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TLI4971 Current Sensor

The MS2Go & S2Go Kit User Manual

About this document

Scope and purpose

Infineon's magnetic current sensor MS2Go evaluation kit is a low cost 2GO kit which enables the user to quickly evaluate the TLI4971 current sensor. The TLI4971 Current 2go Evaluation kit is offered in two configurations, such as Magnetic Sensor 2Go (MS2Go) & Shield 2Go (S2Go) kits.

The following key aspects are discussed in this document.

- Sensor board description & schematic
- Sensor Shield board description & schematic
- MCU board description & schematic
- Current2Go Evalkit GUI description & installation procedure
- GUI operation with MS2Go kit in electric drive application example
- MS2Go, S2Go kit and companion board order information
- MS2Go and S2Go kit use cases
- Typical application setup using MS2Go kit
    - To modify the current sensor parameters such as operating mode, sensitivity, over-current threshold and filtering time using volatile settings, as well as monitoring sensor signals

The programmer board is CE certified and 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 must be operated in the room temperature conditions.

Due to the purpose of the system, it is not subject to the same procedures regarding Returned Material Analysis (RMA), Process Change Notification (PCN) and Product Withdraw (PWD) as regular products.

Intended audience

Current Sensor Module Developers

Inverter/Converter applications

Industrial Drive applications

Smart Relay and socket applications

Welding machine applications

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1 Introduction

The TLI4971 MS2Go and S2Go kits are budget-priced evaluation kits enabling the possibility to evaluate the Infineon TLI4971 current sensor. Infineon's magnetic current sensor available in two configurations, such as MS2Go and S2Go kit.



Figure 1 TLI4971 Current Sensor 2GO Kit

1.1 TLI4971 MS2Go configuration

The MS2Go kit contains the following components in its order package.

- Sensor board (equipped with M4 screw connectors for high current capabilities), built in thick copper technology (140um copper / dual layer) (see Figure 2).
- MCU board equipped with XMC1100 as target microcontroller and XMC4200 as debugger microcontroller. This board implements the application circuit of the sensor (see Figure 2).
- Sensor shield, in addition to the MCU board, the sensor board can be connected to the shield. This PCB only implements sensor application circuit & peripherals with connection pinout to XMC2go platform (see Figure 2). XMC2Go board mounted on the sensor shield board using the pin headers attached in the package.
- Zip lock bag with 2xM4 screws, 1 PCB edge connector (for connecting the sensor board to MCU board/ shield), and pin headers (male & female) to access data lines (see Figure 2).
- Disclaimer for safety precautions.

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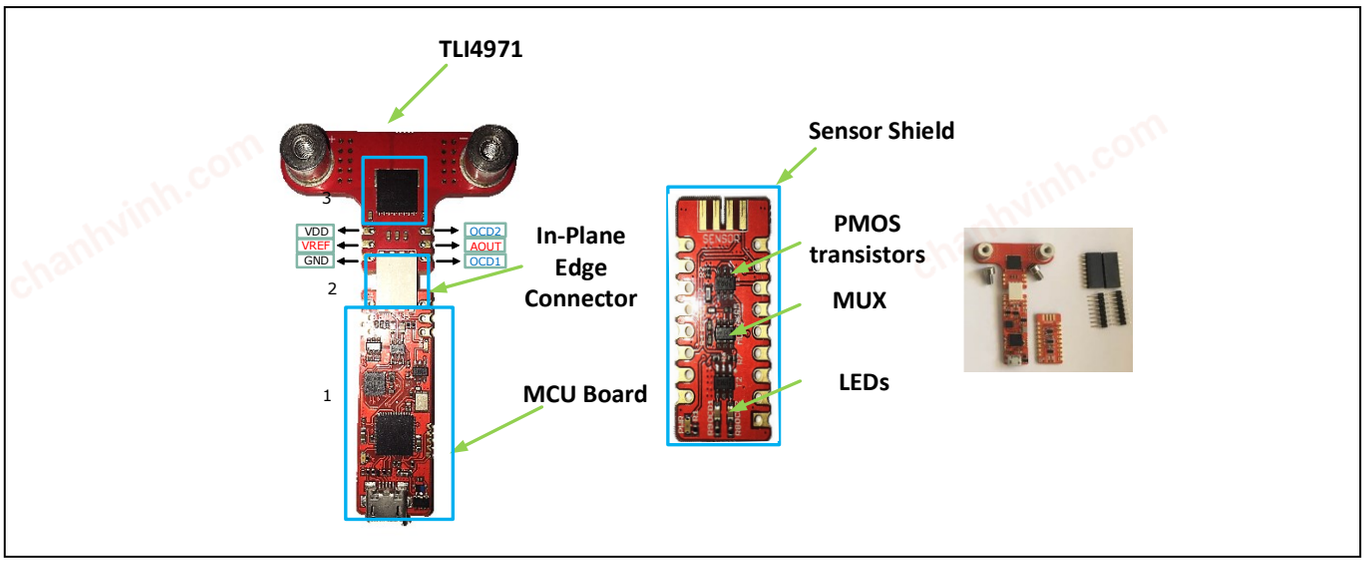


Figure 2 MS2Go kit component list

1.2 TLI4971 S2Go configuration

The S2Go kit contains the following components in its order package.

- Sensor board (equipped with M4 screw connectors for high current capabilities), built in thick copper technology (140um copper / dual layer) shown in Figure 3.
- Sensor shield, in addition to the MCU board, the sensor board can be connected to the shield. This PCB only implements sensor application circuit & peripherals + connection pinout to XMC2go platform shown in Figure 3.
- Zip lock bag with 2xM4 screws, 1 PCB edge connector (for connecting the sensor board to MCU board/ shield), pin headers to access data lines (male & female) shown in Figure 3.
- Disclaimer for safety precautions.

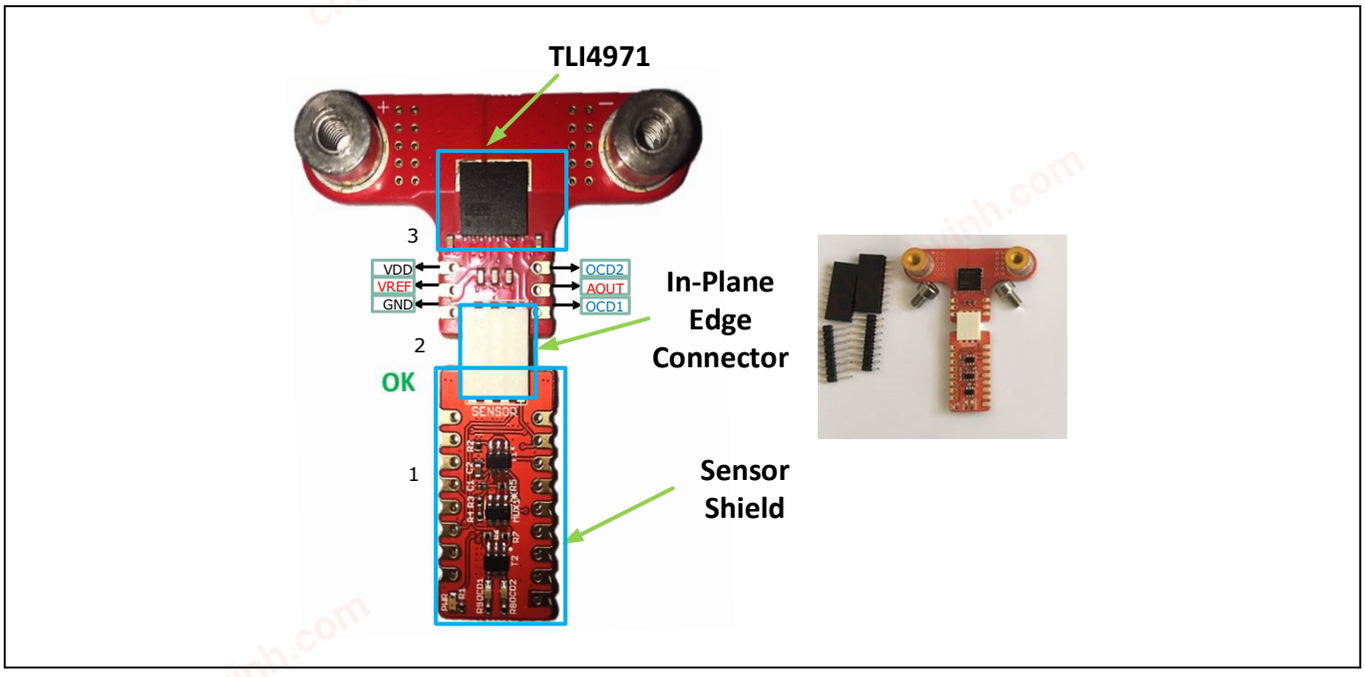


Figure 3 S2Go kit component list

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The MS2Go Kit includes a GUI software that can be downloaded from the Infineon website. Table 1 shows the S2Go & MS2GO kit order information.

Table 1 Order Information

Type / Name	SP – Number
S2GO_CUR-SENSE_TLI4971	SP005345472
TLI4971_MS2GO	SP005345474

The following chapters describe the different parts of the MS2Go kit, hardware connection, software installation and clarifies how to use the graphical user interface (GUI) to do the first evaluations of the sensor in a particular application. The MS2Go kit design meets the required clearance and creepage distances for high voltage applications according to the TLI4971 specification. The sensor on the sensor board provides a galvanic isolation. Please consider the safety precautions for high voltage applications as described in the enclosed disclaimer document along with the delivered sensor kit. The communication between the current sensor and XMC2GO board is provided through a connector called in-plane edge connector which has shown in the Figure 9.

1.3 TLI4971 Current 2Go Evaluation Kit Use Cases

The current 2Go kit can be used for different use cases as shown in the below.

- MS2Go kit use case with MCU Board (See Figure 4)
- S2Go kit use case with XMC2GO Board (See Figure 5)
- Sensor board alone (See Figure 6)

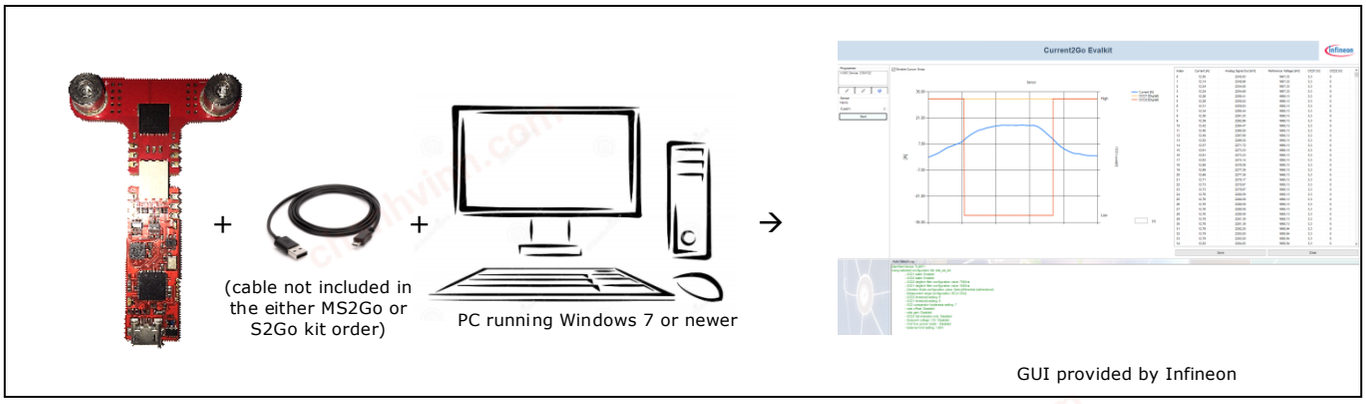


Figure 4 MS2Go kit Use Case with MCU Board

The MS2Go kit can be used as independent evaluation kit by connecting sensor board with MCU board together as shown in the Figure 4. The user has to connect the XMC2GO board with the PC/Laptop using the USB cable, which must have micro USB on one side and standard USB port on the other side of the cable. The provided GUI is plug & play.

The MS2Go kit used with Arduino shield by plugging the sensor board together with the shield board. It is mandatory to have an XMC2go platform, which is not provided in the package. Programming can be done in Arduino IDE by selecting the XMC2go platform.

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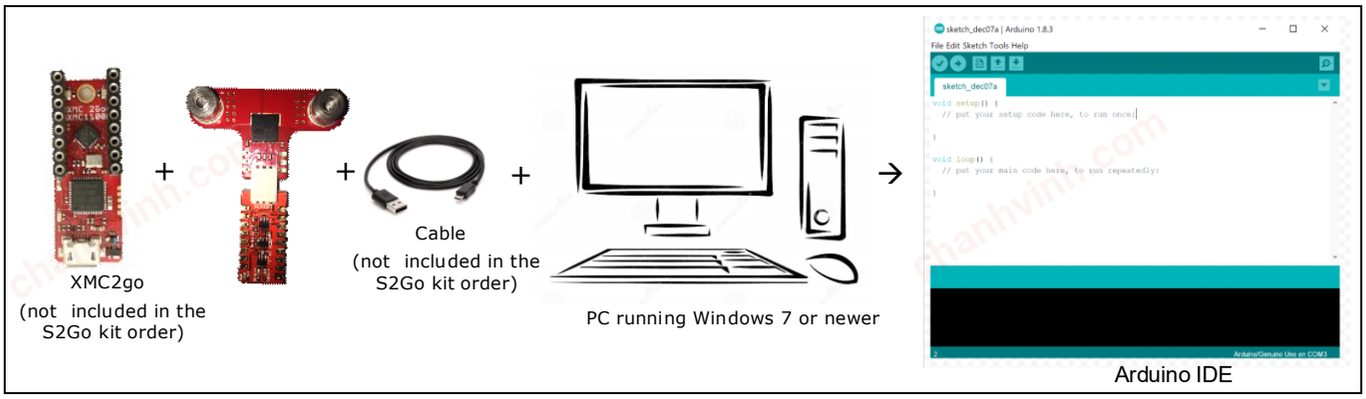


Figure 5 S2Go kit Use Case with XMC2GO Board

The sensor board can also be used as standalone in any customer application (eg. Interfaced with custom MCU platforms, and lab equipment etc…). In Figure 6, M4 screws are used to connect the primary current source and VDD pin to 3.3V.

