

# TLE4978 Evaluation Boards user guide

## XENSIV™ current sensors

### About this document

#### Scope and purpose

This user guide describes the hardware and software functionalities of XENSIV™ TLE4978 current sensor evaluation boards [TLE4978 EVAL 40A](#), [TLE4978 EVAL 50A](#), and [TLE4978 EVAL 60A](#).

#### Intended audience

This document is intended for use by hardware and software engineers involved in the evaluation of the XENSIV™ TLE4978 current sensors.

### About this product group

#### Target applications

- [Server power supply units \(PSU\)](#)
- [DC-DC converters](#)
- [On-board charging](#)
- [General purpose motor drive](#)
- [Photovoltaic](#)

#### Product family

Infineon's [XENSIV™ current sensors](#) deliver precise AC and DC current measurement with internal current rail packages and up to several kiloamps with external current rail packages.

#### Evaluation board

This board is to be used during the design-in process for evaluating and measuring characteristic curves, and for checking datasheet specifications.

*Note: PCB and auxiliary circuits are NOT optimized for final customer design.*

### Safety precautions

### Safety precautions

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

**Table 1** Safety precautions

	<p><b>Warning:</b> The DC link potential of this board is up to 1000 VDC. When measuring voltage waveforms by oscilloscope, high voltage differential probes must be used. Failure to do so may result in personal injury or death.</p>
	<p><b>Warning:</b> The evaluation or reference board contains DC bus capacitors which take time to discharge after removal of the main supply. Before working on the drive system, wait five minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.</p>
	<p><b>Warning:</b> The evaluation or reference board is connected to the grid input during testing. Hence, high-voltage differential probes must be used when measuring voltage waveforms by oscilloscope. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.</p>
	<p><b>Warning:</b> Remove or disconnect power from the drive before you disconnect or reconnect wires, or perform maintenance work. Wait five minutes after removing power to discharge the bus capacitors. Do not attempt to service the drive until the bus capacitors have discharged to zero. Failure to do so may result in personal injury or death.</p>
	<p><b>Caution:</b> The heat sink and device surfaces of the evaluation or reference board may become hot during testing. Hence, necessary precautions are required while handling the board. Failure to comply may cause injury.</p>
	<p><b>Caution:</b> 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.</p>
	<p><b>Caution:</b> The evaluation or reference 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.</p>
	<p><b>Caution:</b> 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.</p>
	<p><b>Caution:</b> The evaluation or reference 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.</p>

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## XENSIV™ current sensors

### 1 The board at a glance

## 1 The board at a glance

The XENSIV™ TLE4978 is a high-bandwidth, high-precision, automotive, coreless current sensor with analog output, overcurrent detection (OCD), and zero-cross detection (ZCD) features.

The following sections describe the different components of the XENSIV™ TLE4978 Current Sensor Evaluation Kit, hardware connections, and software installation. They also describe how to use the graphical user interface (GUI) to perform the first evaluation of the sensor in a particular application. The TLE4978 Evaluation Kit can be used at low voltages, as instructed in the [Safety precautions](#) section. The current sensor provides galvanic isolation. Consider the safety precautions for high-voltage applications as described in the enclosed disclaimer document provided along with the delivered sensor kit.

### 1.1 Scope of supply

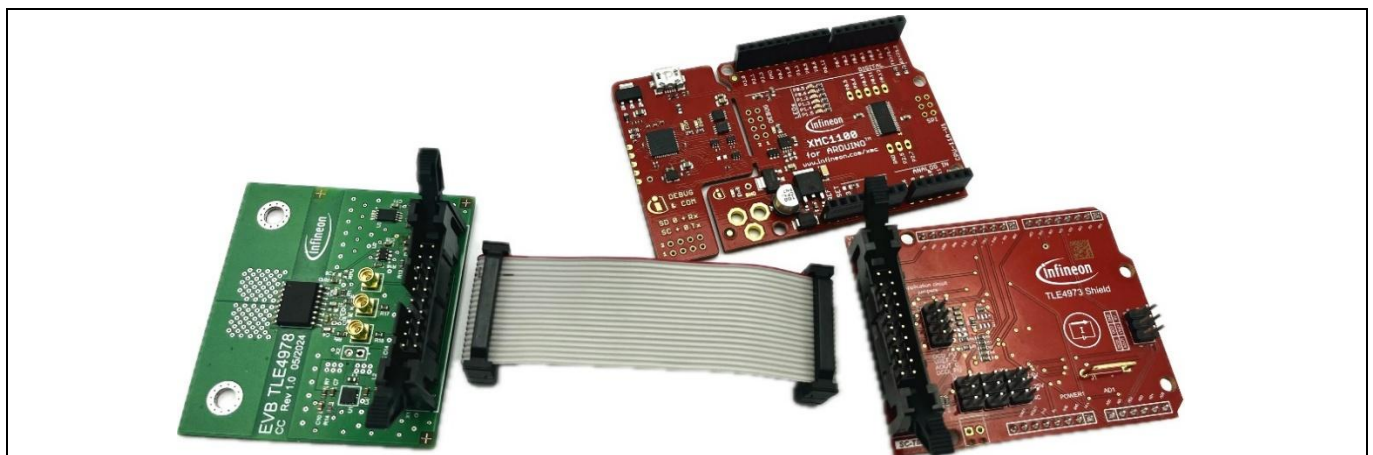
The evaluation kit contains the TLE4978 Evaluation Board – (TLE4978 EVAL 60 A, TLE4978 EVAL 50 A, TLE4978 EVAL 40 A).



**Figure 1** XENSIV™ TLE4978 Current Sensor Evaluation Board

To use the evaluation board, additional components not included in the evaluation kit are required:

- Current sensor programmer shield ([CUR SENSOR PROG GEN2](#))
- XMC1100 Boot Kit ([KIT\\_XMC11\\_BOOT\\_001](#)) from Infineon XMC™ MCU family
- Ribbon cable



**Figure 2** Additional components required for the TLE4978 Evaluation Kit

# TLE4978 Evaluation Boards user guide

## XENSIV™ current sensors

### 1 The board at a glance

#### 1.2 Hardware setup

The software supports connecting sensors in a custom setup. A setup that uses either one or three TLE4978 sensors can be detected by the software. In either of the two cases, make sure to add the components shown in the application circuit.

- 220 pF capacitor on AOUT
- 220 nF capacitor on VDD
- 1 kΩ pull-up resistor on DCDI or populate DCDI\_PU jumper on shield

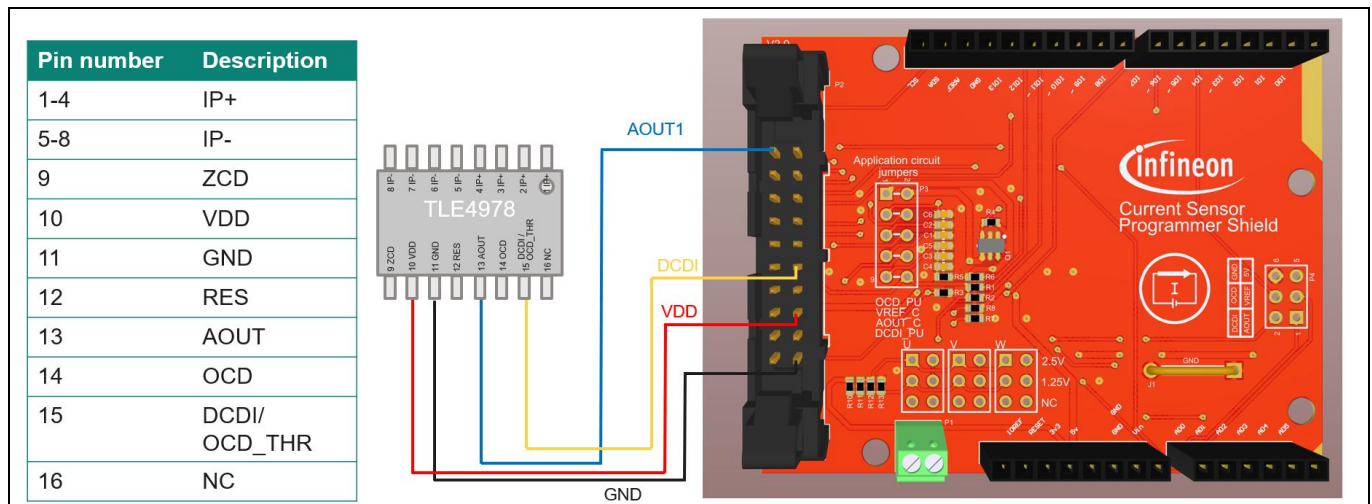


Figure 3 TLE4978 sensor connection

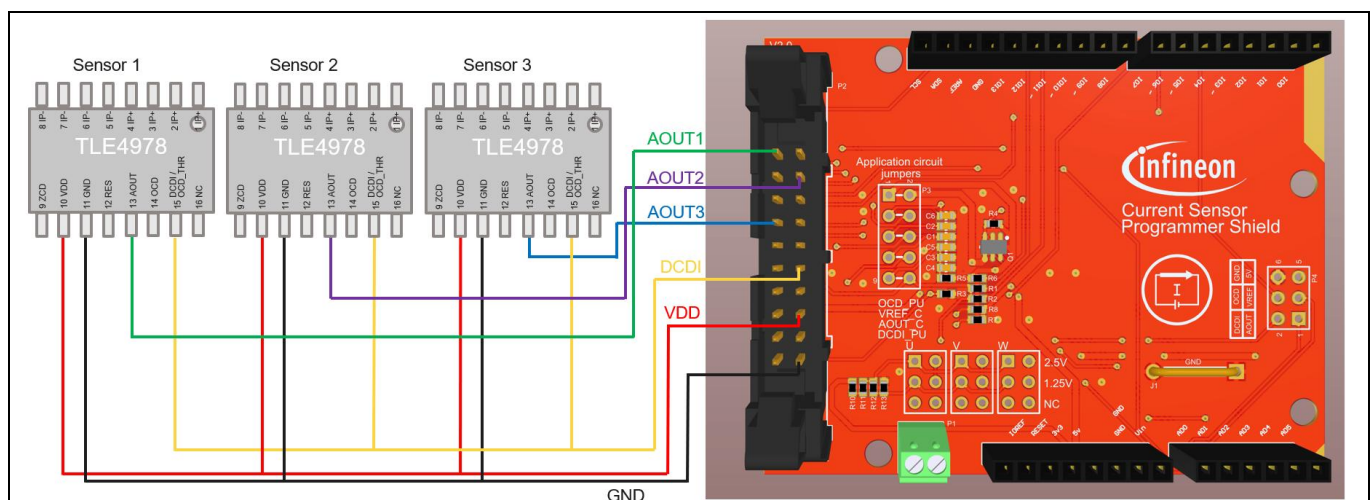


Figure 4 Three TLE4978 sensors connection

For custom setups with one sensor, select “TLE4978 1-Phase Custom” in the initialization wizard, as the default “TLE4978 1-Phase” configuration expects additional components, such as a regulator, analog multiplexer, and feedback voltage. For custom setups with three sensors, select “TLE4978 3-Phase”.

