TLE4972 Current sensor programmer

User guide

About this document

This document describes feature set, hardware and software layers of the Infineon Current Sensor Programmer.

Scope and purpose

The purpose of this document is to guide the user in the programming, calibration and general evaluation of compatible TLE4972 sensing boards using the Infineon Current Sensor Programmer.

Intended audience

This document is written for TLE4972 users who are dealing with the implementation of the product in the system.

Evaluation Board

Infineon's magnetic current sensor evaluation kit consists of the Current Sensor Programmer board, USB cable and evaluation board connection cable. The programmer GUI along with Current Sensor Programmer board can be used to evaluate, program and calibrate Infineon's set of evaluation boards or a customized PCB setup. The programmer board is to be used by the customer solely for the purpose of evaluation and testing. It is not a commercialized product and shall not be used for series production. The programmer board is thus not intended to meet any industrial specifications and the recommended operating ambient temperature is 80°C.

The following key aspects are discussed in this document:

- Programmer board and evaluation board order information;
- Programmer board and GUI description;
- Programmer board ELV and SELV isolation scheme;
- GUI installation procedure;
- Typical application setup with and without Infineon evaluation boards;
- GUI operation with and without Infineon evaluation boards;
- Easy programming of current sensor parameters such as operating mode, sensitivity, overcurrent threshold and deglitch filtering time;
- Internal signals readout (e.g. internal temperature);
- Crosstalk compensation procedure;
- Calibration procedure.

Table 1 Programmer and evaluation boards ordering codes

Device name	SP number	Device information
CUR SENSOR PROGRAMMER	SP004441438	Current Sensor Programmer for TLE4972
TLE4972 EVAL STD PCB	SP005632136	TLE4972 TDSO, multi-layer FR4 board, 45° S-bend
TLE4972 EVAL INLAY	SP005632138	TLE4972 TDSO, FR4 board with copper inlay, 45° S-bend

(table continues...)

Table 1 (continued) Programmer and evaluation boards ordering codes

Device name	SP number	Device information
TLE4972 EVAL VER BAR	SP005632142	TLE4972 VSON, Busbar, Vertical insertion
TLE4972 EVAL LAT BAR	SP005632140	TLE4972 VSON, Busbar, 45° S-bend

Figure 1 TLE4972 Current Sensor Programmer

The Current Sensor Programmer board connection with a 3-phase TLE4972 evaluation board is shown in the figure below. The communication between the current sensor and programmer board is done through an interface cable.

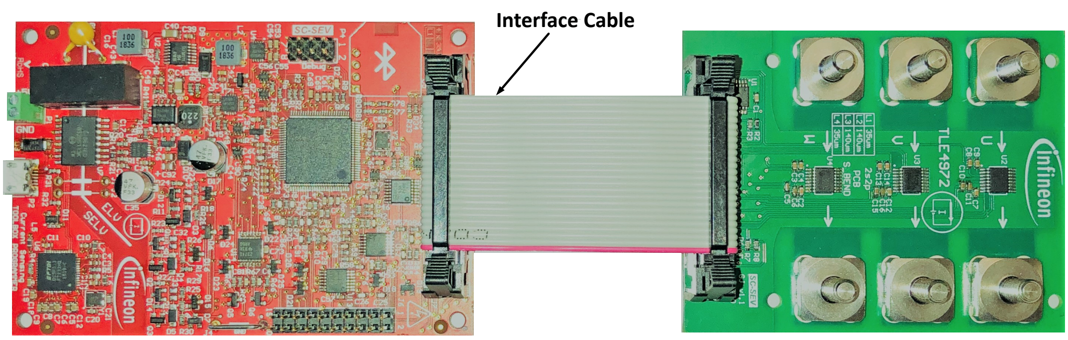

Figure 2 TLE4972 evaluation board (Green) connected to Current Sensor Programmer board (Red)

Table of contents

Table of contents

1 Important notice

“Evaluation Boards and Reference Boards” shall mean products embedded on a printed circuit board (PCB) for demonstration and/or evaluation purposes, which include, without limitation, demonstration, reference and evaluation boards, kits and design (collectively referred to as “Reference Board”).

Environmental conditions have been considered in the design of the Evaluation Boards and Reference Boards provided by Infineon Technologies. The design of the Evaluation Boards and Reference Boards has been tested by Infineon Technologies only as described in this document. The design is not qualified in terms of safety requirements, manufacturing and operation over the entire operating temperature range or lifetime.

The Evaluation Boards and Reference Boards provided by Infineon Technologies are subject to functional testing only under typical load conditions. Evaluation Boards and Reference Boards are not subject to the same procedures as regular products regarding returned material analysis (RMA), process change notification (PCN) and product discontinuation (PD).

Evaluation Boards and Reference Boards are not commercialized products, and are solely intended for evaluation and testing purposes. In particular, they shall not be used for reliability testing or production. The Evaluation Boards and Reference Boards may therefore not comply with CE or similar standards (including but not limited to the EMC Directive 2004/EC/108 and the EMC Act) and may not fulfill other requirements of the country in which they are operated by the customer. The customer shall ensure that all Evaluation Boards and Reference Boards will be handled in a way which is compliant with the relevant requirements and standards of the country in which they are operated.

The Evaluation Boards and Reference Boards as well as the information provided in this document are addressed only to qualified and skilled technical staff, for laboratory usage, and shall be used and managed according to the terms and conditions set forth in this document and in other related documentation supplied with the respective Evaluation Board or Reference Board.

It is the responsibility of the customer’s technical departments to evaluate the suitability of the Evaluation Boards and Reference Boards for the intended application, and to evaluate the completeness and correctness of the information provided in this document with respect to such application.

The customer is obliged to ensure that the use of the Evaluation Boards and Reference Boards does not cause any harm to persons or third party property. The Evaluation Boards and Reference Boards and any information in this document is provided "as is" and Infineon Technologies disclaims any warranties, express or implied, including but not limited to warranties of non-infringement of third party rights and implied warranties of fitness for any purpose, or for merchantability.

Infineon Technologies shall not be responsible for any damages resulting from the use of the Evaluation Boards and Reference Boards and/or from any information provided in this document. The customer is obliged to defend, indemnify and hold Infineon Technologies harmless from and against any claims or damages arising out of or resulting from any use thereof.

Infineon Technologies reserves the right to modify this document and/or any information provided herein at any time without further notice.

2 Safety precautions

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

Figure 3 Safety Precautions

- **Warning**: Remove or disconnect power from the drive before you disconnect or reconnect wires, or perform maintenance work. Failure to do so may result in personal injury or death.
- **Warning**: Do not keep the programmer connected to the laptop while the board is in use in an inverter. The laptop may be damaged during the operation of the system.
- **Caution**: Only personnel familiar with the drive, power electronics and associated machinery should plan, install, commission and subsequently service the system. Failure to comply may result in personal injury and/or equipment damage.
- **Caution**: The programmer board 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.
- **Caution**: A drive that is incorrectly applied or installed can lead to component damage or reduction in product lifetime. Wiring or application errors such as undersizing the motor, supplying an incorrect or inadequate AC supply, or excessive ambient temperatures may result in system malfunction.
- **Caution**: The programmer board 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.

3 The board at a glance

3.1 Delivery content

3.1.1 Software overview

The required software can be acquired from the respective Infineon sales person. The software package contains:

- A Graphical User Interface (GUI);
- FTD chipset USB driver, which is necessary to establish the USB connection. It enables USB 2.0 and USB 3.0 protocol capabilities.

The software can be used in combination with Windows 7 and Windows 10 operating systems. It is compatible with both 32-bit and 64-bit systems. Other operating systems may work, but have not been tested.

3.1.1.1 Software installation

The following description guides through the GUI software installation step by step:

1. Download the required GUI software;
2. Extract the GUI software to a local folder;
3. To start the installation double click on the "Current Sensor Evalkit Vx.x.x.exe" with left mouse button.

For detailed steps please refer to Chapter 5.

3.1.2 Hardware overview

The Current Sensor Programmer board order contains the following hardware items:

- The programmer board, fully assembled;
- Micro USB cable, used to enable communication with GUI and to power up the programmer board and sensors on the evaluation board or external PCB;
- Interface cable. It enables the connection and communication between programmer board and evaluation board.

3.2 Main features

The Current Sensor Programmer board, shown in the figure below, together with the GUI software constitute a ready-to-use evaluation setup which provides the following main features:

- Oscilloscope-like functionality;
- Crosstalk matrix cancellation in real time;
- Sensor calibration and programming.

The main hardware features of the Current Sensor Programmer board are:

- XMC4700 microcontroller based on ARM Cortex™-M4 with 144 MHz frequency used for the debugging and USB communication;
- Micro USB connector for power supply and communication with the GUI;
- External power supply for standalone operation (without USB connection);
- LED for indication of power supply and status indication;
- Circuit for the generation of the sensor EEPROM programming voltage (20.6 V);
- DUT board connector for the connection with DUT boards (e.g. Infineon's evaluation boards);
- Measurement header for measurement instrumentation connection;
- Reinforced galvanic isolation on USB connection and external power supply.

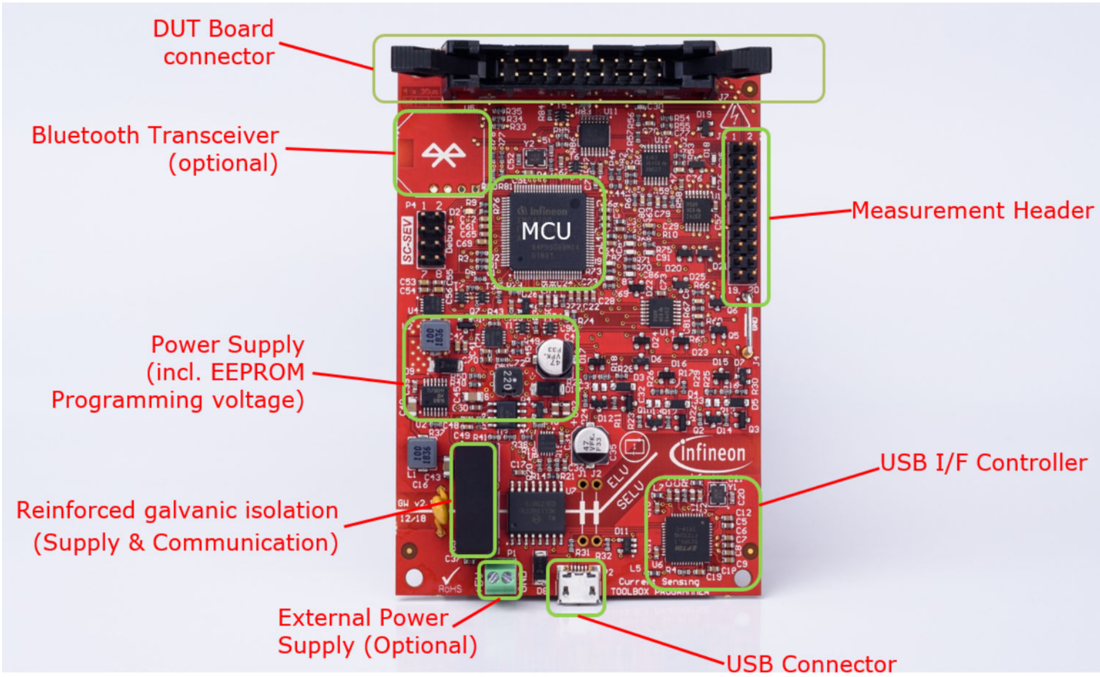

Figure 4 **Current Sensor Programmer board features**

3.3 Block diagram

The figure below shows the block diagram of the programmer board. To provide the required safety isolation level, the controller and interface circuits are isolated. The Micro-USB connector is isolated from the microcontroller through the reinforced insulation of the DC-DC converter. The control circuits are designed to meet the ELV safety standards and the interfacing devices are designed to meet the SELV safety standards. Therefore, regardless of the isolation scheme used on the DUT Board, a safe isolation barrier is provided by the programmer. Nevertheless, under all circumstances proper care must be taken while working with high voltage applications.

