User's Manual

ISL94202 EEPROM Programming GUI

User's Manual: Software

Battery and Optical Systems

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ISL94202 EEPROM Programming GUI

Software User's Manual

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1. Overview

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 guidance by example for programming the device configuration EEPROM. This document assumes the reader is familiar with the operation of the ISL94202 and the evaluation kit hardware and software as a prerequisite. See the ISL94202 datasheet for more details about the settings used in this document.

The information in this document also applies to the ISL94203.

1.1 Key Features

- The ISL94202 EEPROM Programming GUI communicates with the ISL94202 I^2C port using a USB to I^2C conversion dongle
- The ISL94202 EEPROM Programming GUI supports both standard and isolated dongles (see "Dongles" on page 7)
- Programs, reads, and saves both configuration EEPROM and control Registers
- Includes verification of EEPROM programming
- Automated sequence prevents programming errors
- Customizable Excel Visual Basic for Applications source code is included

1.2 Specifications

The EEPROM Programming GUI is backwards compatible with released versions of the ISL94202 and ISL94203 devices, Evaluation Kits, GUI, and dongles. Simple text based configuration files created using the evaluation kit GUI are interchangeable with the EEPROM Programming GUI.

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

1.3 Ordering Information

Part Number	Description
ISL94202IRTZ	ISL94202 48 Ld TQFN
ISL94202EVKIT1Z	ISL94202 evaluation kit, includes standard dongle
ISO-DONGLE1Z	Isolated USB to I^2C conversion dongle
ISL94203IRTZ	ISL94203 48 Ld TQFN
ISL94203EVKIT1Z	ISL94203 evaluation kit, includes standard dongle

1.4 Related Literature

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

- ISL94202 device page
- ISL94203 device page

2. Functional Description

The ISL94202 EEPROM Programming GUI supports writing the device configuration EEPROM to permanently store the device settings in case of a loss of power. On power up the ISL94202 settings stored in the EEPROM are transfered to the registers that control device operation.

To support this function the GUI can read and use settings from a previously programmed device, from a text file or use the included default settings to program the ISL94202 back to its original factory state.

Other supported functions include writing the ISL94202 configuration register settings directly, and saving register and EEPROM settings to separate files.

The GUI was implemented using Microsoft Excel and Visual Basic 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.

2.1 Launch

Open the workbook to get started, there is no installation required. 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 1.

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

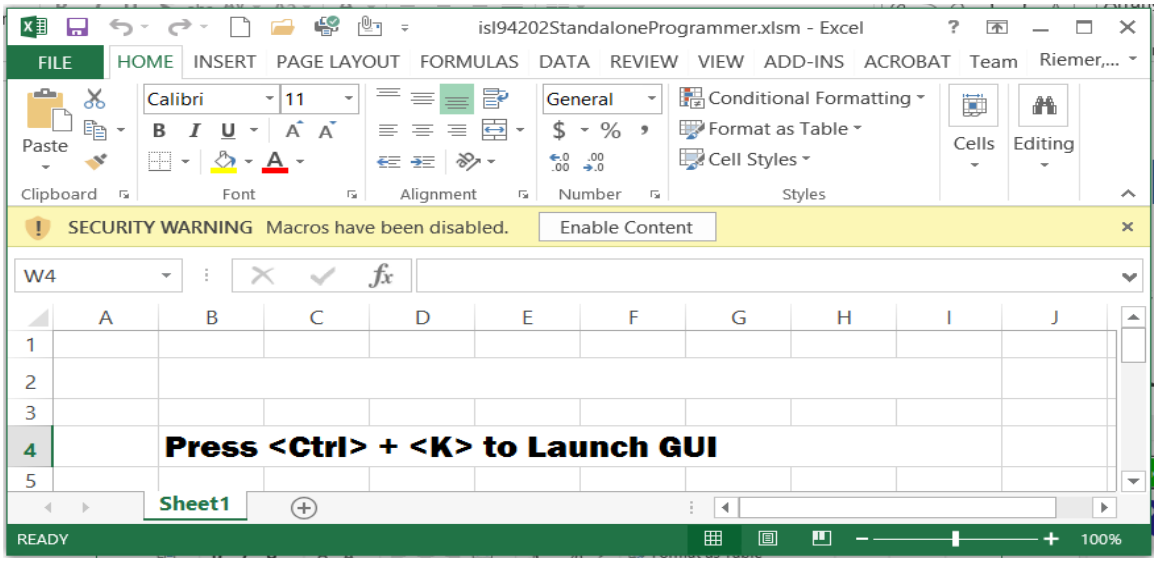

Figure 1. Workbook View

2.2 Connect

The GUI must detect 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 2 on page 4. If not completed previously, apply power to the ISL94202 then connect the dongle I^2C port to the ISL94202 I^2C port.

