Programmer Kit

Current Sensor - TLI 4970

User's Manual

Software Description for Evaluation Kits
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Sense and Control

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Revision History	
Page or Item	**Subjects (major changes since previous revision)**
Rev. 1.2, 2013-06-06	
General	Pictures updated with new filter settings

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1 Introduction

The Programmer Kit is designed to visualize data coming from TLI4970 sensors. It's also possible to read and write the sensor EEPROM. Further, different internal register of the connected TLI4970 can be read and written.

This document will only describe the graphical elements of the Programmer Kit and will not describe any meaning of a register nor explains how the sensor is working. Details about the functionality of the sensor are given in the corresponding data sheet.

Typically, one Programmer Kit contains the following hardware parts, see **Figure 1**:

1. CDROM including the PC software
2. Programmer PGSISI-2
3. External power supply
4. Evaluation Board

Figure 1 Evalkit

The PC software is responsible for visualizing the basic functionality of the TLI4970. Thereby, the PC communicates with the sensor via a programming interface, i.e. PGSISI-2.

The maximum communication rate between PC and sensor is around 41700 samples per second. The PGSISI-2 periodically requests the actual current value from the sensor and returns the response of the sensor to the PC. The PC, then, interprets and visualizes the responds.

Table 1 Order information

Product Name	Product Type	Ordering Number
TLI4970050 PROG-KIT	Complete Programmer Kit for digital current sensor TLI4970.	SP000965088
TLI4970050 EV-BOARD	Evaluation Board and Software for TLI4970. Note: PGSISI-2 programmer not included.	SP000965084

2 Installation Guide

This chapter describes the installation of the hardware and software components of the Programmer Kit package for TLI4970 sensors. First of all the PC software must be installed before the PGSISI-2 can be connected to the PC. During installation of the PC software the driver for the PGSISI-2 will be installed.

2.1 Requirements

Hardware:

- x86 processor at 900 MHz or higher
- 30 MByte RAM
- 5 MByte space on hard disk (for installation files)
- The Programmer Kit Software needs more hard disk space when running (for saving sensor data).

Software:

- Microsoft Windows 2000 or higher

The Programmer Kit software requires Microsoft's .NET Framework 2.0 or later (it is shipped with "setup.exe" and need additional space on hard disk). Normally, Microsoft's .NET Framework Version 2.0 or higher is pre-installed on Windows 7 clients.

2.2 Software

To use the Graphical User Interface for TLI4970, the software must be installed.

First of all run "setup.exe", which is located in the installation folder. This will also install the necessary driver for the programmer, i.e. PGSISI-2. The typical Microsoft Windows installer will guide you through all the steps to install the Programmer Kit software that are:

1. An installation window will appear as illustrated in **Figure 2**. Click **'Next'** to continue with the installation.
2. Read through the license agreement carefully and continue the installation by accepting. If the license agreement is not accepted, the installation will be aborted, see **Figure 3**.
3. Then, the installer will prompt for the installation folder. Accept the default one or use another directory, see **Figure 4**.
4. By pressing the **'Install'** button, the installation of the programmer driver and the GUI is started, see **Figure 5**.
5. During the installation process the PGSISI-2 as well as the Programmer Kit software will be installed, see **Figure 6**.
6. After the installation has completed the installer can be closed by clicking the **'Close'** button, see **Figure 7**.
7. Now the GUI is ready to use. It can be started via the Windows start menu: Start->All Programs->TLI4970-> TLI4970 Evalkit Software.

