chanhvinh.com

TLI4971 / TLE4971 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 / TLE4971 current sensor. The TLI4971 Current 2go Evaluation kit is offered in two configurations, such as Magnetic Sensor 2Go (MS2Go) & Shield 2Go (S2Go) kits whereas the TLE4971 is offered in the Magnetic Sensor 2Go (MS2Go) only.

TLx4971 in this document will stand equaliy for TLI4971 as well as for TLE4971. For easier readability TLx4971 was chosen as common name.

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

chanhvinh.com

Table of contents

About this document **1**
Table of contents **2**
1 Introduction **3**
1.1 TLx4971 MS2Go configuration 3
1.2 TLI4971 S2Go configuration 4
1.3 TLx4971 Current 2Go Evaluation Kit Use Cases 5
1.4 MS2Go & S2Go Kits Features 6
1.5 MS2Go & S2Go Kits Hardware and Software Overview 7
1.5.1 Hardware Overview 7
1.5.2 Software Overview 7
1.5.3 Software Installation 7
2 MS2Go and S2Go Kits Description **8**
2.1 Sensor Shield Pin Description 8
2.2 MCU Board 9
2.3 In-Plane Edge Connector 10
2.4 Sensor Board 10
3 Current Sensor Evaluation Setup **11**
3.1 Graph View 11
3.2 Volatile Settings 14
3.3 EEPROM Map 16
4 Appendix I **17**
5 Appendix II **23**
6 Glossary **25**
7 References **26**
Revision history **27**

chanhvinh.com

1 Introduction

The TLI4971 MS2Go and S2Go kits as well asd the TLE4971 MS2Go kit are budget-priced evaluation kits enabling the possibility to evaluate the Infineon TLx4971 current sensor.



Figure 1 TLx4971 Current Sensor 2GO Kit

1.1 TLx4971 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.

chanhvinh.com

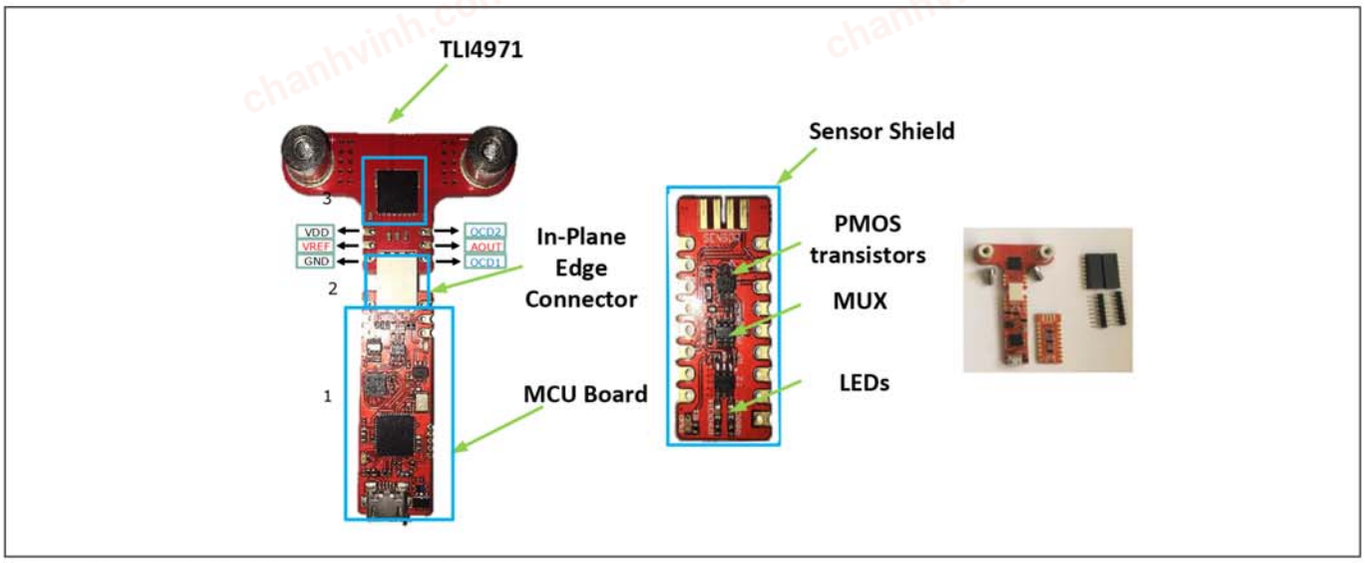


Figure 2 MS2Go kit component list

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.

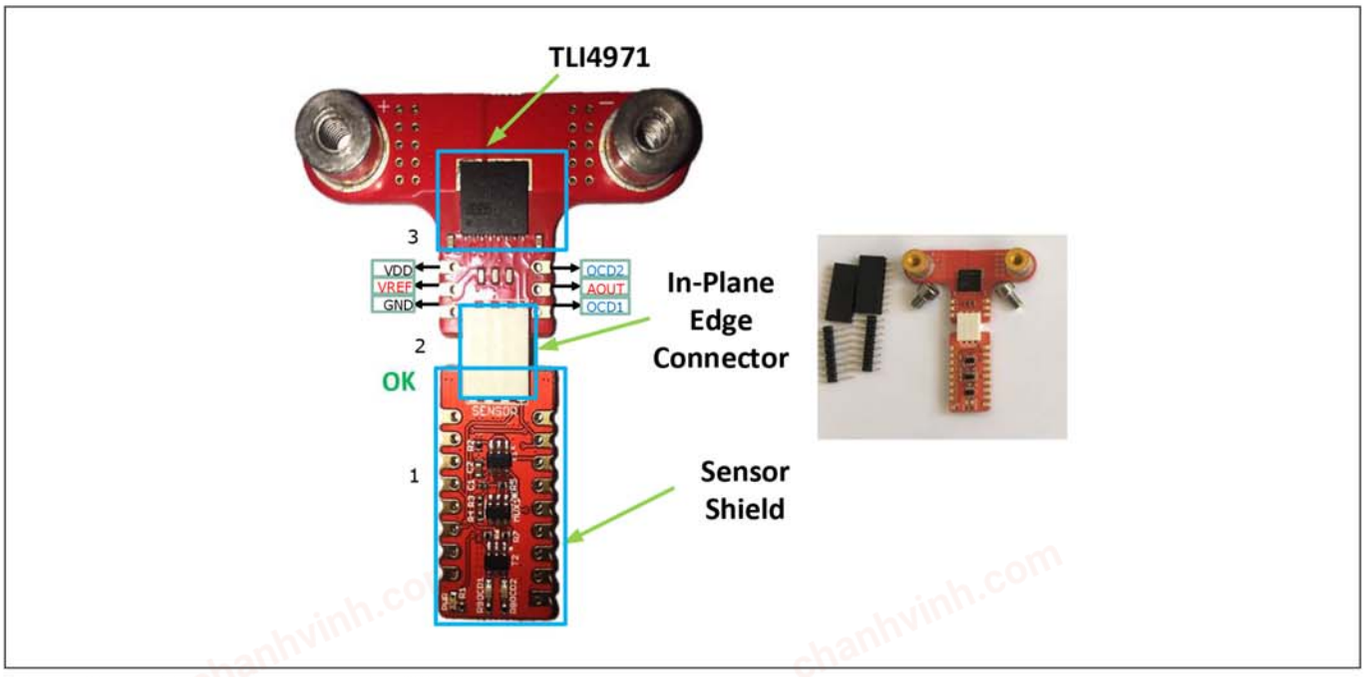


Figure 3 S2Go kit component list

chanhvinh.com

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
TLE4971_MS2GO	SP005857720

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 TLx4971 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 TLx4971 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)

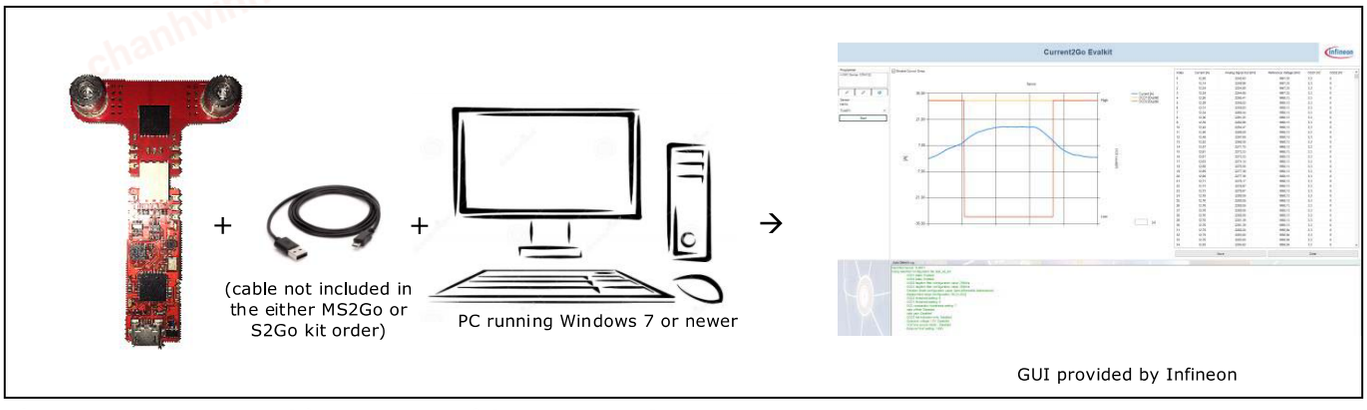


Figure 4 MS2Go kit Use Case with MCU Board

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.

chanhvinh.com

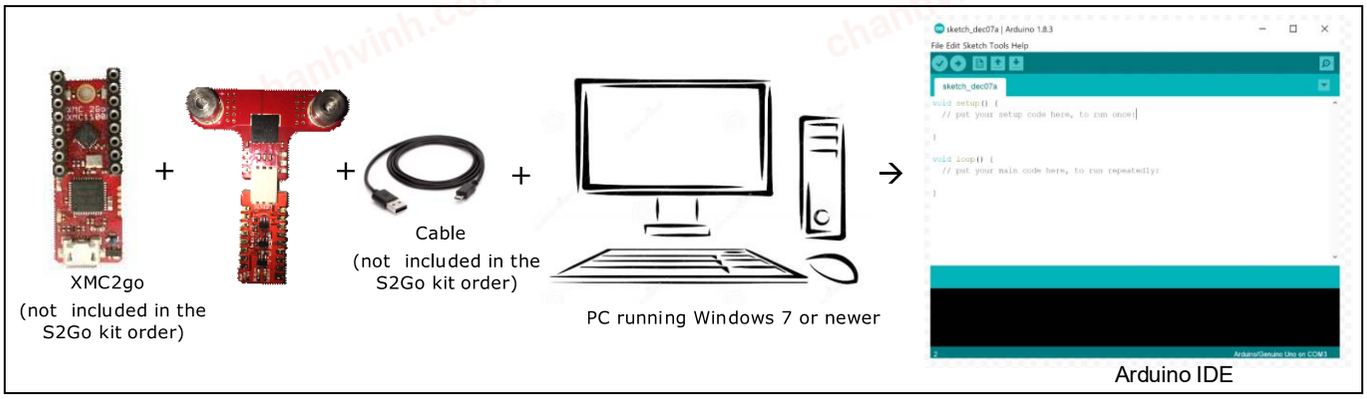


Figure 5 S2Go kit Use Case with XMC2GO Board

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.