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.

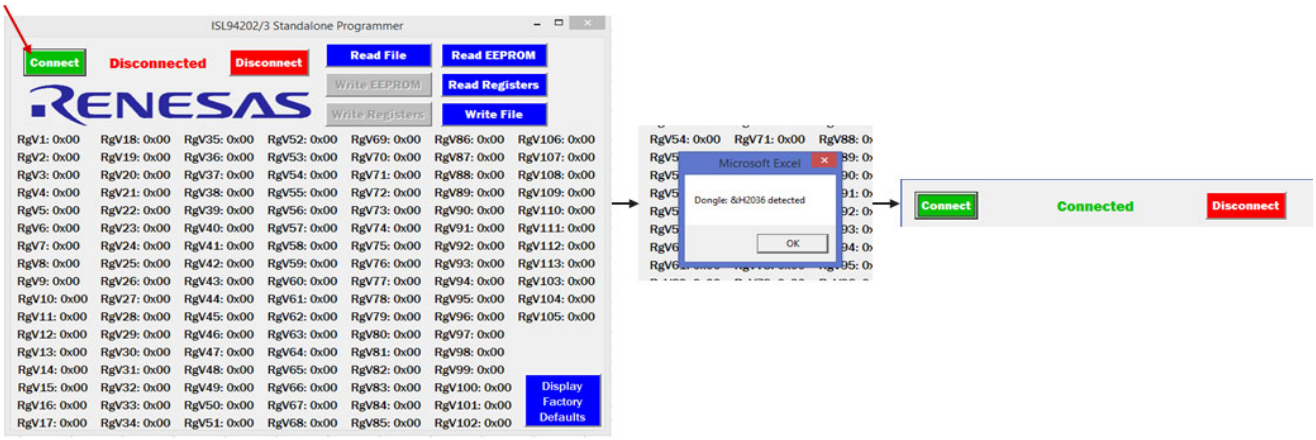

Figure 2. Connect Sequence

2.3 Read

When connected, the GUI is ready to load or **Read** the configuration settings. The settings are displayed on the GUI and stored in a programming array. Following the first GUI Launch and Connect (see page 3) of the dongle, the settings contained in the GUI are all 0x00. It is not advised to write this into the device.

There are four options to update the display and programming array values with the desired configuration settings before programming the EEPROM:

(1) **Read File** - Load configuration settings from a file

(2) **Read EEPROM** - Load configuration settings from a previously programmed device EEPROM

(3) **Read Registers** - Load configuration settings from the previously programmed device registers

(4) **Display Factory Defaults** - Load the factory default settings

After configuration settings are loaded the **Write EEPROM** and **Write Registers** buttons/functions are enabled (see page 5). Regardless of the source, reading in the values only changes the values displayed and stored in the programming array, it does not automatically write to the device when executing read functions.

2.3.1 Read File

This is the preferred method for loading the desired configuration settings into the GUI. Press **Read File** to launch a file explorer window where a pre-created text file containing the configuration settings can be selected and loaded. In the text file, each line is a 2-digit hex value to be written sequentially to addresses 0x00 to 0x4B. See Figure 3 on page 5.

This GUI and the ISL94202 evaluation board GUI create compatible configuration files.

2.3.2 Read EEPROM

Select **Read EEPROM** to read the desired configuration settings from the EEPROM of a previously programmed device into the GUI. These settings can then be used to program the next device.

It is highly recommended to save the customer specific configuration settings to a file, see "Write File" on page 5.

2.3.3 Read Registers

Select **Read Registers** to read the desired configuration settings from the configuration registers of a previously programmed device into the GUI. These settings can then be used to program the next device.

It is highly recommended to save the customer specific configuration settings to a file, see "Write File" on page 5.

2.3.4 Display Factory Defaults

Select “Display Factory Defaults” to load the device factory default configuration settings into the GUI display and programming array. These settings can then be used to put the ISL94202 back to its original state as shipped. Though some of the default settings can be appropriate, the default settings in their entirety are rarely appropriate for a typical battery pack.