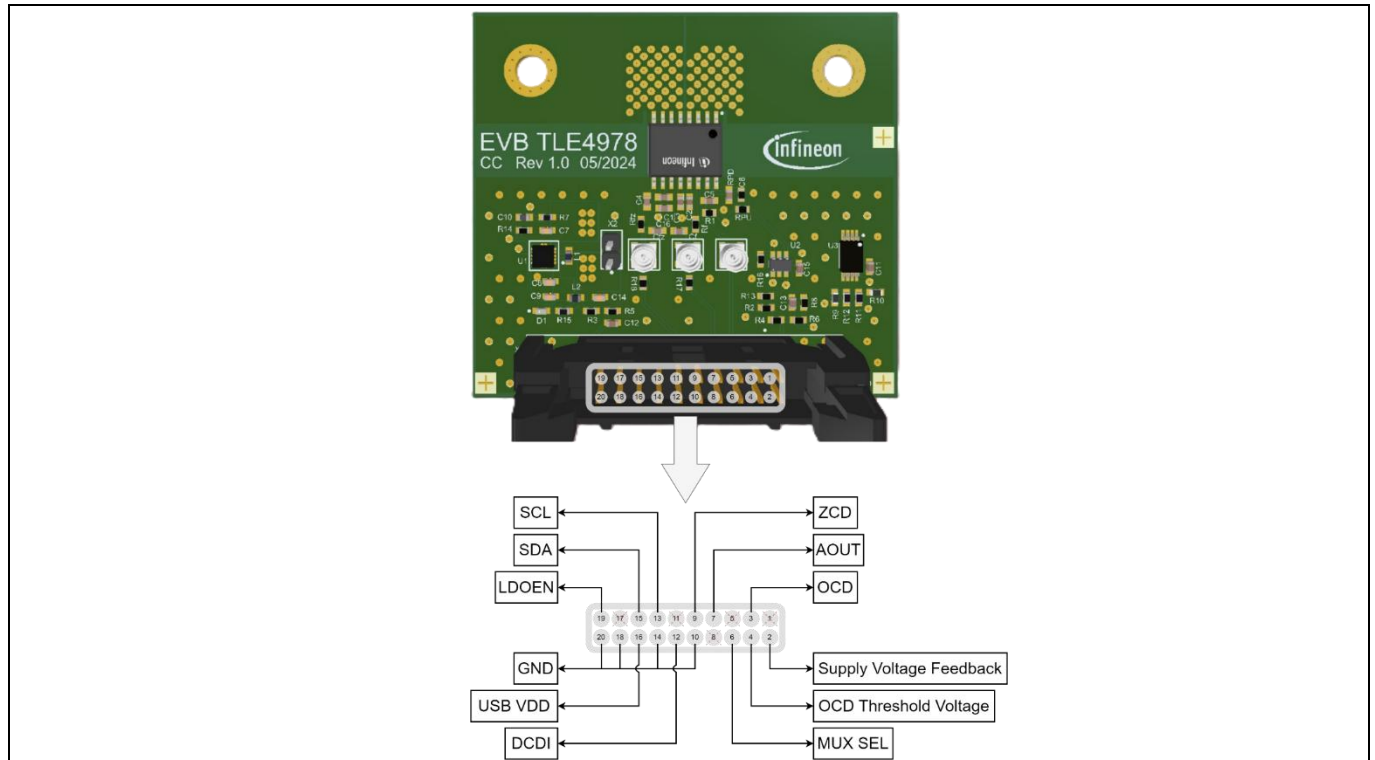
# TLE4978 Evaluation Boards user guide

## XENSIV™ current sensors

### 1 The board at a glance

#### 1.3 Connector details

The evaluation board connector is described in [Figure 5](#) and can be used for debugging, probing, or connecting additional hardware.



**Figure 5** TLE4978 evaluation board connector pinout

The external EEPROM uses the **SCL** and **SDA** pins. **LDOEN** is used by the Buck-boost converter that takes the USB voltage from **USB VDD** and regulates it at 5 V. **AOUT**, **OCD**, **ZCD** and **DCDI** are used directly by the sensor. **MUX SEL** is used by the analog multiplexer to switch the sensor's DCDI pin between OCD threshold and DCDI communication pin, depending on the sensor's operating mode. The OCD threshold voltage comes out of a voltage divider (~1 V) and is also on the connector, so it can be measured and displayed in software. **Supply Voltage Feedback** is the output voltage of the Buck-boost converter, which is also measured and displayed in software.

# TLE4978 Evaluation Boards user guide

## XENSIV™ current sensors

### 2 System and functional description

## 2 System and functional description

### 2.1 Getting started

The [XENSIV™ TLE4978 Current Sensor Evaluation App](#) assists in the swift evaluation of the TLE4978 sensor. The software allows live current and temperature readout as well as EEPROM read and burn operations.

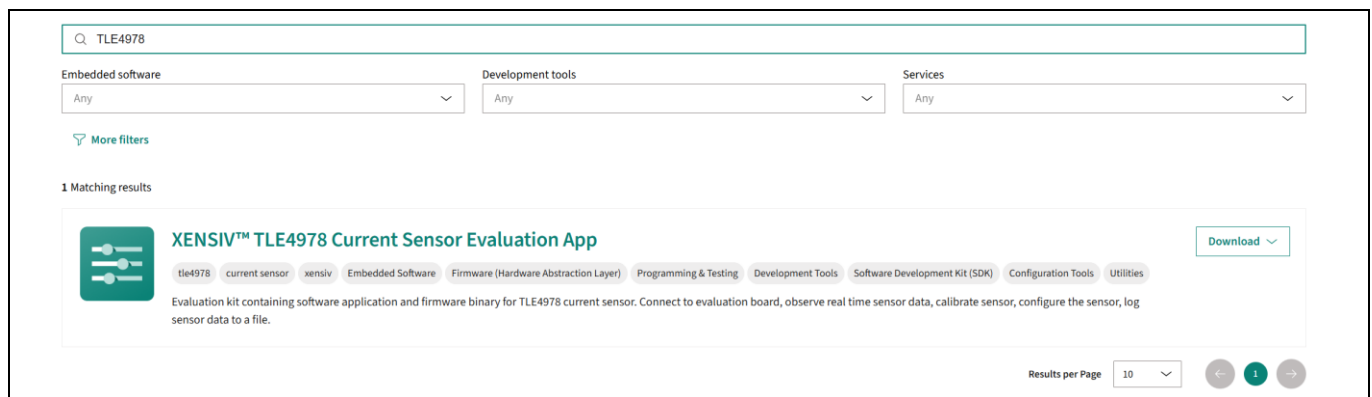
#### 2.1.1 Requirements

The TLE4978 evaluation software was developed and tested using the following PC configuration:

- **Operating system:** Windows 10 64-bit/Windows 11 64-bit (also supports Windows 7)
- **RAM:** 8 GB (maximum RAM usage estimated at around 150 MB when data logging is on)
- **Storage:** 512 GB (minimum required for installation: 250 MB, including dependencies)
- **CPU:** 3.00 GHz, 4 cores (lower performance CPUs may suffer from performance issues)

#### 2.1.2 Software download

Infineon offers the graphical user interface software via the [Infineon Developer Center](#) online platform or from the [Infineon Developer Center Launcher](#). You can filter the tool list by searching for “Current Sensor” or “TLE4978” and it will display **XENSIV™ TLE4978 Current Sensor Evaluation App** as shown in [Figure 6](#).



**Figure 6** XENSIV™ TLE4978 Current Sensor Evaluation App

It is highly advised to install the [Infineon Developer Center Launcher](#) application before installing the above-mentioned application.

Note that the *XENSIV™ TLE4978 Current Sensor Evaluation App* can be downloaded only by users registered with a MyInfineon account.

#### 2.1.3 Software installation

1. Double-click the *XENSIV™ TLE4978 Current Sensor Evaluation App* installer to begin the installation

*Note:* Ensure that you have administrator rights to install the software.

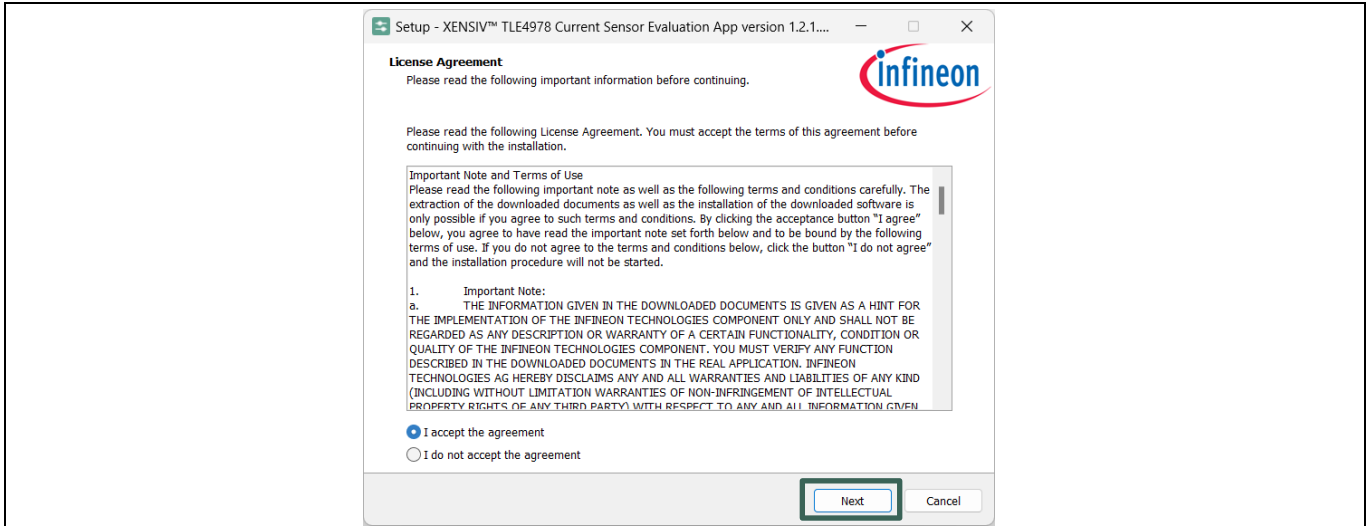
The installer file contains the following elements:

- Binaries/compiled objects needed for running the graphical user interface
- SEGGER J-Link driver for establishing serial port communication with the onboard debugger