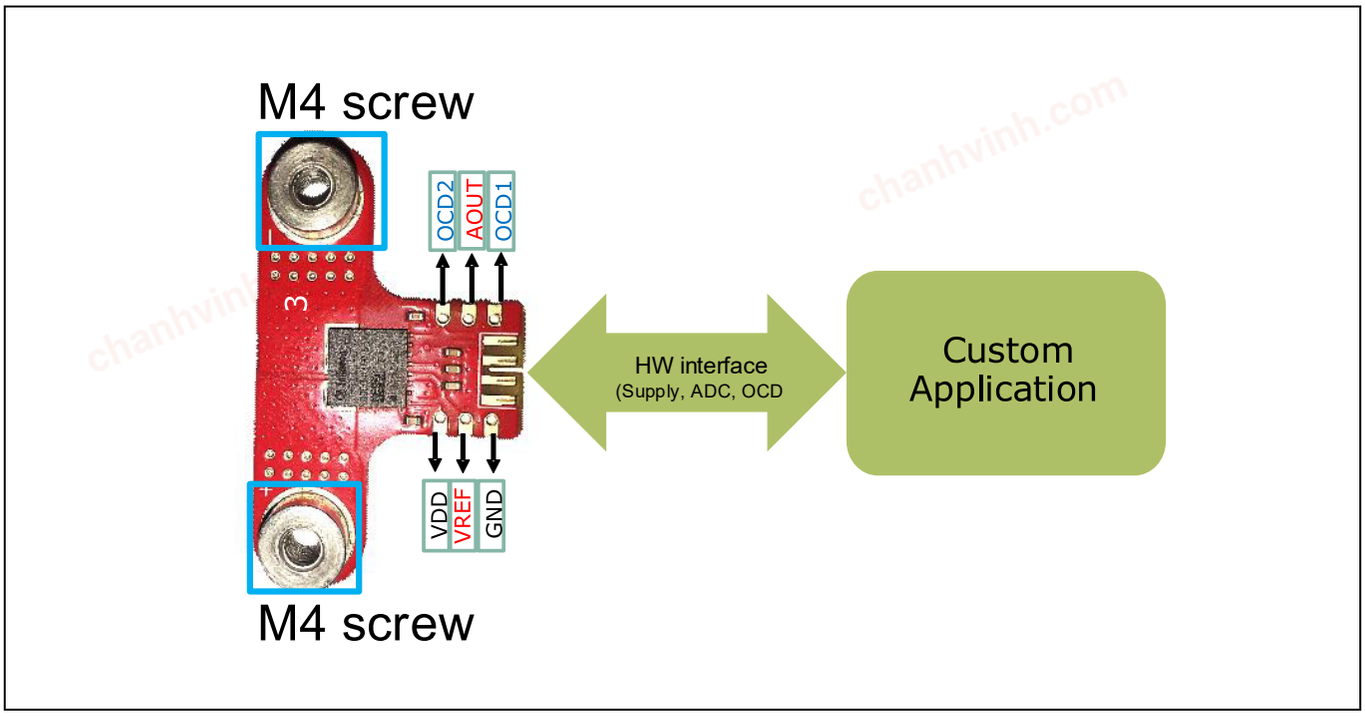


Figure 6 MS2Go or S2GO kit Use Case with Custom Platform

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 TLx4971 different output modes
- RAM programming support, after powering down the sensor, the programming is lost.
- Automatic detection of a sensor board

chanhvinh.com

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".

chanhvinh.com

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.

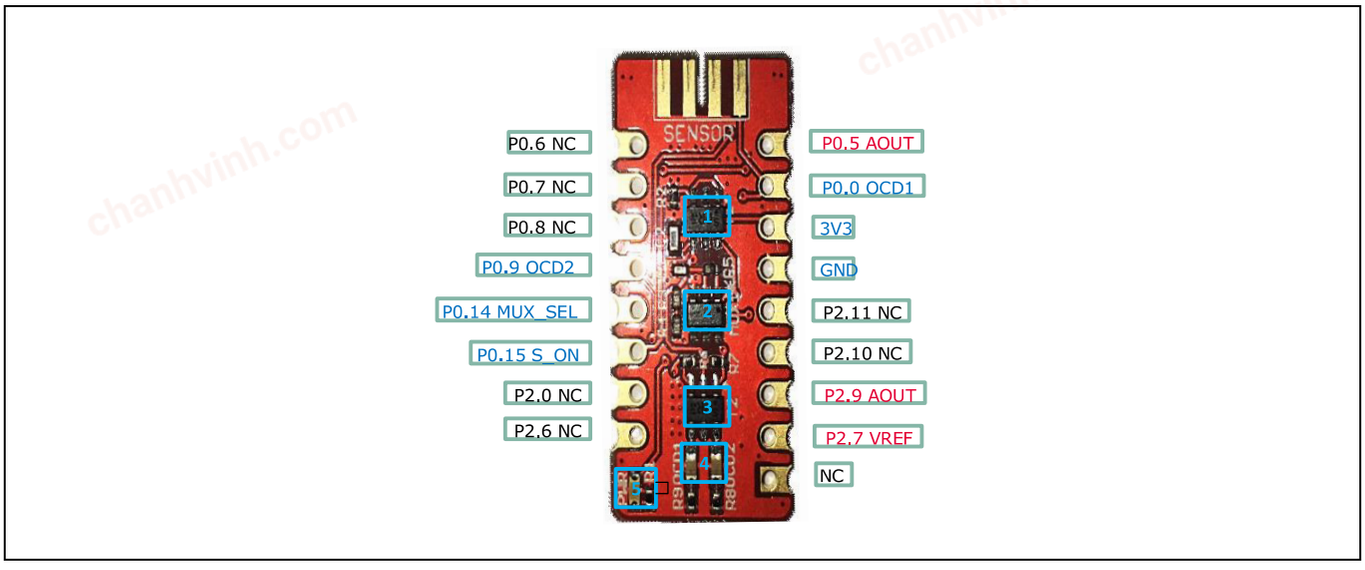


Figure 7 Sensor Shield pin description

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 30 in section 5.

chanhvinh.com

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 30Figure 32 in section 5.

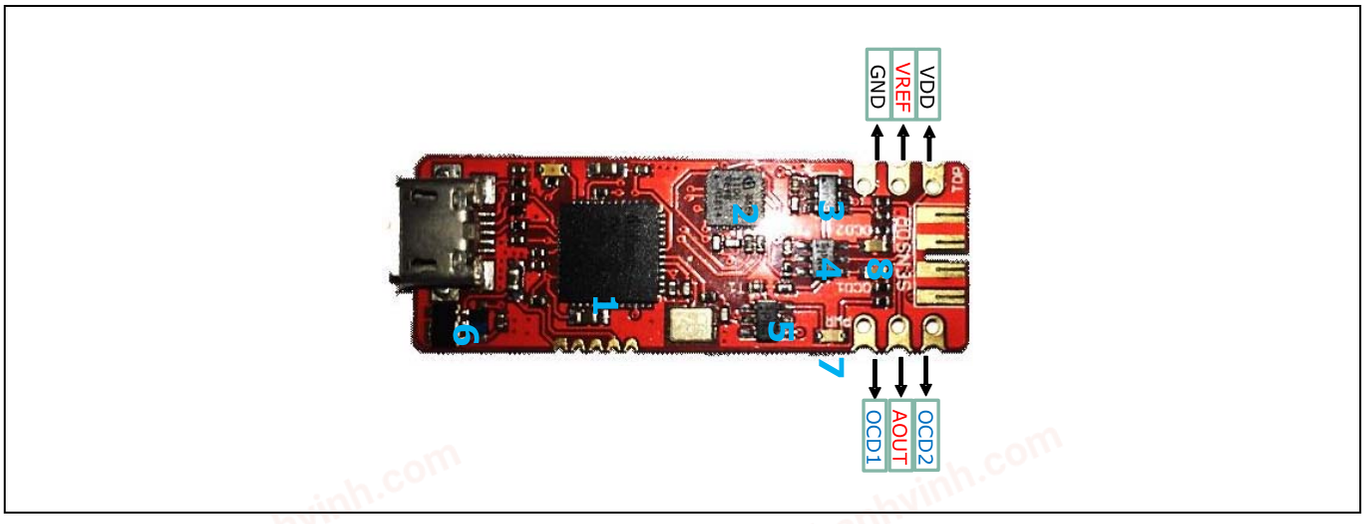


Figure 8 MCU Board Description

chanhvinh.com

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.

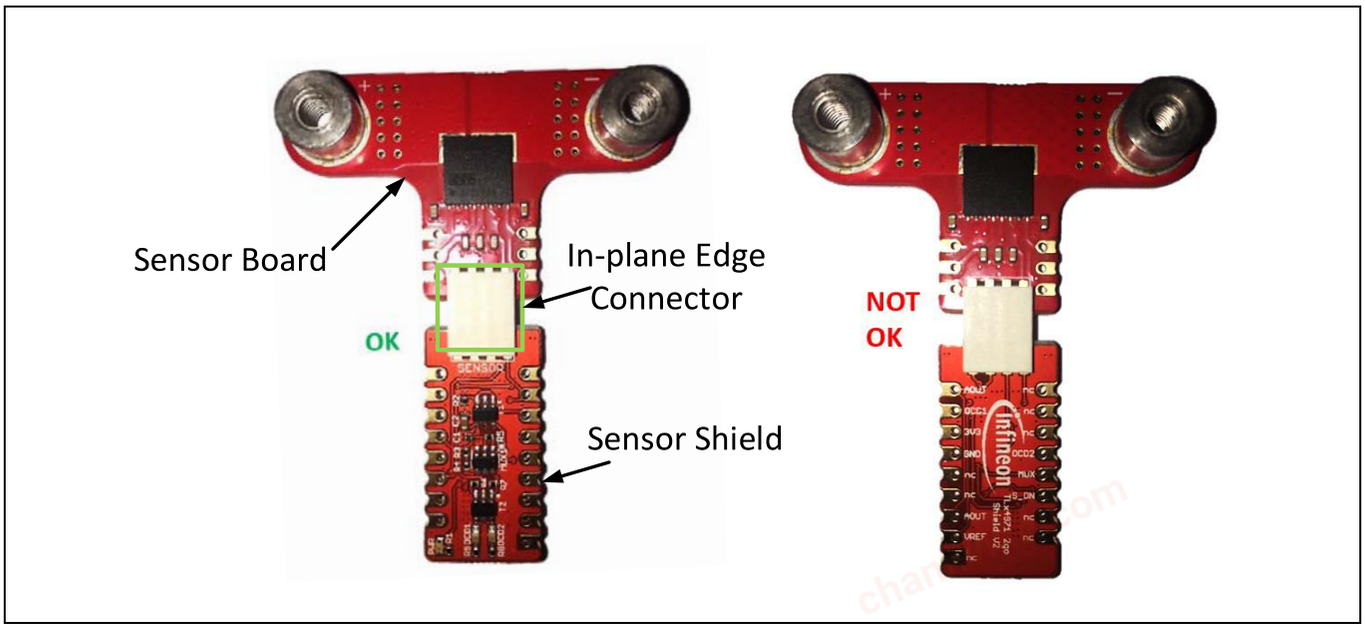


Figure 9 In-Plane Edge Connector Setup with Sensor Shield

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 31 in section 5.