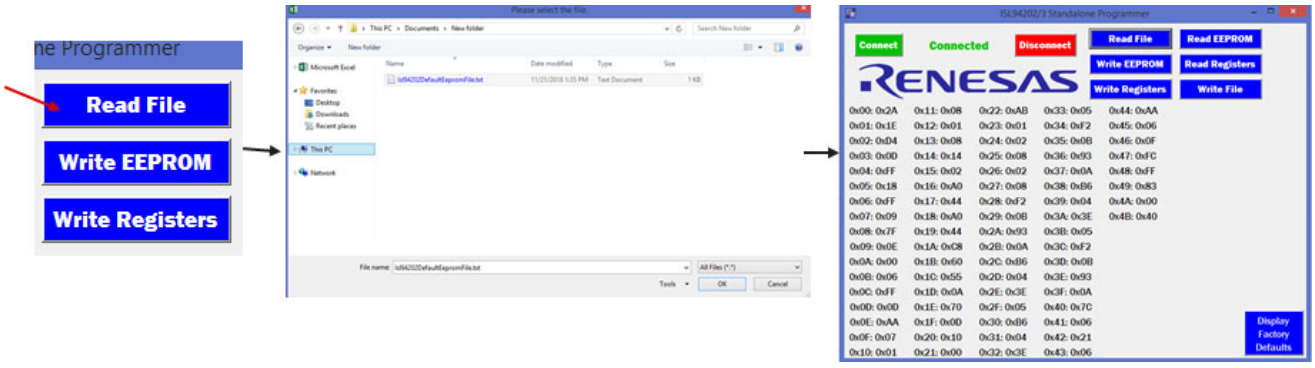

Figure 3. Read File

2.4 Write

After configuration settings are loaded the write buttons/functions are enabled. EEPROM or Registers can only be written to after selecting one of the following:

(1) **Read File** - Load configuration settings from a file

(2) **Read EEPROM** - Load configuration settings from a previously programmed device EEPROM

(3) **Read Registers** - Load configuration settings from the previously programmed device Registers

(4) **Display Factory Defaults** - Load the factory default settings

2.4.1 Write EEPROM

This function prepares the ISL94202, programs the EEPROM, verifies the results, and returns the device to its previous status where possible. Failure of any of these steps is indicated by a message pop-up and then stops, see “Message Pop-ups” on page 8. “EEPROM Programming” on page 6 has a detailed description of the programming steps.

2.4.2 Write Registers

This function prepares the ISL94202, writes the control registers, and verifies the results. Failure of any of these steps is indicated by a message pop-up, see “Message Pop-ups” on page 8.

2.4.3 Write File

This function saves a copy of the displayed programming array to a text file for later reload, see “Read File” on page 4. This text file is compatible with the configuration files created by the ISL94202 evaluation board GUI. The files are intentionally interchangeable between the EEPROM programmer GUI and the evaluation board GUI.

3. EEPROM Programming

To program the ISL94202 EEPROM, there are a number of steps that must be followed. The purpose of this GUI is to demonstrate these steps by example to enable trouble-free programming in a production environment. Prior to programming the ISL94202 ensure:

(1) The device is in NORMAL or IDLE mode

(2) No faults are present

(3) No load or charger is connected

The following subsections detail how EEPROM programming is executed by the GUI “Write EEPROM” function.

3.1 Prepare the ISL94202

The first step taken following selection of **Write EEPROM** is to set the ISL94202 mode. The function forces the ISL94202 into IDLE mode by setting Register 0x88 to 0x01 (see the ISL94202 datasheet). This setting prevents the device from transitioning to lower modes based on the timer selections (Registers 0x46-0x49). This setting cannot prevent a mode transition due to a fault.

The ISL94202 EEPROM cannot be programmed if the device is in SLEEP mode or Power Down, nor can IDLE mode be forced using Register 0x88 if the device is in SLEEP mode or Power Down. The user must take the steps outlined in the datasheet to transition the device to NORMAL mode, a CHMON or LDMON detection is required.

After forcing IDLE mode, automatic scans are disabled by setting Register 0x87 to 0x04. Disabling automatic scans prevents faults detected during measurement scans caused by any programming induced glitches from forcing the device into SLEEP mode or Power Down. Mode transition during EEPROM programming must be avoided.