### 2 System and functional description

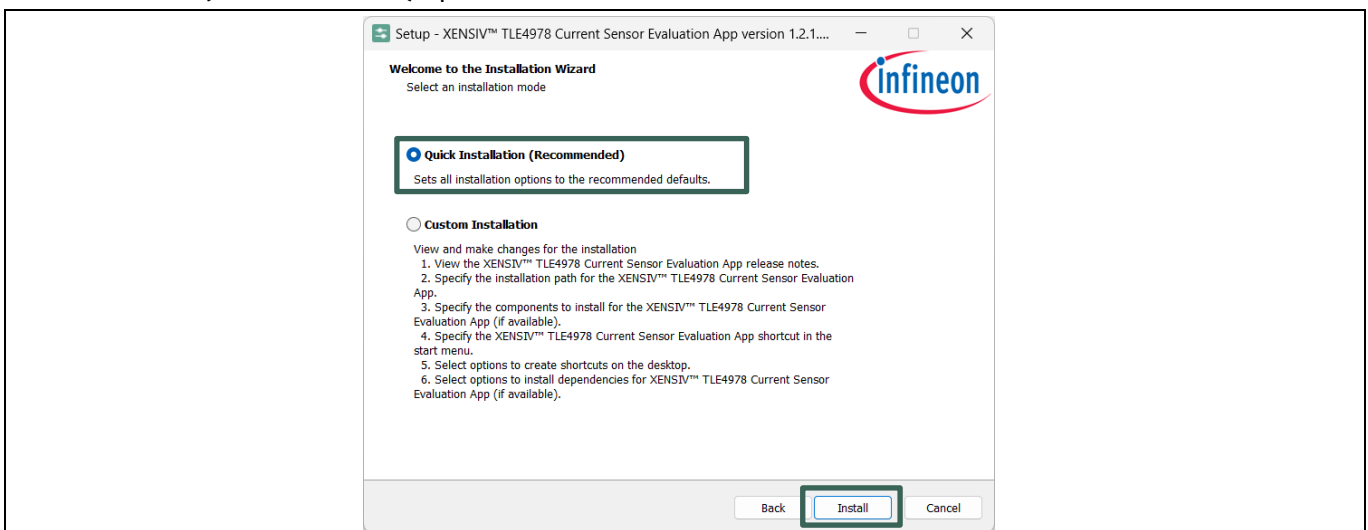
- .NET 4.8 online installer (needed only for older versions of Windows, which do not have this already installed). Installation requires a stable Internet connection

#### 2. Read and accept the License Agreement, and then click **Next**



**Figure 7** Accept the License Agreement

#### 3. Select the installation type and click **Install** to begin the installation. It is recommended to use the **Quick Installation (Recommended)** option



**Figure 8** Quick installation

#### 4. After the binaries are copied to the installation folder, you will be prompted to install the SEGGER J-Link driver. Click **Next** to finish the installation

If the J-Link is already installed, you can skip this step. Note that without the J-Link driver, the USB connection between the PC and the TLE4978 Evaluation Board cannot be established.

# TLE4978 Evaluation Boards user guide

## XENSIV™ current sensors

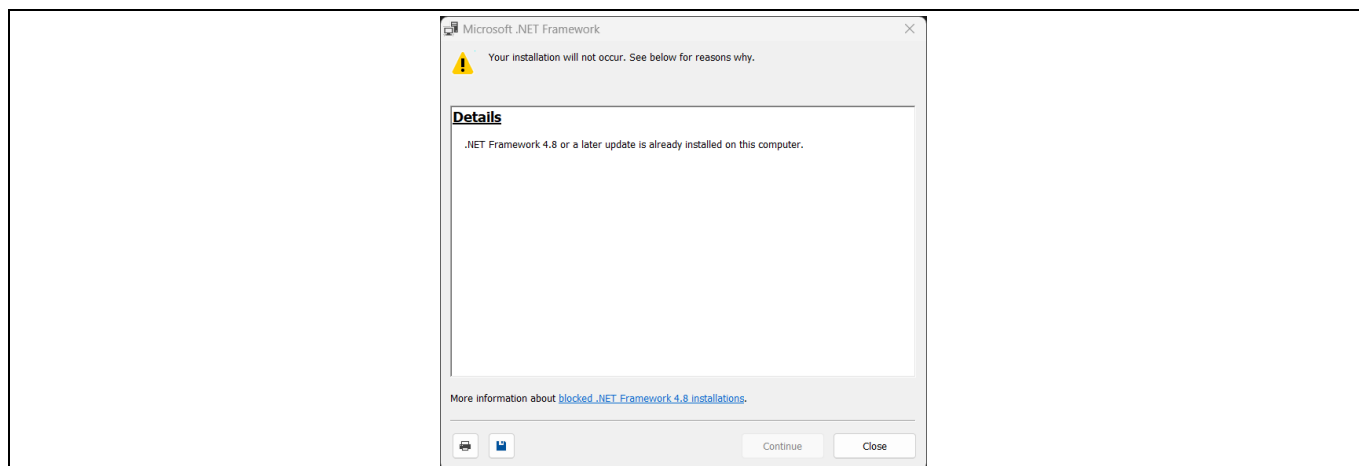
### 2 System and functional description



**Figure 9** SEGGER J-Link driver installation

5. After the SEGGER J-Link driver is installed, you will be prompted to install .NET Framework 4.8, and then click **Continue** or **Close** based on your Windows version

*Note: This version of the .NET Framework is preinstalled on Windows versions starting from Windows 10 build 1903 (released in May 2019). If it is already installed, a corresponding notification will be displayed. Otherwise, the installation will proceed, provided that an active Internet connection is available.*



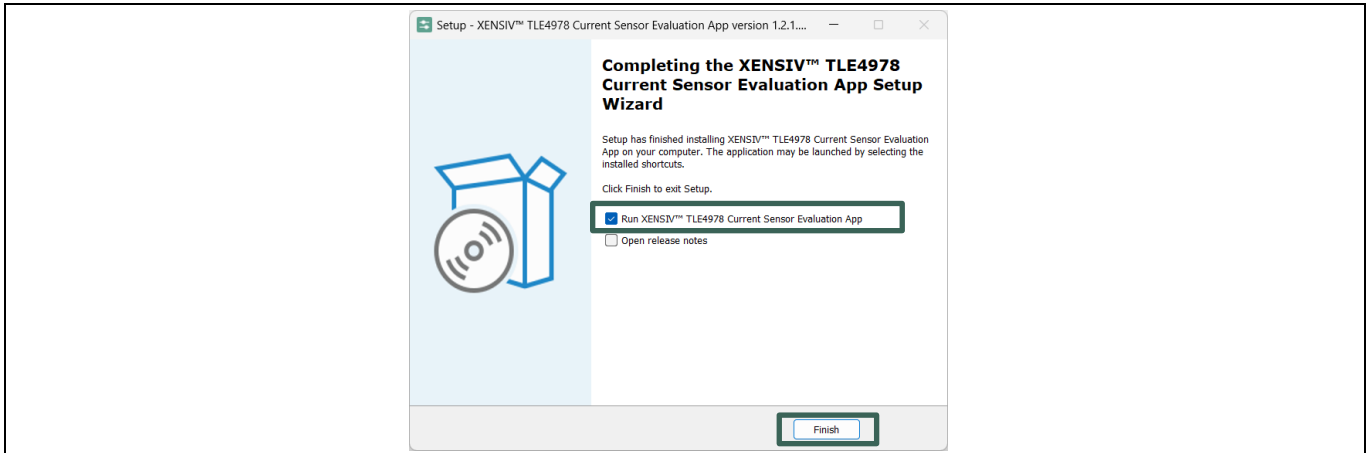
**Figure 10** .NET 4.8 installation

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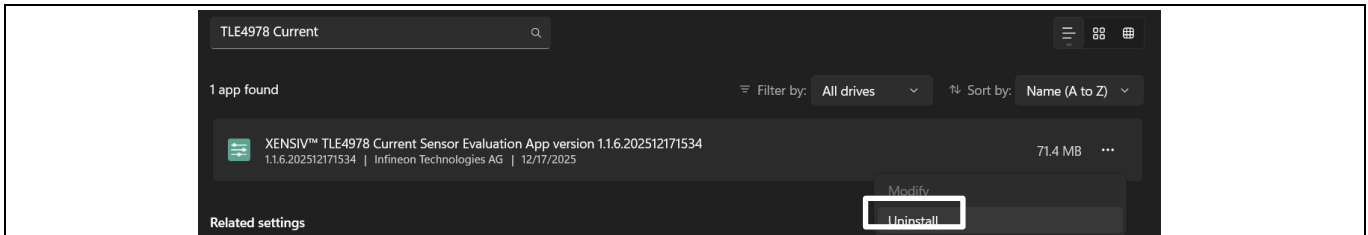
- Click **Finish** to exit the setup. You will be notified after completion of all installer processes, and a shortcut will be created on the Desktop by default. You can choose to run the application after installation



**Figure 11** Installation complete

#### 2.1.4 Software uninstallation

To uninstall the software package, select **Start > Add or remove programs**, search for the “*XENSIV™ TLE4978 Current Sensor Evaluation App*”, right-click the application, and select **Uninstall** to remove it from the PC.



**Figure 12** Software uninstallation

The uninstaller deletes all installation files from the system, except:

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

### 2.2 Using the evaluation software

This section describes all the features and their usage on the *XENSIV™ TLE4978 Current Sensor Evaluation App* in correlation with the TLE4978 Evaluation Board. Ensure that the evaluation board is attached to the current sensor programmer shield and XMC1100 Boot Kit via the ribbon cable.

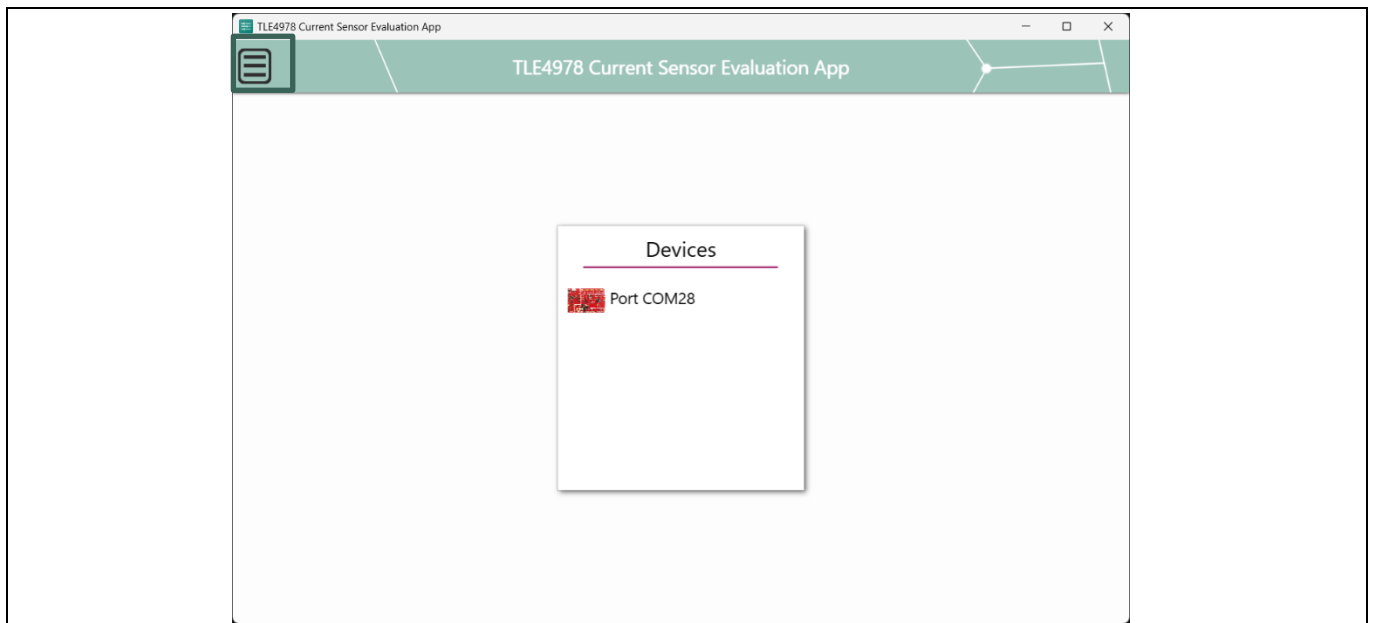
## 2 System and functional description

### 2.2.1 Startup screen and connecting to the programmer

Figure 13 shows the default screen of the *TLE4978 Current Sensor Evaluation App* after startup.

