voltage they are monitoring can be adjusted to test the function. This document was written with the intention of helping you become familiar with the GUI prior to evaluating the device operation, so the examples are simplified for this purpose.

2. Hardware Setup

An ISL94202 BMS assembly consists of the following components:

- ISL94202EVAL1Z - ISL94202 evaluation board
- ISL-DONGLE1Z - ISL94202 communications dongle with USB cable
- A resistor ladder board (or target battery pack)
- Power supply

2.1 Evaluation Board

The ISL94202 board as shipped from stock is set up for 8 cells.

Supply current can be monitored by connecting a voltmeter across CS1 and CS2.

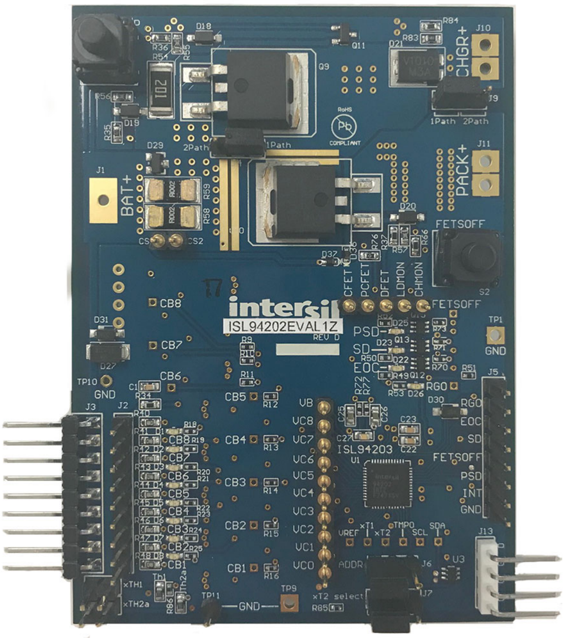


Figure 1. ISL94202EVAL1Z Board

2.2 Communications Dongle

The communications dongle is a board designed to isolate the ISL94202 evaluation board assembly ground from the PC and workbench grounds. Most Battery Management Systems (BMS) operate isolated from earth ground. When an oscilloscope probe is connected to the assembly it can provide a path to earth ground, which could potentially reset the ISL94202 in severe cases.

The dongle uses I^2C communication in combination with the evaluation GUI to communicate with the ISL94202 device. Connect the Dongle to the PC using the provided USB cable.

Note: The communications dongle should not be connected to the ISL94202 evaluation board when powering up the evaluation board, or the dongle can prevent the ISL94202 from properly powering on.

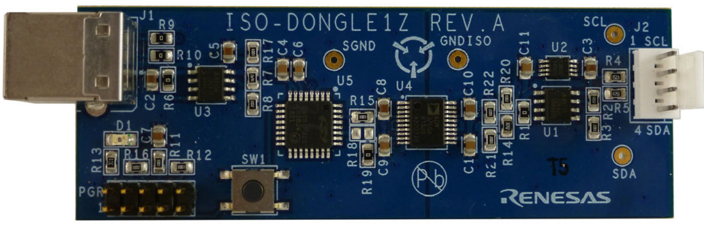


Figure 2. ISO-DONGLE1Z Board

2.3 Resistor Ladder

A resistor ladder board is used to mimic a cell stack (limited) if a battery pack is not available. AC or heavy load currents and cell balancing cause voltage fluctuations when using a resistor ladder that would not occur with batteries.

Connector J3 can be used to short out center cells for evaluation of systems with fewer than eight cells.

Each cell of the resistor ladder consists of three 300Ω resistors in parallel resulting in 100Ω per cell.

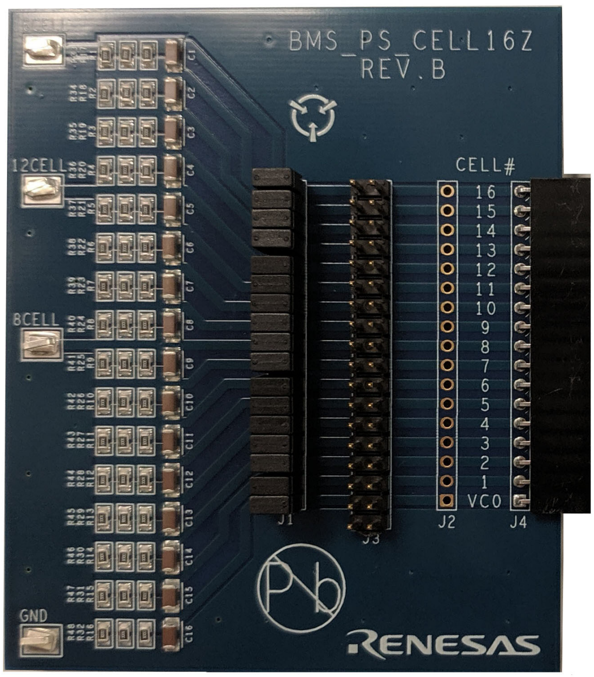


Figure 3. Resistor Ladder

2.4 Power Supply

In many cases a battery pack is not available so the combination of a power supply and a resistor ladder is used. The power supply must be selected so it can supply the ladder, ISL94202, and load at the desired voltage without current limiting.

With the power supply disabled, connect the negative terminal to the GND clip and the positive terminal to the 8-Cell clip on the resistor ladder board.

Set the power supply output voltage to 28V but keep the output disabled. If using a reduced number of cells, set to the appropriate voltage.

Enable the power supply output prior to connecting the dongle and executing the Connect step in the Connect section.

2.5 BMS Assembly

The three boards previously described are connected together as shown in Figure 4.

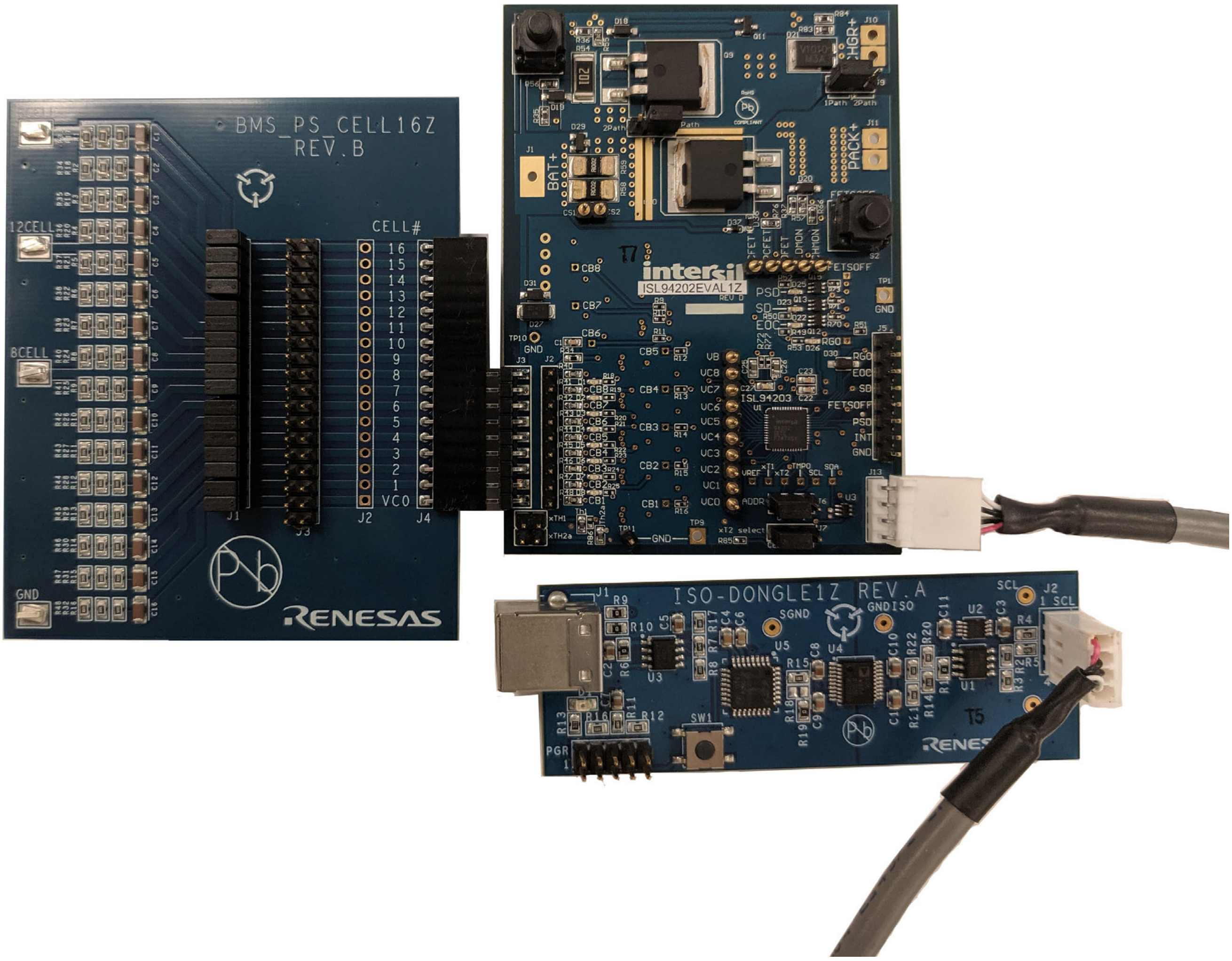


Figure 4. Board Connection

3. Evaluation GUI

The following section contains information on how to use the evaluation portion of the GUI. To ensure proper operation, the steps should be completed in the order they are presented. Completing this section provides you with the level of experience required to feel comfortable using the kit for your application.

3.1 Launch

Open the workbook to get started, there is no installation required. **Note:** Macros are automatically disabled on some PCs. If the message *SECURITY WARNING Macros have been disabled* is visible beneath the menu bar, select **Enable Content**. See Figure 5.

Press the <**Ctrl**> and <**J**> keys simultaneously to start the GUI.

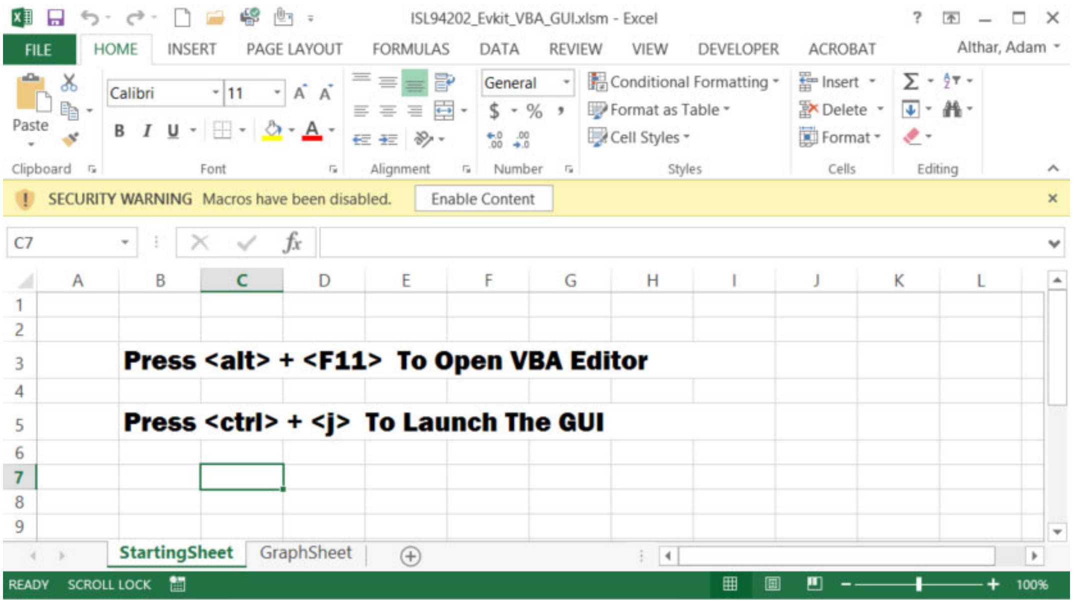


Figure 5. Workbook View

3.2 Connect

The GUI must detect that the dongle is present to operate, this is referred to as the Connect step. Connect the USB cable to the dongle then press the green **Connect** button to start the detection process as shown in Figure 6.

Note: The ISL94202 must be powered up before connecting the dongle to the ISL94202 I^2C pins. If the ISL94202 is not powered, the dongle I^2C pull-ups can inadvertently provide power to the ISL94202 through the RGO pin and force it into an indeterminate state. This situation must be avoided for proper EEPROM programming and also applies if the ISL94202 is in its Power-Down state. See the *ISL94202 Datasheet* for more details.

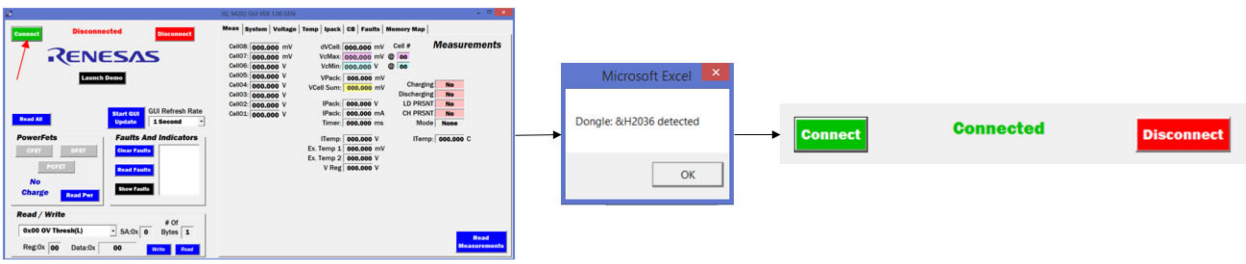


Figure 6. Connect Sequence

3.3 Read All

After connecting press the **Read All** button, highlighted in Figure 7. This button reads all relevant information from the device and updates the GUI to reflect this information. Renesas recommends performing a **Read All** whenever the GUI is launched to prevent errors caused by a discrepancy between the GUI information and actual device settings.

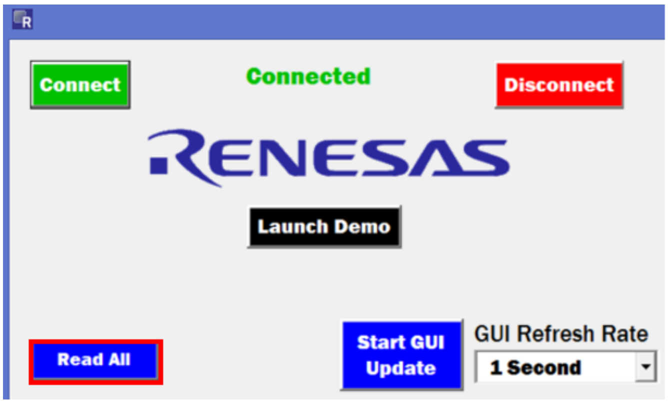


Figure 7. Read All Button

3.4 Default Settings

Upon receiving the ISL94202 evaluation kit the device EEPROM should contain the factory default values. However, if the evaluation kit has been used previously it is possible the EEPROM values have been modified, which could cause problems while using this manual. To reset the device to its default, first navigate to the **Memory Map** tab of the GUI. Then press the **Display Factory Defaults** button on the right side of the GUI, (highlighted in yellow in Figure 8). This updates the display with the factory default values for the configuration memory, but does not write the values to the device. To write the values to the device, press **Write EEPROM** (highlighted in green in Figure 8) to write the default values to the EEPROM. This takes a brief period of time due to the timing required to write to the device EEPROM. A confirmation message should be displayed that the EEPROM was written successfully, as shown in Figure 9. Next, click **Write Registers** (highlighted in red in Figure 8) to write the default configuration settings to the device registers. A confirmation message appears as shown in Figure 9 if the registers were successfully written.