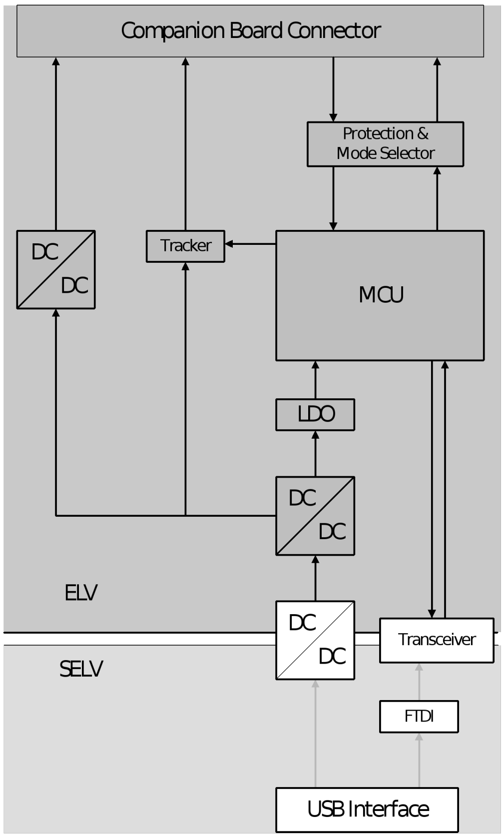

Figure 5 Current Sensor Programmer board architecture

4 System and functional description

4.1 Commissioning

4.1.1 Initial setup

The figure below shows an example about how to connect the TLE4972 evaluation boards with the programmer board via USB connector to a PC or laptop in case of general purpose drive application. Here, the green color board shown in the figure below could be either of the following boards:

- Infineon's evaluation board;
- An user designed generic DUT board.

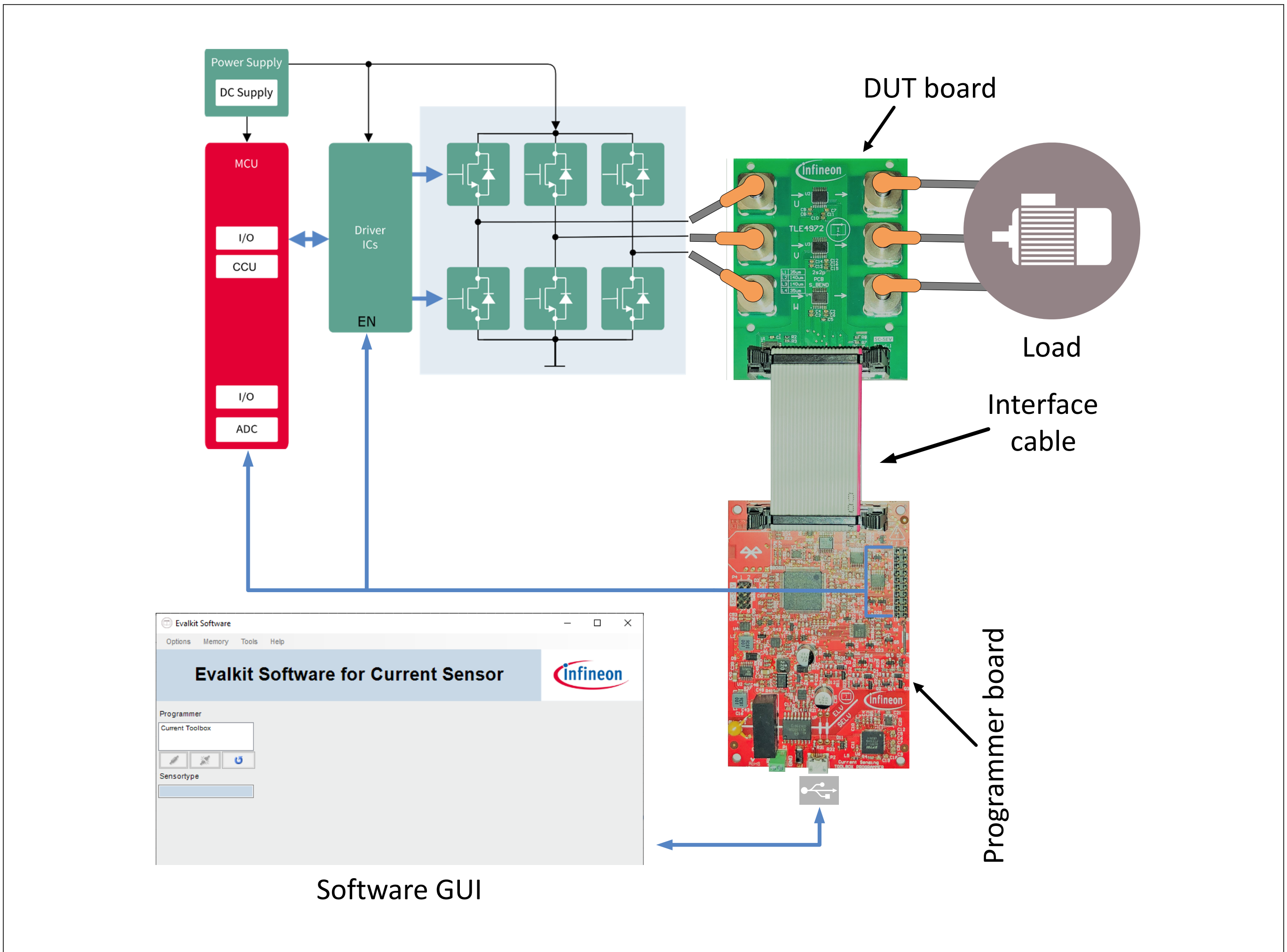

Figure 6 Test setup of TLE4972 DUT board with programmer board

Once the test set up is done, the user has to to connect the programmer board through USB connection and open the GUI software in order to start the communication with the hardware. If the USB connection is successful, the LED D1 on the programmer board will light. If the programmer board is correctly recognized by the GUI, it will appear as "Current Toolbox" in the devices list, as shown in the figure below. Click on the connection button to start the communication.

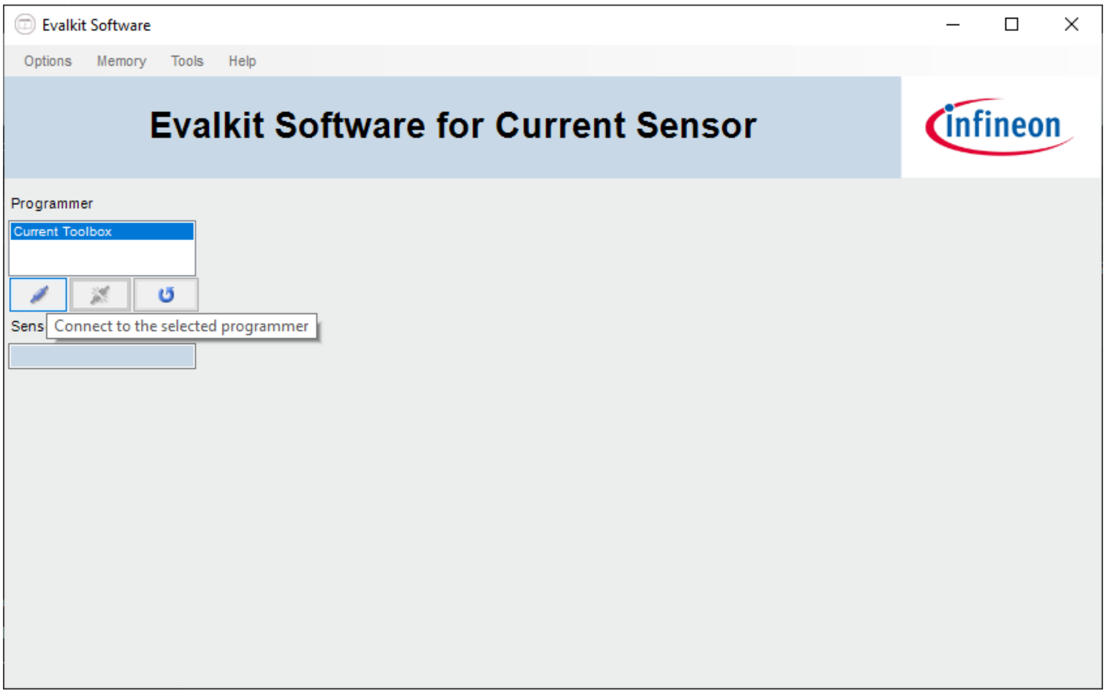

Figure 7 **Connection with programmer board**

If an Infineon evaluation board is connected as DUT board, the "Continuous readout" window will appear (Chapter 4.2.4.1) and the led D2 on the programmer board will start blinking. The software GUI will automatically configure itself using configuration data stored on the Infineon evaluation board external EEPROM.

4.1.2 Initial setup with generic DUT board

As discussed in the previous section, the GUI software and the programmer board support customized DUT boards. The pinout for the DUT board connector is shown in Chapter 4.2.1. The following window will pop-up if the user did not connect an Infineon evaluation board but a custom DUT board, without a properly programmed external EEPROM on it. The user has to enter the expected sensitivity in [mV/A] and confirm it by selecting the "Set" button; the tool uses the value entered here to convert the [V] reading into [A] reading in the continuous readout mode.

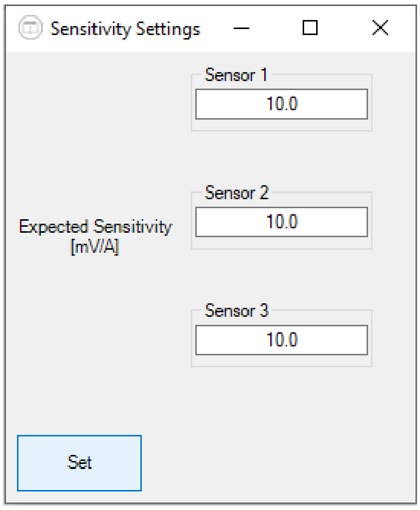

Figure 8 **Connection with generic DUT board**

After clicking on "Set", the "Continuous readout" window will appear (Chapter 4.2.4.1) and the led D2 on the programmer board will start blinking. Since there is no external EEPROM on the generic DUT board, the software GUI cannot configure itself. The user has to select the sensor family from the pane on the left, as shown in the figure below.

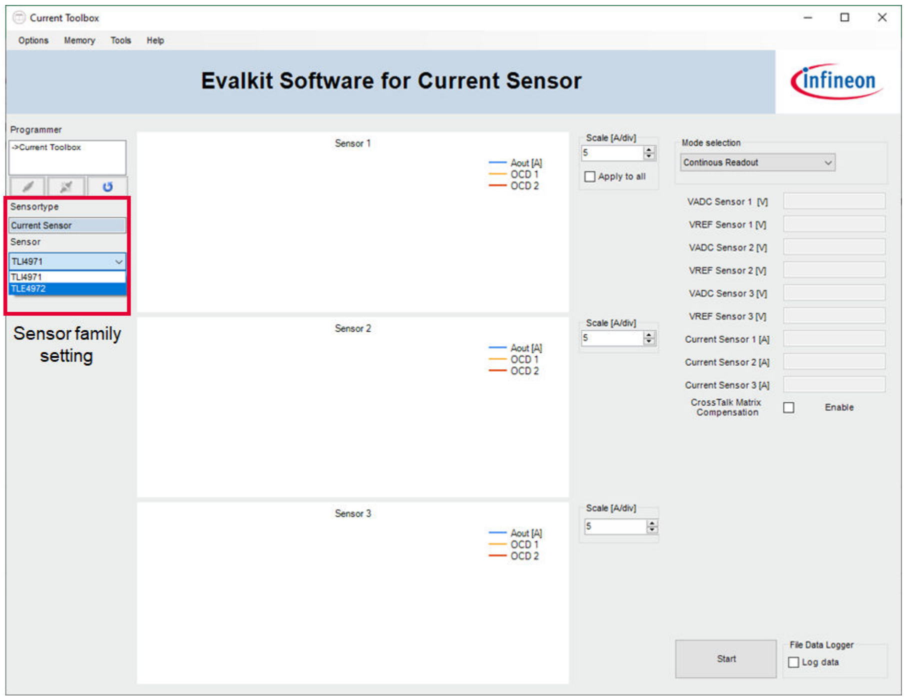

Figure 9 **Sensor family setting**

4.1.3 Sensor not recognized

If the "Not supported" indication appears in the "Design Step" text box, the sensors on the DUT board have not been recognized. This might be due to malfunctioning sensors, or to interface problems such as soldering issues, bad cabling or wrong connection scheme.