The software monitors all USB ports and checks if any connected device matches the signature of the TLE4978 Evaluation Board. If a match is found, the software displays the detected device as shown in Figure 13. By selecting the device, the software connects to the board.

If the firmware is out of date, the software automatically flashes the correct firmware version to the target microcontroller. Otherwise, the connection is established using the existing firmware version on the selected board.



**Figure 13** Startup screen

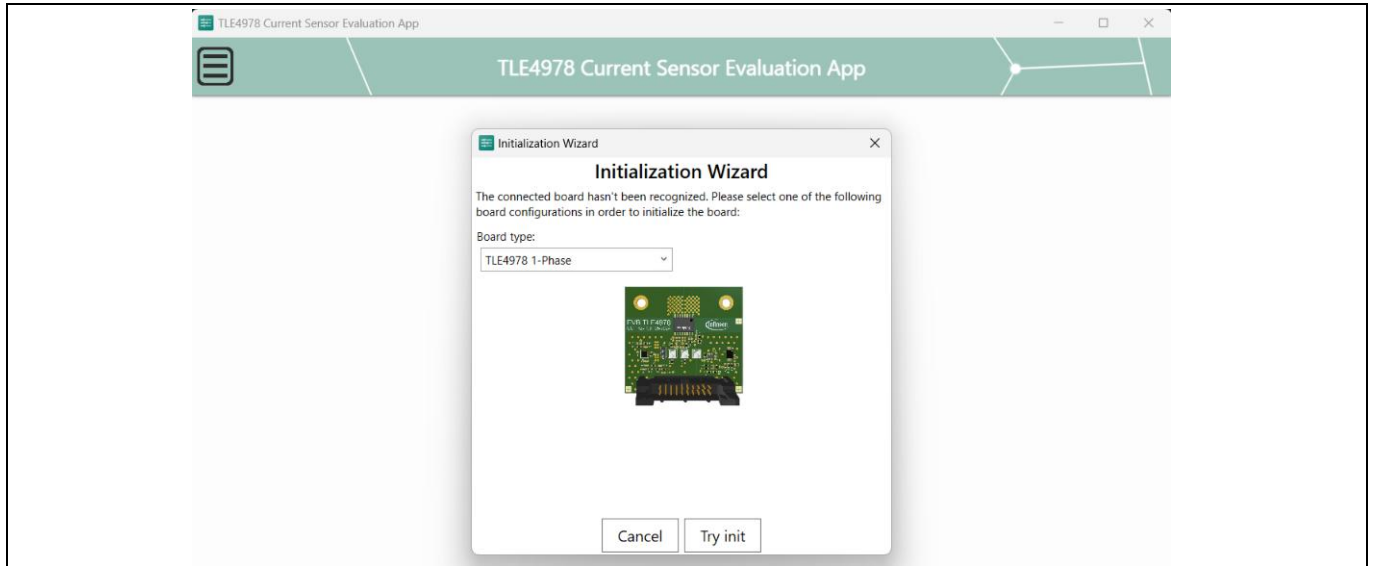
*Note:* Firmware can be flashed forcefully by going to **Settings** (accessible via the menu button in the top-left corner) and checking “Always update firmware (irrespective of current version)”.

After connecting to the board, the software will display the view described in Section 2.2.2. The software automatically recognizes the sensor range and sensitivity. The software adjusts the scaling in the “Current Readout” view (Section 2.2.3.1) accordingly.

## 2 System and functional description

### 2.2.2 Initialization wizard

If the evaluation board's external EEPROM has been previously burned with the correct configuration, the software will proceed to display the main menu. Otherwise, an initialization wizard will be displayed where you can choose from a predefined list of possible configurations, as shown in [Figure 14](#).



**Figure 14** Initialization wizard

Click the “**Board type**” drop-down menu to show the possible board configurations:

- **TLE4978 1-Phase:** The evaluation board described in this user guide
- **TLE4978 3-Phase:** Custom setup with one, two, or three sensors

After selecting a configuration, the software also checks if the connected board meets the required conditions. Some configurations require a digital control and diagnostic interface (DCDI) pull-up jumper to be placed on the shield, and other boards require a transistor for toggling power.

The software notifies you if these conditions are not met. If no errors are shown, you can proceed with using the software.

# TLE4978 Evaluation Boards user guide

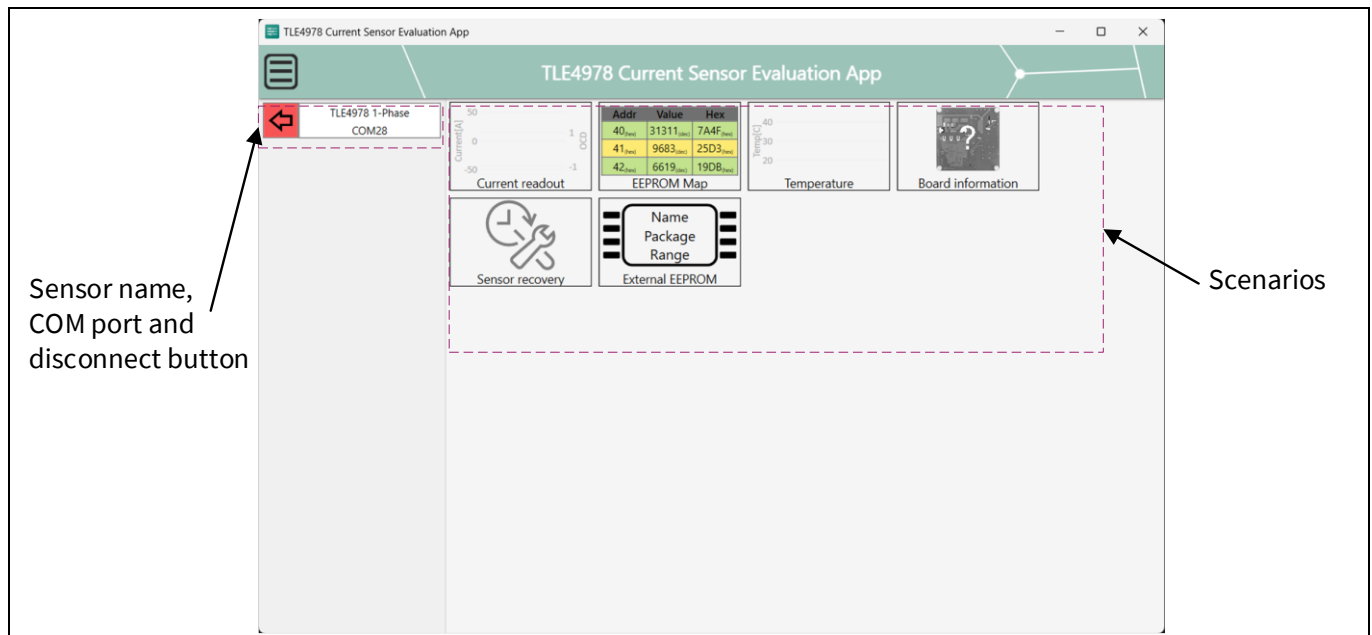
## XENSIV™ current sensors

### 2 System and functional description

#### 2.2.3 Main window and scenarios

Once the board is connected, the GUI updates as shown in [Figure 15](#). The GUI is divided into two sections:

- **Sensor controls:** Located on the left side of the application. This panel allows you to disconnect the board or control the sensor. If a scenario is selected, different buttons and controls are displayed accordingly
- **Main section:** Located on the right side of the application. This panel allows you to select and interact with different scenarios. This panel is not meant to interact with the sensor directly



**Figure 15** Main screen

## 2 System and functional description

### 2.2.3.1 Current readout

The main function of the sensor is current readout. In the software, the value of the current is displayed on a chart, along with the status of overcurrent detection (OCD) and zero cross detection (ZCD) pins.

The panel on the left allows you to start or stop the readout. This only enables or disables continuous readout between the PC and the microcontroller, as the sensor is always sending data on AOUT. OCD and ZCD status is also displayed in the panel on the left:

- **If the circle is green:** The pin is inactive, indicating that it is at its default status (HIGH for OCD and LOW for ZCD)
- **If the circle is red:** The pin is active (OCD goes LOW and ZCD sends a HIGH pulse)
- **If the circle has no color:** Readout is off

The controls panel (left) allows you to start or stop readout, change readout frequency, or observe OCD and ZCD status. The XMC™ boot kit ADC is sampled at 20 kHz. You can choose how many samples are averaged before sending it to the software. Then, you can also pick the maximum frequency.

#### Example:

For example, with 250 Hz and 64 averaging points, the averaging window is 64 samples wide, so a value is sent to the software at a frequency of  $20,000/64 = 312.5$  samples per second (ADC sample rate is 20 kHz). You can select 250 Hz as the maximum frequency, so the actual readout rate will be 250 samples per second.

The current readout scenario, as shown in [Figure 16](#), has the following features:

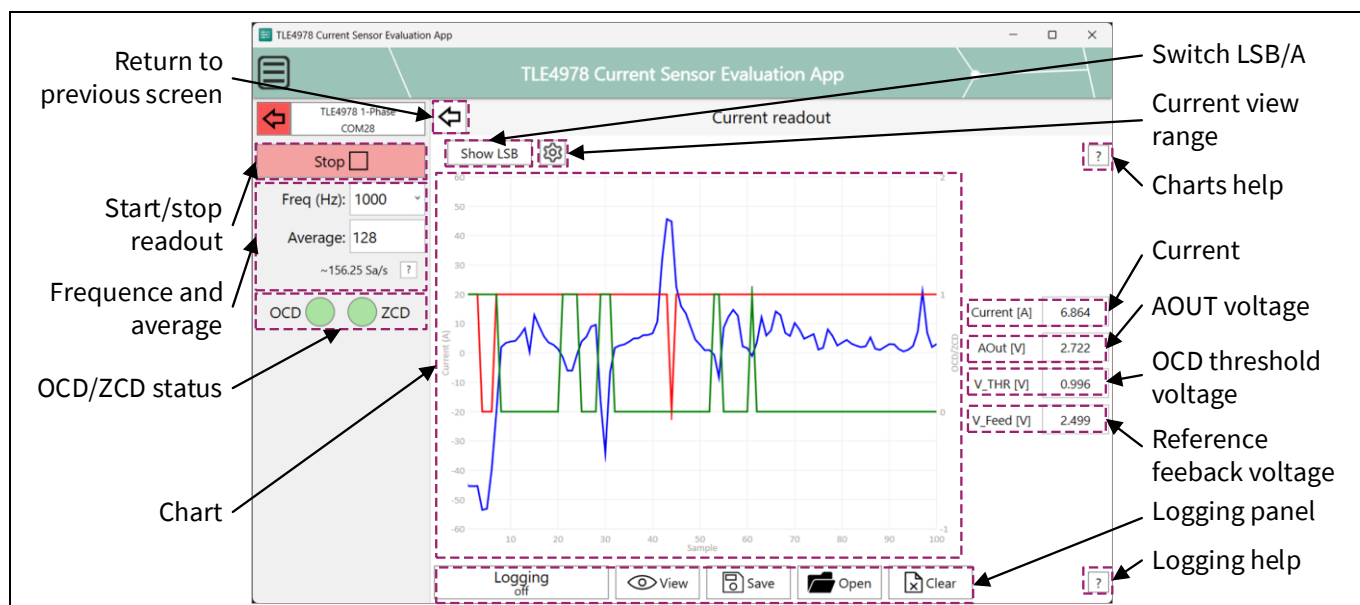
- Switch current units between LSB and Amperes (A). This changes the unit for the chart, but also for the values on the right:
- **AOUT:** Voltage of the sensor's analog output, either in LSB or Volts (V)
- **VRef:** LDO reference voltage used to calculate the current in Amperes
- **Current value:** Always in Amperes. The value of the current in LSB will be the same as AOUT in LSB
- **VThr:** OCD threshold voltage, the voltage at which the OCD pin goes LOW. For the OCD threshold voltage formula, see the [TLE4978 sensor datasheet](#)

The chart shows the value of the current in the selected unit of measurement, along with the status of OCD and ZCD pins. The chart automatically scales to higher current values. The settings button allows changing the chart limits to custom ones. Sensor readings are enabled by default when you enter the scenario.