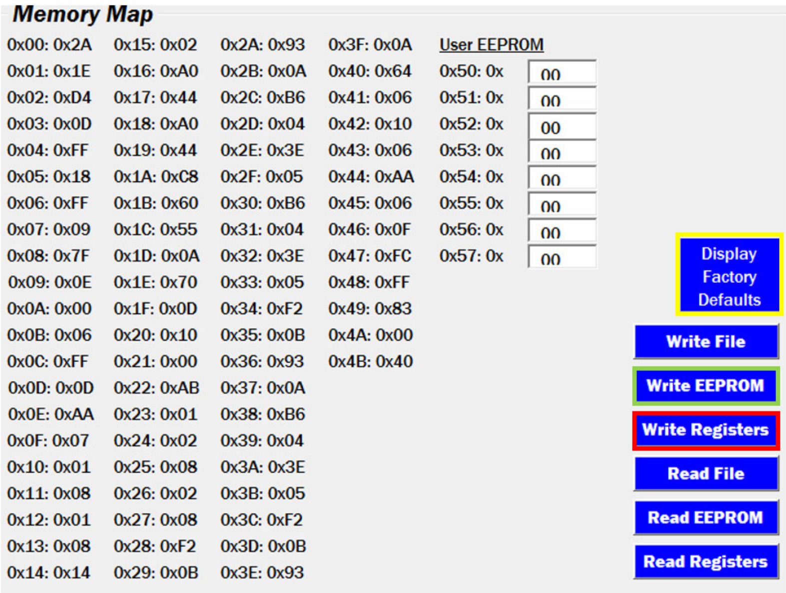


Figure 8. Memory Map Tab

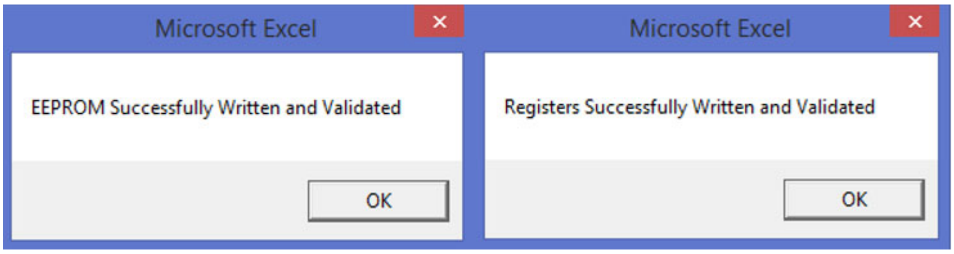


Figure 9. EEPROM and Register Write Confirmation Messages

After this, the device is in its factory configuration.

3.5 Operating Mode

After powering on, the device enters Normal mode. The mode can be confirmed in the **Mode** box on the **Meas** tab (highlighted in Figure 10). In Normal mode the device monitors for overcurrent and scans the voltages every 32ms.

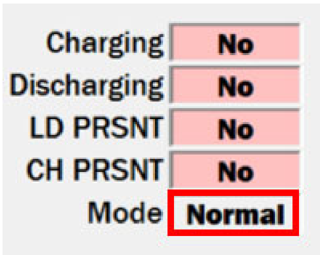


Figure 10. Mode Display

Depending on the amount of time that has elapsed between powering on the device and checking the mode, the device may no longer be in Normal mode. If the mode is displayed as **Sleep,** press the **WakeUp** button located on the ISL94202 evaluation board. If the mode is displayed as **Idle** or **Doze**, no action is required. Switch to the **System** tab. In the bottom right corner, select **Idle** from the **Mode Set** drop-down menu and press the **Write Mode** button. This puts the device into Idle mode. Press the **Read Mode** button and confirm the IN_IDLE bit is set. This sequence is shown in Figure 11.

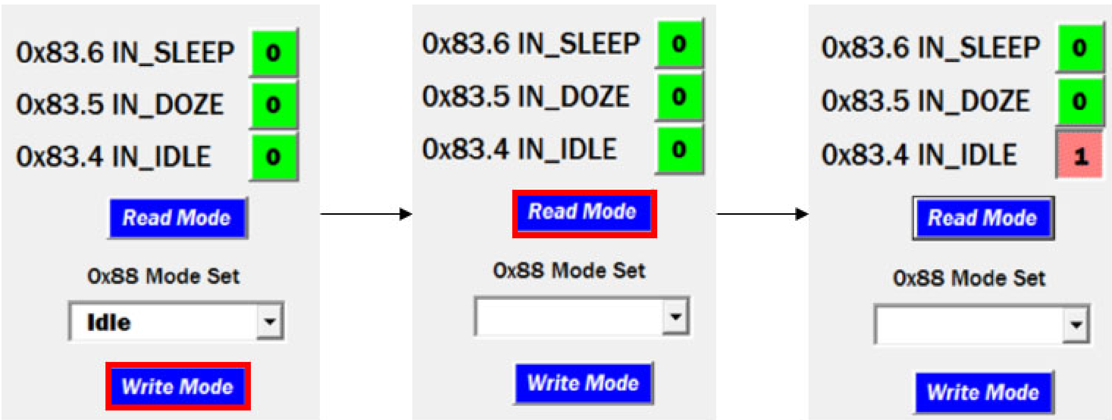


Figure 11. Idle Mode Write/Read Sequence

While in Idle mode the device scans at a rate of 256ms and can perform communication. A charge or discharge current detection causes the device to transition back to Normal mode. On the bottom left of the **System** tab select **0 Minutes** from the Idle and Doze mode timer as shown in Figure 12. Press **Write Timers** to write the setting to the device, then press **Read Timers** to confirm the setting was written properly. This timer controls the amount of time required without a current flow detection for the ISL94202 to transition from Normal mode to Idle mode and Idle mode to Doze mode.

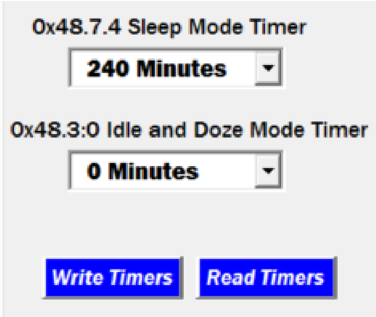


Figure 12. Mode Timers

Press **Read Mode** and note that **IN_IDLE** is still set. This is because when Register 0x88 is used to set the device mode, the mode does not transition due to the timers. To allow the timers to cause mode transition Register 0x88 must be cleared. To do this, select **Clear** from the **Mode Set** menu then press the **Write Mode** button. Next, press the **Read Mode** button. The **IN_DOZE** indicator should be set as seen in Figure 13. In Doze mode, the device scan rate is once every 512ms.

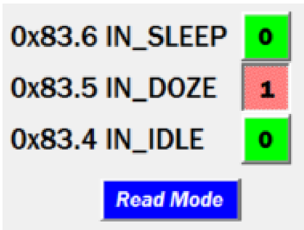


Figure 13. IN_DOZE Status Indicator

Select **15 Minutes** from the **Idle and Doze Mode Timer** drop-down list, then write and read the timers to set and confirm the mode. Next, select **0 Minutes** from the **Sleep Mode Timer** drop-down menu and perform a **Write Timers** followed by a **Read Timers**. Next, perform a **Read mode**. The **IN_SLEEP** indicator should now be set as seen in Figure 14.

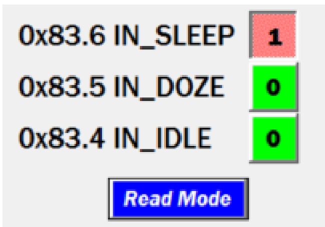


Figure 14. IN_SLEEP Status Indicator

Attempt to set the device into idle by using the **Mode Set** drop-down menu as previously discussed and perform a **Read Mode**. The **IN_SLEEP** indicator is still set. This is because in Sleep mode the device cannot be written to. In Sleep mode, the only operational components of the ISL94202 are the 2.5V regulator and wake-up circuits. Press the **WakeUp** button on the ISL94202 evaluation board. This connects the CHMON pin to VBAT causing the device to think a charger is connected and takes the device out of Sleep mode.

3.6 Cell Configuration

The default cell count for the ISL94202 is three cells. To check the cell configuration of the device, navigate to the **System** tab and locate the region labeled **0x49 Cell Configuration**. Select **8 Cells** from the drop-down menu. This writes the value to Register 0x49 to configure the ISL94202 for eight cells. To confirm the value was set properly, press the **Read Cell Config** button (highlighted in Figure 15) and verify the label reads 8 Cells.

Figure 15. Cell Configuration Menu

3.7 Overvoltage (OV)

Navigate to the Meas tab and press the **Read Measurements** button to update the GUI with the latest measurements from the ISL94202. For now, look at the cell voltages as shown in Figure 16.

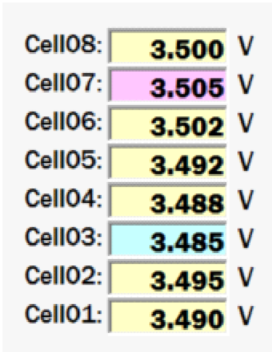


Figure 16. Cell Voltage Measurements

The highest cell voltage of the enabled cells is highlighted in pink, and the lowest cell voltage is highlighted in blue. This information can also be found on the **Meas** tab, as shown in Figure 17.

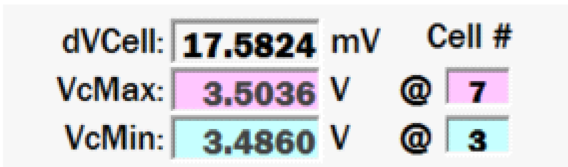


Figure 17. VcMax/VcMin Display

Make mental note of the VcMax voltage and switch to the **Voltage** tab. Locate the boxes labeled **0x01 - 0x00 OV Threshold** and **0x03 - 0x02 OV Recovery**. Change the value in the threshold box to a value ~200mV beneath the VcMax value previously read and change the value in the recovery box to a value ~300mV beneath the VcMax value previously read. Next, press **Write Thresh** button to write the new threshold to the device and then the **Read** button to confirm the threshold was set properly. This entire sequence is shown in Figure 18.

Note: When the **Write Thresh** button is pressed, the values entered in the boxes change to the closest possible setting. This reflects the actual value written to the device, which is the closest threshold value compatible with the device based on what was entered in the threshold box. For more information, see the *ISL94202 Datasheet*.

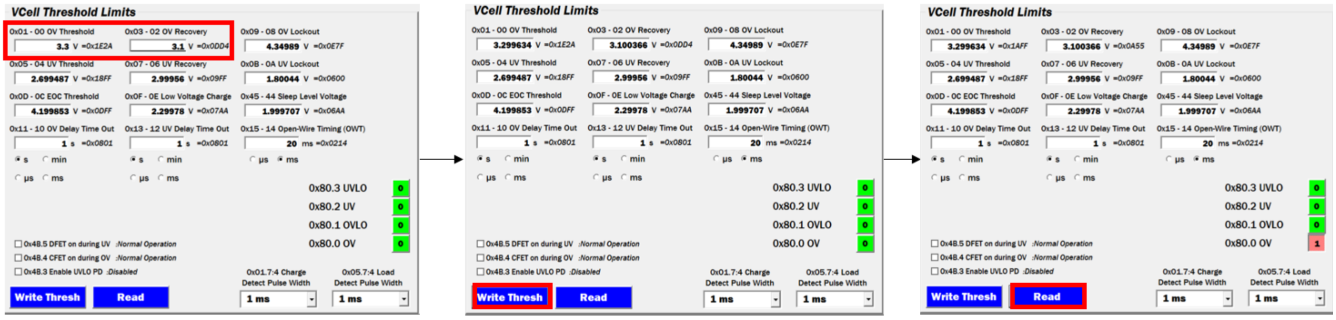


Figure 18. OV Thresh Configuration Sequence

If done correctly, the **OV Fault** indicator bit is also set. To confirm this, perform a **Read All**. In the **Faults And Indicators** box on the left-hand side of the GUI should now show OV. Additionally, the CFET should now be off as indicated by its gray color. Figure 19 shows how these status indicators should look.

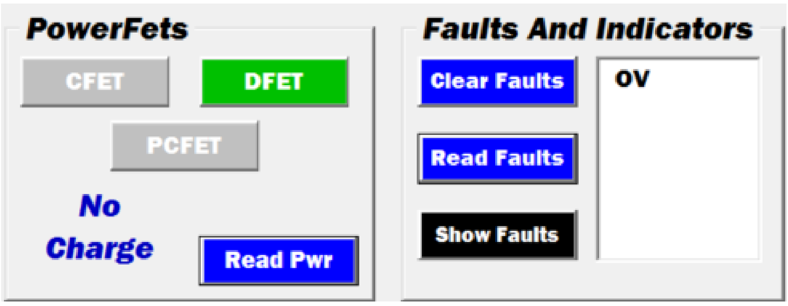


Figure 19. OV Fault

On the **Voltage** tab, set the **OV Threshold** and **Recovery** to their default values, which are approximately 4.25V and 4.15V, respectively. Then, press the **Clear Faults** button followed by the **Read Faults** button in the **Faults And Indicators** box. Next, perform another **Read Pwr**. The **Faults And Indicators** should display no faults, and both CFET and DFET should be enabled indicated by their green color as seen in Figure 20.

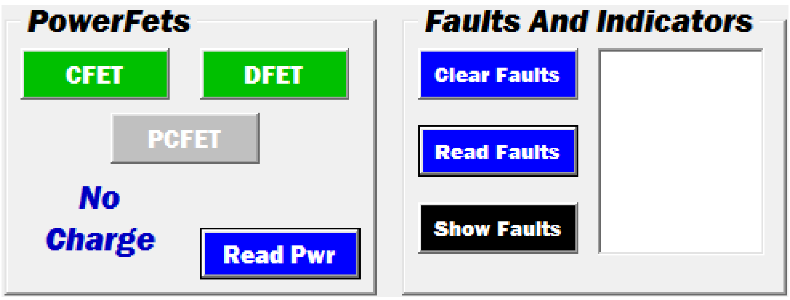


Figure 20. No Faults Present

3.8 Overvoltage Lockout (OVLO)

On the **Voltage** tab, locate the box labeled **0x09 - 08 OV Lockout**. Adjust the value in the box to ~100mV beneath the read VcMax value. Adjust the value in the **OV Threshold** box to a value ~200mV beneath the VcMax value and **OV Recovery** ~300mV beneath the VcMax value as previously done. Perform a **Write Thresh** to write the settings to the device followed by a **Read** to confirm the settings were written properly. The **OVLO** indicator on the **Voltage** tab should now be set. Perform a **Read All** and examine the **PowerFets** and **Faults And Indicators** boxes. The **PowerFets** box should indicate the CFET has been disabled as shown in Figure 21.

