TLE4973 current sensor bootkit programmer

User guide

About this document

Scope and purpose

This document describes the hardware and software functionalities of the Infineon CUR SENSOR PROG GEN2 package, named generically in this document as “TLE4973 bootkit”.

The TLE4973 bootkit is a utility package specially designed for interfacing TLE4973 evaluation kits (three-phase) or a stand-alone XENSIV™ TLE4973 Hall current sensor (single-phase). The TLE4973 bootkit is compatible with the software provided by Infineon via the Infineon Developer Center platform.

Intended audience

This TLE4973 bootkit user manual is written for hardware and software engineers.

Important notice

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Safety precautions

***Note**: Please note the following warnings regarding the hazards associated with development systems.*

	*Warning*: ***The device surfaces of the TLE4973 bootkit and associated TLE4973 current sensors/evaluation kits may become hot during testing. Hence, necessary precautions are required while handling the board. Failure to comply may cause injury.***
	*Warning*: ***An overload or incorrectly installed setup can damage the TLE4973 bootkit and the connected TLE4973 current sensors/evaluation kits permanently or cause the reduction of their lifetime. Unpremeditated high current, high voltage, or excessive ambient temperature may result in system malfunction.***
	*Warning*: ***The TLE4973 bootkit contains parts and assemblies sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing, or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.***
	*Warning*: ***The TLE4973 bootkit is shipped with packing materials that need to be removed prior to installation. Failure to remove all packing materials that are unnecessary for system installation may result in overheating or abnormal operating conditions.***
	*Warning*: ***The customer assumes all responsibility and liability for the correct handling and/or use of the TLE4973 bootkit. The customer undertakes to indemnify and hold the Infineon Technologies harmless from any third-party claim in connection with or arising out of the use and/or handling of the TLE4973 bootkit.***

Table of contents

1 Introduction

The TLE4973 bootkit is a medium-priced evaluation kit that enables the possibility to evaluate the behavior and performance of the XENSIV™ TLE4973 Hall current sensor, a high-precision miniature coreless magnetic current sensor for AC and DC measurements with analog interface and fast over-current detection output. All negative effect (saturation, hysteresis) commonly known from open loop sensors using flux concentration techniques are avoided. The differential measurement principle allows great stray field suppression for operation in harsh environments. The compatible software provided is designed to visualize data acquired from the XENSIV™ TLE4973 Hall current sensor with configurable measurement settings, as well as to analyze or modify the behavior of the sensor prior to integration in a system where current monitoring is required.

This board is compatible with all TLE4973 (VSON, TISON, and TDSO packages) three-phase evaluation kits and may be used for performing live current-level readouts, diagnostic checks (for example, OCD check), EEPROM configuration, and calibration. Compatible evaluation boards are listed in Table 1.

Table 1 Currently supported evaluation boards

Evaluation board	Description and features
TLE4973 EVAL LAT BAR	Three phase, VSON, external current rail, ~682 A full sc. rg.
TLE4973 EVAL VER BAR	Three phase, VSON, external current rail, ~920 A full sc. rg.
TLE4973 EVAL STD PCB	Three phase, TDSO, external current rail, ~221 A full sc. rg.
TLE4973 EVAL INLAY	Three phase, TDSO, external current rail, ~460 A full sc. rg.
TLE4973 EVAL 120A	Three phase, TISON, internal current rail, ~120 A full sc. rg.

2 Getting started

The following chapters describe the distinct parts of the TLE4973 bootkit evaluation kit package, the hardware connections, the software installation process, and clarifies how to use the graphical user interface (GUI) to perform the first evaluation of the sensor in a particular application.

2.1 Kit content

The evaluation kit package consists of the following components:

- Current sensor programmer shield. Check the hardware details below and revision history
- XMC1100 for ARDUINO. Both boards are already stacked together via headers
- TLx497x evaluation kit USB isolator V1.0, for supplying power to the XMC1100
- 20-pin ribbon cable, for connecting the current sensor programmer shield to a TLE4973 evaluation board
- 2 × micro USB cable

The evaluation hardware can be ordered only via the Infineon sales channels. The required order numbers are listed in Table 2.

Table 2 TLE4973 bootkit list with order numbers

Name	Description	Infineon sample request (ISaR) SP number
CUR SENSOR PROG GEN2	Utility board for interfacing TLE4973 current sensors and evaluation kits	SP005859612

Figure 1 depicts the content of TLE4973 bootkit.

***Note**: Please note that this picture is generic, and the latest variant might suffer modifications.*

Figure 1 TLE4973 bootkit evaluation kit components

2.2 Hardware design

This chapter offers a detailed hardware design description of the TLE4973 bootkit evaluation kit. The latest revision of this evaluation kit is V2.0.

The evaluation kit is composed of two PCBs connected via headers:

- **XMC1100 for ARDUINO:** To control the system and to interface it with the PC via USB
- **Current sensor programmer shield:** To interface the sensors/evaluation kits and to provide the necessary peripheral connections to the XMC1100 board for analysis and measurements

The current sensor programmer shield is suited to interface any of the TLE4973 evaluation kits enumerated in Table 1, via the provided 20-pin cable or a stand-alone XENSIV™ TLE4973 Hall current sensor, without the need of external passive components, via the 3×2 pin header located on the right side of the board. These connections are equivalent to Sensor 1 of a TLE4973 evaluation kit (labeled Sensor U). The application circuit pin header provide the necessary connections to ensure the proper functionality of the sensor. By populating the pin headers with jumpers, the following connections are established:

- 1:2 reserved (populated by default)
- 3:4 OCD1 decoupling capacitor and pull-up resistor (not populated by default)
- 5:6 VREF1 decoupling capacitor (not populated by default)
- 7:8 AOUT1 decoupling capacitor (not populated by default)
- 9:10 DCDI decoupling capacitor and pull-up resistor (not populated by default)

In the single-ended measurement mode, the TLE4973 current sensor requires an external reference voltage level, 1.25 V or 2.5 V. The reference voltage level is selectable from the eep_ext_vref bit, EEPROM address 0×42, and has a default value of 0 (2.5 V). The value of this bit can be changed by either sending a sensor command (as described in Sensor commands) or by modifying the EEPROM map (as described in EEPROM map).

Regarding hardware, the current sensor programmer shield provides three 3×2 pin headers labeled U, V, and W, corresponding to the three sensors on a TLE4973 evaluation kit, which supply independent reference voltage levels to the VREF pin of each sensor.

Danger: *Applying an incorrect reference voltage level will cause erroneous sensor readings!*

Figure 2 shows the location on the board where a standalone XENSIV™ TLE4973 Hall current sensor, the configurable voltage reference, and the application circuit jumpers should be connected.

Note: *Please note that this picture is generic, and the latest variant might suffer modifications. Please check schematic and pin-out description in the next chapters.*

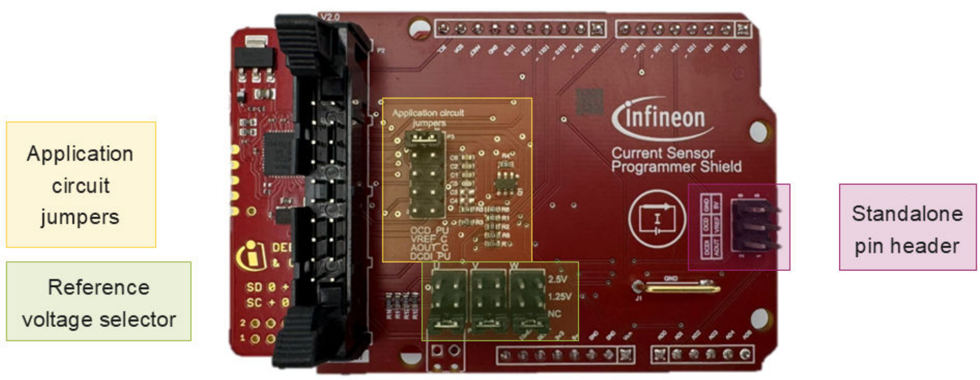

Figure 2 **Current sensor programmer shield pin headers**

2.2.1 Current sensor programmer shield schematic

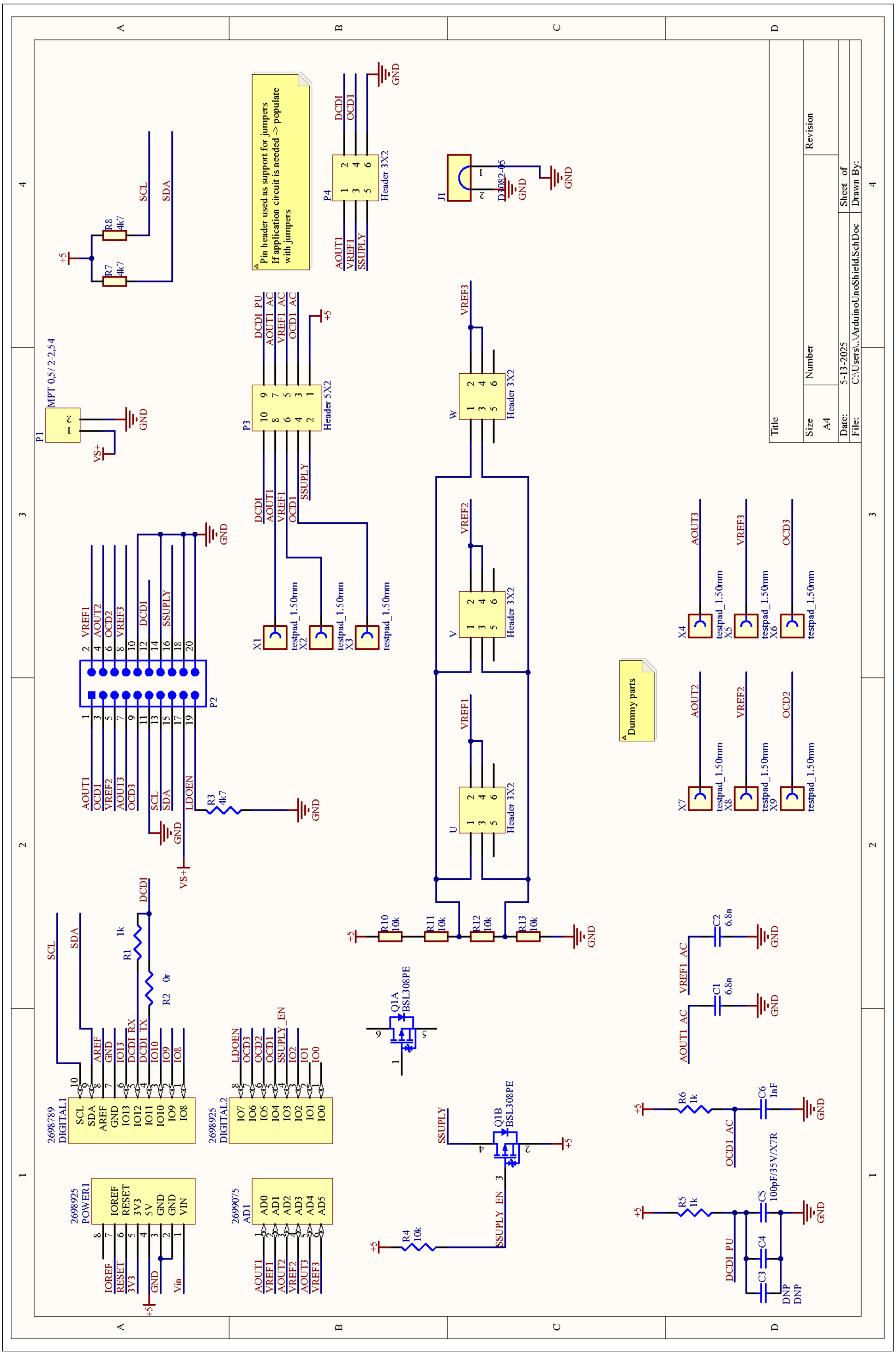

Figure 3 Current sensor programmer shield schematic

2.2.2 Current sensor programmer shield PCB design

The hardware design is physically implemented in the PCB technology, using a standard process with the following technical characteristics:

- PCB material: FR4
- PCB thickness: 1.6 mm ± 10%
- Copper: 2 layers top/bottom, 35 µm thickness