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## XENSIV™ current sensors

### 2 System and functional description



**Figure 16** Current readout

#### 2.2.3.2 Sensor data logging

The logging feature is useful when capturing an event is needed, along with some samples before and after the event. Logging is enabled by clicking the first button labeled **Logging**. Performing this changes the small text underneath from **off** to **on** and the color of the button to red. Click the button again to disable logging.

Other buttons in the logging panel:

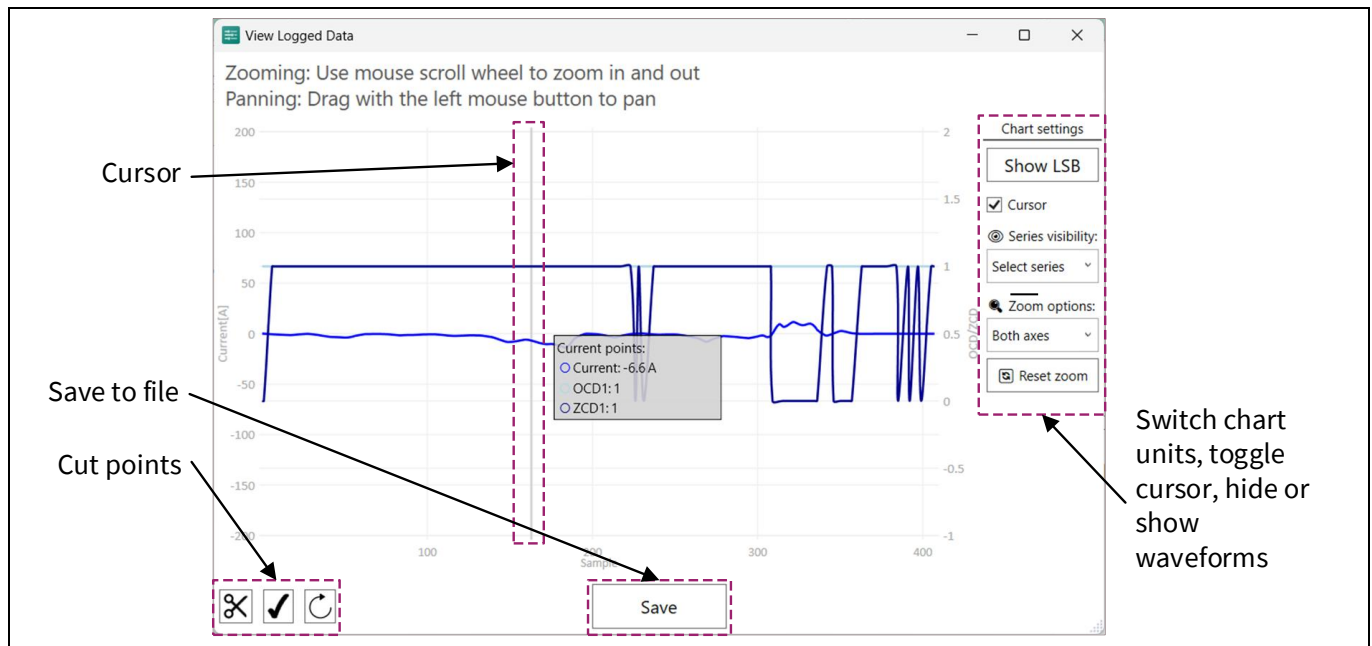
- **View:** Opens a new window where the logged points are displayed
- **Save:** Saves the logged points to disk
- **Open:** Displays the logged points from a previously saved file
- **Clear:** Empties the logged points list

Data logging is supported in the current readout and temperature readout scenarios. Each scenario has its own logging file format. You can press the **Open** button in either of the two scenarios and choose any logging file type (current or temperature).

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## XENSIV™ current sensors

### 2 System and functional description



**Figure 17 Logging window**

The logging file contains values for current (Amps and LSB), OCD, and ZCD. The software saves the files in comma-separated values (.csv) format. The software does not limit the number of points that can be logged. Data logging takes place in a temporary file initially, so memory usage will not increase when logging is in progress.

Figure 17 shows the logging window where you can view and edit logged points. The buttons on the bottom right of the panel allow you to cut a certain part of the chart, accept the modifications temporarily, or reload the previously saved dataset. To commit to the changes, click the **Save** button.

The panel on the right allows you to change the following parameters of the chart:

- **Show LSB/Show A:** Switches between LSB and Amperes
- **Cursor checkbox:** Enables or disables the chart cursor. Disabling the cursor also hides the current points popup
- **Series visibility:** Shows or hides certain waveforms
- **Zoom options:** Allows zoom only on the vertical or horizontal axes
- **Reset chart:** Zooms to fit the whole chart and pan to the center

After clicking the **Save** button, enter a comment that will be added to the header of the file. The logged points are saved in the .csv format with the following structure:

- **Header section:** It contains the timestamp, sensor name, logging mode (current or temperature), and the user comment
- **Data section:** Each logged line consists of a data bundle containing the index, computed current, OCD and ZCD status, and current in LSB format

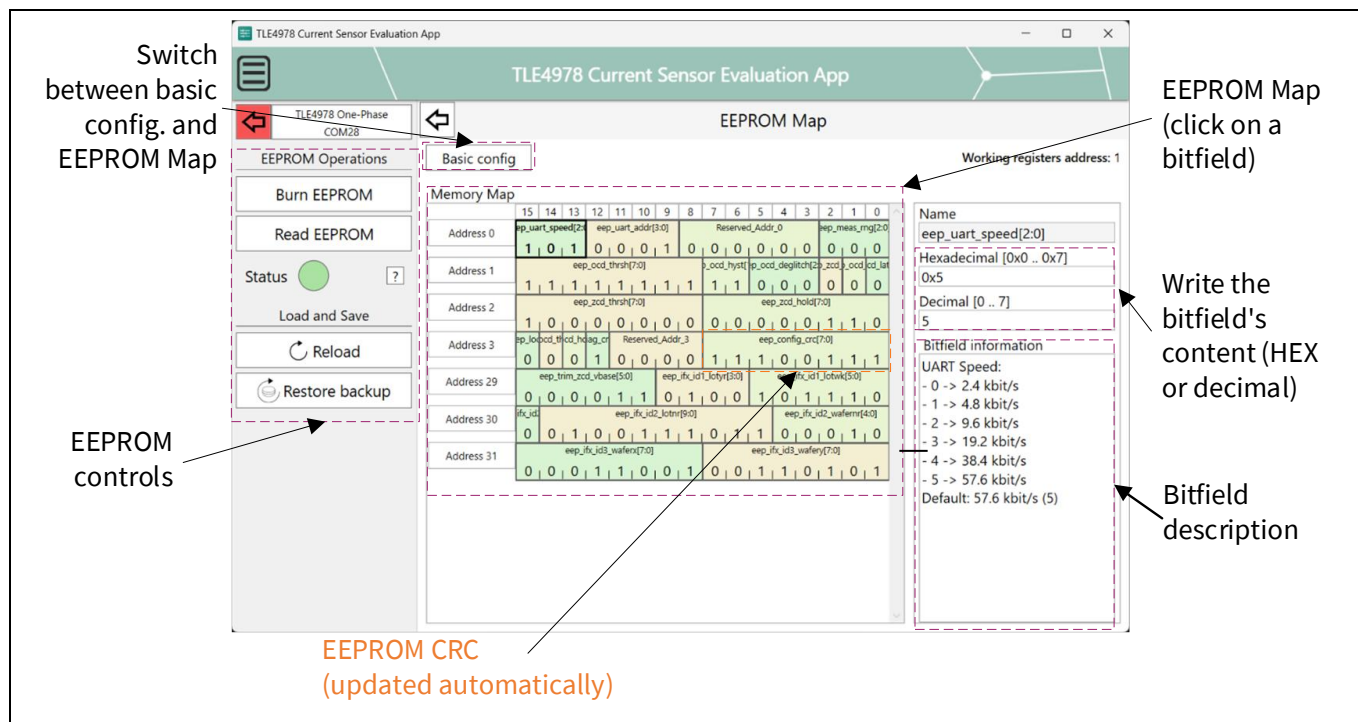
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## XENSIV™ current sensors

### 2 System and functional description

#### 2.2.3.3 EEPROM Map

The EEPROM Map scenario allows you to view or change various parameters of the sensor, such as DCDI address, baud rate, OCD/ZCD threshold, ZCD hold time, and OCD deglitch parameters. You can change any of the parameters except cyclic redundancy check (CRC), which is automatically calculated and displayed in the GUI after every change of the EEPROM.