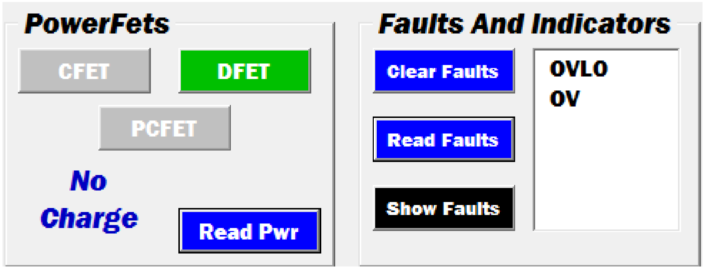


Figure 21. OVLO Fault

Look at the ISL94202 evaluation board. A number of red LEDs should be lit, including one labeled **PSD** as shown in Figure 22.

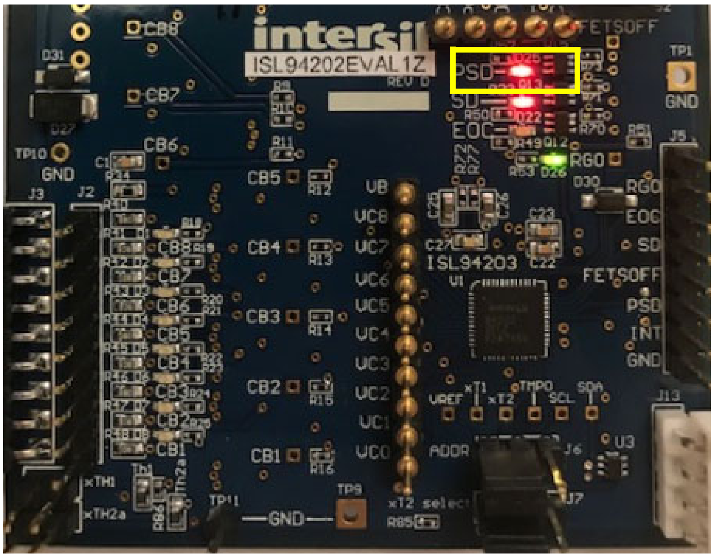


Figure 22. Lit PSD Indicator

This LED indicates that the PSD pin is being driven high. This pin can be used with additional external components to blow a fuse when specified out of bounds conditions occur, such as OVLO. Write the OV Threshold, OV Recovery, and OV Lockout values to their default. Perform a **Clear Faults** followed by a **Read All** to confirm that the OVLO condition is no longer present.

3.9 Undervoltage (UV)

Navigate back to the **Meas** tab and perform a **Read Measurements**. This time make a mental note of the VcMin voltage value and return to the **Voltage** tab. Locate the boxes labeled **0x05 - 04 UV Threshold** and **0x07 - 06 UV recovery**. Change the value in the threshold box to a value ~200mV above the previously read VcMin value, and change the value in the recovery box to a value ~300mV above the previously read VcMin. Perform a **Write Thresh** to write the values followed by a **Read** to confirm the values were set properly. The **UV indicator** on the **Voltage** tab should now be set. Perform a **Read All**. The GUI should display the UV fault that is present and the DFET should be off, as indicated by its gray color as shown in Figure 23.

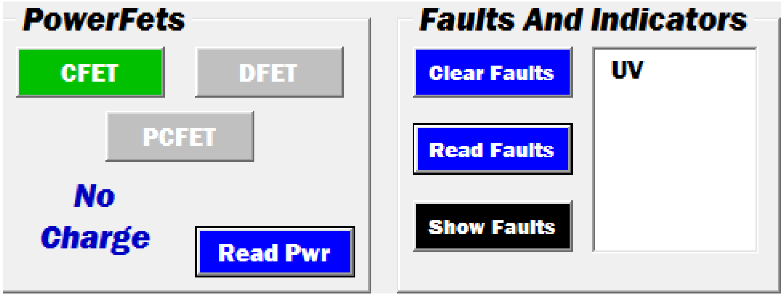


Figure 23. UV Fault

Return to the **Voltage** tab. Return the **UV Threshold** and **UV Recovery** boxes to their default values, then perform a **Write Thresh** followed by a **Read** to set and confirm the original values were set properly.

3.10 Undervoltage Lockout (UVLO)

On the **Voltage** tab locate the box labeled **0x0B - 0A UV Lockout**. Adjust the value in the box to ~100mV above the read VcMin value. Adjust the value in the **UV threshold** box to a value ~200mV above the VcMin value and **UV Recovery** to a value ~300mV above the VcMin value as done previously. Perform a **Write Thresh** to write the thresholds to the device followed by a **Read** to confirm the settings were written properly. The **UVLO indicator** should now be set. Perform a **Read All** and examine the **PowerFets** and **Faults And Indicators** boxes. The DFET should be disabled and the **Faults And Indicators** box should list UVLO as shown in Figure 24.

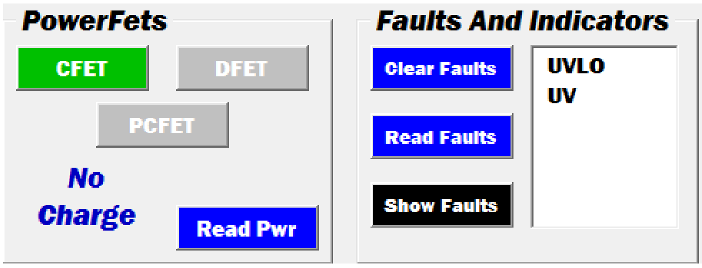


Figure 24. UVLO Fault

Note: The ISL94202 can be configured to power down when a UVLO condition occurs. To enable this, check the box labeled **0x4B.3 Enable UVLO PD** on the bottom of the **Voltage** tab as shown in Figure 25. When the device is in power-down, it can only wake up with a charger detection (**Wake up** button on EvKit). If the cell voltage(s) are below the UVLO threshold the device immediately returns to power-down.

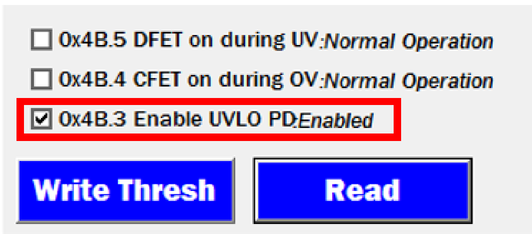


Figure 25. Enable UVLO PD Option

Change the values in the **UV Threshold**, **UV Recovery**, and **UV Lockout** boxes to their original values. Then perform a **Write Thresh** followed by a **Clear Faults**. Next, perform a **Read All** to confirm the settings were written properly and the UV and UVLO faults are no longer present.

3.11 Current Readings

Navigate to the **Meas** tab and perform a **Read Measurements**. The following sections are primarily concerned with the current related measurements shown in Figure 26. The areas to note are the **IPack** measurements, shown both as a voltage and calculated current.

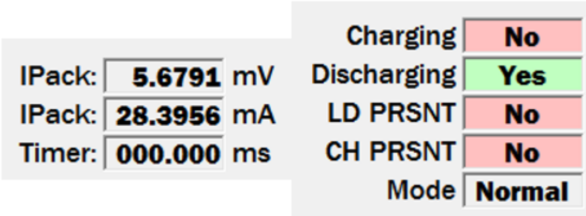


Figure 26. Current Measurements and Indicators

Note: The values displayed in the **IPack** boxes are only accurate if there is enough current for either the Charging or Discharging bits to be set. If they are not set, the data from the IPack measurement cannot be considered reliable. In the GUI this is noted by the **IPack** boxes having a red background, as shown in Figure 27. To simulate a charge or discharge current, apply a voltage across the sense resistors by connecting a floating power supply to the CS1 and CS2 pins.

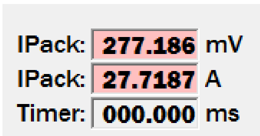


Figure 27. Invalid Current Measurements

3.12 Discharge Overcurrent (DOC)

Configure the board to simulate a discharge current, then navigate to the **Meas** tab and execute **Read Measurements**. Make note of the IPack measurement in mV. Then switch to the **IPack** tab and locate the drop-down menu labeled **0x16 6:4 Discharge Overcurrent Threshold** and select a value from the drop-down menu that is less than the measured IPack voltage. The value is immediately written to the device when it is selected from the drop-down menu. Perform a **Read All** and examine the **PowerFets** and **Faults And Indicators** boxes. Both FETs should be disabled and the DOC should be listed as a fault as seen in Figure 28.

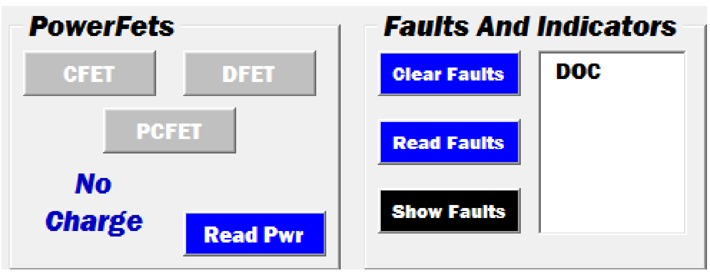


Figure 28. DOC Fault

Return the DOC Threshold to its original value and perform a **Clear Faults** followed by a **Read All** to verify the fault is no longer present.

3.13 Discharge Short-Circuit (DSC)

On the **IPack** tab locate the drop-down menu labeled **0x1B - 1A Discharge Short-Circuit Threshold**. Select a value less than the measured IPack voltage value. The value is immediately written to the device when it is selected from the drop-down menu. Perform a **Read All** and examine the **PowerFets** and **Faults And Indicators** boxes. Both FETs should be disabled and DSC should be listed as a fault as seen in Figure 29.

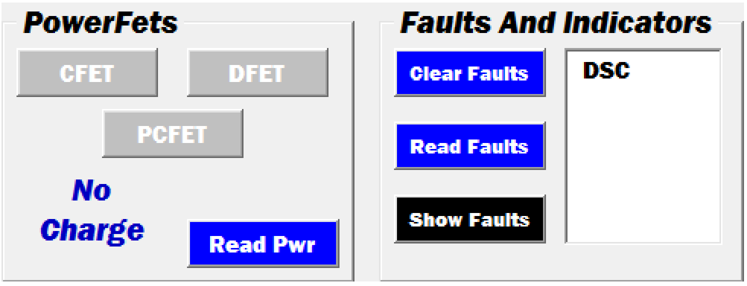


Figure 29. DSC Fault

3.14 Charge Overcurrent (COC)

Configure the board to simulate a charge current, then navigate to the **Meas** tab and execute **Read Measurements**. Confirm the charging indicator is set and make note of the IPack mV value. Return to the **IPack** tab and locate the drop-down menu labeled **0x18.6:4 Charge Overcurrent Threshold**. Select a value from the drop-down list lower than the previously read IPack mV value. The value is immediately written to the device when it is selected from the drop-down menu. Perform a **Read All** and examine the **PowerFets** and **Faults And Indicators** boxes. Both FETs should be disabled and the COC should be listed as a fault as seen in Figure 30.

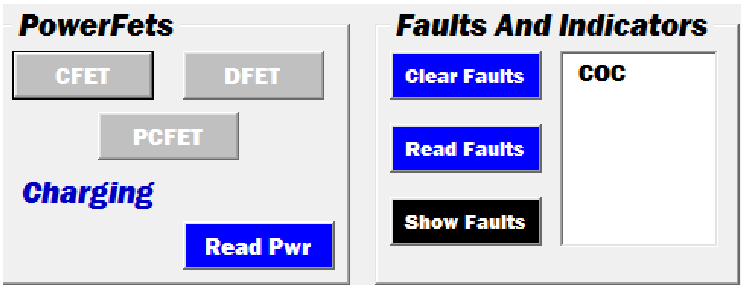


Figure 30. COC Fault

3.15 Internal Over-Temperature (IOT)

Navigate to the **Meas** tab and perform a **Read Measurements**. Locate the various temperature related measurements shown in Figure 31.

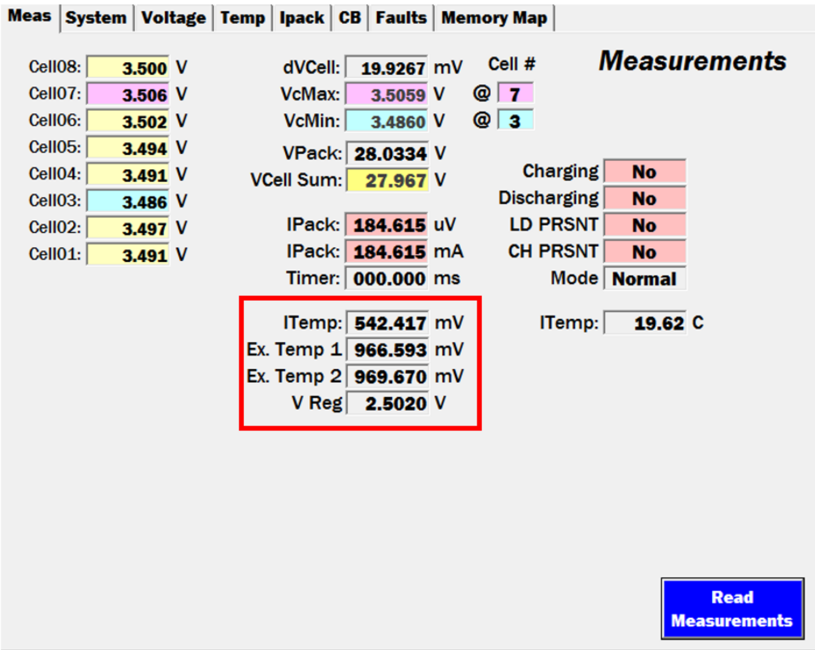


Figure 31. Temperature Related Measurements

Make note of the displayed ITemp value. Navigate to the **Temp** tab and locate the boxes labeled **0x41 - 40 Internal OT Voltage** and **0x43 - 42 Internal OT Recovery Voltage** as shown in Figure 32.