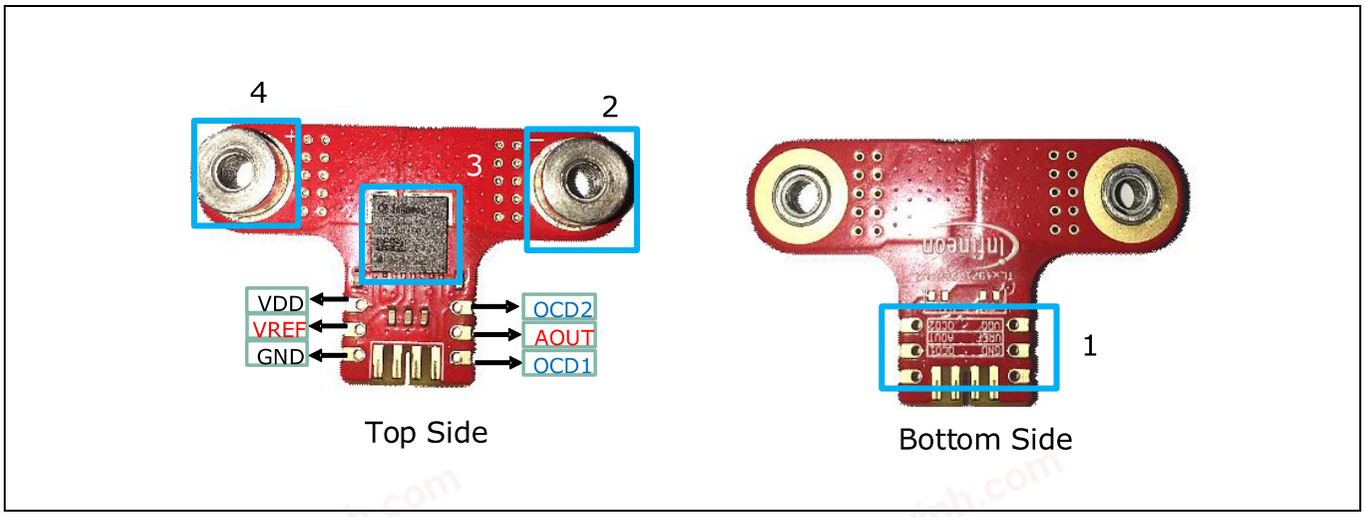


Figure 10 Sensor Board Top and Bottom View

chanhvinh.com

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.

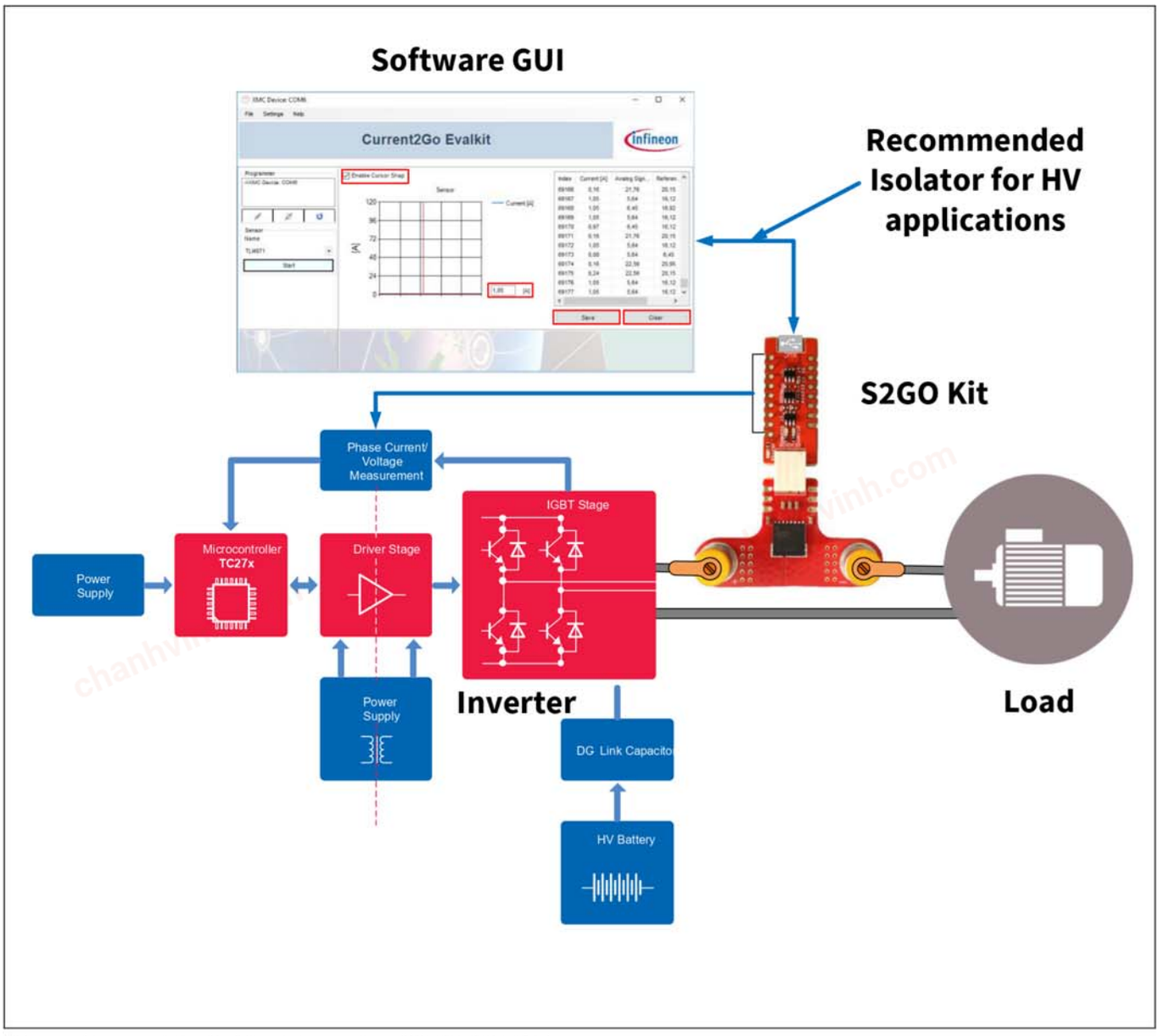


Figure 11 Test Setup Example with MS2Go Kit

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 “TLx4971 Current Sensor Evaluation App” will pop up as shown in Figure 12.

chanhvinh.com

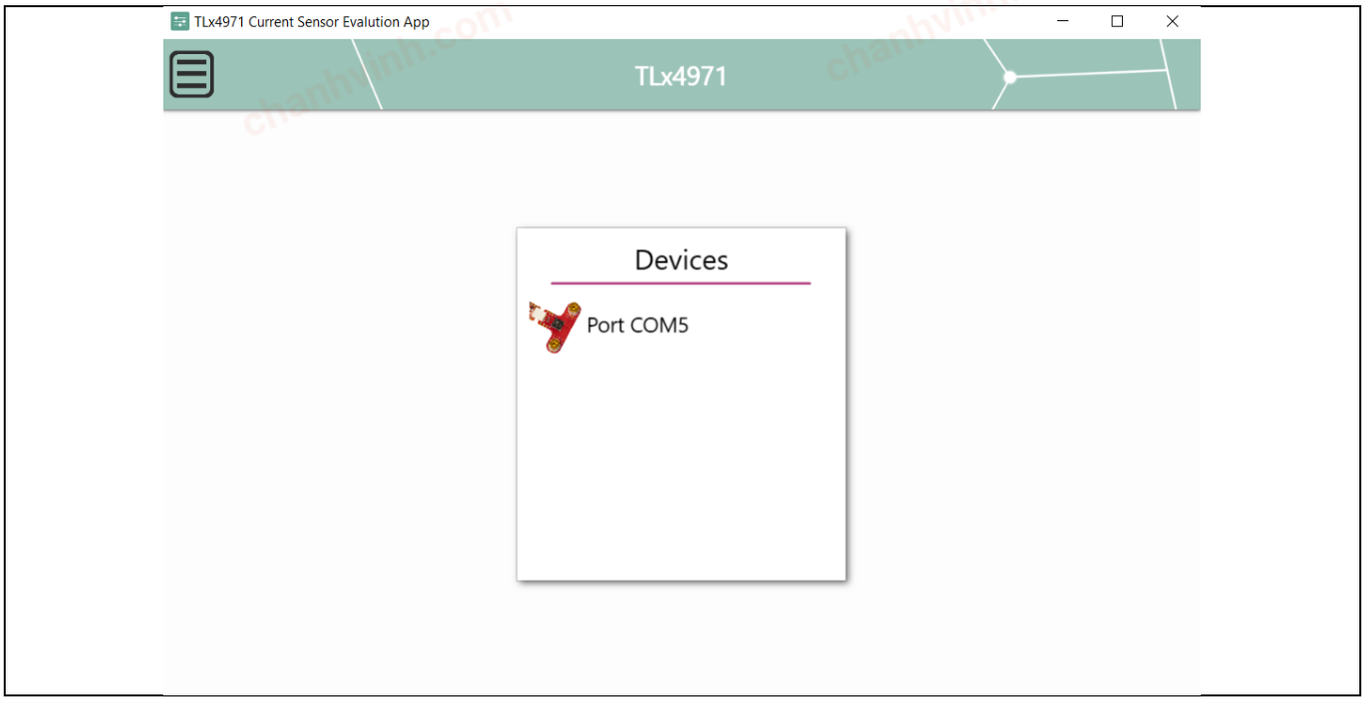


Figure 12 Log and Evalkit Software Window

- Select the "**XMC Device: COM5**" option in the "Programmer" dialogue box as shown in the below Figure 13 which is highlighted with red color box.

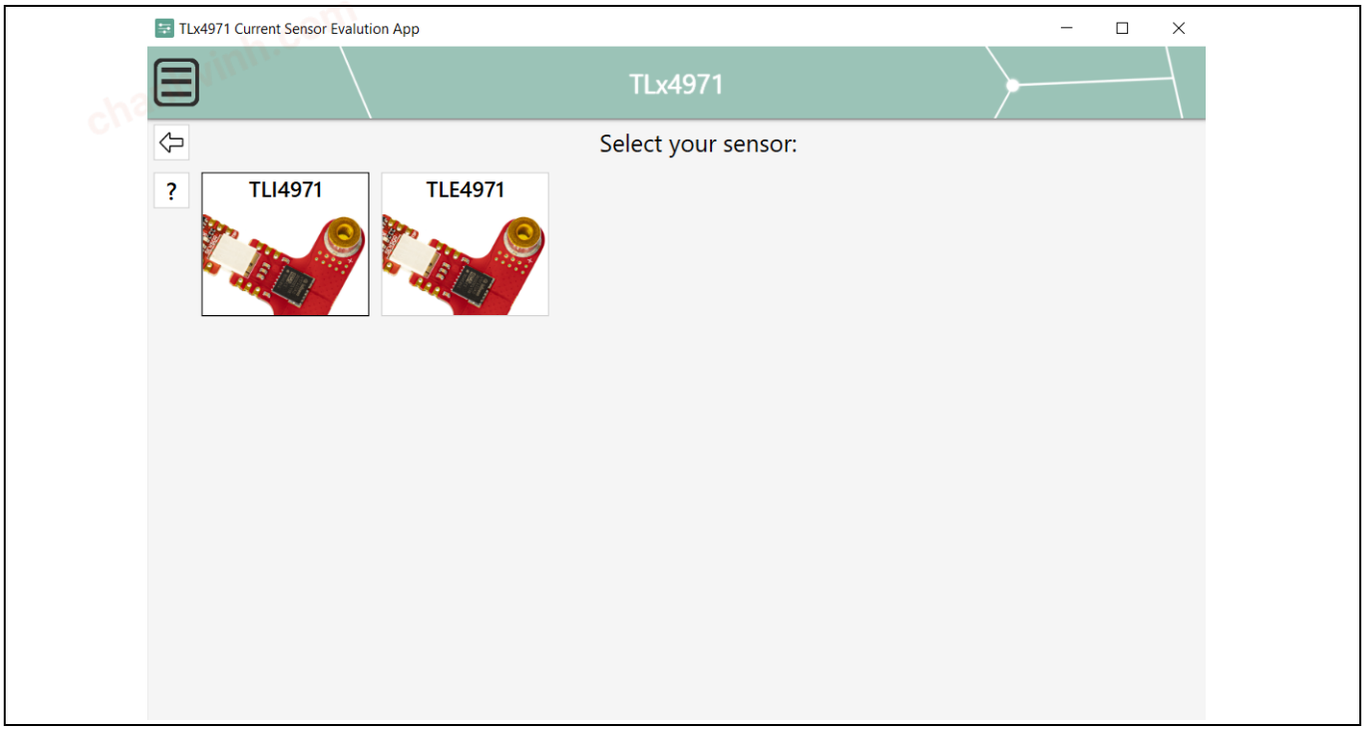


Figure 13 XMC Device: COM5 window: Sensor Selection

- After that the following window will pop up if the software is successfully installed (see Figure 14). Then click on the "Start" button, which is highlighted in red color box, to perform the measurements on the connected sensor.