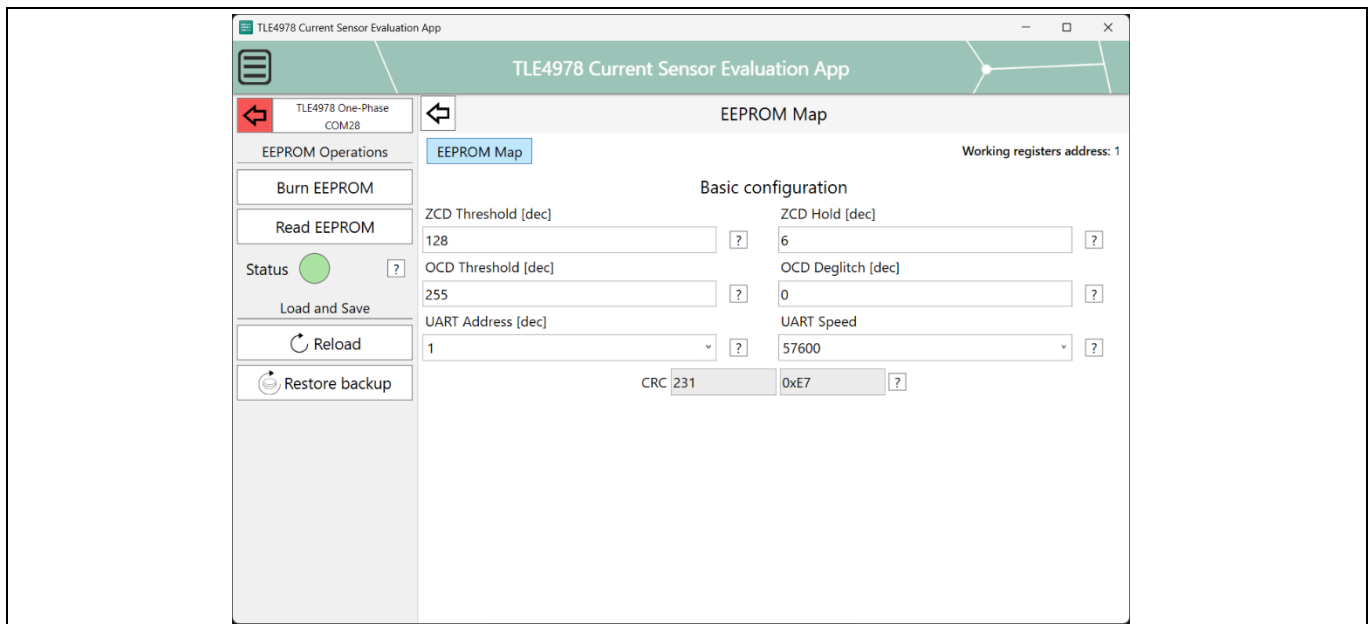
**Figure 18** EEPROM Map

The scenario starts with a loading screen while the software reads the sensor EEPROM. Only the user-accessible area of the EEPROM can be changed, while the reserved area will be hidden. The software needs to read the whole register map to compute the correct CRC. There are currently two views in this scenario:

- **EEPROM Map:** The memory map is displayed, with all the user-accessible rows and bitfields. Clicking on a bitfield will update the description on the right side of the panel. You can write either in decimal or hexadecimal format. See [Figure 18](#)
- **Basic configuration:** A simpler view, which displays only the fields you can modify. The bitfield values can be entered only in decimal format. Each field comes with a description tooltip that displays when the cursor is on top of the question mark button. See [Figure 19](#)

You can switch between the two views by clicking the button near the top left of the view: **Basic configuration** or **EEPROM Map**. Both views have the same effect and are updated in real time, so if you change something in one view, it will be reflected in the other view as well.

### 2 System and functional description



**Figure 19 EEPROM basic configuration**

When writing to the bitfields, the sensor’s EEPROM is not changed. If you want to commit the changes, click the **Burn EEPROM** button on the left. This operation may take some time. **Do not** disconnect the sensor or close the program. Doing so may result in permanent sensor damage.

The software verifies each bitfield content. For example, if a bitfield is 3 bits wide, the content can be in the range [0, 7] and you cannot write a value outside that range. You cannot write to the CRC register as it is automatically calculated. The contents of the reserved registers are also locked, and you cannot modify them.

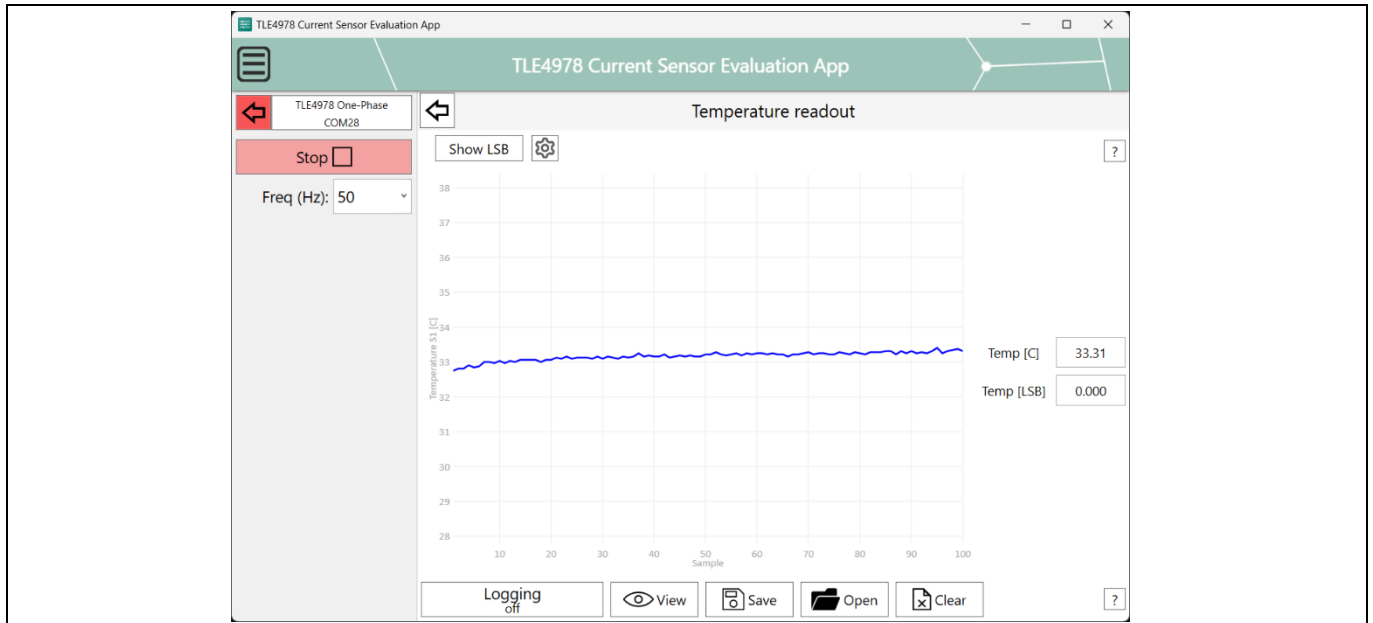
The panel on the left contains buttons for EEPROM burn and read, which are the only two operations that require the sensor. The status light indicates when the EEPROM is busy or if an error occurred during the last EEPROM operation. The **Reload** button is used for reloading the EEPROM to the last known state without reading it again from the sensor.

The software will automatically save the first EEPROM content detected for each sensor (based on the ID fields) and will store that content on disk. Click the **Restore backup** button to reload the first configuration to the sensor. This backup contains only the EEPROM configuration that was first detected by the software on the current PC.

## 2 System and functional description

### 2.2.3.4 Temperature readout

The temperature readout scenario displayed in [Figure 20](#) is used to display the sensor's temperature in Celsius or LSB. The temperature is read digitally from a DCDI register. Therefore, the sensor will be in test mode in this scenario. The same features from the current readout scenario are also available here: start/stop readout, frequency, data logging, and switching between LSB and °C. The temperature readout frequency depends on the DCDI baud rate: a lower DCDI baud rate will result in a longer readout frame width.



**Figure 20** Temperature readout

Data logging in temperature readout mode works in the same way as current readout. This functionality is explained in [Section 2.2.3.2](#).

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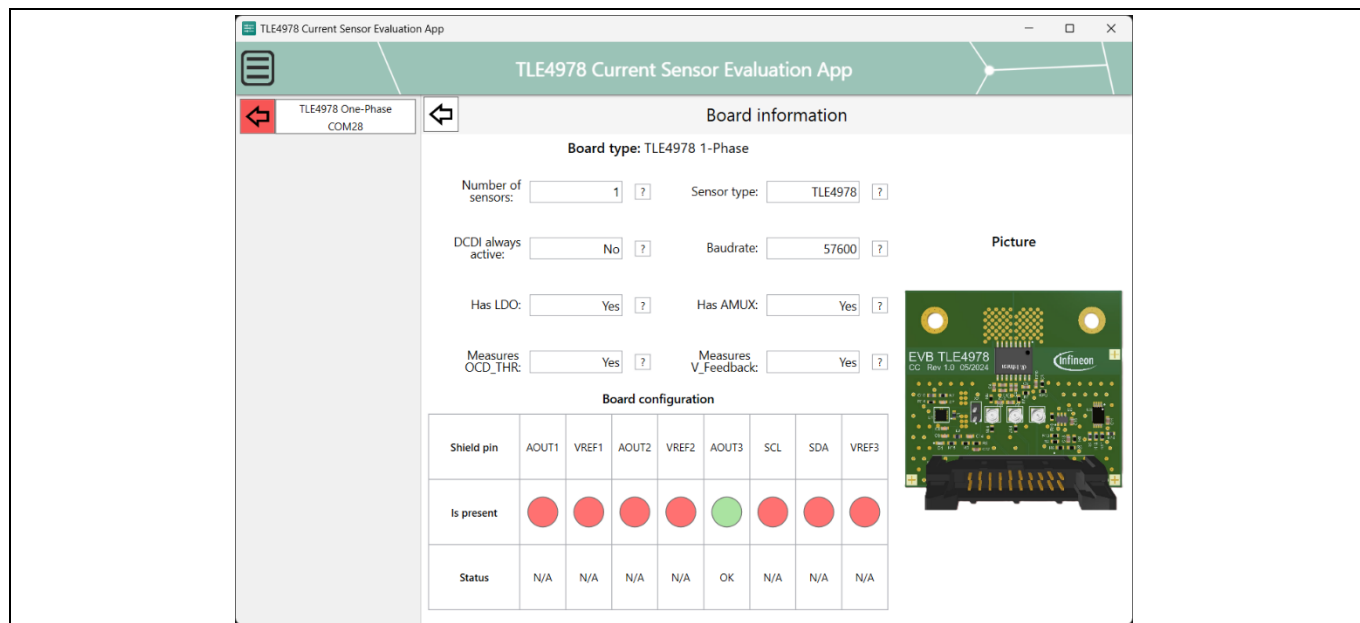
## XENSIV™ current sensors

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#### 2.2.3.5 Board information

The software supports multiple sensors and multiple board configurations. In this view, the software will show all the information about the currently selected board:

- The number and type of the sensors on the board
- Baud rate (must be the same for all sensors)
- Whether or not DCDI is always enabled on the sensors
- Other features: OCD threshold measurement, analog multiplexer, feedback voltage measurement, LDO

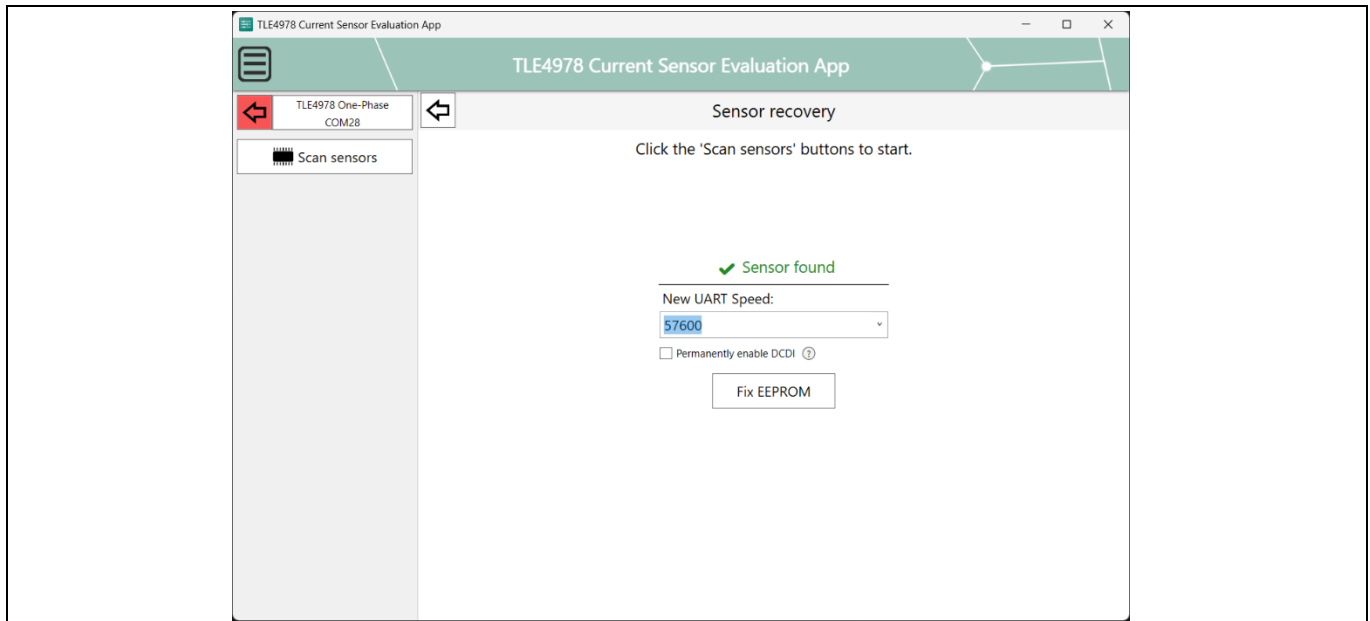


**Figure 21 Board information**

#### 2.2.3.6 Sensor recovery

In some cases, the sensor’s EEPROM might be compromised. If the sensor detects a wrong CRC in the EEPROM, the shadow registers will be set to their default values, indicating that the sensor will be stuck at a baud rate of 57,600 bps and DCDI will require a special sequence to be activated. The analog output of the sensor will also be wrong.