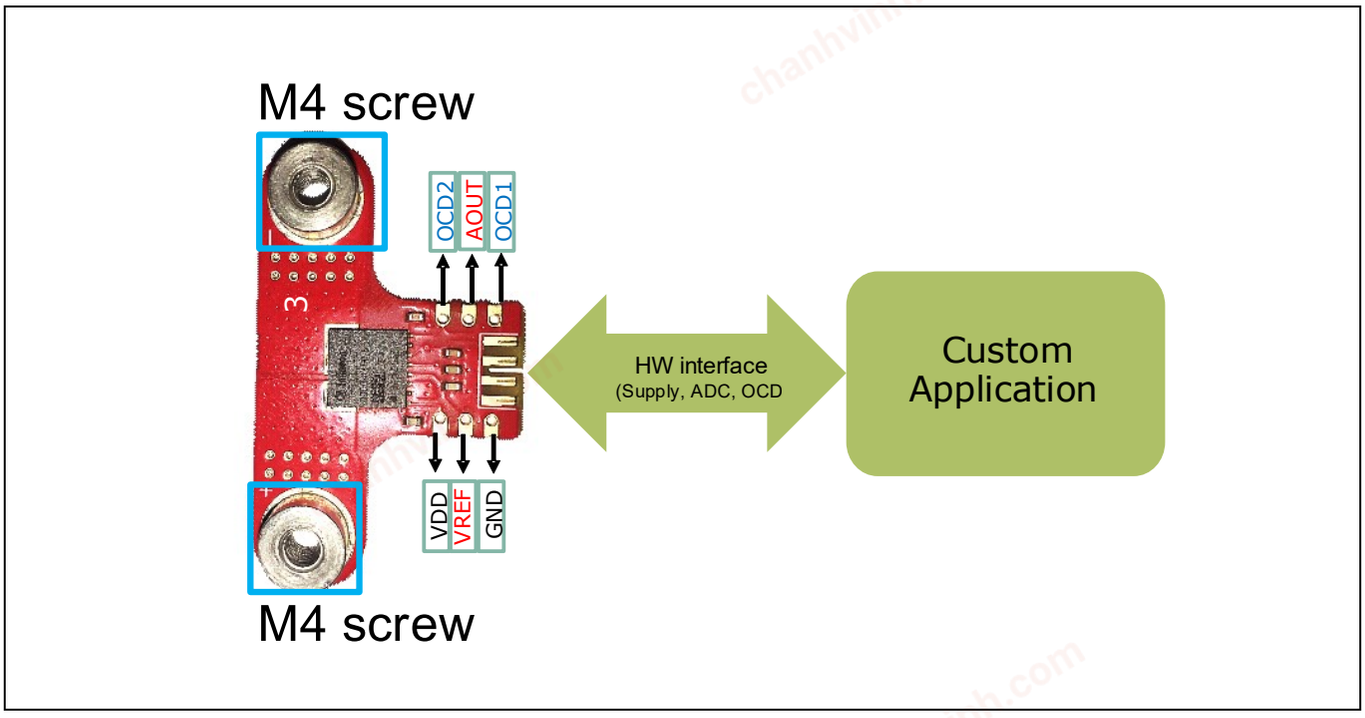


Figure 6 MS2Go or S2GO kit Use Case with Custom Platform

1.4 MS2Go & S2Go Kits Features

The Following section describes the main features of the MS2Go evaluation kit.

- USB Interface
- Supply via USB cable
- Oscilloscope functionality
  - Real-time roll-mode
- Support for all TLI4971 different output modes
- RAM programming support, after powering down the sensor, the programming is lost.
- Automatic detection of a sensor board

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1.5 MS2Go & S2Go Kits Hardware and Software Overview

1.5.1 Hardware Overview

The MS2Go and S2Go kit contains the following items:

- The XMC2GO board contains (Neither MS2Go nor S2Go contains this board, needs to order separately)
  - XMC1100 Infineon target micro-controller
  - XMC4200 on-board debugger microcontroller running a SEGGER Jlink debugger
- In-plane edge interface connector
- Sensor shield board
- MCU Board (Not included in the S2Go kit order)
- Isolator board (Not included in the either MS2Go or S2Go kit order): This board might be required if the customer required reinforced HV application s.
- Sensor board
- USB Cable (Not included in the either MS2Go or S2Go kit order)
- Disclaimer and Safety precautions document

1.5.2 Software Overview

Please download the required software from Infineon website. For further information about the software installation please refer to the Section 1.5.3.

The software package contains:

- A Graphical User Interface (GUI) software for the sensor evaluation.
- SEGGER Jlink debugger software with USB driver.

This software was designed to be used with Windows 7 and Windows 10. It is compatible with both 32-bit and 64-bit systems. Other versions may also work, but have not been tested. The MS2Go & S2Go kit will work with GUI version 1.0.0 and onwards.

1.5.3 Software Installation

The following description guides through the installation procedure of the free evaluation software for the MS2Go & S2Go kit through the following steps:

- Before proceeding further, please get the Admin Rights to proceed with the installation
- Download the required software from the Infineon website.
- Connect the MS2Go kit via the USB link to your PC (see Figure 11).
- Extract the GUI software from *Current2GoEvalkitX.X.X.zip* file to local folder
- To start the installation double click on the "**Current2GoEvalkitX.X.X.exe**" [see folder .../ Current2GoEvalkit**X.X.X**.zip] and proceed as discussed in the Appendix.
- After the successful completion of the installation, to start the GUI software, go to **Windows Start** button and select the "Current2GO".

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2 MS2Go and S2Go Kits Description

The MS2Go and S2Go kit contains the following main components as discussed in the section 1.1 & 1.2, which are the ready-to-use printed circuit boards (PCBs).

- Sensor board
- Sensor Shield board
- MCU Board
- In-plane edge connector

Note: The MS2Go & S2Go kit automatically detects the different types of Infineon Current Sensor EVAL boards connected to the programmer

2.1 Sensor Shield Pin Description

The sensor shield pins can be used to extend the evaluation board or perform measurements on the TLI4971. Figure 7 shows the sensor shield pin description in the board. The pinning table is also printed onto the bottom side of the PCB. The pin header can be used to access directly the magnetic current sensor pins which are described in Table 2.

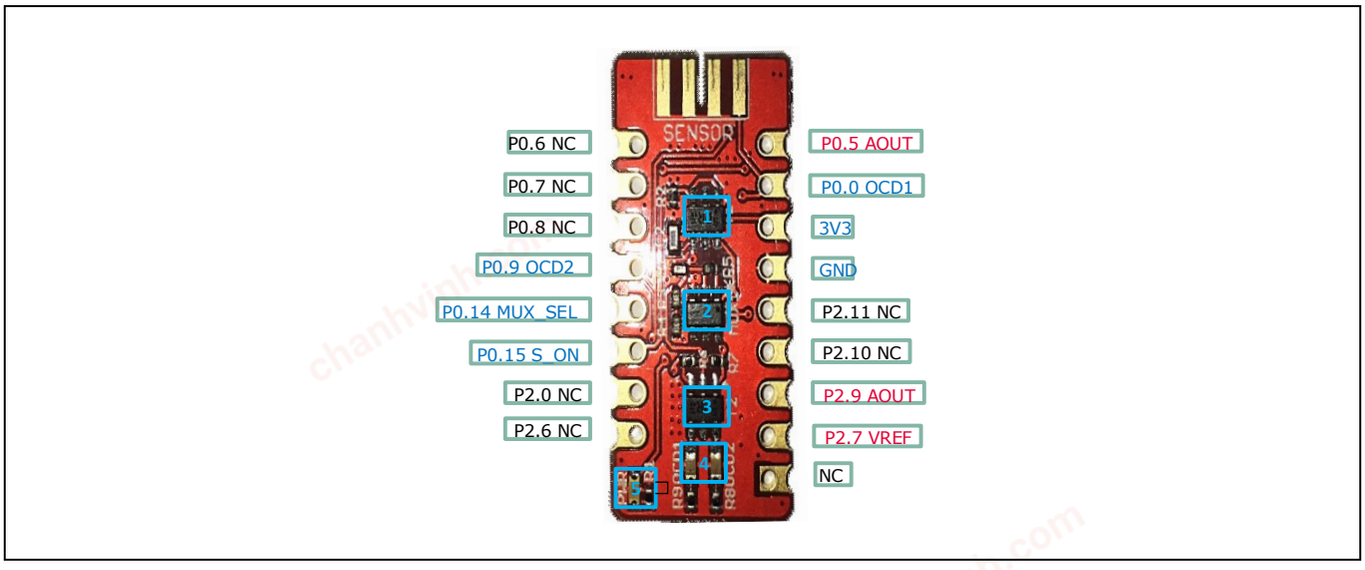


Figure 7 Sensor Shield pin description

The sensor shield will connect the sensor board to the XMC 2Go microcontroller board or any other compatible platform. The shield contains:

- Two BSL308PE dual package PMOS transistors (1,3) used for:
  - Switching ON/OFF the sensor supply,
  - Switching ON/OFF the sensor supply LED (LED1) (5)
  - Switching ON/OFF the overcurrent indicator LEDs (4).
- MAX4624EUT / STG719STR Analog MUX (2) is used to select an external or internal sensor voltage reference.

The magnetic current sensor pins description and the corresponding sensor shield pins are shown in Table 2. The sensor shield board schematic has shown in the Figure 33 in section 5.

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Table 2 Sensor Shield Pins Description

TLI4971 pin number	Pin name on board	Header (J6) Pin	Sensor pin description
1	VSENS	--	Supply Voltage (VDD) pin of TLI4971
2	GND	--	Ground pin of TLI4971
3	VREF	P2.7	Reference Voltage pin of TLI4971
4	AOUT	P0.5	Analog Output Voltage pin of TLI4971
5	OCD1	P0.0	Over Current Detection (OCD1) pin of TLI4971
6	OCD2	P0.9	Over Current Detection (OCD2) pin of TLI4971
NA	MUX_SEL	P0.14	To select an external or internal sensor voltage reference.
NA	S_ON	P0.15	

2.2 MCU Board

The micro controller unit (MCU) board can be connected directly to sensor board in order to obtain a plug & play evaluation system. The MCU board contains:

- One XMC4200 microcontroller running a SEGGER Jlink license for debugging (see ‘1’ in Figure 8)
- One XMC1100 microcontroller used as target MCU (see ‘2’ in Figure 8)
- MAX4624EUT / STG719STR Analog MUX (see ‘3’ in Figure 8) is used to select an external or internal sensor voltage reference.

Also, it contains two BSL308PE dual package PMOS transistors (see ‘4, 5’ in Figure 8) used for:

- Switching ON/OFF the sensor supply
- Switching ON/OFF the sensor supply LED (see ‘7’ in Figure 8)
- Switching ON/OFF the overcurrent indicator LEDs (see ‘8’ in Figure 8).

The microcontroller 12 bit ADC sensor reads the analog output / reference signal. This board is connected with an in-plane edge connector to the sensor board. The MCU board schematic has shown in the Figure 33Figure 35 in section 5.

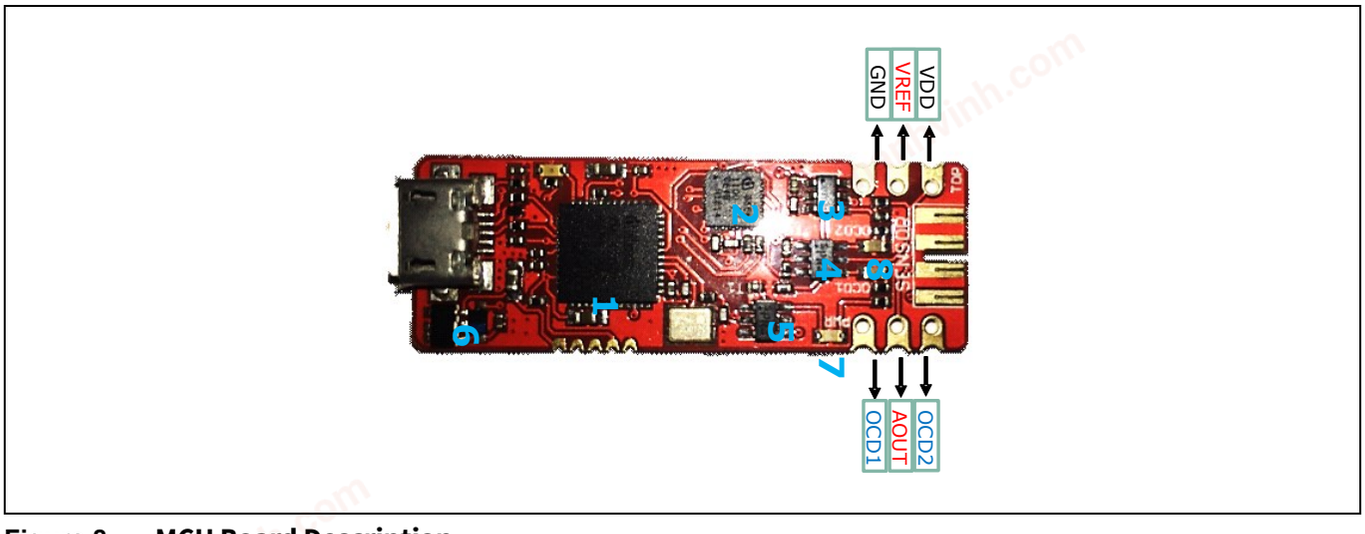


Figure 8 MCU Board Description

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2.3 In-Plane Edge Connector

The in-plane edge Connector is used to establish the connection between the sensor shield board and the sensor board. The below figure shows the in-plane edge connector correct and incorrect setup with the sensor shield and sensor boards. Always connect the two PCBs with all components facing the same side as shown in the Figure 9.