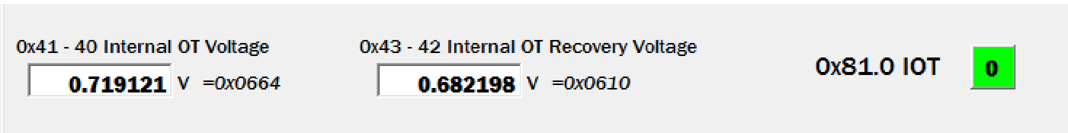


Figure 32. Internal Over-Temperature Thresholds

Change the value in the **Internal OT Voltage** box to a value ~150mV less than the measured ITemp voltage. Change the value in the **Internal OT Recovery Voltage** box to a value ~100mV less than the measured ITemp voltage. Perform a **Write Thresh** to write the settings to the device then a **Read** to confirm the setting was written properly. The **IOT fault indicator** on the **Temp** tab should now be set. Perform a **Read Faults** in the **Faults And Indicators** box and a **Read Pwr** in the **PowerFets** box. The **Faults and Indicator** section should display that an IOT fault is present, and CFET and DFET should both be disabled as shown by their gray color, as seen below in Figure 33.

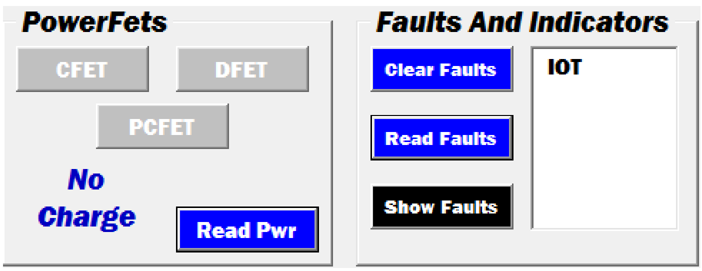


Figure 33. IOT Fault

Return the IOT Voltage and IOT Recovery Voltage values to their original values and perform a **Write Thresh**. Then perform a **Clear Faults** followed by a **Read All** to confirm that the IOT Voltage values were properly set and the IOT fault is no longer present.

3.16 Charge Over-Temperature (COT)

Go to the **Meas** tab and perform a **Read Measurements**. Make note of the Ex. Temp 1 and Ex. Temp 2 values. Switch to the **Temp** tab and locate the boxes labeled **0x31 - 30 Charge OT Voltage** and **0x33 - 32 Charge OT Recovery Voltage** as shown in Figure 34.

Note: For the COT/CUT and DOT/DUT faults to set, the corresponding charge/discharge current direction bit must also be set.

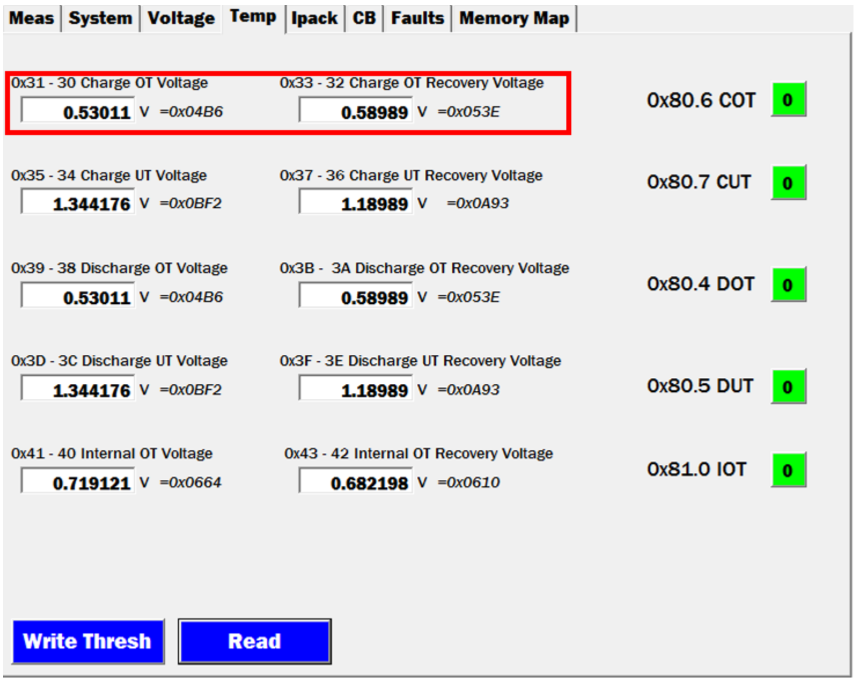


Figure 34. Charge Over-Temperature Thresholds

Replace the value in the **Charge OT Voltage** box with a value 50mV above the Ex. Temp 1 and Ex. Temp 2 values. Replace the value in the **Charge OT Recovery Voltage** box with a value 100mV above the Ex. Temp 1 and Ex. Temp 2 values. Perform a **Write Thresh** followed by a **Read** to set the new voltage thresholds and confirm they were properly set. The **COT indicator** on the **Temp** tab should now be set. Perform a **Read All** and examine the **PowerFets** and **Faults And Indicators** boxes. The CFET should now be disabled and COT should be listed in the **Faults And Indicators** box as seen in Figure 35.

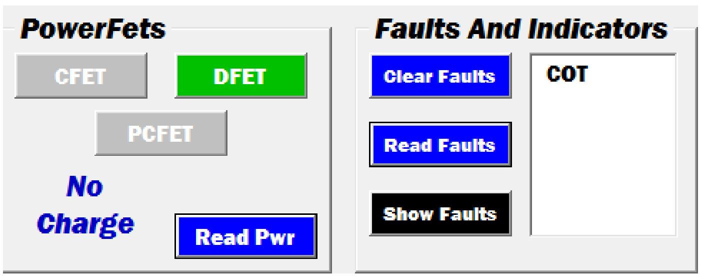


Figure 35. COT Fault

Change the Charge OT Voltage and Charge OT Recovery voltages to their default values and perform a **Write Thresh** followed by a Clear Faults. Perform a **Read All** to confirm the voltage thresholds were written properly and the fault is no longer present.

3.17 Charge Under-Temperature (CUT)

On the **Temp** Tab locate the boxes labeled **0x35 - 34 Charge UT Voltage** and **0x37 - 36 Charge UT Recovery Voltage** shown in Figure 36.

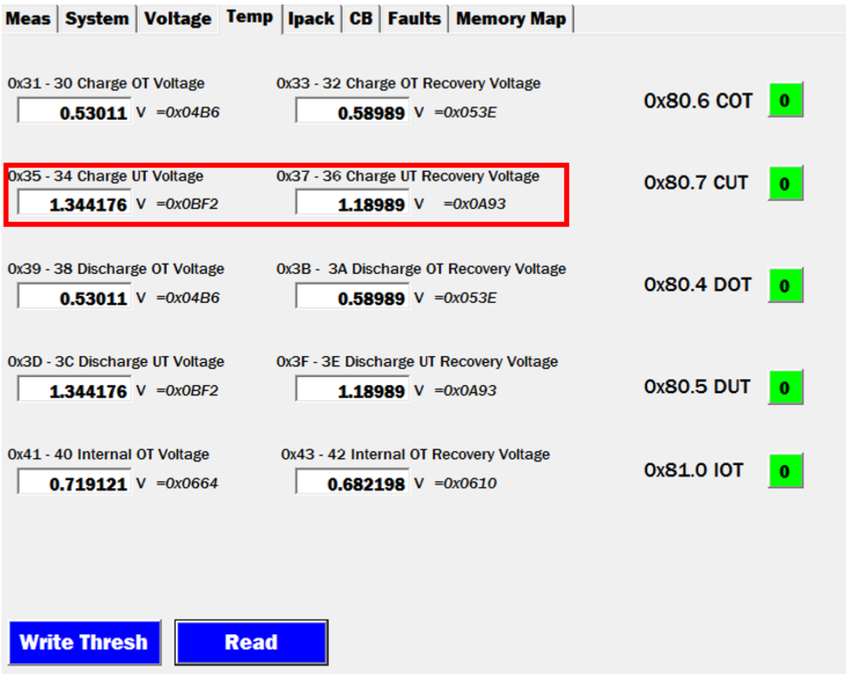


Figure 36. Charge Under-Temperature Thresholds

Replace the value in the **Charge UT Voltage** box with a value ~50mV below the measured Ex. Temp 1 and Ex. Temp 2 values and replace the value in the **Charge UT Recovery Voltage** box with a value ~100mV below the measured Ex. Temp 1 and Ex. Temp 2 values. Perform a **Write Thresh** followed by a **Read** to write the thresholds to the device and confirm they were written properly. The **CUT indicator** on the **Temp** tab should now be set. Perform a **Read All** and examine the **PowerFets** and **Faults And Indicators** blocks. The DFET should be disabled and CUT should be listed in the **Faults And Indicators** box as shown in Figure 37.

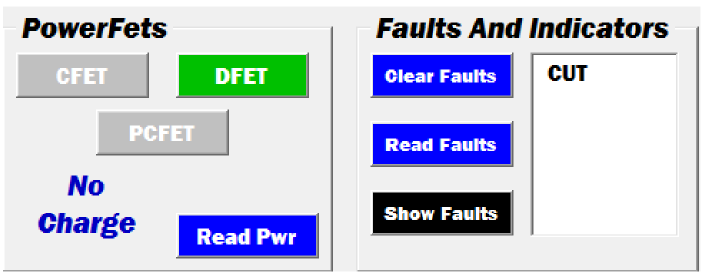


Figure 37. CUT Fault

Write the Charge UT Voltage and Charge UT Recovery Voltage values to their original value and perform a **Write Thresh**. Next, perform a **Read All** to confirm the voltage thresholds were set properly and the CUT fault is no longer present.

3.18 Discharge Over-Temperature (DOT)

On the **Temp** tab locate the boxes labeled **0x39 - 38 Discharge OT Voltage** and **0x3B - 3A Discharge OT Recovery Voltage**, highlighted in Figure 38.

Note: For the DOT/DUT faults to set, the discharge current direction bit must also be set.

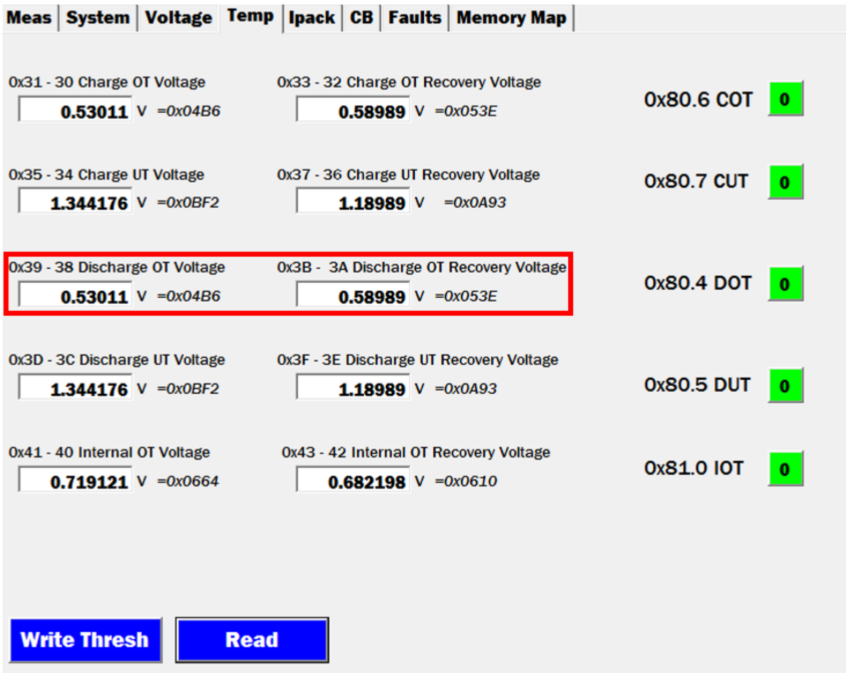


Figure 38. Discharge Over-Temperature Thresholds

Replace the value in the **Discharge OT Voltage** box with a value 50mV above the Ex. Temp 1 and Ex. Temp 2 values. Replace the value in the **Discharge OT Recovery Voltage** box with a value 100mV above the Ex. Temp 1 and Ex. Temp 2 values. Perform a **Write Thresh** followed by a **Read** to set the new voltage thresholds and confirm they were properly set. The **DOT indicator** on the **Temp** tab should now also be set. Perform a **Read All** and examine the **PowerFets** and **Faults And Indicators** boxes. The DFET should be disabled, and DOT should be listed in the **Faults and Indicator** box as seen in Figure 39.

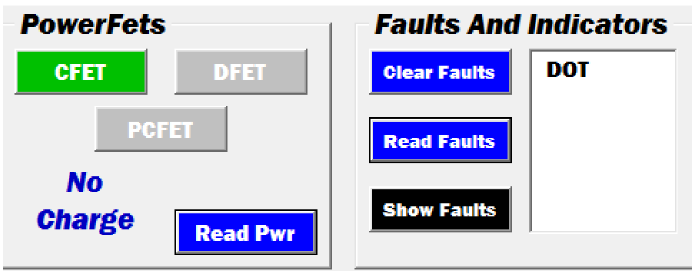


Figure 39. DOT Fault

Write the Discharge OT Voltage and Discharge OT Recovery Voltage values to their original values and perform a **Write Thresh**. Next, perform a **Read All** to confirm the voltage thresholds were set properly and the DOT fault is no longer present.

3.19 Discharge Under-Temperature (DUT)

On the **Voltage** tab locate the boxes labeled **0x3D - 3C Discharge UT Voltage** and **0x3F - 3E Discharge UT Recovery Voltage** shown in Figure 40.

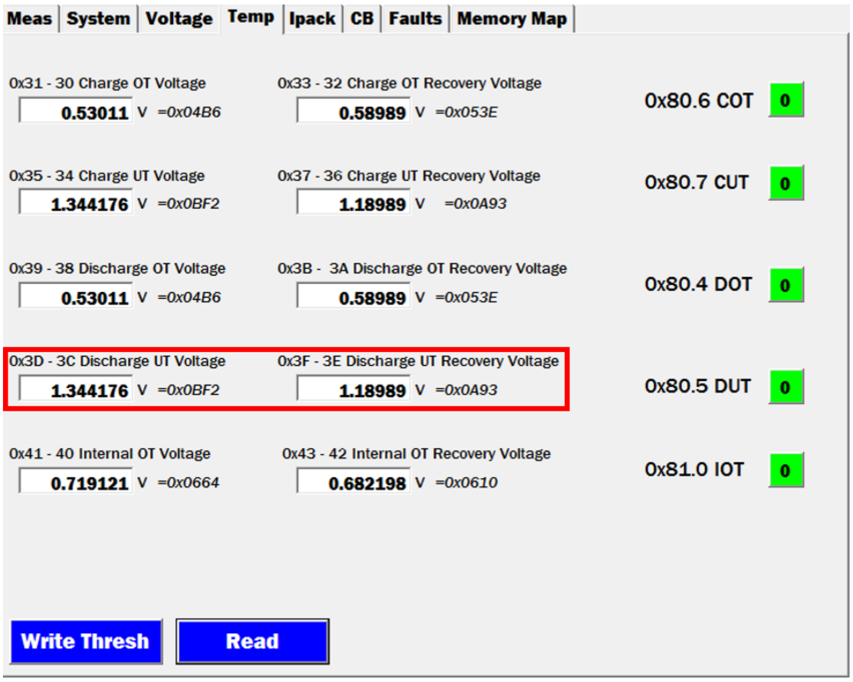


Figure 40. Discharge Under-Temperature Thresholds

Replace the value in the **Discharge UT Voltage** box with a value ~50mV below the measured Ex. Temp 1 and Ex. Temp 2 values and replace the value in the **Discharge UT Recovery Voltage** box with a value ~100mV below the measured Ex. Temp 1 and Ex. Temp 2 values. Perform a **Write Thresh** followed by a **Read** to write the thresholds to the device and confirm they were written properly. The **DUT indicator** on the **Temp** tab should now be set. Perform a **Read All** and examine the **PowerFets** and **Faults And Indicators** blocks. The DFET should be disabled and DUT should be listed in the **Faults And Indicators** box as shown in Figure 41.