If the software does not detect a sensor, you can still use the software, and enter the “*Sensor recovery*” view to restore the sensor’s EEPROM to a working condition.



**Figure 22** Sensor recovery

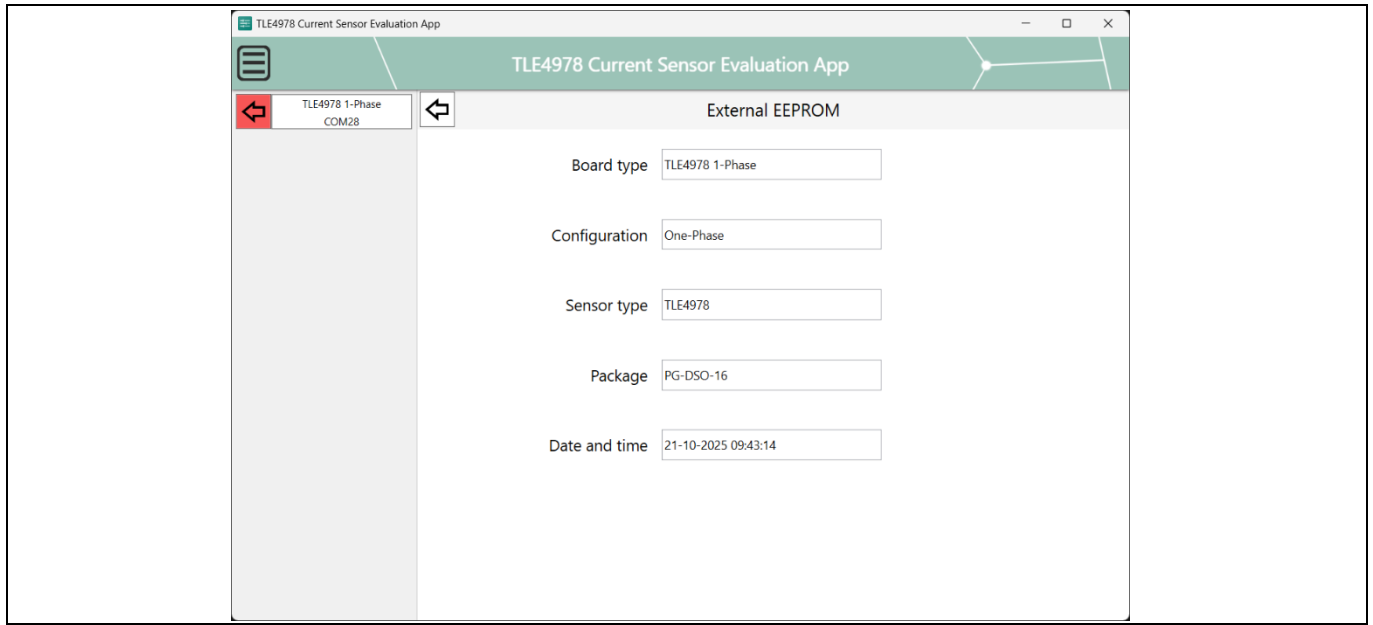
After clicking the **Scan sensors** button on the left, the software will begin scanning for sensors at all known baud rates. If a sensor is detected, you will be notified, and it can be revived.

You can choose a UART speed for the sensor and whether to permanently enable DCDI. For TLE4978 sensors, this is not required as the DCDI sequence is always used. Ensure that by always enabling DCDI, the sensor will ignore any voltage on the OCD\_THR pin and rely on the value stored in the EEPROM, in the “**eep\_ocrd\_thrsh**” field.

Clicking the **Fix EEPROM** button will set the sensor’s address to ‘1’. A message will be shown about the operation’s result. After restoring the sensor’s EEPROM, all the other views can be used again.

#### 2.2.3.7 External EEPROM

The TLE4978 Evaluation Board also contains an external I<sup>2</sup>C EEPROM used for writing sensor name, range, package, and the date and time of programming (Figure 23). If no external EEPROM exists, this scenario will not appear. The scenario does not have any controls in the left panel. The external EEPROM is read-only; therefore, it cannot be modified.



**Figure 23 External EEPROM**

### 3 Troubleshooting

## 3 Troubleshooting

### Problem

The J-Link driver is not installed correctly. If the device is not recognized correctly in Device Manager (for example, it is reported as “BULK interface”), the driver is not installed.

The software was either installed without admin rights or there was another problem during the installation.

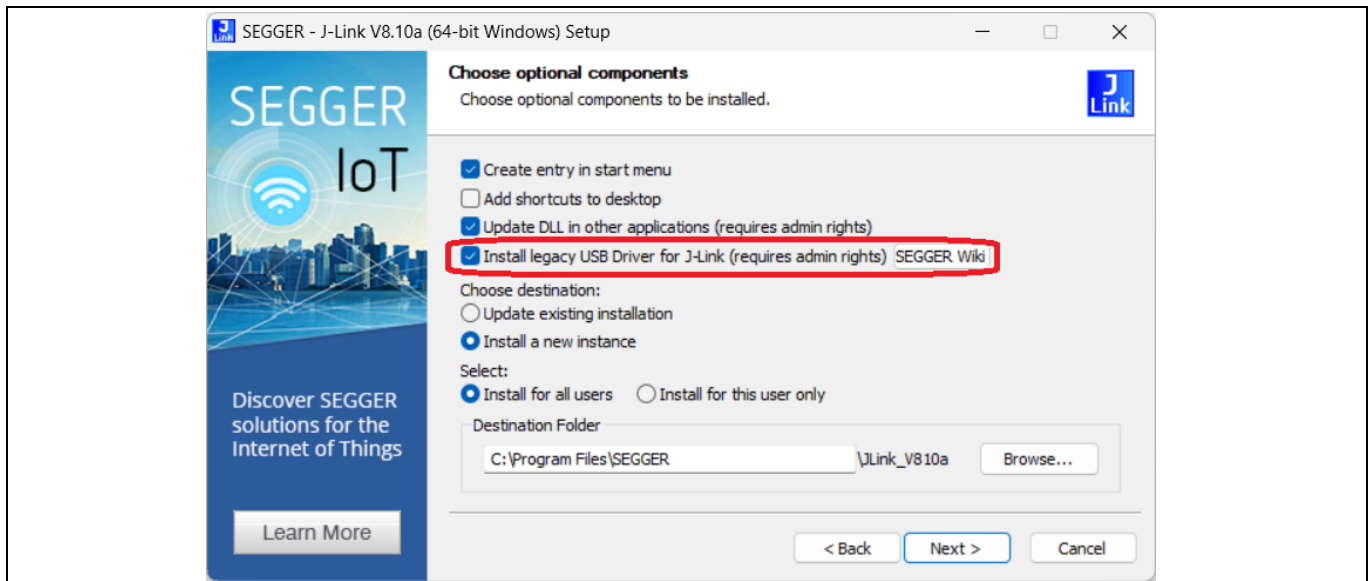
### Symptoms

The software shows one of the following error messages:

- “Flashing finished successfully but expected FW is still different than actual FW”
- “J-Link driver missing or inaccessible”
- “Firmware version mismatch after flashing”
- “Firmware failed to answer after flashing”

### Solution

Install the latest version of J-Link from the [SEGGER](#) website. Run the installer with admin rights. Make sure to select “**Install legacy USB driver for J-Link**” when prompted ([Figure 24](#)). If the checkbox is missing (older J-Link versions), the driver will automatically be installed.



**Figure 24** J-Link installation

## 4 System design

This section offers a detailed description of the hardware design Rev 2.0 of the TLE4978 Evaluation Board.

The hardware is composed of the following main blocks:

- **Application circuit:** Consisting of the following components:
  - The TLE4978 sensor (60 A/50 A/40 A), powered by a buck-boost converter
  - TS5A3159QDBVRQ1 analog multiplexer used to switch the OCD\_THR pin's function between OCD threshold voltage and DCDI communication pin
  - Low-pass filter on the AOUT line
- **Power supply:** The TPS63002 buck-boost converter is used for supplying a steady 5 V to the sensor. The input voltage comes directly from USB
- **External EEPROM:** The M24C02-WDW6TP I<sup>2</sup>C EEPROM is used on the evaluation board to store sensor information like name, package, and range
- **Current Sensor Programmer Shield:** Used to connect the TLE4978 Evaluation Board to the XMC1100 Boot Kit. Also contains jumpers that can be used to connect the sensor without the other components present on the evaluation board. An additional PMOS transistor can also be used to control sensor power when the buck-boost converter is not present
- **Target microcontroller:** The main microcontroller is an XMC1100, TSSOP38 package, 64 KB of flash. This device handles communication with the sensor and data forwarding to USB via the debugger
- **Onboard debugger:** The XMC1100 Boot Kit board features a debugger implemented via an XMC4200 microcontroller. This auxiliary microcontroller features a debug probe firmware delivered by SEGGER – J-Link. This debugger is used for flashing the target microcontroller and for establishing serial communication via USB