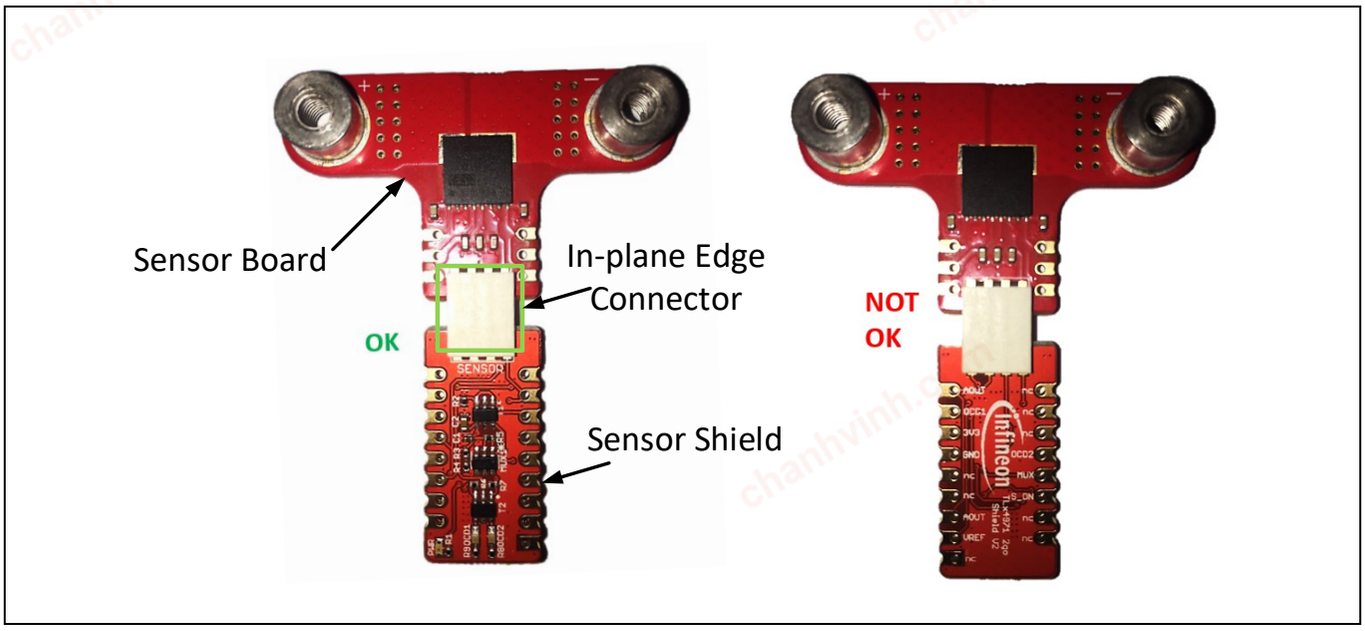


Figure 9 In-Plane Edge Connector Setup with Sensor Shield

2.4 Sensor Board

The current sensor (see '3' in the Figure 10) is placed on a board with two M4 screw connectors (see '2 & 4' in the Figure 10) for high current (≤20A) applications. The PCB is manufactured in 140 um copper technology and the sensor provides functional galvanic isolation. The sensor inputs/outputs are easily accessible via 2 x 3 pole pin headers with 2.54mm pitch (see '1' in the Figure 10). The sensor board schematic has shown in the Figure 34 in section 5.

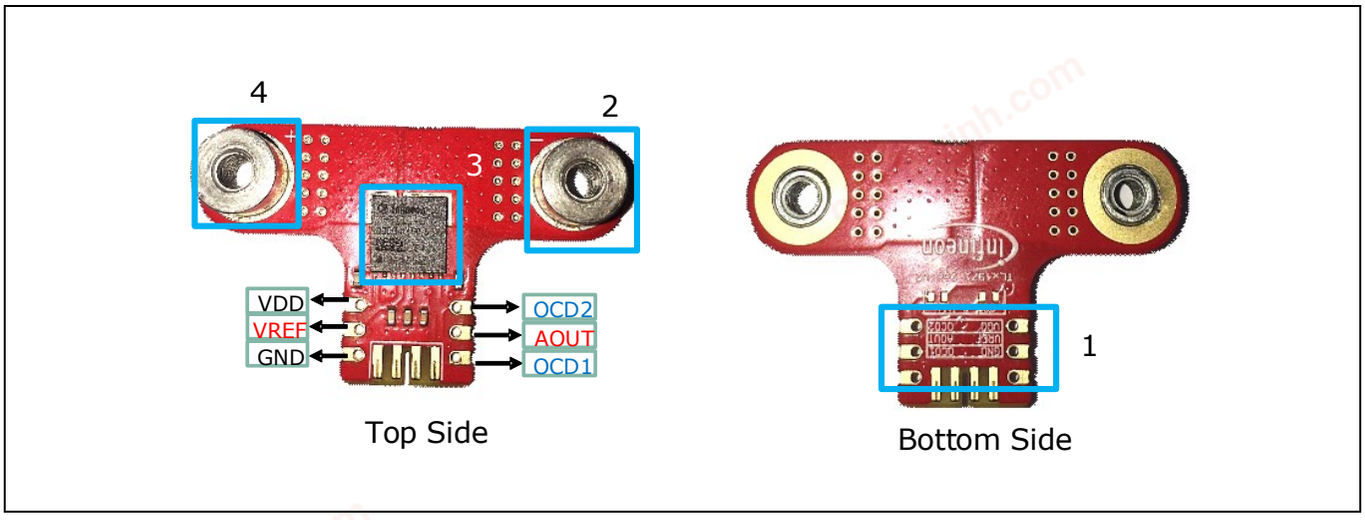


Figure 10 Sensor Board Top and Bottom View

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3 Current Sensor Evaluation Setup

Figure 11 shows an example measurement setup on how to connect the MS2Go & S2Go kit via USB connector to a PC or laptop in a single phase inverter for motor drive application. The user can vary the sensor parameters for external field and sensitivity compensation using programmer board and GUI software.

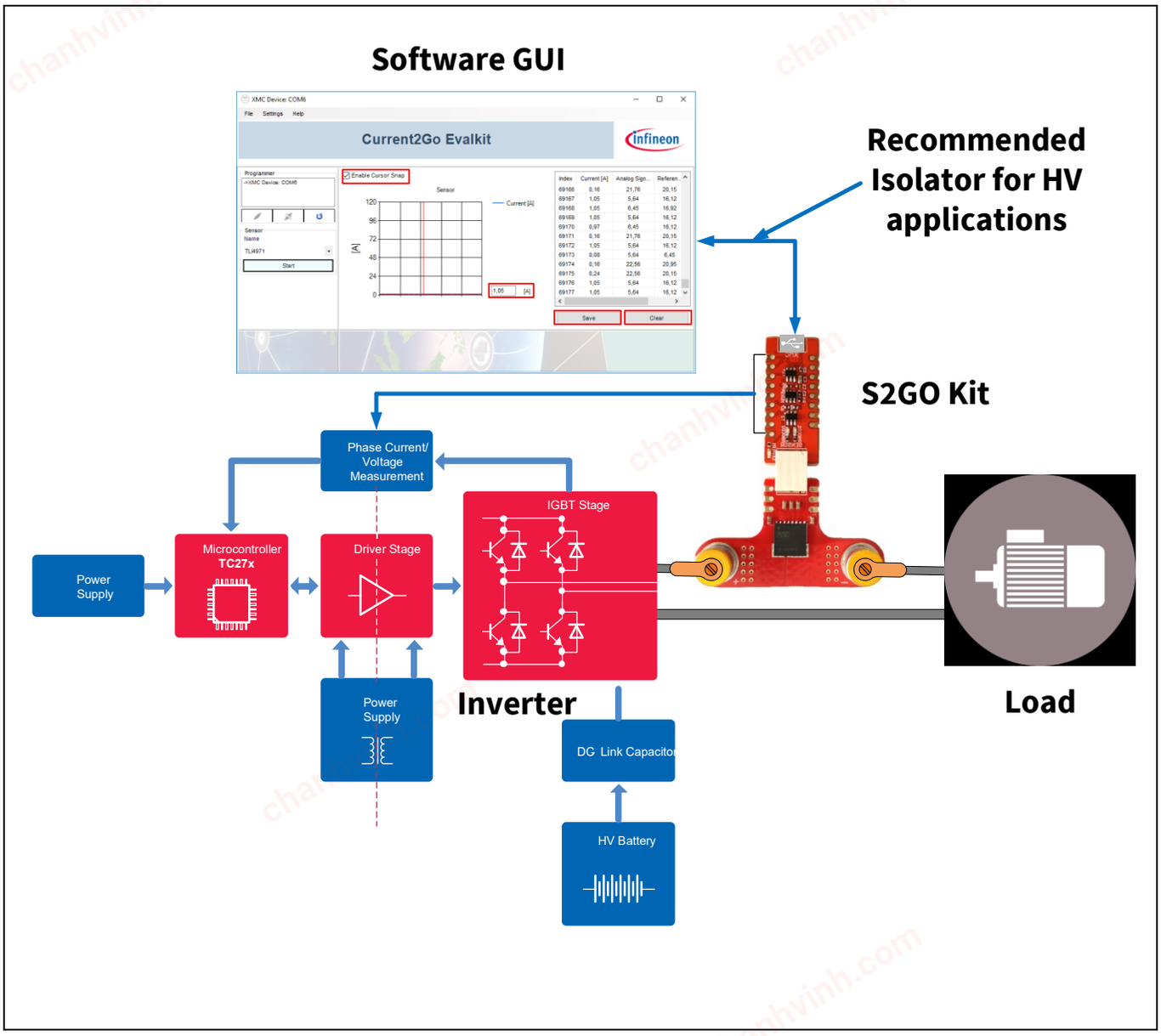


Figure 11 Test Setup Example with MS2Go Kit

3.1 Graph View

The GUI for MS2Go kit allows the user to interface and communicate with the connected current sensor. Once the test set up is done as shown in Figure 11, the user has to open the GUI software and it will start communicating with the hardware. If the connection is successful then the XMC Device: COM6 window which has shown in the below will display on the monitor.

- If the MS2Go kit is connected to a PC through the USB cable and the connection is successful, then a window called “Current2GO EvalKit” will pop up as shown in Figure 12.

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Figure 12 Log and Evalkit Software Window

- Select the "**XMC Device: COM6**" option in the "Programmer" dialogue box as shown in the below Figure 13 which is highlighted with red color box.

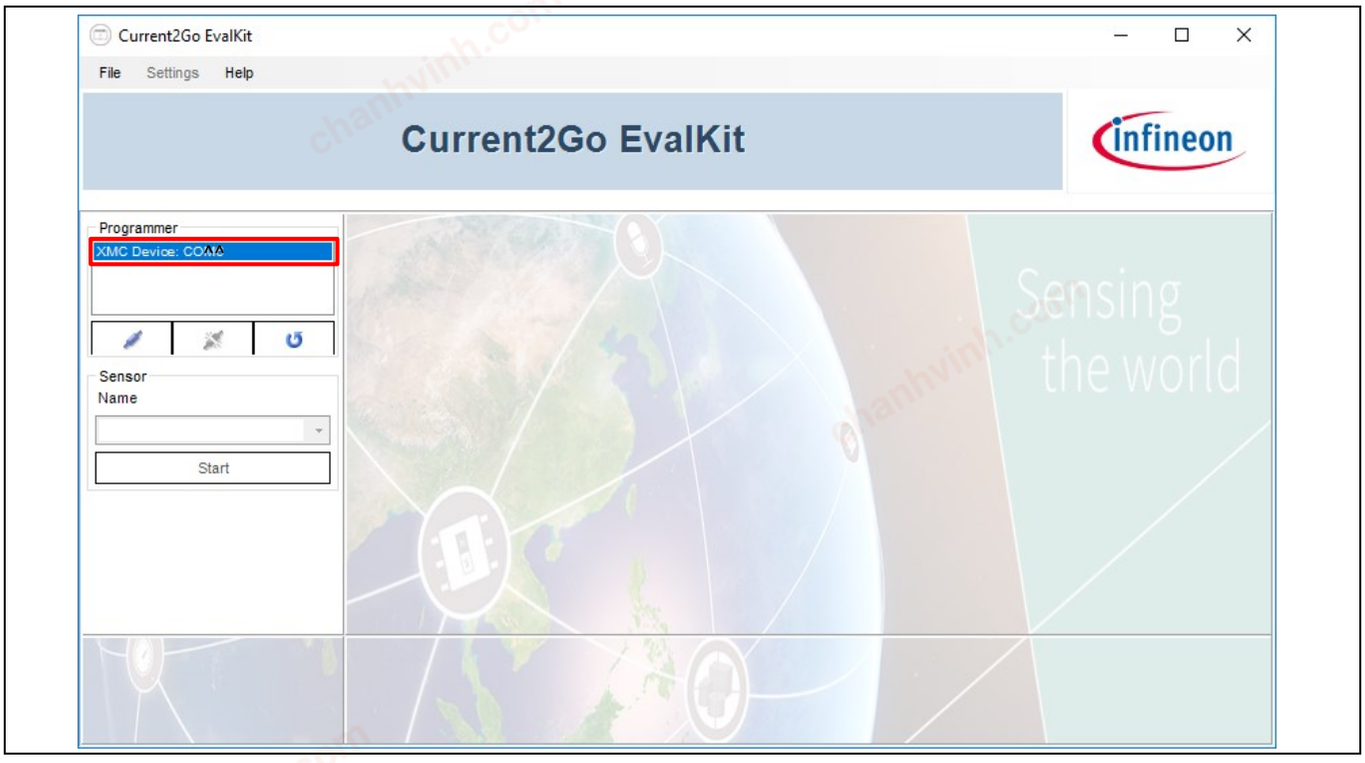


Figure 13 XMC Device Selection

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- Click with the left mouse button on the symbol that is marked with a red color box in Figure 14 to establish the connection with the MS2Go kit.

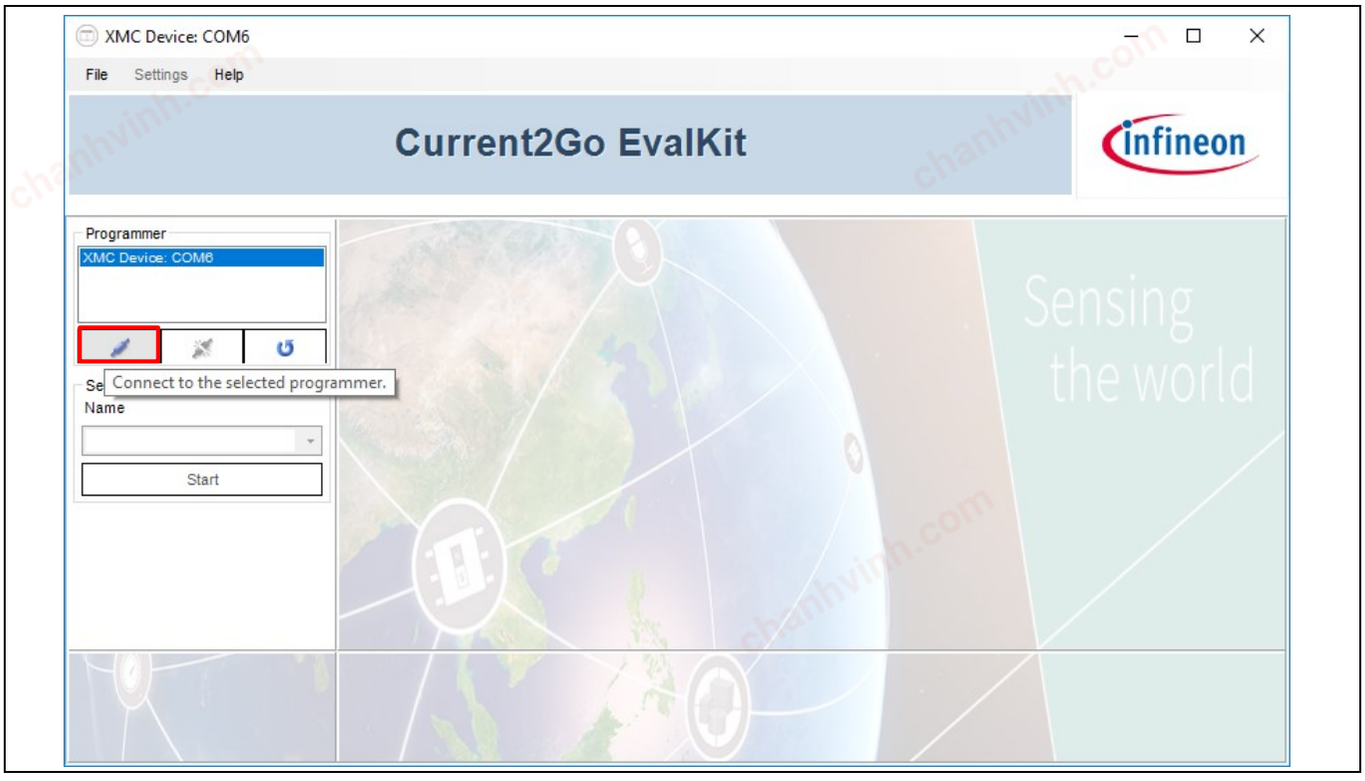


Figure 14 XMC Device: COM6 window: Establish Connection

- Then click on the button which is highlighted in red color box of Figure 15 to select the sensor from the selection menu and then click on the sensor name (For ex: TLI4971) which is highlighted in orange color box.