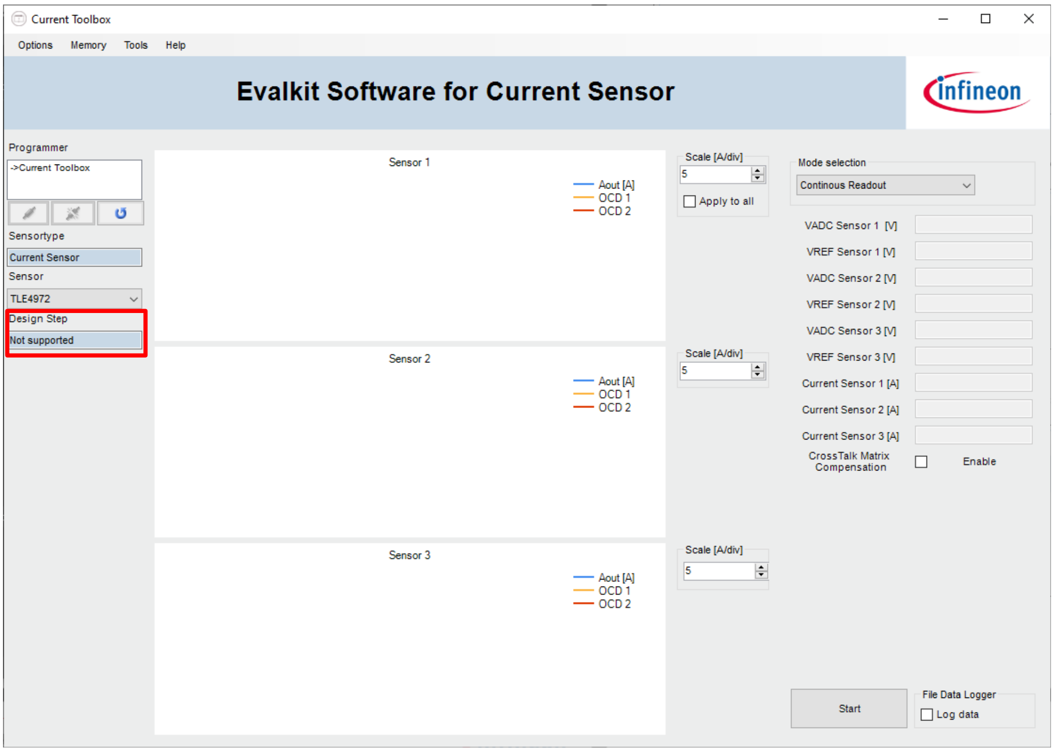

Figure 10 **Design step not supported error**

4.2 Description of the functional blocks

4.2.1 DUT board connector

The DUT board connector is used to establish the connection between the programmer and the DUT board. The figure and table below show the DUT board connector pinout.

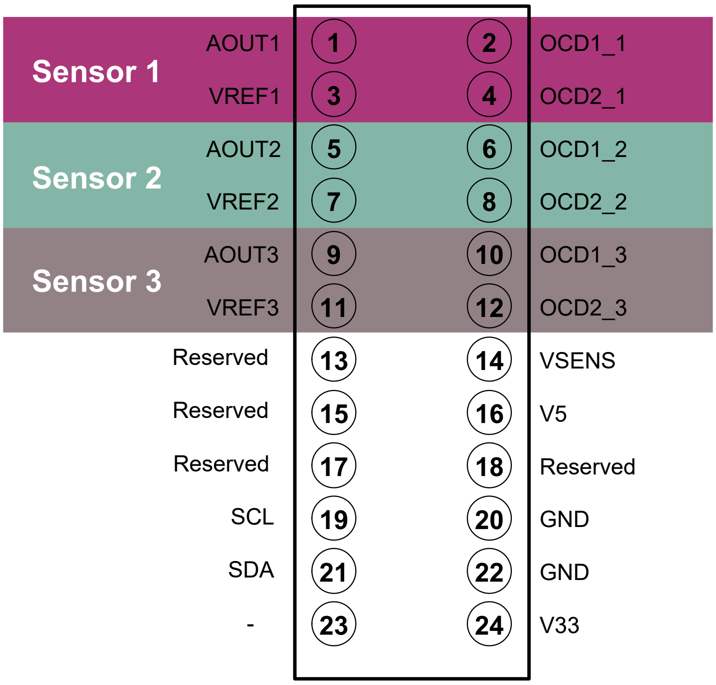

Figure 11 **DUT board connector pinout**

Table 2 **DUT board connector pinout**

Pin Number	Pin name	Pin function
1	AOUT1	Analog output voltage of sensor 1
2	OCD1_1	Over Current Detection channel 1 of sensor 1 (open drain)
3	VREF1	Reference voltage of sensor 1
4	OCD2_1	Over Current Detection channel 2 of sensor 1 (open drain)
5	AOUT2	Analog output voltage of sensor 2
6	OCD1_2	Over Current Detection channel 1 of sensor 2 (open drain)
7	VREF2	Reference voltage of sensor 2
8	OCD2_2	Over Current Detection channel 2 of sensor 2 (open drain)
9	AOUT3	Analog output voltage of sensor 3

(table continues...)

Table 2 (continued) DUT board connector pinout

10	OCD1_3	Over Current Detection channel 1 of sensor 3 (open drain)
11	VREF3	Reference voltage of sensor 3
12	OCD2_3	Over Current Detection channel 2 of sensor 3 (open drain)
13	Reserved	Additional ADC input, connected to µC XMC4700 P14_7 on the programmer board
14	VSENS	Sensor supply voltage, used for sensor test mode activation
15	Reserved	Additional ADC input, connected to µC XMC4700 P14_9 on the programmer board
16	V5	5 V supply voltage
17	Reserved	External trigger input, connected to µC XMC4700 P4_0 on the programmer board
18	Reserved	-
19	SCL	Clock for communication with external EEPROM on Infineon's evaluation boards
20	GND	Ground connection
21	SDA	Data link for communication with external EEPROM on Infineon's evaluation boards
22	GND	Ground connection
23	-	-
24	V33	3.3 V supply

4.2.2 Measurement header

The figure and table below show the pinout of the measurement header. It can be used to connect measurement instrumentation directly to the programmer board.

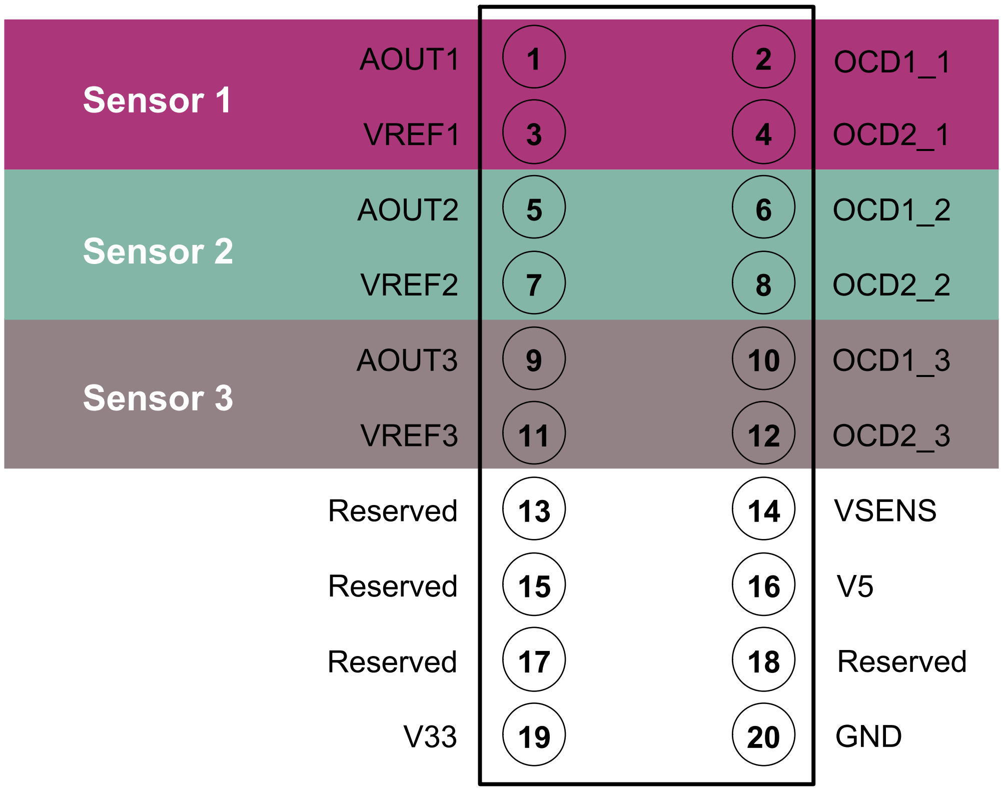

Figure 12 Measurement header pinout

Table 3 Measurement header pinout

Pin Number	Pin name	Pin function
1	AOUT1	Analog output voltage of sensor 1
2	OCD1_1	Over Current Detection channel 1 of sensor 1 (open drain)
3	VREF1	Reference voltage of sensor 1
4	OCD2_1	Over Current Detection channel 2 of sensor 1 (open drain)
5	AOUT2	Analog output voltage of sensor 2
6	OCD1_2	Over Current Detection channel 1 of sensor 2 (open drain)
7	VREF2	Reference voltage of sensor 2
8	OCD2_2	Over Current Detection channel 2 of sensor 2 (open drain)

(table continues...)

Table 3 (continued) Measurement header pinout

9	AOUT3	Analog output voltage of sensor 3
10	OCD1_3	Over Current Detection channel 1 of sensor 3 (open drain)
11	VREF3	Reference voltage of sensor 3
12	OCD2_3	Over Current Detection channel 2 of sensor 3 (open drain)
13	Reserved	Additional ADC input, connected to µC XMC4700 P14_7 on the programmer board
14	VSENS	Sensor supply voltage, used for sensor test mode activation
15	Reserved	Additional ADC input, connected to µC XMC4700 P14_9 on the programmer board
16	V5	5 V supply voltage
17	Reserved	External trigger input, connected to µC XMC4700 P4_0 on the programmer board
18	Reserved	-
19	V33	3.3 V supply
20	GND	Ground connection

4.2.3 Optional external power supply connection

The programmer board typically draws about 350 mA when connected to the TLE4972 evaluation boards. This current can be delivered via the USB port of a PC, which is usually specified to deliver up to 500 mA. A reverse current protection diode ensures safe operation and protects the USB port of the Laptop/PC in case power is provided through the measurement header at the same time.

In Chapter 3.2 it is shown an optional power supply plug to provide a connection to an external power supply in case the USB connection can't support the power requirement of the programmer board.

4.2.4 Mode selection

4.2.4.1 Continuous readout

The figure below shows the GUI software appearance when the programmer board is successfully connected to the DUT board. The Continuous readout mode is selected by default.

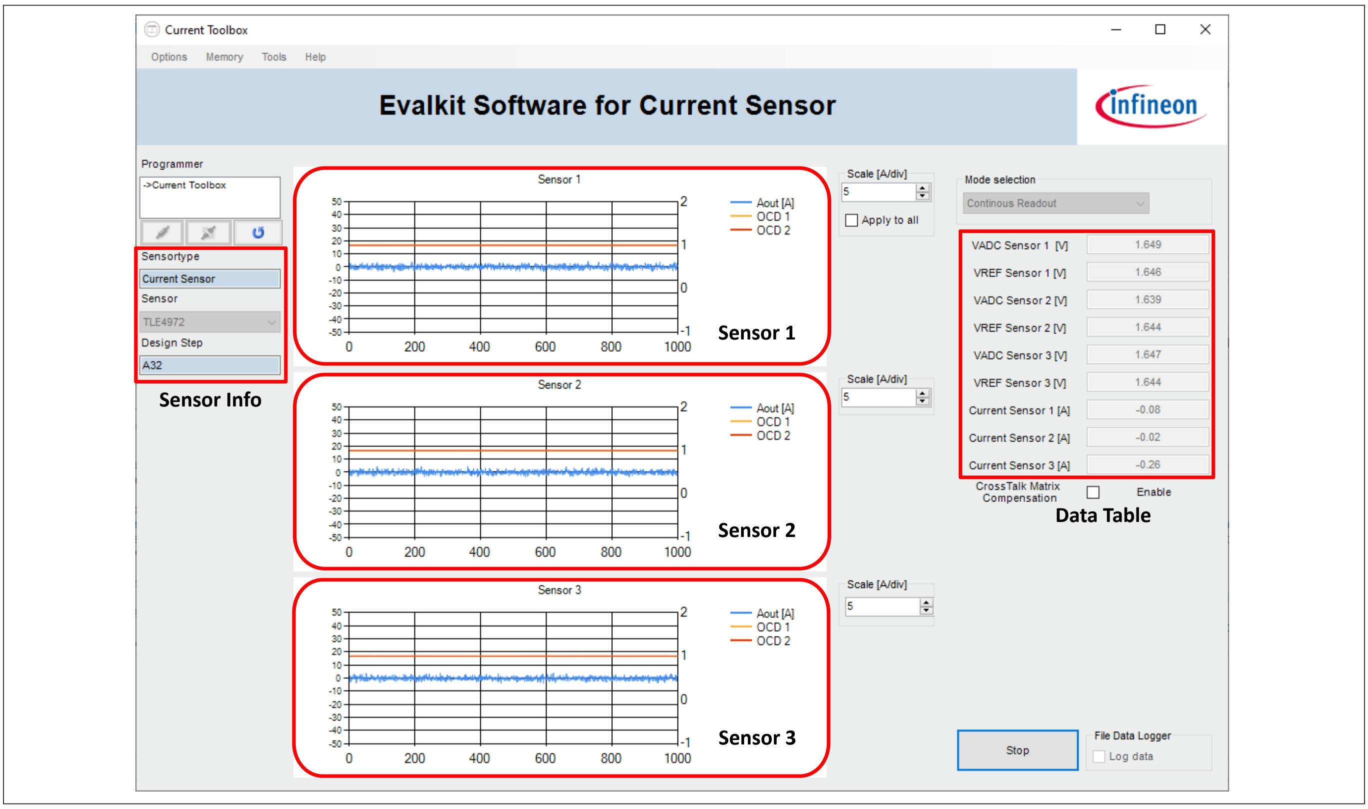

Figure 13 **Continuous readout mode**

The window contains the following visual elements:

1. Sensor info pane on the top left side: it displays the sensor type, the sensor family name and the sensor design step;
2. Phase current and over current detection info in the middle pane: the Y axis shows the current in ampere and the X axis shows the acquired samples with a sampling rate of 10 k sample per second. Additionally, the over current detection signals OCD1 (orange color plot) and OCD2 (red color plot) are also shown. The right side Y axis of each plot shows the status "1" for normal operation and "0" when OCD is triggered;
3. Data table pane on the top right side: it displays all parameters measured for sensor 1 to sensor 3 at the last sampling event;
4. Mode selection drop down menu on the top right side: to start a new mode click the "Stop" button shown on the bottom right corner of the window and select a new mode from the "Mode Selection" drop down menu which is on the top right corner;
5. Crosstalk matrix compensation check box: it can be enabled or disabled to compensate the external field effects on the sensor. The crosstalk matrix has to be characterized by the user and stored in the External EEPROM in the DUT board. A detailed explanation is provided in Chapter 4.2.5.1;
6. Log data option at the bottom right corner of the window: it can be used to save the measured data.

4.2.4.2 Basic configuration

The basic configuration mode helps the user in the configuration of the sensor for the target system. It is useful when a custom DUT board is connected, for which the correct sensor settings are not known yet.

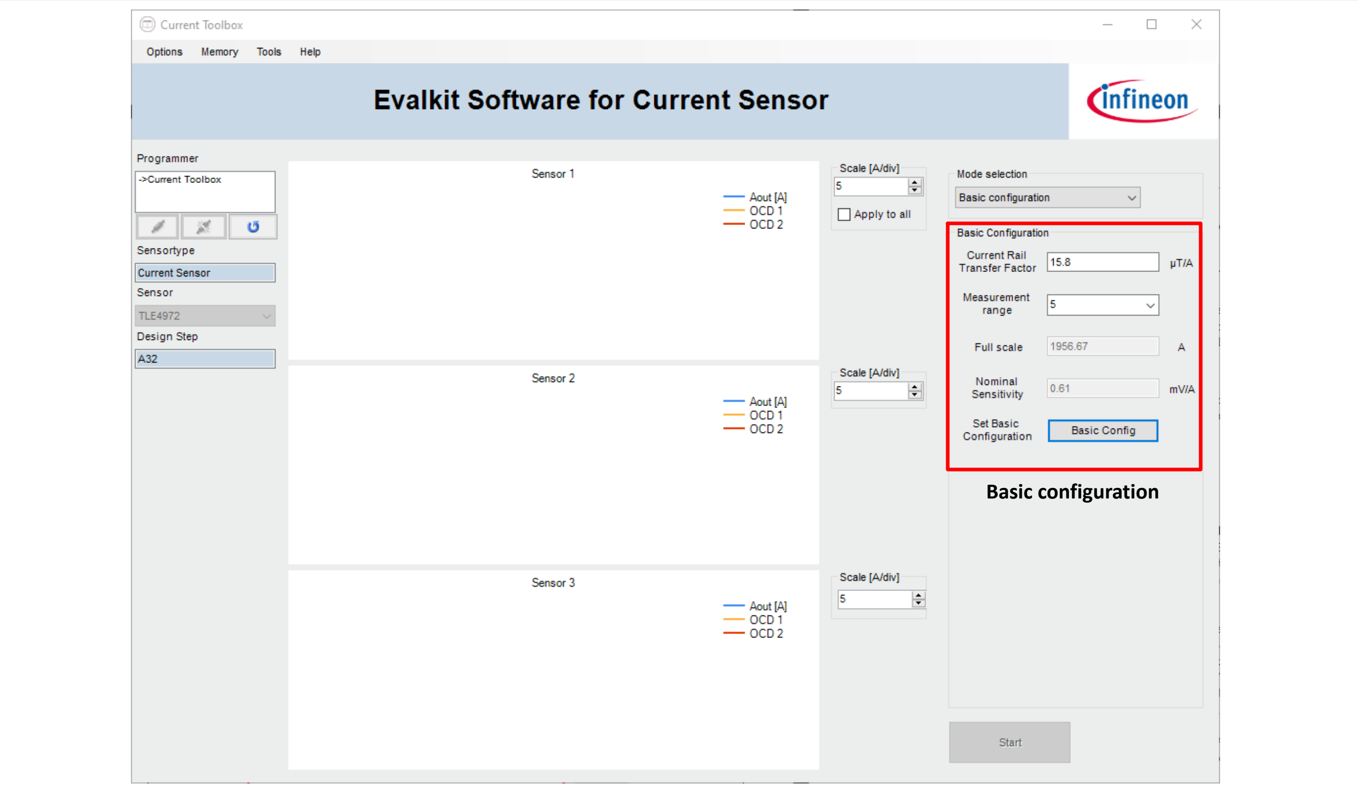

Figure 14 **Basic configuration mode**

This mode is based on 5 visual items:

1. Current Rail Transfer Factor: this is the transfer factor in [µT/A] associated with the sensing structure. The value must be known from simulations or measured on the final system. Please refer to Chapter 4.2.7.2 for instructions on how to estimate the current rail transfer factor using the Current Sensor Programmer software;
2. Measurement range: decimal value. This is the measurement range code to program in the sensor integrated EEPROM. Only the measurement ranges linked to sensitivity settings specified on product datasheet [1] can be used in the final productive system (e.g. *S1* = 5; *S2* = 6; *S3* = 8; *S4* = 12; *S5* = 16; *S6* = 24). The measurement range codes corresponding to the sensitivity settings specified on the product datasheet [1] are reported on the User manual [2]. Other measurement ranges are available for programming for testing purposes;
3. Full scale: this represents the nominal full scale in ampere that is resulting from the choice of the current rail transfer factor and measurement range values;
4. Nominal Sensitivity: this represents the nominal sensitivity in [mV/A] that is resulting from the choice of the current rail transfer factor and measurement range values. This is the value to be used as target sensitivity for calibration;
5. Basic Config button: this is a shortcut for the Basic Configuration window, described in Chapter 4.2.6.1.

For further information about target sensitivity for calibration and calibration procedures please refer to the User manual [2].

4.2.4.3 Double Code Word Calibration

Before starting sensor calibration, it is recommended to always store the original internal EEPROM of each sensor using the functionality explained in Chapter 4.2.6.2. If the calibration needs to be repeated, the user should restore the original EEPROM content of the sensor before starting the new calibration procedure.

The Double Code Word method is used to calibrate the sensors to the target sensitivity and target offset (zero offset). The complete algorithm is explained in the User manual [2] in the Calibration section. The programmer GUI software implements and automatizes the calibration based on the Double Code Word algorithm.

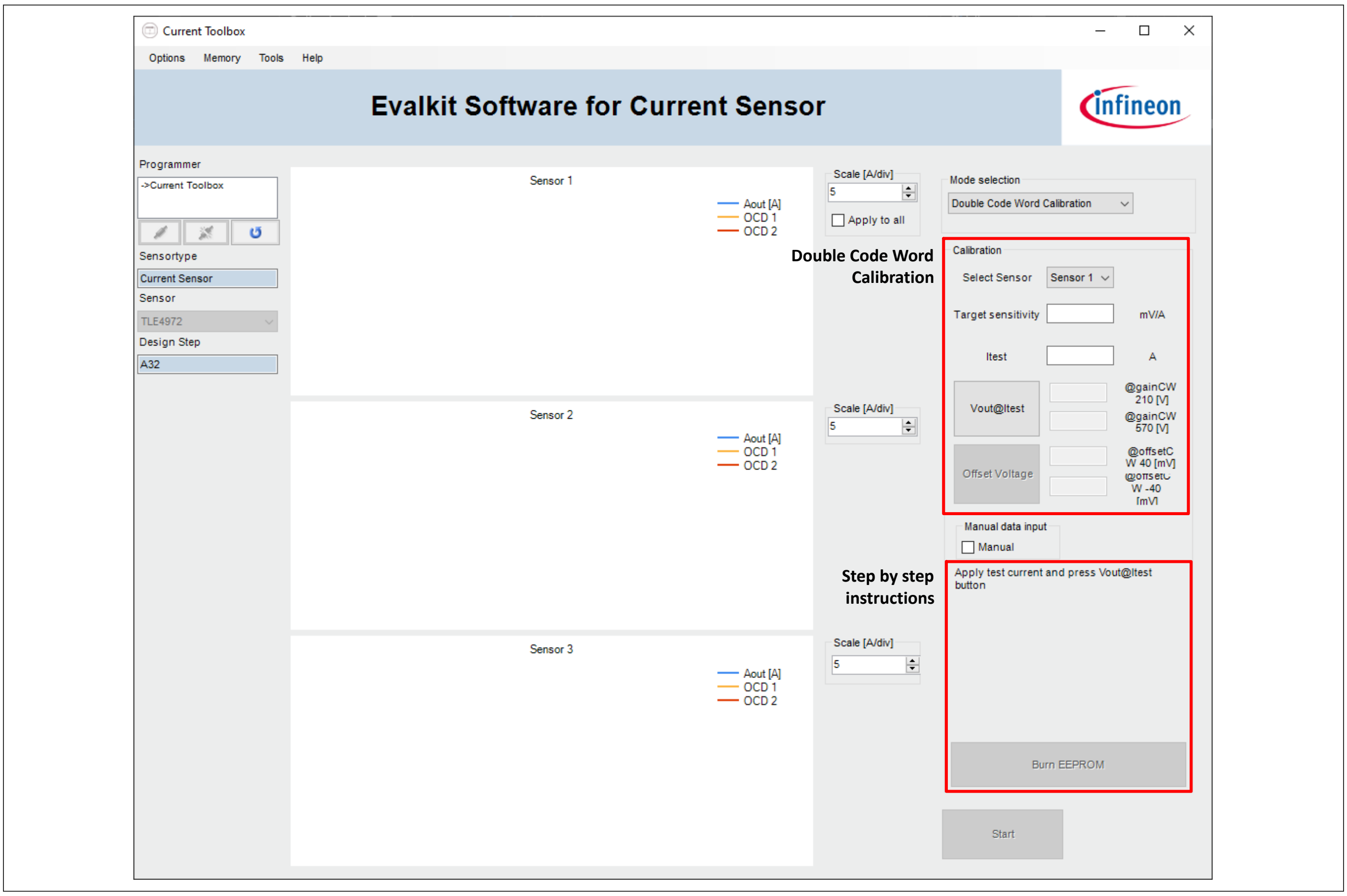

Figure 15 Double Code Word Calibration mode

This mode is based on 8 visual items:

1. Select sensor: this dropdown menu has to be used to select which sensor has to be calibrated;
2. Target sensitivity: the target sensitivity is the sensitivity to be used as a target for the calibration. All error components (within the sensor calibration range, reported on the product datasheet [1]) are compensated in order to reach the target sensitivity, and the sensor calibration parameters are stored at the end of the calibration process in the sensor internal EEPROM. The target sensitivity has to match the nominal one; in this way, the entire calibration range is used to compensate error components rather than fine-trimming the sensitivity to the desired one. The target sensitivity has to be entered doubled in case of fully-differential output mode, due to the doubled output voltage swing. For further information about target sensitivity for calibration and calibration procedures please refer to the User manual [2];
3. Itest: the user has to enter in this field the test current used during calibration. Measure the test current using a calibrated current source, a shunt combined with a multimeter or any other precise current measurement device;
4. Vout@Itest button: this button has to be pressed as part of the calibration procedure, explained above. By pressing this button, the software executes the Double Code Word algorithm part related to sensitivity calibration;
5. Offset Voltage button: this button has to be pressed as part of the calibration procedure, explained above. By pressing this button, the software executes the Double Code Word algorithm part related to offset calibration;
6. Manual data input checkbox: can be used to execute voltage readings during calibration using external measurement instrumentation, instead of the onboard ADC of the Current Sensor Programmer. Typically not needed;
7. Step by step instructions text box: it provides step by step instructions during calibration;
8. Burn EEPROM button: it programs effectively the new calibration parameters in the sensor internal EEPROM.