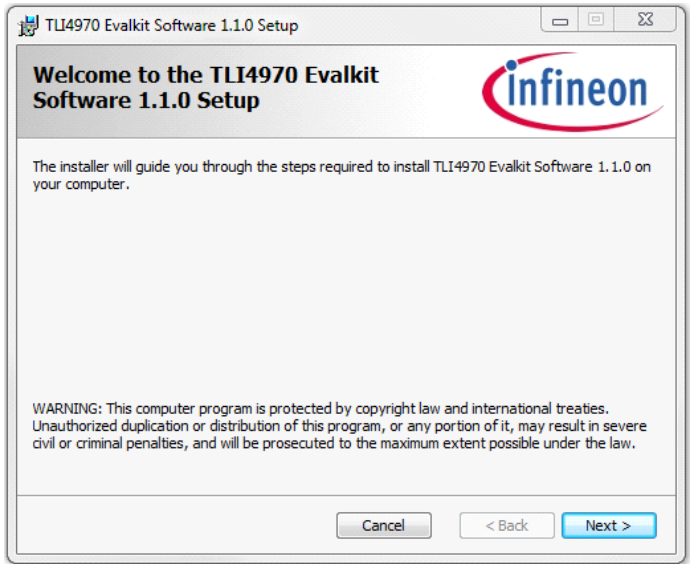

Figure 2 EvalKit Installer - Welcome

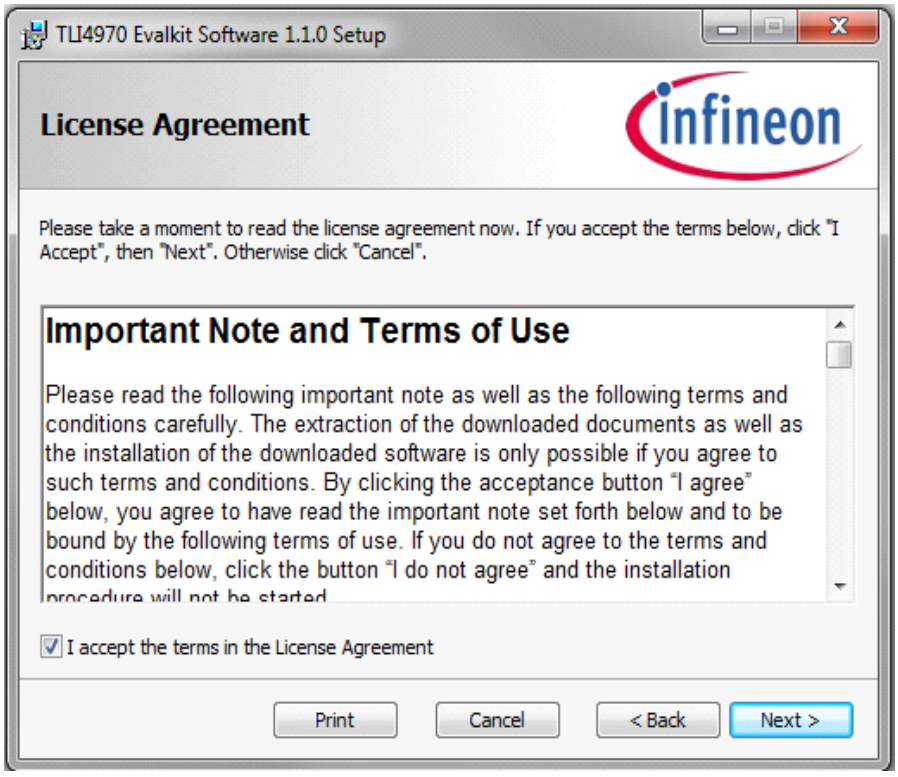

Figure 3 EvalKit Installer - License Agreement

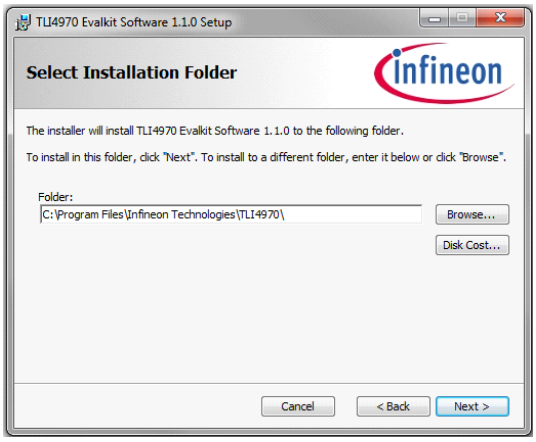

Figure 4 EvalKit Installer - Select Installation Folder

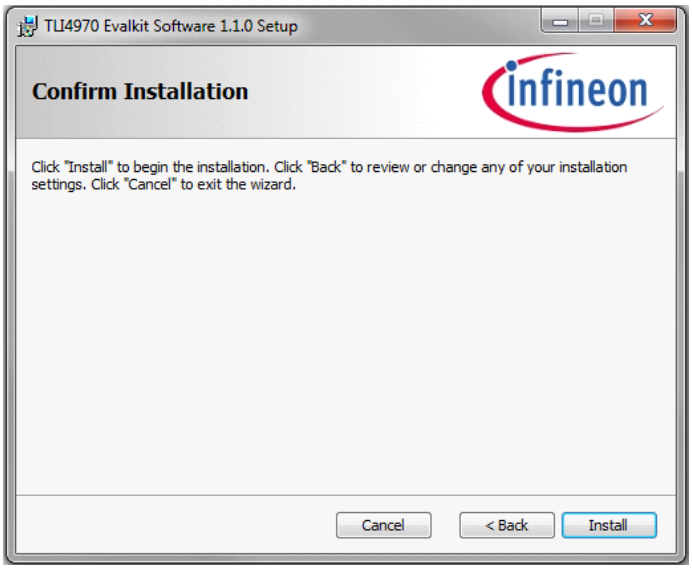

Figure 5 EvalKit Installer - Confirm Installation

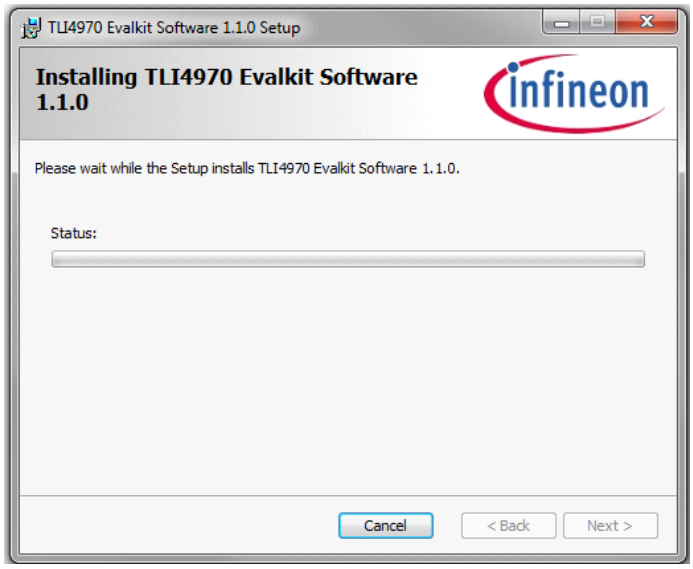

Figure 6 Evalkit Installer - Installing

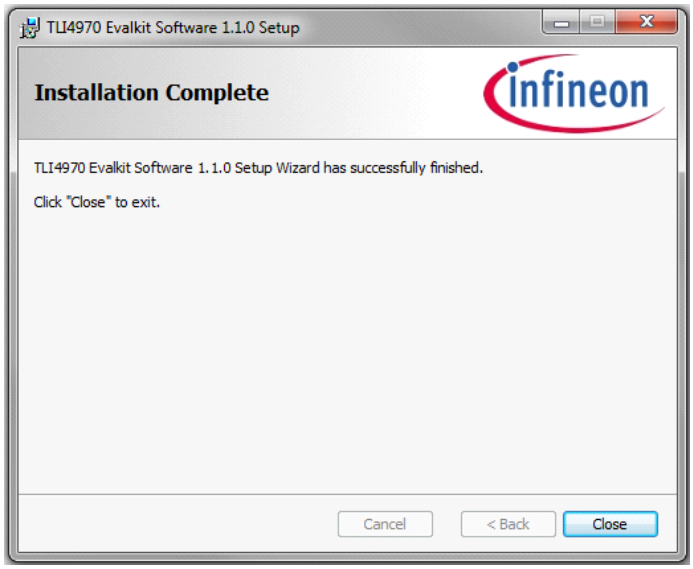

Figure 7 EvalKit Installer - Installation Complete

3 Evaluation Board

The Evaluation Board, see **Figure 8**, acts as an interface between one TLI4970 and one PGSISI-2. The objective of the Evaluation Board is to electrically connect the sensor with the 25 pin D-Sub (DB25) connector of the PGSISI-2.

The following chapter describes the functionality of the hardware. The layout and the schematic of the Evaluation Board are shown in **Figure 9** and **Figure 10** respectively.

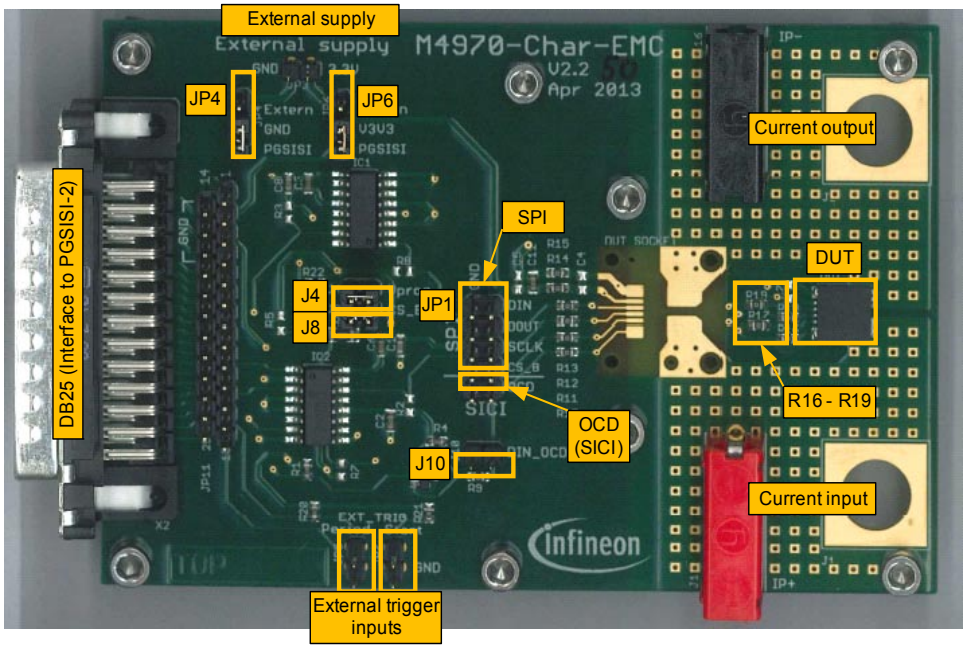

Figure 8 Evaluation Board for TLI4970

Table 2 Absolute maximum ratings[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply voltage on “External supply” pins	V_{DD}	-0.3	-	+5.5	V	
Maximum primary current in socket	I_{P_Socket}	-10	-	+10	A	Sensor mounted inside the socket
Maximum primary current for soldered device	I_{P_PCB}	-50	-	+50	A	Sensor soldered to PCB and no sensor inside the socket
Maximum isolation voltage	U_{ISO}			50	V	Voltage between current rail and measurement GND
Maximum ambient temperature	T_{A_Max}			+60	°C	

1) General conditions (unless otherwise specified): V_{DD} = 5.0 V; T_A = 25 °C

3.1 Hardware Settings of the Evaluation Board

The Evaluation Board allows the operation of the TLI4970 current sensor under different test conditions. This chapter describes the different jumper settings, which can be used for the evaluation of the TLI4970 current sensor. The locations of the different jumpers are marked in **Figure 8**.

Note: The level shifter ICs (IC1 and IC2) on the Evaluation Board are only needed since the micro controller of the PGSISI-2 is operated on +5 V, while the TLI4970 is operated with a supply voltage of +3.3 V. In order to allow reliable communication between the two voltage domains, the level shifter ICs are needed.

3.1.1 Mounting Options for the Current Sensor

The Evaluation Board has two mounting options for the TLI4970 current sensor. It can be placed inside a socket or can directly be soldered onto the PCB. Please note that at any time only one sensor can be operated. Therefore, when operating the soldered sensor (DUT), the socket (DUT_SOCKET) needs to be empty. On the other hand, if the sensor in the socket (DUT_SOCKET) is used, the soldered current sensor (DUT) or the 0 Ohm resistors (R16 - R19, see **Figure 8**) must be removed. **Due to overloading of the pogo-pins of the socket, please do not apply more than 10 A to the Evaluation Board, if a current sensor is located inside the socket (DUT_SOCKET).** If current sensor is soldered onto the PCB and the socket is empty, the board can be loaded with a maximum of 50 A_{peak}.

3.1.2 Normal Operation

During normal operation the full functionality of the TLI4970 can be tested without the need for any external power supplies or connections. All needed voltages for the sensor and the level shifter ICs are supplied by the PGSISI-2. All jumpers need to be in their default setting as specified in **Table 3** and shown in **Figure 9**.

The current to be measured can be applied via two standard 4mm “Banana” plugs or by the two screw lugs with 7mm screw bolts. For maximum current loading of the socket and the board please refer to **Table 2**.

The operation of the SPI interface can be monitored via the connectors JP1. This also allows the connection of a logic analyzer. The overcurrent response of the TLI4970 can be monitored via the OCD-pin. This pin also allows monitoring of the SICI[1)]-interface, which is used for EEPROM programming.