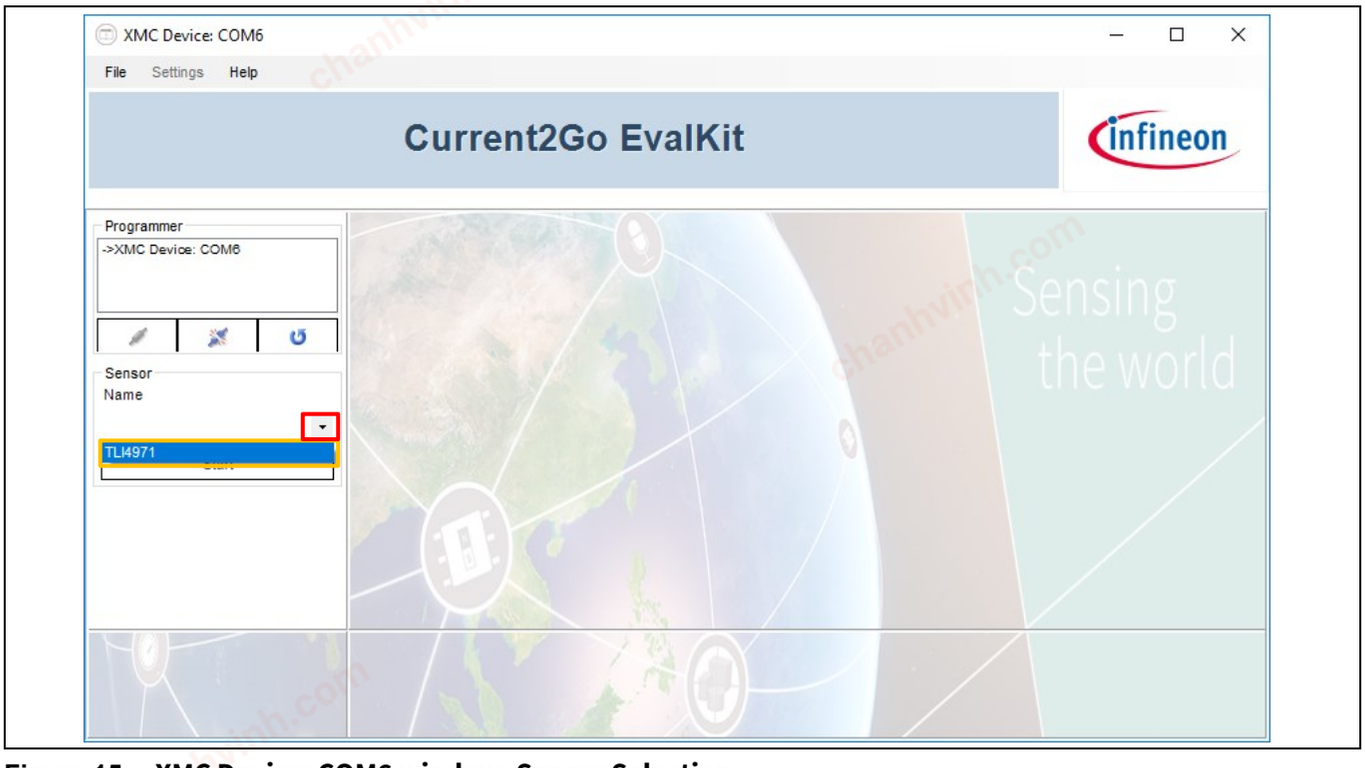


Figure 15 XMC Device: COM6 window: Sensor Selection

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- After that the following window will pop up if the software is successfully installed (see Figure 16). Then click on the “Start” button, which is highlighted in red color box, to perform the measurements on the connected sensor.

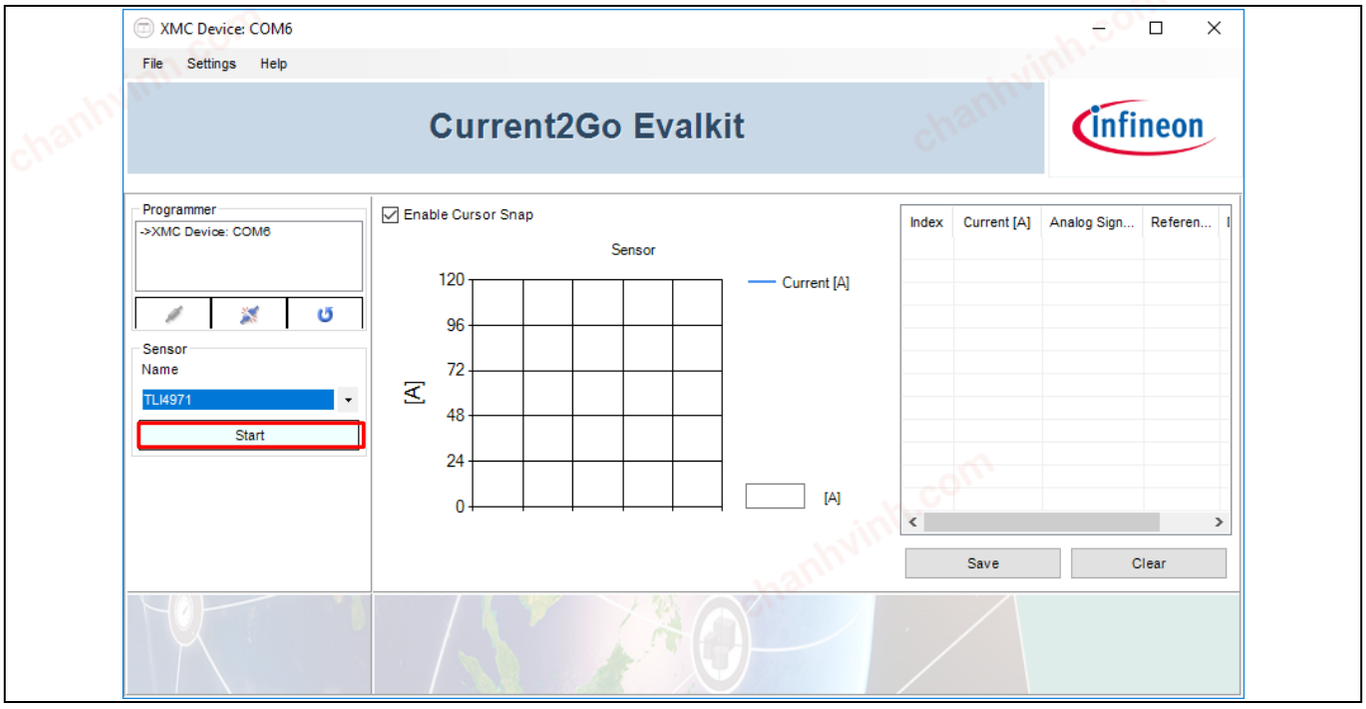


Figure 16 XMC Device: COM6 window: successful connection with Sensor

- When the user click on the *“Start”* button then the GUI starts real time graph for plotting the current value(in ampere scale) and OCD line status in the middle pane of the Current2Go Evalkit window, and displays offline acquired values (current computation, AOUT/VREF voltage, OCD states) , as shown in the below Figure 17.

  Also, either it is possible to save or clear the data by using the “**Save**” or “**Clear**” buttons respectively that are highlighted in red color boxes which are on the bottom right side of the XMC Device: COM6 window.

  The user can click on at any point on the plot window and the respective cursor data will be shown in the small box that is highlighted in red color box which has shown in the bottom right corner of the plot window

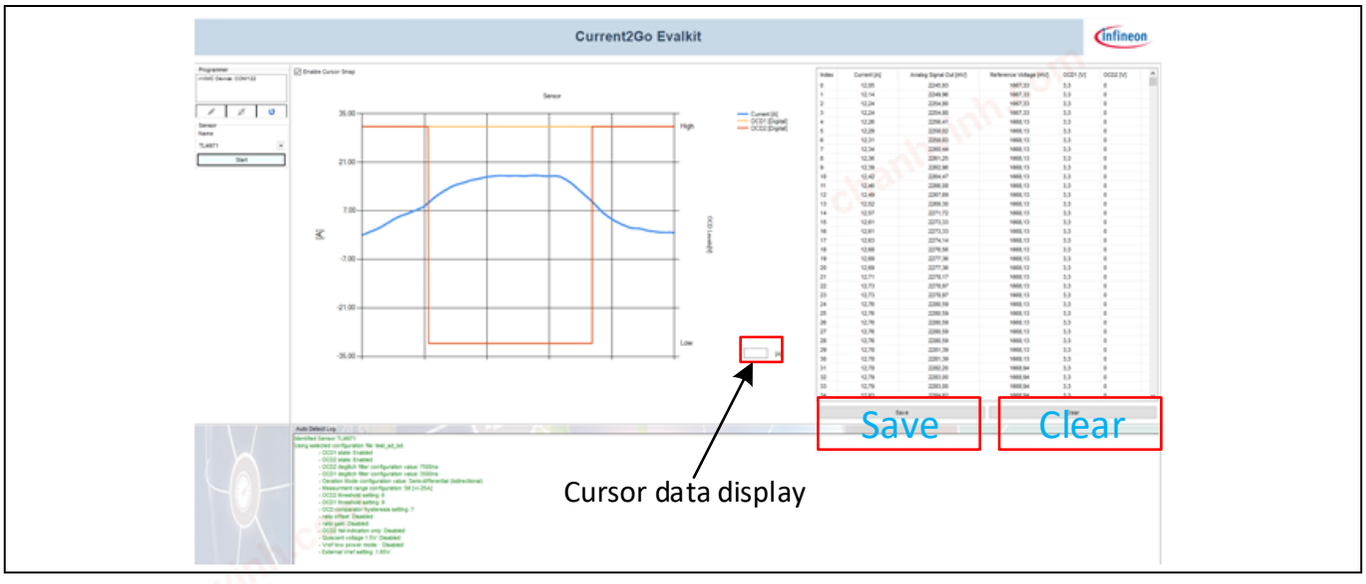


Figure 17 XMC Device: COM6 window: Save and Clear options

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- Finally, click with the left mouse button on the symbol that is marked with a red color box in Figure 18 to disconnect the MS2Go kit from the PC.

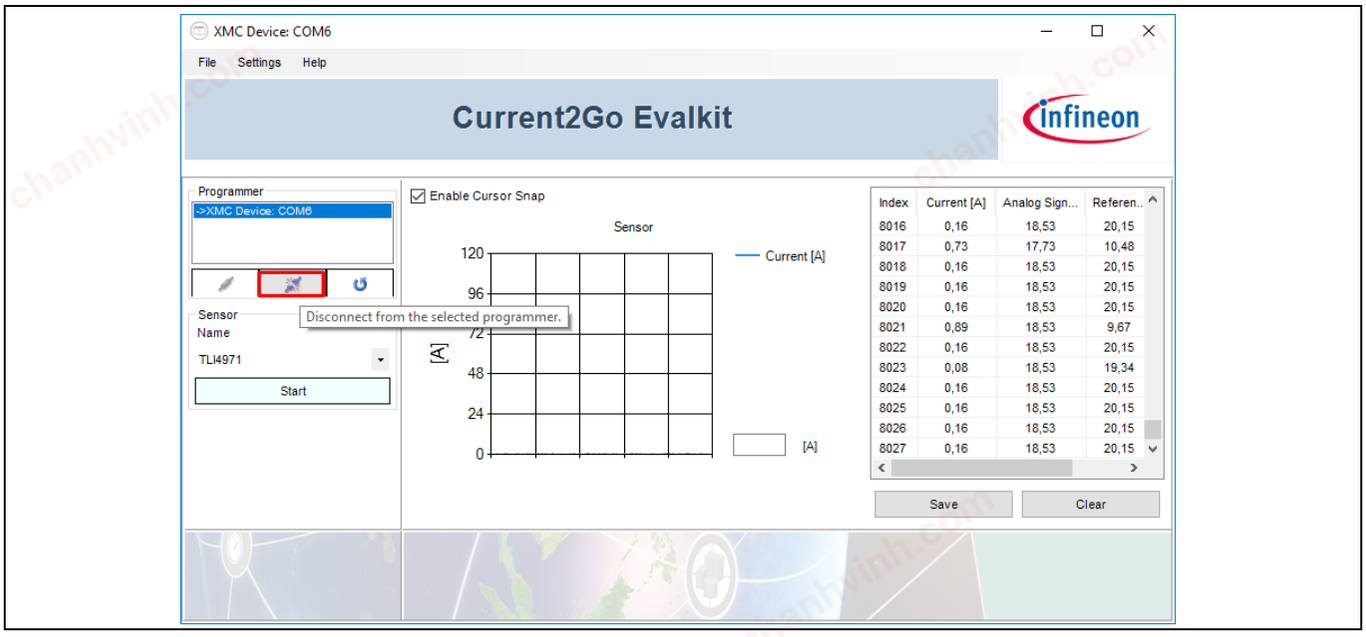


Figure 18 XMC Device: COM6 window: Disconnection Button

When the data acquisition is stopped, the user can zoom on the chart using the mouse scroll. At the bottom right corner of the *XMC Device: COM6* window, the user has the option to save the acquired data by clicking the “Save” button in the sensor panel. A save menu will pop-up: enter the path & file name as .CSV and save your data. The .CSV file may be open in Microsoft Excel and post processing of data can be done.