chanhvinh.com

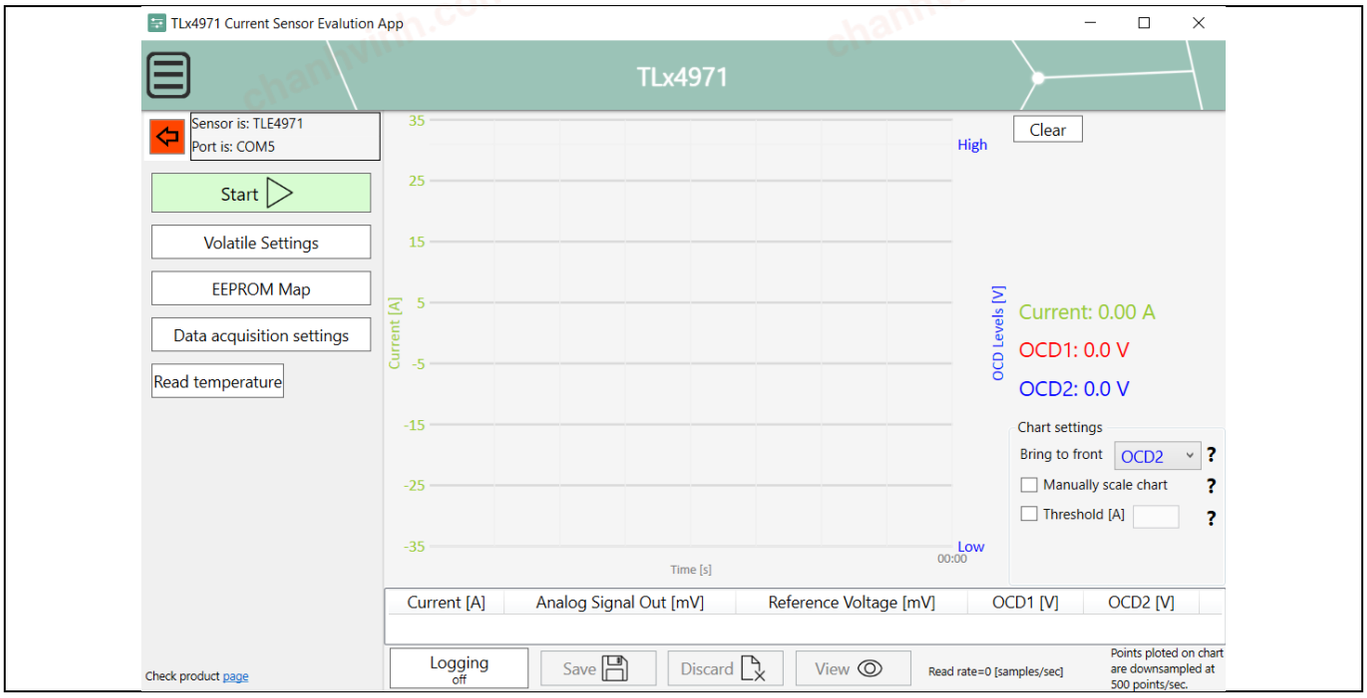


Figure 14 XMC Device: COM6 window: successful connection with Sensor

- 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 15.

  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

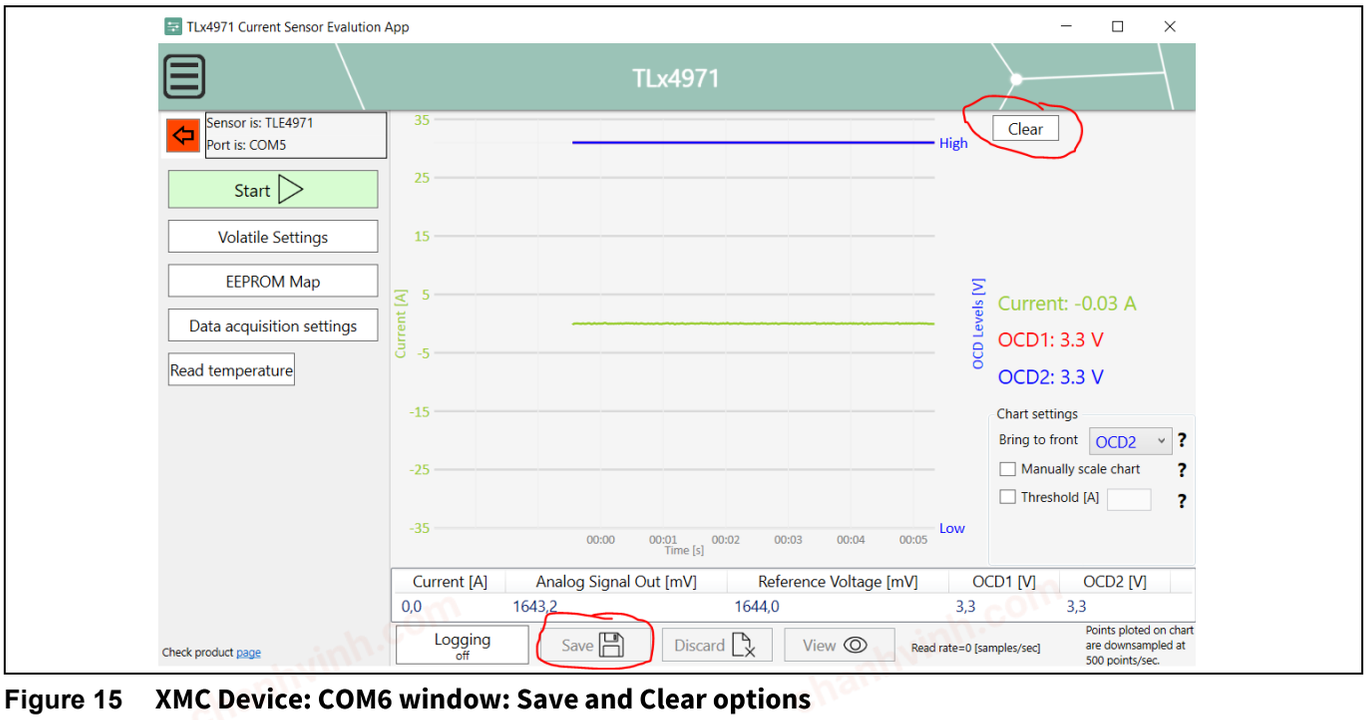


Figure 15 XMC Device: COM6 window: Save and Clear options

chanhvinh.com

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: COM5* 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.

3.2 Volatile Settings

When the user selects the ‘VolatileSettings’ menu item, the window shown in Figure 16 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.

- “Configuration Files” pane list (Figure 16) 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 (Figure 16) displays the parameters stored by the configuration file (name, description, sensor parameters).
- “Delete Config File” (Figure 16), by pressing this button, the configuration file will be physically deleted from the disk and from the list.
- “Create New Config File” (Figure 16), by pressing this button, a new window will pop-up allowing the user to create a new configuration file which has shown in Figure 17.
- “Set as Default Config file” (Figure 16), 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” (Figure 16), by pressing this button, the configuration parameters will be set into the RAM of the sensor.

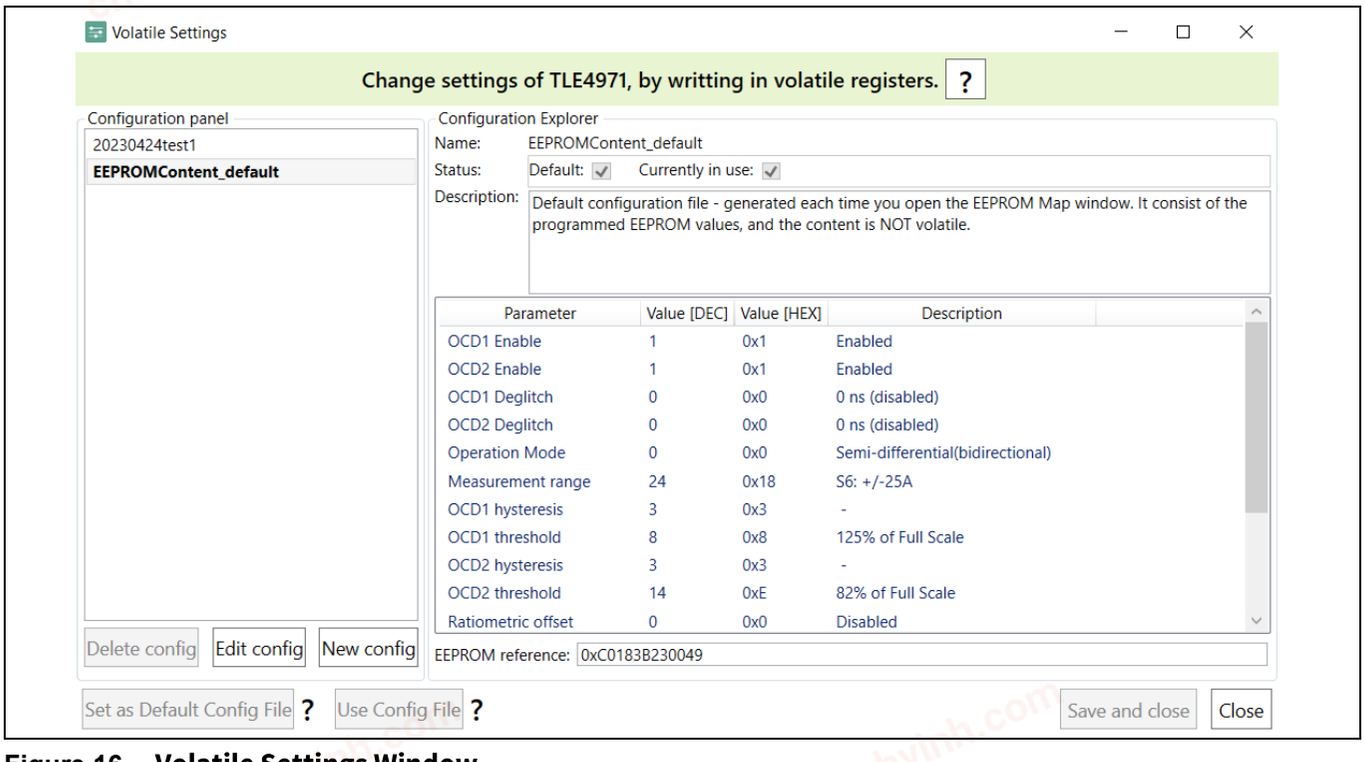


Figure 16 Volatile Settings Window

chanhvinh.com

The following Figure 17 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, press “Create Configuration” button to save the parameters into a XML configuration file. This configuration is now accessible in the “Volatile Settings” window.