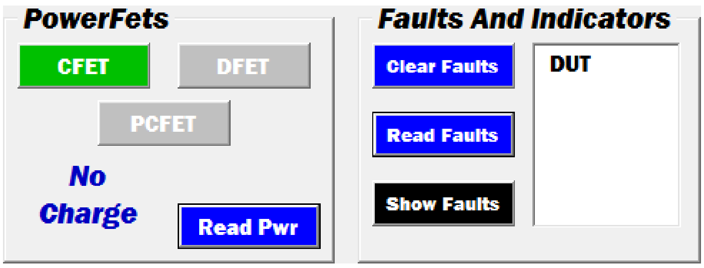


Figure 41. DUT Fault

Restore the Discharge UT Voltage and Discharge UT Recovery Voltage values back to their original values and perform a **Write Thresh** followed by a **Clear Faults**. Next, perform a **Read All** to confirm the voltage thresholds were written properly and the fault is no longer present.

3.20 Cell Fail

Go to the **Meas** tab and perform a **Read Measurements**. Locate the dVCell value (highlighted in Figure 42).

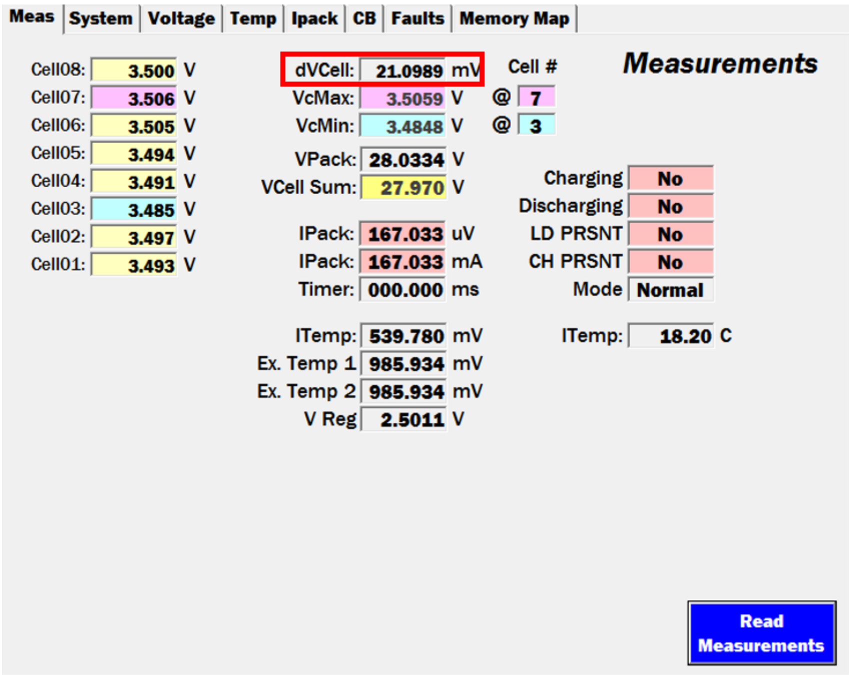


Figure 42. dVCell Value

Switch to the **CB** tab and locate the boxes labeled **0x21 - 20 CB Min Delta Threshold** and **0x23 - 22 CB Max Delta Threshold** (highlighted in Figure 43).

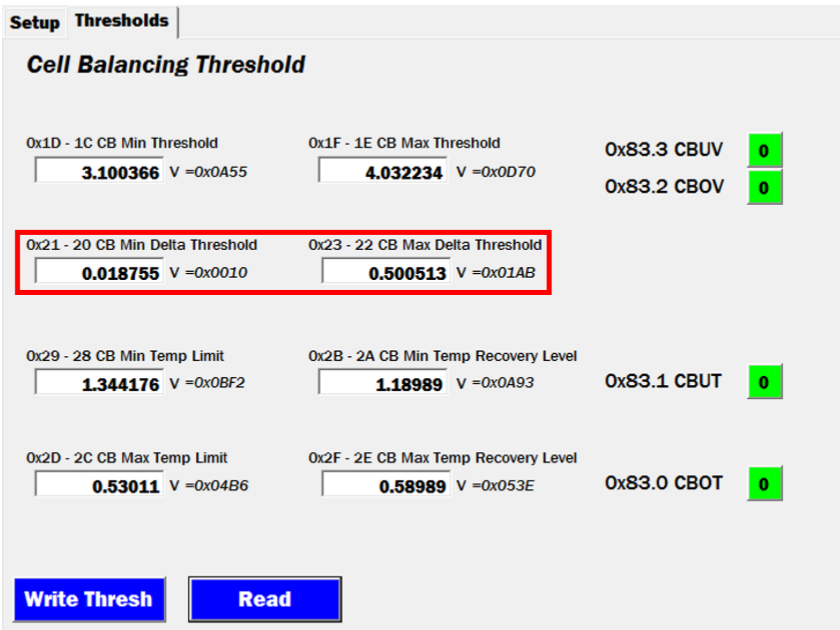


Figure 43. Cell Balance Delta Thresholds

Replace the value in the **CB Min Delta Threshold** box with a 0. Replace the value in the **CB Max Delta Threshold** with a value beneath the previously read dVCell. Perform a **Write Thresh** followed by a **Read** and confirm the thresholds were set properly. Next, perform a Read All and examine the Powerfets box and Faults And Indicators box. The CFET and DFET should be disabled and the **Faults And Indicators** box should list CELL FAIL as shown in Figure 44.

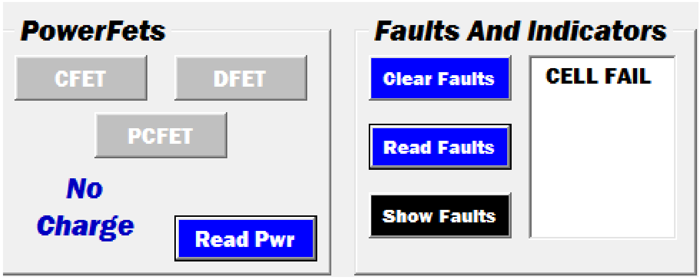


Figure 44. Cell Fail Fault

Return the CB Min Delta Threshold and CB Max Delta Threshold to their original values and perform a **Write Thresh**. Next, perform a **Read All** to confirm the thresholds were written properly.

Switch to the **System** tab and look at the group of check boxes labeled **0x4A System Settings** (highlighted in Figure 45). Check Bit 7 **CELL PSD** and press the **Write** button, followed by a **Read**. The box should remain checked indicating the bit was successfully written to the device. Perform the same steps to create a cell fail condition and examine the ISL94202 evaluation board. The PSD LED should now be illuminated. This is because the CELLF PSD causes the device to drive the PSD pin high when a CELLF condition occurs.

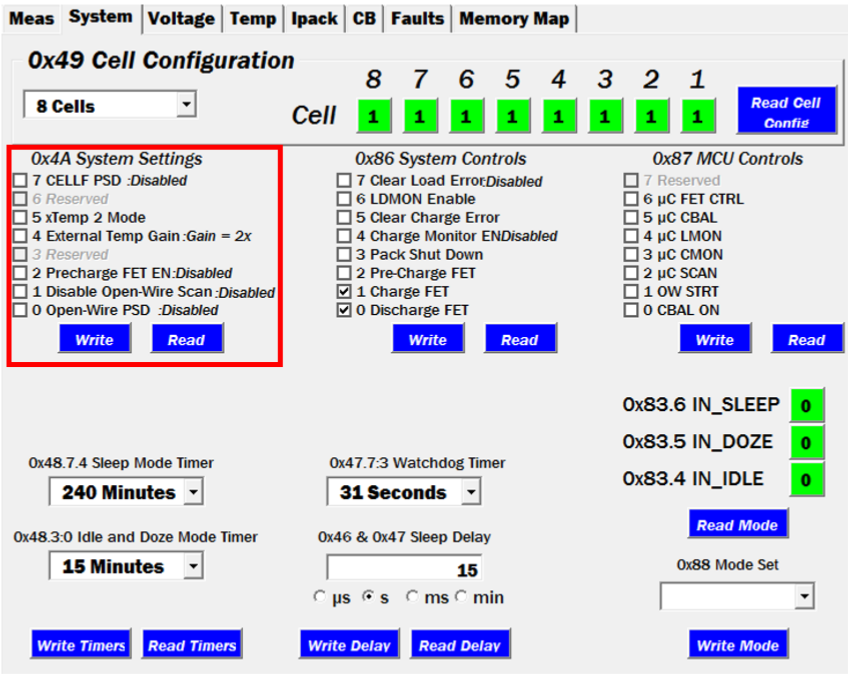


Figure 45. System Settings Register Control Area

4. Demonstration GUI

The evaluation GUI includes a demonstration GUI designed to highlight some of the key features and behaviors of the ISL94202.

4.1 Launching the GUI

To launch the demonstration, first press the green **Connect** button. If the device is not connected, the demonstration GUI does not launch and you are prompted with an error message. After connecting, press the **Launch Demo** button to bring up the demo GUI.

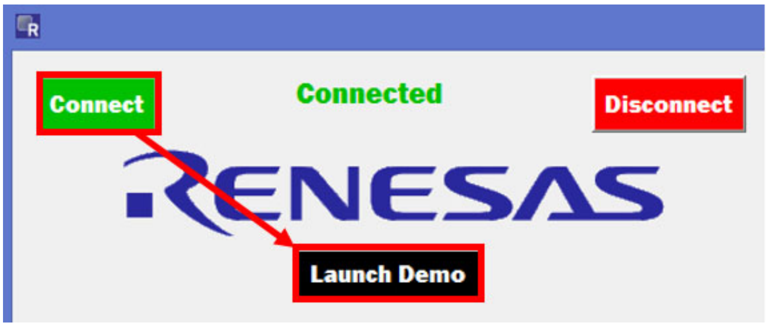


Figure 46. Launching the Demo GUI

4.2 Initializing the Demonstration GUI

After launching the demo GUI press the **Demo Init** button on the left side of the GUI. This configures the ISL94202 with settings appropriate for demonstration then reads these settings into the GUI.

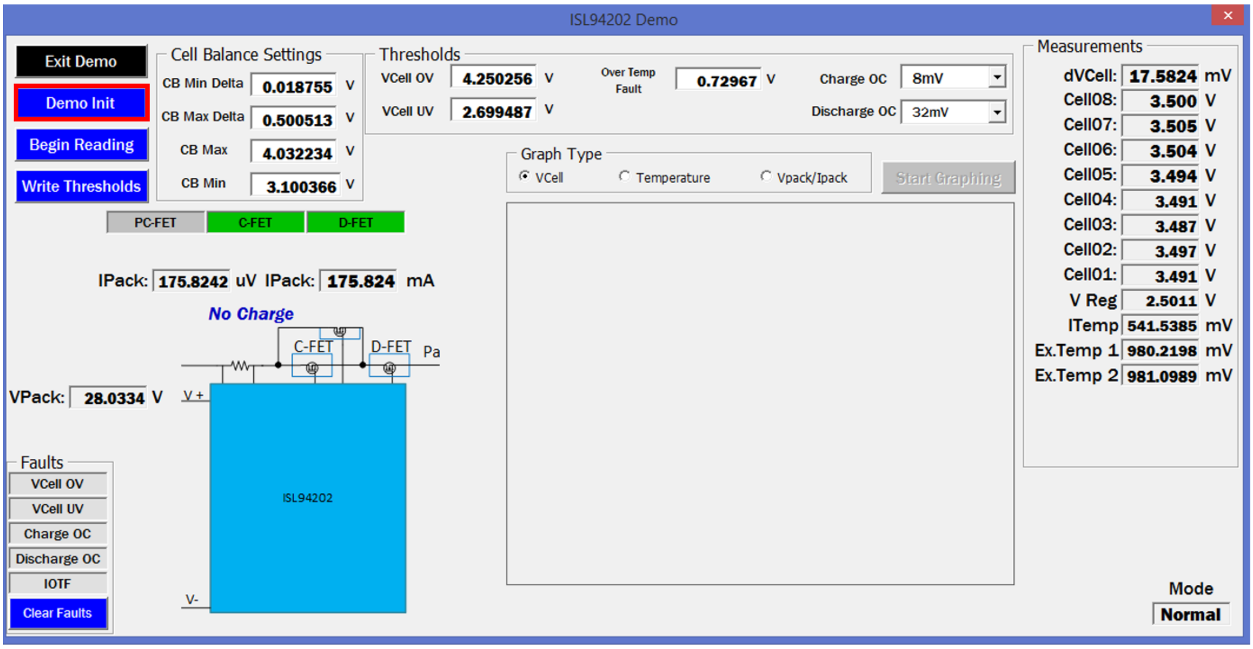


Figure 47. Demo Init Button

4.3 Demonstration System Read

The **Begin Reading** button (highlighted below) causes the GUI to begin continuously reading all relevant information from the device into the demonstration GUI. This begins a continuous read in which the GUI updates with the latest information from the device every two seconds.