The left pane of the XMC Device: COM6 window displays buttons and selection boxes to connect or dis-connect the MS2Go kit as well as a refresh button.

3.1.1 File (Drop down Menu)

The following menu items are available in the “File” Drop down Menu.

3.1.1.1 Quit

To Close the Current Toolbox Window

3.1.2 Settings (Drop down Menu)

When the user left clicks on "*Settings (Drop down Menu)*" in " XMC Device: COM6 window", then it shows the following menu item (see Figure 21).

1. Volatile Settings menu item is used to modify the sensor parameters
2. EEPROM Map menu item is used to display the sensor parameters

3.1.2.1 Volatile Settings

When the user selects the ‘VolatileSettings’ menu item, the window shown in Figure 19 will open, here, initially the user will find the existing configuration file which is “EEPROMContent_default.xml”. This file is automatically generated by the Software (SW) based on the preprogrammed EEPROM settings in the sensor. This main window components are described as follows.

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- "Configuration Files" pane list (see '1' in Figure 19) all configuration files are automatically stored under Users/<CurrentUser>/AppData/Local/InfineonCurrent2GoTemp\ConfigFiles. All XML files at this location will be parsed by the SW and checked if it is a valid sensor configuration.
- "Configuration Explorer" pane (see '2' in Figure 19) displays the parameters stored by the configuration file (name, description, sensor parameters).
- "Delete Config File" (see '3' in Figure 19), by pressing this button, the configuration file will be physically deleted from the disk and from the list.
- "Create New Config File" (see '4' in Figure 19), by pressing this button, a new window will pop-up allowing the user to create a new configuration file which has shown in Figure 20.
- "Set as Default Config file" (see '5' in Figure 19), by pressing this button a new configuration file – as copy of the selected one, named "default_config.xml". If this configuration is found at startup, it will be automatically loaded into the sensor RAM.
- "Use Config File" (see '6' in Figure 19), by pressing this button, the configuration parameters will be set into the RAM of the sensor.

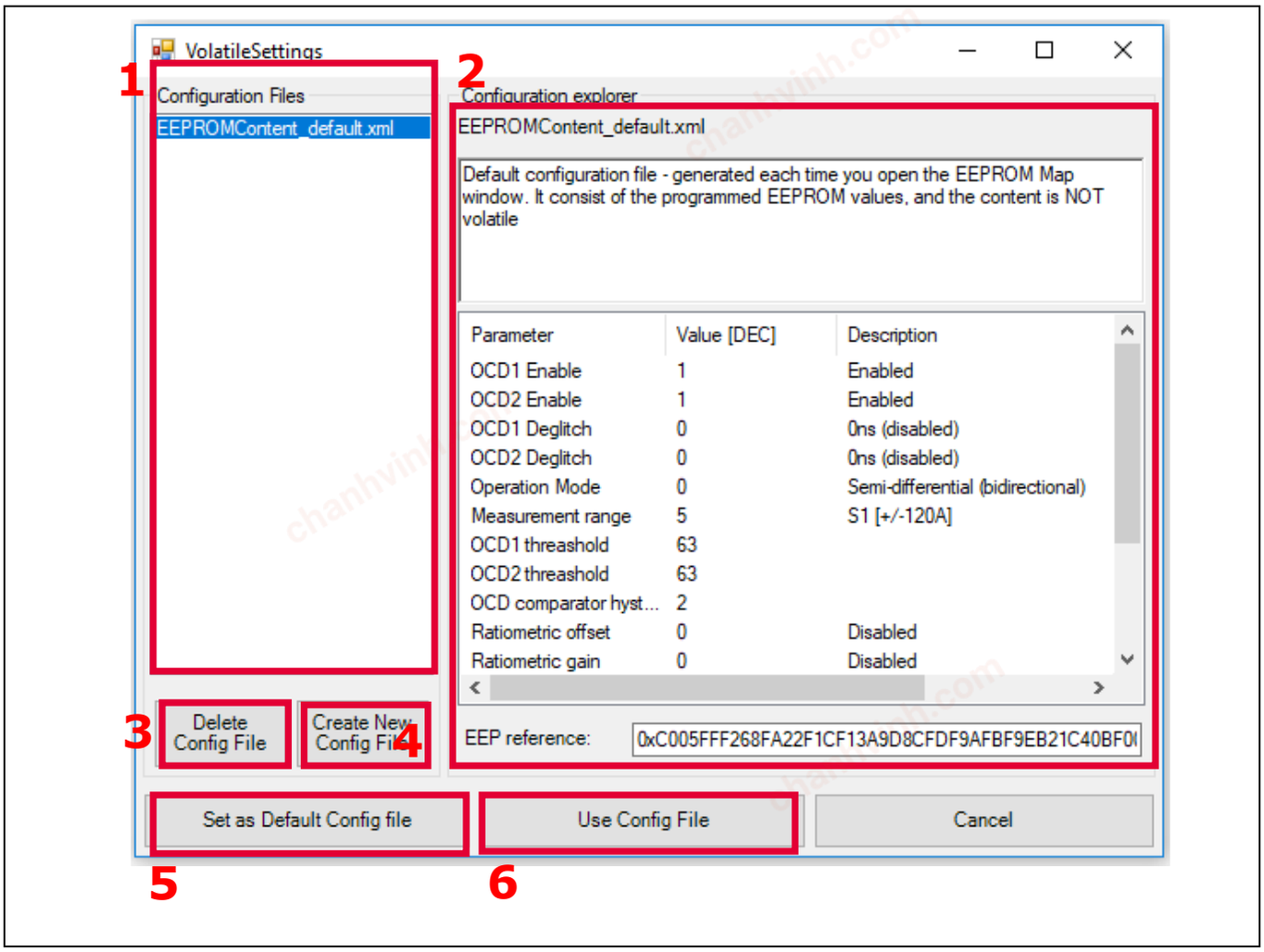


Figure 19 Volatile Settings Window

The following Figure 20 shows the new configuration file creation flow to modify the existing current sensor parmeters, where all text fields (name / description) shall have a value in the below shown figure. All selection boxes such as deglitch, Operation mode, measure range, threshold, VREF value shall have a selection. Finally,

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press “Create Configuration” button to save the parameters into a XML configuration file. This configuration is now accessible in the “Volatile Settings” window.

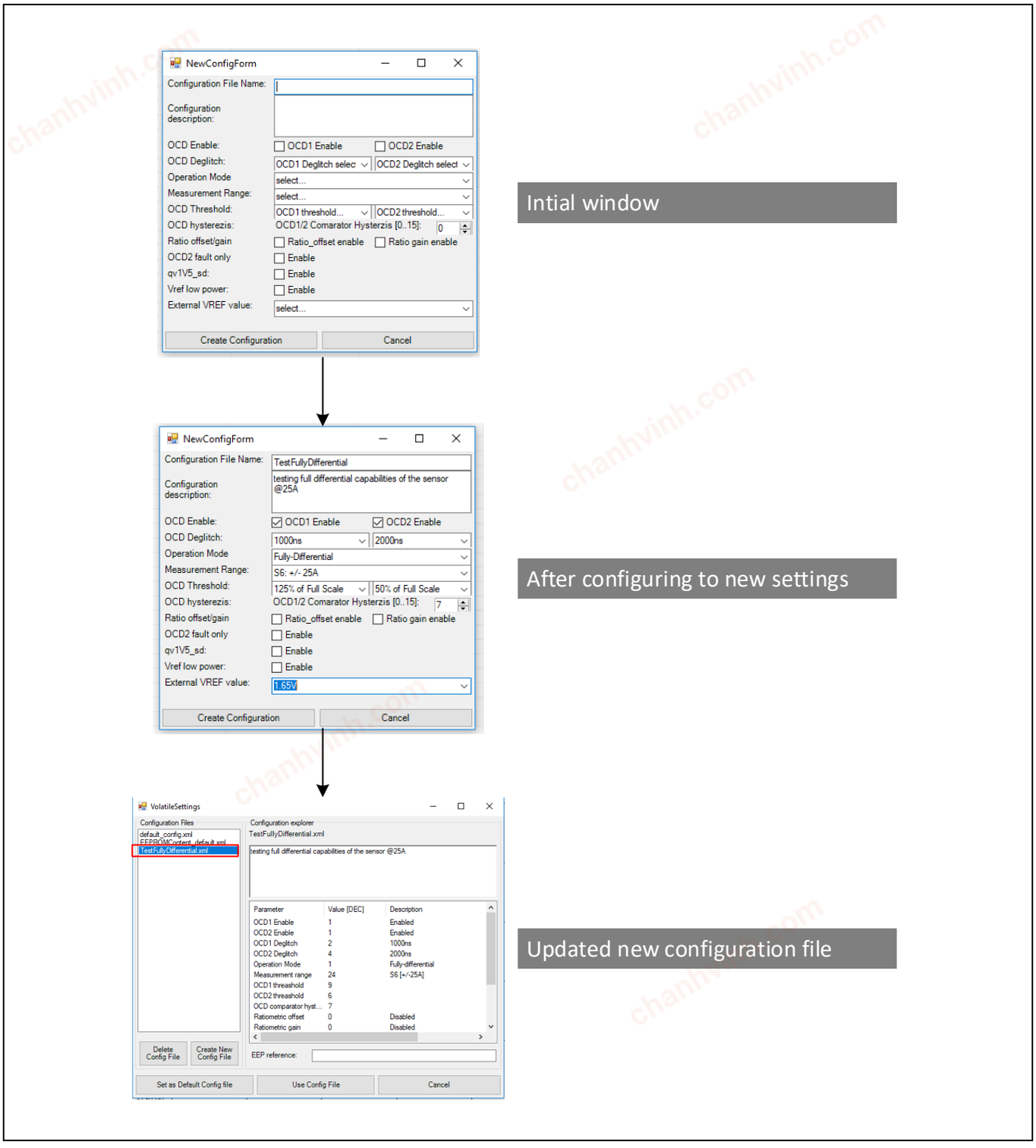


Figure 20 New Configuration File Creation

After creating the new configuration file, user can select it as ‘*Use Config File*’, which means it is stored in the RAM and deleted once the GUI is closed, or ‘*Set as Default Config file*’, which means it acts as stored in the EEPROM and retains the new configuration data even the GUI is closed. The newly created file called default_config.xml is displayed in the ‘*Configuration Files*’ pane of the ‘*VolatileSettings’* window as shown in the above figure.

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3.1.2.2 EEPROM Map

In EEPROM mapping each address contains 16 bits and group of bits are assigned to different variables as shown in Figure 21. The EEPROM Memory map pane is highlighting the programmed EEPROM content bit by bit, field by field or line by line. No modifications are allowed in this window as the volatile settings shall be used to modify these parameters listed in the EEPROM Map. For further details please refer to the application note AN_TLI4971_ProgrGuide.

For further information about *Address 0 …. Address 17,* which are shown in the EEPROM Mapping Window, please refer to application note AN_TLI4971_ProgGuide.

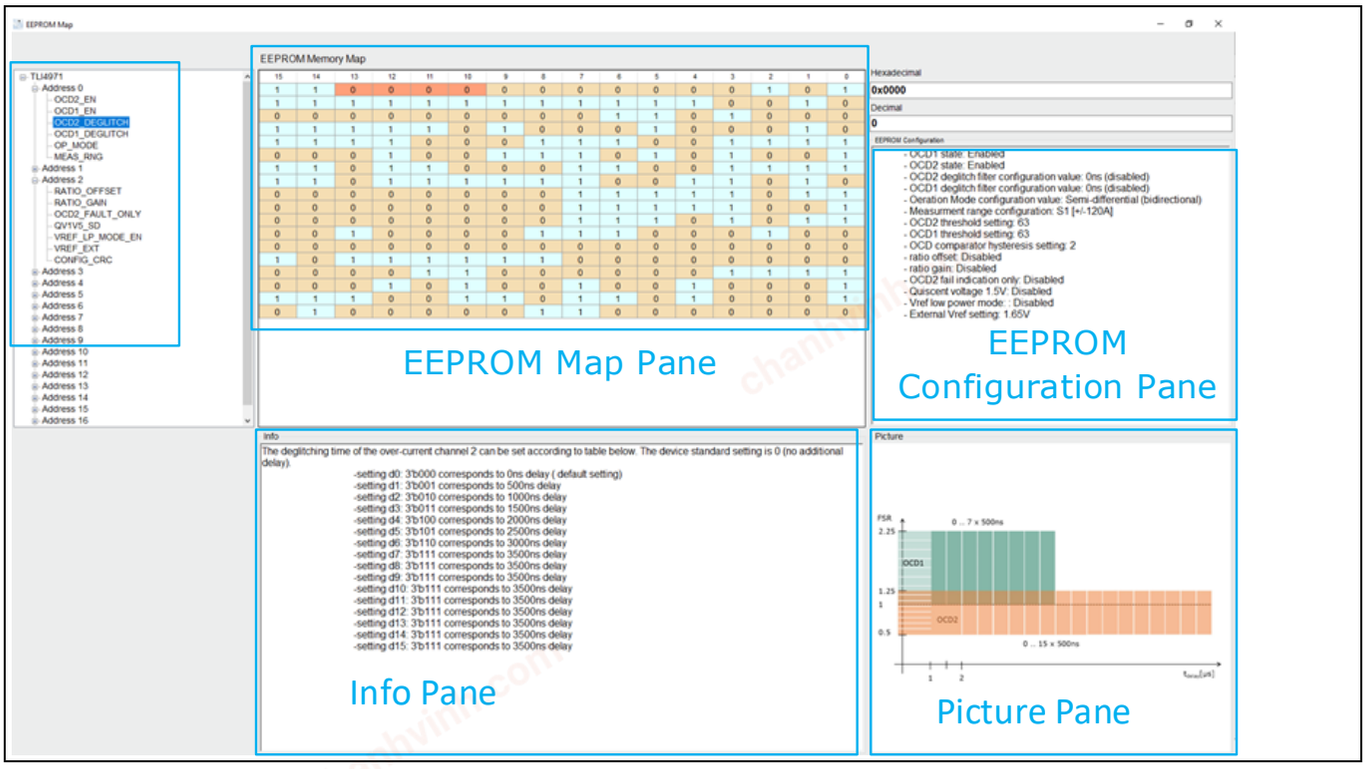


Figure 21 EEPROM Mapping Window

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4 Appendix I

- The following initial setup window will display. Click “**Next**” button to continue with the installation