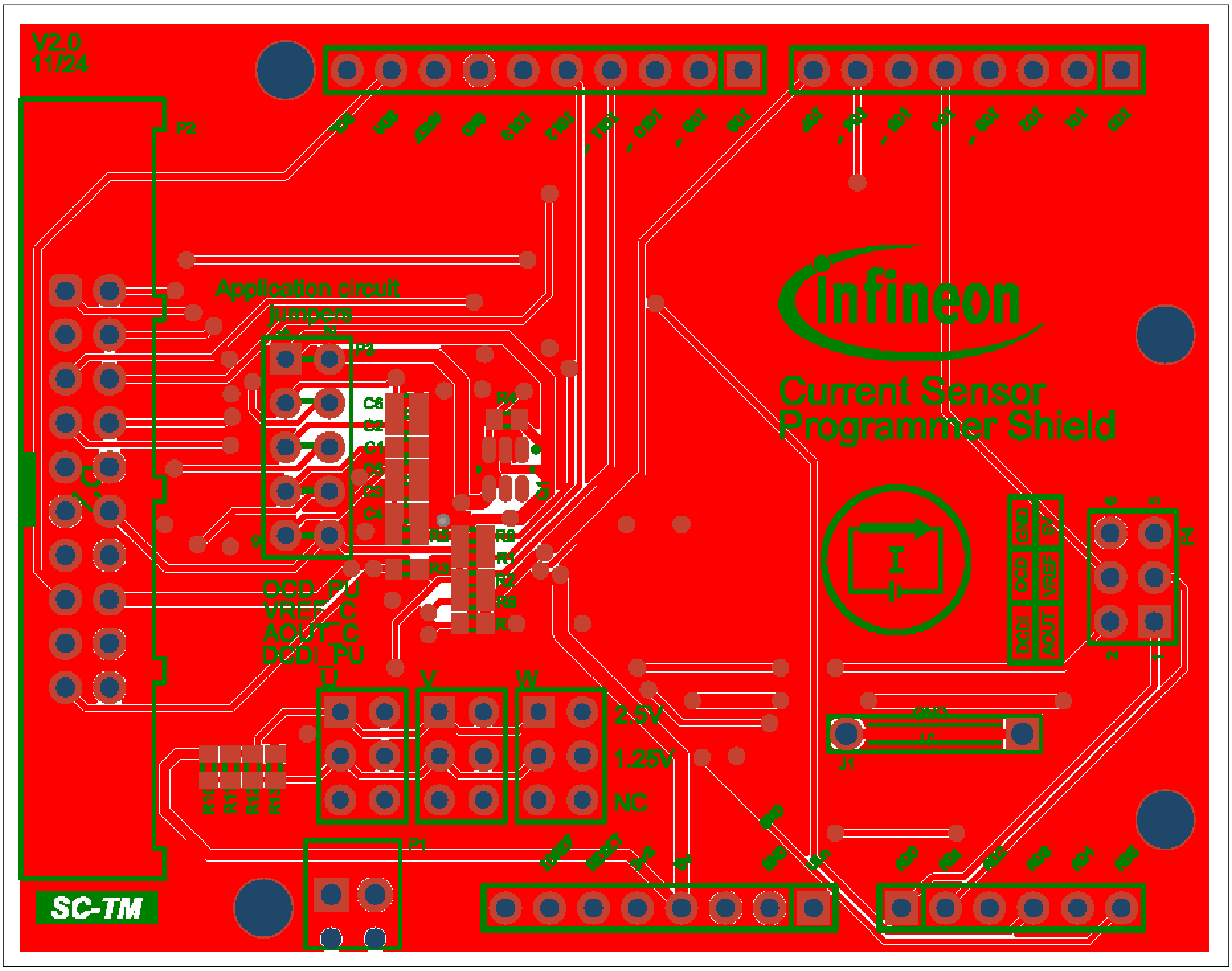

Figure 4 **Current sensor programmer shield PCB (top layer)**

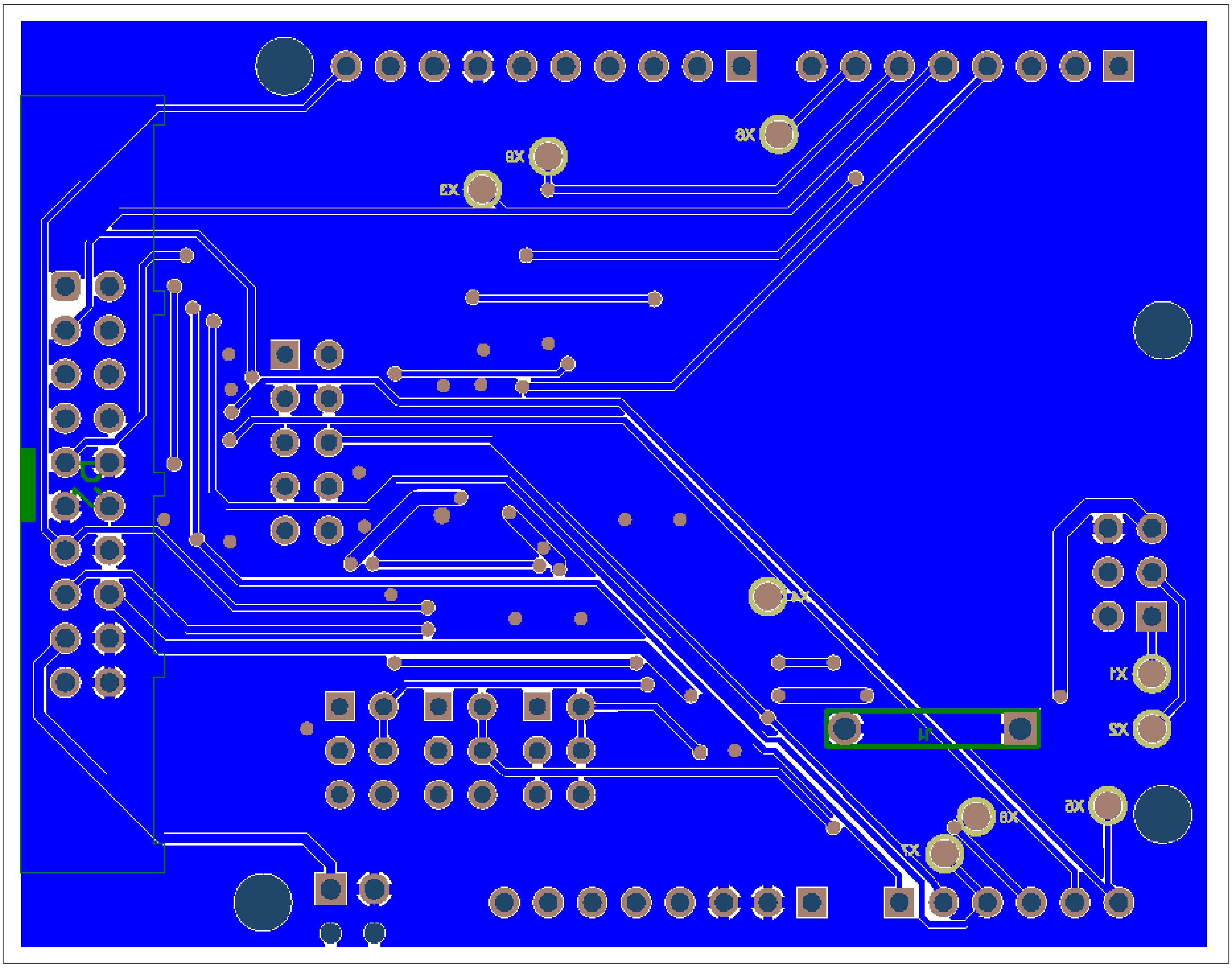

Figure 5 **Current sensor programmer shield PCB (bottom layer)**

2.2.3 Bill of materials

Table 3 Current sensor programmer shield board assembly bill of materials

Parts	Value	Device	Package/footprint	Description
X1, X2, X3, X4, X5, X6, X7, X8, X9	testpad_1.50 mm	testpad_1.50 mm	testpad_1.50 mm	testpad_1.50 mm
R10, R11, R12, R13	10 k	Resistor	R0603	0.1%
R9	0R	Resistor	RESC1608X55N-2	100 mW, 5%
R7, R8	4k7	Resistor	R0603	
R4	10 k	Resistor	R0603	
R3	4k7	Resistor	R0603	
R2	0R	Resistor	R0603	
R1, R5, R6	1 k	Resistor	R0603	
Q1		BSL308PE	INF-PG-TSOP-6 N	P-channel OptiMOS™ P3 small-signal transistor, -30 V VDS, -2 A ID, -55 to 150°C
POWER1		POWER_UNO	Header 8×1 8.5 mm	
P4, U, V, W		Header 3×2	HDR2×3	Header, 3-pin, dual row
P3		Header 5×2A	HDR2×5_CEN	Header, 5-pin, dual row
P2		61202022821	61202022821	WR-BHD box header with long lever, male, pitch 2.54 mm, THT, straight, 20p
P1	MPT 0,5/2-2,54	Header 2	HDR1×2_PH	Header, 2-pin
J1		D3082-05	FP-D3082-05-MFG	1 mm uninsulated shorting plug
IOL1		IOL	Header 8×1 8.5 mm	
IOH1		IOH	Header 10×1 8.5 mm	
C6	1 nF	Capacitor	C0603	
C5	100 pF/35 V/X7R	Capacitor	C0603	
C3, C4	DNP	Capacitor	C0603	
C1, C2	6.8 nF	Capacitor	C0603	
AD1		AD	Header 6×1 8.5 mm	

2.3 Software installation

2.3.1 Requirements

The current sensor bootkit hardware and software bundle was developed and tested on the following PC configuration:

- Operating system: Windows 10/Windows 11
- RAM: 8 GB (maximum RAM usage estimated at 250 MB)
- Storage: 512 GB (minimum required for installation: 250 MB, including dependencies)
- CPU: 3 GHz, 4 cores (lower performance CPUs might have an impact on the performance of the GUI)

2.3.2 Software download

The GUI software is offered free-of-charge on our website, via the Infineon Development Center online platform, in the **Tools** section, or from the Infineon Developer Center Launcher application. The user may filter the tool list by inserting the text *Current Sensor* or *TLE4973* and the following record shall appear: **XENSIV™ TLx4973 Current Sensor Programmer App**.

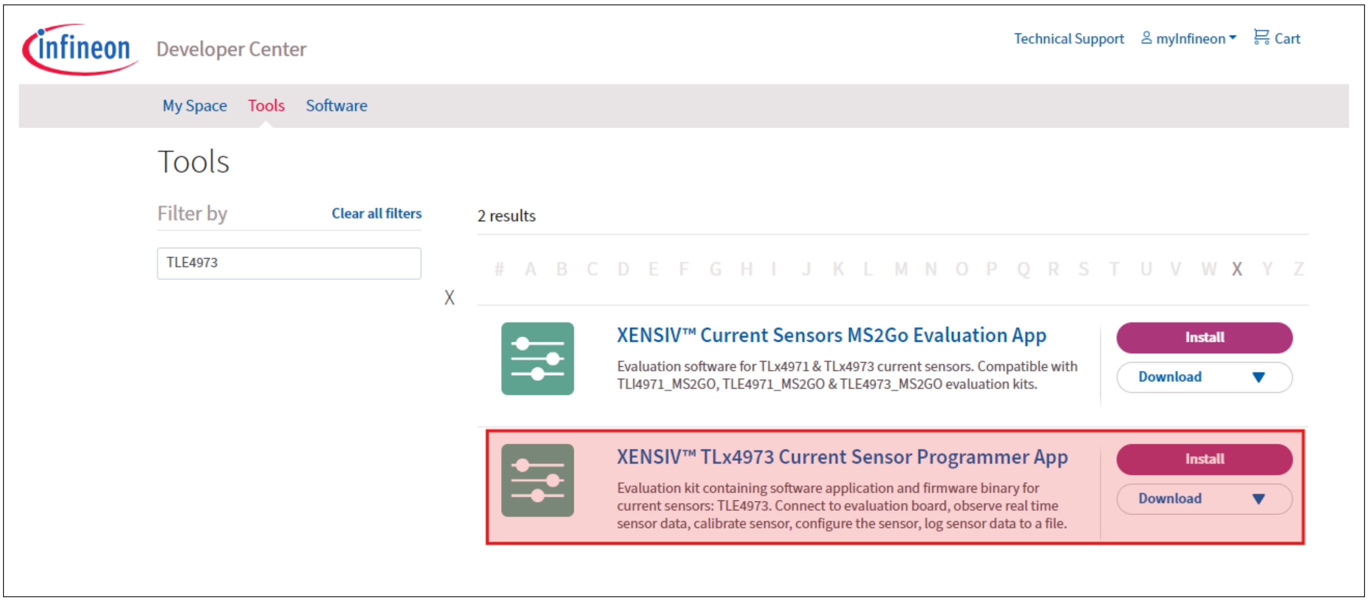

Figure 6 **Infineon development center – online tools filtering**

***Note**:*

- *It is highly advised to install the Infineon Developer Center Launcher application prior to installing the evaluation kit software.*
- *The download of the **XENSIV™ TLx4973 Current Sensor Programmer App** is open only for users registered with a **MyInfineon** account.*

2.3.3 Installing the software

Download the **XENSIV™ TLx4973 Current Sensor Programmer App** from Infineon website or from Infineon Developer Center Launcher. Install the *Evaluation Kit* software by clicking the highlighted **Install** button or by double clicking on the installer file.