Table 3 Default jumper settings

Name	Label	Default setting	Comment
J4	Vprog	Closed	Enables programming voltage on $\overline{CS}$ pin for EEPROM programming
J8	CS_B	Closed	Enabling of SPI communication to sensor
J10	DIN_OCD	Open	Data-Input for 4-pin SPI communication[1)]
JP4	GND	GND-PGSISI	Allows disconnection of sensor GND from PGSISI-2
JP6	V3V3	V3V3-PGSISI	Supply voltage V_{DD} for sensor from PGSISI-2

1) Needs to be enabled via EEPROM programming. Currently not available.

1) SICI: Serial Inspection and Configuration Interface (Infineon proprietary interface and protocol)

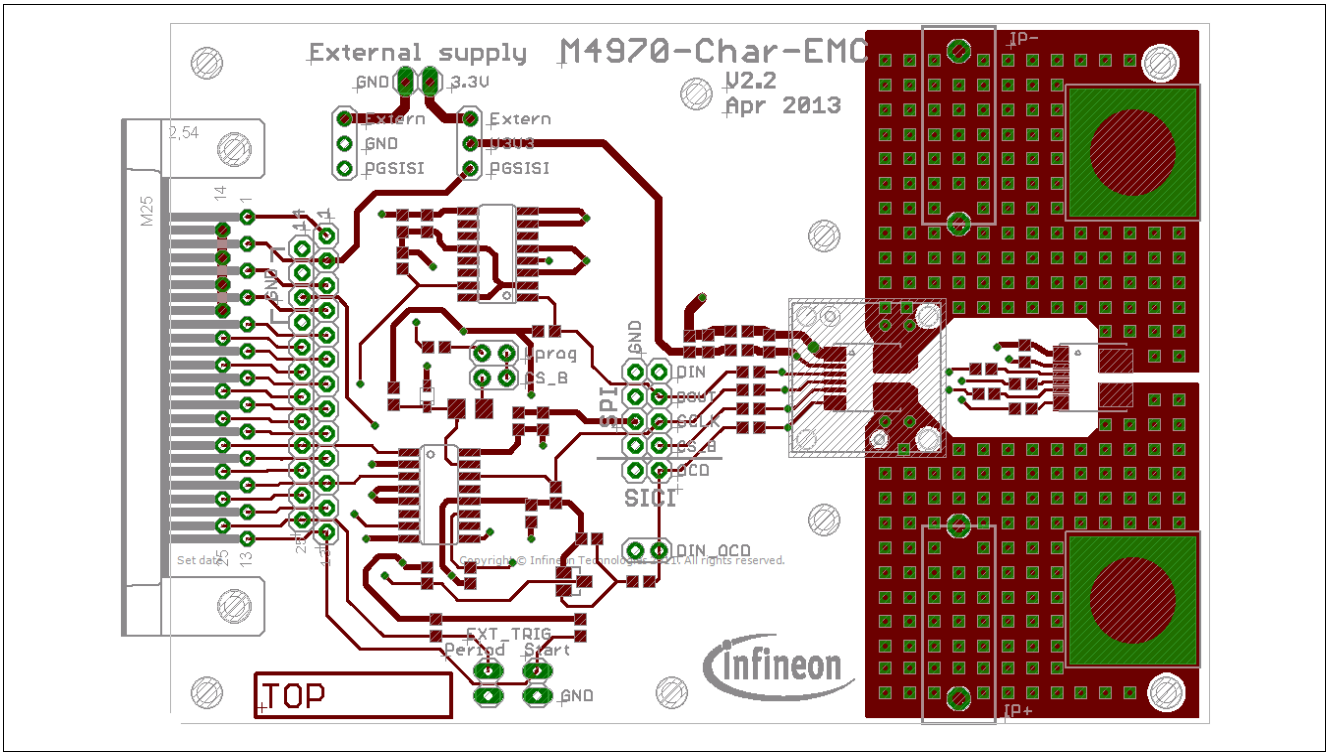

Figure 9 Layout of the Evaluation Board

3.1.3 Operating with External Power Supply

The connector pins “External supply” (JP3) can be used to apply an external V_{DD} supply voltage to the sensor. When using this option, the jumpers JP4 and JP6 need to be set to the “Extern” setting. Then the V_{DD} voltage for the sensor is no longer taken from the PGSISI-2 but from the external power supply. The level-shifters are still supplied by the PGSISI-2.

Note: When the sensor is supplied by the external supply voltage, the “RESET” and the “POWER” button are only operating on the GUI, but not on the sensor. In order to do a “Sensor Reset” or a reload of the EEPROM settings, the external supply voltage needs to be recycled.

3.1.4 Programming of the Sensor EEPROM

The user area of the EEPROM can be reprogrammed via the PGSISI-2. This allows the evaluation of different settings for the low-pass-filter or overcurrent limit. These settings can be set either temporarily in the RAM until the power is cycled or can permanently be programmed into the EEPROM. For details please see the software description.

If the sensor should be protected during evaluation from false EPPROM programming, the jumper J4 can be opened. In this case, only temporary settings in the RAM can be tested and after a power cycle, the original settings will be restored again.

3.1.5 Programming Interface

The TLI4970 contains a special programming interface (SICI), which allows the user a bidirectional communication with the sensor via a single pin. For this communication, the OCD pin is used. Due to the bidirectional data transfer, the level shifting between the +5 V micro controller on the PGSISI-2 and the 3.3 V current sensor domain needs a special level shifter. On the Evaluation board, this bidirectional level shifter is realized by a NMOS-source-follower.

Note: This voltage follower is not needed in applications, where the micro controller and the sensor are working on the same voltage domain.

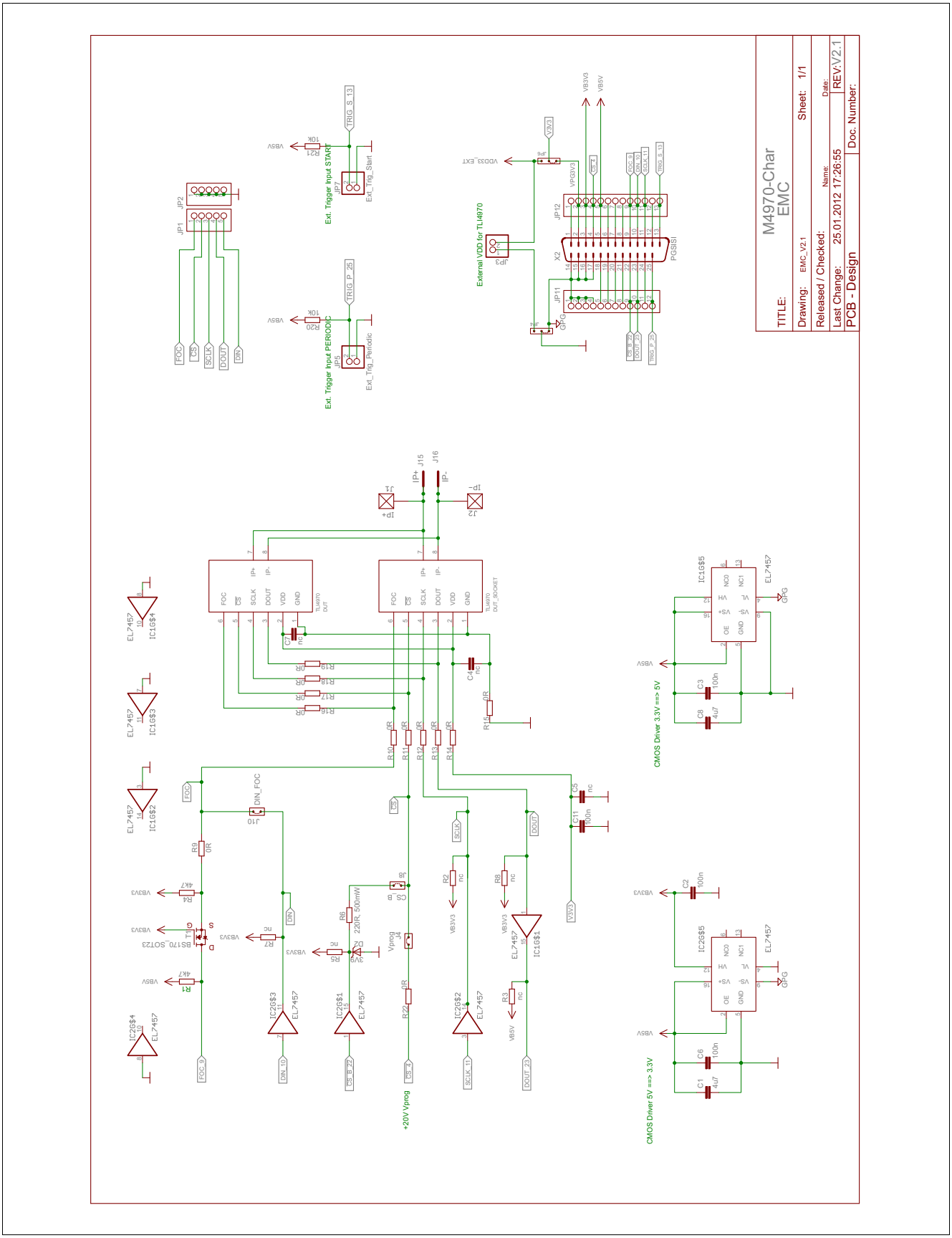

Figure 10 Schematic of the Evaluation Board

4 Graphical User Interface

The objective of the Graphical User Interface (GUI) is to illustrate the functionality of the sensor and to allow basic investigations of TLI4970 sensor. In particular the GUI allows the user to monitor data output of the sensor. The values of the monitored signals can then be saved in a CSV file for subsequent analysis with special software, for example, Excel or Matlab. Further, internal settings of the sensor can be configured either in the RAM or in the EEPROM. Details about the sensor parameters are given in the corresponding data sheet.