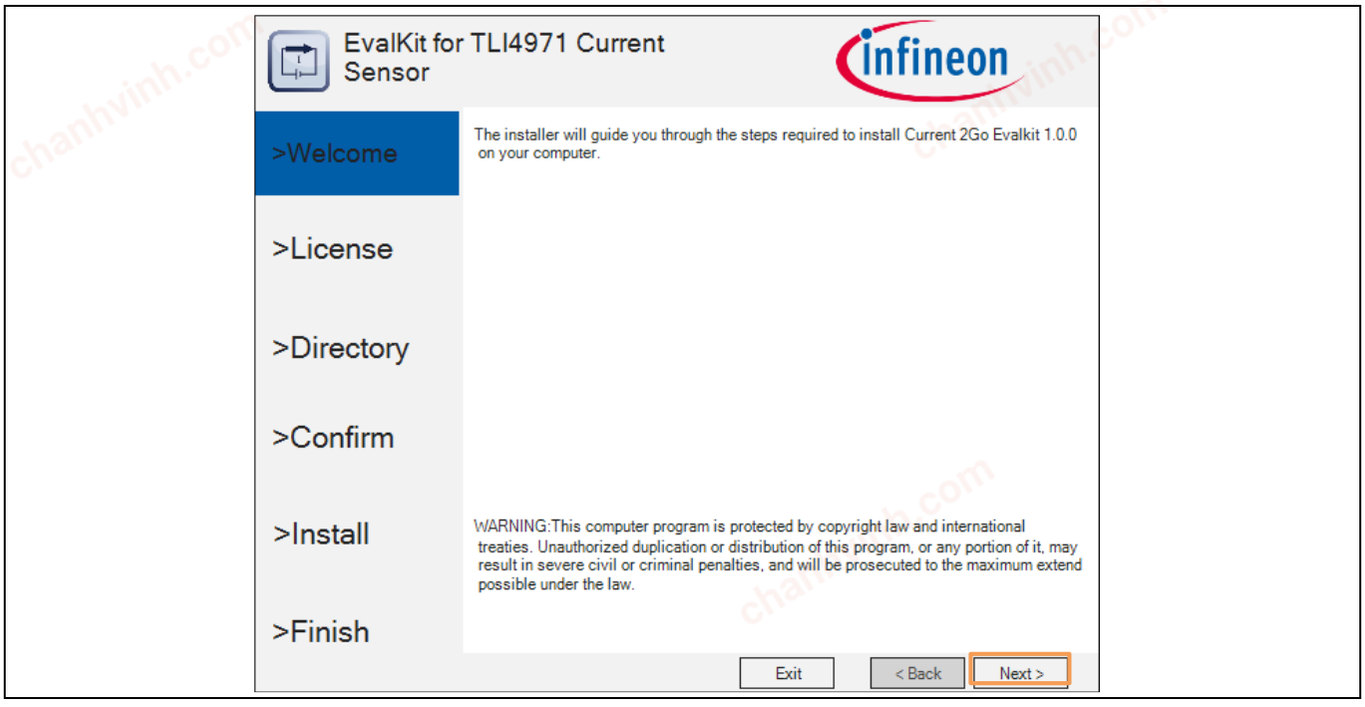


Figure 22 EvalKit Installer 1.0.2 – Welcome

- Read through the license agreement carefully and continue the installation by selecting the check box of “*I accept the terms in the license agreement*”, see orange color box in Figure 23. If the license agreement is not accepted, then the installation will not continue to further steps. Click “**Next**” button to continue with the installation

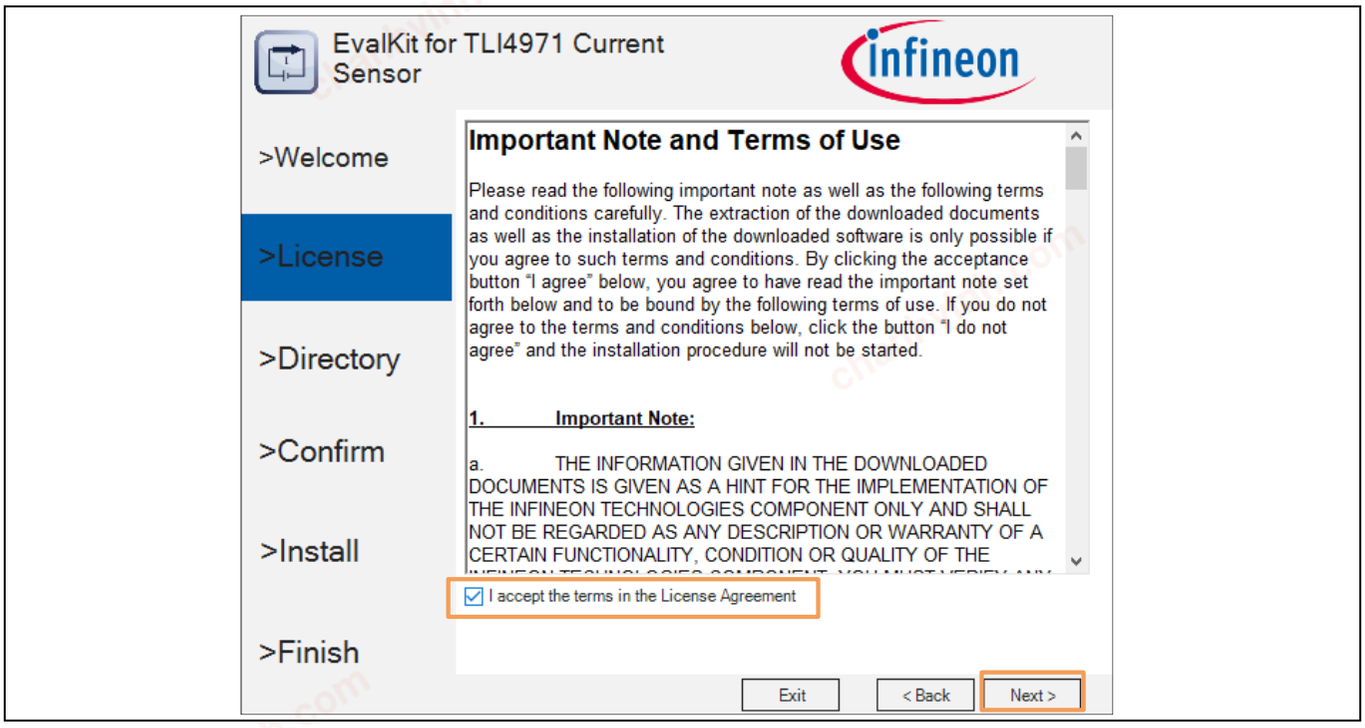


Figure 23 EvalKit Installer 1.0.2 – License Agreement

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- 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 of Figure 24. Also, select the check boxes of "Add Desktop Shortcut" and "Install Jlink". Click "**Next**" button to continue with the installation

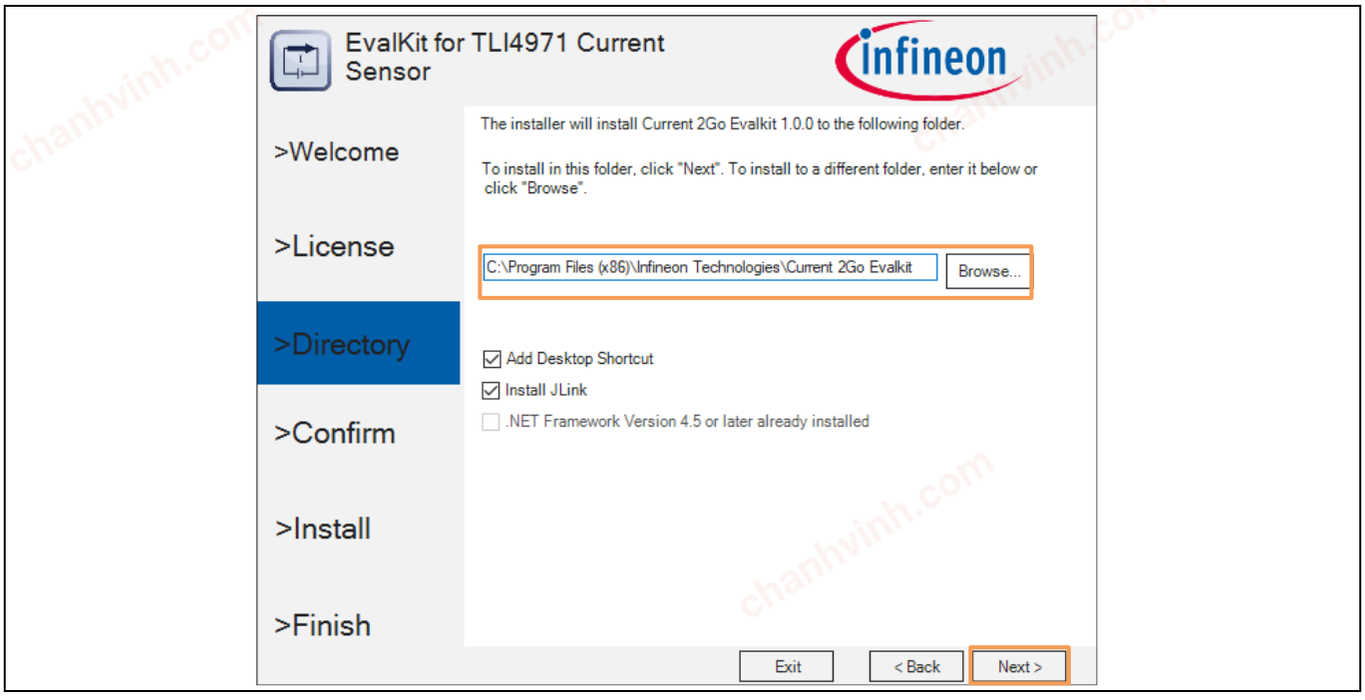


Figure 24 EvalKit Installer 1.0.2 – Select the installation folder

- Click "**Install**" to begin the installation which shown in Figure 25 (Red Color box). The installation will continue if you have the **admin rights** otherwise the installation might be aborted without completing the installation.