The guided calibration procedure consist in the following steps:

1. Input target sensitivity and test current;
2. Supply the test current for the selected sensor and click on the button "Vout@Itest";
3. Stop the current supply when new values are generated in the text fields on the right of the button;
4. Click on the button "Offset Voltage";
5. If no errors are indicated in the "Step by step instructions" box click on the "Burn EEPROM" button to store the calibration parameters in the sensor integrated EEPROM;
6. Using the measurement header, perform a sensitivity and offset measurement to check if the target sensitivity and offset are met. Sensitivity and offset measurement procedure is explained in the User Manual [2].

4.2.5 Options drop down menu

4.2.5.1 EXT EEPROM

This menu item is used to fetch the information from the external EEPROM of the Infineon's evaluation boards. The figure below shows the dialog box that will pop up if user selects the menu item "EXT EEPROM" under the "Options" menu. If there is no external EEPROM available on the DUT board connected to the programmer board this menu item will not appear in the "Options" menu dropdown list.

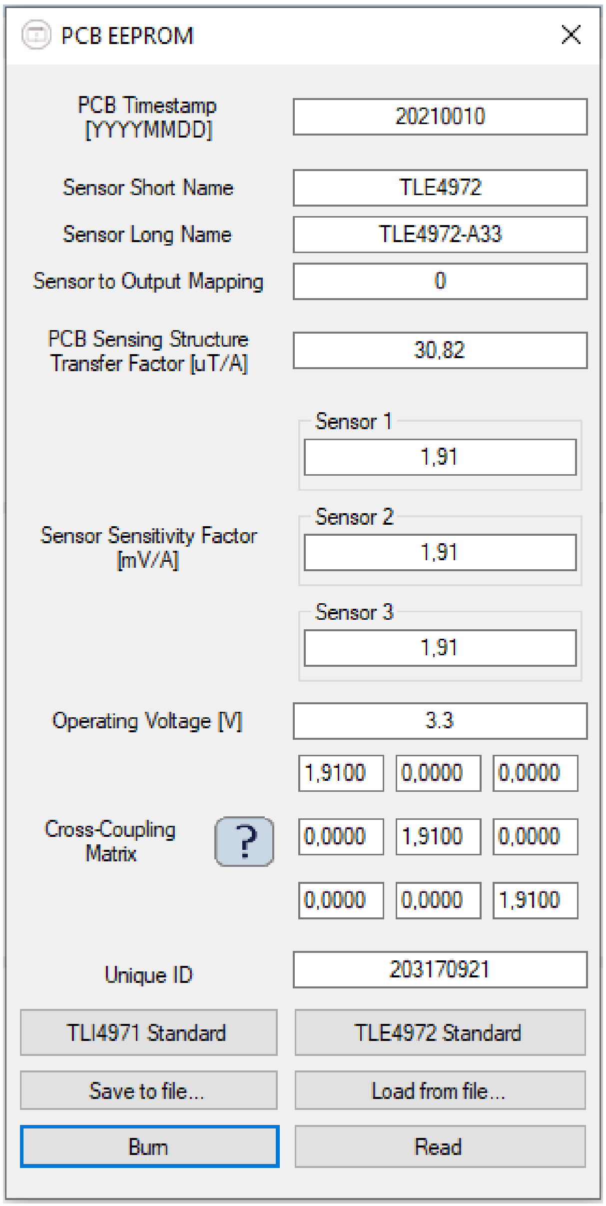

Figure 16 **EXT EEPROM menu item**

The following information are programmed in the external EEPROM:

- PCB Timestamp: related to evaluation board hardware release;
- Sensor Short Name: family name of the current sensors on the evaluation board;
- Sensor Long Name: complete product name of the current sensors on the evaluation board;
- Sensor to Output Mapping: 0 is default. It defines the mapping of the three sensors on the evaluation board with acquisition channels in the programmer board (Sensor 1, Sensor 2 and Sensor 3);

- PCB Sensing Structure Transfer Factor [µT/A]: the transfer factor related to the sensing structure realized on the evaluation board;
- Sensor Sensitivity Factor [mV/A]: the target sensitivity used for calibration of the sensors on the evaluation board;
- Operating Voltage [V]: the analog interface voltage level of the sensors on the evaluation board;
- Cross-Coupling Matrix: the cross coupling factors in [mV/A] between the three phases of the evaluation board. Further information are available on the User manual [2] and by clicking on the "?" button;
- Unique ID: unique identifier of the evaluation board. Useful for direct support by Infineon;
- TLI4971/TLE4972 Standard buttons: to reset the external EEPROM content to default values;
- Save to/Load from file: to save and restore the external EEPROM content;
- Burn button: the external EEPROM content is effectively written in the external EEPROM after pressing the "Burn" button;
- Read button: to load the dialog box with values read from the external EEPROM. It can be used to verify correct programming.

4.2.5.2 Temperature Readout

The Options drop down menu also offers the "Temperature Readout" menu item to read the current sensor internal temperature from the DUT board. If the temperature readout is executing then analog output and OCDs output are not reliable, since the sensors are put into test mode. In the figure below, the Y axis shows the temperature in [°C] and X axis shows the number of acquired samples.

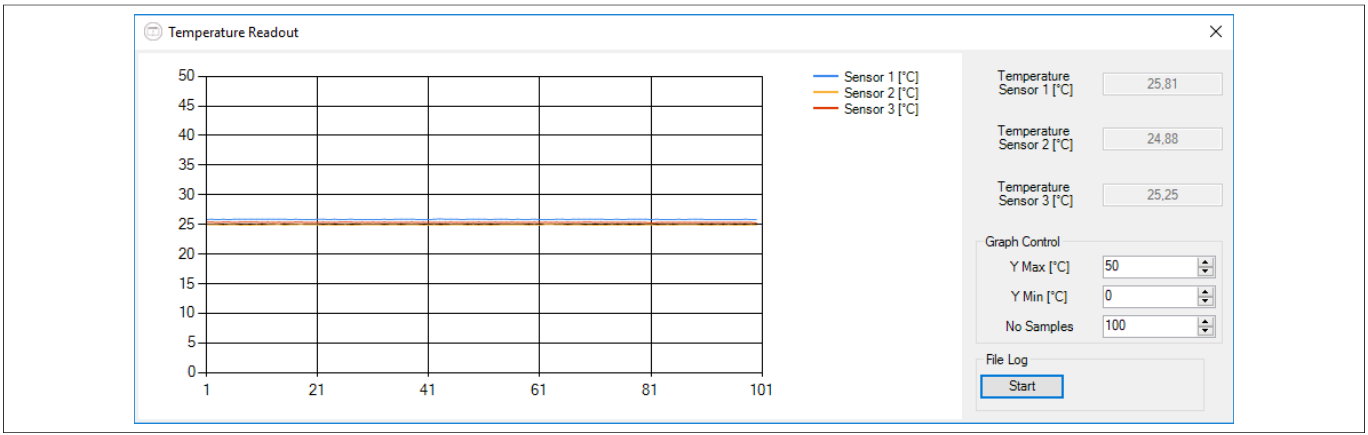

Figure 17 Temperature Readout window

4.2.5.3 Register Readout

This menu item opens the Register Readout window. This window allows the user to observe the change of internal registers in real time, for testing purposes. If the registers readout is executing then analog output and OCDs output are not reliable, since the sensors are put into test mode. The registers accessible by the user are reported in the user manual [2].

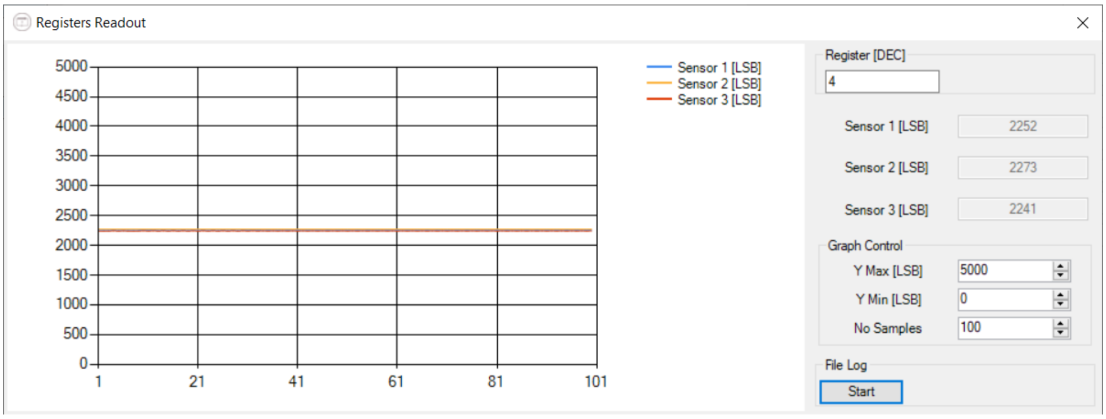

Figure 18 Registers Readout window

4.2.5.4 EXIT

This menu item closes the Current Sensor Programmer GUI window.

4.2.6 Memory drop down menu

4.2.6.1 Basic Configuration

This menu item opens the Basic Configuration dialog window. This window allows the user to configure the most important sensor settings. The description of the EEPROM settings is available on the User manual [2].

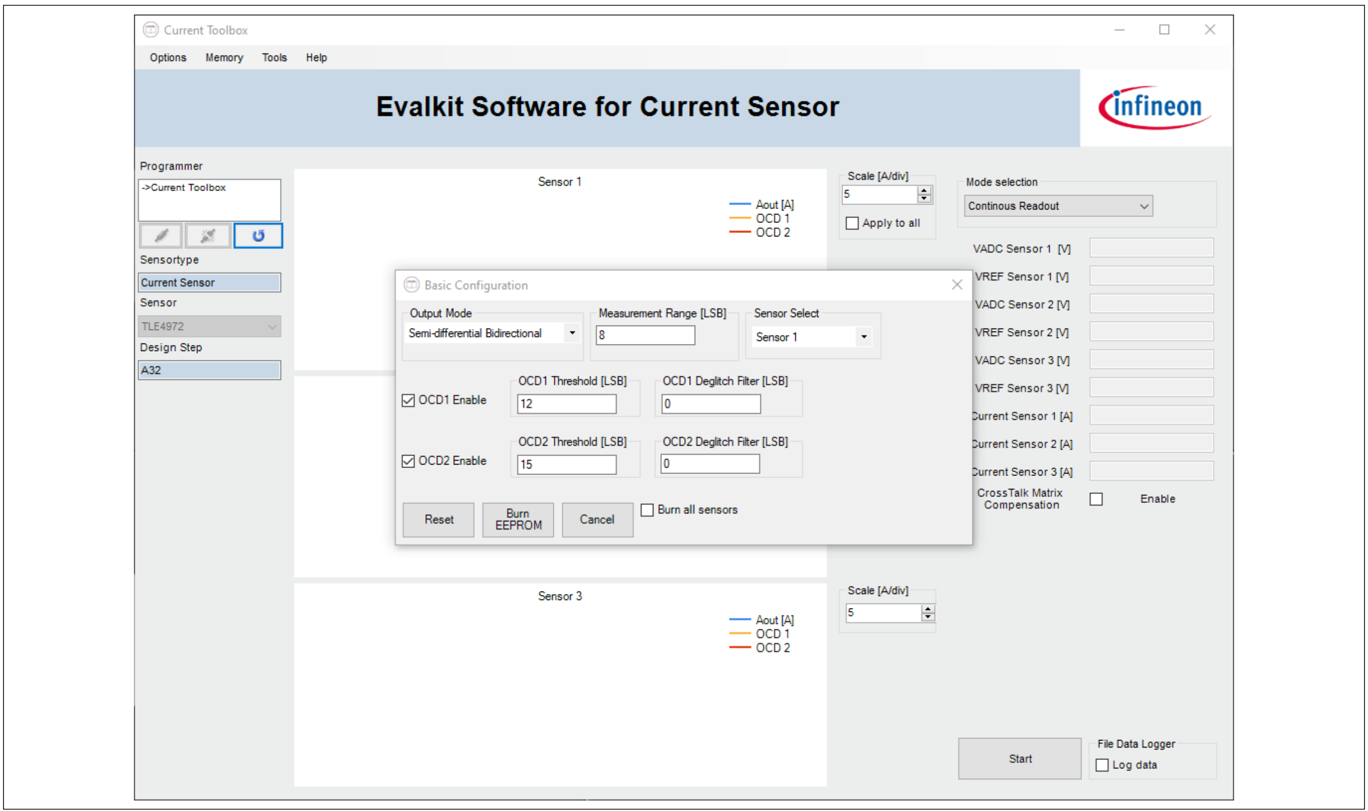

Figure 19 **Basic Configuration window**

By clicking on the Burn EEPROM button, the internal EEPROM of the sensors is effectively programmed.
In case an Infineon evaluation board is connected, the software will ask the user whether to update the external EEPROM of the evaluation board to fit to the new programmed sensor settings, as shown in the figure below. The external EEPROM content is shown in Chapter 4.2.5.1. E.g. if the measurement range setting is changed, the sensitivity of the sensors in [mV/A] is updated in the external EEPROM content.