In the following sections all features of the GUI will be explained in detail.

4.1 Main Window

The Evalkit software can be started via the start menu (Start->All Programs->TLI4970->TLI4970 Evalkit Software). The main window of the application is illustrated in **Figure 11**.

The field “Programmer” will show a list of all PGSISI-2 that have been connected to the PC via a USB cable. If the respective field is empty, please connect a PGSISI-2 via USB cable to the PC or press the update button. The number of connected PGSISI-2 programmer is not limited. For each connected programmer one entry in the list of “Programmer” will be shown. The number behind the name PGSISI-2 specifies the serial number of the respective box so that a link between the PGSISI-2 in the list and the physical connected PGSISI-2 can be made.

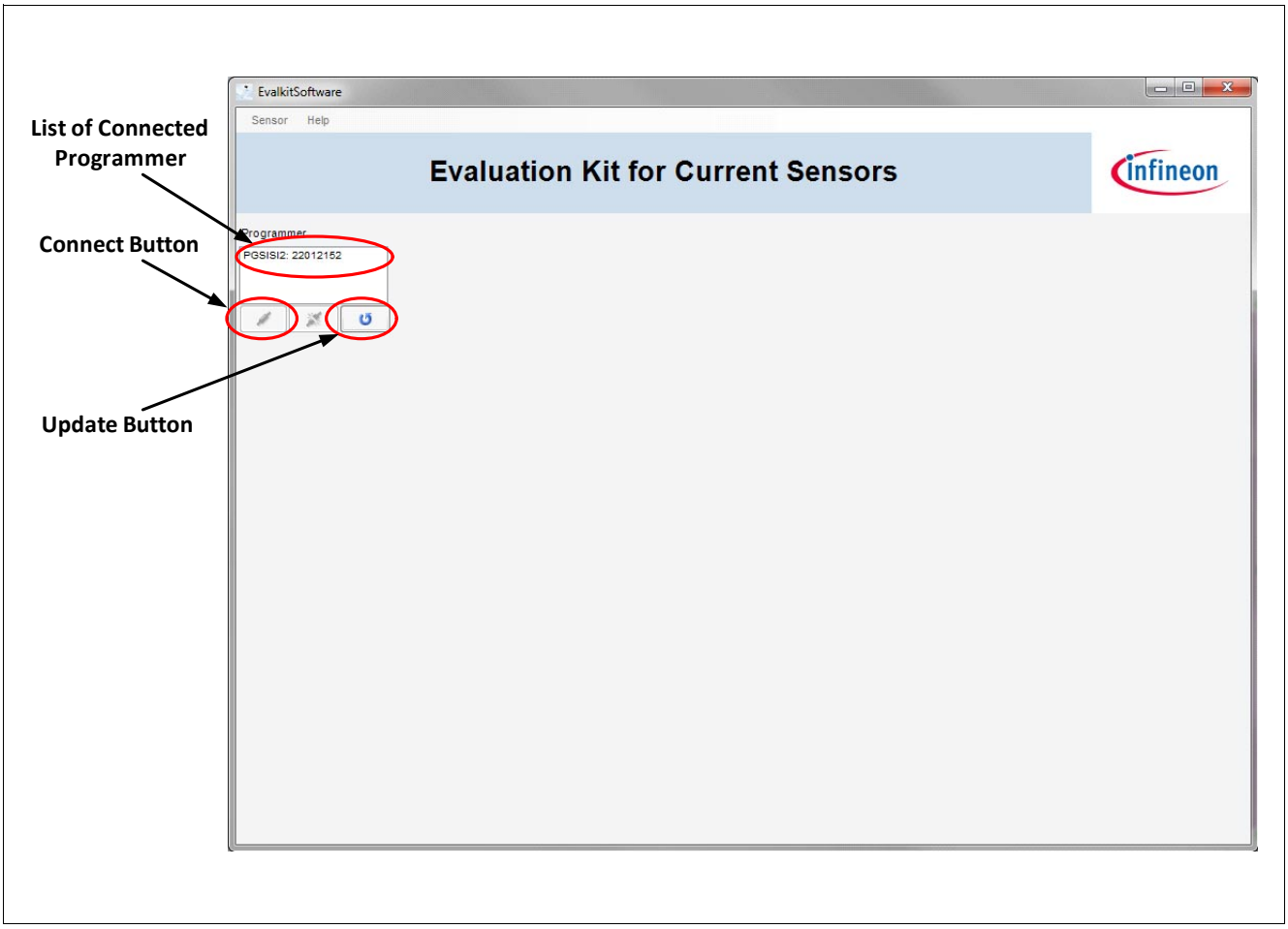

Figure 11 Main Window

To open a communication with a programmer please select one entry in the list and then press the connect button as shown in **Figure 11**. As soon as a connection with the PGSISI-2 has been opened successfully the main window will change and new GUI elements will be available, see **Figure 12**. First of all, the title of the main window

will change to the name of the programmer selected in the list. Further, the name of the programmer that has been selected before will be extended with a so-called connect symbol as illustrated in **Figure 12**.

Afterwards, the main window will be extended with a field “Sensor”. This field must be used to determine the type of sensor that has been connected to the Evaluation Board. Please select the correct type of sensor, for example TLI4970.