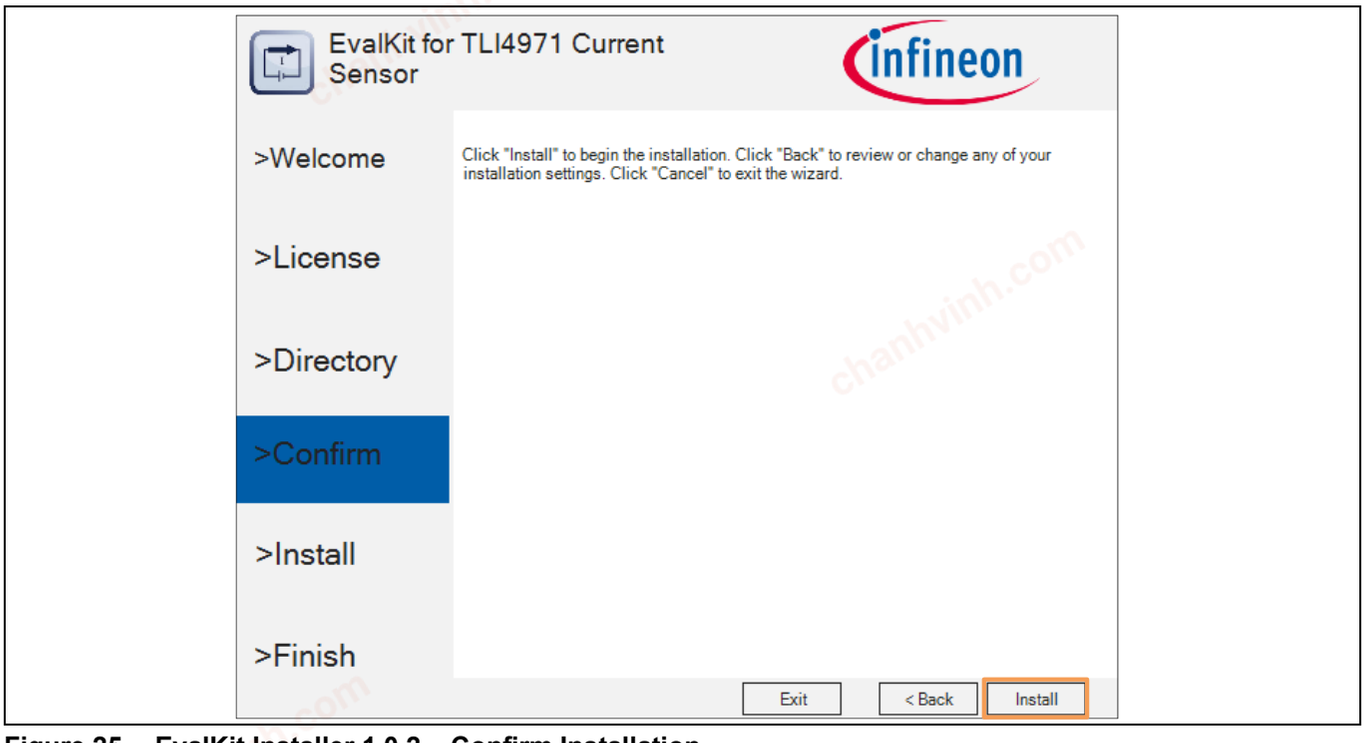


Figure 25 EvalKit Installer 1.0.2 – Confirm Installation

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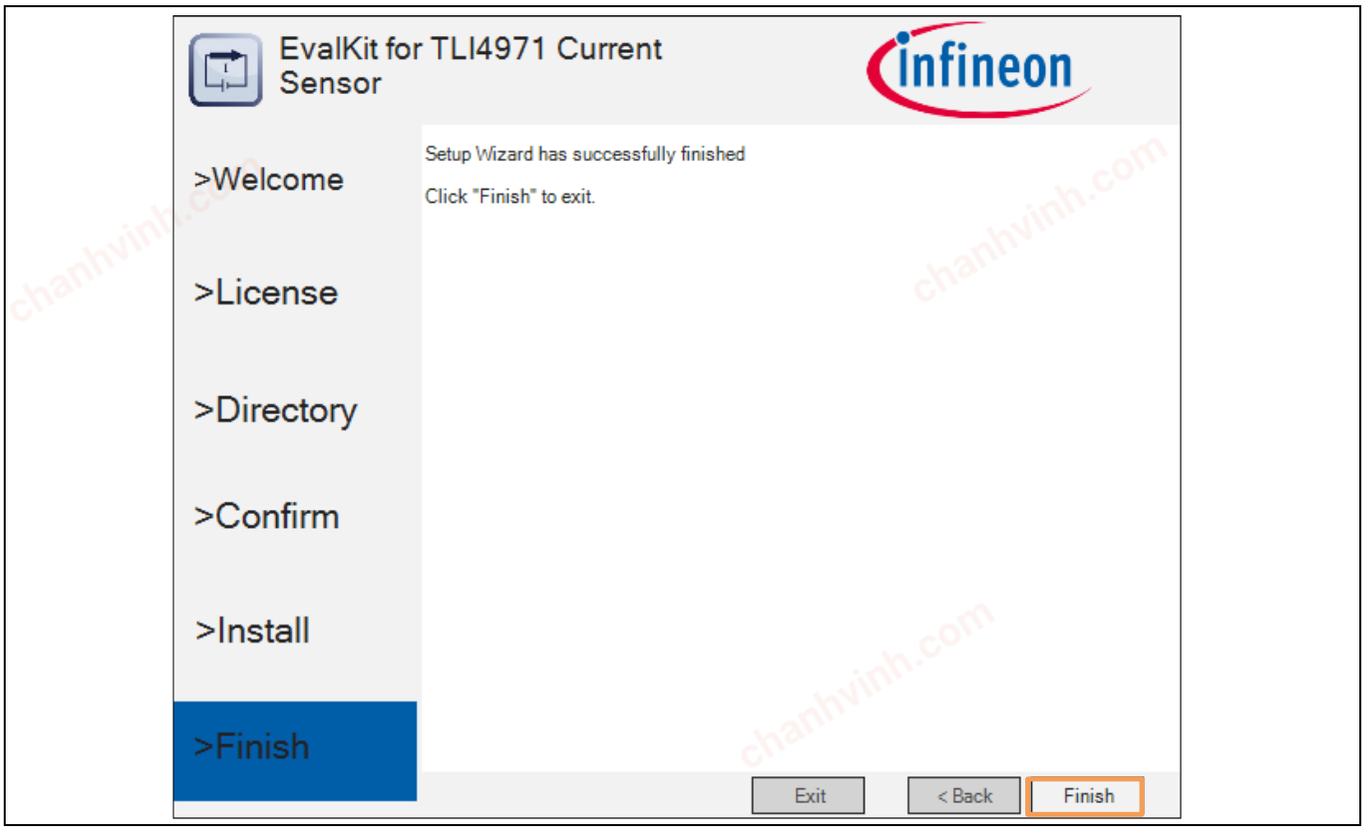


Figure 26 EvalKit Installer 1.0.2 –Installation Completed

- The software installation will only complete if the user install the SEGGER Jlink debugger software in parallel to the GUI software installation. Automatically, the software will prompt the welcome window to install the Jlink software as shown in the below Figure 27. Click "**Next**" button to continue with the installation.



Figure 27 SEGGER JLINK Drivers – Welcome

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- Read through the license agreement carefully and continue the installation by accepting it (see orange color box of Figure 28). If the license agreement is not accepted, then the installation will be aborted. Click **“Next”** button to continue with the installation.

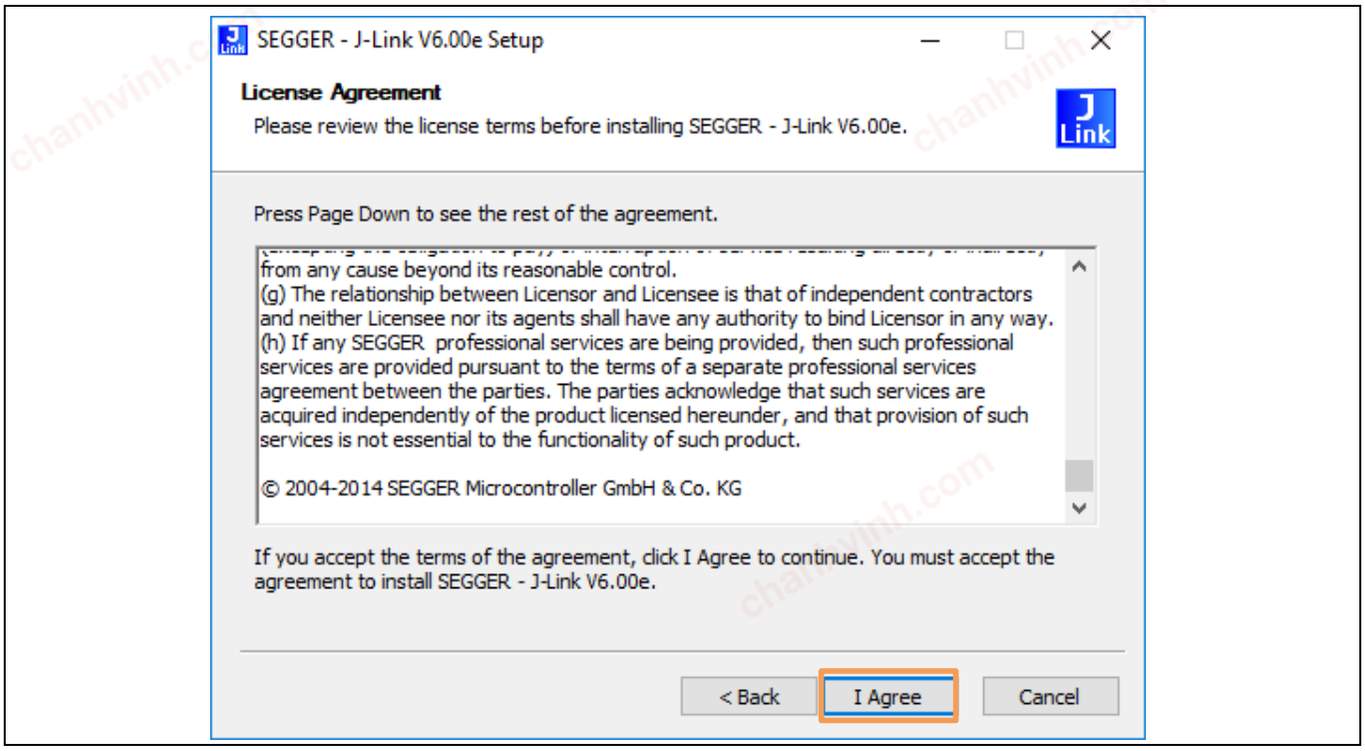


Figure 28 SEGGER JLINK Drivers – License Agreement

- Select the check boxes as shown in the highlighted orange color box of Figure 29 and click **“Next”** button to continue with the installation.

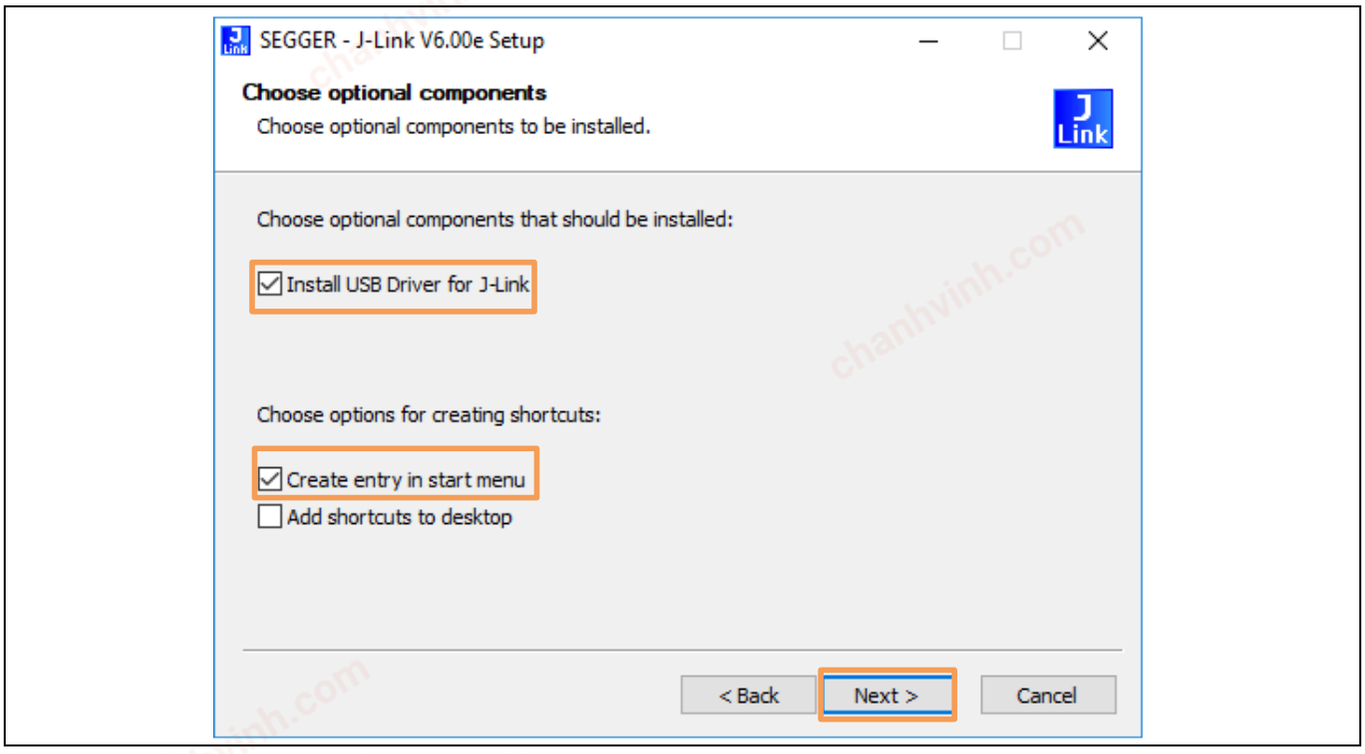


Figure 29 SEGGER JLINK Drivers – USB Driver Installation

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- 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 of Figure 30. Click **"Next"** button to continue with the installation.

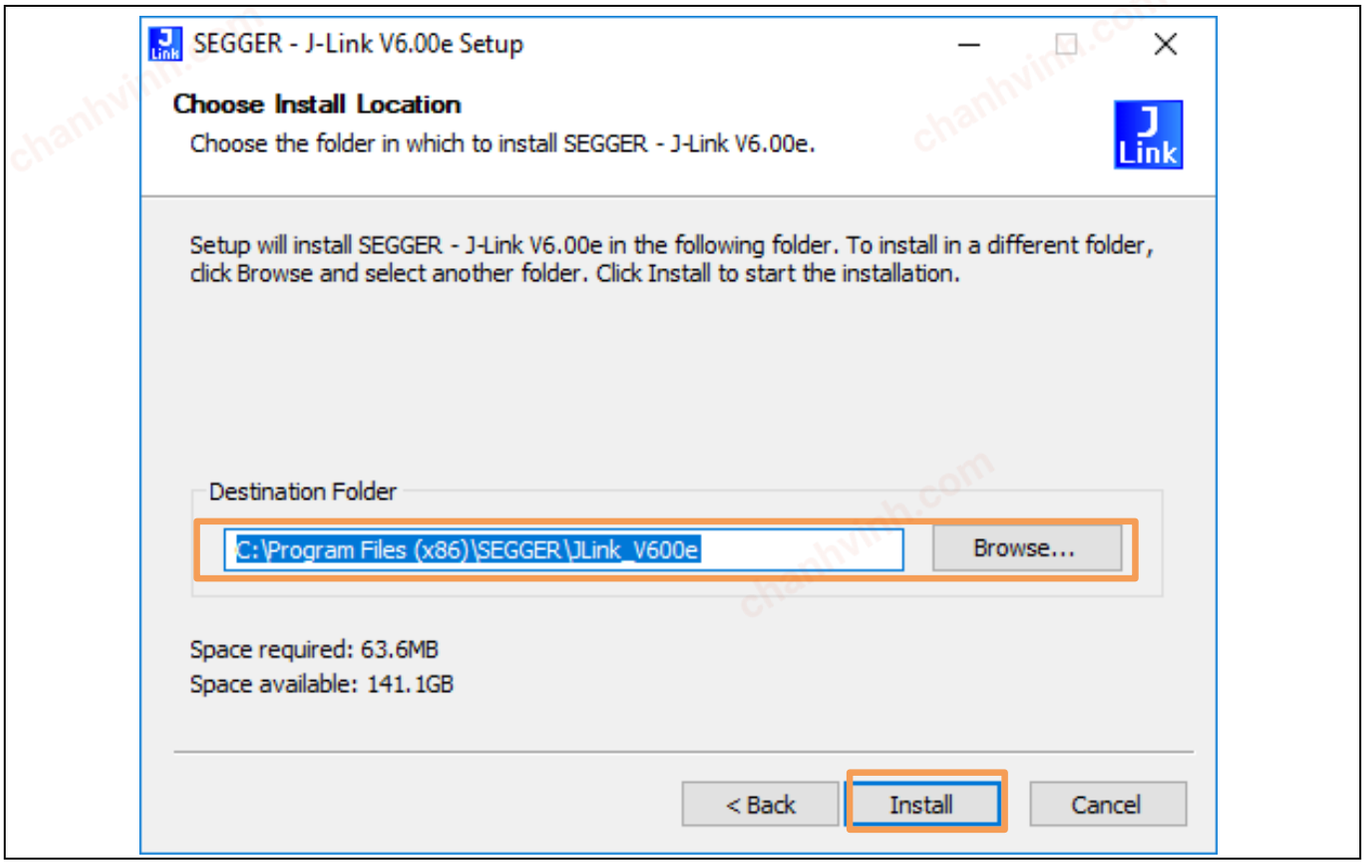


Figure 30 SEGGER JLINK Drivers – Confirm Installation

- Click **"Ok"** button to complete the Jlink driver installation which has shown in the below Figure 31.