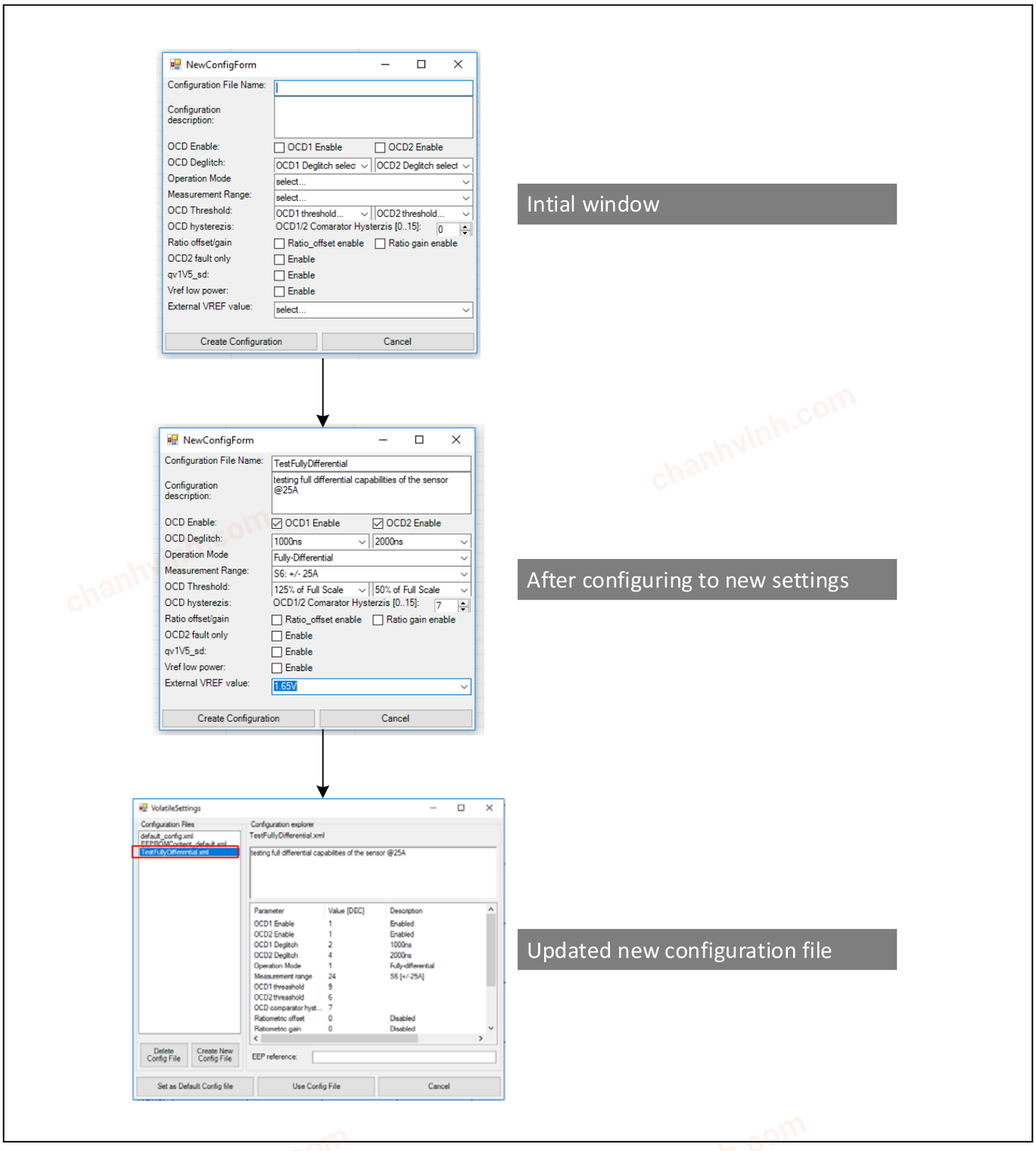


Figure 17 New Configuration File Creation

chanhvinh.com

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.

Please be aware there are different mapping of EEPROM-content in "Address 1" as described in a separate document provided on https://www.infineon.com/cms/en/product/sensor/current-sensors/ in the "TLE4971 addendum to TLI4971 programming and user manual".

3.3 EEPROM Map

In EEPROM mapping each address contains 16 bits and group of bits are assigned to different variables as shown in Figure 18. 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 information about *Address 0 …. Address 17,* which are shown in the EEPROM Mapping Window, please refer to application note AN_TLI4971_ProgGuide and the addendum for TLE4971: "TLE4971 addendum to TLI4971 programming and user manual".

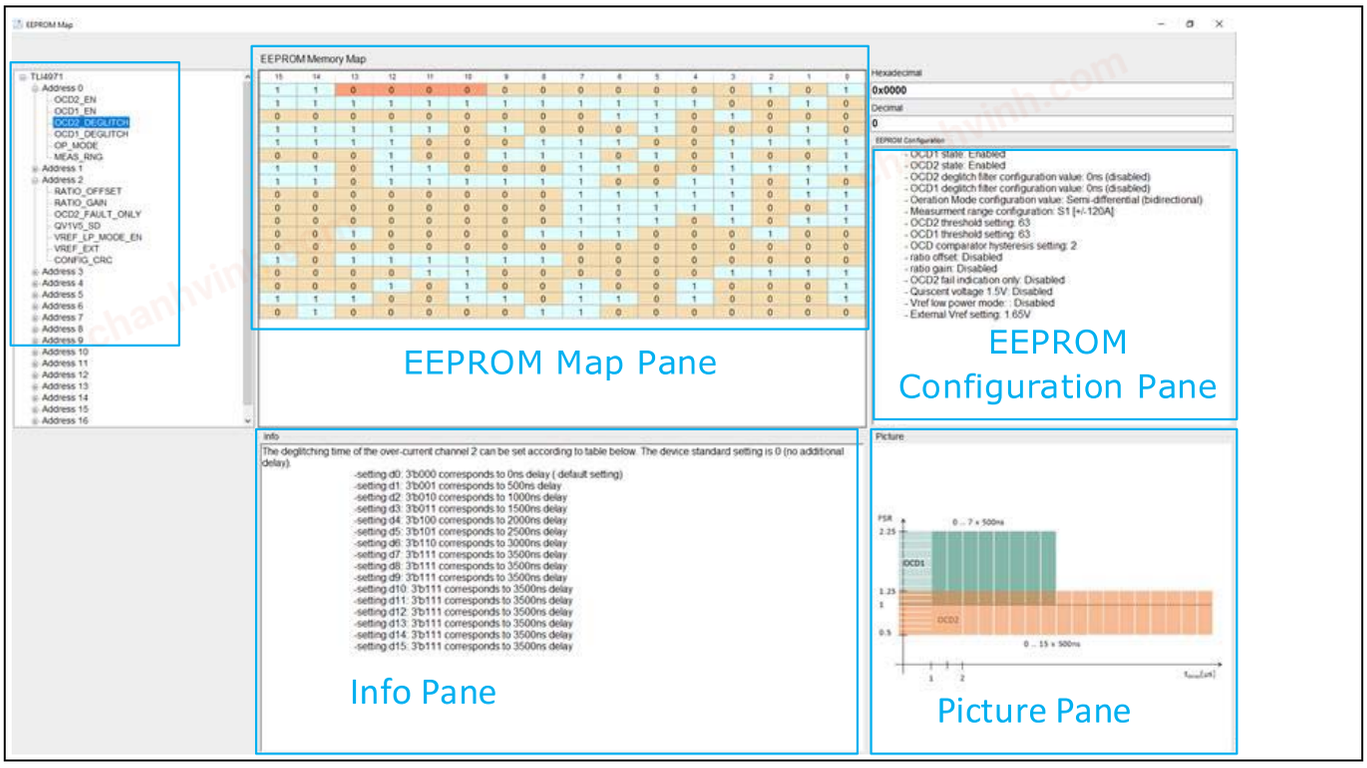


Figure 18 EEPROM Mapping Window

chanhvinh.com

4 Appendix I

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

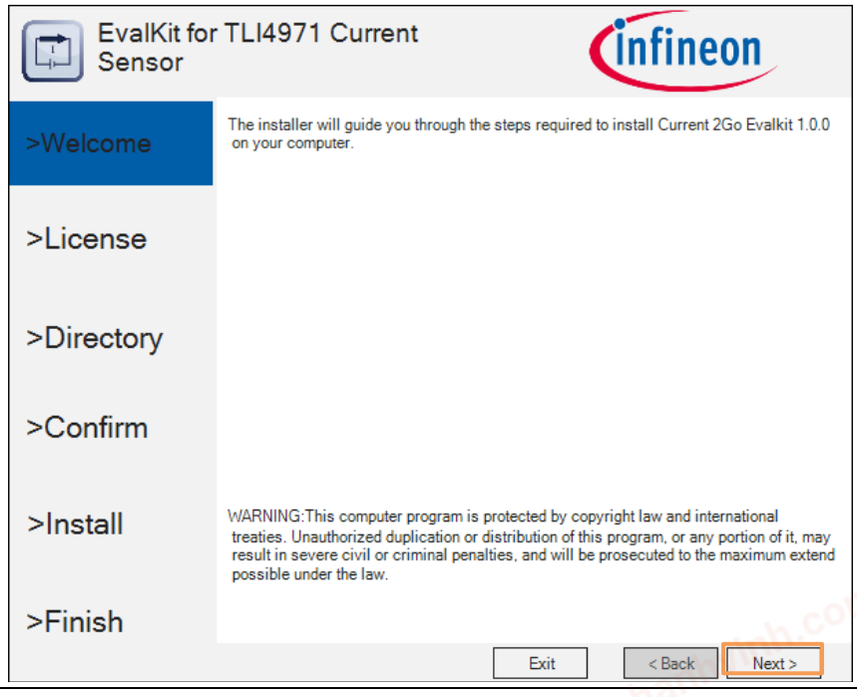


Figure 19 EvalKit Installer 1.0.2 – Welcome

- 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 20. If the license agreement is not accepted, then the installation will not continue to further steps. Click “**Next**” button to continue with the installation