***Note**: To install the software, administrator rights are required.*

The installer file contains the following elements:

- Binaries/compiled objects needed for running the GUI
- SEGGER J-LINK driver for the communication with the PC on USB
- .NET 4.8 online installer (needed only for the older versions of Windows which do not have this already installed). Installation requires stable internet connection

Installation steps

- **License agreement:** It is required that you agree with the Infineon terms and conditions before continuing. After accepting, press **Next**.

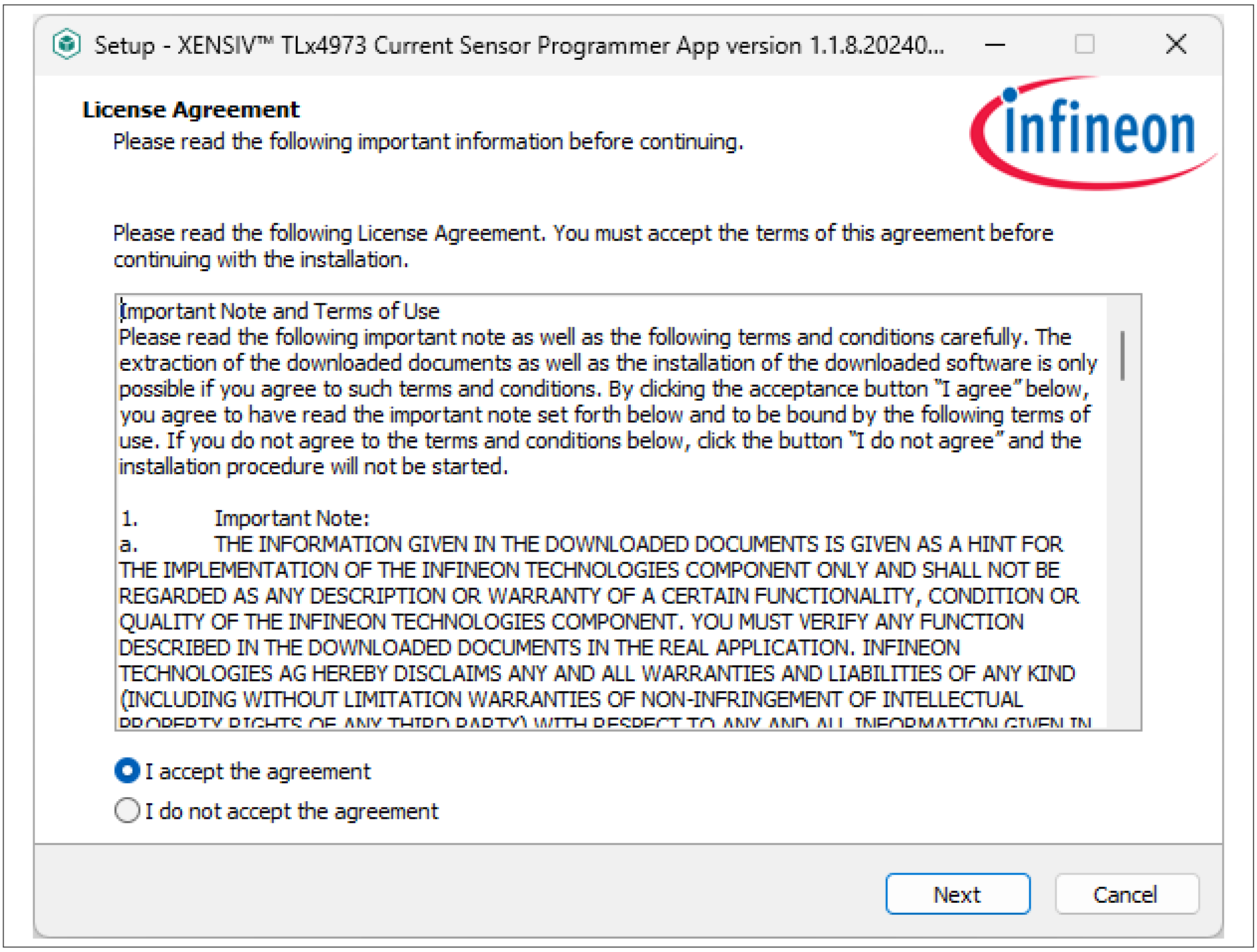

Figure 7 Software installation step – license agreement

- **Installation type selection:** It is recommend to use the **Quick Installation** type. Select your preferred installation mode and press **Install**.

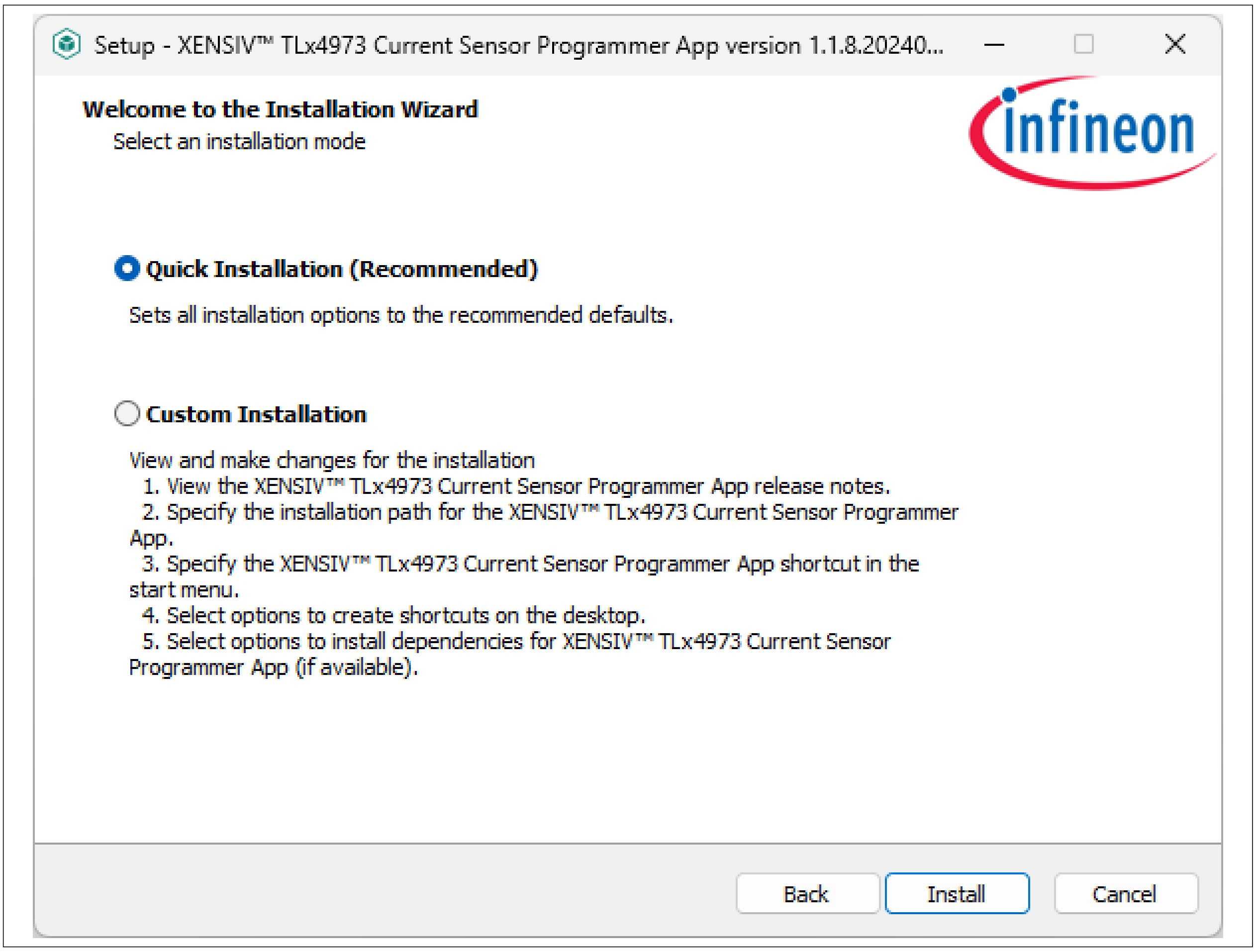

Figure 8 **Software installation step – quick installation**

- **SEGGER J-LINK drivers:** Once the binaries are copied to the installation folder, the user is prompted for installing **SEGGER J-LINK** drivers. If the user has already installed a newer version on the computer, no changes will be made.

  ***Note**: By not having this driver installed, the USB connection between PC and the current sensor bootkit will not function.*

  Proceed with the installation process by using the **Next** and **Install** buttons, as required.

Figure 9 **Software installation step – SEGGER J-LINK drivers installation**

- **.NET Framework 4.8:** Once the **SEGGER J-LINK** drivers are installed or the operation is canceled, the user is prompted for installing **.NET Framework 4.8**.

***Note**: For operating systems starting from Windows 10, build 1903, this version has already been pre-installed with **.NET Framework 4.8** and the user is notified that the required package is already installed. If not, the user should ensure that an internet connection is in place to complete the installation process.*

Click **Close** to complete the installation process.