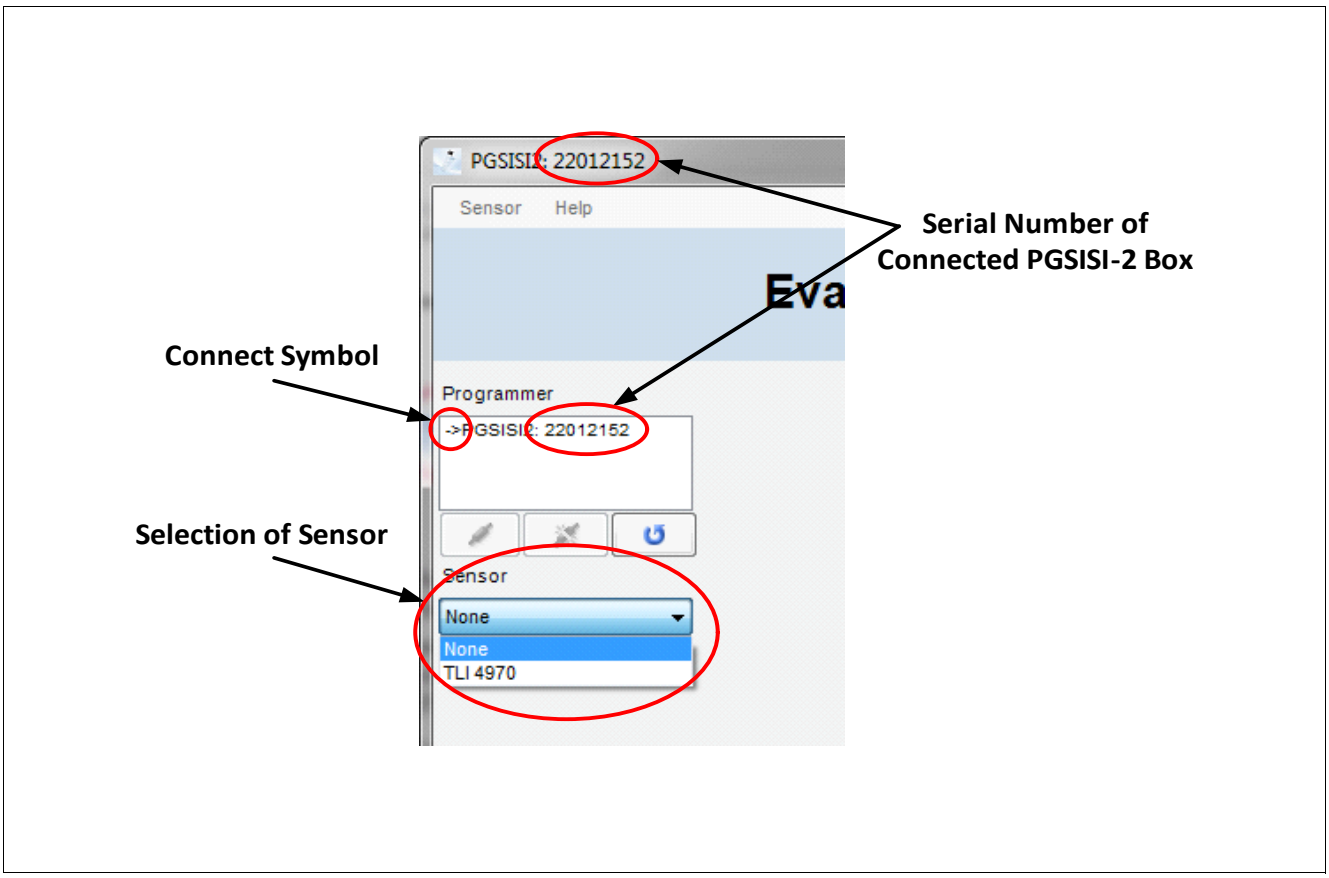

Figure 12 Selection of sensor

Once a sensor has been selected the main window changes again. This time the menu bar is activated and sensor specific information is displayed, see **Figure 13**.

After a correct type of sensor has been selected, the menu bar is enabled and can be selected. The menu bar offers functions to display and change the content of the EEPROM, see **Chapter 4.3**. Further, the menu bar provides information about the version of the Evalkit software, see **Chapter 4.4.1**.

To monitor the current values of the sensor the “Start” button must be pressed. Depending on the configuration inside the sensor specific area, current values will be read from the sensor, periodically. The read values will be interpreted, analyzed, and displayed by the software, see **Chapter 4.2**. For example, each value, which has been read from the sensor, will be stored temporarily in a CSV file located in the folder “C:\ProgramData\Infineon Technologies\TLI4970”[1)].

Before the sensor or the Evaluation Board will be unplugged, turn off the supply power of the sensor. To turn off the power please press the button “Power is On”. After pressing this button the power is turned off and the name

1) *The folder “C:\ProgramData\” is provided by the operating system for application specific data and is hidden, typically. To show this folder, please open the “Folder and Search options” dialog that is available in the Windows Explorer in the section “Organize (see **Figure 14**). Change the selection from “Don’t show hidden files, folders, or drives” to “Show hidden files, folders, and drives”. Press OK to take over the new setting. Afterwards, the respective folder “C:\ProgramData\” is shown by the Windows Explorer.*

of the button changes to “Power is Off. Pressing the button again will turn on the power of the sensor and the name of the button will change back to “Power is On”. Turn off the power of the sensor is recommended before the sensor or the Evaluation Board is removed.

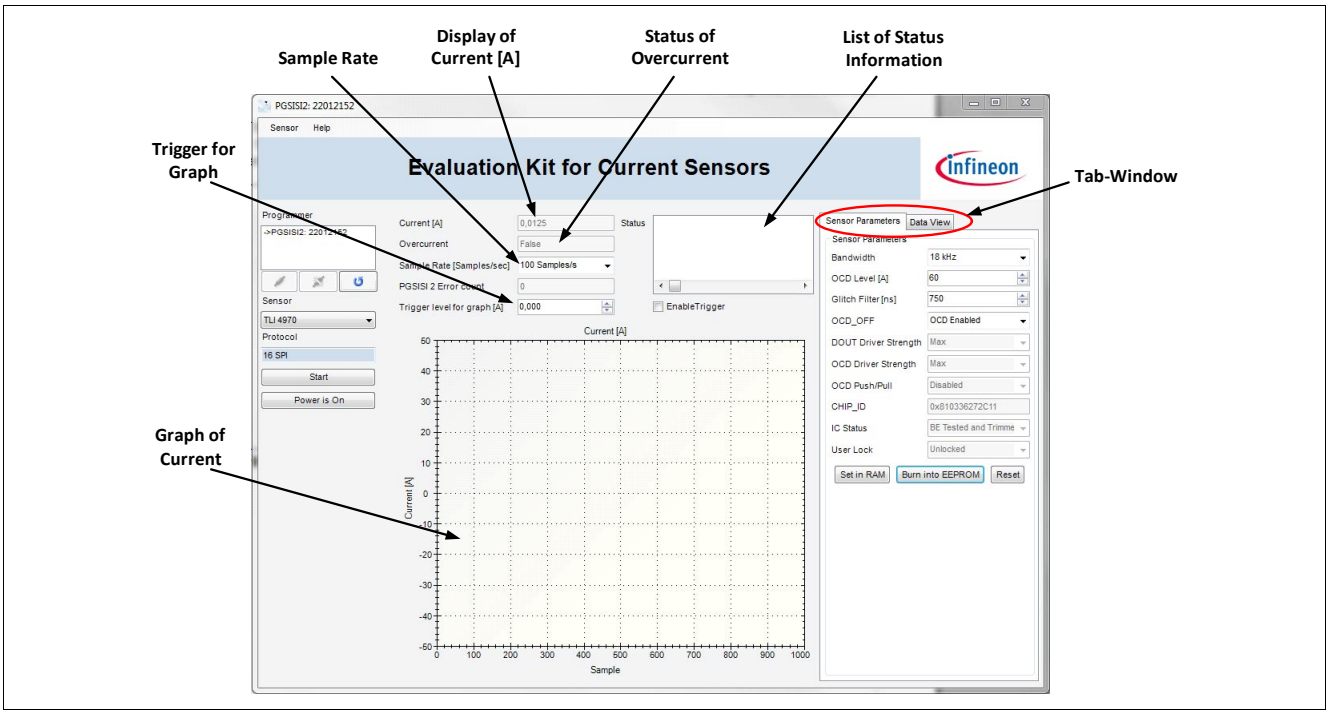

Figure 13 Data window

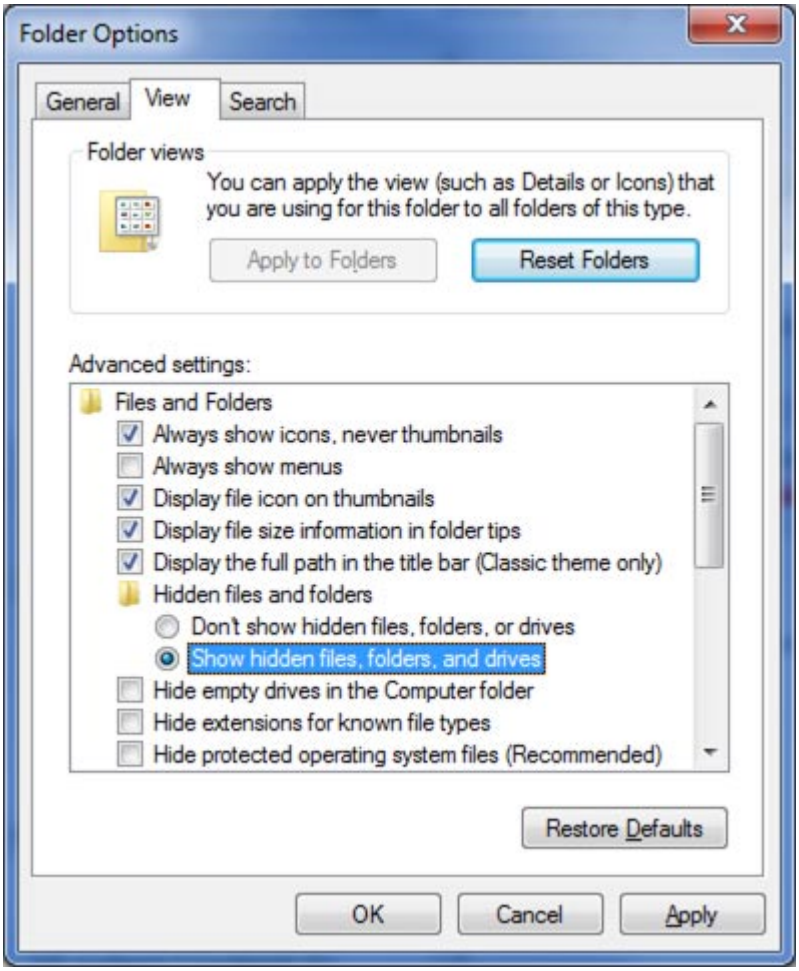

Figure 14 Folder and Search Options

4.2 Sensor Specific Elements

The sensor specific elements are located mainly in the center and on the right side of the window, see **Figure 15**. The objective of the elements located in the center is to visualize the current measured by the sensor and to display the status values. The meaning of the status values can be found in the data sheet.