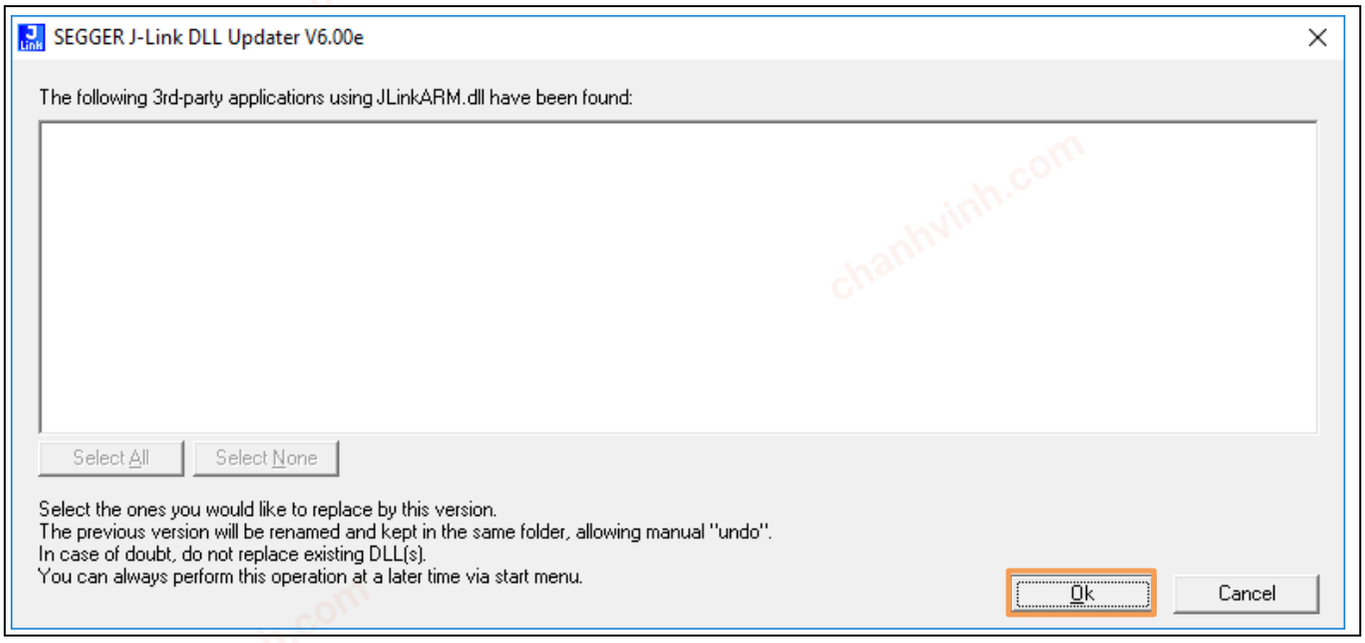


Figure 31 SEGGER JLINK Drivers – End of Installation

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- Click **“Finish”** button which has shown in the below Figure 32 to complete the Jlink driver installation.



Figure 32 SEGGER JLINK Drivers – End of Installation

- Click **“Finish”** button which has shown in the below Figure 26 to complete the Evalkit software GUI installation.

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5 Appendix II

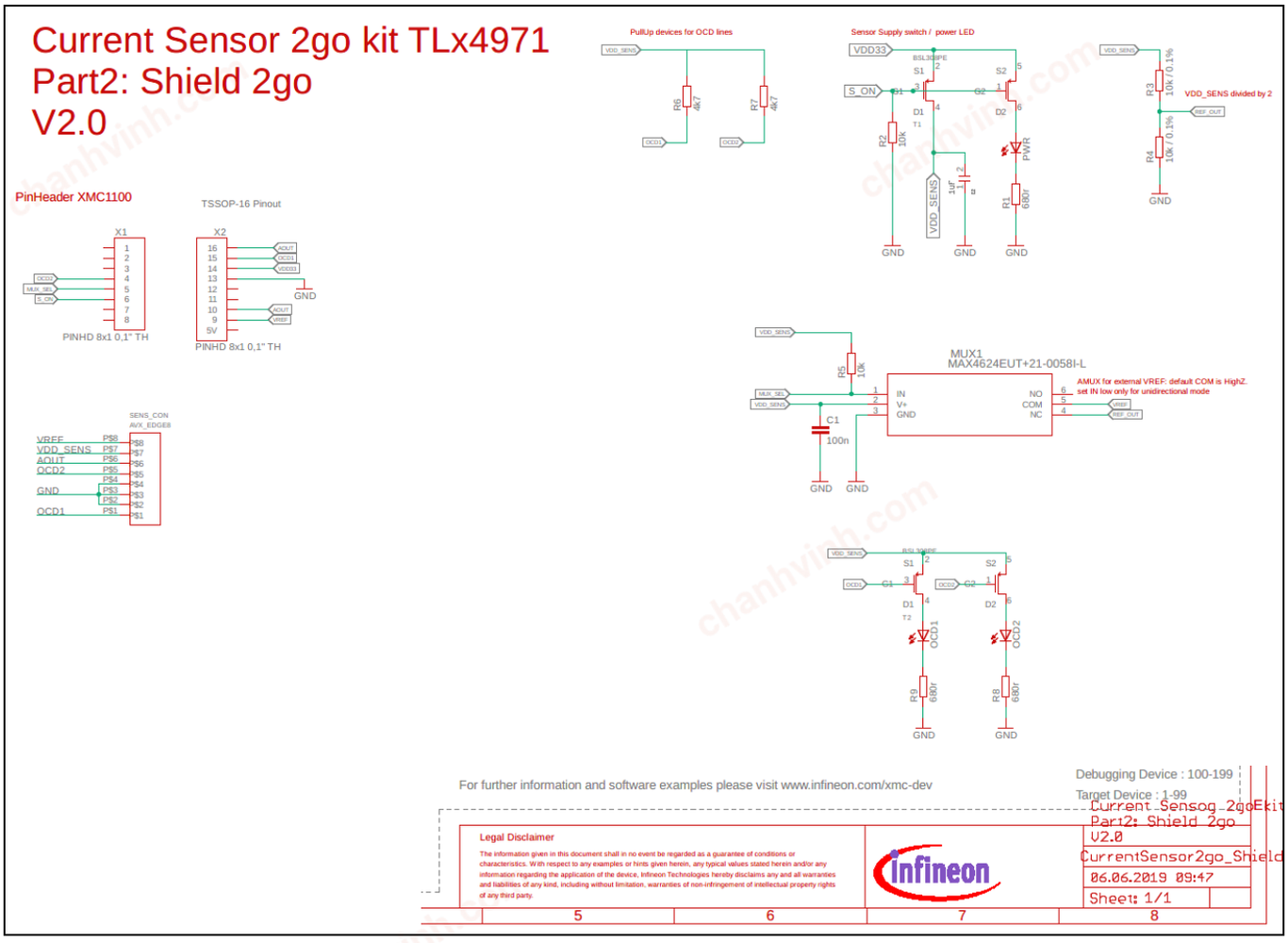


Figure 33 Sensor Shield Board Schematics

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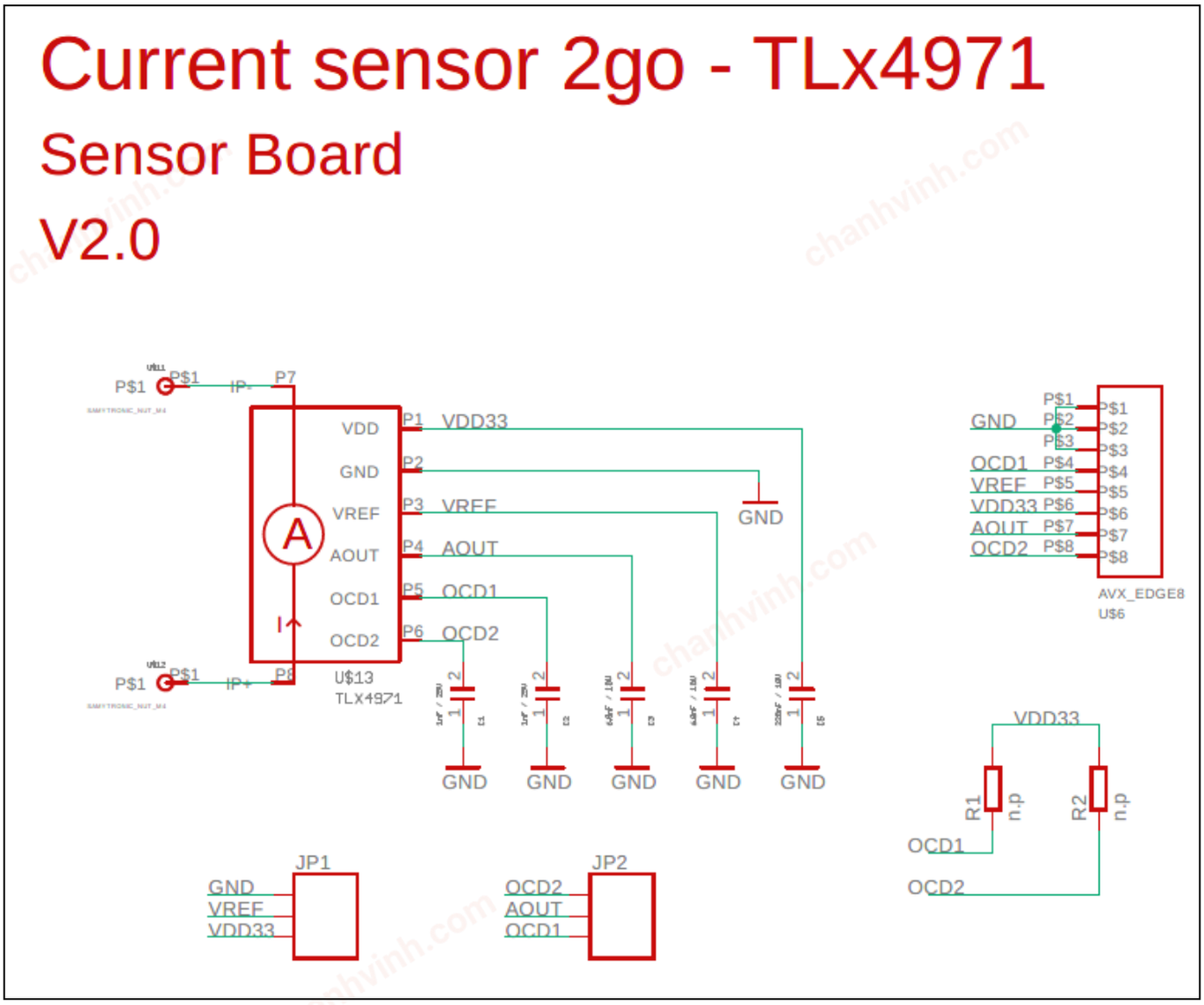


Figure 34 Sensor Board Schematic

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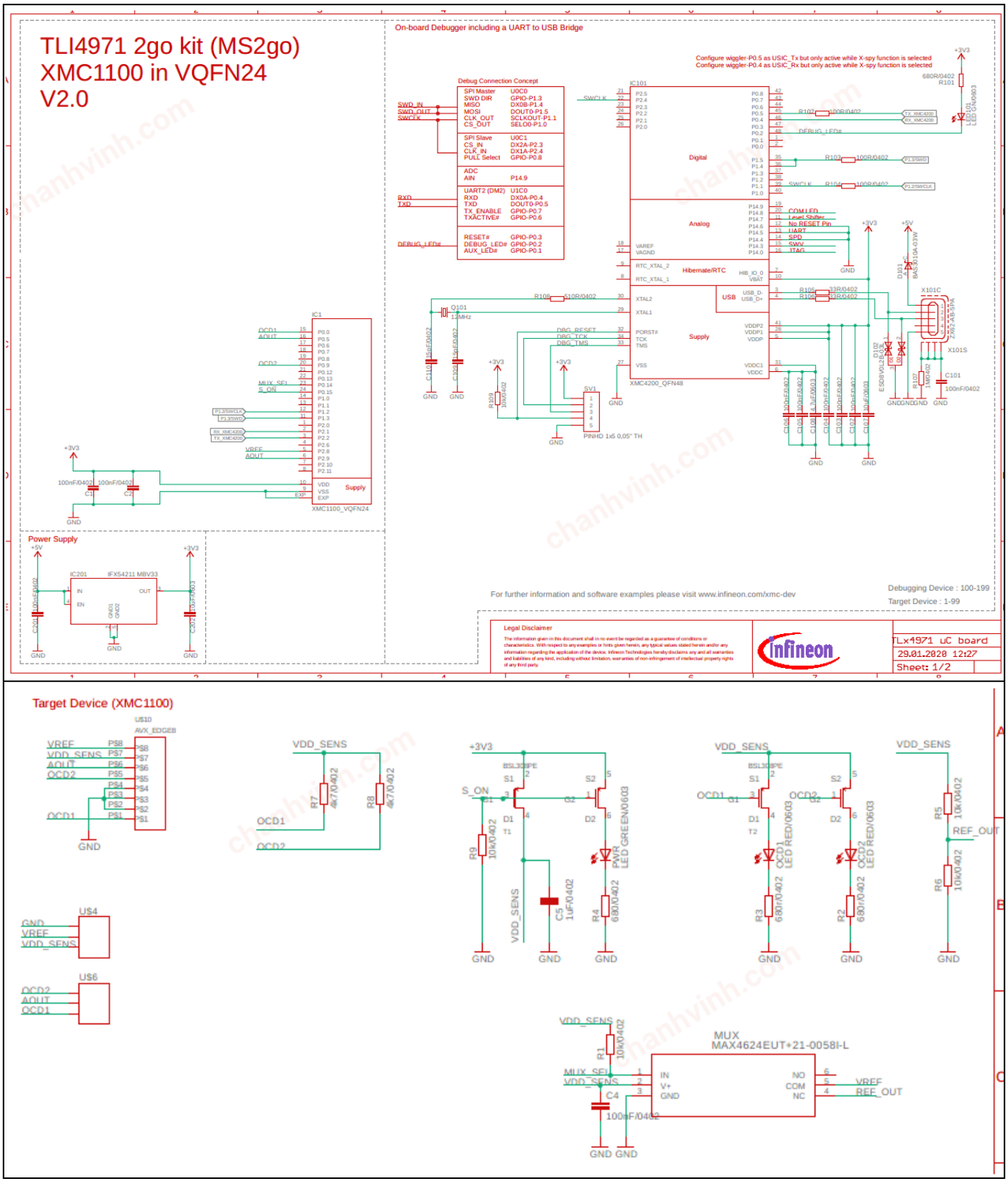


Figure 35 MCU Board Schematic

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6 Glossary

Abbreviation	Description
S2Go PROGRAMMER	Shield to Go Programmer
MS2Go	Magnetic Shield to Go
PCB	Printed Circuit Board
GUI	Graphical User Interface
EEPROM	Electrically Erasable Programmable Read-Only Memory
OCD	Over Current Detection
USB	Universal Serial Bus
DUT	Device Under Test
HV	High Voltage
LED	Light Emitting Diode
MCU	Micro-Controller Unit
EXT	Exit
AN	Application Note
SW	Software

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7 References

[1] A Reference. See the code examples at **www.infineon.com**

[2] AN_TLI4971_ProgGuide User Manual

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Revision history

Document version	Date of release	Description of changes
V 1.0	2019-04-05	Initial version

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