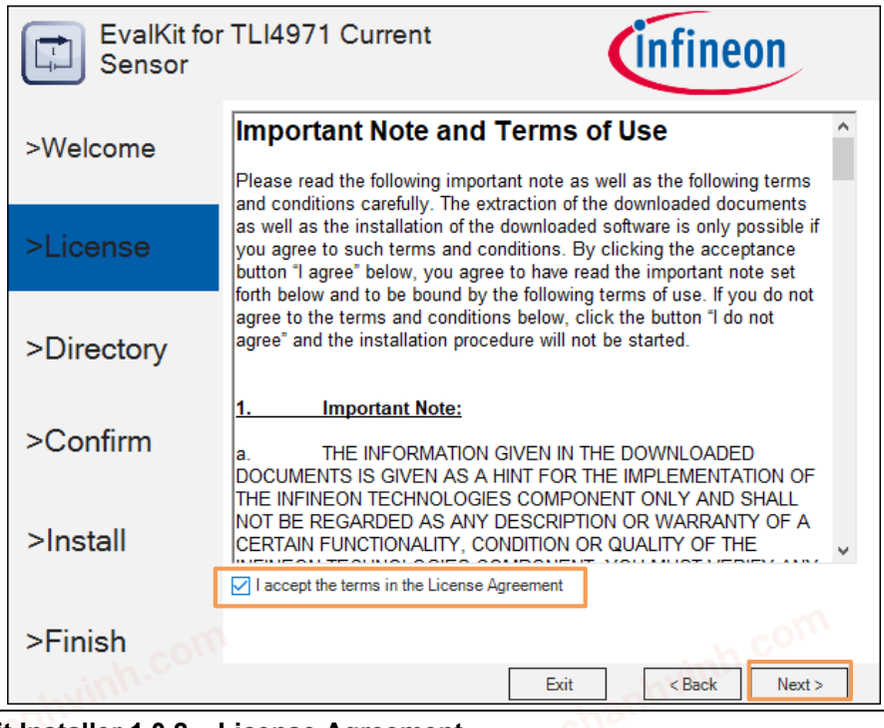


Figure 20 EvalKit Installer 1.0.2 – License Agreement

chanhvinh.com

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

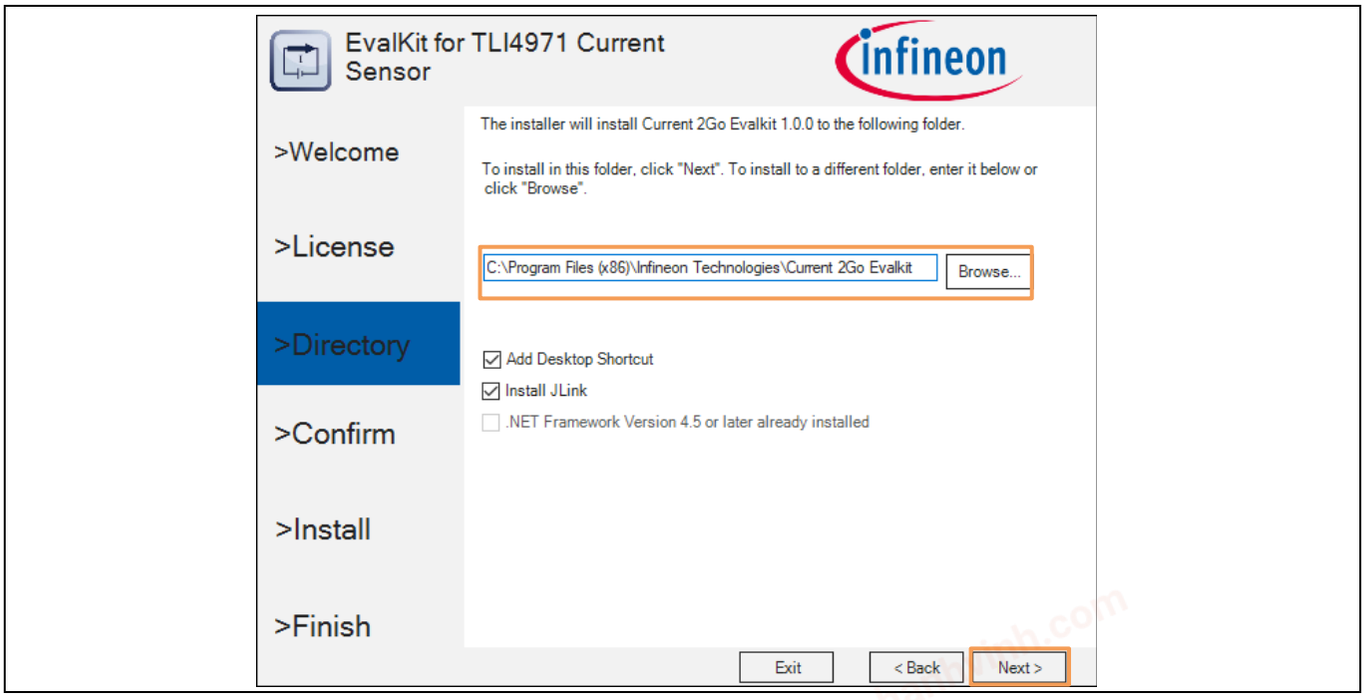


Figure 21 EvalKit Installer 1.0.2 – Select the installation folder

- Click "**Install**" to begin the installation which shown in Figure 22 (Red Color box). The installation will continue if you have the **admin rights** otherwise the installation might be aborted without completing the installation.

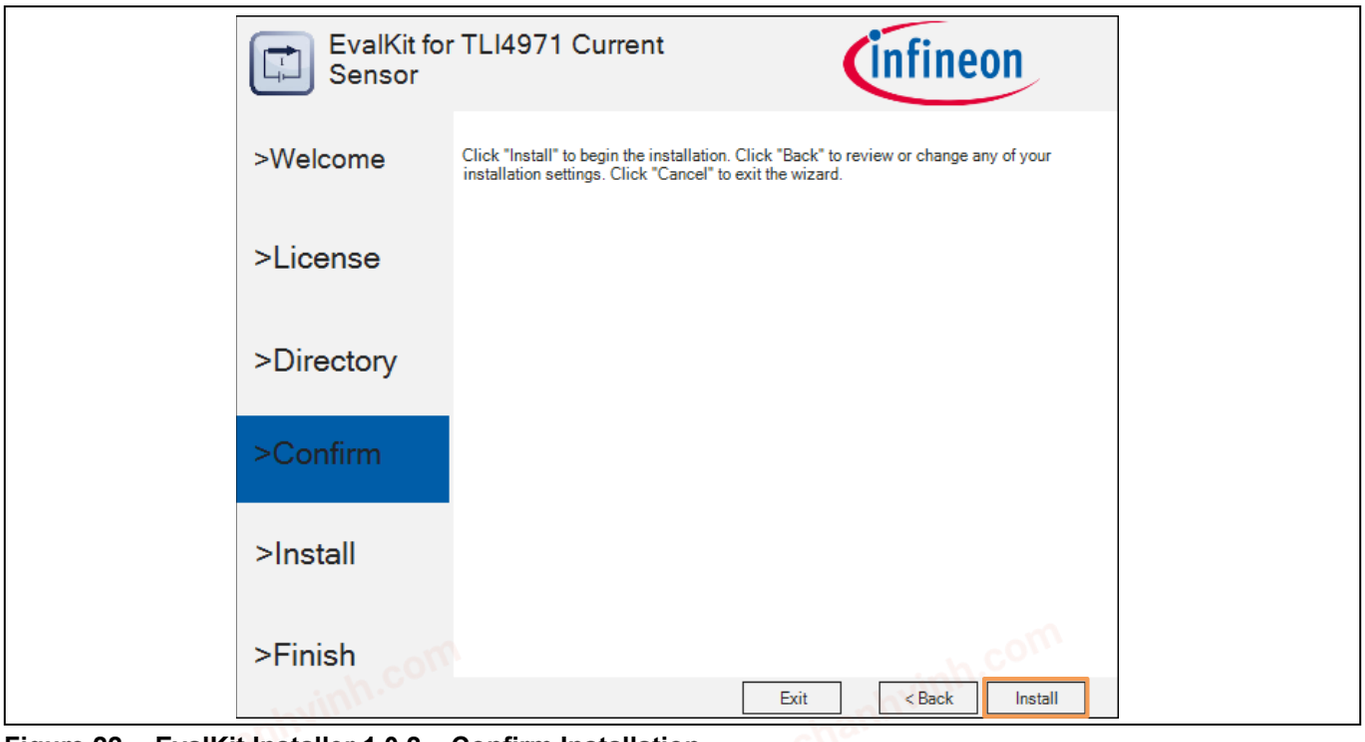


Figure 22 EvalKit Installer 1.0.2 – Confirm Installation

chanhvinh.com

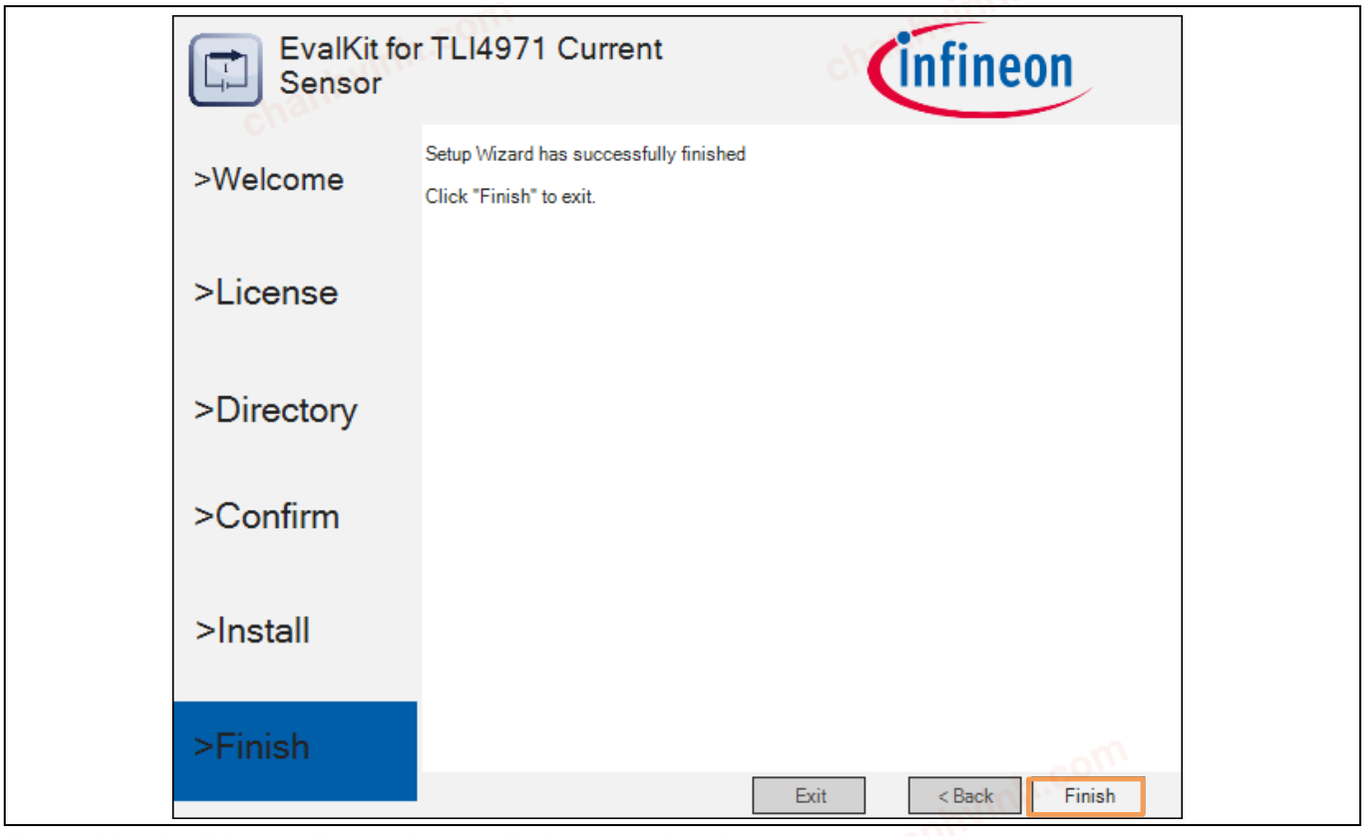


Figure 23 EvalKit Installer 1.0.2 –Installation Completed

- 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 24. Click "**Next**" button to continue with the installation.



Figure 24 SEGGER JLINK Drivers – Welcome

chanhvinh.com

- Read through the license agreement carefully and continue the installation by accepting it (see orange color box of Figure 25). If the license agreement is not accepted, then the installation will be aborted. Click **"Next"** button to continue with the installation.

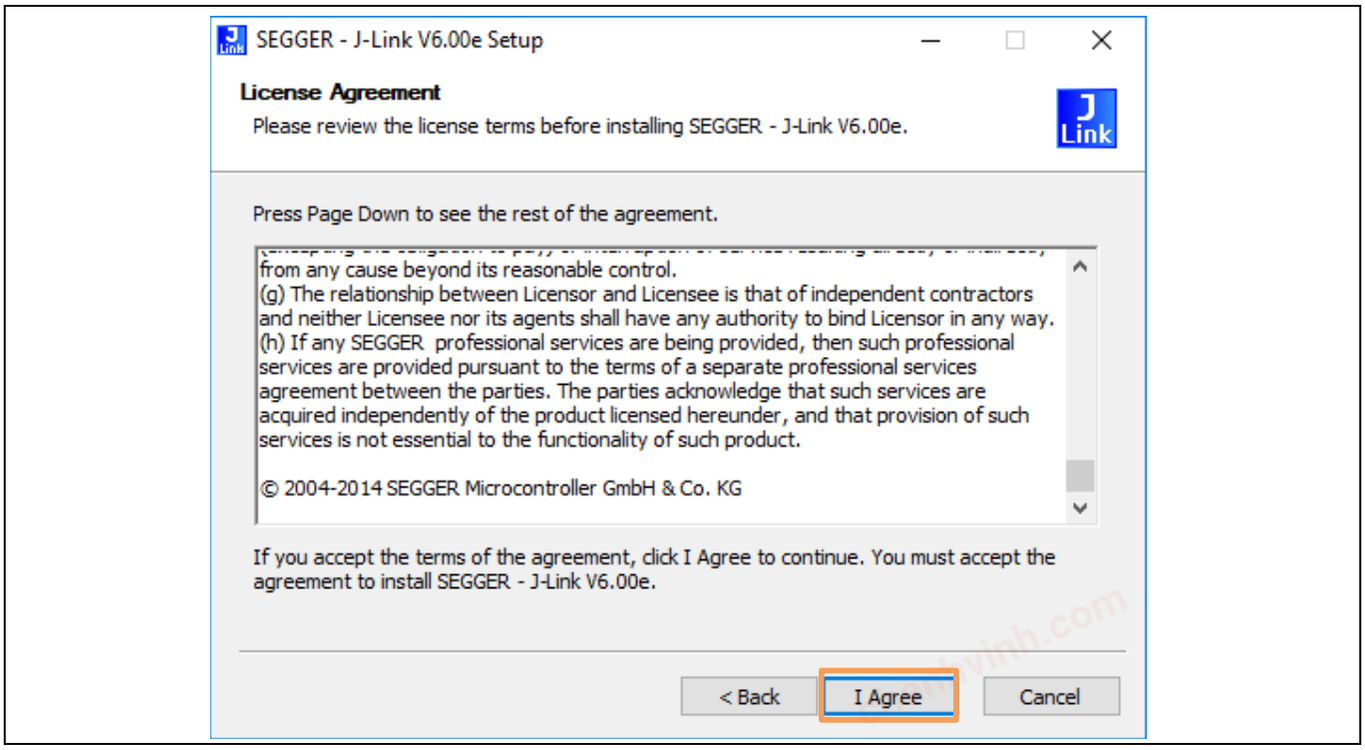


Figure 25 SEGGER JLINK Drivers – License Agreement

- Select the check boxes as shown in the highlighted orange color box of Figure 26 and click **"Next"** button to continue with the installation.