Currently, 41700 samples per second are read from the sensor. The sample rate can be changed in the field “Sample Rate”.

One sample is defined to be one 16 bit output word of the sensor. As described in the data sheet, the sensor output can either be a value word or a status word. A value word contains one current value, specifies if an overcurrent has been detected, and a parity bit that can be used for detection of a communication error.

4.2.1 Graph View

The current value is displayed in the graph and in a text box. The dimensions of the graph can be configured by a right click with the mouse onto the graph area. The right click will open a drop down menu see **Figure 16**. The command “Autoscale” will automatically calculate the minimum and maximum values that are currently drawn inside the graph and adjust the y-axis accordingly. Axis, y- and x-axis, can also be adjusted manually, see **Figure 17**. Due to the resolution of the graph small values are not displayed accurate according to the y-axis.

When an overcurrent has been detected by the sensor then the text of the field “Overcurrent” changes to “True”.

The status information is displayed as a list in the field “List of Status Information”.

The update rate of the graphical elements may lag on computer with low processing power. To avoid a hang-up of the PC select a low sample rate. By default the sample rate is 100 Samples per second.

On the right side of the window, a so-called tabbed window is shown. The tabbed window contains two tabs, i.e. “Sensor Parameters” and “Data View”, respectively. Both tabs are described in **Chapter 4.2.1.1** and **Chapter 4.2.2**.

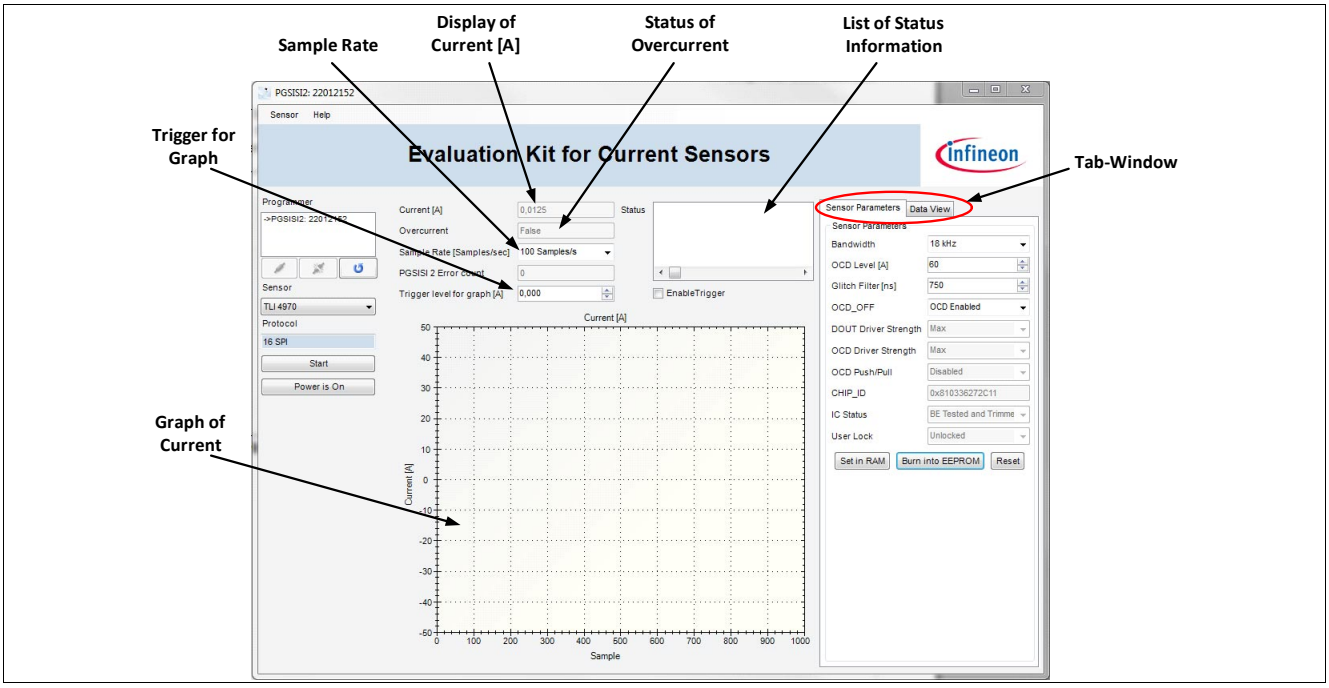

Figure 15 Sensor specific elements

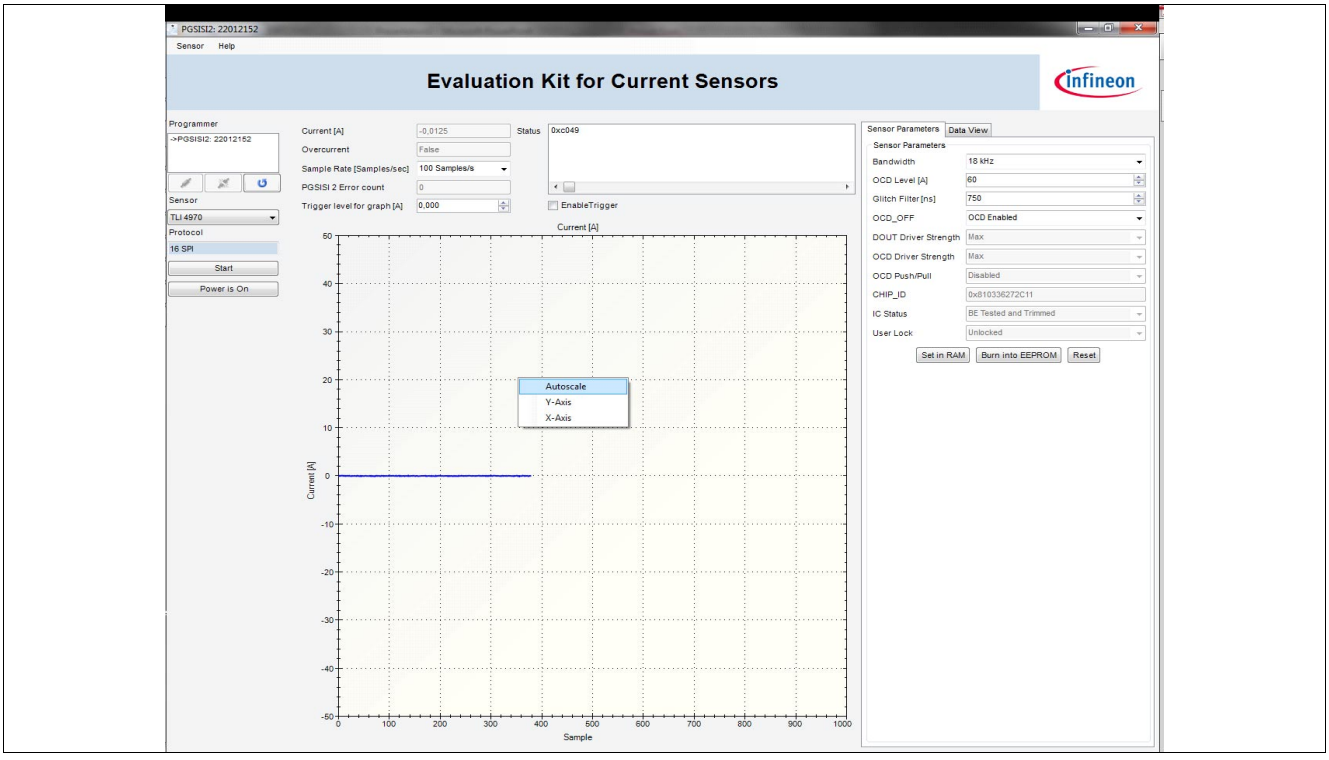

Figure 16 Drop down menu for graph

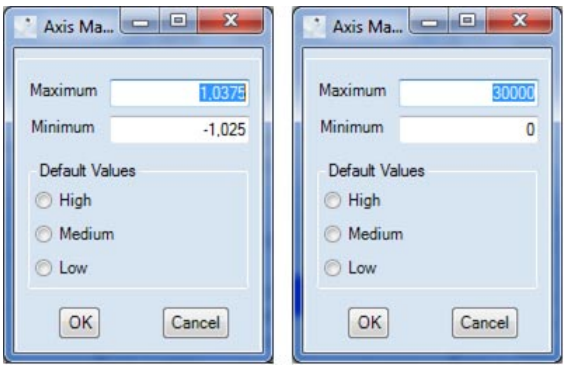

Figure 17 Window for configuring the y- and x-axis

4.2.1.1 Sensor Parameters

This tab window can be used to change some predefined parameters of the connected sensor, see **Figure 18**. Details about the meaning of these parameters are given in the data sheet or programmer's guide. The given parameter can either be changed in the EEPROM or in the RAM. Changing of the parameters is only possible when the measurement process is stopped. Reading or writing the respective registers is performed over the so-called Serial Inspection and Configuration Interface (SICI). This interface uses the OCD pin of the sensor for communication.