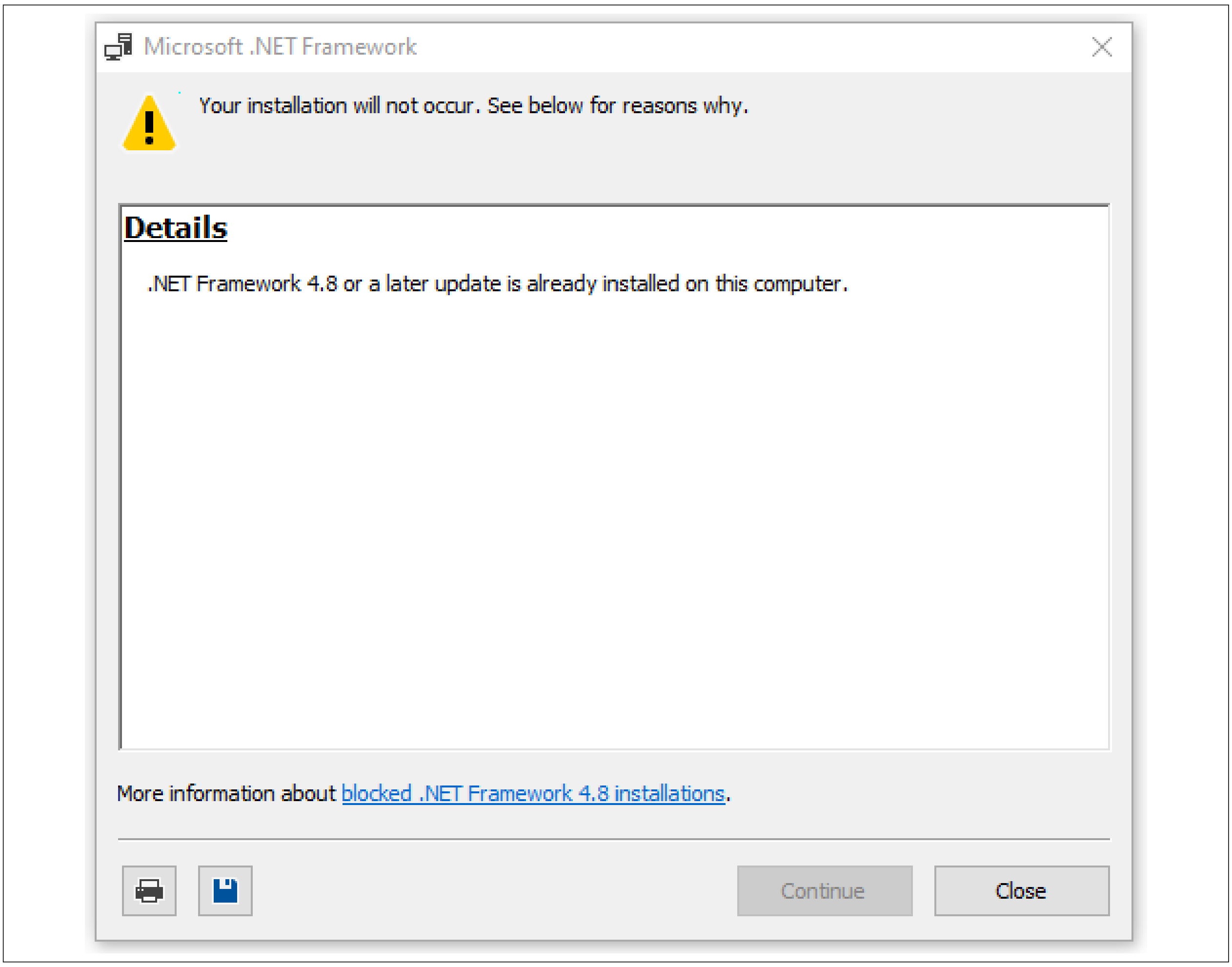

Figure 10 Software installation step – .NET 4.8 installation

- **Finishing the installation:** The user is notified upon the completion of all the installer processes and a shortcut is, by default, created on the **Desktop**. The user may opt to **Open release notes** (to check the latest updates) or to run the installed **XENSIV™ TLx4973 Current Sensor Programmer App**.

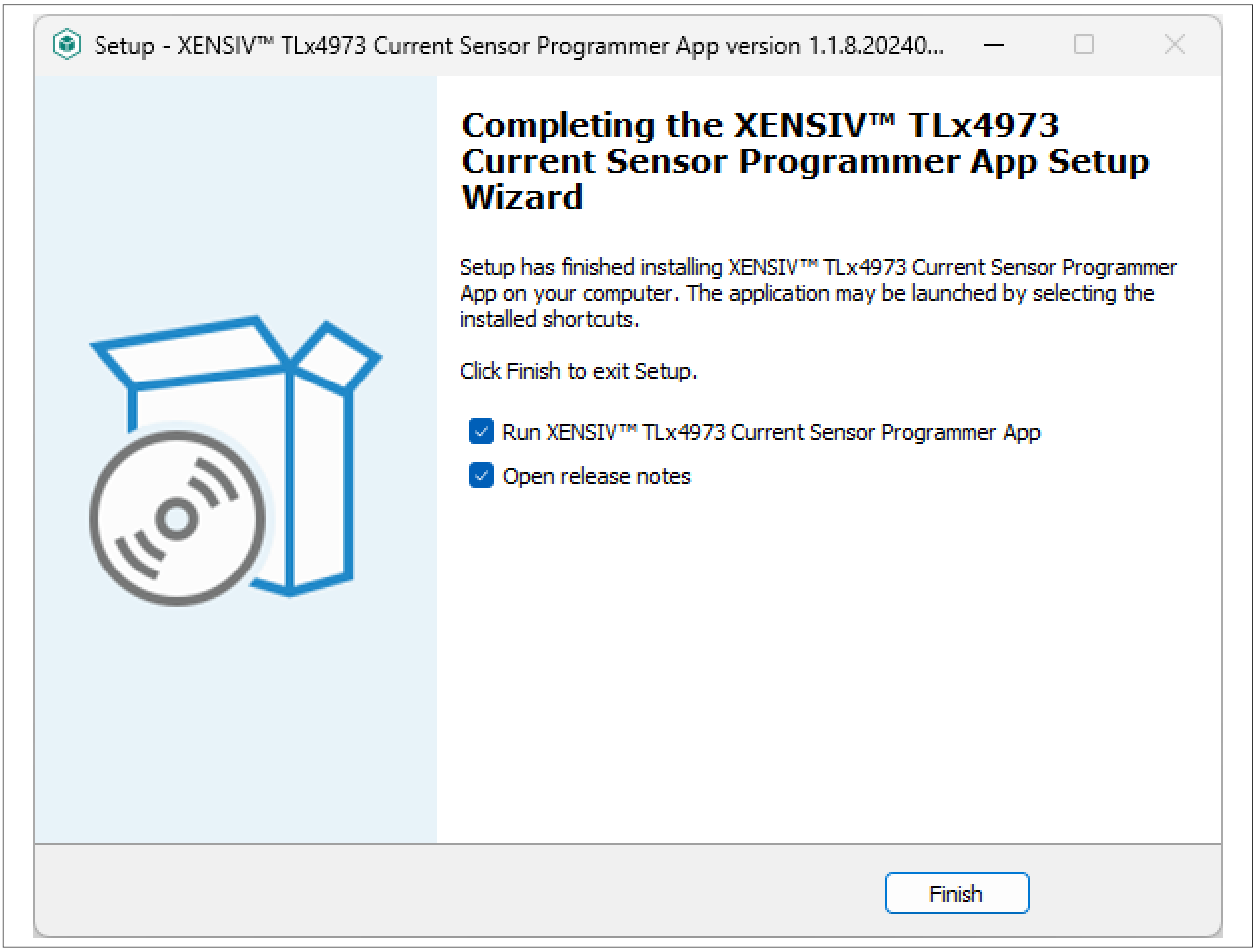

Figure 11 Software installation step – completion

2.3.4 Uninstalling the software

To uninstall the software package, go to **Start**, select **Add or remove programs**, and then search for *TLx4973*, as *Current Sensor* is a generic keyword for multiple Infineon evaluation software applications. Press **Uninstall** to delete the software from your PC.

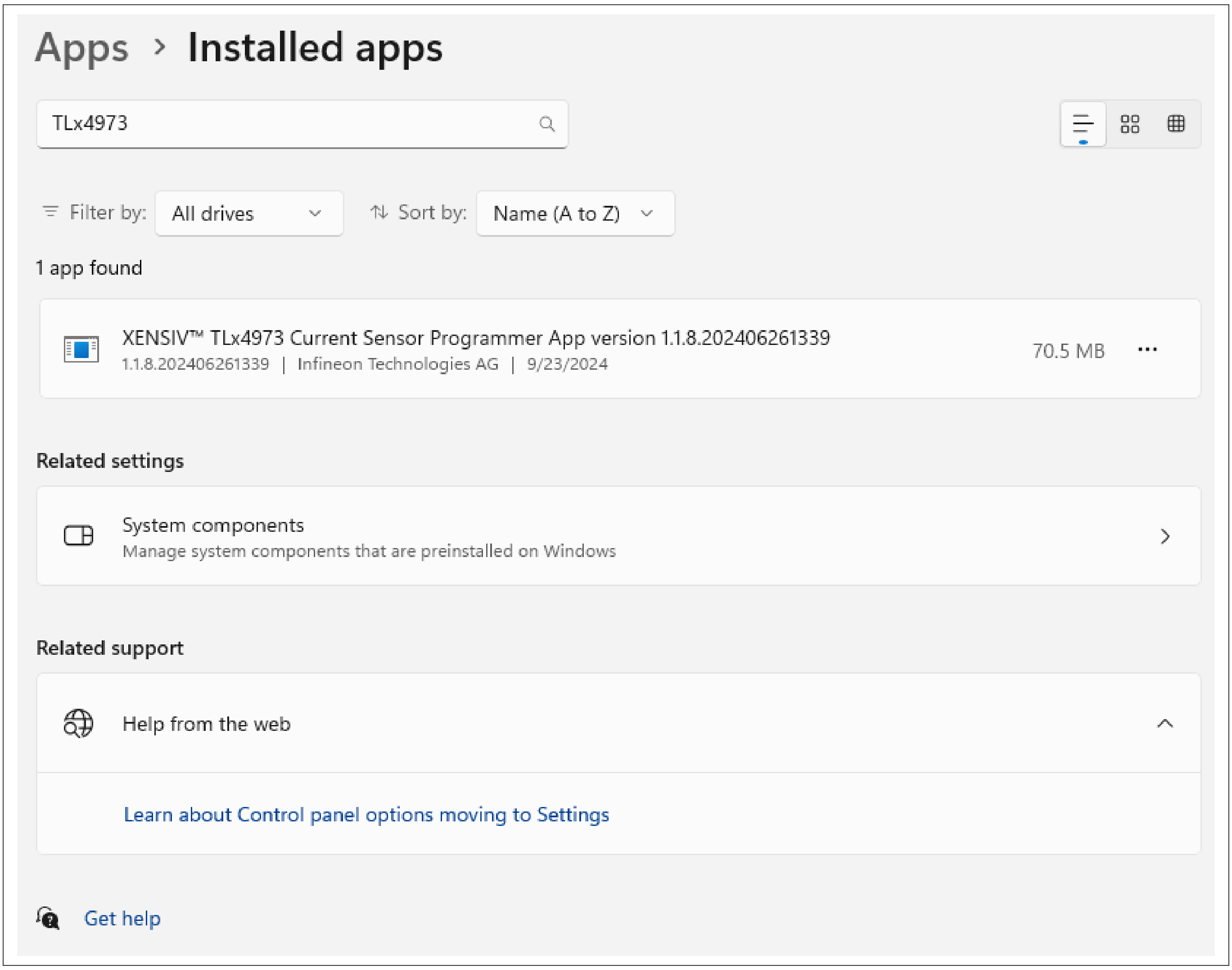

Figure 12 Software uninstall

All installation files are deleted from the system except:

- SEGGER J-LINK driver, which, if needed, can be uninstalled separately
- .NET 4.8 dependencies, which on most cases are part of the operating system

3 Using the evaluation software

This chapter describes all features of the **XENSIV™ TLx4973 Current Sensor Programmer App** and the usage, in correlation with the TLE4973 bootkit. Make sure that the XMC1100 board is connected to your PC via micro-USB cable and a TLE4973 current sensor/evaluation kit is connected to the shield before proceeding with the next steps.

3.1 Startup screen and device connection

Figure 13 depicts the default screen of the **XENSIV™ TLx4973 Current Sensor Programmer App** after startup. The GUI software will monitor all USB ports and check if any of them matches the signature of the TLE4973 bootkit. If a match is found, a new device will appear as depicted in the figure below: **XMC Device on COMx**. By selecting the device and pressing the first button, **Connect**, the GUI will connect and flash the latest version of the firmware on the target microcontroller. The second button disconnects the currently connected device, and the third button refreshes the USB device list.

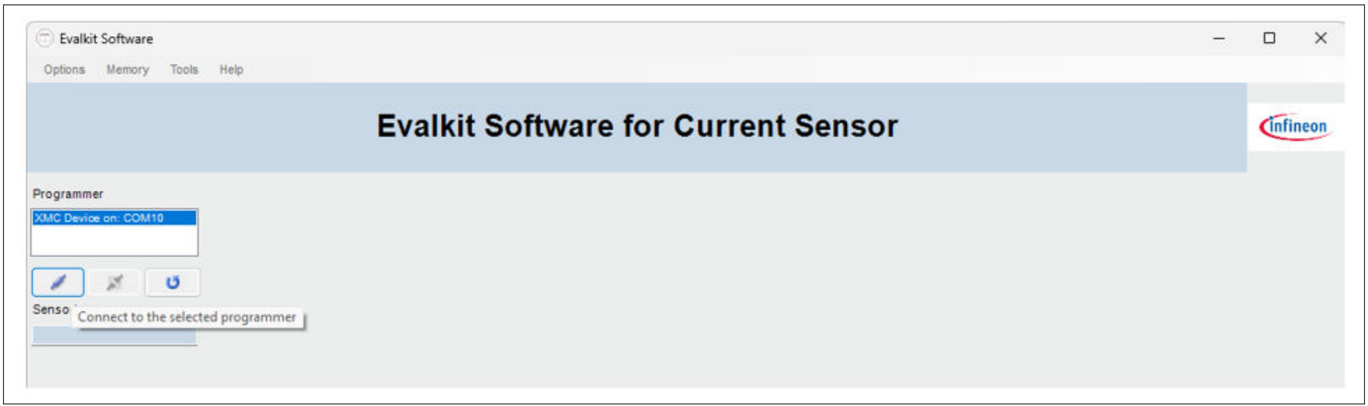

Figure 13 **Software usage – startup screen**

After a successful connection, the main window will appear and the toolbar will become accessible.