The next step is to set the Sleep Voltage Threshold Registers 0x44-0x45 to 0x00, or 0V. This setting prevents a low cell voltage from causing the device to transition to SLEEP mode. Because measurement scans were disabled in the previous paragraph, this step is redundant. Values prior to this change are retained to be returned later.

Failure of any of the above steps produces an error message pop-up and then function exits without attempting to program the EEPROM (see “Message Pop-ups” on page 8).

3.2 Program EEPROM

EEPROM programming can begin now that the ISL94202 is in a known state. Register 0x89 is set to 0x01 to enable access to the EEPROM instead of the configuration registers. This description is a simplification, as with any EEPROM actual programming requires multiple steps. This setting enables a state machine that handles EEPROM programming for the user.

When writing to the EEPROM there are two important guidelines to follow:

• Only single byte writes are permitted, do not attempt multi-byte transfers

• Wait 30ms between each EEPROM write

These guidelines are followed automatically by the “Write EEPROM” function.

3.3 Verify EEPROM

Following the Program EEPROM step, the function automatically reads the EEPROM back into a second array. It then executes a verification by comparing the two arrays. Verification failure is announced by a pop-up message. Following verification, pass or fail, the device configuration register changes made in “Prepare the ISL94202” on page 6 are returned to normal (not to be confused with NORMAL mode):

(1) Set 0x89 to 0x00 to switch from EEPROM to Register access

(2) Set 0x87 to 0x00 to put the device back into automatic scan mode

(3) Set 0x44-0x45 back to previous values

It is highly recommended that the user execute “Write Registers” after a successful “Write EEPROM”.

4. General Information

This section covers a variety of items related to the use of this GUI and the ISL94202 evaluation board GUI.

4.1 Configuration Text Files

The EEPROM Programming GUI described in this document and the ISL94202 evaluation board GUI have functions to read and write text-based configuration files. These files are intended to store the configuration settings to be programmed into the ISL94202 EEPROM and configuration registers. Given the same ISL94202, both GUIs will produce identical files that can be used interchangeably by both GUIs.

The evaluation board GUI has significantly more functionality as it is intended to enable a detailed evaluation of the ISL94202 and its various modes of operation. Under normal circumstances, this GUI would be the source of the configuration text file to be used for EEPROM programming and Register setup.

The EEPROM GUI demonstrates the most effective steps to program the ISL94202 EEPROM and configuration registers. It automates steps that are not included in the Evaluation Kit GUI “Write EEPROM” function, though the user does have the ability to manually execute these steps.

4.2 Dongles

Both the EEPROM Programming GUI and the ISL94202 Evaluation Board GUI are designed to communicate with an ISL94202 through a communications dongle. The dongle provides an interface between the USB port of a PC and the I^2C port of the ISL94202.

The standard dongle shipped with the Evaluation Kit passes the PC earth ground through to the ISL94202 board it connects with.

There is an isolated version of this dongle available (ISO-DONGLE1Z) which isolates the PC earth ground from the ISL94202 board it connects with.

4.2.1 Ground

Because typical battery packs do not have a connection to earth ground, the voltages present, including the local PCB ground, can be significantly different than earth ground. If an I^2C connection with a non-isolated ground is connected to the pack it is suddenly provided a path to earth ground. This can cause undesired device resets or a POR, and in some cases eventually damages the non-isolated dongle. There are two common solutions:

(1) Use an isolated dongle.

(2) Tie the pack ground to earth ground before connecting the I^2C port.

4.3 Register Settings

ISL94202 operation is controlled directly by the configuration registers. Programming the EEPROM has no effect on the register settings until the device experiences a POR. If the EEPROM is programmed without programming the registers and the device never experiences a POR, then the device may not operate as desired. Unless a POR can be ensured it is highly recommended that both the EEPROM and configuration registers be programmed one after the other.

4.4 Device Modes

As previously stated, the ISL94202 EEPROM cannot be programmed properly if the device is in SLEEP mode or powered down. Though it will not damage the ISL94202, attempting to program the device EEPROM in either case can cause it to declare a fault and power down. The user may not be able to recover normal operation in some cases. When programming these devices in production, it is very important to follow the guidelines contained in this document to avoid preventable yield loss.

5. Message Pop-ups

This section covers the possible failures that can trigger an error message pop-up to occur and what possible steps can be taken to resolve them. It does not cover messages that confirm correct operation.