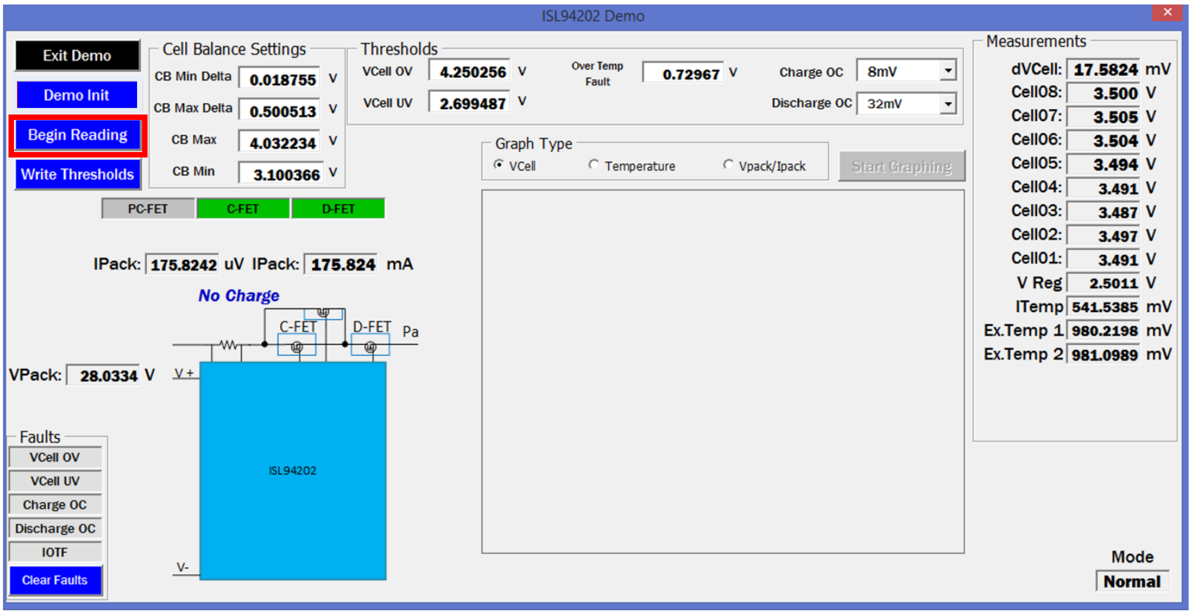


Figure 48. Begin Reading Button

4.4 Demonstration Graphing

The demonstration GUI enables graphing of measurements of interest versus time.

Note: The graphing function must generate an image in the directory in which the workbook is stored to function properly.

To use the graphing function a continuous read must be in progress, otherwise the **Start Graphing** button is grayed out and locked.

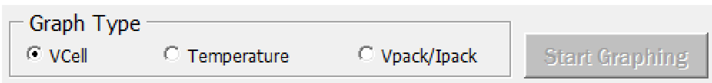


Figure 49. Graph Type Options

When a continuous read has been started, the **Start Graphing** button can be pressed. The graph displays information based on which option is selected in the **Graph Type** section. The VCell option displays the voltage of each cell, the temperature option shows both internal and auxiliary temperatures, and the VPack/IPack option shows the VPack and IPack values. When graphing has started you can freely switch between the three graph types without erasing the data for any of them.

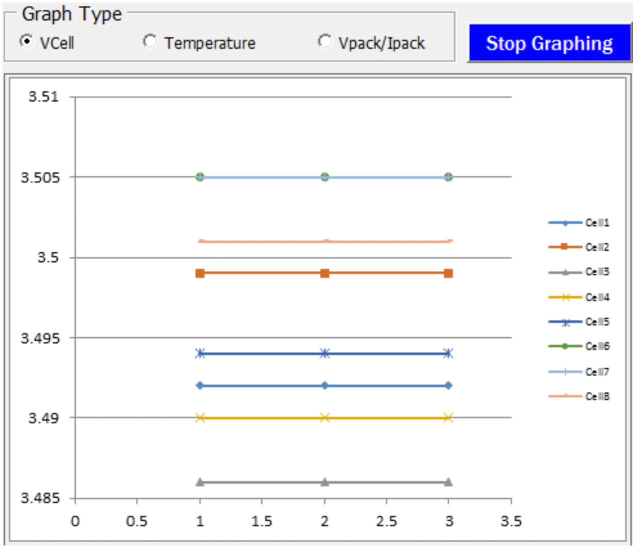
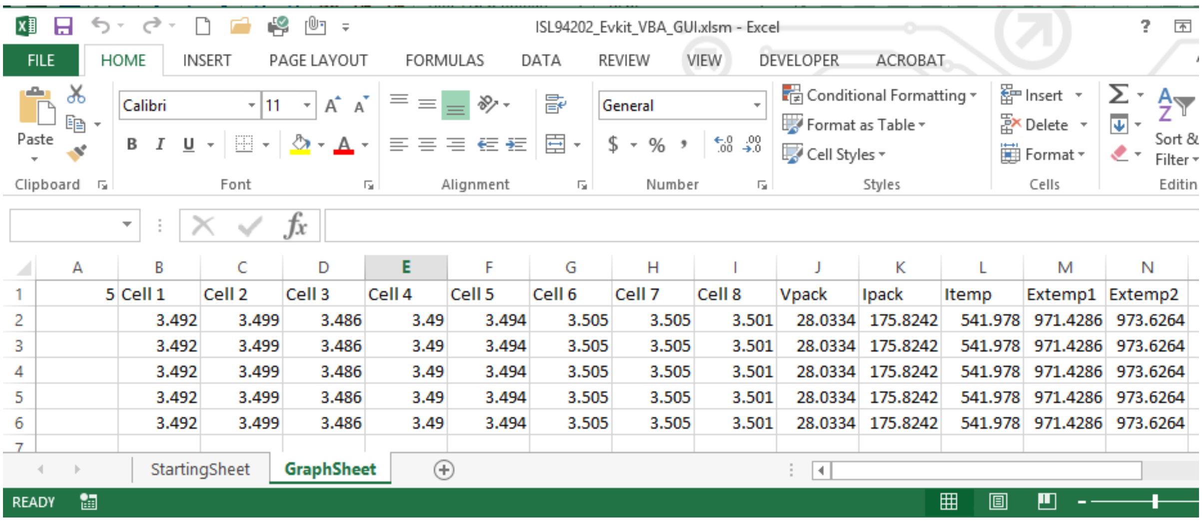


Figure 50. Demo Graph Example

If you want to more closely examine the data that is used to make the graphs, it can be seen on the **Graph Sheet** tab of the GUI workbook. This data gets erased every time **Start Graphing** is pressed.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	5	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7	Cell 8	Vpack	Ipack	Itemp	Extemp1	Extemp2
2		3.492	3.499	3.486	3.49	3.494	3.505	3.505	3.501	28.0334	175.8242	541.978	971.4286	973.6264
3		3.492	3.499	3.486	3.49	3.494	3.505	3.505	3.501	28.0334	175.8242	541.978	971.4286	973.6264
4		3.492	3.499	3.486	3.49	3.494	3.505	3.505	3.501	28.0334	175.8242	541.978	971.4286	973.6264
5		3.492	3.499	3.486	3.49	3.494	3.505	3.505	3.501	28.0334	175.8242	541.978	971.4286	973.6264
6		3.492	3.499	3.486	3.49	3.494	3.505	3.505	3.501	28.0334	175.8242	541.978	971.4286	973.6264

Figure 51. Graph Data in Workbook

4.5 Demonstration Threshold Modification

Demo Init sets some of the key thresholds in the ISL94202 to values more useful than that of the default values, but these values may need to be modified further. To modify any of the available settings, simply change the value in the boxes, then press the **Write Thresholds** button. A system read should be performed to confirm the settings were written correctly.

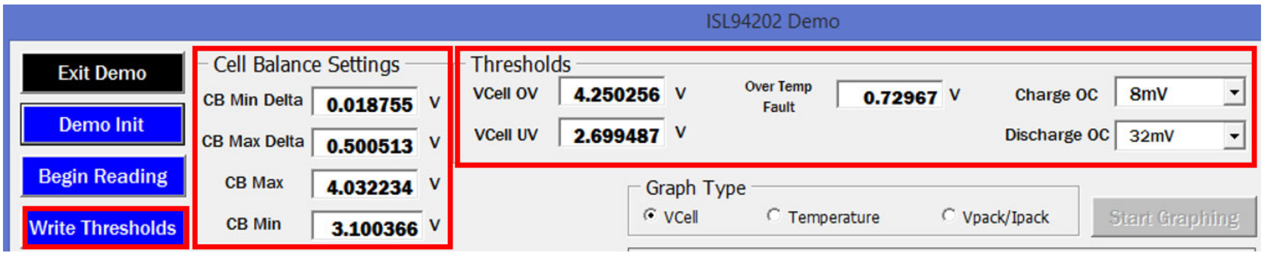


Figure 52. Demonstration Fault and Cell Balance Thresholds

4.6 Demonstration Fault Indicators/Clearing

The bottom left side of the screen provides fault indicators. If any of the faults listed are detected during a scan, the corresponding **Fault** box turns red. This can be seen for VCell OV in Figure 53. Pressing **Clear Faults** writes these bits to 0, but keep in mind some faults cannot be written low while the fault condition persists.

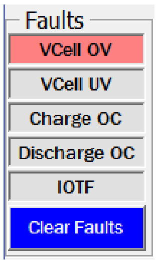


Figure 53. Demonstration Fault Display

4.7 Exiting the Demonstration GUI

To return to the evaluation GUI from the demonstration GUI simply press the **Exit Demo** button in the top left corner of the display.

Figure 54. Demonstration Exit Button

A. Appendix

A.1 Appendix A - GUI Overview

The values displayed in Figure 55 are the factory default values. This tab functions identically to the ISL94202 Standalone EEPROM Programmer GUI. For detailed instructions on proper programming, see the ISL94202 EEPROM Programmer User's Guide.

The **Memory Map** tab displays the values of all registers that have EEPROM associated with them or the User EEPROM space. The **Display Factory Defaults** button updates the GUI to show the default values for the EEPROM. The **Read Registers** button updates the **Memory Map** tab for values 0x00 through 0x4B with the values that are currently stored in the connected device shadow registers. **Read EEPROM** updates the **Memory Map** tab with the values stored in the device EEPROM, including the User EEPROM space. The **Read File** button updates the **Memory Map** tab from your selected text file. Text files are generated by the evaluation GUI, stand-alone EEPROM programmer, and legacy ISL94202 evaluation GUI.

Note: Display Factory Defaults, **Read File**, **Read EEPROM**, and **Read Registers** only update the values displayed in the **Memory Map** tab, it does not update the values in the device. The **Write Registers** button updates the shadow registers associated with addresses 0x00 through 0x04B with the values displayed in the Memory Map. The **Write EEPROM** button updates the EEPROM for addresses 0x00 through 0x04B and the User EEPROM. The **Write File** button allows you to create a text file copy of the Memory Map.