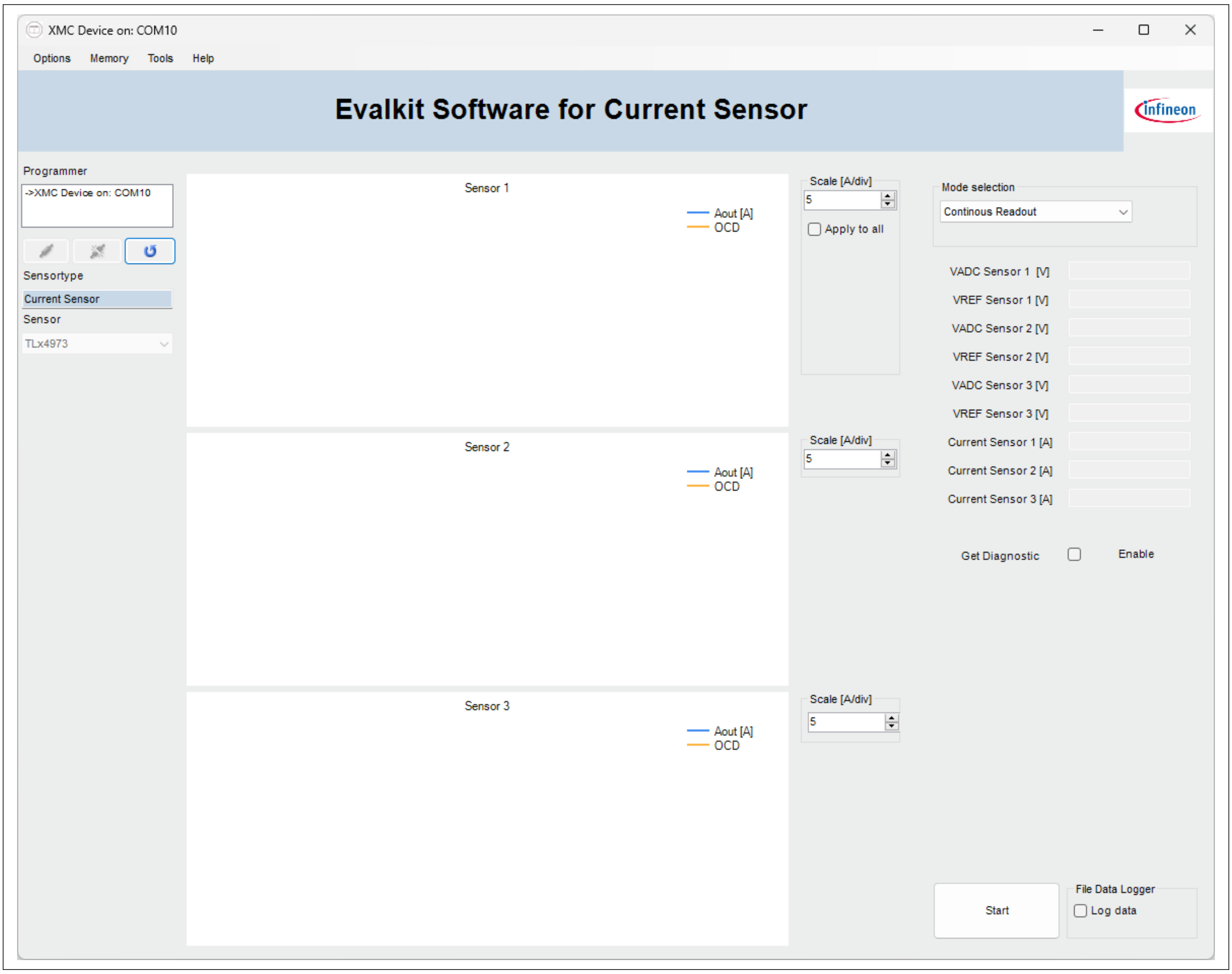

Figure 14 **Software usage – startup screen**

3.2 Toolbar

At the top of the window, the toolbar provides multiple buttons, allowing the user to monitor and configure the TLE4973 bootkit, the software application, and the associated TLE4973 evaluation kits:

- **Options:** Independent register readout, temperature monitoring, and sensor commands
- **Memory:** Memory map view, EEPROM field read/write, and basic measurement configuration
- **Tools:** Current rail transfer factor calculation and calibration parameters fine tuning
- **Help:** Details about the firmware, software, and driver versions

3.2.1 Board transfer factor

Depending on the type of TLE4973 evaluation kit connected, the software requires a different transfer factor to calculate the value of the current, due to the physical attributes and technological processes used in the board manufacturing. The board transfer factor [uT/A] and the preset values for the TLE4973 evaluation kits are enumerated in Table 1. Based on the application requirements, a custom board transfer factor can be introduced, but it should be calculated by the user.

***Note**: For more information about the process involved in calculating this transfer factor, refer to the TLE4973 current sensor user manual.*

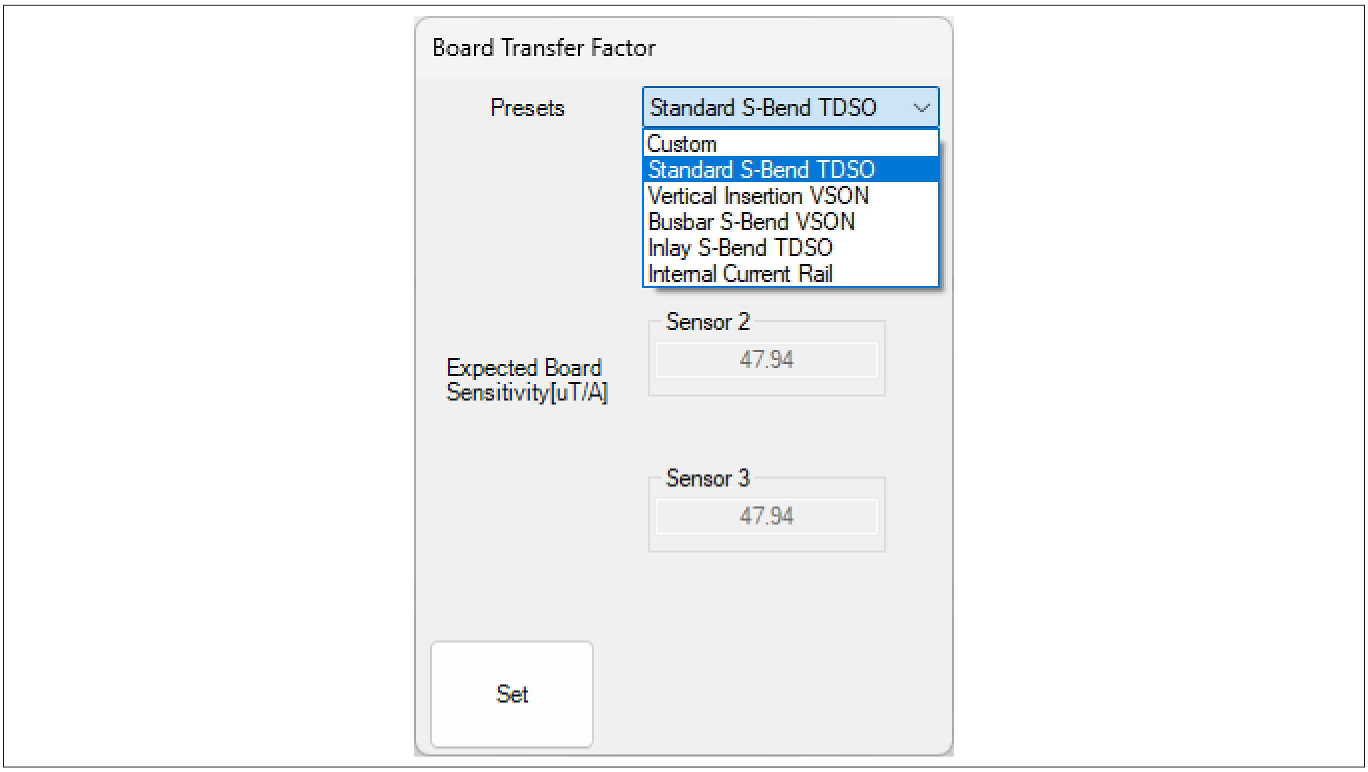

Figure 15 Toolbar – board transfer factor

3.2.2 Temperature readout

The temperature of each individual sensor on a TLE4973 evaluation kit or of a standalone TLE4973 current sensor can be monitored. The provided graph features custom limits, variable sample number, and logging in CSV format.

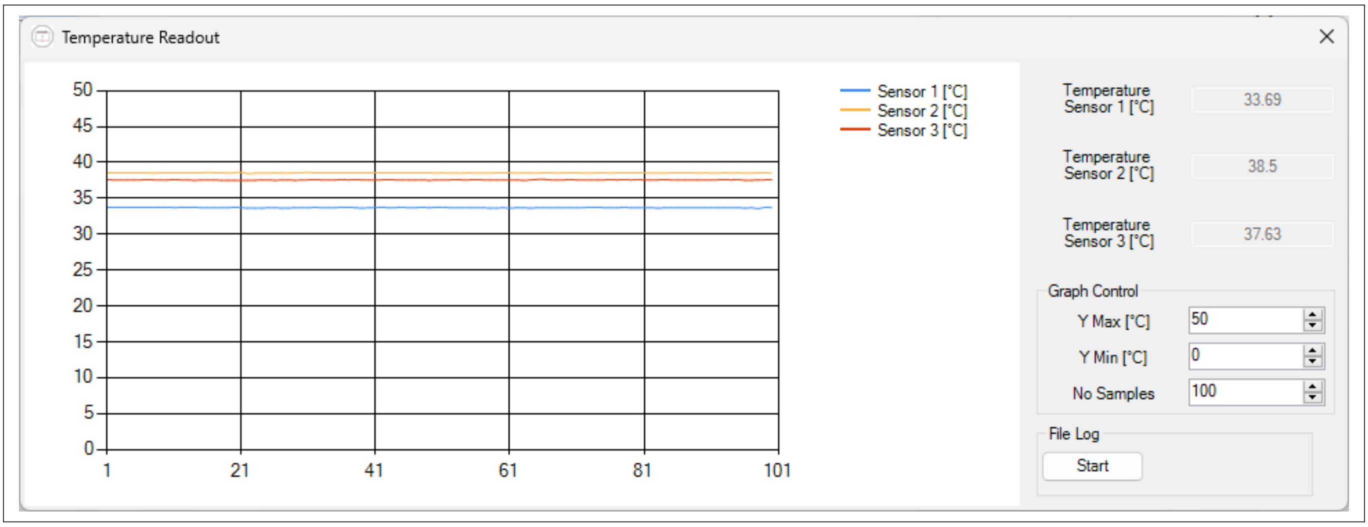

Figure 16 Toolbar – temperature readout

3.2.3 Register readout

Independent register values can be read from all the three sensors on a TLE4973 evaluation kit or a standalone TLE4973 current sensor, in LSB format, using a similar interface to the temperature readout graph. For more details regarding the configurable bit fields and binary representation of the internal registers, refer to the EEPROM map or the TLE4973 current sensor user manual.