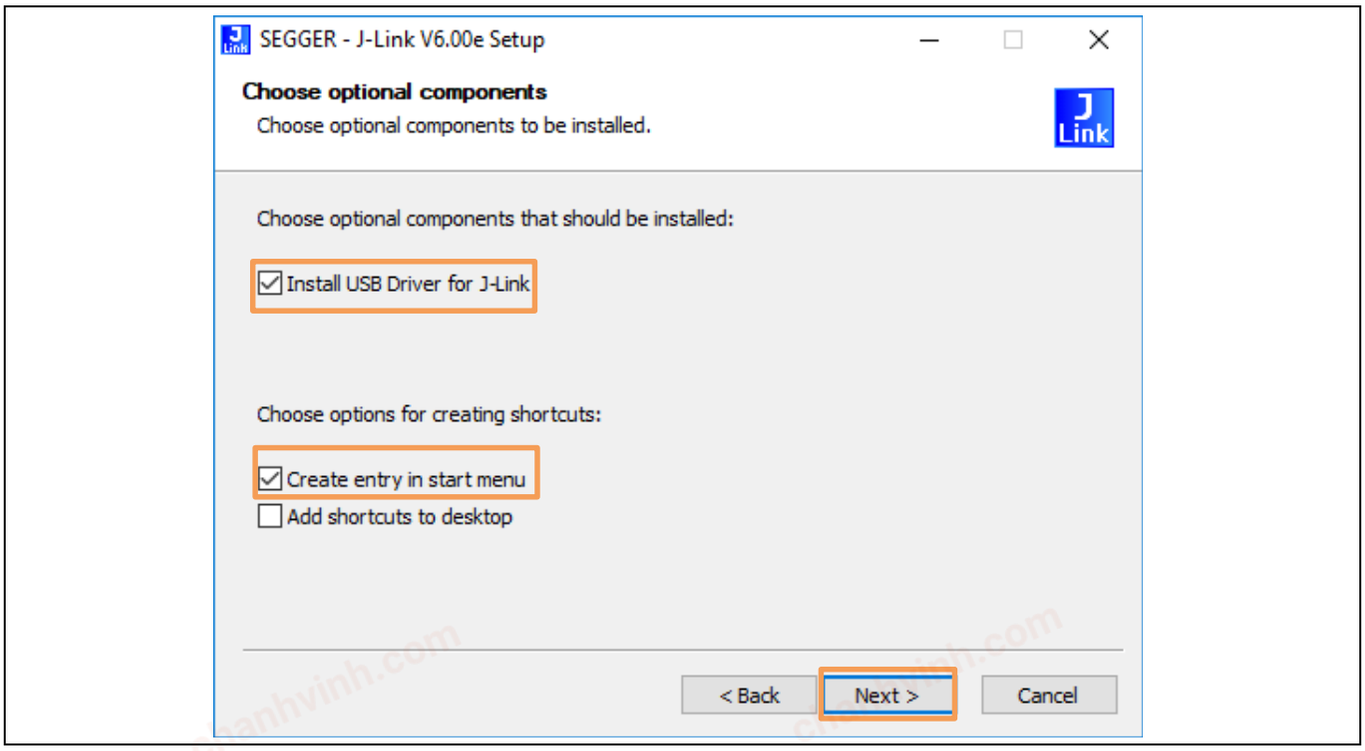


Figure 26 SEGGER JLINK Drivers – USB Driver Installation

chanhvinh.com

- 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 27. Click **"Next"** button to continue with the installation.

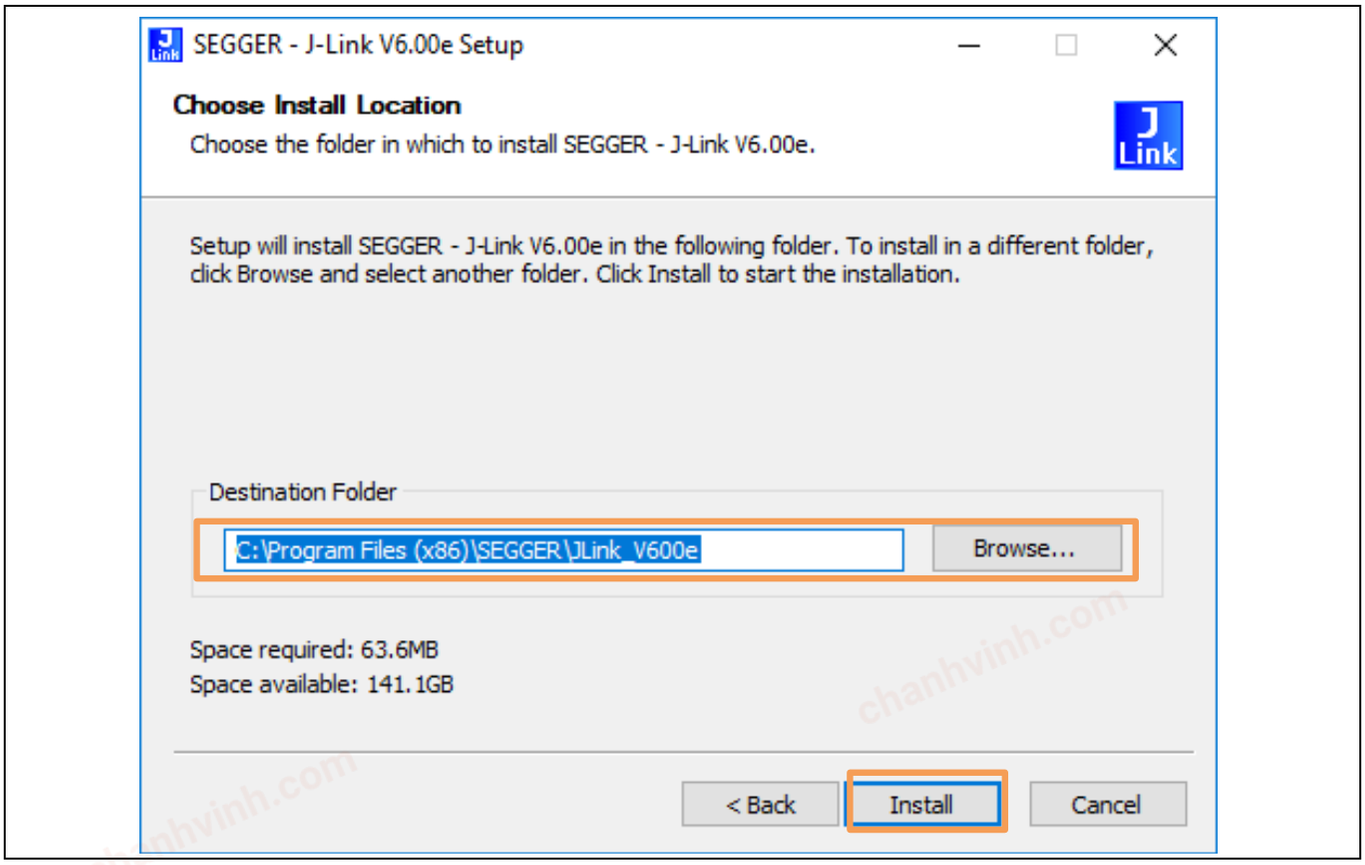


Figure 27 SEGGER JLINK Drivers – Confirm Installation

- Click **"Ok"** button to complete the Jlink driver installation which has shown in the below Figure 28.

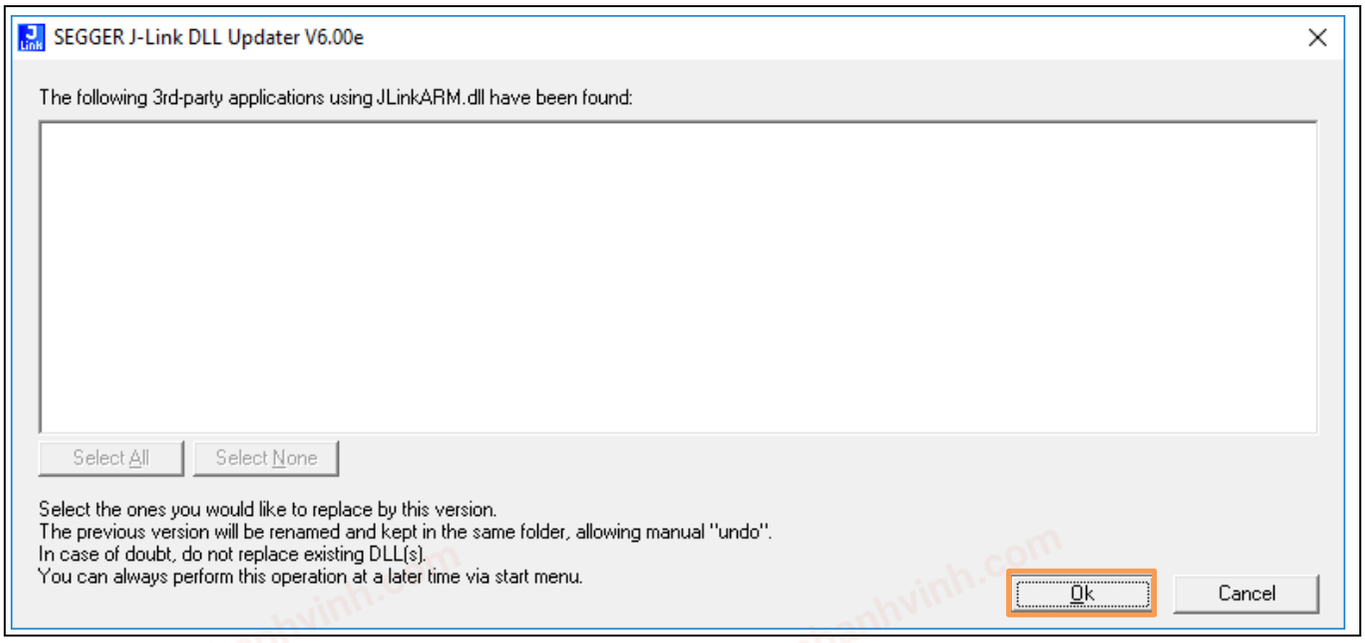


Figure 28 SEGGER JLINK Drivers – End of Installation

chanhvinh.com

- Click **“Finish”** button which has shown in the below Figure 29 to complete the Jlink driver installation.