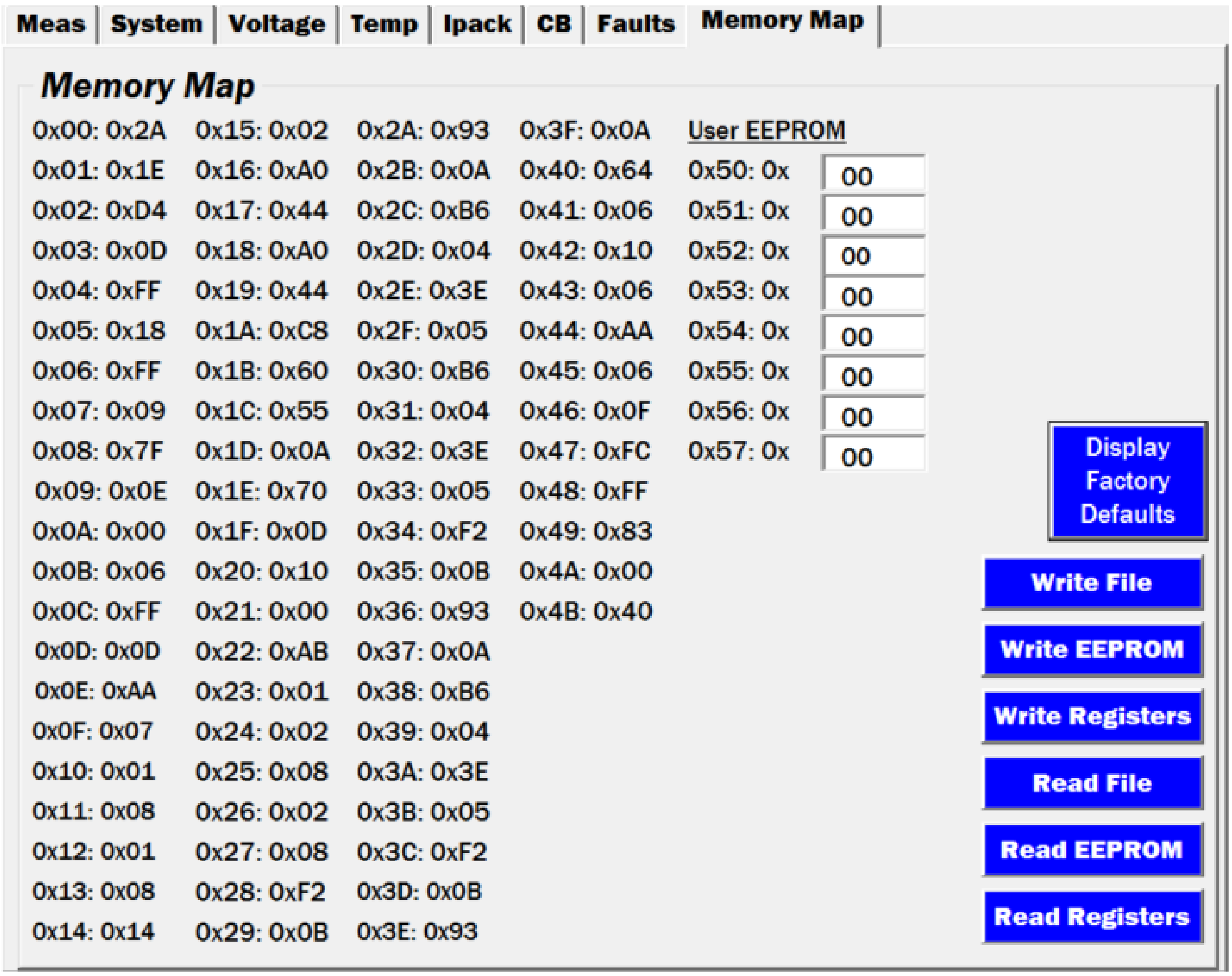


Figure 55. Factory Default Values

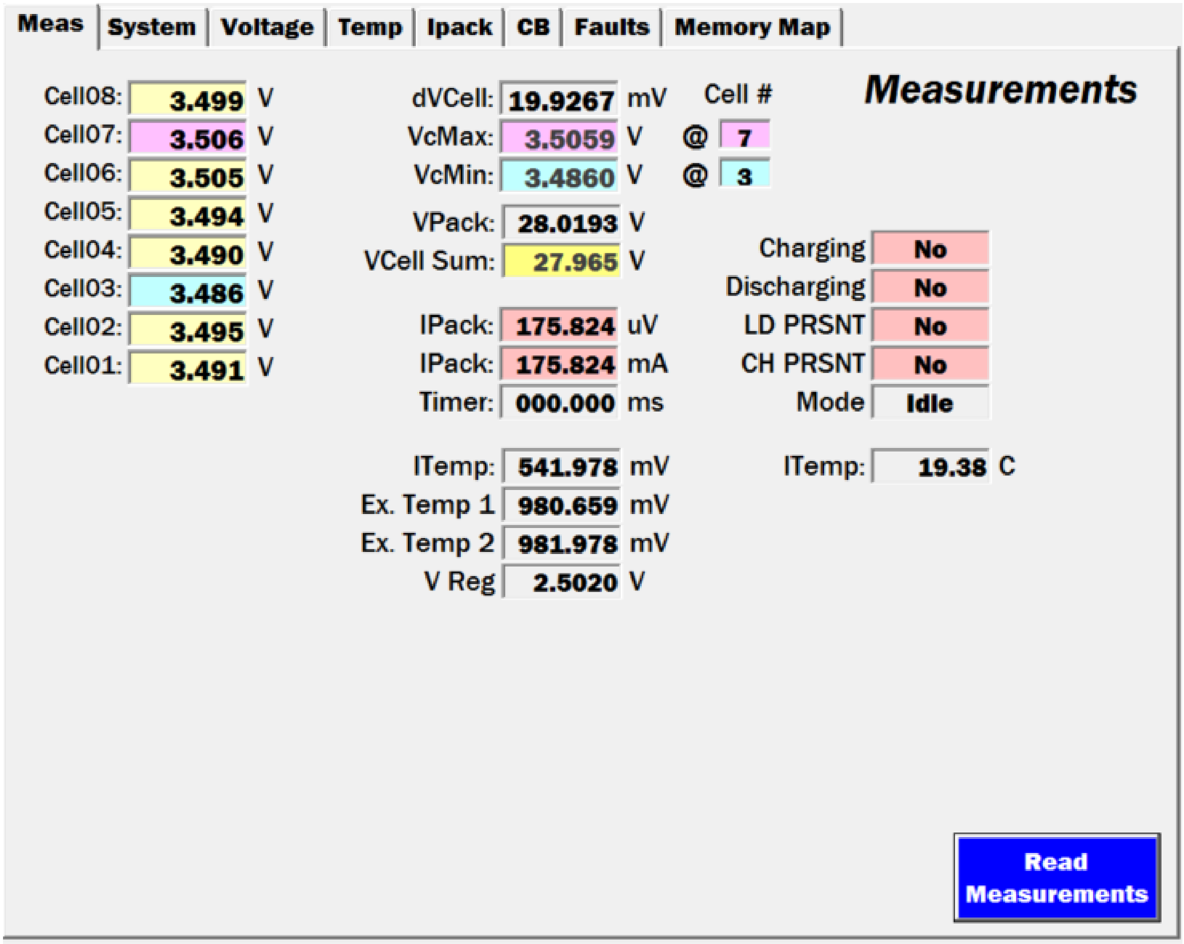


Figure 56. Measurement Tab

The **Meas** tab allows you to see the ISL94202 measurement results from a scan. The equations used to convert from the digital value to the displayed measurement value can be found in the *ISL94202 Datasheet* and the included GUI source code.

The IPack current measurement is calculated by dividing the IPack voltage by the RSense resistor value stored on the **IPack** tab.

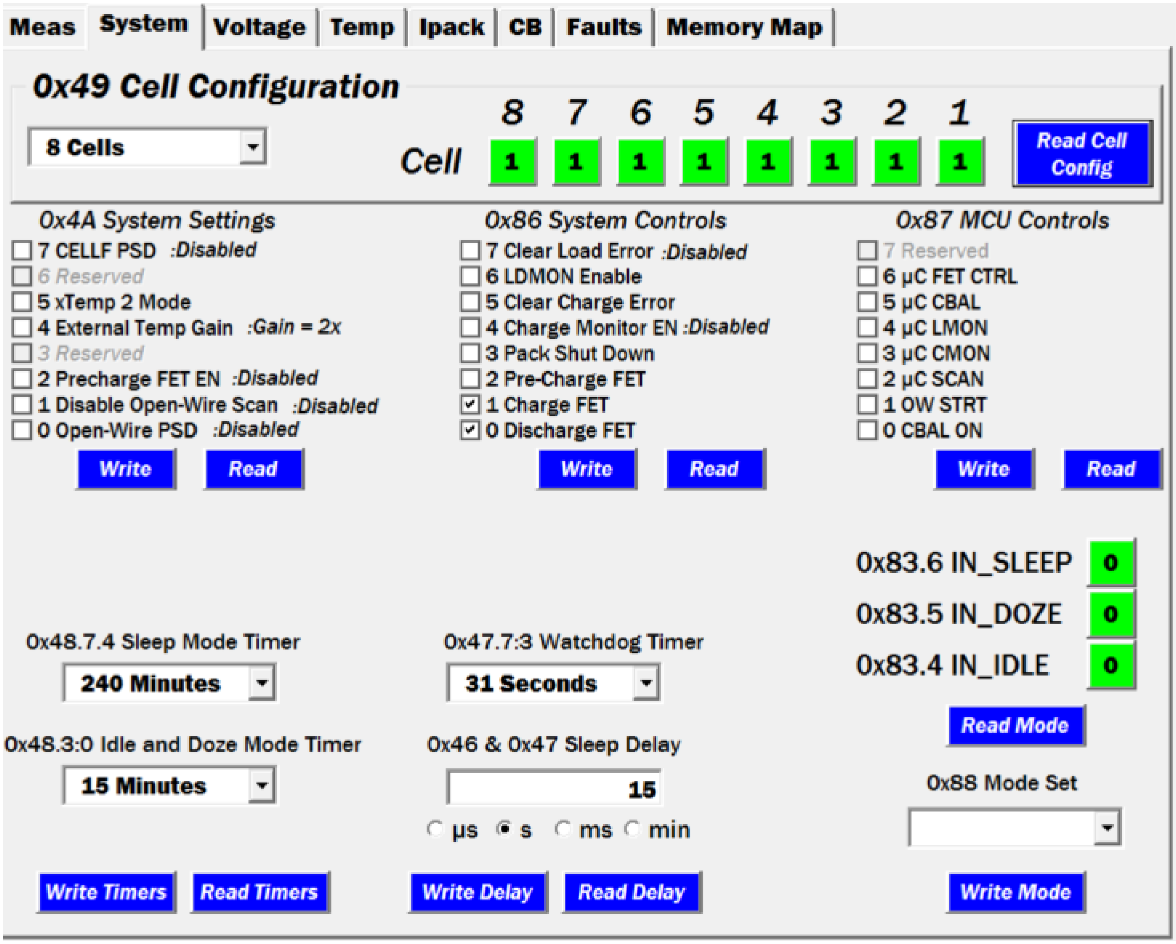


Figure 57. System Tab

The **System** tab contains various settings related to overall system behavior including which cells are present, mode transition timers and delays, mode status bits, and other miscellaneous options.

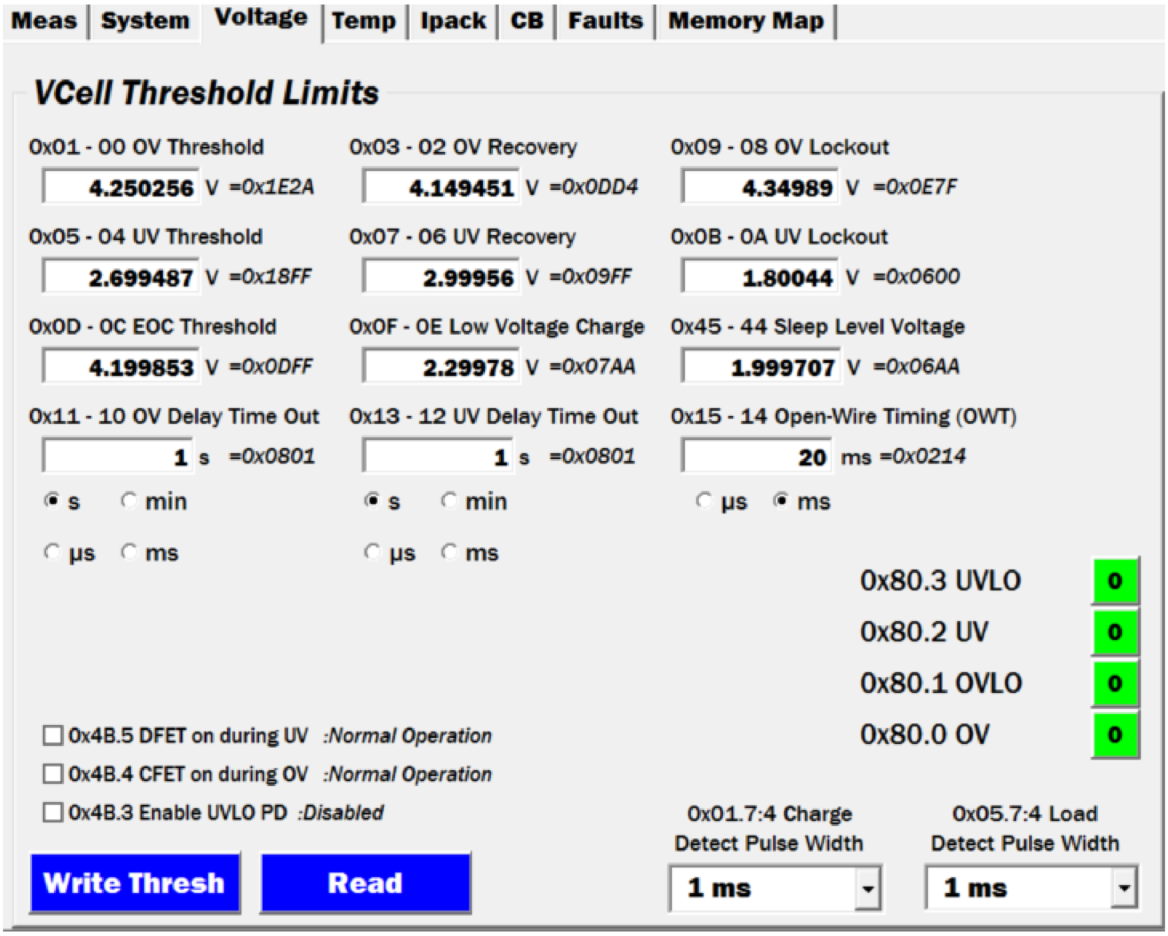


Figure 58. Voltage Tab

The **Voltage** tab allows you to view and change various thresholds and settings related to cell voltage. Options include the overvoltage and undervoltage fault thresholds, recovery thresholds, and delay time outs. Additional voltage options include the sleep level voltage, low voltage charge level, and end-of-charge voltage. There are a number of miscellaneous settings including if DFET can be on during an undervoltage condition, CFET can be on during an overvoltage condition, UVLO causing PD, charge detect pulse width, and load detect pulse width. The UVLO, UV, OVLO, and OV fault status indicators are also found on this tab.

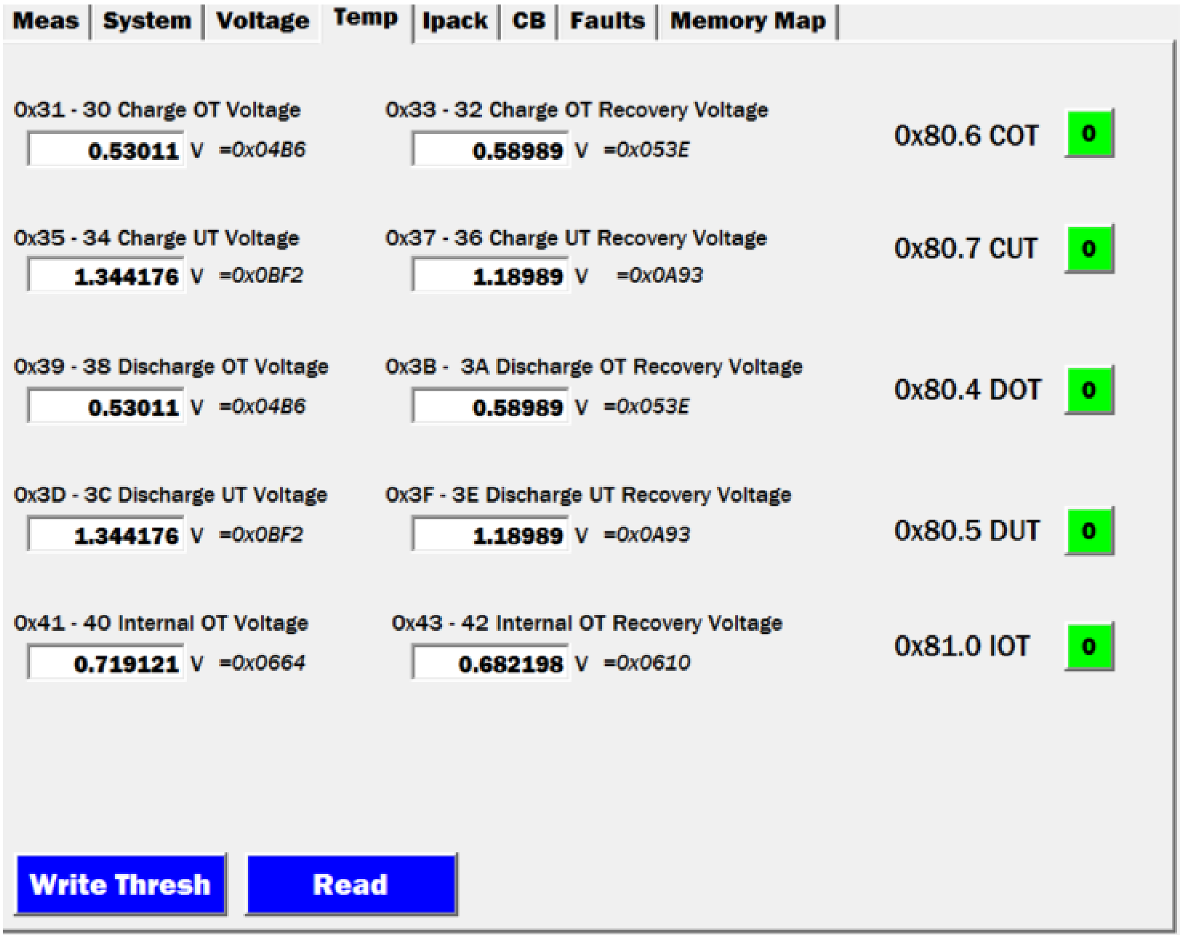


Figure 59. Temperature Tab

The **Temp** tab allows you to view and change various settings related to temperature fault and recovery thresholds. See the *ISL94202 Datasheet* for additional information on temperature conversions and calculations. The various temperature fault indicators are also duplicated on this tab.