Note: If the OCD pin is enabled and the current is above the OCD level the EEPROM cannot be burned because the communication for the burn process and the OCD output share the same pin of the sensor. Thus, the detection of an overcurrent will interrupt the communication during the burn process and can lead to corrupted EEPROM.

For changing the parameters in the EEPROM use the "Burn into EEPROM" button. The burn process is described in **Chapter 4.3**. After the new settings of the parameters have been burned into the EEPROM a reset of the sensor is executed, i.e. power is turned off and on again.

Pressing the "Set in Ram" button sets the values only in the corresponding RAM registers of the sensor. After a reset of the sensor the values of the EEPROM are reloaded into the RAM.

Pressing the "Reset" button will turn the power off and on, read the register values, update the "Sensor Parameters" tabbed window, and resets all graphical elements including the "Data View".

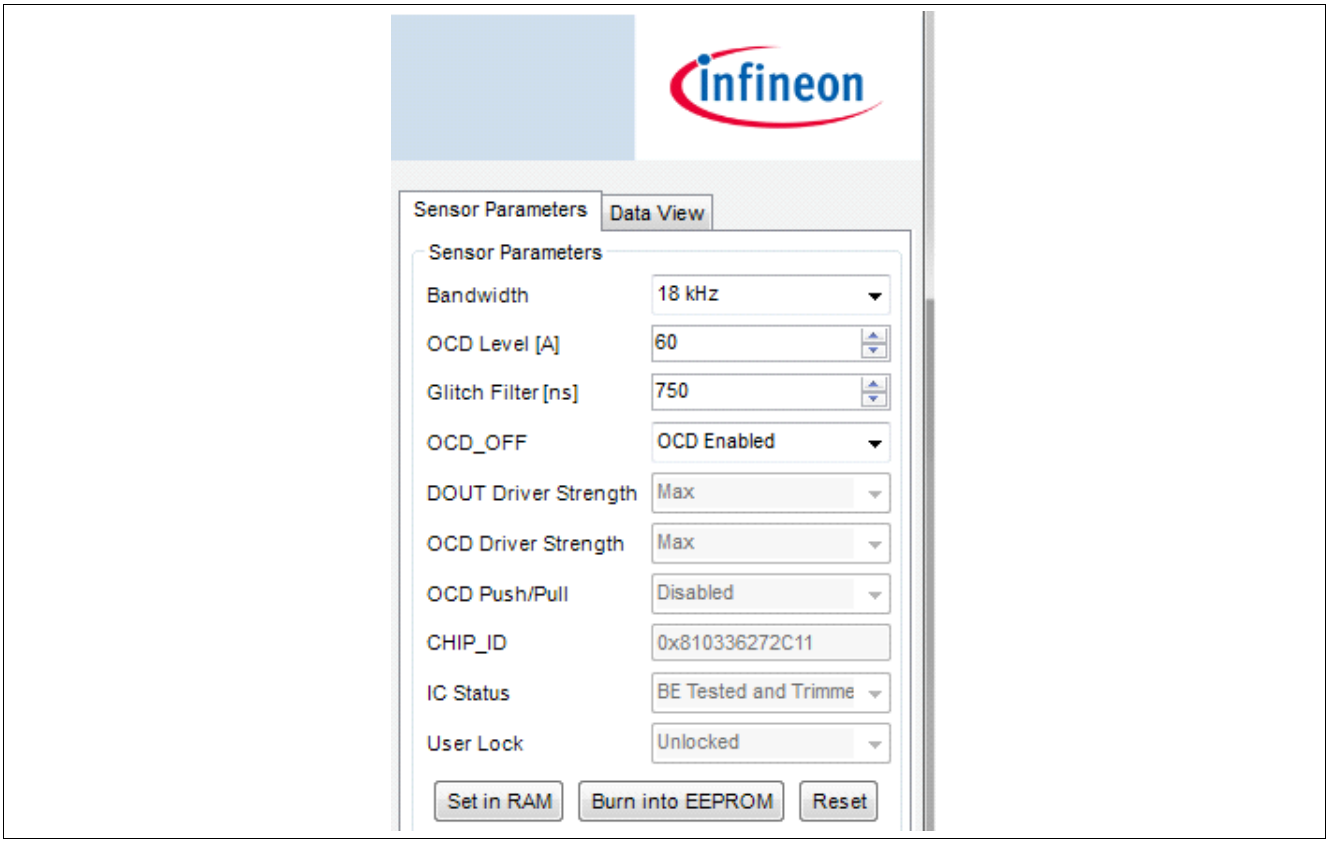

Figure 18 Sensor Parameters

4.2.2 Data View

The “Data View” window shows the last 1000 samples that are displayed on the graph. This view displays value words as well as status words, see **Figure 19**:

- **Index:** The index corresponds to the sample index that has been sent from the programmer to the PC. The PC compares the actual number of received samples with the sample number received from the programmer. If one sample got lost during the communication, for example a buffer overflow, the “PGSISI 2 Error count” is incremented.
- **Current:** This column shows the current in ampere.
- **Parity OK:** This column shows if the parity of one sample is “OK” or ”wrong”.
- **OCD active:** This column shows if an overcurrent has been detected or not. Therefore bit number 13 of the SPI frame is evaluated.
- **SPI data:** This column shows the raw SPI data that has been received from the sensor.

The data view only shows a history of the previous 1000 samples. Whereas all samples during one measurement are stored in a text file, as previously mention in **Chapter 4.1**. Please press the “Save” button to store the monitored samples in a user-defined text file.

Note: The file size depends on the sample rate. The maximum growth rate is around 2MByte per second. After a couple of minutes the file size can be up to 1GByte or even higher. To store such huge files may take several minutes.

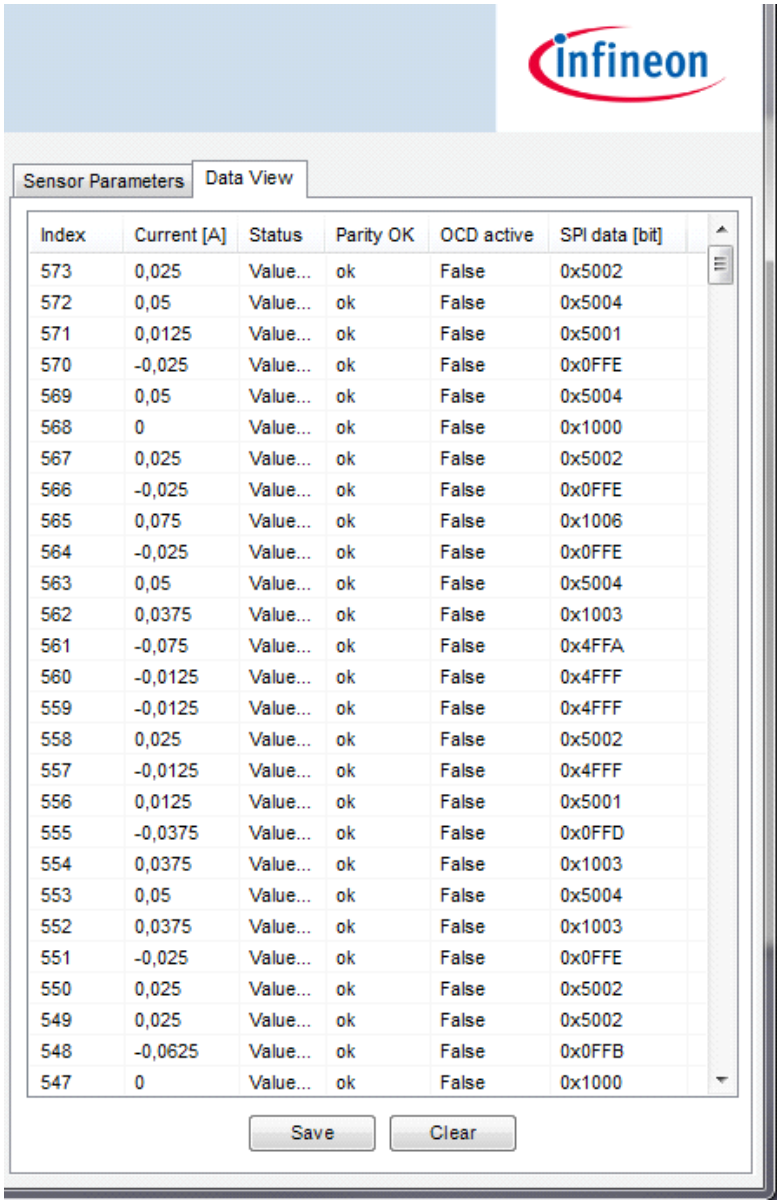

Figure 19 Data View

4.3 EEPROM Window

The EEPROM window is used to read and write the EEPROM of the TLI4970. Each line consists of 16 bits.