Figure 29 SEGGER JLINK Drivers – End of Installation

- Click **“Finish”** button which has shown in the below Figure 23 to complete the Evalkit software GUI installation.

chanhvinh.com

5 Appendix II

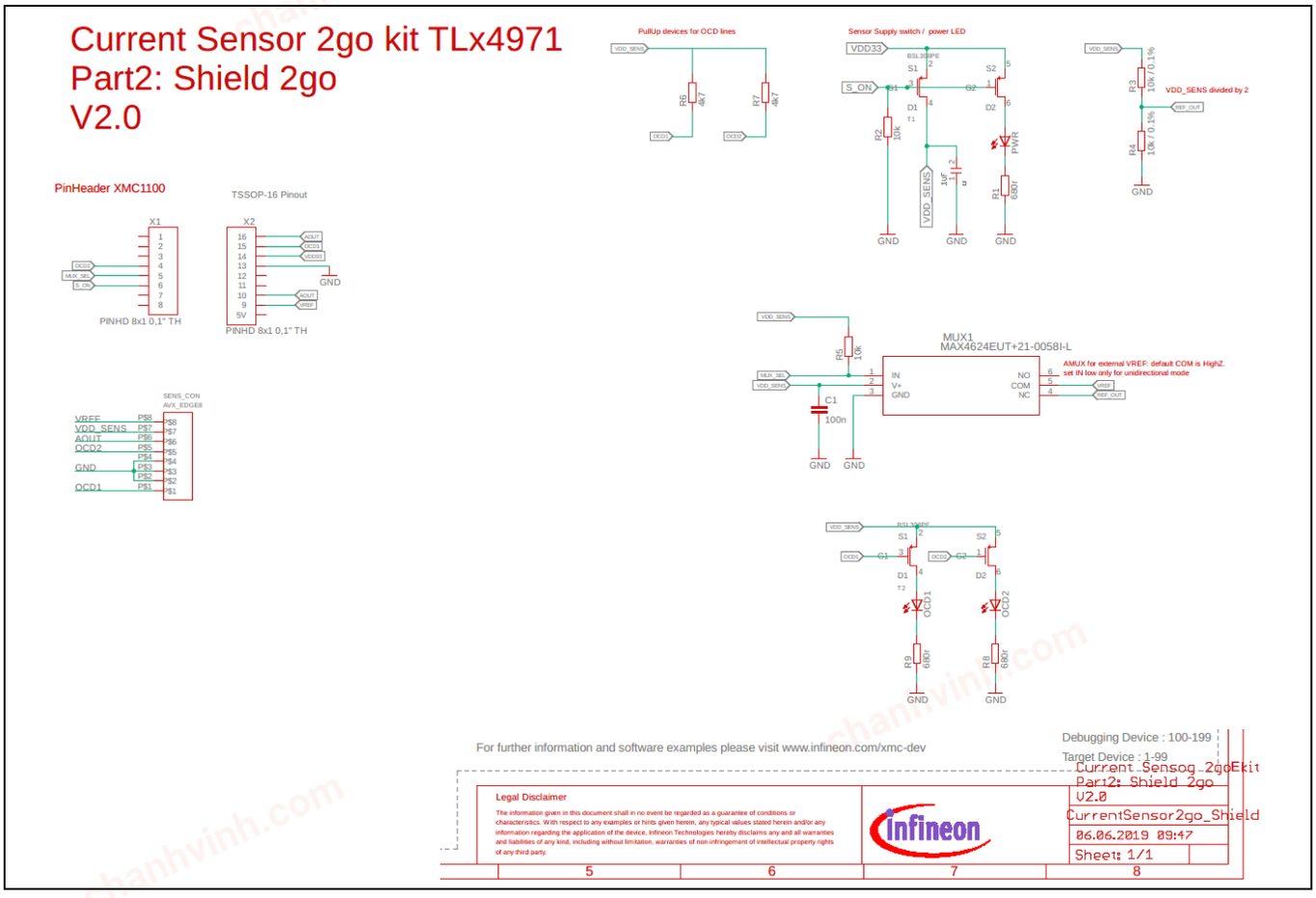


Figure 30 Sensor Shield Board Schematics

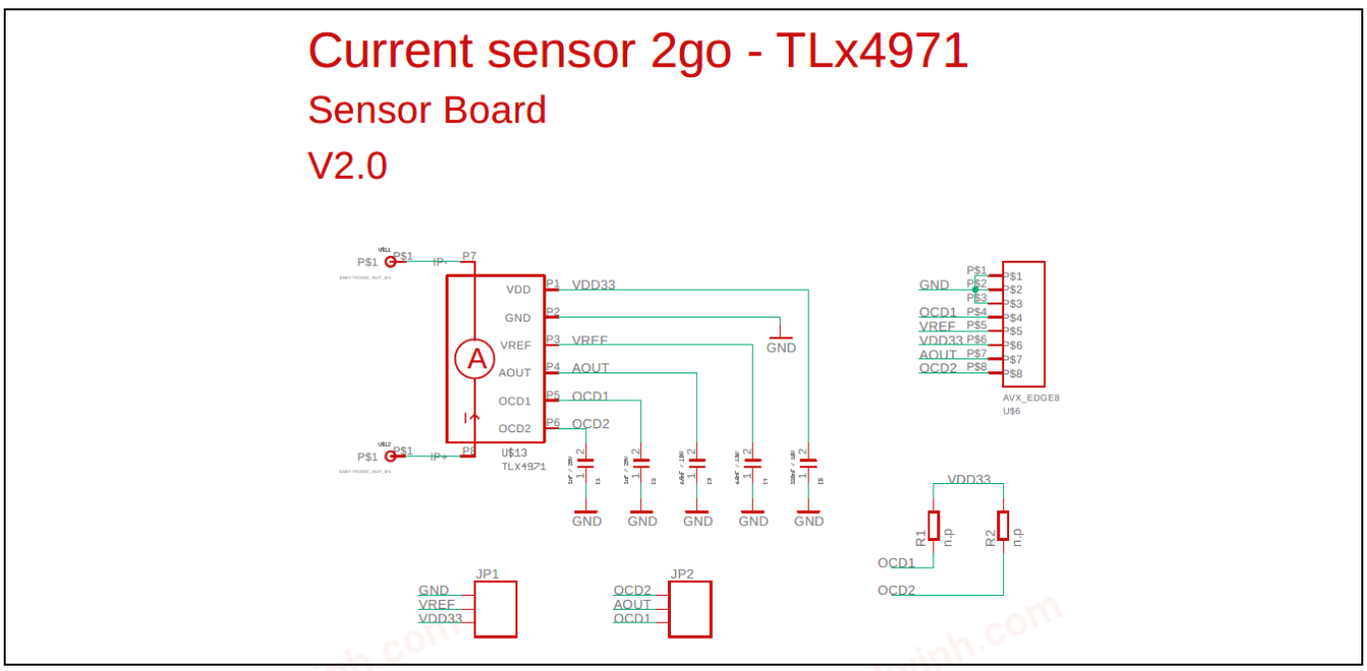


Figure 31 Sensor Board Schematic

chanhvinh.com

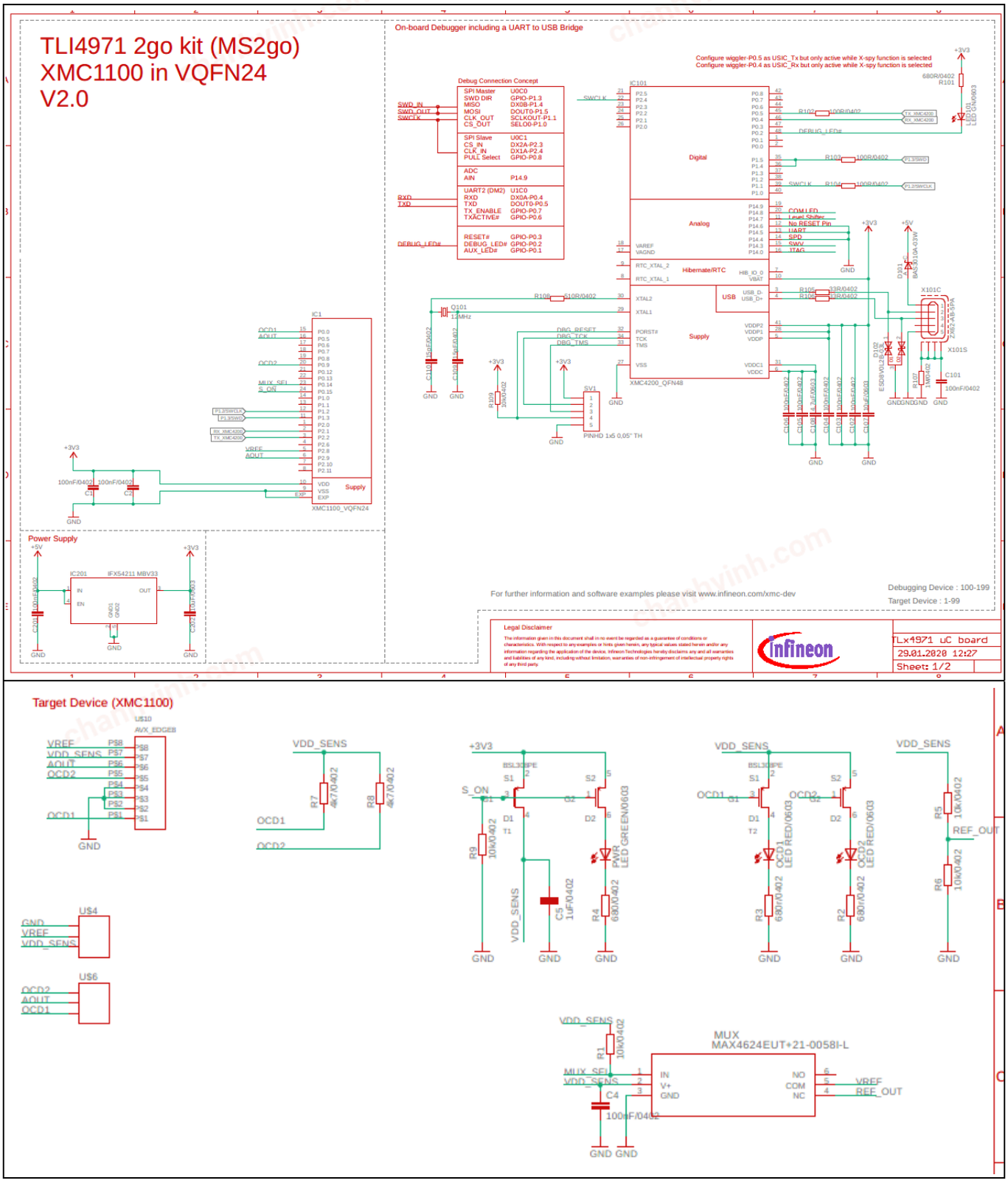


Figure 32 MCU Board Schematic

chanhvinh.com

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

chanhvinh.com

7 References

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

[2] AN_TLI4971_ProgGuide User Manual

[3] Current sensor TLE4971 addendum to TLI4971 programming and user manual

chanhvinh.com

Revision history

Document version	Date of release	Description of changes
V 1.1	2023-05-01	Adding MS2Go-variant for TLE4971
V 1.0	2019-04-05	Initial version

chanhvinh.com

...

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

Edition 2023-05-01

Published by

Infineon Technologies AG

81726 Munich, Germany

© 2023 Infineon Technologies AG. All Rights Reserved.

Do you have a question about this document?

Email: erratum@infineon.com

Document reference
AppNote TLI4971 / TLE4971 MS2Go & S2Go

IMPORTANT NOTICE

The information contained in this application note is given as a hint for the implementation of the product only and shall in no event be regarded as a description or warranty of a certain functionality, condition or quality of the product. Before implementation of the product, the recipient of this application note must verify any function and other technical information given herein in the real application. Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind (including without limitation warranties of non-infringement of intellectual property rights of any third party) with respect to any and all information given in this application note.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology delivery terms and conditions and prices please contact your nearest Infineon Technologies office (**www.infineon.com**).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.