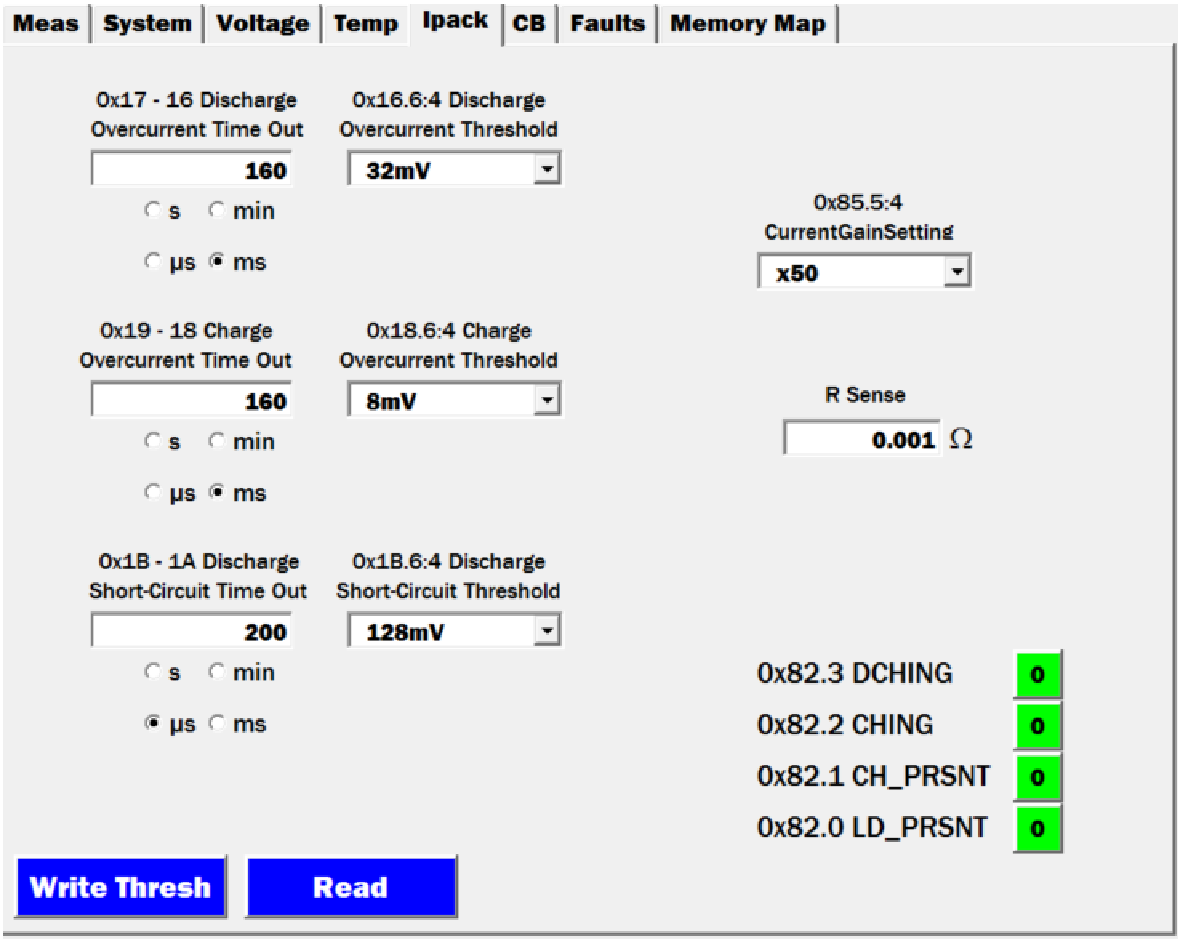


Figure 60. IPack Tab

The **IPack** tab allows you to view and modify settings related to pack current. The discharge overcurrent, charge overcurrent and discharge short-circuit thresholds, and timeouts can be adjusted on this tab along with the current gain setting. Importantly, this is where you can set the RSense value the GUI uses to calculate the current displayed on the **Meas** tab. Press **Write Thresh** to store the value after changing it.

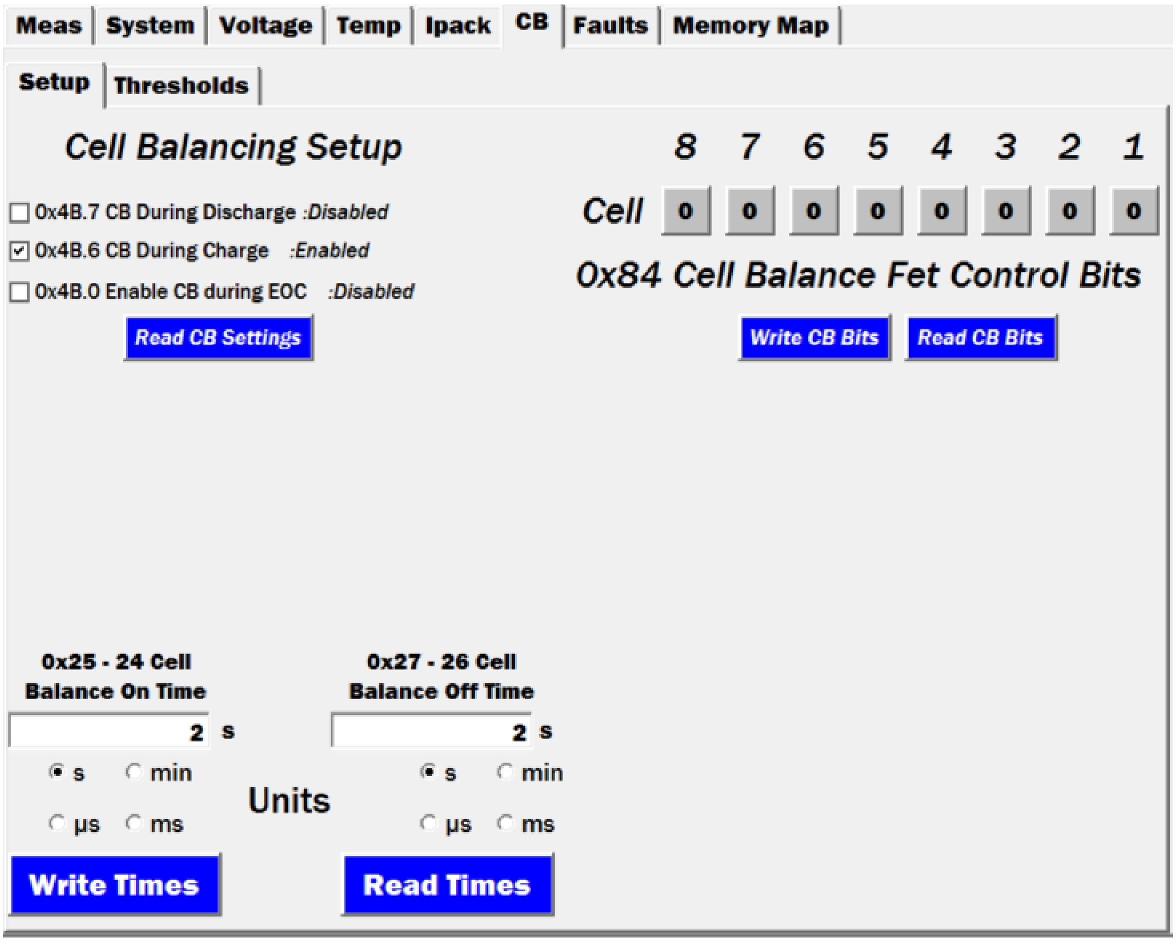


Figure 61. Cell Balance Tab

The **CB** or **Cell Balance** tab is comprised of two sub-tabs. The first sub-tab is the **Setup** tab. This tab contains configuration options for cell balancing behavior, including the cell balance on-time and off -time and if cell balancing can occur during discharge, charge, or end-of-charge. The Cell Balance FET Control Bits can also be read and written to on this tab. See the *ISL94202 Datasheet* before attempting to use these bits, as they require certain settings related to MCU control options (register 0x87, see **Systems tab**) being enabled or disabled.

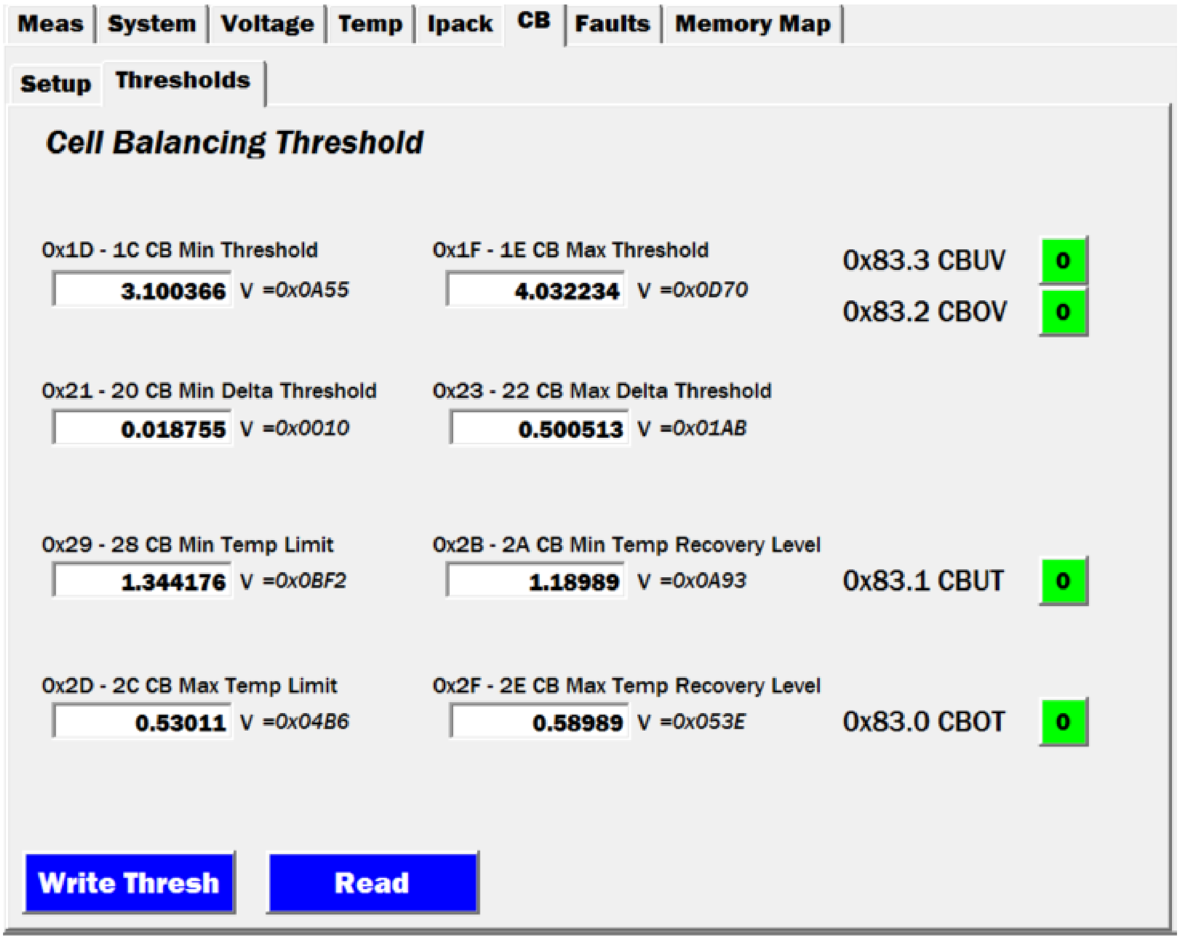


Figure 62. Threshold Tab

The second sub-tab in the **CB** tab is the **Threshold** tab. This tab allows you to view and modify thresholds related to cell balancing. These include the various voltage and temperature limits in which cell balancing is allowed to occur. The fault indicators related to cell balancing are also duplicated on this tab.

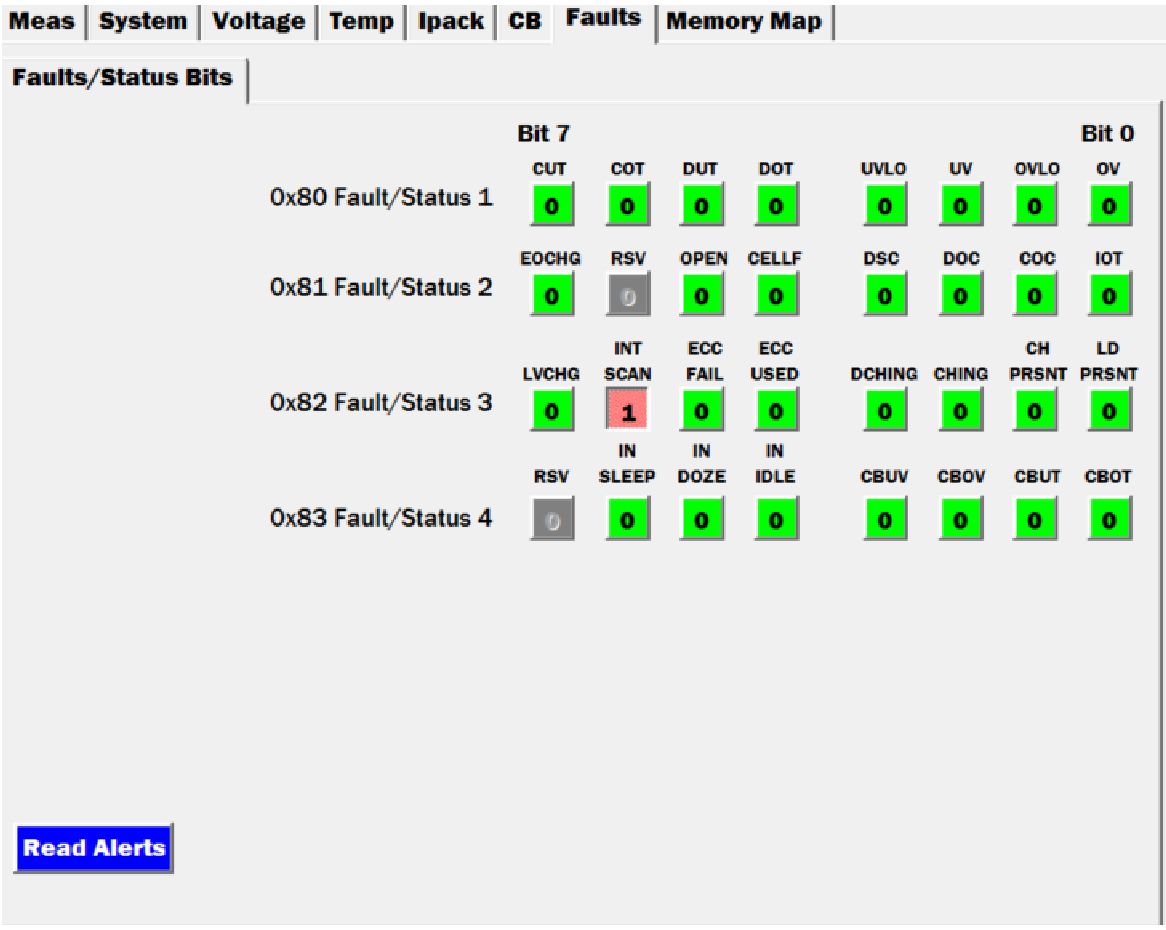


Figure 63. Faults Tab

The **Faults** tab shows the status of the various fault and status bits contained in the ISL94202.

5. Revision History

Rev.	Date	Description
1.01	Dec 12, 2023	Applied latest template. Updated page 1 information.
1.00	Sep 12, 2019	Initial release

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