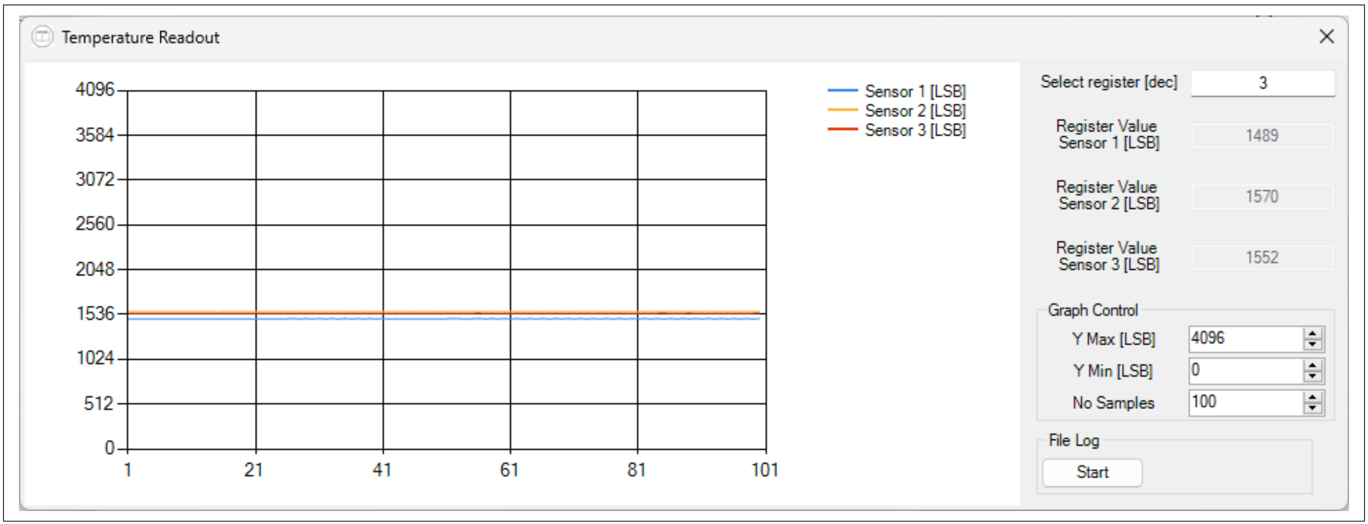

Figure 17 **Toolbar – register readout**

3.2.4 Sensor commands

This window provides a complete overview of the communication between the TLE4973 current sensor and the GUI, allowing the user to send and receive data, as well as to monitor the communication safety mechanism implemented in the DCDI protocol. To gain access to the internal sensor bitmap, the `UNLOCK` and `DISABLE ISM` commands must be issued first, as detailed in the TLE4973 current sensor user manual.

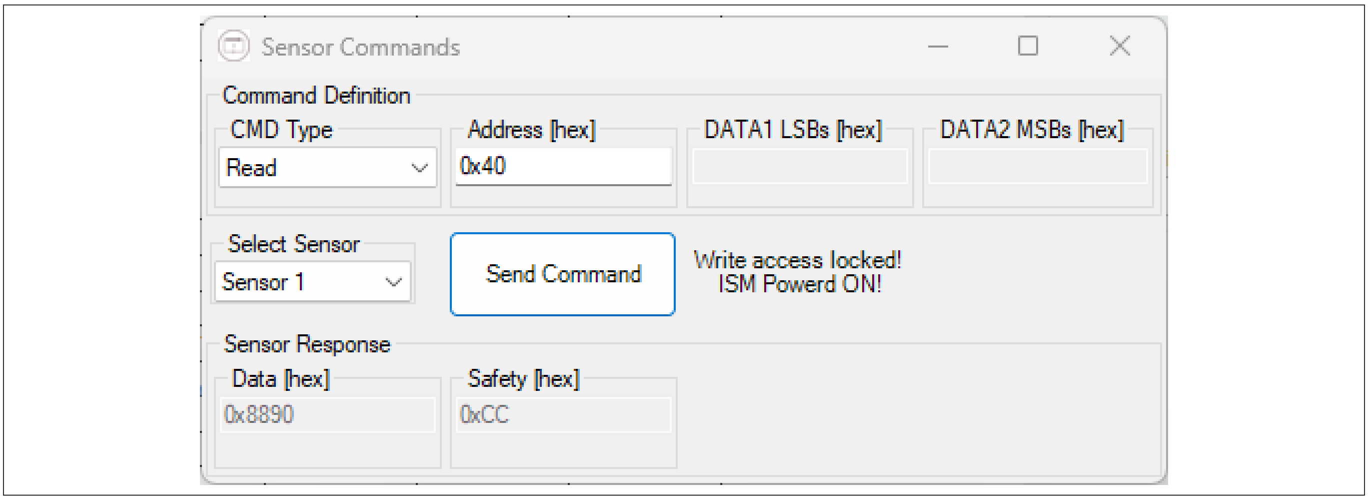

Figure 18 **Toolbar – sensor commands**

3.2.5 EEPROM map

The **EEPROM Mapping** window displays the content of the internal registers in binary format, alongside a brief description of the bit fields, as described in the TLE4973 current sensor user manual. Selecting an address from the menu displays all the corresponding bit fields, with their respective name on the left and the decimal/hexadecimal values on the right side of the window. The value of the bit fields can be edited in the text boxes. The drop-down menu on the right allows the user to switch to the EEPROM map of any detected sensor.

The buttons at the bottom of the window allow the user to:

- Burn the EEPROM and save the changes made
- Read the EEPROM and refresh the window
- Store the EEPROM in .xml format
- Load a previously stored EEPROM
- Exit the window

***Note**: It is recommended that upon making the first custom configuration, the user should save the factory-issued EEPROM as a back-up to restore the sensor to the default state in case of malfunctioning.*

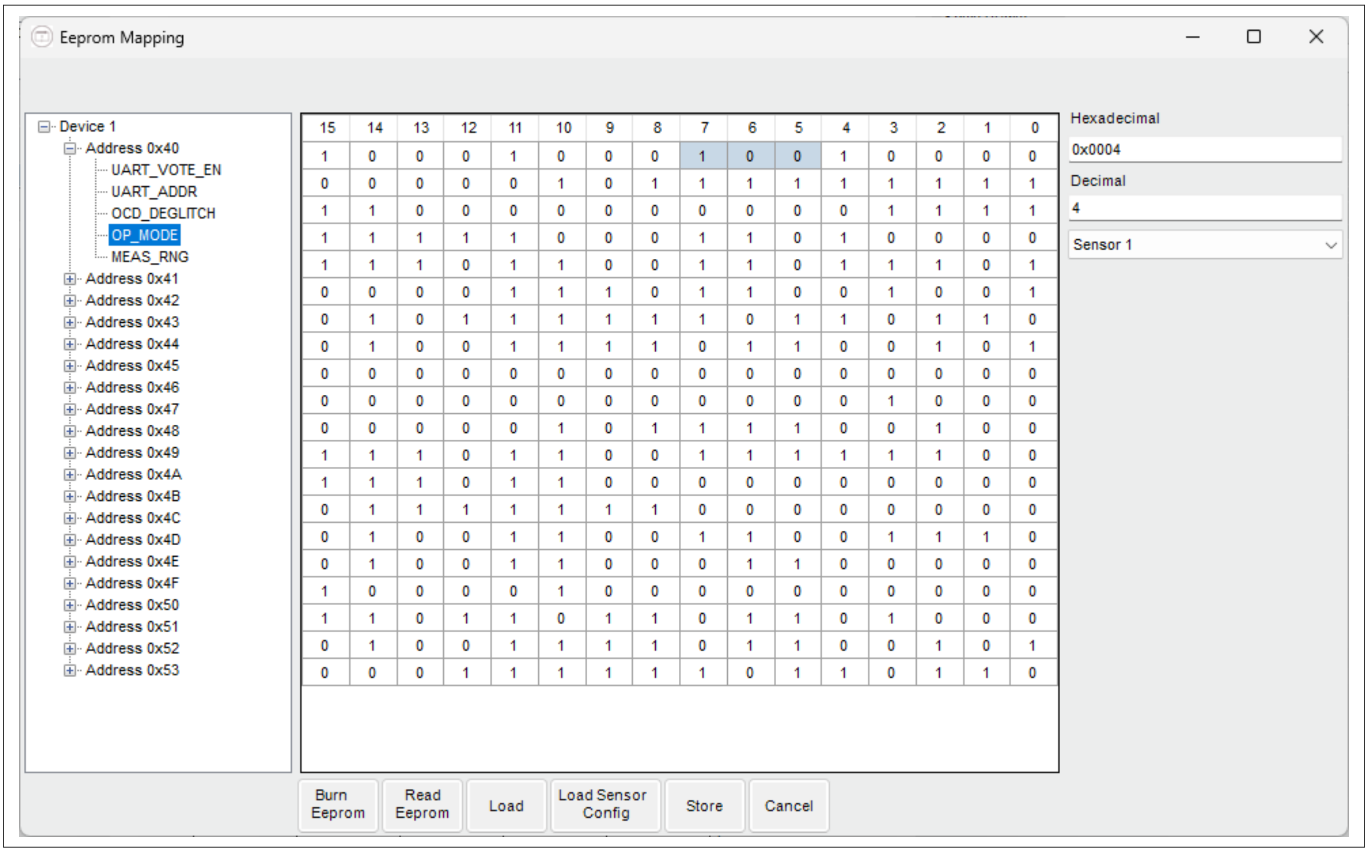

Figure 19 Toolbar – EEPROM mapping

Attention**: **The Register Readout and Sensor Commands windows are an advanced way of communicating and interfacing the TLE4973 current sensor/evaluation kits and are not recommended for configuring the sensor for a particular application without thorough TLE4973 current sensor user manual cross-referencing. EEPROM registers contain calibration parameters that can cause sensor malfunction, if modified. The recommended approach for modifying measurement settings is through the Basic Configuration and EEPROM Mapping windows.

3.2.6 Basic configuration

The most common measurement settings can be configured in this window, using the provided drop-down menus and the manual input text boxes. The **Sensor Select** drop-down menu switches between the three independent sensors on a TLE4973 evaluation kit and performs an EEPROM read when modified. After modifying the configuration of a particular sensor, press **Burn EEPROM** to save the changes made to the internal registers, otherwise the changes will not be saved upon closing the window or switching to another sensor!

The configurable parameters from this window are as follows:

- **Output Mode:** Depending on the desired measurement mode, do not forget to connect the reference voltage jumpers, as described in Hardware design
- **Measurement Range:** Provides the mV/mT sensitivity required for calculating the value of the current, according to the target current full-scale and the board transfer factor
- **OCD:** Configurable threshold and deglitch time, additional disable checkbox
- **UART Address:** The current version of the firmware supports auto-addressing of the three sensors on a TLE4973 evaluation kit, avoiding collisions in case of multiple sensors having the same address
- **UART Speed:** Once modified for one sensor, the software will automatically cycle through and program the same baud rate for all the detected sensors

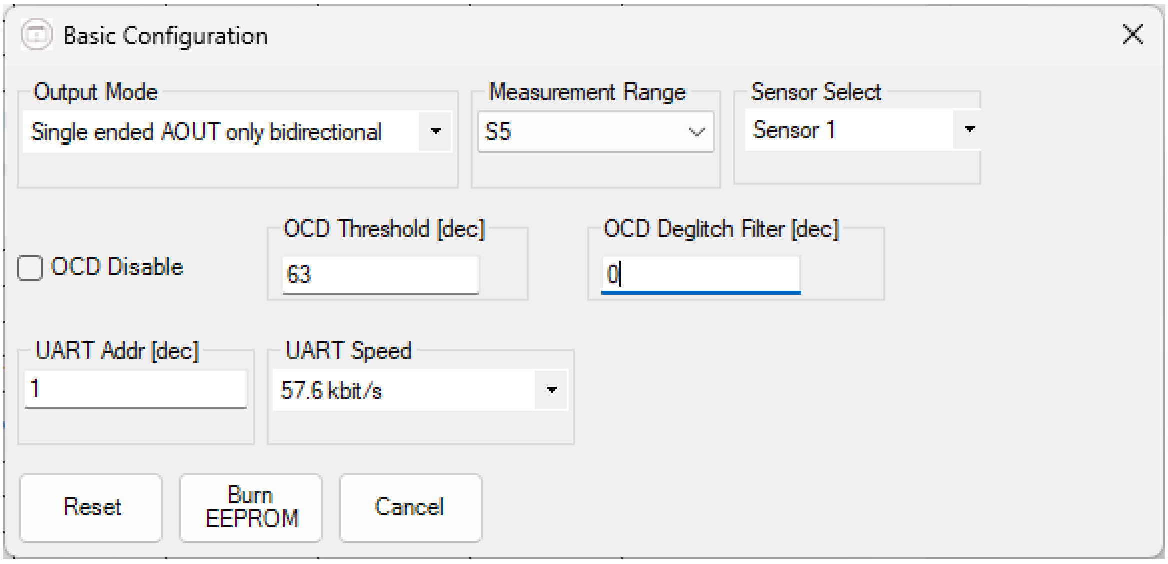

Figure 20 Toolbar – basic configuration

3.2.7 Calibration parameters

While the **Basic Configuration** window displays the most frequently used configuration settings, this window provides information about the gain, offset, sensitivity, and other calibration parameters necessary for the correct measurement and calculation of the value of the current.