5.1 Device Not Ready

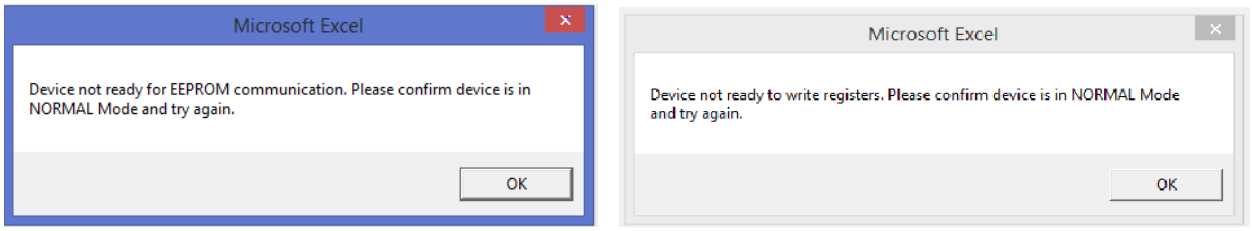

Figure 4. Device Not Ready (DNR) Messages

5.1.1 DNR EEPROM

This message occurs when one or more of the register settings written in section "Prepare the ISL94202" on page 6 fails. This failure is usually due to the ISL94202 being in either SLEEP mode or Power Down. The user must take the steps outlined in the datasheet to transition the device to NORMAL mode, usually a CHMON or LDMON detection is required.

5.1.2 DNR Registers

This message occurs when one or more of the register settings written in section "Write Registers" on page 5 fails. This failure typically occurs if the command to place the device in IDLE mode fails, usually due to the ISL94202 being in either SLEEP mode or Power Down. The user must take the steps outlined in the datasheet to transition the device to NORMAL mode, usually a CHMON or LDMON detection is required.

5.2 Device Not Connected

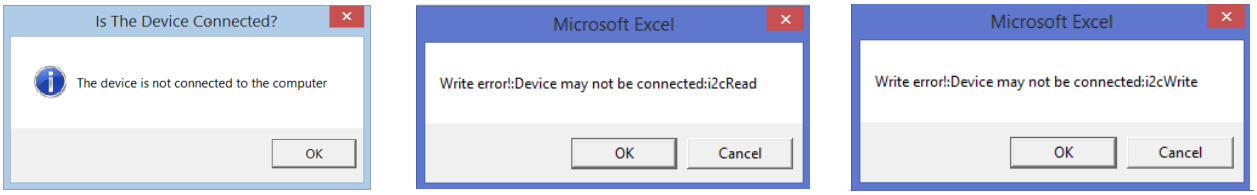

Figure 5. Device Not Connected (DNC) Messages

5.2.1 DNC Connect

This message occurs if step "Connect" on page 3 fails. Disconnect then reconnect the communications dongle and USB cable from the PC and ISL94202 evaluation board then retry **Connect** (see "Connect" on page 3).

5.2.2 DNC Read

This message occurs when an I^2C Read communication attempt fails at any point. This can be caused by poor connections between the dongle and ISL94202, a mismatch of or damage to the I^2C pull-ups, or a variety of other issues. If repeated attempts fail, use an oscilloscope to probe the I^2C signal to determine the cause.

5.2.3 DNC Write

This message occurs when an I^2C Write communication attempt fails at any point. This can be caused by poor connections between the dongle and ISL94202, a mismatch of or damage to the I^2C pull-ups, or a variety of other issues. If repeated attempts fail, use an oscilloscope to probe the I^2C signal to determine the cause.

5.3 EEPROM Write Failed

This message occurs during the step "Verify EEPROM" on page 6 if the values read back following the EEPROM write do not match the intended values. Check all connections, verify the device mode and if necessary, use the Evaluation Board GUI to aid in debugging.

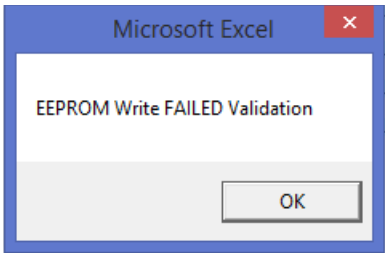

Figure 6. EEPROM Write Failed Message

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7. Revision History

Rev.	Date	Description
0.00	Jan 11, 2019	Initial release

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