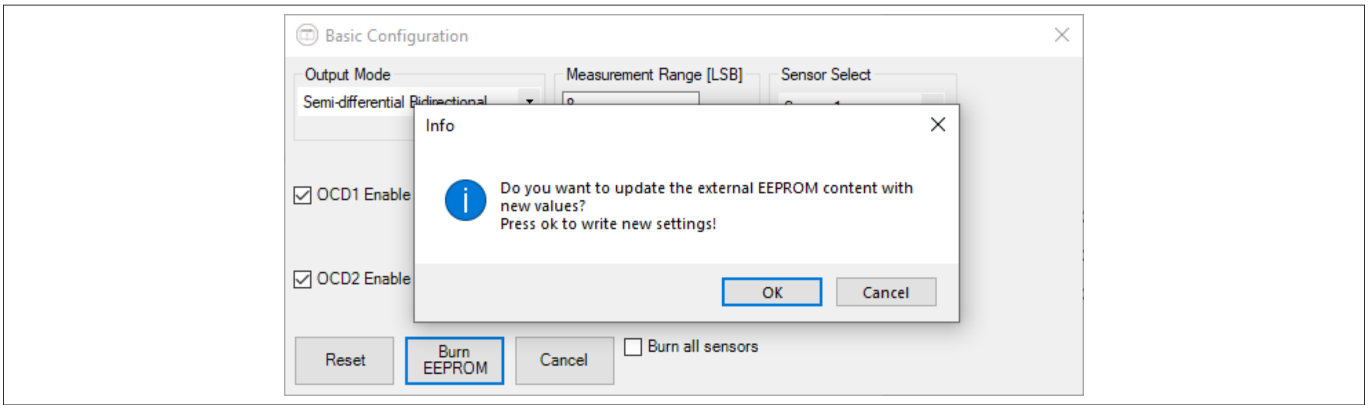

Figure 20 **External EEPROM content re-programming**

4.2.6.2 EEPROM Map

This menu item opens the EEPROM Mapping window, allowing the user to store, load and modify the internal EEPROM of the sensors on the DUT board. Before modifying the internal EEPROM content it is suggested to store the original internal EEPROM content of the sensor; in that way the original sensor status can always be restored. The internal EEPROM content is explained in the User manual [2].

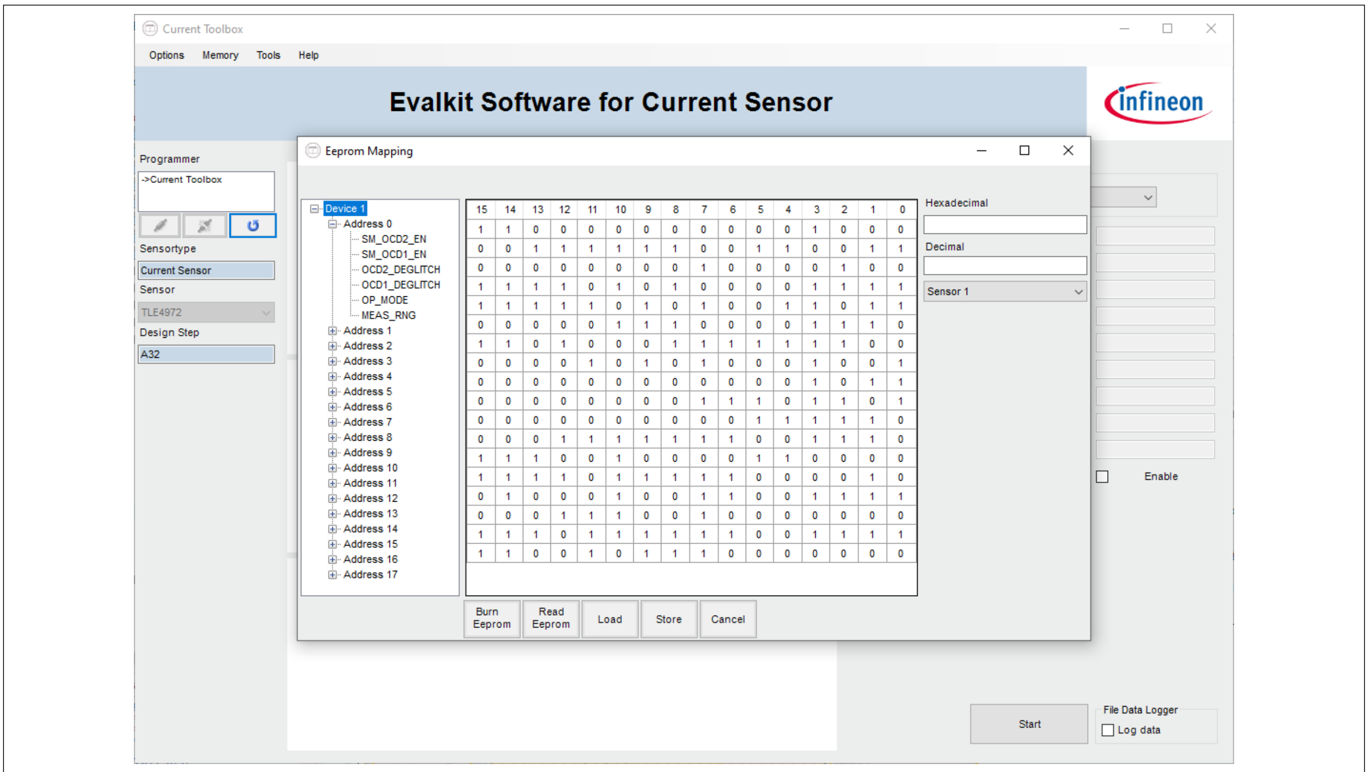

Figure 21 EEPROM Mapping window

The EEPROM Mapping window is composed by the following visual elements:

1. EEPROM addresses navigation pane, on the right: it allows to navigate the internal EEPROM content based on register address and register field names. By clicking on the register field name, the corresponding bits are highlighted;
2. EEPROM content pane, in the center: it displays the entire internal EEPROM content;
3. Hexadecimal text box, on the right: it displays the hexadecimal conversion of the content of the selected register field;
4. Decimal text box, on the right: it displays the decimal conversion of the content of the selected register field;
5. Sensor selection drop down menu, on the right: it is used to select the sensor for which the EEPROM content has to be displayed;
6. Burn EEPROM button, on the bottom: it effectively programs the displayed internal EEPROM content in the selected sensor;
7. Read EEPROM button, on the bottom: it reads the internal EEPROM content of the selected sensor;
8. Load button: it loads a backup file for the internal EEPROM content from the local drive; internal EEPROM backup files are in ".XML" format;
9. Store button: it stores the displayed internal EEPROM content in ".XML" format;
10. Cancel button: it closes the EEPROM Mapping window.

4.2.6.3 Calibration Parameters

When the user selects the Calibration Parameters item then the Calibration Parameters window appears. This window allows the user to manually change the sensor calibration parameters.

The sensor calibration parameters are set as the result of the sensor calibration over temperature and sensor trimming procedures in Infineon's production line. They are then modified automatically by the end of line calibration algorithm, which is automatized by the software functionality explained in Chapter 4.2.4.3 and explained in details in the User manual [2].

The calibration parameters should not be changed manually by the user unless directly indicated by Infineon. It is strongly recommended to store the original internal EEPROM content as explained in Chapter 4.2.6.2 before modifying the internal EEPROM content. Information about the calibration parameters are provided in the User manual [2].

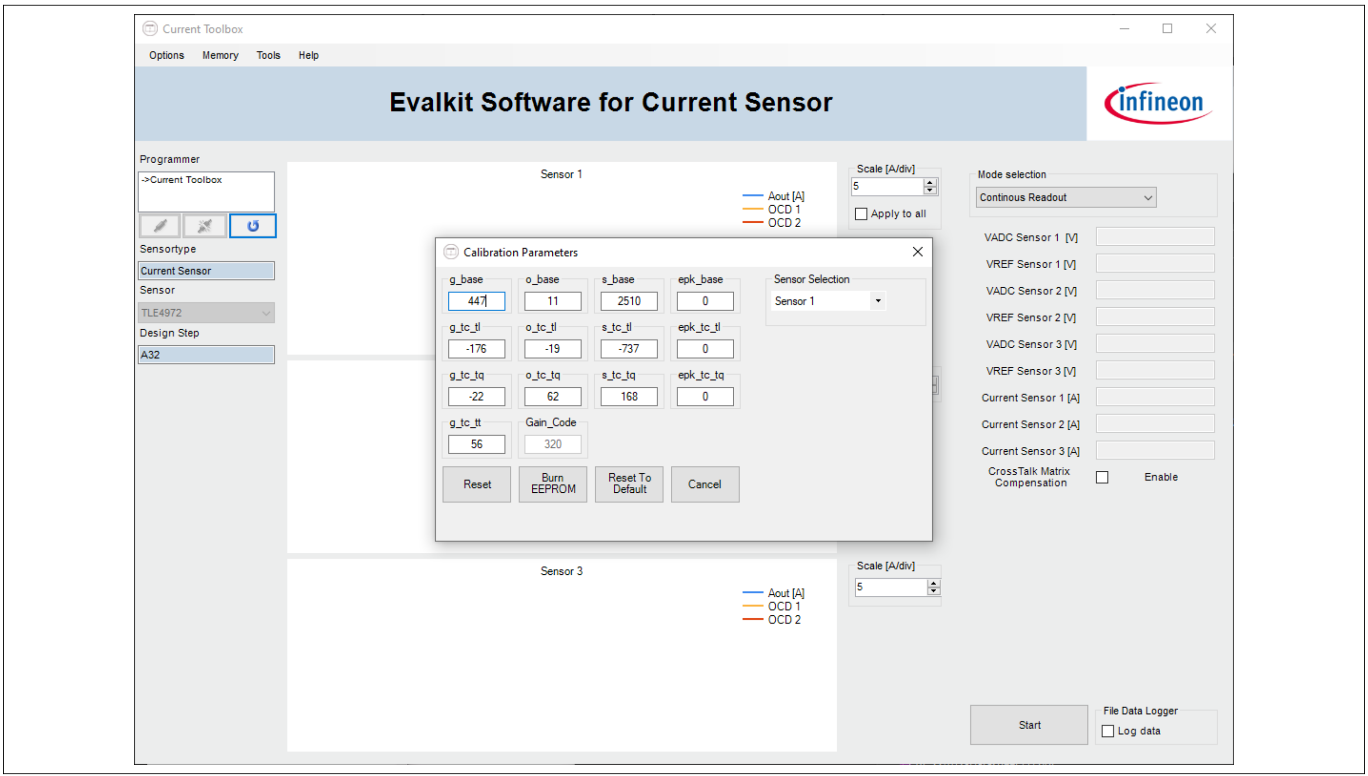

Figure 22 **Calibration Parameters window**

4.2.7 Tools drop down menu

4.2.7.1 OCD Calculation Tool

This menu item opens the OCD Calculation Tool window. It allows to setup the OCD thresholds for OCD1 and OCD2 pins, if the Current Rail Transfer Factor is known. The latter can be estimated using the software functionality explained in Chapter 4.2.7.2, further information are available on the User manual [2].