The first time a sensor is connected to the TLE4973 bootkit and the software is launched, a copy of the EEPROM is saved. The **Restore** button will load the saved calibration parameters in case the values have been manually modified and the sensor behaves wrongly, or the calibration sequence does not provide satisfactory results. More details about the calibration sequence are provided in Double code word calibration.

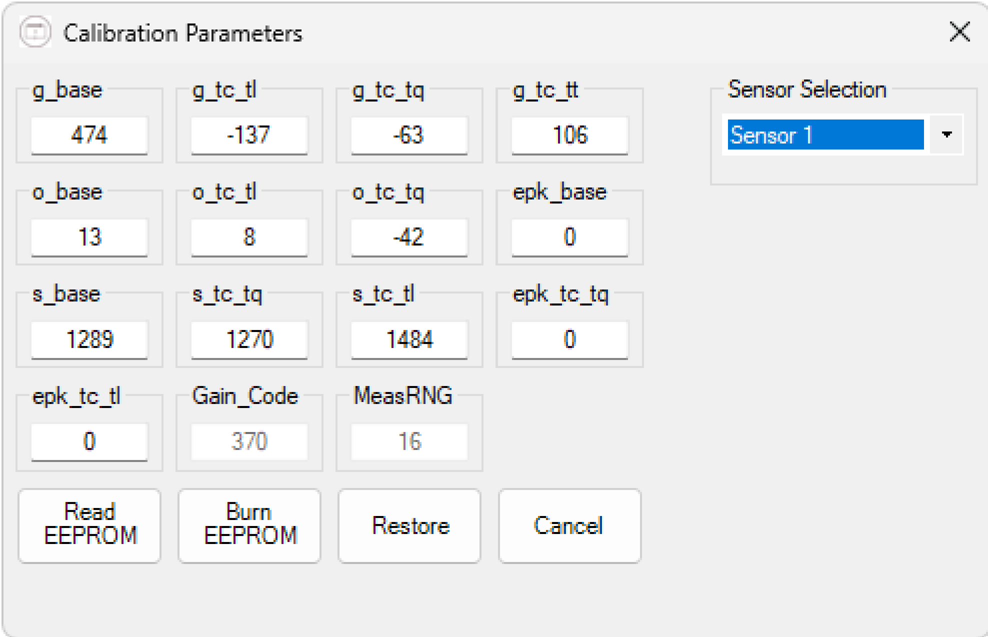

Figure 21 **Toolbar – EEPROM map**

3.2.8 Current rail transfer factor

As described in Board transfer factor, the transfer factor is a vital component in calculating the value of the current. The current rail transfer factor [uT/A] and the sensitivity [mV/A] are complementary, with predetermined values for the TLE4973 evaluation kits listed in Table 1. For a custom integration of the TLE4973 current sensor, the transfer factor can be calculated using this window by manually measuring the sensitivity. In case of a device programmed in fully-differential output mode, provide half of the measured sensitivity (single-ended sensitivity).

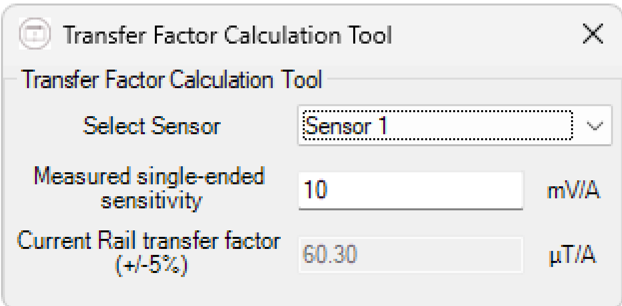

Figure 22 **Toolbar – transfer factor calculation tool**

3.3 Continuous readout

Evaluation of the sensor output can be performed without any configuration, as the TLE4973 evaluation kits are pre-programed and can provide valid current measurements through the TLE4973 bootkit out-of-the-box. Pressing the **Start** button will begin the logging of values on three graphs, one for each of the three phases. On the right side of the window, important values such as sensor output voltage level (VADC), reference voltage level (VREF), and the calculated current value are displayed for each of the three sensors. In case the selected measurement mode does not require an external reference voltage (reference voltage jumper set to **NC**), it is normal for the text box to display **N/A**.

The **Get Diagnostic** checkbox enables the direct monitoring of the OCD line, saturation information, and temperature of each sensor. The graphs are initially scaled to 5 A/div, but the scale can be manually changed up to 100 A/div, each graph independently or all three at once, selectable from the **Apply to all** checkbox.

The measured current values can be logged in CSV format. Upon checking the **Log data** checkbox, a .csv file is created into which VADC and VREF data will be continually saved. Stopping the continuous readout and starting it again will continue to save data in the same .csv file previously created. Starting another logging session will create another .csv file.

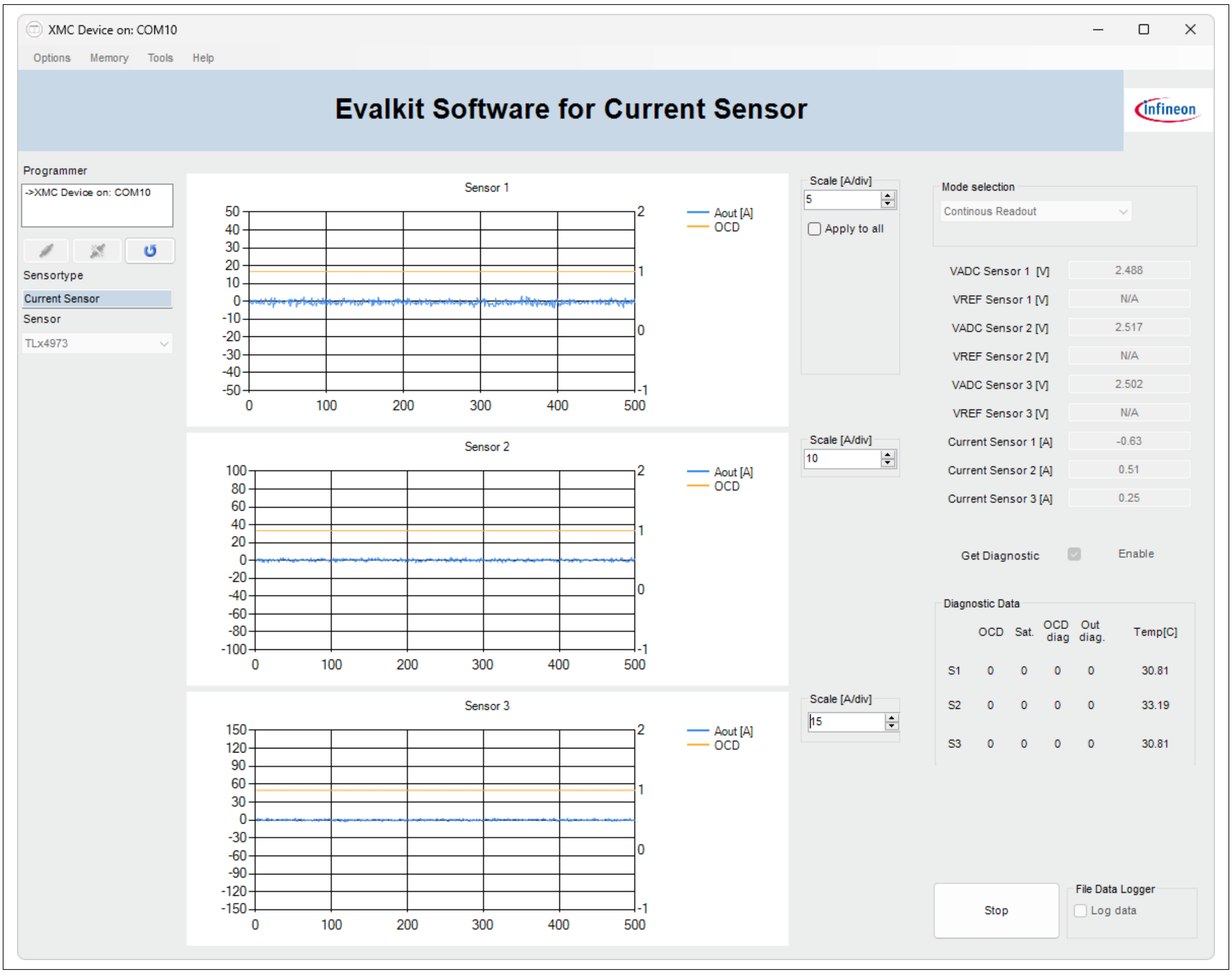

Figure 23 **Continuous readout**

3.4 Double code word calibration

The **XENSIV™ TLx4973 Current Sensor Programmer App** can be used to further calibrate a TLE4973 current sensor as a last step of the integration in a particular application. This calibration method is based on providing a known current to the sensor and making multiple measurements, from which new calibration parameters are calculated (particularly, sensitivity calibration coefficients (g_base, g_tc_tl, g_tc_tt) and the offset calibration coefficients (o_base, o_tc_tl, o_tc_tq), as shown in Calibration parameters). Selecting the **Double Code Word Calibration** mode is done from the **Mode selection** drop-down menu, located in the top-right corner of the main window.

The **Double Code Word Calibration** procedure can be performed in two ways: **Automatic** and **Manual**. This selection can be made from the **Manual data input** checkbox. The difference between the two calibration methods consists in whether the voltage measurements are performed by the XMC1100 microcontroller or by the user.

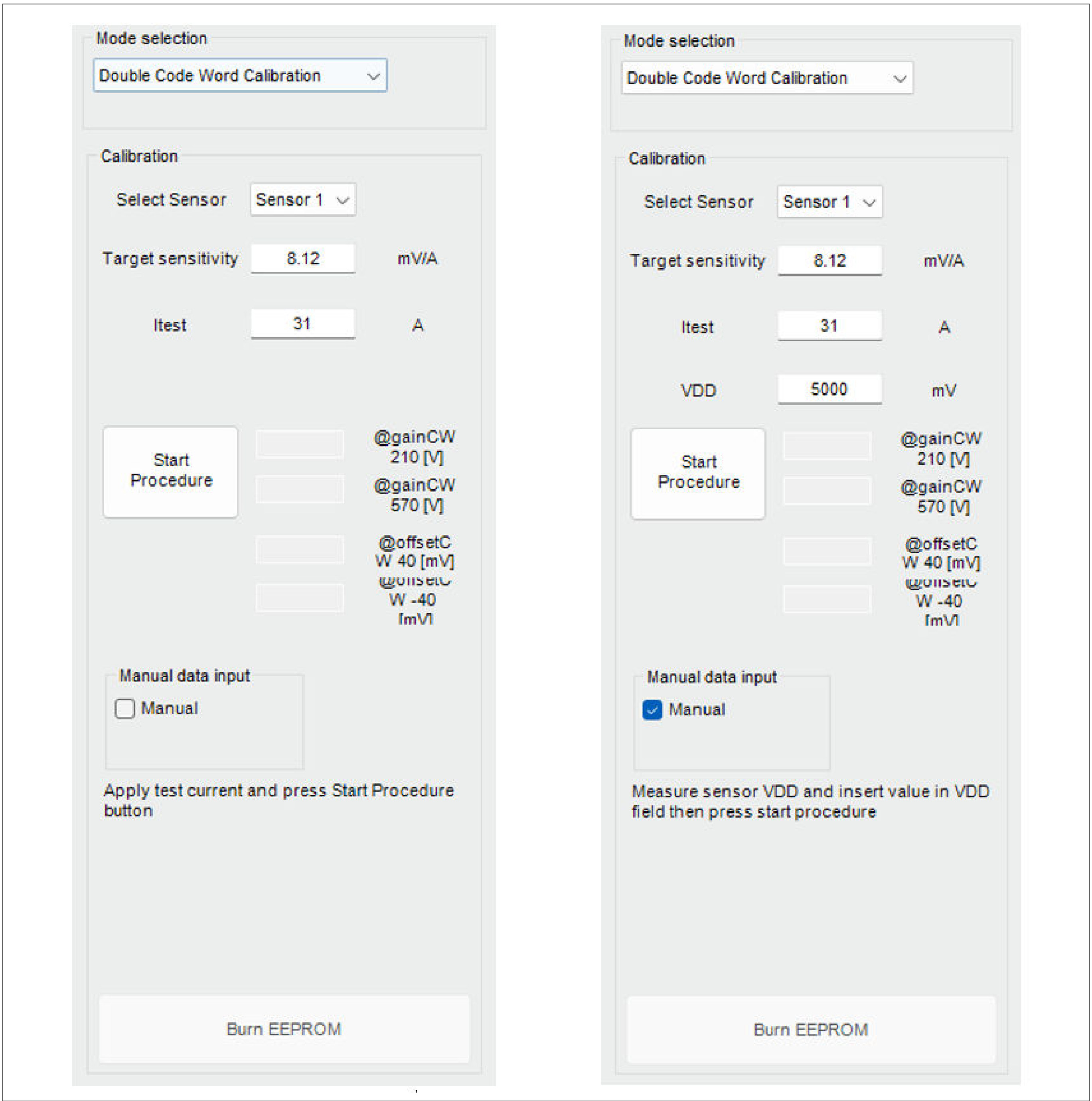

Figure 24 Automatic (left) and manual (right) double code word calibration

3.4.1 Automatic double code word calibration

- The first step of the calibration process is the selection of the sensor for which the calibration is performed, using the **Select Sensor** drop-down menu
- The **Target sensitivity** text box should be filled with the sensitivity value calculated according to the formula provided in the TLE4973 current sensor user manual
- The **ITest** text box needs to be filled with the value of the test current that will be provided to the selected sensor