### 4.1 Schematics

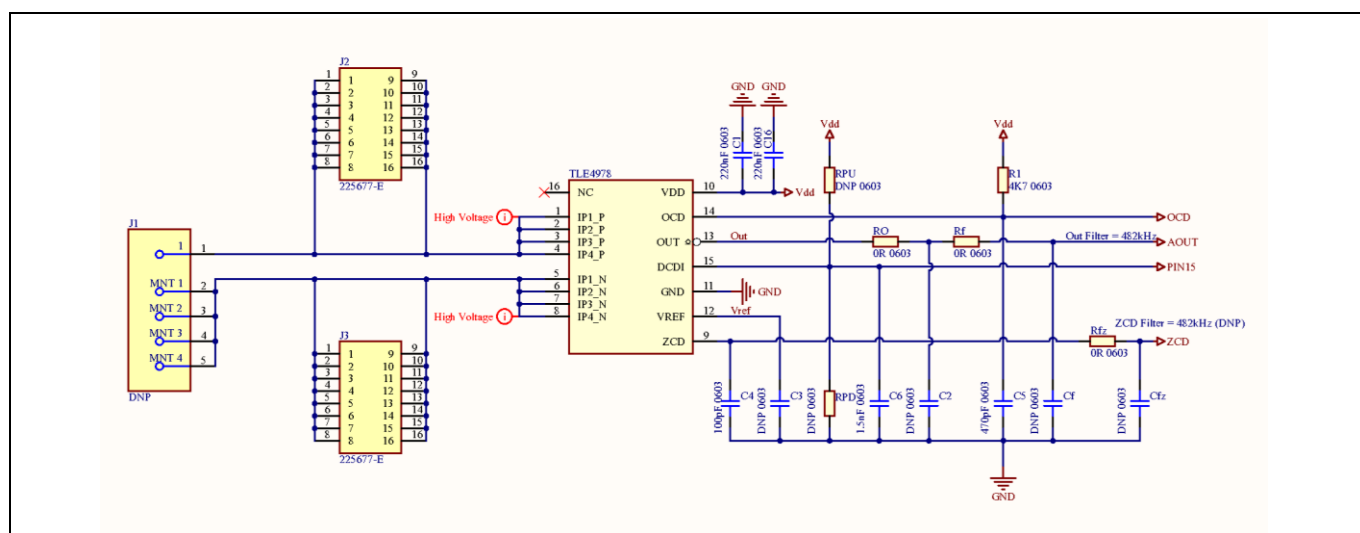


Figure 25 Application circuit

# TLE4978 Evaluation Boards user guide

## XENSIV™ current sensors

### 4 System design

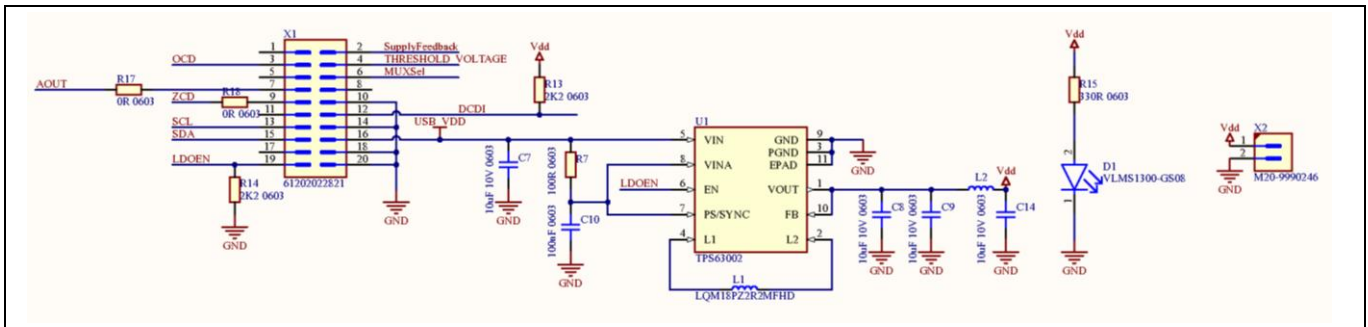


Figure 26 Connector and LDO

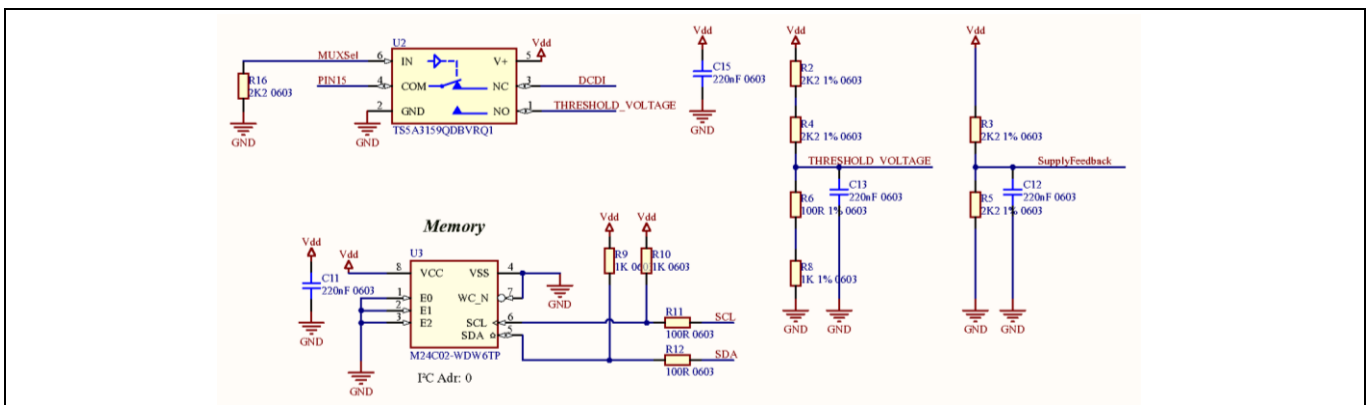


Figure 27 Analog multiplexer and external EEPROM

## 4.2 PCB layout

The design shown in Section 4.1 is physically implemented in PCB technology using a standard process with the following characteristics:

- PCB material: FR4
- PCB thickness: 1.6 mm ±10%
- Copper: Four layers, 70 μm thickness for outer layers, 140 μm thickness for inner layers

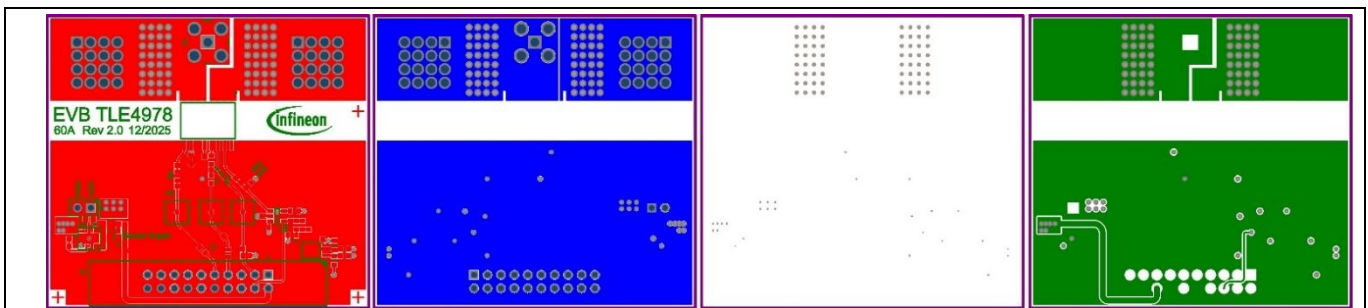


Figure 28 TLE4978 Evaluation Board PCB layout

### 4 System design

#### 4.3 Bill of materials

**Table 2 Bill of materials**

Qty.	Ref designator	Description	Footprint	Populated
6	C1, C11, C12, C13, C15, C16	220 nF 0603	CAPC1608X90N, CAPC1608X90N-3	Yes
6	C2, C3, Cf, Cfz, RPD, RPU	DNP 0603	CAPC1608X90N-4, CAPC1608X90N, RESC1609X50N	No
1	C4	100 pF 0603	CAPC1608X90N	Yes
1	C5	470 pF 0603	CAPC1608X90N	Yes
1	C6	1.5 nF 0603	CAPC1608X90N	Yes
4	C7, C8, C9, C14	10 µF 10 V 0603	CAPC1608X120N	Yes
1	C10	100 nF 0603	CAPC1608X87N	Yes
1	D1	VLMS1300-GS08	FP-6_541-5092_01-4-MFG	Yes
1	J1	DNP	FP-142-0701-201-MFG	Yes
2	J2, J3	225677-E	225677E	Yes
2	L1, L2	LQM18PZ2R2MFHD	INDC1608X95N_LQM18P_FR	Yes
3	MMCX_OCD, MMCX_Out_Flt, MMCX_ZCD	734152061	CON-SMA-734152061	Yes
1	R1	4K7 0603	RESC1609X50N	Yes
4	R2, R3, R4, R5	2K2 1% 0603	RESC1608X55N-1	Yes
1	R6	100R 1% 0603	RESC1608X55N-1	Yes
3	R7, R11, R12	100R 0603	RESC1608X55N-2	Yes
1	R8	1K 1% 0603	RESC1608X55N-1	Yes
2	R9, R10	1K 0603	RESC1608X55N-6	Yes
3	R13, R14, R16	2K2 0603	RESC1608X55N-1	Yes
1	R15	330R 0603	RESC1608X55N-2	Yes
5	R17, R18, Rf, Rfz, RO	0R 0603	RESC1609X50N, 1608[0603], RESC1608X55N-1	Yes
1	TLE4978	TLE4978 (60 A/50 A/40 A)	SOIC127P1030X265-16N-4	Yes
1	U1	TPS63002	SON50P300X300X100-11N-1-V	Yes
1	U2	TS5A3159QDBVRQ1	SOT95P280X145-6N-6	Yes
1	U3	M24C02-WDW6TP	SOP65P640X120-8N-1	Yes
1	X1	61202022821	CON-M-THT-61202022821	Yes
1	X2	M20-9990246	CON-M-THT-M20-9990246	Yes

## 5 Related resources

- [XENSIV™ current sensors webpage](#)
- [XENSIV™ current sensors Developer Community](#)

### References

### References

- [1] Infineon Technologies AG: *XENSIV™ TLE4978 current sensor datasheet*; [Available online](#)
- [2] Infineon Technologies AG: *XENSIV™ TLE4978 current sensor user manual*; [Available online](#)

### Glossary

### Glossary

**ADC**

*analog-to-digital converter (ADC)*

**CRC**

*cyclic redundancy check (CRC)*

**DCDI**

*digital control and diagnostic interface (DCDI)*

**EEPROM**

*electrically erasable programmable read-only memory (EEPROM)*

**OCD**

*overcurrent detection (OCD)*

**PCB**

*printed circuit board (PCB)*

**SCL**

*serial clock (SCL)*

**SDA**

*serial data (SDA)*

**UART**

*universal asynchronous receiver-transmitter (UART)*

**ZCD**

*zero-cross detection (ZCD)*

### Revision history

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#### Revision history

Document revision	Date	Description of changes
1.00	2026-03-13	Initial release
1.10	2026-06-23	Updated document to board revision 2.0

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### Safety & Operating Instructions:

Customer shall check the Evaluation Board for any physical damage which may have occurred during transport. If customer detects any damages or defects in the Evaluation Board, customer shall not connect the Evaluation Board to a power source. Customer shall contact Infineon for further support. If customer observes unusual operating behavior during the evaluation process, customer shall immediately shut off the power supply to the Evaluation Board and consult Infineon for support.

Customer shall not touch the Evaluation Board during operation and keep a safe distance.

Customer shall not touch the Evaluation Board after disconnecting the power supply, several components may still store electrical voltage and can discharge through physical contact. Several parts, like heat sinks and transformers, may still be very hot. Allow the components to cool before touching or servicing.

The electrical installation must be completed in accordance with the appropriate safety requirements.