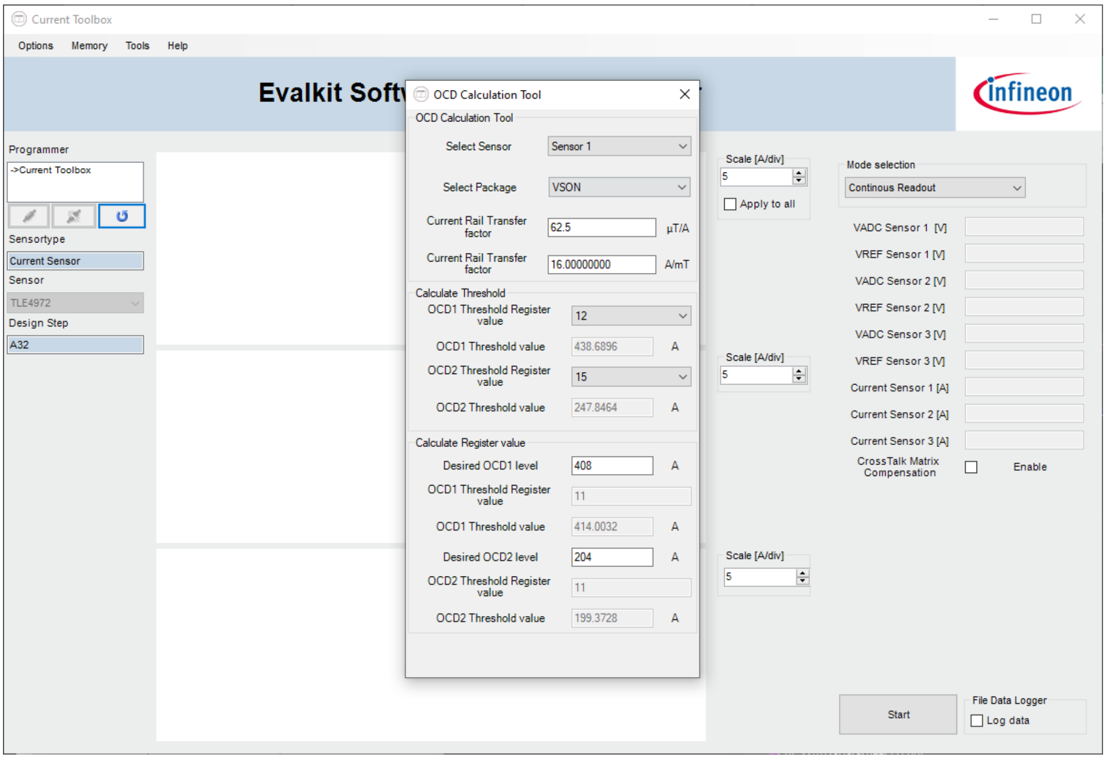

Figure 23 OCD Calculation Tool window

This window is made by the following visual elements:

1. Select Sensor dropdown menu: select the sensor for which the calculation of the OCD thresholds should be done;
2. Select Package: select the package version of the selected sensor;
3. Current Rail Transfer Factor: enter the nominal current rail transfer factor for the selected sensor;
4. Calculate Threshold pane: this section allows to calculate the resulting threshold in ampere, given the OCD threshold code programmed in the corresponding internal EEPROM register of the selected sensor. The OCD threshold code can be easily programmed using the Basic Configuration window (Chapter 4.2.6.1);
5. Calculate Register value: this section allows to calculate the OCD threshold code which provides the closest OCD threshold value to the desired OCD threshold value in ampere.

4.2.7.2 Current Rail Transfer Factor

This menu item opens the Transfer Factor Calculation Tool. This tool allows the user to estimate the transfer factor with typically an accuracy of ± 5 %.

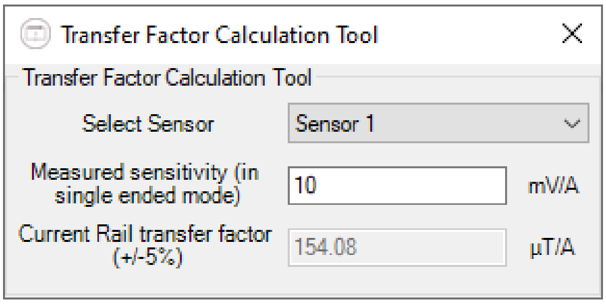

Figure 24 **Transfer Factor Calculation Tool window**

The procedure for the current rail transfer factor estimation is the following:

- Select the sensor for which the current rail transfer factor has to be estimated;
- Measure the sensitivity of the sensor by connecting external measurement instrumentation to the measurement header (Chapter 4.2.2) on the programmer board. If the sensor is set in fully differential mode, the sensitivity measured by the user will be doubled with respect to the other modes. As a consequence, enter here half of the measured value. The procedure for the sensitivity measurement is explained in the User manual [2];
- The current rail transfer factor estimation is provided with a typical accuracy of ± 5 %.

Note: In order to obtain a precise estimation of the current rail transfer factor, it is suggested to measure it through the method explained above on multiple systems (more than 10) and to consider the average value.

4.2.7.3 Calibrate Toolbox

This menu item starts the Current Sensor Programmer board sensor inputs calibration. This calibration procedure is not needed unless directly indicated by Infineon.

5 References and appendices

5.1 GUI software installation

The following initial setup window will display when the user starts the installation by double clicking on the "Current Sensor Evalkit Vx.x.x.exe". Click "Next" to continue with the installation.

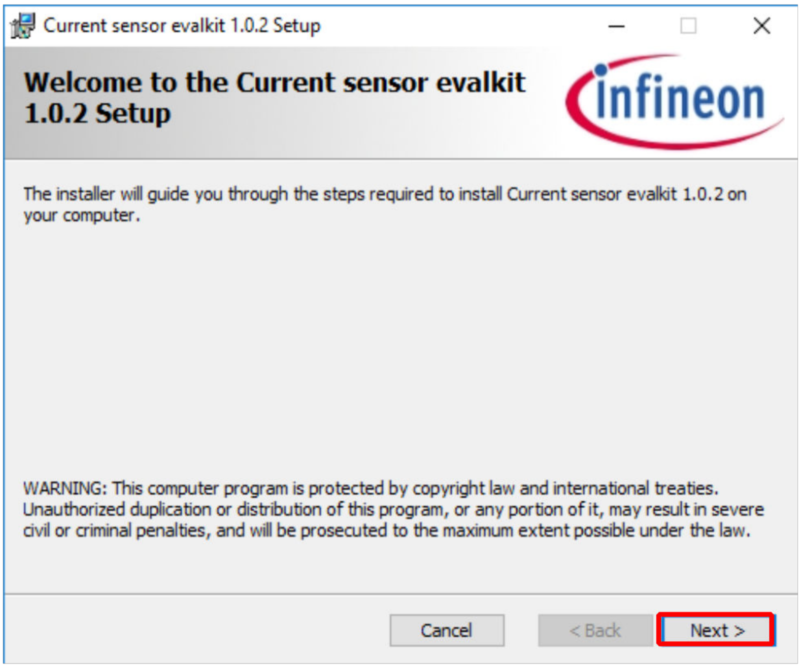

Figure 25 EvalKit Installer – Welcome

Read through the license agreement carefully and continue the installation by accepting it, see orange color box. If the license agreement is not accepted, then the installation will be aborted. Click "Next" to continue with the installation.

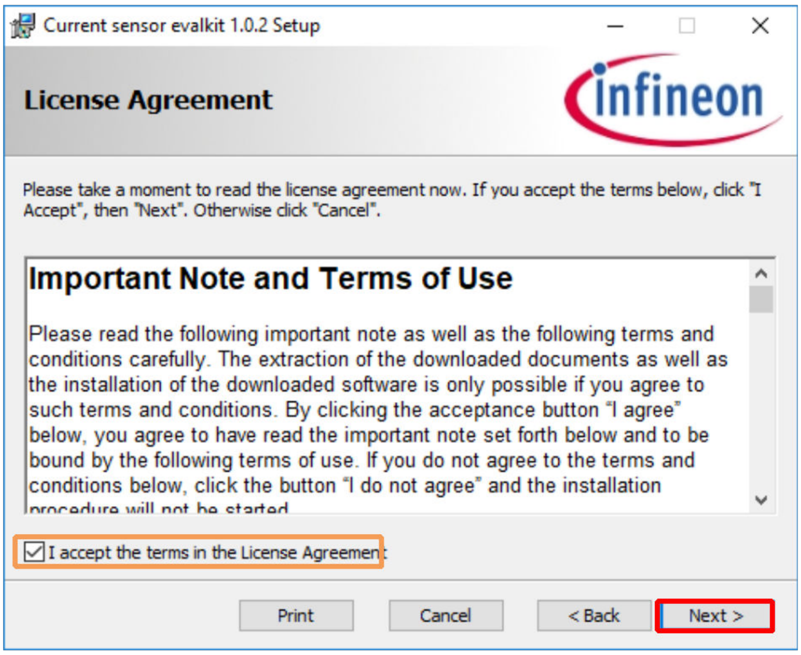

Figure 26 EvalKit Installer – License Agreement

Then the installer will prompt for the installation folder. Accept the default one or use another directory by selecting the "Browse" button as shown in Orange color box. Click "Next" to continue with the installation.

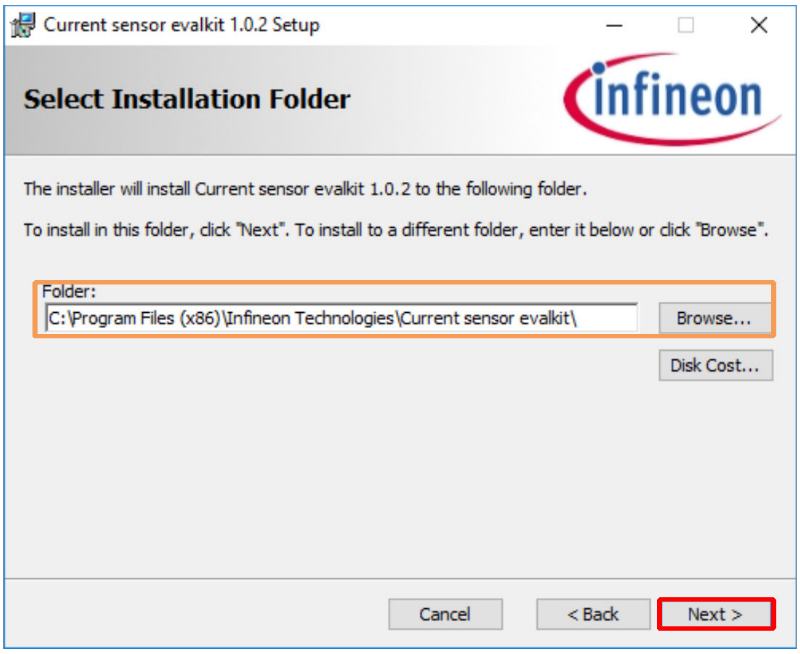

Figure 27 **EvalKit – Select the installation folder**

Click "Install" to begin the installation. The installation will continue if you have the admin rights otherwise the installation might be aborted without completing the installation.

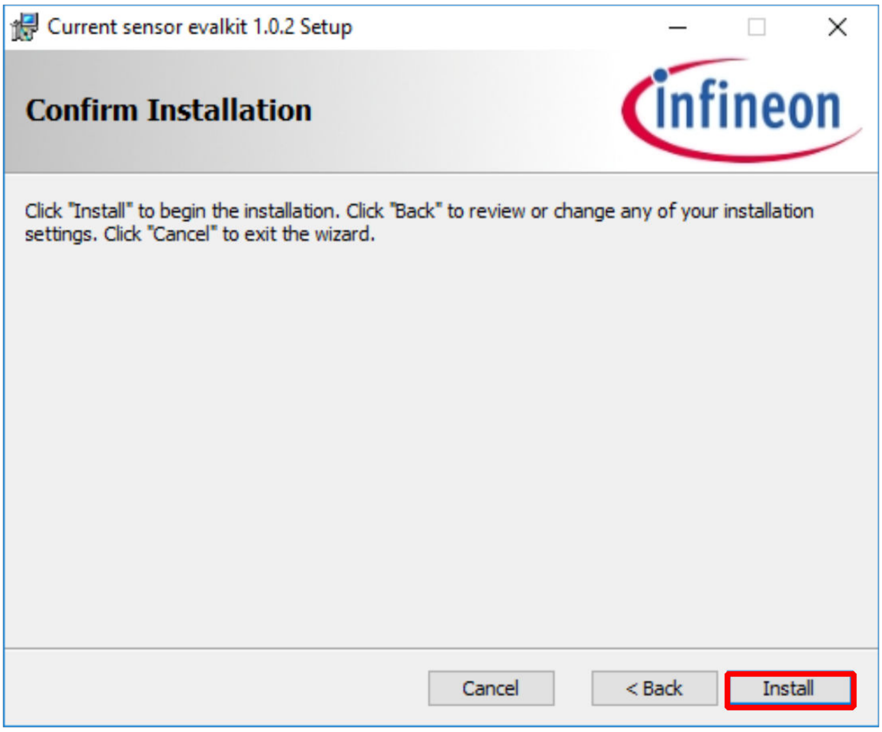

Figure 28 **EvalKit Installer – Confirm Installation**

If the installation was successful then the following window will display. Click "Close" to complete the software installation.