- Upon pressing the **Start Procedure** button, a series of pop-up instructions will appear, instructing the user to connect or disconnect the current source from the sensor
- At the end of the process, the new *g_base* and *o_base* values will be checked automatically by the application for validity, requiring the user to press the **Burn EEPROM** button to save the changes. In case the new calibration values are not valid, the calibration process can be restarted

3.4.2 Manual double code word calibration

- The first step of the calibration process is the selection of the sensor for which the calibration is performed, using the **Select Sensor** drop-down menu
- The **Target sensitivity** text box should be filled with the sensitivity value calculated according to the formulas provided in the TLE4973 current sensor user manual
- The **ITest** text box needs to be filled with the value of the test current that will be provided to the selected sensor
- The **VDD** text box should be filled with the measured supply voltage of the selected sensor
- Upon pressing the **Start Procedure** button, a series of pop-up windows will appear, by which the user is prompted to introduce the multimeter measurement of the AOUT pin of the sensor. Six such measurements are required for the full calibration process

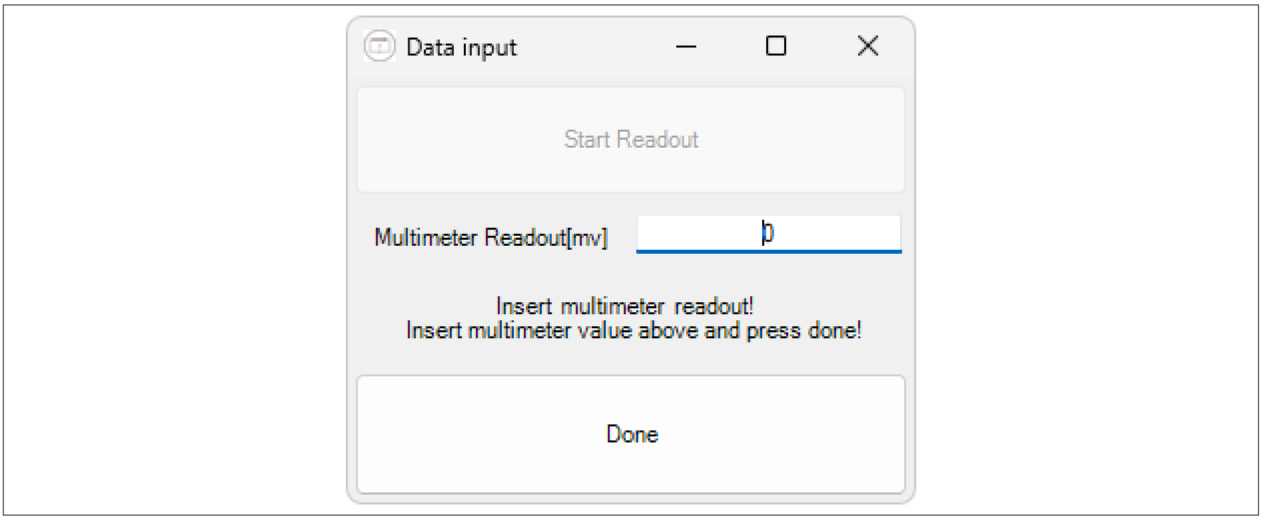

Figure 25 Manual double code word calibration – measurement input

- At the end of the process, the new *g_base* and *o_base* values will be automatically checked by the application for validity, requiring the user to press the **Burn EEPROM** button to save the changes. In case the new calibration values are not valid, the calibration process can be restarted

3.5 Fine tuning of calibration parameters

The **XENSIV™ TLx4973 Current Sensor Programmer App** can be used to fine tune the offset and sensitivity of a TLE4973 current sensor as an aid to the initial system development. As mentioned in Calibration parameters, the EEPROM of the connected sensors is automatically stored on the local machine at the first connection.

The fine tuning uses the original EEPROM content as a base for the calculation of the new calibration coefficients. The fine tuning is realized by introducing a correction factor for either offset or sensitivity. The correction factor is used to calculate the new calibration coefficients for offset and sensitivity, using the ones available in the original device EEPROM as a starting point. The change can be made permanent through an EEPROM burn. Selecting the **Fine Tune** window is performed from the **Tools** drop-down menu of the toolbar.

***Note**: This functionality requires that Microsoft Excel software is installed on the machine as a prerequisite.*

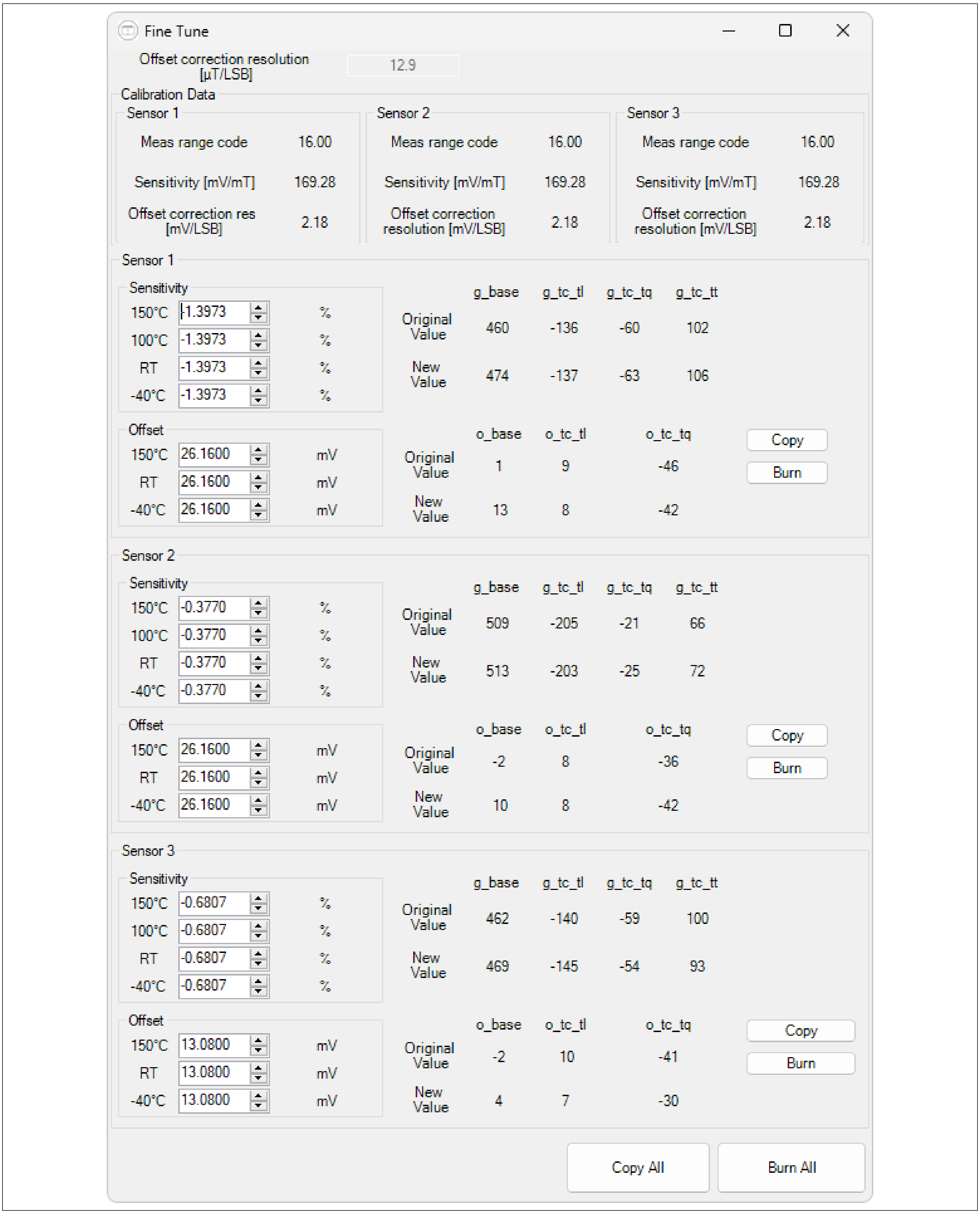

Figure 26 **Fine tuning calibration**

The calibration data of the connected sensor is shown at the top of the window. The programmed measurement range in decimal values is extracted from the device EEPROM and the corresponding sensitivity [mV/mT] and offset correction resolution [mV/LSB] are reported.

Each connected sensor is allocated a separate section, labeled **Sensor x**:

- On the left side, input boxes allow the user to modify the sensitivity [%] and offset [mV] by either manually entering the values, or by using the provided increment/decrement controls
- On the right side, the two rows of text show the sensitivity calibration coefficients (g_base, g_tc_tl, g_tc_tt) and the offset calibration coefficients (o_base, o_tc_tl, o_tc_tq)
  - The **Original** values are correspondent to the calibration parameters read initially from the EEPROM, as mentioned in Calibration parameters
  - The **New** values are the calculated calibration parameters, computed according to the changes made in the input boxes on the left side of the window

***Attention**: The offset fine tuning is developed with the aim to correct sensor-level initial offset error. The offset correction applied to the sensor should not exceed the "Initial offset error" reported on the product datasheet.*

***Attention**: The sensitivity fine tuning is developed with the aim to correct the system level sensitivity error. The sensitivity correction applied to the sensor should not exceed the "Sensitivity calibration range" reported on the product datasheet.*

The provided software keeps track of each calibration sequence performed by the user. By always comparing the original EEPROM and the current EEPROM whenever a new calibration sequence is started, the windows are automatically updated as described in Table 4.

Table 4 Fine tune calibration data update behavior

Sensor was not calibrated by the user through **Double Code Word Calibration**	• Input boxes will be populated with 0 • Original values and new values will be identical
Sensor was calibrated by the user through **Double Code Word Calibration** on the same machine/computer	• Input boxes will be populated with the correction factors that were applied to the original values to obtain the new values • Original values are the first-launch EEPROM values • New values are the current EEPROM values
Sensor was calibrated by the user through **Double Code Word Calibration** on a different machine/computer	• Input boxes will be populated with 0 • Original values and new values will be identical • EEPROM content is altered!

***Attention**: Avoid multiple re-calculations of the calibration parameters to reduce quantization errors. In case the calibration parameters are modified on a different machine/computer, either by Double Code Word Calibration or by manual alteration, ensure to restore the original EEPROM content before performing a new calibration.*

The new values of the coefficients can be programmed in the device EEPROM by clicking the **Burn** button, or copied to memory by clicking the **Copy** button. The **Copy All** and **Burn All** buttons allow a fast execution of the fine tune process for all the connected sensors.

Revision history

Document revision	Date	Description of changes
1.00	2025-04-08	Initial release
2.00	2025-05-15	Hardware V2.0 introduction

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