On the left side of the window the EEPROM addresses are displayed including their corresponding EEPROM field names. Each address or field can be selected by left click on the respective entry. Depending on which field has been selected the corresponding bit field in the center of the window is highlighted. Further, the value of the selected bit field is shown on the right side. The value is displayed in hexadecimal and in decimal. The content of each address or bit field can be changed by selection of the respective field name on the left side of the window and then by changing the value either in hex or in decimal on the right side of the window.

By pressing the buttons on the bottom of the window the following tasks can be executed:

- **Burn EEPROM:** Pressing this button will burn the displayed values into the sensor's EEPROM. The procedure is as follows: The power of the sensor is turned off and on. Then, the test mode is enabled. Finally, the new values of the EEPROM will be written. After burning the EEPROM cells of the sensor, the power is turned off and on again. Then, the content of the sensors EEPROM is compared with that values hold in the EEPROM window. If the content of the EEPROM differ an, error message will appear. Otherwise a notification that the EEPROM content has been burned successfully will pop up.
- **Read EEPROM:** This task will read the EEPROM values of the currently connected sensor and updates the table in the center of the window. Also in this task the power of the sensor is turned off and on. Then the test mode is enabled and the register values are read and displayed in the window.
- **Load:** With this task an EEPROM setting can be loaded from a XML file that has been stored before.
- **Store:** The current values of the EEPROM register can be stored as an XML file. All values of the displayed addresses are stored.
- **Close:** Pressing this button will close the EEPROM window.
- **Set in RAM:** Pressing this button will set the displayed content of the EEPROM only in the RAM. The EEPROM cells are not modified, thus, after resetting the sensor the RAM will be overridden with the EEPROM values.

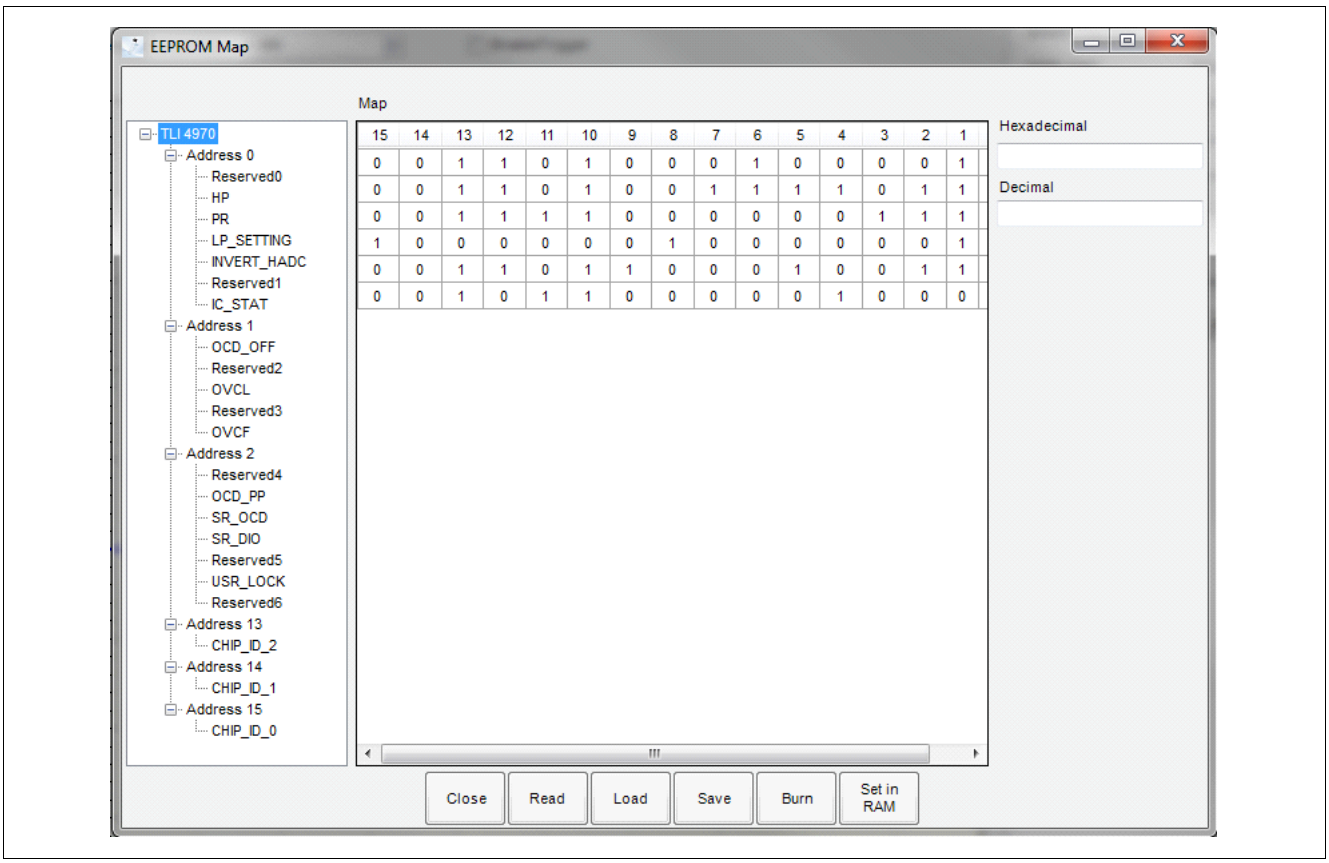

Figure 20 EEPROM Window

4.4 Menu Bar: Help

The Help entry of the Menu Bar provides information about the current version of the Programmer Kit Software modules as well as opens the manual.

4.4.1 About Window

The "About" window shows information about the version of the used libraries. The About window can be opened via menu bar "Help->About". An example of a typical "About" window is shown in **Figure 21**.

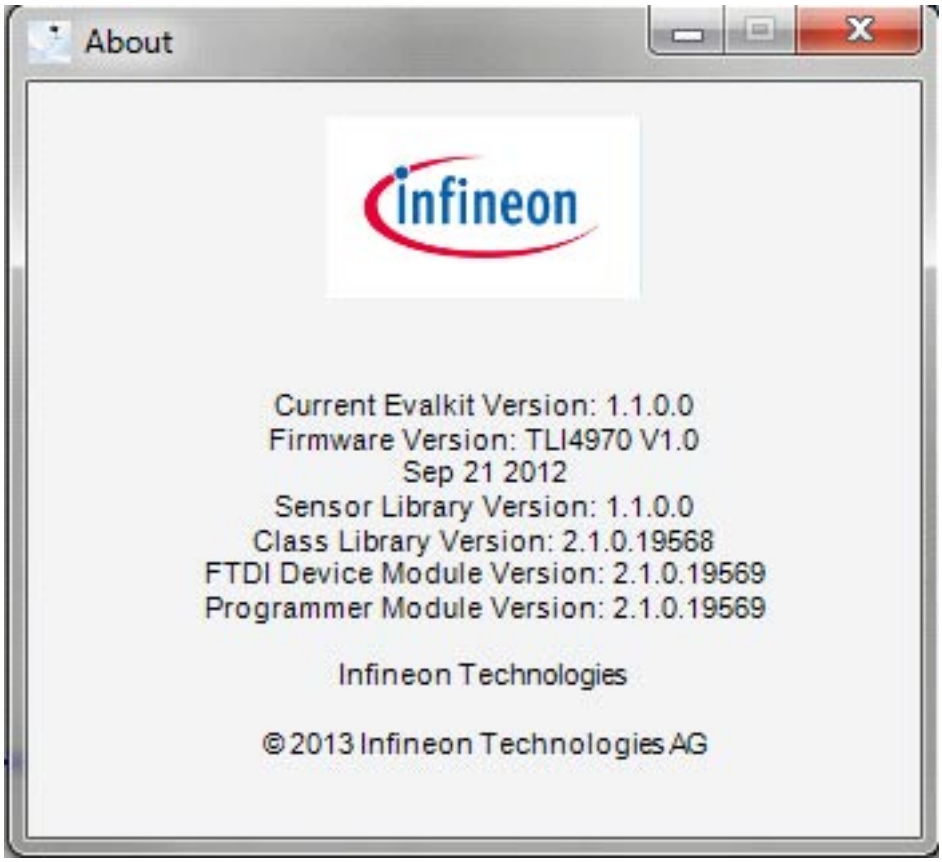

Figure 21 About Window

w w w . i n f i n e o n . c o m

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