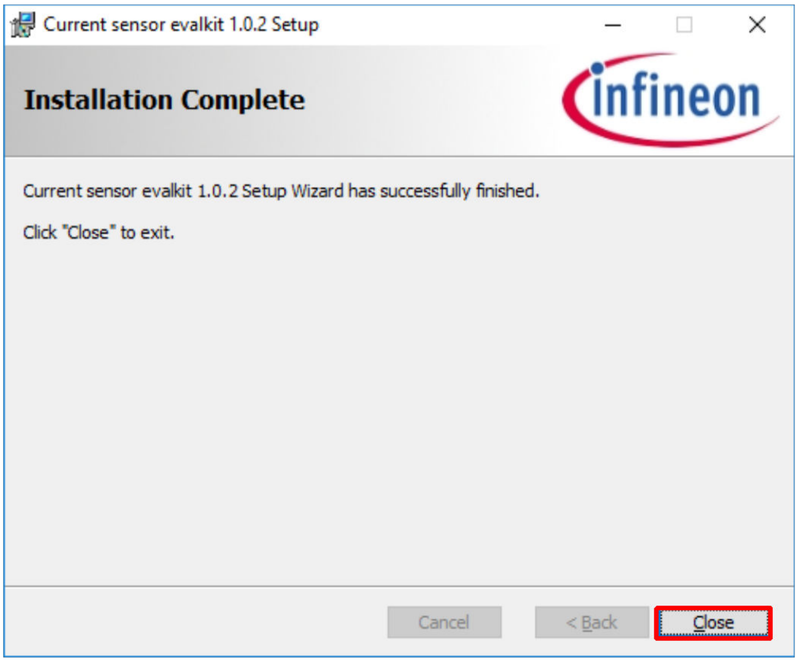

Figure 29 EvalKit Installer – Installation Completed

5.2 FTDI drivers installation

After software installation, the FTDI CDM Drivers need to be installed, if not already installed. When the user runs the "Current Sensor Evalkit Vx.x.x.exe" file a parallel window to the installer window is automatically opened at the end of the installation procedure. Click on the "Extract" button to continue the driver installation procedure.

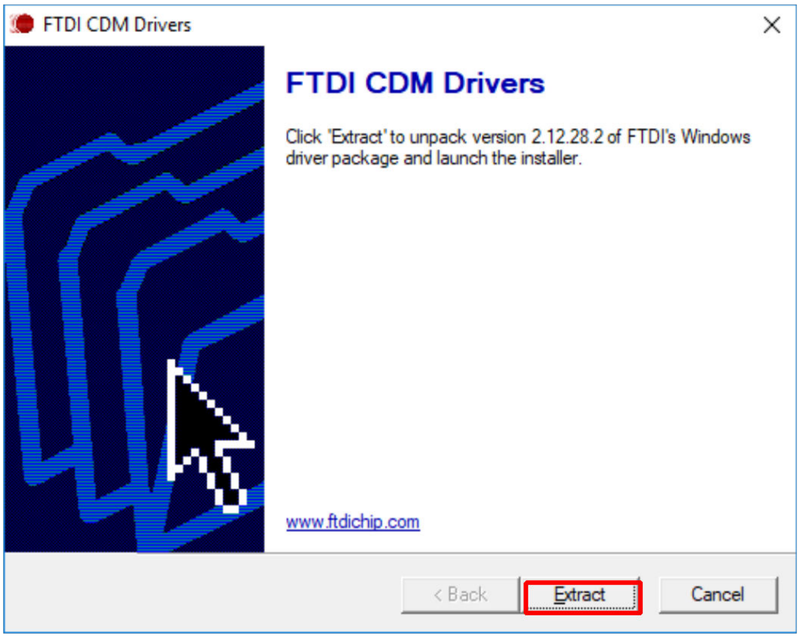

Figure 30 FTDI CDM Drivers – Files Extraction

The welcome wizard for the driver installation will appear after the successful extraction. Click "Next" to continue with the installation.

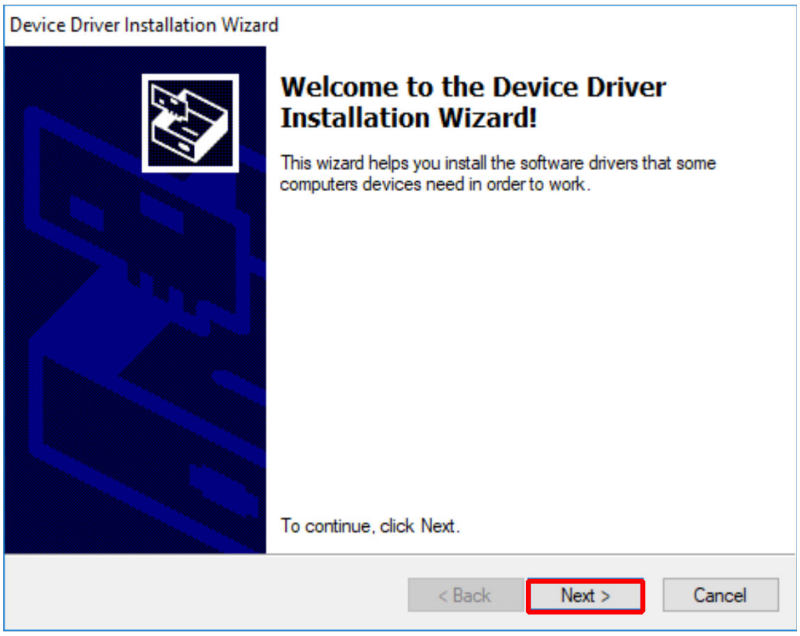

Figure 31 **FTDI CDM Drivers – Installation Wizard**

Read through the license agreement carefully and continue the installation by accepting it (see orange color box). If the license agreement is not accepted the installation will be aborted. Click "Next" to continue with the installation.

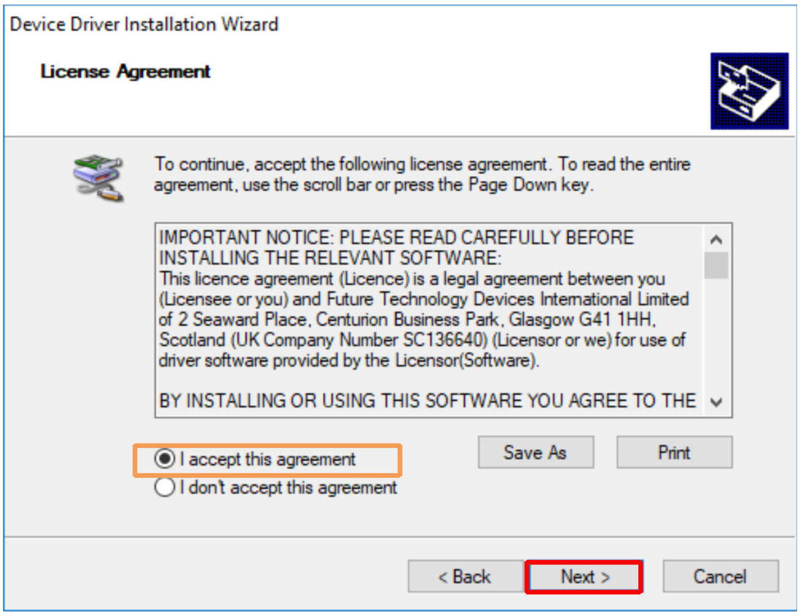

Figure 32 **FTDI CDM Drivers – License Agreement**

Click "Finish" to complete the device driver installation.

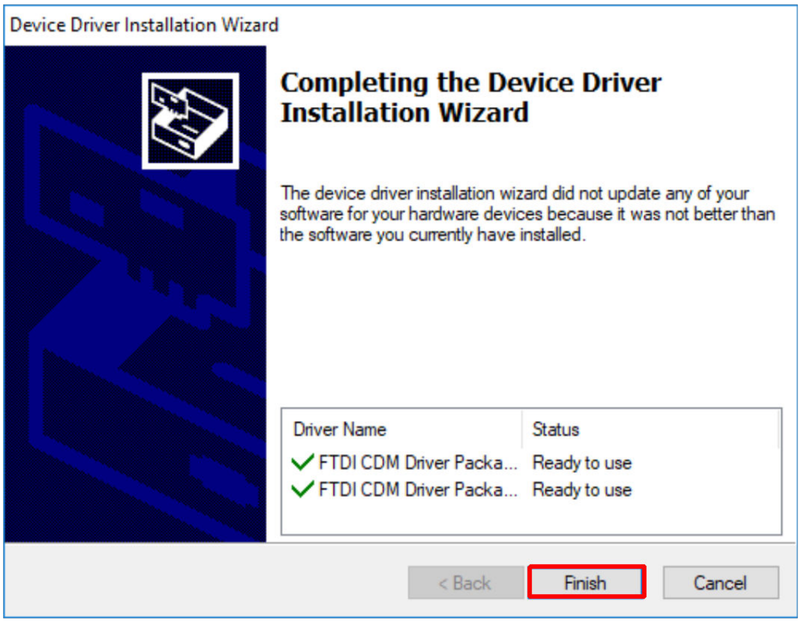

Figure 33 **FTDI CDM Drivers – End of Installation**

To start the GUI software, go to the Windows Start button and type "Current sensor evalkit" in the search box, then select it.

In case of connection problems, go to the device manager and check whether the driver was installed correctly or not. If you see the window as shown in the figure below, please reinstall the driver software as described in the procedure above.

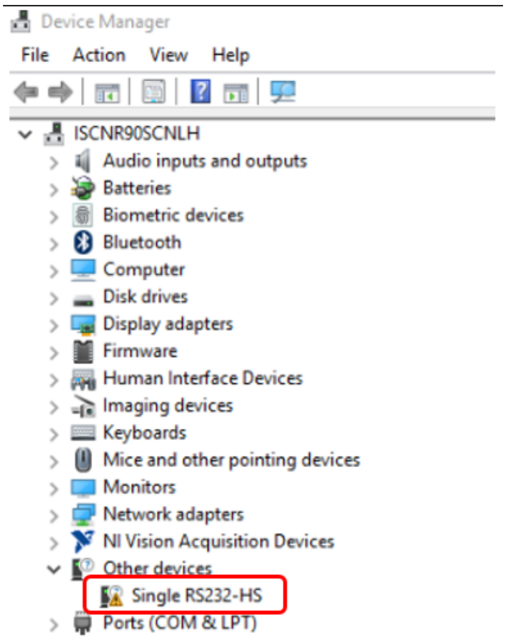

Figure 34 **Missing RS232 HS Driver**

5.3 Abbreviations and definitions

Notation	Description
AC	Alternating Current
CE	European Conformity
DC	Direct Current
EMC	Electro-Magnetic Compatibility
EEPROM	Electrically Erasable Programmable Read-Only Memory
ESD	Electro-Static Discharge
FEM	Finite Element Method
GUI	Graphical User Interface
OCD	Over Current Detection
PCB	Printed Circuit Board
PCN	Process Change Notification
PD	Product Discontinuation
RMA	Returned Material Analysis
SCL	Serial Clock
SDA	Serial Data
USB	Universal Serial Bus
DUT	Device Under Test
LED	Light Emitting Diode
MCU	Micro-Controller Unit
SELV	Safety Extra Low-Voltage
ELV	Extra-Low Voltage

5.4 References

[1] Infineon-TLE4972-AE35S5-DS-vxx_xx-EN.pdf; Infineon-TLE4972-AE35D5-DS-vxx_xx-EN.pdf
[2] Infineon-TLE4972-User_manual-vxx_xx-EN

6 Revision history

Document revision	Date of release	Description of changes
01.00	05.04.2022	Initial release.

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

Edition 2022-04-05

Published by

Infineon Technologies AG

81726 Munich, Germany

Do you have a question about any aspect of this document?

Email: **erratum@infineon.com**

Document reference
IFX-yux1648209648559